



University of  
South Australia

# Institute for Telecommunications Research

Connected. Reliable. Real Solutions.

## 25 year anniversary

Experience. The Difference.



“My time at ITR was the perfect kick start for turning a research idea into a real company. Now I have been part of creating a company with a world-class product backed by world-class research.”

**Dr Paul Alexander**, Co-founder and Chief Technology Officer, Cohda Wireless

“I am grateful that I was given the opportunity to attend workshops and conferences, not only in Australia but overseas.”

**Dr Monica Navarro**, Senior Research Fellow, University of Catalunya, Spain

“The most important advantage for me about studying at ITR was the enthusiasm, encouragement and support provided by supervising staff.”

**Dr Peter Shoubridge**, Research Leader, Defence Science Technology Organisation

“I am glad that I am a part of this ITR family to feel the extreme kindness, helpfulness and most of all the perfect guidance.”

**Ms Chinthani Uduwerelle**, PhD Student

“I was attracted to ITR by the popularity and friendly environment. I enjoy the ITR team like being a family member, everyone here is very helpful and very cooperative.”

**Mr Muhammad Khan**, PhD Student

“On completing my post-graduate studies, I was searching for a job that allowed working and interacting with world-class researchers whilst offering a great work-life balance. Personally, ITR was just the right place to be.”

**Dr Badri Vellambi**, Research Fellow

“The research environment at ITR is competent, inspiring and lively. This is unique.”

**Dr Gottfried Lechner**, Research Fellow

“What I like about ITR includes its international focus, a relaxed, social and flexible environment, and the feeling of being part of world class research excellence.”

**Dr Mark McDonnell**, Senior Research Fellow



# Welcome to 25 years of the Institute for Telecommunications Research

Formally recognised as a University research Institute in 1994, the Institute for Telecommunications Research (ITR) builds on antecedent organisations going back over 25 years. From humble beginnings, housed in temporary huts hidden behind the Charles Todd building, to a nationally and internationally recognised Institute with world-class researchers and facilities, the journey has been remarkable. Today, with over 60 dedicated research staff and students, ITR is Australia's largest University research Institute specialising in the areas of wireless and satellite telecommunications technology.

Since its foundation, the Institute has had a long and proud history of working with local and international industrial, defence and government partners to deliver commercial-grade hardware and software solutions for challenging communications problems. Building strongly on this heritage of applied research and development, the Institute has also emerged as a theoretical powerhouse. Our research staff and postgraduate students not only work with their international collaborators to tackle the fundamental mathematical aspects of modern telecommunications, they also work together with our highly skilled engineering team to deliver new communications technologies that are only made possible by breakthrough science. This is a unique characteristic of the Institute – strong connections between theory, application and commercialisation.

Our 25th anniversary is a wonderful opportunity to reflect on the successes of our Institute, and to celebrate all of the staff and students that have made it such a special research environment. Looking forward, the future is exciting! From remote sensing using satellites for climate change and earth resource monitoring through to gigabit indoor wireless communications and saving lives through vehicle-to-vehicle communications, our ultimate focus is to make the world a better place through novel use of information.

A handwritten signature in black ink, appearing to read "Alex Grant".

Professor Alex Grant – ITR Director, 2007-present

# A 25 year timeline





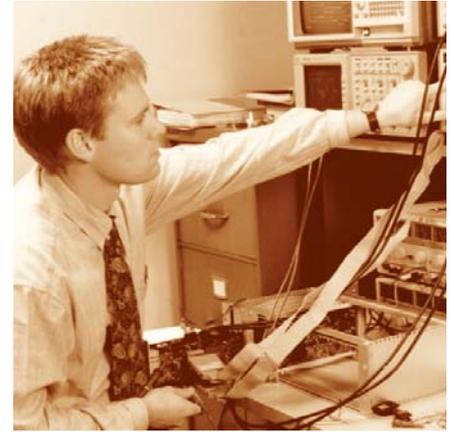
1985

### **Formation of Digital Communications Group**

The Digital Communications Group (DCG) is established by virtue of Professor Mike Miller starting to hire staff to work on sponsored research projects. Initially it was Ian Morrison, soon to be followed by Bill Cowley. Before long, the list of staff and students outgrew the initial room, and transportable "ATCO" huts accommodated the group until 1992, when the "SPRI Building" was completed and this has housed the group until now.

### **Defence Science and Technology Organisation (DSTO) – Interleaver Study and Implementation**

Initial project to investigate and implement interleaver structures. This was to be the first of more than 20 projects, ranging from simple advice and consulting, through to simulation, analysis and proof of concept developments involving terrestrial, helicopter, optical and satellite communications as well as speech processing.



1986

### **Signal Processing for Digital Transmission Modulation and Coding Course**

Lead presenters are Dr Gottfried Ungerboeck (IBM Fellow Zurich), Dr Michael Miller and Dr Bill Cowley. The course looks at new techniques for the design of digital communications equipment which utilise methods of combining modulation and coding techniques referred to as 'Ungerboeck Schemes'.

### **First Master's research degree awarded**

Ian S. Morrison, "Burst Error Control," Masters Thesis, *Uni. of South Australia*, June. 1986.

1987

### **OTC-IBS for Intelsat**

2Mbit/s satellite modem project development commences for Australian Overseas Telecommunications Commission.



1988

### Mobile satellite modems for Aussat (later OPTUS)

Significant role in the specification, development, demonstration and technology transfer of the baseband components of Australia's mobilesat™ mobile satellite phone service. This later included involvement with NEC for second generation product development.

### BAeA modem development

The TDMA satellite modem capable of operating a 2Mbit/s is developed to form part of the M-SAT network developed by British Aerospace Australia.

### Minimum shift keyed modem for MOS-1

A satellite receiving system is designed, constructed and installed for CSIRO Office of Space Science & Applications (COSSA) at the Australian Centre for Remote Sensing, Alice Springs. The modem is capable of receiving 8 Mbit/s minimum shift keyed (MSK) signals from the Japanese MOS-1 satellite. The satellite carries remote sensors capable of providing detailed images of four remote sensing purposes.

1989

### OTC-IDR for Intelsat

45 Mbit/s satellite modem project development following successful outcomes from the IBS project.

### Generic Industry Research and Development Grant

In association with other University and industry partners, study various aspects of satellite and terrestrial systems, including potential interoperability issues.

### IEAust Fellowship

Professor Mike Miller is elected Fellow of IEAust.



1990

### Inmarsat First Project – P21 Study

The first of many projects with Inmarsat (UK). The initial project was called P21 (later ICO). It involved the analysis, simulation and proof of concept development hardware for an Inmarsat proposed Medium Earth Orbit satellite system.

