# BlackBerry Enterprise Server for Novell GroupWise

Version: 5.0
Service Pack: 4

Performance Benchmarking Guide

BlackBerry

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# 1 BlackBerry Enterprise Server 5.0 SP1 or later for Novell GroupWise

## Overview: BlackBerry Enterprise Server benchmarking

Research In Motion performed two sets of benchmark tests to determine the performance characteristics of the BlackBerry Enterprise Server 5.0 SP1 for Novell GroupWise. User-scaling tests were performed to determine how the number of BlackBerry device users in an organization's environment affects how the BlackBerry Enterprise Server uses system resources. Passive and active workload tests were performed to determine how the BlackBerry Enterprise Server affects the resource usage of the various servers in an organization's environment. The results in this chapter apply to the BlackBerry Enterprise Server 5.0 SP1 and later for Novell GroupWise.

The testing environment included 500 users who each have an email account on the Novell GroupWise messaging server. Each user's email account was prepopulated with approximately 100 MB of email messages, tasks, and user directory entries. Each performance test was conducted for four hours. The data compiled in the final two hours of the performance testing was used for the performance-benchmarking analysis. The tests were run multiple times to verify that the results were repeatable and accurate. Performance counters were monitored to verify that hardware bottlenecks were not present during testing.

The results of the performance tests and the conclusions that are based on the results are guidelines only. The results are based on the workloads that were used in the performance tests and might vary depending on your organization's environment and the usage patterns of the users. You should not apply simple multipliers to the messaging-server resources based on the results because applications on the messaging servers, such as antivirus software, backup processes, auditing software, and archiving software, might affect the load statistics.

**Related information**

Monitoring server performance, 25

# Testing conditions

## Environment

### BlackBerry Enterprise Server

| Type | Components |
|---|---|
| Hardware | One HP ProLiant BL460c G6 server with the following features:<br>• Intel Xeon Processor E5540 with a quad core processor at 2.53 GHz (4 cores total)<br>• 6 GB memory<br>• HP NC532i Dual Port 10 GbE Multifunction BL-c Network Adapter<br>• HP Smart Array P410i controller with 512 MB read cache with two 140 GB drives in a RAID 1 configuration |
| Software | • Windows Server 2008 Standard x64 SP2<br>• BlackBerry Enterprise Server for Novell GroupWise 5.0 SP1; all BlackBerry Enterprise Server components installed on the computer except the BlackBerry Administration Service |

### Computer that hosts the BlackBerry Administration Service

| Type | Components |
|---|---|
| Hardware | One HP ProLiant BL460c G1 server with the following features:<br>• Intel Xeon Processor E5150 with a dual core at 2.66 GHz (2 cores total)<br>• 4 GB memory<br>• HP NC373i Integrated Multifunction Gigabit Server Adapter<br>• HP Smart Array E200i controller with 64 MB read cache with two 72 GB drives in a RAID 1 configuration |
| Software | • Windows Server 2008 Standard x64 SP2<br>• BlackBerry Administration Service 5.0 SP1 |

## Database server

| Type | Components |
|---|---|
| Hardware | One HP ProLiant BL460c G1 server with the following features:<br>• Intel Xeon Processor E5440 with a quad core at 2.83 GHz (4 cores total)<br>• 10 GB memory<br>• HP NC373i Integrated Multifunction Gigabit Server Adapter<br>• HP Smart Array E200i controller with 64 MB read cache with two 72 GB drives in a RAID 1 configuration<br>• QLogic QLA 2462 series Fibre Channel HBA, 4 GB |
| Software | • Windows Server 2003 Standard x64 SP2<br>• HP MPIO driver 3.01<br>• Microsoft SQL Server 2005 (Standard Edition x64) SP2 |

## Novell GroupWise messaging server

| Type | Components |
|---|---|
| Hardware | One HP ProLiant BL460c G1 server with the following features:<br>• Intel Xeon Processor E5440 with a quad core at 2.83 GHz (4 cores total)<br>• 10 GB memory<br>• HP NC373i Integrated Multifunction Gigabit Server Adapter<br>• HP Smart Array E200i controller with 64 MB read cache with two 72 GB drives in a RAID 1 configuration<br>• QLogic QLA 2462 series dual port Fibre Channel HBA |
| Software | • SUSE® Linux Enterprise Server 10 SP2<br>• Novell GroupWise 8.0.2 SP2 |

## Load generators

| Type | Components |
|---|---|
| Hardware | Two VMware ESX 3.x-based virtual machines with the following features: |

| Type | Components |
|---|---|
| | • virtual E5540 Processor core at 2.53 GHz<br>• 1 GB memory<br>• virtual NIC<br>• 20 GB virtual local disk space |
| Software | • Windows Server 2003 Standard SP2<br><br>Testing tools<br><br>• BlackBerry Performance Engineering Resource Kit 2.0: a tool developed by Research In Motion that simulates the BlackBerry device network and permits testing without requiring the BlackBerry Infrastructure or a population of devices.<br>• BlackBerry MDS Connection Service push load test tool: an internal tool that RIM developed that simulates applications pushing web content to devices.<br>• Novell GroupWise load tool (custom configuration): a tool developed by RIM that generates client-simulated workloads for the Novell GroupWise messaging server. The tool uses Perl scripts that specify user tasks and rates for email actions, calendar actions, task actions, and contact-list actions. Workloads are specified using frequency characteristics. |

# Test details

## User-scaling tests

The user-scaling tests measured the resource usage of the servers in relation to the number of BlackBerry device users with activated BlackBerry devices. All of the user accounts that were used in the user-scaling tests were active. For more information about passive user accounts and active user accounts, see the passive and active workload tests section below.

