From: Peter Houston
Sent: Monday, September 09, 2002 8:03 AM
To: Bill Veghte; Bob Kelly
Subject: FW: MS Business Value White Paper

Mac Word 3.0 (356 KB)

Bill & Bob -

Here is the near final draft from IDC. I think its ready for you guys to have a look. The 'issues' that are there are not likely to change much.

I don't want to bias your reading of this, so I won't say much. Only that I think there is a lot of really good stuff in there, written under the name(s) of some very influential analysts (Dan Kusnetsky has been a pain in our butt in the past, and this paper would force a change in his game plan).

And, I'm not happy with what the report says about the downtime data, but I will say that the report has a lot of credibility, and says a lot of very good things for us. And, every piece of data we have says that customers already think Linux is more reliable than Windows. Also, I think we can get IDC to make some wording changes, if they are not too 'big' w/r/t changing the current framing. Melba tells me that it has been hard to get all of the IDC people on the report to agree on some of the wording.

I think we have some alternatives w/r/t how to actually use the data. For example, we could IDC release the report. Or, we could just use it with customers (along with some additional context setting) but not draw a lot of attention to the report, or we could launch the report. I would lean towards letting IDC issue the report.

Looking forward to your thoughts...

-Pete

-----Original Message-----
From: Melba Kurman
Sent: Friday, September 06, 2002 3:46 PM
To: Peter Houston
Subject: FW: MS Business Value White Paper

I haven't even looked at it yet.

Here it is. I need to read it now to make sure it's ready to go up to the top. IDC is more than willing to make any changes we suggest, and they're still planning on a final polish in terms of grammer and wordsmithing, tables, etc.

Melba

-----Original Message-----
From: David Shiang [mailto:dshiang@idc.com]
Sent: Friday, September 06, 2002 3:41 PM
To: Melba Kurman
Subject: MS Business Value White Paper

Melba,

Revised draft attached. Please note that it still needs to go through editing and production here, so please don't be too concerned if you find minor grammatical mistakes. Look forward to your team's comments.

Regards,

David

(See attached file: MS Business Value White Paper v5 0906.doc)

Explore new economic landscapes, technology solutions, and strategies for IT investments at IDC's European IT Forum.

Date: September 16-17, 2002
Location: Grimaldi Forum, Monaco

For more information, visit http://www.idc.com/itforum02.

Windows 2000 vs. Linux in Enterprise Computing: An Assessment of Business Value for Selected Workloads

An IDC White Paper
Sponsored by Microsoft Corporation

Analysts: Jean Bozman, Al Gillen, Charles Kolodgy, Dan Kusnetzky, Randy Perry, David Shiang

September, 2002

DRAFT 0906

IDC Opinion

Linux is widely-regarded as "free" because there is no or little cost associated with software acquisition. But after taking into account all costs, notably IT staffing, is Linux truly lower cost than competing platforms like Windows?

IDC has just completed a study of five common workloads in enterprise computing that challenges the common industry perception that Linux is "free." Our in-depth study suggests that Microsoft Windows 2000 offers lower total cost than a Linux solution in four of the five workloads common to most corporate IT environments. In these four workloads (network

infrastructure, print serving, file serving, and security applications), the cost advantages of Windows are significant – 11-22% less over a 5-year period. The cost advantages are driven primarily by Windows' significantly lower costs for IT staffing, generally the largest single component of IT costs. For the fifth workload, Web-serving, Linux had a cost advantage of 6% compared to Windows 2000 over the 5-year period.

IDC's study confirms that low initial software acquisition costs are only one factor, not the deciding one, in determining the 5-year total cost of ownership for the two operating environments.

Executive Summary

This study compares the 5-year total cost of ownership (TCO) of Microsoft Windows 2000 server environments with Linux server environments (from multiple Linux vendors) at 100 different North American companies. Consideration was given to the following five unique workloads:

- Network infrastructure
- File serving
- Print serving
- Web-serving
- Security applications

The bottom-line results of users interviewed in this research effort show that Microsoft's Windows 2000 environment offered a comparable, if not superior, 5-year TCO advantage in four of the five workloads, the exception being the Web-serving workload. Overall findings were as follows:

Table 1

5-Year TCO for Selected Workloads

	Windows 2000	Linux
Networking	11,787	13,263
File	99,048	114,381
Print	86,849	106,989
Web	32,305	30,600
Security	70,495	90,975

The TCO metrics are described in terms of 5-year costs for 100 users. IDC's TCO methodology, which is described at length later in this document, takes into account the 5-year costs of acquiring and supporting the hardware and software required for each of these specific workloads. Costs are broken out into

categories including hardware, software, staffing, downtime, IT staff training, and outsourcing costs.

Key Findings

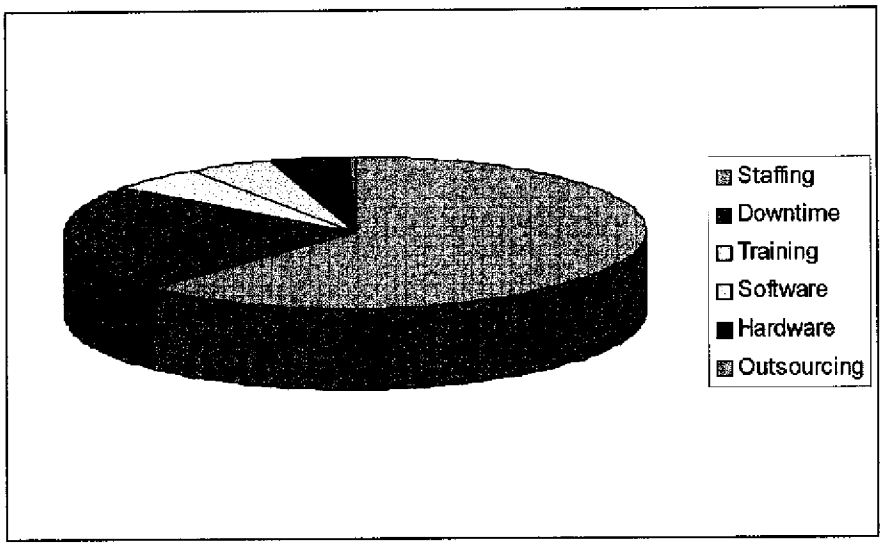
IDC TCO studies often find that mature computing platforms have an advantage in cost measurements. This is not surprising, as it is a direct result of the experience that customers have with the existing server operating environment, associated hardware and systems software platforms, and the applications and software tools. Mature environments also tend to have more skilled IT professionals readily available on the open market, resulting in a depth of knowledge and expertise that cannot be duplicated by emerging platforms.

