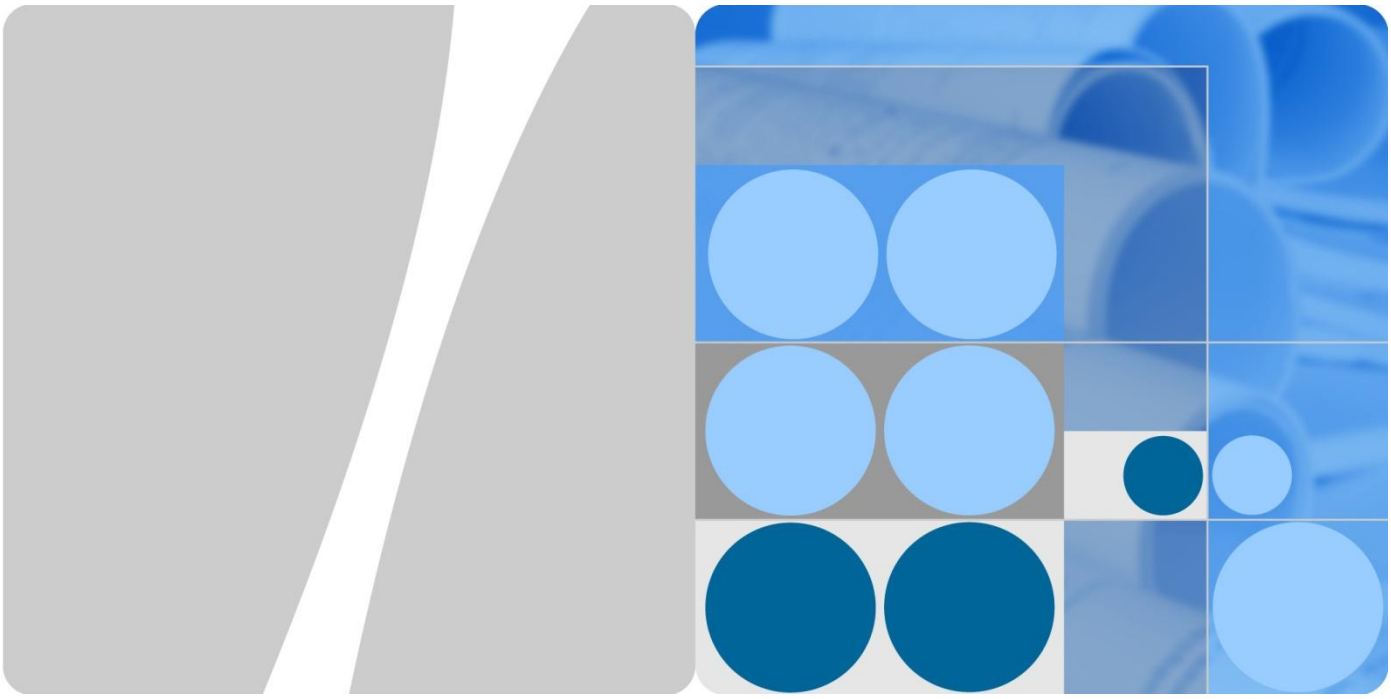

Huawei FusionCloud Desktop Solution 5.3

Full Memory Desktop Technical White Paper

Issue 01

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1 Overview

1.1 Background

As the virtual desktop infrastructure (VDI) technology becomes increasingly popular and is used by more and more enterprises, storage configuration and consumption problems of VDIs become more and more serious. Improper storage configuration will affect experience of end users.

Compared with traditional PCs, VDIs centralize users' storage resources. This achieves resource sharing and improves storage usage, but also brings I/O storms in certain scenarios. For example, when multiple VMs are logged in to at the same time, read I/O operations burst with the quantity increased by several times or even hundreds of times. This is called boot storm or login storm. In extreme cases, tens of minutes or even several hours are required for starting and loading a virtual desktop, which is disastrous for end users. When patches are concurrently installed or viruses are concurrently scanned on multiple VMs, a large number of I/O operations are generated with the quantity increased by several times. Before deploying VDIs for an enterprise, you need to ensure that the storage system can stand I/O storms with high input/output operations per second (IOPS). To address I/O storms, high-performance media, such as solid state disks (SSDs) or InfiniBand network interface cards (NICs), is often used in the industry, which brings high costs.