### Satellite Communications Research Centre

A national centre for commercially targeted research and product development in satellite communications and space related signal processing. One of the Australian Government Space Industry Development Centres.

### Mobile Communications Research Centre

MCRC addresses next generation personal mobile communications needs through its research in communications systems, networks and standards. Funding is provided from Telecom Research Labs that would last 9 years.

### First PhD degree awarded

Liren Zhang, "Recovery of Cell Loss in ATM Networks," PhD. Dissertation, *Uni. Of South Australia*, Nov. 1990.



1991

**Australian Space Centre for Signal Processing**

Virtual centre within the Digital Communications Group undertakes strategic research and development of space related subsystems in the area of satellite communications and telemetry.

**Intelsat high-speed satellite codec**

A major program for developing a codec that uses advanced coding techniques to allow transmission of 155 Mbit/s through satellite transponders with bandwidth of only 72MHz. Subsequently the codec technology was commercialised by EF Data (US).

**Remote sensing demodulators for ACRES**

First generation Earth Resource Satellite Demodulators is developed for Australian Centre for Remote Sensing.

1992

**Signal Processing Research Institute building officially opened**

The institute is officially opened by the then South Australia Premier Mr John Bannon.

**High Speed Coding Feasibility Study**

An initial design of application specific intergrated circuit for 45Mbits high speed error correction coding

**Digital microwave modems for MITEC**

Digital microwave modem product development.

1993

**Defence Communications Research Centre**

A centre for excellence in the defence communications field. The DCRC addresses opportunities to commercialise intellectual property with a view to maximising the benefits to Australia. Sponsorship from the Defence Science and Technology Organisation Communications Division.

**Microwave modem (DRFL 700) developed for JNS Electronics**

Multiphase project that developed an advanced modulation microwave product with a pathway to higher bandwidth efficiency.



1994

**Telecommunications Systems Engineering Centre**

Focussed on telecommunications information networks and the techniques and methods for the engineering of concurrent systems. Computer aided tools are developed to support its research into complex industrial systems for the telecommunications and defence industries.

**Awarded research Institute status at UniSA**

UniSA recognises the work of Professor Mike Miller and the Digital Communications Group by giving the group a Research Institute status – only one of two awarded. The group is now the Institute for Telecommunications Research.

1995

**Inmarsat – Initial studies with higher order modulation and Turbo Coding**

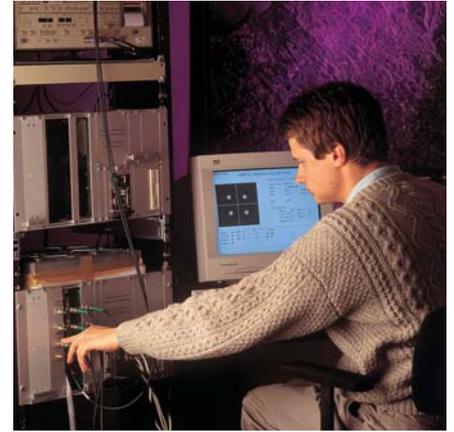
ITR's first major development using turbo codes commences with Inmarsat.

**Dual mode handset feasibility project**

Sponsored by Ericsson, investigate the implementation and performance tradeoffs with a dual mode GSM and CDMA satellite phone.

**NEC Australia**

Modem development subsystem design and developments for terrestrial backhaul and mobile satellite products.



1996

**Inmarsat – Turbo Project Implementation**

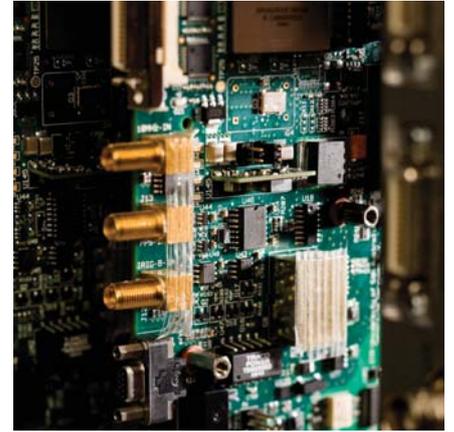
Development of first demonstrator of higher order modulation with turbo codes commences.

**Sequential Decoder Project**

Implementation of 2Mbits sequential decoder for digital satellite receiver.

**DSTO Self Organising Networks**

Investigation of adaptive self-organising and control techniques for radio networks.



1997

### **Cooperative Research Centre for Satellite Systems**

The Cooperative Research Centre for Satellite Systems is created to assist Australian industry to take advantage of opportunities arising from new generations of small satellite systems. The Cooperative Research Centre for Satellite Systems is a collaboration involving core partners, CSIRO, Queensland University of Technology, University of Technology, Sydney, Auspace Ltd, Vipac Engineers and Scientists, DSpace and University of Newcastle.

### **Wireless radio loop development**

Joint development between ITR and PT INTI, Indonesia, in the development of a new wireless local loop system.

1998

### **Nortel Networks**

Work commences on research into signal processing and coding issues relating to future 3G.

### **Ericsson Interference Study**

Work undertaken to investigation interference mitigation and base station sensitivity improvements.

1999

### **Inmarsat service designs**

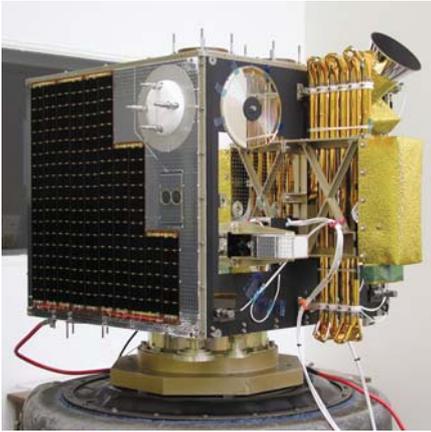
Various projects undertaken to study, simulate and recommend various air interface specifications for various low rate data services.

### **Universal Mobility in Asia and The Pacific Program**

Student exchange grant offering placements to Institut Teknologi Bandung, Indonesia.

### **Radio Basestation Design**

Investigation of structures and signal processing to maximise throughput for point to multipoint services.



2000

### **Founding Director retires**

Founding Director retires, Professor Bill Cowley is appointed Director.

### **m.Net Corporation formed**

Initial aim to demonstrate and research third generation phone systems.

### **CRCSS Comms Payload**

Major design and development effort resulting in an advanced data and messaging payload that would eventually be flown on FedSat, as well as the Korean satellite, KAISTSAT-4.

