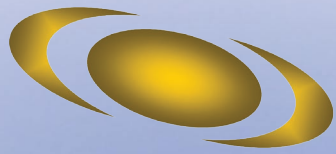# The 2008 Australasian Telecommunication Networks and Applications Conference

7–10 December 2008 • Adelaide, Australia

ATNAC 2008

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Keynotes

Network Dogmas and Network Evolution

Andrew Odlyzko; University of Minnesota, USA

The evolution of the Internet will depend heavily on the interaction between what users want and what technology can deliver. Unfortunately the networking community continues to be guided by a collection of misleading dogmas that impede proper direction of research, development, and deployment. The roles of voice communication, of content, and of streaming real-time transmission versus file transfers are widely misunderstood, which leads to plans that are likely to be seriously flawed.

The Australian National Broadband Network: New Opportunities, New Challenges

Leith H. Campbell; Ovum Consulting, Australia

The Australian National Broadband Network (NBN), to be supported by an Australian Government investment of up to $4.7 billion (USD 3.75 billion), will create a step change in telecommunications. It is being planned to deliver downstream transmission rates of at least 12 Mb/s (and probably more) to 98% of Australian households. As well as voice service and broadband internet access, it will probably carry IPTV and other new services.

The NBN raises new challenges for network planners and designers. Foremost it should lead to a radical rethinking of the Public Switched Telephony Network (PSTN). The PSTN was designed primarily in the days of cross-bar voice switches. With long-reach Passive Optical Networks, a new access infrastructure could serve the suburbs of any Australian city from a handful of sites. Whether this is a suitable architecture depends to some extent on what services are to be delivered. In regional Australia, the NBN should change the boundary between regional network and "backhaul", thereby changing the economics of service in regional areas. These new design issues will require academic and engineering studies if they are to be well resolved.

In addition, a recent study for the ACCC suggests that Distribution Areas (DAs), the fundamental geographic unit for access networks are not well laid out. This raises the possibility of rethinking the network even at the street-by-street level. The replanning of DAs while retaining economic quantities of existing copper cables is a substantial issue.

Further, the existence of an NBN will most likely move much competitive pressure from access to physical facilities, as at present, to access for business-support and operations systems to bitstream service. This should lead to a rethinking of regulation and new quality-of-service issues.

The Australian telecommunications community and its academic supporters must rise to these new challenges. The NBN represents a once-in-a-generation opportunity to rebuild the network infrastructure — and we need to get it right.

Failure is an Option

Geoff Huston; APNIC, Australia

IPv6 has always been portrayed as an inevitable upgrade for the Internet. The intent of IPv6 was to provide the Internet with a longer term answer to the issue of the exhaustion of the IPv4 address space, and the intended process was to facilitate the universal adoption of IPv6 prior to the exhaustion of the remaining pool of IPv4 addresses. Recent projections of IPv4 address consumption predict exhaustion of the unallocated address pool within 24 months or so, and the level of adoption of IPv6 in todays Internet is relatively slight. So Is IPv6 still inevitable? Or is failure an option here? And if the Internet fails to undertake a transition to IPv6 what alternatives exist and how may they affect the Internet of the future? This presentation explores these issues and the potential consequences for the Internet.

"Mate! Where the $!@@&~#%!! Is My Network?"

Michael Boland; Cisco, Australia

You hear it time and time again, a frustrated plea for the network to deliver! All too late in the application/service deployment cycle stakeholders become tragically aware of deficiencies that were planned or unplanned into their networks from the beginning.

Such deficiencies at the very least impede, and at their tragic worst, destroy the user experience.

While there are many reasons for how we arrived here, ... the separate evolution of services and network, the complexity of networking technologies, silos within organisations and network suppliers, to name a few, ... more often applications and service developers, information technology vendors, organisations and even government find themselves in a state of being "mercifully free from the ravages of network intelligence", to the detriment of themselves and their stakeholders.

This session will introduce a model, influenced by a well known theory in the study of psychology, to provide an understanding the structured functions required from networks to deliver the user experience supported by them.

While network technology will be discussed, you do not need to be a network scientist to attend & understand this presentation.

Using Multi-Gigabit Networks to Transform Radio Astronomy

Shaun Amy; CSIRO, Australia

Science (particularly astronomy and particle physics) is well positioned to benefit from recent advances in global network connectivity. Significant increases in bandwidth and the implementation of network technologies such as "lightpaths" (dedicated point-to-point optical circuits) have the potential to influence the way that research is conducted.

e-VLBI (electronic Very Long Baseline Interferometry) is now able to achieve results in a matter of hours, rather than in weeks or months by streaming the data in real-time to a correlation facility.

This presentation will outline recent upgrades to the Australian VLBI Array and give an overview of recent e-VLBI observations performed using radio telescopes in Australia and elsewhere with the data being streamed across the network and correlated in real-time. Some of the problems associated with sustained long-haul high-bandwidth data transmission and possible solutions will also be discussed.

Australia's involvement in the development of technologies for the next generation of radio telescopes will also be discussed with a particular emphasis on the development of the Australian Square Kilometre Array Pathfinder (ASKAP) radio telescope being constructed in Western Australia.

Broadband Access

Economic Analysis of Broadband Access for Australian Rural and Remote Areas

J.C. Ellershaw, J.L. Riding, A.V. Tran, L.J. Guan, T. Smith; University of Melbourne, Australia

We model and compare the deployment costs of three broadband access technologies, namely digital subscriber loops (DSL), passive optical networks (PON), and WiMAX wireless access, in Australian rural and remote areas. The analysis shows that wireless technologies are cheapest for a 20 Mbit/s rate when the number of homes per square kilometer is less than one. For 50+ Mbit/s, passive optical networks are the most economic.

Internode's Rural WiMAX Rollouts

Vinita Rajagopal; Agile Communications, Australia

Wireless communication has played an important role in delivering vital services to Australia's regional areas and with continuous developments in the technology, remains one of the most cost-effective and reliable solutions available. Recently, Internode / Agile determined that 'fixed WiMAX' would be the most robust and efficient wireless technology to meet its needs, which could be implemented to provide NBN grade broadband and IP voice services to large areas of regional South Australia. This paper looks at what factors where involved in Agile's decision to implement 802.16d standard for its regional networks against the 802.16e standard, the advantages of using licensed spectrum, and finally Agile's WiMAX deployments in Yorke Peninsula and Coorong regions.

VDSL2: Co-Existence Study

Dion Ljubanovic; Agile Communications, Australia

In the context of Next Generation Network's in Australia, attention if being brought to VDSL2 to deliver the next wide spread high speed fixed line communications to the wider community. Integral to its design, node based deployments have the potential to introduce large amounts of interference to existing exchange based services within the same cable binder. This paper will look at some of the preliminary techniques into achieving a mixed fed exchange/remote deployment in which current DSL deployments can co-exist with node based VDSL2. Furthermore, this paper will report findings from analysis of lab tested results into performance gains, losses and impact of introducing VDSL2 as a node into existing exchange based systems; namely ADSL2+. In conclusion, the technical matter of whether node based VDSL2 can co-exist with exchange based systems will be categorically answered.

Optical Hub Network Design for CWDM Access Network

Jun-ichi Mizusawa; Aoyama Gakuin University, Japan

This paper discusses the key design issues in applying both CWDM (Coarse Wavelength Division Multiplexing) and Optical Hub technology to an Access Network. The purpose is to reconsider characteristics of both optical circuits (such as a splitter, a coupler, a laser diode, a photo diode) and CWDM technology, and to try to find improved optical components deployment in access areas. The core of the network is composed of optical components, i.e., Optical Hub and fibers. CWDM functionality (such as LD and PD) is provided by newly designed ONICs (Optical Network Interface Card) located at a station site. The proposed access network structure has advantages in simplicity and scalability. Test bed implementation is included.

Internet

Quantitative Analysis of Incorrectly-Configured Bogon-Filter Detection

Jon Arnold[1], Olaf Maennel[2], Ashley Flavel[3], Jeremy McMahon[3], Matthew Roughan[3]; [1]DSTO, Australia; [2]Technische Universität Berlin, Germany; [3]University of Adelaide, Australia

Newly announced IP addresses (from previously unused IP blocks) are often unreachable. It is common for network operators to filter out address space which is known to be unallocated ("bogon" addresses). However, as allocated address space changes over time, these bogons might become legitimately announced prefixes. Unfortunately, some ISPs still do not configure their bogon filters via lists published by the Regional Internet Registries (RIRs). Instead, they choose to manually configure filters. Therefore it would be desirable to test whether filters block legitimate address space before it is allocated to ISPs and/or end users. Previous work has presented a methodology that aims at detecting such wrongly configured filters, so that ISPs can be contacted and asked to update their filters. This paper extends the methodology by providing a more formal algorithm for finding such filters, and the paper quantitatively assesses the performance of this methodology.

Minimizing the Number of Congested Links in OSPF Routing

Mohammed H. Sqalli, Sadiq M. Sait, Syed Asadullah; King Fahd University of Petroleum & Minerals, Saudi Arabia

Efficient network utilization using available resources is the main goal of traffic engineering and routing is the core criteria which regulates traffic over Internet links. Open Shortest Path First (OSPF) is a routing protocol which is widely used in the industry and uses the link weights as its routing metric. Optimizing these link weights leads to efficient routing and better network utilization. Setting weights on links for given traffic demands such that congestion can be avoided is an NP-hard problem. In this paper, Tabu Search, a non-deterministic iterative heuristic is applied to this problem using two different cost functions proposed in the literature. Moreover, we present the results for two additional performance

metrics *viz.* Number of Congested Links and Percentage of Extra Load. This provides the network designer with more flexibility to optimize desired parameters based on the requirements. Our results show superior performance of Tabu Search over other heuristics.

