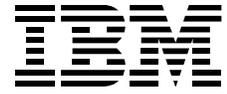


IBM S/390



The Advantages of LINUX for S/390
July 2000

Introduction

Based on real world experience, customers have come to understand that S/390® enterprise servers are the engines of e-business. The mission-critical data / applications residing on them are the foundation of successful e-business systems.

A number of recent announcements, particularly the availability of Linux® for S/390, helps S/390 remain the platform of choice for e-transaction processing.

The availability of Linux Internet applications accelerates the process of Web enabling your S/390.

This paper provides a high-level overview of the importance and benefits of Linux for S/390 for businesses evolving to e-businesses.

What's here, what's coming

In recent months, there have been a number of exciting developments involving S/390 and Linux. In May IBM announced the first native Linux distributions for S/390: TurboLinux and SuSE announced the general availability of its Linux distributions for S/390 in 4Q 2000. Customers selecting either version will be eligible to receive support from IBM Global Services through their normal IBM Software Support structures.

Announcement Highlights

- *First native Linux distributions for S/390*
- *IBM Integrated Facility for LINUX*
- *IBM Virtual Image Facility for LINUX*
- *Major ISV support*
- *IBM middleware*
- *Tivoli management applications*

Initial reaction to this announcement was extremely positive. During the technical validation program, more than 2,100 customers obtained Linux for S/390 files, a 100 MB download. Existing customers such as Grede Foundries, a parts supplier in the manufacturing industry, and Equant Integration Services, a global

network integrator and service provider, have conducted successful tests of Linux for S/390 as a development and deployment environment. Commenting on using Linux for S/390 to set up a Domain Name Server (DNS) for the company intranet, Rich Smrcina, systems software specialist at Grede, said, "I got the request to bring up the DNS and had it up and running while the other guys were still looking up what PC to buy on the Internet."

In early August, IBM announced several additional initiatives aimed at helping customers run Linux on S/390 more quickly and easily and at a lower cost.

First, a new hardware feature available on S/390 G5 and G6 servers, the IBM Integrated Facility for LINUX, lets customers add processor capacity exclusively for Linux use. This new Linux feature is priced competitively for similar workloads running on other platforms.

Many leading S/390 Independent Software Vendors (ISVs), including BMC Software, Candle Corp., Computer Associates, Compuware and SAGA Software, are supporting IBM's pricing strategy for the IBM S/390 Integrated Facility for LINUX. These vendors do not plan to charge customers additional charges for their ISV software running on existing S/390 processors with the addition of this new hardware feature. These ISVs have or plan to announce software products for Linux for S/390.

A new software product, the S/390 Virtual Image Facility for LINUX, offers a complete server environment for multiple Linux systems on one S/390 processor. Virtual Image Facility, an easy-to-use, high-performance supervisor, operates within a logical partition or in native S/390 mode and provides the capability to create tens to hundreds of Linux images on a single S/390 server.

As part of this announcement, IBM will offer the following middleware on Linux for S/390 later this year: DB2® Universal Database™ V7, DB2 Connect™ V7, IMS Connect V7, CICS® Transaction Gateway Version 3.1, MQSeries® client, and WebSphere® Application Server Version 3.5 with Java JDK™ V1.2.2. This middleware will give customers the ability to run Linux e-business applications as well as let them access existing S/390 data from their Linux environments. DB2 UDB and DB2 Connect were available for beta testing at announce; all other middleware will be available in 3Q2000. This new middleware will be priced consistently on all IBM Linux environments (Intel®, RISC and S/390) with comparable terms and conditions.

Also announced is Tivoli®'s first customer shipments during 4Q2000 of its core management applications on Linux for S/390. Tivoli solutions will help customers manage the new capabilities of Linux for S/390 and assist them in the application and server migration/consolidation process.

Successful e-business

Why are these announcements generating so much excitement? Because e-business is not about putting a business on the Web; it's about creating a smooth and successful e-business experience for our customers.

This has tremendous implications for the technology that underlies e-business. It means a successful e-business IT infrastructure must not only handle millions of hits, but must link existing business systems and add new applications and services quickly. It must run around the clock, but not on a regular schedule. It has to do all this while providing high levels of availability, security and quick response times, with no margin for error.

