

Migration from Microsoft to Linux on Servers and Desktops.

P. K. Ajith Kumar

Information Technology,
Bay of Plenty Polytechnic
Tauranga, New Zealand.

Ajith.Kumar@boppoly.ac.nz

Abstract

Recent times have witnessed a considerable amount of interest in migration to Linux from various operating systems, in particular from Microsoft based operating systems. There are several factors that influence the migration to Linux. The aim of this research was to study the migration of servers and desktop from Microsoft based operating systems to Linux.

Keywords: Linux, Microsoft, migration, server, desktop

1 Introduction

The role of IT in businesses has been substantial for over 20 years. As more and more businesses use it for a broader range of their business processes, it continues to grow rapidly. In the process of their evolution, IT has seen the rise and fall of UNIX, the surge of Apple operating system, the emergence and dominance of Microsoft operating system and in the recent past the coming of age of the operating system with a relatively new category of software called open source, of which Linux operating system is a major player. For almost two decades, Microsoft has been the leader of the operating system market to a point that it had virtually become a monopoly. Competitors or alternative operating systems emerged but disappeared without making much impact or diminishing Microsoft operating systems' market share.

For various reasons, businesses have been looking for a viable alternative to Microsoft operating system and in the recent past, it has arrived in the form of Linux, which is a free operating system similar to UNIX and belongs to the open source software category. Open source software has been gaining recognition during the last decade and major credit for that goes to Linux. Apart from becoming a major competitor for Microsoft operating system, Linux has been able to cause a change in the mentality of business organisations (small to large) and has been able to register a steady to significant growth over the last decade. According to IDC estimates, Linux will be the operating system registering the fastest growth in the next few years (eWeek, 2004).

What attracts many people and organisations to Linux is that it is a free and open source operating system, which

means that it is free to download and also have access to its source code. It is an interesting option for those who would like to customise the operating system. Besides, several free applications like Moodle, Apache, MySQL, PHP, Firefox, Open Office are also available that run on both Linux and Microsoft operating system. This allows people to try these options and the fact that despite being free, the operating system and the applications have so many features that they can completely replace any Microsoft operating system or applications, including Microsoft operating system file formats, which is a major attraction (Holton, n.d.).

Over the last five years there have been ongoing debates about the viability of Linux, its effectiveness in the business environment, comparative performance advantage over Microsoft operating systems, cost benefit, security, TCO and various other factors (Wagner, 2004; Metz, 2004; Wheatley, 2004; Didio, 2005).

In this paper the focus is on the migration from Microsoft operating system to Linux on servers and desktops in business organisations of varying sizes and types. The comparative rate of migration on servers and desktops are also discussed. Further research and analysis is being carried out to identify the factors that are driving the migration.

2 Literature review

Though operating systems have been around for nearly as long as the computers have been around for, Linux emerged only in the last sixteen years. It has been considered as a serious contender for use as a server operating system only in recent times. This has meant that there is a scarcity of relevant material available on this research topic. Most of the materials that were found were from IT-related websites, magazines and newspapers.

Linux and open source have now become a mature technology and have been able to prove their cost effectiveness in the business world (Barker, 2005). More and more business organisations are looking at Linux as an alternative to Microsoft operating system. Various major corporations (Becker, 2004b; Lettice, 2003), banks (Loney, 2002), governments departments (Shankland, 2004; Shankland, 2005a; Marson, 2005b) and other businesses have migrated to Linux and this has popularised the movement of migrating to Linux. In the process, the operating systems that have been affected the most are Microsoft operating systems (Becker, 2004b; Shankland, 2004; Keizer, 2004; Wilcox, 2002; Bloor, 2004b).

This quality assured paper appeared at the 20th Annual Conference of the National Advisory Committee on Computing Qualifications (NACCQ 2007), Nelson, New Zealand. Samuel Mann and Noel Bridgeman (Eds). Reproduction for academic, not-for profit purposes permitted provided this text is included. www.naccq.ac.nz

When Linux was still on the verge of gaining market share in the server and desktop areas, companies like Sun, Dell and IBM had come out in support of Linux. However, in the year 2002 they had to drop their support for Linux due to lack of response. A major reason for the lack of demand was that the systems were very expensive for large organisations to replace their existing ones and it was never priced in the range of a home use PC (MacVittie, 2002).