In the education industry, virtual desktop images must be quickly updated during the break for the next class. A large number of images must be updated and restored during a 10-minute break, which stresses the storage performance. In the manufacturing industry, after a shift handover, a large number of VMs must be quickly started and updated for employees on the next shift. Eliminating I/O bottlenecks caused by VM start and restoration using traditional virtual desktop hardware is difficult.

The Huawei brand-new full memory desktop solution emerges as required. By utilizing the memory that provides high read/write I/O performance and adopting online deduplication and compression technologies, this solution converts read/write operations on storage of virtual desktops to in-memory read/write operations. This solution resolves the I/O problem of the VDI system and improves user experience without increasing investment.

1.2 Introduction

In the VDI system, user VMs usually run the same operating systems (OSs) and applications. Therefore, different user VMs have similar system disk data. In a common VDI system,

similar system disk data of multiple users is stored in the storage system, which wastes storage capacity.

The full memory desktop feature stores all system disk data of user VMs in the memory that serves as the storage medium of system disks, which improves I/O performance by a hundred times and prevents I/O storms. In-memory online deduplication and real-time compression technologies (IOTailor for short) are adopted to deduplicate and compress data on system disks of user VMs, which reduces data storage space. The deduplication rate is higher than 90%.

Compared with traditional VDIs and linked clone technology, full memory desktops adopt the full-disk deduplication technology. The full-disk deduplication technology provides the following advantages:

- System data is deduplicated online, which maximizes the storage usage. The linked clone technology deduplicates base volume data only but does not deduplicate sub-volume data.
- Storage performance deterioration does not need to be considered. All system disk data is kept in the memory, while the linked clone technology stores sub-volume data in disks.
- Full memory desktops use memory as the primary storage medium. This minimizes required storage resources and simplifies O&M while improving user experience.
- IOTailor implements special optimization for VDIs and memory. During deduplication and compression, data interaction timeliness and data consistency are ensured. Highly-efficient space management algorithms are adopted to resolve storage problems of small data blocks, which reduce space management consumption.
- Emergency disk protection mechanisms are provided to ensure that services are not interrupted when the memory space is exhausted.

1.3 Benefits

During desktop cloud use and O&M, improper storage configuration causes storage bottlenecks as well as poor user experience, for example:

- A long time is required to create and provision VMs in batches, affecting O&M efficiency.
- A long time is required to start and restart VMs, affecting user experience.
- User experience is poor when a large number of users concurrently start VMs, and scan viruses and install patches on VMs.
- The system processes operations of reading, writing, copying, and saving files slowly, providing poor experience.

The full memory desktop feature can resolve the preceding problems without increasing customers' investment.

