Dell Compellent Storage Center Microsoft Exchange Server 2010

Best Practices

Document revision

Date	Revision	Comments
11/19/2009	A	Draft
11/30/2009	B	Initial Release
7/26/2010	C	Technical Review/Updates
01/24/2012	D	Formatting Updates
01/26/2012	E	Technical Review/Updates

Contents

General syntax

Table 1.   **Document syntax**

Item	Convention
Menu items, dialog box titles, field names, keys	**Bold**
Mouse click required	Click:
User Input	`Monospace Font`
User typing required	Type:
Website addresses	http://www.compellent.com
Email addresses	info@compellent.com

Conventions

Notes are used to convey special information or instructions.

Timesavers are tips specifically designed to save time or reduce the number of steps.

Caution indicates the potential for risk including system or data damage.

Warning indicates that failure to follow directions could result in bodily harm.

Preface

The purpose of this document is to provide additional guidelines when using Microsoft Exchange Server 2010 with Dell™ Compellent™ Storage Center™.

These guidelines should be evaluated thoroughly as every environment configuration is different, and should not be construed as final recommendations in the configuration of your Dell Compellent Storage Center or Microsoft Exchange environments.

Customer support

Dell Compellent provides live support 1-866-EZSTORE (866.397.8673), 24 hours a day, 7 days a week, 365 days a year. For additional support, email Dell Compellent at [support@compellent.com.](mailto:support@compellent.com) Dell Compellent responds to emails during normal business hours.

Pre-Deployment

Understanding storage visualization

Traditional SAN solutions require you to create a LUN by carving out a specific amount of disk space from a specified set of spindles. This process is time-consuming and hard to manage because you have to keep track of what servers are mapped to what storage via what worldwide name (WWN). Not only is this time-consuming, but also confusing since you wind up managing your storage configuration via a spreadsheet or other means outside of the storage management interface.

Dell Compellent virtualizes storage at the disk-level and uses all available spindles as a single virtual disk pool. Dell Compellent can create volumes where all the drives are used together and performance is improved since the blocks of data are written in parallel to all drives at once.
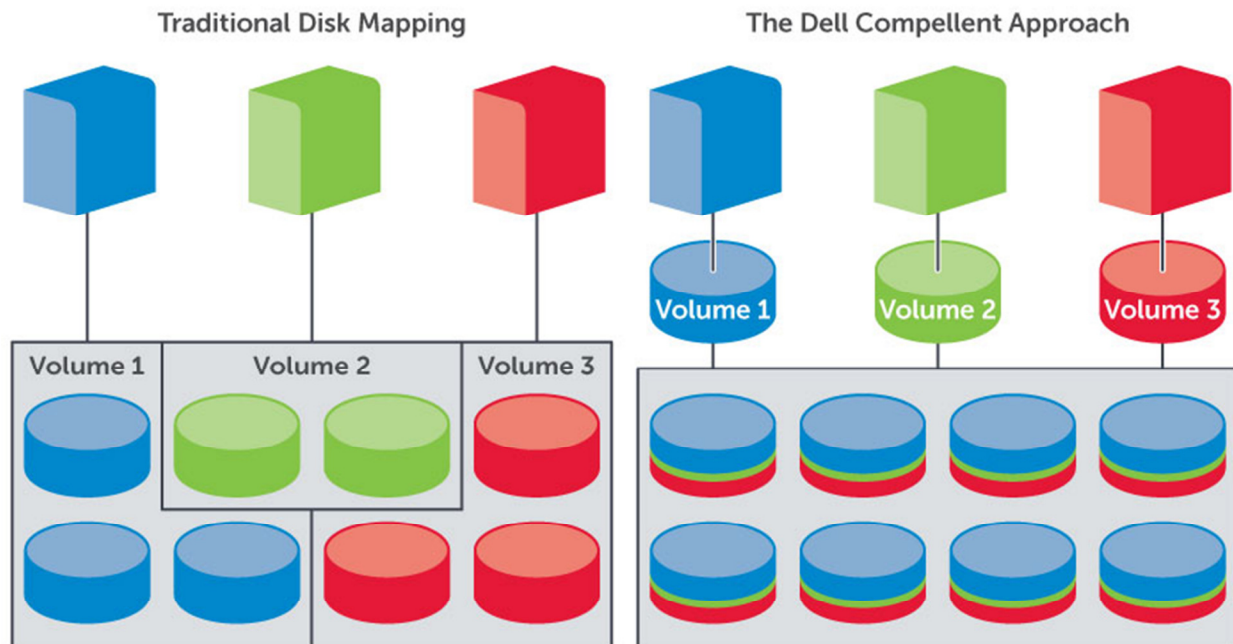
Understanding your I/O

The SAN configuration is an important part of any application configuration, especially Exchange. Understanding Exchange and how it works with storage will ensure that systems run in high performance and in their most capable state.

