ESRP Storage Program

EMC Iomega ix12-300r (260 User)
Exchange Server 2010 Mailbox Resiliency
Storage Solution

Tested with: ESRP - Storage Version 3.0
Tested Date: 16 May 2010
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Overview

This document provides information on the EMC® Iomega® ix12-300r (260 User) Mailbox Resiliency storage solution for Microsoft Exchange Server 2010 based on the Microsoft Exchange Solution Reviewed Program (ESRP) - Storage program (Version 3.0). For any questions or comments regarding the contents of this document, see the “Contact information” section.

The ESRP - Storage program was developed by Microsoft Corporation to provide a common storage testing framework for vendors to provide information on its storage solutions for Microsoft Exchange Server software. For more details on the Microsoft ESRP - Storage program, visit:


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The information contained in this document represents the current view of EMC on the issues discussed as of the date of publication. Due to changing market conditions, it should not be interpreted as a commitment on the part of EMC. In addition, EMC cannot guarantee the accuracy of any information presented after the date of publication.
The Iomega StorCenter ix12-300r Network Storage Array offers easy-to-use, powerful and affordable network storage for any small business or remote office. Powered by enterprise-class EMC LifeLine software, the StorCenter ix12-300r is available in configurations starting at 4TB, and can be expanded up to 24TB in a single array. Robust connectivity allows simultaneous multi-protocol file and iSCSI block-level access. High performance makes the ix12-300r an ideal candidate for email and database applications or as a fast backup target. High reliability features ensure maximum availability, including RAID with hot-swap drives and automatic rebuild, dual hot-swap power supplies, and redundant variable-speed hot-swap chassis cooling fans.

**Figure 1** illustrates an Iomega StorCenter ix12-300r Network Storage Array.

**Figure 1** Iomega StorCenter ix12-300r Network Storage Array

- **Capacity:** Starting at 4 TB (4 x 1 TB SATA-II Hard Disk Drives or HDDs) with maximum capacity of 24 TB (12 SATA-II HDDs)
  - 4-drive disk packs enable expansion to 8- or 12- drive configurations
- **RAID support:** On-disk data protection and organization configurable as RAID 0, 1, 5, 6 and 10. Automatic RAID rebuild and hot swap drives.
- **Storage pools:** Storage Pools group drives of like size and RAID protection together to simplify management.
**Features**

- **Sophisticated networking:** Ethernet port bonding for load balancing, high performance bandwidth aggregation or failover; Virtual LAN (VLAN) capability simplifies management and operation by enabling devices to be logically, but not physically in the same subnet.

- **Expandability:** Add storage capacity by simply adding drives in the unpopulated drive bays. Added drives can be brought into an existing Storage Pool or made into a new Storage Pool. Additionally, USB connected Hard Disk Drives can be attached and used as shares. The StorCenter ix12 supports read and write on Fat32, NTFS, or ext2/ext3 formatted hard disks; read only of external HFS+ formatted drives.

- **Sharing:** Access files from any networked Windows, Mac, or Linux workstation or server for easy file sharing, data backup and print serving.

- **Network and file protocols supported:**
  - FTP
  - HTTP
  - SNMP
  - Microsoft (CIFS/SMB/Rally)
  - Linux/UNIX (NFS)
  - Apple AFP / Bonjour support
  - Windows DFS
  - WebDAV

- **Data organization and access:** Windows DFS organizes folders and files on a network, such that they appear to be all in one directory tree on a single Iomega StorCenter system, even if the folders reside on many devices in many different locations. WebDAV (Web-based Distributed Authoring and Versioning) enables viewing, adding, or deleting files on a StorCenter from the web, via HTTP or HTTPS for added security.

- **iSCSI support:** Provides block-level access for the most efficient storage utilization, especially for database and email application performance.

- **High performance:** Quad-Gigabit Ethernet connectivity and high-performance embedded architecture, plus link aggregation (port bonding) provide extremely high throughput.
• **Active directory support**: Allows the domain users and groups to authenticate to the Active Directory service to access the StorCenter ix12.

• **UPS support**: Enables an uninterruptible power supply to communicate with the system via a USB port to initiate an unattended system shutdown without data loss in the case of extended power failure.

• **Drive spindown**: For maximum energy efficiency, drives spin down based on user-set policy.

• **E-mail alerts**: If the device detects a problem, an email alert is sent to one or more email addresses.

• **Remote access**: Connect from anywhere on the Internet to access content or manage the device.

• **System dashboard**: Provides a one-stop summary for status information on space utilization, device, peripheral, and backup status.

• **VMware certified**: HCL certified NAS (NFS) and iSCSI storage for VMware ESX (vSphere).


• **Citrix certified**: HCL certified NAS (NFS) and iSCSI storage for Citrix XenServer.

• **Replication**: The StorCenter ix12 supports device-to-device (D2D) asynchronous replication based on the end-user determined policy. Replication uses the secure rsync, rsync, or remote CIFS protocols.

• **Total data protection**:
  • Multiple network interface cards (NICs) can be configured for I/O failover.
  • Robust username and password authorized access or integration with Microsoft Active Directory Service.
  • Configure with RAID 0, 1, 5, 6, 10 to assure data integrity if a drive fails.
  • RSA BSAFE technology protects installs and upgrades.
Features

• **Security camera**: Connect Axis and/or Panasonic network security cameras and the StorCenter ix12 captures and stores video without the need of a dedicated PC.

• **Simple to use**:
  • Easy network file sharing with automatic configuration; ready to work with any networked computer
  • Management via user-friendly web interface
  • Event logging and e-mail notification
  • 11 languages supported by the user interface (concurrently from different clients)

• **Software compatibility**: Compatible with today’s most common backup software titles, web browsers, media devices and computers.

• **Software included**: StorCenter Manager.

• **Warranty**: 3 years, Basic coverage.
Solution description

This solution utilizes low-cost, high-capacity 1 TB SATA disks for Microsoft Exchange data in a RAIDless configuration. High availability is provided for this solution with the use of Microsoft Database Availability Groups (DAGs). A DAG is a set of mailbox servers that uses continuous replication to provide automatic recovery in the event of failures. A DAG may contain up to 16 mailbox servers, each one having a replicated copy of the production databases and log files.

Due to changes in the architecture of Exchange Server 2010, failover is now at the individual database level. DAGs provide automatic failover without the complexity of traditional clustering. With the new features in Exchange Server 2010, customers can now deploy much larger mailboxes than with previous versions of Exchange Server, without degraded performance. Exchange data can now also reside on lower speed disks such as the SATA drives as used in this solution.

This solution uses a building-block approach to storage design. One of the methods used to simplify the sizing and configuration of storage for use with Microsoft Exchange Server 2010 is to define a unit of measure -- a building-block. Such a unit of measure needs to meet all of the Microsoft Exchange Server recommended metrics for excellent reliability, scalability and performance, and needs to be easy to implement. An organization can take this block of work and multiply it by some factor until the desired number of Microsoft Exchange server users (that is, Microsoft Messaging API (MAPI) Outlook users), has been properly met or configured to satisfy the Microsoft Exchange server recommended performance metrics. If each unit is properly configured, it will match the Microsoft Exchange server recommendations for a healthy-performing system, from both a disk and an end-user perspective.

EMC's best practices involving the building-block approach for an Exchange server design proved to be very successful throughout many customers' implementations.

In this configuration, a single disk spindle supports a database and its corresponding log files. A 1 TB spindle can be used for 65 users with a profile of 0.18 IOPS (which includes 20 percent overhead) and a mailbox size of 10 GB. This building block can then be used for each DAG copy of the Exchange data. A total of four Exchange building blocks without RAID were used in this solution. When RAID is not
being used there must be at least three copies of the database to provide sufficient protection in the event of disaster. In this solution, there are three copies of each of the four Exchange server databases, and each copy of the database is placed on a separate array.

Note: In a larger deployment, you can fully utilize the 12 drives from each ix12 -300r to host four primary database copies and eight secondary database copies for the other two Exchange servers. Therefore, this environment can support up to 780 user mailboxes in total.

Network redundancy is provided by utilizing two switches, each having connection both to the Windows server where JetStress is installed and to the ix12 device. Network teaming is configured on the Windows server and networking bonding is set up on the ix12 side to provide the high availability. Figure 2 illustrates the layout of the physical architecture.
Targeted customer profile

The ESRP-Storage program focuses on storage solution testing to address performance and reliability issues with storage design. However, storage is not the only factor to consider when designing a scalable Exchange solution. Other factors that affect the server scalability are:

- Server processor utilization
- Server physical and virtual memory limitations
- Resource requirements for other applications
- Directory and network service latencies
- Network infrastructure limitations
- Replication and recovery requirements
- Client usage profiles

All these factors are beyond the scope for ESRP-Storage. Therefore, the number of mailboxes hosted per server as part of the tested configuration may not necessarily be viable for some customer deployment.