### **Defence Theatre Broadcast System**

ITR plays a prime role to Defence Material Organisation (DMO) to take satellite technology developed by the Defence Science and Technology Organisation under a concept and technology development project, and manage a program of work to consolidate the outcomes so that DMO is able to put out to tender to enable terminals and services to be provided to defence services.

2001

### **Intelsat Modelling**

Provision of comprehensive suite of models and libraries for Intelsat to use in modelling and simulating their satellite link and network performance.

### **Radio Resource Management**

Detailed modelling and verification of resource management algorithms for optimal communications resource usage.



2002

### **FedSat launch**

On the 14 December 2002, the first Australian research satellite for over 30 years is launched from Tanegashima Space Centre, Japan. ITR plays a significant role in the development of a communications payload that fly on FedSat. ITR's ground station, developed during the Cooperative Research Centre program, is exclusively used to monitor and control the satellite during its approximately four year lifetime.

FedSat is a small breed of satellite, establishing a new generation of compact satellites for future telecommunications use and research. It carries out a range of vital experiments set to bring long term benefits to Australian industry and researchers.

### **ERSDEM 2**

Second generation earth resource satellite demodulator development – all digital, flexible architecture.



## 2003

### **Low rate Earth Resource Demodulator**

Design, prototyping and product development of low rate (up to 25 Msym/s) earth resource satellite demodulator for Australian company Environmental Systems and Services.

### **ARC Discovery Project success**

ITR is awarded its first Discovery Project for research into high data rate wireless networks. ITR has since been successful in every round of ARC Discovery.

### **SPOT satellite data reception**

Since 2003, ITR has received data daily from the SPOT 2, 4 and 5 satellites for Raytheon Australia, and from 2006, for SPOT Imaging Services with its 6.8m steerable X-band receive facility.

### **Electronics Industry Association Gold Cup winner**

ITR wins Gold Cup Excellence Award for taking its turbo coding technology from theoretical concept to global commercialisation.

### **Spin-off company:**

#### **Cohda Wireless**

Cohda Wireless is set up to take advantage of robust communication protocols developed by ITR, applying and developing them for reliable vehicular communications.

### **Spin-off company:**

#### **Iterative Connections**

Iterative Connections is set up to develop and market a superior performance codec for high end moderns.



## 2004

### **ETRI: Iterative turbo coded techniques**

One of several projects undertaken with ETRI (Korea) developing collaborative research outcomes and demonstrators

### **Inmarsat Multi-user detection**

Studies into multi-user detection result in patents for Inmarsat.

### **International Space University Summer Program**

ITR provides significant resource into the success of the International Space University Summer Program.

### **Professor Alex Grant is awarded the Tall Poppy Science Award**

At 33 years of age, UniSA's youngest Professor wins a Tall Poppy Science Award for his contribution to information theory where he has been using mathematical theories to explore and extend communications systems such as wireless data networks, broadband, systems and new mobile telephone networks.

### **Professor Andrew Parfitt appointed Director**



## 2005

### **Australian Research Council Communications Research Network**

ITR is the host and coordinating institution for a five-year funded, national research network in communications, tasked with facilitating interaction between researchers in academia and industry, nationally and internationally. This includes workshops, seminars, visiting specialists and other networking activities to create opportunities for increased collaborations in the ICT area.

### **Onboard processor design project**

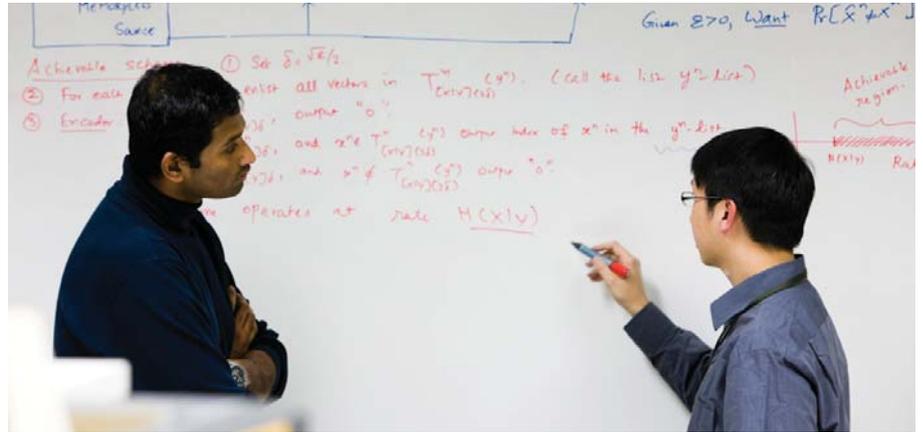
Conceptual designs of onboard processing options for future satellite missions

### **Military Adhoc Networks**

Studies into the tradeoffs in performance for various adhoc network scenarios.

### **VSAT modem-codec development**

Development of a VSAT modem product incorporating advanced coding performance for US-based client.



## 2006

### **Fundamental limits of wireless communications**

Dr Alex Grant is awarded a National ICT Australia Fellowship to conduct research into the mathematical foundations of wireless communications.

### **60 GHz Indoor Wireless**

ITR is key partner in ARC Linkage program to provide baseband processing expertise in the design and implementation of structures to support Gbit/s data rates for indoor wireless applications.

### **ERSDEM 3**

Third generation earth resource satellite demodulator development commences – multi-channel, 1 Gbit/s capability.

### **Free space optical**

Research work commences in this new area for ITR, using coding techniques not previously used in this application to provide more robust communications. Investigations include intra-satellite, inter-satellite, satellite to ground and ground to ground communications, as well as hybrid optical and radio frequency (RF) schemes.

### **Satellite multiuser**

Studies into benefits of using multiuser techniques in various satellite application areas.

## 2007

### **Professor Alex Grant appointed Director**

Professor Parfitt takes up position within UniSA as Divisional Pro-Vice Chancellor to the Division of Information Technology, Engineering and the Environment.

### **Intersatellite Links**

Investigation of connection times, data transfer capability and performance of various satellite topologies, including the use of low earth orbit satellites with the possibility of data transfer to geostationary satellites.

### **Integration of terrestrial and satellite networks**

Sponsored by ETRI, this study investigated the integration issues relating to terrestrial WiBro and networks with satellite fill-in service.



2008

**South Australian Networking Laboratory – SANLab**

ITR, together with University of Adelaide and partners Tenix, ASC and Cisco, receives funding through the state Premier Science and Research Fund to develop expertise in the area of mobile ad-hoc networks, incorporating software defined radio.

**French Space Agency – ATV tracking**

ITR is part of a small international network of ground stations tracking the European Space Agency Automated Transfer vehicle. This is a new generation of space craft, initially intended to resupply the International Space Station. Future launch tracking is anticipated.

