



# 11TB and 23TB Data Warehouse Fast Track Reference Architecture for Microsoft SQL Server 2014 using PowerEdge R730 and Dell Storage SCv2020

Dell configuration and performance results

Dell Storage Engineering  
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## Revisions

Date	Description
November 2015	Initial release

## Acknowledgements

Dell Storage Technical Solutions: Chuck Farah

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## Executive summary

Dell and Microsoft collaborate to provide guidelines and principles that assist customers in designing and implementing balanced configurations for Microsoft® SQL Server® Data Warehouse workloads to achieve out-of-the-box scalable performance. These database reference architectures enable each of the components in a database stack to provide optimal throughput to match the capabilities of the specific setup. Innovative 13th-generation Dell™ servers, along with robust and cutting edge Dell Storage SCv2020 arrays, form efficient candidates for a high performing data warehouse solution.

This reference architecture describes architectural design principles and guidelines to achieve an optimally balanced 23 TB and an 11 TB Data Warehouse Fast Track reference architecture for Microsoft SQL Server 2014 using Dell PowerEdge™ R730 servers and Dell SCv2020 SAS-connected storage. The configuration used to achieve the performance numbers for the reference configuration is discussed in detail.

The target audience for this paper is database administrators, business intelligence architects, storage administrators, IT directors, and data warehousing users seeking sizing and design guidance for their enterprise business intelligence (BI) solutions with Microsoft SQL Server 2014.



# 1 Introduction to Data Warehouse Fast Track reference architectures for SQL Server 2014

Data Warehouse Fast Track (DWFT) reference architectures provide tested and validated configurations and associated resources to help customers identify the right environment for their data warehouse solutions. Tangible benefits of following these recommended configuration best practices and guidelines are:

- Accelerate data warehouse projects with pretested hardware and SQL Server configurations.
- Reduce hardware and maintenance costs by purchasing a balanced hardware solution and optimizing it for a data warehouse workload.
- Reduce planning and setup costs by leveraging the certified reference architecture configurations.
- Ensure predictable performance by configuring the system correctly and taking advantage of the tuning directions.

The DWFT reference architectures provide a balanced server, memory, network, and storage hardware configuration and avoid the risk of improperly designed and configured hardware systems. These guidelines ensure that the capability and throughput for the entire system is maximally utilized. Configurations are designed specifically for the data warehouse or BI systems.

## 1.1 Dell Data Warehouse Fast Track reference architectures for SQL Server 2014

Dell and Microsoft have refreshed the DWFT reference architecture offerings with the latest technology advancements in database, server, and storage technology. Dell PowerEdge 13th-generation servers, Dell Storage SCv2020 arrays, and Microsoft SQL Server 2014 are the latest additions to the list of reference architecture components.

The Dell 13th-generation server platforms, featuring enhanced onboard memory, storage, and processor speeds, have advanced features that boost data warehouse performance. The latest Intel® Xeon® E5 series processors, larger memory capacities, higher memory speed, and third-generation PCI Express slots on the newer PowerEdge platforms ensure faster database throughput.

Dell Storage SC Series arrays offer enterprise-class performance and reliability, intelligent automation, and seamless virtualization of storage with simplified storage management. The Dell Storage SC Series offers exceptional performance for both sequential and transactional applications, with linear scalability as arrays are added. The Dell Storage SC Series delivers a modular and cost-effective solution that can be deployed in appropriate increments for small and medium businesses.

Microsoft SQL Server 2014 Enterprise Edition comes with several exciting features that directly benefit data warehouse environments. One of these features is column store indexes. Introduced in SQL Server 2012, column store indexes enable storing data in columnar fashion, providing better query performance and better compression rates. This is very beneficial for data warehouse environments as they typically handle large amounts of data. In SQL Server 2014, column store indexes were enhanced to allow clustering and



updating, making them even easier to incorporate. For more information on column store indexes, visit [msdn.microsoft.com/en-us/library/gg492088.aspx](https://msdn.microsoft.com/en-us/library/gg492088.aspx). Microsoft DWFT for SQL Server 2014 guidelines incorporate the benefit of column store indexes for improved query performance.

The Dell DWFT reference architectures for SQL Server 2014 are engineered jointly by Dell and Microsoft. The hardware and software optimizations are tested by Dell and the performance results are crosschecked by Microsoft. This approach presents a faster time-to-value using integrated, balanced, and verified architectures.



## 2 Recommended reference architectures

The following subsections describe the two different DWFT reference architectures for SQL Server 2014, comprised of PowerEdge R730 servers and Dell Storage SCv2020 arrays.

### 2.1 Single server reference architecture

Figure 1 illustrates the single server reference architecture with the major elements and Table 1 lists the configuration details.