For more information on identifying and addressing performance bottlenecks in an Exchange system, please refer to Microsoft's Exchange Server 2010 Performance and Scalability document, available at:

Targeted customer profile

This solution is intended for small-sized businesses hosting under 500 Exchange mailboxes. The configuration used for testing is described below:

- 260 users.
- 1 host attached.
- User I/O profile of 0.18 (including 20% headroom).
- User mailbox size of 10 GB.
- Background Database Maintenance (BDM) was running 24x7.
The testing is performed on one EMC Iomega ix12-300r array and with one Exchange server with 4 databases simulating 3 database copies. The following tables summarize the tested environment.

### Simulated Exchange configuration

Table 1 lists the simulated Exchange configuration details.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Exchange mailboxes simulated</td>
<td>260</td>
</tr>
<tr>
<td>Number of DAGs</td>
<td>1</td>
</tr>
<tr>
<td>Number of servers/DAG</td>
<td>3</td>
</tr>
<tr>
<td>Number of active mailboxes/server</td>
<td>260</td>
</tr>
<tr>
<td>Number of databases/host</td>
<td>4</td>
</tr>
<tr>
<td>Number of copies/database</td>
<td>3</td>
</tr>
<tr>
<td>Number of mailboxes/database</td>
<td>65</td>
</tr>
<tr>
<td>Simulated profile: I/O’s per second per mailbox</td>
<td>0.18</td>
</tr>
<tr>
<td>(IOPS, include 20% headroom)</td>
<td></td>
</tr>
<tr>
<td>Database/Log LUN size</td>
<td>800 GB</td>
</tr>
<tr>
<td>Total database size for performance testing</td>
<td>2536 GB</td>
</tr>
<tr>
<td>% storage capacity used by Exchange database**</td>
<td>79.25%</td>
</tr>
</tbody>
</table>

**Storage performance characteristics change based on the percentage utilization of the individual disks. Tests that use a small percentage of the storage (~25%) may exhibit reduced throughput if the storage capacity utilization is significantly increased beyond what is tested in this paper.**
### Storage hardware

Table 2 lists the hardware used in the environment.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Connectivity (Fibre Channel, SAS, SATA, iSCSI)</td>
<td>iSCSI</td>
</tr>
<tr>
<td>Storage model and OS/firmware revision</td>
<td>Iomega StorCenter ix12-300r, Firmware version 2.6.5.11910</td>
</tr>
<tr>
<td>Storage cache</td>
<td>2 GB memory/cache (No mirroring)</td>
</tr>
<tr>
<td>Number of storage controllers</td>
<td>1</td>
</tr>
<tr>
<td>Number of storage ports</td>
<td>4 gigabit Ethernet Ports</td>
</tr>
<tr>
<td>Maximum bandwidth of storage connectivity to host</td>
<td>4 Gb/s</td>
</tr>
<tr>
<td>Switch type/model/firmware revision</td>
<td>2 Cisco Catalyst 3750E switches</td>
</tr>
<tr>
<td>HBA model and firmware</td>
<td>Software iSCSI</td>
</tr>
<tr>
<td>Host server type</td>
<td>Dell PowerEdge R710 2 core CPUs, 8 GB RAM</td>
</tr>
<tr>
<td>Total number of disks tested in solution</td>
<td>4</td>
</tr>
<tr>
<td>Maximum number of spindles that can be hosted in the storage</td>
<td>12</td>
</tr>
</tbody>
</table>
Table 3 lists the software used in the environment.

### Storage software

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipathing</td>
<td>Microsoft iSCSI Initiator Version 6.0 Build 6000</td>
</tr>
<tr>
<td>Host OS</td>
<td>Microsoft® Windows Server® 2008 Enterprise Service Pack 2 (6.0.6002.131072)</td>
</tr>
<tr>
<td>ESE.dll file version</td>
<td>14.0.639.19</td>
</tr>
<tr>
<td>Replication solution name/version</td>
<td>N/A</td>
</tr>
</tbody>
</table>
**Storage disk configuration (database and log disks)**

Table 4 lists the disk configuration (database and log disks) for the environment.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk type, speed and firmware revision</td>
<td>SATA II 5900 rpm</td>
</tr>
<tr>
<td>Raw capacity per disk (GB)</td>
<td>932</td>
</tr>
<tr>
<td>Number of physical disks in test</td>
<td>4</td>
</tr>
<tr>
<td>Total raw storage capacity (GB)</td>
<td>3728</td>
</tr>
<tr>
<td>Disk slice size (GB)</td>
<td>932</td>
</tr>
<tr>
<td>Number of slices per LUN or number of disks per LUN</td>
<td>1</td>
</tr>
<tr>
<td>RAID level</td>
<td>N/A, JBOD was used</td>
</tr>
<tr>
<td>Total formatted capacity</td>
<td>3200 GB</td>
</tr>
<tr>
<td>Storage capacity utilization</td>
<td>86.11%</td>
</tr>
<tr>
<td>Database capacity utilization</td>
<td>68.03%</td>
</tr>
</tbody>
</table>
Best practices

A building block approach should be used when designing Exchange 2010 storage layouts. The building block approach defines the number of physical disks required for a certain number of users with a certain user profile.

In this solution each individual disk supports 65 users with a user profile of 0.18 IOPS (including 20% overhead). Each disk holds the database and log files on one single LUN that was created on each disk. A mailbox size of 10 GB per user was also used.

Microsoft Exchange Server 2010 has changed significantly since early versions of Exchange particularly when it comes to I/O and storage. There have been many changes to the core schema and the extensible storage engine (ESE) to reduce I/O. Due to this I/O reduction, Exchange Server 2010 now also supports SATA disks. In addition, Mailbox Resiliency solutions that utilize 3 or more copies of a database can choose to use JBOD storage.

For more information on these changes, visit: http://technet.microsoft.com/en-us/library/bb125040(EXCHG.140).aspx#StoreSchemaChanges


Based on the testing run using an ESRP framework, EMC recommends the following best practices to improve storage performance with Exchange solutions.

1. Disk alignment is no longer required when running Microsoft Windows Server 2008.

**Note:** Exchange Server 2010 requires Windows Server 2008.

2. When formatting a new NTFS volume, it is recommended that for database and log files, set the allocation unit size (ALU) size to 64 KB. This can be done from the drop-down list in Disk Manager or through the DiskPart command.

3. The following list details the recommended best practices for networking:
   a. Multiple network switches are preferred for fault tolerance and performance. Where this is not possible, VLANs must be used to isolate iSCSI traffic.
b For iSCSI solutions, 1 GB NICs are recommended as a minimum.

c On each iSCSI NIC, do the following:
   – Set all iSCSI NIC speeds to 1 GB full.
   – Disable **Microsoft Networking**.
   – Disable **File & Print Sharing**.
   – Disable **IPv6** if not being used.
   – Disable all TCP offload engine parameters.

4 The following list details the recommended best practices for core storage:

a. Enable Write Cache on the ix12-300r to optimize the storage performance.

b Isolate the Microsoft Exchange server database workload from other IO-intensive applications or workloads. This ensures the highest level of performance for Exchange and simplifies troubleshooting in the event of a disk-related Microsoft Exchange performance issue.

c Always size the disks for IOPS before capacity. Once this is calculated, determine the capacity required.

d When you get the actual IOPS numbers, always apply a 20 percent I/O overhead factor to your calculations to add some reserve.

e Logs and databases can be placed on the same physical spindles under the following conditions:
   – DAG is in place.
   – DAG contains a minimum of three database copies.

f Mailbox Resiliency solutions that utilize 3 or more copies of a database can use JBOD storage. When using JBOD storage solutions, use the following configurations:
   – Placing both log files and database files for a given database only on a single disk spindle.
   – You can choose to configure two volumes per spindle (one for log files, and one for the database file) or one volume per spindle (where logs are placed in a separate directory from the database file). Both configurations are OK.

g The maximum number of database copies is 16 but it is recommended that 3 to 6 copies are selected for JBOD configuration.
Microsoft recommends a maximum database size of 200 GB in solutions where DAG is not being used. When DAG is being used with a minimum of three database copies, the maximum database size can be up to 2 TB. Backup (if applicable) and restore times should be accounted for when calculating the database size.

For more information on EMC solutions for Microsoft Exchange Server, visit:

Test results summary

This section provides a high-level summary of the test data from ESRP, as well as links to the detailed reports that are generated by the ESRP testing framework. The results are located in “Appendix: Test reports” on page 23.

Reliability

A number of the tests in the framework are designed to test reliability over a 24-hour period. The goal of these tests is to verify that the storage can handle high I/O load for a long period of time while replicating synchronously. Following the stress test, both log and database files on production and DR hosts are analyzed for integrity to ensure there is no database/log corruption.

- No errors were reported in the event log file for the storage reliability testing.
- No errors were reported for the database and log checksum.
- No errors were reported during the backup-to-disk test.

Storage performance results

To see the Jetstress performance results (2-hour performance test), see the section “Microsoft Exchange Server 2010 Jetstress – 2-hour performance” on page 34.

The Primary Storage performance testing is designed to exercise the storage with maximum sustainable Exchange type of I/O for 2 hours. The test is to show how long it takes for the storage to respond to an IO under load. The data below is the sum of all of the logical disk I/Os and average of all the logical disks I/O latency in the 2-hour test duration.

