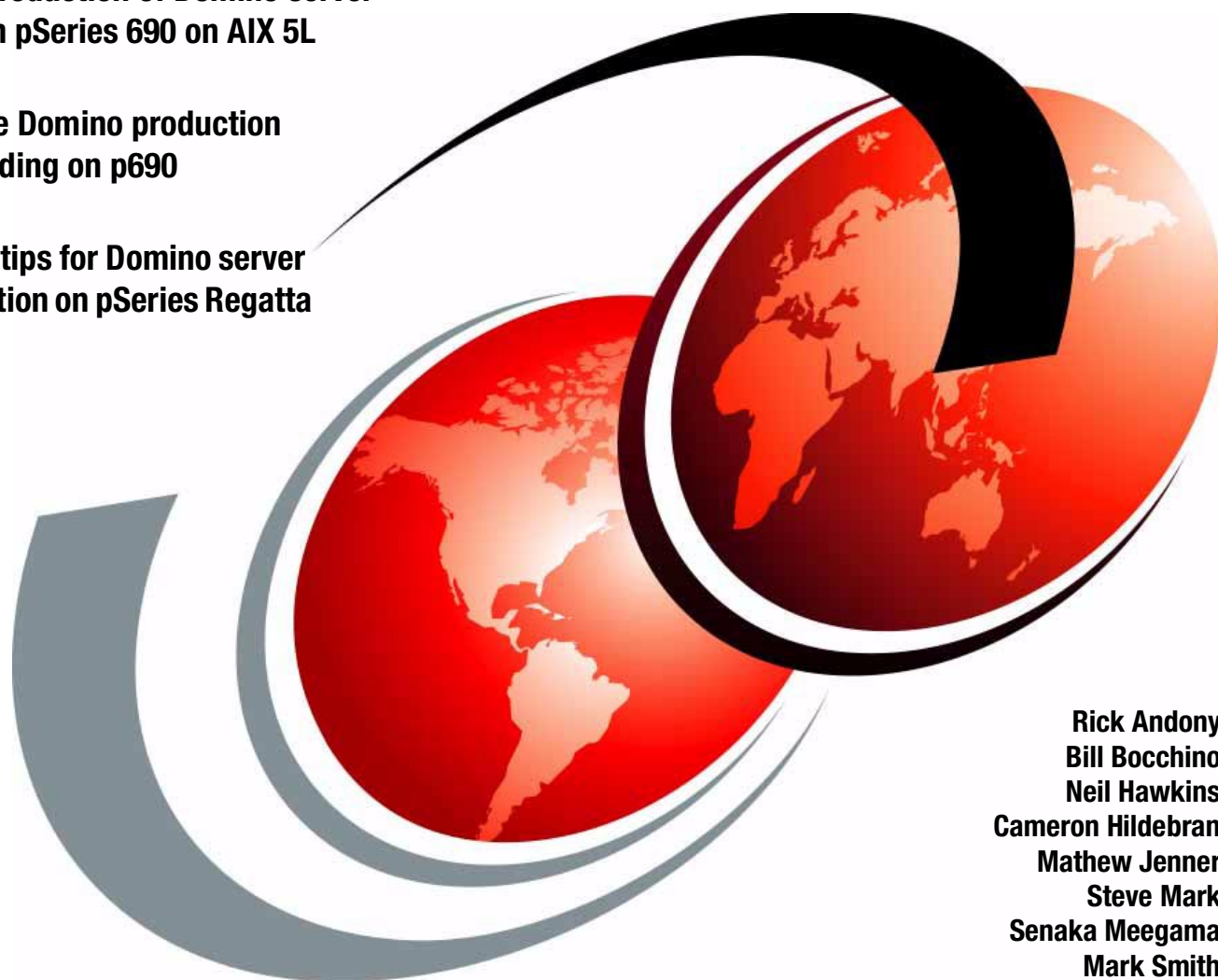


IBM server pSeries 690 and Lotus Domino Mail Server Consolidation An IBM Global Services Case Study

Dramatic reduction of Domino server
images on pSeries 690 on AIX 5L

Worldwide Domino production
server loading on p690

Hints and tips for Domino server
consolidation on pSeries Regatta



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International Technical Support Organization

**IBM @server pSeries 690 and Lotus Domino Mail
Server Consolidation**
An IBM Global Services Case Study

March 2003

Note: Before using this information and the product it supports, read the information in “Notices” on page v.

First Edition (March 2003)

This edition applies to IBM @server pSeries 690 and Lotus Domino 5 and 6 servers.

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Preface

This is the third in a series of case studies detailing Lotus® Domino™ server loading on IBM @server™ pSeries servers. As in previous case studies, this IBM® Redpaper details lessons learned by running large Domino mail servers on AIX®. In this study, we describe Domino 5 and Domino 6 server migration and loading experiences, as well as exploiting multiple AIX 5L logical partitions (LPARs) defined on each pSeries 690 system. The pSeries 690 system, also known by the internal name Regatta H, currently supports the largest Domino mail and application deployment within IBM.

Prior case studies are also available and detail the first and second phases of Domino server loading efforts on IBM RS/6000® and IBM @server pSeries systems. Phase one was documented in an IBM Redpaper titled, *IBM RS/6000 Enterprise Server M80 and Domino R5 Server Loading Efforts*, REDP0201, published in July 2001, and available at the following URL:

<http://publib-b.boulder.ibm.com/cgi-bin/searchsite.cgi?query=REDP0201>

Phase two was documented in an IBM Redpaper titled, *IBM RS/6000 Enterprise Server S80 and Domino R5 Server Loading Efforts*, REDP0226, published in February 2002, and available at:

<http://publib-b.boulder.ibm.com/cgi-bin/searchsite.cgi?query=REDP0226>

This document is intended to be read by system engineers, architects, technical and marketing support personnel, and sales representatives. In addition to the logical and physical design of the solution, details about system configuration parameters and server statistics during the server loading of the pSeries 690 system are presented.

The team that wrote this Redpaper

This Redpaper was written with the input of a number of people who participated in the efforts of the IBM @server pSeries 690 server migration project.

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It is especially gratifying to have assistance from such a talented core set of people who have made invaluable contributions to the overall pSeries 690 project:

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IBM eServer pSeries 690 and Lotus Domino mail server consolidation

This case study describes Lotus Domino server loading on IBM @server pSeries servers.

1.1 Executive summary: Objectives

The IBM @server pSeries 690 (p690) phase of the Domino loading pilot began in April 2002 after a preproduction system was replaced with production-level p690 system components. Server consolidation began as new Domino partitions were defined on the p690 with load migrated from 17 smaller mail servers (RS/6000 SP™ Silver or Winterhawk nodes). The p690 was the first platform used internally by IBM for large-scale Domino mail server consolidation. The p690 platform was critical to the continued success of the IBM data center consolidation.

The knowledge and performance data gathered from this project was used to assist in other internal and commercial accounts. By doing so, IBM and IBM Global Services (IGS) were able to monitor the progress of this project to control costs and reduce complexity in administration of Domino, while maintaining equal levels of service availability on a worldwide basis. This effort was coordinated with ongoing Domino server consolidations across a number of IBM internal Domino Service Delivery Centers (SDC) as defined by the IBM Global Notes Architecture (GNA).

Initial p690 server consolidation activities began in the U.S. West (Boulder) SDC. The first installed system consisted of one pSeries 690 running AIX 5L with 32 POWER4 1.1 GHz processors with 128 GB of RAM with Gigabit Ethernet network interfaces and storage attached using Fibre Channel. Figure 1-1 on page 3 and Table 1-1 on page 2 outline the system configuration. The primary goal, as with the RS/6000 Enterprise Server Model M80 and S80 pilots, was to architect a solution that would provide the most efficient loading of the much larger p690 server while taking advantage of the logical partitioning (LPAR) capabilities of p690 servers and the AIX 5L operating system. Logical partitioning, new to pSeries with 690 and AIX 5L™, allows one physical server to allocate hardware resources (such as processors, memory, and I/O slots) to multiple “logical” servers, each running its own operating system instance.

