



**2009 Global Network
Interconnectivity (GNI) Symposium**

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Department of Information Science

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2009

Global Network Interconnectivity (GNI) Symposium



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1. Introduction

Telecommunications technologies and Internet services are experiencing unprecedented growth. Technological advances together with the growing scale of deployments are driving rapid change in the telecommunications arena. All these factors contribute to the push towards convergence on the network core. Next generation networks, programmable networks, and the converged core opens up and provides new network architectures and new converged service opportunities.

The Global Network Interconnectivity (GNI) Project was established at the University of Otago in 2006 to develop expertise, provide knowledge sharing and conduct activities supporting new ICT technologies that contribute to telecommunications, multimedia, and information systems convergence.

The aim of the GNI Symposium was to bring together academic and industry leaders for one day to discuss current and future issues relating to convergence in the ICT and Telecommunications arena. This report provides a summary of the day's presentations and discussion sessions.

2. Schedule

Time	
8.50 am	Welcome - Professor Martin Purvis
Session 1 - Next Generation Network and Service Technologies	
9.00 am	Social Interactions Analysis Based Services Composition Dr Hakim Hacid Bell Labs Alcatel-Lucent, France *Remote Presentation
9.30 am	Next Gen Services: Enabling Participation and Technology Refinements Dr Mariusz Nowostawski Department of Information Science, University of Otago
10.00 am	Using SABSA to Architect Survivable Next Generation Networks Dr Malcolm Shore Head of Security, Telecom NZ
10.30 am	Morning Tea
Session 2 - Technology Enhanced Collaboration	
11.00 am	Virtual Worlds and the Next Generation 3D Internet Ryan McDougall RealXtend, Finland
11.30 am	Virtual Reality and Virtual Worlds in Health Care Dr Arin Basu Health Sciences Centre, University of Canterbury
12 noon	The Future of Technology Enhanced Collaboration John Eyles - Research and Venturing, Telecom New Zealand Alexander Hayes - Operations Manager, EDUPOV
12.30 pm	Open Source: The Waves and The Tide Nicolás Erdödy Director, Erdödy Consultancy Ltd.
1.00 pm	Lunch and student poster/demos
Session 3 - NGNs: Challenges and Opportunities	
2.00 pm	NGN – Next Generation Nightmare? Martin Sharrock CTO, Alcatel-Lucent New Zealand
2.30 pm	Challenges in Mobility Management and Resource Allocation in NGNs Bhaskar Ashoka Department of Computer Science, University of Otago
3.00 pm	NGN Capacity, Performance and Resilience Planning Tools Peter Chappell CTO, Harmonic
Parallel Discussion Sessions - Afternoon Tea served during session	
3.30 pm	Services and Architectures Chair: Jeremiah Deng
	Technology Enhanced Collaboration Chair: John Eyles
4.15 pm	Summary of Discussion Sessions
4.45-5 pm	Closing - Professor Martin Purvis

3. Summary of sessions



The slides from the following presentations are available from the GNI Project website: <http://www.gni.otago.ac.nz>

Session 1: Next Generation Network and Service Technologies

This session was chaired by Professor Martin Purvis, Head of Information Science Department and Director of Telecommunications Programme at the University of Otago.

Social Interactions Analysis Based Services Composition

Dr Hakim Hacid - Researcher, Alcatel-Lucent Bell Labs, France

With the emergence of Web 2.0 and the related technologies, composing services has left the traditional frontiers of enterprises. In fact, end-users need to use a certain kind of composition in different situations especially that Web 2.0 has brought a set of technologies making it easy to create or collaborate on new services or use others services, e.g., Mashups. On the other hand, users participate to different communities and social networks to share common interests and find lacking expertise offered by others. This is also true for Web services composition tools like Mashup tools that try to consider the social dimension of the user in the composition process. Thus, we believe that there is an under-exploitation of the big potential of social relations to reinforce services composition in such contexts. This presentation proposes to review some related concepts and work to motivate the need for a social composition and then introduce a first view of our framework, named Social Composer (SoCo), aiming at contributing to this issue.



