21 TB Data Warehouse Fast Track for Microsoft SQL Server 2014 Using the PowerEdge R730xd Server

Deployment Guide

Notes, cautions, and warnings

NOTE: A NOTE indicates important information that helps you make better use of your computer.

CAUTION: A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

WARNING: A WARNING indicates a potential for property damage, personal injury, or death.

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Abbreviations

Table 1. Abbreviation and expansion table

Abbreviation	Expansion
CPLD	complex programmable logic device
DIMM	dual in-line memory module
DWFT	Data Warehouse Fast Track
NTFS	New Technology File System
OS	Operating System
PD	physical disk
RA	reference architecture
SAS	Serial Attached SCSI
SCSI	Small Computer System Interface
VD	virtual disk

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Overview

This guide provides the step-by-step approach to build a balanced configuration for Microsoft SQL server data warehouse workloads on Dell enterprise products, as specified in the *21 TB Data Warehouse Fast Track RA for Microsoft SQL Server 2014 using PowerEdge R730xd Server* document. The guide also covers requirements for preparing the hardware platform and provisioning the OS to achieve a balanced, optimized 21 TB configuration for Microsoft SQL server 2014 data warehouse by using Dell PowerEdge R730xd servers and Microsoft DWFT principles.

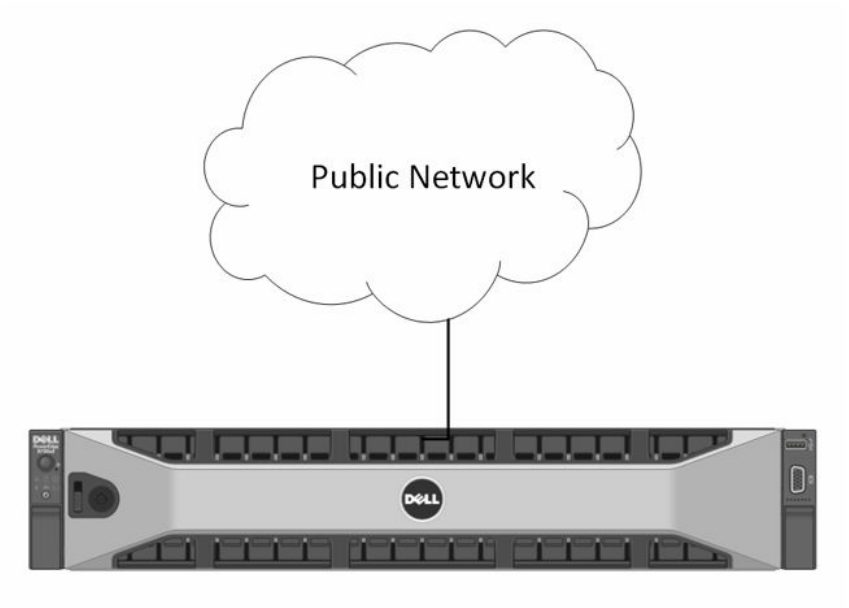

Figure 1. Single server reference architecture

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Solution requirements

This section lists the hardware, software, and firmware requirements for implementing a balanced configuration for Microsoft SQL server data warehouse workloads by using the Dell PowerEdge R730xd server.

Table 2. Hardware and software requirements

Server component	Requirement
Server	Dell PowerEdge R730xd with 2.5-inch chassis
Processors	1 × Intel Xeon E5-2650v3 (2.3 GHz, 10 cores, 20 threads) NOTE: A single socket with a 10-core Intel Xeon E5 2650 V3 processor operating at 2.3 GHz is used.
Total cores	10
Total logical processors	20 processors with hyper-threading enabled
Total memory	192 GB (12 × 16 GB DDR4 DIMMs at 2133 MHz)
Network adapters	Minimum of one network adapter (1 Gbps or 10 Gbps based on requirements) to connect to public network NOTE: It is recommended that you have more than one network adapter with load balancing configured.
Operating system	Windows Server 2012 R2 Standard Edition
Database software	Microsoft SQL Server 2014 Enterprise Edition
Internal RAID Controller	PERC9 H730P Mini
Disk drives	24 × 1.2 TB 10K SAS 2.5" + 2 × 146 GB 15K SAS 2.5" rear hard disk drives

The solution is verified using the following firmware version on the PowerEdge R730xd server.

