

Deploying a Virtualized Session-Based Remote Desktop Services Solution

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**Applies to:** Remote Desktop Services with Windows Server 2008 R2

Abstract

This document provides guidance on deploying Remote Desktop Session Host (RD Session Host) and other Remote Desktop Services role services in a virtualized environment with minimal hardware resources. The document also provides scalability information for a virtualized Remote Desktop Services role configuration by using the Knowledge Worker scenario to help size hardware for similar workloads.

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# Introduction

Hyper-V™ in Windows Server® 2008 R2 is a powerful virtualization technology that corporations can use to consolidate servers and thus lower total cost of ownership (TCO). An RD Session Host server-based deployment consists of several role services: RD Session Host, RD Licensing, RD Gateway, RD Connection Broker, and RD Web Access. For a small to medium scale deployment, there are many advantages in deploying the Remote Desktop Services role services on virtual machines. This document presents the advantages and recommendations for deploying Remote Desktop role services on virtual machines. It also presents scalability data for a given hardware and virtual machine configuration by using Knowledge Worker scenario.

# RD Session Host server-based deployment

A Windows Server 2008 R2 RD Session Host server-based deployment provides session-based desktops and RemoteApp programs to client computers. An RD Session Host server-based deployment consists of the following:

* An RD Session Host server
* An RD Licensing server
* An RD Gateway server
* An RD Connection Broker server
* An RD Web Access server
* Roaming profiles

Figure 1 shows a simple RD Session Host server-based deployment, highlighting the Remote Desktop Services role services and relationships among different components.

RD Web Access

RD Gateway

RD Connection Broker

RD Session Host

RD Licensing

Client computer

Figure 1: RD Session Host-based deployment

# Virtualized RD Session Host server deployment

Deploying the RD Session Host role service on a virtual machine is also known as a virtualized RD Session Host server deployment. The primary advantages of deploying Remote Desktop Services role services on virtual machines are as follows.

**Server Consolidation.** Resources consumed by the RD Session Host role service depend on the applications and number of users. Remote Desktop Services role services, such as RD Licensing and RD Connection Broker, consume significantly fewer resources. For a small and medium scale deployment, all the role services can be installed on different virtual machines running on a single server instead of installing them on different servers, thus providing both isolation and server consolidation.

**High Availability.** The RD Session Host role service can be deployed in a farm in a large deployment. The farm load can be equally distributed among physical servers. For example, in a two farm scenario, one virtual machine belonging to each farm can run on both physical servers. In such a scenario, even if one server is not available, both farms will be available for a reduced number of users.

# Deployment scenarios

## Server hardware

The following hardware configurations were chosen to illustrate example scenarios suitable for a small/medium deployment. The processors on these servers support Extended Page Technology (EPT). The advantage of leveraging this hardware technology by the Second Level Address Translation (SLAT) feature of Windows Server 2008 R2 Hyper-V is discussed in “Remote Desktop Session Host Capacity Planning in Windows Server 2008 R2” (<http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=ca837962-4128-4680-b1c0-ad0985939063>).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Server | CPU model | Sockets | Cores | Core speed | RAM |
| HP DL370 | Intel® Xeon® Processor E5530 | 1  | 4 (4x1) | 2.4 GHz | 16 GB |
| HP DL370 | Intel® Xeon® Processor E5530 | 2  | 8 (4x2) | 2.4 GHz | 32 GB |

Table 1: Hardware configuration

The following server roles are assumed to exist on separate servers in the deployment:

* Active Directory Domain Services
* DNS
* Dynamic Host Configuration Protocol (DHCP)
* File Services (for roaming profiles)

## Server operating system

Windows Server 2008 R2 Enterprise was chosen as the operating system for Hyper-V servers and virtual machines. The license for Windows Server 2008 R2 Enterprise allows up to four virtual machines on a single Hyper-V server without any additional operating system licensing cost. All the configurations below have a maximum of four virtual machines.

## Single farm virtualized RD Session Host server deployment

The configuration consists of a single RD Session Host server farm, the RD Licensing role service, the RD Connection Broker role service, and the RD Gateway role service installed on virtual machines.

On the Host1 server, three virtual machines running Windows Server 2008 R2 are created. On the first virtual machine, the RD Licensing and RD Connection Broker role services are installed. On the second virtual machine, the RD Gateway and RD Web Access role services are installed. The RD Session Host role service is installed on the third virtual machine.

On the Host2 server, one Windows Server 2008 R2 virtual machine is created and the RD Session Host role service is installed.