Then came a phase where organisations were happy to trial Linux on cheap or unused PCs and once they saw the potential it could offer, they subsequently began installing them on servers and desktops and deployed MCAs on Linux servers. (MacVittie, 2002).

Though Microsoft operating systems have been market leaders, ever since the emergence of Linux, Microsoft operating system's market share has gradually reduced and one of the various reasons identified for the reduction is its remote administration feature, which after all the recent releases and improvements, still ranges from being painful to a nightmare (Dickerson, 2003).

There are various reasons why Linux adoption has gained momentum around the world of which its low upfront cost, low TCO, customisability, control, security and flexibility are some of the major factors (Hanrahan, 2005; Rowe, 2001).

Although there have been relatively few endeavours to research and analyse the factors influencing the migration to Linux (Rankin, 2006), most of them have been carried out by businesses (IBM, 2005) or have been opinion pieces (Korzeniowski, 2005; Earnshaw, 2003). This brings to light the fact there is an acute shortage of academic research that has been carried out on the topic of migration from Microsoft operating system to Linux. Hence, this research is aimed to fill that gap.

2.1 About Linux

Linux operating system is a UNIX variant, which has some very exceptional features. One of them being that Linux is based on the highly dependable UNIX operating system. That makes Linux an extremely secure and robust operating system. Additionally it also means Linux's file structure, commands and behaviour are very similar to those of UNIX (Easttom, 2004).

It may look strange that a free operating system has become a powerful entity in servers and is gaining market share in desktops. Unlike most of the other operating systems, Linux's growth was not from entry level PCs to the servers rather it has been from high-end servers dominated by UNIX and Microsoft operating systems, down to desktops. One of the main reasons for this is its compatibility with the various UNIX flavours (Rowe, 2001).

Linux had a small and slow beginning in 1991 when Linus Torvaldus, a student of the University of Helsinki, asked people to help him build an operating system that in his words would be "just a hobby; won't be big and professional". (Langley, 2004). In recent years, Linux has emerged as one of the major competitors for Microsoft operating systems on both servers and desktops.

One of the most common misapprehensions of Linux is that it is not very user friendly and is difficult to understand, which is far from true. On the contrary, Linux is as user friendly and only as difficult as any popular Microsoft or Apple operating system (Easttom, 2006).

For some time now, Microsoft has been cautiously considering the threat of the open source phenomenon; they have had to be very pragmatic about the fact that Linux is here to stay and is gaining market share. It is soon going to reach a point where Microsoft will have to accommodate or counter it and as a step towards doing so, they have started to make their proprietary code available to software developers. This will allow software developers to have a look at how Microsoft operating system works and develop programs that operate on the operating system, thereby preventing Microsoft software programmers from defecting to Linux or other substitutes (Flatow, 2004).

2.2 Migration to Linux by businesses

It is an undisputed fact that Microsoft operating system dominates the IT world with almost 95 percent of the PCs worldwide running on Microsoft operating system with Apple Macintosh and Linux in second and third places respectively. This does not mean that Linux is sitting on the fringes, rather it is continuing to make strides and reducing Microsoft's market share. An IDC study forecasts that by the year 2008 the sale of PCs with Linux installations will be US \$10 million. It also predicts that the Linux environment will grow at an annual rate of over 25 percent to more than US \$35 million (Singer, 2005).

While that is the projection, the good news for people looking at implementing Linux is that companies like Oracle, Novell, Credit Suisse First Boston, IBM and Merrill Lynch have moved over to Linux in a big way (Baker, n.d.). Countries like India, China, Japan, Germany, England, Korea, Brazil and Mexico have during the last year, initiated fresh projects to migrate their government servers and desktops from Microsoft operating system to Linux. IBM, U.S. Department of Defence and various other businesses and organisations have started the process of migrating to Linux (Alacos, 2005). One of the major boosts came when Dreamworks used Linux in the production of some of their major blockbuster movies like Shrek, Spirit: Stallion of the Cimarron and Lord of the Rings (Baker, n.d.).

Linux has grown from obscurity to a relatively wide acceptance and support in a very short span of two to three years. According to IBM, Linux use has grown around 65 percent over the last five or six years. In France, the Ministry of Equipment is one of the organisations that have migrated from Microsoft operating systems to Linux. The migration was quite substantial since it involved replacing 1500 Microsoft Windows NT servers with Linux and this highlights a trend seen among medium to large sized European organisations. One of the reasons for this migrating is cost cutting (Mohamed, 2004).