Dr Hakim Hacid is currently a researcher at Alcatel-Lucent Bell Labs France. His current research focuses on social interactions analysis to provide added value applications for users and services providers. Before joining Alcatel-Lucent Bell Labs, Hakim was a research associate at the University of New South Wales (Australia) where he worked with the Service Oriented Computing (SOC) group which he joined after obtaining his PhD in computer Science from the University of Lyon, France. His research interests include Data mining, databases, information retrieval, and service oriented computing. Hakim has published different articles and is still investigating different research aspects in these areas.

Next Generation Services: Enabling Participation and Technology Refinements

Dr Mariusz Nowostawski - Lecturer, Department of Information Science, University of Otago

In this talk we will present some concepts behind reification and feedback mechanisms that are part of many modern IT architectures. We look how some technologies enable large-scale participation and how participation refines the underlying technology. The focus of the discussion will be on the new intelligent networks and services that enable participation in scales that has not been observed before.



Dr Mariusz Nowostawski is currently a lecturer in the Department of Information Science at the University of Otago. He lectures in the area of networking and network security on 300 and 400-levels. His research interests cover a number of fields, including high-performance networking, multicore technology, evolutionary and artificial life systems, theory of computation and research on biologically inspired computing architectures. Mariusz recently completed his PhD thesis on Evolvable Virtual Machines (graduating in December 2008).

Mariusz is the Directory/CEO of Ngarua Technologies, a software company specialising in software systems for high-end servers and telecommunication markets. Ngarua Technologies collaborate with Sun Microsystems on software development for their latest Niagara multi-core platforms. Additionally, Mariusz is the Director/CEO of Praeteritio, a company specialising in software systems, software architectures, parallel programming, virtual machines, and evolvable virtual machines.

Using SABSA to Architect Survivable Next Generation Networks

Dr Malcolm Shore - Head of Security, Telecom NZ

SABSA has been widely adopted as a framework for developing security architectures which reflect real business needs, whilst incorporating the industry standards required for compliance with recognised standards. RAPSA has been proposed as a standard for risk assessment of the survivability of critical infrastructure systems. In this paper we demonstrate how RAPSA can be incorporated into the SABSA framework to deliver a coherent methodology for designing next generation networks with a business-driven level of survivability.



Dr Shore was born in England and worked on J-level operating systems with International Computers Ltd. He studied Computer Science at the University of London after which he emigrated to New Zealand. Shortly after his arrival in New Zealand, he accepted a commission in the RNZAF and was the Chief Systems Programmer supporting the introduction of the Sperry Univac mainframe. Dr Shore was subsequently posted to policy and strategic planning positions in Air Staff and then in the Directorate of Joint Command, Control, Communications and Information Systems in Defence Headquarters.

Malcolm retired from the RNZAF and moved to the Government Communications Security Bureau where he developed and implemented New Zealand's national information systems security policy. During this appointment, Malcolm also completed his PhD at Otago University. He retired from the Government Communications Security Bureau as Director Information Systems Security. Since working for Government, Dr Shore has been the Technical Director for CES Communications Ltd in which position he was responsible for the design and development of commercial landline, satellite, and radio encryption products. He is currently Head of Security at Telecom NZ.

Over the last five years, Dr Shore has held an adjunct position as Senior Fellow in the Computer Science and Software Engineering department of Canterbury University, where he lectures in Computer Forensics and Information Warfare.

Session 2: Technology Enhanced Collaboration

This session was chaired by Associate Professor Stephen Cranefield, Department of Information Science, University of Otago.

Virtual Worlds and the Next Generation 3D Internet

Ryan McDougall - realXtend, Finland

This presentations describes what are Virtual Worlds and their applications, what is needed from a Virtual World technology platform, and how realXtend intends to deliver the platform for the next generation 3D Internet.



