IN CONFIDENCE

RESEARCH

QUARTERLY 76

A RESEARCH UPDATE FOR TELSTRA STAFF ONLY

July 1994

FOREWORD

This quarterly publication provides brief insights into recent project activities and achievements of the Telecom Research Laboratories (TRL) that might be of wider interest or assistance to Telecom staff in the performance of their work. Information is provided under a number of headings including:

- The Telecom Research Laboratories – A Brief Overview
- Customer Services and Systems
- Switched Networks
- Transmission Networks and Standards
- Telecommunication Science and Technology
- Research Laboratories Information Transfer – includes reports, papers, talks and Standards Contributions.
- Visitors to TRL
- Staff contacts

The names and telephone numbers of appropriate TRL personnel are included throughout this booklet. If you would like to get further information on a particular topic, please call the contact person nominated.

A.K. Mitchell
for DIRECTOR OF RESEARCH

Our cover:

Researcher Trevor Long evaluating compressed video. Video compression will help to provide hundreds of television or video channels through the telecommunications network.

The Research Quarterly has been printed on 100% Australian made Recycled paper.

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THE TELECOM RESEARCH LABORATORIES – A BRIEF OVERVIEW

Mission Statement

To provide Telecom with technological and scientific leadership, knowledge and expertise so that it can be the best provider of telecommunications and information services.

The Mission

Telecom Research Laboratories' (TRLs') mission is to provide Telecom with technological and scientific leadership, knowledge and expertise so that it can be the best provider of telecommunications and information services.

The mission is being achieved through seven key areas:

- provision of strategic advice and expert consultancy;
- value adding to Telecom's products and services;
- cost reduction of Telecom's equipment, systems and networks;
- technical support of Telecom's existing plant and equipment;
- transfer of technology to other parts of Telecom;
- increased ownership of Telecom's products through system and component design;
- maintenance of a highly skilled, expert and motivated workforce.

A Resource for Telecom

TRL is responsible for performing Telecom's research needs. TRL conducts a Research Programme derived from a corporately endorsed and approved business plan. The services that TRL provides are available to all other organisational units of Telecom.

The annual formulation of the business plan requires the consideration of corporate priorities and performance needs of R&D projects and related activities. This is in terms of the required deliverables, and the resources needed to ensure their timely delivery. These processes require that specific projects are either funded by a particular client unit in Telecom or on a corporate basis.

Deliverables include:

- the conduct of the Research Programme in accordance with the approved business plan;
- the operation of corporate facilities (National Information Resource Centre, Intellectual Property Consultancy, and Time and Frequency Standards);
- the management of and participation in corporate external R&D Programmes on behalf of Telecom.

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CUSTOMER SERVICES AND SYSTEMS

Distributed Systems Security

With more and more reliance placed on distributed systems, the security associated with these systems becomes increasingly important. Almost all currently used systems rely on passwords to authenticate users, and in many cases these passwords are transmitted between systems "in the clear" without any protection. Clearly this poses enormous security risks.

Work in the Telematic & Security Systems Section is focussing on security in distributed systems. Of particular interest is the secure authentication of users' identities in distributed environments such as the Open Software Foundation's (OSF) Distributed Computing Environment (DCE) which has been chosen as the standard operating environment for middleware in Telecom.

A number of authentication systems are being evaluated. These include the widely used Kerberos system, and an IBM developed system called KryproKnight, which forms the basis for IBM's Network Security Product. Both of these are based on symmetric key cryptography which means that secret keys must be shared before authentication can take place. In practice the shared key is obtained from the user's password via a one-way function. An on-line security server is required to authenticate users when they first log in to the system, and also to distribute keys which are used for mutual authentication of clients and servers in the system.

Currently, DCE provides a Kerberos based authentication system. While this is a distinct improvement over many systems, it falls short of Telecom's Corporate Security Baseline, which requires token (e.g. smart card) based authentication. TSS Section is currently investigating the way in which smart cards could be used to store the cryptographic keys used by Kerberos and DCE.

One very promising authentication system which has not yet been released in the form of a commercial product is Digital's SPX. This is based on public key cryptography. Public key cryptography uses different keys for encryption and decryption. Since the "public" key does not need to be kept secret, the task of distribution is far simpler, and does not require an on-line server. Instead, public keys are distributed in the form of certificates which are cryptographically "signed" by a certification authority.

Future releases of DCE will incorporate public key cryptography, and are expected to make use of the certificate format defined in the X.509 standard. TSS is actively contributing to this via the Distributed Systems Technology Centre in Queensland, who are members of the OSF. Telematic and Security Systems Section is also developing a certification authority which will produce X.509 certificates which may be stored in the X.500 based Corporate Electronic Directory. The provision of certificates in the CED will enable other applications such as secure electronic mail and a generic digital signature facility.

(Contact: M. Warner, Customer Services & Systems Branch, (03) 253 6720)

Service and Tariff Modelling

With the introduction of competition in the telecommunications market place there is a need for better understanding of customer behaviour. Key issues are demand levels for services, how customers choose their telecommunications carrier, and the influence of price on demand for services. It has also been recognised that specialised mathematical skills will be required to estimate the elasticities between demand and price, to model carrier selection and winback processes, and to estimate marginal costs of products. The Service and Tariff Modelling project was initiated to enable TRL to contribute in these areas.

The elasticity in demand resulting from a change in the price of a product, and changes in the prices of complementary products, needs to be estimated in a competitive environment for the range of Telecom's services. Various sources of data are available and need to be tapped, and then equations developed to predict customer demand, particularly for STD, IDD and Intelligent Network products. Parameters will vary for different customer segments, and these differences need to be explored. For STD the differences in elasticities at different times of the week on different routes also need to be explored.

Marginal costs of Telecom's products need to be developed so that Telecom can make better informed pricing decisions, can target customer segments, and prepare financial analyses for all kinds of marketing and investment decisions. Incorrect pricing decisions could cost Telecom millions of dollars in lost revenue.

Telecom needs to know why customers make the communications decisions they do make. For example, Telecom needs to know why customers switch between carriers. This is also called "switching elasticity" and sometimes "winback". A number of factors are expected to impact on switching elasticity, including advertising, service and price perceptions. This customer behaviour and the influence of these factors needs to be modelled so that Telecom can develop appropriate marketing strategies. At a later stage the cross-service impacts of one service on another need to be modelled and evaluated so that Telecom has a better understanding of its business.

Over the last twelve months a number of issues have been investigated as part of this Service and Tariff modelling project. They include the following:

- calculation of margins for STD and IDD using the STEM financial analysis tool.
- development of a "Reseller" product package with Commercial. This work entailed investigating customers calling patterns and evaluating impacts of various pricing plans.
- calculation of elasticity of demand for IDD in the post Christmas special period.
- investigation of the financial contributions of Intelligent Network products.
- investigation and report on customers' price perceptions in the monthly poll.
- determination of the key predictors of carrier selection by segmentation analysis.
- investigation into whether Flexiplans have had an impact in customers carrier selections.
- quantification and evaluation of customers' perceptions in Perth prior to the ballot there, compared with the eastern seaboard capital cities. Issues examined were price, service and overall impressions of the two carriers.
- comparison of fee based Flexiplans and no-fee based Flexiplans on customers' carrier choices.

The Service and Tariff Modelling work will expand in future. This modelling work can benefit from multiple disciplines, including econometrics, business, social science and engineering. Some skills new to TRL need to be developed.

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Radiation Hazard Expert Systems

Telecom is in the process of introducing a new Mandatory Practice for Radiofrequency (RF) Radiation – Safe Work Practices for Transmitter Sites. The process is coordinated by National Health Safety and Environment Branch and Electromagnetic Compatibility Section. The new mandatory practice will involve the introduction of standardised Site Radiation Folders, containing drawings of transmitter sites structures with clear indication of areas with restricted access.

