

**MIGRATING TO LINUX:
APPLICATION CHALLENGES AND SOLUTIONS**



Access to Applications Anywhere.

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SECTION 1: EXECUTIVE SUMMARY

The Linux operating system is literally taking the world by storm. Promising lower costs, higher performance, and better stability and security than its Windows counterpart—not to mention freedom from being locked into a single supplier—Linux is on a roll.

As an operating system for servers, Linux has seen double-digit growth rates for seven consecutive quarters. Fully embraced by the likes of IBM, Hewlett-Packard and Sun, the ubiquitous Linux-based server has already established itself as the low-cost, high-reliability alternative to the traditional Windows-based server.

Linux on the desktop, however, is a slightly different matter. While making inroads into Microsoft's prized desktop territory, Linux desktop deployments face significant challenges in replacing Windows systems. The main reason? Lack of native Linux applications.

While native Linux-based alternatives are readily available today for basic productivity applications—OpenOffice, for example—the porting of many other applications that organizations depend on is certain to be a slow and painstaking process. In fact, in many cases it may never happen. Without all of their trusted applications (i.e., customer relationship management, human resources, financial applications, and more), major organizations in both the private and public sectors will be hard pressed to migrate their users to Linux at a rapid pace—regardless of the promised benefits.

Nonetheless, a number of robust Windows-to-Linux solutions exist today that are helping many organizations migrate in an orderly fashion to the Linux desktop. This paper establishes the characteristics of an ideal cross-platform solution—and then reviews these available alternatives in light of this ideal standard. The paper then takes a closer look at the pros and cons of various solutions—and outlines the business benefits that can be readily achieved.

SECTION 2: LINUX TRENDS

Introduction

Linus Torvalds began work on Linux in 1991 as a student at the University of Helsinki in Finland. For a class project, Torvalds wanted to build a simple UNIX that could run on a 386 PC. He released the initial version of Linux for free on the Internet, inadvertently spawning one of the largest software-development phenomena of all time.

Today, Linux is authored and maintained by thousands of developers loosely collaborating across the Internet. In addition, companies such as Red Hat, SUSE (a subsidiary of Novell), Mandrake, Xandros and others provide Linux support, package Linux into easy-to-install distributions, and market workstations pre-installed with the Linux software.

Business Drivers

In order to increase profitability—and survive and prosper in an increasingly competitive world—most enterprises and organizations today are facing two common challenges: how to lower costs while accelerating time-to-market. In other words, companies need to get their latest product or service out the door faster than the competition—at a lower cost.

To help meet these business challenges, IT departments are looking to Linux to lower IT costs and increase computing efficiencies—and hence user productivity. As an alternative to Windows, the promise of Linux includes:

- Lower costs
- Better stability and reliability
- Higher performance, faster throughput
- Better resource utilization
- Better security
- Freedom from single vendor lock-in

Linux on the Server

Already, Linux has gained a very strong foothold in the enterprise server market. IDC reports that since the second half of 2002, Linux servers have grown at double-digit rates for seven consecutive quarters. For the first quarter of 2004, worldwide shipments of Linux-based servers grew 56.9% to \$900 million, which translates to a \$3.6 billion annualized market.

Grid Computing for HPC Applications

A related trend is the emerging concept of *grid computing* or *Linux clustering*. Large organizations are networking together thousands of inexpensive Intel-based processors running Linux to create high-performance computing (HPC) alternatives to traditional UNIX multiprocessor systems and supercomputers. Typical industries deploying Linux-based grid computing networks include major manufacturers (for design, analysis, simulation, and manufacturing), electronics and semiconductor companies (for chip design, simulation, and layout), oil and gas producers (for seismic data processing and reservoir simulation), and entertainment companies (for digital movie rendering, editing, special effects, and animation).

Tracking IT Industry Leaders

From an IT industry standpoint, Linux is making equally strong inroads. For example, IBM appears to have fully embraced Linux on the server. The industry giant is currently bundling SUSE Linux with every server it ships. Internally, IBM is rapidly migrating its user desktops to Linux as a way to counteract Microsoft. Reportedly, the company has already migrated 50,000 desktops to Linux.