Staffing Costs Were Greatest Contributor to Cost

For all the workloads studies by IDC – with the notable exception of Web-serving – by far the most significant cost areas were associated with staffing costs. That is, the largest component of total cost was not related to the initial purchase or hardware and software but rather to ongoing labor-intensive support and related costs. The average cost breakdown over 5 years showed that staffing accounted for 62% of total costs, with downtime coming in second at 23%. Training, software acquisition and upgrades, and hardware acquisition and upgrades were approximately 5% each; outsourcing amounted to 0.4%. These findings are consistent with past studies conducted by IDC. In most of the workloads considered in this study and others, software and hardware costs were relatively insignificant when considered as part of the 5-year TCO for 100 users.

Figure 1

Average Breakdown Over 5 Years by Cost Category



This study shows that there was a distinct gap between the support costs associated with Windows and Linux platforms, with Linux support costs exceeding that of Windows in every case. IDC believes that this differential in staffing costs is because the tools that are available to support Linux are less mature than those used for Windows 2000. Therefore, there is typically more work required to configure, program, and support Linux server environments.

Maturation of supporting tools is an evolutionary process that takes place with every new operating environment to emerge. Using Windows as an example, when Windows NT Server 3.5 was released in 1993, management tools were in extremely short supply. Major vendors such as Tivoli, Computer Associates and BMC had not yet extended their tools to manage Windows NT Environments.

In 1993, Microsoft's own tools, including Systems Management Server, were only in their earliest releases, and third party Windows management vendor partners (which would eventually include companies such as NetIQ, Mission Critical Software, Aelita Software, and others), either had not yet developed, or had not delivered products for Windows NT Server. By comparison, today Microsoft benefits from a robust third-party ISV community building management tools; its own tools have matured considerably, and the integrated management tools in Windows 2000 including Active Directory and Group Policy Objects have vastly simplified the process of managing a Windows environment.

It is worth noting that IDC believes that, over time, the gap in support costs between Linux and Windows will contract. As Linux matures and as more packaged software becomes

available in the Linux server market, IT professionals will become more skilled in the efficient installation, deployment, and maintenance of Linux server environments.

IDC expects that tools will emerge to ease the management of Linux operating environments both from the open source developer community, and from vendors of proprietary technologies. This will occur in an evolutionary manner just as was the case with Windows. Microsoft will, of course, also make progress in the Windows environment, although it is in a leadership position and therefore has less work to accomplish.

Windows 2000 Supports a Larger Number of Workloads

Another interesting aspect of the analysis shows, as expected, that there was a clear difference in the number of workloads running on each type of server system. Our study found that Microsoft servers tend to run more workloads per server than Linux systems typically carry. This is not surprising given the relative maturity of the Windows 2000 environment and the abundance of packaged applications ready to run on the Windows 2000 platform. This factor is likely further exaggerated by the selection of Windows 2000 servers in this study, as we did not consider servers running Windows NT.

IDC notes that the Windows 2000 environment is a more stable, more scalable operating environment than Windows NT. The inclusion of older Windows NT servers would likely have increased the amount of downtime shown at respondent sites.

It is likely that this gap in number of supported workloads between Windows 2000 and Linux servers will narrow over time as Linux applications become more pervasive, more ISV software packages and solutions are ported to Linux, and the scalability of Linux improves.

Acquisition Costs and Number of Processors

Hardware and software acquisition costs showed a general trend that favored Linux systems. IDC notes that with the exception of the Web-serving workload, software costs accounted for less than 9% of total 5-year costs per 100 users. IDC also notes that combined hardware and software costs accounted for less than 13% of the total costs of the configurations examined in this study.

Linux software costs were far lower than Microsoft software costs in most cases. However, since the Windows 2000 environments were, in general, shown to be more cost-effective over a 5-year usage period, it appears that low initial acquisition costs of software are not the critical factor in swinging 5-year TCO values in favor of either operating system. We will examine this topic in greater depth as the findings of the study are presented in more detail later in this white paper.

IDC believes that in addition to software licensing costs, which generally favored Linux, an important reason for the lower cost of acquisition is that typical Linux server configurations are 1-processor or 2-processor systems, while typical Windows server systems are 2-way, 4-way, and even 8-way systems. These more robust systems carry a higher average acquisition cost. This factor also had a direct correlation with the number of workloads supported per server, as we have already noted that Windows 2000 servers generally ran more workloads than Linux servers.

Many Linux servers are purchased as "thin" servers – which are typically 1-processor and 2-processor systems – thus enhancing the perception of lower cost of ownership for Linux server systems. However, as Linux matures as an operating system, it will likely be able to run on more scalable servers (4-8 processors, for example). This is expected to drive up the average sales price of the typical Linux server over time. IDC also anticipates that Linux will run on SMP server blades (with up to 4 processors) and on Itanium-based server "partitions" within large scalable servers (each partition could have 4-8 processors). Windows 2000 can already run on these form-factors today.

The Effect of System Downtime on TCO

Downtime is another cost factor that must be considered, as it was the second-largest cost component. This study found that Linux servers had less downtime than Windows 2000 systems, which agrees with customer perceptions about overall Linux server reliability. However, the costs associated with that downtime were relatively higher for Linux due to the finding that there were a higher average number of users per Linux system compared to Windows 2000 systems.

IDC notes that any study such as the one presented here represents a snapshot in time for a given collection of survey participants, while considering the trends that are expected to take place over the life cycle described in the study questionnaire. As such, this static view does not necessarily allow for every change that will take place in the industry in future years.

For instance, the introduction of new management tools or self-healing operating environments could potentially alter the administrative costs associated with a given platform.