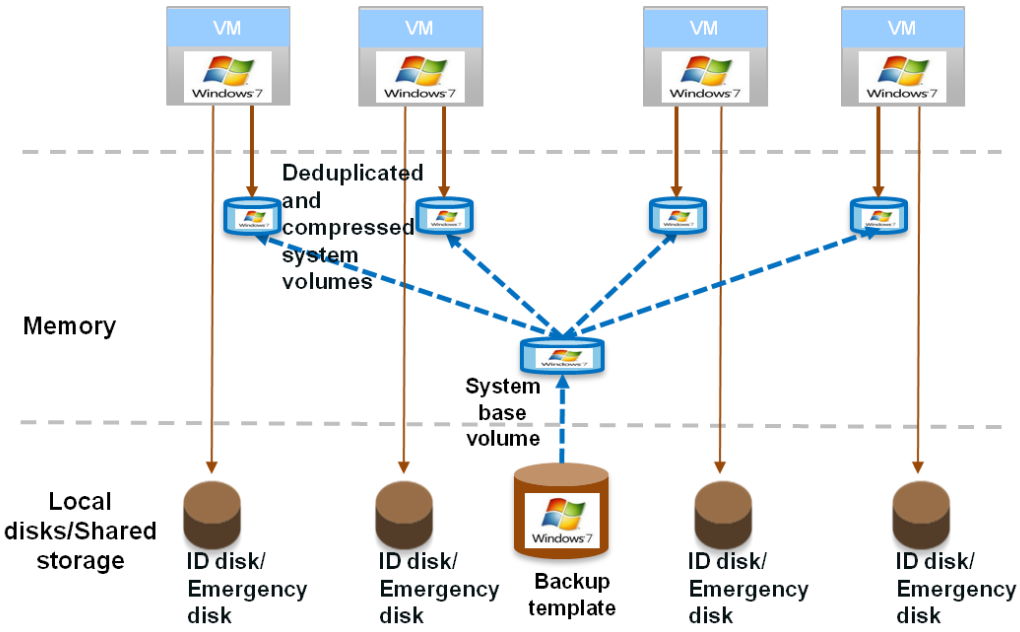
2 Huawei Full Memory Desktop Solution

2.1 Solution Overview

2.1.1 Overview

With the IOTailor technology, full memory virtual desktops store all system disk data of VMs in the memory after online, real-time deduplication and compression to get high-speed I/O performance. Real-time persistence is not implemented for data in the memory. After VMs are shut down or server hosts restart, VMs are restored to the initial state. The full memory desktop solution applies to stateless task-based desktop scenarios, such as the education industry, call centers, and CI.

Figure 2-1 Full memory desktop solution



In the full memory desktop solution, VMs use the same public system template. After deduplication, differentiated system data is stored in related deduplicated system volumes. The backup template is stored in local disks or shared storage, which is used to restore the system after hardware is powered on again after power-off. Data of ID disks and emergency

disks is also stored in local disks or shared storage, which is used for shutdown restoration and emergency use in case of full disks respectively. Full memory desktops support unified VM template deployment, update, and restoration. Full memory desktops support dynamic pool and static pool deployment modes.

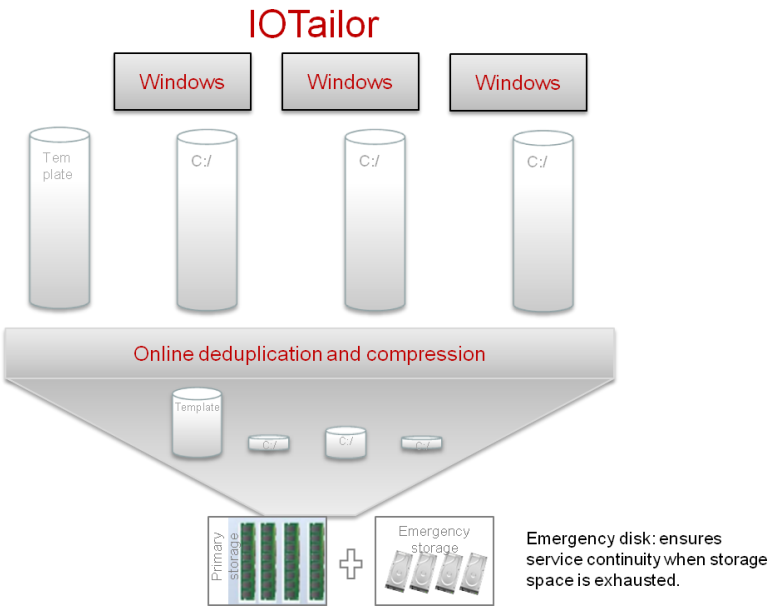
2.1.2 IOTailor

When using virtual desktops, users tend to compare virtual desktops with PCs. Compared with PCs that use dedicated storage hardware (local disks), virtual desktops provide poorer storage I/O performance and user experience than PCs due to storage consumption for virtualization and storage network latency.

