TELSTRA RESEARCH LABS
80 YEARS OF INNOVATION

Telstra Research Laboratories (TRL) is a significant part of the company's proud tradition of being a leader in developing today and tomorrow's technology solutions. For the past 80 years, TRL has focussed on innovation and commercialisation, as well as capturing visionary ideas for the company.

Consisting of about 300 staff, Telstra Technology's TRL is home to many of the company's high achievers, working in an environment that stimulates their creativity.

To celebrate TRL's 80th anniversary and the public release of New Horizons – TRL's showcase magazine – we have gathered together some of our achievements over the past year to give you a peek into the future.

To view more of TRL's achievements, visit our New Horizons publication online from 1 September at **www.telstra.com.au/trl/index.htm**

THE MOBILE PHONE
WE'RE TALKING ABOUT A REVOLUTION

Mobile phone technology has been embraced by most Australians and it is now hard to imagine doing business or conducting a social life without a mobile phone. Traditionally mobile phones were just used to make voice calls, but now we have the ability to send text messages and ring tones across the mobile network. We can even use the mobile phone as a radio, and more recently, communication has been extended to include other machines, giving users the ability to download emails from their laptop using the mobile phone as a modem.

Andrew Scott, Leader of the Telstra Research Laboratories (TRL) mobile services group, says that the mobile phone is not just limited to interpersonal communication. Exciting developments now allow the mobile phone to interact with machines in a different way. "Mobile Commerce, or m-Commerce, provides a new way to pay for goods and services with your mobile phone, and it is a concept that we believe will revolutionise the way mobile phones are used in Australia."

m-Commerce helps overcome issues for both the vendor and the purchaser such as vandalism, coin collection, and finding the right change at the right time.

For example, a mobile phone can be used instead of coins to pay for things such as parking meters and goods from vending machines. These developments are currently being trialed. If eligibility criteria for the trial are met, the purchase price appears on a subsequent Telstra phone bill. A customer's mobile phone has the potential to become a personal payment device, as essential as the credit cards and cash. An added bonus of paying for the parking meter with a mobile phone could be that the customer receives an SMS message, reminding that the parking bay is about to expire[1].

In order to support scenarios like this, TRL has developed a generic vending protocol that connects a network of m-Commerce machines, such as parking meters, to a central m-Commerce platform. None of the existing standards for vending were sufficiently flexible, so a new protocol was needed. The resulting protocol supports machines from petrol pumps to golf-ball vending machines, and will allow Telstra to support new m-Commerce machines as needed.

Customers can communicate with the machines either through the network and a keypad on the payment device or via the infra-red function on their mobile phone. Currently the infra-red capability on the mobile phone is used to turn the phone into a wireless modem for use with a laptop. However, as Andrew points out, "the infra-red interface in a mobile phone is capable of much more than simply providing a connection to the Internet."

> ***"A customer may pay for goods and services by activating the infra-red function on their mobile phone and pointing it at an appropriately equipped machine."***

A customer may pay for goods and services by activating the infra-red function on their mobile phone and pointing it at an appropriately equipped machine. The machine detects the infra-red signal, and uses it to connect – through the customer's phone – back to a central m-Commerce platform. When the platform has authorised the transaction, it sends a notification back through the infra-red path to the machine, signalling it to proceed with the transaction.

Since the machine uses the customer's phone, it does not need to communicate with the mobile network directly. This means that it is possible for the m-Commerce function to be added to certain existing machines in a cost-effective manner. Also, since infra-red operates along a line-of-sight, the customer may specify what machine they want to use by simply pointing their phone at it. Another benefit is that no numbers need to be dialled, reducing the complexity and time taken to use the service.

Further improvements in the future to the m-Commerce service may involve Bluetooth, a radio frequency alternative to infra-red that is currently available in some new mobile phones. There are limitations in sending data across the infra-red frequency; it is directional and needs a direct line of sight. Bluetooth uses radio waves rather than light, so there is no need to diligently line up the devices; all that is needed is to be within range. For example, from your laptop you could dial up your ISP (Internet Service Provider) using your mobile phone.

