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The Power of Knowledge

Wall Street Romances the Penguin: The Growing Popularity of Linux

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Vision

The Linux operating system, symbolized by a penguin, has come a long way in its short, 10-year lifetime. Running on Intel and rivaling low and midtier Unix servers in performance, scalability, and reliability at a fraction of the total cost of ownership (TCO) of other platforms, it creates a compelling proposition for securities firms, especially in this environment where cost has become a paramount concern for chief information officers. Besides these appealing aspects, Linux is also gaining popularity because it promotes openness. It easily deploys over a range of platforms, and an increasing number of independent software vendors (ISVs) are migrating applications onto the penguin's back.

For too long, the absence of large, established firms that guaranteed adequate support and service around Linux was a major obstacle to institutions deploying the operating system. Since 1999, a slew of firms have staked their business on addressing these concerns, from distributors like Red Hat and SUSE to diversified firms like IBM and HP, and major vendors have geared up to facilitate the adoption of Linux and provide comprehensive support through long-term contracts.

Highlights

- The Linux operating system creates a compelling value proposition for securities firms by offering high performance, scalability and reliability, low cost of ownership, growing support and services from distributors and established technology firms, portability across a range of platforms, and an openness leant by its Open Source origins.
- Linux offers firms the option of adopting an Intel architecture ("Lintel") and gaining higher performance while staying within a Unix environment that guarantees stability, availability, and fail-over. Firms are also considering Linux deployments on virtual cluster machines running on a single mainframe.
- Firms are deploying Linux in five major ways: workload consolidation, clustering, infrastructure solutions, distributed architecture, and via an applications strategy. Linux clustering is one of the most popular ways for firms to deploy the operating system and it provides the same redundancy and fail-over as supercomputers at a fraction of their price.
- Linux is being actively deployed by several influential securities firms including Morgan Stanley, Merrill Lynch, Goldman Sachs, CSFB, and E*TRADE. While some bulge bracket broker/dealers are pushing the envelope and deploying trading applications on Linux, second-tier brokers have not progressed beyond using it to deploy file/print servers as they wait for ISVs to begin supporting it.
- TowerGroup estimates Linux is currently deployed on 7% of total servers at North American brokerage firms. Microsoft has 58% of the market (NT and 2000 combined), while Unix has 27%. Linux will grow at an annual rate of 22% in the North American securities server market over 2002–2005.

What's the state of current growth? Despite the recent growth and rapid adoption in the securities industry of Linux, it currently remains and will remain in a state of flux over the next three years as it moves toward mass adoption in the industry. A few large brokerage firms (like Merrill Lynch and CSFB) will continue to push the envelope with Linux and deploy more mission-critical applications on it. For every such success story at a top-tier broker, 5–10 smaller sell-side firms will decide to commit to Linux in a less extensive way. The Linux vendor market will continue to grow dynamically with new vendors emerging and a few large players consolidating their position (Red Hat for distribution, IBM for support and services). Unless the current economic slump lifts from over the global economy in the next two years, the Linux market will be one of the few technology areas in securities that will witness real growth and stay vibrant.

What's required for ongoing growth? For Linux to grow further, users need to continue actively deploying it and pushing the envelope with its adoption. Distributors must continue to enhance installation, training, and support services around it, and ISVs must aggressively extend applications to support it, especially in domain-specific and niche markets.

TowerGroup advises securities firms to regard adopting Linux as a strategic decision and create a detailed plan to implement it over time. They must begin by analyzing their current IT infrastructure and their business and technological priorities and determine where Linux fits into their environment. Institutions must not let the current enthusiasm around Linux and the aggressive marketing by distributors sway their decision toward hastily implementing it. While Linux continues to develop rapidly, it is still more suitable for particular tasks (mainly infrastructure related) and unsuitable for others (real-time trade processing). So even a large firm like CSFB, which is a poster child for Linux in the securities industry (it deploys its global order routing architecture on Linux servers), is not replacing its current mix of Risc Unix, NT, Windows 2000, and mainframe platforms because it believes each platform serves its particular purpose well in the brokerage infrastructure. Other firms must learn that lesson well.

