Lotus

White Paper

Evaluating Appropriate Workloads for the AS/400e Dedicated Server for Domino

A Lotus Development Corporation White Paper

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Executive Summary

Lotus Domino for AS/400, announced in January of 1998, has achieved tremendous success in the marketplace. It offers the rock-solid reliability that customers seek as their e-mail, collaborative, and Web-enabled applications become mission-critical. Through its ease of management and its ability to reliably run a mixed workload on a single server footprint, Domino for AS/400 also delivers a low total cost of ownership. Many customers and Business Partners asked for these same characteristics for pure Domino environments. They did not need the capability or want the costs associated with support for running "traditional AS/400 applications," such as ERP applications written in RPG or COBOL. In response, IBM and Lotus announced the AS/400e Dedicated Server for Domino (Dedicated Server).

The new AS/400e Dedicated Server for Domino builds on the existing Northstar technology of the AS/400e Model 170. By focusing the processing power on Domino, the new Dedicated Server delivers significantly better Domino price/performance than other AS/400e Model 170 servers. Even the cover of the new Dedicated Server, with its yellow accent panel, emphasizes its design: processing capability targeted for Domino applications.

The simplest and safest implementation for the Dedicated Server is a "pure Domino" implementation, such as e-mail and applications that use "out of the box" Domino templates and capabilities. However, many customers and Business Partners want to go beyond these limits, or to understand what the limits truly are. This paper explores the behavior of the AS/400e Dedicated Server for Domino and provides guidance on predicting how well various Domino applications will perform on the Dedicated Server. This guidance information is provided using predictions, examples, and laboratory data. The actual performance and behavior you experience may vary.

Potential workloads for the Dedicated Server fall into these areas:

Appropriate: Our testing shows that pure Domino applications and most Domino applications that serve as a front-end to legacy data on another AS/400 system fall within the design guidelines for the Dedicated Server. You can expect that they will take full advantage of the price/performance characteristics of the Dedicated Server. These applications include:

- Domino e-mail
- Domino applications or agents using only Domino databases
- Domino.Doc
- Domino applications that use normal integration methods (e.g., @db, LS:DO, DECS) to access DB2/400 databases on another AS/400 server. (**Note:** these integration methods take advantage of the AS/400 Distributed Relational Database Architecture (DRDA) support.)

In addition, applications on the Integrated Netfinity Server (INS) that share AS/400 resources (such as disk storage, printers, and tape devices) but use minimal AS/400 processing power are also appropriate for the Dedicated Server. Both NT-based file and print serving and a firewall fall in this category.

Notes:

- Some exceptional processing with DRDA might fall outside the recommended limits. These cases are described in the topic "Accessing External Databases on a Different AS/400 Server."
- We expect that other Domino "add-in" applications besides Domino.Doc will fall within the "pure Domino" category. We do not yet have complete test results for other add-in applications. Their omission from this list should not be interpreted as evidence that they will not perform well.

Not appropriate: Applications that fall primarily outside the realm of Domino use excessive non-Domino capacity and generally will not perform well on the Dedicated Server. These applications include:

- Interactive 5250 applications (although sufficient interactive capacity is available to use a single 5250 session for systems administration functions)
- Standalone JAVA applications
- Applications that access Domino databases without going through a Domino server (e.g., using Domino APIs)
- Domino e-mail integration with other e-mail systems (e.g., Internet mail) via the AS/400 Anymail Framework. For e-mail integration on the Dedicated Server, you should use the built-in Domino R5 SMTP capabilities.

It depends: The design of the Dedicated Server includes a limited amount of non-Domino capacity, which is intended for complementary work such as database integration or file and print serving. When your proposed workload includes this type of non-Domino work, the performance results you experience will depend on both the mix of work on your Dedicated Server and on your application design. The majority of this paper is devoted to assisting you in evaluating and analyzing whether the level of non-Domino work you anticipate will fall within a range where you can expect to take full advantage of the price/performance characteristics of the Dedicated Server.

When you run an inappropriate workload (excessive non-Domino work) on a Dedicated Server, you can expect the following symptoms:

- With excessive interactive work (above the specified interactive CPW), overall performance of all work on the Dedicated Server degrades until the interactive work decreases.

- With excessive client-server or batch non-Domino work (above the specified processor CPW), overall performance of all work on the Dedicated Server may be impacted by increased processor utilization due to increased system overhead. However, new Domino work can be added in this environment and will replace the system overhead without increasing processor utilization. This assumes that you have configured your system correctly with Domino work running at a higher priority.

Several remedies are available for a workload that is not appropriate for a Dedicated Server configuration:

- Upgrade to a larger Dedicated Server with a higher processor CPW rating.
- Move the non-Domino work to a traditional AS/400e server.
- Increase the ratio of Domino work compared to non-Domino work. The Dedicated Server is designed to allow new Domino work to “reclaim” the CPU cycles being consumed by the system overhead that non-Domino batch work generates. By running more Domino work, you take better advantage of the CPU cycles available on the server.

Keep in mind that in general, the classic red AS/400e server is the best choice to provide real-time integration between Domino applications and DB2/400 data on the same server. This paper explores the behavior and performance of light data integration on the same server to help with your planning and analysis. However, our bottom line recommendation for data integration is either to use a Dedicated Server as a front-end to another AS/400 or to run Domino applications on a suitably configured classic red server that houses your DB2/400 data.

An Overview of Dedicated Server Capacity and Performance Behavior

To analyze an AS/400e Dedicated Server for Domino for any work other than pure Domino, you need to understand its projected capacity and how it behaves under various workloads. Table 1 shows the performance capacities for the three Dedicated Server processor features.