On the Correlation of Internet Packet Losses

Hung X. Nguyen, Matthew Roughan; University of Adelaide, Australia

In this paper we analyze more than 100 hours of packet traces from Planet-Lab measurements to study the correlation of Internet packet losses. We first apply statistical tests to identify the correlation timescale of the binary loss data. We find that in half of the traces packet losses are far from independent. More significantly, the correlation timescale of packet losses is correlated with the network load. We then examine the loss runs and the success runs of packets. The loss runs are typically short, regardless of the network load. We find that the success runs in the majority of our traces are also uncorrelated. Furthermore, their correlation timescale also does not depend on the network load. All of these results show that the impact of network load on the correlation of packet losses is nontrivial and that loss runs and success runs are better modelled as being independent than the binary losses themselves.

An Internet Distance Prediction Service Based on Passive Measurements

Matthias Scheidegger, Torsten Braun, Benjamin Zahler; University of Bern, Switzerland

Distance estimation services support the adaptivity of distributed applications on the Internet by predicting the network characteristics between end systems. A common problem of such services is their need for large-scale deployment in order to operate properly. We propose a peer-to-peer-based distance measurement and prediction service that is able to predict distances from a single site to arbitrary end systems on the Internet while only requiring deployment at this specific site. In this paper we present the service architecture, and we demonstrate the viability of the approach with results from a prototype deployment of the service.

Security

Performance Evaluation of the Information Sink in a Multi-Probe Statistical Anomaly Detection System

Thomas Zinner[1], Dirk Staehle[1], Phuoc Tran-Gia[1], Andreas Mäder[1], Kurt Tutschku[2]; [1]University of Würzburg, Germany; [2]NICT, Japan

Statistical anomaly detection (SAD) becomes an increasingly important tool for the early recognition of potential threats for security-relevant information systems. SAD systems heavily rely on the probing of potentially very large networks. Our contribution is an analysis of the resource requirements on the information sink which constitutes the bottleneck of Client/Server-based SAD systems. In order to dimension the system appropriately, we investigate the trade-off between accumulated and distributed arrival patterns, and the impact of the processing phase of the information sink.

SMEmail — A New Protocol for the Secure E-Mail in Mobile Environments

Mohsen Toorani; Iran University of Science & Technology, Iran

The electronic mail plays an unavoidable role in the humankind communications. With the great interest for the connection via mobile platforms, and the growing number of vulnerabilities and attacks, it is essential to provide suitable security solutions regarding the limitations of resource restricted platforms. Although some solutions such as PGP and S/MIME are currently available for the secure e-mail over the Internet, they are based on traditional public key cryptography that involves huge computational costs. In this paper, a new secure application-layer protocol, called SMEmail, is introduced that provides several security attributes such as confidentiality, integrity, authentication, non-repudiation, and

forward secrecy of message confidentiality for the electronic mails. SMEmail offers an elliptic curve-based public key solution that uses public keys for the secure key establishment of a symmetric encryption, and is so suitable for the resource restricted platforms such as mobile phones.

Design & Implementation of a Secure Sensitive Information System for Wireless Mobile Devices

Xianping Wu, Huy Hoang Ngo, Phu Dung Le, Balasubramaniam Srinivasan; Monash University, Australia

Protecting sensitive information systems from security threats such as unauthorised access, information eavesdropping and information interfering, is significant. Most of the natural approaches employ strong authentication and/or cryptography systems to protect critical data. But those approaches do not stress on the potential amount of risks associated with sensitive information, especially the vulnerability of long term cryptographic keys. Therefore, in this paper, a secure sensitive information system is proposed and implemented based on a dynamic key generation technique. It associates with elliptic curve key exchange protocol as a design solution for wireless mobile devices to achieve critical information data security and network security.

Calculating a Cryptographic Primitive: Suitable for Wireless Sensor Networks

Shan Suthaharan; University of North Carolina at Greensboro, USA

A sensor node in a wireless sensor network has a limited machine word size. This limitation restricts the use of cryptographic algorithms developed for computer networks in a wireless sensor node. Most of the modern cryptographic algorithms use the multiplicative inverse of a Galois field and therefore it is important to develop storage- and energy- efficient approaches for sensors to calculate multiplicative inverses. This paper presents two techniques to compute multiplicative inverses of a Galois field of order prime p for a wireless sensor network. The performance of the proposed algorithm is compared with that of the extended Euclid algorithm. The results show that the proposed approaches are storage- and energy- efficient, and are computationally better than the extended Euclid algorithm.

Broadband Performance Management

On Approximating Throughput in Wireless Systems with Complex Rate Variability and QoS

P. Fitzpatrick, M. Ivanovich; Telstra, Australia

Beyond 3G wireless systems will support real time and elastic traffic over a common packet-switched radio channel using QoS mechanisms. This paper studies the key question of how to estimate the throughput performance of "best effort" elastic traffic when it is subject to available capacity variations due to changes in (i) the amount of higher priority traffic and (ii) the radio channel. We extend previous work in this area to show that for the QoS mechanisms studied, an equivalent PS model provides a good closed-form approximation to call-average throughput, with desirable properties of independence from radio channel variations and best effort call volume distribution. Our findings therefore provide a basis for practically estimating throughput performance of best effort traffic with arbitrary call volume distribution, in radio systems with multiple QoS levels and complex rate variability.

Fixed Broadband Wireless Access Based on HAPS Using COFDM Schemes: Channel Modelling and Performance Evaluation

Israel R. Palma-Lázgare, José A. Delgado-Penín; Universitat Politècnica de Catalunya, Spain

The high-data rate links in broadband wireless communications are being essential for a constant growth in the tough environment of radio transmissions, and orthogonal frequency division multiplexing (OFDM) can deal with these circumstances. Coded OFDM (COFDM) research in wireless communications is a concept of the

well-use spectrum for robust high-data rate transmissions, and its regulation in the IEEE and ITU may have a profitable contribution in our high altitude platform (HAP) study. Moreover, HAP station (HAPS) based systems are now taking part in the world of wireless technologies to carry on with the anywhere and anytime wireless network service considerations. Due to all last considerations, HAP-channel modelling and COFDM-HAPS' performance evaluations conform our study. For our system representation the HAP-based system and ground users are considered as fixed terminals. Herein, our stratospheric channel modelling is approximated to real transmission conditions via the experimental land mobile satellite (LMS) record adoption. Performance results by means of BER vs SNR simulations are plotted and show that our proposal can overcome the wireless link effects of frequency selectivity and multipath fading; our results can offer an alternative idea of an efficient and robust solution for distribution of broadband wireless communications.

Poster Session

Performance Evaluation of VoIP Services Using Different CODECs Over a UMTS Network

Jianguo Cao, Mark Gregory; RMIT University, Australia

In this paper, we evaluate the performance of Voice over Internet Protocol (VOIP) services that use different compression and decompression (CODEC) schemes, over a hybrid network that includes a Universal Mobile Telecommunications System (UMTS) network segment. We focus on the VoIP transmission end-to-end delay. We found that different CODECs provide very different results depending on the hybrid network. The research found that for VoIP services to operate over a hybrid network including a UMTS network segment, with an end-to-end delay comparable to that of circuit switched voice service, there is a requirement for careful comparison and design on choosing the CODEC scheme.

A Simple Cooperative Cyclic Delay Diversity in Wireless Networks

Jin-Hyuk Song, Jee-Hoon Kim, Jung-In Baik, Hyoung-Kyu Song; Sejong University, Korea

Cyclic delay diversity (CDD) was introduced to obtain spatial diversity in multi-input multi-output (MIMO) system. In practice, terminals are difficult to have multiple antennas due to high cost or limited size. Accordingly, the cooperative scheme has recently emerged and given considerable attention. In this paper, CDD is incorporated into the wireless cooperative communication system, in which each terminal has single antenna. The proposed cooperative CDD scheme is compared with cooperative orthogonal space time block code (STBC). Cooperative CDD attains generally worse performance than cooperative STBC from orthogonal design, but cooperative CDD can be easily applied with an arbitrary number of relays and do not require additional complexity at both transmitter and receiver.

Carrier Frequency Offset Mitigation Using MSE-OFDM in Cooperative Communications

Sung-Ju Lee, Jae-Seon Yoon, Hyoung-Kyu Song; Sejong University, Korea

In this paper, we propose a cooperative communication scheme using multi-symbol encapsulated orthogonal frequency division multiplexing (MSE-OFDM), in which one cyclic prefix (CP) is used for multiple OFDM symbols. We use the FFT size-reduced MSE-OFDM system which can be used to reduce the peak-to-average power ratio (PAPR) and improve the robustness to carrier frequency offset. The cooperative communication uses not only direct path from source to destination but also indirect path via relay station. Each different relays require more precise frequency synchronization and lower PAPR, so we adopt the MSE-OFDM to increase the system performance. The performance analysis of cooperative MSE-OFDM in multipath fading channels has been done and the effect of carrier frequency offset and PAPR have been studied.

A New Robust Voice Activity Detection Method Based on Genetic Algorithm

M. Farsinejad, M. Analoui; Iran University of Science & Technology, Iran

In this paper we introduce an efficient genetic algorithm based Voice Activity Detection (GA-VAD) algorithm. The inputs for GA-VAD are zero-crossing difference and a new feature that is extracted from signal envelope parameter, called MULSE (Multi-plication of Upper and Lower Signal Envelope). The voice activity decision is obtained using a Threshold algorithm with additional decision smoothing. The key advantage of this method is its simple implementation and its low computational complexity and introducing a new simple and efficient feature, MULSE, for solving the VAD problem. The MULSE parameter could be appropriate substitution for energy parameter in VAD problems. The GA-based VAD algorithm (GA-VAD) is evaluated using the Timit database. It is shown that the GA-VAD achieves better performance than G.729 Annex B at any noise level with a high artificial-to-intelligence ratio.