Earlier another organisation, Allied Irish Bank, migrated 7,500 desktops from Microsoft operating system to Linux. According to estimates made by IDC, an analyst firm, various organisations in Western Europe spent up to

£5.3 million on Linux and other open source software in 2004 and will have invested up to £23 million by the end of 2008. IDC further predicts that more and more public sector organisations will be migrating to open source software in the immediate future. One of IDC's senior researchers notes that large organisations have been adopting a cautious stance with regard to Linux and other free software. However, many public sector organisations in France, Germany and other Nordic countries are now moving from the assessment phase to implementing Linux and other free software like StarOffice productivity suite, Ximian email and Firefox browser. The migration trend is helped by similar announcements in recent times by public sector organisations in Norway, Munich and Paris (Mohamed, 2004).

In addition to this, major IT players like Novell, Dell, HP, Oracle, IBM and Red Hat have proclaimed their backing for Linux. This is an indication that they regard Linux to be the standard operating system of future business and government organisations. Today, almost all the leading PC manufacturers offer PCs with Linux pre-installed on them (Rowe, 2001). Because of these developments, many organisations are beginning to appreciate the benefits delivered by Linux operating system and have started migrating proprietary applications to Linux (Alacos, 2005).

2.3 Challenges encountered in data collection and interpretation

Trying to assess Linux's server market share is a challenging task and most of the current estimates could be inaccurate since it is not easy to monitor the numbers. While estimating the number of servers that are shipped with Linux is a relatively easy task, the challenge lies in trying to calculate approximately how many repurposed servers are out there – servers that were earlier installed with Microsoft operating systems or versions of UNIX. An educated guess of such replacements in large organisations could be a possibility but not in the case of small or medium-sized organisations and also not in countries like India, China and Brazil, where Linux has been exceptionally popular and where there are higher chances of repurposing (Bloor, 2004a).

3 Methodology

This research was initiated with the primary objective of exploring and finding out the rate of migration from Microsoft operating system to Linux on servers and desktops, among small, medium and large sized organisations.

For this research there was a primary need to identify the responses of the participants for various factors of Linux and Microsoft operating system and compare them in order to get a clearer idea. Clear boundaries and meanings associated with values was a very important factor to be able to make the comparison.

Quantitative data was collected by means of a questionnaire that was sent out to a group of 200 people in the networking and decision-making fraternity in countries like India, New Zealand, Australia, Singapore, UK and USA. The group consisted of people from organisations and businesses that have already

implemented, or were in the process of implementing Linux, independent or major resellers and technical support organisations. These participants were selected through personal and professional contacts and referrals by organisations and businesses involved in the process of implementing Linux.

The data was collected from the following types of people:

- Network consultants
- ISS managers of medium to large sized organisations
- Owners of small to medium size IT businesses and
- Technical policy managers

The research was aimed at finding out the various factors that influence, the trend and the outcome of migration from MS OS to Linux. Hence the questionnaires were sent to organisations that had migrated or were in the process of migration or were considering migration from MS OS to Linux. That was perhaps the only way to get a clear perspective on the topic. Organisations that have not considered migrating to Linux were not in a position to provide any meaningful data to the research. Furthermore the research was carried out across various types & sizes of organisations to get an overall perspective rather than confining it to small or medium or large organisations or organisations from a specific field or sector.

4 Results

The research aim was to find out the relative migration of Linux on servers and desktops in the business sector. The respondents were requested to furnish details of the total number of servers in their organisation and of that the number of servers that were migrated to Linux. Similarly, they were requested to provide similar figures for desktops as well. One fact implied was that for various reasons most of the organisations would not be able to provide an exact figure for the questions they were being asked. Therefore, the objective of the questions was not to analyse the ratio of servers and desktops or the importance of IT to the organisation. Rather the intent was to analyse the migration trends of Linux in the server and desktop markets.