TABLE 1

Processor Feature	*Simple Mail Users*	*Processor CPW*	*Interactive CPW*
170-2407	1,300	30	10
170-2408	2,300	60	15
170-2409	4,300	120	20

Following are descriptions of the three performance capacities:

- **Simple Mail Users** is a commonly used measurement for comparing Domino capacity across different Domino server platforms. (**Note:** A typical rule of thumb when equating simple mail users to "real world" or typical mail users is to divide by three.)
- **Processor CPW** is intended to support a limited amount of system resource activity (Integrated File System, communications, storage management, back-up and recovery, etc.) and Domino application integration functions (DB2 Universal Database access, external program calls, Java applications, etc.) in support of Domino applications running on the server. The processor CPW represents a planning estimate, not a guaranteed level of capacity to perform non-Domino work. Throughout the remainder of this paper, we use the term non-Domino work to refer to Processor CPW because Domino applications do not normally have a "5250 interactive" component.
- **Interactive CPW** (often referred to as "green screen" processing) is designed to support system administration functions using a 5250 session.

Note: Simple Mail Users, Processor CPW, and Interactive CPW capacities are not additive. Each of the guidelines in Table 1 individually represent a recommended maximum capacity.

You can think of the non-Domino capacity of a Dedicated Server in two ways:

- Non-Domino work should not exceed 10 to 15% of the total capacity of the processor.
- Non-Domino work should not exceed 25% of the work currently being performed on the server. For example, assume that your Dedicated Server is currently running at 50% CPU utilization. Then the non-Domino work should be no more than 12.5% of the total CPU capacity (25% of 50).

Expressed another way, for your Dedicated Server to achieve its full price/performance potential, your ratio of Domino to non-Domino work should always be 3 to 1 or greater.

The Dedicated Server treats processing as Domino work when the processing runs within the Domino R5 code. Processing that runs any function other than Domino R5 code should be considered as non-Domino work. Non-Domino work includes functions that a Domino thread or process calls, such as a LotusScript call to SQL. The processing time in the SQL code is non-Domino work. In other words, when an application goes "outside Domino," it is performing non-Domino work. We'll explore examples of Domino versus non-Domino throughout this paper.

Evaluating AS/400 Application Integration on the Dedicated Server

Most of the questions that we receive about appropriate workloads for the Dedicated Server focus on application and database integration. The only definitive method for ensuring that your proposed application integration will fall within the desired performance guidelines for the Dedicated Server is to test. However, in this section, we'll provide general guidance and analysis to help you determine whether your proposed workload mix is reasonable and worth expending the effort to test it.

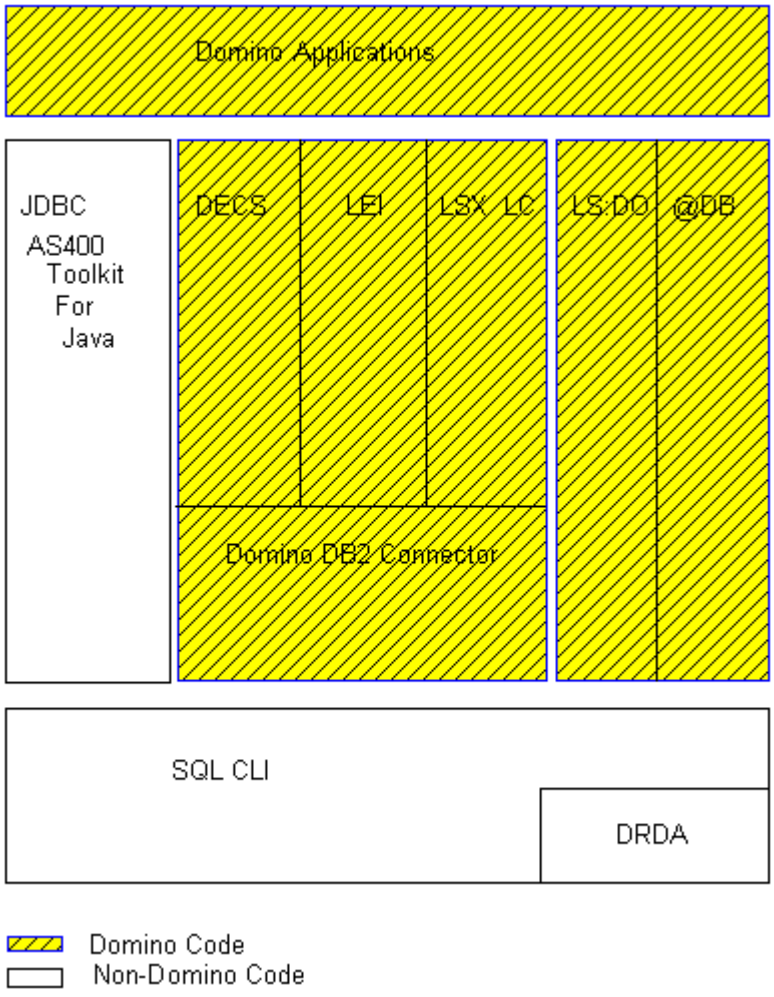

Figure 1: Overview of Domino Integration Techniques

Figure 1 shows the common techniques for integrating Domino applications with DB2 UDB database files. It classifies the methods as to whether they are generally considered as Domino or non-Domino processing on the Dedicated Server. From a programming standpoint, these integration techniques are the same on the AS/400 as they are on other

Domino platforms. “Under the covers,” all of the methods shown use the AS/400 SQL Call Level Interface (CLI) to access DB2 data. (A possible exception would be some custom-written connectors.) In addition, when the data being accessed resides on a different server in the network, OS/400 uses the DRDA layer to provide the access. Again, this happens “under the covers” without extra coding by the Domino programmer.

In the sections that follow we’ll discuss each of these methods and their likely performance implications on the Dedicated Server in more detail.

Domino Enterprise Connection Services (DECS)

Domino Enterprise Connections Services runs as part of the Domino server. A DECS connector is an interface to access back-end databases in real time for Domino users. The data that a Domino user sees looks like it is coming from a Domino database, but it is in fact coming from a relational database outside Domino. Many DECS connectors are available, both for specific databases, such as DB2, Oracle, and Sybase, and also for applications. The amount of non-Domino work that a connector runs varies based on the design of the connector.