Ensuring that your application runs in its optimal environment is an important part of configuring Exchange. You can easily get a feel for whether your server and disk subsystem can provide the performance you are looking for by running some simple tests.

Several tools exist to put a load against and test the performance of your Exchange Server and disk, including LoadGen and Jetstress. Each of these has the capability to simulate Exchange I/O patterns as well as the client experience, which can give you an idea of what kind of performance numbers to expect from the disk subsystem.
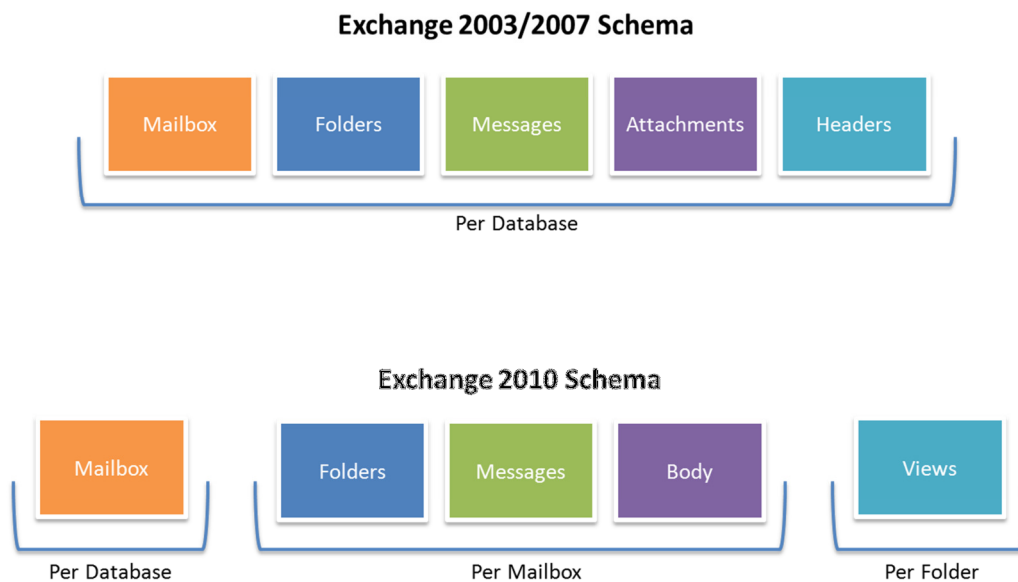
LoadGen and Jetstress are available from Microsoft as free downloads and are discussed in a later section on Sizing your Exchange Server.

Monitoring performance in an existing environment using a tool like Performance Monitor allows you to define a baseline and get an understanding on how the application can be expected to perform in your current environment.

Exchange 2010 Architecture Changes

Database I/O & Schema
The architecture and data structure of mailbox databases has changed drastically in Exchange 2010. The database has been restructured and the schema flattened to produce a more efficient, sequential-like write pattern. This change alone has helped to reduce the overall I/O of the database and reduced mailbox IO requirements by 70%. This reflects an IOPS per mailbox decrease of 90% since Exchange 2003. With all of the changes in the mailbox database structure, Exchange now has the capability to offer mailboxes that are 5GB-10GB each.

Exchange 2003/2007 Schema

Mailbox	Folders	Messages	Attachments	Headers

Per Database

Exchange 2010 Schema

Mailbox		Folders	Messages	Body		Views

Per Database   Per Mailbox   Per Folder

The database page size has been increased to 32K (up from 4K in Exchange 2003 and 8K in Exchange 2007). This means that more data can be written to a page which in turn requires less overall reads. "Space Hints" has been introduced and is the process by which Exchange allocates more contiguous database space helping to improve database read speeds by putting related data closer together realizing much more sequential access than in the past.

Storage Groups
The concept of storage groups is deprecated in Exchange 2010. The core object is the mailbox database. Mailbox databases are peer objects now to a mailbox server which means that databases can be moved from server to server, automatically via Database Availability Groups (DAGs), or brought online on any mailbox server with database portability. In addition, each mailbox database has its own set of transaction logs which are 1MB each.