Over the next 2–3 years, more securities firms will become comfortable with the Open Source movement and with the prospect of deploying Linux. But only a handful of firms will bet the house on it and be willing to repeat what one top-tier broker's IT executive said about the stakes involved in his firm's decision to deploy Linux on the trading floor: "If Linux fails, we will be forced out of the equity trading business!"

Business Drivers

- Securities firms are considering migrating large parts of their IT infrastructure to Linux because of the need to enhance flexibility within their IT infrastructure, to gain the ability to port applications across platforms, and to increase leverage with key hardware and software vendors.
- Severe economic and business conditions are forcing securities firms to curtail their IT budgets. Having exhausted most avenues for further budget cuts, firms have begun focusing on reducing their software licensing and hardware expenses by migrating off proprietary operating systems to Linux.

Implications

- Firms will look to maintain their high-end Unix servers while migrating low-end Unix servers (non-Linux) as well as NT servers to Unix machines running Linux; they will also look to consolidate applications on Linux virtual machines running on Linux-compatible mainframes.

- Large technology vendors with business models based on revenue generated from licensing proprietary operating systems will face pressure from Linux and will need to explore new revenue opportunities by providing support and service functions around Linux.

Introduction

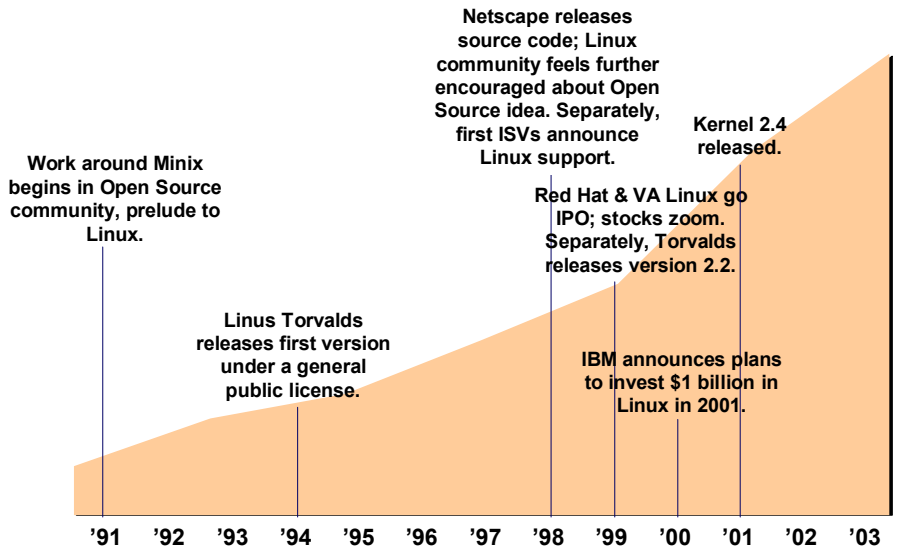
From a specification put out over the Internet for comment in 1991 by Linus Torvalds, Linux has emerged as a major operating platform rivaling established systems and creating a completely new market of installation, support services, and tools around it. In the mid 1990s, Linux essentially was being used by academic, research, scientific, and governmental organizations, but the late 1990s saw Linux emerge as a platform that firms across different industries were using to deploy solutions (albeit non-mission-critical functions like e-mail, file, and print servers). Linux is now entering its next stage of growth and is positioned to become a force in the enterprise market for critical business functions like trading and transaction processing in the securities industry.

What is crucial is that unlike the growth of similar operating platforms in the past, the growth of Linux is not directed by a single vendor like Sun or Microsoft but by a silent momentum created by several parties, including Linus Torvalds, the millions that contribute to Linux kernel releases, distributors, major hardware and software players (IBM, HP, Oracle, etc.), and finally by end users that have the most to gain from it.

