

# “\$100,000 OUT OF THE WINDOW? YOU CANNOT BE SERIOUS!”

## ABSTRACT

A city council in New Zealand is implementing a real-time public information system for their buses, with arrivals and departures being displayed at bus stops, and next stop information inside the buses. This project started in April 2002, with the first phase being completed in January 2003. The displays are driven by a single-board computer. The original plan was to use Windows CE, but the cost for this was 10 times over the planned budget. Additionally, the time to build a suitable version of Windows CE was 6 weeks, which would have caused an unacceptable over-run of time for the project.

A Linux expert was brought into the project. The application was originally written in C in a Windows environment, and this was ported to Linux. The Linux expert plumbed the application into the new environment. The initial reaction of the contractor to the change to Linux was one of horror, followed by amazement at what had been achieved in two weeks. The first phase of the project was successful.

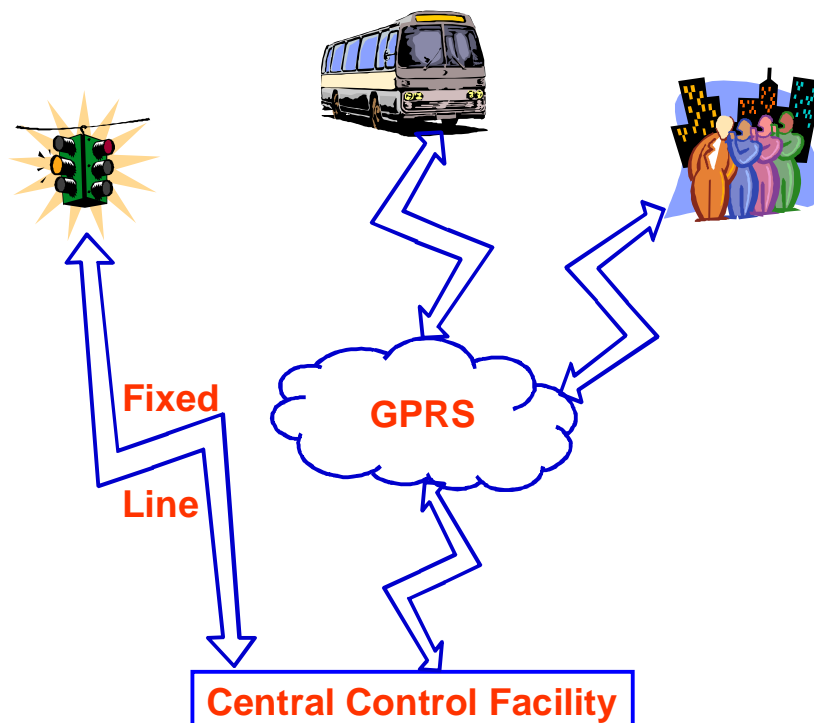
The two major factors that led to the success are (i) writing the application with portability in mind, and (ii) employing people with the appropriate skills.

The major lessons learned are described, and the business impacts are assessed.

This is followed by an evaluation of the likely relative market positions of Windows and Linux from a competitive viewpoint over the longer term.

## BACKGROUND

A city council in New Zealand, which wishes to remain anonymous, is currently installing a bus passenger information system through a contract with Saab-ITS who are themselves based in Adelaide. Signs are being installed in buses and on the streets. On the buses, the signs show the name of the next stop, and the attractions that passengers can find there. On the streets, the destinations and the expected times of arrival are displayed for the waiting passengers. Both types of sign have an audio capability for the benefit of blind and partially sighted passengers. These all communicate with a central control facility by means of GPRS modems. The central control facility also communicates with traffic lights to allow bus prioritisation. The project started in April 2002, with the first phase being completed in January 2003. Phases two and three are expected to be completed over the following months.



Screentech is a Perth based company specialising in the supply of signs suitable for use in this project. They won the sub-contract with Saab-ITS for the provision of the signs. The author's involvement was in the combined rôle of systems designer and software developer.

Each sign contains a single board computer. These are cut-down versions of desktop and laptop computers, and rather more powerful versions of the embedded computers that are found in CD and DVD players.

The main thrust of this paper is the examination of the process of switching from Windows to Linux in the middle of a project.

## **THE DESIGN AND IMPLEMENTATION PROCESSES**

The design process went through all the usual stages of hardware and software selection. A range of single board computers were examined for disk-on-chip capability, serial communications facilities, USB, screen output and keyboard/mouse input. Suitable peripheral devices such as appropriately sized disk-on-chip and USB memory sticks were found, and the hardware design was basically complete.

