

# Understanding The AS/400

*With 40% of new AS/400 ERP systems and 30% of new AS/400 Domino systems being sold to sites with no previous AS/400 installation, many IT staff outside IBM's traditional domain are having to face this system for the first time. Why are people choosing the AS/400 over alternative servers, and what are the implications for the IT manager?*

*By Andrew Ward*

**W**hen initially launched, the AS/400 suffered something of a mixed reception, and may well have been dismissed by many within the IT community as something only of interest to the loyal IBM customer. But since then, the hardware has undergone a substantial and complete redesign, and the AS/400 is now one of the most advanced computing platforms available. It is the only true 64-bit mainstream system - the hardware, operating system and even applications are 64-bit throughout.

In terms of positioning, it makes most sense to think of the AS/400 as a server, competing with high-end PC servers and Unix servers from vendors such as HP, Compaq, Sun and even IBM itself. But the AS/400 is also extremely scalable, from entry-level systems on a par with NT servers supporting just one or two hundred users, right up to models delivering mainframe performance. Lotus Domino running on the AS/400 has produced world-beating benchmarks with 27,000 users.

The current AS/400 product range has adopted a letter e suffix - AS/400e - the e being designed to associate the AS/400 range with modern applications such as e-business and e-commerce. Within this range, there are a large number of different models, which vary primarily in terms of processor and memory architecture, and hence the performance delivered. Dif-

ferent models are balanced in different ways, so that some are more suited to running dumb-terminal applications, while others are better for running today's server applications with higher processing demands.

Dont' let the mention of dumb terminals revive the idea that this is old-fashioned proprietary technology. Although IBM standards can still be supported, the AS/400e range, together with the current operating system version (4.3), uses modern open standards such as Ethernet and TCP/IP. An AS/400e can be considered to be a black box sitting on the network (and indeed they are black) providing just the same services as you might expect from an NT, Unix or Linux system.

## **Benefits**

This rather begs the question as to why anyone would choose an AS/400e system over any of the alternatives, and the answer lies with total cost of ownership (TCO). Several vendors, and Microsoft in particular, have jumped onto the TCO bandwagon in recent years, but according to an Aberdeen Group report the AS/400 division at IBM has consistently focused on lowering TCO for over a decade. In a survey by IDC of different ERP platforms including Unix, Windows NT and the AS/400, the AS/400 was shown to have the lowest TCO. This ought to go some way to dispel another myth that, being proprietary, the

AS/400 is also expensive to own and difficult to manage. In the same survey, the AS/400 took the mid-ground on cost of acquisition, with Unix installations being more expensive and NT systems cheaper.

But the AS/400 also took first place in two important categories - customer satisfaction, and speed and consistency of application deployment. The survey revealed that application deployment on the AS/400 actually took one third of the time that it did on Unix and NT systems. This highlights an extremely important benefit from the IT manager's point of view - the low amount of hands-on administration that the AS/400 requires, both to set it up and to keep it running. And what little administration that does need to be done, can be carried out remotely, making the AS/400 an ideal choice for branch and overseas offices where there may be fewer IT support resources. Indeed, it's quite common to find AS/400 sites that have no IT personnel at all, something unimaginable with a large PC LAN.

Other benefits that customers, analysts and surveys suggest as being important are reliability, security and scalability - a list which probably looks rather familiar, as being a list of those attributes which PC servers and operating systems would most like to have. Support is also important - and the AS/400 is supported in over 150 countries and in 51 national language versions.

### App Availability

Clearly, boasting the lowest cost of computing is of little use if a platform won't run the application you want. But today, all leading ERP vendors have ported their packages to the AS/400, and there are over 150 other ISV (independent software vendor) solutions available, and that's on top of IBM's own offerings such as various vertical market solutions and Lotus Domino. Within the USA, 45% of ERP solutions sold on AS/400 are now going to new AS/400 accounts - in Europe, the figure is slightly lower at 40%. And worldwide, the figure for Domino systems on AS/400s being sold into new AS/400 accounts has reached 30%.

