The Methodology Behind the Dell™ SQL Server™ Advisor Tool

Database Solutions Engineering

By

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Executive Summary

The Dell™ SQL Server™ Advisor is intended to perform capacity planning and sizing for Microsoft® SQL Server™ database deployments. The tool gathers inputs or requirements from the customer and recommends solutions to address these requirements. The recommended solutions provides the bill of materials for the complete hardware stack for SQL Server database deployment which includes server, network components and storage. The Dell SQL Advisor tool also recommends all components required for software stack like database edition, management software. This white paper details the working methodologies for Dell SQL Advisor tool and is available at www.dell.com/sql.
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Introduction
Microsoft® SQL Server™ is a Relational Database Management System (RDBMS) which provides a secured and reliable method for storing business critical application data. Editions of SQL Server provide several advanced features (e.g. partitioning, encryption, mirroring) which help customer manage their data as per application requirements.

Planning the deployment of SQL Server is complex. Customers need to consider several parameters to deploy the SQL Server database. Insufficient planning and inappropriate hardware sizing can result in performance degradation for the applications.

The SQL Server Advisor tool is designed to enable users to seamlessly create and visualize sample architectures for a backend SQL Server infrastructure by answering a set of reference questions. The tool provides a complete view of hardware, software, and services capabilities required for the recommended architecture. It is available at http://www.dell.com/sql.

Dell has performed extensive testing and characterization of Microsoft SQL Server by simulating real customer scenarios on Dell enterprise servers and storage to design solutions that meet the performance requirements. The Dell SQL Server Advisor design formulas were designed from the data derived from this experimentation.

This whitepaper outlines hardware capacity planning and sizing concepts and explains how the Dell SQL Server Advisor tool is used to make recommendations for SQL server deployments. This paper also provides insight into all the questions that are asked to customers as a basis for proposing the solutions.

Hardware Capacity Planning & Sizing Considerations

Hardware capacity planning and sizing is very critical for any database deployment. Typically, in the process of capacity planning, hardware resources are identified that meet the business needs and are fine tuned to suit specific needs like applications, workloads, etc. For any database deployment several considerations are taken into account while performing hardware capacity planning. A few of the important considerations are described below:

Application Type
Most database applications are IO intensive and require significant host processing power, but performance requirements vary depending on the type of application using the database. For example, Online Transaction Processing (OLTP) applications need to have a storage subsystem which can process small random IO within permissible response time. Decision Support Systems (DSS), however, demand host processor cycles and need to have a storage subsystem with the appropriate bandwidth. The hardware bill of materials for the stack is highly dependent on the application type that uses the SQL Server database.
Database Size
Database size plays a big role in capacity planning and sizing activities. The amount of storage required for the SQL Server database deployment is dependent on the size of the database that needs to be deployed. As the database grows and performance requirements increase, the customer can add more spindles to the storage subsystem and increase computing power to the database hosts. Application performance requirements are the key considerations in this exercise. Acceptable response times for database queries and storage I/O operations are required to meet the SLAs for OLTP applications and high throughput is the major consideration for DSS applications. Hence, an end-to-end hardware stack should be chosen which can meet these different performance requirements as well as accommodate the size of these different types of application.

High Availability and Disaster Recovery Requirements
Today’s businesses cannot afford to have application down time even though applications are prone to have planned or unplanned outages. Planned downtime is required for hardware or software maintenance activities but unplanned downtime may occur for several reasons like hardware crashes, software corruption, or any form of natural disasters. High availability and disaster recovery (HA and DR) solutions need to be considered while performing capacity planning and sizing activities.

Dell™ SQL Server Advisor – Process Flow
The Dell SQL Server Advisor provides a very simple user interface where users provide the requirements (performance, high availability etc.) for their SQL server deployments by responding to the interview style series of questions. The tool gathers these requirements, maps them to Dell’s enterprise portfolio capabilities and recommends solutions. The tool provides a summary page which collates all the inputs given by the customer, and enables them to trace back and change the values or options if required. Finally, the tool recommends 2 solution options in the output section. For novice users, we provide coaching guidelines and pointers to help them make the most of informed choices. As mentioned earlier, all the proposed solutions are based on the best practices derived from extensive experimentation performed in Dell Labs.

The following sections elaborate on the SQL Server Advisor input questions which are asked to customers for capturing database requirements.