Other industry heavyweights leading the way to Linux include:

- **Hewlett Packard:** Reports \$2.5 billion in Linux-based revenues in 2003
- **Novell:** Purchased Ximian in 2003 and SUSE in 2004
- **Oracle:** Recently switched to Linux internally for 9,000 developers, thereby becoming the largest Linux development organization in the world
- **Computer Associates:** Embracing Linux with series of major initiatives and commitment to open-source software

Worldwide Migration

Linux is a worldwide phenomenon. For example, the demand for Linux in Europe is outpacing the strong demand in the US. According to IDC's latest *European Server Tracker*, the increasing role of Linux has translated into 41.5% annual revenue growth for Linux servers in Western Europe. Both Red Hat and SUSE are making big pushes into the European market for Linux desktops.

In recent European news, for example, the city government of Munich, Germany voted resoundingly to switch from Windows to Linux. Meanwhile, the Norwegian city of Bergen announced that it would move 100 schools and 32,000 users to Linux by the end of this year.

On the other side of the world, China, Japan and South Korea have announced that they are currently working together on Linux initiatives, with the main goal being the establishment of a Linux standard that will support Asian languages. These governments are particularly concerned about being too dependent on Windows from a national security standpoint.

Today, Chinese officials are touting their Red Flag Linux as reliable alternative to Windows. Lenovo Group, China's largest PC vendor, has launched two new Linux PCs with Red Flag Linux preinstalled.

While not developing its own version, Japan has set aside \$8.3 billion towards Linux research. In a related development, Fujitsu, IBM Japan and Oki Electric have submitted a Linux-based proposal to manage payroll and personnel data for 800,000 Japanese public servants. The companies are claiming that maintenance costs will be cut in half.

Linux on the Desktop

Though not growing at quite the hectic pace of Linux servers, the Linux desktop market is nonetheless becoming a viable industry unto itself. Linux desktop deployments are making major inroads into both the government and private sectors.

IDC reports that Linux-powered PC desktops are growing at a very healthy 25%-30% this year. Currently, Linux desktop distributions are available from a number of vendors, including the following:

- Red Hat
- Fedora (a community project sponsored by Red Hat)
- Sun
- Mandrake
- SUSE
- Xandros
- TurboLinux and others

So what is holding back the desktop market when it comes to Linux? The key lies in the lack of native Linux versions of enterprise-class applications. Though tempted by the substantial business benefits of desktop Linux, many enterprises and organizations report that they are unwilling to migrate until their mission-critical Windows applications are made available on the Linux platform.

SECTION 3: WINDOWS APPLICATION MIGRATION

For organizations relying on general-purpose productivity applications, there are a number of native Linux alternatives available on the market today. For example, OpenOffice and StarOffice are excellent alternatives to Microsoft's Office suite.

However, there are thousands of enterprises and organizations that have either purchased or developed mission-critical, Windows-based applications that are not available under Linux (and may never be). Typical examples include supply chain management, customer relationship management (CRM), inventory control, warehouse management, human resources, financial packages, and countless other specialized applications.

In the fullness of time, the most popular of these applications will probably be ported to Linux. Others may never be ported for a variety of reasons. It may be that they are too complex, or that they address a very small market segment. In other cases, development resources may not be available or the original source code may even be difficult to find.

The question, then, is how can an organization that depends on mission-critical Windows applications begin the migration to Linux? In order for these organizations to deploy Linux desktops, they need a solution that provides Windows application support when no native Linux application exists.

The Ideal Desktop Solution

The ideal answer to this problem would be a solution that allows the Linux desktop to run native Windows applications. Characteristics of such an ideal solution can be defined as follows:

- **Compatibility:** The ideal solution should provide high compatibility for Windows applications without the requirement to "certify" an application. The Windows application should work right out of the box.
- **Performance:** The ideal solution must provide performance that is comparable with the Windows application executing in a native Windows environment. Users will be unwilling to accept the Linux environment if their applications run noticeably slower. This performance requirement should not cause the organization to buy more expensive hardware. Remember, the promise of Linux is to lower the organization's overall computing costs.
- **Transparency:** The ideal solution should support transparent integration of the Windows application into the Linux environment. For example, a user should be able to cut and paste between a Window and Linux application. The Windows

application should be able to read and write files in the Linux file system. It should be able to access and use devices attached to the Linux desktop, such as printers, CD drives, etc. Launching the Windows application should be as simple as launching a native application. The Linux environment should recognize a file type that requires a Windows application and simply launch the application when the user accesses the file (respecting access rights, of course).