Three sets of tests were run with 125 users, 250 users, and 500 users, respectively. The users read, replied to, and forwarded email messages. Users also retrieved additional information on their devices such as web content. All of the user accounts were Novell GroupWise users that were BlackBerry enabled. In most environments, only some of the user accounts on the messaging server are BlackBerry enabled users.

| Test ID | Number of users | Number of users receiving workload |
|---|---|---|
| **S1** | 125 | 125 |
| **S2** | 250 | 250 |

| Test ID | Number of users | Number of users receiving workload |
|---|---|---|
| **S3** | 500 | 500 |

## Passive and active workload tests

The passive and active workload tests measured the differences in resource usage on the BlackBerry Enterprise Server and messaging servers when passive and active user accounts were added to the environment. The tests were run with 500 BlackBerry enabled user accounts, with the same workload applied to each user. The message rate through the messaging server was maintained at approximately the same level while running tests for both passive and active user accounts.

All of the user accounts were Novell GroupWise users that were BlackBerry enabled. In most environments, only some of the user accounts on the messaging server are BlackBerry enabled users.

| Test ID | Test mode | Description |
|---|---|---|
| **C1** | Passive users | • simulated the minimum affect that a BlackBerry device user might have on the environment with the specific workload<br>• all of the BlackBerry Enterprise Server components running<br>• users received email messages and other data (for example, web pages)<br>• users did not create email messages on their devices, users did not retrieve any additional information (for example, attachments) on their devices<br>• workloads were created for the messaging server using the Novell GroupWise load tool |
| **C2** | Active users | • simulated the typical affect that a device user might have on the environment with the specific workload<br>• all of the BlackBerry Enterprise Server components running<br>• users received email messages and other data (for example, web pages)<br>• users sent, read, replied to, and forwarded email messages, created and processed calendar entries, created and processed organizer data, and retrieved additional information (for example, attachments) on their devices<br>• users shifted approximately 16% of their tasks from the email applications on their computers to their devices; the workload tools for the messaging server were adjusted proportionately to keep the message rate through the messaging servers similar to or higher than the message rate for the passive users testing mode |

## Message prepopulation for test users

Each user's email account was prepopulated with 1000 email messages before the performance tests were run. The size of each user's email account was approximately 100 MB.

## Workload description

The workload that was used for the performance tests represented a broad scope of the BlackBerry Enterprise Server 5.0 SP1 functionality. The workload consisted of the following activities:

- managing email messages: replying to email messages, marking email messages as read or unread, marking email messages for follow-up, and filing, deleting, and forwarding email messages; supporting rich-content and text email messages
- managing meeting invitations: creating (with and without document attachments), forwarding, and replying to meeting invitations
- managing calendar appointments
- managing personal contact lists and distribution lists
- managing tasks

The following workload activities were performed on the devices:

- synchronizing email messages and organizer data
- searching the user directory for a contact
- retrieving additional content in lengthy email messages
- retrieving and viewing images and other supported attachments
- receiving push content
- creating and sending email messages and meeting requests

**Related information**

Workload details, 22

# User-scaling test results

## Results: BlackBerry Enterprise Server

The processor usage, disk throughput, and network throughput scaled up linearly as the number of users was increased. The committed bytes remained above 1000 MB for all the tests, increasing in small increments with the number of users.

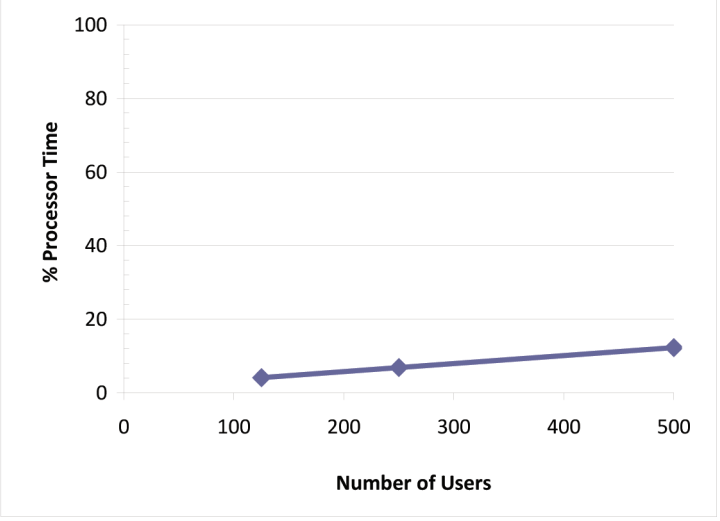
**Table 1: Scaling data for the BlackBerry Enterprise Server**

| | S1 | S2 | S3 |
|---|---|---|---|
| Number of users | 125 | 250 | 500 |

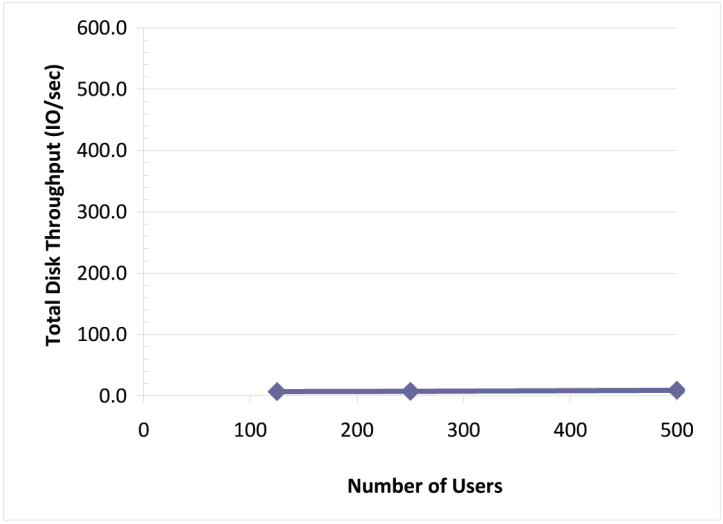
| | S1 | S2 | S3 |
|---|---|---|---|
| % Processor Time | 4.1 | 6.9 | 12.3 |
| Committed Bytes (MB) | 1789 | 1878 | 1985 |
| Total Disk Throughput (IOPS) | 7.0 | 7.5 | 9.2 |
| Network Throughput (Mbps) | 0.21 | 0.41 | 0.73 |
| Email messages received each minute | 31.9 | 64.8 | 134.9 |
| Email messages sent each minute | 2.9 | 6.3 | 13.5 |