Each server is listed separately, and the aggregate numbers across all servers are listed in “Server metrics” on page 20.
Test results summary

Server metrics
The information in this table includes the sum of I/Os across storage groups and the average latency across all storage groups on a per-server basis.

<table>
<thead>
<tr>
<th>Database I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database disks transfers/sec</td>
</tr>
<tr>
<td>Database disks reads/sec</td>
</tr>
<tr>
<td>Database disks writes/sec</td>
</tr>
<tr>
<td>Average database disk read latency (ms)</td>
</tr>
<tr>
<td>Average database disk write latency (ms)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transaction log I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log disks writes/sec</td>
</tr>
<tr>
<td>Average log disk write latency (ms)</td>
</tr>
</tbody>
</table>

Database backup/recovery performance
There are two test reports in this section. The first one is to measure the sequential read rate of the database files, and the second is to measure the recovery/replay performance (playing transaction logs into the database).

Database read-only performance
This test is used to measure the maximum rate at which databases could be backed up using Volume Shadow (Copy) Service (VSS). The following table shows the average rate for a single database file.

<table>
<thead>
<tr>
<th>MB read/sec per database</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.275</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MB read/sec total per server</th>
</tr>
</thead>
<tbody>
<tr>
<td>113.1</td>
</tr>
</tbody>
</table>

Transaction log recovery/replay performance
This test is used to measure the maximum rate at which the log files can be played against the databases. The following table shows the average rate for 500 log files played in a single storage group. Each log file is 1 MB in size.

<table>
<thead>
<tr>
<th>Average time to play one log file (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.55</td>
</tr>
</tbody>
</table>
Conclusion

The testing described in this document validated the ESRP for Exchange Server 2010 on EMC Iomega ix12-300r. This solution was tested under a very heavy user profile of Exchange server 2010 with mailbox resiliency. The high performance achieved makes the StorCenter ix12-300r an ideal candidate for Exchange server 2010. Furthermore, the robust connectivity allows simultaneous multi-protocol file and iSCSI block-level access, and the high reliability features, including hot-swap drives and automatic rebuild, dual hot-swap power supplies and redundant variable-speed hot-swap cooling fans, ensure maximum availability for your Exchange server environment.

The building-block approach and methodologies were used in this solution to deploy Exchange Server 2010. A unit of 260-user profile was defined and tested to meet all of the Microsoft Exchange Server recommended metrics. An organization can take this block of work and multiply it by some factor until the desired number of Microsoft Exchange server users are properly configured. Available in configurations starting at 4TB, the StorCenter ix12-300r can be expanded up to 24TB in a single array without I-O interruption. Therefore, this solution can expand to a 780-user environment with 3 Exchange servers attached, by fully utilizing ix12-300r's 12 drives to host 4 primary database copies and 8 (4 x 2) secondary database copies for the another 2 Exchange servers. StorCenter ix12-300r offers easy-to-use, powerful and affordable network storage for any small- to medium-sized business or distributed enterprise.

This document has been developed by EMC, and reviewed by the Microsoft Exchange Product team. The test results/data presented in this document are based on the tests introduced in the ESRP test framework. The customers should not quote the data directly for their predeployment verification. It is still necessary to go through the exercises to validate the storage design for a specific customer environment.

The ESRP program is not designed to be a benchmark program; tests are not designed to get the maximum throughput for a given solution. Rather, it is focused on producing recommendations from vendors for the Exchange application. Therefore, the data presented in this document should not be used for direct comparisons among the solutions.
EMC recommends that you consult with EMC Professional Services to assist with the design and deployment of a similar solution. For information regarding this or any other EMC solution, use the following numbers:

United States: (800) 782-4362 (SVC-4EMC)
Canada: (800) 543-4782 (543-4SVC)
Worldwide: (508) 497-7901

For additional information on EMC products and services available to customers and partners, visit:

http://EMC.com

or to:

http://Powerlink.EMC.com
Appendix: Test reports

The test results included in this section include:

- “Microsoft Exchange Server 2010 Jetstress – 24-hour stress” on page 24
- “Microsoft Exchange Server 2010 Jetstress – 2-hour performance” on page 34
- “Microsoft Exchange Server 2010 Jetstress – database backup” on page 48
- “Microsoft Exchange Server 2010 Jetstress – soft recovery” on page 51
Microsoft Exchange Server 2010 Jetstress – 24-hour stress

Stress test result report

Test summary

**Overall Test Result**: Pass

**Machine Name**: E2010-JETSTRESS

**Test Description**

- **Test Start Time**: 5/17/2010 4:07:09 PM
- **Test End Time**: 5/18/2010 4:26:54 PM
- **Collection Start Time**: 5/17/2010 4:26:49 PM
- **Collection End Time**: 5/18/2010 4:26:48 PM
- **Jetstress Version**: 14.01.0043.000
- **Ese Version**: 14.00.0639.019
- **Operating System**: Windows Server (R) 2008 Enterprise Service Pack 2 (6.0.6002.131072)
- **Performance Log**: C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.blg
  
  C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.blg

**Database sizing and throughput**

- **Achieved Transactional I/O per Second**: 92.199
- **Target Transactional I/O per Second**: 46.8
- **Initial Database Size (bytes)**: 2728166424576
- **Final Database Size (bytes)**: 2731840634880
- **Database Files (Count)**: 4
Jetstress system parameters

Thread Count 1 (per database)
Minimum Database Cache 128.0 MB
Maximum Database Cache 1024.0 MB
Insert Operations 40%
Delete Operations 20%
Replace Operations 5%
Read Operations 35%
Lazy Commits 70%
Run Background Database Maintenance True
Number of Copies per Database 3

Database configuration

Instance2572.1 Log Path: G:\LOG1
Database: G:\DB1\Jetstress001001.edb
Instance2572.2 Log Path: H:\LOG2
Database: H:\DB2\Jetstress002001.edb
Instance2572.3 Log Path: I:\LOG3
Database: I:\DB3\Jetstress003001.edb
Instance2572.4 Log Path: J:\LOG4
Database: J:\DB4\Jetstress004001.edb
### Transactional I/O performance

<table>
<thead>
<tr>
<th>Instance</th>
<th>Database Reads Average Latency (msec)</th>
<th>Database Writes Average Latency (msec)</th>
<th>I/O Database Reads/sec</th>
<th>I/O Database Writes/sec</th>
<th>I/O Database Reads Average Bytes</th>
<th>I/O Database Writes Average Bytes</th>
<th>I/O Log Reads Average Latency (msec)</th>
<th>I/O Log Writes Average Latency (msec)</th>
<th>I/O Log Reads/sec</th>
<th>I/O Log Writes/sec</th>
<th>I/O Log Reads Average Bytes</th>
<th>I/O Log Writes Average Bytes</th>
<th>I/O Log Reads Average Bytes</th>
<th>I/O Log Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>13.037</td>
<td>8.214</td>
<td>13.823</td>
<td>9.372</td>
<td>40632.059</td>
<td>36763.689</td>
<td>0.000</td>
<td>1.195</td>
<td>0.000</td>
<td>8.509</td>
<td>0.000</td>
<td>4591.476</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>13.189</td>
<td>8.280</td>
<td>13.669</td>
<td>9.244</td>
<td>40536.136</td>
<td>36790.271</td>
<td>0.000</td>
<td>1.202</td>
<td>0.000</td>
<td>8.449</td>
<td>0.000</td>
<td>4607.971</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>13.714</td>
<td>9.417</td>
<td>13.754</td>
<td>9.417</td>
<td>40284.641</td>
<td>36869.624</td>
<td>0.000</td>
<td>1.203</td>
<td>0.000</td>
<td>8.478</td>
<td>0.000</td>
<td>4612.322</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>14.014</td>
<td>9.444</td>
<td>13.735</td>
<td>9.297</td>
<td>40654.331</td>
<td>36737.220</td>
<td>0.000</td>
<td>1.277</td>
<td>0.000</td>
<td>8.434</td>
<td>0.000</td>
<td>4605.662</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Background database maintenance I/O performance

<table>
<thead>
<tr>
<th>Instance</th>
<th>Database Maintenance I/O Reads/sec</th>
<th>Database Maintenance I/O Reads Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>28.271</td>
<td>261463.871</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>28.245</td>
<td>261509.717</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>27.827</td>
<td>261473.383</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>27.745</td>
<td>261484.436</td>
</tr>
</tbody>
</table>
### Log Replication I/O performance

<table>
<thead>
<tr>
<th>MSExchange Database ==&gt; Instances</th>
<th>I/O Log Reads/sec</th>
<th>I/O Log Reads Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>0.312</td>
<td>60944.181</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>0.312</td>
<td>60760.946</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>0.313</td>
<td>61000.593</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>0.310</td>
<td>60429.238</td>
</tr>
</tbody>
</table>