The Windows range of operating systems were examined for appropriate drivers for com ports, USB, VGA and keyboard. Additional functionality in the form of a dialler, a TCP/IP stack and sound output was also found in Windows, and evaluated as being appropriate for the project.

At this point it is useful to note that technology does not live in a vacuum. It exists in an economic context. In this case, the economic context included timeliness – Screentech had to deliver not only within budget, but also within timescale. Given unlimited resources, the project would have been delivered on a Windows XP platform using VB.NET, and it would have been delivered early.

Windows CE is advertised as the “operating system of choice” for embedded systems. So Screentech initially considered Windows CE. This is one of the Windows range of operating systems. Compatibility of software developed in a desktop environment and ported to the Windows CE would thus not be an issue. Development and availability issues were also not seen as posing problems, until some detailed questions were raised.

The lead time for a suitable copy of Windows CE was six weeks. The cost was an initial \$(AU) 40,000, plus approximately \$(AU) 60 per unit. Given that 1,000 units were required, the total cost of using Windows CE would have been \$(AU) 100,000. It was necessary to have a suitable operating system in two weeks, not six weeks. The cost of \$(AU) 100,000 was also well beyond budget. These two factors rendered the Windows CE solution unacceptable to Screentech.

The author has used Linux occasionally over a number of years, and suggested this as a serious alternative to Windows CE to the Screentech's CEO. As an open-minded individual, he welcomed the suggestion as a possible solution. At about the same time, a Linux expert knocked on the CEO's door, enquiring about possible employment. He was interviewed, and brought into the project.

At this point, 50% of the application had already been written, using C. Thus the next task was to port the existing code onto a Linux platform prior to continued software development.

The project included the use of a GPRS modem. Most of the material describing the use of GPRS modems was found to be either too general, (being aimed at addressing the business potential of the technology) or too specific, (being aimed at telecommunications engineers). There appeared to be nothing for the individual with a reasonable understanding of networks in general, and a need to use GPRS technology to communicate to a peer application from within a C program. Another sub-contractor for the overall project was using a Windows-based approach, so they were unable to cast any light on the Linux scenario. A mixture of research and trial software development was used to produce a document filling the gap left by the existing over-general or over-specific materials. This document covered both the Linux and Windows cases and has been passed on to Saab-ITS.

The switch from a well-known operating system, under the control of a single vendor, to an operating system offered by a proliferation of vendors, would be regarded by many project managers as a very high risk activity. After Screentech had successfully delivered its product, the quality manager at Saab-ITS openly admitted that upon hearing about the switch, he threw up his hands in horror and said that the whole project was bound to fail. Events showed this to be an unduly pessimistic assessment.

By the end of the implementation process, the application was developed within budget, within timescales, and to the required standard.

## ANALYSIS

### Factors For Success

There were a number of factors that contributed to the success of the project. The following are presented in no particular order.

- The initial software development was done using the *lingua franca* of the embedded and process control world, C. C was chosen because the target operating system was at the time completely unspecified: it could have been one of at least Windows, or Linux, or a specialised operating system used for Digital Signal Processors. Portability and accessibility for other programmers were key drivers behind the choice of C. These considerations also ruled out the use of C++ .
- Linux is a mature product. It is stable (even though it is evolving), and it has a wide base of support from both unpaid and professional individuals. It is also supported by an effective file system - "ext3".
- The availability of a Linux expert on the team. The expert contributed in three invaluable ways: firstly, knowledge of all the fundamentals of Linux; secondly, an understanding of the Linux-based support applications, such as sox, that were needed to build the final product; and thirdly, navigation around the kernel. This saved the team weeks in terms of learning time.
- The CEO had no prejudices. He fully supported (and still does support!) the technical experts who help him to develop and deliver products to his clients.
- There is a wide range of support applications associated with Linux. In this case, the support applications included bash, X-windows, GNOME, wvdial, mc and mcredit, nano, pppd and sox.
- The kernel is easily customisable. In 30 minutes, a Linux expert can pick the required modules, re-compile the kernel, and have a ready-prepared operating system ready for you to use. This compares very favourably with 6 weeks, and \$(AU) 40,000. There are also no per-unit costs.
- Finally, and perhaps most importantly, is the philosophy of open source. While the detractors point to the proliferation of different vendors of Linux, stating that this creates confusion, this would appear to be its precise strength. Equally, the two streams of operating systems emerging from Seattle, with their mutual incompatibilities, seemingly endless service packs, and increasingly restrictive and onerous licensing procedures, serve to create a nightmare for both system designers and application developers.
  - Various distributions of Linux were used during the course of the project: Red Hat 7.1 and 7.3, Debian 2.2, and Knoppix 3.1, depending upon the need of the moment. This is in marked contrast to Windows XP, where the installation process may result in the computer being disabled for 3 days while Microsoft generates a new Product Key for it.