- **Resource Requirements:** The ideal solution should not cause the organization to increase its desktop budget for hardware or software, thereby negating the promised savings from a Linux deployment. Wherever possible, it should take advantage of assets the organization already owns. For example, an organization migrating to Linux desktops from Windows typically has already licensed the Windows applications they wish to run.
- **Administrative Simplicity:** The ideal solution should not be overly complex for the administrator to deploy. The desktop management requirements should be minimal.

Today's Alternatives

EMULATORS

There are a number of products known as emulators that support running Windows applications directly on the Linux desktop. They operate by providing support at the system call layer for the Application Programming Interface (API) that the Windows application requires. These products typically provide excellent *transparency* and *administrative simplicity* for applications that have been certified. Examples of products that emulate the Windows environment to support running Windows applications on Linux are CrossOver and WINE.

Unfortunately, it is very difficult to provide high levels of *compatibility* with emulation solutions due to the complex and often unknown ways in which the native Windows APIs are implemented. Therefore, the companies who supply these applications are forced to certify the Windows applications that are supported.

VIRTUAL MACHINES

Another class of products known as virtual machines also support running Windows applications on Linux desktops. They do this by creating a virtual PC where the Windows operating system is installed. Once the virtual PC is booted, Windows applications can be installed and executed. Examples of virtual machine solutions include VMWare from EMC and Win4Lin from NeTraverse.

Virtual machine products provide excellent *compatibility* because the applications actually execute in their native Windows environment. In addition, they typically provide good *transparency* due to the laudable efforts of their developers.

Unfortunately, *performance* often suffers due to the requirement to run multiple operating systems on the same machine. To offset this, their *resource requirements* are often higher than alternative solutions. And their *administrative simplicity* suffers due to the requirements to install and manage clients with multiple operating systems and application types—not to mention the requirements to purchase multiple OS licenses for the same desktop.

SERVER-BASED, THIN-CLIENT SOLUTIONS

An alternative approach is to run the Windows applications directly on a Windows server that in turn serves the application's user interface to the Linux desktop clients. Server-based, thin-client solutions include Microsoft Windows Terminal Services, Citrix MetaFrame for Windows, and GO-Global for Windows from GraphOn Corp.

Thin-client solutions typically provide excellent *compatibility* because—like the Virtual Machine—the application is running directly on Windows. *Performance* is normally very good since only the painting of the user interface and the capturing of keystrokes is happening on the client. These solutions also provide *transparency* through file system mapping and device access. The *resource requirements* are usually very low, making use of existing Windows servers and applications, while only requiring a very thin layer on the Linux client.

The primary advantage of these solutions is in the area of *administrative simplicity*. Since the Windows applications are being managed centrally, the organization can easily publish the applications to selected users. The *administrative simplicity* provided by these solutions reduce an organization's Total Cost of Ownership (TCO). The administrative complexity that sometimes exists on the server can be mitigated depending on the chosen solution.

Below is a brief overview of the three thin-client solutions mentioned above:

- **Microsoft Windows Terminal Services (WTS):** This thin-client alternative can be an adequate solution, but it does come with some drawbacks. WTS remotes a new session of the Windows operating system for each new user, which can consume excessive system resources per server and lead to decreased scalability. The licensing of this product is also restrictive. Users are typically licensed per user or device. This can lead to substantially higher

costs for organizations spanning a large number of occasional users. WTS supports only limited concurrent license scenarios and can be expensive to implement.

- **Citrix MetaFrame:** This comprehensive and expensive solution may be overkill for many environments. Citrix introduces an additional level of application management infrastructure and complexity that must be deployed, monitored and maintained. This solution typically requires additional user training, as well as added IT administrative resources. Citrix layers on top of WTS, which means it is subject to some of the same restrictions inherent in WTS. Furthermore, Citrix requires the licensing of both WTS and Citrix.
- **GO-Global for Windows:** This cost-effective, application-centric solution publishes Windows applications not only to Linux client desktops, but also to UNIX and Macintosh clients. In addition, it allows Web-based application access from any browser. Unlike Citrix MetaFrame, GO-Global does not require the installation and maintenance of WTS. GO-Global is ideally suited for organizations that require a fast, easy, cost-effective solution. Unlike other solutions, GO-Global is offered on a cost-effective concurrent licensing basis.