Currently the site drawing for Radiation Folders are produced manually using standard CAD systems for each of thousands of transmitter sites. This is a rather wasteful process, since with proper software most structure drawings can be done automatically and the radiation patterns can be produced in principle using measured data for a few dozen antennas.

The Artificial Intelligence Section is developing automated tools for RF Radiation Hazard pattern generation, drawing on our expertise gained in constructing expert systems for structural design. The systems for structural design are used to automate the process of assessing structural integrity of poles for mobile communications antennas or masts and towers for other transmitter sites. They use neural network technology in their engine and, importantly from the users point of view, sophisticated interactive graphics to construct the structure under consideration.

Graphics developed for this Pole Expert System and similar systems for other radio structures – masts and towers – can be reused in Radiation Hazard Expert Systems. We are developing four separate products for poles, towers, guyed masts and rooftops. The overriding objective of the project is to construct systems that in most of the cases will produce drawings for Radiation Folders with minimal human intervention, but in non standard cases will enable the operator to produce drawing semi-manually.

The final versions of the systems are planned to have the following features.

(i) Graphics for structures and the general layout of the drawings will be created automatically.

(ii) Sophisticated editors will enable creation and manipulation of hazard patterns as well as text on screen as well as introduction of changes structures or drawing non standard structures.

(iii) All information for a particular site can be saved to a file for subsequent editing or printing.

(iv) High quality A4 colour printouts are created.

(v) Predefined radiation patterns will be imported for mounted antennas.

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SWITCHED NETWORKS

Intelligent Network Activities in ITU-T

ITU-T Study Group 11 Working Party 4 (Intelligent Networks) completed a major revision of Intelligent Network Capability Set 1 (IN CS-1) at its September 1994 meeting. The major purposes of the revision were to provide sufficient information to ensure that all implementors would interpret the Recommendations in the same way, so that interoperability between different vendor's products would be supported, and to correct some known deficiencies. Final minor editing of the revised text of the six revised Recommendations, totalling about 1000 pages, will occur at a meeting in January and the revised Recommendations are being proposed for accelerated approval in April 1995. Evelyn Swenson is a member of the editing teams for the two key Recommendations, Q.1214 and Q.1218.

Recommendation Q.1214 ("Distributed Functional Plane for Intelligent Network CS-1") now provides much more information about the call model in the switch and the detection points (DPs) where call processing can be suspended while an IN interaction occurs. The most important additions are full descriptions of the data from the network which is available at each DP, complete information on criteria for allowing an IN interaction to occur, and rules about data to be included in messages.

Recommendation Q.1218 ("Interface Recommendation for Intelligent Network CS-1") now encompasses the enhancements made to the Intelligent Network Application Protocol (INAP) since 1992 by ETSI; the "ETSI Core INAP" will now become essentially a subset of the ITU-T INAP. Most of the additional information in Q.1218 describes operational and error procedures.

The subset of the INAP protocol for the interface between service logic and databases was inadequate as defined in the original CS-1 Recommendations. The first proposed solution, that proposed for the ETSI Core INAP, was found to be incorrect only because of work at TRL on IN service creation by Alan Hopson and the team who were enhancing INSET, the TRL IN testbed, to allow services to be modelled for CS-1. Mr Hopson, together with Rolf Exner (TRL), was then instrumental in having X.500 adopted as the basis for a revised interface description, and has continued to play a leading role in the successful development of the new description. In addition, Study Group 7 Question 15 will make some further changes to the X.500 Recommendations to suit IN requirements, led by the Q15 Rapporteur (Mr Exner).

Future work in Intelligent Networks in Study Group 11 aims to have Capability Set 2 finalized in 1Q96 and CS-3 (with full support of mobility services) in 1Q97.

The active role of TRL personnel in the IN developments in Study Group 11 places Telstra in a very strong position to influence further developments and ensures relevant expertise is available to the company.

(Contact: E. Swenson, Switched Networks Branch, (03) 253 6327)

TINA Overseas Visit

Background

Stephen Leask (NSSS/SNB) undertook an overseas visit to Paris, between 22nd October and 30th October, 1994, to attend the following 3 meetings:

1. CNET, France Telecom – to discuss and compare TINA auxiliary experiment objectives, progress, and common areas of technical focus.
2. TINA Consortium Technical Committee meeting
3. TINA 95 Program Committee meeting

1. Meeting with CNET, France Telecom

CNET run 2 TINA auxiliary experiments: The Arcade experiment (run at the CNET Issy Les Moulineaux site) and a Data Distribution Manager experiment (run at the CNET Lannion site). The purpose of this visit was to investigate the Arcade experiment, and compare progress/experiences with Telecom Australia's PLATyPus experiment.

A presentation of the Arcade experiment was given by Frederic Dang Tran. This experiment aims to produce a TINA DPE of commercial robustness. The underlying platform is known as Chorus, a micro-kernel operating system, which is used by a number of vendors (including Siemens and Alcatel) in commercial products. A further layer of software known as COOL (Chorus Object-Oriented Layer) gives Chorus a minimal ORB (Object Request Broker) functionality, and makes it suitable as the basis of a DPE.

The major dates for the Arcade experiment are:

March 1995 – Produce a TINA conformant DPE

December 1995 – Add real time support

The addition of real-time support will mean that the Arcade DPE can be used to support services needing to control bearer connections, initially on an FDDI ring used within the CNET laboratory, but also later in an ATM environment. The PLATyPus experiment enables bearer control in a model narrowband ISDN environment, but only by encapsulating existing bearer control software within a TINA "building block".

2. TINA Consortium Technical Committee (CTC) Meeting

The TINA CTC meets every 3-4 months. These meetings are attended by a representative of each company in the TINA consortium, and are intended to review the progress of the TINA Core Team in meeting the Consortium objectives, in addition to other Consortium activities, such as TINA world-wide demonstrations, and auxiliary experiments. Previous CTC meetings this year have been attended by Gordon Monsbourgh (New Jersey, U.S.A., January, 1994) and Peter Richardson (Nara, Japan, June 1994). The following are some topics of relevance to Telecom which emerged at this meeting.

Core Team Progress

Stuart Feldman, the new Core Team Technical Leader, reported a very positive impression of Core Team progress during his first two weeks in the job. However, he also identified a number of pressing problems. These include:

- technical foundations of TINA are incomplete
- other activities e.g. the ATM Forum are focussing on narrower problem
- domains than TINA, and are progressing independently
- rapid staff turnover
- internal Core Team organisation needs changing

He also foreshadowed a number of changes to the operation of the Core Team.

These include:

- a shift in emphasis from architecture definition to prototyping
- a need to demonstrate the advantages of TINA
- a need to link TINA work with that being performed in the Eurescom and ACTS initiatives in Europe

Key technical issues to be addressed by the Core Team in the future include:

- performance
- service components
- service composition

Auxiliary Experiment Report

The auxiliary experiment coordinator, John Evans (GPT, UK), briefly reviewed the 11 auxiliary projects underway in various member companies. More detailed presentations of 5 of these were then given. These were:

- the PLATyPus project (Stephen Leask, Telecom Australia)
- the SECRETO experiment (Juan-Carlos Moreno, Telefonica)
- the ARCADE experiment (Jean-Bernard Stefani, CNET)
- Value Analysis of TINA (Jonathon Homa, Northern Telecom)
- the PINTA experiment (Samir Mourtada, Swiss Telecom PTT)

Salient points from these presentations were:

- Telecom Australia re-iterated the need for stable versions of particular TINA standards, notably the TINA Object Definition Language (ODL)
- A "Business Value of TINA" questionnaire has been sent to member companies, and will be used to help focus the Core Team work plan.
- Telefonica are addressing the issue of service creation in TINA, which has not been covered by work in the Core Team.

An auxiliary experiment workshop is to be held at TRL in Melbourne on the 9th and 10th of February, 1995, the week preceding TINA '95.