Table 3. Host server support matrix table

Device	Revision
BIOS	1.1.4
System CPLD	1.0.1
PERC H730P Mini	25.2.1.0037
Broadcom Gigabit Ethernet BCM5720	7.10.17

Device	Revision
integrated Dell Remote Access Controller (iDRAC)	2.02.01.01
Lifecycle Controller	2.02.01.01
Dell OS Single Driverpack for 13G	A00, 14.10.00

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Deploying 21 TB DWFT RA for Microsoft SQL server 2014 Using the PowerEdge R730xd server

This section outlines the sequence of deploying 21 TB DWFT solution for Microsoft SQL server 2014 using the Dell PowerEdge R730xd server.

Deployment workflow

Perform the following tasks to deploy Microsoft SQL server 2014 on the Dell PowerEdge R730xd servers.

1. Configure the Dell PowerEdge R730xd servers. See Configuring components.
2. Install and configure the Windows operating system. See Installing and configuring Microsoft Windows server 2012 R2.
3. Install and configure the SQL application software. See Installing and configuring Microsoft SQL server 2014.

Configuring components

This section describes how to configure the Dell PowerEdge R730xd servers.

Configuring the Dell PowerEdge R730xd server

The PowerEdge R730xd server is a 2-socket, 2U rack server that supports the latest Intel Xeon E5 series Haswell processors and DDR4 RAM. To balance the internal storage and memory on the PowerEdge R730xd server, a single socket with a 10-core Intel Xeon E5 2650 V3 processor operating at 2.3 GHz and a memory of 192 GB operating at 2133 MHz is used. The reference architecture leverages the twenty-four plus two-hard drive system with up to twenty-four, 2.5-inch hard drives, and 2.5-inch back accessible hard drives. Perform the following steps to configure the PowerEdge R730xd server for a 21 TB solution.

1. Configure the BIOS setting. See Configuring BIOS.
2. Configure PERC9 H730P Mini by using the PERC BIOS utility. See Configuring PERC H730P Mini.

Configuring BIOS

About this task

Configure the BIOS setting as follows:

Steps

1. Press **F2** to enter the system BIOS setup mode, and then click **System BIOS**.
2. Set **System Profile Settings** to **Performance**.

NOTE: Ensure that the **Logical Processor** option is enabled.

3. Click **Back**, and then click **OK** to return to the main BIOS page.
4. Restart the server to activate the BIOS changes.

Configuring PERC H730P Mini

About this task

This solution leverages nine RAID 1 disk groups for database data VD, one RAID 1 disk group for log VD, and one RAID 0 disk group for stage VD. Apart from this, one RAID 1 disk group is created for the OS VD.

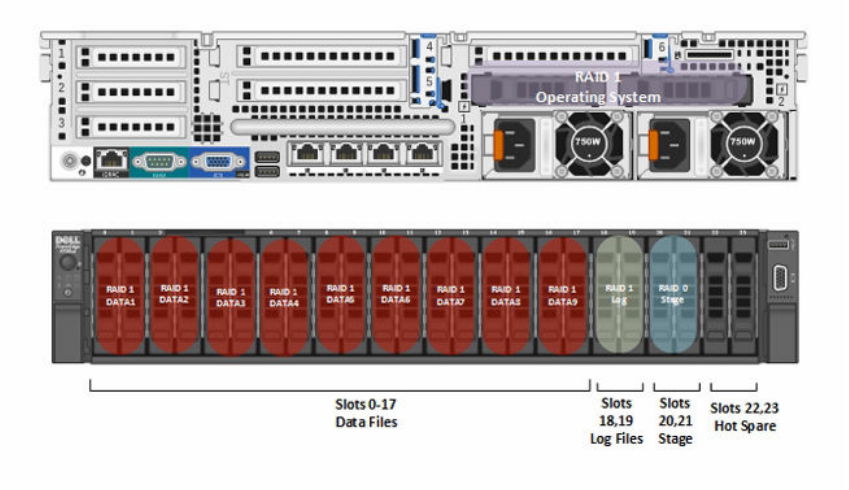

Figure 2. RAID configuration

Steps

1. After the BIOS screen is displayed, press Ctrl+R to launch **PERC H730 Mini BIOS Configuration Utility**.
2. Press F2, select **Create New VD**, and then press Enter.
3. In the **RAID Level** option, select the appropriate RAID levels.