## Performance graphs

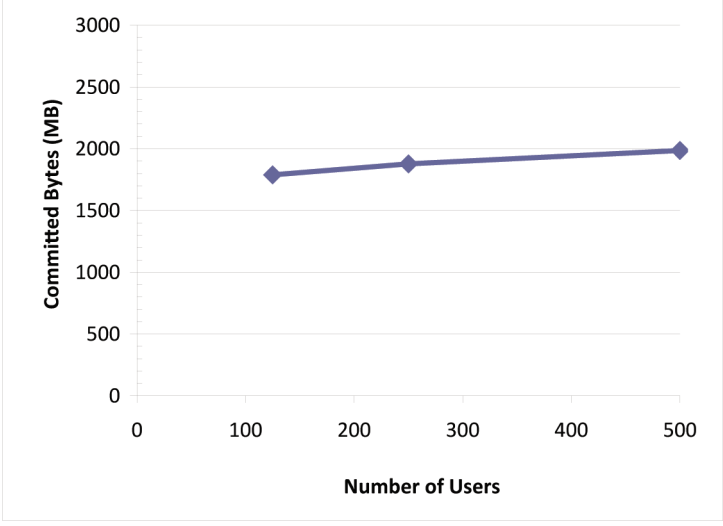
**BlackBerry Enterprise Server scaling — % Processor Time**



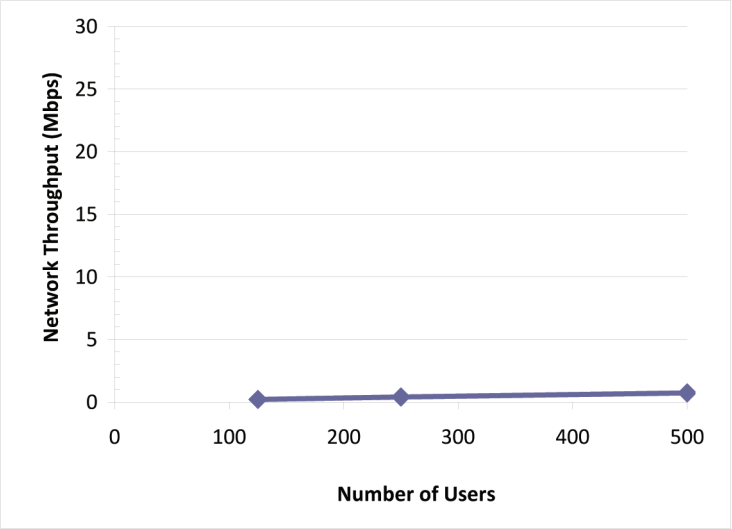

**BlackBerry Enterprise Server scaling — Total Disk Throughput**




**BlackBerry Enterprise Server scaling — Committed Bytes**




**BlackBerry Enterprise Server scaling — Network Throughput**




# Results: Computer that hosts the BlackBerry Administration Service

The performance of the computer that hosts the BlackBerry Administration Service was relatively unaffected throughout the tests. The number of users sending, receiving, and managing email messages, calendar items, organizer data, and web-based transactions did not have a significant effect on the performance of the computer that hosts the BlackBerry Administration Service.

**Table 2: Scaling data for the computer that hosts the BlackBerry Administration Service**

| | S1 | S2 | S3 |
|---|---|---|---|
| Number of users | 125 | 250 | 500 |
| % Processor Time | 0.6 | 0.6 | 0.7 |
| Committed Bytes (MB) | 1810 | 1806 | 1822 |

# Results: Database server

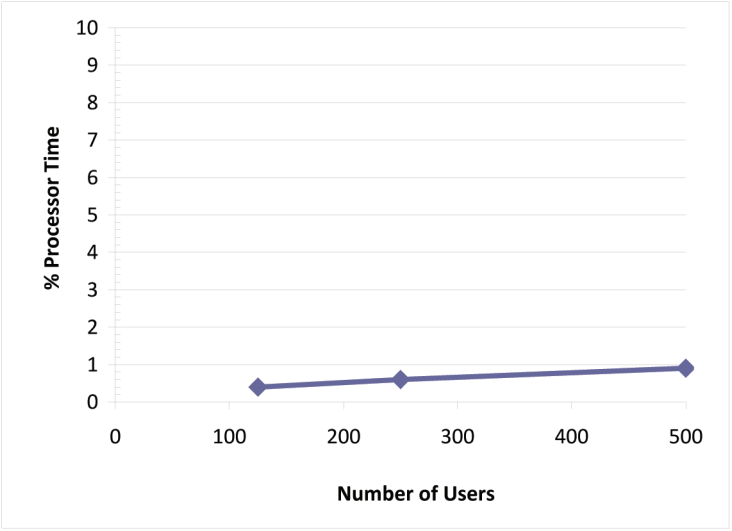
The processor usage and disk throughput of the database server remained very low throughout the tests as the number of users increased. The number of connections to the database remained relatively constant as the number of users increased.