**Network coding**

ITR receives its first ever five-year Australian Research Council Discovery Project for basic research into network coding.

**Engineers Australia IREE Neville Thiele Award**

Professor Alex Grant receives the highest award from the ITEE College of Engineers Australia.

2009

**5.9GHz Intelligent transport systems interoperability study**

Simulation and measurement studies to predict likely interference affects of 5.9 GHz Dedicated Short Range Communications (DSRC) communications on existing satellite station facilities and vice versa. The study is used to inform the Australian Communications and Media Authority on considerations for spectrum allocation.

**Multuser satellite demonstration**

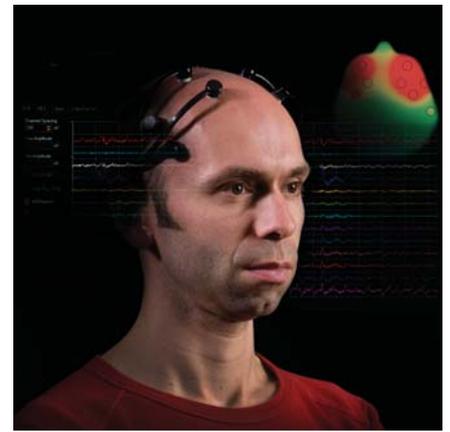
Demonstration of benefits of multuser technology for various satellite applications.

**Free space optical for military application**

Design, implementation and demonstration of how coding enhances free space optical links.

**3G wireless trials**

Measurement trials to identify the performance of service provider's 3G networks in various locations, and both fixed and mobile environments.



2010

**ARC Fellowships**

Dr Mark McDonnell and Dr Siu-Wai Ho are both awarded prestigious fellowships from the Australian Research Council.

**Computational and theoretical neuroscience**

Dr Mark McDonnell expands ITR's research areas towards understanding the processing and use of information in the brain.

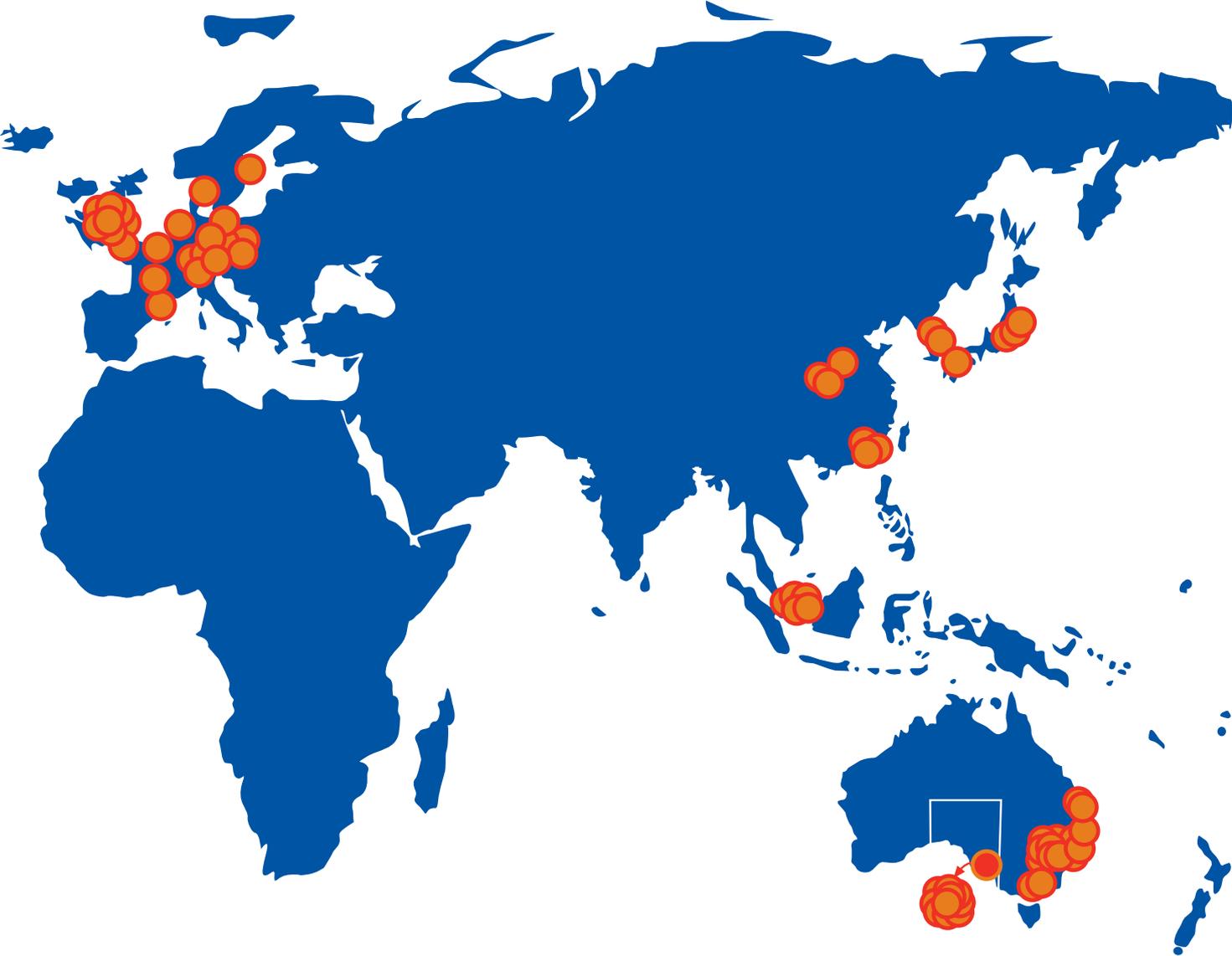
**High Speed Wireless link implementation**

Implementation of baseband radio functions as part of project to demonstrate very high speed terrestrial wireless links.

**Gigabit satellite demodulator completed**

Final verification and first production run of multi-channel, very high rate satellite demodulator for Satellite Services BV (Netherlands).

# ITR international collaborations





## 25 Year Fast Facts

### **Students Graduated**

108  
(PhD 68, Masters 40)

### **Employees**

152

### **Publications**

934

### **Revenue**

\$87.5 million



## Directors' Statements

**Emeritus Professor Mike Miller AO,  
Founding Director to 2000**

When in 1985 a small group of colleagues decided to commence collaboration in digital communications research, could we have conceived that today we would be celebrating 25 years of achievement? Thanks to our many corporate and other sponsors, and the strong support of UniSA, the research team has grown to be among Australia's leaders in research into satellite systems, mobile communications and digital networks.

