BlackBerry™ Enterprise Server Performance Characteristics and Sizing Recommendations

For Lotus® Domino™
Version 2.0 with Service Pack 3

Research In Motion

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Introduction

This paper describes the performance characteristics of the BlackBerry Enterprise Server version 2.0 for Lotus Domino with Service Pack 3. It highlights the results of performance testing that was conducted to quantify the BlackBerry Enterprise Server performance, and it provides important insights for the system administrators responsible for BlackBerry deployment in a Lotus Notes/Domino messaging environment.

This paper also provides important considerations for planning a rollout, including sizing information, which can help facilitate budget planning and hardware procurement.

Target audience

This paper assumes a working knowledge of the following items:

- BlackBerry Enterprise Server for Lotus Domino
- Lotus Domino Server software
- performance metrics

Performance design

The BlackBerry Enterprise Server for Lotus Domino has been designed to leverage the performance of the Lotus Domino Server. Adding a BlackBerry Enterprise Server for Lotus Domino to your existing enterprise environment results in only minimal impact to the existing server performance. The load associated with enabling mail users in a BlackBerry solution is centralized on the BlackBerry Enterprise Server.

The BlackBerry Enterprise Server, using the Domino application programming interface (API), maintains cached sessions with each mail server on which BlackBerry users reside. Because of the nature of the polling model, in which the BlackBerry Enterprise Server opens each user’s mailbox to check for new messages at a regular interval, session caching avoids the overhead associated with creating and tearing down a session at each interval. From the Domino mail server’s perspective, the activity generated by the BlackBerry Enterprise Server is similar to the activity of an active user or another Domino server accessing it for replication; it is just another Notes Remote Procedures Call (NRPC) session.

At each polling interval, the BlackBerry Enterprise Server performs the following steps to check for new messages and, if required, deliver them to the BlackBerry handheld:

1. The BlackBerry Enterprise Server verifies that the mail database has changed since the last polling interval. Using a lightweight API call, the BlackBerry Enterprise Server quickly determines if further analysis of the mail file is required.

2. If the database has changed, the BlackBerry Enterprise Server uses another API call to enumerate all new or modified documents in the mail file.

3. For each new or modified document, the BlackBerry Enterprise Server evaluates the message to determine if it is eligible for delivery, or should be filtered according to the user’s custom filter settings.

4. For each message that is eligible for delivery, the BlackBerry Enterprise Server retrieves only the message text and the file name and file size properties of any attachments. The first 2 KB of the message text, and relevant attachment details, is bundled with the message headers to be Triple-DES encrypted, compressed, and delivered to the handheld.

A total of 20 worker threads carry out the polling and message delivery activity, ensuring timely and consistent message delivery for all users. The threading model has been designed to facilitate adding more users by increasing hardware resources on the BlackBerry Enterprise Server, which avoids the costly, high-risk task of making similar changes directly to your mail servers.
Testing methodology

The performance data collected in this paper was obtained through a series of tests conducted by Research In Motion Limited to obtain accurate sizing information and throughput data for the BlackBerry Enterprise Server. After installing and configuring the test environment, a suite of 12 tests were run to establish baseline performance data for mail delivery only to users in groups of 250. The second suite of tests reproduced the first suite exactly, except that all users in each test were BlackBerry enabled.

Test environment

The test environment consisted of four Compaq DL360s, with two 1-GHz processors and 1 GB of RAM. The disk subsystem used the on-board Compaq array controller, and two Compaq 36-GB Ultra3 10,000 RPM SCSI disks, configured as a mirrored pair at the array controller level. At the operating system level, the disk was divided into two NTFS volumes. The C drive was the operating system partition (4044 MB), and the E drive was the data partition (30,648 MB). The Compaq standard utilities partition occupied the remainder of the disk.

The four servers were connected to the same Cisco Catalyst 3500 XL network switch via the on-board Compaq NC3163 Fast Ethernet controller, operating at 100 mbps full-duplex. The operating system was Windows NT 4.0 Service Pack 6a with the Compaq configuration. The server was further configured to disable all unnecessary Windows NT services (alerter, browser, ftp publishing service, gopher publishing service, license logging service, messenger, spooler, World Wide Web publishing service), and the following registry values were set to a value of zero as recommended by Lotus:

- HKLM\System\CurrentControlSet\Control\PriorityControl\Win32PrioritySeparation
- HKLM\System\CurrentControlSet\Control\Session Manager\Memory Management\LargeSystemCache

Each server was installed with Domino 5.0.9 Application Server using the default options. The binary and data directories were both placed on the E drive. The server tasks to be loaded on startup were reduced to Replica, Router, AMgr, Adminp, and Sched through modifying Notes.ini.