**Table 3: Scaling data for the database server**

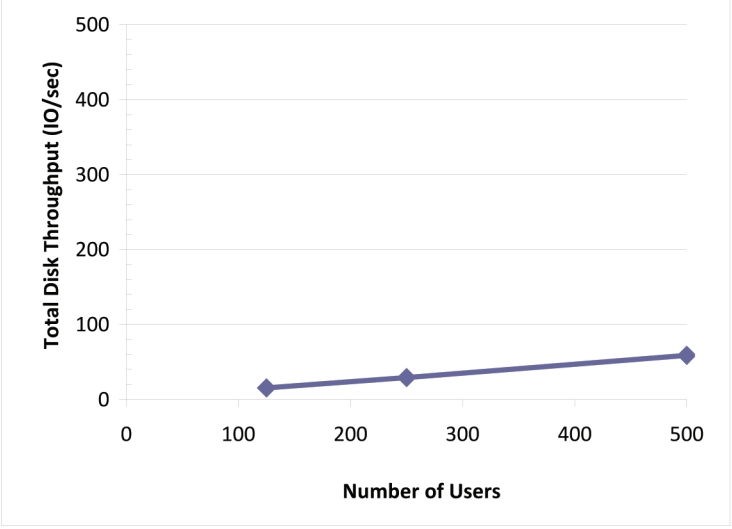
| | S1 | S2 | S3 |
|---|---|---|---|
| Number of users | 125 | 250 | 500 |
| % Processor Time | 0.4 | 0.6 | 0.9 |
| Committed Bytes (MB) | 4018 | 4011 | 3770 |
| Total Disk Throughput (IOPS) | 15.6 | 29.1 | 59.0 |
| Network Throughput (Mbps) | 0.06 | 0.08 | 0.12 |
| Transactions per second | 12.15 | 23.74 | 48.54 |
| Number of user connections | 96.81 | 99.08 | 101.14 |

## Performance graphs

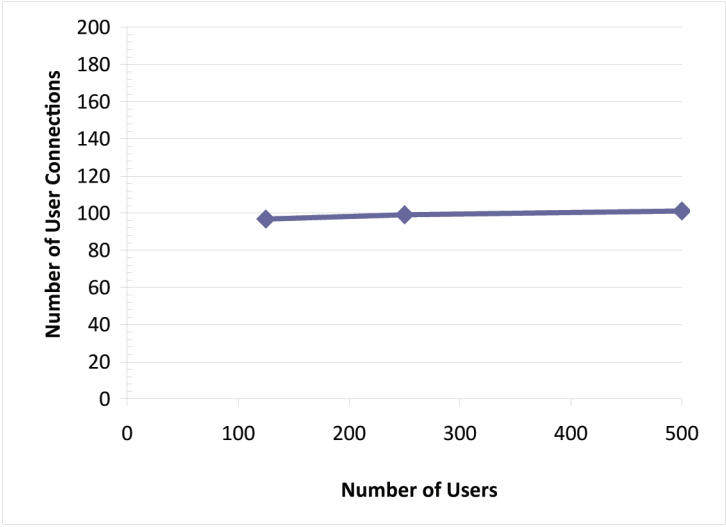
**Database server scaling — % Processor Time**




**Database server scaling — Total Disk Throughput**




**Database server scaling — user connections**




# Results: Novell GroupWise messaging server

On the Novell GroupWise messaging server, the processor usage and disk throughput increased linearly as the number of users increased.

All of the user accounts used in the performance tests were Novell GroupWise users that were BlackBerry enabled. In most real-world environments, only some of the user accounts on the messaging server are BlackBerry enabled users.

**Table 4: Messaging server scaling data**

| | S1 | S2 | S3 |
|---|---|---|---|
| Number of users | 125 | 250 | 500 |
| % Processor Time | 6.7 | 14.2 | 29.4 |
| Total Disk Throughput (IOPS) | 23.2 | 42.5 | 78.7 |
| IOPS Per User | 0.19 | 0.17 | 0.16 |

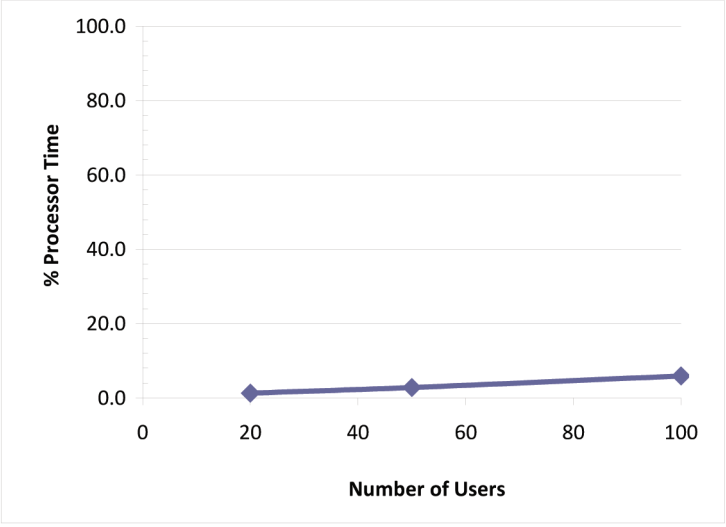
The testing data was also scaled to simulate a scenario in which only 20% of the messaging server users were BlackBerry enabled.

**Table 5: Messaging server scaling data — 20% of the messaging server users are BlackBerry enabled**

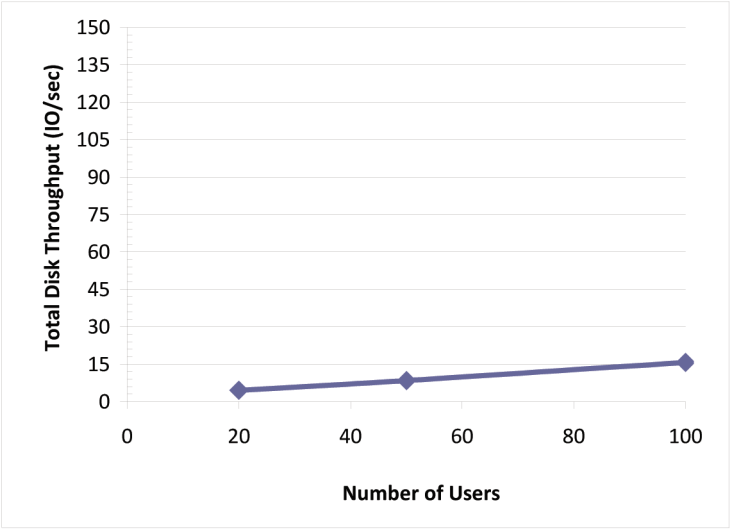
| | S1 | S2 | S3 |
|---|---|---|---|
| Number of users | 25 | 50 | 100 |
| % Processor Time | 1.3 | 2.8 | 5.9 |
| Total Disk Throughput (IOPS) | 4.6 | 8.5 | 15.7 |

# Performance graphs

**Messaging server scaling — % Processor Time when 20% of the messaging server users are BlackBerry enabled**




**Messaging server scaling — Total Disk Throughput when 20% of the messaging server users are BlackBerry enabled**




# Test results for passive workloads and active workloads

## Results: BlackBerry Enterprise Server

Performance tests were run with both passive user accounts and active user accounts to measure the resource usage of the BlackBerry Enterprise Server and its effect on the various servers that were used in the testing environment.