Long Term Work Plan

A draft of the Long Term Work Plan (LTWP) was presented by Motoo Hoshi (NTT, Japan). This plan is an output from the TINA Liaison team, and is intended to provide some continuity to the efforts of the TINA Core Team, in the face of constant staff turnover. It is intended to use this document to help form the annual Core Team work plan.

All member companies will provide input to refine this document, which will be presented in its revised form to the CTC meeting in January, 1995. The revised document is expected to show:

- a method of assessing the progress of the Core Team towards their stated objectives.
- the relationship of the TINA Consortium to other similar bodies.
- a shift in the emphasis in Core Team activities from architectural to prototyping.
- a shift in the responsibility for some activities from the Core Team to member companies.

TINA Legal Agreement

Martin Read of BT gave an overview of the TINA legal agreement, which was recently sent out to all consortium members for signature. Telecom has received a copy of this agreement, which is currently being considered by the Corporate Legal Directorate.

The various issues which had prevented earlier signature of this agreement appear to have been ironed out, and once all signatures have been received, a press release will be issued within a month, possibly at the Globecom 94 conference in late November.

Migration/Interworking Questionnaire Results

Stefano Montesi (CSELT) presented the results from a TINA migration/interworking questionnaire distributed to the TINA member companies. The questionnaire mostly dealt with the use of TINA for service delivery, with less emphasis on its use for operations and support systems (OSS).

Most member companies saw the deployment of TINA in ATM environments as a major requirement. The ability to support Personal Communications services such as UPT was also rated highly. An interesting point was that the interworking of TINA with existing PSTN networks had a very low priority.

World Wide Demonstrations

Guiseppe Giandonato (CSELT) reported on the status of the two World-Wide Demonstration (WWD) proposals, led by NTT and Bellcore respectively. The NTT-led proposal (to be shown in Geneva in September, 1995 at Telecom 95) will demonstrate multi-booth interworking (as distinct from the more technically challenging multi-location problem), federated trading, implementation of the TINA Connection Management Architecture, and

Distributed Processing Environment (DPE) interworking. Telecom Australia is maintaining an open offer to provide tool support for this WWD proposal.

TINA Conformance

The issue of what it means to be "TINA conformant" was raised on several occasions. A criteria document was presented by Yuji Inoue (NTT), for use by individual companies wishing to present TINA conformant demonstrations at Telecom 95 in Geneva.

The wider issue of conformance to TINA standards (independent of Telecom 95) was also raised. The criteria document can also be used to gain such approval from the CTC.

TINA 95 Organizational Status

A presentation was given by Stephen Leask (Telecom Australia) which described the planning status of the TINA 95 conference to be held in Melbourne, February 13-16, 1995. The key points from this presentation were:

- The major current activity is the selection of the program for TINA '95. Approximately 150 papers have been submitted, while only around 57 can be accepted. This should lead to a very high quality of technical material presented at the conference.
- Special sessions (keynote addresses, tutorials, and video and panel sessions) have been almost finalised, with most topics agreed and speakers invited.
- The conference announcement and registration form has been widely distributed electronically and as hard copy. CTC members were urged to submit their registrations early to avoid disappointment, as there is a hard limit on the number of attendees (250).
- Accommodation is unbundled from the conference/tutorials fee, but can still be organized separately by the Professional Conference Organizers (Convention Network).
- The conference will be advertised locally through a series of press briefings to technical journalists.

Miscellaneous

IBM are now a paid-up Consortium member, with a Core Team representative.

Reviewers for all 1994 deliverables (reports and baseline documents) have been chosen, after considerable interest was shown by member companies. Yuji Inoue (NTT) will process requests from member companies which still wish to join the review team for a particular document.

3. TINA '95 Program Committee (PC) Meeting – Friday 28th October, 1994

The purpose of this meeting was to select papers to be presented during the technical sessions of the TINA '95 conference (Melbourne, Feb 95) and to construct a program based around these papers. Other conference details, such as the selection of keynote addresses, technical session and tutorial chairs, and the acceptance/rejection process were also finalised.

Approximately 150 extended abstracts had been submitted for consideration, and of these, 57 were chosen. The 5 papers submitted by Telecom (some in conjunction with other authors) were all accepted. The technical session program thus devised consists of 3 parallel streams, Architecture, Technology, and Services.

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Handover Analysis in GSM

A computer simulation tool to evaluate handover performance in Telecom's GSM cellular radio network has been developed by the Network Analysis Section. Known as GHoST (GSM Handover Simulation Tool), the tool is now being used by Mobile Networks to assist with the task of optimising handover parameters.

The handover process, by which a call in progress is maintained as the mobile subscriber moves through the network, is a fundamental function of a cellular mobile radio network, and has a bearing on capacity and quality of service issues. How and when a handover occurs is governed by the handover algorithm. A handover algorithm typically takes measurements of physical quantities such as signal strengths, interference, distance etc., references a database of pre-set parameters, such as signal threshold levels, hysteresis margins, averaging periods etc. and makes a decision according to a series of rules whether a handover is required and if so, to which base station and channel.

The advanced features of GSM permit a much more efficient and complex handover algorithm than in the AMPS analogue cellular system. Both the mobile and the network assist in the GSM handover process. The handover parameter values can be set by the operator. This offers a high degree of flexibility for adaption to different operating philosophies, terrain, cell sizes, frequency reuse plans and traffic distributions. The cost of this flexibility is increased complexity.

The number of parameters and the existence of complex interrelationships between them, in addition to the inherent vagaries of propagation and traffic, makes the problem of optimising parameter values using conventional network design tools and survey techniques very difficult. GHoST provides a framework in which to define propagation, interference, mobility and base station configuration scenarios and then to perform the handover process on this environment.

(Contact: Taka Sakarai, Switched Networks Branch, (03) 253 6312)

TRANSMISSION NETWORKS AND STANDARDS

CAN Radio Overlay (CRO) Pilot, Dalby-Queensland

Telecom is currently evaluating the concept of using a CAN Radio Overlay as an interim means to provide customer service by using a point-to-multipoint radio system. This approach has potential benefits where conventional access methods are either unavailable, too costly or where main, distribution or O pair relief is not able to be programmed in the near the future.

The aim is to provide a rapid response for service activation, be able to defer provision of new or relief capacity and then later transfer customers to their permanent access technology without disruption to service.

An additional benefit is that the equipment can then be economically reused at another customers premises.

A number of objectives for the pilot are:

- To quantify the impact of using CRO as an interim delivery method in terms of cost savings
- Assess customer perceptions
- Assess systems and operational issues

What Has Been Done?

In Dalby, Queensland some 200 km due west of Brisbane, Telecom has installed a modified High Capacity Radio Concentrator (HCRC) system with two base stations located respectively on the radio tower of the exchange and the town's water tower.

Telecom also widely uses these systems to augment or replace existing Digital Radio Concentrator Systems (DRCS) for our more remote customers and therefore equipment and expertise are readily available.

At each customers premises a weatherproof self contained micro station is installed above ground level and a simple antenna is attached to an integral pole or clipped to the house roof guttering to give line of sight back to either base station. The system is powered by the customer's 240 volt supply and battery back up is included in the weatherproof container.

The customers are located within a 5 km radius of one of the two base stations.

Orders are processed in DCRIS as for a conventional order and similarly for cable assignment (FACS) and fault management (LEOPARD).

Installations commenced in September 1993 and to date there have been a total of 78 customers connected by this method.

An initial survey was commissioned to obtain customers feedback and opinions.

This indicated **widespread acceptance** of the CRO delivered solution with few concerns about the service differing from cable, sound and call quality was **not** mentioned as a major problem by the customers and the time taken to install the radio telephone service was **regarded favourably** by a large percentage of our customers.

The trial has already shown benefits in being able to defer and better manage the distribution area and main cable work and activities.

Future Timing of Activities

The next phase of the pilot will be that customers will be progressively migrated onto their permanent access technology solution between September and December 1994.

Outputs

Outputs from the trial will be an evaluation of the costs and benefits of adopting this technique and the improved operational processes that would be required for any larger scale deployment.