As core technology, IOTailor applies to virtual desktops and improves virtual desktops in the following aspects:

- Simulates server memory as disks to be used as the system disks for user VMs. Provides high-experience user VMs based on high I/O performance of memory. Supports 300+ IOPS for each desktop, and provides storage I/O performance higher than PCs.
- Adopts deduplication and compression technologies to reduce required storage space and increase the number of stateless full memory desktops that is supported by a server.
- Deeply integrates with desktop cloud software or virtualization platforms to improve deployment efficiency.

Figure 2-2 IOTailor



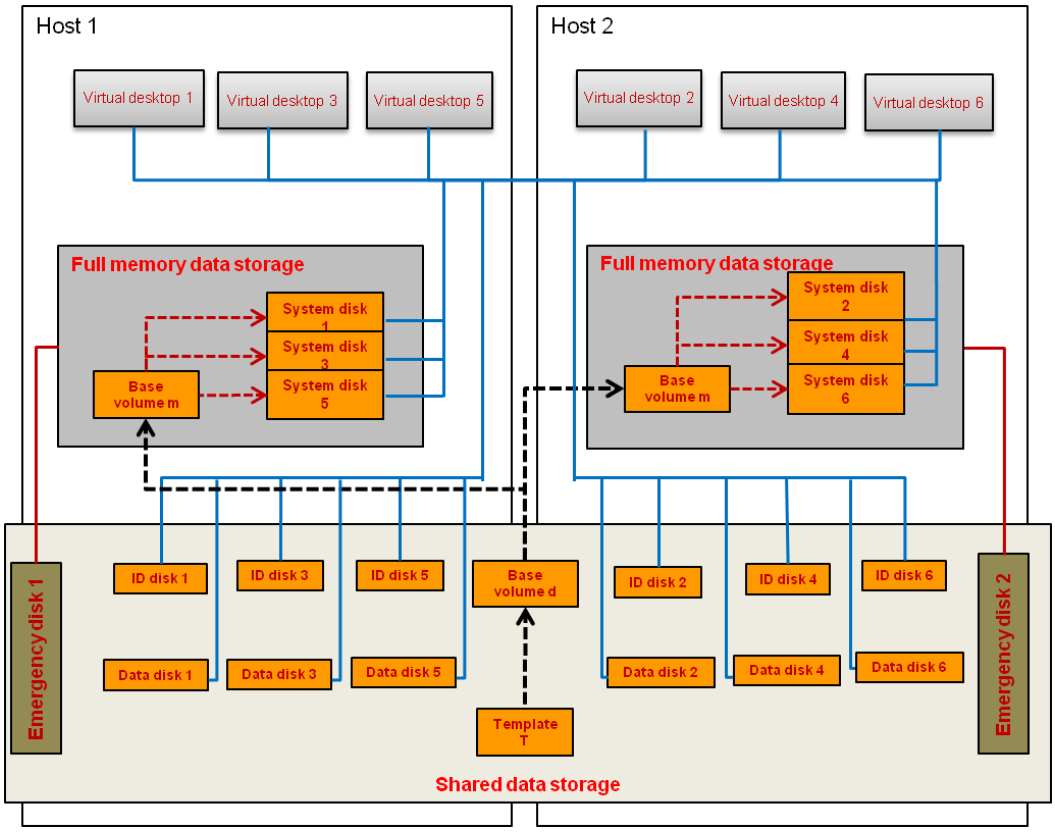
2.2 Solution Architecture

The full memory desktop feature is provided by the FusionAccess desktop cloud software and the FusionSphere cloud platform. FusionSphere implements full memory storage resource configuration and memory deduplication and compression, and FusionAccess implements unified provisioning and deployment of full memory desktops. For hardware deployment, full

memory desktops use shared storage or local disks to store the system template, and data of emergency disks and ID disks in persistent manner. (Local disks refer to non-virtualized local disks of servers.)