TCO Results are Only One Factor in Platform Selection

Although we found that Windows 2000 generally had a cost advantage ranging from 13% to 22% compared to Linux, this advantage is not always in and of itself a compelling reason to initiate a move from one platform to the other. IDC notes that evaluating such a move would require a return-on-investment justification as well as a compelling TCO metric. In addition,

there are a host of other factors, some of them difficult to quantify, that must be considered in the choice of operating environment.

Attaining a reasonable ROI during a transition from one operating environment to another can be difficult to achieve when the TCO values that are associated with each of the compared platforms are relatively close – as is the case in our comparison between Linux and Windows 2000. Thus, where platforms are currently in use within an organization, continued use of those platforms often makes a great deal of economic sense.

This study strongly suggests that IT professionals who are considering deployment of the workloads evaluated should consider far more than acquisition costs of the technologies they plan to deploy. Other factors such as strategic IT choices, company standards, IT staff skills and competencies, application availability, application deployment, and performance considerations should be considered as part of a total platform evaluation.

IT professionals who are considering the broader strategic deployment of Linux within their IT environment need to carefully consider these findings in order to examine all aspects of cost associated with Linux server systems. Many drivers of cost need to be uncovered in such an examination and evaluation, and the "risk/return" trade-offs of Linux versus Windows may not be as obvious as they appear at first glance.

Project Scope and Methodology

Scope of Study

This study covered Linux and Windows 2000 running on general-purpose systems. In order to make comparisons more balanced, IDC did not evaluate appliance servers, which are dedicated systems that run a combination of vendor-installed operating system software and applications. Examples include security servers, firewall servers, caching servers, and proxy servers from companies such as Dell, Sun/Cobalt, HP, IBM, and others. Users do not have to modify the system software in any way prior to deployment, eliminating the need for application development and professional staffing for application deployment.

User Demographics and System Configurations

To obtain the TCO data used in this analysis, IDC interviewed by telephone IT executives and managers at 104 North American companies. Companies interviewed for this analysis generally considered themselves "late adopters" of technology—not risk takers, so their Linux workloads consisted of routine server tasks. Interviewees were selected, at random from a list provided by Network World, an IDG publication. Each

interviewee was asked about a specific workload (file, print, security, Web, networking) and a specific server (Windows 2000 or Linux). In some cases, interviewees provided information on multiple workloads or multiple servers. Occasionally, multiple interviewees were conducted within a single company.

Most of the larger companies had heterogeneous environments including Windows 2000, Windows NT, Linux, and Unix. Nearly 40% had both Microsoft and Linux servers.

TCO, ROI, and Business Value

It is important to clarify that in this study, IDC evaluated the total cost of ownership (TCO), as opposed to return on investment (ROI). TCO measures cost outlays over a specific time period, and it is a primary method of weighing alternative purchase decisions. This measure is used especially to compare systems running basic infrastructure workloads. Not surprisingly, these basic infrastructure workloads also represent a highly price-competitive environment for software and systems vendors. ROI, on the other hand, measures the specific benefit that one expects to achieve by investing in a new technology, product, approach, etc.

When evaluating the TCO for any given system, it is important to weigh all the factors contributing to cost, including initial acquisition costs for hardware and software, the cost of IT staffing, outsourcing costs associated with deployment, support or maintenance, and the cost of system downtime – which adversely affects end-users' ability to access applications and data.

Ongoing operational costs are comprised mainly of IT support costs, and this labor-intensive cost component lessens the overall impact of initial software and hardware acquisition costs as time goes by. An environment having highly integrated functions, more mature administration and operations tools, and readily available expertise would generally have an advantage over an operating environment which does not have these attributes. Ultimately, the out-of-pocket initial cost for hardware and software may be outweighed by other, continuing costs that are associated with operations, support and maintenance of the system.

Of course, there are other factors at play in any IT evaluation, some of them difficult to quantify. IDC uses the term "Business Value" to take into account these factors as well as measurable TCO results. Non-quantifiable (or difficult to quantify) factors include strategic IT choices, adherence to standards, asset management, application availability, application deployment and deployment, and performance considerations. In addition, longstanding relationships with hardware and software suppliers may carry more weight in a decision on the components of a specific, single system than the TCO of that single system. Business Value represents the best overall objective measure

of total customer value – especially for the type of infrastructure workloads that IDC is analyzing in this study.

IDC measured the total cost of creating, deploying and maintaining the computing infrastructure to support 1,315 users of specific workloads and then projected the costs over a period of five years. IDC then took snapshots of the total costs at the 3 and 5-year mark. The total cost embraces costs related to staffing, programming/development, configuration, installation, optimization/tuning and ongoing maintenance. Both IT staff and user productivity are included as costs. IT staff productivity accounts for the time IT staff is engaged in activities that are not contributing to the business, specifically training and responding to outages. User productivity can also be measured by studying how often the systems go offline and by measuring the impact of that downtime on end-user work.

Major Cost Factors

IDC captured the total costs to deliver network, file, print, Web and security applications to an environment of 1,315 users growing to 1,597 users (about 4% growth per year) over five years. Major cost components were as follows:

Hardware

- Purchase – Acquisition of the hardware only
- Installation – Costs to initially set up the server and for annual hardware upgrades
- Maintenance – External and Internal costs to support hardware

Software-OS

- Purchase- Costs of the OS stripped out from the total server costs
- Installation- Costs to initially deploy the OS and for annual upgrades
- Training – External costs for initial training of IT staff, specifically on the OS
- Maintenance – External and internal costs to support software

Applications Software

- Total costs for applications specific to each workload

Software-management

- Management software costs allocated across all workloads based on the IT staffing breakdowns

Staffing

- Annual loaded salary, which includes cost for over overhead and bonuses

Outsourced services

- IT services to support and maintain servers

Annual IT Staff training

- This includes fees for outside trainers as well as the productivity loss of staff for time spent in training

Downtime

- User productivity – hours of downtime x 40% productivity factor x annual loaded salary. The productivity factor allows us to recognize that users are not 100% non-productive during network outages.
- IT staff productivity – time staff spends identifying and fixing the causes of outages x loaded salary.