Exhibit 1 illustrates how Linux has grown over time and major milestones in its growth.

Exhibit 1

Major Milestones in the Evolution of Linux



Source: TowerGroup

This TowerGroup Research Note analyzes the current status of Linux, its nature and extent of adoption in the securities industry, and examples of how firms are deploying it. For more information about Linux and the Open Source movement, see TowerGroup Research Notes:

021:29, "Linux in the Financial Services Industry: Not Just Your Developer's Operating System"

032:38SI, "Insights, Implications, and Challenges Regarding Linux and the Open-Source Movement"

Linux

The origins of Linux can be traced back to August 1991 when Linus Torvalds put a request on the Internet for software developers worldwide to contribute their comments on Minix, which strongly resembled the operating system he would eventually develop (to be called Linux). Linux 1.0 was released in 1994 under a General Public License (GPL) and new versions have been continuously released since, the current version (2.5) being released in 2001. Exhibit 2 lists a glossary of terms related to Linux.

Exhibit 2

Glossary of Major Linux-Related Terms

Term	Definition
Clustering	Arrangement of multiple processors on a single machine that share a common operating system; or multiple machines strung together so they share work and back up each other
Forking	The modification of a software kernel by third parties (e.g., distributors) to create multiple versions, which while sharing some common elements with the original kernel, often incorporate different code and address different issues as they evolve
Hacker	Unlike the common perception of a hacker as someone with the intent to break into a system or software, a hacker in the Open Source community refers to smart developers seeking to solve complex programming problems
Kernel	The nucleus or core of an operating system on which other components depend; initially used in relation to Unix, the term is now most often used to refer to a particular, original version of Linux that has not been modified by a distributor

Source: TowerGroup

As an operating system, Linux can provide an alternative to two major platforms: Microsoft NT and Unix. In the last two years, much of the growth that Linux has achieved has been by replacing Unix servers (initially low-end but recently some midtier Unix servers as well) and some NT servers. In other instances, firms have replaced expensive supercomputers with Linux clusters or consolidated Unix servers on virtual clusters running on a single Linux mainframe. However, Linux's penetration on the desktop has been much more limited than in the server market, and Microsoft continues to dominate the desktop in the securities industry.

Because Linux was developed with a keen eye on Unix, the two platforms closely resemble each other across several parameters: performance, reliability, manageability, etc. But when comparing the two operating systems in a broader context—taking into account the overall cost of support, service, and management—and when considering the flexibility that each provides (or denies) a CIO, the scales often tip in Linux's favor. Of course, any such analysis needs to be made in the context of a particular firm's IT environment, and generalizations are difficult to make.

In the current economic environment, where there is intense pressure to curtail expense, CIOs are making technology decisions after seriously pondering both hard parameters (cost, performance, and reliability) and soft parameters (manageability, ease of support, flexibility provided, ability to negotiate prices in the long run). Such a holistic attitude toward making technology decisions is referred to as taking a total cost of ownership (TCO) view. Under a TCO analysis, Linux has proved to have a marked advantage over alternative operating platforms (especially Unix in the server market) in that it has a lower TCO, both in terms of lower hardware and software expense and in ongoing maintenance and support.