Ryan is an open source fanatic, and virtual world believer, and sometime software architect. Graduating with degrees in computer science and mathematics in Calgary, Canada; Ryan took the road less travelled and moved to Tokyo, Japan; where he worked on web systems and real-time 3D visualization software. Ryan then helped found the first company in Japan to focus on open source virtual world systems. He has since joined the Oulu, Finland-based non-profit open-source realXtend project, as community manager and lead architect.

Virtual Reality and Virtual Worlds in Health Care

Dr Arin Basu, University of Canterbury Health Sciences Centre

Traditionally, teaching and provision of health care has been predicated by the concurrence of the patients, trainees, providers, and teachers of health care at the same place and time. However, increasingly that paradigm of health care is changing as technology enables provision of medical care to be more widely distributed and even asynchronous. Lately, use of virtual worlds have provided a new medium of interaction where patients, providers, medical and nursing trainees and teachers can come and collaborate in real time so that this new medium can foster training of physicians and facilitate electronic disease diagnosis and management of various conditions. In this talk, we shall discuss the roles of virtual worlds such as Second Life in medical education, training and provision of medical care and describe our recent TEC funded project at the University of Canterbury on immersive learning through virtual reality.



Arin Basu is a medical doctor, lecturer, and an epidemiologist. He works at the University of Canterbury at Christchurch as a senior lecturer in the Health Sciences Centre and serves as a senior researcher at the Health Services Assessment Collaboration, Health Sciences Centre. Arin is currently leading two research projects at the Health Sciences Centre - the first one is funded by the Tertiary Education Commission on immersive learning through virtual reality applications for the training of physicians and nurses and the second project, funded by Ako Aotearoa, is on the technology used for the professional training of nurses, physicians and other health care workers who are involved in the provision of Telehealth services. Arin's research interests include use of virtual worlds in medical education, training, and provision of medical care.

The Future of Technology Enhanced Collaboration

John Eyles - Telecom NZ, Alexander Hayes - EDUPOV

An interactive view of emerging point of view technologies (POV) and their intersection with communication, art and science. This presentation posits future directions for where POV can augment technology enhanced collaboration at the intersection of education and entertainment. Alex will utilize wearable point-of-view technologies to engage both physical and the virtual GNI audiences including live-to-field streaming of education oriented training and assessment underway in rural and remote locations of Australia. John will look

at issues around connectivity, engagement and mobility for achieving great communication across contexts, and will invite participants from around the world to collaborate.



John Eyles is a Research and Alliances Leader at Telecom New Zealand, looking 3-5 years into the future to identify opportunities and threats for the business. His current expertise is in Social Networking, E-Learning, Social Media, Virtual Worlds, Online Collaboration, Mobile Services and understanding what the Future Telco looks like. John's vision is education towards freedom for an inclusive and sustainable world through cooperation, mutual respect and understanding, supported by new communication technologies.

John is also Chair of EON Foundation, a not for profit social enterprise dedicated to advanced global learning (<http://www.e-o-n.org>) and owner of Neosophy Limited, providing consultancy in strategic thinking, new knowledge systems and e-learning.



Alexander Hayes is a Director of EDUPOV, a start-up web based business. An avid interest in web marketing and communication management has led Alexander to forge a career path working with organizations to embed information communication and networked learning leadership as part of an e-business portfolio. Alexander facilitates workforce, capability and career development training needs, calling upon an extensive range of skills and experiences as a professional educator, artist and web developer. Alex has worked extensively with the Australian Flexible Learning Framework, TAFE NSW, TAFE Western Australia and has an extensive teaching career spanning over two decades with the primary, secondary, tertiary and other government departments as Lecturer, Web Developer, Project Manager, Researcher and Curriculum Instructional Design.