In forming in 1985 what would become known as the Institute for Telecommunications Research, I was delighted to be joined by other co-founders Ian Morrison and Bill Cowley, and afterwards by others such as Jeff Kasparian, Ted Bullen and Alan Mitchie.

The 1980s represented a time when telecommunications networks were going through a massive transformation from traditional analogue to new digital strategies for representing and transmitting information. Our research team was excited at the prospect of being able to assist this transformation by contributing our knowledge of new mathematical coding theory for error control and innovative digital signal processing for implementing transmitter and receiver hardware.

Our initial projects were focused on new satellite communications subsystems for client users. The first involved Ian Morrison, who left the Defence Science and Technology Organisation to join the team, to lead the design of a coder/interleaver for defence to improve the reliability of ship-to-shore data propagation which suffered from scintillation effects at sunrise and sunset.

Then in late 1985, we received our first major 'breakthrough' project funding from the Overseas Telecommunications Commission, Australia's satellite operator at the time, to develop, under Professor Bill Cowley's leadership, a high-speed digital modem for use in what was to become known as an intermediate data rate satellite service.

In the first years, we were particularly advantaged by having several world 'stars' in the digital communications field visit from overseas to share with us newly emerging theoretical concepts. These included Professor Shu Lin, a leading coding theorist from the University of Hawaii – he had been my PhD supervisor three years earlier. We also benefited from visits from Professor Jim Omura of UCLA, an expert in encryption techniques, and by Professor Mischa Schwartz of Columbia University, a leading figure in

digital network protocols. Undoubtedly, the greatest impact came from Dr Gottfried Ungerboeck, an IBM Visiting Scholar and the founder of trellis coding modulation, who visited for several weeks in 1986.

We had become known as the Digital Communications Group and by the end of the 1980s we were growing fast – too fast in fact for UniSA to be able to find building space to accommodate us. Undaunted, we hired transportable cabins which were set up, higgledy-piggledy, alongside the Sir Charles Todd Electrical Engineering Building. We went from a focus on satellite communications research to research into newly emerging cellular mobile telephone networks for Telstra, and subsequently in support of the Defence Science and Technology Organisation, we branched into defence communications.

In 1990 the group became partitioned to include a Satellite Communications Research Centre and a Mobile Communications Research Centre, and later in 1993, a Defence Communications Research Centre.

By this stage, we numbered over 30 academic staff, research leaders, research engineers, postgraduate students and support staff.

What a relief it was when UniSA was persuaded with the help of the Technology Park Organisation to build us a special-purpose research building. It was opened in 1992 as the Signal Processing Research Institute. Concurrently, UniSA decided to designate us as one of its first two research institutes and we became known as the Institute for Telecommunications Research.

The rest, as they say, is history!

After 25 years, it is good to take time out to reflect and celebrate. May the Institute continue to flourish productively over the next 25 years.



## Professor William Cowley, Director 2001 - 2004

Coincidentally with Mike Miller's retirement in 2000, the telecommunications sector saw the dot-com bubble of the last decade burst and a downturn in the satellite industry. Fortunately our Institute had a major role in the Cooperative Research Centre for Satellite Systems (CRCSS) and was busy with the design of FedSat's ground station and communications payload. The satellite was launched in December 2002 from Tanegashima Space Centre in southern Japan. This had been a challenging time as the financial collapse of the UK company responsible for key systems components required major restructuring of the CRCSS budget in order to complete the mission in Australia.

After launch, ITR's ground station was used for telemetry tracking and control. Our reconfigurable communications payload, a burst demodulator and turbo decoder worked well and were highly innovative for that time.

The early part of this decade also saw numerous projects, including a 2 Mbit/s turbo codec that provided at least 3 dB performance improvement over their current standard. Iterative decoding expertise in ITR had grown rapidly from the late 1990s with important contributions to both efficient real-time architectures and algorithms suitable for

gate-array implementation, plus theoretical extensions to the iterative paradigm that allowed iterative receiver applications such as equalisation and interference mitigation. Assoc Professor Adrian Barbuлесcu and Professor Alex Grant, were responsible for our Institute becoming one of the world's leading groups in this area. One indication of the success was the award of the Electronics Industry Association Gold Cup in 2003. A related initiative during this period was the birth of two ITR spin-off companies – Iterative Connections and Cohda Wireless.

In his new role of Business Manger, Jeff Kasparian had a key part in a number of these projects. While some of our traditional clients of the previous decade declined, partly as a result of the privatisation of Intelsat and Inmarsat, this period also saw a growth in our Australian Research Council funding due to a strengthening of fundamental research skills, particularly in the information theory and communications signal processing areas led by Professor Alex Grant and Professor Lars Rasmussen. Research ties with European groups were strengthened during this period. This included stronger links with the International Space University, culminating in the highly successful Space Studies Program held in Adelaide in 2004.



## Professor Andrew Parfitt, Director 2004-2007

When Bill Cowley stepped back to his research role in mid 2004, I took over as Director while retaining the position as CEO of the Cooperative Research Centre for Satellite Systems (CRCSS). ITR was well placed in a number of areas with a strong reputation in the satellite communications sector and a growing academic research profile in more fundamental areas underpinning future wireless communications.

Significant funding was being won from the Australian Research Council (ARC), and ITR also stepped up to the plate to host one of the newly funded ARC research networks – the Australian Communications Research Network (ACoRN). ITR had well-established industry links and was deriving income both from licensing of intellectual property for satellite demodulator systems and turbo codes, as well as from contracts with IT companies such as Cisco Systems.

As UniSA's research began to grow significantly, there was an increasing emphasis on research quality – at a time when the Australian government also wanted to take

stock of its research and introduced what was then known as the Research Quality Framework (RQF). The RQF emphasised both academic quality and the wider impact of research on end users using metrics that recognised ITR's heritage. With a change of government and the introduction of a research metrics based Excellence in Research Australia, the work published by groups at ITR led by Professor Alex Grant and Professor Lars Rasmussen came to the fore, and ITR went through a significant phase of balancing its industry focused work with more traditional research activities.

In its profile ITR also maintained a significant communications networking activity, but the emphasis moved to focus on areas in which both commercial advantage and academic distinction could be maintained – information theory, coding, new satellite networks and innovations in wireless communications.

During this period the CRCSS wound up and the various ground station activities found other applications. FedSat ceased to operate in 2006 after exceeding all expectations.



## Professor Alex Grant, Current Director since 2007

Sometimes in life, the smallest events can have long lasting consequences.

“Could we have a chat about your future sometime?”

This comment, written by Mike Miller on the front cover of my 1992 final examination in Communications System Theory, was my introduction to the Institute for Telecommunications Research.