Database Availability Groups (DAGs)
Cluster Continuous Replication (CCR), Local Continuous Replication (LCR), and Standby Continuous Replication (SCR) have also been deprecated in Exchange 2010 although the log shipping technology is still being used with the new feature, Database Availability Groups (DAGs). Mailbox server clusters no longer exist, but have been replaced by DAGs. Windows Failover Clustering doesn't have to be setup to install a DAG; Exchange 2010 automatically configures and uses some of the components of clustering in its operations. DAGs still provide automated failover in the event of component failure or worse.

Database Copies
Each mailbox server can now contain up to 100 databases (5 databases in Standard Edition) and each database can have up to 16 copies for high availability.

Single Instance Storage (SIS)
SIS also no longer exists in Exchange 2010. When Single Instance Storage was available in earlier versions of Exchange it was intended to help make mailboxes and databases leaner when users would send attachments. When a user would send a message with an attachment to other users in the same mailbox database, instead of creating a copy of the attachment for each mailbox, it would use pointers to the location of the attachment thus reducing mailbox overhead. This scenario worked fine with a limited amount of databases and users, but as environments grew larger with a large number of databases and more distributed users, SIS becomes less useful.

Without SIS, the overall database size increases by approximately 20%. This increase in space is mitigated by database page compression, another feature of Exchange 2010.

Configuration

Disk layout

Determining your disk layout before the installation of Microsoft Exchange Server is an important step as it can have direct impact on performance when using other disk solutions.

With Exchange 2010, Microsoft allows placement of logs and databases on the same volume.

The Jet database (EDB) activity is more sequential-like reading and writing to 32 KB blocks. The transaction logs see 100% sequential reads and writes.

This table shows a sample disk layout based on best practices:

Drive	Recommended Configuration	Contents
C:	DAS/SAN	Windows, Exchange Binaries
D:	DAS/SAN	Pagefile
E:	SAN	Database 1 / Logs 1
F:	SAN	Database 2 / Logs 2

When using a Dell Compellent Storage Center with Exchange it is recommend that the Microsoft best practices are followed for disk layout and data placement. This will also aid in management as well as make it easier for a vendor to understand your configuration layout in a support situation.

Exchange 2010 supports 100 databases per server with up to 16 copies of each to other mailbox servers in the organization. A best practice is to minimize the number of databases, as much as recovery objectives will allow. As the number of databases increases so does the IO required supporting the additional data streams. This can have a negative impact on the IO load of a system.

As environments grow larger and larger, it will become commonplace to run out of drive letters for the volumes. For the purpose of scalability, it may be suitable to use Windows mount points for database and log volumes.

This table shows a sample disk layout based on best practices using mount points:

Drive	Recommended Configuration	Contents
C:	DAS/SAN	Windows, Exchange Binaries
D:	DAS (if available)	Pagefile
E:	SAN	Mount Points
VMP	E:\Database1	Database 1 / Database 1 Logs
VMP	E:\Database2	Database 2 / Database 2 Logs
VMP	E:\Database3	Database 3 / Database 3 Logs

Storage Center page size considerations

By default, the Dell Compellent Storage Center writes data to individual 2MB pages. Exchange 2010 writes database pages of 32KB each. Write concatenation will attempt to put as many I/Os together to fill a page where possible.

It is very likely that during the course of a day many pieces of the database will be accessed and changed. That being considered it is also important to understand that a single block being altered constitutes a change of that 2MB page where it is located on the Storage Center. Potentially that could be the only block on that 2MB page that was changed. This can result in larger than expected replay sizes in your environment.

Customers who experience large Replays (75 percent or greater of database size) can consider the 512K page option for their Exchange volumes on the Storage Center. This will reduce the amount of blocks that can write to a page, thus reducing the Replay sizes.

Storage Profiles & Data Progression

Storage Profiles were introduced in Storage Center 4.2. The "Recommended" storage profile will provide the best Data Progression configuration for most implementations. Essentially, this storage profile will write new data to RAID10 with Replay data being placed on RAID5-9.

Disk alignment & volume setup

The minimum operating system version requirement to run Exchange 2010 is Windows 2008. Microsoft recommends Windows 2008 R2.