   NOTE: Select RAID level as RAID 1 for the data VD, log VD, and OS VDs. Select RAID 0 for the stage VD.
4. From the **Physical Disks** list, select the two rear 146 GB PDs for the OS VD and the 1.2 TB front PDs for the data, log, and stage VD.
5. Select the default virtual disk size in the **VD Size** field.
6. In the **VD Name** field, type a virtual disk name using the following naming convention:

   Table 4. Virtual disk naming convention

VDs	Naming convention
OS VD	OS
Data VD 1–9	Cage1-Card1-vData1 to Cage1-Card1-vData9
Log VD	Cage1-Card1-vLog
Stage	Cage1-Card1-vStage

7. In the **Advanced** settings, configure the parameters as shown in the following table.

Table 5. Advanced settings

Advanced settings	Values
Stripe Size	512 KB
Read Policy	Read Ahead
Write Policy	Write Back

8. Press the tab key to select **OK**.
9. By using the down-arrow key, highlight the physical disk number 22 and press F2. A list of actions is displayed. By using the down-arrow key, highlight **Make Global HS** from the list of actions, and then press Enter.

   The physical disk number 22 is changed to a global hot spare. The status of the physical disk as a global hot spare is displayed under the heading **State**.

   NOTE: To replace a failed physical disk, global hot spares must use the same disk technology and must be equal or greater in size.
10. Repeat step 9 to add the physical disk number 23 to global hot spare.

Next steps
The solution hot spares are configured to cover disk failure scenarios. The OS, data, log, and stage VDs are now ready to be discovered and used in the operating system to create database volumes.

Installing and configuring Microsoft Windows Server 2012 R2

This section describes the installation and configuration of Windows Server 2012 R2 for the SQL server application.

Installing Microsoft Windows Server 2012 R2

Prerequisites
Keep the Windows installation media ready to start the installation.

Steps
1. Follow the instructions in the **Windows Setup** wizard and click **Next** to go to the installation screen.
2. Click **Install**.
3. In the **Windows Setup** wizard, enter the product key to activate Windows.
4. Select the **Windows Server 2012 R2 Datacenter (Server with a GUI)** option.
5. In **License Agreement**, select **I accept the terms in the license agreement** and then click **Next**.
6. Select the **Custom Install Windows only** option.
7. Select **Drive 0 Unallocated Space** and click **New**.
8. Select the partition where you want to install the OS and click **Next**.

   An information box about Windows creating additional partitions for system files is displayed.
9. Click **OK** to continue.

   The **Windows Setup** wizard displays information about the partitions for your reference. Click **Next**.

   NOTE: The **Windows Setup** wizard gathers all the required information and proceeds with the installation.
10. Click **Restart now** to complete the installation of the OS.

11. In the **Settings** window, enter the user name and password for the built-in administrator account.
12. Click **Finish**.

Next steps
The Windows server installation is now complete. Enter the user name and password to sign in to the Windows server.

Configuring Microsoft Windows Server 2012 R2

About this task
To configure Windows Server 2012 R2 on a database server, perform the following steps:

Steps
1. Make the newly discovered VDs online and initialize the disk with the GUID partition table (GPT).
2. After the disks are initialized, click **create a new simple volume**.
3. Mention the full volume size and mount the VDs to the respective C:\FT mount point as depicted in the following table.
4. Format the volume with NTFS and allocation unit of 64 KB. Enter a volume name as shown in the logical label column of the following table.

Table 6. Mount-point naming and physical enclosure mapping

Disk group	Virtual disk	Virtual disk label	Logical label	Full volume path	Capacity (GB)
1	1	Cage1-Card1-vData1	Data1	C:\FT\Cage1-Card1-vData1	1117.25
2	2	Cage1-Card1-vData2	Data2	C:\FT\Cage1-Card1-vData2	1117.25
3	3	Cage1-Card1-vData3	Data3	C:\FT\Cage1-Card1-vData3	1117.25
4	4	Cage1-Card1-vData4	Data4	C:\FT\Cage1-Card1-vData4	1117.25
5	5	Cage1-Card1-vData5	Data5	C:\FT\Cage1-Card1-vData5	1117.25
6	6	Cage1-Card1-vData6	Data6	C:\FT\Cage1-Card1-vData6	1117.25
7	7	Cage1-Card1-vData7	Data7	C:\FT\Cage1-Card1-vData7	1117.25
8	8	Cage1-Card1-vData8	Data8	C:\FT\Cage1-Card1-vData8	1117.25
9	9	Cage1-Card1-vData9	Data9	C:\FT\Cage1-Card1-vData9	1117.25
10	10	Cage1-Card1-vLog	Log	C:\FT\Cage1-Card1-vLog	1117.25