Normalization and Presentation

Ultimately, the value of any TCO analysis lies in its utility to the IT buyer. To be useful in the buying decision, the analyst must take information from very different environments and standardize it so that IT buyers can compare their own environments to the standard.

To ensure that the two server environments are compared fairly, IDC normalized all costs on a per server basis for average number of users and workloads. For example, in Web-serving workloads, Linux environments averaged 314 users per server, whereas Microsoft averaged 168. When comparing costs we assumed the costs of 1.87 Microsoft servers for every one Linux server. Likewise, on a per servers basis, Microsoft servers were running 1.67 workloads for each workload run on a Linux server.

IDC presents the TCO findings on a per 100 user basis so that companies of all sizes can relate the costs and benefits of the study to their environments.

Windows 2000 vs. Windows NT 4.0

IDC focused on Windows 2000 environments using data from companies with pure Windows 2000 environments or mixed Windows environments where servers running Windows NT accounted for 20% or less of the total Windows systems.

The makeup of the systems within the study sample is dominated by single and dual processor configurations. Four-way SMP systems accounted for 8% of the Windows sample.

Linux System Configurations

Linux environments typically consisted of a Linux distribution (Red Hat, Caldera, SuSE, etc.) running on standard Intel architecture servers. Server configurations by operating environment are as follows:

Server Configurations	Microsoft	Linux
1-Way	53%	55%
2-Way	39%	45%
4-Way	8%	0%

Workloads Measured by IDC

We will now examine the detailed models for each workload. Table 2 presents the TCO values obtained for each of the five workloads studied. Costs are broken into six general categories, including hardware, software, staffing (mainly Full Time Equivalent personnel per 100 users), downtime, IT training, and outsourced costs.

Table 2

	Networking		File		Print		Security		Web	
	Microsoft	Linux	Microsoft	Linux	Microsoft	Linux	Microsoft	Linux	Microsoft	Linux
Hardware	$1,211	$1,004	$5,703	$3,139	$1,173	$2,172	$1,653	$2,041	$7,087	$3,006
Software	$211	$940	$3,988	$1,009	$1,665	$340	$5,829	$6,609	$7,107	$1,390
Staffing	$8,392	$8,201	$54,030	$81,204	$40,247	$59,080	$50,609	$71,056	$15,102	$23,015
Downtime	$1,412	$1,494	$30,133	$20,788	$38,857	$39,746	$10,335	$4,385	$1,646	$1,541
IT Staff Training	$534	$677	$5,191	$7,670	$4,787	$5,282	$2,000	$6,445	$1,304	$1,584
Outsourced	$26	$946	$3	$570	$121	$369	$49	$440	$59	$64
Total	$11,787	$13,263	$99,048	$114,381	$86,849	$106,989	$70,495	$90,975	$32,305	$30,600

Source: IDC, 2002

Networking Workloads

Networking workloads include systems providing the basic infrastructure services that are consumed by typical business networks. This category includes server systems offering services such as dynamic host configuration protocol (DHCP), domain name system (DNS), Windows Internet Naming Service (WINS), as well as directory services and caching services. This workload also includes remote access/application sharing servers, and traditional servers that are used as routers, hubs and switches. (This study excluded devices, such as dedicated routers, hubs and switches, that were not built on general-purpose server operating systems.)

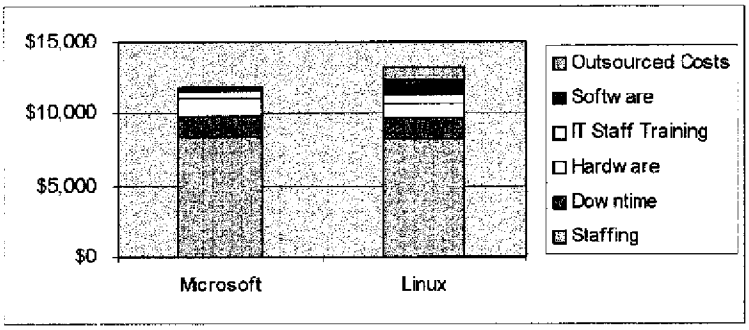
For Networking workloads, the study found that Windows 2000 was 11% less expensive per 100 users over a 5-year ownership period, when compared to a similar solution based on Linux. Microsoft Windows 2000 server environments showed a 5-year TCO for 100 users to be at $11,787, lower than the $13,263 figure recorded for Linux environments.

For both Windows 2000 and for Linux, the number one cost item was staffing, with that component accounting for 71% of

the costs in the Microsoft platform, and just under 62% of the costs in the Linux platform. Other costs were effectively equal on a percentage basis between the two environments, while hardware costs were slightly higher for Microsoft environments than for Linux.

Figure 2 shows the detailed breakout of specific costs involved in the network infrastructure workload.

Figure 2
Five-Year Total Cost of Ownership for Network Infrastructure Workloads



Source: IDC, 2002

What is most interesting about the Network Infrastructure workload was the nature of the remaining cost categories. Software in the Linux category was 7% of the TCO value over a 5-year period, while in the Windows 2000 environment, software costs only accounted for 1.8% of the TCO over the same 5-year period.

Paralleling this was the outsourced costs (which incorporates installation at an outsourced location, upgrades, application development, co-location costs and cost of operations there), which had a similar difference, with Linux outsourced costs accounting for 7.1% of the Linux TCO, and Windows 2000 outsourced costs accounting for only 0.2% of the TCO.

Looking a level deeper, this study found that operating systems software costs were roughly equal for Linux and Windows, but that purchased management software and application software costs for Linux far exceeded software costs for Windows.

One possible reason for the comparably higher management software costs is because in many instances, customers custom-build the software tools that are used to manage Linux server systems. Once again, the lack of maturity of the overall Linux environment, coupled with the rarity of packaged system-management software for Linux, exacerbates this problem. In time, IDC expects a more mature Linux ecosystem will develop,

including management tools and system-management framework products ported to the Linux server environment.