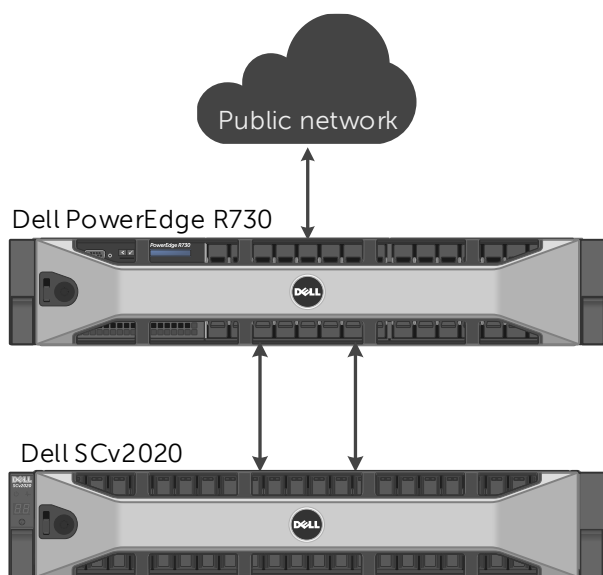


Figure 1 Single server reference architecture

Table 1 Single server reference architecture details

Component	Description	
<b>Server</b>	PowerEdge R730	
	Processors	Intel Xeon E5-2643 v3 (3.40Ghz 6 cores, 12 threads)
	Total cores	12
	Total logical processors	24 (Hyper-Threading enabled)
	Total memory	23TB Rating: 256GB 11TB Rating: 128GB
	Network adapters (LAN)	Minimum of one network adapter (1Gbps or 10Gbps based on requirements) Recommended to have more than one network adapter with load balancing configured
	SAS HBAs	2 x Dell 12Gbps SAS Dual port PCIe HBA (LSI chipset)
	Internal disks	2 x 300GB 15K Raid 1
<b>Software</b>	Operating system	Microsoft Windows Server® 2012 R2 Standard Edition
	Database software	SQL Server 2014 Enterprise Edition
<b>Storage</b>	Storage array	1 x Dell Storage SCv2020
	Disk drives	23TB Rating: 12 x 960GB SSDs, 1 HS (RAID 5) 11TB Rating: 7 x 960GB SSDs, 1 HS (RAID 5)



## 2.2 Highly-available reference architecture

To achieve high availability for the database, Microsoft Windows failover clustering is recommended. Using Microsoft clustering services, one database server is configured as the primary (active) server and the second server is configured as the secondary (passive) server. The secondary server should have exactly the same configuration as the primary server. Since the database is only active on a single server at any point of time, the performance of the database on the primary server (active) is comparable to the single server configuration (discussed earlier).

Figure 2 depicts the highly available reference architecture with the major elements, and Table 2 lists the configuration details.

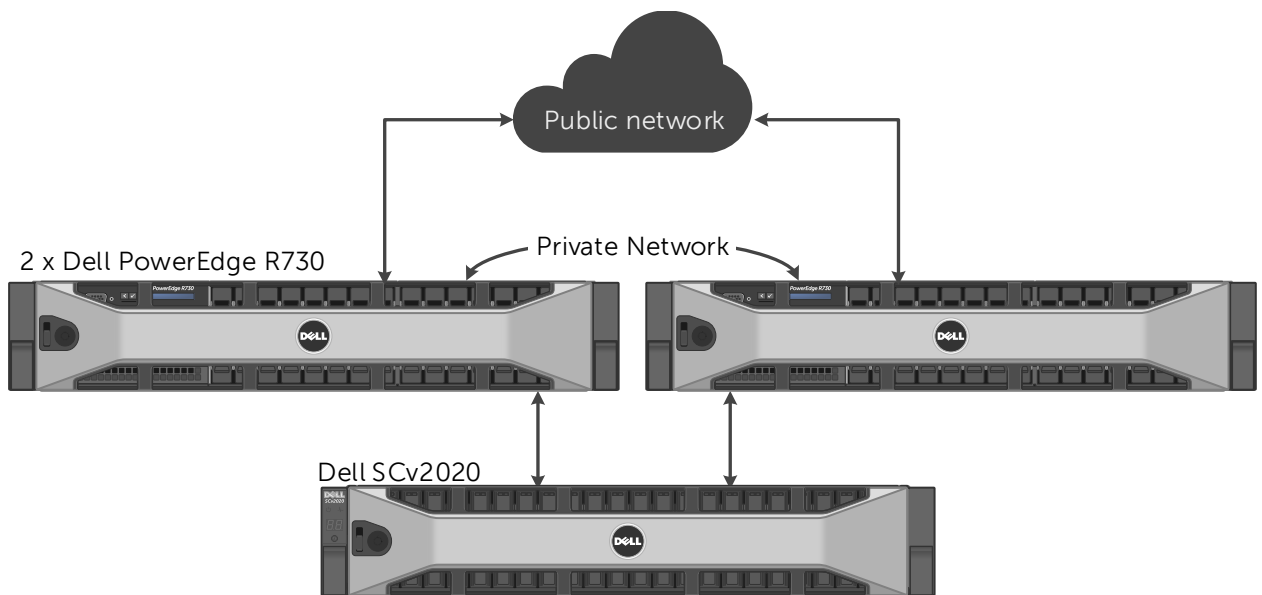


Figure 2 Highly-available reference architecture

Table 2 Highly-available reference architecture details

Component	Description	
<b>Server</b>	2 x PowerEdge R730	
	Processors	2 x Intel Xeon E5-2643 v3 (3.40Ghz 6 cores, 12 threads)
	Total cores	12
	Total logical processors	24 (Hyper-Threading enabled)
	Total memory	23TB Rating: 256GB 11TB Rating: 128GB
	Network adapters (LAN)	Public Network: Minimum of one network adapter (1Gbps or 10Gbps based on requirements) per server with load balancing configured  Private Network (Cluster): Minimum of one network adapter with 1Gbps or 10Gbps connectivity per server
	SAS HBAs	2 x Dell 12Gbps SAS dual port PCIe HBA (LSI chipset)
	Internal disks	2 x 300GB 15K Raid 1
<b>Software</b>	Operating system	Windows Server 2012 R2 Standard Edition
	Database software	SQL Server 2014 Enterprise Edition
<b>Storage</b>	Storage array	1 x Dell Storage SCv2020
	Disk drives	23TB Rating: 12 x 960GB SSDs, 1 HS (RAID 5) 11TB Rating: 7 x 960GB SSDs, 1 HS (RAID 5)



## 3 Hardware components

### 3.1 Dell PowerEdge R730 server

The PowerEdge R730 is a highly versatile, two-socket 2U rack server with impressive processor performance, a large memory footprint, extensive I/O options, and a choice of dense, high-performance storage or low-cost, high-capacity storage. The R730 offers simplified management, purposeful design, and energy efficiency with support for Intel E5 series (Haswell) processors and ECC DDR4 memory with a maximum memory capacity of 768 GB. PowerEdge R730 provides up to seven Gen3 PCIe slots.