1. **Shared storage deployment scheme**

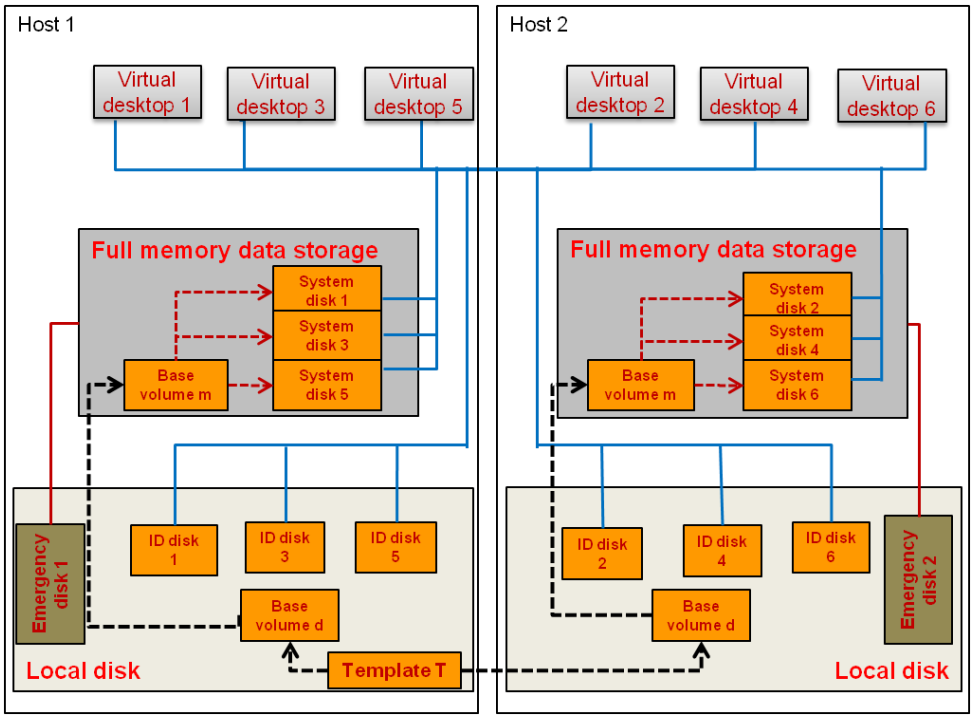
Figure 2-3 Full memory desktop solution architecture with shared storage



- Full memory templates are deployed on shared storage. When the administrator creates VMs, the system generates the backup base volume d on the shared storage based on the selected VM template. Each service host loads the backup base volume d to the local memory and generates the system base volume m which then provisions VMs.
- The ID disks of all VMs are stored in the shared storage. When a host is faulty, user VMs can start up on other hosts. User VMs support HA. After the VM HA is implemented, the system disks restore to the initial state.
- Data disks can be configured. All data disk information is stored on shared storage. After the VM HA is implemented, data disk information is not lost.
- The shared storage deployment scheme applies to static and dynamic pools.

2. **Non-virtualized disk scheme**

Figure 2-4 Full memory desktop solution architecture with non-virtualized disks



- Full memory templates are deployed on the local disk of a host. When the administrator creates VMs, the system generates the backup base volume d on the local disk of each host in the cluster based on the selected VM template. Each service host loads the backup base volume d to the local memory and generates the system base volume m which then provisions VMs.
- The ID disks of all VMs are stored on the local disks of hosts. When a host is faulty, user VMs cannot be migrated to other hosts. User VMs do not support HA.
- You are not advised to configure data disks. If data disks are configured, all data disk information is stored on the local disks of hosts. Once the host is faulty, all personal data is lost, which affects services.
- This mode applies only to dynamic pools. Users can dynamically select available VMs to ensure service continuity. If this mode is applied to static pools, a user is bound with a VM. Once the host is faulty, the user cannot use the VM, which affects service continuity.