We will examine two DECS connector examples below. The first example is a good fit for the Dedicated Server; the second is not.

DB2 DECS Connector Example: In our testing, the DB2 connector has generally worked acceptably on the Dedicated Server because it performs relatively simple DB2 work outside Domino that does not require significant processor resources. Following is an example of integration using the DECS DB2 connector. It highlights which processing steps are Domino versus those that are non-Domino:

1. (Domino) Domino user opens document
2. (Domino) DECS connector to DB2 sends request to find fields in DB2
3. (Non-Domino) DB2 receives request
4. (Non-Domino) DB2 finds row
5. (Non-Domino) DB2 returns fields to DECS
6. (Domino) DECS receives fields from DB2
7. (Domino) DECS sends fields to Domino document

Because DB2 UDB is integrated on AS/400 and because this example involves simply fetching or inserting a single row, this use of the DECS DB2 connector is not likely to exceed the non-Domino processing limits on the Dedicated Server.

That said, keep in mind that no DB2 database exists in a vacuum. Theoretically, it’s possible to provide simple access between a Domino application and DB2 databases without exceeding the non-Domino capacity of a Dedicated Server. However, what else surrounds that DB2 database? It’s probably part of a line-of-business application with maintenance and reporting programs that run outside Domino. In the “real world,” the DB2 database that you want to access may involve enough non-Domino processing to make this approach inappropriate for the Dedicated Server. To take full advantage of the

Domino price/performance capabilities of the Dedicated Server, we strongly recommend using Domino database integration between the Dedicated Server and DB2 databases on another AS/400e server.

Custom Written DECS Connector Example: In this example, we'll use an "AppX" connector, a sample connector that interfaces Domino with its custom database environment. Instead of using DECS to return values of fields in the database, it sends commands to AppX to generate a report.

Following is an AppX DECS connector example highlighting which processing steps are Domino versus those that are non-Domino:

1. (Domino) Domino user opens document
2. (Domino) DECS connector to AppX sends request to find a field in AppX application
3. (Non-Domino) AppX application receives request
4. (Heavy Non-Domino) AppX uses the field request to collect statistics about the database. The application then finds rows matching a query, computes the average of the results, creates a log entry of the query results, and sends a report to a printer.
5. (Non-Domino) AppX returns a field with the text "Action Complete" to DECS
6. (Domino) DECS receives field from AppX
7. (Domino) DECS sends field to Domino document

It is likely that the AppX Connector that we described will not perform well on the Dedicated Server. The complexity of the work that this Connector is doing outside Domino is likely to cause a large amount of non-Domino processing which will likely make it difficult to maintain the recommended 3-to-1 ratio between Domino and non-Domino work.

Lotus Enterprise Integrator (LEI)

Lotus Enterprise Integrator (previously known also as NotesPump) is a method for transferring the contents of one database to another. The source and target database can be any combination of supported formats, including Domino, DB2, SAP, etc. Like DECS, LEI uses a connector to interface the databases. Based on our tests and analysis, we have these recommendations for using LEI:

- Generally, when at least one of the databases in the transfer is a Domino database, Domino processing will be sufficient to maintain a 3-to-1 ratio of Domino to non-Domino work and you can expect good server throughput.
- When both the source and target databases are something other than Domino databases, you are likely to see non-Domino processing that will exceed the recommended 3-to-1 ratio of Domino to non-Domino work. Consequently, the performance that you experience for the data transfer will be less than the full performance capabilities of your Dedicated Server.

- Many customers want to perform large-scale LEI data transfer infrequently, during off-shift hours. In these cases, the reduced performance that might result from exceeding non-Domino performance limits during the data transfer is acceptable. In other words, the data transfer will run successfully. It simply will not be able to take full advantage of the performance capabilities of the Dedicated Server.

Note: The Real-time component of LEI has the same characteristics as DECS.

Accessing External Databases on the Same AS/400 Server

An external (non-Domino) database is a database that is not a Domino .NSF file, such as DB2 UDB for AS/400. From Domino, you can access an external database by using @DB Functions or agents written in LotusScript or Java (via JDBC).

LotusScript LS:DO access: Domino provides a set of classes known as LS:DO (LotusScript:Data Object) that allow easy programming access to external databases. On AS/400, the underlying access from LS:DO occurs in two ways, both of which are considered non-Domino processing:

- When the Domino LS:DO processing runs on the server (e.g., as a server agent), AS/400 provides direct access to DB2 UDB using the SQL Call Level Interface (CLI).
- For other LS:DO access (e.g., processing running on the client), LS:DO uses an ODBC connection to access external databases.

JDBC access: JDBC is a defined interface in Java that allows Java programs to access external data, such as DB2 UDB for AS/400. Java, the JDBC driver classes, and the code that it runs are all non-Domino processing.

How much external database access is OK?

Our tests show that simple queries from a Domino application to DB2 databases on the same Dedicated Server should work acceptably. Factors that could potentially push this SQL CLI work above the non-Domino limit include the following:

- Running complex queries that are processor intensive.
- Running many queries simultaneously.
- Running queries against extremely large DB2 databases.
- More complex database access.

Accessing DB2 through Java classes and JDBC is roughly equivalent to running a complex query, because the Java classes, JDBC, and the access itself are all non-Domino work.

As we said in the DECS discussion, no DB2 database exists in a vacuum. While it's possible to provide simple access between a Domino application and DB2 databases without exceeding the non-Domino capacity of a Dedicated Server, you need to consider what else surrounds that DB2 database. It's probably part of a line-of-business

application with maintenance and reporting programs that run outside Domino. In the "real world," the DB2 database that you want to access undoubtedly carries enough non-Domino "baggage" to make this approach inappropriate for the Dedicated Server. To take full advantage of the Domino price/performance capabilities of the Dedicated Server, we strongly recommend using Domino database integration between the Dedicated Server and DB2 databases on another AS/400e server.