For more information on PowerEdge R730 servers, visit <http://www.dell.com/us/business/p/poweredge-r730/pd>.

### 3.2 Dell 12Gbps SAS Dual port PCIe HBA (LSI Chipset)

The proposed reference architecture includes the use of two LSI dual port 12 Gbps Serially Attached SCSI (SAS) connections to PCI express Host Bus Adapters.

For more information, refer to the [Dell PowerEdge 12Gbps SAS HBA User's Guide](#).

### 3.3 Dell Storage SCv2020

The SCv2020 series is designed to offer the perfect blend of high performance data storage at an affordable price. The SCv2020 offers an interesting suite of feature-rich options including proven data protection features, RAID tiering to optimize capacity, data-migration services, and multi-protocol connectivity, balancing the low cost per terabyte with superior IOPs performance.

Dual redundant controllers, 24 internal drives, eight ports of 12 Gbps SAS direct access, plus two IP ports for management and replication are all delivered in a space-saving 2U chassis, making the SCv2020 a true all-in-one solution. The SCv2020 may be ordered with SAS, iSCSI, or FC connectivity.

The SCv2020 supports 8 GB of memory per module for a total of 16 GB of memory per array. By adding Dell SC100 or SC120 enclosures, the SCv2020 can support a raw capacity greater than 500 TB.

With the Fluid Data architecture, Dell Storage changes the way organizations manage data. Empowered by real-time system information about each block of data, Dell Storage Center optimizes data placement, management and protection throughout its lifecycle. This level of data awareness also enables Storage Center to virtualize the storage infrastructure, bringing new efficiency, flexibility and reliability to enterprise storage by creating a pool of high-performance storage shared by all servers and applications.

For more information on Dell Storage SCv2020 arrays, visit [www.dell.com/us/business/p/storage-sc2000/pd](http://www.dell.com/us/business/p/storage-sc2000/pd)



## 4 Storage configuration

### 4.1 Cabling

The hardware components were connected using Dell Storage best practices. High availability and optimum performance may be achieved by alternating connectivity between the host and the SCv2020 controller ports.

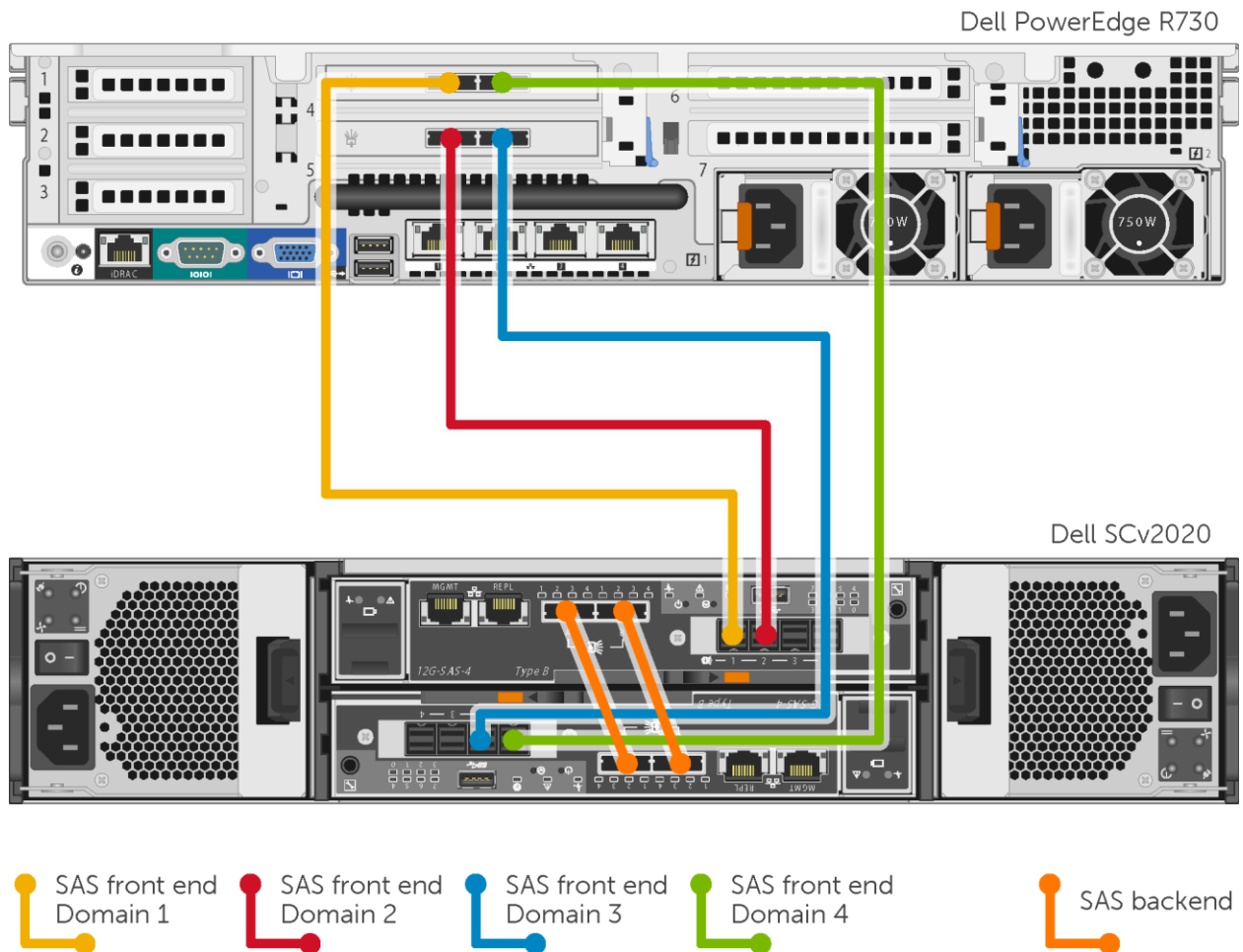


Figure 3 Cabling diagram for single-server configuration

### 4.2 Storage type

The disk folder storage type defines the page size on the Storage Center and whether the disks are configured for redundancy (single or dual). The disk folder can be configured to use a 512KB, 2MB (default) or 4MB page.