Another exciting application of m-Commerce is Mobile EFTPOS. Credit and debit cards can be used with a mobile phone that is fitted with a special EFTPOS keypad and card-swipe attachment. The Mobile EFTPOS connects through the wireless mobile network. It offers a payment option when there is no land

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Riding on the crest of the TECHNOLOGY WAVE...

Our prediction is that broadband and wireless data will have the most impact on the online experience.

In the last five years we have lived through the Internet and the dot com boom and bust. Despite the tech wreck, the technological world today is completely different from even a few years ago. The much vaunted advent of the Internet has seen significant changes to the way people do business, entertain and inform themselves, with more than half of us online, using the Internet daily in our personal and business lives.

There is nothing quite like the communications industry, in terms of sheer impact it has on people's lives. When we look back over the past decade, we can only marvel at the way mobile phones and the Internet have transformed the way we live and – as we look forward – there is so much more change to come. The Internet is rapidly becoming broadband enabled, making it possible to do so much more with it, and the mobile phone is becoming data enabled, so not only do we have access to people on the move, but information as well.

Our prediction is that these two technologies – broadband and wireless data – will have the most impact on the online experience for users in the next three years. Devices will progressively become IP (Internet Protocol) enabled... cameras, PCs, mobile phones and digital TVs will all be connected.

While all this technology is great, at the end of the day it is only a means to an end. The end in this case will be to offer richer multimedia communications to human beings who are separated by distance; to allow businesses to deliver better service to their customers while achieving greater productivity; to enable us to continue on a journey of life long learning with all the information we need at our fingertips; to be entertained in the way we choose as individuals as opposed to being part of a herd; to be healthier and safer in our daily existence. Such visions make R&D truly exciting and we at TRL will continue to play our part in this ever changing communications industry.

In TRL's 80th anniversary year, I hope you enjoy reading about the interesting projects we have been developing.

HBradlow

Dr Hugh Bradlow
Chief Technology Officer
Managing Director, Telstra Research Laboratories

JAVA* AND BREW** *Making possible* a wireless software market

Almost everyone has a mobile phone – now it just got smarter. Sun Microsystems' Java and Qualcomm's BREW software environments are being built into many of the latest phones. Java and BREW will make mobile phones more like PCs – able to be upgraded with new software whenever it is desired. These new PC-like phones are known as smart phones.

For developers, this is the first time that open programming environments can be used on mobile and wireless devices. Developers will now be able to write applications in Java or BREW that will be able to work on many different mobile handsets. They will be able to write software for mobile phones, and users will be able to buy and then wirelessly download this software in the same way that desktop users now purchase, install and run software on their PCs.

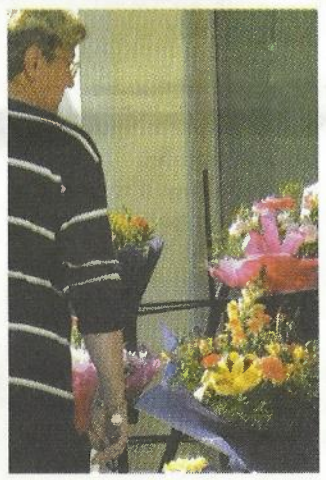
Phones as computing devices are more limited in terms of memory and processor speed than PCs, and handset users generally have higher expectations of quality and robustness. Telstra Research Laboratories (TRL) has been working to solve these challenges in order to enhance our customer experience and make possible, a wireless software market.

Mobile phone customers may expect a veritable flood of software to choose from - games and communications programs are touted as potentially being the most popular. Companies too, may want to integrate their services more intelligently onto the mobile phone by taking full advantage of the power of this new paradigm.

TRL has prototyped an email application for mobile phones, written in Java, which allows customers to check their email accounts and send email messages. Typically, phones are designed to enable voice communication, not email. TRL has overcome problems of developing complex communications-style programs for mobile phones to prototype this application.

* Registered trademark of Sun Microsystems Inc., a Delaware Corporation. ** Registered trademark of Qualcomm Incorporated.

Location enhanced information services



"Find me the nearest chemist."

Incorporating location technology to find products and services via SMS easily.