Mention must be made of the excellent cooperation between many separate areas of Telecom with Telecom Research Laboratories including Consumer & Commercial (CAN Design, Service Activation, Marketing), Network Operations and NTG Capacity Planning.

(Contact: Bill Newhouse Transmission Networks & Standards Branch (03) 253 6364)

Protecting the TF200 against Lightning

TRL and Telecom Technologies believe that they have now solved the ongoing problem of how to make the Touchfone TF200 more resistant to damage due to lightning. The cost of lightning damage (including material and the labour cost to replace the phone) has been estimated to be in the order of $15M per annum.

Standard international high-voltage test waveshapes do not reproduce in the laboratory the damage seen in TF200s from the field. While it is possible to cause damage with the phone "off hook", the type of damage is different to lightning-damaged phones returned from the field which almost always have a failed audio chip.

Concurrent with this work was a field trial of standard and lightning hardened TF200's. These modified TF200's used either a solid-state protection device, instead of a metal oxide varistor, or a mechanical hookswitch instead of a transistor.

Out of approximately 15,000 phones installed in the field trial, 101 phones were returned to TRL with lightning damage. TRL then contacted 50 of these 101 customers for additional information. Of these 50 lightning-damaged phones there were 10 standard phones, 23 mechanical hookswitch phones and 17 solid-state protected phones. From customer recollection only 3 of the 50 phones failed while "off hook" and of these 50 customers, 21 customers recalled lightning striking nearby. Almost half of these services had a gas-filled protector (GFP) at the line termination point and only one phone broke down to an earthed object. These statistics indicate that:

- the damage appears to be related to a nearby lightning strike and hence high voltages, probably 10'skV, are involved
- a GFP will not protect the TF200 from damage
- the lightning-hardened phones do not appear to perform any better
- a breakdown to an earthed object was not required to cause damage.

These results gave rise to the theory that perhaps fast rising impulses were causing capacitive charging currents to flow into the parasitic capacitance between the phone and ground. A second theory was that a cable breakdown, one leg to ground, was causing a high voltage to appear between line to line at the phone terminals. To test these theories a phone under test was powered using an isolated supply and insulated with respect to ground to a very high voltage, greater than 500kV. With impulses of 60kV a breakdown occurred from one side of the line to ground, the phone was damaged and inspection of the audio chip revealed damage very similar to that of field damaged phones. As a result of this breakthrough it is now thought that a strike to ground in the vicinity of the customer's premise is causing a breakdown of the phone cable to ground and thus causing to phones to be damaged.

Further testing has revealed that standard TF200's can be damaged by high voltage cable breakdowns as low as 25kV. TRL has now developed techniques and identified components that will protect the TF200. Tests with voltages up to 300kV cannot damage the protected phones. It is expected that this improved protection will be incorporated into the next generation of telephone and should significantly reduce the number of telephone failures due to lightning.

(Contact: P. Day, Telecommunication Science & Technology Branch, (03) 253 6619)

Lightning Strike Damage at the Perth International Telecommunications Centre, Gnangara, W.A.

The Perth International Telecommunications Centre is one of four Telstra tele-communication installations which provide the links between Australia's domestic communications network and Telstra's international network of submarine cables and satellite systems.

Its facilities include:

- An international digital telephone exchange and associated transmission systems, including the Australia – Indonesia – Singapore submarine cable terminal
- Satellite earth station for both The INTELSAT and the INMARSAT satellite networks
- Satellite Tracking, Telemetry, Command and Monitoring operations provided under a contract to the European Space Agency and INTELSAT
- Maritime and VHF international radio communication services
- National network digital telephone exchange and transmission equipment.

Some of these telecommunication services and their support facilities sustained considerable lightning damage during a recent severe thunderstorm. The most extensive damage occurred to the Maritime communication services which included the Global Maritime Distress Safety System, and the commercial Seaphone, Radphone, Seagram, and Seatex services. The thunderstorm also damaged some of the video surveillance cameras, the security card readers, the UPS, and caused power trip-out problems at the submarine cable terminal.

The PITC has been damaged by thunderstorms in the past but never so extensively or severely. Site inspection, tests and measurements showed that this damage was caused by a direct lightning strike to one of the transmitter antennae associated with the Maritime services and that the main factors which contributed to the extent and

TELECOMMUNICATION SCIENCE AND TECHNOLOGY

the severity of the damage were: the severity of the strike, the height at which the antenna feeder was attached to the mast, an inadequate mast grounding system, and the way the antenna feeder entered the Maritime services building. Some of the factors which contributed to the damage of the surveillance and other support equipment included inadequate surge protection for the equipment and also inadequate grounding and bonding. Consequently, TST's High Voltage Group has recommended a number of changes to reduce the risk of any further lightning strike damage.

(Contact: E. Bondarenko, Telecommunication Science & Technology Branch (03) 253 6600)

Electromigration In ASICs: Trends & Issues For Reliability

Electromigration processes (the movement of metal atoms as a result of electrical current) in ASICs have been of considerable concern to Telecom over the past few years. Indeed, there have been several system failures, and subsequent ASIC replacement programs have been necessary to restore the level of reliability expected. Consequently, TRL keeps a close watch on this issue. That electromigration is a growing concern of the semiconductor industry was very clearly highlighted at this year's International Reliability Physics Symposium, held in San Jose USA in April this year. This article summarises some of the main trends and issues regarding electromigration that were presented at that symposium.

Present day integrated circuits employ 0.5 μm wide metal lines to interconnect transistors together and it is possible to have 4-6 separate layers of interconnect metallisation. By the end of the decade this is likely to be 0.25 μm with additional levels of metal. Such aggressive scaling will result in an increase in the design value current density in the metal tracks from the present 0.2-0.4 x10^6 A/cm^2 to a projected 106 A/cm^2 by the year 2000. Further, the increasing density of circuitry will lead to an increase in the temperature at which circuits operate. Both of these factors are critical in the process of electromigration that can lead to open or short circuit tracks.

Whilst ASIC manufacturers clearly try to achieve reliable product, the demands being placed on materials as semiconductor technology evolves means that the long term (greater than five years) implications for reliability may not be well understood. Additionally, techniques used to accelerate the testing of ASIC metallisation have been questioned and there are some doubts as to the validity of extrapolating test data, obtained at higher than normal operating temperatures and current densities, to provide an expected lifetime of thin metal lines under their actual conditions of use.

The use of higher current densities has been enabled by the use of complex layers of metals and the alloying of small quantities of other metals with the aluminium that forms the main component of the interconnection metallisation. For example, stacks of metals such as Ti/TiN/Al-Si-Cu/TiN are now commonly used, as are underlying layers of refractory metals such as W, Mo, Pd, Pd/Nb or Sc to stop the movement of metal into the semiconductor regions. However, these additional layers can alter the microstructure (grain characteristics) of the aluminium leading to increased electromigration problems. The amount of copper used in the aluminium is also critical and the optimum annealing conditions required to achieve adequate reliability differ with the amount of copper introduced. Unfortunately, these optimum conditions for annealing cannot always be met due to the processing requirements of the ASIC wafers. Intermetallic alloy precipitates, such as Al_2Cu, become an increasing proportion of the line width as dimensions decrease, and have been shown to act as preferential sites for electromigration.

Stress induced migration (the growth of voids in the metal tracks due to mechanical stress on the metal films) is also becoming more of a problem. Below 0.5 μm line widths, stress voids, which develop during storage after fabrication, act as sites for electromigration, and it is expected that electromigration lifetime will decrease leading to further reliability problems. It is anticipated that circuit design will have to become tolerant of substantial increases in the resistance of interconnection metallisation, resistance values that at present would result in circuit failure.

Alternatives to adding copper to the aluminium have been suggested and include titanium, palladium, niobium/palladium and scandium.Whilst some of these do appear to be promising there is no clear alternative that provides the lifetime of Al-Cu. Laboratory investigations of copper replacing aluminium entirely have been reported, however, there are practical problems with the ongoing corrosion of copper from the chlorine based plasma etching chemistries used. Copper is also far more susceptible to moisture induced corrosion and would introduce reliability problems in this regard.