Accessing External Databases on a Different AS/400 Server

When a Domino application accesses an external database on another server, you make use of the AS/400 Distributed Relational Database Architecture (DRDA) support. From a programming perspective, you use one or more of the normal Domino techniques for accessing relational data: @db, LS:DO, DECS, or JDBC. Under the covers, these techniques make use of AS/400 DRDA support when the relational data resides on another server. The DRDA call, which occurs on your Dedicated server, is non-Domino work. However, all of the DB2 work to access the database and return the result runs on the connected server that houses the database. Therefore, the processor load on the Dedicated Server to send DRDA database requests to another machine is light and should generally perform acceptably on the Dedicated Server.

Although standard DRDA access will perform acceptably on the Dedicated Server, the following factors have the potential to increase the SQL CLI component and push your non-Domino processing above the recommended ratio:

- Large data streams being returned, which causes increased buffer management work
- Character translation, which occurs on the source server (the Dedicated Server)
- 2-phase commit, which is coordinated by the source server (the Dedicated Server)
- Large number of transactions per request, more SQL DRDA transactions require more processing on the source. For example, if the application is doing lots of inserts versus a query, many invocations of the SQL CLI and DRDA code are performed.
- Buffer format. If the remote system is non-AS/400, or it is an AS/400 but the data tends to have large amount of NULLABLE or VARCHAR fields, then the formatting type used is less efficient and requires more processing on the source.

Java Agents or Servlets

Java can be used in many ways on the AS/400. Java is essentially non-Domino, but it can work well on the Dedicated Server when the Java processing is light and there is interaction with the Domino server. For Java to run well on the Dedicated Server, two things are required:

- Java must be run from Domino. This includes agents written in Java or servlets through Domino's HTTP task.
- The Java application must use Domino functions, which are found in the lotus.domino.* or lotus.notes.* classes. If there is no interaction with Domino, then the Java processing will cause significant non-Domino processing which will likely result in system overhead. Java runs most of its code independently of the Domino server.

Remember, external database access using JDBC is non-Domino. Keeping the database access light will increase the chances your Java will perform well on the Dedicated Server.

File Serving on a Dedicated Server

Many customers have inquired as to whether it is feasible to run a small amount of file serving on a Dedicated Server in addition to their Domino applications. While file serving processing is considered non-Domino, one approach which may accommodate the file serving requirements and also limit the amount of file serving processing on the Dedicated Server is to use an Integrated Netfinity Server. Since the vast majority of processing occurs on the Integrated Netfinity Server (INS), typically no more than a few percent of the AS/400 CPU resource is required to perform the disk accesses generated by the Integrated Netfinity Server. However, if you are running an environment that is near the 3-to-1 Domino to non-Domino ratio, the added non-Domino processing for file serving may at times affect Domino performance as discussed in this paper.

Notes:

- When sizing a Dedicated Server to include file serving, you should take into account that you may need more disk arms to accommodate the I/O activity generated by the file server.
- Each INS requires some AS/400 processor resources. Therefore, you should not plan on supporting a large number of INSs on a Dedicated Server. Chapter 19 of the AS/400 Performance Capabilities Reference (SC41-0607) provides information about the performance characteristics of the INS. You can find it online in the AS/400 library (http://publib.boulder.ibm.com/html/as400/infocenter.html).

Application Examples with Performance Data

As part of our analysis, we are testing and measuring a variety of applications on the Dedicated Server. In this section, we describe the results for an application available from Domino for AS/400 ISVs, and one of the example applications that we have in our sizing document on the Web.

Binary Tree: ezMerchant

Description: The ezMerchant application provides businesses with a tailorable e-commerce solution which includes a product catalogue, shopping cart, and order management interface. ezMerchant 1.6.1 was tested on a 170-2408 Dedicated Server using a scenario comprised of the following end-user activities: 70% browsing, 20% purchases, and 10% registering as a new customer. The ezMerchant scenario accessed data residing in Domino databases.

Results: ezMerchant is a good fit for the Dedicated Server (as are other applications which access data in Domino databases). Using the scenario described above, test results showed greater than 82% of the processing was in Domino code. This test was run with a CPU utilization of 70%.

Sample Web Shopping Application: This application is described on the Domino Performance application sizing Web page (http://www.as400.ibm.com/domino /D4appsz.htm). The Web Shopping Application is a robust, transaction-oriented application for purchasing on the Web. It uses more databases and longer, more complex calculations (formulas) than would be typical of an information search and retrieval type application. Three different versions of the Web Shopping Application were compared:

- Accessing the data strictly in Domino databases (.NSF files)
- Using LS:DO to access the data locally in DB2 database files on the Dedicated Server
- Using LS:DO with DRDA to access data remotely on another AS/400 server.

Results: Table 2 shows the results we experienced with the three different versions of this application. (**Note:** Increased system overhead indicates that the ratio between Domino and non-Domino work has fallen below the recommended 3-to-1 ratio.) When using DRDA to access data on a remote server, average response times will also be impacted by the speed of the DRDA connection and the utilization of the server where the target databases reside.

Table 2

	Processing % in Domino	*System Overhead from non-Domino work*	*Average Response Time*
Data in .NSF files	77	none	0.39
LS:DO on Dedicated Server	55	some	0.51
LS:DO and DRDA to another AS/400 server	66	none	1.23

Observing Dedicated Server Performance

Throughout this paper, we've emphasized that the Dedicated Server delivers the best performance results when your ratio of Domino to non-Domino work is at least 3-to-1. When you fall below that ratio and non-Domino work on your Dedicated Server approaches the limits, system overhead on your server increases until you reach 100% CPU utilization. But how do you observe your Dedicated Server to know whether your non-Domino work is too high?

The easiest method for determining whether your Dedicated Server is operating at its optimal level is the Work with System Activity (WRKSYSACT) command. It shows all of the jobs and tasks on the AS/400e server that are consuming CPU cycles. For each processor on a system, you will see a system task called CFINTxx. For example, on a 2-way 2409 Dedicated Server, you will see CFINT01 and CFINT02. These CFINTxx tasks indicate the amount of system overhead on the server. If CFINTxx is using more than approximately 3% of the CPU, you have an indication that your workload balance may be below the recommended ratio. When you increase the amount of Domino processing or decrease the amount of non-Domino processing, you move the workload balance back to a 3-to-1 ratio and cause the system overhead to return to minimal levels.