The Assigned disk folder was configured for single redundancy, using the default page size of 512KB.

## 4.3 Storage profile

The Storage Center uses storage profiles to define the RAID level and tiers on which data is stored for a given volume. By default, newly created volumes use the **Balanced (RAID 10 Active – Parity RAID)** storage profile. This storage profile uses RAID 10 for active (writeable) data and RAID 5 for Replays.

To increase capacity, the reference architecture uses RAID 5 for all data stored on the SQL Server data volumes. RAID 5 is the default for the **Maximize Efficiency (Parity RAID)** storage profile.

Figure 4 shows the storage profile selection for one of the SQL Server data volumes.

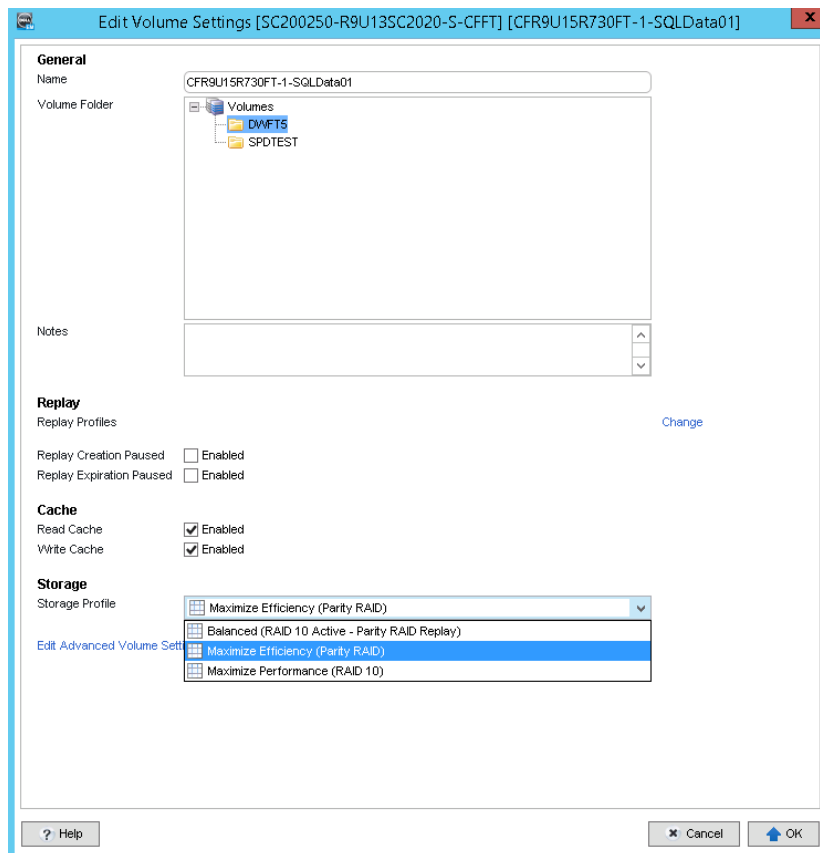


Figure 4 Selecting the **Maximize Efficiency (Parity RAID)** for the SQL volumes.

## 4.4 Storage Center server object

The process of mapping a volume to a server object creates the I/O path (or paths) between a volume and a server. When creating a server object, the operating system of the server is defined. The Storage Center includes both single path and multi-path definitions for each version of Windows.

In this configuration, the server object on the Storage Center was created using the **Windows 2012 MPIO** operating system definition. Since the MPIO version of the Windows 2012 definition was chosen, each volume mapping will contain 4 paths.

Figure 5 shows the creation of the server object.

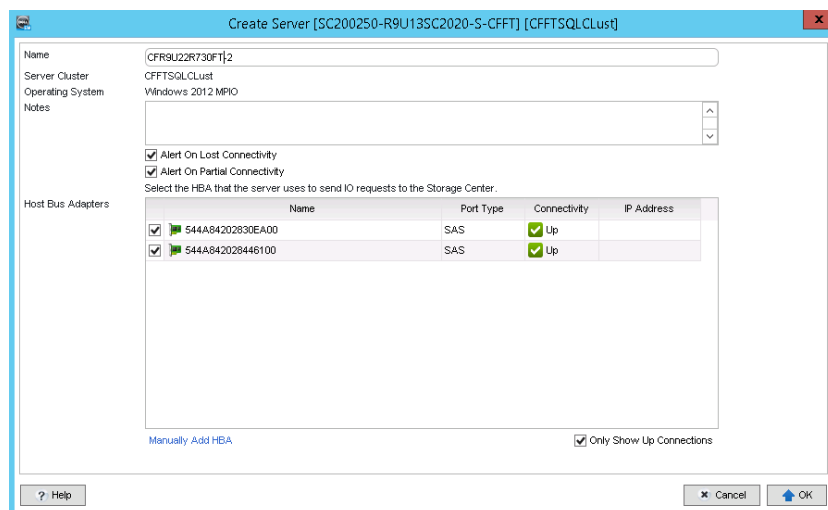


Figure 5 Creating a server object with Windows 2012 MPIO

## 4.5 Storage Center volumes

The **Maximize Efficiency (Parity RAID)** storage profile is assigned to all volumes. None of the volumes were configured to use Replays. The reference architecture may not have enough hardware resources to support the use of Replays.