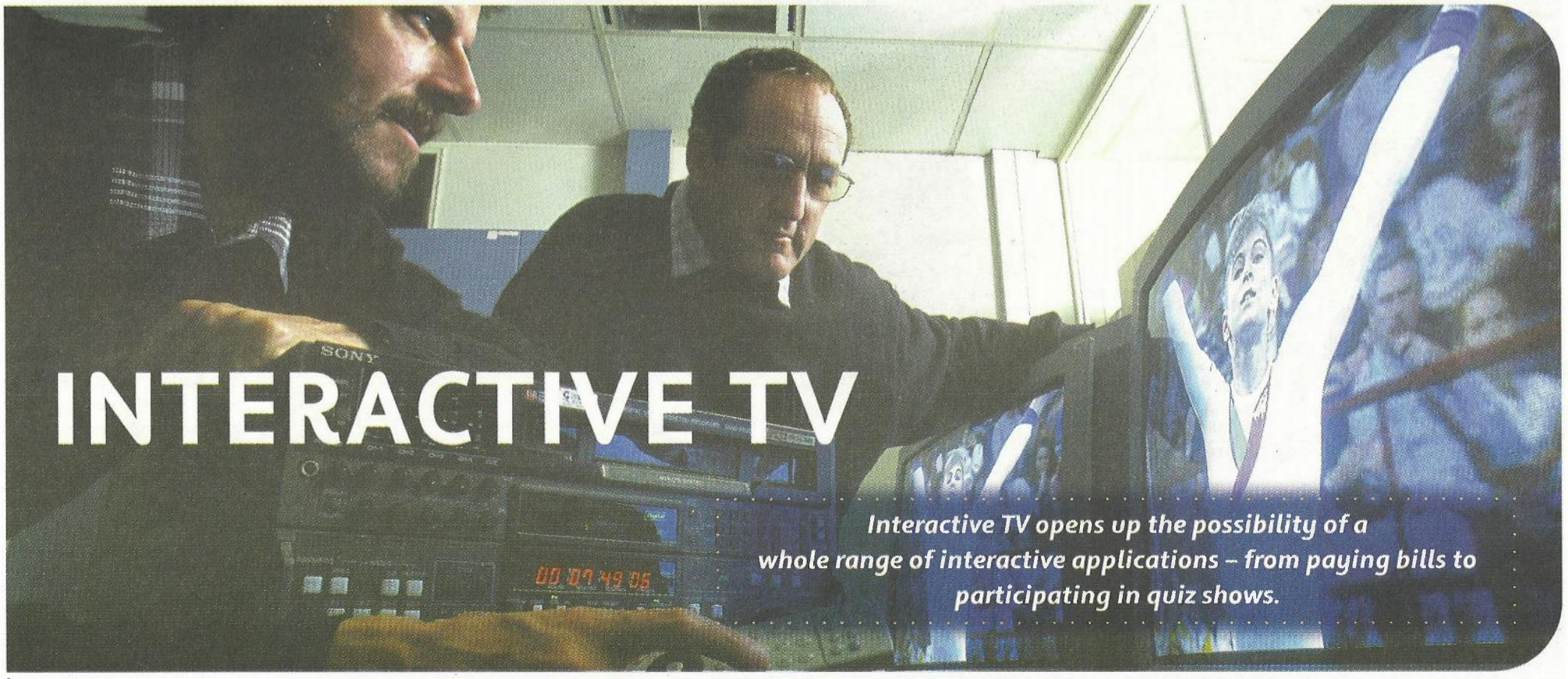
The mobile phone is becoming much more than a voice communication tool for people on the move. Customers are eager to access content from databases, such as the Yellow Pages® – via the enormously popular Short Messaging System (SMS) medium – but the challenge for Telstra has been how to deliver high value information over such a limited interface.

Telstra Research Laboratories has incorporated location technology in order to provide a way of quickly and easily accessing relevant information via SMS. The result is a prototype service – SMS FIND.

SMS FIND will allow users to search for facilities and services either in their current vicinity or in another nominated area. The search term, e.g. ***'chemist'***, is sent to SMS FIND, which matches the request to a database and responds via SMS with the chemists closest to you. Or ***'florists hampton'*** lists the florists in Hampton.

Users should be able to quickly find health services such as doctors or chemists, entertainment and eating venues such as cafes and restaurants, or retail facilities such as petrol stations and florists.

