

David Johnson
Principle Researcher – Meraka Institute – CSIR – South Africa
Adjunct Senior Lecturer – University of Cape Town – South Africa

Personal Details

Full Name	David Lloyd Johnson
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Education

1991-1995: BSc Electronic Engineering, University of Cape Town
Distinction in final year thesis – Sound synthesis using Genetic Algorithms
Graduated December 1995

2003-2004: Honors Computer Engineering, University of Pretoria
Distinctions in Computer networks, Research methodology and Digital design (Distinction average)

2005-2007: Masters Computer Engineering, University of Pretoria
Topic: “Performance Analysis of mesh networks in indoor and outdoor wireless testbeds”
Graduated September 2008 with distinction

2008-2012: Masters Computer Science Department, University of California, Santa Barbara
Graduated June 2012: GPA average: 3.9 (max 4.0)

2008-2013: PhD Computer Science department, University of California, Santa Barbara
Topic “Re-architecting Internet access and wireless networks for developing regions”
Graduated March 2013

General Experience

1996 – 1999: CSIR – Icomtek - Information Delivery Software group (software engineer)

2000 – 2002: CSIR – Meraka Institute - various groups dealing with wireless connectivity (Telecommunications engineer)

2003 – 2005: CSIR – Meraka Institute – Mobile Platform technology (Technical group leader)

2005 – 2007: CSIR – Meraka Institute – Wireless Africa (Research leader)

2008 – 2013: University of California, Santa Barbara – Computer Science Department– Teaching assistant, Research assistant, PhD degree coursework and research

2013 – Present: CSIR – Meraka Institute – Research group leader for new research group:

2014 – Present: UCT – Computer Science Department, Adjunct senior lecturer: teaching an honours course on wireless networks in developing regions and supervising masters and PhD students

I have 18 years experience in software and telecommunications engineering research and development with key skills in software design, RF engineering, radio planning, operating systems, programming in Linux and embedded environments, networking in rural areas, network traffic pattern analysis, mesh networks, Bluetooth, WiFi, OpenBTS-based GSM and White space networks. I have taught and tutored various courses at universities in South Africa and the US over the past 11 years. I also have 11 years experience in leading small teams (up to 7 employees or students) of developers/researchers in cutting edge wireless technology projects and research.

Current Position and responsibilities

I am currently leading a new research group, Cognitive Radios for Emerging Regions (CORE) within the Networks and Media group at Meraka that focuses on developing cognitive radios and white space technology for rural developing/emerging regions.

The objective of this group is to develop a series of white space radio prototypes based on cognitive radio technology for rural broadband access. Prototypes and pilots will be used to showcase the impact of Cognitive radios and white spaces in South Africa to the regulator and the Department of Communications. This research group has a narrow window of opportunity until 2016 when the official DTV switch-over will occur. After this date, TV white spaces may become available as license-exempt spectrum in South Africa for wireless service providers on a secondary use basis where spectrum may be used if terrestrial TV broadcasters are not using the spectrum in a specific area.

I also hold an adjunct senior lecturer position in the Computer Science Department of the University of Cape Town. I teach an honours course on Networking in Developing Regions and supervise PhD and Masters students that focus on wireless networking research with a specific focus on Dynamic Spectrum Access networks.

Past Responsibilities

I have led various teams of researchers and developers since 2003. In 2003, I was appointed as a Technical group leader of the Mobile Platform Technology group to oversee the direction of various mobile technologies with a specific focus on applications for Bluetooth. During this period I led a team that developed various Bluetooth products including a Bluetooth heart rate tracker, a Bluetooth-based mortar firing system, a Bluetooth HF radio audio gateway and a Bluetooth assistive communication device.

In 2005, I began to focus on research related to wireless networking for rural areas with an emphasis on wireless mesh networking. Students were appointed on a Studentship program and I was placed in charge of leading the research direction for this group as well as overseeing the students research. I acted as a research group leader for a group of approximately 7 students until 2008. During this period I helped define a three-year road map for the research team, assisted with topic identification for post graduate studies, completed the construction of an indoor 7x7 wireless mesh test bed (one of 3 such test beds in the world) and built the first rural wireless mesh network in South Africa in Peebles valley,

a rural area near White river. These outputs were used for numerous research papers and blueprints for future wireless mesh networking work that are now part of current government-funded mesh networking projects such as BB4All.