NOTE

If web disks are used to store personal data of users, the web disks are configured in the same way as common VMs. The networking mode of web disks is not described here.

2.3 Deployment Modes

Full memory desktop hardware deployment supports three modes: standard desktop cloud, desktop cloud appliance, and CompactVDI. Because of FusionCube mapping problems, desktop cloud appliance of FusionAccess 5.2 does not support full memory desktops.

Table 2-1 Deployment modes

	Full Memory Desktop	
	Shared Storage	**Non-Virtualized Disk**
Standard desktop cloud	Supported	Supported
Desktop cloud appliance	Supported (V100R005C30)	Supported (V100R005C30)
CompactVDI	N/A	Supported

2.4 Solution Highlights

Full memory desktops use memory as the primary storage of VDIs to resolve storage I/O bottlenecks, provide high desktop experience for end users, and improve performance of O&M indicators as well as work efficiency of administrators.

The experience of end users is tested using the Huawei quality of experience (QoE) testing tool. When 81 VMs are deployed on a server, the experience provided by full memory desktops is improved by 21% than common desktops.

For performance indicators, see Table 2-2.

Table 2-2 Performance indicators

Indicator	Common Desktop	Full Memory Desktop	Improved By	Remarks
End-user experience	98%	119%	1.21 times	An E5-2680V2 CPU runs 81 VMs.
Large file copy	12 seconds	2 seconds	6 times	1 GB large file
Small file copy	61 seconds	25 seconds	2.5 times	1 GB small files (divided into 3,200 files)
Compression	15 seconds	9 seconds	1.7 times	
Decompression	223 seconds	146 seconds	1.5 times	

When operations are concurrently performed on 50 VMs, 150 VMs, and 250 VMs, compared with common desktops, performance of full memory desktops is significantly improved.

In the teaching scenario, desktops must be restored during a 10-minute break for the next class. Common desktops that use traditional storage area network (SAN) devices cannot meet requirements of the teaching scenario due to their limited I/O capabilities. When 50 VMs are running on a server, full memory desktops can be restored within 8 minutes, which meets requirements of the teaching scenario.

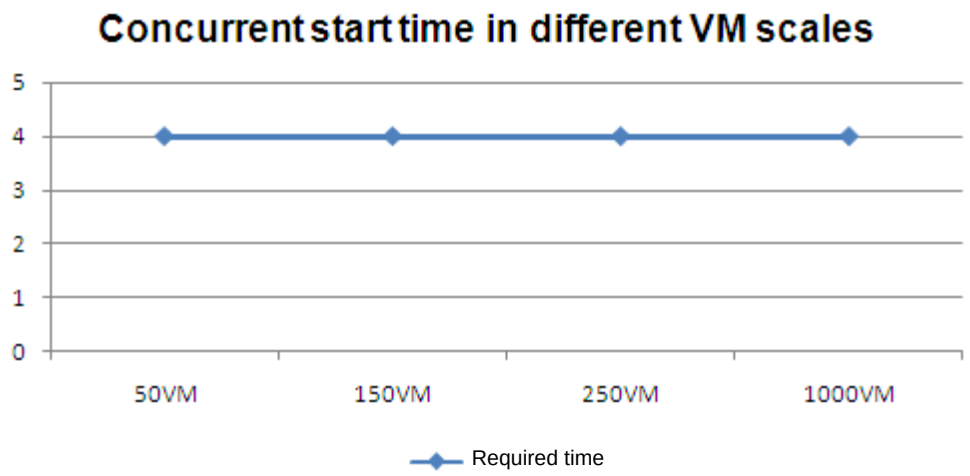
For performance indicators, see Table 2-3.