® Registered trademark of Telstra Corporation Limited.



INTERACTIVE TV

Interactive TV opens up the possibility of a whole range of interactive applications – from paying bills to participating in quiz shows.

Broadcasting of Digital TV has already started in Australia. Satellite-delivered TV has been digital for some time, and cable TV can be expected to be digital from 2004. Digital TV allows greater quality pictures and many more channels. With the provision of a suitable return path it also allows other data to be sent both to and from the digital Set-Top Unit (STU).

This opens up the possibility of a whole range of interactive applications. Many of these may be connected with the television programs, such as participation in quiz shows or instantly purchasing items as they are advertised. Other interactive applications will function entirely in their own right.

Customers could potentially control the Telstra services to which they subscribe: requesting new services, paying bills, and accessing email to send and receive messages via the TV.

The television environment allows for much richer presentation of information than a voice system does over the telephone, but several unique constraints apply. The TV screen resolution is much lower than that of a PC, the memory and processing power of an STU is much less than that of a PC and most importantly, an STU remote control cannot easily be used to issue complex and lengthy commands. Telstra Research Laboratories (TRL) is applying both its technical and human factors expertise to these problems.

Although interactive TV is in its infancy in Australia, TRL is experimenting with prototype systems and has already had services running in the laboratory for exchanging SMS messages with mobile phones, accessing chat sessions on telstra.com® and displaying information from the telstra.com website - all correctly formatted for best presentation on the TV screen.

Much of the work undertaken at TRL has involved achieving an understanding of the different ways people relate to and use their television sets. TRL's Human Factors teams have studied the nature of the human/TV interface, including work on application look and feel, development of a style guide to ensure consistency between applications, and focus group studies to obtain real data on real users under tightly controlled conditions.

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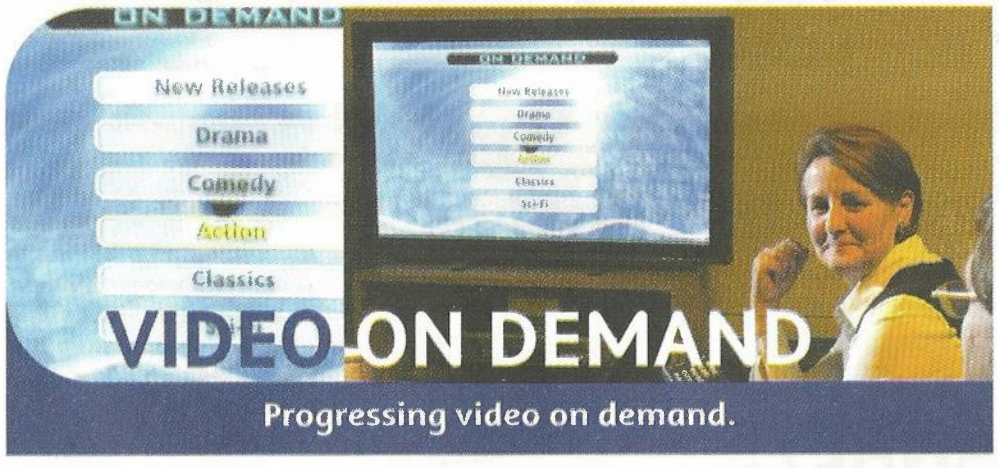


Progressing video on demand.

The concept of receiving videos on demand through the network is not new. However for years now it has been a source of frustration for both users and potential providers and so the concept has not become a reality. Telstra Research Laboratories (TRL) has been actively involved in the development of the video on demand concept and has solved, in past years, a number of the impeding technical problems.

TRL has developed sophisticated cost models which allow Telstra to assess options based on a variety of different network environments, different devices in the home and different video qualities. These developments are constantly reviewed on the basis of new technologies, new commercial products and new techniques that may make the commercial implementation of Video on Demand services possible. These include techniques that will allow management of digital rights to protect against piracy and ensure legitimate distribution of the content.

These models will help Telstra determine when the commercial environment is right, and position it to quickly respond and provide the infrastructure to support the heavy demands that this service will place on the networks, as well as keeping the price to the customer to a minimum.