Predicting Whether a Domino Application is Appropriate for the Dedicated Server

You can analyze a Domino application that is running on any AS/400e server to determine the amount of non-Domino work that it generates. Tools such as the Work with Active Jobs (WRKACTJOB) command provide a high level view by showing the amount of work running under the QNOTES users profile. However, when a Domino application calls system services as well as many other non-Domino functions, this non-Domino processing runs under the same job structure and QNOTES user profile. Therefore, you cannot assume that all processing that runs using the QNOTES user profile is Domino processing. The best method for determining the exact amount of Domino processing is by using the Performance Explorer.

Using Performance Explorer to Analyze Domino Processing

You can use the AS/400 Performance Explorer (PEX) tool to help determine whether a given Domino application environment is a good fit for a Dedicated Server. The PEX tool provides detailed information on what percent of the CPU cycles are running Domino code and non-Domino code. Here are the recommended prerequisites for using the PEX tool for Dedicated Server application analysis:

- OS/400 at least V4R3 (V4R4 is preferred to get a more accurate estimate)
- Domino 4.6 or higher (R5 is preferred to get a more accurate estimate)
- AS/400 Performance Tools Licensed Program

Note: You can run PEX on any AS/400e server that meets the above prerequisites. A Dedicated Server is not required for this analysis.

Following are the steps for using PEX to collect, report, and analyze Domino for AS/400 data:

Step 1) Use the following command to create a definition for the PEX data that you plan to collect:

```
ADDPEXDFN DFN(TPROFRC5) TYPE(*TRACE) JOB(*ALL) TASK(*ALL)
MAXSTG(100000) INTERVAL(5) TRCTYPE(*SLTEVT) SLTEVT(*YES)
BASEVT(*PMCO)TEXT('5 millisecond profile based on run
cycles')
```

Step 2) Use the following command to create a library for storing the data that the PEX tool collects:

```
CRTLIB LIB(DSDPEXDATA) TEXT('a place for my Dedicated Server
PEX data')
```

Note: You can use any library name you choose. Just replace DSDPEXDATA with whatever name you choose in all of the commands below as well.

Step 3) Before you begin collecting data, ensure that your Domino application(s) is running in a way that is representative of what you want to measure. In addition, *system CPU utilization should be above 50%* to ensure a high degree of confidence in the results.

Step 4) Use the following command to begin the PEX data collection process:

```
STRPEX SSNID(younameit) DFN(TPROFRC5)
```

Note: If you want to measure multiple scenarios, just use a different session name (the SSNID parameter) for each scenario. If you want to reuse a session ID, you must specify RPLDTA(*YES) on the ENDPEX command (Step 5) for the system to write over previously collected data.

Step 5) Wait 20 to 30 minutes while PEX collects data. Then use the following command to end the data collection process.

```
ENDPEX SSNID(session_name) DTALIB(DSDPEXDATA) TEXT('brief
description of test')
```

When the PEX data collection ends, the system deposits the data into the library that you created in Step 2.

Step 6) To generate the PEX report, use the following command:

```
PRTPEXRPT MBR(younameit) LIB(DSDPEXDATA) TYPE(*PROFILE)
PROFILEOPT(*SAMPLECOUNT *PROCEDURE)
```

Note: If you do not have the Performance Tools LP installed on this AS/400e server, you will need to move the library with the data, DSDPEXDATA, to a system that has the Performance Tools LP.

To analyze the PEX report, start on page 3 of the report (see example below). Look for the line that says **QNOTES** in the Name column. On this line, observe the value in column **Hit %.** If this value is above 60 (63.4 in the example below), then this application (based on the workload active during the PEX collection) is a good candidate for the Dedicated Server. Because of the amount of Domino processing, this application should see little or no system overhead as a result of non-Domino work. A smaller Hit% number indicates that the amount of Domino work might not be large enough to maintain a 3-to-1 ratio with non-Domino processing, thus preventing system overhead. Based on the 3-to-1 ratio we've been discussing, one might expect a 75% Hit% would be needed in order to maintain a 3-to-1 Domino to non-Domino processing ratio. However, based on our lab experiments, if a Hit% of 60 or more is shown for QNOTES component as shown in the report below, the environment is a good candidate for a Dedicated Server.

```
                          Performance Explorer Report          9/9/99 12:34:20
                               Profile Information                       Page 3

                                    Library Section

Library . . : DOMINO501
Member. . . : TPROF01

Description : T&T DB2 over DRDA to system Clara 28 users 8 iterations

Histogram       Hit      Hit   Cum       Start        Map   Stmt   Name
                Cnt       %     %        Addr         Flag  Numb

-------------------------------------------------------------------------------
               1080     2.0   19.4   FFFFFFFF8036CF84 MP     0    QU          LIC
                                                      |
                                                      |
                  1     0.0   83.0   263ED2E5D1004D34 MP     0    QNOTESINT
              34712    63.4   83.0   0743B72BD507B960 MP     0    QNOTES
                 11     0.0   83.0   FFFFFFFFC10BE400 MP     0    QM          LIC
                 48     0.1   83.1   FFFFFFFFC1208E38 MP     0    PX          LIC
                                                      |
                                                      |
                  4     0.0   99.7   FFFFFFFFC1574E3C MP     0    M2          LIC
```

Sizing a Dedicated Server for Your Domino Application

The recommended method for sizing Domino workloads for a Dedicated Server is the IBM Workload Estimator for AS/400. The Workload Estimator is available for Business Partners and IBMers. IBM and Lotus Representatives can access it from the Server Sales Web site (Select Proposal Resources, then Tools Downloads). Business Partners can access it from PartnerInfo (Select All Servers, then AS/400, then Proposal Resources, then Tools Downloads).