### Total I/O performance

<table>
<thead>
<tr>
<th>MSExchange Database ==&gt; Instances</th>
<th>I/O Database Reads Average Latency (msec)</th>
<th>I/O Database Writes Average Latency (msec)</th>
<th>I/O Database Reads/sec</th>
<th>I/O Database Writes/sec</th>
<th>I/O Database Reads Average Bytes</th>
<th>I/O Database Writes Average Bytes</th>
<th>I/O Log Reads Average Latency (msec)</th>
<th>I/O Log Writes Average Latency (msec)</th>
<th>I/O Log Reads/sec</th>
<th>I/O Log Writes/sec</th>
<th>I/O Log Reads Average Bytes</th>
<th>I/O Log Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>13.037</td>
<td>8.214</td>
<td>42.094</td>
<td>9.372</td>
<td>36763.889</td>
<td>1.179</td>
<td>1.195</td>
<td>0.312</td>
<td>8.509</td>
<td>60944.181</td>
<td>4591.476</td>
<td></td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>13.189</td>
<td>8.280</td>
<td>41.914</td>
<td>9.244</td>
<td>36790.271</td>
<td>1.092</td>
<td>1.202</td>
<td>0.312</td>
<td>8.449</td>
<td>60760.946</td>
<td>4607.971</td>
<td></td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>13.714</td>
<td>9.417</td>
<td>41.581</td>
<td>9.305</td>
<td>36869.624</td>
<td>1.186</td>
<td>1.203</td>
<td>0.313</td>
<td>8.478</td>
<td>61000.593</td>
<td>4612.322</td>
<td></td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>14.014</td>
<td>9.444</td>
<td>41.479</td>
<td>9.297</td>
<td>36737.220</td>
<td>1.083</td>
<td>1.277</td>
<td>0.310</td>
<td>8.434</td>
<td>60429.238</td>
<td>4605.662</td>
<td></td>
</tr>
</tbody>
</table>
Appendix: Test reports

Host system performance

<table>
<thead>
<tr>
<th>Counter</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Processor Time</td>
<td>1.240</td>
<td>0.234</td>
<td>6.471</td>
</tr>
<tr>
<td>Available MBytes</td>
<td>3875.257</td>
<td>3765.000</td>
<td>3982.000</td>
</tr>
<tr>
<td>Free System Page Table Entries</td>
<td>33559343.811</td>
<td>33558526.000</td>
<td>33560285.000</td>
</tr>
<tr>
<td>Transition Pages Repurposed/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Pool Nonpaged Bytes</td>
<td>62118463.489</td>
<td>62107648.000</td>
<td>62148608.000</td>
</tr>
<tr>
<td>Pool Paged Bytes</td>
<td>1446539784.714</td>
<td>1446383616.000</td>
<td>1482387456.000</td>
</tr>
<tr>
<td>Database Page Fault Stalls/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Test log

5/17/2010 4:07:09 PM -- Jetstress testing begins ...
5/17/2010 4:07:09 PM -- Prepare testing begins ...
5/17/2010 4:07:13 PM -- Attaching databases ...
5/17/2010 4:07:13 PM -- Dispatching transactions begins ...
5/17/2010 4:07:13 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
5/17/2010 4:07:19 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/17/2010 4:07:19 PM -- Attaining prerequisites:
5/17/2010 4:26:49 PM -- \MSExchange Database(JetstressWin)\Database
Cache Size, Last: 967061500.0 (lower bound: 966367600.0, upper bound: none)

5/18/2010 4:26:50 PM -- Shutting down databases ...
5/18/2010 4:26:54 PM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete)
5/18/2010 4:26:54 PM -- Verifying database checksums ...
5/18/2010 10:51:40 PM -- G: (100% processed), H: (100% processed), I: (100% processed) and J: (100% processed)
5/18/2010 10:51:40 PM -- C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.blg has 769 samples.
5/18/2010 10:51:44 PM -- C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.html is saved.
5/18/2010 10:51:44 PM -- Verifying log checksums ...
5/18/2010 10:51:44 PM -- G:\LOG1 (7 log(s) processed), H:\LOG2 (6 log(s) processed), I:\LOG3 (7 log(s) processed) and J:\LOG4 (7 log(s) processed)
5/18/2010 10:51:44 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.blg has 5835 samples.
5/18/2010 10:51:44 PM -- Creating test report ...
5/18/2010 10:52:12 PM -- Instance2572.1 has 13.0 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.1 has 1.2 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.1 has 1.2 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.2 has 13.2 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.2 has 1.2 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.2 has 1.2 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 13.7 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 1.2 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 1.2 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 14.0 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 1.3 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 1.3 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/18/2010 10:52:12 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/18/2010 10:52:12 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.xml has 5757 samples queried.
## Test result report

### Checksum statistics - All

<table>
<thead>
<tr>
<th>Database</th>
<th>Seen pages</th>
<th>Bad pages</th>
<th>Correctable pages</th>
<th>Wrong page-number pages</th>
<th>File length/seconds taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>G:\DB1\Jetstress001001.edb</td>
<td>20842802</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651337 MBytes / 23054 sec</td>
</tr>
<tr>
<td>H:\DB2\Jetstress002001.edb</td>
<td>20843058</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651345 MBytes / 23069 sec</td>
</tr>
<tr>
<td>I:\DB3\Jetstress003001.edb</td>
<td>20840498</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651265 MBytes / 23081 sec</td>
</tr>
<tr>
<td>J:\DB4\Jetstress004001.edb</td>
<td>20842802</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651337 MBytes / 23085 sec</td>
</tr>
<tr>
<td>(Sum)</td>
<td>83369160</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2605286 MBytes / 23085 sec</td>
</tr>
</tbody>
</table>

### Disk subsystem performance (of checksum)

<table>
<thead>
<tr>
<th>LogicalDisk</th>
<th>Avg. Disk sec/Read</th>
<th>Avg. Disk sec/Write</th>
<th>Disk Reads/sec</th>
<th>Disk Writes/sec</th>
<th>Avg. Disk Bytes/Write</th>
</tr>
</thead>
<tbody>
<tr>
<td>G:</td>
<td>0.101</td>
<td>0.000</td>
<td>452.157</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
<tr>
<td>H:</td>
<td>0.101</td>
<td>0.000</td>
<td>451.894</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
<tr>
<td>I:</td>
<td>0.100</td>
<td>0.000</td>
<td>451.753</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
<tr>
<td>J:</td>
<td>0.100</td>
<td>0.000</td>
<td>451.513</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
</tbody>
</table>
Memory system performance (of checksum)

<table>
<thead>
<tr>
<th>Counter</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Processor Time</td>
<td>8.991</td>
<td>7.692</td>
<td>11.110</td>
</tr>
<tr>
<td>Available MBytes</td>
<td>4922.135</td>
<td>4880.000</td>
<td>4952.000</td>
</tr>
<tr>
<td>Free System Page Table Entries</td>
<td>33559636.693</td>
<td>33558802.000</td>
<td>33559752.000</td>
</tr>
<tr>
<td>Transition Pages RePurposed/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Pool Nonpaged Bytes</td>
<td>62130152.031</td>
<td>62119936.000</td>
<td>62177280.000</td>
</tr>
<tr>
<td>Pool Paged Bytes</td>
<td>1445642948.411</td>
<td>1445294080.000</td>
<td>1445875712.000</td>
</tr>
</tbody>
</table>

Test log

5/17/2010 4:07:09 PM -- Jetstress testing begins ...
5/17/2010 4:07:09 PM -- Prepare testing begins ...
5/17/2010 4:07:13 PM -- Attaching databases ...
5/17/2010 4:07:13 PM -- Dispatching transactions begins ...
5/17/2010 4:07:13 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
5/17/2010 4:07:19 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/17/2010 4:07:19 PM -- Attaining prerequisites:
5/17/2010 4:26:49 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 967061500.0 (lower bound: 966367600.0, upper bound: none)
5/18/2010 4:26:50 PM -- Shuttting down databases ...
5/18/2010 4:26:54 PM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete)
5/18/2010 4:26:54 PM -- Verifying database checksums ...
5/18/2010 10:51:40 PM -- G: (100% processed), H: (100% processed), I: (100% processed) and J: (100% processed)
5/18/2010 10:51:40 PM -- 
C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.blg has 769 samples.
Microsoft Exchange Server 2010 Jetstress – 2-hour performance

Performance test result report

Test summary

Overall Test Result: Pass

Machine Name: E2010-JETSTRESS

Test Description: N/A

Test Start Time: 5/18/2010 11:08:42 PM

Test End Time: 5/19/2010 1:29:16 AM

Collection Start Time: 5/18/2010 11:29:11 PM

Collection End Time: 5/19/2010 1:28:57 AM

Jetstress Version: 14.01.0043.000

Ese Version: 14.00.0639.019

Operating System: Windows Server (R) 2008 Enterprise Service Pack 2 (6.0.6002.131072)

Performance Log:
- C:\JetStress_Test_Results\Performance_2010_5_18_23_8_51.blg
- C:\JetStress_Test_Results\DBChecksum_2010_5_19_1_29_16.blg