It was clear from the papers presented at the conference and from the workshops specifically devoted to electromigration that electromigration failures are likely to occur in future ASICs, despite the best intentions of the ASIC vendors. One real advantage we have at TRL is that as an independent group we have access to confidential information from a number of vendors that can be pieced together to enable informed choices of the best technology options. The information about electromigration issues obtained at the symposium is currently being applied in an

evaluation of SDH equipment ASICs for Transport Technologies, Planning & Products.

(Contact: T. Rogers, Telecommunication Science & Technology Branch, (03) 253 6636)

Silica Planar Optical Waveguides

Research into planar waveguide technology is currently being undertaken in Optoelectronics Section as part of a larger TRL project in Photonic Networks. This research is a collaborative effort which so far has included members of Optical Networks-TNS branch, Optical Fibre Technology Centre (OFTC) in Sydney, ANU Canberra and RMIT in Melbourne. The main focus of this work is on planar waveguide devices which will have applications in future optical networks. Wavelength Division Multiplex (WDM) systems allow the transmission and manipulation of data at very high aggregate bit rates for applications in the optical domain. Wavelength multiplexers and de-multiplexers, wavelength routers and wavelength dependant filters needed for WDM systems can all be formed as integratable planar waveguide devices or "Photonic Integrated Circuits". Other devices which have been fabricated are passive splitters, optical modulators, optical switches and waveguide lasers, all components that may be used in various aspects of an all-optical network.

At present a number of technologies for forming photonic circuits in silica glass are being investigated. These involve producing localised regions of altered refractive index without inducing excessive structural damage.

Photo-induced planar waveguides are being fabricated and tested at TRL in a combined effort with OFTC. For this process, UV laser light is used to alter the refractive index of Germanosilica glass and produce a light guiding core. Although this technique is currently used to make Bragg gratings in optical fibres, the physical process of refractive index change is complex and not yet fully understood. Buried, laterally confined waveguides were directly written in planar germanosilicate glass grown by Plasma Enhanced Chemical Vapour Deposition (PECVD). The measured loss value was 1.2dB/cm which is somewhat higher than the target value of ~ 0.1 dB/cm for low loss waveguides. The reason for this residual loss is the subject of ongoing investigation. The next stage in the development of this technology is to UV-write a Bragg grating into the current samples to produce a wavelength dependant filter. This technology, if successful could lead considerably simplified manufacturing with fewer steps translating into lower costs and increased yields.

Also under investigation is waveguide formation by Germanium ion implantation to produce a refractive index change in silica. Implantation is being performed under contract by the Australian National University using their high energy ion implanter. Preliminary work on implanted rib waveguides has produced guides with propagation loss of 7.3 dB/cm. We believe these are the first silica waveguides fabricated by Ge ion implantation. This high loss figure is being investigated but is believed to result from either implantation damage (reducible by annealing) or small 0.1μm edge corrugations in the rib used to produce horizontal confinement. Buried channel waveguides can also be directly written by ion implantation using a thick plated gold mask. Devices using this technology, which is expected to yield production and performance advantages have been completed and are now under evaluation.

Straight rib guides and y-splitters in flame-hydrolysis grown silica on silicon and straight guides in PECVD grown silica on silicon have been formed by plasma etching. Values of propagation loss obtained were 3.1 dB/cm for the flame-hydrolysis grown rib guides and 2.7 dB/cm for the PECVD samples. Inspection of the plasma etched sidewalls by Scanning Electron Microscopy reveal similar edge corrugations to the implanted rib guides. The effects of this roughness on loss characteristics and improvements in the fabrication process to eliminate the problem are currently being investigated.

(Contact: M. Faith, Telecommunication Science & Technology Branch, (03) 253 6456)

TRL INFORMATION TRANSFER

During the last quarter, the TRL staff have published or presented details of the progress and noteworthy achievements of various projects and activities. These publications comprise both official Telecom publications (in the form of Research Laboratories Reports and Branch Papers) and papers submitted for external publications in learned journals or presented to outside organisations (including professional institutions and societies).

Some of the listed Research Laboratories Reports and Branch Papers are confidential and restricted to appropriate areas within Telecom. These are indicated by the '*' included in the publication number. Only the titles of such publications are included.

Reports and Branch Papers 'for general use' are available on request and are also listed with abstracts or summaries of the contents of such publications given after the lists.

If you want to get copies of Research Laboratories Reports or Branch Papers, please telephone (03) 523 6700. Or you can complete a request form (included on the next page) and send it to:

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- BAM, Customer Services and Systems Branch (03) 253 6483
- BAM, Switched Networks Branch (03) 253 6401
- BAM, Telecommunication Science and Technology Branch (03) 253 6674
- BAM, Transmission Networks and Standards Branch (03) 253 6399

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RESEARCH LABORATORIES REPORTS

8295* – Radio Link Error Performance of GSM Mobile Data Services
Findlow, G.L., Ping, L.

8296* – Radio Link Error Performance of the GSM Speech Service
Gitlits, M., Findlow, G.A., Campbell, J.C.

8297* – MPEG Systems
Alton, T.J.

8301* – Interworking GSM and ISDN Basic Circuit Mode Services
Liu, A.

8304* – A Bandwidth Optimiser for an AI Environment: Design and Implementation
Gates, D. & Hogg, S.E.

8305* – Corporate Traffic Measurements and Modelling
Theimer, T.H.

8307* – Unplanned Outage and Planned Event Processes for the Transmission Network
Ginger, J.L.

8309* – Dynamic Traffic Management for Telecom Australia's Inter-capital Telephony Network
Soh Kam Hung

8311* – An Overview of an Experimental Distributed and Automated Management System
Hogg, S.E.

8312* – Magnitudes of the Near E-Fields Close to Hand-Held GSM Digital Mobile Telephones
Ian P. Macfarlane

8315* – The Design of Future VOD Network Architectures
Pettitt, M.J.

8318* – On Providing Intelligent Screen-Based Telephone Services: A Feasibility Study
Dai, W.

*Reports marked * are classified as 'IN CONFIDENCE – For Telecom Australia Use Only'.*

Research Laboratories Reports Note: In some cases Research Laboratories Reports classified as 'In Confidence – For Telecom Australia Use Only' will only be released to staff when accompanied by their Section Manager's authorisation.

CUSTOMER SERVICES AND SYSTEMS

Slice Based Approaches to Improving the Error Robustness of MPEG-like Compressed Video Bitstreams, Packet Video Workshop, Portland, Oregon, U.S.A., September 1994.
Leditschke, M., Biggar, M.

Developing an Appropriate Telecommunications Policy for Open Learning, UNESCO International Seminar, Sydney, N.S.W., September 1994.
Isaacs, D.

Inductive Learning of Search Control Rules for Planning, Journal of Artificial Intelligence.
Leckie, C., Zuckerman, I. (Monash Uni)*

The Incidence of Chance Resemblances on Language Comparison, Journal of Quantitative Linguistics.
Guy, J.

The Question of Recursion in Natural Language, Language/Journal of Quantitative Linguistics.
Guy, J.

Electron Liquid Excitations in Coupled Quantum Wells, 22nd International Conference on Physics of Semiconductors, Vancouver, Canada, August 1994.
Swierkowski, L. (Uni of N.S.W.), Szymanski, J., Neilson, D. (Uni of N.S.W.).*

Magneto-Polarons in Quantum Wells With High Electron Concentrations, 22nd International Conference on Physics of Semiconductors, Vancouver, Canada, August 1994.
Szymanski, J., Swierkowski, L. (Uni of N.S.W.)*

Getting Schools onto the Information Highway: Key Aspects of an Appropriate Telecommunications Policy, Schools and the Information Highway Conference, July 1994.
Isaacs, D.