Wintel versus Lintel

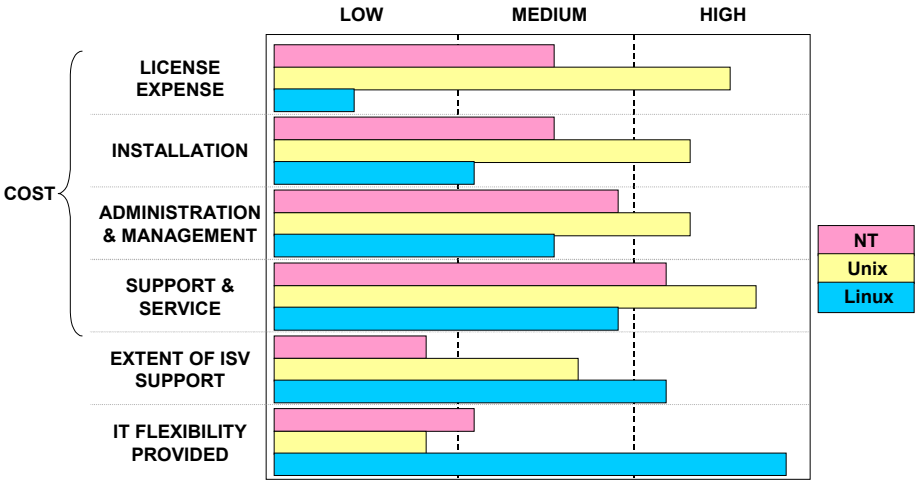
The choice to go with Linux is also closely related to the fact that it runs on Intel chip architecture. When firms make choices among NT, Linux, and Unix, the processing power provided by the underlying chip plays a major factor in the competitive positioning of the various platforms. In the low- and midtier server market, securities firms have essentially faced a choice between Microsoft NT, which runs on Intel chip architecture (casually referred to as "Wintel": Windows + Intel), and Unix servers that run on other proprietary chips (Sun Microsystems' Unix servers run on SPARC chips and Sun servers dominate the brokerage industry). As Intel has improved chip performance and vastly lowered the cost/performance ratio over other chips, securities firms have been attracted by the faster performance of the Wintel architecture. But firms have not been comfortable in migrating critical functions like trading and processing onto the NT platform from Unix servers (again, provided by firms like Sun) because NT does not have the scalability, reliability, and availability that midtier and high-end Unix servers possess. So, even though firms like the superior performance of the Intel architecture, they have been forced to stay with the Unix platforms from firms such as Sun due to their higher scalability, stability, and performance.

The arrival of Linux running on Intel chips (often referred to as "Lintel": Linux + Intel) and its support by most major Unix server providers has changed the situation considerably. Firms now have the option of choosing Unix servers that run Linux with Intel chips inside (Lintel) offered by firms such as IBM, Fujitsu, and HP (excluding Sun-Unix as it runs on proprietary SPARC chips) in addition to the two earlier options of Microsoft NT running on Intel (Wintel) and Sun Unix servers running Solaris. Firms finally have the ability to adopt the faster Intel chip architecture deployed on Linux systems running on Unix servers, so they enjoy the high reliability and scalability they have always wanted.

Exhibit 3 illustrates how Linux, NT, and the Unix operating environments currently compare across several parameters including cost, extent of ISV support, and the flexibility and openness they provide users.