Database sizing and throughput

Achieved Transactional I/O per Second: 90.872

Target Transactional I/O per Second: 46.8

Initial Database Size (bytes): 2731840634880

Final Database Size (bytes): 2732184567808

Database Files (Count): 4
Jetstress system parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread Count</td>
<td>1 (per database)</td>
</tr>
<tr>
<td>Minimum Database Cache</td>
<td>128.0 MB</td>
</tr>
<tr>
<td>Maximum Database Cache</td>
<td>1024.0 MB</td>
</tr>
<tr>
<td>Insert Operations</td>
<td>40%</td>
</tr>
<tr>
<td>Delete Operations</td>
<td>20%</td>
</tr>
<tr>
<td>Replace Operations</td>
<td>5%</td>
</tr>
<tr>
<td>Read Operations</td>
<td>35%</td>
</tr>
<tr>
<td>Lazy Commits</td>
<td>70%</td>
</tr>
<tr>
<td>Run Background Database Maintenance</td>
<td>True</td>
</tr>
<tr>
<td>Number of Copies per Database</td>
<td>3</td>
</tr>
</tbody>
</table>

Database configuration

<table>
<thead>
<tr>
<th>Instance</th>
<th>Log Path</th>
<th>Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>G:\LOG1</td>
<td>G:\DB1\Jetstress001001.edb</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>H:\LOG2</td>
<td>H:\DB2\Jetstress002001.edb</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>I:\LOG3</td>
<td>I:\DB3\Jetstress003001.edb</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>J:\LOG4</td>
<td>J:\DB4\Jetstress004001.edb</td>
</tr>
</tbody>
</table>
### Transactional I/O performance

<table>
<thead>
<tr>
<th>MSExchange Database =&gt; Instances</th>
<th>Database Maintenance I/O Reads/sec</th>
<th>Database Maintenance I/O Reads Average Bytes</th>
<th>Database Maintenance I/O Writes/sec</th>
<th>Database Maintenance I/O Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>27.824</td>
<td>261520.478</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>27.944</td>
<td>261508.762</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>28.046</td>
<td>261506.635</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>27.883</td>
<td>261484.484</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Background database maintenance I/O performance

<table>
<thead>
<tr>
<th>MSExchange Database =&gt; Instances</th>
<th>Database Maintenance I/O Reads/sec</th>
<th>Database Maintenance I/O Reads Average Bytes</th>
<th>Database Maintenance I/O Writes/sec</th>
<th>Database Maintenance I/O Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>27.824</td>
<td>261520.478</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>27.944</td>
<td>261508.762</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>28.046</td>
<td>261506.635</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>27.883</td>
<td>261484.484</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
## Log replication I/O performance

<table>
<thead>
<tr>
<th>MSExchange Database ==&gt; Instances</th>
<th>I/O Log Reads/sec</th>
<th>I/O Log Reads Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>0.299</td>
<td>57897.179</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>0.299</td>
<td>57897.179</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>0.301</td>
<td>59275.162</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>0.301</td>
<td>58383.710</td>
</tr>
</tbody>
</table>

## Total I/O performance

<table>
<thead>
<tr>
<th>MSExchange Database ==&gt; Instances</th>
<th>I/O Database Reads Average Latency (msec)</th>
<th>I/O Database Writes Average Latency (msec)</th>
<th>I/O Database Reads/sec</th>
<th>I/O Database Writes/sec</th>
<th>I/O Database Reads Average Bytes</th>
<th>I/O Database Writes Average Bytes</th>
<th>I/O Log Reads Average Latency (msec)</th>
<th>I/O Log Writes Average Latency (msec)</th>
<th>I/O Log Reads/sec</th>
<th>I/O Log Writes/sec</th>
<th>I/O Log Reads Average Bytes</th>
<th>I/O Log Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance 2572.1</td>
<td>13.947</td>
<td>8.832</td>
<td>41.406</td>
<td>9.224</td>
<td>188977.302</td>
<td>36457.921</td>
<td>0.979</td>
<td>1.263</td>
<td>0.299</td>
<td>8.151</td>
<td>188977.179</td>
<td>4515.105</td>
</tr>
<tr>
<td>Instance 2572.2</td>
<td>13.763</td>
<td>8.209</td>
<td>41.611</td>
<td>9.265</td>
<td>188977.661</td>
<td>36221.551</td>
<td>1.018</td>
<td>1.220</td>
<td>0.299</td>
<td>8.146</td>
<td>188977.179</td>
<td>4580.866</td>
</tr>
<tr>
<td>Instance 2572.3</td>
<td>13.147</td>
<td>8.471</td>
<td>41.404</td>
<td>8.947</td>
<td>190340.805</td>
<td>36477.918</td>
<td>1.033</td>
<td>1.245</td>
<td>0.301</td>
<td>8.176</td>
<td>190340.756</td>
<td>4575.389</td>
</tr>
<tr>
<td>Instance 2572.4</td>
<td>13.749</td>
<td>8.696</td>
<td>41.453</td>
<td>9.261</td>
<td>189152.654</td>
<td>36129.928</td>
<td>1.030</td>
<td>1.290</td>
<td>0.301</td>
<td>8.326</td>
<td>189152.710</td>
<td>4569.544</td>
</tr>
</tbody>
</table>
Host system performance

<table>
<thead>
<tr>
<th>Counter</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Processor Time</td>
<td>1.096</td>
<td>0.312</td>
<td>3.041</td>
</tr>
<tr>
<td>Available MBytes</td>
<td>5134.119</td>
<td>5114.000</td>
<td>5235.000</td>
</tr>
<tr>
<td>Free System Page Table Entries</td>
<td>33559871.221</td>
<td>33559765.000</td>
<td>33559944.000</td>
</tr>
<tr>
<td>Transition Pages RePurposed/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Pool Nonpaged Bytes</td>
<td>62127136.067</td>
<td>62124032.000</td>
<td>62136320.000</td>
</tr>
<tr>
<td>Pool Paged Bytes</td>
<td>117737074.372</td>
<td>117682176.000</td>
<td>117792768.000</td>
</tr>
<tr>
<td>Database Page Fault Stalls/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Test log

5/17/2010 4:07:09 PM -- Jetstress testing begins ...
5/17/2010 4:07:09 PM -- Prepare testing begins ...
5/17/2010 4:07:13 PM -- Attaching databases ...
5/17/2010 4:07:13 PM -- Dispatching transactions begins ...
5/17/2010 4:07:13 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
5/17/2010 4:07:19 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/17/2010 4:07:19 PM -- Attaining prerequisites:
5/17/2010 4:26:49 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 967061500.0 (lower bound: 966367600.0, upper bound: none)
5/18/2010 4:26:50 PM -- Shutting down databases ...
5/18/2010 4:26:54 PM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete)
5/18/2010 4:26:54 PM -- Verifying database checksums ...
5/18/2010 10:51:40 PM -- G: (100% processed), H: (100% processed), I: (100% processed) and J: (100% processed)
5/18/2010 10:51:40 PM -- C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.blg has 769 samples.
5/18/2010 10:51:44 PM -- C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.html is saved.
5/18/2010 10:51:44 PM -- Verifying log checksums ...
5/18/2010 10:51:44 PM -- G:\LOG1 (7 log(s) processed), H:\LOG2 (6 log(s) processed), I:\LOG3 (7 log(s) processed) and J:\LOG4 (7 log(s) processed)
5/18/2010 10:51:44 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.blg has 5835 samples.
5/18/2010 10:51:44 PM -- Creating test report ...
5/18/2010 10:52:12 PM -- Instance2572.1 has 13.0 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.1 has 1.2 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.1 has 1.2 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.2 has 13.2 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.2 has 1.2 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.2 has 1.2 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 13.7 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 1.2 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 1.2 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 14.0 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 1.3 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 1.3 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/18/2010 10:52:12 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/18/2010 10:52:12 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.xml has 5757 samples queried.
5/18/2010 10:52:13 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.html is saved.
5/18/2010 10:52:13 PM -- C:\JetStress_Test_Results\Application_2010_5_18_22_52_13.evt is saved.
5/18/2010 10:52:13 PM -- C:\JetStress_Test_Results\System_2010_5_18_22_52_13.evt is saved.
5/18/2010 11:08:42 PM -- Jetstress testing begins ...
5/18/2010 11:08:42 PM -- Prepare testing begins ...
5/18/2010 11:08:42 PM -- Attaching databases ...
5/18/2010 11:08:47 PM -- Prepare testing ends.
5/18/2010 11:08:47 PM -- Dispatching transactions begins ...
5/18/2010 11:08:47 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
Appendix: Test reports

5/18/2010 11:08:47 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
5/18/2010 11:08:51 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
5/18/2010 11:08:51 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
5/18/2010 11:08:53 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/18/2010 11:08:53 PM -- Attaining prerequisites:
5/18/2010 11:29:11 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 966672400.0 (lower bound: 966367600.0, upper bound: none)
5/19/2010 1:29:12 AM -- Shutting down databases ...
5/19/2010 1:29:16 AM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete)
5/19/2010 1:29:16 AM -- Verifying database checksums ...
5/19/2010 7:54:07 AM -- G: (100% processed), H: (100% processed), I: (100% processed) and J: (100% processed)
5/19/2010 7:54:07 AM -- C:\JetStress_Test_Results\DBChecksum_2010_5_19_1_29_16.blg has 769 samples.
5/19/2010 7:54:12 AM -- C:\JetStress_Test_Results\DBChecksum_2010_5_19_1_29_16.html is saved.
5/19/2010 7:54:12 AM -- Verifying log checksums ...
5/19/2010 7:54:12 AM -- G:LOG1 (7 log(s) processed), H:LOG2 (7 log(s) processed), I:LOG3 (8 log(s) processed) and J:LOG4 (7 log(s) processed)
Appendix: Test reports