4.1 Linux on servers

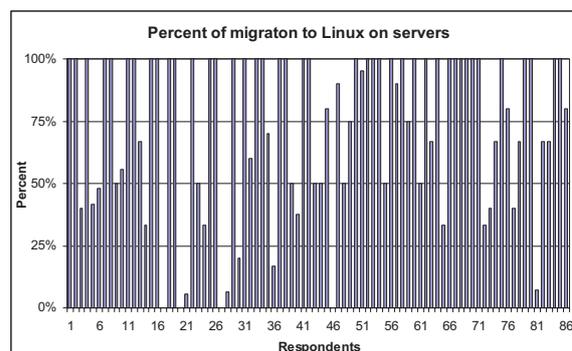


Figure 1: Percent of migration to Linux on servers in organisations.

The first analysis carried out was on the data collected for servers (figure 1). The graph gives an overview of all the

responses collected for the question. It shows a lot of activity in the area of migration to Linux on servers. The chart shows that there are a number of organisations that have migrated partially to Linux on servers, while a reasonable number of them have migrated all their servers to Linux.

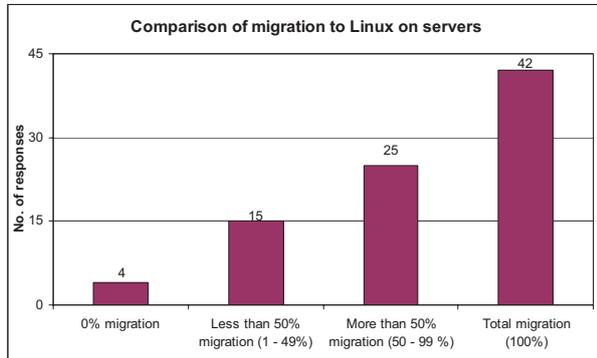


Figure 2: Comparison of migration to Linux on servers.

Taking a closer look the data shows that of the total 86 responses for the question, a small number of 4 organisations (5 percent) were found to have not migrated any of their servers to Linux (figure 2). 15 organisations (17 percent) had migrated less than half of their servers to Linux. The remaining 67 organisations (78 percent) have migrated more than half of their servers to Linux, of which 42 organisations (49 percent) have had a total migration to Linux on their servers.

4.2 Linux on desktops

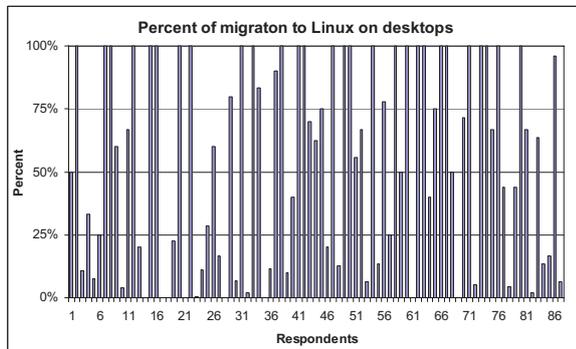


Figure 3: Percent of migration to Linux on desktops in organisations.

An analysis of the data collected for desktops shows that while there is certain amount of activity with Linux installations on desktops, it is not as vigorous or comparable with that of Linux on servers (figure 3). There are fewer Linux migrations on the desktops and even fewer when it comes to total migration. The graph also shows significant gaps, indicating that fewer organisations have made the choice of Linux on their desktops. While this chart gives an overall picture of the scenario, an in-depth analysis of the data comes out with results that are much more apparent.

Further analysis of the data reveals that the number of organisations that have not migrated any of their desktops to Linux is double that for migration to servers (figure 4).

87 participants responded with details about migration on their desktops; of which eight organisations (9 percent) had not migrated any of their desktops to Linux. The corresponding numbers for Linux on servers was four organisations (5 percent), which is half as many.

The number of organisations that have migrated some, but less than half, of their desktops to Linux is quite substantial, with 30 organisations (34 percent) having done so. 49 organisations (56 percent) had migrated at least half of their desktops to Linux of which 28 organisations (32 percent) had a total migration.

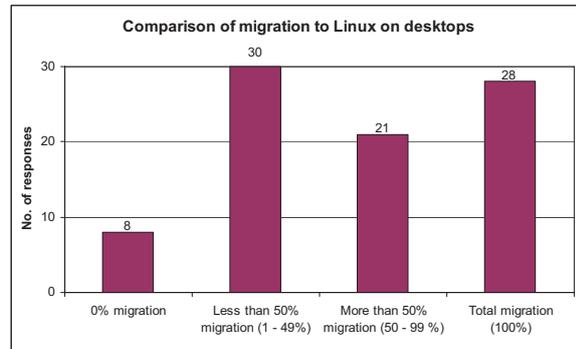


Figure 4: Comparison of migration to Linux on desktops.