Multi-Core Security Defense System (MSDS)

Ashley Chonka[1], Wanlei Zhou[1], Yang Xiang[2]; [1]Deakin University, Australia; [2]Central Queensland University, Australia

Today's security program developers are not only facing an uphill battle of developing and implementing. But now have to take into consideration, the emergence of next generation of multi-core sys-tem, and its effect on security application design. In our previous work, we developed a framework called bodyguard. The objective of this framework was to help security software developers, shift from their use of serialized paradigm, to a multi-core paradigm. Working within this paradigm, we developed a security bodyguard system called Farmer. This abstract framework placed particular applications into categories, like Security or Multi-media, which were ran on separate core processors within the multi-core system. With further analysis of the bodyguard paradigm, we found that this paradigm was suitable to be used in other computer science areas, such as Spam filtering and multi-media. In this paper, we update our research work within the bodyguard paradigm, and showed a marked improvement of 110% speedup performance with an average cost of 1.5ms.

Identification of Malicious Web Pages with Static Heuristics

Christian Seifert, Ian Welch, Peter Komisarczuk; Victoria University of Wellington, New Zealand

Malicious web pages that launch client-side attacks on web browsers have become an increasing problem in recent years. High- interaction client honeypots are security devices that can detect these malicious web pages on a network. However, high-interaction client honeypots are both resource-intensive and known to miss attacks. This paper presents a novel classification method for detecting malicious web pages that involves inspecting the underlying static attributes of the initial HTTP response and HTML code. Because malicious web pages import exploits from remote resources and hide exploit code, static attributes characterizing these actions can be used to identify a majority of malicious web pages. Combining high-interaction client honeypots and this new classification method into a hybrid system leads to significant performance improvements.

Challenges and Recent Advances in QoS Provisioning, Signaling, Routing and MAC Protocols for MANETs

Shivanajay Marwaha, Jadwiga Indulska, Marius Portmann; University of Queensland, Australia

Mobile Ad hoc Networks (MANET), which comprise of mobile nodes connected wirelessly, are emerging as a very important technology for future generation of wireless networking. MANETs are being used in numerous application domains from emergency rescue and relief to wireless sensor networks. Quality of Service (QoS) provisioning in MANETs is of utmost importance in order to support real-time communications (such as audio and video) over MANETs. However, QoS provisioning in highly mobile wireless networks such as MANETs is a very challenging problem compared to provisioning of QoS in wired IP networks. The main reasons behind this being unpredictable node mobility, wireless multi-hop communication, contention for wireless channel access, limited battery power and range of mobile devices as well as the absence of a central coordination authority in MANETs. Previous QoS surveys in MANET have only looked at QoS provisioning models, signaling and routing. This paper presents a complete survey of the challenges and current state of the art of QoS protocols being developed for MANET across multiple network layers as well as the various MANET QoS signaling and QoS models being developed.

Categorized Multimedia Information Sharing Service in IMS

Xiao Wang; Alcatel-Lucent Technologies, China

A new SIP event package called information-category is proposed based on the SIP event notification framework. With this event package an information sharing service is provided in IMS with SIP signaling. The end user could subscribe to interested information categories with SUBSCRIBE, get information from information sharing application server with NOTIFY, and post information with PUBLISH message. A method is provided to let information-category subscribers share multimedia information. Some basic SIP event notification extensions are analyzed to show the new event package is compliant with the existing event package family. With this new service SIP users could get seamless access to community-based and user-generated content on various devices in IMS network.

Evolutionary Multi-Channel Management Based on Mobility in Multi-Hops Heterogeneous Wireless Networks

Ming-Shen Jian[1], Shu-Hui Hsu[2]; [1]Shu-Te University, Taiwan; [2]International Megatrend Smart Technology Ltd, Taiwan

This paper develops an evolutionary multiple channel management based on mobility in multiple hop wireless network. The n-hops limitation theories are proposed first. Based upon these theories, the enhanced multiple channel management is proposed which consists of channel assignment method and topology prediction method. The channel assignment method is based on the en-hanced genetic algorithm. Mobile devices are assigned different data channels individually and can be directly established without any RES message cost. All mobile nodes can communicate based upon the assigned potential channels. Also, due to the change of topology of all mobile devices, a topology prediction method is proposed to predict the velocities and directions of all mobile nodes. Simulation shows that the proposed management can make the success communication about 9.7~129.3% more than the competing algorithm.

Causal Multi Quantile Noise Spectrum Estimation for Speech Enhancement

Mohsen Farhadloo[1], Abolghasem Sayadian[1], Meysam Asgari[1], Ali Mostafavi[2]; [1]Amirkabir University of Technology, Iran; [2]University of Birmingham, UK

Suppression of additive noise from speech signal is a fundamental problem in audio signal processing. We present in this paper a novel algorithm for single channel speech enhancement. The algorithm consists of two steps: First, estimation of the noise power spectrum with a multi quantile method and second, elimi-nation of the estimated noise from the observed signal by spectral subtraction or Wiener filtering. In this method, instead of a global quantile for all frequency bands, we divide the entire frequency band into three regions and use different quantile in each region. Our simulation results show that the new method has better performance than quantile based noise estimation.

A Scheme of Relay Server Selection Methods for NAT Traversal Through Home Gateways

Toshinori Takabatake; Shonan Institute of Technology, Japan

As technologies of computer network have been advanced, appli-ances as well as personal computers being networked together

in the home have been connected to the Internet. However, the number of IP addresses in IPv4 is estimated to be not enough in the near future. IPv4 has been thus switched with IPv6. Meanwhile, Network Address Translator (for short, NAT) has been used for solving the lack of the IP addresses. On the other hand, since a communication from the Internet to the private or home networks in NAT is difficult, many NAT traversal techniques have been developed as the solution. One of the NAT traversal techniques is that of "relaying". However, the relaying techniques have a drawback such that the relay server can be overloaded according to an increase in the number of communications. In this paper, as NAT traversal in a home gateway which is connected the home to the Internet, a scheme to balance the load by several relay servers and by a surveillance one is presented and two relay server selection methods are proposed. The proposed methods are a random selection and a priority-based one. Simulation results show that the load makes it possible to balance well in inverse proportion to the relay servers by the proposed methods.

Double-Layered Mobile P2P Systems Using Energy-Efficient Routing Schemes

Jung-Suk Han, Jin-Woo Song, Taek-Hun Kim, Song-Bong Yang; Yonsei University, Korea

As the mobile technology advances, various mobile peer-to-peer (P2P) systems have been developed. Since mobile devices have limited energy capacity, efficient use of the energy is indispensable for mobile P2P systems. In this paper, we propose an energy-efficient P2P system that is a type of the double-layered P2P systems in which files are searched mainly through the peers in the upper level, called super peers. The proposed system selects greedily the peers with more energy as super peers. The peers in the proposed system can identify themselves as super peers or sub-peers autonomously in a decentralized manner. We also propose three energy-efficient routing schemes, each of which is incorporated with the proposed system individually. The first routing scheme tries to utilize the energy of the peers on the routes more evenly, the second scheme chooses a route with the 'strongest' peer among the peers each of which is the 'weakest' peer on a route, and the last scheme selects a route with the second scheme among the routes with the smallest number of hops. Note that a routing scheme is applied each time when a route between a pair of super peers is chosen during the message transmission. Functionality and performances were evaluated through various experiments, and the results showed that the proposed P2P system with the third routing scheme improved the average network lifetimes by 368% and 22% over the double-layered and the proposed systems without applying any proposed scheme, respectively.

Digital Signal Processing for a Ka Band Satellite Beacon Receiver / Radiometer

Cornelis J. Kikkert, Owen P. Kenny; James Cook University, Australia

This paper describes the Digital Signal Processing (DSP) techniques required to ensure that a Ka band Satellite Beacon Receiver / Radiometer remains locked to the satellite beacon and provide a measure of both the sky noise and the attenuation caused by rain to satellite signals. To enable the receiver to stay locked to satellite beacon signals with received power levels between -110 dBm and -170 dBm, a receiver with an ultra low phase noise, an absence of spurious signals and using advanced Digital Signal Processing (DSP) techniques is required.

Performance Improvement of Cooperative Relaying Scheme Based on OFCDM in UWB Channel

Jung-In Baik, Jee-Hoon Kim, Jin-Hyuk Song, Hyoung-Kyu Song; Sejong University, Korea

Orthogonal frequency and code division (OFCDM) provides a good performance on broadband or wide-band channel, because it can mitigate multi-path interference with keeping high data rate. So, this scheme is suitable to employ the future wireless communication system. And, Cooperative relaying scheme has been proposed to get the spatial diversity gains in multiuser wireless systems. Because, this scheme need no multiple antenna, it makes devices with low cost and small size. In this paper, we proposed the cooperative relaying scheme based on OFCDM. This

system has profit of OFCDM and cooperative relaying schemes. It is also not much more complex the single antenna OFCDM system. This scheme is appropriate to the next generation mobile wireless system, because of having both advantage. The performance of the proposed scheme is evaluated in terms of bit error rate (BER) performance for the OFCDM in the UWB channel.