The four servers were placed in the same Domino Domain, organization, and organizational unit. A connection document was created to force scheduled replication from Server 1 to each of the other servers every 15 minutes. Each server document was modified to explicitly set the server’s IP address in the Notes Network Ports tab, and all four servers were placed in the same Domino Named Network. On each of the first three servers, 1000 users and mail files (based on the standard R5 template) were created using the text import function of the Domino Administrator tool. Including the administrator account that was created at installation, there were 3001 person documents in the Domino Directory.
Figure 1: Test environment
Methodology

Mail was generated using a custom LotusScript that was launched from a Notes database located on Server 1 by a client computer separate from the server. The script was designed to send messages to a configurable number of users, but the load was equally balanced between the three mail servers. For example, if the script was configured to send mail to 750 users, 250 would be on Server 1, 250 on Server 2, and 250 on Server 3. Additionally, a total of five messages were available to be sent, and the script iterated through them, resulting in each test user receiving each message type in order. For example, message 1, 2, 3, 4, 5, and then back to 1. The messages were 11 KB, 2 KB, 10 KB, 1 KB, and 4 KB respectively. Message 3 had a 1-KB attachment. Message delivery was timed so that each user received a total of 20 messages per hour, evenly distributed over the full 60 minutes.

The BlackBerry Enterprise Server for Lotus Domino (server number 4) was configured with BlackBerry Enterprise Server version 2.0 for Lotus Domino with Service Pack 3. Defaults were used throughout the installation, including the polling interval of 20 seconds. A simulated wireless network was configured, which closely simulates the real wireless network, and the IP address of that host was specified in the BlackBerry Enterprise Server as the SRP Host. Users were loaded incrementally in blocks of 250 (sorted in the same order as the mail generation script) using a custom tool designed for the purpose. The custom tool created the users, generated an encryption key, and set the default filters.

Four primary performance monitor counters were recorded, including CPU, Average Logical Disk Queue Length, Network bytes per second total, and Memory Committed percent bytes in use. Performance monitor logging was run from a remote Windows 2000 computer, and collected data for all four servers during each run. BlackBerry Enterprise Server message flow information was logged with the native logging facility, and the logging level was turned up to level 4 for full debug-level information.

Each test ran for 60 minutes, and delivered messages at a rate of 20 messages per user per hour. Tests were numbered 1 through 24. Tests 1 through 12 were baseline tests. For example, messages were sent to 250, 500, 750, 1000 (and so on) users, where mail was delivered to users in increments of 250 using the mail generation script. Tests 13 through 24 were conducted identically, but each user in each test was enabled on the BlackBerry Enterprise Server. A baseline snapshot of each server configuration was taken prior to the start of testing, and that environment was restored prior to the start of test 13.
Mail server load

The BlackBerry Enterprise Server for Lotus Domino was designed to cause minimal impact on the existing mail infrastructure. The tests conducted measured that impact.

The additional load placed on a mail server hosting BlackBerry users is minimal. For example, for 1000 BlackBerry handheld users—spread across three mail servers and receiving 20 messages per user per hour—each mail server experienced an approximately 3.5% increase in CPU usage when the users were enabled in a BlackBerry solution, versus the baseline taken earlier with strictly email delivery. The additional load is illustrated below.

Figure 2: Additional CPU usage on mail servers

The above figure shows that as mail volume increased considerably (from 5,000 messages per hour for 250 users to 60,000 messages per hour for 3,000 users) as more users were added, the additional impact on the mail servers was nominal.

Based on this data, it is reasonable to conclude that an existing mail server, which is operating within normal performance parameters, will not be excessively burdened by BlackBerry enabling the user community it hosts. It is prudent to plan for a 10% CPU increase.
Polling overhead

The BlackBerry Enterprise Server for Lotus Domino polls each BlackBerry user’s mail file every polling interval. This test measures the overhead associated with the polling activity, both the load applied to the mail servers, and to the BlackBerry Enterprise Server.

The test was run in two parts. First, the servers were run idle with the BlackBerry Enterprise Server disabled. Second, the BlackBerry Enterprise Server was started with 3000 users configured but no email flowing to the users. The difference in performance metrics between the two tests represents the overhead associated with the polling activity alone. The test results are illustrated below.

![Figure 3: Mail server and BlackBerry Enterprise Server polling overhead](image)

Note the minimal impact on the mail servers. Network activity, as would be expected, increased considerably. In terms of network utilization, the polling activity for 3000 users receiving no email generated approximately 500 bytes per user per polling interval.
BlackBerry Enterprise Server performance characteristics

As the core of the BlackBerry solution, the BlackBerry Enterprise Server for Lotus Domino can be scaled appropriately to handle the load generated by new mail arriving for your user community. The following graph illustrates the key metrics collected for the BlackBerry Enterprise Server over a series of tests in which the number of BlackBerry users increased with each iteration.