Six volumes (LUNs) were created to store the SQL Server data files for the data warehouse, with three volumes assigned to each controller. Four volumes were created to store the tempdb data files, with two volumes assigned to each controller. If the volumes are created and mapped to the server at the same time, one after the other, the Storage Center should automatically distribute the volumes evenly across the controllers. Otherwise, the controller can be manually selected in the advanced dialog box when mapping the volume to the server. To achieve optimal results, the SQL Server data volumes should be evenly distributed across the controllers.

Table 3 Storage Center volumes created for the reference architecture

Volume name	Storage profile	Volume purpose
FTSCv2020 – MPHost	Maximize Efficiency (Parity RAID)	Mount point host
FTSCv2020 – SQLSystem	Maximize Efficiency (Parity RAID)	SQL Server system databases and files
FTSCv2020 – SQLLog	Maximize Efficiency (Parity RAID)	Transaction log files for tempdb and the data warehouse
FTSCv2020 - SQLData01	Maximize Efficiency (Parity RAID)	Data files for the data warehouse
FTSCv2020 - SQLData02	Maximize Efficiency (Parity RAID)	Data files for the data warehouse
FTSCv2020 - SQLData03	Maximize Efficiency (Parity RAID)	Data files for the data warehouse
FTSCv2020 - SQLData04	Maximize Efficiency (Parity RAID)	Data files for the data warehouse
FTSCv2020 - SQLData05	Maximize Efficiency (Parity RAID)	Data files for the data warehouse
FTSCv2020 - SQLData06	Maximize Efficiency (Parity RAID)	Data files for the data warehouse
FTSCv2020 - TempdbData01	Maximize Efficiency (Parity RAID)	Data files for tempdb
FTSCv2020 - TempdbData02	Maximize Efficiency (Parity RAID)	Data files for tempdb
FTSCv2020 - TempdbData03	Maximize Efficiency (Parity RAID)	Data files for tempdb
FTSCv2020 - TempdbData04	Maximize Efficiency (Parity RAID)	Data files for tempdb



## 5 Server configuration

### 5.1 System BIOS

The system profile is set to **Performance**. All other options, outside of iDRAC configuration, were left at their factory default settings. The logical processor option, under processor settings, is left at its default setting of **Enabled**. This enables hyper-threading, which maximizes the number of logical processors available to SQL Server.

### 5.2 Host bus adapters

For the Dell 12Gbps SAS HBAs default settings were used.



## 6 Windows 2012 R2 configuration

### 6.1 Power plan

To maximize performance, the server was configured to use the **High performance** power plan as shown in Figure 6.

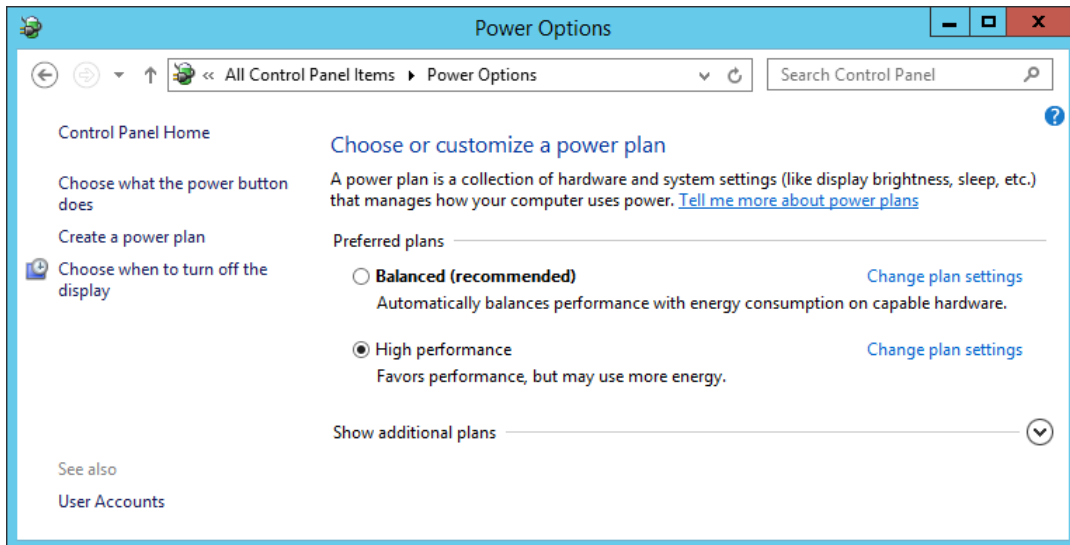


Figure 6 Windows power plan

### 6.2 Lock pages in memory

To prevent Windows from paging SQL Server memory to disk, the Lock pages in memory option was enabled for the SQL Server service account.

For information on enabling this option, visit <https://msdn.microsoft.com/en-IN/library/ms190730.aspx>.

### 6.3 Windows volumes

A single Windows volume was created on each Dell Storage SC array volume. All volumes were formatted with the NTFS file system. The mount point host volume used the default allocation unit. All other volumes used an allocation unit of 64KB.

For DWFT reference architectures, Dell recommends using mount points for the volumes instead of drive letters. It is highly recommended to assign appropriate volume and mount point names in order to simplify troubleshooting and performance analysis. Ideally, the mount point names should be assigned in such a way that makes it easy to identify the SC volume for a given Windows volume.

For this reference architecture, all logical volumes are mounted to the Q:\FT folder.

Table 4 shows the volume labels and access paths used for the reference configuration.