Table 2 shows the memory configurations for the virtual machines.

|  |  |  |
| --- | --- | --- |
| Physical host | Role service | RAM for 16-GB configuration |
| Host1 | RD Web Access, RD Gateway | 2 GB |
|
| RD Connection Broker, RD Licensing | 1 GB |
| RD Session Host server farm 1 | 10 GB |
| Host2 | RD Session Host server farm 1 | 10 GB |

Table 2: Memory configuration for single farm deployment



Figure 2: Single farm deployment on virtual machines

## Two farm virtualized RD Session Host server deployment

The configuration consists of two RD Session Host server farms, the RD Licensing role service, the RD Connection Broker role service, and the RD Gateway role service installed on virtual machines.

On the Host1 server, four virtual machines running Windows Server 2008 R2 are created. On the first virtual machine, the RD Web Access and RD Gateway role services are installed. On the second virtual machine, the RD Connection Broker and RD Licensing role services are installed. The RD Session Host role service is installed on the third and fourth virtual machines. One RD Session Host virtual machine belongs to Farm 1 and the second RD Session Host virtual machine belongs to Farm 2.

On the Host2 server, two virtual machines are created and the RD Session Host role service is installed on each. The first virtual machine belongs to Farm 1 and the second belongs to Farm 2.

Table 3 shows the memory configurations for the virtual machines.

|  |  |  |  |
| --- | --- | --- | --- |
| Physical host | Role service | RAM for16-GB configuration | RAM for 32-GB configuration |
| Host1 | RD Web Access, RD Gateway | 2 GB | 2 GB |
| RD Connection Broker, RD Licensing  | 1 GB | 1 GB |
| RD Session Host server farm 1 | 5 GB | 13 GB |
| RD Session Host server farm 2 | 5 GB | 13 GB |
| Host2 | RD Session Host server farm 1 | 5 GB | 13 GB |
| RD Session Host server farm 2 | 5 GB | 13 GB |

Table 3: Memory configuration for two farm deployment

An optional third low end server can be used as a file server for a high availability cluster solution.



Figure 3: Two farm deployment on virtual machines

## High availability deployment

One of the goals of the proposed virtualized RD Session Host solution is that the deployment should remain operational when one of the two Hyper-V servers goes down or is shut down for planned maintenance. For example, the Hyper-V server, or the RD Session Host virtual machine running on that server, needs to be patched and restarted. One cost effective way of achieving this goal is to use failover clustering and Internet SCSI (iSCSI) technology. The Hyper-V servers are clustered, and the two virtual machines that are not running the RD Session Host role service are configured to be highly available. A third low-end server is installed with the iSCSI target service and will act as the file server. When the first Hyper-V server needs to be shut down for maintenance, the virtual machines that are not running the RD Session Host role service are quickly migrated to the second Hyper-V server.



Figure 4: High availability deployment

For more information about failover clustering and iSCSI, see the Hyper-V: Step by Step Guide: Hyper-V and Failover Clustering (<http://technet.microsoft.com/en-us/library/cc732181.aspx>) and Step-by-Step: Using the Microsoft iSCSI Software Target with Hyper-V (<http://blogs.technet.com/josebda/archive/2009/01/31/step-by-step-using-the-microsoft-iscsi-software-target-with-hyper-v-standalone-full-vhd.aspx>).

High-level steps for a high availability configuration are as follows:

1. Create virtual machines on two servers as per the configuration described in the sections “Single farm virtualized RD Session Host server deployment” and “Two farm virtualized RD Session Host server deployment” earlier in this white paper.
2. Install the iSCSI target service on the file server and place the Virtual Hard Disk (VHD) files of the virtual machines on the file server. The two Hyper-V servers use iSCSI to access these VHD files.
3. Install the Failover Clustering feature and cluster the two Hyper- V servers. Configure the role service virtual machines other than RD Session Host for high availability. Ensure that the second Hyper-V server has been allocated enough free memory for the virtual machines that are not running the RD Session Host role service to run. This ensures that when the first Hyper-V server goes down, the virtual machines that are not running the RD Session Host role service will migrate and run on the second Hyper-V server.

This solution ensures that at least half of the total supported users of the RD Session Host server farm are operational during a maintenance window.

## Test results

For test details, see “Appendix: Testing methodology” later in this white paper. Scalability results for the Knowledge Worker scenario with and without PowerPoint® are presented in Table 4 and Table 6. The Knowledge Worker with PowerPoint scenario is more processor-intensive than the Knowledge Worker without PowerPoint scenario.