### Lessons Learned

There were a number of trade-offs that arose from the decision to go to Linux. These are described below.

- There were the economics – this was perhaps the most important item. While there was a superficial saving of \$(AU) 100,000 to be made, some of this was needed to pay the Linux expert. The CEO's budget had included a sum to allow for the customisation of an operating system. The cost of employing the Linux expert was not too dissimilar to the original budget for acquiring Windows CE.
- There were the personal stress factors involved. There were questions such as “What happens if this suggestion/recommendation to use Linux results in a disaster?”, and “How do I get my head around *this* lot?”
- There was the time taken to do the port: two weeks. As might be expected, most of this was taken up with getting the application to work correctly in the new operating environment. The com ports need to be handled differently. The VGA output buffer is handled differently. The real reason for the length of time was ignorance about how to do these things in a new and unfamiliar operating system. Somebody who knew what they are doing could have achieved the port in two days or less.
- There was for a long time an outstanding issue with the way things are displayed on VGA output. Text was likely to be displaced by up to 3 lines and/or 1 column. This was due a paucity of documentation of “mvaddchnstr”.
- At a purely personal level, the author benefited immensely from the transition from Windows to Linux. He has been on a fairly steep learning curve for some months, and admits that he have scarcely scratched the surface of what is available. That may be what discourages some people from switching to Linux.

## **OUTCOMES**

No business process is complete unless it can be reviewed, and thereby be used to improve the business. The switch from Windows to Linux is no exception.

The overall system was provided on a fixed-cost contract. The use of Linux rather than Windows CE has had a direct positive impact on everybody's bottom line. It was just as effective a solution, and was less expensive to implement.

Linux, in whatever flavour is appropriate, is now the operating system of choice for Screentech's embedded applications. The includes the sorts of signs that can be seen on the train system here in Perth, the displays full of moving red dots that are above airport check-in desks, and tidal traffic flow signs.

However, the same cannot be said for Screentech's larger installations, such as horse racing tracks and football stadia. Screentech already has a large investment in software running under various flavours of Windows, and the business case for porting it to Linux simply does not exist in this case.

The exchanges of understanding between the Linux expert and the Windows expert have enriched the lives and work of both parties. This has put Screentech in a stronger market position than before – it is maintaining its competitive edge.

As is usual with any learning experience, Screentech is now in a much better position to budget for, and hence control, its costs in all similar future projects. This will result in better cash-flow projections.

Saab-ITS runs with a mixture of Windows and Linux on its own computers. The next logical step is to see if Screentech and Saab-ITS can agree to use an open source office suite such as Open Office for the preparation and exchange of documents between the two companies. This is not to say that Microsoft Office will be given the push, as both companies will still need to exchange electronic documents with other organisations, and there are currently too many incompatibilities between Open Office and Microsoft Office to completely abandon the more expensive Office.

## POSSIBLE FUTURE TRENDS

Anybody who makes predictions about the future automatically makes themselves a hostage to fortune. Equally, failure to make a reasoned projection of the future makes a mockery of any planning exercise. As such, the predictions below are subject to the vagaries of future events.

### The Office Desktop Computer

Those that were in the IT industry in the 1970's will remember the phrase "nobody got sacked for buying IBM". Today it is a case of "nobody gets sacked for buying Microsoft". Microsoft has brought about the integration of a whole range of office applications that were sold as separate products from separate vendors 20 years ago. Examples include Lotus-123, WordPerfect and Harvard Graphics. However, there is limit to the amount of integration that can be achieved with these applications. It would seem that Office-XP has not been a resounding success in replacing Office-2000. One the reason for that could well be the marginal performance gain for the extra financial cost: for a lot of organisations, it is simply not economic to upgrade. The great majority of organisations that accept electronically submitted documents state that they must be Word-97 compatible (not even Word-2000 compatible). How has Microsoft's reacted to this? They have diversified: "Xbox" serves as an example of this.