4.3 Migration to Linux on servers vs. desktops

Comparing the Linux migration trend across servers and desktops of organisations that have migrated at least half of their systems, clearly suggests that migration to Linux is more popular on servers than on desktops (figure 5). While 78 percent of the organisations that took part in the research indicated they have migrated to Linux on at least half of their total number of servers only about 56 percent have done the same on their desktops. The considerable difference between the responses for server and desktop yet again proves that Linux is more widely implemented and popular on servers than on desktops.

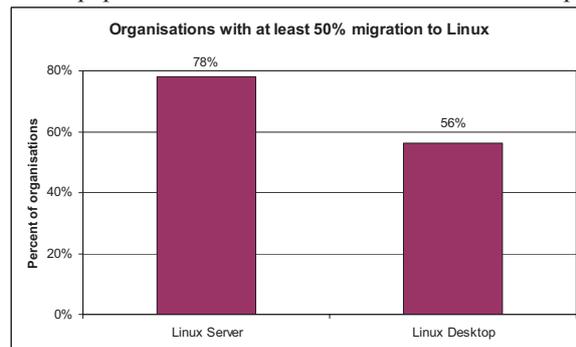


Figure 5: Organisations with at least 50% migration to Linux.

Further analysis on the organisations that have totally migrated (100 percent migration) their servers and desktops to Linux, gives added validation to the above said facts (figure 6). The results show that almost half of the organisations that responded to the survey have totally migrated their servers to Linux (49 percent) where as only 32 percent have done so with their desktops, which is less than a third of all the responses.

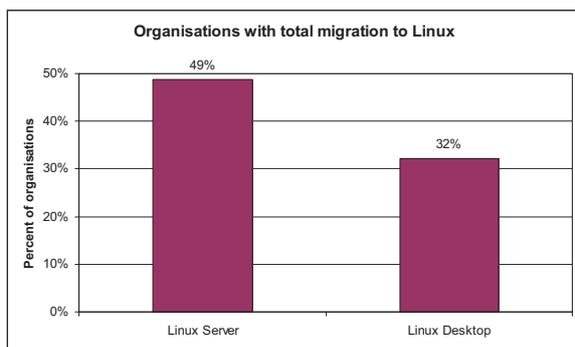


Figure 6: Organisations with total migration to Linux.

5 Discussion

This paper is based on a component of a major research project that endeavoured to find the various factors that influence, the trend and the outcome of migrating from MS OS to Linux. The focus of this paper is on the trend of migration to Linux across servers and desktops and it was found that migration was happening more on the server front than on desktops.

5.1 Linux on servers

As evident in figure 1, the fact that almost half of the respondents have had a total Linux migration on their servers proves the point that Linux is gaining a reputation as a server operating system. The first success for Linux on servers was in the mid 1990s, running Apache and has ever since establish itself as a reliable and robust operating system for servers (Rowe, 2001).

One of the major areas where Linux scores over Microsoft operating system with its increasing popularity on servers is the capability to create clusters with low cost and used PCs like Pentium II and Pentium III. Most of these PCs cannot be used for any worthwhile purpose running on Microsoft operating system but when installed with Linux, they are transformed from old or low cost PCs into robust, high capacity servers. As further evidence of the growing reputation of Linux on servers, in 2001 IBM had internally migrated 841 of its servers to Linux and the number has increased considerably ever since. According to IBM the migration was not because it was the latest fad, rather (Loney, 2002):

“It is done for one reason: to lower cost in a reliable, structured low-service way.”

5.2 Linux on desktops

Välimäki et. al., 2005 indicated that some of the key factors that influence the adoption of Linux on desktops are: its ease of use, enhanced hardware detection, constant improvements to applications, availability of practical and feasible substitutes for applications like productivity suites, web browsers, e-mail and fax clients and accounting applications. The survey respondents gave similar results.

The result of the analysis says that more organisations have had either no migration or less than 50 percent migration to Linux on desktops and that is a indicator to the fact that Linux has not yet gained a substantial market share in the desktop market as it has in the server market.

