ENTERPRISE SOLUTIONS FOR LOTUS DOMINO

Cost/Benefit Analysis for Large-Scale IT Deployment

International Technology Group

885 North San Antonio Road, Suite C
Los Altos, California 94022-1305
Telephone:(650) 949-8410
Facsimile: (650) 949-8415
Email: itg1@pacbell.net

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BUSINESS-CRITICAL

The role of Lotus Domino extends beyond messaging. It has become a critical component in enterprise infrastructures for the communication and exploitation of information. Increasingly, it supports intranets, extranets and a wide range of new applications driven by Web technology and the mandates of e-business competitiveness.

Demand for Domino for S/390 is growing rapidly. More organizations are choosing to deploy Domino on S/390 systems because Domino has become a business-critical resource. As such, it requires deployment strategies that are fundamentally different from those of first generation e-mail systems and small-scale Notes applications.

Organizations that have deployed, or are in the process of deploying Domino for S/390 report that this platform provides three main sets of advantages:

1. ***Service quality***. Higher levels of availability are cited by 79 percent of users as a critical S/390 benefit. System and data management, response time and security capabilities of this platform are also reported to contribute to higher levels of service quality than can be delivered by any other platform.

    The ability to leverage existing mainframe skills and infrastructures is valued by a wide range of users. As Domino becomes business-critical, the same quality and predictability of service as for data center systems is required. S/390 strengths in service quality, along with the ability to support large, volatile workloads, appeal particularly to organizations using Domino for e-business applications.

2. ***Enterprise integration***. As Domino solutions become more closely integrated with other systems within the enterprise, mainframe interoperability becomes a central component of the integration equation. For 72 percent of Domino for S/390 users, this is a critical benefit. Access to core mainframe applications and databases proves to be a simpler, more reliable, faster process if this platform is employed.

    Among most Domino for S/390 users — and in most large organizations worldwide — mainframes continue to run business-critical systems that generate the vast majority of transaction data. The often-heard figure that "70 percent" of corporate data resides on mainframes is an understatement. Levels commonly exceed 90 percent.

3. ***Lower costs***. Overall, 53 percent of Domino for S/390 users report that S/390 systems offered the lowest cost compared to any other platform evaluated. Two percent report that S/390 costs were higher, while five percent said costs were similar. The remainder had not conducted detailed analyses.

    In 12 examples detailed in this report, average three-year UNIX server costs for conventional Notes mail and applications are more than 54.7 percent higher than for S/390-based systems. Costs are also more than 81.5 percent higher for new technology applications employing Domino with Web browsers, intranets and extranets. UNIX server costs are based on Sun Microsystems platforms. Microsoft Windows NT and Windows 2000 costs were also reported to be significantly higher.

These conclusions are based on a survey of 43 Domino for S/390 users. Results indicate that the S/390 is becoming an increasingly competitive option for Domino deployment for a wide range of organization sizes, industries and application requirements.

SUMMARY OF RESULTS

Transitions

Deployment of Domino for S/390 began to accelerate markedly in 1999. By the end of the year, more than 400 systems had been installed, supporting approximately 1.5 million client users. On current trends, the figures at yearend 2000 will be more than 700 systems and three million client users.

Domino for S/390 momentum is, to some extent, due to changes at the product level. Removal of scalability constraints in Domino software means that the benefits of extremely large system images inherent to S/390 architecture may be more fully realized. R5 enhancements in such areas as memory management and locking enable S/390 strengths in I/O-intensive performance to be more effectively exploited.

According to users interviewed for this report, these changes materially improve the cost/benefit case for S/390 for Domino serving. It can be expected that the significantly higher levels of scalability and I/O performance of the zSeries architecture will make this platform an even more attractive option for hosting large-scale, high-volume Domino solutions extending across and — increasingly — beyond the enterprise.

Increasing demand for Domino for S/390 reflects fundamental shifts in the manner in which Domino is deployed and managed. Deployment on S/390 intersects with a pervasive trend toward server consolidation. Among the 43 organizations surveyed, 31 (72 percent) had replaced, or were in the process of replacing smaller servers with centralized S/390 systems.

A variety of platforms can be used to consolidate Domino servers. But the distinctive appeal of the S/390 platform involves other characteristics whose value to users is increasing over time.

Service Quality

Many Domino users are moving to implement effective service-level management practices. Outages that would be merely irritating at the departmental or divisional level are a great deal more serious when they impact business-critical networks and applications supporting organization-wide user bases.

The "classical" strengths of the S/390 platform have become more attractive as this transition occurs. Among the organizations surveyed, 34 (79 percent) cited the higher availability and reliability levels that could be achieved for Domino networks using S/390 systems.

Availability was, however, only part of the service quality equation. Response time, predictability, backup and recovery, as well as other factors were also major issues. It was necessary to manage all service variables effectively, in real-time. S/390 strengths in these areas were widely cited as reasons for deploying Domino on this platform.
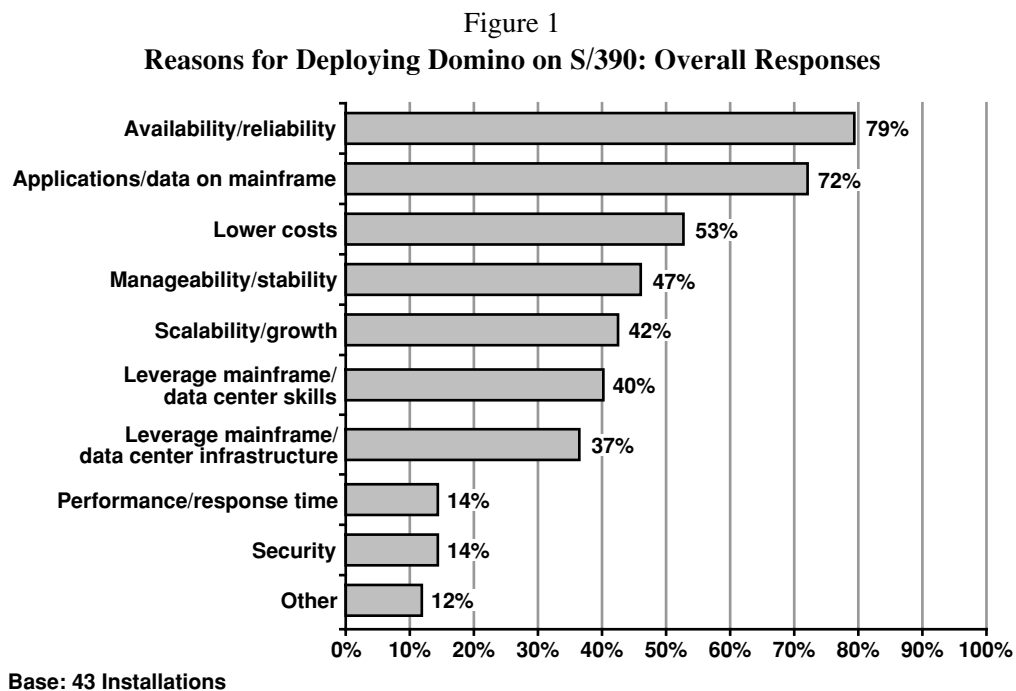
Among organizations using Domino for new technology applications such as intranets and extranets, the proportion citing availability and reliability — 88 percent — was even higher than the overall average. S/390 strengths were seen as particularly critical to maintaining 24/7 availability for Web applications that interfaced to customers, partners and suppliers.