Wireless Communications 1

Joint Time-Domain/Frequency-Domain Impulsive Noise Reduction in OFDM-Based Power Line Communications

Khalifa Al-Mawali, Amin Z. Sadik, Zahir M. Hussain; RMIT University, Australia

Impulsive noise is one of the major challenges in power line communications and can cause serious problems in OFDM-based PLC systems. In this paper, we propose a combined Time-domain/Frequency-domain technique for impulsive noise reduction in OFDM-based PLC systems. The performance of the proposed technique is studied against well known time-domain nonlinearities by means of computer simulations. The obtained simulation results show that the Combined TD/FD technique performs better than practically used nonlinearities and can reduce the adverse effect of impulsive noise significantly.

A Recursive Single Parity Check Product Code with Non-Gaussian Fixed Weight Distribution

In Jun Park, Tongsok Kim, Yong Cheol Kim; University of Seoul, Korea

In iterated product of single parity check (SPC) codes, weight distribution is an important factor for the performance against transmission errors. A product code with Gaussian weight distribution should have a good performance. We present a closed-form solution for the weight distribution of a recursive SPC product code. We show that the code weights for this code are symmetrically distributed at $(N \pm \sqrt{N})/2$, where N is the full-length of a codeword. Though this code does not have a Gaussian weight distribution, it has better performance than conventional product codes. When soft-output iterative decoding is applied, the performance is away from the Shannon capacity limit by only 0.95 dB. Hence, we conclude that Gaussian weight distribution is not a necessary condition for a good performance.

Alternative Subspace Method for Improved Blind Channel Estimation in Uplink Zero Padded MC-DS/CDMA Systems

Deolinda Fontes Cardoso [1], Fabian David Backx [2], Raimundo Sampaio-Neto [2]; [1]CASNAV, Brazil; [2]PUC-Rio, Brazil

This work investigates the problem of uplink blind channel estimation in Zero Padded Multi Carrier Direct Sequence Code Division Multiple Access (MC-DS/CDMA-ZP). Using only the spreading code of the user of interest, our method explores the orthogonality of the signal and noise subspaces in conjunction with power techniques to estimate the Channel State Information (CSI) from the received data sequence. We also present an improved channel estimator that relies on the assumption that all the relevant multipath components of the channel impulse response lie within the guard interval duration. Simulations of mean square error and bit error rate performances demonstrate the robustness of the proposed scheme, and for moderate-to-high signal to noise ratios the presented method achieves performance comparable to existing subspace techniques but at a softer computational cost.

Gaussian Random Fields as a Model for Spatially Correlated Log-Normal Fading

Daniel Catrein, Rudolf Mathar; RWTH Aachen University, Germany

Slow fading or shadowing on a wireless channel is commonly modeled by stochastically independent, log-normally distributed random variables. However, as slow fading is caused by buildings and large size obstacles, spatial correlations occur. In this paper,

Gaussian random fields are used as a model for correlated slow fading in urban environments. An exponential correlation function is employed. The according parameters are estimated from path gain predictions by an accurate ray-optical propagation algorithm, named CORLA. Furthermore, a multidimensional model is suggested to describe correlated shadowing of the path gains from different base stations to a single receiver.

Mixed Wireless Topics 1

Radiation Losses from a Single Wire Earth Return Power Line with Bends

Cornelis J. Kikkert, Geoffrey D. Reid; James Cook University, Australia

It is desirable to use existing Single Wire Earth Return (SWER) lines for data communication as well as transmitting power in remote areas. The radiation losses of the communication signal is a critical system design parameter. Existing radiation models are not adequate since they assume: firstly that the antenna is a small number of wavelengths long and secondly that the currents along the line are constant, so that no power lost in radiation. The model presented here overcomes these limitations. The model shows that bends in the SWER line significantly effect both the radiated power and the radiation patterns.

Indoor Propagation Measurements for Performance Evaluation of IEEE 802.11g

Nurul I. Sarkar, Eric Lo; Auckland University of Technology, New Zealand

Using indoor propagation measurements, the throughput performance of an IEEE 802.11g wireless local area network (WLAN) under different received signal strength (RSS) values is investigated. By using a pair of wireless laptops and an access point (AP) we conducted several experiments involving IEEE 802.11g computer links, which were carried out in an obstructed office block at the AUT University within the School of Computing and Mathematical Sciences office building. Results obtained show that the link throughput of an IEEE 802.11g is not always increasing with RSS in an obstructed office building.

Bluetooth Information Exchange Network

Linda Xiaoning Liu, Adnan Al-Anbuky; AUT University, New Zealand

The paper discusses the development of a Bluetooth based information exchange network (BIEN). The network is based on the Bluetooth scatternet idea and governed by set of additional rules that helps regulating the information traffic. The architecture has been prototyped and tested on a typical network. Early investigation to the throughput on different piconet and scatternet size has yielded good results. The work presented here is an attempt at implementation of a distributed multi-hop scatternet with an integrated routing protocol. While the literature focuses on covering the modeling, this work focuses on the implementation.

SiPiA: The Shortest Distance to Positive Ideal Attribute for Interface Selection

Phuoc Nguyen Tran, Nadia Boukhatem; TELECOM ParisTech, France

Once a mobile node is equipped with multiple interfaces, it is possible to select dynamically the best interface according to different attributes such as the interface characteristics, user preferences, application preferences, . . . In this paper, we propose the shortest distance to positive ideal attribute (SiPiA) algorithm to help terminal to dynamically select the best interface while avoiding the raking abnormality problem, one of the main limits of the TOPSIS method. Simulation results are presented to validate the SiPiA approach.

Ad-Hoc Networks 1

Characterising the Interactions Between Unicast and Broadcast in IEEE 802.11 Ad Hoc Networks

Jerry Chun-Ping Wang, Daniel R. Franklin, Mehran Abolhasan, Farzad Safaei; University of Wollongong, Australia

This paper investigates the relative performance of unicast and broadcast traffic traversing a one-hop ad hoc network utilising the 802.11 DCF. An extended Markov model has been developed and validated through computer simulation, which successfully predicts the respective performance of unicast and broadcast in a variety of mixed traffic scenarios. Under heavy network traffic conditions, a significant divergence is seen to develop between the performance of the two traffic classes — in particular, when network becomes saturated, unicast traffic is effectively given higher precedence over broadcast. As a result, the network becomes dominated by unicast frames, leading to poor rates of broadcast frame delivery.

Self-Restraint Admission Control for Adhoc WLANs

Hushairi Zen, Daryoush Habibi, Iftekhar Ahmad; Edith Cowan University, Australia

Admission control is an important mechanism for sustaining throughput and supporting quality of service (QoS) for real-time traffic in a wireless local area network (WLAN). In an adhoc WLAN scenario where no access point (AP) is available, admission control has to be self-managed by each node. We propose a self-restraining admission control mechanism that works by monitoring the congestion level of the network in the adhoc WLAN. Wireless nodes can listen to all nodes within their range and be aware of the collision rates. A node wishing to join the network measures the current collision rate, and predicts the post-admission collision rate, on the basis of which the self-restraining mechanism in the node decides if it can join the network. We analyse the impact of key parameters, such as the collision threshold level, on the performance of the self-restraining mechanism and show that this mechanism works effectively in sustaining traffic in an adhoc WLAN.

A Cross-Layer Approach for Using Multiple Radio Channels with Directional Beams in a Suburban Ad Hoc Network

Sk. Mohammad Rokonuzzaman, Ronald Pose, Iqbal Gondal; Monash University, Australia

The capacity of wireless ad hoc networks can be increased by using multiple radio channels. But due to interference the capacity is still not fully utilized. This is caused by the limited number of available radio channels. The interference problem can be reduced using directional beams instead of omni-directional beams. This paper presents a novel cross-layer approach to use multiple radio channels with directional antennas. We are using three different radio channels. Each node has three fixed directional beams having fixed beamwidth and with different radio frequency. Two nodes can communicate when both the sending and receiving beams are pointing towards each other using the same frequency channel. In this study the directions of beams cannot be changed dynamically. A modified version of Ad hoc On-demand Distance Vector (AODV) routing protocol has been used. Simulation results show that our approach outperforms other methods using three different radio channels with omni-directional antennas.

Power and Placement: Increasing Mobile Adhoc Network Capacity and Power Efficiency

Robert A. Hunjet; DSTO, Australia

There is great interest in using mobile adhoc networks (MANETs) for military and civilian applications. There are still a lot of interesting problems investigating the capacity and the optimal design of these networks. This paper looks at one of these outstanding problems. Specifically the problem addressed is to determine how the capacity of a MANET can be increased by the optimal placement of an additional dynamic node in a power efficient manner. This node is envisaged to be a platform whose primary purpose is to increase the capacity and power efficiency of the MANET.

Given a specific network configuration the optimal location of an additional node is investigated. This node insertion is teamed with power adjustments of all the nodes carried out in a manner consistent with topology control. This approach is then compared to topology control methods not using an additional node. The simulations performed show that the technique described can significantly decrease the jamming experienced within a MANET, thereby increasing the network's capacity. Additional benefit is also observed in the power usage of the MANET falling, thereby increasing the operational lifetime of the network. From the results obtained it will be inferred that a simple distributed algorithm to find the optimal point is not a trivial exercise.

Wireless Communications 2

Power Savings Analysis of Clipping and Filtering Method in OFDM Systems

Arun K. Gurung, Fawaz S. Al-Qahtani, Amin Z. Sadik, Zahir M. Hussain; RMIT University, Australia

The clipping and filtering method is analyzed in terms of power savings. The analysis takes account of the gain in the amplifier efficiency due to Peak-to-Average-Power-Ratio (PAPR) reduction. Assuming a linear amplifier and a typical digital signal processor, the power savings is shown to be in the order of Watts.