A Closer Look at GO-Global for Windows

GO-Global for Windows is a server-based, ultra-thin-client solution that allows the organization to publish Windows applications to the corporate network or the Web. Without touching a single line of code, the organization can instantly make mission-critical Windows applications accessible to Linux, UNIX, Windows and Macintosh desktops—while retaining all of the application's features, functionality and branding.

GO-Global for Windows is a simple, straightforward solution that eliminates the need for Windows Terminal Services or Citrix MetaFrame. It is optimized for reliable, secure, scalable application delivery to virtually any network-attached device, regardless of platform or operating system. For maximum performance—and ease of deployment and maintenance—GO-Global publishes only the application, not the entire desktop. Utilizing near-zero-footprint clients, only the application's user interface is delivered over the network and displayed on the remote devices.

HOW IT WORKS

As illustrated in Figure 1, the GO-Global for Windows solution consists of three key components:

- *The GO-Global server component* runs on a central Windows server alongside the server-based application. It is responsible for intercepting user-specific information for display on the desktop.
- *The GO-Global desktop component* or *client* is extremely thin (virtually a zero-footprint client). It is responsible for sending keystrokes and mouse motion events to the server. It also presents the application interface to the desktop user. This keeps the desktop very simple, as well as independent of application requirements for resources, processing power and operating system.
- *The GO-Global Rapid X Protocol (RXP)* enables efficient communication over fast networks or slow dial-up connections. It allows applications to be accessed from remote locations with LAN-like performance and responsiveness.

Unlike Windows Terminal Services or Citrix MetaFrame, multiple GO-Global Windows sessions can run with a single instance of the Win32 subsystem. GO-Global publishes only the application's user interface, not the entire Windows desktop.

LOWER TCO

GO-Global for Windows can significantly reduce an organization's computing costs. With GO-Global, applications are installed, run, and maintained from a centralized location. Administrators install applications once on a central server—not on individual client desktops. All application data is stored, manipulated, and executed on a server, which ensures that data integrity and security is maintained. This server-based architecture simplifies desktop management and significantly reduces the time and labor investment required of IT departments.

GO-Global software runs existing desktop applications on a standard Windows NT, Windows 2000 or Windows 2003 Server, without rewriting code for each client platform. As a result, the organization can extend the value of existing Windows applications. GO-Global for Windows lowers the organization's TCO by centralizing application deployment and management, improving security and virus protection, refining application license management, and increasing the productivity of administrators and users.

CROSS-PLATFORM COMPATIBILITY

With GO-Global, enterprises can deliver the same set of Windows applications to all users, regardless of the client's hardware, operating platform, or network connection. It is the

ideal solution to deliver critical Windows applications to Linux desktops. The organization can provide universal access to centrally stored data and applications, while leveraging existing hardware and software investments—and allowing users to work in their preferred computing environments.

FAST REMOTE ACCESS

GO-Global utilizes the patented RXP data transmission protocol which is faster and offers better data compression than other alternatives. RXP provides fast, efficient, LAN-like performance over all network connections, including low-bandwidth commercial satellite links and latency-intensive Web connections.

Unlike Microsoft Windows Terminal Services which transmits entire screen bitmaps, the RXP protocol only sends drawing commands to the remote device and only receives keyboard and mouse events from the device. The net result is extremely fast performance.

DESKTOP INTEGRATION

Applications deployed through GO-Global for Windows are seamlessly integrated with the user's desktop. Although applications are installed on a server, they look, feel, and perform as if installed locally on the client machine. Applications are accessed in their native format, with 100% of their existing features and functionality.