Enterprise Integration

Conventional e-mail systems, discussion databases or chat rooms may, to some extent, be managed as standalone resources. But business-critical applications, groupware, intranets and extranets require integration with other systems and databases.

For 31 of the 43 (72 percent) organizations surveyed, the fact that key applications and data sources were mainframe-based was a primary reason for deploying Domino on S/390 systems. Application interoperability and data access could be more easily realized by hosting Domino servers on the same platform.

As figure 1 shows, this ranked as the Number 2 reason overall for choosing this platform. If organizations employing only Domino-based e-mail systems are excluded, the proportion increases to 31 of 38 (82 percent).

Figure 1
Reasons for Deploying Domino on S/390: Overall Responses

Reason	Percentage
Availability/reliability	79%
Applications/data on mainframe	72%
Lower costs	53%
Manageability/stability	47%
Scalability/growth	42%
Leverage mainframe/data center skills	40%
Leverage mainframe/data center infrastructure	37%
Performance/response time	14%
Security	14%
Other	12%

Base: 43 Installations

S/390 hosting, according to users, significantly reduced complexity of implementation. Clients could access mainframe data without having to go through a middle tier of servers and replication mechanisms. Maintaining consistency and currency of content was also easier. Real-time data access could be more effectively realized by eliminating the complexities of an intermediate architectural layer.

Production synergies can be realized with any platform. If primary production platforms are UNIX, Windows 2000 or AS/400 servers, integration will be materially easier if these are also employed for Domino hosting. But in all of the organizations surveyed — and in many others — mainframes support primary business-critical systems, and mainframe databases house the data generated by these.

Workload Growth

The ability of S/390 to handle large workloads, and to scale easily to support increases in these, also emerged as a significant reason for deciding to deploy Domino on this platform.

Among corporate users, mergers and acquisitions (M&As) significantly expanded networks in at least six cases. One company's Notes user population had grown from 50,000 to 90,000 within a couple of years. Another expected an increase from 120,000 to 170,000 as a result of a pending acquisition.

Such experiences were common in industries with high levels of M&A activity, such as financial services and insurance. Expansion was, in these cases, coupled with consolidation of e-mail, groupware and intranet networks that had previously been managed by individual business units and subsidiaries.

Overall, 18 of the organizations surveyed — 42 percent — reported scalability and growth as a key reason for choosing the S/390 platform. However, among new technology users — organizations that had deployed, or were in the process of deploying browser-based applications, Web mail, intranets and extranets — the proportion was, as figure 2 shows, considerably higher at 59 percent.

Figure 2
Reasons for Deploying Domino on S/390: New Technology Users
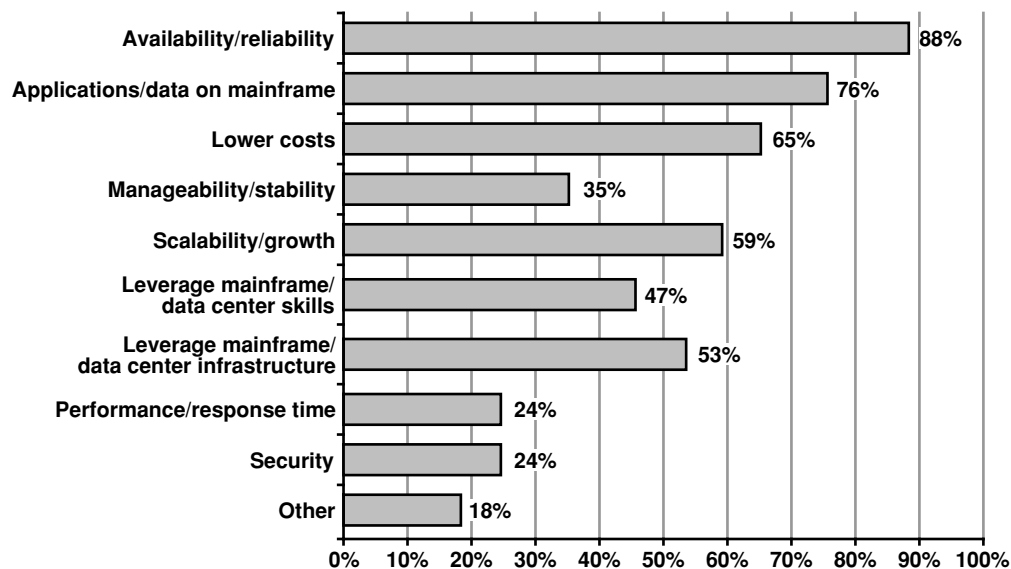
Base: 17 Installations

The greater significance of S/390 scalability strengths among new technology users reflects, to some extent, the higher levels of server loading generated by Web browsers. According to most respondents employing these, server workloads were routinely three to five times greater than for comparable Notes client applications. This effect obliged a number of companies to revise platform choices.

One company planning to migrate from Notes clients to browsers was, for example, faced with the probability that its NT server base would expand from 120 to more than 500 servers. Another found that even the most scalable UNIX servers "crashed with half the workload" that could be supported by a mid-sized S/390 system.

New technology workloads were also less predictable than in Notes client e-mail networks. The latter had typically been in place for some time, and user populations and behavior patterns were relatively stable. But with new technology workloads — particularly for intranets and extranets — rapid growth and high levels of spiking were the norm.

It can be expected that the new Lotus "Shimmer" code will reduce server loading for Web applications. Among most organizations, however, it was clear that rapid growth in the size and volatility of Web workloads would continue for the foreseeable future. Overall server loading would thus continue to increase — and S/390 scalability strengths would continue to be important — even as Shimmer software was deployed.

Cost Picture

NT and Windows 2000

Organizations that had evaluated multiple platform options consistently reported that the overall costs of S/390-based Domino deployments were significantly less than those for NT and Windows 2000 servers. Most reported that overall costs for NT-based Domino services were three to five times higher than for equivalent S/390 implementations.

One respondent also noted that difficulties in obtaining and retaining qualified NT and Windows 2000 specialists contributed substantially to higher costs for these platforms. Turnover, costs to hire (routinely $60,000 or more per individual), and the often unsatisfactory skill and experience levels of staff which were available represented major — if not always visible — cost items.

Disparities increased if — as had occurred in at least five organizations — allowance was made for lost revenues and productivity due to outages. In these cases, it was estimated that the costs of e-mail downtime ranged from $5,000 to more than $8,000 per hour — the average was approximately $6,500. Losses due to application downtime could be significantly larger.

S/390 and UNIX Servers

Organizations that had evaluated UNIX platforms — including Sun servers (seven), IBM RS/6000s (four) and Hewlett-Packard servers (one) — also reported that S/390 systems offered a lower-cost option. In other cases, detailed cost comparisons were not conducted because it was determined that UNIX servers could not handle workloads, or could not do so while delivering adequate service quality.

Higher UNIX server costs were a function of four main factors:

1. *Performance*. Among organizations that conducted custom "stress tests" for different platforms, it was reported that the actual performance of UNIX servers with Domino workloads was significantly lower than had originally been expected. Generalized benchmark tests such as NotesBench tended to give a misleading impression of how systems would perform in practice.

    Comparisons of NotesBench results and actual user configurations for Sun platforms showed particularly wide disparities. Several respondents commented on this. S/390 capacity projections were reported to be more accurate. Based on actual performance, S/390 systems yielded significantly better price/performance levels.