Exhibit 3

Current Comparison of the Linux, NT, and Unix Operating Platforms



Source: TowerGroup

Open Source and Linux Value Proposition for Securities Firms

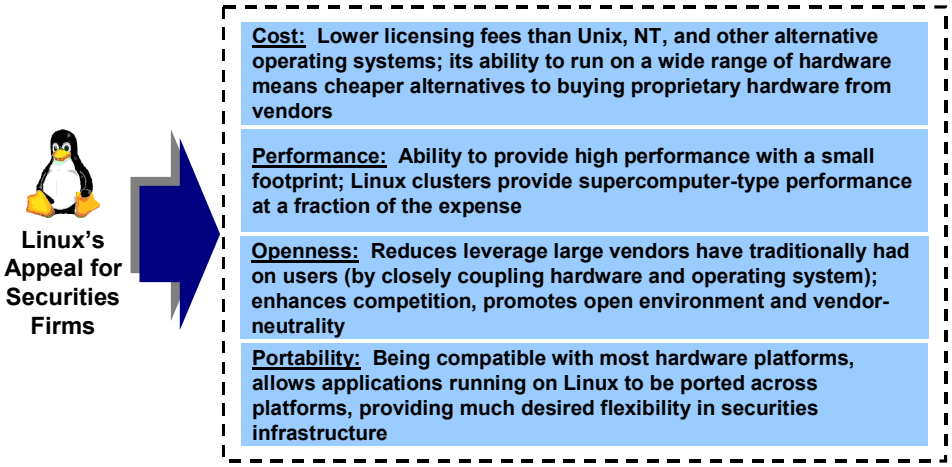
Linux is the most successful effort that has emerged from Open Source thus far. The Open Source model is especially relevant for securities firms because they have historically spent vast amounts of money on technology, either by buying it from commercial vendors or by extensively developing proprietary applications when suitable third-party products were unavailable. The Open Source software model offers cheaper alternatives to buying licensing software from traditional vendors like Sun, Microsoft, and Oracle, while Linux offers the ability to cut hardware expenses by running it on cheaper machines instead of on servers or mainframes that are more expensive. Besides lower software and hardware expense, Open Source and Linux force greater competition among traditional vendors and drive them toward greater standardization and interoperable solutions, two factors that greatly benefit securities institutions. Linux's innate ability to port across different platforms and hardware provides firms much greater flexibility, because they can more easily port third-party and homegrown applications to their platform of choice.

Linux provides a compelling argument when considering its high performance, reliability, and stability, all at a much lower cost than most alternatives, and it enables firms to realize greater flexibility in their technology infrastructure by not locking them into a particular vendor's technology. Large bulge bracket brokerage firms recognize that this flexibility can be a major strategic advantage because it allows them to leverage new technology without being unduly restricted by their current IT infrastructure. (Historically, securities firms, being constrained by previous technology decisions, have often not been able to leverage emerging technologies or innovative third-party applications. Integrating new systems and migrating old data and processes off older technology onto new platforms have proven to be daunting challenges.) Linux also provides institutions greater leverage in negotiating prices and service terms with infrastructure vendors and ISVs by giving them a viable alternative to third-party technology.

Exhibit 4 illustrates major reasons why Linux is especially appealing for securities firms.

Exhibit 4

Why Wall Street Is Romancing the Penguin



Source: TowerGroup

Financial services firms, and especially securities firms, have long had a reputation of leading the charge in adopting new technologies and riding emerging trends ahead of other industries. Financial firms have begun aggressively adopting Linux, but heavy Linux implementations are concentrated at large bulge bracket broker/dealers and we have yet to see mass adoption of the operating system for critical applications. Mass adoption hasn't happened because of a number of reasons: Most firms have invested vast amounts of money in Unix and NT infrastructure and are loath to write that off, they have developed huge proprietary systems on Unix, and they are apprehensive about support services currently available around Linux.

Meanwhile, other industries have been aggressively adopting Linux, including manufacturing, retail, biotech research, and the government sector.

Types of Linux Deployment

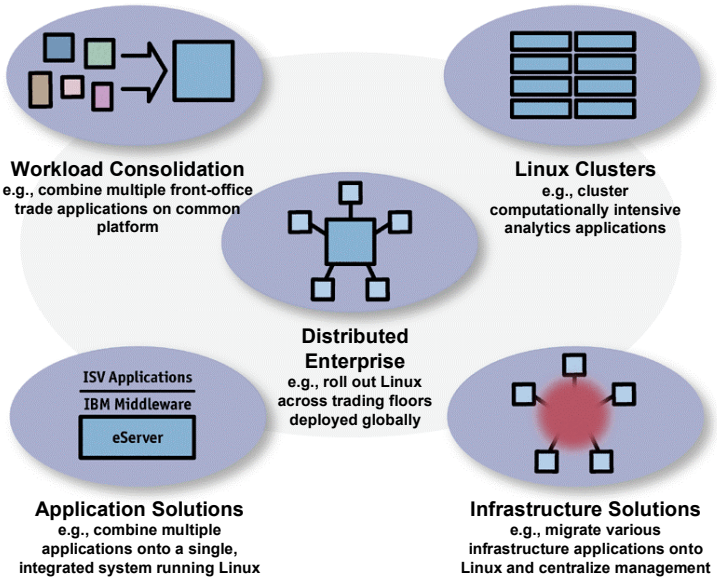
Securities firms are deploying Linux in several major ways (Exhibit 5 illustrates five major ways that IBM, a major Linux player, has witnessed brokerage firms deploying Linux). The particular deployment option that a securities firm chooses is a function of its internal IT architecture, business and technological needs, objective in adopting Linux, and comfort level with the current state of the system and expected growth in the future. Each deployment option has its particular merits and demerits and may include a different combination of the operating system, underlying hardware, integration services, and other tools.