Little did I know at the time, this personal interest taken by Mike (very characteristic!) was to put me on a path that eventually led me to take over as Director some fifteen years later.

I feel incredibly fortunate to have studied for my PhD at ITR during a time when the Institute was really establishing itself on the international stage. International star recruits like Christian Schlegel, Phil Whiting and Lars Rasmussen had long lasting impact, not just for me personally, but on the Institute more broadly. At that time, the telecommunications world was completely turned on its head with the invention of turbo codes. This opened a vast array of research opportunities for code design. It also completely redefined the significance of information theory, as a practical engineering tool. Against this

backdrop, and supported by a generous travel fund won by Lars, many of the Mobile Communications Research Centre students spent significant fractions of our PhD study in overseas research labs.

This experience set me on a trajectory to explore the mathematical foundations of telecommunications. Returning after a postdoctoral year with Jim Massey at ETH Zurich, Mike encouraged me to take leadership of the Information Theory group (again, a seemingly small, but incredibly influential act).

Fast-forwarding to 2010, I am very proud of ITR as an Institute that leverages the highest quality fundamental research to deliver high impact technological outcomes. ITR continues to gain over 75% of its income from external sources, with a strong emphasis on the delivery of commercial-grade solutions. This focusses the mind intensely on research that delivers benefit. One might expect such an external commercial focus to shorten the research horizon and to dilute quality. However the opposite is true. ITR now earns significant income from National Competitive grants, and over 80% of our papers are published in A\* and A ranked journals (highest ranked by the ARC), and are cited

well above world and national averages. This is our key differentiator and our competitive advantage - the capacity to deliver unique real world benefits that both leverage and inform basic scientific outcomes. Visitors to ITR are continually surprised at this combination, and it is something to be celebrated.

Today, the Institute is at a very exciting time of its development. At the time of writing, ITR is bursting with its largest number of research fellows in its history. With over two-thirds of our research staff recruited internationally, the Institute is more widely connected than ever before. I am really looking forward to seeing where the energy and enthusiasm of our young research stars will be taking us in the future.

# Reflections



**Mr Neil Bryans**  
**Current Board Chair**

The Institute has managed to retain its position as a leader in telecommunications research within its area of Satellite Communications, High Speed Data Communications, Flexible Networks and Computational and Theoretical Neuroscience. In particular, due to the leadership of the senior staff and the strategic appointment of senior and younger researchers. ITR's research achievement is at an all time high for the national competitive grants, international and national company projects.

I look forward to continued growth of the Institute.

**Mr Michael Davis**  
**Past Board Chairman**

I witnessed the evolution of ITR from its predecessor centres and watched it grow and establish its reputation and achieve great things. As Chair of the Advisory Board I had a strong working relationship with the four Directors and I enjoyed working with the numerous board members who each made a positive contribution to the work of ITR.

I wish ITR well in the next 25 years.

## **Dr Ian Morrison**

### **Senior Research Engineer, 1985-1995**

It was 1985 when I got a call from Mike Miller asking if I'd be interested in working with him. He'd won some funding from Overseas Telecommunications Commission (OTC) to develop an all-digital satellite modem for the Intelsat IBS standard. I didn't know what IBS was, but the 'all-digital modem' part got my attention. I'd been in close contact with Mike since finishing my Bachelor of Engineering in 1982. At the start of 1983 I worked for the Defence Science and Technology Organisation's (DSTO) satellite communications group but when the call came from Mike it was an easy decision to leave behind the structured career-path of the public service in favour of the total unknown that was soon to be called the Digital Communications Group (DCG). Soon after I arrived, Bill Cowley, John Asenstorfer, Bruce Vyden, Rod Staker and others came on the scene, and substance really started gaining momentum.

I recall our first technical meeting with Codan who were a commercial partner on the IBS modem project. Their top modem expert couldn't see how our digital design could possibly work – which did concern us a little.

But history records show that our modem did in fact work, and quite well at that. We had some very useful help from the great Gottfried Ungerboeck who visited DCG around that time, but mostly our success was down to a great team effort. I believe that was the first all-digital high-speed modem developed in Australia (if you call 128 kbit/s high-speed).

Some outstanding new engineers and students joined the group from 1987, including Richard Wyrwas, Mark Rice, Paul

Gray, Steve Pietrobon, Gerald Bolding, Ted Bullen and Jeff Kasparian.

With Mike's help we bid and won a prestigious contract with Intelsat Labs in Washington DC to develop the world's first codec to carry a full 155 Mbit/s stream over a single satellite transponder. Team 155 broke new ground in various ways, including a state-of-the-art multi-dimensional trellis codec and a self-synchronising Reed-Solomon codec. That design went on to become a de-facto international standard and production codecs were manufactured by EF Data in the US. There were a lot of other fantastic projects and people at DCG in those early years, but to this day, that project stands as the high point of my professional career – a great bunch of guys at the top of our game and achieving an outstanding engineering solution for an international customer. Maybe it was our matching Team 155 t-shirts.

One of the defining features of life at DCG and later the ITR was the incredible freedom Mike gave us to explore novel ideas and solutions. There were so many amazing people and it was such a vibrant environment in which to work. Mike also didn't seem to mind our habit of re-charging our mental batteries with lunchtime card games (500 naturally). Some days our lunch break was a little 'extended' shall we say. I recall Mike walking in on one classic encounter that was still going at 4:30pm. He asked his question and headed off without batting an eyelid. I like to think it was because he thought we were achieving 'great things as a group' and he was totally comfortable that we'd make up for the lost time with our general brilliance. But in hindsight he was probably just too stunned to say anything.

Here's to the next 25 years!



**Mr Gary Moran**  
**Defence Theatre Broadcast System**

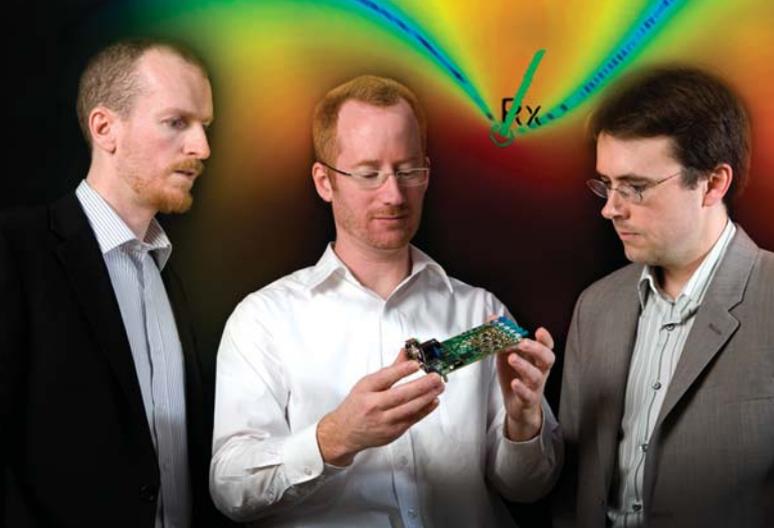
For operational reasons the Theatre Broadcast System JP2008 Phase 3C Program Office, working closely with DSTO, had to source key satellite communications skill-sets that had a good grasp on the technologies utilised within the Theatre Broadcast System architecture. Because we were transitioning the capability from DSTO into the Defence Materiel Organisation's Project Office we also needed people who understood the cultures of the two organisations. As ITR had a broad range of those skills plus the added bonus that many had worked within DSTO it was an obvious marriage.