2. *Service levels*. As one respondent noted, "the cost structure for an (enterprise infrastructure) is altogether different" from a basic e-mail system. Maintenance of high levels of availability and response time required larger configurations. Effective data security, backup and recovery also required extensive investments.

    There was general agreement that S/390 systems met these requirements more cost-effectively than other platforms. Higher levels of CPU utilization and disk occupancy could, for example, be employed without impairing service quality. Several organizations reported, for example, that they were able to sustain efficient production operations with peak CPU utilization in the 95 percent to 100 percent range.

3. *Personnel*. Numbers of full time equivalent (FTE) system administrators were reported to be higher for UNIX servers — by at least two to three times — than for S/390 configurations. This occurred even when relatively large multiprocessor servers with 32 to 64 CPUs were employed. In practice, multiple servers were typically required to provide Domino performance equivalent to single a S/390 system.

    The choice was thus often not between an S/390 and a single UNIX server with two to three times higher staffing. It was between a single S/390 and two or three UNIX servers, each with two to three times higher staffing. This significantly increased disparities in the number of system administration staff required.

4. *Pricing*. Users reported that IBM pricing for S/390 hardware and software for Domino deployment was, to quote one respondent, "very aggressive." In all comparisons with the Sun E10000, S/390 capital costs were reported to be lower. OS/390 license fees were also heavily discounted.

The combined impact of these factors on relative costs is shown in figures 3 through 6. These figures compare configurations and cost for a set of actual Domino R5 installations for conventional (companies A through F) and new technology (G through L) applications. All S/390 configurations employ G6 technology, while Sun configurations are based on 400 MHz UltraSPARC-II CPUs.

Figure 3
Three-Year Cost Comparisons: Conventional Users (1)

INSTALLATION	COMPANY A Finance	COMPANY B Distribution	COMPANY C Finance
Profile	80,000+ users Notes mail Peak 30% active 80 MB avg. mail file 50 KB avg. message Multiple TB database 24/7 availability	30,000 users Notes mail, calendaring & scheduling Peak 35% active 40 MB avg. mail file 24/7 availability	15,000 users Notes mail, calendaring & scheduling Peak 35% active 50 MB avg. mail file 24/7 availability
S/390 CONFIGURATION			
Configuration & staffing	2xZ97-12 LPARs 36 GB RAM 6.5 TB ESS OS/390 base 4 FTEs	Z67-6 LPARs 18 GB RAM 1.2 TB ESS OS/390 base 2 FTEs	Z37-3 LPARs 9 GB RAM 750 GB ESS OS/390 base 1 FTE
3-Year Cost ($000)			
Hardware	$6,845	$2,487	$1,360
Maintenance	767	279	152
Software	677	255	137
Personnel	1,127	564	282
TOTAL	**$9,416**	**$3,585**	**$1,931**
SUN CONFIGURATION			
Configuration & staffing	E10000 5x64 320 GB RAM 9 TB SEA Solaris 20 FTEs	E10000 2x64 128 GB RAM 1.6 TB SEA Solaris 4 FTEs	E10000 60 CPUs 60 GB RAM 1 TB SEA Solaris 2 FTEs
3-Year Cost ($000)			
Hardware & Software	$9,404	$3,510	$1,687
Maintenance	118	439	228
Personnel	5,375	1,075	538
TOTAL	**$14,897**	**$5,024**	**$2,453**

ESS: Enterprise Storage Server – RVA: RAMAC Virtual Array – SEA: StorEdge Array

The three profiles above are of large installations employing Domino for conventional Notes Mail, and Notes Mail with calendaring and scheduling. The S/390 configurations average between 27 and 30 registered users per MIPS, while the Sun configurations average between 234 and 250 registered users per 400 MHz CPU.

The Sun figures are based on user experiences. It should be noted that they are significantly different from the NotesBench test numbers employed in Sun and (in some cases) third-party documentation as a recommended basis for configuration sizing.

S/390 economies of scale in system and staff utilization become more significant as installation sizes increase. In Company A (80,000 users), three-year UNIX server costs are 58.2 percent higher than costs for S/390 systems. In Company B (30,000 users) and Company C (15,000 users) costs are 40.1 and 27.0 percent higher respectively.

Figure 4
Three-Year Cost Comparisons: Conventional Users (2)

INSTALLATION	COMPANY D Computer Services	COMPANY E Manufacturing	COMPANY F Finance
Profile	20,000+ users Notes mail, calendaring & scheduling Notes applications Peak 45% active 120 MB avg. mail file Multiple TB database 24/7 availability	40,000+ users POP3 mail Peak 33% active 24/7 availability	3,000+ users IMAP4 mail Peak 33% active
S/390 CONFIGURATION			
Configuration & staffing	ZZ7+Z87 6 LPARs 24 GB RAM 4 TB ESS OS/390 base 2 FTEs	Z57-4 LPARs 6 GB RAM 1 TB RVA OS/390 base 3 FTEs	120 MIPS LPAR 3 GB RAM 100 TB RVA OS/390 base 0.5 FTE
3-Year Cost ($000)			
Hardware	$6,634	$2,089	$288
Maintenance	743	234	32
Software	716	217	43
Personnel	564	846	141
TOTAL	**$8,657**	**$3,386**	**$504**
SUN CONFIGURATION			
Configuration & staffing	E10000 6x60 360 GB RAM 6 TB SEA Solaris 12 FTEs	E10000 2x50 100 GB RAM 1.5 TB SEA Solaris 6 FTEs	E4500 12 CPUs 12 GB RAM 120 GB SEA Solaris 1 FTE
3-Year Cost ($000)			
Hardware & Software	$10,122	$3,007	$236
Maintenance	1,265	376	30
Personnel	3,225	1,612	269
TOTAL	**$14,612**	**$4,995**	**$535**

ESS: Enterprise Storage Server – RVA: RAMAC Virtual Array – SEA: StorEdge Array

The three conventional user profiles above represent "special cases." Company D is characterized by exceptionally heavy Notes Mail, calendaring, scheduling and business application workloads. The S/390 and Sun configurations average only around 7.4 registered users per MIPS and 56 registered users per 400 MHz CPU respectively.

The average ratios are higher for both platforms for Company E — 46 registered users per MIPS, and 400 registered users per CPU respectively — reflecting lower server loading for simple POP3 mail. In Company F, a relatively small installation employing IMAP4 protocols, averages are closer to conventional Notes Mail.

For companies D, E and F, three-year UNIX server costs are 68.8, 47.5 and 6.2 percent higher respectively than for S/390 systems.