Load compensation was performed for the tests using active BlackBerry device users. The load was transferred from the email applications on users' computers to their BlackBerry devices. The message rate through the messaging server remained consistent, indicating that the tuning of the load parameters was reasonably accurate.

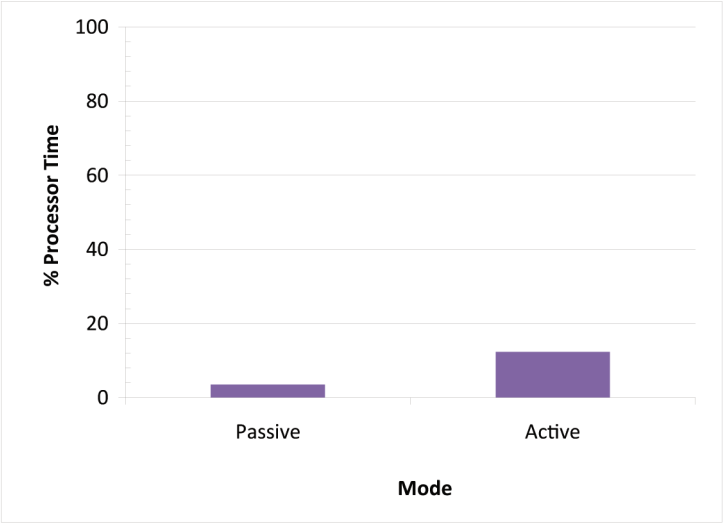
**Table 6: Resource usage data for the BlackBerry Enterprise Server**

| | C1 | C2 | Notes |
|---|---|---|---|
| Mode | Passive users | Active users | — |
| Number of users | 500 | 500 | — |

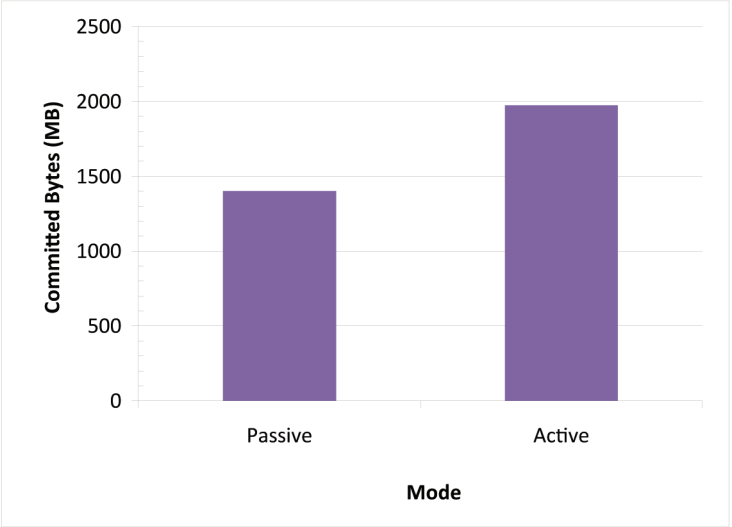
| | C1 | C2 | Notes |
|---|---|---|---|
| % Processor Time | 3.5 | 12.3 | — |
| Committed Bytes (MB) | 1402 | 1985 | — |
| Total Disk Throughput (IOPS) | 9.9 | 9.2 | — |
| Network Throughput (Mbps) | 0.38 | 0.73 | — |
| Messages received per minute | 134.2 | 134.9 | Ratio (C2/C1): 1.01 |
| Messages sent per minute | N/A | 13.5 | — |

## Performance graphs

**BlackBerry Enterprise Server resource usage — % Processor Time**




**BlackBerry Enterprise Server resource usage — Committed Bytes**




# Results: Computer that hosts the BlackBerry Administration Service

The computer that hosts the BlackBerry Administration Service was relatively unaffected by the specified workload throughout the tests.

**Table 7: Resource usage data for the computer that hosts the BlackBerry Administration Service**

| | C1 | C2 |
|---|---|---|
| Mode | Passive users | Active users |
| Number of users | 500 | 500 |
| % Processor Time | 0.6 | 0.7 |
| Committed Bytes (MB) | 1811 | 1822 |

# Results: Database server

The processor usage and disk throughput of the database server remained low for all of the tests. The disk throughput was higher when BlackBerry device users were active instead of passive.

**Table 8: Resource usage data for the database server**

| | C1 | C2 |
|---|---|---|
| Mode | Passive users | Active users |
| Number of users | 500 | 500 |
| % Processor Time | 0.7 | 0.9 |
| Committed Bytes (MB) | 3959 | 3770 |
| Total Disk Throughput (IOPS) | 33.7 | 59.0 |
| Network Throughput (Mbps) | 0.09 | 0.12 |
| Transactions per second | 30.0 | 48.54 |
| Number of user connections | 100.74 | 101.14 |

# Results: Novell GroupWise messaging server

The following table displays the estimates for CPU usage and disk throughput usage on the messaging server as both passive and active users were added to the configuration. The estimated IOPS per BlackBerry device is approximately 2.66.

All of the user accounts used in the performance tests were Novell GroupWise users that were BlackBerry enabled. In most real-world environments, only some of the user accounts on the messaging server are BlackBerry enabled users.