The ITR team who worked on the Theatre Broadcast System were outstanding as they demonstrated professionalism, commitment and, most importantly, flexibility, as the project needs grew. From a contractual basis they not only met but exceeded the requirements under the contract and much of this can be attributed to the good work of Jeff Kasparian in managing this contract.

**Dr Mark McDonnell**  
**Australian ARC Research Fellow**

I joined ITR in 2007 after being awarded an Australian Research Council (ARC) Australian Postdoctoral Fellowship in the Discovery Projects scheme. The project was entitled "A lossy compression paradigm for sensory neural coding" and had the aim of increasing our understanding of how biological senses compress information in their transduction mechanisms. This three year fellowship finished in June 2010. One of the main research thrusts was to use ideas and methods from information theory, which is why ITR was an ideal environment.

In 2009 I successfully applied for a five-year ARC Australian Research Fellowship in the Discovery Projects scheme. The project title is "Communication and information storage mechanisms in complex dynamical brain networks". It involves theoretical research into the biophysical mechanisms that allow communication between neurons and networks of neurons within the brain. The project can be described as 'reverse-engineering' the brain, using mathematical modelling and numerical simulations based on biologically-faithful models.



**Mr Peter Harriss**  
**Cohda Wireless**

Cohda Wireless was founded on intellectual property emanating from ITR. In our early years it provided tremendous credibility to our story to maintain an active association with a world-class research institution like ITR.

As our intellectual property portfolio grew and the company established a prominent foundation in an emerging market, we have maintained this close relationship. Recently this has resulted in a highly productive Australian Research Council linkage grant, further solidifying our position as a technology leader in our market space.

Cohda Wireless is now a global market leader in vehicular broadband communications. The strength of our ongoing relationship with ITR is an important part in maintaining this leadership, through effective research and development capability.

**Dr Les Sabel**  
**former Senior Research Fellow,**  
**Scomm Technologies**

I was attracted to Professor Mike Miller's Digital Communications Group in the mid 1980s due to the outstanding research work that was being undertaken by an internationally recognised and rapidly growing team. That team was the start of ITR. I spent several years from the mid 1980s through to 1997 in various roles starting as part-time Masters student, then becoming ITR's first PhD student and ending as a Senior Research Fellow responsible for major industry research contracts with Vodafone and Ericsson. I also supervised several PhD students. During this time I met many very talented researchers both at ITR and internationally. This was a very exciting and stimulating time, one which I remember with great affection and one where I made many friends. The knowledge obtained during that time was also the basis that allowed me to work for a range of companies in the UK and USA undertaking research and development in 3G mobile communications, wireless broadband and digital broadcasting technologies. It was the springboard that allowed me to travel the world for both business and pleasure and eventually return to Australia as a self employed consultant. Working in communications technology – great. Working at ITR – priceless!



**Dr Weimin Zhang**  
**former PhD Student, Defence Science**  
**and Technology Organisation**

I joined the Digital Communications Group (DCG) from Jinan, China, in October 1985 through Mike Miller who was also a guest professor of Shandong University. His China link was established via Mr Wu Kaizhen of Shandong University who was a visiting scholar at the Hawaii University under Professor Shu Lin where Mike Miller was a PhD student.

Apart from Mike Miller, the group consisted of Bill Cowley, Ian Morrison, John Asenstorfer and Rod Staker. Alan Michie from OTC Sydney was also temporarily working for the DCG. Soon we were enhanced by three undergraduate students of that year, Stephen Pietrobon, Paul Gray and David Lyons, as well as my classmate Liren Zhang.

My first project involved making speed-wire board. At that time I was a visiting scholar supported by a one year scholarship from Shandong Province. I intended to change my status from a visiting scholar to a Masters student but the visa change was very difficult. Mike Miller spent a lot of effort to eventually achieve this dream.

I took part in many projects within the DCG. The first exciting one was the MOS-1 satellite image demodulator. I did the simulation of the minimum shift keyed differential detector with the help of Rod Staker, and Ted Bullen collaborated with Codan for hardware implementation. The images received was said to be the first batch for Australia.

By the time I had conducted several contracts for DSTO in 1994 I was quite confident on my level of ability. ITR gave me the chance to gain knowledge and skills on many sub-fields of digital communications. My last project at ITR was for Inmarsat under Mark Rice who persuaded me to delay joining DSTO for a few months. By the time I left ITR in January 1995 I had published 20 papers and submitted my PhD thesis in September.



## **Mr Ken Lever** **Research Professor**

My introduction to ITR was at a meeting with Mike Miller in June 1991. I had arrived in Adelaide from London earlier that month to work on adaptive radio systems at DSTO.

Joint employment by industry and academia had been for me an ideal way of life, but when I left the UK I had no inkling that I would soon be working in the same mode. At the meeting Mike got out his architect's plans and explained to me his vision for a Signal Processing Research Institute (SPRI). Coming from the cash-strapped zero-growth culture of the UK at the time, this was music to my ears. I had questions: "Have you got the finance?" – "Yes, we have"; "Where will you build it?" – "We have the space" (I was later shown an unprepossessing sheep paddock, overused to the point of toxicity); "How long will it take to build?" – "Six months" (Mike was wrong: it took five months); – and the rest is history.

I was mandated by Dr Scot Allison, the Director of DSTO, to spend half my time setting up and directing the Defence Communication Laboratory in ITR. As ITR grew, the Defence Communications

Laboratory grew with it. Appointed originally as an Associate Professor whilst still employed by DSTO, within three years my role had become a full-time job, and in 1994 DSTO agreed to release me to become a full-time Professor of Communications Signal Processing and Associate Director in ITR. This was for me a wonderful period of productive achievement, operating in my preferred 50/50 industrial-academic mode, in a flourishing, expanding environment working with a constant procession of extremely gifted researchers in ITR and SPRI, many of whom were seconded from DSTO for their Masters and PhD studies.