5.3 Migration to Linux on servers vs. desktops

The total number of servers in the organisations that took part in the research ranged from 1 to 1000, of which the number of servers that have been migrated to Linux ranged from 0 to 900. Similarly, the total number of desktops ranged from 1 to 3500 of which the number of desktops that were migrated to Linux ranged from 1 to 500.

The difference between the migration to Linux on servers and desktops is highlighted by a study carried out by the Yankee group, the results of which establish that more organisations plan to migrate to Linux from Microsoft operating systems than any other operating system. In addition, the results reveal that the migration is going to be predominantly on servers than on desktops, with a substantial number of organisations proposing to add more Linux servers to their existing network. On the desktop front, more than a third of the respondents of the Yankee group study said that they would have a few Linux desktops. A significant majority of 57 percent indicated that they did not have any plans to migrate to Linux on their desktops and only about 5 percent had plans for a total migration (Becker, 2004a).

Although organisations are migrating to Linux on desktops because of the fact that it is reliable, simple and fast; it has not made any significant inroads into Microsoft operating system’s desktop market share. Even though Linux comes as a pre-installed option on most of the major manufacturers’ desktops for a few years now, it has not been so on laptops around the world. Despite the fact that Linux has been available on laptops in Asia and Europe, it had to be specially ordered everywhere else. The case with Europe is that it has a small base of Microsoft operating system, they are very price sensitive and are very open to accepting Linux (Rowe, 2001). However, there are signs that this scenario is changing. The PC company, HP, released its first Linux-based laptop in January 2005 and more are said to be in the offering (Searls, 2005b).

Further evidence for the results discussed in figure 6 can be ascertained from the fact that half of the large organisations use Linux on servers for various purposes like special application, e-mail and web (Fontana, 2005).

The opportune time for Linux migration seems to be when there is a need to purchase new hardware, because of Linux’s low hardware configuration needs. Linux enables organisations to buy hardware with basic configuration and install Linux, thereby saving them money. The scalability factor of Linux becomes a major advantage if the organisations’ needs are growing too fast and when the situation demands that the servers and desktops be upgraded. In such scenarios, Linux makes perfect sense both in monetary terms and in terms of saving time (Pastore, 2003).

Migrating servers to Linux does not automatically result in major modification of the organisation’s existing infrastructure. Rather it presents the organisations with an opportunity to reuse their current hardware for a longer period due to Linux’s low hardware resource requirements. Proprietary applications can still run on Linux servers and desktops while document files, data

and e-mails can be transferred smoothly and in an uncomplicated manner (Alacos, 2005).

In the words of Francois Bancelhon (Loftus, 2005), CEO of Madriva Linux –

“The overall perception is that analysts and experts tend to sense a 10% Linux desktop market share by the end of the decade. Now it is more like 2% or 3%, so we will basically add 1% market share each year-over-year.”

This suggests that Linux is expected to have a steady growth over the next four years to have a notable share of the desktop market. Although Linux's 10 percent is not a substantial market share compared to Microsoft's almost 90 percent, the fact is that Linux is making reasonably rapid progress in the desktop market as well.

6 Conclusion

In the current business world, IT plays a major role in keeping businesses abreast or ahead of their competition. IT offers businesses the opportunity to increase their efficiency, effectiveness, reach out to a larger customer base and thereby enhance their growth in their business sector and geographical region.

Though there are numerous distributions of Linux available in the market and the responding organisations are using a variety of them, the finding is that a vast majority of the organisations are happy with their choice of distribution and expect to continue using the same in the near future. This result is consistent across the different sizes of organisations. Cost was not the only factor for the organisations to look at Linux as an alternative and adopt it. In fact Linux's security and stability are perceived to be better than those of MS OS.

100 percent of the large organisations, 95 percent of the medium-sized organisation and 83 percent of the small organisations that took part in the research were found to be running at least one Mission Critical Application on Linux. Some of the important factors that influence the migration are: Linux is stable, robust, either free or costs very little, is of open source nature, requires meagre resources, runs on inexpensive hardware and runs on various processors. The research also found that a significant 94 percent of the organisations were able to achieve the strategic goals they had set for Linux. In the case of the expected financial results of the migration to Linux, the research findings were that a substantial 91 percent organisations achieved them.