Questionnaire (User Input)
After choosing the initial type of workload, the questions break out into the following flow:

- General Questions (Q2 – Q6) are independent of the workload type
- OLTP workload specific: Q7 – Q9
- OLAP workload specific: Q7 – Q10
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- The final two questions address the overall deployment and apply to both workloads.

The headings in each sub-section below specify the classification of each question.

**General: Identify the Database Workload**

![Figure 1: Specifying the Workload](image)

Most database applications can be placed into one of the following two categories - Online Transaction Processing (OLTP) or Online Analytical Processing (OLAP). OLTP applications are characterized by small and random IO, whereas OLAP applications feature large sequential IO patterns. Performance requirements for OLTP applications differ from those of OLAP applications. Without knowing the type of workload, it is impossible to provide appropriate hardware sizing guidance. Storage I/O response times are the key performance metric for an OLTP workload, whereas storage throughput is the key considerations for OLAP workload. This question helps in identifying the overall IO pattern for the application, which is very critical in sizing the hardware components.

Because the performance requirements for OLTP and OLAP workloads are different, the sizing considerations vary depending on the database workload type. The question in figure 1 helps the advisor tool to understand the SQL server database workload to perform the sizing correctly.
Dell has conducted performance analysis to characterize the enterprise hardware (servers, storages and network components) associated with OLTP and OLAP database workloads. This performance data is used by the Dell SQL Server Advisor tool to provide the reference architecture which not only addresses the current database performance requirements, but also makes sure that the database performance is sustained with database growth in future.

**General: Balance Customer Priorities**

Customer priorities vary depending on the criticality of applications. Each IT shop has different guidelines under which hardware is deployed. For some applications, performance is of utmost importance. For other applications, customers may compromise on performance and will opt for a lower-cost solution. In general, high performing solution components are more expensive and customers need to consider the cost vs. performance tradeoffs. This requirement helps to better understand the target processor utilization for database hosts and to recommend the proper server configuration.
General: Identify the Class of Storage Array

![Image: The Dell Solution Advisor - Windows Internet Explorer provided by Dell I/T](image)

Figure 3: Understanding Storage Need

Dell has a wide range of storage portfolio options, spanning across iSCSI, SAS and FC technologies, for both entry and enterprise level customer needs. Entry level storage has benefits over internal server storage, which includes higher availability, increased manageability, easier backup/recovery and higher drive capacity utilization. Enterprise class storage has all of the benefits of Entry Level Storage plus greater scalability, increased data protection capabilities and better integrated into disaster recovery solutions. Regardless of scalability or performance, the feature set of availability options delivered with the array is a differentiator between these two classes of products.

Dell has done performance analysis for both entry level and enterprise storage, designed to determine the maximum IOPS and throughput that each array can deliver. In addition to just the maximum number of IOPS, the storage is also tested for scalability. Storage scalability is performed to better understand whether the storage sub-system can sustain the database performance requirements with the growing database size.
General: Determine Server Characteristics

Dell has an expansive range of enterprise server offerings on which to deploy their SQL Server database solutions. Dell’s customers tend to standardize on a form-factor and processor vendor for their entire IT infrastructure. Dell allows customers to choose from different form factors (e.g. Rack, Blade, and Tower servers) and offers a choice between Intel or AMD processors.

All combinations of server and processor types are analyzed during the server performance characterization study, across both types of workloads. The tests are carried out to find the maximum userload that the server can handle. Scalability aspects involving the memory and CPU capability and features (cores, clockspeeds and cache sizes) are also tested during the performance evaluation.
General: Ascertain Whether Additional Features are Needed

![SQL Server Advisor](image)

**Figure 5: Additional Feature Set Requirements**

While deploying SQL database solutions, it is very important to understand the different high availability and disaster recovery (HA and DR) requirements for the application. Customers can choose to deploy HA and DR solutions using various technologies. The question in figure 5 gathers additional features selected to achieve HA and DR requirements.

SQL Server Database Mirroring uses the log shipping method to transfer the log from principal server to the mirror server. The mirror database is synched up with the principal database by replaying the transaction logs. In the event of failure to the principal databases, the mirrored database can act as the principal database and all application users can be continued to be served by the new principal database. But to setup this infrastructure, customers need to have a highly available environment with a redundant set of hardware.

Windows server failover clustering can be used to make cluster-aware applications like SQL Server Standard/Enterprise Edition highly available. If the primary node fails, the cluster fails over the
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application to an alternate server. This solution does not require additional storage arrays, but requires additional server resources to act as the failover host.