**Table 9: Resource usage data for the messaging server**

| | C1 | C2 |
|---|---|---|
| Mode | Passive users | Active users |
| Number of users | 500 | 500 |
| % Processor Time | 14.5 | 29.4 |
| Total Disk Throughput (IOPS) | 1266.90 | 1329.7 |
| IOPS Per User | 2.53 | 2.66 |

# Conclusions

**BlackBerry Enterprise Server**

You should configure the BlackBerry Enterprise Server with sufficient processor capacity to manage the number of BlackBerry device users in your organization's environment and their workload. You can install and configure multiple BlackBerry Enterprise Server instances to manage additional users. In medium-sized and large organizations, you should not host the BlackBerry Administration Service and BlackBerry Configuration Database on the computer that hosts the BlackBerry Enterprise Server.

To improve performance and to keep the network latency as low as possible, you can place the computers that host BlackBerry Enterprise Server instances in close proximity to the computers that host the messaging server and user accounts. You can configure multiple BlackBerry Enterprise Server instances to use one database server.

**Computer that hosts the BlackBerry Administration Service**

You should configure the computer that hosts the BlackBerry Administration Service with sufficient memory to manage the number of users in your organization's environment and their workload. The BlackBerry Administration Service performs various administrative tasks that can consume significant processor resources in an environment that includes multiple BlackBerry Enterprise Server instances. These tasks were not tested in the benchmarking tests.

To improve performance and to keep the network latency as low as possible, you can place the computer that hosts the BlackBerry Administration Service in close proximity to the database server.

Research In Motion plans to conduct further performance tests and publish additional performance documentation to indicate the workloads that affect the performance of the computer that hosts the BlackBerry Administration Service.

**Database server**

You should configure the database server with sufficient processor capacity and disk throughput capacity to manage the number of users and tasks in your organization's environment.

Various administrative tasks that the BlackBerry Enterprise Server and BlackBerry Administration Service perform can consume significant processor resources and disk throughput in an environment that includes multiple BlackBerry Enterprise Server instances. These tasks were not tested in the benchmarking tests.

Research In Motion plans to conduct further performance tests and to publish additional performance documentation to indicate the workloads that affect the database server.

**Novell GroupWise messaging server**

You should configure the Novell GroupWise messaging server with sufficient processor capacity and disk throughput capacity to manage the additional resource load caused by adding users to your organization's environment.

You cannot apply simple multipliers to the messaging server resources because other applications on the messaging servers, such as antivirus software, backup processes, auditing software, and archiving software, might affect the load statistics.

# Workload details

## General workload information

| | |
|---|---|
| Hours each day | 8 |
| Target workload split | 84% desktop email application and 16% BlackBerry device |
| Target email message type | 100% HTML |
| Mailbox prepopulation | used in all scenarios |
| Number of recipients for each email message | 2 |
| Number of invitees for each meeting | 2 |

## Characteristics of the email messages that were created by the Novell GroupWise load tool

| Email message description | Format | Attachments and graphics | Text markup | Weight | Size (KB) |
|---|---|---|---|---|---|
| Small email message with markup | HTML | none | Yes | 38 | 1 |
| Medium-sized email message with markup | HTML | none | Yes | 18 | 2 |
| Large email message with markup | HTML | none | Yes | 14 | 4 |
| Small image attachment | HTML | JPG graphic file | Yes | 7 | 15 |
| Medium image attachment | HTML | JPG graphic file | Yes | 3 | 104 |
| Small document attachment | HTML | 2003 document | Yes | 4 | 37 |
| Small document attachment | HTML | Microsoft Word 2003 document | Yes | 7 | 24 |

| Email message description | Format | Attachments and graphics | Text markup | Weight | Size (KB) |
|---|---|---|---|---|---|
| Small spreadsheet attachment | HTML | Microsoft Excel 2003 document | Yes | 4 | 16 |
| Medium-sized presentation attachment | HTML | Microsoft PowerPoint 2003 file | Yes | 2 | 100 |
| Large presentation attachment | HTML | Microsoft PowerPoint 2003 file | Yes | 2 | 1069 |
| Large document attachment | HTML | Microsoft Word 2003 document | Yes | 2 | 2185 |

## Characteristics of the email messages that were created by the BlackBerry Performance Engineering Resource Kit

| Email message description | Format | Attachments and graphics | Percentage | Size |
|---|---|---|---|---|
| No attachment | Text | None | 70 | ~150 bytes text |
| Attachment | Text | 1 attachment chosen in the following weightings:<br>10% — 1195 KB JPG<br>10% — 104 KB JPG<br>80% — 70 KB JPG | 30 | ~200 bytes text with attachment |
| Forwarded email message | Text and original email message | None | All forwarded email messages | Adds ~1750 bytes of text to original message |

## Details about the messaging server load

| Workload detail | Passive | Active |
|---|---|---|
| Email messages sent | 40 / user / day | 34 / user / day |
| Meetings created | 2 / user / day | 1 / user / day |
| Appointments created | 1 / user / day | 1 / user / day |

| Workload detail | Passive | Active |
|---|---|---|
| Notes | Create 2 / user / day | Create 2 / user / day |
| Personal contacts | Create 3 / user / day<br>Modify 1 / user / day<br>Delete 1 / user / day | Create 3 / user / day<br>Modify 1 / user / day<br>Delete 1 / user / day |
| Tasks | Create 4 / user / day | Create 4 / user / day |
| BlackBerry MDS push rate | 115.2 pushes / user / day | 115.2 pushes / user / day |