In 1997, I was also acting Director of ITR for a 10 month period whilst Mike was seconded to the Engineering School to oversee its restructuring. It was during this time that I had the pleasure of signing the papers committing UniSA to a leading role in the Cooperative Research Centre for Satellite Systems.

But the Mike Miller era came to an end when he retired and in 2001 I was headhunted back to the UK to become Professor of Communications Signal Processing at Cardiff University.



Earlier this year, I was honoured to be appointed Adjunct Research Professor in ITR and have already spent two months working with ITR. ITR is different the second time around but still as exciting and as enterprising as ever under its new leadership. I shall be returning in October to participate in the ITR 25 year celebrations and resume my research with ITR and DSTO colleagues for another two months. Hopefully I'll be back here in 2035 for ITR50!

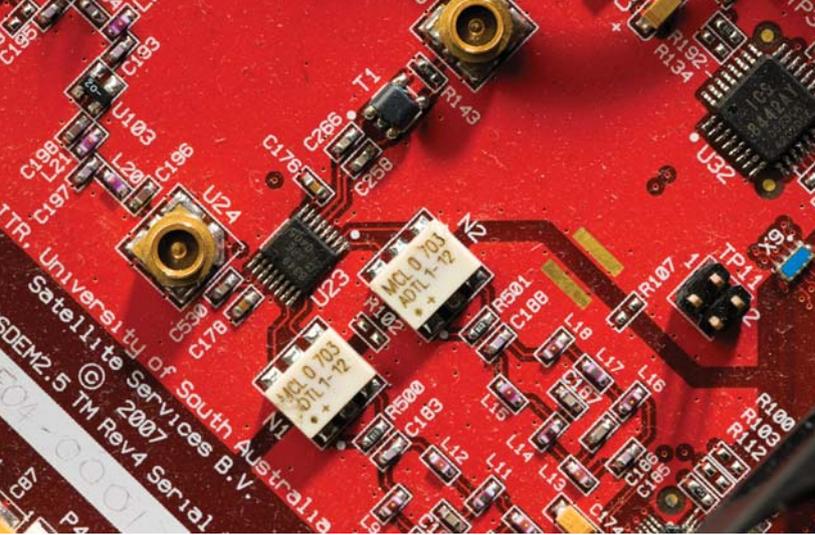
**Dr Sui Wai Ho**  
**Research Fellow**

It was my great honor to receive the ITR Director's Fellowship which supports early career research in the area of information theory and do fundamental research in the mathematical foundations of information transmission, processing and utilisation. I have also received an Australian Research Council Discovery Project Australian Postdoctoral (APD) Fellowship. This four-year fellowship allows me to continue my research work in ITR on the privacy issues in biometric authentication systems together with Research SA Fellowship support.

**Mr Rob Lees**  
**SPOT Imaging Services**

SPOT Imaging Services has a very successful ongoing relationship with ITR for the reception of telemetry from the SPOT Imaging Services earth observation satellites. Our partnership with ITR started in 2003 and ITR has provided continuous service 364 days of the year (we let them have Christmas day off) ever since. SPOT 5 is expected to operate for another five years so we anticipate our relationship continuing for at least that long.

I pay tribute to the skilled staff at ITR, engineers and operators who have kept the 'ASTRA' antenna operational and have achieved a 92 percent collection rate for SPOT Imaging Services. This rate ranks up there with most of the SPOT Imaging Services stations around the world. Excellent considering the antenna's age!



**Mr Brett Biddington**  
**Cisco Systems**

In 2000 Cisco Systems established a small global space team with the task of creating a market for internet technologies in and between satellites.

The vision was that, in time, every satellite would be a node on the network, at once emulating in space and extending the internet as it has developed on Earth. This vision, if realised, has the potential to transform space communications as they have developed in the first half century of the space age.

One member of the Cisco Systems space team was Dr Daniel Floreani. Daniel gained his PhD from ITR in May 1998.

ITR conducted a series of studies to address some of the fundamental challenges which needed to be addressed and solved for inter-satellite communications to move from theory to practice. The work done by ITR led to a series of academic papers and was of immediate use to Cisco Systems.

I am a member of the ITR Advisory Board and I am committed to ensuring that ITR is the 'go to' research institution in Australia for anything to do with wireless and satellite communications. As Australia develops

a national broadband network, ITR has unparalleled opportunity to influence some of the basic technology and operational decisions which will need to be made over the next five years.

**Dr David Haley**  
**Cohda Wireless, former staff member and student**

I joined ITR in 1999, working as a contract engineer on the FedSat project. In this role I worked in a team engineering a satellite communications payload that was later successfully launched. I appreciated the chance to work with a highly talented and friendly team while transferring theory into practice. I was then offered a postgraduate position and commenced full-time study. Throughout my studies ITR provided a supportive and collaborative research environment. ITR's strong international ties gave me the opportunity to build relationships and visit other researchers overseas. The Institute provided a positive workplace culture and the chance to balance work with regular soccer games, running, cycling and social activities. ITR offered a strong blend of theory and practical application within a friendly atmosphere and I believe these features are integral to its success.

“I meet absolutely everybody who passes through ITR – staff, postgraduates, interns, minor thesis, work experience and casuals – and the likeability and intelligence of the people surely couldn’t be bettered anywhere.”

**Mr Bill Cooper**, IT Manager

“Strong links with industry means that the relevant application of your research is at the heart of things and that’s a really motivating factor for a student.”

**Professor Alex Grant**, ITR Institute Director and past student

“ITR is a vibrant place. People here are excellent. Its great connections to the telecommunications industries has also given me a lot of opportunities to apply my research in practice. I really enjoy working in ITR.”

**Dr Terence Chan**, Senior Lecturer

“Satellites make you to look up and imagine. They give you a different perspective over a fragile and interconnected world in which we live. Working in the satellite communications field shrinks distances, increases ones horizons, allows new connections all over the world, opens new possibilities...”

**Associate Professor Sorin Adrian Barbulescu**,  
Associate Research Professor in Satellite Communications

“Over the last 25 years, ITR has allowed me to work with many talented people, on a wide range of projects. At times ITR can offer the best of both worlds: scientific inquiry through to novel engineering solutions.”

**Professor Bill Cowley**, Professor of Communications Signal Processing

“ITR offers me great opportunities to be involved in projects with strong linkage with industry. I am excited to apply state-of-the-art wireless communication technologies to real applications, such as the pioneer vehicle-to-vehicle communications.”

**Dr Lin Luo**, Research Fellow

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