This difference in application software costs suggests that users were deploying the Linux systems either for network infrastructure workloads for which there was no open source application software available, or had chosen to forego open source application packages and instead purchased commercial software for deployment in this configuration. One example for how such a scenario could play out would be for a system intended to provide directory server service. In the case of Windows 2000 this is an included feature, where for Linux, a user would need to deploy a commercial directory server package such as IBM's Directory Server, Novell's eDirectory or Sun ONE Directory Server.

Taking a high-level view, the 5-year TCO for both the Windows and Linux network workloads was relatively low, amounting to only $12,000 to $13,000 per year for 100 supported users. By comparison, other workloads evaluated in this study show a cost of $30,000 to more than $100,000 per year for 100 supported users over a 5-year usage period.

IDC's recommendation is that the network workload TCO benefit that Windows offers is an important factor to consider in a side-by-side evaluation. However, remember that the application software cost for the precise workload deployed will have a direct and significant influence on the ultimate TCO figures. In addition, keep the relative cost in perspective as this workload accounts for just a fraction of the overall 5-year cost of ownership for 100 supported users for both Linux and for Windows supporting other workloads examined by this study.

File Serving Workloads

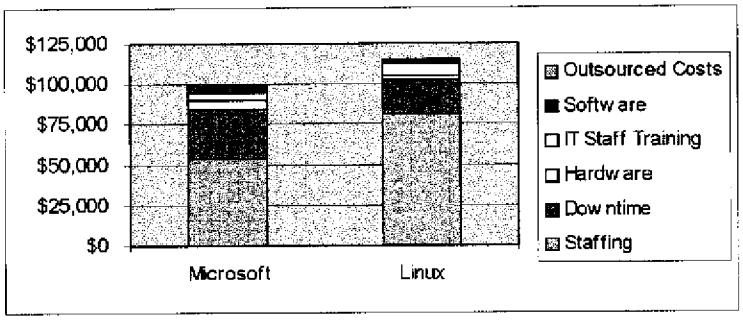
For this study, IDC split the file and print functions into two separately measured workloads. This approach aligns with the practice at many organizations of utilizing separate banks of print servers and file servers, allowing each function to grow as needed without impacting the other function. This also allows file service information to be archived without requiring sophisticated procedures for excluding transient print information.

File server workloads include providing services such as file transfer protocol (FTP), file sharing using the network file system protocol (NFS), and file sharing using the common internet file system (CIFS). In this study, file workloads specifically exclude network attached storage (NAS) devices, since these dedicated devices generally are not built using standard server operating systems and general purpose hardware.

Figure 3 illustrates the comparison between 5-year TCO values determined by this study.

For file serving workloads, Microsoft Windows 2000 server configurations showed a 5-year cost for 100 users to be 13% less expensive when compared to a similar solution based on Linux. From a cost perspective, the 5-year cost of ownership for 100 users for Windows 2000 environments is projected to be $99,048, lower than the $114,381 figure recorded for similarly sized Linux environments.

Figure 3
Five-Year Total Cost of Ownership for File Serving Workloads



Source: IDC, 2002

For file serving workloads, staffing costs were the single largest cost factor influencing the TCO values found by this study. This study found staffing costs to account for between 55% and 71% of the 5-year TCO for 100 supported users.

In fact, Linux staffing costs were more than 50% higher on a dollar basis than were Windows staffing costs. IDC believes this is another example of how a relatively new operating environment is unable to offer the same ease of management that is available for an incumbent, well-known operating environment. If the open source community is able to improve Linux built-in manageability, it's possible that over time, IDC would expect this situation to improve within the maturing Linux environment.

Focusing next on the other major cost factor, collected in the other costs category, the underlying data shows the single most important component of this line item is costs associated with downtime. For both Linux and Windows environments, downtime costs accounted for ¾ or more of the total of the other costs line item. Clearly, this is an element that IT departments need to be aware of, and proactively address.

Taking a closer look at the data, despite the vast improvements of Windows 2000 over Windows NT, this study still found that downtime associated with Linux servers is considerably less –

often well less than half the downtime than what users experience with Windows 2000.

The fact that Linux file servers had less downtime than Windows file servers could relate the tendency for Linux systems to carry smaller numbers of workloads, while Windows file servers tended support a higher number of other workloads per system. This added complexity and interaction between applications could increase the risk of planned and unplanned downtime.

When calculating the actual costs of downtime, Windows 2000 systems benefited from the multiple workloads, since the number of users per workload tended to be lower than Linux systems, which were more heavily leveraged on a per workload basis. So when multiplying the number of users affected by downtime against downtime costs, the higher number of users on Linux systems for file workloads narrowed downtime costs comparison.

Interestingly, for file workloads, the 5-year TCO for hardware, software and outsourced costs collectively amounted to less than 10% of the total value both for Windows 2000 and Linux environments.

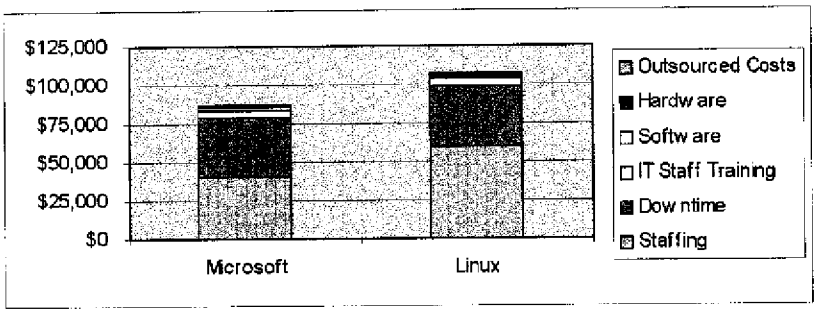
Print Workloads

Print server workloads include print stream protocols such as Windows' native print service, Internet printing protocol (IPP), and foreign protocols including line printer daemon (LPD) for Unix and Linux clients and AppleTalk for Macintosh systems.

Print servers configured with Windows 2000 achieved a 5-year TCO of $86,849 for 100 supported users, compared to $106,989 for Linux, showing Microsoft with a 19% lower TCO than Linux could offer.

Figure 4 illustrates the comparison between 5-year TCO values determined by this study for print serving workloads.