## User load details

| Workload facet | Passive users | Active users |
|---|---|---|
| Email messages sent | Off | 2 / user / day |
| Inbox processing (email arrival) | Off | Arrival driven (not polled)<br>• Process all attachments<br>• 25% Read<br>• 5% Mark for follow-up<br>• 6% Reply<br>• 1% Reply To All<br>• 1% Forward<br>• 3% Delete<br>• 50% Request More |
| Meetings created | Off | 1 / user / day<br>• ~400 bytes text |
| Meeting request processing | Off | Arrival driven (not polled)<br>• Process all attachments<br>• 10% Accept<br>• 5% Decline<br>• 5% Tentative<br>• 10% Delegate (Forward) |

| Workload facet | Passive users | Active users |
|---|---|---|
| Synchronization of mailbox, folder management, organizer data, and so on | BlackBerry devices accept updates from the BlackBerry Enterprise Server | Active — Bidirectional |
| Synchronization data generation (device to BlackBerry Enterprise Server) | Off | 10 updates / user / day<br>80% mail server data: tasks, memos, email filters, email settings<br>10% device management<br>10% Backup |
| Contact lookup | Off | 0.5 / user / day |
| BlackBerry MDS HTTP retrieve | Off | 2 / user / day |

# Monitoring server performance

Research In Motion uses the Windows Performance Monitor to monitor many counters on performance testing servers, and to verify that the tests avoid hardware resource bottlenecks that can invalidate the results. The following tables document some of the primary counters that you should track, as well as guidelines for warning conditions. The guidelines refer to average values over a period of time.

## Processor

| Counter | Guidelines |
|---|---|
| % Processor Use | < 75% |
| Processor Queue Length | < 1 for each processor core |

## Disk I/O

Disk throughput capacity is critical for messaging servers and the BlackBerry Enterprise Server. The delivery of email messages can take longer than expected when one or more disks on a messaging server are over-used.

| Counter | Guidelines |
|---|---|
| % Disk Busy Time | This counter is not reliable, use % Disk Idle Time instead. |
| % Disk Idle Time | > 45% |

| Counter | Guidelines |
| --- | --- |
| Disk Transfers/second | • Depends on disk speed, type, RAID configuration, and cache characteristics<br>• < 120 to 180 IOPS per disk spindle for 15 K RPM drives |
| Average Disk Queue length | • Typically used for direct attached storage<br>• < 1 per spindle |
| Average Seconds per Read or Write | • Typically used for SAN storage<br>• Messaging servers can be particularly sensitive to high latencies<br>• Average: less than 5, 10, or 20 milliseconds, depending on the application<br>• Spikes: over 50 milliseconds for several seconds can indicate performance issues |
| Logical Disk Free Megabytes | This counter is often overlooked. If drives fill up, processing might stop. |

## Network (typically WAN)

| Counter | Guidelines |
| --- | --- |
| Output queue length | < 1 |
| Bytes total per second | • Bandwidth limit depends on length<br>• < 25% of the available bandwidth |

## Memory — Server

The server memory is a global resource for all processes.

| Counter | Guidelines |
| --- | --- |
| Available Bytes | > 50 MB (In the Windows Task Manager, Total - Committed = [approx] Available) |

## Memory — Process

You can monitor the memory of individual processes to determine a root cause if the server memory is being consumed.

| Counter | Guidelines |
| --- | --- |
| Private Bytes | Private Bytes is the terminology used in the Windows Performance Monitor. In the Windows Task Manager, this counter is known as the VM Size, and must be |

| Counter | Guidelines |
| --- | --- |
| | added as a column since it is not visible by default. It is not the same as the Mem Usage column in the Windows Task Manager. The Private Bytes or VM Size counter typically demonstrates whether a process has a memory allocation problem. Caches that grow slowly also build up this counter. |
| Virtual Bytes | This is the user mode address space of a process and is available in the Windows Performance Monitor only. It is sometimes called virtual memory, however, you cannot view it in the Windows Task Manager. This counter is not the same as the VM Size measure that is available in the Windows Task Manager.<br>On 32-bit Windows systems, each process can only address 2 GB unless you configure the 3 GB switch. On 64-bit Windows systems, a 32-bit process that is large-address aware can address up to 4 GB. |

## Additional counters to monitor

Microsoft SQL Server counters

- Transactions/second
- Full Scans/second
- Table Lock Escalations/second
- SQL Compilations/second, SQL Recompilations/second
- User Connections

Memory/Disk Interactions

- Paging might display as a disk bottleneck, but is actually a memory issue

Memory/CPU Interaction - Garbage Collection (Java, Microsoft .NET framework)

- Managed memory allocation problem might display as high CPU

## SUSE Linux counters

In addition to using the Windows Performance Monitor on the Windows-based servers, standard UNIX-based counters were used to monitor the performance of the Novell GroupWise messaging server. The primary resources monitored were processor utilization and disk throughput.

The following monitoring tools were used to monitor the performance of the messaging server:

- iostat: provides information about CPU consumption and disk utilization
- vmstat: provides information about processes, memory, paging, block I/O, traps, and CPU activity

# Database maintenance

## Planning Microsoft SQL Server database maintenance for the BlackBerry Enterprise Server

To maintain optimal operating performance for the BlackBerry Enterprise Server, you must perform maintenance regularly on the Microsoft SQL Server databases. Microsoft SQL Server databases maintain indexes that update changes in the database tables. The indexes can become fragmented over time and extensively fragmented indexes can degrade query performance and cause applications to respond slowly. You must maintain accurate and up-to-date database statistics for optimal query performance.

You should develop an appropriate maintenance schedule for your organization's Microsoft SQL Server databases based on the size, complexity, and recovery requirements of your organization's BlackBerry Domain. To create an effective maintenance schedule, you should consider the following factors:

- index fragmentation
- database statistics
- transaction log growth

### Determining a maintenance schedule

To determine an effective maintenance schedule for your organization's Microsoft SQL Server databases, you can monitor index fragmentation levels over a period of a few months. The following is an example of a fragmentation monitoring schedule that you can use to determine a baseline measurement of how quickly indexes become fragmented in your organization's BlackBerry Domain:

- monitor fragmentation daily for two weeks
- monitor fragmentation weekly for the following three weeks
- monitor fragmentation monthly at the end of months two and three

You can perform index maintenance on a regular basis, for example, daily, weekly, or monthly. If fragmentation occurs at regular intervals, you can schedule maintenance for the indexes to occur at the same intervals that the fragmentation occurs at. You can also create a maintenance schedule with mixed intervals that you specify, such as daily and mid-week or weekly and monthly.