It is clear from the above discussed results that Linux is more favoured on servers than on desktops and that migration is taking place more on servers than on desktops. One of the reasons for that is that Linux gained initial credibility by making rapid progress on web servers with Apache. Since then it has been installed on all types of servers. But when it comes to desktops, though it has been making reasonable progress, it has a long way to go before it can match the success it has achieved on the servers.

The research findings are that most of the organisations that have migrated their servers to Linux have migrated 50 percent or more, with a significant number of them migrating all their servers. One major reason for this is

that it is easy to create server clusters with low cost and used Pentium II and Pentium III PCs. The same PCs cannot be used for any worthwhile purpose if installed with Microsoft operating systems. This helps organisations cost saving and enables them to extend the life of the PCs.

Though there are some key factors that help in the migration of desktops to Linux, like ease of use, better hardware detection, availability of productivity suites, web browsers etc.; the research found that the rate of migration was relatively low and hasn't been able to gain a significant market share. There are positive signs for Linux to grow and it is expected that Linux will have about 10% of the desktop market share by the end of the decade.

7 References

- Alacos. (2005): The top ten reasons to switch to Linux. www.alacos.com/Top_Ten_Reasons_To_Switch.pdf. Accessed 23 Feb 2005.
- Baker, S. (nd): Beating the Microsoft licence - Is migrating to Linux a possibility? http://www.peterborough.net/lifestyle/articles/mstolinu_x.asp. Accessed 15 Feb 2005.
- Barker, C. (2005): Unisys throws weight behind 'mature' Linux. http://news.com.com/Unisys+throws+weight+behind+mature+Linux/2100-7344_3-5931590.html. Accessed 8 Nov 2005.
- Becker, D. (2004a): Linux sees big potential in small businesses. http://news.zdnet.co.uk/software/linuxunix/0,39020390_39167305,00.htm. Accessed 22 Sep 2005.
- Becker, D. (2004b): Switching to Linux picks up steam. http://news.com.com/Switching+to+Linux+picks+up+steam/2100-7344_3-5330340.html. Accessed 13 Sep 2005.
- Bloor, R. (2004a): The dominance of Linux on the server. <http://www.it-analysis.com/technology/infrastructure/content.php?cid=7196>. Accessed 6 Sep 2005.
- Bloor, R. (2004b): Linux is pushing Microsoft pricing down. <http://www.it-analysis.com/technology/infrastructure/content.php?cid=7225>. Accessed 5 Oct 2005.
- Dickerson, C. (2003): With Linux, there are no absolutes. http://www.infoworld.com/article/03/08/29/34OPconnection_1.html. Accessed 22 Sep 2005.
- DiDio, L. (2005): Linux vs. Windows: TCO comparison. http://www.newsfactor.com/story.xhtml?story_id=100000028WT4. Accessed 16 Dec 2005.
- Earnshaw, A. (2003): Local businesses edge toward Linux systems. <http://portland.bizjournals.com/portland/stories/2003/12/15/focus5.html?t=printable>. Accessed 14 Oct 2005.
- Easttom, C. (2004): *Moving from Windows to Linux*. Hingham, MA, Charles River Media. 580pp
- eWeek. (2004): Linux market to top \$35B by '08, says IDC.