In 2008, I was offered a scholarship to do a PhD in the USA at UCSB¹ in computer science with a group interested in wireless mesh networks and rural connectivity. I left in August, 2008 to begin my PhD studies at UCSB. During my tenure at UCSB, apart from my courses and research work, I was instrumental in helping establish a new research area in ICT for development in the MOMENT lab of the Computer Science department of UCSB . I was involved in writing funding proposals in this specific field. I contributed to Villagenet - A \$1.2 million NSF proposal funded in 2010 and Immunet – a \$100000 Bill and Millinda Gates foundation project . I also co-supervised 3 masters students and 2 PhD students in the research lab I was working in. My PhD degree was conferred in March 2013.

¹ UCSB is ranked 5th best research university in the world based on Mean normalized citation score and 7th best in the world based on the proportion of the publications to the top 10% most frequently cited. (<http://www.leidenranking.com/ranking.aspx>).

Publications

1995

- Honours Thesis: Final year Electronic Engineering thesis on Sound synthesis using a genetic algorithm

2004

- Conference paper: D.L. Johnson, Hardware and software implications of creating Bluetooth Scatternet devices, 2004 IEEE Africon conference

2005

- Conference paper: A. Smith, D.L. Johnson, Y.Kaka, Initial research results on affordable community-owned information networks in South Africa, 2005 Community Informatics Research Network (CIRN) conference

2006

- Conference paper: D.L. Johnson, Y. Kaka, J. Hay, A new grid based test bed environment for carrying out ad-hoc networking experiments, 2006 Southern African Telecommunications Networks and Applications Conference (SATNAC). (Poster for conference)
- Workshop poster: D.L. Johnson, The quest to connect 450 million rural people in Africa, 2006 Association for Progressive Communication workshop in London sponsored by the IDRC

2007

- Conference paper: D.L. Johnson, A. Lysko, Overview of the Meraka wireless grid test bed for evaluation of ad-hoc routing protocols, 2007 Southern African Telecommunications Networks and Applications Conference (SATNAC) (Presentation for conference)
- Journal paper: D.L. Johnson, A. Lysko, Comparison Of MANET Routing Protocols Using A New Grid Based Test Bed Environment, Special issue on "Advances in Wireless Mesh Networks" of the Journal of special issues on Mobility of Systems, Users, Data and Computing (MONET), Springer US
- Conference paper: D.L. Johnson, Evaluation of a single radio rural mesh network in South Africa, IEEE/ACM International Conference on Information and Communication Technologies and Development (ICTD2007) (Poster for conference)

2008

- Masters thesis: Performance analysis of mesh networks in indoor and outdoor wireless testbeds

- Conference paper: D.L. Johnson, C. Aichele, N.Ntlatlapa, A simple pragmatic approach to mesh routing using BATMAN, 2nd IFIP International Symposium on Wireless Communications and Information Technology in Developing Countries (WCITD'2008)
- Conference paper: D.L. Johnson, K. Roux 2007, Building rural wireless networks: Lessons learnt and future directions, Wireless Networks and Systems for Developing Regions (WiNS-DR'2008)
- Conference paper: A.A. Lysko, D.L. Johnson, A Numerical Study of Propagation Effects in a Wireless Mesh Test Bed, The 6th WSEAS Int. Conf. on Applied Electromagnetics, Wireless and Optical Communications (Electroscience '08)

2009

- Journal paper: D.L. Johnson, G.P. Hancke, Comparison of two routing metrics in OLSR on a grid based mesh network, Ad Hoc Networks, Elsevier
- Journal paper: A.A. Lysko, D.L. Johnson, A Study of Propagation Effects in a Wireless Test Bed, WSEAS Transactions on Communications

2010

- Conference paper: D.L. Johnson, E.M. Belding, K. Almeroth, G. van Stam, Internet usage and performance analysis of a rural wireless network in Macha, Zambia, 4th ACM Workshop on Networked Systems for Developing Regions (NSDR 2010)
- Conference paper: P.A.K. Acharya, D.L. Johnson, E.M. Belding, Gateway-aware Routing for Wireless Mesh Networks, 4th IEEE International Workshop on Enabling Technologies and Standards for Wireless Mesh Networking (MeshTech 2010)