Reduced Complexity Combined Soft-Decision MLSE Equalization and Decoding

H.C. Myburgh, L.P. Linde; University of Pretoria, South Africa

A Maximum Likelihood Sequence Estimation (MLSE) combined equalizer and decoder with soft-decision decoding performance, that has a computational complexity superior to that of conventional MLSE equalization, is proposed. Its performance is compared to a system containing a soft-output Viterbi MLSE equalizer followed by a soft-decision Viterbi MLSE decoder. It is shown via computer simulation that the proposed algorithm's performance matches that of conventional soft-decision decoding, while eliminating the use of a decoder in the receiver, for frequency-selective Rayleigh fading channels.

A Real-Time Input Data Buffering Scheme Based on Time Synchronization for a T-DMB Software Baseband Receiver

Jeong Han Jeong, Moohong Lee, Byungjik Keum, Jungkeun Kim, Young Serk Shim, Hwang Soo Lee; KAIST, Korea

To decode a broadcasting signal such as a T-DMB signal using a software baseband receiver running on a digital signal processor (DSP), real-time input data buffering is important. A time offset of each received frame, which is caused by a difference in the sampling frequency between the transmitter and the receiver, makes input buffer management difficult, eventually resulting in the performance deterioration of the receiver. This work proposes an input data buffering scheme based on a ring buffer for a T-DMB software baseband receiver running on a DSP. The time offset of each received frame is estimated by a time synchronization block using a phase reference symbol and is used by a buffer controller to control the ring buffer so that the receiver on the DSP always reads valid data for data decoding. The validity of the proposed scheme is confirmed by showing that the ring buffer never goes into an overflow state when buffering the input data with a time-varying time offset. Thus, the specified receiver performance is guaranteed over time.

Compressed Sensing Using Chaos Filters

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Compressed sensing, viewed as a type of random undersampling, considers the acquisition and reconstruction of sparse or compressible signals at a rate significantly lower than that of Nyquist. Exact reconstruction from incompletely acquired random measurements is, under certain constraints, achievable with high probability. However, randomness may not always be desirable in certain applications. Taking a nonrandom approach using deterministic chaos and following closely a recently proposed novel efficient structure of chaos filters, we propose a chaos filter structure by exploring the use of chaotic deterministic processes in designing the filter taps. By numerical performance, we show that, chaos filters generated by the logistic map, while being possible to exactly reconstruct original time-sparse signals from their incompletely acquired measurements, outperforms random filters.

Sensor Networks

Automatic Placement of Actors Within Wireless Sensor-Actor Networks

Sami J. Habib; Kuwait University, Kuwait

This work explores the automatic placement of actors within wireless sensor-actor network through an evolutionary approach. A wireless sensor network (WSN) consists of two sets of nodes: sensors and actors, where the set of sensors performs all the sensing (data collection) from their surrounding environment. Since sensors operate by batteries, then they are limited with their processing and communication capabilities due to the short life-span of the batteries. On the other hand, the set of actors has more capabilities with extended life-span batteries, and their roles are to collect and process the raw data from the sensors to determine the next action for WSN. The actor placement problem is to select a minimal set of actors and their optimal locations in WSN keeping in mind the communication requirements between sensors and actors. We have encoded the actor placement problem into the evolutionary approach, where the objective function is to find the minimal total number of actors covering as many sensors as possible subject to budgetary and performance constraints. The experimental results demonstrate the feasibility of our evolutionary approach in covering 77% of 61 sensors by three actors within an area of 375 meters by 375 meters.

A Hybrid Distance-Measurement/Angle-of-Arrival Approach to Localization

Sunit Kumar Ghosh, Michael J. Ryan, Michael R. Frater; UNSW@ADFA, Australia

Localization has received considerable attention because many wireless sensor network applications require accurate knowledge of the locations of the sensors in the network. The two main localization techniques are distance measurement and angle-of-arrival measurement. The former requires extensive calculations to resolve sign ambiguities in calculated angles, while the latter requires careful calibration to provide high accuracy. In this paper, we describe a hybrid technique, in which low-accuracy estimates of the angle-of-arrival are used to resolve the sign ambiguity in distance measurements. In many practical situations, the ambiguity can be resolved with a high probability of success even with an RMS error as high as 30 degrees in the line-of-bearing estimate, which avoids the need for calibration. Early resolution of this sign ambiguity can be used to develop lower-complexity localization techniques using distance measurement.

Source Localisation in Wireless Sensor Networks Based on Optimised Maximum Likelihood

M. Ziaur Rahman, Daryoush Habibi, Iftekhar Ahmad; Edith Cowan University, Australia

Maximum Likelihood (ML) is a popular and effective estimator for a wide range of diverse applications and currently affords the most accurate estimation for source localisation in wireless sensor networks (WSN). ML however has two major shortcomings namely, that it is a biased estimator and is also highly sensitive to parameter perturbations. An *Optimisation to ML* (OML) algorithm was introduced that minimises the sum-of-squares bias and exhibits superior performance to ML in statistical estimation, particularly with finite datasets. This paper proposes a new model for acoustic source localisation in WSN, based upon the OML estimation pro-

cess. In addition to the performance analysis using real world field experimental data for the tracking of moving military vehicles, simulations have been performed upon the more complex source localisation and tracking problem, to verify the potential of the new OML-based model.

Optimizing Sensor Identification in Long-Delay Networks to Account for Maximum Frame Size and Variations in Propagation Speed

Md. Shafiul Azam Howlader, Michael R. Frater, Michael J. Ryan; UNSW@ADFA, Australia

Long-delay networks (LDNs) are networks in which the propagation wave speed is lower than that of radio waves, such as in underwater acoustic networks (UANs). The number of nodes is normally large in such a sensor network and the number may very due to different factors such as power failure or environmental disasters. An identification procedure is needed in this network to observe which nodes are currently operational and a large amount of time can be wasted in every probe of the procedure due to the long propagation delay. Optimizing the number of probes improves the identification time and power consumption by 75% and 60% respectively in both the slotted and un-slotted cases [1]. While optimizing the number of probes for the long delay, the frame size (the time within which the nodes send their packets) increases due to the lower offered load. In this work we show that even with the limitation of the maximum frame size our procedure works well. One of the limitations of LDNs is the variation of the propagating wave speed. We observe that if the standard deviation of the propagation speed is approximately less than $1/e$ of the packet size then the identification procedure for the slotted case is better than that for the un-slotted case. In order to alleviate the effect of variation in propagation speed we use a guard time in the slotted case. Furthermore we show that with propagation speed variation and guard time, when the number of neighbors is not known to the probing node, an estimation of that number needed to optimize the throughput of identification procedure can only be found with the empty spaces in the frame, i.e. it is independent of the speed variation.

Ad-Hoc Networks 2

Dynamic Topology Control Scheme in MANETs for AODV Routing

Anahita Naghshegar [1], Amir Darehshoorzadeh [2], Arash Dana [1], Mehdi Dehghan [3]; [1] Islamic Azad University, Iran; [2] Iran University of Science & Technology, Iran; [3] Amirkabir University of Technology, Iran

The topology of wireless multihop ad hoc networks can be controlled by varying the transmission power of each node. Topology control is the problem of changing node's transmission power in ad hoc networks so it maintains a specified network topology while minimizing energy consumption and increasing life time. In this paper, we changed the criteria of choosing neighbors in neighbor-based topology control XTC over AODV routing for mobile ad hoc networks and evaluated the effect of them with different parameters.

Ripple Effect: An Improved Geographic Routing with Local Connectivity Information

Ming Li; Deakin University, Australia

One of the key challenges in geographic routing is how to deal with dead-ends, where greedy routing fails to find a neighbor node which is closer to the destination. Most existing geographic routing algorithms just switch to the deterministic face routing or limits its face searching range. In this paper, we demonstrate that we can improve routing performance by considering local connectivity status at each node before making routing decision. We present a protocol, Density Ripple Exchange (DRE), that maintains local density information at each node, and a new geographic routing algorithm, Geographic Ripple Routing (GRR), that achieves better routing performance in both hop stretch and transmission stretch than existing geographic routing algorithms by exploiting

available connectivity information. Our simulations demonstrate that we increased the performance for GRR over Greedy Perimeter Stateless Routing (GPSR) by about 15%. The cost of this improved performance is a small amount of additional local connectivity information required for our algorithm.

Autoconfiguration for Peer-to-Peer Mobile Ad-Hoc Networking

Wolfgang Fritsche; IABG, Germany

Mobile ad-hoc networking is used in many peer-to-peer networking scenarios. The applications for those are already numerous and are increasing day by day. Examples range from connecting sensor networks over the connection of radios from emergency services to the connection of different vehicles in order to perform collision detection. Many of these applications have one common property – the requirement for autoconfiguration. Either the networked devices have no human interface for performing configuration tasks, as it is the case for sensor networks, or the users don't have the expertise and time to perform configuration tasks, as it is the case for emergency services. This Industry Presentation discusses more detailed the requirements for autoconfiguration in peer-to-peer mobile ad-hoc networking and proposes first solutions.

The full text of this Industry Presentation is available at the end of this abstract book.

A Model of Autonomous Motion in Ad Hoc Networks to Maximise Area Coverage

J. Göbel [1], A.E. Krzesinski [2]; [1] University of Hamburg, Germany; [2] University of Stellenbosch, South Africa

Ad hoc networks are self-configuring networks of mobile nodes, connected by wireless links. Suppose each mobile node can make observations within a circular area of radius r_{obs} centred on its own location. The area coverage of the network is defined as the total area observed by the mobile nodes. We investigate a distributed scalable method based on local interactions with minimal sensing and low computational cost whereby the nodes move autonomously (self-deployment) in order to maximise the coverage of the network, while at the same time ensuring that the mobile nodes do not move so far away from each other (thus trivially maximising the coverage) that they become disconnected. Certain nodes may be instructed to move to specified locations. These guide nodes induce a correlated movement of groups of nodes which follow the guide nodes and establish maximal coverage in the specified locations. Simulation results demonstrate the coverage achieved by a group of 100 nodes when moving on an unbounded plane (optional guide nodes induce a collective motion to areas of interest) and when moving on a bounded plane with barriers or hills.