Table 1-1 System configuration

LPAR #	1	2	3	4	5	
Function	Mail: Domino 5.0.10 plus fix then Domino 6	Mail Domino 6	Test server	Applications Domino 5.0.10	Tivoli® Storage Manager (replication and tape backup)	Free pool of CPUs and memory
CPUs	10	8	3	8	3	0
Memory	24 GB	24 GB	9 GB	24 GB	9 GB	38 GB
Registered users	7,850	5,800	N/A	N/A	N/A	N/A
Server names	D03NM690 D03NM691	D03NM118 D03NM119 D03NM694		D03DBM01-0 6	D03BK100	
CPU avg.	42%	58%		72%	70%	

Using LPAR technology originally developed for IBM mainframes, the p690 was logically partitioned into five LPARs, as seen in Table 1-1 on page 2. Two LPARs supporting mail clients on the p690 utilize a dedicated Total Storage Enterprise Storage Server™ (ESS, also called Shark) with 3 TB of storage. Shark was used for storage of Notes® client mail databases, as well as for the Domino server transaction logs. Backing up client mail databases was accomplished by replicating these databases to a dedicated Domino backup

server (LPAR 5) that was then backed up by the IBM Tivoli Storage Manager product to tape drives directly attached to LPAR 5.

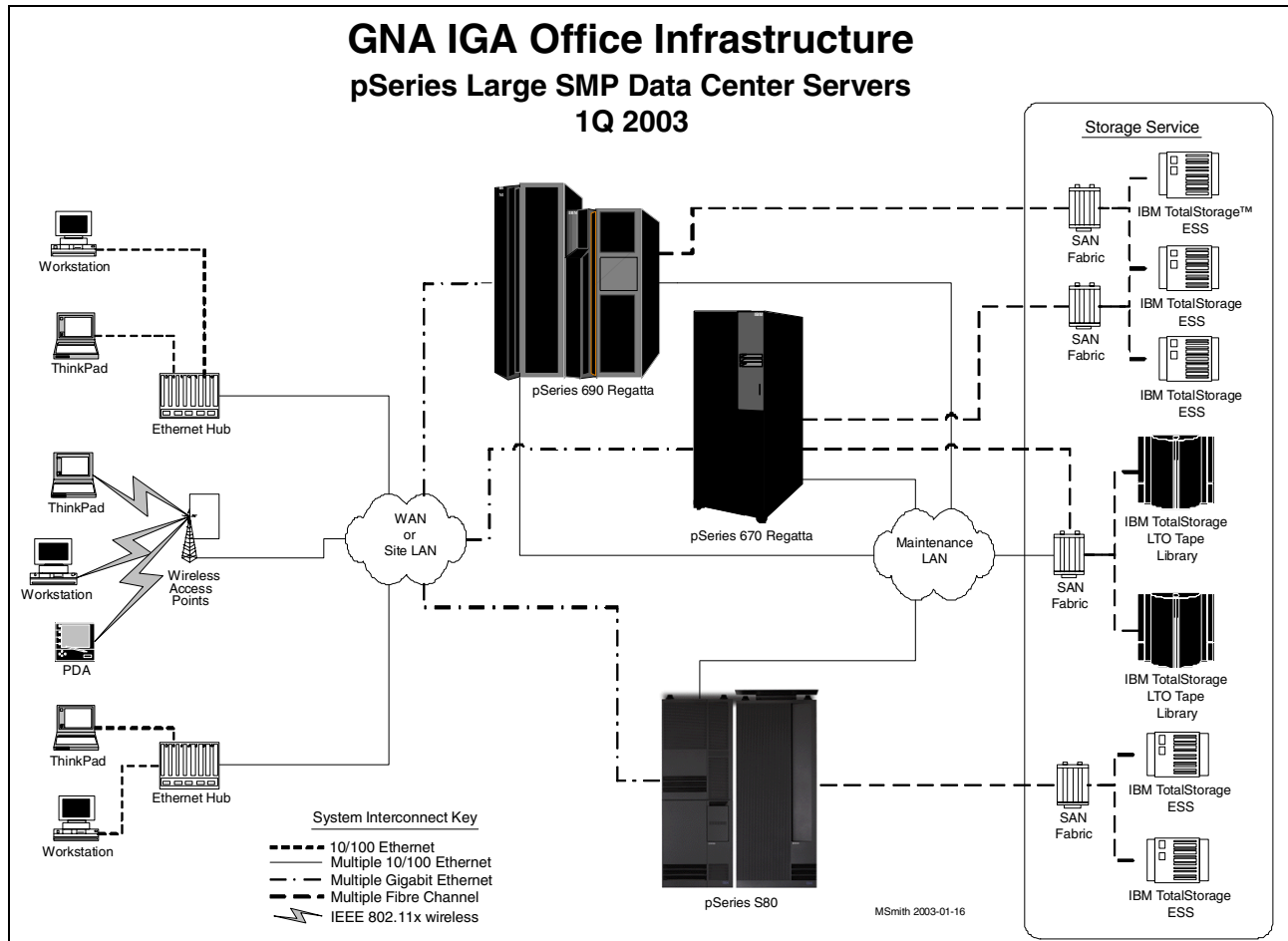


Figure 1-1 GNA IGA office infrastructure

The IBM Boulder SDC continued to be the host for this effort, coordinated with concurrent consolidation efforts in Portsmouth (U.K.), Ehningen (Germany), Sydney (Australia), and Japan. This paper documents the experiences learned from deploying the p690 in the Boulder environment, while also sharing the p690 deployment efforts in other GNA SDCs worldwide. This document focuses primarily on the first two LPARs that were dedicated to Domino mail.

A total of 17 Silver and Winterhawk SP nodes were consolidated to LPARs 1 and 2. This led to a reduction of more than 8 to 1 operating system images and more than 3 to 1 Domino instances. The worldwide deployments are to have one OS image with a target of 12,000 users per deployment. The migration of clients to LPAR 1 started on April 17th and ended on June 17th, loading this LPAR with 7,500 clients evenly distributed among two Domino 5 partitions. LPAR 1 has approximately 7,850 clients as of the end of January 2003.

The loading of LPAR 2 was done to stress Domino 6 on the p690. Migrations spanned two and a half months through spring and summer of 2002. The D03NM119 server currently supports close to 4,000 clients, while the other two Domino partitions have a combined total of 1,800 clients. The smaller client loading is due to segmented user populations on dedicated Domino partitions (that is, IBM Research division and Software Group). Two servers (D03NM118 and D03NM694) are clustered with other servers due to business needs. Domino clustering requires additional server resources (processor, memory, and I/O

utilization) that are dependent on factors such as number of cluster mates, cluster replication schedules, and the number of registered clients.

At the end of the initial migrations, the p690 supported just under 13,000 mail clients on two LPARs. By the end of January 2003, the p690 supported approximately 13,650 mail clients.

Server performance on LPAR 1 dramatically improved after Domino 5 code enhancements were applied, as well as when the servers were upgraded to Domino 6. The Domino 5 enhancements resolved what was known as the “high yield call” or “context switching” issue reported on Solaris and AIX platforms. The situation where Domino generated a large number of CPU cycles while looking for work was exacerbated on the larger SMP servers. Resource utilization improved further due to performance enhancements incorporated in Domino 6.

Detailed server statistics and findings are presented later in this document, collected from performance tools, such as Server Resource Management (SRM) tool and Activity Trends (now a released component in Domino 6). The total number of physical systems has been reduced by a factor of 3 and system images cut in half, while increasing total Domino server capacity by almost 15%, as seen in Figure 1-2.

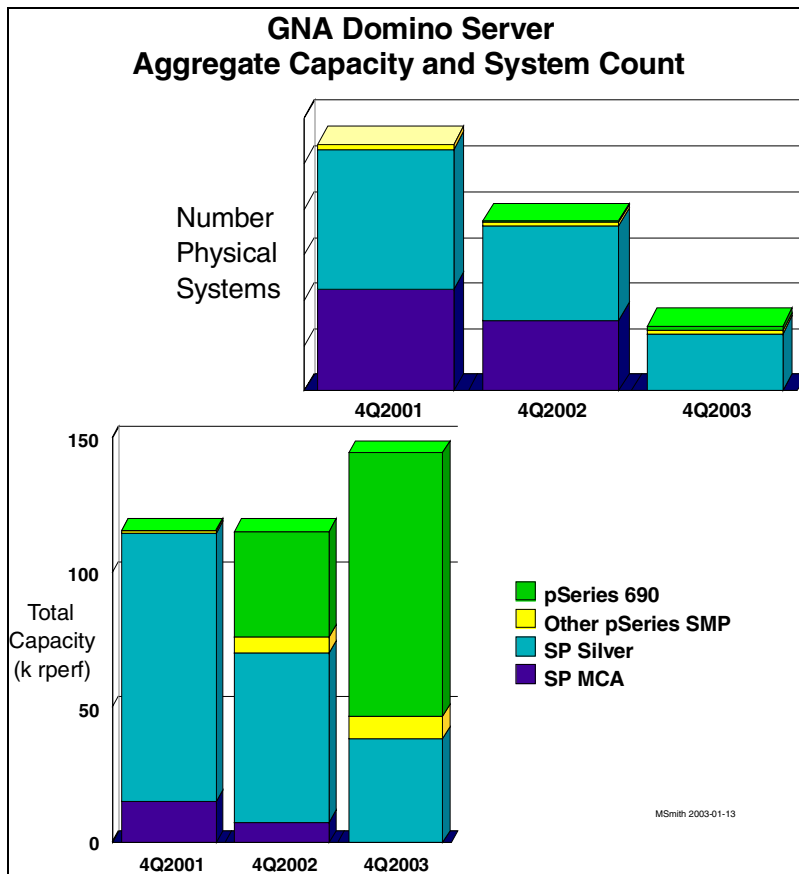


Figure 1-2 GNA Domino server: Aggregate and capacity system count

1.2 Server configuration in SDC West: Boulder

The hardware environment for our project consisted of an IBM eServer pSeries 690 (7040-681) server attached to dedicated Shark storage. Following is a comparison of the p690, S80, M80, and SP Silver node hardware platforms used in Boulder migrations and consolidations.