In Windows 2008 and later, aligning partitions is not necessary. Windows Server 2008 automatically aligns the beginning of a partition to a 1,024 KB boundary. In addition, the use of Basic disks is recommended.

Default allocation unit size

Exchange reads and writes to the database in 32KB chunks. Formatting volumes with the correct default allocation unit size is also an important best practice. Using a default allocation unit size of 64KB is recommended.

Partition Type

GPT (GUID Partition Table) is recommended for Exchange 2010 volumes. Volumes larger than 2TB will require that GPT is used to access the entire size of the volume. MBR (Master Boot Record), the default partition type is also supported, but partition size is limited to less than 2TB.

Mailbox Server Sizing Considerations

Understanding your user patterns is an important part of determining sizing parameters for any Exchange Server.

Specifically, tools like Jetstress, Profile Analyzer, and LoadGen can help determine the best settings for the type of mailbox user, mailbox sizes, and server configuration. By having information such as mailbox count, required mailbox size, send/receive statistics, and average message size, Jetstress can use these parameters to run a performance test to see how the configuration would perform on your hardware.

Servers should be sized before they are moved into production. This process should include a Jetstress test to determine if the hardware and disk configurations are suitable for the type and amount of traffic to be expected. Once a successful Jetstress test is completed, client testing should be performed using LoadGen. LoadGen, the replacement for LoadSim simulates actual client traffic operations such as sending and receiving mail, creating calendar appointments, and accessing public folder data. A number of other tests are available as part of the profile configuration and can be customized to your needs.

Mailbox I/O requirements are substantially different in Exchange 2010. The overall I/O requirement for Exchange 2010 mailboxes has decreased by over 90% from Exchange 2003.

Mailbox Profile IO Requirements
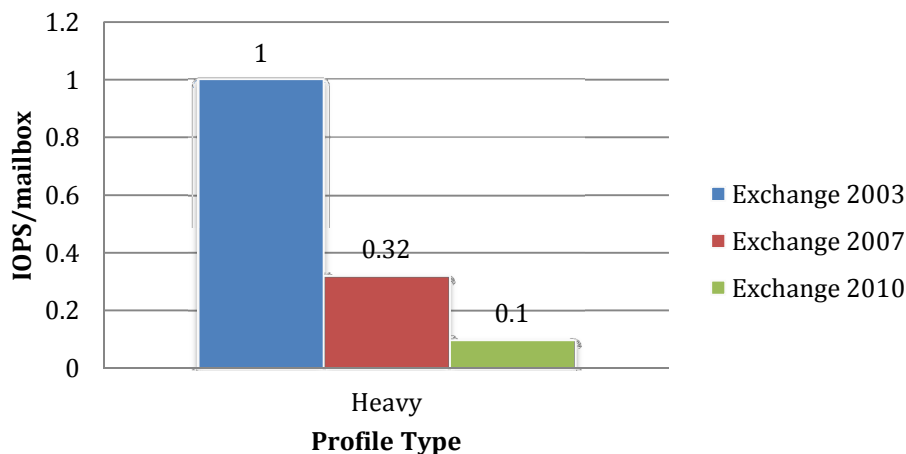
Jetstress 2010 should be used to simulate disk I/O load on a test server running Exchange to verify the performance and stability of your disk subsystem before putting your server into a production environment. You can find more information at:
http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=13267027-8120-48ed-931b-29eb0aa52aa6.

Exchange Load Generator 2010 is a simulation tool to measure the impact of MAPI, OWA, ActiveSync, IMAP, POP and SMTP clients on Exchange servers. You can find more information at:
http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=cf464be7-7e52-48cd-b852-ccfc915b29ef.

Exchange Profile Analyzer collects estimated statistical information from a single mailbox store or across an Exchange Server organization. The collected data can be used for such tasks as analyzing the performance and health of a server that has mailboxes, improving capacity planning models, and improving testing methodologies and tools. You can find more information at: http://www.microsoft.com/downloads/details.aspx?familyid=C009C049-9F4C-4519-A389-69C281B2ABDA&displaylang=en.

Archive Mailboxes

A new feature in Exchange 2010 is the archive mailbox. Each mailbox in the database can have an archive mailbox. The purpose of this is for users to have an archive repository that doesn't impact any existing mailbox quotas and allows them to retain data for longer periods of time. Archive mailboxes are useful in elimination of PST files and keeping information all contained within Exchange.

It is important to note that archive mailboxes are a separate object from the user mailbox.