Wireless Communications 3

On the Spectral Efficiency for Selection Combiner Diversity (SCD) Over Slow Fading

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In this paper we derive closed-form expressions for the single-user capacity of selection combining diversity (SCD) system, taking into account the effect of imperfect channel estimation at the receiver. The channel considered is a slowly varying spatially independent flat Rayleigh fading channel. The complex channel estimate and the actual channel are modelled as jointly Gaussian random variables with a correlation that depends on the estimation quality. Two adaptive transmission schemes are analyzed: 1) optimal power and rate adaptation; and 2) constant power with optimal rate adaptation. Our numerical results show the effect of Gaussian channel estimation error on the achievable spectral efficiency.

Capacity and Power Control in Spread Spectrum Macro-Diversity Radio Networks Revisited

Virgilio Rodriguez, Rudolf Mathar, Anke Schmeink; RWTH Aachen University, Germany

Macro-diversity — all base stations decode cooperatively each received signal — can mitigate shadow fading, and increase the capacity of a spread-spectrum communication network. Assuming that a terminal's transmission power contributes to its own interference, the literature determines whether a vector of quality-of-service targets is feasible through a simple formula, which is insensitive to the terminals' channel gains. Herein, through Banach' contraction-mapping principle — and without the self-interference approximation — a new low-complexity capacity formula is derived. Through its dependence on *relative* channel gains, the new formula adapts itself in a sensible manner to special conditions, such as when most terminals can only be heard by a subset of the receivers. Under such conditions, the original may significantly overestimate capacity.

User and Transmit Antenna Selection for MIMO Broadcast Wireless Channels with Linear Receivers

M. Arif Khan[1], Rein Vesilo[1], Linda M. Davis[2], Iain B. Collings[3]; [1]Macquarie University, Australia; [2]University of South Australia, Australia; [3]CSIRO, Australia

This paper considers a signalling scheme for a multi-user wireless broadcast system where the base station has multiple transmit antennas and users can have multiple receive antennas. Independent data streams are transmitted in this system by allocating different transmit antennas to different selected users where multiple transmit antennas may be allocated to each selected user. The signalling scheme is used to select the particular users to receive data in a transmission block and to allocate transmit antennas to those users. We examine two partial feedback schemes for selecting users: one that we call norm-based and the other that we call SINR-based. We also present a novel transmit-antenna selection scheme for allocating multiple transmit antennas to selected users based on the Gram-Schmidt orthogonalisation algorithm. The signalling scheme presented in this paper reduces the amount of channel information required by the base station. We study the performance of the user selection and transmit-antenna selection schemes when linear receivers are used at the receiver side for decoding the transmitted signal. In particular, we consider zero-forcing (ZF) and minimum mean square-error (MMSE) receivers. We examine the sum capacity performance of the system compared to schemes with no feedback and using random antenna selection. We show that the best performance is achieved with norm-based user selection, Gram-Schmidt antenna selection and MMSE receivers.

Mobility Management

How to Improve the Efficiency of IPv6 Handovers in IEEE 802.16 Networks

Tomasz Mrugalski, Jozef Wozniak; Gdansk University of Technology, Poland

The first generation of fully conformant IEEE 802.16-based networks is being deployed throughout the world. Most of these networks do not support full mobility, due to radio access layer limitations. Newer solutions, based on IEEE 802.16-2005 standard, offer mobility support for subscriber stations. Unfortunately, after quickly changing the point of attachment on the WiMAX layer, very slow and inefficient IPv6 reconfiguration takes place. Delays introduced by DHCPv6 stateless automatic configuration and Mobile IPv6 can easily diminish or even render useless all benefits gained using the efficient WiMAX — data link layer. IPv6 automatic configuration process was not designed with fast reconfiguration in mind. As handover speed is a crucial requirement in mobile cellular environments, reasons behind delays introduced by IPv6 layer mechanisms have to be analyzed and appropriate countermeasures applied. Proposals include novel use of DHCPv6 relays for remote configuration, solving DAD delays, limiting Binding Update procedure in Mobile IPv6, configuring routing through DHCPv6 communication and some other.

This paper describes all stages of full IPv6 handover in IEEE 802.16 environment, focusing on major reasons of reconfiguration delays. A new metric for assessing impact of every stage on handover efficiency is defined. Several proposed improvements to the IPv6 handover process are evaluated and simulation results are presented. A discussion regarding possible generalization of best

improvement proposals and further research areas concludes this paper.

Instant Handoffs for Wireless Infrastructure Meshed Networks

Alexander A. Kist; University of Southern Queensland, Australia

Infrastructure meshed networks provide access to wireless clients that do not participate in traffic forwarding. This paper proposes Minimalist Instant Handoff for wireless Access Networks (MIHAN), allowing for seamless movement of nodes in coverage areas, while maintaining connectivity. The approach of MIHAN is that all client frames, send in radio range of an access node, are received and forwarded to a central gateway. The node removes duplicate packets and tracks the network attachment of wireless clients. MIHAN relies on standard medium access control and a TCP/IP protocol stack. It is transparent to and does not require any special support, in the clients. Only limited configuration changes are necessary in the access nodes; all routing and tracking is handled by the gateway. Advantages include instant handoffs, no changes to access points and protocols and the simplicity of the solution. The paper introduces the scheme, provides details on various implementation options and gives simulation results that show the operation. Proof of concept implementation and some test results are presented.

Evaluation of Wireless Mesh Network Handoff Approaches for Public Safety and Disaster Recovery Networks

Ryan Wishart[1], Marius Portmann[2], Jadwiga Indulska[2]; [1]NICTA, Australia; [2]University of Queensland, Australia

In Public Safety and Disaster Recovery (PSDR) scenarios, reliable communication is often imperative. Unfortunately, communication infrastructure is often destroyed or overwhelmed by whatever precipitated the scenario (e.g., a hurricane or terrorist attack). Thus, the PSDR workers must often deploy their own communications infrastructure on-site. Wireless mesh networks (WMN) have been identified as being ideally suited to this task. WMN offer a high-capacity wireless backhaul network, provided by mesh routers, through which clients can connect to one another or with external networks. Mobility of clients within the mesh is particularly important for Public Service and Disaster Recovery scenarios. This creates a challenging problem as clients may move out of range of the mesh router they were using to connect to the mesh and need to associate with another. Client handoff mechanisms provide this functionality. In this paper we provide a critical survey of client handoff approaches applicable to IEEE 802.11 WMN evaluating them based on the strict QoS requirements established by the US Department of Homeland Security for PSDR networks.

Wireless Communications 4

On Multi-Channel MAC Protocols in Cognitive Radio Networks

Alvin Kok-Lim Yau, Peter Komisarczuk, Paul D. Teal; Victoria University of Wellington, New Zealand

Cognitive Radio (CR) exploits underutilized licensed spectrums to improve its bandwidth availability. Using CR technology, a node is able to adapt its transmission and reception radio parameters including channel frequency dynamically according to local spectrum availability. For channel access between wireless nodes, a cognitive Medium Access Control (MAC) protocol is necessary to coordinate the CRs. Multi-channel MAC protocol extensions have been proposed in IEEE802.11 to enable a node to operate in multiple channels in order to improve network-wide throughput. These multi-channel MAC protocols have several functions that can be leveraged by cognitive MAC protocols due to their similarities in certain aspects, though the CR has an additional requirement to cope with the existence of licensed users that have higher authority over the channels. Current research in cognitive MAC protocols assumes the availability of a common control channel at all times, which is an approach in the multi-channel MAC protocols. This approach has certain hardware requirements that may not

be readily available at CR nodes. Hence, other approached may be necessary. In this paper, various types of multi-channel MAC protocols are reviewed, followed by discussion of their merits and demerits in multi-channel environments. The purpose is to show the additional functionalities and challenges that each multi-channel MAC protocol has to offer and address in order to operate in multihop CR networks. By providing discussion on possible technology leverage from multi-channel to cognitive MAC protocols, we aim to establish a foundation for further research and discussion.

C^2net: A Cross-Layer Quality of Service (QoS) Architecture for Cognitive Wireless Ad Hoc Networks

Alvin Kok-Lim Yau, Peter Komisarczuk, Paul D. Teal; Victoria University of Wellington, New Zealand

Cognitive Radio (CR) improves utilization of the overall radio spectrum through dynamic adaptation to local spectrum availability. In CR networks, unlicensed or Secondary Users (SUs) may operate in underutilized spectrum owned by the licensed or Primary Users (PUs) conditional upon PU encountering acceptable interference levels. A Cognitive Wireless Ad Hoc Network (CWAN) is a multihop self-organized and dynamic network that applies CR technology. The research into Quality of Service (QoS) in CWAN is still in its infancy. To date, no attempt has been made to model a QoS architecture as a unified solution for CWAN and so this is the focus of this paper. We present a novel QoS architecture called C^2net for CWAN based on a cross-layer approach. C^2net provides service prioritization to different traffic types in the presence of nodal mobility and PUs. The main objective is to provide stable QoS assurance to high priority flows. This is realized by a number of distributed features of C^2net including topology management, congestion control, scheduling, and dynamic channel selection. The purpose of this paper is twofold. Firstly, to present the architectural framework based on Next Steps in Signaling (NSIS) for C^2net. Secondly, to discuss the challenges and open issues posed by the intrinsic complexities of CWAN to spark new research interests in this field.