Because the Workload Estimator uses Java, your Netscape Browser must have the appropriate level of Java support. You must have Netscape Communicator 4.51 or higher, or, for Netscape Communicator 4.03 or 4.04, you must apply the appropriate patch to Netscape Communicator. Download it from Netscape Support for JDK 1.1 Archive for Communicator 4.03 and 4.04 at:
http://developer.netscape.com/software/jdk/download.html#NT_INSTALL

For sizing AS/400 servers other than the Dedicated Server, the Workload Estimator is the only tool that allows the combined effect of Domino, Java, Net.Commerce, and traditional workloads to be simultaneously estimated for a single server.

Tuning Tip for the Dedicated Server

Because the Dedicated Server supports limited interactive processing, you should use OS/400 defaults which enable Server Dynamic Tuning. This will prevent interactive processing from impacting Domino performance. Server Dynamic Tuning is applicable to all AS/400 servers, including the Dedicated Server. It acts as a regulator which can help reduce the impact to non-interactive processing when additional interactive workload is placed on the system. Using Server Dynamic Tuning can cause a noticeable slowdown in interactive response, which is the desired environment on a Dedicated Server to preserve Domino performance. You can ensure Server Dynamic Tuning is enabled by setting two system values to 1 ("ON").

- QDYNPTYSCD - Dynamic priority scheduler - this improves the job scheduling based on job impact on the system.
- QDYNPTYADJ - Dynamic priority adjustment - this uses the scheduling tool to shift interactive priorities after the threshold is reached.

(**Note:** The shipped default for both system values is "1", ON).

For additional information on Server Dynamic Tuning, please refer to Chapter 2, *AS/400 RISC Server Model Performance Behavior, of the AS/400 V4R4 Performance Capabilities Guide* (August 1999 edition) which can be accessed online at: http://publib.boulder.ibm.com/pubs/html/as400/online/chgfrm.htm.

Web Sites with Dedicated Server Information

You can find more information about the Dedicated Server and about Domino for AS/400 at the following Web sites:

http://www.as400.ibm.com/domino/dsd.htm	AS/400e Dedicated Server for Domino home page
http://www.as400.ibm.com/domino	Domino for AS/400 home page
http://www.notes.net	Select Iris Today for information about Domino R5

Appendix: Detailed Information about Dedicated Server Performance Behavior

The AS/400e Dedicated Server for Domino is functionally capable of running applications not related to Domino. However, it is designed to run applications that are purely or predominantly Domino. An application that is completely or predominantly not Domino will not run well on a Dedicated Server.

The Dedicated Server delivers optimal performance when the ratio of the Domino to non-Domino work is approximately 3-to-1 or higher. When the ratio drops below that level (either because the non-Domino workload is increasing or the Domino workload is decreasing), system overhead (seen in CFINT) increases. This system overhead has the effect of adding CPU service time, which can increase response times for all users on the system including Domino application users.

The published guideline is that you keep the non-Domino processing at or below 10-15% CPU. Staying within this guideline has the following benefits:

- Your server is less likely to fall below the 3-to-1 Domino to non-Domino processing ratio
- You minimize the amount of system overhead that occurs even if the ratio drops below 3-to-1
- You allow for brief spikes of non-Domino processing with minimal impact to response times.

If you add non-Domino workload beyond this 10-15% rating guideline, system overhead will continue to increase with the non-Domino workload. The total CPU utilization will approach 100% and eventually saturate. The point at which this will occur varies by processor feature. We do not recommend operating the Dedicated Server beyond this guideline.

If you find your Dedicated Server operating in a manner in which higher levels of system overhead are present due to non-Domino work, additional Domino processing can reclaim the processing resources being used by that system overhead. (This is different than the system overhead behavior which occurs when you exceed the interactive capacity limit on an AS/400.) Depending on how much Domino processing you add, the overall CPU utilization may be nearly the same as before the additional Domino work was added. When you restore the workload to the recommended 3-to-1 ratio, system overhead is minimal and the server achieves a higher level of Domino throughput. Within the development lab, we refer to this new behavior as Favored Priority Inversion.

Performance Tip: Use OS/400 job priority settings to prioritize Domino processing above non-Domino processing. This allows the Domino workload to compete more effectively for system resources and lessen the impact of system overhead. This is particularly important at high levels of CPU utilization. Please note, however, that non-Domino processing initiated by a Domino thread will run at the same priority as the Domino thread, so this tip might not always be applicable.

Examples of Dedicated Server Performance Behavior

The following figures describe Dedicated Server behavior for the 170-2409 processor feature for four different workload environments. The figures describe Dedicated Server behavior as the workloads change, and assess whether the workloads are appropriate for the Dedicated Server. In these examples, the terms workload and processing can be used interchangeably. (**Note:** The 2407 and 2408 processor features will handle a slightly higher percentage of non-Domino processing than what is shown for 2409). *Please note that in all of the following examples, you can reclaim most of the processing used by system overhead when you increase the amount of Domino processing on the system.*

Appropriate Workload Balance for the Dedicated Server

Figure 1 and Figure 2 show the use of Dedicated Server system resources when the ratio of Domino processing to non-Domino processing is greater than 3-to-1. This is an appropriate workload for the Dedicated Server and provides the most efficient use of system resources.

In Figure 1, the Domino work remains constant at 75% of the CPU. The non-Domino work varies.