TRL is also identifying all the potential service opportunities in this area, including retail and wholesale business, home consumers, and industries such as the hospitality industry.

LYREBIRD™ SPEECH APPLICATION DEVELOPMENT TOOL

Potentially amazing time-savings in creating prototype natural speech application.

Telstra Research Laboratories (TRL) has successfully completed the initial product release of the Lyrebird Speech Application Development Tool. The Lyrebird tool is a complete, integrated development environment (IDE) for developers to rapidly create and deploy complex and high quality natural language speech applications – using innovative mapping techniques and an integrated graphical environment.

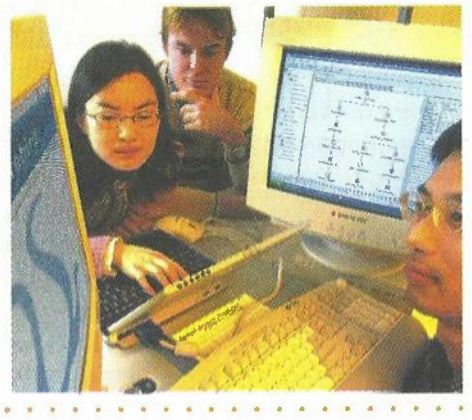
Natural speech applications enable people to interact with a system by speaking naturally. For example, to book a ticket to the cinema, instead of having to navigate through a complex menu structure as you do today, you would be able to phone up and say to a machine:

"I would like two tickets to see the new James Bond film tonight at the Rivoli at 7.30pm".

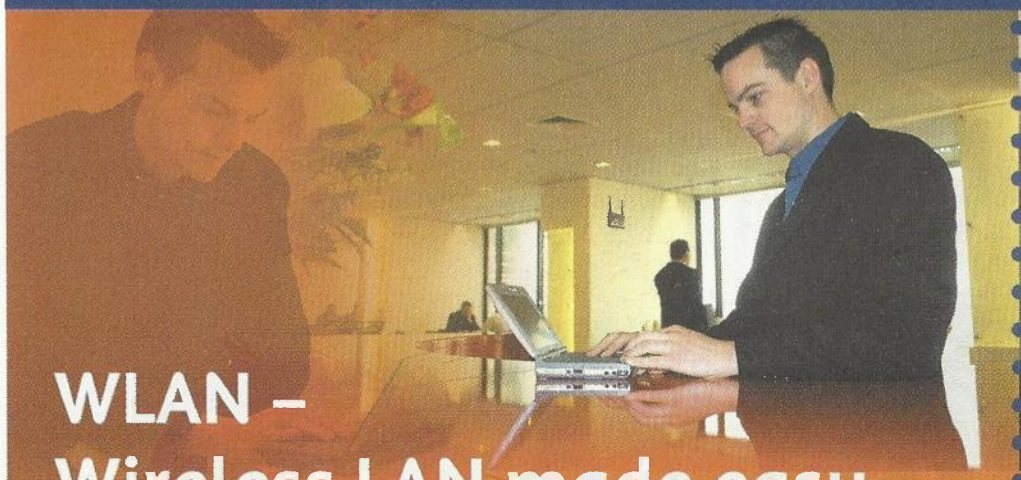
It is easy, fast and cost-effective to create natural speech applications with Lyrebird through the use of TRL machine learning technologies, innovative techniques to map graphical objects to the VoiceXML speech application scripting standard, and an integrated graphical development environment[2].

Initial benchmark comparison with a speech developer using standard tools[3], showed that Lyrebird achieved a potential 10-fold time saving in the creation of a prototype application, and a potential four-fold time saving in the creation of a complete application.

This initial product is being used by Telstra's Interactive Voice Recognition (IVR) Solutions Group. It is also being evaluated by a number of speech application development companies. The team is working on an updated version of the product.



™ Trademark of Telstra New Wave Pty Limited.
2 Patent applications filed by Telstra New Wave Pty Limited.
3 This comparison was commissioned by (TRL).



WLAN – Wireless LAN made easy

Users free to roam wireless Internet sites with...

- a single access point to multiple services
- an authentication process
- a single customer bill from all sites

...by just using their mobile phone.