Table 2-3 Performance indicators

Indicator	Common Desktop	Full Memory Desktop	Improved By	Remarks
Time for concurrently provisioning 50 VMs	27 minutes	9 minutes	3 times	Concurrent operations are performed on a single computing server.
Time for concurrently starting 50 VMs	16 minutes	4 minutes	4 times	
Time for concurrently restarting 50 VMs	32 minutes	4 minutes	8 times	
Time for concurrently restoring 50 VMs	24 minutes	8 minutes	3 times	
Time for concurrently provisioning 150 VMs	35 minutes	17 minutes	2 times	Concurrent operations are performed on three computing servers.
Time for concurrently starting 150 VMs	16 minutes	4 minutes	4 times	
Time for concurrently restarting 150 VMs	31 minutes	4 minutes	8 times	
Time for concurrently provisioning 250 VMs	40 minutes	24 minutes	1.6 times	Concurrent operations are performed on five computing servers.
Time for concurrently starting 250 VMs	19 minutes	4 minutes	5 times	
Time for concurrently restarting 250 VMs	34 minutes	4 minutes	8 times	

With the same number of VMs on a single server, as the VM scale increases and more servers are added accordingly, time required for starting or restarting VMs stays the same.

Table 2-4 Concurrent start time in different VM scales



The preceding testing data shows that full memory desktops that adopt IOTailor technology greatly improve end-user experience and concurrent operation performance while reducing customers' storage investment.

2.5 Constraints

- The primary storage media for system disks of full memory desktops is host physical memory. The configuration of full memory desktops is different from the configuration of other types of VMs. Therefore, configure full memory desktops in different clusters with other types of VMs (full copy VMs and linked clone VMs) to simplify deployment.
- It is recommended that two full memory desktop templates be deployed in a cluster. Memory planning is configured based on two templates. If more than two templates are deployed, multiple logical clusters can be used in memory planning.
- In static pool + data disk deployment mode, shared storage (such as IP SAN) must be deployed. The reason is that if data disks are deployed on local storage, data disks on a faulty server cannot implement HA. As a result, all data is lost. Therefore, VMs with data disks cannot be configured if no shared storage is deployed.
- Full memory VMs are deployed only in stateless desktop scenarios. That is, no personalized programs are installed on system disks of user VMs, no personalized settings are saved, and system disks can be updated and restored in a unified manner. In stateful desktop scenarios, full copy VMs are deployed. The boot storm of full copy VMs can be prevented by setting scheduled tasks for starting VMs in different batches on the system.

olution, especially in small-scale scenarios.

3 Application of Full Memory Desktops

3.1 Teaching Scenario

3.1.1 Requirements

- Typical users: students
- Scenario description: Students view books and teaching materials, do homework, and browse external materials on virtual desktops. After the class, virtual desktops are restored to the initial state.
- Scenario characteristics:
  - Students in the same class use the same desktop. The administrator creates template images to update application programs in a unified manner.
  - VMs are dynamically allocated to students. The same VM is used by different students in different classes. VMs must be restored during break.
  - Students concurrently perform operations on applications. All students may start the same application or read the same data area at the same time.
  - Students use web disks to store notes and personal data. Students are not allowed to install irrelevant software on VMs.

3.1.2 Solution

The typical requirements for students' desktops are as follows:

- High performance is required for concurrent read/write operations on storage.
- VMs concurrently start frequently. VMs must start up quickly, and all VMs must be restored during a short break.
- Concurrent start of applications and read/write operations on files require quick response to improve class efficiency.

Full memory desktops meet the requirements of the teaching scenario. Full memory desktops use memory to store system data of VMs to provide powerful capabilities of reading and writing system data, resolve I/O performance problems, and improve user experience.

Scenarios similar to the teaching scenario include scenarios with high concurrency, such as call centers and task-based office desktops. With strong I/O performance of the memory, full memory desktops is a perfect solution to storage I/O bottlenecks.

3.2 Secure Internet Access

3.2.1 Requirements

Enterprises need to use Internet resources and communicate with others through the Internet for business. Therefore, Internet access is inevitable for enterprises.