What is Microsoft likely to do to its Office suite in the future? It could try further enhancements, to "innovate" as their lawyers would say. This may not be a long-term viable future. Or they could try to consolidate Office, but it is unclear what they could do to their office suite to achieve that. This leaves a gap for the various free and paid-for office suites to fill. Which operating system those vendors will target will be a function of, among other things, the relative economics of Windows and Linux at the time of project commencement.

With the continued efforts of software developers working on closing the gap between their products and the then most popularly used version of Microsoft Office, the case for remaining with the Microsoft product becomes less sustainable. For any given office suite which is capable of running under both Windows (which costs) and Linux (which is free), and all other things being equal, rational economics would suggest that the Linux implementations should become very much more popular than the Windows equivalents.

As with the erosion of IBM's dominance, it is likely that Microsoft will cease to be the principle supplier of choice in perhaps 10 years' time, rather than simply being snuffed out of existence like Systeme, Segundo Data Systems and ICL. Perhaps, like Hewlett-Packard and Compaq, it will become a combine. The future may see an AOL-Time-Warner-*Microsoft* being formed.

Microsoft is highly likely to continue developing Windows to suit its own purposes for the foreseeable future. The current move into entertainment could have significant impacts on future versions of Windows. However, it is unlikely that Microsoft would wish to surrender its dominance of the office desktop market at the same time.

In the light of this proposition, it can be argued that there are a number of hurdles that must be overcome before Linux can replace Windows. Firstly, the level of technical expertise needed to install and maintain a Linux system needs to continue falling, though it need not go down as far as that required for most Windows installations in similar situations. When the marginal cost of installing and maintaining a Linux system becomes clearly less than that of installing and maintaining an equivalent Windows system, today's trickle of "migrants" could become a flood. Secondly, a number of commercial organisations may see a vacuum left by Microsoft's re-focussing of its business into entertainment. Whether those organisations attempt to corner the Linux market, or attempt to replace Windows with an entirely new operating system which also rivals Linux, is a question which only future economics can answer. Thirdly, there is the question of decision makers' perceptions. A well-founded economic argument to use Linux instead of Windows may not be sufficient to persuade many managers for the next few years. Two arguments will be used to slow down the transition – one: "if it is so good, why aren't other people doing it?", and two: "the risk factors associated with using Linux instead of Windows have not been sufficiently weighed in your argument."

## Other Environments

There are many environments other than the office desktop computer. In particular, there is technical computing and there is embedded computing. It would seem that these decision makers are rather more open to the idea of using Linux as an alternative to Windows XP (for technical computing) and CE (for embedded systems).

There are far fewer business considerations that would keep such organisations in the Microsoft fold. Specifically, the need to exchange documents is replaced by the need to exchange data. There are a large number of data formats available suited to a number of different needs, and these can always be agreed in advance. The monopolistic Word-97 format or nothing does not arise in this case. The various participants in a project are free to choose whatever tools are appropriate for the exchange of data.

For organisations that are developing standalone embedded systems from the ground up, the need to exchange data with other equipment does not arise, and so the designer has even more choice.

It is quite possible that Linux will overtake Windows XP (or its successor) in the "ordinary" commercial environment. The same possibility also exists in the technical and embedded systems environments. Given the ideas presented earlier, it could be argued that Linux installations will overtake Windows installations in the technical and embedded systems environments rather sooner than it does in the commercial environment.

## CONCLUSION

It is generally agreed that it is appropriate to have the right tool for any particular job. This applies just as much in the computing environment as it does everywhere else. As a result, it is highly likely that in increasing number of companies will use Linux as well as Windows, and that in the longer term future, say 15 years ahead, the number of Linux installations will outnumber Windows installations.

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Screeentech (Aust) Pty Ltd  
6/106 Norma Road,  
Myaree,  
WA, 6154  
Australia

Tel: +61 8 9330 8485  
Fax: +61 8 9330 8486  
Web: [www.screentech.com.au](http://www.screentech.com.au)  
e-mail: [ilanglands@screentech.com.au](mailto:ilanglands@screentech.com.au)

Saab ITS Pty Ltd  
Fourth Avenue,  
Technology Park,  
Mawson Lakes,  
SA, 5095  
Australia

Tel: +61 8 8343 3800  
Fax: +61 8 8343 3778  
Web: [www.saabsystems.com.au](http://www.saabsystems.com.au)  
e-mail: [sales@saabsystems.com.au](mailto:sales@saabsystems.com.au)