Table 1-2 Comparison of p690, S80, M80, and SP Silver node

	p690	S80	M80	SP Silver node
CPU speed	1.1 GHz	450 MHz	500 MHz	332 MHz
Number of CPUs	32 (18 for mail)	18	8	4
Memory	128 GB (48 GB for mail)	32 GB	16 GB	3 GB
Storage adapter	Two 64-bit Fibre Channel per LPAR	Two 32-bit Fibre Channel	Two 32-bit Fibre Channel	Two Advanced SerialRAID SSA
Network adapter	1 Gigabit Ethernet adapter per LPAR	1 SP Switch 1 Gigabit Ethernet adapter	1 Gigabit Ethernet adapter	1 SP Switch
Domino partitions	5 Mail 6 Application 1 Backup	2	2	1
LPAR capability	Yes	No	No	No
Operating system	AIX 5L Version 5.1	AIX 4.3.3	AIX 4.3.3	AIX 4.3.3
Total registered users per machine	13,650 (2 LPARS)	12,026	5,180	1,100 to 1,300
Concurrent users per machine at peak time	Prime shift avg: 4,200 Prime shift peak: 5,000	Prime shift avg: 3,600 Prime shift peak: 4,200	Prime shift avg: 1,500 Prime shift peak: 1,800	Prime shift avg: 300 Prime shift peak: 400
Prime shift mail CPU	LPAR 1: 42% LPAR 2: 58%	73%	46%	74%

1.2.1 Client configuration

IBM Lotus Domino users frequently access their mail files during the workday. In addition, some clients directly open the server copy of their mail file, while others replicate their mail to their workstation and continue to replicate changes throughout the day.

The majority of users use the Domino 5 client, with an increasing number of these clients upgrading to the Domino 6 client as time goes on. All IBM clients use a highly customized IBM mail template derived from the Lotus Domino 5 mail template included with Domino. The average mail file size for an IBM client is 100 MB. Along with the use of mail, the IBM clients are also heavy users of Calendar and Scheduling. In addition to the resident clients on the server (those defined to the server), the server also plays host to nonresident clients who may open sessions on these servers to either manage or view the calendars of resident clients.

Compared to the industry standard test measurement of NotesBench clients (running R5 NRPC workload), a production IBM client is between two to four times more active in terms of transaction counts and mail file size. In addition, a typical IBM client has larger message sizes (an average mail message size of 70 KB) and sends and receives mail at greater frequencies.

1.3 Server migration results

As with the S80 efforts, the p690 server migration allowed the Boulder SDC to consolidate clients residing on smaller and older hardware to the newer server platforms, such as the p690.

The server was configured with two logical partitions (LPARs) The first LPAR was set up with two instances of Domino 5.0.10 and served a total of 7,850 users. Eventually, both instances were upgraded to Domino 6 on this LPAR. The second LPAR was set up with three instances of Domino 6.0, serving a total of 5,800 users. Nine hundred of these users are exploiting some of the advanced features of Domino 6.0, such as iNotes and IMAP. Stressing LPAR 2 beyond the 5,800 client loading was not a goal of this effort; it has additional CPU capacity to handle other workloads.

Initial loading efforts of LPAR 1 onto the two Domino 5 partitions had not provided the full benefits expected with the number of CPUs and memory that were allocated. There was no impact to end user response time or availability, but the team felt there was a need for additional investigation. As a result, a performance team was organized to isolate the root cause. The team discovered that Domino spent much of its time looking for work, thereby generating unnecessarily high CPU utilization. This problem was referred to as the “high yield call” or “context switching” problem. Once the problem was isolated, Lotus product development provided a fix that dropped the CPU utilization from 80% down to 66%. This issue existed on other pSeries servers; system performance was not impacted until the larger and faster SMP servers, such as the p690, were utilized. The SPR for this fix is CMCY5FGT7A, which is delivered in Domino 5.0.12 and incorporated into Domino 6.

Further CPU savings were obtained after these partitions were upgraded from Domino 5 to Domino 6. At this point, the CPU utilization dropped from 66% to 42%. During this time, the user count stayed relatively constant, while the prime shift transaction count remained at nine million and peaking at 10 million. This clearly demonstrates the efficiency of resource utilization by Domino 6 on large SMP servers, providing an opportunity for reallocating CPUs and memory from LPAR 1 and 2 in the future.

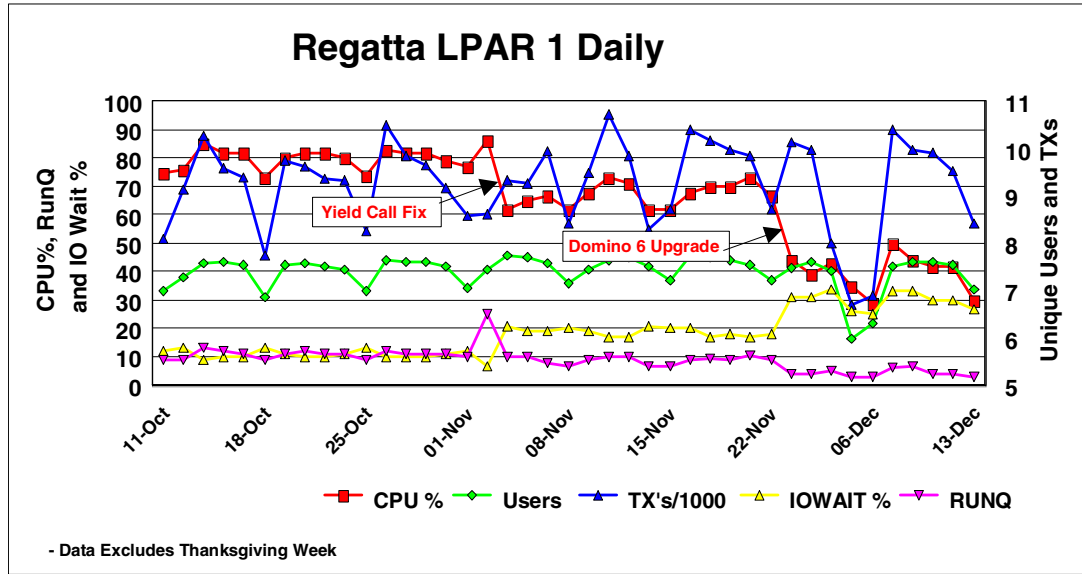


Figure 1-3 Regatta LPAR 1: Daily

The data in Figure 1-3 represents the CPU utilization and transaction counts for LPAR 1 running Domino 5.0.10 as the high yield call fix was implemented and after the Domino 6 upgrade. The CPU utilization statistics were gathered using Server Resource Management (SRM). SRM is an IGS Web application and service offering that reports historical trends of key server resources, such as CPU, memory, and disk. The transaction rates were collected using the Activity Trends tool (incorporated in Domino 6). The primary source of the Activity Trends data collected is the standard Lotus Domino Log database (log.nsf). Activity Trends records and reports statistics that portray the activity of clients against the databases on the Domino server where this database resides.

Figure 1-4 represents the CPU utilization on a weekly interval for LPAR 1 since the start of this project.