Enterprises need to resolve the following problems when accessing the Internet:

- How to protect enterprise systems against Trojan horses and viruses?
- How to prevent phishing websites or Trojan horses from accessing data and obtaining business secrets?
- How to improve information security to prevent malicious disclosure of key asset information?

Enterprises are burdened with complex security control that decreases work efficiency of employees and increases management pressure on IT management personnel.

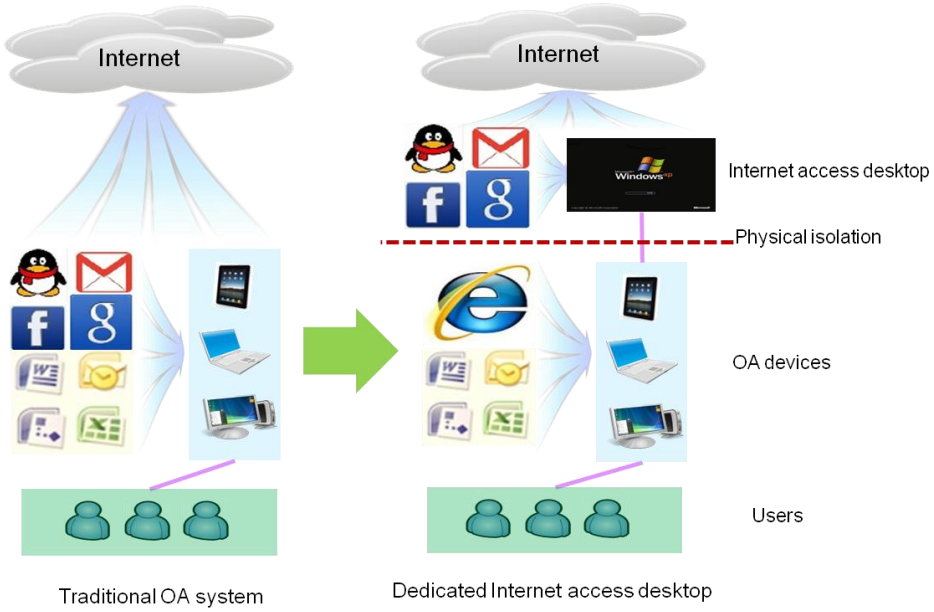
3.2.2 Solution

The Huawei FusionCloud Desktop Solution adopts full memory desktop technology and Huawei Desktop Protocol (HDP) to meet requirements of secure Internet access.

- Employees use existing OA devices (PCs or laptops). Based on security requirements of enterprises, the OA devices are isolated from the Internet and cannot communicate with the Internet.
- If users need to access the Internet, they can log in to the Internet access desktops (full memory desktops) from software clients (SCs). The Internet access desktops have permissions to access the Internet. Users can query information and download data on the Internet access desktops.
- The administrator delivers the same policies to all users. The policies specify that when users log in to the Internet access desktops from SCs, users are not allowed to transmit PC data to the Internet access desktops, which prevents information security risks.
- **The Huawei desktop cloud system adopts HDP to transmit files from virtual desktops to local terminals. The administrator configures the same policies for all users to allow users to transmit files downloaded on the Internet access desktops to local PCs.**
- After Internet access desktops are disconnected, full memory desktops are restarted based on power management policies, clear temporary user information, and restore to the initial state, which prevents intrusion of phishing websites through Trojan horses.

By accessing the Internet through full memory desktops, OA devices are isolated from network viruses and Trojan horses, which prevents hackers or rogue software from stealing business secrets. Enterprise users cannot send local data to the Internet, preventing data disclosure.

Figure 3-1 Secure Internet access solution



Scenarios similar to secure Internet access include open scenarios such as external reading rooms, open libraries, and public meeting rooms. In such scenarios, user behavior is uncontrollable. With the function of deleting memory data upon shutdown, full memory desktops can prevent unauthorized operations performed by users and reduce management and control costs.