Disk group	Virtual disk	Virtual disk label	Logical label	Full volume path	Capacity (GB)
11	11	Cage1-Card1-vStage	Stage	C:\FT\Cage1-Card1-vStage	2234.5

5. In Server Manager, point to **Manage**, and select **Add Roles and Features**.
6. In **Add Roles and Features Wizard**, in **Before you begin**, select **Next**.
7. In **Installation Type**, select **Role-based or feature-based Installation**, and click **Next**.
8. In **Server Selection**, select **Select a server from the server pool** and in the server pool, select server and then click **Next**.
9. In **Server Roles**, click **Next**.
10. In **Features**, select **.Net Framework 3.5 Features** and click **Next**.
11. In **Confirmation**, click **Specify an alternate source path** and navigate to Windows Server 2012 R2 media (for example, E:\Sources\SxS\)
12. Select **Restart the destination server automatically if required**, and click **Install**.

    This enables the .Net Framework 3.5 on Windows server 2012 R2.
13. Open **Server Manager** and go to **Local Server**.
14. On the **Computer Name** tab of the **System Properties** dialog box, click **Change** to change the system name to R730xd-FT.
15. Restart the server.
16. After the server restarts, click the computer name to view the **Computer Name/Domain Changes** window.
17. In **Computer Name/Domain Changes**, enter a domain name and restart the server.

    The server is now connected to the domain.
18. In Windows **Control Panel**, go to **Hardware and Sound**, and then select **Power Options**.
19. Select **Balanced** as the preferred plan and close **Control Panel**.
20. Type **gpedit.msc** in the **Run** dialog box and then press Enter to enable the lock pages.
21. On the **Local Group Policy Editor** console, expand **Computer Configuration**, and then expand **Windows Settings**.
22. Expand **Security Settings**, and then expand **Local Policies**.
23. Select the **User Rights Assignment** folder.

    The policies appear in the details pane.
24. In the pane, double-click **Lock pages in memory**.
25. In the **Local Security Setting – Lock pages in memory** dialog box, click **Add User or Group**.
26. In the **Select Users, Service Accounts, or Groups** dialog box, add the SQL server service account.
27. Log out and then log back in for this change to take effect.

Next steps

The configuration of Windows Server 2012 R2 is now complete and you can now proceed with the installation and configuration of SQL server 2014.

Installing and configuring Microsoft SQL server 2014

After installing SQL server, apply the tunings to the SQL server application to achieve up to 21 TB capacity for data warehouse.

- Add startup options

- Set the SQL maximum memory
- Set the maximum degree of parallelism
- Allocate disk space to the tempdb data files

See Configuring SQL server 2014 for more information.

Installing Microsoft SQL server 2014

Prerequisites
Keep the SQL server installation media ready to start the installation.

About this task
To install Microsoft SQL server by using the installation wizard, perform the following steps:

Steps

1. Double-click SQL server setup.exe.
   The **SQL Server Installation Center** window is displayed.
2. Select **Installation** in the left pane to start the installation.
3. In the **Product key** window, enter the product key and click **Next >**.
4. In the **License Terms** window, select **I Accept the license terms** and click **Next >**.
   The installation wizard runs a validation in the **Global Rules** window to determine problems and report, if any.
5. In the **Microsoft Update** window, select **Use Microsoft Update to check for updates (recommended)** and click **Next >**.
6. Click **Next >**.
   The details of all the verifications are displayed in the **Install Rules** window.
7. Click **Next >**.
8. In the **Setup Role**, select the **SQL Server Feature Installation** option and click **Next >**.
9. In the **Feature Selection** window, select the following features and click **Next >**.
   - **Database Engine Services**
   - **Client Tools Connectivity**
   - **Client Tools Backwards Compatibility**
   - **Client Tools SDK**
   - **Management Tools – Basic**
   - **Management Tools – Complete**
   - **SQL Client Connectivity SDK**

   The status of running the rules of installation is displayed in the **Feature Rules** window.
10. Click **Next >** to proceed.
11. In the **Instance Configuration** window, select **Default instance** and enter MSSQLSERVER in the **Instance ID** field. Click **Next >**.
12. In the **Server Configuration** window, select the service accounts for the SQL server actions. Click the **Collation** tab. You can select SQL server collation that supports most commonly used languages and click **Next >**.
13. In the **Database Engine Configuration** window, select **Mixed Mode** and enter the password for the SQL server system administrator. Click **Add** to add users based on the service accounts created in step 12. Click the **Data Directories** tab and separate the log files from the data files by allocating separate locations in the C:\FT folder. Click the **FILESTREAM** tab and select all the options. Click **Next >**.