Figure 5
Three-Year Cost Comparisons: New Technology Users (1)

INSTALLATION	COMPANY G Transportation	COMPANY H Finance	COMPANY I Finance
Profile	125,000+ users Enterprise portal Peak 250K hits/hour Multiple TB database 24/7 availability	25,000+ users Web mail & applications Intranet & extranet Peak 40% active 50 MB avg. mail file Multiple TB database 24/7 availability	20,000 users Intranet & extranet Web mail & applications Notes mail & applications Peak 40% active 50 MB avg. mail file 24/7 availability
S/390 CONFIGURATION			
Configuration & staffing	Z37-4 LPARs 12 GB RAM 6 TB ESS OS/390 base 3 FTEs	2xZ67 6 LPARs 24 GB RAM 4 TB ESS OS/390 base 2 FTEs	2xZ67 6 LPARs 24 GB RAM 2 TB ESS OS/390 base 2 FTEs
3-Year Cost ($000)			
Hardware Maintenance Software Personnel	$1,811 203 137 846	$4,916 551 510 846	$4,969 556 510 564
TOTAL	**$2,997**	**$6,823**	**$6,599**
SUN CONFIGURATION			
Configuration & staffing	E10000 2x44 88 GB RAM 8 TB SEA Solaris 6 FTEs	E10000 5x60 300 GB RAM 2 TB SEA Solaris 15 FTEs	E10000 5x56 280 GB RAM 2.4 TB SEA Solaris 12 FTEs
3-Year Cost ($000)			
Hardware & Software Maintenance Personnel	$3,480 435 1,612	$8,027 1,003 4,031	$7,556 945 3,225
TOTAL	**$5,527**	**$13,061**	**$11,726**

ESS: Enterprise Storage Server – RVA: RAMAC Virtual Array – SEA: StorEdge Array

The three profiles above are of major new technology installations. Company G employs an S/390 system for a relatively low-impact enterprise portal application. Although user populations are smaller in companies H and I, application workloads are significantly larger, and configurations and costs are correspondingly higher.

In these cases, performance and cost disparities in favor of S/390 systems are greater than for most conventional installations. This appears to reflect the greater impact of S/390 scalability, performance and quality of service optimization relative to the E10000 platform for these types of workload.

Three-year UNIX server costs are 84.4, 91.4 and 77.7 percent higher than for S/390 systems for companies G, H and I respectively.

Figure 6
Three-Year Cost Comparisons: New Technology Users (2)

INSTALLATION	COMPANY J Finance	COMPANY K Finance	COMPANY L Insurance
Profile	10,000+ users Intranet & extranet Web mail & applications Notes mail & applications Peak 30% active 40 MB avg. mail file 24/7 availability 99.996% service level	5,000+ users Web mail & applications Intranet Peak 30% active 50 MB avg. mail file	5,000+ users Web applications Intranet Peak 40% active 24/7 availability
S/390 CONFIGURATION			
Configuration & staffing	Z47-2 LPARs 12 GB RAM 600 GB ESS OS/390 base 1 FTE	Z37-2 LPARs 10 GB RAM 400 GB RVA OS/390 base 1 FTE	Z27 4 GB RAM 250 GB RVA OS/390 base 1 FTE
3-Year Cost ($000)			
Hardware	$1,756	$1,171	$900
Maintenance	197	131	101
Software	153	115	94
Personnel	282	282	282
TOTAL	**$2,388**	**$1,699**	**$1,377**
SUN CONFIGURATION			
Configuration & staffing	E10000 2x64 128 GB RAM 1 TB SEA Solaris 4 FTEs	E10000 60 CPUs 60 GB RAM 500 GB SEA Solaris 2 FTEs	E10000 48 CPUs 48 GB RAM 300 GB SEA Solaris 2 FTEs
3-Year Cost ($000)			
Hardware & Software	3,444	$1,619	$1,381
Maintenance	431	202	173
Personnel	1,075	538	538
TOTAL	**$4,950**	**$2,359**	**$2,092**

ESS: Enterprise Storage Server – RVA: RAMAC Virtual Array – SEA: StorEdge Array

The three profiles above are of smaller new technology installations. Performance and cost disparities again favor S/390 systems. Three-year UNIX server costs are 38.8 and 51.9 percent higher than for S/390 systems in companies K and L respectively.

The greatest disparity between S/390 and UNIX server costs for any installation — 107.3 percent — is for Company J. This financial services firm operated with a mandated service level of 99.996 percent for business-critical Web applications. It was questionable, however, whether even a clustered Sun configuration with low utilization levels could have met this goal.

Overall disparities — based on raw cost totals for each group of installations — are that UNIX server costs are 54.7 higher for conventional installations (companies A to F) and 81.5% higher for new technology installations (companies G to L).

Skill Bases

Overall, 17 of the organizations surveyed (40 percent) cited the ability to leverage existing data center skills as a reason for deciding to deploy Domino on S/390 systems.

Skills were an important issue among smaller organizations, particularly those without a base of UNIX systems and personnel. But even in larger installations, several respondents commented that the presence of a competent and experienced mainframe staff contributed to decisions in favor of the S/390 platform.

The issue was summarized by a manager who observed that "it's easier to teach mainframe people to support Domino than to teach Notes Administrators to do service-level management." Using existing data center staff to manage availability and performance was said to be a great deal easier than attempting to build a similar base of skills among Notes specialists whose experience and culture focused on different values.

This was notably the case in that existing mainframe tools could be employed to provide a richer set of functionality than their Domino-specific counterparts. The Resource Measurement Facility (RMF) incorporated in the OS/390 base environment, along with a number of other IBM and third-party tools were specifically cited.

The attractions of using existing mainframe staff were reinforced by the fact that, in most cases, Domino could be deployed with little or no increase in headcount for S/390-specific system administration, system administration and related personnel . Most organizations reported (to quote one respondent) a "zero increase" in these categories of staff. Even the largest installations reported increases of only three or four FTEs.

Infrastructures

A similar number of organizations — 16 (37 percent) — cited the ability to leverage existing mainframe and data center infrastructures as a reason for deploying Domino on S/390 systems. Although skills and infrastructures were often mentioned by the same organizations, this was not always the case.

Companies that had deployed, or planned to deploy intranets and extranets tended to be more sensitive to infrastructure issues. Among new technology users, nine (53 percent) cited existing mainframe-based infrastructures as a key factor in their decisions.

These included finance and insurance companies, as well as service bureaus active in these industries. Some of these companies were employing Domino for customer extranets for applications such as online banking, Web self service and electronic funds transfer. Workloads were transaction-intensive and required de facto 100 percent uptime and high security levels.

The profile of these applications was a great deal closer to conventional mainframe-based business-critical systems than to, say, Notes mail. The strengths of S/390 architecture were obviously relevant, and became decisive in the platform selection process.

DETAILED ANALYSIS

Demand Drivers

Types of User

Domino for S/390 users surveyed covered a wide range of organization sizes, industries and applications. Generally, however, these companies — and their reasons for choosing to deploy Domino on S/390 systems — can be segmented as follows.

The two largest groups were (1) conventional Notes and Domino users, and (2) new technology users employing browsers and Web applications.

A third group of organizations employed Domino for S/390 only for Notes business applications. As reasons for deploying Domino on S/390 systems, these respondents typically cited classical S/390 strengths, the ability to leverage existing skills and — most important — the fact that data sources were mainframe-based.

The survey also included a university and a manufacturing company using Domino for S/390 for relatively light-duty POP3 mail, along with a service bureau using IMAP4 mail. Most of the survey population, however, employed full-function Notes clients, browsers or (increasingly) both.

Conventional Users

This group consisted of organizations employing Notes client software and Domino primarily for e-mail, calendaring, scheduling and business applications. They included six large organizations in the range of 20,000 to more than 80,000 registered users, along with a wide range of smaller installations.

In most cases, these had been early Notes users who had originally deployed Domino on NT or UNIX platforms, and had then moved or were moving to Domino for S/390 as part of server consolidation initiatives. Consolidation exercises ranged from 400 users and a few servers to 80,000 users (two cases) and more than 600 servers.