High-speed Internet without wires is a reality. With cheap Wireless LAN (WLAN) equipment, also known as Wi-Fi, anyone can wirelessly connect to their existing home or office Internet connection at speeds as fast as on offer via ADSL (Asymmetric Digital Subscriber Line) technology.

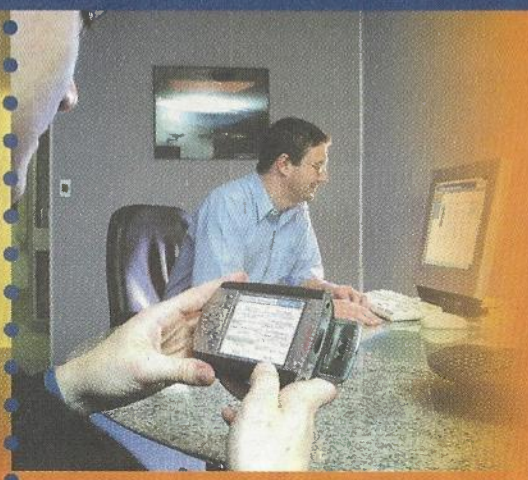
Laptops, handheld computers and mobiles can all be used to communicate with the Internet. It is anticipated that many schools, offices, airports, hotels and homes will be installed with WLAN technology, and hospitals, restaurants and shopping centres will join them. However, WLAN can become problematic when all of these WLAN sites are owned and operated by different people. For example, if different accounts and passwords were needed for access - or there was a different configuration for each site - it would restrict people's ability to roam from site to site freely...and some of the benefits of WLAN would be lost.

There needs to be a single access point and authentication process for people to log in. Telstra Research Laboratories (TRL) has developed an authentication mechanism based on use of a mobile phone.

Using this solution, Telstra would make available a common web page to each site, where a WLAN user would enter their Telstra mobile phone number. A text message would be sent to that mobile containing a unique password. After the WLAN user has submitted that password to the web page, they could access the Internet using the WLAN connection, and have usage charges billed to their mobile phone account until they disconnect.

TRL has developed a solution that does not require proprietary hardware or special software to be used in the laptop or handheld computer and could potentially be extended to allow non-Telstra mobile phones to log-in, with charges billed according to inter-carrier agreements. This would take advantage of existing roaming agreements between carriers and could even work for overseas travellers with mobile phones.

Wireless LAN is an amazing technology, with the potential to allow people to connect to - and browse - the Internet as freely as they talk on their mobile phone. TRL is working to make this vision a reality.



WLAN security 'sniffer' tool

Ensures a level of data integrity and secrecy in an increasingly risky wireless environment.

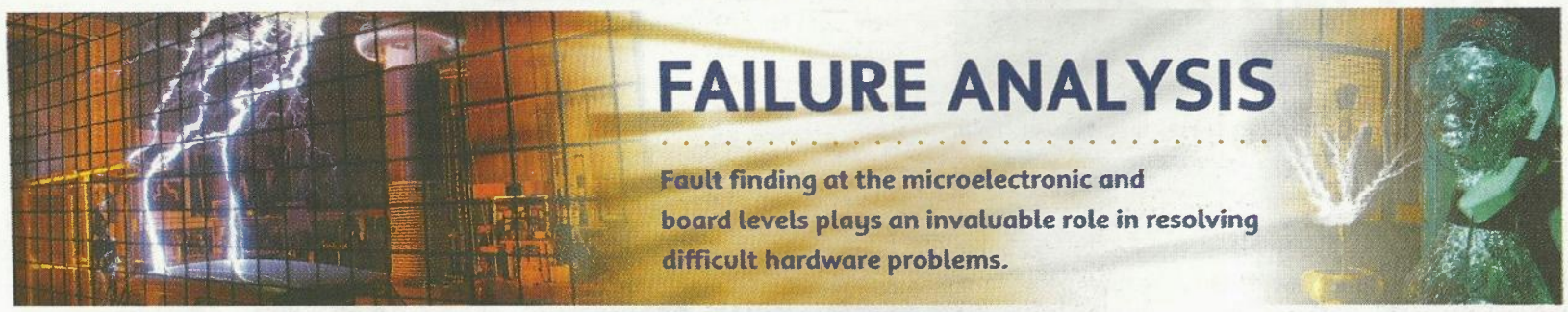
How safe is your wireless data? Could mercenary hackers be selling your corporate secrets to your competitors? Could individuals be downloading gigabytes of MP3 music over your expensive Internet link?