TELECOMMUNICATION SCIENCE AND TECHNOLOGY

Component Analysis Report:

*CAR94/009** – 'Failure Analysis of AWM 1728 Audio ICs From Touchfone 200s'.
Li, S.W.C., Anderson, R.J.

*CAR94/012** – 'Failed Laser Modules From NEC 140Mbit Equipment'.
Charles, S.

*CAR94/013** – 'Quality Evaluation of The CLA70037 ASIC Used In A Telpec Digital Pair Gain System'.
Thornton, R.P.

*CAR94/014** – 'Hast Testing of NEC ASICμPD65658GF-133-3BA'.
Li, S.W.C., Scott, K.L, Nolte, D.A., Rogers, T.P., Molnar, S.

*CAR94/015** – 'Avalanche Photo Diode From Alcatel 505 Mbit/s Optical System'.
Charles, S.

*CAR94/016** – 'The Suitability of Krone Silver-Plated Connectors For Use In The RIM'.
Kibel, M.H., Hand, R.G.

*CAR94/017** – Initial Evaluation of The Electrical Resistibility Of Alcatel System 12 ALCN Exhange Line Cards
Day, P.W., Willis, D.C., Parkinson, S.L.

Consultancy Report

*CR94/03** – 'Report to Access Products ONI Optoelectronic Device Developments
Faith, M.E., Kemeny, P.C.

*CR94/04** – 'Comparison of Thermal Papers For Use With Vic TAB Print Heads'.
Kibel, M.H.

*CR94/05** – 'Lightning Strike Damage to Maritime Communication Services at the Perth International Telecommunications Centre, Gnangara, W.A.'
Bondarenko, E.

*CR94/06** – 'Examination of Tusonix-π-Type Low Pass Filters'.
Scott, K.L

*CR94/07** – 'Failure Analysis of NEC D17055C Programmable Parallel Interface ICs'.
Li, S.W.C., Rogers, T.P.

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RESEARCH LABORATORIES BRANCH PAPERS

RESEARCH LABORATORIES PAPERS PRESENTED/ PUBLISHED

TRANSMISSION NETWORKS AND STANDARDS

Evolution of a Standard for ADSL, IEEE Communication Society Lunchtime Lecture, 27 September 1994, RMIT Melbourne.
Davies, W.S.

TELECOMMUNICATION SCIENCE AND TECHNOLOGY

Electrical Characteristics and Reliability of Ohmic Contacts For InGaAs/InGaAlAs/InP Lasers; European Solid State Devices Research Conference, Edinburgh, September 1994.
Leech, P.W., Reeves, G.K. (RMIT)*

Optimization of Pd/Zn/Pd/Au Ohmic Contacts To p-Type InGaAs/InP; Spring Meeting, Materials Research Society, San Francisco, Symposium B: Advanced Metallization for Devices and Circuits-Science, Technology and Manufacturability, April 1994.
Leech, P.W., Reeves, G.K. (RMIT)*

Electrical Properties of In/Yb/n-$Hg_{1-x}Cd_xTe$ Contacts; Journal of Materials Science: Materials in Electronics 5 (1994) 226-228.
Leech, P.W.

**Denotes TRL Professionals.*

STANDARDS CONTRIBUTIONS

ANSI TIE.4 meeting, 19-23 September 1994, Minneapolis, U.S.A.

'Proposed Living List Item for Issue 2 ADSL Standard – Extension of Impulsive Noise Tests'.
Joint contribution: Davies, W.S. (Telecom) & Angelovski, Z. (NEC Australia).

Standards Australia

Draft Australian Standard DR94349, 'AMPS Receiver Immunity to Interfering Signals Employing Amplitude Modulation'.
Macfarlane, Ian, P.

CISPR/G/WG1 (Macfarlane) 94-1, July 1994.
'Suggested New Work: Radio Devices and ITE'.
Macfarlane, Ian, P.

CISPR/G/WG1 (Macfarlane) 94-2, September 1994.

'Limitation of Radiated and Conducted Radio Frequency Disturbances from ITE With Air Interfaces – Radio Devices Combined With ITE'.
Macfarlane, Ian, P.

CISPR/G/WG3 (Macfarlane/Day) 94-1, September 1994.

'Comments on CISPR/G (Secretariat) 74: Standard ECMA-200; Immunity of Information Technology Equipment to Lightning Surges'.
Macfarlane, Ian, P., Day, Phillip.

BIBLIOGRAPHIES

In the recent quarter the National Information Resource Centre has conducted literature searches to compile bibliographies on the following topics:

Clayton NIRC

94/198 ATM and network architecture

94/207 Performance appraisals, June 1993 to July 1994

94/209 Evaluation of training

94/231 Brainstorming

94/294 Windows Help and WinHelp – authoring tools and undocumented features

Melbourne NIRC

888/94 Facsimile market trends (Australia and USA)

906/94 Performance appraisal for teams

983/94 Self-directed work teams

993/94 Home shopping (pay TV) channels

1004/94 Paradigm shifts

1039/94 Predictive dialling

1044/94 Employee assistance programmes

1045/94 Prioritising new products/services

1090/94 PSTN – benchmarking/quality of service/network performance

1092/94 Distribution channels (telecomms industry)

1093/94 Distribution channels (general)

1110/94 Activity based costing/activity based management

1146/94 Language and corporate culture

1163/94 Corporate citizenship/corporate social responsibility

1164/94 Group decision making

1213/94 Service quality/customer service, satisfaction

1214/94 Card payment systems

1220/94 Performance appraisal

1309/94 Quality of service – network performance

1313/94 Technology adoption

1349/94 New product growth

Sydney NIRC

246/94 IDD and Tariffs

250/94 Worldpartners, AT&T, MCI, BT

257/94 Telcos and change management

259/94 Object Oriented Workflow Management Systems

263/94 Transaction processing

290/94 AT&T and credit cards

289/94 ATM network development worldwide

272/94 Online Debit Networks

275/94 Electronic commerce

To obtain a copy of a bibliography please contact the NIRC office which produced the bibliography. Full contact details are given below.

Clayton National Information Resource Centre
M8/770 Blackburn Road,
Clayton, Vic. 3168
Enquiries: (03) 253 6162
Fax: (03) 562 8660

Melbourne National Information Resource Centre
1/242 Exhibition Street,
Melbourne, Vic. 3001
Enquiries: (03) 634 5317
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22/233 Castlereagh Street,
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Enquiries: (02) 396 3527
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Other offices of the National Information Resource Centre are located at:

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VISITORS TO TRL

A wide variety of people from within Telecom and from external organisations visit the Laboratories, either as individuals or in groups. The visitors include executives, clients, researchers and officials of government and private organisations, and the purposes of such visits are to facilitate information transfer relating to the management and outcomes of R&D activities of mutual interest. Some notable visitors during the last quarter were:

July

National Mutual
Mario Scibilia, Steve Fabiny, Karl Patton, Brian Little, Leanne Harry and Derek Nowill accompanied by Patrick Mann, Account Executive, Paul Casbolt, Communications Consultant, Jim Tzivakis, Corporate Account Assistant, Andrew Cottrill, Banking and Finance, Tracie Flack, Sales Support.

Sri Lanka Telecom
Professor Perera, Chairman accompanied by Peter Keating, Business Manager, India and Sri Lanka.

New Scientist
Bill O'Neill, Features/Special Projects Editor, London accompanied by Kerrina Lawrence, Public Affairs Officer, NTG Communications.

Telecom Australia
Lesley Tannihill, Corporate Affairs, WA; David Carter, GM, HR; Caroline Zaman, PA; Jill Ross, Team Briefing Coordinator; Janet Williams, PA; Seona Travers, PA; Lea Williams, Communications Officer; Denise Foster, Executive Assistant; Richard Castle, Manager, HR; Pat Concannon, Manager, HR; Samantha Glynn, Project Manager, HR; Cheryl Shegedyn, Consultant, HR; Simon Berry, Manager, HR; Graeme White, Advisor, HR; Joannie Wallace-Smith, Research & Admin.; Wendy Hui Fox, Organisational Development Consultant.