1. **Workload Consolidation.** This type of Linux deployment makes sense for securities firms looking to consolidate workload currently spread over several machines onto a single Linux machine or set of Linux machines. Workload consolidation provides the benefit of reduced cost, improved performance, faster deployment, and a potentially lower TCO over time. Securities firms that have a siloed infrastructure with different systems for different asset classes may use this deployment option to consolidate their processing resources onto centralized systems.

2. **Clustering.** Linux clustering is becoming popular among securities firms and involves either stringing multiple processors onto a single server or linking different servers so that they are managed as a single machine and share their workload. This strategy provides enhanced performance and helps firms achieve a better price/performance ratio, improved uptime, and rapid installation. Clustering is helpful for brokerage firms as a way to prepare for disaster recovery and for providing fail-over capabilities.
3. **Distributed Enterprise.** Such a Linux deployment makes sense for firms looking to create a distributed computing environment where applications are deployed in multiple locations but need to be coordinated and managed centrally. As an example, a brokerage firm with multiple trading floors located around the world could use this deployment option. Linux is especially powerful in such an environment because it can operate on different hardware platforms and is conducive to remote management and support. Advantages of this option are lower cost, easier manageability, and high reliability and stability.
4. **Application Solutions.** This is a deployment option where different types of technology—applications, middleware, tools, etc.—are combined to run on Linux. The particular applications, middleware, and hardware may be a combination of what the institution currently owns or acquires from a third party. Linux vendors may often provide pieces of the solution in addition to the core Linux offering. For example, Exhibit 5 depicts IBM's middleware and third-party applications running on an IBM mainframe running Linux. This is a very common deployment option and can be utilized by securities firms anywhere across their entire enterprise. As an example, it can be utilized to create a straight through processing (STP) solution set comprised of different applications all running on a Linux platform.
5. **Infrastructure Solutions.** While this option resembles distributed enterprise deployment, it is different because it has a much greater amount of centralized systems management, monitoring, and maintenance. Such a deployment makes sense in smaller departments where systems have very close interaction and where a centralized control infrastructure is required. Advantages of this option are lower cost, easier setup, and expansion.

Exhibit 5

Five Major Ways in Which Linux Is Being Deployed by Securities Firms



Sources: IBM; TowerGroup

Current Implementations on Wall Street

Linux has gained popularity in the last two years among Wall Street brokerage houses and second-tier brokerage firms as rising cost pressures and a growing sense of comfort with the operating system have convinced CIOs to adopt it. An interesting feature of its adoption on Wall Street is that it was first introduced into the brokerage environment in the late 1990s mainly by enterprising developers excited about its Open Source origins. These developers had to then convince senior technology managers to try out the operating system, but senior management was quite apprehensive to try out this immature technology that didn't have the support of large established firms. So, while Linux was adopted, it remained relegated to run small, noncritical applications like print and file servers.

By early 2001, however, brokerage firms became much more comfortable and savvy about Linux and were dealing with one or more of the several firms (from Red Hat to IBM to HP) that provide services like installation, training, support, and consulting around Linux deployment. As a result, the Linux argument today is quite often being made at brokerage firms not by low-level developers but by senior management, who are becoming more convinced about its growing capability . What were small private firms providing support around Linux (like Red Hat and VA Linux) are today more established firms with a successful track record. Large firms like IBM and HP are equipping their core hardware platforms with Linux and providing comprehensive service contracts to support the system. Thousands of tools, utilities, and programs are offered on the Internet to support Linux, many of them free. The Open Source concept has been validated not only by the success of Linux but also by other projects like Apache and Samba (Apache is a free Web server; Samba is a network file system).