The **Feature Configuration Rules** window is displayed. If all the entries are fine, the SQL installation wizard automatically proceeds to the next step.

14. Specify the ConfigurationFile.ini from the path C:\Program Files\Microsoft SQL Server\120\Setup Bootstrap\Log\Date_Time\ConfigurationFile.ini
15. Click **Install** to start the installation.

    The wizard displays the installation progress and prompts you with the **Complete** window after the installation is over.
16. Click **Close** to exit the installation wizard.

Next steps

The SQL server installation is now complete and you can proceed with the SQL server configuration for data warehouse.

Configuring Microsoft SQL server 2014

About this task

Perform the following steps by using the SQL Server Management Studio GUI:

Steps

1. In the **Run** dialog box, type SQLServerManager12.msc and press Enter to open SQL Server Configuration Manager.
2. In SQL Server Configuration Manager, click **SQL Server Services** in the left pane.
3. In the right pane, right-click SQL server (<MSSQLSERVER>), and then click **Properties**.

   The **SQL Server Properties** window is displayed.
4. On the **Startup Parameters** tab, in the **Specify a startup parameter** box, click **Add** and enter -E and -T1117 successively as startup parameters.
5. Click **OK** to exit.
6. In the **Run** dialog box, type SSMS and press Enter to open SQL Server Management Studio.
7. In the **Connect to Server** dialog box, verify the default settings, and then click **Connect**. To connect, the **Server name** box must contain the name of the local server.

   A default environment of SQL Server Management Studio with **Object Explorer** on the left hand side is displayed.
8. In **Object Explorer**, right-click the local server name and click **Properties**.

   The **Server Properties – R730XD-FT** window is displayed.
9. In the **Server Properties – R730XD-FT** window, in the Select a page pane, click **Memory** to configure the maximum server memory. Enter 180224 in the **Maximum server memory (in MB)** field as mentioned in the RA document.
10. Click **OK**.
11. In the **Server Properties – R730XD-FT** window, in the Select a page pane, click **Advanced** and then expand **Parallelism** in the right pane. Enter 8 in **Max. Degree of Parallelism** as mentioned in the RA document.
12. Click **OK**.
13. In the **Object Explore**r of SQL Server Management Studio, expand **Management** and click **Resource Governor**.
14. Right-click **Resource Governor** and select **Properties**.

    The **Resource Governor Properties** window is displayed.
15. In the **Workload groups for resource pool: default** box, update the **Memory Grant %** field in the first row with 12%.
16. Click **OK**.

17. In the **Object Explorer** of SQL Server Management Studio, expand **Database** → **System Databases**, right-click **tempdb** and select **Properties**.

    The **Database Properties – tempdb window** is displayed.

18. In the **Database Properties – tempdb** window, select **Files** in the **Select a page** pane.
19. In the **Database Files** box, add nine tempdb data files on the nine data volumes by clicking **Add**.

    NOTE: Enter the tempdb details such as, **Logical Name**, **File Type**, **Filegroup**, **Initial Size**, **Autogrowth / Maxsize**, **Path**, and **File Name**. Enter C:\FT in the **Path** field. The tempdb log file is created on the log volume with auto grow enabled.

20. Click **OK**.

Next steps

Applying the Windows Server 2012 R2 tuning to SQL Server application is now complete.

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Verifying the deployment

To verify that the solution is deployed successfully by testing client connectivity to the database server using telnet, perform the following:

Steps

1. Type Telnet in the command prompt to connect to the installed SQL server database.
2. From a client machine that is connected to the SQL database server, type the **telnet <database server IP> 1433** command and press Enter.

   After the command succeeds, the client is connected to the SQL server database.

Next steps

The solution is verified now.

NOTE: If the telnet command fails, make sure that the steps mentioned in the installation and configuration of SQL server section are followed correctly.

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Appendix

For additional information before deploying the solution, you can refer to the following documents:

- 21 TB Data Warehouse Fast Track Reference Architecture for Microsoft SQL Server 2014 using PowerEdge R730xd Server
- Dell PowerEdge R730 and R730xd Owner's Manual
- Dell Data Warehouse Fast Track for SQL Server Advisor
- Dell PowerEdge RAID Controller (PERC) H730P Mini specifications