5/19/2010 7:54:12 AM -- C:\JetStress_Test_Results\Performance_2010_5_18_23_8_51.blg has 560 samples.
5/19/2010 7:54:12 AM -- Creating test report ...
5/19/2010 7:54:15 AM -- Instance2572.1 has 13.9 for I/O Database Reads Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.1 has 1.3 for I/O Log Writes Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.1 has 1.3 for I/O Log Reads Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.2 has 13.8 for I/O Database Reads Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.2 has 1.2 for I/O Log Writes Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.2 has 1.2 for I/O Log Reads Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.3 has 13.1 for I/O Database Reads Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.3 has 1.2 for I/O Log Writes Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.3 has 1.2 for I/O Log Reads Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.4 has 13.7 for I/O Database Reads Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.4 has 1.3 for I/O Log Writes Average Latency.
5/19/2010 7:54:15 AM -- Instance2572.4 has 1.3 for I/O Log Reads Average Latency.
5/19/2010 7:54:15 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/19/2010 7:54:15 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/19/2010 7:54:15 AM -- C:\JetStress_Test_Results\Performance_2010_5_18_23_8_51.xml has 478 samples queried.
## Test result report

### Checksum statistics - All

<table>
<thead>
<tr>
<th>Database</th>
<th>Seen pages</th>
<th>Bad pages</th>
<th>Correctable pages</th>
<th>Wrong page-number pages</th>
<th>File length/seconds taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>G:\DB1\Jetstress001001.edb</td>
<td>20845362</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651417 MBytes / 23068 sec</td>
</tr>
<tr>
<td>H:\DB2\Jetstress002001.edb</td>
<td>20845618</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651425 MBytes / 23074 sec</td>
</tr>
<tr>
<td>I:\DB3\Jetstress003001.edb</td>
<td>20843058</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651345 MBytes / 23090 sec</td>
</tr>
<tr>
<td>J:\DB4\Jetstress004001.edb</td>
<td>20845618</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>651425 MBytes / 23079 sec</td>
</tr>
<tr>
<td>(Sum)</td>
<td>83379656</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2605614 MBytes / 23091</td>
</tr>
</tbody>
</table>

### Disk subsystem performance (of checksum)

<table>
<thead>
<tr>
<th>LogicalDisk</th>
<th>Avg. Disk sec/Read</th>
<th>Avg. Disk sec/Write</th>
<th>Disk Reads/sec</th>
<th>Disk Writes/sec</th>
<th>Avg. Disk Bytes/Write</th>
</tr>
</thead>
<tbody>
<tr>
<td>G:</td>
<td>0.101</td>
<td>0.000</td>
<td>451.920</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
<tr>
<td>H:</td>
<td>0.101</td>
<td>0.000</td>
<td>451.887</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
<tr>
<td>I:</td>
<td>0.100</td>
<td>0.000</td>
<td>451.319</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
<tr>
<td>J:</td>
<td>0.100</td>
<td>0.000</td>
<td>451.732</td>
<td>0.000</td>
<td>65535.994</td>
</tr>
</tbody>
</table>
Appendix: Test reports

Memory system performance (of checksum)

<table>
<thead>
<tr>
<th>Counter</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Processor Time</td>
<td>8.918</td>
<td>7.562</td>
<td>10.330</td>
</tr>
<tr>
<td>Available MBytes</td>
<td>6174.332</td>
<td>6068.000</td>
<td>6196.000</td>
</tr>
<tr>
<td>Free System Page Table Entries</td>
<td>33559647.848</td>
<td>33559318.000</td>
<td>33559911.000</td>
</tr>
<tr>
<td>Transition Pages Repurposed/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Pool Nonpaged Bytes</td>
<td>62130599.449</td>
<td>62124032.000</td>
<td>62152704.000</td>
</tr>
<tr>
<td>Pool Paged Bytes</td>
<td>116994910.876</td>
<td>116350976.000</td>
<td>152584192.000</td>
</tr>
</tbody>
</table>

Test log

5/17/2010 4:07:09 PM -- Jetstress testing begins ...
5/17/2010 4:07:09 PM -- Prepare testing begins ...
5/17/2010 4:07:13 PM -- Attaching databases ...
5/17/2010 4:07:13 PM -- Dispatching transactions begins ...
5/17/2010 4:07:13 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
5/17/2010 4:07:19 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/17/2010 4:07:19 PM -- Attaining prerequisites:
5/17/2010 4:26:49 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 967061500.0 (lower bound: 966367600.0, upper bound: none)


5/18/2010 4:26:50 PM -- Shutting down databases ... 

5/18/2010 4:26:54 PM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete) 


5/18/2010 4:26:54 PM -- Verifying database checksums ...  

5/18/2010 10:51:40 PM -- G: (100% processed), H: (100% processed), I: (100% processed) and J: (100% processed) 


5/18/2010 10:51:40 PM -- C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.blg has 769 samples. 

5/18/2010 10:51:44 PM -- C:\JetStress_Test_Results\DBChecksum_2010_5_18_16_26_54.html is saved. 

5/18/2010 10:51:44 PM -- Verifying log checksums ... 

5/18/2010 10:51:44 PM -- G:\LOG1 (7 log(s) processed), H:\LOG2 (6 log(s) processed), I:\LOG3 (7 log(s) processed) and J:\LOG4 (7 log(s) processed) 

5/18/2010 10:51:44 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.blg has 5835 samples. 

5/18/2010 10:51:44 PM -- Creating test report ... 

5/18/2010 10:52:12 PM -- Instance2572.1 has 13.0 for I/O Database Reads Average Latency. 

5/18/2010 10:52:12 PM -- Instance2572.1 has 1.2 for I/O Log Writes Average Latency. 

5/18/2010 10:52:12 PM -- Instance2572.1 has 1.2 for I/O Log Reads Average Latency. 

5/18/2010 10:52:12 PM -- Instance2572.2 has 13.2 for I/O Database Reads Average Latency. 

5/18/2010 10:52:12 PM -- Instance2572.2 has 1.2 for I/O Log Writes Average Latency. 

5/18/2010 10:52:12 PM -- Instance2572.2 has 1.2 for I/O Log Reads Average Latency. 

5/18/2010 10:52:12 PM -- Instance2572.2 has 1.2 for I/O Log Reads Average Latency.
Appendix: Test reports

5/18/2010 10:52:12 PM -- Instance2572.3 has 13.7 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 1.2 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.3 has 1.2 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 14.0 for I/O Database Reads Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 1.3 for I/O Log Writes Average Latency.
5/18/2010 10:52:12 PM -- Instance2572.4 has 1.3 for I/O Log Reads Average Latency.
5/18/2010 10:52:12 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/18/2010 10:52:12 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/18/2010 10:52:12 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.xml has 5757 samples queried.
5/18/2010 10:52:13 PM -- C:\JetStress_Test_Results\Stress_2010_5_17_16_7_17.html is saved.
5/18/2010 10:52:13 PM -- C:\JetStress_Test_Results\Application_2010_5_18_22_52_13.evt is saved.
5/18/2010 10:52:13 PM -- C:\JetStress_Test_Results\System_2010_5_18_22_52_13.evt is saved.
5/18/2010 11:08:42 PM -- Jetstress testing begins ...
5/18/2010 11:08:42 PM -- Prepare testing begins ...
5/18/2010 11:08:47 PM -- Attaching databases ...
5/18/2010 11:08:47 PM -- Prepare testing ends.
5/18/2010 11:08:47 PM -- Dispatching transactions begins ...
5/18/2010 11:08:47 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
5/18/2010 11:08:47 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
5/18/2010 11:08:51 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
5/18/2010 11:08:51 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
5/18/2010 11:08:53 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/18/2010 11:08:53 PM -- Attaining prerequisites:
5/18/2010 11:29:11 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 966672400.0 (lower bound: 966367600.0, upper bound: none)
5/19/2010 1:29:12 AM -- Shutting down databases ...
5/19/2010 1:29:16 AM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete)
5/19/2010 1:29:16 AM -- Verifying database checksums ...
5/19/2010 7:54:07 AM -- G: (100% processed), H: (100% processed), I: (100% processed) and J: (100% processed)
5/19/2010 7:54:07 AM -- C:\JetStress_Test_Results\DBChecksum_2010_5_19_1_29_16.blg has 769 samples.
## Microsoft Exchange Server 2010 Jetstress – database backup

### Database backup statistics - All

<table>
<thead>
<tr>
<th>Database Instance</th>
<th>Database Size (MBytes)</th>
<th>Elapsed Backup Time</th>
<th>MBytes Transferred/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>650465.59</td>
<td>06:24:07</td>
<td>28.22</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>650465.59</td>
<td>06:22:29</td>
<td>28.34</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>650385.59</td>
<td>06:24:29</td>
<td>28.19</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>650465.59</td>
<td>06:22:26</td>
<td>28.35</td>
</tr>
</tbody>
</table>