An interesting feature about the adoption of Linux in the securities industry is that large firms seem to have been much more aggressive in adopting it than small and midsize firms. Large firms like Merrill Lynch and Morgan Stanley have pushed the envelope and rolled out trading and trade processing applications on Linux while second- and third-tier firms are still only rolling out Linux on smaller, less mission-critical areas. There are a few major reasons why this has happened:

- Large brokers have a much more complex IT infrastructure with a high degree of proprietary applications developed on different platforms as well as newer applications they have acquired from third parties. The ability to port all these applications onto a common platform (Linux) is a major incentive for them to adopt it. Smaller firms have traditionally had a greater proportion of standard vendor applications and thus have had to wait for ISVs to begin supporting Linux.
- In the current highly competitive environment in the securities industry, large brokers are keen to explore how to leverage IT to gain a competitive advantage through greater technological performance (offered by Linux) or via a lower expense structure (lower TCO for Linux).
- Large firms have also been relatively less apprehensive about the level, nature, source, and degree of service and support available around Linux. Most large firms have enterprising developers with personal experience with Linux and may have contributed to various Open Source projects. If not, then they have the resources to train and develop a service/support infrastructure within their firm. Smaller firms are more dependent upon third-party providers for service and support and have thus often lagged behind larger firms in adopting Linux.

There are several examples of Linux's adoption in the securities industry. (See Exhibit 6.)

Exhibit 6

Major Linux Implementations in the Securities Industry

Linux Implementation	Project Description
CS First Boston	Deployed Linux on Egenera blade servers to support its global order routing architecture processing an average of 35 million transactions per day
E*TRADE	In summer 2002, decided to replace Sun Unix boxes with Linux servers to run its new Web site
Morgan Stanley	Estimates indicate one-sixth of systems run Linux; firm is in the process of completing migration of its North American equity market data distribution platform to Linux
Securities Industry Automation Corporation (SIAC)	Migrated its ARTMAIL application, which notifies trade participants about trade executions, from Sun SPARC to IBM's mainframe running Linux
Salomon Smith Barney	Consolidated workload by replacing Gateway servers with Linux virtual machines running on IBM mainframes

Source: TowerGroup

In summer 2002, E*TRADE decided to migrate off Sun Unix servers running Solaris to Linux to power its new Web site. The firm was attracted to Linux because of its cost advantage and the flexibility it would provide to replace ISVs and hardware manufacturers without having to be held hostage by its current environment. Another online brokerage firm, Datek, has been running 20% of its applications on Linux over the last few years.

CSFB has become a poster child for the growing success of Linux in the securities industry. In early 2002, it decided to migrate its global order routing architecture to three BladeFrame servers (from Egenera) that run Linux. If this test case is successful, the firm intends to migrate its entire enterprise architecture to the BladeFrame Linux architecture. Other areas where the firm is looking to extend the BladeFrame Linux architecture are calculation engines, middleware, and transaction processing systems.

The Securities Industry Automation Corporation (SIAC) has moved its ARTMAIL application, which delivers daily activity reports to Wall Street brokers and member firms on their respective buy/sell transactions, to Linux. ARTMAIL was ported over from Sun SPARC servers to an IBM eServer zSeries mainframe running Linux machines.

Merrill Lynch has been very vocal about its support and excitement for Linux in part to send a clear message to ISVs, especially those active in the financial services space, to continue supporting the Linux movement and offering their applications on it. Morgan Stanley claims to have more than one-sixth of its systems running on Linux and plans to grow it threefold by 2003, including the migration of its North American equity market data distribution platform to Linux.