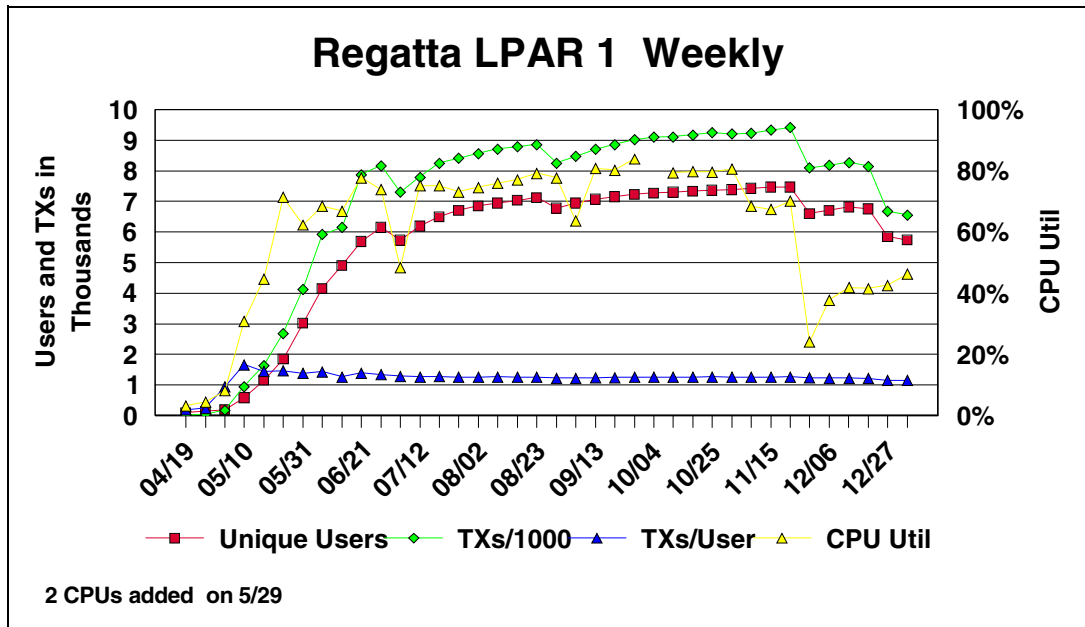


Figure 1-4 Regatta LPAR 1: Weekly

1.3.1 Explanation of performance statistics

This section details the memory, CPU, and disk performance statistics.

Memory

Physical memory allocated to the p690 LPARs allowed each of the Domino partitions to utilize up to 4 GB of memory. Allocation of this memory within Domino was specified by notes.ini parameters to achieve optimal shared versus process memory balance for Domino on AIX. For a detailed explanation about Domino memory management parameters implemented, see the Lotus Developer Domain (LDD) article titled, “Configuring Domino 5 for AIX/pSeries in large physical memory environments,” available at:

<http://www-10.lotus.com/ldd/today.nsf/a2535b4ba6b4d13f85256c59006bd67d/1fd510f06058115785256c980049d6b6?OpenDocument>

None of the Domino partitions experienced paging or other memory-related performance bottlenecks or issues.

CPU

No form of processor binding was implemented. Therefore, all processors were available to any Domino tasks. Utilization was monitored on a per-processor basis, but the results were averaged across all processors. The most useful high-level processor statistics on the server were the system, user, wait, and idle utilization percentages, which are measured by using vmstat, sar, or topas.

Disk

Because the Domino data directories are stored on direct-connected storage servers, our disk statistics, such as percent busy or cache-hit ratios, must be examined with care. Disk statistics reported by tools running under AIX 5L on the p690 record only the operating system view of disk activity. The AIX 5L disk statistics were consistently higher than that reported by the ESS Expert tool. Each Fibre Channel path from the p690 to a logical unit

number (LUN) on the Shark server appears to AIX 5L as an hdisk. In this environment, there are two paths to each LUN and multiple LUNs for each Domino data directory, so the I/O was spread across two paths (hdisk) per Domino data directory.

1.4 Multiple Domino version level support

New with Domino 6 is the ability to run multiple Domino versions on the same operating system image. One server (or LPAR within a server in our case) is capable of running, for example, Domino 5, Domino 6.0, and Domino 6.x beta partitions concurrently within the same AIX instance. This is accomplished by simply applying a unique name to each of the Domino server directories at install time. In order to support unique customer requirements, the three DPARs in LPAR 2 utilized this new feature.

The Research division in Almaden resides on a partition (D03NM694) in LPAR 2. This DPAR would support the testing of the new iNotes and IMAP functionality incorporated into Domino 6. This required the DPAR to be running the most current daily builds of Domino 6. These were then bundled into the mainstream daily builds, or milestone builds, at a later date.

The Software Group (SWG) test clients used the second Domino partition in LPAR 2 (D03NM118). This group has responsibility for testing new builds for stability and new functionality. As the Domino 6 pilot progressed, they often required new builds to be implemented. These builds incorporated enhancements to address issues encountered by the users on D03NM694, as well as other beta test groups.

The third and final Domino partition in LPAR 2 (D03NM119) was considered to be the steady state Domino 6 partition, because it ran the latest release candidate code stream. This partition required greater availability and stability than the other two Domino partitions.

The Domino 6 server code allows the installation of multiple code streams in different definable directories. This feature provided a means to meet the unique demands of the three Domino partitions in this LPAR. Table 1-3 indicates how this was done and the typical code implemented on each within a single LPAR.

Table 1-3 Regatta p690: LPAR 2

Server name	Typical code stream	Location of code
D03NM694	iNotes/IMAP daily builds	/opt/lotus/notes/latest/ibmpow
D03NM118	Weekly builds	/opt/DPAR2/lotus/notes/latest/ibmpow
D03NM119	Release candidate builds	/opt/DPAR3/lotus/notes/latest/ibmpow

Implementing the multiple code streams in this manner provided a path to upgrade the Domino 6 server code easily as needed without affecting the other Domino partitions within the LPAR. Each group's unique requirements could then be met without the overhead of separate LPARs. It must be noted that post-pilot upgrades (single code level) must be done for each partition even though they may be running the same code. Although it appears cumbersome when all three partitions are running the same code, it does provide flexibility to incorporate new code releases at any time on a given partition.

1.5 Client migrations: Large-scale mail migration process

The Boulder migration process of large numbers of mail clients entails a week of activity. It starts with a seven-day advance notification sent to the client community and culminates with

address book changes that redirect the client to the new mail file on the target server. Migrations are performed by Notes replication, which means that the customer mail file resides on both the “source” (old) and “target” (new) servers for the entire week. Once address book changes are made to redirect mail to the new mail file, the old mail files are retained for two weeks so that any client who may have been out of the office can still access the old mail file in order to obtain directions to the new one. The entire mass migration process is managed through the use of a specially developed Notes database that automates several of the migration procedures.

Activities performed during the week to prepare for the migration are done during normal business hours. When activities are performed on a server, such as creating new replica mail files on the target server or synchronizing mail file replicas between the source and target servers, they are done by an administrator familiar with the environment that monitors server performance to ensure there is no impact to clients or response time. This process ensures minimal disruption to clients while maintaining mail integrity.

For details about the migration process used, please refer to Appendix G, “Client migration details” on page 29.

1.6 pSeries 690 consolidations worldwide

Concurrent with the Boulder p690 consolidations, several other delivery centers around the world coordinated activities with the GNA Consolidation team. These other delivery centers were in the IBM geographies: Europe, Middle East, and Africa (EMEA) and Asia Pacific (AP).

1.6.1 IBM Europe, Middle East, and Africa (EMEA)

Until recently, IBM GNA service in EMEA was hosted by 13 server farms using RS/6000 SP servers (primarily Silver nodes) using SP Switch and token-ring or ATM network interconnect. These 13 locations were managed remotely by one team in the U.K. The primary reason for this large number of server farms has been the cost of network bandwidth in EMEA. Consistent with the U.S. consolidation planning, the planned implementation of an enhanced data network in EMEA, based on Multiprotocol Layer Switches, provides a significant increase in network bandwidth in EMEA.

In 2001, a study was performed to understand the cost benefits of consolidating the server farms to two SDCs in EMEA, reducing the number of Domino servers by utilizing the new pSeries servers. In 2002, the EMEA server farm consolidation was started with the plan to consolidate Switzerland, France, and Austria to Germany by the end of 2002. Consolidation began with the least complex data center, Switzerland, which was migrated to the German GNA data center. The French GNA data center soon followed, and the whole of the 13 data centers in EMEA are planned to consolidate into the two data centers in the U.K. and Germany by early 2004.

The p690 server with 32 CPUs and 1.3 GHz processors was selected, consistent with the GNA p690 pilot in Boulder, as the preferred configuration to host the new Domino servers. This system maximizes the amount of Domino server capacity within the smallest footprint and greatest LPAR flexibility. The storage service was also built in coordination with worldwide storage operations groups.

pSeries 690 EMEA configurations

Table 1-4, Table 1-5, and Table 1-6 show the EMEA p690 configurations: the amount of CPU and memory allocated to each LPAR, its purpose, and the number of Domino partitions running on the LPAR. AIX 5L Version 5.1, PSSP 3.4 was installed on all the LPARs with a mix

of Domino 5.0.9a and 5.0.10 server code. Additional details about the system setup in EMEA can be found in Appendix F, "Worldwide consolidation addenda" on page 25.