Science & Technology – Korea
Dr. Rhee, Director.

Australian Broadcasting Commission
John Bigeni, ABC TV; David Swan, ABC IT; Peter Kepreotes, ABC Radio; accompanied by Barry Ihle, Communications Consultant and Judy Tucker, Account Executive.

Standing Committee on Industry, Science, Technology, Transport, Communications and Infrastructure
Senator Bruce Childs, ALP NSW, Chairperson; Members: Senator Bryant Burns, ALP Qld; Senator John Devereux, ALP Tas; Senator Alan Ferguson, LP SA; Senator John Panizza, LP WA; Robert Diamond and Peter Hallahan, Secretariat; accompanied by John Burke, Group Manager, Finance and Administration and Adam Smith, Manager, Industry Policy.

MSS Alarm Services
Bob Stirling, National Technical Services Manager, Alarms, accompanied by Brian McNamee, Consultant.

RAEME Training Centre
Major John Lord; Captain Mohd Radzi; WO2 Mark Heydon; WO Mick Elliott; Students: Sgt. Andrew Baly; Sgt. Tim Dare; Sgt. John Dodd; Sgt. Gary Pitt; Sgt. David West; Sgt. Paul Witson; WO2 PG Ali; Staff Sgt. Haslen; Driver: Private Rick Maurici.

INTEC of Japan
Mr Takizawa, Corporate Planning & Strategy; Mr Yamada, Research & Engineering accompanied by Ian de Montfort, Business Development Manager, Korea/Japan; Paul Castell, Telstra – Japan; Peter Dee, Vice President, Japan; Chris Haig, Manager, Technology Strategy.

August

Department of the Army
Donald Meissier, US Army Research Lab.

Prime TV
Jake Van Der Stock, Network Chief Engineer accompanied by Kathy Curtis, Account Exec.

Telecom – Marketing
Marion Steele, Manager, Commercial & Consumer Business; Kerryn Hammond, Graduate Officer; Marion Macleod, Market Research Coordinator, Natalie Arapakis, Research Coordinator.

ACT Government Service Electronic Business Strategy Project
John Turner, Secretary, Dept. of Urban Services; Mike Woods, Under Treasurer; Alan Chrisp, Director, Government IT Policy Unit; Phil Sadler, First Assistant Secrtetary; Ross Sue See, Exec. Director, Business Development & Marketing; Tony Wein, Director, Technology Business Unit; Sue Barber, Senior Consultant, Azimuth Consulting accompanied by Paul Thompson, ACT Account Executive.

NorTel Australia
Kim Sung Hee, Kwak Jaw Cheol, Oh Jong Hwan, Park Byung Geon, Ji Jae Sik, Kang Jin Sung, Kim Hyeong Seok, Park Ho Suk, Kim Hyung Su, Han Dong Seok.

Kawasaki Central Research Laboratory/NEC
Mr Ushirokawa, Assistant Manager; Derek Dawkins, NEC.

Defence Centre Canberra
Clive King accompanied by Dan Buckley, CIEB and Stuart Storey, Sales Manager.

IMMS (Interactive Multi Media Services)
Chris Vonwiller, Director, C&C; Carmel Quartuccio, Executive Aide; David Brown, Manager, Business Strategy and Finance; Rosemary Senn, Manager, Finance; Mouli Gangulay, Applications Manager, Video on Demand; Robert Eames, Manager, C&G; Phil Sykes, Manager, Network Infrastructure; Mike Alsop, PA Consulting; Judy Slatyer, Applications Manager; accompanied by Telecom Enhanced Services: Greg Carvouni, National Manager, CIEB;, Peter Bakunowicz,

National Manager, Business Development; Geoff Lindner, Senior Development Manager, CIEB; Paul Heath, National Manager, CIEB.

Environment Protection Authority
David King, Manager, IT; Rob Allen, Technical Support; Jan Barton, Catchment & Marine Studies; Paul Cardenti, Operations; George Tsivoulides, Operations; Chris Connelly, Emergency Response/Hazardous Chemicals; Brian Hellyer, Air Quality Studies; Steve Piper, Enterprise Network; Don Thompson, Enterprise Network; Public Relations Information Staff Member accompanied by David Eades, Corporate Account Assistant.

Beijing Solar Engergy Research Institute
Professor Gong Bao, President, Beijing Academy of Science; Professor Jiang Xi Nian, Managing Director, Beijing Solar Energy Research Institute; Professor Zhao Yu Wen, Chief Engineer, Beijing Solar Energy Research Institute; James Yu, Superlink International.

Victoria University of Technology
Neil Shaw, Director of Computer Aided Learning; Mike Wingate, Senior Lecturer, Electrical/Electronic Engineering; Greg Martin, Senior Lecturer; Garry Hatton, Business Manager; Simon Kardash, Multi Media Consultant; Chris Trembearth, Program Consultant; Lecturers: Leon Reznik, Larrissa Al-Dabbagh, Dr Prem Dassanayake, Reza Berangi, Dr Hao Shi; PHD Students: Sheng Ping Yan, Chanaka Kannangara, Mahmood Zonoozi; Rushan Muttucumaru, Research Assistant; Research Students: Omar Ghanayem and Naser Hosseinzadeh; Technical Officer: Rusmir Ahmic and Adrian Stoica accompanied by David Ellis, Communications Consultant.

Leongatha Christian School
Peter Bakker, Careers Officer and Students.

Telecommunications Industrial Development Authority
Peter More

Monash University
Phillip Branch and Paul Richardson.

1Telecom Account Executives/Banking
Graeme Davidson, Manager, Business Development; Dominica Hobkirk, Business Development; Simon Beresford-Wylie; Jill Polley; Evelyn Moore; Dennis Nicholson; Grahame England; Gary Davey; David Simpson; Grant Riddoch and Sue Eason.

Commonwealth Bank of Australia (Two Days)
Mike Smith, Chief Manager, Information Services; David Kidd, Executive Manager, Information Services accompanied by Dennis Nicholson, Account Executive, Mark Richards and Brian Holland, Communication Consultants.

ABC – TV
Lloyd Capps, Director of Marketing accompanied by Barry Ihle, Communications Consultant.

September

RF State Coordinators
38 Participants.

Vermont Secondary College – Years 11 and 12 Students
24 Students and Teacher.

Telecom
Kosta Patsan, National Account Manager, C&I Sales, Hospitality, Accountants & Legal.

Box Forest Secondary College – Years 9 and 10 Students
15 Studenta and Teacher

IEE: Melbourne University & Ericsson Australia Pty Ltd
Dr Alan Rudge, President of the IEE; Dr John Williams, Member of the IEE; Don Hewitt, Senior Lecturer, Dept. of Electrical Engineering, Melbourne University; John Giddy, Ericsson Australia Pty Ltd.

CSIRO Division of Radio Physics
Dr Dennis Cooper, Chief; Dr John O'Sullivan, Deputy Chief; Denis Redfern, Marketing Manager; Dr Geoff Poulton, Program Manager; Dr Terence Percival, Seniot Project Leader; Glynn Rogers, Senior Project Leader; Alan Young, Program Leader accompanied by Warwick Broxam, Assistant General Manager and Tony Hobbs, Communications Consultant.

NRMA
Daniel Wilkie, General Manager, IT; Des Kennedy, Assistant General Manager, Communications accompanied by Graham Brown, National Account Executive and Mal Keeler, Communications Consultant.

Colonial
Gerrard Paver, Barry Wilson, Graeme Lyell, Lew Hall, David Dowling and Paul Sharman accompanied by Patrick Mann, Account Executive, Business Development and Andrew Cottrill, Communications Consultant.