Figure 4
Five-Year Total Cost of Ownership for Print Serving Workloads



Source: IDC, 2002

In this workload, Windows 2000 was found to be 19% less expensive for 100 users when compared to a similar solution based on Linux, over a 5-year period of use. Microsoft Windows 2000 server environments showed a cost for 100 users to be $86,849, compared to $106,989 recorded for Linux environments, over a 5-year period of use.

As was found with file serving workloads, staffing costs and other costs (including downtime and training costs) together accounted for the vast majority – for this workload, more than 95% of the 5-year TCO expense for these workloads.

However, unlike file workloads, where staffing costs exceeded all other cost items by at 20 percentage points or more, the print workload's major costs items were closer to being split equally between staffing and other costs.

In the case of Windows 2000 environments supporting print workloads, the "other" costs line-item – for which the greatest contributor was the high cost of downtime – unseated staffing costs as the single most expensive element in a 5-year usage period. In no other workload or platform studied did any cost item displace staffing costs as the single most important component in a 5-year TCO calculation.

While other costs did not displace staffing costs for Linux as the leading factor, the spread on these cost areas was far closer than on any other workload.

The message here seems to be that print workloads TCO are directly related to the amount of downtime experienced by servers supporting this workload. Managing the downtime factor can have considerable influence on lowering TCO for either of these environments.

As with file workloads, the tendency for Linux systems to carry smaller numbers of workloads, while Windows file servers

tended to support a higher number of other workloads per system likely added complexity and interaction between applications could increase the risk of planned and unplanned downtime. In addition, the effect of a higher average number of users connected to Linux systems raised the calculated downtime cost for Linux servers in this study.

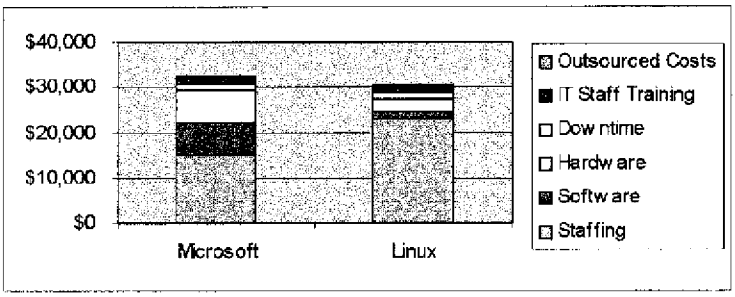
Web Workloads

Since the category of Web server is a broad term that spans many different types of deployments, for this analysis, IDC's definition of Web serving was defined to cover Internet, intranet and extranet Web servers delivering both static and dynamic Web pages. This definition would include Web servers delivering HTML pages (generally described as static Web pages), as well as Java Server Pages (JSP), Active Server Pages (ASP), PERL and PHP pages. This analysis did not include large scale Web hosters, nor did it include web pages as a front-end for back-end line-of-business and database applications.

The Web workload was the one area in this study for which the TCO values for Linux servers were lower than those for Windows 2000 servers. The results of this study found Windows 2000 to be 6% more expensive in its 5-year TCO for 100 users when compared to a similar solution based on Linux. For Web workload environments, Microsoft Windows 2000 server environments showed the cost for 100 users to be $32,305 compared to $30,600 recorded for Linux environments, over a 5-year period of use.

Figure 5 shows, in graphical form, the results of this comparison.

Figure 5
Five-Year Total Cost of Ownership for Web Workloads



Source: IDC, 2002

The Web workload is unique beyond the fact that it was the only workload studied where Linux 5-year TCO was lower than Windows 2000. This study found this workload to the second least expensive workload to support overall, but one with the highest relative costs for hardware and software acquisition.

Looking deeper at these cost items, software costs on Windows 2000 represented 22% of the 5-year TCO total, while hardware costs represented another 22% of the 5-year TCO for 100 supported users. No other workload on either platform had hardware/software costs remote approaching this total.

The Windows software costs were largely attributable to acquisition of the operating system, with that item accounting for 16% out of the 22% total software cost for the 5-year TCO.

Meanwhile, Linux had a similar trend, although the acquisition costs for software and hardware were not nearly as high on either a percentage basis or on a real dollars basis. Nevertheless, the combined hardware/software costs for the Linux platform were among the highest recorded for all the workloads studied on Linux.

One big factor, staffing costs, was nearly 30 percentage points higher for the Linux platform than for the Windows platform. In fact, it was only because of the huge savings on initial software and hardware acquisition costs that allowed Linux to edge past Windows 2000 in this workload component of the study.

IDC's interpretation of these results suggests that Linux acquisition costs are very low, as would be expected, but that support costs for Linux are much higher than Windows 2000. Support costs have been found to consistently be a major cost item for workloads supported aboard Linux in this study, so this comes as little surprise for the Web workload.

The question remains why Windows operating system software acquisition costs are relatively high for this workload. One possibility is that factors such as the tight integration between Internet Information Server and other Microsoft technologies, including SQL Server and Active Directory, are being factored in as an operating system expense by users who see these components as part of an IIS solution – not as independent application software. A low expense for related application software recorded by this study does not allow for costs that would be incurred by using other Microsoft products to support such a solution.

Security Workloads

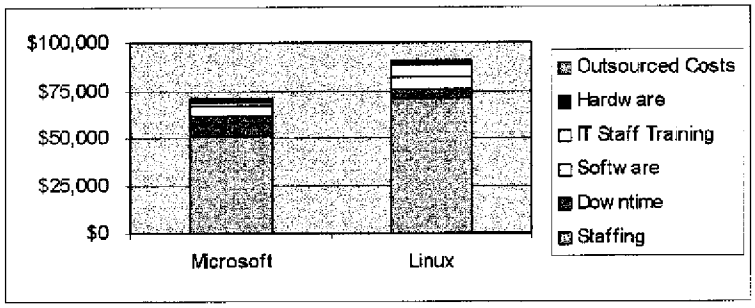
One of the best examples of the subtle TCO advantages of using Windows 2000 instead of Linux is the security workload configuration. Here, Windows 2000 servers posted an appreciable benefit over Linux servers, with a 5-year TCO for 100 supported users comparison showing Windows costs at $70,495 as compared with Linux costs at $90,975, over a 5-

year usage period. This represents a cost savings of 22.5% for Windows 2000 when compared to Linux in this workload.