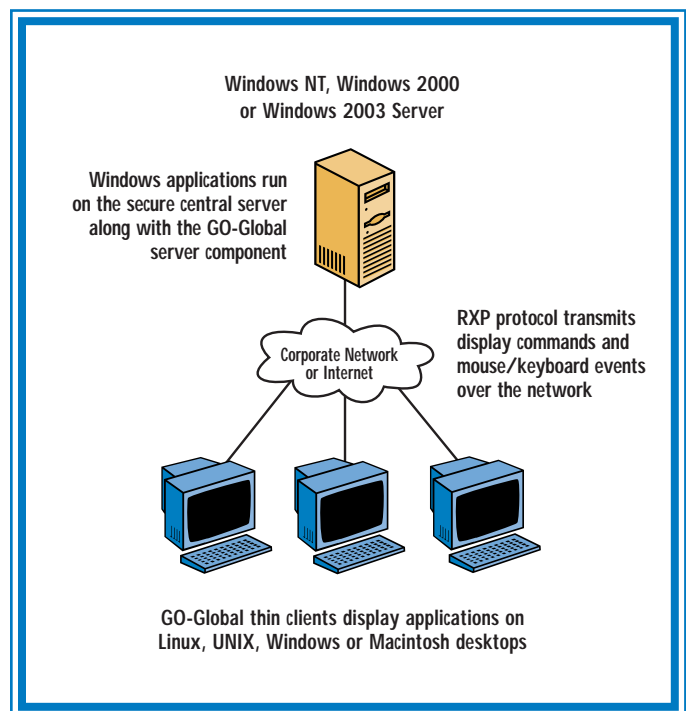


Figure 1. The GO-Global for Windows Solution

SECTION 4: UNIX APPLICATION MIGRATION

Many organizations today are also migrating from UNIX to Linux. Linux has proven itself as a server environment and organizations are now migrating their mission-critical UNIX X11 applications to the Linux platform. Reasons include the excessive purchase and maintenance costs of RISC-based UNIX hardware which can be significantly reduced by using commodity “PC-based” UNIX hardware (i.e., Linux on an Intel chipset).

Of course, applications in this environment have traditionally been fat; that is, dependent on client-based X servers which are administratively complex. As organizations benefit from the lower-cost Linux platform, they also have an opportunity to review alternative approaches that may further reduce their IT budgets.

Traditionally, organizations have often been plagued by complex UNIX application environments. For example:

- Users have two boxes on their desk—one a PC running Windows, another a RISC workstation running UNIX. In this model, maintenance costs are high, IT staffs may not be cross-platform capable, and interoperability is difficult.
- Organizations often deploy UNIX servers regionally to provide higher performance for their X11 applications on the local office LAN. This is an expensive and hard-to-maintain approach.
- Users often need access to a limited number of X11 applications. In this case, Windows PCs are typically deployed as the desktop of choice with client-side X servers (PC X servers) providing the bridge to the UNIX applications. IT departments find the PC X server very expensive to maintain.

The Ideal Solution

The ideal solution will focus on TCO considerations to further support the migration from the expensive RISC environment to one based on a low-cost Linux x86 configuration. The important characteristics to migrate X11 applications to Linux are:

- **Performance:** The ideal solution must provide high levels of performance over LANs, WANs and dial-up connections.
- **Transparency:** The ideal solution should support transparent integration of the application into the desktop environment.
- **Resource Requirements:** The ideal solution should reduce the organization’s budget for hardware or software.
- **Administrative Simplicity:** The ideal solution should not be overly complex to administer.

Today’s Alternatives

CLIENT-SIDE X SERVERS

PC X servers exist today for Linux distributions and Windows PCs. They provide connectivity to the X application running on the Linux platform. Unfortunately, PC X server overhead tends to degrade client performance, requires more systems resources, and does not work well over dial-up connections.

VNC PRODUCTS

Virtual Network Computer (VNC) based products are available from a variety of sources, both for a fee and for free. This solution provides good support for viewing the desktop of a remote computer. However, it is typically not the highest-performing solution.

SERVER-BASED, THIN-CLIENT SOLUTIONS

Thin-client application publishing solutions such as GO-Global for UNIX extend the reach of UNIX applications to any device, platform, or location without requiring PC X server software. GO-Global lets the organization publish or Web-enable complex, feature-rich applications easily and cost-effectively for access over LANs, WANs, dial-up connections, or the Internet.

A Closer Look at GO-Global for UNIX

With GO-Global for UNIX, the organization can make UNIX and Linux applications instantly available to Windows, Linux and Macintosh desktop clients. GO-Global for UNIX retains all of the application’s features, functionality and branding. Using a Java applet, a browser plug-in, or a near-zero-footprint native client, users can easily run heavy-duty UNIX applications on any network-attached device, regardless of platform or operating system. GO-Global for UNIX lowers overall TCO by eliminating the need for cumbersome local X Server software, while maximizing existing investments in UNIX and Linux applications.