An Improved FEC Scheme for Mobile Wireless Communication at Vehicular Speeds

Iftekhar Ahmad, Daryoush Habibi, M. Ziaur Rahman; Edith Cowan University, Australia

WiMAX has emerged as a promising wireless communication technology with potential to deliver high throughput and guaranteed quality of service to the end applications. Recent studies suggest that while WiMAX (802.16e) is capable of delivering a data rate of up to 75 Mbps for fixed wireless communications, data rate decreases drastically for mobile wireless communications, often providing a data rate less than 1 Mb/s when the mobile nodes travel at vehicular speeds. High bit error rate caused at high vehicular speeds is the key reason for low throughput. In noisy mobile communication environments, standard error control mechanisms like the transmission control protocol (TCP) has limited and often detrimental impacts on the overall throughput because of the excessive retransmission overheads. To address this issue, WiMAX standard incorporates forward error correction (FEC) mechanism that eliminates the need for retransmissions. In FEC, extra parity bits are added to the original message to recover the corrupted information. Adaptive FEC that adjusts the size of extra parity bits in response to packet retransmission requests is an enhancement over standard FEC that uses fixed block of party bits. Existing adaptive FEC schemes, however, have limited efficiency when the end terminal moves at vehicular speeds. In this paper, we propose a new FEC scheme that estimates and adjusts the size of extra parity bits to suit the channel conditions. We apply the concept of interval based data sampling to address the dynamic nature of communication environments at high vehicular speeds. We simulate the proposed scheme for a centralized live video surveillance system in a public train where the train is the mobile node and sends real-time video data to the base stations on train platforms. The results show that the proposed scheme achieves significantly higher throughput and lower jitter compared to other standard schemes.

Mixed Wireless Topics 2

Modelling QoS in a Tactical Data Links Network

Dushy Tissainayagm[1], Nick Warner[1], Andrew Coyle[1], Arthur Filippidis[2], Mario Gencarelli[2]; [1]University of Adelaide, Australia; [2]DSTO, Australia

If new IP enabled waveforms are introduced to the tactical environment the nature of the communications systems will evolve. Multiple systems will operate with one another to deliver efficient, secure diverse applications across different platforms. The Internet Protocol can be used to bind together the different platforms and technologies to create a common network. In this environment the protocols working at the different OSI layers must combine to create a seamless communication's link between source and destination. Modelling of the interactions between these protocols to ensure that the system requirements for the network's traffics are met is vital. Limited bandwidth, a dynamically changing environment, and the need for tight security all complicate the ability to create a network to handle the network's traffic.

A software tool has been created to analyse the tactical military environment. This software tool will realistically characterise the radio communication environment in the tactical battlespace. From this the quality of service between any platform or testbed/ node can be calculated. These results can then be used to add more realism in a tactical exercise by replacing the ethernet connection between various nodes with realistic link propagation characteristics due to geographic, atmospheric and other signal to noise ratio effects. The software tool will also allow an analyst to replace an existing tactical link between nodes with various future links in order to compare the effects of the different technologies on data transfer.

This talk will introduce some basic tactical data links and will show how the software tool can be used to help analyse the capability of these links in a tactical environment.

Improving Mobile Sensor Connectivity Time in the IEEE 802.15.4 Networks

Kartinah Zen, Daryoush Habibi, Iftekhar Ahmad; Edith Cowan University, Australia

In the IEEE 802.15.4 medium access control (MAC) protocol for wireless sensor networks, a sensor node needs to associate with a coordinator before it starts sending or receiving data. The sensor node will mostly choose the nearest coordinator to associate with. However, this method is not suitable for a constantly moving sensor node because it will end up switching coordinators too often due to short connectivity time. The IEEE 802.15.4 has a simplistic and inadequate method of choosing a coordinator in this context. In this paper, we introduce a method to increase the mobile sensor node connectivity time with its coordinator in IEEE 802.15.4 beacon-enabled mode. Our method is based on the timestamp of the beacons received from the nearby coordinators and filtering weak beacon signals. By choosing the coordinator which has sent the most recent received beacon with good signal quality, we increase the moving node connectivity time with the coordinator. Our technique results in significant improvement by reducing the number of times the moving node switches coordinators. This increases the throughput and reduces the wasted power in frequent associations.

Adaptive Emitting Power Control Protocol for Wireless Sensor Networks

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Since sensor nodes are energy constrained devices, optimizing the energy efficiency of Wireless Sensor Networks (WSNs) is a key issue. In this paper we present a new, simple and easy to implement protocol to reduce the energy consumption of nodes. The purpose of the proposed algorithm is to monitor the transmission power of sensor nodes while communicating. The algorithm has been studied, analyzed and then implemented on the nodes. The quantitative and qualitative analysis present similar results, and with the proposed solution a reduction of 50% of the energy spent in the transmis-

sion process compared with the standard specifications has been achieved.

Traffic and QoS 1

Servicing Best Effort Traffic Using nrtPS on Fixed WiMAX

Shehan Perera, Harsha Sirisena; University of Canterbury, New Zealand

IEEE 802.16 is a wireless metropolitan area broadband access technology which provides layer two service differentiation for many types of traffic flows. In this paper the transport of uplink best effort traffic from the subscriber to the base station is considered. The performance of best effort service class is analyzed and compared with non-real-time polling service class which can also be used for low priority flows such as file transfer and web traffic. We propose performance enhancements and modifications to increase the efficiency of the nrtPS class. Namely using a dynamic polling period based on the activity on the connection, using dummy keep alive messages when inactive and releasing idle connections to conserve bandwidth.

FoF-R Ant: Ant-Based Survivable Routing Scheme for Shared Path Protection

William Liu, Harsha Sirisena, Krzysztof Pawlikowski; University of Canterbury, New Zealand

This paper proposes a novel framework to solve the survivable routing problem with shared path protection in a distributed control environment. The work mainly concerns how to dynamically determine a protection cycle (i.e., two link-disjoint paths between a source-destination node pair) and allocate spare capacity for a connection establishment request so as to minimize total bandwidth consumption in the network. This is known as the Spare Capacity Allocation (SCA) problem and its resulting Integer Linear Programming (ILP) formulation is known to be NP-hard. This paper tackles the SCA problem using a new matrix-based model and a heuristic algorithm, termed Friend or Foe - Resilient (FoF-R) ant-based routing algorithm. First, a new concept of Resilience Matrix (RM) is introduced to capture the local bandwidth usage information and investigate the relationship between a failed link and other links with protection capacity allocated. Next, based on the special link cost derived from the RM, the novel FoF-R ant-based routing algorithm, which is inspired by the principle of ant colony optimization, is developed to find the optimal protection cycles and explore the sharing ability among protection paths using a headroom-dependent attraction/repulsion function. By keeping a suitable number of mobile agents (i.e., FoF-R ants) in a network to continually and proactively update the RMs, the survivable routing solution for a connection request can be obtained within a reasonable computation time. Simulation results based on the OMNeT++ tool show that the FoF-R scheme with the distributed RM structure is a promising approach to solve the survivable routing problem and it has a good trade off between solution optimality and computation speed.

Adaptive Window Flow Control in MPLS Networks Using Enhanced Kalman Filtering

Napasool Wongvanich, Harsha Sirisena; University of Canterbury, New Zealand

This paper presents an adaptive sliding window flow control protocol for MPLS networks, based on estimating the available link bandwidth using Kalman Filtering enhanced by Bias Estimation. An optimal control algorithm is then implemented that minimizes the variance of queue length deviations from the desired target. The simulation results show that, with bias estimation, the bandwidth estimate converges much faster than with ordinary Kalman filtering. We also achieve the goal of maximizing the bandwidth link utilization efficiency while minimizing the packet loss rate.

An Intelligent Model to Control Preemption Rate of Instantaneous Request Calls in Networks with Book-Ahead Reservation

Iftekhar Ahmad [1], Joarder Kamruzzaman [2], Daryoush Habibi [1], Farzana Islam [3]; [1] Edith Cowan University, Australia; [2] Monash University, Australia; [3] Asian Institute of Technology, Thailand

Resource sharing between Book-Ahead (BA) and Instantaneous Request (IR) reservation often results in high preemption rate of on-going IR calls. High IR call preemption rate causes interruption to service continuity which is considered as detrimental in a QoS-enabled network. A number of call admission control models have been proposed in literature to reduce the preemption rate of on-going IR calls. Many of these models use a tuning parameter to achieve certain level of preemption rate. This paper presents an Artificial Neural Network (ANN) model to dynamically control the preemption rate of on-going calls in a QoS-enabled network. The model maps network traffic parameters and desired level of preemption rate into appropriate tuning parameter. Once trained, this model can be used to automatically estimate the tuning parameter value necessary to achieve the desired level of preemption rate. Simulation results show that the preemption rate attained by the model closely matches with the target rate.

Network Services and Applications 1

A Study of the Effect of Using Kademlia as an Alternative to Centralized User Location Servers in SIP-Based IP Telephony Systems

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Some proposals are found on the literature for decentralizing SIP-based Voice over IP (VoIP) systems, replacing the client-server architecture for a P2P overlay network but none of the proposed solutions deploying a P2P network had studied the impacting of decentralization on call setup delay. We proposed a system using Kademlia instead of a centralized user location approach. Kademlia offers concurrent searches and this improves the latency in user location and thus provide a faster call establishment when the network experiences different delays, as showed in this study. In this paper it is also described how the system using Kademlia works as well as the tests performed in order to measure the impact on call establishment time when decentralizing a user location service on an IP telephony system.