For this analysis, security workloads include servers offering a variety of services. These services include firewall services, support for virtual private networking (VPN), intrusion detection services, anti-virus management services, authentication, access and authorization services, including both certification services and digital rights management services. This study considers those situations where applications are added by a user to a standard server configuration for security-related functions. This study excludes comparisons between either servers running Windows or Linux along with security application software and dedicated Linux–based security appliances in which the manufacturer installs the application software.

Figure 6 illustrates the comparison between 5-year cost of ownership values, as determined by this study for security workloads.

Figure 6
Five-Year Total Cost of Ownership for Security Workloads



Source: IDC, 2002

To support security server workloads, staffing was once again the largest single component contributing to the total cost of ownership. Linux staffing costs amounted to nearly 78% of the 5-year TCO value, while Windows staffing costs was 72%. The only other cost component of the security workload that registered in double-digits was cost of downtime once again showing itself to be the chief culprit for raising that cost component for Windows 2000 platforms.

In keeping with the challenges of conducting a fair "apples to apples" comparison between Linux and Windows TCO, security server deployment, like the other workloads studied, reflected the trend of Linux usage for single-purpose servers. IDC research from other studies confirms that the vast majority

of Linux security deployments are associated with closed security appliances. Because this study did not ask about specific security-hardware configurations, we cannot say exactly how many of the security servers we surveyed were appliance servers. This impacts the hardware pricing input to the IDC TCO model, since most appliance servers are priced less than general-purpose servers.

For security serving in particular, IDC has found that most users are typically not concerned about the choice of operating system (since the operating system is "buried" inside the server appliance), but they do care about the product's performance. In order to decrease complexity for the end-user, Linux appliance servers are configured to run with little interaction from the user so they're difficult to compare to general-purpose servers running either Windows, Unix or another operating system. Although Microsoft offers its own appliance server that is capable of supporting security workloads, many vendors building security server appliances choose operating systems such as Linux and BSD Unix (Free BSD or Open BSD) because these operating systems do not carry any royalty payments, and because the vendors can optimize these operating systems for security and performance through tuning of the system software.

Major security vendors have been slow to provide enterprise software products that run on general-purpose servers using Linux. These vendors historically have concentrated on Windows or Unix operating systems. These commercial, enterprise operating systems are the preferred avenue for security software vendors because of their extensive deployment within the enterprise. Since users have a strong understanding of the operating system, security vendors don't need to concentrate as much on upgrades, configurations and patches. Although there are many open source security packages available for Linux, there are few commercial security solutions for the Linux server platform. However vendors are slowly rolling out Linux client security software. As Linux moves into the enterprise, security vendors will utilize the platform users select.

There are other factors, not just cost that come into consideration when comparing operating systems such as Linux to Microsoft Windows 2000 in security. There are customers who philosophically avoid using Microsoft systems for security. They may want the ability to harden the operating system and they may prefer the improved reliability of Linux.

However, IDC believes that the TCO advantage for Microsoft over Linux server security workloads will remain for a number of years because the deployment of Linux software security applications will take time. The real issue is the replacement of servers with dedicated security appliances. It is here that Linux and other open operating systems have the greatest impact.

Challenges and Opportunities

IDC expects the current computing environment and the available platform choices to continue to evolve over the next several years. Neither Microsoft nor Linux advocates will stand still; they will both address customer demands and make their products more usable and cost-effective. It is entirely possible that enough cost factors will change over time to narrow the gap between Microsoft and Linux for selected workloads included in this TCO study. Microsoft's challenge will be to correctly identify the aspects of the overall Linux ecosystem that are most appealing to end-customers and to create software solutions that are equally appealing and cost-effective.

Packaged software for Linux will increasingly be bundled in with the server hardware, thus reducing the need for tuning, optimization and development, going forward. This has already begun to happen, with packaged products like Oracle's 9iRAC (Real Application Clusters) for Linux, Veritas storage-management software, Linux security software packages, and soon to come, Sun's Line of general-purpose Linux servers. This will reduce the need for professional staffing for Linux software installation, configuration and application development.

It is reasonable to expect that Linux will support a more mature computing environment over the next few years, gaining better ISV support for commercial applications and packaged database products. It is also reasonable to expect that less customization and scripting for will be required for Linux computing over time, as Linux tools mature and become easier to use, thus reducing the total cost of ownership for Linux server environments. Thus, we can expect that today's early adopters of Linux technology, who are now spending significant time and resources making the Linux environment suitable for a range of business and high-performance applications, will have an easier task deploying similar workloads in three to five years' time.

The evolution of supporting management tools is an evolutionary process that takes place with every new operating environment to emerge. This evolutionary process already has taken place with Windows environments, with the operating system going through four major revisions between its launch in 1993 and 2000, and accompanied by quantum improvements in Microsoft- and third party-supplied management tools.

There is a major caveat, however, to this view of an improving 5-year TCO picture for Linux: If too many Linux variants emerge, then it is possible that the open-source community could become fragmented in a way that is similar to the fragmentation of the 32-bit Unix world in the 1990s. This fragmentation diluted the effectiveness of the Unix open-systems movement that began in the late 1980s by eventually making the overall Unix development and deployment

environment crowded with Unix variants, and thus more complex for IT management. A leading challenge for Linux, and for the system vendors that are selling Linux solutions, will be to prevent fragmentation of the open-source community's support for current Linux distributions and related applications, databases, system software and middleware.

(Note: IDC has published numerous pieces evaluating the future of the Linux operating system, interested readers may want to review the following: *Worldwide Linux Operating Environments Forecast and Analysis, 2002-2006: A Market in Transition*, IDC #27521, July 2002; *Sun Ups the Ante with Linux Software-Hardware Package*, IDC #27833, August, 2002, *UnitedLinux Sets Stage for Consolidation, Competition*, IDC #27357, June 2002; and *Building the Linux Desktop: The Ximian Story*, IDC #27243, June 2002.)