Open Source: the waves and the tide

Nicolás Erdödy - Director, Erdödy Consultancy Ltd

What do Enterprise Software, Social Networks, Learning Management Systems and Parallel Computing have in common? They have a robust open source solution available today. "(Beware of) the waves and (watch) The Tide" is a talk that shows how Open Source is a solution today for business, education and every layer of commercial software. We briefly present its history and discuss how the global economic crisis is just boosting its adoption. We analyse its evolution towards a convergence with the current proprietary status and present how the Open Source model could contribute to the solution of one of the biggest challenges for the software industry of the last decades: Multicore and Parallel Computing.



Nicolás Erdödy is Director of Erdödy Consultancy Ltd, a New Zealand based firm specialised in capital, strategy and technology for different industries. He conceptualised, established and led 15 start-ups in his 30 years of entrepreneurship career, including a boutique venture capital firm specialised in funding early stage high technology start-ups and leveraging them globally. In that role, Nicolás created the first multicore software company of New Zealand in 2005. In the education sector, Nicolás created in Uruguay the first online Mathematics Academy of South America in 2000 with students in 14 countries.

Around Open Source, Nicolás was Program Manager of the Open Source Learning Lab, and organises the Open Source, Multicore and Parallel Computing miniconference for LCA 2010, one of the major Linux conferences worldwide.

Nicolás holds a Master of Entrepreneurship from Otago University, a Research Diploma on New Technologies applied to Education from INRP France and studied Hydraulics, Mathematics and Computer Science at the School of Engineering of the Universidad de la Republica, Montevideo, Uruguay.

Session 3 - NGNs: Challenges and Opportunities

This session was chaired by Mrs Hailing Situ, GNI Project Technical Manager, Department of Information Science, University of Otago.

NGN - Next Generation Nightmare?

Martin Sharrock - CTO Alcatel-Lucent, New Zealand

In this seminar Martin Sharrock explores how Telecoms innovation continues apace, but who will pay? And How?



Martin Sharrock is the Chief Technology Officer and head of the Solutions and Marketing team for Alcatel-Lucent in New Zealand. He has held this role since April this year after holding a similar position for the company in Japan over the previous 2 ½ years. Martin has spent the last 5 years working in Asia and has also lived in Malaysia where he held the position of CTO for Alcatel's Mobile Communication Group in the APAC region. In a career spanning 18 years in the Telecommunications and IT industries, Martin has worked for the UK Ministry of Defence, Motorola, Lucent Technologies and Alcatel in technical, marketing and program management leadership roles living mostly in the UK but having lived or worked in over 40 different countries. Martin is a keen sportsman and is looking forward to living an outdoor life with his wife and 2 children as start a new chapter of their life in New Zealand.

Challenges in Mobility Management and Resource Allocation in NGNs

Bhaskar Ashoka - Department of Computer Science, University of Otago

Deployment of Next Generation Network (NGN) comprised of different service providers, different Radio access technologies and multimode user terminals to be compatible with existing services and technologies has provided many challenges for the researchers and service providers. In particular providing a desired service such as video streaming, conferencing, data download/upload to the moving user refining the acceptable Quality of Service (QoS) anywhere, anytime considering different networks and global roaming is a difficult task. These diverse needs of NGN demands efficient and reliable technologies to satisfy user as well as Network Providers. Many areas are being explored currently. In this talk we classify few of the user oriented and technological challenges and discuss the technological challenges and trends involved in two areas namely Resource management and mobility management for next generation networks.



Bhaskar Ashoka has a Masters of Technology from VTU (Vishveshvaraya Technological University), India. He is currently undertaking the first year of his PhD in Computer Science at the University of Otago. His background includes working as a Programmer Analyst with Infosys Technologies Ltd, Bangalore, India, and also as a Software Consultant with IBM India Pvt Ltd, Bangalore, India. His research interests include wireless networks, and mobility and resource management in next generation networks.