Building the kind of infrastructure required for successful e-business depends heavily on end-to-end system requirements that emerge in three major categories:

- End-to-end qualities of service: the ability to provide high levels of availability and rapid response times across the network.
- Speed of innovation: requiring a simple, flexible IT infrastructure that permits rapid development and deployment of new capabilities.
- Affordable total delivery cost.

In addition to determining infrastructure design, these requirements have a significant impact on application sourcing and development.

Traditional programming models for developing and deploying enterprise-class applications were not always best suited to meeting the integration requirements of e-business. The most efficient way to achieve that level of integration is to separate the user interface from the business logic. This makes the system more manageable, easier to understand and easier to update as business requirements change.

S/390 offers the best of both worlds

- *IBM Application Framework for e-business for creating portable e-business applications with true enterprise-class qualities of service*
- *Linux, the open source operating system that simplifies application rehosting across multiple hardware platforms*

Separating the user interface from the business logic requires the availability of open interfaces and programming models that have been missing from the traditional enterprise development environment. Up to 80 percent of the programmer's time is spent in platform-specific coding, the repetitive task of defining, incorporating and testing the interfaces in order to ensure qualities of service.

Developing a "high-volume" platform, such as UNIX or Windows NT®, offers a broader selection of open tools and interfaces. For the ISV or Application Service Provider (ASP), it provides a significantly larger market. The greater choice of sourcing options available with this approach is expected to improve speed to implementation.

The IBM S/390 Enterprise Server family now offers the best of both worlds by supporting the IBM Application Framework for e-business, a programming model specifically designed for creating portable e-business applications with true enterprise-class qualities of service, and Linux, the open source operating system that simplifies application rehosting across multiple hardware platforms.

Application Framework for e-business

The Application Framework for e-business addresses many of the important issues in the development of e-business solutions. The framework is prescriptive; it maximizes the use of Internet and other open standards and protocols versus proprietary technologies. However, developing in the context of the framework still leaves a wide choice of technologies, which can be selected based on the required performance, robustness and usability of a solution.

Developing applications using the framework is guided by these four key principles:

- Maximize ease and speed of development and deployment.
- Accommodate any client device.
- Ensure portability across a diverse server environment.
- Leverage and extend existing assets.

S/390 servers also offer a portfolio of e-business tools, built on the structure of the IBM Application Framework for e-business, that provide the application interoperability required for end-to-end solutions. These tools provide rich capabilities to support simple to sophisticated applications and they support a rapid application development environment based on cross-platform standards including Java.

The Linux explosion

Over the past few years, Linux has evolved from a niche platform to the pervasive open reference platform for e-business applications that has begun to compete seriously for market share with Windows NT and Solaris.

This trend is accelerated by new Internet companies adopting Linux as their primary platform for development and deployment and major UNIX ISVs declaring Linux as their UNIX reference platform.

IBM fully supports the growth of Linux as an e-business deployment platform and has announced that applications, development tools and middleware components of the Application Framework for e-business will be available on Linux. In addition, IBM is an ongoing contributor to the Linux community, helping to enhance Linux's capabilities as an operating system for e-business.

With Linux as part of the Application Framework for e-business, organizations now have application portability and rehosting capabilities with a single deployment platform.

One of the major advantages of the Application Framework for e-business is the flexibility it allows in deployment. Applications written as part of the Framework that run using middleware, such as IBM WebSphere Application Server, can change their platform base with no redevelopment cost for maximum portability. For IT organizations, the advantages of

developing on WebSphere with Linux is enhanced speed of implementation and performance.

With the commitment of the open-source community, Linux represents a collaboration of some of the best programmers in the world coming together to create an operating system that supports the widest range of hardware platforms. This greatly simplifies application rehosting. The level of support makes it the fastest growing deployment environment for new special-function and Web-serving applications.

Linux ... can remove from 40 percent to 80 percent of the expense associated with application development as well as significantly improve time to market

The ability to rehost quickly can be of particular importance to the ASPs and ISVs who create applications for other people to run. Today, many of these developers have chosen environments, such as Sun Solaris as their development platform. While such a platform provides a robust application development environment that can yield enhanced programmer productivity, it can lock a company into a single deployment platform. Changing to another deployment platform may require many steps, including the need for a port of the application. Linux can eliminate or significantly reduce the need for some of these steps, which can remove from 40 percent to 80 percent of the expense associated with application development and significantly improve time to market.