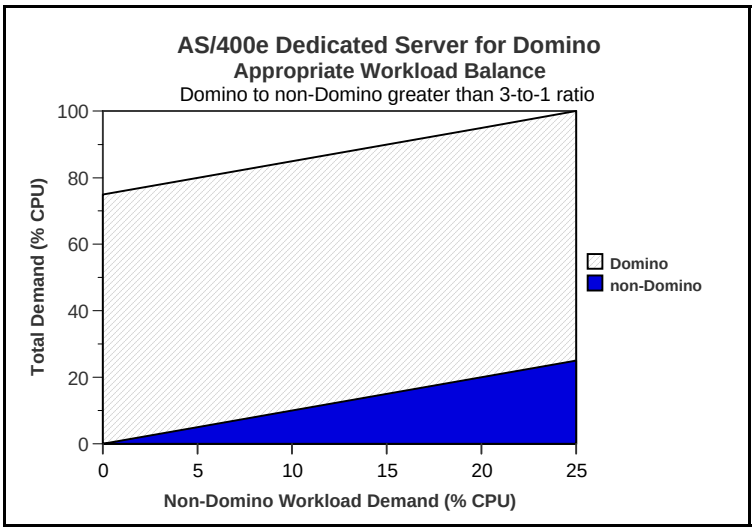

Figure 1: Domino processing is constant at 75% CPU, non-Domino processing varies

In Figure 2, both the Domino and non-Domino work increase proportionately. The example illustrates the desirability of setting the priority of the Domino work higher than the priority of the non-Domino work. In this example, the relatively higher priority of the Domino work helps keep the non-Domino work from exceeding 20% and further interfering with the Domino work.

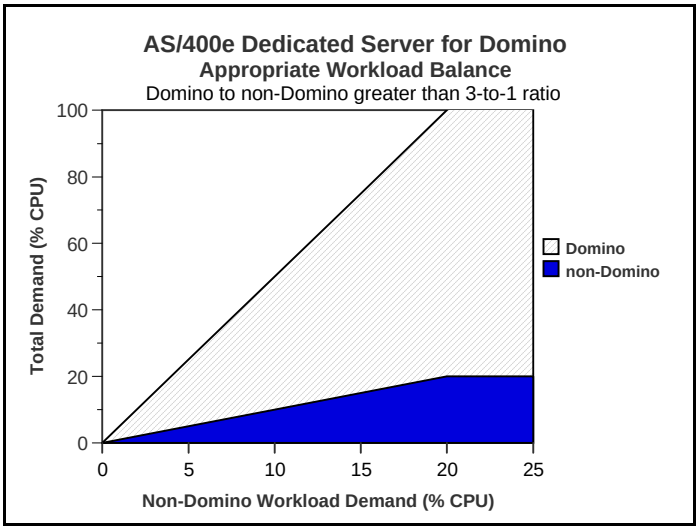

Figure 2: Domino and non-Domino processing increase proportionately

As both Figures 1 and 2 demonstrate, setting the priority of the Domino work higher than the priority of the non-Domino work is particularly important when your server is operating with higher than recommended amounts of non-Domino client/server processing (i.e., operating near the right edge of the graph). The higher relative priority of the Domino processing helps ensure that it continues to receive an appropriate amount of the processing resources, with minimal interference from the non-Domino processing.

Note: You can set a different priority for the non-Domino processing only when it runs in a separate process from the Domino processing.

Marginal Workload Balance for the Dedicated Server

Figures 3 and 4 show system resources when the ratio of Domino to non-Domino processing is near 3-to-1. In Figure 3, the Domino processing remains at a constant 45% of CPU. The non-Domino processing varies. Near a point of 15% non-Domino processing, the ratio drops below 3-to-1 and system overhead becomes measurable as the non-Domino workload increases. (Compare this to Figure 1 where the higher Domino usage effectively reclaims all of the processing resources which would have otherwise been consumed by this system overhead.)

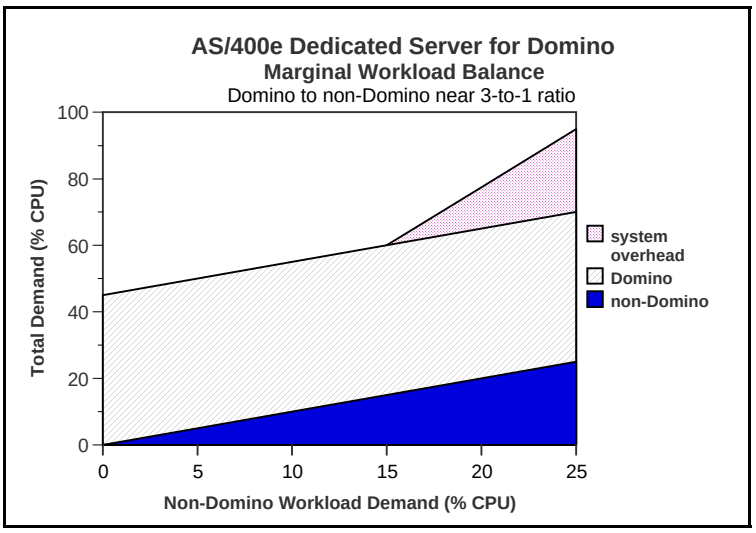

Figure 3: Domino processing is constant at 45% CPU, non-Domino processing varies

In Figure 4, the Domino workload is increasing proportionately with the non-Domino workload. At all points in this example, the Domino workload is using system resources that would otherwise be used by system overhead (as you see in the right hand portion of Figure 3). Figure 4 shows a Dedicated Server running slightly below the 3-to-1 ratio and demonstrates that as Domino workload increases, it can reclaim processing resources being used by the system overhead that was caused by non-Domino processing. This figure also shows that even with low levels of non-Domino work, system overhead can be measurably higher than nominal levels if the ratio of Domino to non-Domino work is less than 3-to-1.