HOW IT WORKS

As shown in Figure 2, the GO-Global for UNIX solution consists of three key components:

- *The GO-Global server component* runs on a central UNIX or Linux server alongside the server-based application and is responsible for intercepting user-specific information for display on the desktop.
- *The GO-Global client* is extremely thin (virtually a zero-footprint client). It is responsible for sending keystrokes and mouse motion events to the server. It also presents the application interface to the desktop user. This keeps the desktop very simple, as well as independent of application requirements for resources, processing power and operating system.

- The *GO-Global RXP* protocol enables efficient communication over fast networks or slow dial-up connections. It allows applications to be accessed from remote locations with local area network-like performance and responsiveness.

LOWERING COSTS

Deploying, maintaining and managing applications using client-side X servers can be very costly and time-consuming. In addition, the high bandwidth requirements of such solutions dictate a LAN connection. With GO-Global's simplified, near-zero-footprint clients, the organization saves time, money and scarce IT resources. UNIX and Linux applications can be efficiently accessed over any connection, even low bandwidth dial-up connections.

MAXIMIZING VALUE

GO-Global maximizes the value of the organization's current investments in UNIX and Linux applications. The net result is faster ROI. For example, the organization can easily publish existing UNIX applications such as AutoCad or HP OpenView to distributed Windows and Linux desktops, thereby allowing employees to be more productive from remote offices or the road.

INCREASING SECURITY

Unlike distributed applications, GO-Global's unique architecture keeps applications and mission-critical data secure on the server behind the corporate firewall. Only the application's user interface is transmitted to the remote devices. All GO-Global for UNIX transmissions are fully encrypted using 256-bit AES encryption.

FAST REMOTE ACCESS

GO-Global's use of RXP means that the solution is much faster and offers better data compression than other alternatives. RXP provides fast, efficient performance over all network connections.

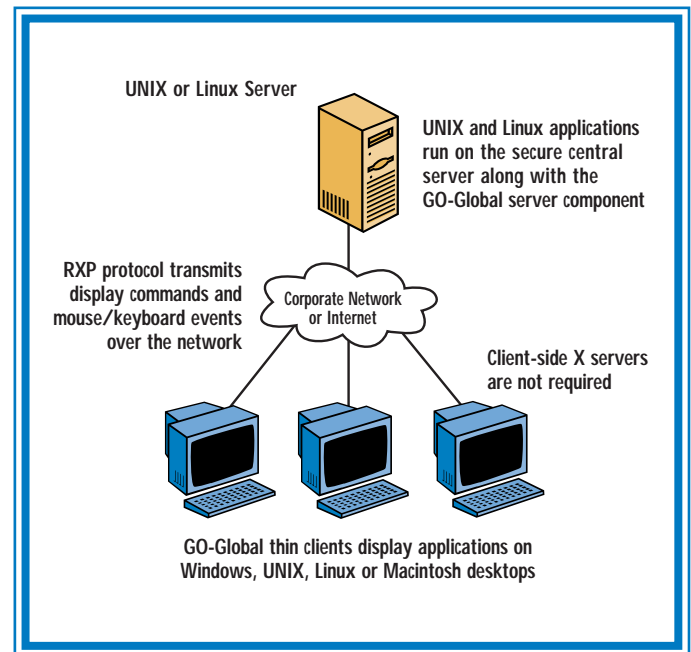


Figure 2. The GO-Global for UNIX Solution

SECTION 5: CONCLUSION

It has been shown that Linux is a viable alternative to Windows. The upstart operating system is bound to play an ever-increasing role both on the server and on the desktop. As the porting of enterprise-class and production-grade applications to the native Linux platform plays out over the next several years, the successful organization will be the one that takes full advantage of currently-available cross-platform solutions to gain immediate results.

By deploying Linux in key strategic areas today and taking advantage of application publishing solutions such as GO-Global, the organization can lower costs and speed time-to-market by reaping many of the rewards promised by Linux—while at the same time fully leveraging their substantial investments in existing Windows applications.



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