Storage based mirroring is another way of implementing a HA and DR solution where a snapshot or clone of the database resides on a different storage array. By having a standby server available the customer can be covered in the event of a site-wide disaster.

Customers can also choose a tape backup solution to archive database backups to tape libraries. Dell has a wide range of offerings for tape libraries to address this requirement.

SQL Server 2008 Enterprise Edition comes with several advanced features like partitioning, transparent data encryption, auditing and compression. To take advantage of these features, Enterprise Edition will be recommended.

General: Determine the Database Size

![Database Size Requirements](image)

Figure 6: Database Size Requirements
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Knowing the database size helps in recommending the number of storage disks needed to accommodate the database. Number of disks required for SQL server database deployment is not only dependent on database size, but also on other performance factors like desired IOPS and throughput; the load that will be exerted on this database. With this consideration in mind, Dell SQL Server Advisor is designed to recommend the size and number of disks which can provide desired IOPS and throughput.

OLTP: Identify Transaction Rate

![Figure 7: Understanding Application Transaction Requirement](image)

A database transaction means a sequence of operations that a user or application performs on the database system. Typically the number of transactions submitted to the database has a direct correlation to the database user load. The Dell SQL Server Advisor tool performs hardware sizing based on the peak performance requirements for the applications. Knowing the number of transactions assists in recommending the optimal amount of CPU, memory and storage to meet OLTP performance requirements.
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OLTP: Identify Storage Performance (IOPS) Requirements

![OLTP: Identify Storage Performance (IOPS) Requirements](image)

Figure 8: Storage Performance (IOPS) Requirement

Knowing the number of IOPS helps in sizing the storage component of the solution stack. Dell SQL Server Advisor determines the optimal storage configuration comprehending the increased size of the database over time.

IOPS requirement is one of the prime factors in determining the number of disks required in the storage subsystem. Besides meeting IOPS requirement for database data, Dell SQL server Advisor also takes care of IOPS requirements for tempdb and transaction log disks. The Dell SQL server Advisor tool provides details on the number of disks recommended for database, log and tempdb in the recommended solution.
OLTP: Quantify Database Connections

Figure 9: Application Usage Requirement

In a multi-tier deployment, the application uses a pool of connections to address the requests from end users. Knowledge about the number of concurrent users is essential in sizing the hardware stack. Basically, every connection to the database consumes some amount of memory and cpu resources of the database host. The resources on database host should be sufficient to serve the required number of database or application users. As the number of user query requests to the database increases, more data will be retrieved from memory/storage. Hence, for I/O intensive workloads the number of database users also affects the IOPS and throughput requirements.
OLAP: Determine Average Row Length

The question in figure 10 helps in understanding the OLAP table schema. The row length helps estimate the database record size, which allows the tool to understand the amount of data that actually needs to be pulled from the database and either stored in cache or processed. Understanding the quantity of data that gets fetched from the storage helps to determine the workload throughput requirements. This in turn allows Dell to provide the proper storage recommendation, ensuring that there will be available bandwidth to satisfy the throughput requirements.
OLAP: Quantify Records Fetched

Figure 11: OLAP Query Volume (Number of records fetched)

The answer to this question is used in tandem with the previous question to calculate the total amount of data that gets fetched. You have the size of a single record multiplied by the total number of records fetched, which results in a total number of MB or GB that needs to be pulled from the storage. The answers to these two questions directly impact the storage recommendation and play a role in calculating the memory requirement.
OLAP: Determine Query Rate

The final piece to the DSS workload survey involves the frequency at which queries get generated. OLAP workloads are host intensive and require CPU and memory resources. These inputs also help provide the upper and lower bounds for the tempdb size.
OLAP: Determine Storage Throughput

Most of the time OLAP workloads are comprised of long running queries and batch jobs with sequential I/Os. The storage array should be able to meet the required throughput for the application and the question in Figure 10 is another way to help the Dell SQL Server Advisor tool determine and recommend the right storage.

The last two questions (Q11 – Q12) are general questions and are independent of the workload type.
General: Allocate Tempdb Space

For the database to be able to perform optimally, tempdb has to be sized appropriately. Tempdb is used as a swap space for non persistent data. Tempdb size should be selected properly as it is a global resource available for all users connected to an instance of SQL server database, meaning there is only one tempdb per instance. The tempdb is leveraged for OLAP database activities like queries (with lots of sorting and hash joins), online index creation, user defined functions, temporary tables usage etc. The tempdb sizing has to take care of all peak database activities and database administrators usually size it bigger to accommodate all peak loads. This size of the tempdb determines the storage requirement for the SQL server deployment. The tempdb size requirement helps in calculating the number of disks required in the storage subsystem. If the tempdb size is unknown, 15% of the size of the database provides a good start, more for complex queries associated with DSS workloads.