Beginning with Exchange 2010 Service Pack 1 (SP1), you can provision a user's personal archive on the same mailbox database as the user's primary mailbox, another mailbox database on the same Mailbox server, or a mailbox database on another Mailbox server in the same Active Directory site.

This updated feature offers the flexibility to utilize Compellent tiered storage architecture to store archive mailboxes on a separate volume utilizing a Tier-3 RAID-5 storage profile, putting this archive data on less expensive disk. Instant Replays can be done much less frequently as this data changes less frequently.

NOTE: Archive mailboxes are also only available while a user is online. They are not available if a user is running in cached mode and not connected to Exchange.

Exchange 2010 Mailbox Server Role Requirements Calculator

This calculator is very helpful in designing the best environment (both storage and hardware) based on your criteria from:

- User profile - the message profile, the mailbox size, and the number of users

- High availability architecture - the number of database copies you plant to deploy, whether the solution will be site resilient, the desired number of mailbox servers

- Server's CPU platform

- Storage architecture - the disk capacity / type and storage solution

- Backup architecture - whether to use hardware or software VSS and the frequency of the backups, or leverage the Exchange native data protection features

- Network architecture - the utilization, throughput, and latency aspects

To download the storage calculator, go to: http://msexchangeteam.com/archive/2009/11/09/453117.aspx.

Online Database Maintenance

Database maintenance for Exchange 2010 has also been modified to work more efficiently. One of the goals of ESE in Exchange 2010 is to reduce the cost of maintaining and managing a database. Database maintenance is comprised of several tasks that manage and keep the integrity of your mailbox database.

Database maintenance is comprised of storage mailbox maintenance and ESE database maintenance.

Online Defragmentation

Online defragmentation now runs 24x7 in the background. There are no configurable settings with this feature. Exchange monitors the database as its being used and small changes are made over time to keep it defragmented for space and contiguity. Online defragmentation is also throttled so it doesn't have a negative impact on client performance.

Online Database Scanning (Checksumming)

The checksumming process runs in two different modes on the active database copies.

The first option is to run as the last task in the scheduled mailbox database maintenance process. You can configure how long it runs by altering the schedule and is recommended for databases that are less than 500GB in size.

The schedule can be modified in the database properties under the organization configuration.

The second option is the have the checksumming run in the background 24x7 (the default behavior). This option is intended for databases that are larger, from 500GB to 2TB, which require longer periods of time to complete a checksum. Exchange scans the database no more than once a day and will alert if it doesn't finish scanning within three days.

For more information on maintaining mailbox databases, see http://technet.microsoft.com/en-us/library/bb691410(EXCHG.140).aspx.

NOTE: Running the daily online database maintenance can have a major impact on replay sizes as the online defragmentation process moves data around and pages are cleared. Although disabling online database maintenance completely is not recommended, some customers have experienced relief by throttling the online database maintenance process back to one day per week.

Database Fragmentation

Defragmentation of the information storage database occurs after information within the database is deleted leaving a data-free page still within the file. Defragmentation has performance implications if not addressed properly. It is advantageous to use the built-in information store maintenance.

Fragmentation is limited and contiguity is maintained through the background processes that run to manage the databases.

Performance and Monitoring

Third-Party Applications Impact

Blackberry

Third-party application such as Blackberry can have an overall effect on the performance of your Exchange system. Blackberry in particular increases overall RPC operations in Windows, and Microsoft has seen a 2x – 4x increase in database I/O. An increase of 3x IOPS per user is typical in this type of environment. Therefore using the Blackberry enterprise server in your environment may increase the storage needs of your Exchange environment.

Anti-Virus

Be sure to utilize Anti-Virus software that is specifically designed to work with Microsoft Exchange Server. It is not recommended to use a non-Exchange aware anti-virus application to scan Exchange application data.

Real-time anti-virus scanning for Exchange is common in most environments to make sure that virus-infected files do not enter through the email system. To this point, it is important to remember to keep the anti-virus engine and its pattern files up-to-date.

Monitoring

Performance Monitor is a helpful tool in monitoring the overall operations of your Exchange server. A number of specific counters are good indicators of performance bottlenecks. The following performance counters are helpful in monitoring and troubleshooting. The thresholds provided are based on standard industry guidance.

By default, the real-time view of Performance Monitor shows the last 1:40 (one minute, 40 seconds) measuring every two seconds and takes the average of the current measurement and last measurement.