NGN Capacity, Performance & Resilience Planning tools

Peter Chappell - CTO, Harmonic

Planning and management of capacity, performance and resiliency for NGN network services poses multi-dimensional challenges. Evolving VoIP, internet and video services are driving increasing expectations, loadings, and complexity into the network. Distributed service intelligence, QoS policy enforcement, and MPLS traffic engineering capabilities mean services can no longer be managed as simple flows. The underlying delivery infrastructure is itself still being rolled out and maturing, and is highly dependent on logical software capabilities as well as physical bandwidth. This presentation will review the requirements

and architecture of an integrated toolset to assist network designers, planners and managers to predict and manage NGN IP services around traffic planning, infrastructure configuration and dimensioning, and service performance and availability. It incorporates powerful analytic, simulation and measurement capabilities.



Peter Chappell joined Harmonic as CTO from Telecom's Technology Strategy and Architecture group where he focused on Service Management. Peter holds a M.Sc in distributed networks and previously led technical and standards development for NZ's EFT-POS system. Peter has consulted for 4 years on national payment systems in the Asian region.

4. Summary of projects presented during lunch

In addition to the talks presented during the day, staff and students from the Information Science department had prepared a number of demonstrations and electronic posters. The intention was to give Symposium attendees an overview of some of the research being undertaken within the department. Below is a summary of the work that was demonstrated.

An Enhanced Stable Election Protocol (SEP) for Clustered Heterogeneous Wireless Sensor Networks

Femi Aderohunmu

While wireless sensor networks are increasingly equipped to handle more complex functions, in-network processing may require these battery powered sensors to judiciously use their constrained energy to prolong the effective network life time especially in a heterogeneous settings. Clustered techniques have since been employed to optimise energy consumption in this energy constrained wireless sensor networks. We propose an Enhanced-SEP clustering algorithm in a three-tier node scenario to prolong the effective network life-time. Simulation results shows that the Enhanced-SEP achieves better performance in this respect, compared to other existing clustering algorithms in both heterogeneous and homogenous environments.

Enabling Communication Between Virtual Worlds and the Real World

Hailing Situ

Virtual worlds, such as Second Life and Opensim, are becoming increasingly popular as 3D platforms for social networking. Users are able to communicate with each other within their own virtual world domains. However, communication with users in other virtual worlds or in the real world is more difficult and sometimes not possible. There is no current solution that provides a flexible mechanism for the people to communicate with each other anytime and anywhere. In this project we have proposed a method to allow users to communicate with each other, regardless of whether they are in a virtual world or in the real world. The JAIN SLEE platform was used to develop a gateway service which allows users in the virtual worlds and real world to communicate with each other by using popular SIP VoIP applications. Using existing JAIN SLEE HTTP and SIP resource adapters can speed up the service development.

Modelling Accessibility to Primary Health Care

Nasser Bagheri

This research has developed an integrated approach for measuring accessibility of primary health care (PHC) services. New Zealand and World Health Organisation (WHO) rules were used to determine optimum levels of minimum travel time to the closest PHC facilities via a road network. A two-step floating catchment area (FCA) method was used to calculate spatial accessibility index based on travel time. A need index was also developed to model high health need groups. Then, the spatial and need indices were combined into one framework to generate a combined index. The results of this study showed that the combined approach better explores the low accessibility clusters within different travel time catchments in the study area. In addition, some parts of north and central Otago do not meet WHO and New Zealand guidelines regarding access to PHC.

The Impact of Mobile Social Networks on Health Information Sharing

Prajesh Chhanabhai

This study highlights the behavioural change that is currently undergoing health information dissemination within the Generation Y (Gen-Y) group through the advent of mobile social networks (MSNs). As Health 2.0 and the uptake of electronic social networks increases it is important to understand the behavioural change fully in order to understand and plan future health awareness campaigns. We have done this by conducting a survey of Otago University students with a focus on what kind of health information and how often they share health information via these mediums.

Self-organization of Peers in Agent Societies

Sharmila Savarimuthu

This work investigates how to achieve self-organisation of groups in a multi agent society where nodes of a P2P system are modelled as simple interacting agents located in different groups. The context of interaction between agents is the sharing of digital goods in electronic societies. This work explains how cooperative sharers and uncooperative free riders can be placed in different groups of a P2P system in a decentralised manner. We have simulated a decentralised, distributed, P2P system which self-organises itself to avoid cooperative sharers being exploited by uncooperative free riders. The developed system, based on a gossip mechanism, shows promising results by encouraging sharers to move to better groups and also by restricting free riders without any centralised control, which makes it favourable for current P2P systems.