The server used in this test had 1GB of RAM. As demonstrated in the graph, even as the message volume increased considerably, the BlackBerry Enterprise Server did not require additional memory resources. Conversely, increasing the message flow (and the number of users) had a direct impact on CPU usage on the server, and on network usage (as would be expected). Disk performance was minimally affected.
Latency

A key metric when measuring the end-user experience of each BlackBerry user is the interval between a message’s arrival in a user’s Notes mailbox and its arrival on the BlackBerry handheld. This interval is referred to as latency. Several factors can contribute to latency, including the following issues:

- the time it takes the BlackBerry Enterprise Server to poll for, discover, and queue a new message
- the bandwidth available between the BlackBerry Enterprise Server and the wireless network infrastructure
- current traffic volume in the wireless network
- the BlackBerry handheld’s wireless network coverage
- the mail server’s responsiveness when accessed by the BlackBerry Enterprise Server, both in server response time and network connectivity between the two servers

While several factors affect latency in the real world, such as wireless network and Internet congestion, this test isolated latency to BlackBerry Enterprise Server performance. This was achieved through the test environment configuration, and by using a simulated wireless network infrastructure that instantly “delivered” messages.

The following graph illustrates that as the message volume (and number of users) increased throughout the suite of tests, the average latency remained close to the polling interval. However, at a very high message rate, the CPU was taxed and latency increased. This can be resolved by adding additional CPUs to the BlackBerry Enterprise Server to improve average latency.

![Graph showing average latency and CPU usage](image-url)
Deployment considerations

To optimize the performance of the BlackBerry enterprise solution in your environment, you should consider the following issues when you are planning your installation.

Physical proximity of the BlackBerry Enterprise Server to your mail servers

It is recommended that the BlackBerry Enterprise Server be placed where it can access mail servers via a local, high-speed, switched network connection. If the mail servers are centralized, this may be a viable option. For a more decentralized server topology, you should consider the physical link speeds between the sites, as well as the geographical placement of the end users. As a rule of thumb, place the BlackBerry Enterprise Server as close to the mail servers as possible and target the mail servers that are hosting the majority of your BlackBerry target audience. Depending on your WAN infrastructure, it might be advisable to deploy a BlackBerry Enterprise Server in more than one site for optimal performance.

BlackBerry Desktop Manager connectivity to the BlackBerry Enterprise Server

The BlackBerry Desktop Manager is the client component of the BlackBerry solution, and should be deployed to each BlackBerry user. The BlackBerry Desktop Manager requires network connectivity (via NRPC) to the BlackBerry Enterprise Server and the user’s home mail server. Most traffic generated during email reconciliation or personal information management (PIM) synchronization operations occurs between the desktop and the mail server, although the BlackBerry Enterprise Server must be available concurrently for most operations.

Internet connectivity

The BlackBerry Enterprise Server requires outbound-initiated Internet connectivity on port 3101. It is critical that any firewall placed between the BlackBerry Enterprise Server and the Internet be configured to permit this traffic. It is also important to size Internet bandwidth to manage the additional traffic placed on your connection by the BlackBerry Enterprise Server. Each message destined for a BlackBerry handheld is 2 KB, but, due to compression, will place only 1 KB of load on the Internet connection. Users can select More for long messages, and each subsequent message portion that is sent is 2 KB.

Bandwidth requirements for Reply-with-Text, Forwards

When a BlackBerry user replies to a message and includes the original text, a pointer is sent to the BlackBerry Enterprise Server that instructs the server to attach the original message text. This operation requires that the BlackBerry Enterprise Server have access to the user’s mailbox to retrieve the full message text, excluding attachments. If the BlackBerry user forwards a message, a similar operation occurs, but the attachments are also retrieved. The message (including text entered on the BlackBerry handheld and the original message content) is then placed in the mail.box on the BlackBerry Enterprise Server for delivery by the Domino router. It is important to keep this in mind when placing the BlackBerry Enterprise Server in a live environment. You should avoid having forwarded messages cross a WAN twice; once from the mail server to the BlackBerry Enterprise Server for message composition, and again from the BlackBerry Enterprise Server’s Domino router for delivery.
Conclusions and sizing recommendations

The BlackBerry Enterprise Server for Lotus Domino integrates well with current Domino deployments and centralizes the system load associated with providing your users with ‘Always On, Always Connected®’ wireless connectivity to their Lotus Notes email.

The data presented in this paper supports some key recommendations:

- Plan for a nominal (less than 10%) CPU increase on mail servers (that host BlackBerry user’s mailboxes) when your rollout is well underway. Introducing the BlackBerry solution into an environment should not have an impact on mail server performance.

- 2000 users per BlackBerry Enterprise Server is a reasonable planning guideline. Depending on end users’ latency tolerance, the network topology in which the BlackBerry Enterprise Server is being deployed, and the message flow characteristics of the environment, greater or fewer users per server could be supported. However the CPU is the most likely bottleneck such that adding more CPUs can alleviate latency.

- Place the BlackBerry Enterprise Server close to mail servers. Doing so will minimize the impact on the WAN, help reduce message delivery latency, and facilitate similar connectivity characteristics when a user is required to connect to the BlackBerry Enterprise Server via the BlackBerry Desktop Manager to synchronize.

- Keep the polling interval default of 20 seconds. It provides timely message delivery, a positive end-user experience, and it costs little in terms of network usage and mail server performance.

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