The appeal of Domino for S/390 was largely driven by classical S/390 strengths such as availability, manageability and support for large workloads using single system images. Organizations had typically experienced service quality problems with networks based on distributed servers. Consolidation savings were also widely cited.

In larger companies, moves to S/390 tended to coincide with larger IT reorganizations (in several cases following M&As) which created centralized management infrastructures for key services. There were typically concerns to achieve enterprise-wide integration of key systems, and to realize economies of scale.

Service quality played a major role in decisions to deploy Domino on S/390. Part of the S/390 appeal was that it assisted in improving the availability and predictability of mail service. Service-level practices that had previously been restricted to the data center environment were now being extended to Notes networks.

There was a trend toward what one respondent described as a better "division of labor" among staff. In several organizations, the management and operation of underlying servers was turned over to data center specialists, enabling Notes Administrators to focus on higher value-added tasks. This led to significantly better utilization of both sets of skills.

This approach was, it was noted, inevitable once companies moved to centrally managed models for their Notes and Domino systems. A Notes Administrator supporting a department or remote site might be able to double as an NT or Windows 2000 server administrator. But it was not realistic to expect them to manage S/390, UNIX or AS/400 systems, or even a more complex clustered Windows 2000 environment.

Availability and reliability issues, as figure 7 shows, played a major role in decisions to deploy Domino on S/390 among this group. The high priority — relative to other types of user — accorded to manageability reflects efforts to put in place more effective service-level management capabilities.

Figure 7
**Reasons for Deploying Domino on S/390: Conventional Users**

Base: 15 Installations
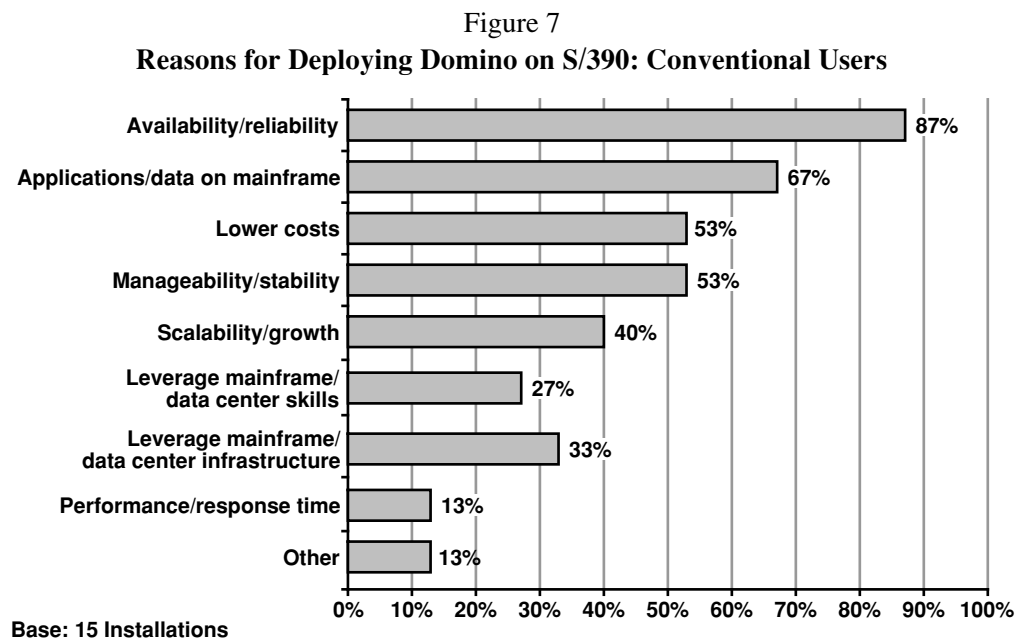
Although none of the organizations in this group planned to replace Notes client software, new applications were typically being deployed using browser interfaces. The general trend among the survey population as a whole was in this direction.

Such transitions also, in at least two cases, represented an argument for deploying Domino for S/390. One respondent commented, for example, that it was possible to host both Domino and Web servers on the same S/390 system, which made integration, interoperability and service-level control for both a great deal easier. It would have been necessary to spread these across multiple platforms if UNIX or NT servers were employed.

Synergies were reinforced by the fact that access to core mainframe databases was a central requirement for Domino applications, as well as for the company intranet and extranet applications that enabled customers to review the status of their orders online.

The resulting solution, illustrated in figure 8, significantly reduced both application deployment time and management complexity for all systems.

Figure 8
Combined Domino and Web Servers on S/390: User Example
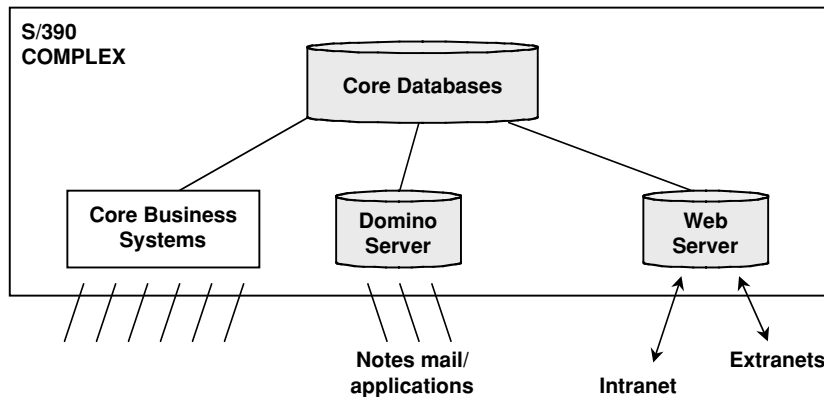
In any organization, if a significant portion of application processing is conducted on and data resides on mainframe systems, enterprise integration strategies must incorporate this environment. Among the organizations surveyed, there was a clear view that accessing mainframe data by Notes applications, intranets and extranets was a simpler and faster process if the Domino server was hosted on the same platform.

The opportunity is particular significant for organizations that must provide interoperability between Domino and Web servers, and between browser and conventional Notes and Domino applications. Maintenance of a single, compact set of data sources will benefit users working in all of these environments.

New Technology Users

A second, major group of Domino for S/390 users was comprised of organizations deploying Domino with browsers for Web mail, intranets, extranets, e-commerce and similar applications. Again, a wide range of organization sizes and industries, as well as some government agencies were included.

At the high end of the spectrum, one company was implementing an enterprise portal to support more than 125,000 Web and intranet users. Banks, insurance companies and other financial services firms, along with some government agencies, were also putting Web-based networks in place to support external as well as internal users.

Among this group, classical S/390 strengths contributed strongly to decisions to employ this platform. Availability was proving to be critical as organizations moved to the Internet and intranets. Large-scale intranets were inevitably sensitive to uptime. In most cases, user bases were expanding rapidly, and numbers of applications were expanding even more rapidly.

Outages would impact hundreds to thousands of different applications, affecting business processes organization-wide. Delays would ripple through the organization, with cumulative effects on productivity and efficiency that would last long after service had been restored. Dissemination of time-critical information would be impaired.

Processes of interaction with customers, partners and suppliers were even more sensitive to availability. A respondent at one company that was rolling out customer extranet applications on Domino for S/390 noted simply, "we're in banking — we have to be up all of the time."

Another observed, "we're a railroad. We can't afford to be down." In this case, outages affecting business-critical Domino-based order management, scheduling and tracking systems could result in millions of dollars in lost business and unnecessary overhead costs.