- <http://www.desktoplinux.com/news/NS8328766582.html>. Accessed 3 Sep 2005.
- Flatow, I. (2004): Analysis: Recent surge in popularity of Linux. Talk of the Nation/Science Friday (NPR). <http://search.epnet.com/login.aspx?direct=true&db=nfh&an=6XN200408271501>. Accessed 5 Oct 2005.
- Fontana, J. (2005): Studies show Windows progress vs. Linux. <http://www.networkworld.com/news/2005/041105studies.html?fsrc=rss-linux>. Accessed 20 Sep 2005.
- Hanrahan, D. (2005): What's driving global Linux adoption? <http://www.computerworld.com/softwaretopics/os/story/0,10801,103140,00.html>. Accessed 23 Sep 2005.
- Holton, D. (ND): Making the switch to open source gradually. <http://www.desktoplinux.com/articles/AT7010636622.html>. Accessed 2 Sep 2005.
- IBM. (2005): Migration to Linux: A roadmap for migration from Windows to Linux. http://whitepaper.tpj.com/cmptpj/search/viewabstract/79400/index.jsp?pos=2&referer=SEARCH_RESULTS:BROWSE&trkpg=browse_research_researchname. Accessed 14 Oct 2005.
- Keizer, G. (2004): NT's retirement opens windows for Linux. <http://www.techweb.com/wire/software/56200649>. Accessed 29 Sep 2005.
- Korzeniowski, P. (2005): Linux emerges as a force in enterprise resource planning. <http://management.itmanagersjournal.com/article.pl?sid=05/03/25/1942205&tid=104&tid=89>. Accessed 18 Oct 2005.
- Langley, N. (2004): Hot skills: More companies are using Linux despite lawsuits and cost issues. <http://www.computerweekly.com/Article134059.htm>. Accessed 18 Feb 2005.
- Lettice, J. (2003): Motor giant Ford to move to Linux. http://www.theregister.co.uk/2003/09/15/motor_giant_ford_to_move/. Accessed 6 Sep 2005.
- Loftus, J. (2005): Mandriva sees a corporate Linux desktop in your future. http://searchopensource.techtarget.com/originalContent/0,289142,sid39_gci1150423,00.html?bucket=NEWS. Accessed 10 Jan 2006.
- Loney, M. (2002): More foreign banks switching to Linux. http://news.zdnet.com/2100-3513_22-887961.html. Accessed 11 Sep 2005.
- MacVittie, L. (2002): The high & low roads to Linux. *Network Computing* 13 (21): 20-21.
- Marson, I. (2005b): Munich's Linux migration slips to 2006. http://news.com.com/Munichs+Linux+migration+slips+to+2006/2100-7344_3-5850633.html. Accessed 11 Sep 2005.
- Metz, C. (2004): Should you switch? <http://www.pcmag.com/article2/0,1895,1618431,00.asp>. Accessed 17 Sep 2005.
- Mohamed, A. (2004): French ministry switches from Microsoft to Linux to reduce costs. <http://www.computerweekly.com/Article132010.htm>. Accessed 15 Feb 2005.
- Pastore, M. (2003): So you want to switch to Linux? <http://www.cioupdate.com/trends/article.php/3086581>. Accessed 3 Sep 2005.
- Rais, M. (2005): Opportune time to switch to Linux. <http://linux.ittoolbox.com/browse.asp?c=LINUXPeerPublishing&r=%2Fpub%2FMR041503.htm>. Accessed 17 Oct 2005.
- Rankin, D. B. (2006): The diffusion and adoption of desktop Linux in government. <http://www.desktoplinux.com/articles/AT8673493458.html>. Accessed 29 Apr 2006.
- Rowe, R. (2001): Mainstream Linux. <http://www.linuxjournal.com/article/5490>. Accessed 5 Sep 2005.
- Searls, D. (2005b): Linux for suits: L'inspired. <http://www.linuxjournal.com/article/8104>. Accessed 25 Sep 2005.
- Shankland, S. (2004): Linux ensnares another European city. http://news.com.com/Linux+ensnares+another+European+city/2100-7344_3-5238146.html. Accessed 4 Sep 2005.
- Shankland, S. (2005a): Debian wins Munich Linux deal. http://news.com.com/Debian+wins+Munich+Linux+deal/2100-7344_3-5689003.html. Accessed 19 Sep 2005.
- Singer, M. (2005): Linux PCs: Customer service or lip service? http://news.com.com/Linux+PCs+Customer+service+or+lip+service/2100-1042_3-5926949.html. Accessed 8 Nov 2005.
- Smith, W. (2004): Migrating to Linux gives companies ROI five to six times faster than traditional processes. <http://www.a42.com/node/view/140>. Accessed 19 Feb 2005.
- Välämäki, M., Oksanen, V., & Laine, J. (2005): An empirical look at the problems of open source adoption in Finnish municipalities. *Proc. ACM 7th International Conference on Electronic commerce*, Xi'an, China. 113: 514 – 520, ACM Press
- Wagner, J. (2004): Hidden costs said to stymie Linux growth. <http://news.earthweb.com/ent-news/article.php/3336561>. Accessed 29 Oct 2005.
- Wheatley, M. (2004): The myths of open source. <http://www.cio.com/archive/030104/open.html>. Accessed 15 Sep 2005.
- Wilcox, J. (2002): Customers shun MS licensing plan. http://news.zdnet.com/2100-3513_22-947168.html. Accessed 22 Sep 2005.