Ansett
Ken Whitters, Manager, Technology Planning and Integration; Hal Pringle, Manager, Systems Enginnering; Allen Levy, Technology Planning Specialist; Graeme Cochran, Communications Consultant; Daryl Hergt, Client Support Manager; David Arkin, Team Leader, LAN Systems Support; Tim Brown, Manager, Information Services accompanied by Graham Brown, National Account Executive and Greg Williams, Communications Consultant.

Optical Waveguides Australia
A. Farelly, E. Musser, K. Hanna, K. Jatczak, G. Morgan, J. Wynne, D. Stainer, P. O'Neill, N. Davis, D. Stirling, K. McNamara, R. Kremser; P. Fielding and D. Doyle from the Engineering Group and Finance.

TRL's Organisation

TRL is headed by the Director of Research and comprises an Executive Group, the National Information Resource Centre and nine Branches. Details of the upper structure of TRL are given in the following table.

STAFF CONTACTS

POSITION TITLE	BRANCH CODE	CONTACT NAME	PHONE 25–	INTERNET ADDRESS
• General Managers:				
– Strategy & Business Planning	SBP	Roger Smith	3 6655	r.smith@trl.oz.au
– Transmission Networks & Standards	TNS	Rod Gray	3 6383	r.gray@trl.oz.au
– Telecommunication Science & Technology	TST	Geoff Mitchell	3 6671	g.mitchell@trl.oz.au
– Switched Networks	SN	Alan Gibbs	3 6354	a.gibbs@trl.oz.au
– Customer Services & Systems	CSS	Noel Teede	3 6676	n.teede@trl.oz.au
– Intellectual Property & Information	IPI	Owen Malone	3 6519	o.malone@trl.oz.au
– National Information Resource Centre	NIRC	Helen Rodd	3 6163	h.rodd@trl.oz.au
– Standards & Regulatory Strategy	SRS	Peter Darling	634 8799	
• Group Manager:				
– Network Design Co-ordination		Leith Campbell	3 6304	l.campbell@trl.oz.au
• Managers:				
– External Strategies	SBP	Geoff Willis	3 6533	g.willis@trl.oz.au
– Promotion & Communication	P&C	Allan Mitchell	3 6200	a.mitchell@trl.oz.au
– Plans & Programmes	SBP	Tony Stevens	3 6532	t.stevens@trl.oz.au
– Finance, Asset & Computing Services	FACS	Mike Chirgwin	3 6508	m.chirgwin@trl.oz.au
– Human Resources	HR	Simon Berry	3 6441	s.berry@trl.oz.au
– General Administration Staff		Erryn Ford	3 6611	e.ford@trl.oz.au

Telecom Technology Contacts

Business Unit	TRL Contact	Phone (03)	Internet Address	Telecom Contact	Phone
Commercial and Consumer	Geoff Mitchell	253 6671	g.mitchell@trl.oz.au		
Corporate, International & Enterprises					
Broadcasting	Ken Joyner	253 6315	k.joyner@trl.oz.au	John Hodgson	(03) 868 9010
Corporate & Government	Adrian McKenzie	253 6374	a.mckenzie@trl.oz.au	Max Boscotti	(02) 396 6955
International Business Unit	Geoff Mitchell	253 6671	g.mitchell@trl.oz.au	Don Nicol	(02) 287 3110
Mobile Communication Services	Rod Gray	253 6383	r.gray@trl.oz.au	Tony Bundrock	(03) 412 1805
Mobile Satellite & Radio Services	Rod Gray	253 6383	r.gray@trl.oz.au	Mick Quinlan	(02) 901 2010
National Directory Services	Chris Rowles	253 6244	c.rowles@trl.oz.au	Brian Smith	(03) 896 4420
Network Products					
Network Design & Construction	Geoff Willis	253 6533	g.willis@trl.oz.au		
Network Operations	Alan Murfett	253 6303	a.murphett@trl.oz.au		
Products and Planning					
– Narrowband	Rob Ayre	253 6182	r.ayre@trl.oz.au	Harvey Sabine	(03) 634 6200
– Broadband	Bernard Smith	253 6422	b.smith@trl.oz.au	Neville Parsons	(03) 634 6829
– Operational Support Services	Alan Murfett	253 6303	a.murphett@trl.oz.au	Greg Fidler	(03) 634 8755
– Intelligent Networks	Jim Vizard	253 6348	j.vizard@trl.oz.au	Mark Eldredge	(03) 634 6165
– Infrastructure Integrity	Geoff Mitchell	253 6671	g.mitchell@trl.oz.au	Harvey Sabine	(03) 634 6200
– Network Performance	Bob Warfield	253 6379	b.warfield@trl.oz.au	Luigi Sorbello	(07) 837 4366
– Service Access	Adrian McKenzie	253 6374	a.mckenzie@trl.oz.au	Peter Zeegers	(03) 634 0356
– Billing, Activation, Support	Chris Rowles	253 6241	c.rowles@trl.oz.au		
Non R&D	Rob Ayre	253 6182	r.ayre@trl.oz.au		
Business Support Services	Geoff Mitchell	253 6671	g.mitchell@trl.oz.au		
Information Technology Group	Chris Rowles	253 6244	c.rowles@trl.oz.au		
Strategic Development	Jim Vizard	253 6348	j.vizard@trl.oz.au	Chris Haigh	(03) 634 4521
Telstra Ventures	Robin Court	253 6294	r.court@trl.oz.au		
Additional activities					
Future OSS	Alan Murfett	253 6303	a.murphett@trl.oz.au	Jim Park	(03) 253 6500
Services Access	Adrian McKenzie	253 6374	a.mckenzie@trl.oz.au	Jim Park	(03) 253 6500
Broadband & Enterprise Network	Brian Kelly	253 6259	b.kelly@trl.oz.au	Jim Park	(03) 253 6500
Photonic Networks	Rob Ayre	253 6182	r.ayre@trl.oz.au	Jim Park	(03) 253 6500
Broadband to the Home	Bernard Smith	253 6422	b.smith@trl.oz.au	Jim Park	(03) 253 6500
3rd Generation Personal Services	Jim Vizard	253 6348	j.vizard@trl.oz.au	Jim Park	(03) 253 6500
Quality of Service	Bob Warfield	253 6379	b.warfield@trl.oz.au	Jim Park	(03) 253 6500
Market Modelling	Paul Kirton	253 6165	p.kirton@trl.oz.au	Jim Park	(03) 253 6500
Corporate Policies	Geoff Willis	253 6533	g.willis@trl.oz.au	Jim Park	(03) 253 6500

TRL BUSINESS PLAN

TRL is managed to a rolling 5-year Business Plan, which is corporately reviewed and approved annually. The Business Plan encompasses agreed 'deliverables' and the resources needed to achieve them. The deliverables include:

- the conduct of the TRL's R&D Programme, comprising a range of investigatory projects performed for and nationally funded by a variety of Telecom Client Divisions, with their endorsement;
- the operation of Corporate Facilities for the whole of Telecom, including the provision of specialised services relating to:
  - library information and translation services,
  - intellectual property consultancy services,
  - academic programme.

The preceding table gives details of TRL activities and appropriate staff contacts.

IN CONFIDENCE

ADDRESS LIST UPDATE

- Are you receiving TRL's RESEARCH QUARTERLY (RQ)? If NO, please tick the "Addition" box and fill out the address form below.
- If you do receive RQ and your present address etc is incorrect, please tick the "Correction" box and fill in your correct address.
- If you wish to nominate others who would benefit by receiving RQ please tick the "Addition" box and fill out the address.
- If you receive RQ now and would like to discontinue receiving it please tick the "Deletion" box and fill out the address form and return it to us.

Thank you for your co-operation.

Addition	Correction	Deletion
☐	☐	☐

Name (in Capitals)_____

Position_____

Department_____

Address_____

_____

Reference No. on Address Label_____

Please return to:

The Information Officer
Promotion and Communication Section
Telecom Research Laboratories (TRL)
P.O. Box 249
Rosebank MDC
Clayton Victoria 3168

Telephone (03) 253 6700
Facsimile (03) 253 6321