The key theme among these companies was that, once business-critical systems were extended via the Web, levels of availability and overall service quality had to be as good as — if not better than — those of the data center environment. Customers were a great deal less tolerant of technical failings than internal users. They could — and would — go elsewhere.

Of the three service bureaus surveyed, all cited service quality as a major argument for the S/390 platform. One respondent noted, "you can't sign a (service-level agreement) if you don't know what your service levels are going to be."

This issue was more broadly relevant. Corporate IT organizations in some of the larger companies surveyed were moving toward a service bureau-like business model in which they supported internal customers under service-level agreements (SLAs) and, in some cases, chargebacks. The computing arms of several banks were notably moving to do this as they were spun off as separate business units or subsidiaries.

This trend was also apparent among government organizations that provided computing services to other agencies. For all of these groups, the service quality advantages and lower costs of the S/390 platform were a means not only of retaining existing business, but also of expanding customer bases to include other entities employing Domino.

Overall, four of five organizations that cited better security as a reason for choosing S/390 systems employed Domino-based intranets and extranets. Conventional users were generally satisfied with security facilities within Domino. New technology users were concerned about broader vulnerabilities as they opened systems to the Web.

Network Topologies

Centralized and Distributed

There was a definite trend toward centralized network topologies among the organizations surveyed. This was particularly the case where server consolidation initiatives had either been carried out or were planned.

One multinational company had, for example, originally deployed Notes mail and applications on distributed NT servers worldwide. All management functions except directory maintenance had been decentralized to business units. However, service quality issues, cost reduction attempts and a broader move toward a centralized IT model had led to the creation a single, centrally managed mail infrastructure.

This was being put in place around two S/390 systems in the United States supporting a North and Latin American user population expected to reach 80,000, and a third system in Europe supporting approximately 10,000 users. The North American systems were divided between two data centers.

It was, however, expected that local servers would remain in place in Asia/Pacific sites. In these cases, wide area connections were not always reliable, or network latencies would have been too great to support clients directly from North America. The resulting topology will resemble that in figure 9.

Figure 9
S/390-Based Global Topology: User Example
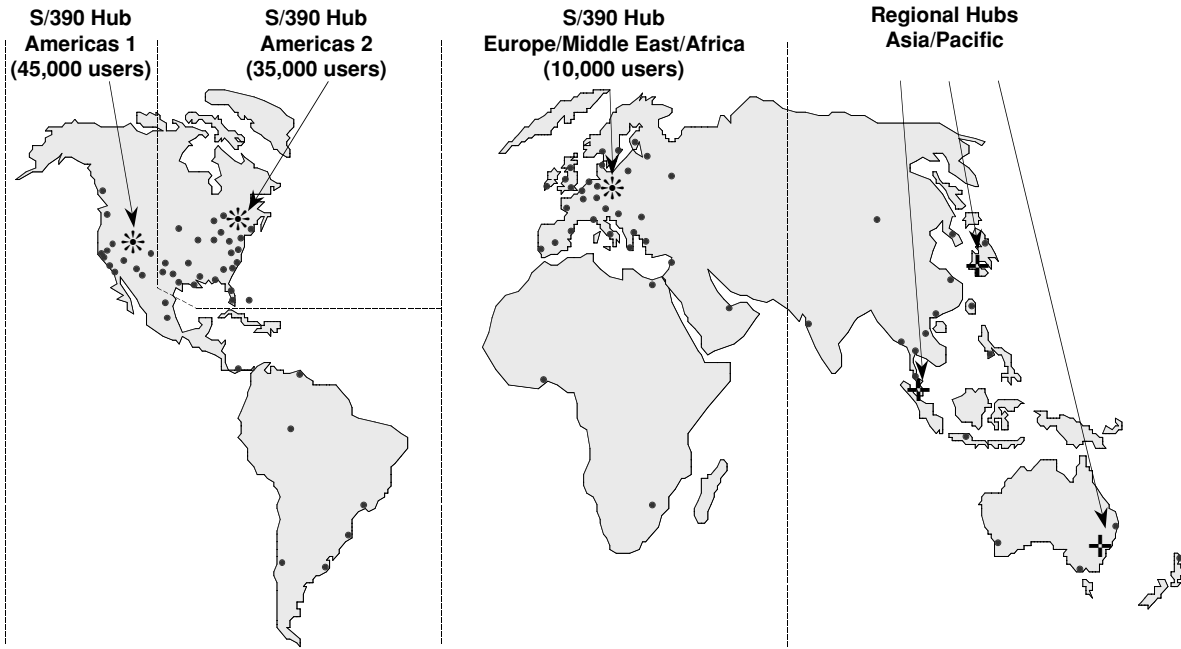
Several other large consolidations were also taking place among multinational users. In all of these organizations, the service quality and operational cost benefits of centralization were seen as outweighing the higher telecommunications costs that would result.

A company deploying a Domino for S/390-based global intranet adopted a similar approach. Although users were dispersed throughout the world, analysis showed that they could be supported more cost-effectively from a central U.S. site while maintaining adequate service quality on a 24/7 basis.

These trends, which generally mirror those occurring in the Notes and Domino world as a whole, represent a marked shift from earlier preoccupations with telecommunications costs in deployment strategies. This change is, to some extent, because of the lower overhead of operating via the Internet. Declining telecommunications costs also play a role.

Large users have acquired significantly better skills in IP network optimization than was the case during the early years of Notes deployment. A wide range of techniques and technologies — including workstation replication, traffic shapers, and compression, caching and streaming tools — are also being employed to control bandwidth consumption.

Data Management Issues

Data management issues played a key role in some centralization decisions. In distributed topologies, replication times easily became excessive, particularly when data had to be transferred between multiple "hops." Movement of data between hundreds or even thousands of dispersed servers also created severe management complexities, and backup and recovery arrangements were difficult to put in place and even more difficult to enforce.

These problems might have been manageable in a low-volume departmental or divisional e-mail system. But they escalated rapidly as corporate networks were integrated, traffic volumes increased, and data volumes became larger. Most large organizations reported that it was already necessary to support multiple terabytes of mail databases, and that these were growing over time — in one case, by five percent per month.

Centralized approaches using any platform can reduce these challenges to more manageable proportions. But there are, again, characteristics of the S/390 platform that make it particularly valuable. The S/390 system architecture is optimized for the efficient management and movement of large volumes of data. This provides advantages for Domino deployment in two areas:

1. *Disk storage*. S/390 systems are generally regarded as the industry's most effective platform for management of large volumes of disk storage, and these strengths have been materially improved by the addition of the IBM Enterprise Storage Server (ESS) and equivalents. Users employing the ESS have, in particular, reported major improvements in Domino performance with this subsystem.

2. *Backup and recovery*. Domino for S/390 users interviewed for this study routinely backed up even very large files on a daily or ongoing basis, without interrupting service. Although replication can also in principle be used in this role, the key benefit of using S/390 systems is that it enables existing high-volume data center backup and recovery infrastructures to be employed.

   This approach not only yields performance advantages, but also enables backup and recovery disciplines to be implemented centrally, using automated tools and procedures. Risks of loss or corruption of business-critical records are much reduced.

A further benefit was cited by two organizations. A government agency, which provided IT support to other departments, was adding Domino backup and recovery to its portfolio of services for users who employed Notes mail on other platforms. A corporate IT organization saw a similar opportunity for new services for its business unit customers.