If you choose a weekly index maintenance schedule, run the index maintenance operations on Sunday mornings after the RIMPurge SQL Server jobs occur because the RIMPurge SQL Server jobs can cause a large amount of index fragmentation.

# Determining fragmentation

The results of avg_fragmentation_in_percent (which is the percentage of out-of-order pages that the scan of the leaf pages of an index returns) provides the extent of index fragmentation. If avg_fragmentation_in_percent is more than 10 percent, you must defragment the indexes.

The following is an example of a query in Microsoft SQL Server 2005 and Microsoft SQL Server 2008 that you can use to determine how much fragmentation occurred, as a percentage, across all indexes:

```
 SELECT DISTINCT I.[name] AS [IndexName],sch.[name] AS
[Schema],o.[name] AS [Object], index_level,
index_type_desc, avg_fragmentation_in_percent,
page_count FROM
sys.dm_db_index_physical_stats(db_id(), null, null,
null, 'DETAILED') AS ips INNER JOIN sys.indexes AS i
ON i.[object_id] = ips.[object_id] and i.index_id =
ips.index_id INNER JOIN sys.objects AS o ON
o.[object_id] = ips.[object_id] INNER JOIN
sys.schemas AS sch ON sch.schema_id = o.schema_id
WHERE (i.name IS NOT null) AND page_count > 1000
```

# Defragmenting and reindexing Microsoft SQL Server databases

You can perform offline maintenance or online maintenance to defragment and reindex the indexes.

## Offline maintenance

You can perform offline maintenance by using the following reindex commands, which lock the table that they run against and make the table unavailable temporarily. You can use the ALTER INDEX REBUILD SQL Server statement in Microsoft SQL Server 2005 and Microsoft SQL Server 2008.

You can run ALTER INDEX REBUILD while the BlackBerry Enterprise Server is online. If a table that is being reindexed contains LOB data, the reindex operation fails. Below is an example of an online query in Microsoft SQL Server 2005 and Microsoft SQL Server 2008 that you can use to reindex all tables using the ALTER INDEX REBUILD statement:

```
 DECLARE @Database VARCHAR(255)
DECLARE @Table VARCHAR(255)
DECLARE @cmd NVARCHAR(500)

DECLARE DatabaseCursor CURSOR FOR
SELECT name FROM master.dbo.sysdatabases WHERE name =
    '<database_name>'
ORDER BY 1
OPEN DatabaseCursor

FETCH NEXT FROM DatabaseCursor INTO @Database WHILE @@FETCH_STATUS
= 0 BEGIN
SET @cmd = 'DECLARE TableCursor CURSOR FOR SELECT table_catalog +
''.'' + table_schema + ''.'' + table_name as tableName
FROM ' + @Database + '.INFORMATION_SCHEMA.TABLES WHERE table_type =
''BASE TABLE'''
```

```
 -- create table cursor
 EXEC (@cmd)
OPEN TableCursor
FETCH NEXT FROM TableCursor INTO @Table
WHILE @@FETCH_STATUS = 0
BEGIN
SET @cmd = 'ALTER INDEX ALL ON ' + @Table + ' REBUILD '
EXEC (@cmd)
FETCH NEXT FROM TableCursor INTO @Table
END
CLOSE TableCursor
DEALLOCATE TableCursor
FETCH NEXT FROM DatabaseCursor INTO @Database END CLOSE
DatabaseCursor DEALLOCATE DatabaseCursor
```

For more information about ALTER INDEX commands, visit http://technet.microsoft.com/en-us/library/ms188388.aspx.

### Online maintenance

The following reindex commands skip pages that are locked, which can cause the reindex operation results to vary. You can use the ALTER INDEX REORGANIZE SQL Server statement in Microsoft SQL Server 2005 and Microsoft SQL Server 2008.

Do not perform the reindex operation on indexes that are fragmented more than 30%. Instead, use the ALTER INDEX REBUILD (in Microsoft SQL Server 2005 and Microsoft SQL Server 2008) SQL statement.

You must update the database statistics manually after the reindex operation completes. You can use the following statement in Microsoft SQL Server 2005 and Microsoft SQL Server 2008: sp_updatestats.

## Managing transaction log growth

The BlackBerry Enterprise Server is highly transactional software that performs many data-manipulation statements and queries that either read or read and write information to the transaction log. Transaction log growth varies according to the recovery model that you implement to control transaction log maintenance. The following three recovery models exist: simple, full, and bulk-logged. If you use the full recovery model, operations such as ALTER INDEX REBUILD are logged to the transaction log.

If you implement the full recovery model for the BlackBerry Configuration Database, you can truncate the transaction log to control file growth and reuse file space. If you use full mode or bulk-logged mode, you must back up the transaction log before you truncate it. If you need to reclaim disc space for data storage, you can shrink the transaction log.

For more information about transaction log truncation, visit http://technet.microsoft.com/en-us/library/ms189085.aspx.

## Best practices: Performing database maintenance

Consider the following guidelines:

- Perform index maintenance if the Logical Scan Fragmentation is 10% or higher.

- Turn on AUTO UPDATE STATISTICS in the BlackBerry Configuration Database so that statistics are updated automatically at regular intervals.
- Back up transaction logs at regular intervals.

For more information about reorganizing or rebuilding a fragmented index in SQL Server, visit http://technet.microsoft.com to read article 189858.

# Glossary

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| | |
|---|---|
| **BlackBerry MDS** | BlackBerry Mobile Data System |
| **HTML** | Hypertext Markup Language |
| **HTTP** | Hypertext Transfer Protocol |
| **I/O** | input/output |
| **IOPS** | input/output operations per second |
| **MPIO** | multipath input/output |
| **NIC** | network interface card |
| **RAID** | redundant array of independent (or inexpensive) disks |
| **SAN** | subject alternative name |
| **SQL** | Structured Query Language |

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