Table 1-4 Switzerland and Austria (24 - 1.3 GHz CPU p690)

LPAR #	1	2	3	4	5	6
Function	Mail Switzerland x 2, Austria, and 9 CER countries	Local applications	Worldwide applications	Zurich Research Lab Mail Domino 6 (Primary)	Zurich Research Lab Mail Domino 6 (Secondary)	Mail hub/ OSM
User count	10,100			400		
CPUs	8	6	4	2	2	2
Memory	32 GB	24 GB	16 GB	8 GB	8 GB	8 GB
Domino partitions	12 DPARs	3 DPARs	2 DPARs	1 DPAR	1 DPARs	3 DPARs
CPU avg. (Jan. 31, 2002)	69%	65%	3%	13%	6%	13%

Table 1-5 France A (32 - 1.3 GHz CPU p690)

LPAR #	1	2	3	4	5	6
Function	Mail France	Local applications	TSM/ mail recovery	FR mail hub/ OSM	QMX	Worldwide applications
User count	11,000					
CPUs	8	8	2	2	2	8
Memory	32 GB	32 GB	8 GB	8 GB	8 GB	32 GB
Domino partitions	3 DPARs	3 DPARs	1 DPARs	3 DPARs	1 DPARs	3 DPARs
CPU avg. (Jan. 31, 2002)	61%	35%	35%	21%	29%	

Table 1-6 France B (32 - 1.3 GHz CPU p690)

LPAR #	1	2	3	4	5	6
Function	Mail France and Hungary	Worldwide applications	TSM /app recovery	Replication hub	OSM	Local applications
User count	8,500 (3,500 spare)			High, med, low, express, local, system		
CPUs	8	8	2	6	2	4
Memory	32 GB	32 GB	8 GB	24 GB	8 GB	16 GB
Domino partitions	3 DPARs	3 DPARs	1 DPAR	6 DPARs	1 DPARs	2 DPARs
CPU avg. (Jan. 31, 2002)	40%	10%	19%	11%	3%	

1.6.2 IBM Asia Pacific: South (Australia and Southeast Asia)

At the end of 2000, IBM AP South (Australia and Southeast Asia) began work in conjunction with the worldwide GNA consolidation effort. Phase one of the effort was focused on mail server consolidation. At the time, there were 28 Domino partitions residing on 14 Silver thin nodes, supporting 12,250 seats using 8 TB of disk storage. The mail servers were consolidated onto 2x7026-M80 (8-way RS64 III 500 MHz CPUs with 16 GB of memory).

In mid-2001, IGS made a decision to relocate the data center. This provided the GNA account team with an opportunity to review the remaining RS/6000 infrastructure. The p690 was selected as the new hardware platform to replace the existing SP complex in coordination with the worldwide GNA service. The consolidation project involved moving multiple Domino application and infrastructure servers running on various types of SP nodes (Thin-2, Thin-4, and Silver [Thin and Wide]). There were a total of 56 Domino partitions migrated from 46 physical systems.

The resulting p690 (24-way 1.3 GHz CPU) LPAR layout is shown in Table 1-7.

Table 1-7 Resulting p690 (24-way 1.3 GHz CPU) LPAR layout

LPAR #	1	2	3	4	5	6	7	8
Function	Worldwide apps and WebSphere MQ	Worldwide apps	App recovery	Replication hub	OSM	Local apps	Test	PwCC Mail server (1,371 users)
CPUs	2	4	4	4	3	2	1	1
Memory	7 GB	14 GB	12 GB	10 GB	11 GB	6 GB	1 GB	4 GB
Domino partitions	6 DPARs	6 DPARs	4 DPAR	4 DPARs	5 DPARs	7 DPARs		1 DPAR
CPU avg. (Jan. 31, 2002)	17%	17%	37%	19%	13%	29%		37%

1.6.3 IBM Asia Pacific: Japan

In 2002, IBM Japan began the migration of their mail users to a pSeries 690 running AIX 5L Version 5.1 with 32 P4 1.3 GHz processors and 64 GB of RAM. This P690 server was configured to support Domino 5 mail servers only. The server would be segmented into eight LPARs, each with four CPUs and 4 GB of memory. There would be one Domino server allocated to each LPAR, each supporting 3,500 clients. Storage for the new servers is provided by 7133 SSA DASD along with ESS. Figure 1-5 shows the system image layout for a second p690 with a similar hardware configuration is clustered with the primary p690 for disaster and maintenance purposes. At the end of 2002, the primary p690 supported just under 27,000 Notes users.

In 2003, a third p690 with the same hardware configuration will be added to support an additional 19,000 clients by year end. This server will also be clustered with the secondary p690 server as seen in Figure 1-5.

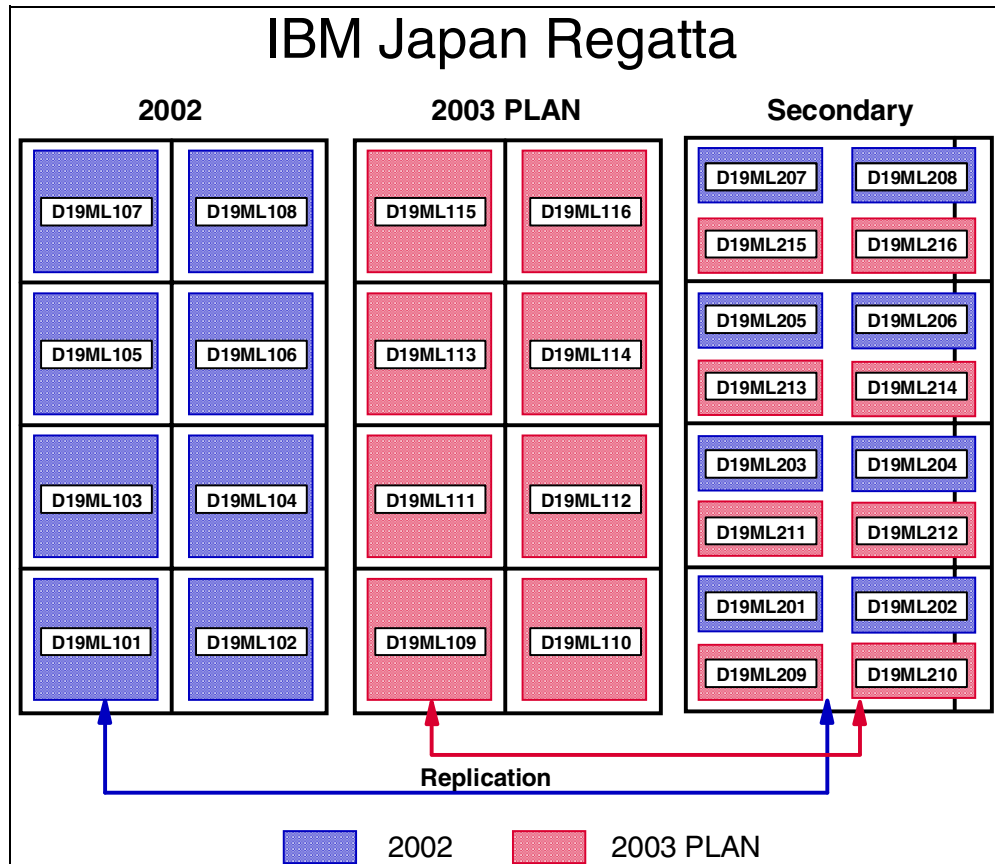
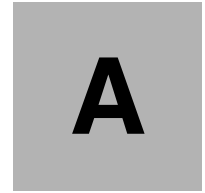


Figure 1-5 IBM Japan Regatta



Boulder AIX and Domino settings

Table A-1 shows the AIX and Domino settings for Boulder.