Perhaps even more interesting is the Java support now built into the AS/400's operating system (OS/400) - in fact, it's the fastest JVM (Java Virtual Machine) of any operating system. This Java support means that AS/400 owners have access to some of the most modern applications, such as the object-oriented databases written in Java from Cloudscape and DataBahn, which have both been ported.

In addition, the AS/400 will run WebLogic from BEA Systems, the first Web/Java application server to fully support all the EJB (Enterprise JavaBeans) APIs, placing it right at the leading edge of software compatibility - ahead even of Sun.

However, you won't find the mainstream databases ported to the

AS/400, because it already includes its own - DB2/400 - which, as you can surmise from the name, is a version of IBM's DB2. Because it is very tightly integrated with the operating system, performance is higher than a third-party vendor could expect to achieve.

### 64-bit Computing

IBM adopted an interesting technique to isolate AS/400 software from the underlying hardware, which explains how its engineers were able to update the AS/400 platform without anyone having to change their applications, and how those applications instantly became true 64-bit.

Instead of a traditional operating system API, which has hard-coded into it some of the characteristics of the underlying hardware (such as the number of bits in a register), the AS/400 uses a hardware-independent machine interface, or MI. This object-oriented interface is quite independent of any aspect of the processor. AS/400 applications are compiled into an intermediate form known as a program template, which is in effect a list of MI instructions. On the first occasion that a program is run, it is compiled into machine-specific code (and hence will run more slowly). On subsequent occasions, that compiled version is run instead.

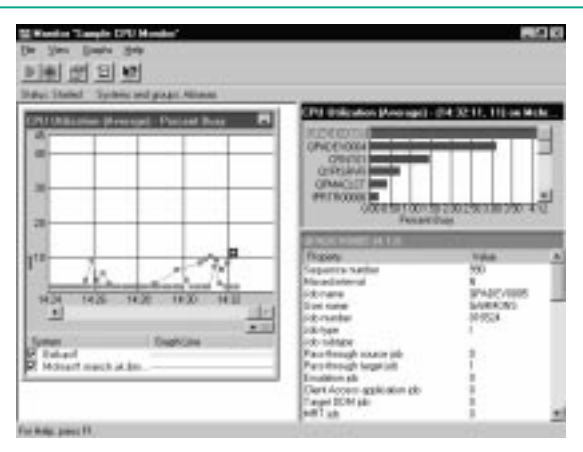
Thus, unless you delete the program template, you can change the AS/400 technology entirely and your application will run entirely unmodi-

fied. The template will be automatically recompiled into the new machine-specific instruction set and your application will take advantage of any performance improvements that the new platform has to offer. If the program template had been deleted (for example, to save hard drive space), then the original application will need to be re-compiled to make a new program template.

This technique of compiling to an intermediate form probably sounds familiar, because that's the way Java works, with the intermediate form in the case of Java being known as Java Byte Code. An important feature of the MI is that it can be extended (but always retains backwards-compatibility), so to support Java, IBM extended the MI to include Java Byte Code. The result is the fastest JVM of any operating system.

### Management

Shipped with OS/400 is a client application called Management Central which provides an up-to-date Windows 95-style interface to many AS/400 administrative tasks. It has to be installed on a PC attached to the network, and can then be used to control all or any of the AS/400s on the network in a typical Windows tree view format. For example, by expanding the entry for a single AS/400, you can then look at the various properties - file systems, databases, printers, job management, system configuration,



## AS/400

security, and users and groups - that can be managed from the PC.

As well as administration, it's also possible to do performance monitoring. Not dissimilar in concept to the Windows NT Performance Monitor, this allows you to monitor key indicators like the percentage CPU utilisation in a graphical display. You can set thresholds that can trigger applications to run on either the AS/400 or the monitoring PC when they are crossed. Scheduled jobs can also be run - for example, to collect performance information for all AS/400s located in the German offices at 0300 on Wednesday morning.