Table 4 Windows volume details

Dell Storage SC volume name	Windows volume label	Access path
FTSCv2020 – MPHost	MPRoot	Q:\FT
FTSCv2020 – SQLSystem	SQLSystem	Q:\FT\SQL2System
FTSCv2020 – SQLLog	SQLLog	Q:\FT\SQLLog
FTSCv2020 - SQLData01	SQLData01	Q:\FT\SQL2Data01
FTSCv2020 - SQLData02	SQLData02	Q:\FT\SQL2Data02
FTSCv2020 - SQLData03	SQLData03	Q:\FT\SQL2Data03
FTSCv2020 - SQLData04	SQLData04	Q:\FT\SQL2Data04
FTSCv2020 - SQLData05	SQLData05	Q:\FT\SQL2Data05
FTSCv2020 - SQLData06	SQLData06	Q:\FT\SQL2Data06
FTSCv2020 - TempdbData01	TempdbData01	Q:\FT\FTTMPDB1
FTSCv2020 - TempdbData02	TempdbData02	Q:\FT\FTTMPDB2
FTSCv2020 - TempdbData03	TempdbData03	Q:\FT\FTTMPDB3
FTSCv2020 - TempdbData04	TempdbData04	Q:\FT\FTTMPDB4

## 6.4 MPIO

MPIO was configured using Dell Storage best practices. MPIO best practices for the Storage Center are documented in *Dell Storage Center - Microsoft Multipath I/O Best Practices* on Dell TechCenter at [http://en.community.dell.com/techcenter/extras/m/white\\_papers/20437917/download](http://en.community.dell.com/techcenter/extras/m/white_papers/20437917/download).

The SCv2020 includes the Dell Storage client which provides a wizard to properly configure MPIO for the hosts attached to the SC. The default configuration provided maximum throughput using the MPIO policy of **Round Robin With Subset**.

Figure 7 shows the default MPIO policy used all SQL Server volumes.



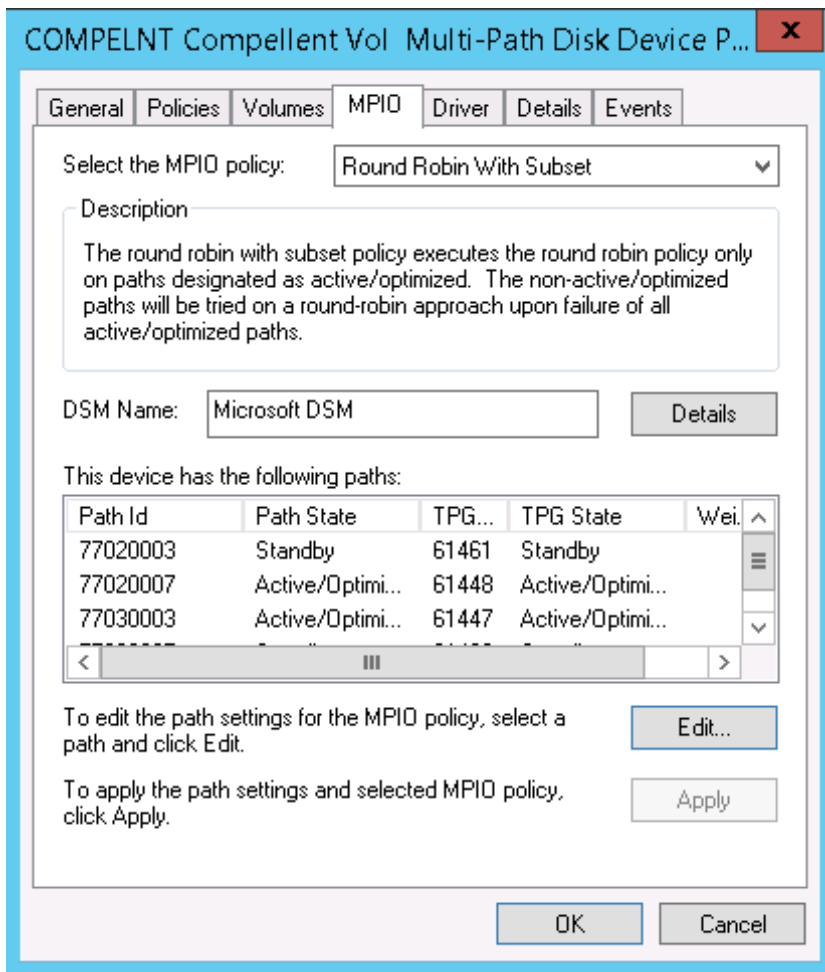


Figure 7 MPIO policy for SQL Server volumes

## 7 SQL Server 2014 configuration

### 7.1 Startup parameters

The following options were added to the SQL Server startup parameters:

#### **-E**

This parameter increases the number of contiguous extents in each file that are allocated to a database table as it grows. This option is beneficial because it improves sequential access.

#### **-T1117**

This trace flag ensures the even growth of all files in a file group when auto growth is enabled. Note that it is recommend to expand the data files to their appropriate size rather than to depend on auto grow.

### 7.2 SQL Server maximum memory

SQL Server was configured to use 92 percent of the memory on the server. Maximum server memory for this reference architecture was set to 236GB for the 23TB MS DWFT rating and 118 GB for the 11TB MS DWFT rating. If additional applications share the server, adjust the amount of memory left available to the operating system accordingly.

### 7.3 Max degree of parallelism (MAXDOP)

The max degree of parallelism was set to 12 for the row store tests and 24 for the column store tests.

For information on configuring the max degree of parallelism, visit <https://msdn.microsoft.com/en-us/library/ms189094.aspx>.

### 7.4 Resource Governor

The Resource Governor was used to limit the maximum memory grant to 12 percent for the row store and column store tests.