The susceptibility of wireless networks to intruders and eavesdroppers has become a significant concern for enterprises installing Wireless LAN (WLAN) equipment. As more workers embrace the freedom of networking without wires, the risks grow. Sensitive company data may traverse a wireless network, and its users must be assured of both secrecy and integrity.

Telstra Research Laboratories has created a WLAN security sniffer tool to help deal with these concerns.

This sniffer tool scans the surrounding area for WLAN access points and reports on their identity, characteristics and security features. Any rogue access points and any misconfigured network nodes will be quickly discovered. Unauthorised users placing devices on the network will also be revealed. Network administrators can get an overview of the security of their company's network and take action to plug the gaps.

An additional feature of the sniffer tool is the ability to monitor network traffic and make an estimate of the time it will take to break the default encryption scheme. This is dependent on how busy the network is and is a good illustration of why the default security mode is potentially inadequate. By analysing and exploring the shortcomings of current WLAN security, this tool serves to guide investigation into future wireless security schemes.



FAILURE ANALYSIS

Fault finding at the microelectronic and board levels plays an invaluable role in resolving difficult hardware problems.

Operational problems with equipment can be costly, complex and hard to identify. Often it is hard to ascertain whether or not the equipment is at fault, or even if the fault can be adequately resolved.

Telstra Research Laboratories' (TRL's) failure analysis group specialises in fault finding at the microelectronic (individual chip) and board levels, and plays an invaluable role in resolving difficult hardware problems.

Failures often result from the harsh environments in which equipment is used. Payphones are an example of a product that experiences a hard life in the field. As an outdoor, remotely located unit, the payphone must contend with lightning, temperature variations and vandalism. TRL has provided many solutions to past and current problems with payphones, the most recent ranging from lightning damage to fraud schemes.

Another example of a reliability problem tackled by TRL is the phenomenon of zinc whisker growth from electroplated surfaces near electronic equipment. This phenomenon has become the scourge of the electronics industry. When these virtually invisible conductive filaments grow, break off and become airborne, they can impact on sensitive electronic circuitry resulting in equipment outages – with no apparent cause.

TRL has been providing risk assessments and recommendations to private industry as well as to other groups within Telstra and has designed, developed and patented an airborne whisker detector to aid investigations into equipment outages.

THE MOBILE REVOLUTION

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line, e.g. in a taxi, or at moveable markets.

Just when you think that mobile phones can do about as much as they can, Andrew says that TRL believes there is still an enormous amount of growth in the development of the technology. "To make this growth more relevant to our customers' needs, TRL's mobile services group extensively consults with customers. The information we gather from these consultations then influences and impacts on the design and delivery of Telstra's new products and services. What is important to us is the consideration of how customers can better use the product or service to better integrate it into their lives."

Users may soon be able to wirelessly download software for games and instant messaging onto their mobile phones, making them more like PCs. Mobile phones as computing devices are, of course, more limited in terms of screen size, keypad, memory and processor speed than PCs. TRL is working with these challenges and aiming to solve the associated problems in order to enhance customer experience and make possible an exciting new wireless software market.

In the longer term TRL is researching the impact of Internet Protocol (IP) technology on cellular networks, which may be optimised to evolve into more cost-effective, general purpose, wireless data networks that may carry voice as well.

"It's great to be involved at the cutting edge of mobile phone technology," Andrew says. "To be a part of something that changes so quickly and makes such a big difference to the way people communicate."

"Originally mobile phones were the size of a briefcase, used only for talking to others, and their users were ridiculed. Ten years later, they can be as small as a matchbox and as varied as wristwatches; they are used for talking, texting and even storing birthdays. Around a billion people worldwide use a mobile phone as an integral part of their daily lives. It's exciting to think about what mobile phones will be like in another 10 years."

1 There are certain circumstances in which a customer will not receive the SMS, such as the mobile phone is switched off, they are not within a mobile coverage area, or their inbox is full. In such cases Telstra would not send the message beyond the meter expiry time.