If you suspect a performance issue it is a good idea to setup Performance Monitor to record key counters during the period of peak usage when the problem occurs.

Physical Disk Counters	Memory Counters	Exchange Counters
Avg. Queue Length	Available MBytes	MSExchangeIS – RPC Avg. Latency
Avg. Disk Sec/Transfer	Pages/sec	ExchangeDB - % Database Cache Hits
Disk Transfers/sec	**Processor Counters**	
% Disk Idle	% Processor Time	
Avg. Disk Bytes/Transfer	**Network Counters**	
Avg. Disk Sec/Read	Bytes Total/sec	
Avg. Disk Sec/Write		

Monitoring the Database Defragmentation Process

In Microsoft Exchange Server 2010, the following performance counters for monitoring the behavior of database defragmentation have been added for use with Performance Monitor:

- **MSExchange Database ==> Instances \ Defragmentation tasks**
  Shows the background database defragmentation tasks that are currently executing.

- **MSExchange Database ==> Defragmentation Tasks completed/Sec**
  Shows the number of background database defragmentation tasks completing execution per second.

- **MSExchange Database ==> Defragmentation Tasks Discarded**
  Shows the background database defragmentation tasks that couldn't be registered.

- **MSExchange Database ==> Defragmentation Tasks Pending**
  Shows the background database defragmentation tasks that are currently pending.

- **MSExchange Database ==> Instances \ Defragmentation Tasks Scheduled/Sec**
  Shows the background database defragmentation tasks scheduled for execution per second.

Monitoring with System Center Operations Manager

Compellent has developed a System Center Operations Manager (SCOM) Management Pack that provides the capabilities to manage the Compellent Storage Center within your Windows environment.

For more information on the SCOM Management Pack for Compellent Storage Center, see the [Compellent Customer Portal Knowledge Center](#). (authentication required)

Troubleshooting

Microsoft Exchange Troubleshooting Assistant

Microsoft includes the Microsoft Exchange Troubleshooting Assistant as an integrated component of the Exchange Management Console Toolbox.

The Exchange Troubleshooting Assistant programmatically executes a set of troubleshooting steps to identify the root cause of performance, mail flow, and database mounting issues.

The tool automatically determines what set of data is required to troubleshoot the identified symptoms and collects configuration data, performance counters, event logs and live tracing information from an Exchange server and other appropriate sources. The tool analyzes each subsystem to determine individual bottlenecks and component failures, and then aggregates the information to provide root cause analysis.

The output of this report is useful and can assist you and your hardware vendors in troubleshooting Exchange-related problems.

Microsoft Exchange Best Practices Analyzer

The Exchange Best Practices Analyzer programmatically collects settings and values from data repositories such as Active Directory, registry, metabase and performance monitor. Once collected, a set of comprehensive 'best practice' rules are applied to the topology.

Administrators running this tool will get a detailed report listing the recommendations that could be made to the environment to achieve greater performance, scalability and uptime.

The Best Practices Analyzer tool is intended to provide feedback on areas of your Exchange environment that need attention from a configuration and best practices perspective.

You can access the Best Practices Analyzer from the Exchange Management Console Toolbox.

Backup and Recovery

Backups and Instant Replays

Backup schedules

A standard backup schedule should be established for every Exchange environment. This backup schedule should include at least one full backup per week. If an environment is small, or if time permits, a daily full backup would be optimal.

With Exchange 2010, Microsoft introduced database copies as a means to eliminate regular backups. By having at least three copies of each mailbox database, Microsoft considers these "highly available". In addition Microsoft recommends having several lag copies of each database available in case there is a need for a point-in-time copy is needed (i.e. logical corruption).

Instant Replays (snapshots)

In addition, leverage Compellent Data Instant Replays with Replay Manager for Microsoft Servers. Instant Replays are not intended to replace your regular backup processes as some verticals have specific regulatory requirements relating to data retention. However, replays make an easy means to recovery individual mailboxes or entire databases very quickly.

Business requirements will dictate what backup schedules should be utilized. As a rule of thumb, Exchange VSS snapshots using Replay Manager Services for Microsoft Servers can be taken in 15 minute increments. Beyond that, your options are limitless as far as the flexibility of your snapshot schedule. It is important to note that if you plan to also run the database consistency check with the backup set that it may not be possible to complete the snapshot and consistency check before the next scheduled job runs when scheduling around the 15 minute window.