Data Synergies

Value Equation

The frequency with which organizations cited the fact that applications and data were already mainframe-based as a factor in platform choices is striking.

At the most basic level, hosting Domino on S/390 systems means that Notes applications could be written simply and quickly to access mainframe data, without creating an additional tier of server-based architecture. But as organizations moved toward broader, enterprise-wide strategies for Domino deployment, implications became more significant.

Domino networks were, in these and many other organizations, becoming infrastructures for the collection, distribution and exploitation of information using e-mail, online publishing, applications, groupware, workflow, intranets and extranets.

The sources of this information, and the centralized structures which enable it to be used as an organization-wide resource, thus play an increasingly critical role — both architecturally, and from a business perspective — in the Domino value equation.

Data Demographics

In all of the organizations surveyed — and in many others — primary business-critical transaction-processing systems are predominantly mainframe-based. The corollary is that most transaction records — which are typically among the most widely sought and valuable types of data for Domino applications — are generated by these systems and housed in mainframe databases.

Examples include core banking systems; policy administration and claims management in insurance companies; central sales and merchandising systems in retailing; reservation and scheduling systems in transportation; and customer information systems. Large-scale billing and accounting systems in a wide range of industries are also predominantly mainframe-based, along with large governmental transaction-processing systems.

The mainframe role as a data source is greater than is generally recognized. A recent International Technology Group study of 282 large U.S. companies in retail banking, insurance, retailing and utilities found that between 90.7 percent and 98.8 percent of core business transactions were processed by mainframes. Figure 10 summarizes these results.

Figure 10
Corporate Transaction-Processing Demographics: Overall Results

Business Transactions, 1999	Retail Banks	Insurance Companies	Retailers	Utilities
Total transactions (billions)	93.8	15.6	33.4	2.65
Percent processed by mainframes	98.8%	97.9%	91.4%	90.7%

Retail banks: 67 companies with more than $5 billion assets
Insurance companies: 61 companies with more than $5 billion assets
Retailers: 93 companies with more than $1 billion sales
Utilities: 61 companies with more than one million customers
Source: *Strategies for e-Volume* Management Brief, International Technology Group

Percentages were, as figure 11 shows, higher among the largest companies in each industry.

Figure 11
Corporate Transaction-Processing Demographics: Largest Companies

Business Transactions, 1999	Retail Banks	Insurance Companies	Retailers	Utilities
Total transactions (billions)	72.1	11.9	23.4	1.2
Percent processed by mainframes	100%	98.6%	96.7%	97.1%

Retail banks: 14 companies with more than $50 billion assets
Insurance companies: 29 companies with more than $50 billion assets
Retailers: 22 companies with more than $10 billion sales
Utilities: 12 companies with more than three million customers
Source: *Strategies for e-Volume* Management Brief, International Technology Group

The mainframe role remains significant in other industries. Among U.S. brokerage firms with more than $5 billion in assets, for example, approximately 93.2 percent of core business transactions in 1999 were processed by mainframes. Among telecommunications companies with more than $1 billion in revenues, approximately 81.4 percent of billing transactions were processed by mainframes.

Access to mainframe databases thus becomes more than a subsidiary goal of Domino implementation for information management — it becomes the core design parameter. The potential to use Domino for S/390 as the central enterprise mechanism for access to and distribution of core mainframe data defines a new strategic role for Domino.

Platform Mixes

At least 20 organizations employed other platforms for Domino applications. This number is probably understated. Some respondents were not directly familiar with different Domino-based systems in place in other divisions and business units within their companies.

In 10 cases, organizations had already deployed Notes mail on other platforms, including NT servers and IBM RS/6000 servers (three cases) and did not intend to replace these. Domino on S/390 was used for applications requiring access to host data, or as a central hub for distributed systems, or new intranet and extranet applications.

In organizations that had already deployed large numbers of Notes applications, multiplatform approaches were the norm. Notes business applications that supported relatively large user populations were more likely to be migrated to the S/390 platform. Smaller departmental- and business unit-specific applications tended to remain on NT, Windows 2000 or UNIX servers.

One government agency employed Domino for S/390 for host applications and the Novell GroupWise system for e-mail. In this case, the decision to deploy Domino on S/390 was influenced by the fact that most applications ran on S/390 and Novell platforms. There was no base of NT or UNIX skills, and management saw no obvious reason to acquire these.

METHODOLOGY

S/390 Survey

Survey Population

Reasons for choosing to deploy Domino on S/390 systems, details of user experiences and commentary are based on a survey of 43 organizations worldwide. All were in production with or had firm plans for deployment of Domino for S/390 as of November 2000.

Industry distribution of the survey population included banks and other financial services (15), insurance (nine), manufacturing (five) and transportation (four) companies, along with three independent computer services firms, five government agencies and two universities. Organizations were based in the United States (20), Canada (5), Western Europe (10), Eastern Europe (one), Latin America (four), and the Asia/Pacific region (three).

Company sizes, based on revenues for their most recent fiscal year, were more than $50 billion (two), $10 to $50 billion (10), $1 to $10 billion (12), and under $1 billion (11). Among these, 13 could be classed as global corporations with over $1 billion in revenues, of which more than 40 percent (seven cases) and 15 to 40 percent (six cases) were derived from outside their home country.

Government agencies were all relatively large federal, state, provincial and equivalent organizations. Both universities reported more than 30,000 users.

Applications

The organizations surveyed employed a wide range of Domino-based applications, which are summarized in figure 12.

Figure 12
Domino for S/390 Applications
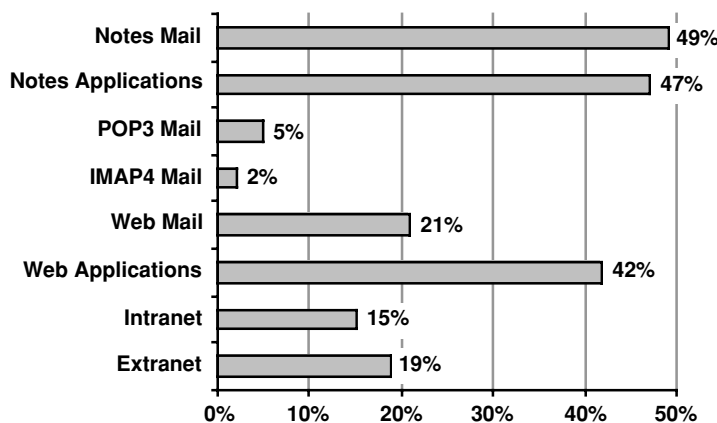
Base: 43 Installations

Extranet, in this context, refers to systems that communicate with customers, business partners and others outside individual enterprises. These included customer information systems, home banking systems, and systems operated by agencies for other government customers and for general public access.

A detailed breakdown of reasons for choosing the S/390 platform by type of application is shown in figure 13.

Figure 13
Reasons for Choosing S/390 by Type of User

Detailed Responses	Notes Mail & Mail plus Applications*	POP3 & IMAP4 Mail	Notes Applications Only	Web/ Intranet/ Extranet	All Users
Availability/reliability	13	3	3	15	**34**
Data on mainframe	10	0	8	13	**31**
Lower cost	8	1	3	11	**23**
Manageability/stability	8	3	3	6	**20**
Scalability/growth	6	1	1	10	**18**
Leverage mainframe/ data center skills	4	2	3	8	**17**
Leverage mainframe/ data center infrastructure	5	1	1	9	**16**
Performance/response time	2	0		4	**6**
Security	0	1	1	4	**6**
Other	2	0		3	**5**
Total Installations	**15**	**3**	**8**	**17**	**43**

*Excluding POP3 & IMAP4

The category of "Other" responses included corporate commitments to the S/390 platform for business-critical applications (two cases), more effective integration with production environments (two) and faster delivery of new Domino applications (one).