Eye-to-Eye Contact in Videoconferencing

Simon Hoermann

We have demonstrated a videoconferencing prototype which simulates a face-to-face conversation. The developed system solution allows either both or just one party in a video conference to experience gaze and eye-to-eye contact awareness. It utilises the novel integration of an holographic optical element screen, projector and optical filter technology and a networked computer setup.

A reputation service for mobile phones using JAIN SLEE and OpenSocial

Stephen Cranefield and Eric Li

This project aims to demonstrate the construction and potential benefits of a service for mobile phone users that could be deployed within a next generation telecommunications network to combine telecommunications services with external Web services. The application is a ratings service allowing users to rate businesses, products and services, and to lookup ratings that are aggregated across all users of the mobile network or based on the user's social network. Users can register the social networking sites they use and these are queried using Google's OpenSocial API to cross reference users' social networks with the ratings information stored by the mobile network provider.

NVS - Next Generation Virtual Stickies

Paul Crane, Julian Munster, Wei Wang and Hanan Al-Shammari

Next Generation Networks provide new opportunities for innovative services and rich collaboration (mash-ups) between various technologies. Our project, Next-Generation

Virtual Stickies (NVS), aims to develop a geographic aware media dropping application using an IMS backend. We've developed the client application on the Android mobile platform, and the Application using Sailfin (a Java based SIP Servlet wrapper), and PostgreSQL with GIS add-ons (to leverage the GIS component). The notes can be any media (text, pictures, audio, movie, 3d-Objects), and can be assigned categories (restaurants, movies, emergency services, etc.). A client would then ask for any of these notes in their surrounding location.

A Coloured Petri Net Framework for Multi-Robot Cooperation

Toktam Ebadi

This work introduces a multi-agent framework that facilitates cooperation in multi-agent robotic systems. It uses a layered approach based on Colored Petri Nets for modelling complex, concurrent conversations among agents in a multi-agent system. In this approach each agent employs the implementation of a Petri Net model that allows agents to follow a plan specifying their interactions. It also allows programmers to plan for the concurrent feature of the conversation and make sure that all possible states of the problem space are considered. The framework assists the agents to identify and adapt different strategies for teammates and perform task selection dynamically. The agents can change their strategies in the course of dynamic environments to improve their performance.

Norm Identification Framework for Artificial Agent Societies

Tony Bastin Roy Savarimuthu

In this demonstration, we present the internal architecture of an agent which identifies what the norms of a society are. The agents employing this framework infer norms without the norms being given to them explicitly. Through simulations, we demonstrate how the norm associated with using a park can be inferred by an agent using the proposed architecture.

5. Summary of discussion sessions

The afternoon was rounded off with two concurrent discussion sessions. Participants split into two groups to discuss technology enhanced collaboration in one, and next generation services and architectures in the other. Below are a short summary of each session, prepared by the session chairs.

Technology Enhanced Collaboration

Session Chair: John Eyles, Telecom NZ

Introduction: Technology has done a fine job cost cutting in the enterprise however leveraging more effective collaboration for peak performance is a frontier yet to be refined. All participants agreed the tools are rapidly improving and nothing beats face to face (currently). During 30 minutes of discussion 3 main themes emerged:

1. Information overload and the fragmentation of conversation

With the increasing variety of applications and locations for conversations synchronous and asynchronous to occur, there are increasing instances of communication fatigue – our human capacity to process and give attention to multiple conversations strained. A steady usage of stealth mode in Skype and a prevailing acceptance that “I can only do so much” is observed.

Ironically it seems our increased connection leads to disconnection and latency in conversation and collaboration. There is an increasing desire for streamlined aggregation and syndication, the need to take out the complexity. There's a loud voice saying: "Make my life easier. Connect me to my local community – and the world."