### Jetstress system parameters

- **Thread Count**: 1 (per database)
- **Minimum Database Cache**: 128.0 MB
- **Maximum Database Cache**: 1024.0 MB
- **Insert Operations**: 40%
- **Delete Operations**: 20%
- **Replace Operations**: 5%
- **Read Operations**: 35%
- **Lazy Commits**: 70%

### Database configuration

- **Instance2572.1**
  - Log Path: G:\LOG1
  - Database: G:\DB1\Jetstress001001.edb
- **Instance2572.2**
  - Log Path: H:\LOG2
  - Database: H:\DB2\Jetstress002001.edb
- **Instance2572.3**
  - Log Path: I:\LOG3
  - Database: I:\DB3\Jetstress003001.edb
- **Instance2572.4**
  - Log Path: J:\LOG4
  - Database: J:\DB4\Jetstress004001.edb
### Transactional I/O performance

<table>
<thead>
<tr>
<th>Instance</th>
<th>MSE Exchange Database =&gt; Instances</th>
<th>I/O Database Reads Average Latency (msec)</th>
<th>I/O Database Writes Average Latency (msec)</th>
<th>I/O Database Reads/sec</th>
<th>I/O Database Writes/sec</th>
<th>I/O Database Reads Average Bytes</th>
<th>I/O Database Writes Average Bytes</th>
<th>I/O Log Reads Average Latency (msec)</th>
<th>I/O Log Writes Average Latency (msec)</th>
<th>I/O Log Reads/sec</th>
<th>I/O Log Writes/sec</th>
<th>I/O Log Reads Average Bytes</th>
<th>I/O Log Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>13.797</td>
<td>0.000</td>
<td>112.790</td>
<td>0.000</td>
<td>262144.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>13.810</td>
<td>0.000</td>
<td>113.369</td>
<td>0.000</td>
<td>262144.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>13.860</td>
<td>0.000</td>
<td>112.611</td>
<td>0.000</td>
<td>262144.000</td>
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<td>0.000</td>
<td>0.000</td>
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<td>0.000</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>13.725</td>
<td>0.000</td>
<td>113.387</td>
<td>0.000</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Host system performance

<table>
<thead>
<tr>
<th>Counter</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Processor Time</td>
<td>6.223</td>
<td>5.016</td>
<td>11.201</td>
</tr>
<tr>
<td>Available MBytes</td>
<td>4967.801</td>
<td>4908.000</td>
<td>4994.000</td>
</tr>
<tr>
<td>Free System Page Table Entries</td>
<td>33558953.292</td>
<td>33558417.000</td>
<td>33559084.000</td>
</tr>
<tr>
<td>Transition Pages Repurposed/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Pool Nonpaged_bytes</td>
<td>62167258.667</td>
<td>62144512.000</td>
<td>62271488.000</td>
</tr>
<tr>
<td>Pool Paged_bytes</td>
<td>1446308832.000</td>
<td>1445568512.000</td>
<td>1446625280.000</td>
</tr>
<tr>
<td>Database Page Fault Stalls/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Appendix: Test reports

Test log

5/17/2010 9:40:35 AM -- Jetstress testing begins ...
5/17/2010 9:40:35 AM -- Prepare testing begins ...
5/17/2010 9:40:42 AM -- Attaching databases ...
5/17/2010 9:40:48 AM -- Backing up databases ...
5/17/2010 4:05:17 PM -- Instance2572.1 (100% processed), Instance2572.2 (100% processed), Instance2572.3 (100% processed) and Instance2572.4 (100% processed)
5/17/2010 4:05:17 PM -- C:\JetStress_Test_Results\DatabaseBackup_2010_5_17_9_40_42.blg has 768 samples.
5/17/2010 4:05:17 PM -- Creating test report ...
# Microsoft Exchange Server 2010 Jetstress – soft recovery

## SoftRecovery test result report

### Test summary

<table>
<thead>
<tr>
<th>Overall Test Result</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Name</td>
<td>E2010-JETSTRESS</td>
</tr>
<tr>
<td>Test Description</td>
<td></td>
</tr>
</tbody>
</table>

| Test Start Time      | 5/16/2010 10:08:33 PM |
| Test End Time        | 5/17/2010 4:01:53 AM  |
| Collection Start Time| 5/16/2010 10:08:58 PM |
| Collection End Time  | 5/17/2010 4:01:39 AM  |
| Jetstress Version    | 14.01.0043.000 |
| Ese Version          | 14.00.0639.019 |
| Operating System     | Windows Server (R) 2008 Enterprise Service Pack 2 (6.0.6002.131072) |
| Performance Log      | C:\JetStress_Test_Results\Performance_2010_5_16_22_8_42.blg |

### Database sizing and throughput

<table>
<thead>
<tr>
<th>Achieved Transactional I/O per Second</th>
<th>121.624</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Transactional I/O per Second</td>
<td>46.8</td>
</tr>
<tr>
<td>Initial Database Size (bytes)</td>
<td>2726992019456</td>
</tr>
<tr>
<td>Final Database Size (bytes)</td>
<td>2728199979008</td>
</tr>
<tr>
<td>Database Files (Count)</td>
<td>4</td>
</tr>
</tbody>
</table>
Jetstress system parameters

Thread Count 1 (per database)
Minimum Database Cache 128.0 MB
Maximum Database Cache 1024.0 MB
Insert Operations 40%
Delete Operations 20%
Replace Operations 5%
Read Operations 35%
Lazy Commits 70%

Database configuration

Instance2572.1 Log Path: G:\LOG1
Database: G:\DB1\Jetstress001001.edb

Instance2572.2 Log Path: H:\LOG2
Database: H:\DB2\Jetstress002001.edb

Instance2572.3 Log Path: I:\LOG3
Database: I:\DB3\Jetstress003001.edb

Instance2572.4 Log Path: J:\LOG4
Database: J:\DB4\Jetstress004001.edb
## Transactional I/O performance

<table>
<thead>
<tr>
<th>Instance2572.1</th>
<th>MSExchange Database Reads Average Latency (msec)</th>
<th>MSExchange Database Writes Average Latency (msec)</th>
<th>I/O Database Reads Average Latency (msec)</th>
<th>I/O Database Writes Average Latency (msec)</th>
<th>I/O Database Reads Average Bytes</th>
<th>I/O Database Writes Average Bytes</th>
<th>I/O Log Reads Average Latency (msec)</th>
<th>I/O Log Writes Average Latency (msec)</th>
<th>I/O Log Reads Average Bytes</th>
<th>I/O Log Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>14.247</td>
<td>4.817</td>
<td>17.984</td>
<td>11.934</td>
<td>32768.000</td>
<td>37612.874</td>
<td>0.000</td>
<td>0.394</td>
<td>0.000</td>
<td>11.442</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>14.703</td>
<td>4.963</td>
<td>18.417</td>
<td>12.316</td>
<td>32768.000</td>
<td>37627.340</td>
<td>0.000</td>
<td>0.407</td>
<td>0.000</td>
<td>11.690</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>15.590</td>
<td>5.097</td>
<td>18.136</td>
<td>12.069</td>
<td>32768.000</td>
<td>37620.479</td>
<td>0.000</td>
<td>0.421</td>
<td>0.000</td>
<td>11.633</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>15.552</td>
<td>5.379</td>
<td>18.464</td>
<td>12.304</td>
<td>32768.000</td>
<td>37582.649</td>
<td>0.000</td>
<td>0.412</td>
<td>0.000</td>
<td>11.635</td>
</tr>
</tbody>
</table>

## Host system performance

<table>
<thead>
<tr>
<th>Counter</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Processor Time</td>
<td>1.285</td>
<td>0.520</td>
<td>3.041</td>
</tr>
<tr>
<td>Available MBytes</td>
<td>3907.104</td>
<td>3792.000</td>
<td>4910.000</td>
</tr>
<tr>
<td>Free System Page Table Entries</td>
<td>33558444.347</td>
<td>33558372.000</td>
<td>33558966.000</td>
</tr>
<tr>
<td>Transition Pages RePurposed/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Pool Nonpaged Bytes</td>
<td>61403899.464</td>
<td>61399040.000</td>
<td>61435904.000</td>
</tr>
<tr>
<td>Pool Paged Bytes</td>
<td>1444947795.277</td>
<td>1443995648.000</td>
<td>1445068800.000</td>
</tr>
<tr>
<td>Database Page Fault Stalls/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Test log

5/16/2010 10:08:33 PM -- Jetstress testing begins ...
5/16/2010 10:08:33 PM -- Prepare testing begins ...
5/16/2010 10:08:38 PM -- Attaching databases ...
5/16/2010 10:08:38 PM -- Prepare testing ends.
5/16/2010 10:08:38 PM -- Dispatching transactions begins ...
5/16/2010 10:08:38 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
5/16/2010 10:08:38 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
5/16/2010 10:08:42 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
5/16/2010 10:08:42 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
5/16/2010 10:08:43 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/16/2010 10:08:43 PM -- Generating log files ...
5/17/2010 4:01:49 AM -- G:\LOG1 (100.2% generated), H:\LOG2 (101.8% generated), I:\LOG3 (100.8% generated) and J:\LOG4 (101.4% generated)
5/17/2010 4:01:49 AM -- Shutting down databases ...
5/17/2010 4:01:53 AM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete)
5/17/2010 4:01:53 AM -- C:\JetStress_Test_Results\Performance_2010_5_16_22_8_42.blg has 1411 samples.
5/17/2010 4:01:53 AM -- Creating test report ...
Appendix: Test reports