By design, VSS allows a 10 second snapshot window. All data has to be captured within those 10 seconds or the snapshot will fail. Since Exchange 2010 now allows databases and logs to reside on the same volume, there are fewer volumes that need to be part of a backup set. Is it recommended to include no more than 12 mailbox databases per VSS backup set. This will allow the snapshot to complete within the 10 second window.

Database verification

Compellent Replay Manager for Windows Servers provides a verification service that can be used to mount the database replay after a successful snapshot to a utility server to run the database verification process as required by Microsoft. The database verification process is a time, processor, and memory intensive operation. It is a critical part of the backup process, but due to the amount of time that it can take, customers who do frequent database snapshots will typically only run verification on the database(s) once a day to check for consistency.

Recovery

Recovery Databases

A recovery database is an Exchange 2010 feature that replaces the recovery storage group (RSG) found in previous versions of Exchange. A recovery database is a special kind of mailbox database that allows you to mount a restored mailbox database (using a replay) and extract data from the restored database as part of a recovery operation. You can use the Restore-Mailbox cmdlet to extract data from a recovery database. After extraction, the data can be exported to a folder or merged into an existing mailbox. Recovery databases enable you to recover data from a backup or copy of a database without disturbing user access to current data.

Before you can use a recovery database, there are certain requirements that must be met. A recovery database can be used for Exchange 2010 mailbox databases only.

NOTE: The target mailbox used for data merges and extraction must be in the same Active Directory forest as the database mounted in the recovery database.

Single Item Recovery

Microsoft Exchange 2010 also makes single item recovery possible through the use of "Dumpster 2.0" which has been modified to handle data preservation makes it possible for users to perform their own recovery of lost and/or deleted messages.

With the new Recoverable Items Folder in Exchange 2010 and the Hold Policy that can be applied to it, it is possible to retain all deleted and modified data for a specified period of time, so recovery of these items is easier and faster. This reduces the burden on Exchange administrators and the IT helpdesk by enabling end users to recover accidentally deleted items themselves, thereby reducing the complexity and administrative costs associated with single item recovery.

For more information on single item recovery and how it works, see:
http://msexchangeteam.com/archive/2009/09/25/452632.aspx.

Disaster Recovery

VSS replays can be replicated using the Storage Center Remote Data Instant Replay. This would allow you to have data as current as your last replay available to bring online at your main site or disaster recovery site.

If your Exchange Server is booting from SAN, then replays from the boot volume as well as the data volumes can be easily mapped up at the disaster recovery site provided that duplicate hardware is used at the site. In order for the operating system to boot properly, the volumes would have to mapped up to hardware that matches the original server hardware that it was mapped up to at the main site. Additional steps for recovery, beyond the scope of this document, would have to be taken for systems with dissimilar main site and disaster recovery site hardware.

It is important to understand your overall disaster recovery strategy around core services such as directory services and DNS in addition to DNS. Exchange relies heavily on Active Directory being available as well as DNS services. Preparations must be taken to ensure that these dependencies are online and operational at the disaster recovery site before the Exchange Server and its services can come online.

Exchange data will be available, but equally important will be making sure that the infrastructure is in place to allow for a smooth cutover to ensure that your users can access Exchange soon after a disaster occurs.

Database Copies & Database Availability Groups

In the event of a hardware or software failure, multiple database copies in a database availability group (DAG) enable high availability with fast failover with no data loss. This eliminates the end-user downtime and resulting lost productivity that's a significant cost of recovering from a past point-in-time backup to disk or tape. DAGs can be extended to multiple sites and can provide resilience against datacenter failures, as well.

While all mailbox servers in a DAG must be in the same Active Directory domain, up to 16 copies of an Exchange 2010 mailbox database can be created on multiple Mailbox servers, provided the servers are grouped into a database availability group (DAG). However, round trip network latency must not be greater than 250 milliseconds (ms).

Appendix A

Additional resources

Remote Instant Replay
http://www.compellent.com/Products/Software/Remote-Replication.aspx

Replay Manager Services for Microsoft Servers
http://www.compellent.com/Products/Software/Replay-Manager.aspx

Microsoft Exchange Team Blog
http://msexchangeteam.com/

Microsoft Exchange Server 2010 Documentation
http://technet.microsoft.com/en-us/library/bb124558(EXCHG.140).aspx

Compellent Replay Manager Best Practices Guide
http://kc.compellent.com/Pages/Download.aspx?DocID=730