Figure 14: Tempdb Requirement for SQL Server
General: Allocate Additional Server Memory

Customers may want to run applications like anti-virus applications, back up agents or business analytics on the same machine running the SQL Server application. Since we do not size for 100% CPU utilization and the CPU footprint of these applications is minimal, we only size for the additional memory requirements.

SQL Server Advisor Output
The Dell SQL Server Advisor navigates through the customer input and generates output based on their answers. The Dell SQL Server Advisor output is organized in the following sub-section tabs:

**Summary:** This tab lists the input from user and provides a tabular representation of the recommended solution. Here, details like the number and configuration of the server and storage hardware are outlined. When Dell first started with advisory tools, we offered two distinct lines of storage that had significant differences in performance and availability. This allowed us to provide a single storage solution in response to a given set of inputs, primarily based on the performance characteristics of the
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storage. In the time since the original advisory tool was released, Dell has greatly expanded our storage portfolio with a variety of options that can meet customer’s needs that extend beyond a single storage fabric. There are two primary technology transitions that have brought us to a point where performance is not the only way we differentiate storage: The replacement of a bus-based parallel SCSI protocol with the switch based Serial Attached SCSI (SAS) protocol and the emergence of iSCSI as a credible datacenter storage fabric.

In order to best demonstrate the capabilities of our entire portfolio, we’ve chosen to modify the Dell SQL Server Advisor’s output to display two solutions, either of which will provide ample performance. This is due to the fact that we have multiple storage platforms that can satisfy a customer’s needs across different fabrics including Fibre-Channel, SAS, and iSCSI.

**Solution:** These tabs portray the graphical representation of the recommended solutions by the Dell SQL Server Advisor. For each of the two recommended solutions, the tabs will give a feel for how the configuration looks, inclusive of the connections between different components. The solution recommended by the Dell SQL Server Advisor is identified and referenced by a unique ID called “Solution ID.” Each time a customer uses the Dell SQL Server Advisor tool for solution generation a unique ID is generated for the corresponding input. The IDs are different for two possible solutions for customer input. The configuration ID can be used for further discussion with TSRs (Technical sales representatives). The ID can be used for purchase ordering and technical discussions.

**Hardware:** For the server and storage chosen as part of the solution, we have a section that outlines the unique features of each component. This includes information about the server technology and features of the platform such as storage and memory capacity. Links to the product pages on [www.dell.com/](http://www.dell.com/) are also displayed.

**Software:** Details about different software components provided with the solution are provided here. Data on versions of operating system, database software, and systems management software are explained here.

**Services:** This tab has details related to the different kinds of services offered to customers along with the solutions. Information about training and technical support is provided here. Helpful information on implementation & designing, and also on features like migration is placed here. Hyperlinks to support sites are embedded to help the customers navigate to that web site for more information.

**Take Action:** You are encouraged to contact your technical salesperson once you’ve run through the advisor. If you do not know your salesperson or have additional questions, we want to hear from you. Our technical sales representatives can help you from a general solution to comprehending your specific needs.
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**Summary**

We have shown that a database solution stack recommendation is greatly affected by various parameters like application type, performance requirements, storage needs, business needs, etc. The automation of the application and database characterization undertaken in Dell Labs has resulted in the creation of the Dell SQL Server Advisor tool. There are many approaches to capturing information from our customers in a way that results in hardware sizing. Our strategy is to ask questions that are easy to answer, in an interview style, to simplify the process of articulating requirements. We encourage you to try out the Dell SQL Server Advisor tool located at [http://www.dell.com/sql](http://www.dell.com/sql).

**References**

1. Dell SQL Server Advisor
   

2. Working with tempDB
   

3. SQL Server maximum capacity specifications
   

4. Analysing memory requirements for SQL Server
   
   [http://www.sqlservercentral.com/articles/Performance+Tuning/analyzingmemoryrequirementsforsqlserver/2498/](http://www.sqlservercentral.com/articles/Performance+Tuning/analyzingmemoryrequirementsforsqlserver/2498/)