2. Open Source and the nature of collaboration

What are the impacts of different ideologies such as open source versus closed proprietary; generative relationship or selective pay for use transaction; community or control? Process defines outcome to a large extent. What is the nature of collaboration and sharing? Is it to be prescribed and legislated? What does it look like to enable others and share in success by giving access. An example given was that of fostering developer ecosystems with open APIs. It was posited that a free and open environment enables greater gain – the ability to build onto and develop the shoulders of giants such as in the Law. Creative Commons, Academia.

3. Virtual Worlds and the nature of engagement

A conversation on what it feels like to have collaborative relationships exclusive in virtual reality hyperspace! Issues of trust were discussed and how it is established, the affordance of anonymity, the disconnect between actions on the screen and consequences in the ‘real’ world considered. It was suggested the ability to hide, avoid conflict or uncomfortable situations may inhibit learning, as the challenge to us is too ‘safe’, this was countered by the benefits of play and creativity in a re-build world. It was generally agreed that while the power of cultural norms over communication is strong, the importance of trust and a background of relatedness is a requisite in building effective collaborative relations. At the moment our experience of the virtual is mediated and heavily impacted by the viewable screen - this will change with uptake of laser projectors on mobiles, holograms, retinal displays and other devices along with increased participation in the GeoWeb.

Next generation services and architectures

Session Chair: Dr Jeremiah Deng, Department of Information Science

Introduction: Next Generation Networks (NGN) have been widely accepted as the future architecture for telecommunications and the Internet. Branding its 'all-IP' solution for voice, data and multimedia, the 'convergence' of services has been on our lips for some time but is yet to happen. What aspects of NGN services and architectures are crucial? What can we do to make it happen, quicker and better? Our discussion, with no intention of being comprehensive, focused on two aspects:

1. Facing the challenges in NGN Reliability

In New Zealand, as in other places, the NGN is most likely to be a mixture of circuit and packet switched networks and various technologies for providing the next-generation convergent services. Reliability will be tightly coupled with the QoS control in highly dynamic data networks. Given this kind of complexity, it is a real challenge to achieve and maintain the high-level of reliability that the old PSTN system still enjoys. Proven by recent incidents, with New Zealand's special geographical layout, the old trick of using a secondary backup link just does not work out. We need to have more redundancy introduced into the telecommunication network, as well as come up with more intelligent and resilient configuration and management tools that provide better traffic monitoring, prediction and planning capabilities. Closer and more effective collaboration between research institutes and the industry may pave out the way.

2. Putting NGN in action

In the atmosphere of the global recession our expectation on government funding behind NGN might have to be further lessened (we lament the recent loss of their support to Open Cloud). On the other hand, it also seems unreasonable to see telcos roll out and even open up their NGN services in the near future. While NGN is surely the technological tomorrow, the dawn remains long to wait on. The University of Otago has been appraised by many key players in the industry as leading the trend of NGN teaching and research within New Zealand, and it should take the initiative to further advocate the R&D and promote more collaboration with the industry in this respect. Otago can incorporate new emerging technologies, such as the Andriod system and its service APIs etc. within the TELE and SENG curriculum, and develop research projects on NGN technologies and services. Otago, with potential cooperation from other research and industrial institutions, may also form a Telecommunication Services Developers Community that allows more interactions of R&D activities among researchers and professionals. Another notion agreed upon during discussions is that while new technologies keep evolving, it is the lower-level understanding of 'data networking fundamentals' that will remain in the future. Therefore teaching programmes at 200- and 300-levels need to remain in focus with this view.

6. Thanks

The organisers would like to thank the speakers for their involvement in the GNI Symposium and all the attendees who participated in the event. We would also like to acknowledge the Tertiary Education Commission who provided financial support for this event through their funding of the GNI Project [UOO KSE ICT 5023].

We hope to see you all in Dunedin again next year for the GNI Symposium '10.