Although the graphical display is useful, it doesn't provide much detail. With release 4.4 of OS/400, detailed information will be available from Management Central, enabling it to be used for things like capacity planning. To make life easy, wizards will allow you to specify the data you want to be collected centrally from the AS/400s on the network.

Another feature available today performs software and hardware inventory collection, and can report on the level of operating system and all applications installed, together with their patch (known as PTF or Program Temporary Fix) levels. Disk capacity and hardware configuration are also reported.

In the desktop world, software distribution challenges have been solved by technologies such as Novell's ZenWorks. Even though AS/400s are somewhat bigger than desktop PCs, as soon as you have more than one or two - and especially if they are spread around the world - software installation becomes a significant overhead. A

new management feature allows you to build a software package on one central machine and then distribute it to other AS/400s - a feature that would be particularly suitable for distribution to branch offices. It's also possible to distribute PTFs in that way.

There's also a Tivoli agent for the AS/400, so all the facilities available from Management Central are also controllable by Tivoli.

### Hardware

The AS/400e uses custom versions of the 64-bit PowerPC processor. Different processors are used on different models - for example, the top-end systems employ the PowerPC AS A30, which has a 256-bit data bus (which is how these systems can deliver mainframe performance). Although clock speeds may appear low in comparison with Intel-based systems, the size of the data bus and other aspects of the system architecture - often using advanced technology from IBM's research labs - deliver vastly greater performance in server applications.

For example, I/O processors are used to avoid loading the main CPU with I/O tasks. And in the high-end multiple processor systems, where extremely high performance is desirable and cost isn't so important, a 128-bit memory crossbar switch is used to control access between the different processor and memory cards, rather than a single bus. This astonishing quantity of high-performance hardware is designed to address the problem of contention that severely limits the scalability of SMP systems that use a single memory bus, such as the usual Intel / Windows NT implementations.

The result is that for each additional processor you add to the AS/400e (and you can have up to 12), you actually benefit by 85-90% of its potential performance.

Other technology included in the AS/400 is aimed at ensuring reliability and availability, and this does seem to pay off. IBM's own experience is that since replacing a network of PC servers with an AS/400 to run Domino, no outages at all, as a result of either hardware or operating system failure, have occurred. An independent survey by IDC of Lotus Domino installations revealed that AS/400 users experienced less than 40 minutes of unscheduled downtime each per year on average, whereas PC LAN users could expect to suffer over 13 hours. Perhaps more interesting is that the average number of IT man-hours spent on recovering from incidents was just 0.9 for AS/400s but five for PC LANs.

One of the technology features is a service processor, which runs even if the main system crashes or is switched off, and monitors the system for any serious problems such as overheating. It can also be used to restart the system in the event of catastrophic failure. The service processor is normally accessed via a hardware control panel and associated LCD display, but it's also possible to connect it directly to a PC. That PC can then be accessed remotely - for example, via a dial-in link - allowing complete control over the AS/400e from anywhere in the world.

Apart from these special features, the hardware specifications look much like any other server, with varying amounts of first and second level cache and main memory depending on the model, and different hard drive sizes and tape drives. Performance may be different than you are used to, however, with tape drives offering backup speeds of up to 32 GB/hour.

### Networking

IBM offers a variety of connection technologies on the AS/400e range, from Twinaxial to Ethernet. In a modern environment, only Ethernet is likely to be of interest, and to a lesser extent Token Ring. Twinax is the technology used by IBM to connect green-

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screen dumb terminals. The AS/400e supports TCP/IP, and OS/400 includes a DHCP server, a DNS server and an http server. From the general TCP/IP networking point of view, it can thus be treated much like a Windows NT, Linux or Unix server.