Technology Levels

Among the organizations surveyed, 21 had deployed or were in the process of deploying Domino R5. Nineteen employed R4.6, and three employed earlier versions.

Client software included Notes only (15 installations), combinations of Notes and browsers (19 installations), POP3 clients (two installations), IMAP4 (one installation) and browsers only (six installations).

The general trend was toward use of browsers. Most Notes client users were moving to these, or expected to do so in the future, and there were numerous mixed installations.

Cost Comparisons

Basis of Comparisons

Effective cost comparison requires proper configuration sizing. If the number, size and actual performance of servers are not known with a reasonable degree of accuracy, hardware, software and maintenance costs cannot be realistically quantified. Configurations also affect personnel costs; e.g. more system administrators will normally be required for two or more servers than for one.

Cross-platform configuration sizing is not a simple process. User populations, user behavior, applications, workloads and service levels vary widely between and in some cases within organizations. Differences in system architecture also materially impact performance, depending on how well a platform is optimized for specific workload types and operating conditions.

Performance comparisons based on industry benchmarks such as NotesBench may be useful, particularly if similar system architectures are being compared. But they suffer from a number of limitations — stylized workloads, simulated user behavior and long ramp-up times. In practice, rarely are such conditions encountered.

Benchmark expectations did not correspond to user experiences. Benchmarks overstated actual performance by at least three to five times. Even more seriously, they overstated performance inconsistently; e.g. performance might be overstated by three times for one workload, and by five times for another. Disparities between platforms were even more striking.

For these reasons, it was decided to base comparisons on actual installations that were generally similar in size, application profile, workload volumes and service levels. These were selected and analyzed as follows.

Installation Profiles

Eleven installations were selected from among the organizations surveyed, and detailed data — including specific configuration sizes and staffing levels — was obtained from these. A 12th profile was based on information supplied by a computer services organization.

Installation profiles are thus based on organizations that had deployed, or planned to deploy Domino for S/390. Six profiles for conventional users of Notes mail and applications, calendaring and scheduling were selected, along with six users focusing primarily on Web mail and applications, intranets and extranets that primarily employed browsers.

Installation details, S/390 configurations and numbers of FTE staff are as reported by these. In some cases, to maintain anonymity, numbers of users have been rounded to the nearest increment of 5,000. Where this is the case, configurations and staffing levels have been prorated accordingly.

Sun comparisons are based on information from 15 similar installations in the same industries. From these organizations, information was obtained on applications, numbers of users (registered and peak active), technology levels, service levels, hardware configurations, FTE staffing levels and other variables.

All but one of the Domino for S/390 installations, and all of the Sun installations reported averages of 30 percent to 40 percent peak active users. Although many organizations had employed higher ratios (e.g. 45 percent or 50 percent) in their initial planning, actual levels were generally lower.

Interestingly, respondents in several organizations where e-mail systems had been in use for some time commented that for planning purposes numbers of registered users were a better indicator than peak active usage estimates.

Configuration Sizing

S/390 processor configurations were sized based on CPU model, main memory (central and expanded storage) and disk volumes as reported by users. Where organizations employed older S/390 technology, configurations were upgraded based on S/390 architecture MIPS to the next largest G6 model; e.g. a 1997-vintage G5 model rated at 410 MIPS was upgraded to a G6 model rated at 481 MIPS.

Where organizations employed older S/390 disk technology, configurations were similarly updated based on reported volume in gigabytes (GB) or terabytes (TB). ESS and — in lower-volume installations — RAMAC Virtual Array (RVA) subsystems were configured accordingly.

Sun processor configurations are based on models and numbers of CPUs reported by users. Where there were variations in variables such as numbers of users, traffic patterns and service quality between Sun installations and their S/390 counterparts, Sun configurations were prorated based on average numbers of registered users per CPU, provided that percentages of average users and mail file sizes were generally comparable.

Processor configurations were rounded to the nearest realistic number of CPUs (e.g. a 43-way prorated configuration was rounded to 44 CPUs) and calculated based on the smallest realistic Sun model corresponding to this (e.g. a 10-CPU configuration was assumed to be based on a midrange E4500). In practice, most of the installations would have required, and were configured with the high-end Sun E10000 model.

Since all of the Sun installations employed models incorporating 400 MHz UltraSPARC-II CPUs, server technology upgrades were not necessary. Some disk storage configurations were, however, upgraded to current Sun StorEdge Array (SEA) technology based on reported capacity in gigabytes or terabytes.

Sun main memory for Domino applications approximated 1 GB per CPU, and this value was used to determine quantities of RAM used in the Sun configurations. Disk storage capacities for Sun servers are higher than for their S/390 counterparts, reflecting the lower levels of occupancy that occur with UNIX server platforms.

Hardware and Software Costs

Hardware and software costs, including maintenance, were calculated as follows:

- ***S/390 configurations***. Since IBM does not publish list prices for S/390 hardware, hardware configurations were costed using street price (i.e. price actually paid by users) norms as of October 2000. For processors, a norm of $2,330 per MIPS was employed for loaded configurations including memory, I/O supplies and other elements typically employed in this type of installation.

  For disk storage, norms of $86 and $76 per GB were employed for ESS and RVA equipment respectively. Three-year maintenance costs were calculated as 11.2 percent of street hardware acquisition prices, assuming that IBM provided service coverage.

  S/390 systems are configured with the OS/390 base operating system package. Costs were based on a norm of $40 per millions of services units (MSUs) per month for the S/390 models used, calculated over a 36-month period.

- ***Sun configurations***. Sun hardware acquisition costs are for loaded processor configurations and SEA equipment based on Sun published list prices, minus a 40 percent discount. Three-year maintenance costs were calculated as 13.5 percent of discounted hardware purchase prices, based on published Sun material.

  Systems are configured with the Solaris operating system. Since the company charges only a nominal sum for this, its cost was included in hardware. This tends to favor Sun platforms. The OS/390 base package contains a number system and storage administration facilities. Additional software products would be required to provide equivalent functionality in the Solaris environment.

Vendor pricing in individual bids may vary, and organizations should base calculations for their own hardware and software costs on detailed vendor proposals. This is particularly the case for S/390 systems, because the predominant vendor — IBM — does not publish list prices. Sun pricing may also vary if servers are acquired through resellers.

Personnel Calculations

Staffing levels for both platforms are for FTE personnel engaged in system administration and related activities, including storage administration, systems programming, operations management and technical support.

Personnel costs were calculated using average annual salary norms of $69,800 for S/390 system programming and system administration personnel, and $66,552 for equivalent Sun personnel. These were based on salary levels as of November 2000.

Annual salaries were increased by 34.6 percent — the average prevailing level for all IT staff reported by Computer Economics — to allow for benefits, bonuses, travel, training and other non-salary cost items, and totaled for a three-year period.

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International Technology Group

885 North San Antonio Road, Suite C
Los Altos, California 94022-1305
Telephone:(650) 949-8410
Facsimile: (650) 949-8415
Email: itg1@pacbell.net