Although these examples involve North American securities firms, Linux is gaining popularity worldwide following the fact that it came out of the Open Source movement, itself a truly global software movement. Italian bank Banca Commerciale Italiana is big on Linux, New Zealand's TSB Bank is migrating to Linux, Banco Mercantil in Venezuela has deployed Linux, and so has Shenzen Bank in China.

TowerGroup believes that securities firms considering the adoption of Linux must see it as a strategic decision and draw out a 3–5 year plan of how they should approach the system. They must begin by analyzing their current IT infrastructure and what their business and technological priorities are. The current enthusiasm around Linux, combined with the announcements by major brokerage firms (like Merrill Lynch and CSFB) of successful Linux deployments as well as aggressive marketing efforts by Linux distributors and ISVs, creates a compelling environment for securities firms not yet thinking of Linux to hastily make a decision in its favor. However, firms must consider the appropriateness of Linux for their environment by closely analyzing its current performance, reliability, and cost of ownership, available support, and ISV participation.

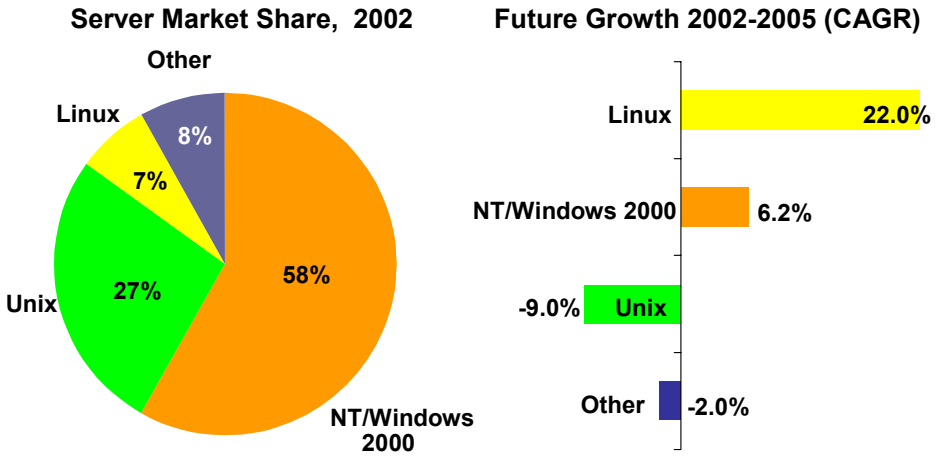
Linux Market Share in the North American Securities Industry

Looking at Linux's market share and how it compares with other operating systems in the North American securities market, TowerGroup estimates that Linux is currently deployed on 7% of the total servers in the North American securities industry. (See Exhibit 7.) Most servers in the securities industry continue to be dominated by Microsoft (58% of the total, NT and 2000 combined) with Unix coming in as the second most popular deployment option (27% of total servers).

TowerGroup believes that over 2002–2005, Linux will continue to make further inroads into the server market in the North American securities industry with Linux servers growing at a compound annual growth rate (CAGR) of 22%.

Exhibit 7

Projected Growth of Linux Deployments on Servers in the North American Securities Industry



Source: TowerGroup

Conclusion

Wall Street's penchant for Linux is driven by an urgent need to explore ways to further reduce IT expenses, and firms have begun exploring how to rationalize and enhance efficiency of their infrastructure. Firms are also dealing with a growing frustration with the cost and quality of commercially available software and a lack of openness of third-party software. As a result, they are considering migrating large parts of their IT infrastructure to Linux to leverage the flexibility it provides and to gain leverage with hardware and software vendors to negotiate better prices and service terms.

Brokerage firms are deploying Linux in several different ways, with top-tier brokerage firms pushing the envelope the most in creatively implementing it. Midtier and smaller brokerage firms have deployed Linux mainly in infrastructure areas, and most are waiting for their ISVs (whose software they use) to begin supporting it.