Unfortunately, there isn't yet the equivalent of NDS for NT for the AS/400e, but there is a product that helps with integration of an AS/400 into a Novell network. OS/400 Enhanced Integration for Novell NetWare will distribute AS/400 group and user profiles to multiple NDS trees and even to NetWare 3.12 bindery services. When AS/400 users change passwords, the change is propagated to NDS or the bindery, and AS/400 users are authenticated against the NDS or the bindery.

AS/400 users also have access to files, directories and printers on NetWare servers. To operate OS/400 Enhanced Integration for Novell NetWare, you need to install an NLM on the NetWare servers. Certain NetWare administrative tasks, such as user profile administration and backup, can be carried out by the AS/400 operator.

Similar facilities are also available for Windows NT, but only where Windows NT is installed on the optional Integrated PC Server (IPCS).

## Partitions

Enterprise servers generally allow some form of partitioning - indeed, Gregory F Pfister said in *In Search Of Clusters*, "Any type of server system, if it is sufficiently large, eventually becomes partitionable by customer demand" - and the AS/400 is no exception. Partitioning is a mechanism whereby several different instances of the operating system and application can exist on one system.

Although operating system outages are unlikely, they are not impossible, and application failures - while they may be far less frequent than on a PC LAN platform - do certainly happen. With partitions, you effectively have several different machines that are protected from each other. Furthermore, each partition can have its own attributes, including language and

time zone, allowing multinationals to support different countries' operations on the same machine.

With Lotus Domino, for example, partitioning can be used to protect line-of-business applications such as ERP from Domino partitions, and Domino partitions from each other. Although downtime may be far less on an AS/400 than on a PC LAN, Domino can fail, and partitioning will limit the number of users affected by one partition failing. Furthermore, the AS/400 features automatic recovery, so a failed partition will be restarted without intervention.

Partitioning means that where you might have considered buying several separate AS/400s in order to protect applications from each other, you can buy a much larger machine instead, with a resultant saving in administrative costs. An IDC white paper published in September 1998 based on a survey of 500 commercial sites determined that a single large system replacing five smaller ones resulted in a 15% annual cost reduction per user.

## IPCS

Recognising that users still want to run PC operating systems such as Novell NetWare and Windows NT, IBM manufactures an IPCS for the AS/400. Basically, this is a PC on a plug-in card, and you can put up to 16 in a single AS/400. Given that PCs aren't exactly expensive, this may seem like a silly thing to do. But because the IPCS shares a lot of the superior AS/400 infrastructure and technology (it uses the AS/400 disk and tape, for example), it benefits from greatly enhanced availability. You can even designate one of the IPCS cards as a hot spare, and switch over to it in the event of failure of one of the others.

Implementing PC servers on IPCS cards will reduce the total support costs of a mixed AS/400-PC environment, and the total number of staff required. For example, if a branch office has an AS/400 plus IPCS, then the hard drive on the IPCS can to all intents and purposes be made larger by an operator working at the AS/400 at central office (by remotely increasing the amount of AS/400 disk allocated to the

IPCS). Tape backups will run at the full AS/400 speed of up to 32 GB per hour, and a very high speed internal TCP/IP link allows fast data transfer between the AS/400 and PC server applications.

The obvious drawback is that the PC market evolves quickly, and the IPCS doesn't. By using standard PCs, you can rapidly take advantage of new technologies and levels of performance when they become available. The IPCS is currently a single-processor design, so SMP isn't an option at all. If that isn't an issue, then in theory the AS/400 can be used purely to consolidate PC servers - with, say, 15 servers and one hot spare - and give better availability than the equivalent 15 PC servers.

## Conclusion

When deciding on an ERP packaged application, businesses generally choose the software first and then the most appropriate platform. In such circumstances, where decisions are driven by considerations of total cost of ownership, the security, reliability and manageability of the AS/400 platform make it definitely worth consideration.

Already a true 64-bit platform, the availability of both high-performance Java and the WebLogic application server from BEA Systems makes the AS/400 one of the most advanced computing platforms today, yet IBM's efforts on the cost of ownership front mean that it requires less effort to manage than an equivalent network of PC servers.



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