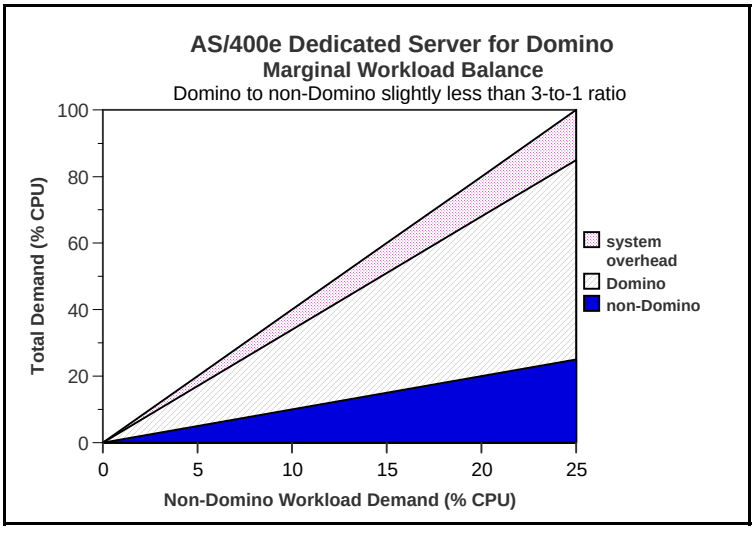

Figure 4: Domino and non-Domino processing increase proportionately

Inappropriate Workload for the Dedicated Server

Figures 5 and 6 demonstrate the system overhead that occurs when the ratio of Domino to non-Domino processing falls significantly below the recommended 3-to-1 ratio. In Figure 5, the Domino processing remains at a constant level. As the non-Domino processing increases, the system overhead increases until the system reaches saturation.

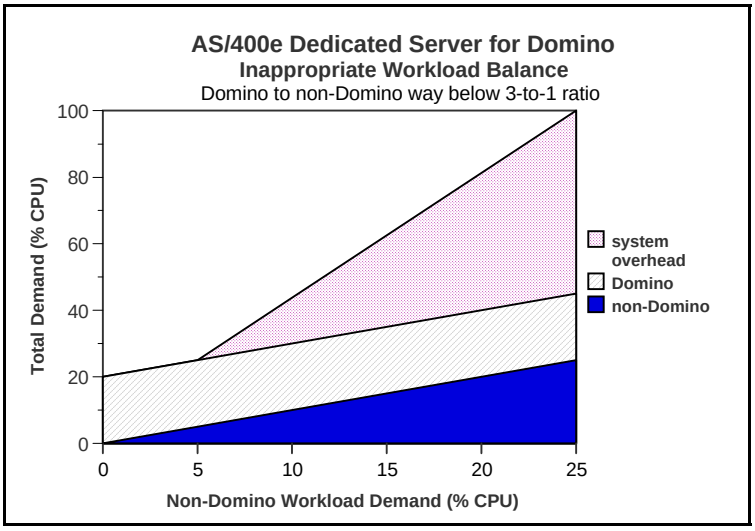

Figure 5: Domino processing is constant at 20% CPU, non-Domino processing varies

In Figure 6, the Domino workload is increasing along with the non-Domino workload but is significantly below the 3-to-1 ratio. At all points in this example, the Domino workload is using system resources that might otherwise be used by system overhead (as you see in Figure 5). Figure 6 again shows that as Domino workload increases, it can reclaim processing resources being used by system overhead that was caused by non-Domino processing.

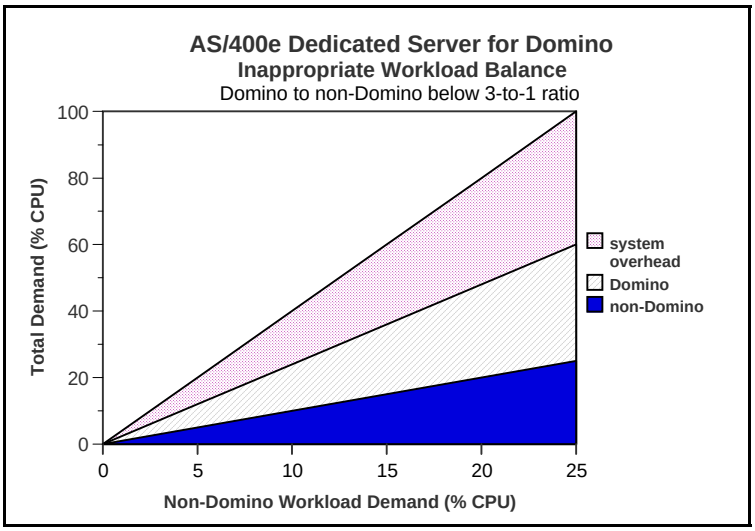

Figure 6: Domino and non-Domino processing increase proportionately

Dedicated Server Running only Non-Domino Workload

Figure 7 shows a Dedicated Server that is running only non-Domino work, for example during system administration activities such as system backup. Adequate system resources are available to perform reasonable administration activities, even though system overhead may be present. Please note that even though a high amount of system overhead is present, the Dedicated Server is providing the full rated non-Domino Processor CPW for such non-Domino administrative operations. If the System Administration activity is performed using interactive jobs, the Interactive CPW limit will apply which will allow a lower CPU utilization for the non-Domino interactive work than what is shown in Figure 7.

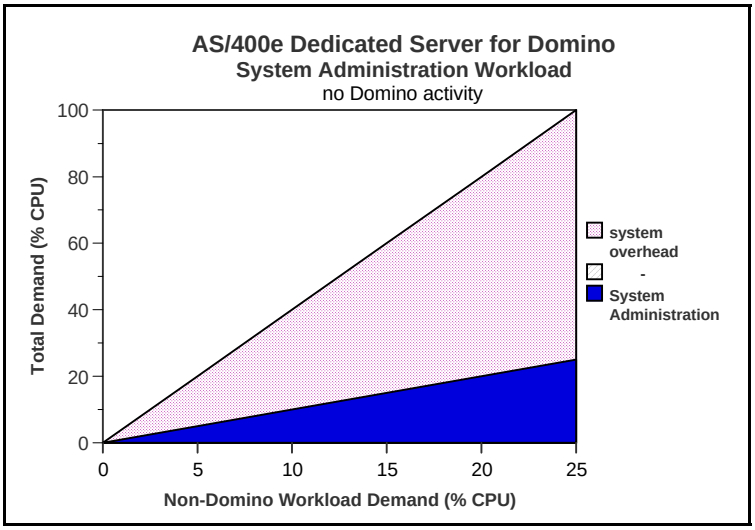

Figure 7: Non-Domino System Administration Workload

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