### Knowledge Worker without PowerPoint scenario

The number of sessions supported on two servers for one farm and two farms is shown in Table 4. Memory becomes the limiting factor for this scenario. If the allocated memory for the virtual machine is increased, the number of sessions will also increase proportionally. Eventually, the virtual machine can run out of processor resources, and the addition of memory will not yield more sessions. In a two farm scenario, there are two RD Session Host server virtual machines per server. Allocating the available memory between the two virtual machines instead of to one virtual machine reduces the number of sessions by 10 percent.

|  |  |  |  |
| --- | --- | --- | --- |
| **Knowledge Worker without PowerPoint scenario** | **One farm 16-GB RAM (10 GB per VM)** | **Two farm 16-GB RAM (5 GB per VM)** | **Two farm 32-GB RAM (13 GB per VM)** |
| Number of Remote Desktop sessions – Host 1 | 110 | 100 | 240 |
| Number of Remote Desktop sessions – Host 2 | 110 | 100 | 260 |
| **Total number of sessions** | **220** | **200** | **500** |

Table 4: Supported users

**CPU Usage Memory Usage**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **One farm (16 GB)** | **Two farms (16 GB)** | **Two farms (32 GB)** |  | **Scenario** | **One farm (16 GB)** | **Two farms (16 GB)** | **Two farms (32 GB)** |
| RD Licensing + RD Connection Broker  | 1% | 1% | 1% |  | RD Licensing + RD Connection Broker  | 412 MB out of 1 GB | 412 MB out of 1 GB | 412 MB out of 1 GB |
| RD Gateway  | 30% | 30% | 32% |  | RD Gateway  | 540 MB out of 2 GB | 560 MB out of 2 GB | 600 MB out of 2 GB |
| Host1 / Farm1  | 76% | 75% | 80% |  | Host1 / Farm1 RD Session Host  | 10 GB out of 10 GB | 5 GB out of 5 GB | 13 GB out of 13 GB |
| Host2 / Farm1 RD Session Host | 73% | 72% | 80% |  | Host2 / Farm1 RD Session Host  | 10 GB out of 10 GB | 5 GB out of 5 GB | 13 GB out of 13 GB |
| Host 1 / Farm2 RD Session Host  | - | 75% | 75% |  | Host1 / Farm2 RD Session Host  | - | 5 GB out of 5 GB | 13 GB out of 13 GB |
| Host 2 / Farm2 RD Session Host | - | 72% | 75% |  | Host2 / Farm2 RD Session Host  | - | 5 GB out of 5 GB | 13 GB out of 13 GB |

Table 5: CPU and memory usage

### Knowledge Worker with PowerPoint scenario

The number of sessions supported on two servers for one farm and two farms is shown in Table 6. The processor becomes the limiting factor for this scenario. As a result, for the same processor configuration, the number of sessions between one farm and two farms does not change. The number of sessions increases by a factor of 1.8 when the number of processor cores is doubled. The numbers presented in Table 6 are for 100 percent and 70 percent processor usage. For the deployment, it is advisable to not load the processor to 100 percent to account for unexpected processor spikes.

|  |  |  |  |
| --- | --- | --- | --- |
| **Knowledge Worker with PowerPoint scenario** | **One farm, single CPU/4 core, 16-GB RAM** | **Two farms, single CPU/4 core, 16-GB RAM** | **Two farms, dual CPU/4 core, 32-GB RAM** |
| **100%** | **70%** | **100%** | **70%** | **100%** | **70%** |
| Number of Remote Desktop sessions – Node1 | 90 | 63 | 90 | 63 | 160 | 112 |
| Number of Remote Desktop sessions – Node2 | 90 | 63 | 90 | 63 | 180 | 126 |
| **Total number of users** | **180** | **126** | **180** | **126** | **340** | **238** |

Table 6: Number of users

**CPU Usage Memory Usage**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **One farm (16 GB)** | **Two farms (16 GB)** | **Two farms (32 GB)** |  | **Scenario** | **One farm (16 GB)** | **Two farms (16 GB)** | **Two farms (32 GB)** |
| RD Licensing + RD Connection Broker  | 1% | 1% | 1% |  | RD Licensing + RD Connection Broker  | 412 MB out of 1 GB | 412 MB out of 1 GB | 412 MB out of 1 GB |
| RD Gateway  | 31% | 31% | 33% |  | RD Gateway  | 514 MB out of 2 GB | 532 MB out of 2 GB | 570 MB out of 2 GB |
| Host1 / Farm1 RD Session Host  | 100% | 100% | 100% |  | Host1 / Farm1 RD Session Host  | 9 GB out of 10 GB | 4.7 GB out of 5 GB | 8.7 GB out of 13 GB |
| Host2 / Farm1 RD Session Host | 97% | 98% | 96% |  | Host2 / Farm1 RD Session Host  | 9 GB out of 10 GB | 4.7 GB out of 5 GB | 9.1 GB out of 13 GB |
| Host1 / Farm2 RD Session Host | - | 100% | 100% |  | Host1 / Farm2 RD Session Host  | - | 4.6 GB out of 5 GB | 8.7 GB out of 13 GB |
| Host2 / Farm2 RD Session Host | - | 98% | 96% |  | Host2 / Farm2 RD Session Host  | - | 4.7 GB out of 5 GB | 9.1 GB out of 13 GB |

Table 7: CPU and memory usage

### RD Gateway resource usage

RD Gateway is processor-intensive, but for the number of sessions supported in the test configuration (500), the processor usage is not significant compared to RD Session Host sessions. Also, 2 GB of RAM is sufficient for 500 sessions.