Table A-1 AIX and Domino settings

oslevel -r:	5100-02
bos.mp	5.1.0.37
bos.iocp.rte	5.1.0.35
ibmSdd_510.rte	1.3.1.3
Firmware levels: p690: RH20413 HMC: R2V1.1 Shark: ECA133	
Two physical paths to each SAN LUN.	
Domino transaction logs reside inside Shark.	
Logical volumes set up with: "Range on physical volumes" = maximum Generate: <code>mklv -e'x'</code>	
JFS attributes of Domino data file systems: frag size: 4096 nbpi: 131072	
Set vmtune <code>-b 2232 -B 2584 -p 10 -P 30 -R 128 -f 1200 -F 2480 -s 1 -c 4</code> Calculated from: <code>-f = \$(120*m) -F = \$(120+128)*m</code> Where m is the number of processors on the server.	
Maximum number of processes allowed per user = 1024 <code>chdev -l sys0 -a maxuproc='1024'</code>	
Set these values in profile for the Domino server ID: AIXTHREAD_SCOPE=S MALLOCMULTIHEAP=1	

Ulimits for Domino (from /etc/security/limits):

```
fsize = -1 (unlimited)
core = -1 (unlimited)
data = 1572864
rss = 589824
nofiles = 4000
stack = 65536
```

Turned on thread parm for Gigabit adapter:

```
ifconfig <interface> thread
```

This is a subset of the environment variables found in the notes.ini on these servers:

```
CleanupScriptPath=/opt/ncotools/notes/rc.d6.faultrecovery
DebugMIMEConversion=1
DEBUGSIGCHILD=1
DEBUG_BTREE_ERRORS=1
DEBUG_CAPTURE_TIMEOUT=10
DEBUG_SHOW_TIMEOUT=1
DEBUG_THREADID=1
EVENT_POOL_SIZE=5000000
FaultRecovery=1
mail_number_of_mailboxes=4
PercentAvailSysResources=12
Server_Max_Concurrent_Trans=1000
Server_Pool_Tasks=100
Server_Session_Timeout=30
ServerTasks=replica,router,update,amgr,adminp,sched,calconn,tmmscan,tmmscan,tivaddin,tmm
scan,tmmscan,tmmscan,tmmscan
SMTPMaxSessions=16
TRANSLOG_Performance=1
Anti-Virus scanner enabled for routed mail.
```



pSeries hints and tips

Table B-1 provides hints and tips for pSeries.

Table B-1 pSeries hints and tips

Monitor <code>hd_pendqblked</code> and <code>fsbufwaitcnt</code> with <code>/usr/samples/kernel/vmtune -a</code> <ul style="list-style-type: none">▶ If <code>hd_pendqblked</code> increases, increase <code>-B</code> or, if <code>fsbufwaitcnt</code> increases, increase <code>-b</code>.▶ If you are going to change either of these parameters, they must be added to <code>/etc/inittab</code> before <code>/etc/rc</code>.
If using Gigabit Ethernet on an SMP machine, turn on dedicated kernel threads: <code>ifconfig <interface> thread</code>
The following daemons are usually run by default. If not needed, they should be turned off: <ul style="list-style-type: none">▶ <code>rpc.ttdbserver:</code> ToolTalk. Used by CDE.▶ <code>rusersd:</code> Responds to queries from the <code>rusers</code> command.▶ <code>rwalld</code> daemon: Handles requests from the <code>rwall</code> command.▶ <code>cmsd:</code> Calendar management functions for CDE.▶ <code>Docsearch:</code> <code>/etc/inittab: httpdlite</code>▶ <code>Common Desktop:</code> <code>/etc/inittab: dt:2:wait:/etc/rc.dt</code>▶ <code>Print daemon:</code> <code>/etc/inittab</code> <code>qdaemon:2:wait:/usr/bin/startsrc -sqdaemon</code>▶ <code>writeserv:</code> <code>/etc/inittab writesrv</code>▶ <code>muxatmd:</code> <code>/etc/rc.tcpip</code>▶ <code>dpid2:</code> <code>/etc/rc.tcpip</code>▶ <code>mkatmpvc:</code> <code>/etc/inittab:</code> <code>mkatmpvc:2:once:/usr/sbin/mkatmpvc</code>▶ <code>atmsvcd:</code> <code>/etc/inittab:</code> <code>atmsvcd:2:once:/usr/sbin/atmsvcd</code>
If not needed, comment out the following in <code>/etc/inetd.conf</code> : <code>chargen; daytime; discard; echo; rstatd; sprayd; talk; rusersd; rwalld; dtspc; pcnfsd</code>

I/O balancing among disks.

To better balance I/Os between the disks, the logical volume "Range of physical volumes" was changed from minimum to maximum.



Shark hints and tips

The following are hints and tips for Shark:

▶ Technical support:

<http://www-1.ibm.com/support/search.wss?rs=503&tc=HW26L&dc=D900>

▶ Model:

The ESS (Shark) used was a Model 2105 Model F20. Better performance can be achieved by using the recently released ESS 2105 Model 800.

▶ DASD performance:

The ESS attached to the p690 had 7,200 RPM disk drive modules. Better disk performance can be achieved by using the recently released 15,000 RPM disk drive modules.

▶ SDD:

Use IBM Subsystem Device Driver (SDD) and a minimum of two Fibre Channel adapters per server. This will give you the best performance and redundancy.

▶ Fibre Channel performance:

If using only two Fibre Channel host adapters on an ESS, the adapters should be installed in bays 1 and 4, or in bays 2 and 3.



Problems encountered

This appendix describes problems and fixes.

Boulder deployment

Table D-1 details problems at the Boulder deployment.

Table D-1 Boulder deployment problems

PMR	Description	AIX 5L Version 5.1 fix
28578 - 033	Reorgvg not working	IY33367: REORGVG FAILS TO PROPERLY REORG LVS WITH MAX INTERPOLICY IY26189 bos.rte.lvm 5.1.0.17
	Reorgvg not working 0516-022 Imigratepp: Illegal parameter or structure value	IY27629 bos.rte.lvm level 5.1.0.25
31119 - 004	Running the 64-bit kernel (bootinfo -K) Domino crashes	IY29475 bos.iocp.rte.5.1.0.16
39351 - 469	System crash in JFS on I/O exception	IY24844 bos.mp64 5.1.0.15
	Microcode download on Fibre Channel Adapter may result in core dump	IY26249 devices.pci.df1000f7.diag:5.1.0.16

Product Introduction Engineering (PIE) team

Table D-2 details the problems encountered by the PIE team.

Table D-2 PIE problems

Description	Fix
ls -l returns: 0503-037 The parameter list is too long	chdev -l sys0 -a ncargs='8' AIX 5L V5.1: ncargs specifies the max allowable size of the ARG/ENV list (in 4 KB blocks) ARG/ENV list (in 4 KB blocks)
Filemon core dumping	AIX 5L V5.1 bos.perf.tools 5.1.0.35
PMR 58640 - 469 NFS Daemon (rpc.lockd) using excessive CPU	IY2583 rsct.basic.rte. 1.2.1.7
automountd using excessive CPU	AIX 4.3.3 IY33240 bos.net.nfs.client 4.3.3.85
INTRPPC_ERR error log entries running 10/100 Ethernet	AIX 5L V5.1 IY30771 devices.pci.23100020.rte 5.1.0.26
Unable to Telnet to machine PROGRAM TSM ABNORMALLY TERMINATED	AIX 4.3.3 bos.rte.security 4.3.3.82
Java divide by 0 Exception in thread "main" java.lang.ArithmeticException: / by zero	Fixed in Java Fixpack 2 http://w3.austin.ibm.com/afs/austin/depts/f13s/www/pub/java/javainfo.html
NIM installed client missing routes other than default	AIX 5L V5.1 IY32065 bos.sysmgmt.nim.client 5.1.0.27



E

GNA data center evolution

The prior papers in this series reviewed experiences migrating Domino servers to earlier pSeries SMP systems. Figure E-1 summarizes the earlier data center configurations using RS/6000 SP frames (each with 8-16 SP Silver or Winterhawk nodes), RS/6000 S80 SMP, and pSeries M80 SMP servers. Notable is the network and data interconnect change over the period where Ethernet displaced token-ring and ATM LANs. A managed storage service using Fibre Channel SAN attached storage servers also displaced SSA direct access storage devices (DASDs).