Advantage: S/390

Before discussing the advantages of Linux for S/390, it might be helpful to review the advantages of S/390 in an e-business environment.

In an e-business environment, there are two critical qualities of service: scalability and availability. Many competitors claim "mainframe-like" capabilities in these areas, but S/390's self-configuring attributes, which provide scalable performance to handle unpredictable e-business workloads, and its self-healing attributes, which offer the continuous availability e-business demands, demonstrate the very real difference between mainframe performance and mainframe-like performance.

S/390 self-configuring and self-healing attributes demonstrate the very real difference between mainframe performance and mainframe-like performance

For example, S/390 self-configuring attributes include fine-grained resource sharing, on-demand resource delivery, simultaneous connectivity to data, unbounded operating system support and operating system spawning. The competition offers none of these.

In the same way, S/390 offers advanced self-healing attributes — computational integrity, fault-tolerant cache hierarchy, transient error recovery, memory chip sparing, CP sparing and zero outage hardware repair — totally eclipsing the competition.

Linux for S/390 inherits all of these qualities of service. In addition, Linux for S/390 provides a number of very specific advantages as companies develop and deploy e-business applications.

First is scalability. S/390 can support up to 15 native Linux images — even more if Linux is run as a guest operating system under VM/ESA®. As a proof of concept, an IBM Business Partner benchmarked more than 41,000 copies of Linux running concurrently under VM on a single S/390 server. This was a limited test, using restricted workloads, but in a more realistic demonstration one customer is running 400 Linux images on an S/390, replacing 400 Sun servers. No other hardware platform can offer this capability.

Second, Linux for S/390 is designed for:

- Ability to scale from small to very large processors
- Multiple images for consolidation
- Complete workload isolation
- Eliminating network latency
- High-speed communication
- Highly efficient memory management

These design points are major factors that make Linux for S/390 an ideal platform for server consolidation. Consolidating Linux applications close to the enterprise data and applications reduces the chance for bottlenecks. Since the Linux application will run in its own partition

with dedicated resources, it can't impact the availability or security of the rest of the system.

A second advantage is the ability to consolidate the workloads from many Linux servers onto S/390 to create a "server farm in a box."

Server consolidation in this fashion permits these applications to benefit from the enterprise-class "qualities of service" of the S/390 platform. For example, it's important to note that in the test mentioned above, VM ran out of resources when running 41,000 instances of Linux, but it did not crash.

In addition, it is possible to consolidate multi-tiered applications onto multiple Linux servers running on S/390: for example, a firewall, a Web server and an application server. This makes it possible to reduce not just the number of servers, but the number of different kinds of servers, greatly simplifying systems management.

Another major advantage in the e-business environment is that running Linux for S/390 permits greater responsiveness. For example, it takes as little as 45 seconds to spawn a new Linux image in response to increased demands on the system. Compare that to the days it can take to set up separate Linux servers.

Advantages of Linux for S/390

- *Increased number of applications for S/390*
- *Flexibility and openness of Linux combined with S/390 qualities of service*
- *Unique ability to consolidate Linux servers onto a single platform easily*
- *Blend data richness of S/390 with Web capability of Linux for highly integrated e-business solutions*

Consolidation of multiple Linux images into a single server can greatly simplify systems management. What enables this capability is the industry's leading partitioning technologies, Logical Partitions (LPARS) and VM, which are available only on S/390. As a result, not only is it possible to run multiple Linux images on a single system, it's possible to run multiple Linux images and multiple OS/390 images side-by-side on a single system. These mixed workloads, as required, can have dedicated or shared access to system resources as necessary, but remain separate and secure in individual

partitions. As a result, a WebSphere Application Server powered by Apache and running under Linux, for example, could have direct, high-bandwidth access to DB2 data without any fear of a security breach or any effect on the rest of the OS/390 system.

This kind of consolidation requires the right applications. They should be either open source or with the source controlled by the customer, already ported or POSIX-compliant applications that are readily portable to Linux. They should be running in multiple server images, and shouldn't be computationally intense, but should require high I/O content.