Conclusions

The "waves" of Linux adoption in recent years have brought increasing reliability and support to the overall Linux environment. But they have not yet succeeded in lowering the total cost of ownership for Linux servers, which require more custom software and hands-on management that comparable Windows 2000 servers, on average, according to the findings of this IDC study.

IDC found that Microsoft Windows 2000 servers were less costly to run and maintain, over a 5-year period, than Linux servers for four important enterprise workloads: networking, file, print and security. This finding may be surprising because many people apparently believe that since acquiring Linux involves minimal out-of-pocket costs, it is therefore less costly to use over time. Linux servers were found to be less costly in the Web space, largely because there were more packaged software products for Linux in that space, and because of the maturity of that use for thin Linux servers arrayed in Web-centric "server farms" or tiers. However, the Windows 2000 servers studied ran, on average, more workloads than the Linux servers, making them cost-effective platforms for IT customer sites that are running business-critical and mission-critical workloads.

Ongoing competition is to be expected as the Linux distributors and Microsoft— along with the systems vendors that provide both kinds of software solutions on their hardware platforms— continue to provide cost-effective software products for the worldwide server market. Along the way, this kind of energetic competition will benefit customers, IDC believes that suppliers provide increasing levels of functionality at more attractive price points, and help customers drive down the cost of computing through enhanced 'ease of' features (installation, management, etc.).

Packaged software for Linux will increasingly be bundled in with the server hardware, thus reducing the need for tuning, optimization and development, going forward. This has already begun to happen, with packaged products like Oracle's 9iRAC (Real Application Clusters) for Linux, Veritas storage-management software, Linux security software packages, and soon to come, Sun's Line of general-purpose Linux servers. This will reduce the need for professional staffing for Linux software installation, configuration and application development.

Note: Sidebars will be placed early in the paper in order to give readers a grounding in the two Operating Systems under consideration.

Sidebar 1:

Linux comes from multiple Linux "distributors," including Red Hat, SuSe, Caldera/SCO, Turbolinux, MandrakeSoft, and others. Thus, there is a single, underlying, operating system kernel that is shipped by multiple distributors around the world. Each of these Linux distributors adds software modules, including utilities and middleware, on top of the basic kernel. Linux was invented in 1991 by Linus Torvalds—then a Finnish graduate student—who sought help in completing the source code from a community of open-source developers via the Internet in the 1990s. Today, Torvalds publishes updated versions of the Linux operating system—but new code from the open-source community is added in each new release. According to the "rules" of Linux publication, developers can create new source code for Linux—but they must publish it back to the open-source community for inclusion in later releases.

This IDC study includes data about servers at user sites that are running different distributions of the basic 32-bit Linux operating system. Thus, the Linux platform studied in this IDC white paper is a generic platform, rather than one provided by any single Linux distributor.

Historically, adoption of the Linux operating system has come in "waves." In the first wave, Linux was added to existing, installed-base client or server machines that were shipped without an operating system—or it replaced and existing operating system. In the second wave, system vendors began to ship Linux on new server systems, starting in 1999. These Linux hardware platforms included appliance servers and general-purpose servers from Dell, HP, IBM. Sun and others. Linux was also being adopted by the high-performance

technical computing (HPTC) community. For HPC applications, Linux is often deployed on Linux workload-balancing clusters including dozens of individual servers running the "Beowulf" open-source Linux-clustering software. In the current wave of adoption, there is much "custom" software development at commercial Linux sites. This requires intense IT staffing/application development related to the Linux custom-application creation, deployment and maintenance. In coming years, there will also be a wave of Linux adoption for support of Web services, which are Web-enabled applications that can link with—and interoperate with other Web-enabled applications via the Internet. Web services for Linux server will likely be based on the Java development environment.

These "waves" of adoption have brought increasing reliability and support to the overall Linux environment. But they have not yet succeeded in lowering the total cost of ownership (TCO) for Linux servers, which, on average, require more custom software and hands-on management than do comparable Windows 2000 servers. That is because custom Linux applications require optimization and tuning, requiring professional time from programmers/developers, system administrators and operations personnel.

Sidebar 2:

Adoption of the Microsoft Windows 2000 has been ramping up since its introduction in February, 2000. Windows 2000 is available in three versions: Standard Server for hardware platforms with two to four processors; Advanced Server for hardware platforms with four to eight processors; and Windows Data Center for hardware platforms with eight or more processors.

This IDC study looked at servers running Windows 2000—and did not look at servers running the Windows NT Server product. This aspect of the study's methodology, which is described in the body of this IDC white paper, ensured that respondents' were commenting on the currently shipping product, rather than on an older product. It also ensured that the TCO metrics were being gathered about the same Windows operating-system platform.

Windows 2000 is available from one software vendor, Microsoft, rather than from multiple software vendors or software distributors, although it can be acquired indirectly through the purchase of OEM server systems. Thus, Microsoft Windows is widely available—and it is supported by Microsoft and its OEM

partners, channel partners and systems-integration partners. The most scalable version of Windows 2000, Windows Datacenter, is available on new servers from system vendors, which ensures that system configuration, and system support is delivered as part of a total solution.

Windows 2000 is now the primary version of 32-bit Windows shipping on Intel-based servers. In many cases, Windows 2000 is a follow-on replacement for earlier versions of Windows, including the widely deployed Windows NT Server 4.0, which Microsoft began shipping in summer, 1996 and which it stopped shipping as a generally available product in early 2002.

Windows 2000 is a mature operating-system product, shipping more than 1 million copies annually on a worldwide basis. There are tens of thousands of packaged applications, including packaged databases, that are available to run on the Windows 2000 server operating system. While programmers can develop custom Windows 2000 programs, there is typically less custom development associated with installing and deploying the Windows 2000 server operating environment, which serves as a platform on which to run those packaged applications.

The next wave of Windows adoption will be versions of the Windows 2000 operating system that include support for .NET—Microsoft's software technology for direct support of Web services. Microsoft expects to enhance the Windows 2000 server products with the addition of .NET versions of Windows 2000 Standard Server, Advanced Server and Datacenter Server, with additional built-in support for Web services, which are Web-enabled applications that can link with—and interoperate with other Web-enabled applications via the Internet, later this year.