GNA Domino Infrastructure

Typical Data Center Servers

1Q 2001

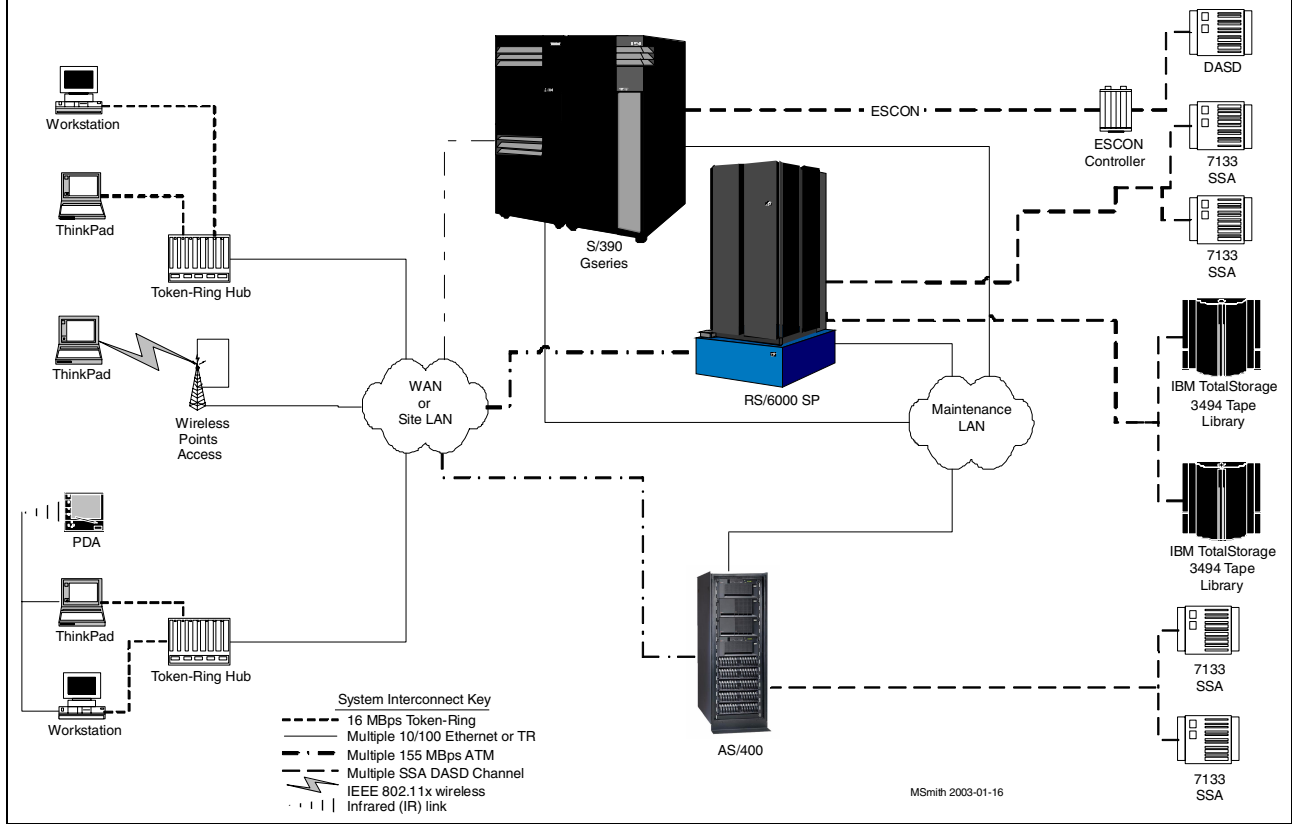


Figure E-1 GNA IGA office infrastructure



Worldwide consolidation addenda

This appendix details worldwide consolidation.

IBM Europe, Middle East, and Africa (EMEA)

The conclusion of a detailed study prior to GNA data center migration indicated cost benefits from consolidating the server farms into two locations, U.K. and Germany, still managed out of the U.K. In 2002, the EMEA server farm consolidation was started with the plan to consolidate Switzerland, France, and Austria to Germany by the end of 2002.

Switzerland was selected as the first country, being the “easiest” in terms of number of users and complexity of the Domino service. France was also a very high priority because IBM was not renewing the lease on the existing building that hosts the Domino servers. Storage for the new servers is provided by a storage area network with ESS F20 using 36 GB disk drives.

The IBM Lotus Domino architecture defines separate Domino domains for mail and applications. This same logic was also applied to the storage architecture. Separate ESSs were installed to host the mail and application data (to cater to different backup requirements for these data types more easily).

One of the benefits of the p690 server is the ability to partition the server into logical partitions. Multiple Domino partitions or DPARs can be run in each LPAR. The target in EMEA, where possible, was to run three Domino partitions in an 8-CPU LPAR, supporting 12,000 registered mail users (4,000 users per Domino server).

A single SP server in EMEA hosts about 1,500 registered users; these were initially set up with two Domino partitions hosting 750 users each. With Domino 5, this has been revised to use a single Domino partition hosting 1,600 users. So effectively an 8-CPU LPAR on a p690 can be used to consolidate eight pSeries SP (Silver) servers, in Domino terms, consolidating between 8 and 16 Domino partitions to just 3.

IBM separates local (EMEA only) applications and worldwide applications onto separate servers. Similar planning assumptions were used for consolidating the applications servers.

For the local applications, five existing Domino partitions will be consolidated onto one new Domino partition.

Because there are 13 server farms in EMEA, there may be several instances of a worldwide application in EMEA, placed locally so that end users get good response times. Rather than consolidating by server, the approach with worldwide applications is to consolidate by application. The intention would be to have one instance of the application on one of the consolidated servers, accessed by all users in the various countries.

This is not always possible, because some applications use selective replication to restrict the application data on a country basis, often due to different legal requirements in different countries. In this case, it is still necessary to have many instances of the application on (separate) consolidated servers.

The ESS FlashCopy® capability was used to back up the Domino databases on the EMEA servers. The Domino servers restarted each night, contacting the Tivoli Storage Manager server to take a FlashCopy as part of the restart process. Once that was completed, the Domino server is restarted, and the Tivoli Storage Manager server then proceeds to back up the data to tape. The Domino server down time was generally about 1 to 5 minutes.

pSeries 690 configuration

The EMEA p690 configurations depicted in Table 1-4, Table 1-5, and Table 1-6 all were running AIX 5L, Release Maintenance Level 2 and PSSP 3.4 on each LPAR with Domino server Release 5.0.9a or R5.0.10.

Switzerland and Austria (24 CPU p690)

This p690 hosts the Zurich Research Lab, which has two mail servers running in a Domino cluster. These servers are used for piloting new Domino server release levels: one half of the cluster runs the latest production Domino server code, the other half can run beta Domino code. Once the new Domino release has met the IBM stability criteria, both halves of the cluster are upgraded to the latest release level. These Domino servers are kept in separate LPARs to allow for prerequisite AIX fixes to be installed independent of the production mail service.

France (2 x 32 CPU p690s)

Two CPUs are unallocated (spare) in each of the French p690s, to be allocated as required.

Status

The France, Austria, and Switzerland migrations are all complete. All users and worldwide and local applications have been migrated to the p690. The old servers are in the process of being shut down.

IBM Asia Pacific: Australia

The pSeries 690 was selected as the new hardware platform to replace the existing SP complex. The p690 provides for the utilization of the LPAR technology, allowing for a reduced number of OS images, better RAS capabilities, latest processor technology in the POWER architecture family, and better server management metrics, leading to lower total cost of ownership. The consolidation project involved moving multiple Domino applications and infrastructure servers running on various types of SP nodes (Thin-2, Thin-4, and Silver [Thin and Wide]). There were a total of 56 Domino partitions migrated from 46 physical servers.

The p690 hardware used for application consolidation consisted of one pSeries 690 running AIX 5L with 24 P4 1.3 GHz processors with 96 GB of RAM. Placement of I/O adapters was so that:

- ▶ The adapters were placed in the I/O drawers as per the *RS/6000 and eServer pSeries PCI Adapter Placement Reference*, SA38-0538.
- ▶ The adapters that have Enhanced Error Handling (EEH) capabilities, such as the FC adapters and Gigabit Ethernet adapters, were isolated (inserted into I/O slots that are attached to separate PCI host bridges) from non-EEH adapters. This ensured that in the case of failure of a non-EEH adapter it would not affect all adapters or partitions connected to a PCI host bridge.

The p690 was built from an AIX SOE CD-ROM. The build was for AIX 5L Version 5.1 Maintenance Level 2.

After the basic AIX install was completed, the LPARs were customized based on recommendations from the following IBM Redbook and Redpapers:

- ▶ *Lotus Domino R5 on IBM RS/6000: Installation, Customization, Administration*, SG24-5138
- ▶ *IBM RS/6000 Enterprise Server M80 and Domino R5 Server Loading Efforts*, REDP0201
- ▶ *IBM RS/6000 Enterprise Server S80 and Domino R5 Server Loading Efforts*, REDP0226

This consolidation included a migration from one site to another in Australia. The data transfer between sites was staged over several weekends. The method chosen was based on Tivoli Storage Manager utilizing backup and restore commands over the 24 MB WAN link between the data centers. The data migration took place in three steps:

1. The existing server was backed up to a Tivoli Storage Manager server and access was granted for the new LPAR instance.
2. The new LPAR instance was then restored from the Tivoli Storage Manager server.
3. The new LPAR instance was then backed up to a new Tivoli Storage Manager server set up for all Regatta servers.