For information about the Resource Governor, visit <https://msdn.microsoft.com/en-us/library/bb933866.aspx>.

### 7.5 Tempdb configuration

The tempdb database was configured to use eight data files of equal size. The data files were evenly distributed across the four tempdb data volumes, with two files stored on each volume. The tempdb transaction log file was placed on the log volume. All files were expanded to the appropriate size and **auto grow** was enabled.



## 8 Additional considerations for the Highly Available (HA) DWFT reference architecture

The HA reference architecture leverages Windows Failover Clustering to achieve high availability. When configuring a Windows failover cluster, there are additional storage considerations:

- The recommended quorum model is **Node majority with witness (disk or file share)** using a disk witness. An additional volume needs to be created and configured as the disk witness. Dell recommends using a 2 GB volume for the disk witness. For more information on quorum configurations in a failover cluster, visit <https://technet.microsoft.com/en-us/library/jj612870.aspx>.
- All volumes need to be mapped to each node of the cluster. The Dell Storage Client should be used to create the Cluster Server Object and then map those volumes to that Cluster Server.
- All volumes need to be configured as a cluster resource and added to the SQL Server cluster resource group.



## 9 DWFT for SQL Server 2014 certification – 23TB



DWFT Certification #2014-035	Dell R730 with SCv2020 - 23TB DWFT Reference Architecture		Report Date: 9/15/2015																			
DWFT Rev. 5.4																						
System Provider	System Name	Processor Type	Memory																			
	Dell PowerEdge R730	Dual socket - Intel Xeon E5-2643 v3 3.4 GHz (6C/12T)	256GB																			
Operating System		SQL Server Edition																				
Windows Server 2012 R2		SQL Server 2014 Enterprise Edition																				
Storage Provider	Storage Information																					
	Dell SCv2020 SAS 12 x 960GB SSD for data, log, tempdb (RAID 5) 2 x 300GB 15K SAS for OS (internal, RAID 1)																					
<table><tr><th colspan="4">Primary Metrics</th></tr><tr><td>Rated User Data Capacity<sup>1</sup> (TB)</td><td>Row Store Relative Throughput<sup>2</sup></td><td>Column Store Relative Throughput<sup>3</sup></td><td>Maximum User Data Capacity<sup>1</sup> (TB)</td><td></td></tr><tr><td>23</td><td>85</td><td>106</td><td>27</td><td></td></tr></table>					Primary Metrics				Rated User Data Capacity <sup>1</sup> (TB)	Row Store Relative Throughput <sup>2</sup>	Column Store Relative Throughput <sup>3</sup>	Maximum User Data Capacity <sup>1</sup> (TB)		23	85	106	27					
Primary Metrics																						
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<table><tr><th colspan="6">Row Store</th></tr><tr><td>Relative Throughput<sup>2</sup></td><td>Measured Throughput (Queries/Hr/TB)</td><td>Measured Scan Rate Physical (MB/Sec)</td><td>Measured Scan Rate Logical (MB/Sec)</td><td>Measured I/O Throughput (MB/Sec)</td><td>Measured CPU (Avg.) (%)</td></tr><tr><td>85</td><td>90</td><td>2,287</td><td>2,715</td><td>2,501</td><td>96</td></tr></table>					Row Store						Relative Throughput <sup>2</sup>	Measured Throughput (Queries/Hr/TB)	Measured Scan Rate Physical (MB/Sec)	Measured Scan Rate Logical (MB/Sec)	Measured I/O Throughput (MB/Sec)	Measured CPU (Avg.) (%)	85	90	2,287	2,715	2,501	96
Row Store																						
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Column Store																						
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106	691	739	N/A	N/A	99																	
The reference configuration is a 2 socket system rated for 25TB using the DWFT V4 methodology																						
<sup>1</sup> Assumes a data compression ratio of 5:1																						
<sup>2</sup> Percent ratio of the throughput to the row store throughput of the reference configuration.																						
<sup>3</sup> Percent ratio of the throughput to the column store throughput of the reference configuration.																						
* Reported metrics are based on the qualification configuration which specifies database size and SQL Server memory.																						

Figure 8 Microsoft DWFT Certification for 23TB with Dell R730 and Dell Storage SCv2020 (12x960GB)