On Path Switching in Overlay Networks

Aun Haider [1], Akihiro Nakao [2]; [1] NICT, Japan; [2] University of Tokyo, Japan

This paper investigates the stability characteristics of overlay networks performing switching between multiple virtual paths. A global stability condition for switched-control-systems has been applied to overlay path switching frequency, that can be incorporated into design of better routing protocols for overlay networks. Further, NS-2 based simulations have been carried out on an overlay network to evaluate the impact of round-trip-time, packet loss probability and throughput metrics on decisions regarding path selection. Throughput based switching decisions have shown to be resulting in lower number of path changes, which is desirable. Also, it has been observed that delay and loss based metrics can result into a large number of frequent path changes, which can push the overlay routing system into an unstable oscillating state for a prolonged period of time.

Relay Path Selection Approaches in Peer-to-Peer VoIP Systems

Quang Duc Bui, Andrew Jennings; RMIT University, Australia

Multipath overlay routing technologies are seen as alternative solutions for VoIP because they inherit path diversity from peer-to-peer overlay networks. We discuss and compare the performances of two relay path selection approaches proposed for VoIP overlay systems through extensive simulations. We propose a new method for

relay path computation that takes into account both path disjoint-edness and other network quality factors (such as packet delay or loss). We further apply our method in different overlay network scenarios by varying the supernode distribution. It is found that there is a considerable improvement of path performance when re-laying traffic through highly connected ASs using the new method.

Performance Evaluation and Improvement of Hybrid TCP Congestion Control Mechanisms in Wireless LAN Environment

Masafumi Hashimoto, Go Hasegawa, Masayuki Murata; Osaka University, Japan

In this paper, we first evaluate the performance of recent TCP vari-ants for high-speed and long-delay networks in IEEE 802.11 wire-less LAN environment through simulation experiments. We show that some of them still have well-known TCP unfairness property between uplink and downlink flows, and that there is another un-fairness problem among uplink flows caused by the loss-based be-havior of hybrid TCP variants. We then propose an end-to-end-basis modification to TCP congestion control mechanisms to alleviate the unfairness problems, which activates the congestion control when detecting ACK packet losses. Through simulation experiments, we present that the proposed method is effective not only for TCP fairness among uplink flows but also for fairness between uplink and downlink flows, while keeping the total throughput to be large enough.

Network Services and Applications 2

Reputation System for User Generated Wireless Podcasting

Liang Hu[1], Lars Dittmann[1], Jean-Yves Le Boudec[2]; [1]Technical University of Denmark, Denmark; [2]ETH Zürich, Switzerland

The user-generated podcasting service over mobile opportunistic networks can facilitate the user generated content dissemination while humans are on the move. However, in such a distributed and dynamic network environment, the design of efficient content forwarding and cache management schemes are challenging due to the lack of global podcast channel popularity information at each individual node. We design a distributed reputation system at each node for estimating the global channel popularity information which is significant for forwarding and cache management decision. Our simulation result shows that, compare to History-based Rank scheme, our reputation system can significantly improve system performance under Community-based Random Way-Point (C-RWP) mobility model and localized channel popularity distribution.

Measuring Available Bandwidth: pathChirp's Chirp Train Structure Remodeled

Shan Suthaharan, Surender Kumar; University of North Carolina at Greensboro, USA

Measuring available bandwidth over a network path is required by many applications including end-to-end admission control and server selection. In order to measure the available bandwidth, the end hosts need network information, such as packet delay, at in-termediate systems. Several techniques have been proposed to ad-dress this problem. We have selected the most recently proposed algorithm called pathChirp and proposed an alternative approach. The main goal of pathChirp is to get the delay information at the in-termediate systems by using the concept of self-induced congestion (which uses chirp train packets) in order to estimate the available bandwidth. However there are scenarios where pathChirp cannot provide accurate available bandwidth. We use the pathChirp mech-anism as our underlying tool and modify its structure of chirp train. In the modified structure, the rate of the odd inter-chirp packet will be the same as the rate of previous even inter-chirp packet. Addi-tionally, rate of inter-chirp packets will be increased exponentially with even power rather than both even and odd power as done in pathChirp scheme. Purpose of this new structure is to capture more network information using three different time-shifted chirp trains, and subsequently to find a better estimate for the available band-width. Our theory and simulation results support this claim.

Bandwidth Optimization for Mobile Thin Client Computing Through Graphical Update Caching

B. Vankeirsbilck, Pieter Simoens, Jeroen De Wachter, Lien Deboosere, Filip De Turck, Bart Dhoedt, Piet Demeester; Ghent University, Belgium

This paper presents graphical update caching as a mechanism to reduce the network load generated by thin client computing sys-tems. In such system, the user interaction and processing are sepa-rated by a network. User input such as keystrokes and mouse clicks are sent to the server over the network and graphical updates are transported the reverse way. The cache proposed in this article is static, meaning that it is composed before the thin client computing session starts and that the cache does not change during the ses-sion. Through experiments with an implementation of the cache, we show that graphical update caching effectively reduces the net-work load generated by thin client computing.

Design and Implementation of a Hybrid Remote Display Protocol to Optimize Multimedia Experience on Thin Client Devices

Pieter Simoens, Paul Praet, B. Vankeirsbilck, Jeroen De Wachter, Lien Deboosere, Filip De Turck, Bart Dhoedt, Piet Demeester; Ghent University, Belgium

In a thin client computing architecture, application processing is delegated to a remote server rather than running the application locally. User input is forwarded to the server, and the rendered im-ages are relayed through a dedicated remote display protocol to the user's device. Existing remote display protocols have been success-fully optimized for applications with only minor and low-frequent screen updates, such as a spreadsheet or a text editor. However, they are not designed to cope with the fine-grained and complex color patterns of multimedia applications, leading to high band-width requirements and an unresponsive user interface. In this ar-ticle, a hybrid remote display protocol approach is presented. The existing Remote FrameBuffer protocol of Virtual Network Comput-ing (VNC-RFB) protocol is leveraged with a video streaming mode to transport the rendered images of multimedia applications to the client. Dependent on the amount of motion in the images to be presented, the images are relayed to the client either through the VNC-RFB protocol or through video streaming in the H.264 format. The architecture of this hybrid image renderer is presented and the implementation is detailed. Furthermore, the decision heuristic to switch between the VNC-RFB and the streaming mode is discussed. Experimental results clearly show the advantage of the hybrid ap-proach in terms of client CPU and bandwidth requirements.

Traffic and QoS 2

Comparative Study of M/M/1 and M/D/1 Models of a SIP Proxy Server

Sureshkumar V. Subramanian[1], Rudra Dutta[2]; [1]Cisco, USA; [2]North Carolina State University, USA

In recent years, transmission of packets over internet has been a real alternative to the traditional Public Switched Telephone Networks (PSTN). The Internet Protocol (IP) offers more flexibility in the de-sign and implementation of features and services. The Session Ini-tiation Protocol (SIP) is a commonly adopted signaling protocol for Voice over IP (VoIP) by many telecommunication industries. Since the signaling system of PSTN, Signaling System Number 7 (SS7) was designed for high reliability, but IP works on the "Best Effort" ba-sis which motivated us to study the performance characteristics of SIP control plane. In this paper, we studied an M/M/1 perfor-mance model of the SIP Proxy Server, showed its limitations, and designed an alternative M/D/1 performance model that enhances the SIP Proxy Server performance.

Minimization of Error in Pitch Detection Algorithm Using Discrete Fractional Cosine Transform

Md. Kamrul Hasan, Md. Lutful Kabir; Bangladesh University of Engineering & Technology, Bangladesh

A novel Discrete Fractional Cosine Transform implementation for pitch estimation of noisy speech using dominant harmonic is intro-

duced in this paper. The basic idea is to preprocess the speech signal with discrete fractional cosine transform before using the rectified dominant harmonic for signal reshaping. The performance of the proposed method is tested and compared with the latest previous method using keele pitch extraction reference database. Comparative results show that the proposed method can detect pitch with better accuracy in terms of gross and fine pitch error as compared to the latest technique.

Voice Activity Detection Using Entropy in Spectrum Domain

Meysam Asgari[1], Abolghasem Sayadian[1], Mohsen Farhadloo[1], Elahe abouie Mehrizi[2]; [1]Amirkabir University of Technology, Iran; [2]University of Birmingham, UK

In this paper we develop a voice activity detection algorithm based on entropy estimation of magnitude spectrum. In addition, the likelihood ratio test (LRT) is employed to determine a threshold to separate of speech segments from Non-speech segments. The distributions of entropy magnitude of clean speech and noise signal are assumed to be Gaussian. The application of the concept of entropy to the speech detection problem is based on the assumption that the signal spectrum is more organized during speech segments than during noise segments. One of the main advantages of this method is that it is not very sensitive to the changes of noise level. Our simulation results show that the entropy based VAD is high performance in low Signal to Noise Ratio (SNR) conditions (SNR < 0 dB).

Spatialized Teleconferencing: Recording and 'Squeezed' Rendering of Multiple Distributed Sites

Eva Cheng[1], Bin Cheng[1], Christian Ritz[1], Ian S. Burnett[2]; [1]University of Wollongong, Australia; [2]RMIT University, Australia

Teleconferencing systems are becoming increasing realistic and pleasant for users to interact with geographically distant meeting participants. Video screens display a complete view of the remote participants, using technology such as wraparound or multiple video screens. However, the corresponding audio does not offer the same sophistication: often only a mono or stereo track is presented. This paper proposes a teleconferencing audio recording and playback paradigm that captures the spatial location of the geographically distributed participants for rendering of the remote soundfields at the users' end. Utilizing standard 5.1 surround sound playback, this paper proposes a surround rendering approach that 'squeezes' the multiple recorded soundfields from remote teleconferencing sites to assist the user to disambiguate multiple speakers from different participating sites.

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