For these reasons, ASPs are prime candidates for server consolidation using Linux for S/390.

With the large number of applications available in the open-source community, many customers will find Linux gives them a relatively low-cost way to deliver and integrate new applications quickly. For others, Internet enablement may be quicker and easier when they modify or extend existing applications. Either way, S/390 support for the Application Framework for e-business and Linux gives that choice and flexibility.

low-latency, inter-partition communication, as discussed above. This approach permits a customer to eliminate outboard servers, routers and other networking gear, reducing floor space requirements and maintenance costs. In addition, Linux has a well-earned reputation for rapid application deployment, giving OS/390 users another key option in how they deploy applications.

For VSE/ESA® users, Linux provides a new source of up-to-date tools and packages that enable e-business applications. These applications can now run alongside the VSE/ESA system, providing the same cost and performance benefits mentioned above.

The second group is customers interested in server consolidation. As a legacy of client/server and the initial design of many e-business systems, it is not unusual for a company today to have hundreds or even thousands of servers to manage, representing 10 different computing architectures and 20 different sub-architectures, all demanding specialized and expensive skills.

The benefits include enhanced qualities of service, more efficient inter-server communication, reduced costs and, perhaps most important, reduced deployment time for new servers

Who benefits the most

What customers are most likely to benefit from Linux for S/390? According to a report by Aberdeen Group, there are three customer sets that should find Linux for S/390 particularly appealing¹:

- Existing enterprise customers
- Companies interested in server consolidation
- Internet Service Providers (ISPs)

For existing S/390 customers, running Linux applications on S/390 lets them build the equivalent of a local-area network in a single machine, with all the advantages in terms of performance and security detailed above. In addition, existing S/390 customers get the flexibility of Linux coupled with the enterprise-class "qualities of service" of S/390. This combination enables a level of integration between Web applications and mission-critical applications that might be more difficult and more expensive to achieve otherwise.

There are two likely scenarios for existing customers. For the OS/390 user, Linux for S/390 brings the ability to access host data efficiently by using high-speed,

If many of the applications running on those servers can be consolidated on Linux, and those Linux servers then consolidated onto S/390, the benefits can be enormous. The potential savings from centralized systems management alone can be enough to justify the move, but the customers also benefit from S/390 "qualities of service".

One likely scenario would be the consolidation of many "edge-of-network" servers. S/390 is well suited to host multiple lightly-to-moderately loaded servers of this type such as firewalls, file and print servers, Domain Name Servers, Internet news servers or Web serving that are not processor intensive. The benefits include enhanced "qualities of service", more efficient inter-server communication, reduced costs and, perhaps most important, reduced deployment time for new servers.

The third group consists of ISPs who are discovering they must provide additional value if they are going to maintain and build their existing client base. In many instances, this means making the transition from ISP to ASP (Application Service Provider). In addition to the

¹ *Linux for S/390: A Perspective for IT Executives*, Aberdeen Group, Inc., May 2000

benefits already discussed, they will see a major advantage in the ability to quickly add capabilities to their systems. For example, as discussed briefly above, it can take an ASP several days to bring a new customer on a new server. With Linux for S/390, adding a new customer means simply spawning a new server, which can take less than a minute.

Summary

In February 2000, *Linux Planet* ran a feature article about Linux for S/390². The author, Scott Courtney, an editor on the Linux Channel at internet.com, remarked that S/390 isn't so much a dinosaur as a herd of dinosaurs, the swift, deadly velociraptor of *Jurassic Park*. He advanced a number of very good reasons why the combination of Linux and S/390 was an exciting and promising development.

He isn't alone. In the conclusion of the report already mentioned in this white paper, Aberdeen Group states that Linux for S/390 delivers a compelling value proposition, for current S/390 users and newcomers to the platform as well.

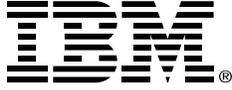
Add these developments to the upcoming announcement of Freeway, the first enterprise server designed specifically for e-business, and it's clear that S/390 isn't just alive, it's accelerating into a whole new era.

For more information on Linux for S/390, visit these Web sites:

ibm.com/linux (Linux site)

[Linux sales kit](#) (Systems Sales intranet site)

² "S/390: The Linux Dream Machine," *linuxplanet.com*, February 23, 2000



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