## 10 DWFT for SQL Server 2014 certification – 11TB



DWFT Certification #2014-037	Dell R730 with SCv2020 - 11TB DWFT Reference Architecture			Report Date: 9/23/2015																			
DWFT Rev. 5.4																							
System Provider	System Name	Processor Type		Memory																			
	Dell PowerEdge R730	Dual socket - Intel Xeon E5-2643 v3 3.4 GHz (6C/12T)		128GB																			
Operating System		SQL Server Edition																					
Windows Server 2012 R2		SQL Server 2014 Enterprise Edition																					
Storage Provider	Storage Information																						
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Rated User Data Capacity <sup>1</sup> (TB)	Row Store Relative Throughput <sup>2</sup>	Column Store Relative Throughput <sup>3</sup>	Maximum User Data Capacity <sup>1</sup> (TB)																				
11	85	109	13																				
<table><tr><th colspan="6">Row Store</th></tr><tr><td>Relative Throughput<sup>2</sup></td><td>Measured Throughput (Queries/Hr/TB)</td><td>Measured Scan Rate Physical (MB/Sec)</td><td>Measured Scan Rate Logical (MB/Sec)</td><td>Measured I/O Throughput (MB/Sec)</td><td>Measured CPU (Avg.) (%)</td></tr><tr><td>85</td><td>93</td><td>2,259</td><td>2,729</td><td>2,494</td><td>98</td></tr></table>						Row Store						Relative Throughput <sup>2</sup>	Measured Throughput (Queries/Hr/TB)	Measured Scan Rate Physical (MB/Sec)	Measured Scan Rate Logical (MB/Sec)	Measured I/O Throughput (MB/Sec)	Measured CPU (Avg.) (%)	85	93	2,259	2,729	2,494	98
Row Store																							
Relative Throughput <sup>2</sup>	Measured Throughput (Queries/Hr/TB)	Measured Scan Rate Physical (MB/Sec)	Measured Scan Rate Logical (MB/Sec)	Measured I/O Throughput (MB/Sec)	Measured CPU (Avg.) (%)																		
85	93	2,259	2,729	2,494	98																		
<table><tr><th colspan="6">Column Store</th></tr><tr><td>Relative Throughput<sup>2</sup></td><td>Measured Throughput (Queries/Hr/TB)</td><td>Measured Scan Rate Physical (MB/Sec)</td><td>Measured Scan Rate Logical (MB/Sec)</td><td>Measured I/O Throughput (MB/Sec)</td><td>Measured CPU (Avg.) (%)</td></tr><tr><td>109</td><td>711</td><td>766</td><td>N/A</td><td>N/A</td><td>100</td></tr></table>						Column Store						Relative Throughput <sup>2</sup>	Measured Throughput (Queries/Hr/TB)	Measured Scan Rate Physical (MB/Sec)	Measured Scan Rate Logical (MB/Sec)	Measured I/O Throughput (MB/Sec)	Measured CPU (Avg.) (%)	109	711	766	N/A	N/A	100
Column Store																							
Relative Throughput <sup>2</sup>	Measured Throughput (Queries/Hr/TB)	Measured Scan Rate Physical (MB/Sec)	Measured Scan Rate Logical (MB/Sec)	Measured I/O Throughput (MB/Sec)	Measured CPU (Avg.) (%)																		
109	711	766	N/A	N/A	100																		
The reference configuration is a 2 socket system rated for 25TB using the DWFT V4 methodology																							
<sup>1</sup> Assumes a data compression ratio of 5:1																							
<sup>2</sup> Percent ratio of the throughput to the row store throughput of the reference configuration.																							
<sup>3</sup> Percent ratio of the throughput to the column store throughput of the reference configuration.																							
* Reported metrics are based on the qualification configuration which specifies database size and SQL Server memory.																							

Figure 9 Microsoft DWFT Certification for 11TB with Dell R730 and Dell SCv2020 (7x960GB SSDs)



## 11 Summary

Dell, in partnership with Microsoft, enables customers to deploy tested and validated data warehouse solutions using Data Warehouse Fast Track (DWFT) reference architectures for SQL Server 2014. These uniquely designed architectures ensure optimal business intelligence (BI) solutions. The end-to-end best practices and recommendations enable the customer to achieve enhanced return-on-investment (ROI) and faster time-to-value with an optimally configured data warehouse environment.

The Dell Microsoft DWFT reference architecture provides the following benefits to customers:

- Delivers a tested and validated configuration with proven methodology and performance behavior
- Delivers outstanding performance on the Dell 13G server platform with blazing processor speeds and leading edge flash-based Dell storage arrays
- Achieves a balanced and optimized solution at all the levels of the stack by following the best practices for both hardware and software components, achieving faster time-to-value and lower total-cost-of-ownership (TCO)
- Avoids over-provisioning of hardware resources
- Offers high availability at all levels of setup (host, switches, and storage)
- Offers single point of contact/accountability for purchases, services, and support; SQL Server is available to purchase from Dell worldwide
- Helps customers avoid the pitfalls of an improperly designed and configured system
- Reduces future support costs by limiting solution re-architect efforts because of scalability challenges

This paper describes a reference architecture using an R730 server with a SAS connected SCv2020 with 960GB SSDs. By implementing Data Warehouse Fast Track for SQL Server 2014 design principles, two configurations were achieved: one for 23TB rating with 12x960GB SSDs and one for 11TB rating with 7x960GB SSDs.



## A Additional resources

Dell products:

<http://www.dell.com>

Dell services:

<http://www.dell.com/services>

Dell Support:

<http://www.dell.com/support>

Dell SQL Server solutions:

<http://www.dell.com/sql>

Dell Data Warehouse Fast Track for SQL Server Advisor:

[http://www.dell.com/solutions/advisors/us/en/g\\_5/SQLFastTrack/4/Start?s=biz#212418](http://www.dell.com/solutions/advisors/us/en/g_5/SQLFastTrack/4/Start?s=biz#212418)

Dell Storage technical content on Dell TechCenter:

<http://en.community.dell.com/techcenter/storage/w/wiki/2631.storage-infrastructure-and-solutions-team>

Referenced or recommended Dell publications:

Dell SCv2000 documentation library (release notes, installation guide, owner's manual, etc.)

<http://www.dell.com/support/home/us/en/04/product-support/product/storage-sc2000/manuals>

Dell 12 Gbps SAS PCIe HBA User's Guide

[http://topics-cdn.dell.com/pdf/dell-sas-hba-12gbps\\_User's%20Guide\\_en-us.pdf](http://topics-cdn.dell.com/pdf/dell-sas-hba-12gbps_User's%20Guide_en-us.pdf)

Dell Storage Compatibility Matrix:

<http://en.community.dell.com/dell-groups/dtcmmedia/m/mediagallery/20438558>

Dell Storage Center Microsoft Multipath I/O Best Practices Guide:

[http://en.community.dell.com/techcenter/extras/m/white\\_papers/20437917](http://en.community.dell.com/techcenter/extras/m/white_papers/20437917)

Dell SC series storage technical content library (whitepapers, videos, best practices):

<http://en.community.dell.com/techcenter/storage/w/wiki/5018.compellent-technical-content>