### RD Licensing/RD Connection Broker resource usage

Processor and memory usage of the RD Licensing and RD Connection Broker virtual machine is insignificant and doesn’t have an impact on the number of sessions in our tests.

## Hardware and software cost

This section provides an *indicative* cost of hardware and software for the two-server deployment with and without the high availability solution. The costs are based on the standard hardware configurations available in the market. It should be noted that the hardware costs can be different in different geographical regions and can vary over time. The Remote Desktop Services client access license (RDS CAL) cost is not included in this estimate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Single processor, quad core, 16 GB | Single processor, quad core, 16 GB with HA | Dual processor, quad core, 32 GB | Dual processor, quad core, 32 GB with HA  |
| Hyper-V server | 2\*$2250=$4500 | 2\*$2250=$4500 | 2\*$3100=$6200 | 2.4 GHz |
| File server | - | $1000 | - | $1000 |
| Windows Server 2008 R2 Standard | 2\*$1030=$2060 | 3\*$1030=$3090 | 2\*$1030=$2060 | 3\*$1030=$3090 |
| iSCSI license | - | $1300 |  | $1300 |
| Total cost | **$6,560** | **$9,890** | **$8,260** | **$11,590** |

Table 8: Indicative cost

# Conclusion

The virtualized RD Session Host solution helps to consolidate all Remote Desktop Services role services on a server in a cost-efficient way. Farm load can be distributed across two servers, and with an additional low-end server, the solution can be made highly available. Servers with a single quad core processor and 16 GB of memory can support between 150 to 200 sessions for the Knowledge Worker scenarios. Servers with two quad core processors and 32 GB of memory can support between 300 to 500 sessions.

# Appendix: Testing methodology

These tests were conducted following the same methodology described in the “RD Session Host Capacity Planning in Windows Server 2008 R2” document (<http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=ca837962-4128-4680-b1c0-ad0985939063>). The test consists of gradually loading the test server with user connections while measuring response times for a set of user interface interactions across the server. The number of user connections supported is determined by the moment when response times degrade beyond a predefined threshold. Response times are measured by computing the time interval between the moment the user interface automation sends input to an application and the moment when the application raises the accessibility event associated to the user interface element that it draws in response to processing the input. For example, when sending a CTRL-F to Microsoft® Word, the response time will be computed as the interval between the moment the key combination is sent to Word and the moment Word raises a MENU accessibility event.

Test bench had two test servers with Windows Server 2008 R2 Enterprise and the Hyper-V server role installed. The virtual machine memory configurations for the tests are in Table 2 and Table 3. Each virtual machine hosting the RD Session Host role service had Office 2007 Service Pack 2 (SP2) installed on Windows Server 2008 R2 Enterprise. All virtual machines were configured to use four virtual processors. The test bed included the following elements on a private network: Domain Controller/DNS/DHCP Server/Test Controller, Exchange/IIS /File Server, Test clients.

|  |  |  |  |
| --- | --- | --- | --- |
| Test deployment component | Operating system version | Operating system components | Applications |
| Host server  | Windows Server 2008 R2 Enterprise  | Hyper-V  | N/A  |
| Virtual machine 1  | Windows Server 2008 R2 Enterprise | RD Gateway, RD Web Access | N/A  |
| Virtual machine 2 | Windows Server 2008 R2 Enterprise | RD Connection Broker, RD Licensing | N/A  |
| RD Session Host virtual machine | Windows Server 2008 R2 Enterprise | RD Session Host | Office 2007 SP2  |
| Controller  | Windows Server 2008 Enterprise | DC, DNS, DHCP  | Remote Desktop Load Simulator Controller  |
| Test infrastructure server  | Windows Server 2008 Enterprise  | IIS, File Server  | Exchange Server 2007  |
| Test clients  | Windows 7 Ultimate | Default  | Remote Desktop Load Simulator Client  |

Table 9: Test configuration

New user connections are created by the test clients based on commands sent by the test controller. Each user connection creates a session on the virtual machine hosting the RD Session Host role service through the RD Gateway server and RD Connection Broker server, and then executes a Knowledge Worker scenario by using client-side driven user interface automation. The knowledge worker cycles through Outlook®, Excel®, Word, PowerPoint, and Internet Explorer® while performing typical user actions following a distribution based on Office SQM usage data.