5/17/2010 4:01:58 AM -- Instance2572.1 has 14.2 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.1 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.1 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.2 has 14.7 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.2 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.2 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.3 has 15.6 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.3 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.3 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.4 has 15.6 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.4 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.4 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/17/2010 4:01:58 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/17/2010 4:01:58 AM --
C:\JetStress_Test_Results\Performance_2010_5_16_22_8_42.xml has 1410 samples queried.
Appendix: Test reports

SoftRecovery test result report

Soft recovery statistics - All

<table>
<thead>
<tr>
<th>Database Instance</th>
<th>Log files replayed</th>
<th>Elapsed seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance2572.1</td>
<td>500</td>
<td>3705.1329507</td>
</tr>
<tr>
<td>Instance2572.2</td>
<td>508</td>
<td>3835.8773888</td>
</tr>
<tr>
<td>Instance2572.3</td>
<td>503</td>
<td>3831.1037582</td>
</tr>
<tr>
<td>Instance2572.4</td>
<td>506</td>
<td>3854.7067095</td>
</tr>
</tbody>
</table>

Database configuration

Instance2572.1
Log Path: G:\LOG1
Database: G:\DB1\Jetstress001001.edb

Instance2572.2
Log Path: H:\LOG2
Database: H:\DB2\Jetstress002001.edb

Instance2572.3
Log Path: I:\LOG3
Database: I:\DB3\Jetstress003001.edb

Instance2572.4
Log Path: J:\LOG4
Database: J:\DB4\Jetstress004001.edb
### Transactional I/O performance

<table>
<thead>
<tr>
<th>Instance</th>
<th>MSEExchange Database ==&gt; Instances</th>
<th>MSEExchange Database I/O Database Reads Average Latency (msec)</th>
<th>MSEExchange Database I/O Database Writes Average Latency (msec)</th>
<th>MSEExchange Database I/O Database Reads Average Bytes</th>
<th>MSEExchange Database I/O Database Writes Average Bytes</th>
<th>MSEExchange Database I/O Log Reads Average Latency (msec)</th>
<th>MSEExchange Database I/O Log Writes Average Latency (msec)</th>
<th>MSEExchange Database I/O Log Reads Average Bytes</th>
<th>MSEExchange Database I/O Log Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2572.1</td>
<td>1066.5</td>
<td>200.802</td>
<td>65.881</td>
<td>0.809</td>
<td>75277.628</td>
<td>19472.130</td>
<td>2.268</td>
<td>0.001</td>
<td>1.215</td>
</tr>
<tr>
<td>2572.2</td>
<td>1111.178</td>
<td>216.418</td>
<td>65.557</td>
<td>0.793</td>
<td>73187.004</td>
<td>19196.372</td>
<td>2.260</td>
<td>0.000</td>
<td>1.190</td>
</tr>
<tr>
<td>2572.3</td>
<td>1188.600</td>
<td>316.592</td>
<td>64.308</td>
<td>0.787</td>
<td>71207.477</td>
<td>20290.689</td>
<td>2.171</td>
<td>0.000</td>
<td>1.183</td>
</tr>
<tr>
<td>2572.4</td>
<td>1139.918</td>
<td>251.585</td>
<td>65.545</td>
<td>0.787</td>
<td>72327.086</td>
<td>19482.750</td>
<td>2.244</td>
<td>0.001</td>
<td>1.182</td>
</tr>
</tbody>
</table>

### Background database maintenance I/O performance

<table>
<thead>
<tr>
<th>Instance</th>
<th>MSEExchange Database ==&gt; Instances</th>
<th>Database Maintenance I/O Reads/sec</th>
<th>Database Maintenance I/O Reads Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2572.1</td>
<td>11.962</td>
<td>216538.338</td>
<td></td>
</tr>
<tr>
<td>2572.2</td>
<td>11.421</td>
<td>216559.394</td>
<td></td>
</tr>
<tr>
<td>2572.3</td>
<td>10.769</td>
<td>211965.489</td>
<td></td>
</tr>
<tr>
<td>2572.4</td>
<td>11.171</td>
<td>216586.912</td>
<td></td>
</tr>
</tbody>
</table>
## Total I/O performance

<table>
<thead>
<tr>
<th>Instance</th>
<th>MSEExchange Database --&gt; Instances</th>
<th>I/O Database Reads Average Latency (msec)</th>
<th>I/O Database Writes Average Latency (msec)</th>
<th>I/O Database Reads Average Bytes</th>
<th>I/O Database Writes Average Bytes</th>
<th>I/O Log Reads Average Latency (msec)</th>
<th>I/O Log Writes Average Latency (msec)</th>
<th>I/O Log Reads Average Bytes</th>
<th>I/O Log Writes Average Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instance 2572.1</td>
<td>1066.525 200.802 77.843 0.809</td>
<td>96985.199 19472.130 2.268 0.001</td>
<td>64579.737 0.556</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instance 2572.2</td>
<td>1111.178 216.418 76.979 0.793</td>
<td>94459.379 19196.372 2.260 0.000</td>
<td>63250.467 0.269</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instance 2572.3</td>
<td>1188.600 316.592 75.077 0.787</td>
<td>91397.314 20290.689 2.171 0.000</td>
<td>63043.036 0.538</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instance 2572.4</td>
<td>1139.918 251.585 76.716 0.787</td>
<td>93333.570 19482.750 2.244 0.001</td>
<td>62537.685 0.268</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Host system performance

<table>
<thead>
<tr>
<th>Counter</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Processor Time</td>
<td>2.198</td>
<td>0.000</td>
<td>13.953</td>
</tr>
<tr>
<td>Available MBytes</td>
<td>3917.117</td>
<td>3837.000</td>
<td>4933.000</td>
</tr>
<tr>
<td>Free System Page Table Entries</td>
<td>33558781.443</td>
<td>33558417.000</td>
<td>33558882.000</td>
</tr>
<tr>
<td>Transition Pages ReRePurposed/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Pool Nonpaged Bytes</td>
<td>62938631.219</td>
<td>61427712.000</td>
<td>63492096.000</td>
</tr>
<tr>
<td>Pool Paged Bytes</td>
<td>144602258.966</td>
<td>144446208.000</td>
<td>1481175040.000</td>
</tr>
<tr>
<td>Database Page Fault Stalls/sec</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Test log

5/16/2010 10:08:33 PM -- Jetstress testing begins ...
5/16/2010 10:08:33 PM -- Prepare testing begins ...
5/16/2010 10:08:38 PM -- Attaching databases ...
5/16/2010 10:08:38 PM -- Prepare testing ends.
5/16/2010 10:08:38 PM -- Dispatching transactions begins ...
5/16/2010 10:08:38 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
5/16/2010 10:08:38 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
5/16/2010 10:08:42 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
5/16/2010 10:08:42 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
5/16/2010 10:08:43 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/16/2010 10:08:43 PM -- Generating log files ...
5/17/2010 4:01:49 AM -- G:\LOG1 (100.2% generated), H:\LOG2 (101.8% generated), I:\LOG3 (100.8% generated) and J:\LOG4 (101.4% generated)
5/17/2010 4:01:49 AM -- Shutting down databases ...
5/17/2010 4:01:53 AM -- Instance2572.1 (complete), Instance2572.2 (complete), Instance2572.3 (complete) and Instance2572.4 (complete)
5/17/2010 4:01:53 AM -- C:\JetStress_Test_Results\Performance_2010_5_16_22_8_42.blg has 1411 samples.
5/17/2010 4:01:53 AM -- Creating test report ...
Appendix: Test reports

5/17/2010 4:01:58 AM -- Instance2572.1 has 14.2 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.1 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.1 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.2 has 14.7 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.2 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.2 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.3 has 15.6 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.3 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.3 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.4 has 15.6 for I/O Database Reads Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.4 has 0.4 for I/O Log Writes Average Latency.
5/17/2010 4:01:58 AM -- Instance2572.4 has 0.4 for I/O Log Reads Average Latency.
5/17/2010 4:01:58 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/17/2010 4:01:58 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/17/2010 4:01:58 AM -- C:\JetStress_Test_Results\Performance_2010_5_16_22_8_42.xml has 1410 samples queried.
5/17/2010 4:01:58 AM -- C:\JetStress_Test_Results\Performance_2010_5_16_22_8_42.html is saved.
5/17/2010 4:02:00 AM -- Performance logging begins (interval: 2000 ms).
5/17/2010 4:02:00 AM -- Recovering databases ...
5/17/2010 5:06:14 AM -- Instance2572.1 (3705.1329507), Instance2572.2 (3835.8773888), Instance2572.3 (3831.1037582) and Instance2572.4 (3854.7067095)

5/17/2010 5:06:15 AM --
C:\JetStress_Test_Results\SoftRecovery_2010_5_17_4_1_58.blg has 1915 samples.

5/17/2010 5:06:15 AM -- Creating test report ...