A combination of ESS and native SSA disk storage was used to house the application data. The ESS was configured with RAID5 LUNs and the SSA subsystems with both RAID5 (for data) and RAID-1 (for domlogs) arrays. The SAN switches used in the fabric are IBM Model 2109-S16.

IBM Asia Pacific: Japan

In 2002, IBM Japan began migration of their mail users to a pSeries 690 running AIX 5L with 32 P4 1.3 GHz processors and 64 GB of RAM. This p690 server was configured to support Domino 5 mail servers only. The server was segmented into eight LPARs, each with four CPUs and 4 GB of memory. There was one Domino server allocated to each LPAR, each supporting 3,500 clients. Storage for the new servers is provided by SSA 7133 DASD, along with ESS.



Client migration details

In general, the migration process for moving clients from one server to another for the consolidation efforts is as follows:

1. Seven days prior to the migration:
 - Send notifications to all affected clients, informing them of the migration, their new server, the change record number, and the date the change will take effect.
 - Replica stubs of the client's current mail file are created on the new mail server.
 - Replica stubs of the client's mail file are created on the backup server that correspond to the new mail server to ensure a viable backup is available on the day of the migration.
 - Replication is initiated between the source and target server as a means of moving mail data between the old and new mail files. Replication is staged to ensure that the impact on the server is minimal. This is accomplished by limiting the number of replicator tasks running on the target server at any given time.
2. Six days prior to the migration:
 - Replication of mail databases between old and new servers proceeds to keep replicas synchronized up to the moment when address book changes take effect. Replication is staged to ensure that the impact on the server is minimal.
 - Document counts are taken using the migration database previously mentioned to ensure old and new mail files match and appropriate action is taken as needed, which may include ACL modifications, replication setting changes, or brand new replicas on the target.
3. Day of migration:
 - Required changes are made to the master copy of the mail domain's address book prior to 06:00 mountain time (MT). These changes do not replicate to the mail servers until later in the evening. The affected person documents are modified to indicate the client's new server.

- Notifications are sent to all affected clients reminding them of the migration and providing detailed information about client changes required to ensure a successful migration with uninterrupted mail delivery. This consists of a series of automated buttons and steps to ensure ease of use and eliminate potential errors. These buttons assist the client in adding the new replica icon to the workspace and changing location documents to access the new server. Notifications are sent prior to 07:00 MT to ensure that customers are provided adequate time to prepare as necessary.
- Replication of mail databases between old and new servers proceeds to keep old and new mail files synchronized. Replication is initiated several times during the day to ensure that data is synchronized in order to minimize data transfer once address book changes take effect.
- At 20:00 MT, normal scheduled replication of the mail domain's address book from Atlanta to the Boulder mail hubs occurs. This replication takes 15 to 20 minutes and is monitored to ensure all necessary address book changes required to complete the migration are replicated.
- At 21:00 MT, replication between the Boulder mail hubs and all the servers involved in the migration (source and target servers) is initiated manually. This is done in advance of normal scheduled replication to the mail servers at 22:00 MT to ensure that all address books on all affected servers contain the same information, which eliminates the possibility of delivery failures occurring. Because normal scheduled replication at 22:00 is staged at different times for different servers, the failure of all servers involved in the migration to receive updates at the same time would lead to mail delivery failures; therefore, forced replication prior to 22:00 eliminates this possibility. After the forced replication to the mail servers is complete, mail delivery to the new/migrated mail file begins.
- A final synchronizing replication is performed to ensure that the new/migrated mail file contains all the data from the old mail file that was delivered up to the time of address book replication and is available in the new mail file.
- By 22:00 MT, the time advertised to the client that mail delivery to the new/migrated mail file begins, delivery is in fact occurring and all data from the old mail file is available as well.

4. Two weeks after migration:

- Mail files remain on the old/source mail server for two weeks following the migration to allow people out of the office on the day of the migration to access their old mail file, which includes the instructions directing them to their new mail file. After two weeks, these files are deleted from the old server, and if no other users exist on the old server, it can be decommissioned.
- ACLs on the new mail files are updated to remove the old server entry.

As users were migrated from the South SDC to the West SDC, it allowed for the consolidation of 17 servers to be consolidated into 4. This was accomplished based on two criteria:

- ▶ Existing Winterhawk nodes loaded lightly (underutilized)
- ▶ More powerful capabilities of the p690

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this Redpaper.

IBM Redbooks

For information on ordering these publications, see “How to get IBM Redbooks” on page 32. Note that some of the documents referenced here may be available in softcopy only.

- ▶ *IBM RS/6000 Enterprise Server M80 and Domino R5 Server Loading Efforts*, REDP0201
- ▶ *IBM RS/6000 Enterprise Server S80 and Domino R5 Server Loading Efforts*, REDP0226
- ▶ *Lotus Domino R5 on IBM RS/6000: Installation, Customization, Administration*, SG24-5138

Other publications

These publications are also relevant as further information sources:

- ▶ “IBM consolidates mail servers for a dramatic reduction in TCO,” IBM Business Brief about Domino server consolidation and total cost of ownership, available at:
<http://www-3.ibm.com/software/success/cssdb.nsf/cs/NAV0-5BGNXK?OpenDocument&Site=software>
- ▶ *IBM eServer pSeries 690 Availability Best Practices*, available at:
http://www-1.ibm.com/servers/eserver/pseries/hardware/whitepapers/p690_avail.pdf
- ▶ *IBM eServer pSeries and IBM RS/6000 Performance Report*, available at:
http://www-1.ibm.com/servers/eserver/pseries/hardware/system_perf.pdf
- ▶ Lotus Developer Domain article titled “Configuring Domino 5 for AIX/pSeries in large physical memory environments” by Scott Hopper, available at:
<http://www-10.lotus.com/1dd/today.nsf/a2535b4ba6b4d13f85256c59006bd67d/1fd510f06058115785256c980049d6b6?OpenDocument>
- ▶ *RS/6000 and eServer pSeries PCI Adapter Placement Reference*, SA38-0538

Online resources

These Web sites and URLs are also relevant as further information sources:

- ▶ IBM @server pSeries Support
<http://techsupport.services.ibm.com/server/support?view=pSeries>
- ▶ IBM @server pSeries Resource Library
<http://www-1.ibm.com/servers/eserver/pseries/library/>
- ▶ Introduction to rPerf
<http://www-1.ibm.com/servers/eserver/pseries/hardware/rperf.html>

- ▶ Lotus Domino performance and technical information
<http://www-10.lotus.com/1dd>
- ▶ Lotus Domino sizing (IBM intranet only)
IBM employees in the Americas can get assistance with sizing Domino Mail on IBM @server by going to <http://w3.ibm.com/support/americas/sizing.html> and selecting the Domino Mail Questionnaire. Instructions for completing and submitting the questionnaire to Techline are included in the questionnaire itself.
- ▶ Lotus Product Introduction Web site
<http://w3quickplace.lotus.com/productintroduction>
- ▶ e-business Application Center of Competence (CoC) (IBM intranet only)
<http://w3.ibm.com/services/iga/gad/ebizappcoc/cocweb.nsf>
- ▶ NotesBench Consortium
<http://www.notesbench.org/bench.nsf?OpenDatabase>
- ▶ Dataseg Utility Information
Technote 189972, see also Technote 190356 for related information
<http://www.ibm.com/software/lotus/support>
- ▶ Server Resource Management (SRM) (IBM intranet only)
<http://srmweb.raleigh.ibm.com>
- ▶ Boulder AMA (IBM intranet only)
<http://bldr1dbl.boulder.ibm.com/ama>

How to get IBM Redbooks

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ibm.com/redbooks



IBM [™]@server pSeries 690 and Lotus Domino Mail Server Consolidation

An IBM Global Services Case Study



**Dramatic reduction of
Domino server
images on pSeries
690 on AIX 5L**

**Worldwide Domino
production server
loading on p690**

**Hints and tips for
Domino server
consolidation on
pSeries Regatta**

This is the third in a series of case studies detailing Lotus Domino server loading on IBM @server pSeries servers. As in previous case studies, this IBM Redpaper details lessons learned by running large Domino mail servers on AIX. In this study, we describe Domino 5 and Domino 6 server migration and loading experiences, as well as exploiting multiple AIX 5L logical partitions (LPARs) defined on each pSeries 690 system. The pSeries 690 system, also known by the internal name Regatta H, currently supports the largest Domino mail and application deployment within IBM.

Prior case studies are also available and detail the first and second phases of Domino server loading efforts on IBM RS/6000 and IBM @server pSeries systems.

This document is intended to be read by system engineers, architects, technical and marketing support personnel, and sales representatives. In addition to the logical and physical design of the solution, details about system configuration parameters and server statistics during the server loading of the pSeries 690 system are presented.

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