2011

- Conference paper: D.L. Johnson, V. Pejovic, E.M. Belding, G. van Stam, Traffic Characterization and Internet Usage in Rural Africa, 20th International World Wide Web Conference (WWW 2011)
- Conference paper: M.T. Masonta, D.L. Johnson, M. Mzyece, The White Space Opportunity in Southern Africa: Measurements with Meraka Cognitive Radio Platform, 3rd International ICST Conference on e-Infrastructure and e-Services for Developing Countries (AFRICOMM)

2012

- Conference paper: D.L. Johnson, V. Pejovic, E.M. Belding, G. van Stam, Network traffic locality in a rural African village, IEEE/ACM International Conference on Information and Communication Technologies and Development (ICTD2012)
- Conference paper: A. Anand, V. Pejovic, E.M. Belding, D.L. Johnson, VillageCell: Cost Effective Cellular Connectivity in Rural Areas, IEEE/ACM International Conference on Information and Communication Technologies and Development (ICTD2012)
- Conference paper: D.L. Johnson, V. Pejovic, E.M. Belding, G. van Stam

VillageShare: Facilitating content generation and sharing in rural networks, 2nd Annual Symposium on Computing for Development (ACMDEV2012)

- Journal paper: V. Pejovic, D. L. Johnson, M. Zheleva, E. M. Belding, L. Parks, and G. van Stam, The Bandwidth Divide: Obstacles to Efficient Broadband Adoption in Rural Sub-Saharan Africa International Journal of Communication
- Conference paper: G. van Stam, D. L. Johnson, V. Pejovic, C. Mudenda, A. Sinzala, and D. van Greunen, Constraints for Information and Communications Technologies implementation in rural Zambia Africomm 2012
- Conference paper: A. Lysko, D.L. Johnson, M.O.R. Mofolo, Significant Performance Improvement Obtained in a Wireless Mesh Network Using a BeamSwitching Antenna, 2012 Southern African Telecommunications Networks and Applications Conference (SATNAC)

2013

- Conference paper: M. Zheleva, A. Paul, D.L. Johnson, and E.M. Belding, Kwiizya: Local cellular network services in remote areas, Mobisys'13
- Conference paper: C. Mudenda, D.L. Johnson, L. Parks, G. van Stam, Power Instability in Rural Zambia, Case Macha, 5th International ICST Conference on e-Infrastructure and e-Services for Developing Countries (AFRICOMM)
- Conference paper: D.L. Johnson, E.M. Belding, C. Mudenda, Kwaabana: file sharing for rural networks, 4th Annual Symposium on Computing for Development (ACMDEV2013)
- PhD thesis: Re-architecting Internet Access and Wireless Networks for Developing Regions, University of California, Santa Barbara (dissertation, defence presentation)

2014

- Conference paper: V. Pejovic, D.L. Johnson, M. Zheleva, E.M. Belding, and A.Lysko, VillageLink: Wide-area Wireless Coverage, 6th International Conference on Communications Systems and Networks (COMSNETS 2014)
- Book: A.K. Mishra, D.L. Johnson, White Space Communication: Advances, Developments and Engineering Challenges, Springer International Publishing, November 2014
- Book chapter: A. Lysko, M.T. Masonta, D.L. Johnson, The Television White Space Opportunity in Southern Africa: From Field Measurements to Quantifying White Spaces, White Space Communication. Springer International Publishing, 2014. pp. 75-116
- Book chapter: V. Pejovic, D.L. Johnson, M. Zheleva, E.M. Belding, VillageLink: A Channel Allocation Technique for Wide-Area White Space Network, White Space Communication, Springer International Publishing, 2014, pp. 249-280
- Conference paper: A. Lysko, M.T. Masonta, M.R.O. Mofolo, L. Mfupe, L. Montsi, D.L. Johnson, F. Mekuria, D.W. Ngwenya, N.S. Ntlatlapa, A. Hart, C. Harding, A. Lee, First large TV white spaces trial in South Africa: A brief overview, Ultra Modern

Telecommunications and Control Systems and Workshops (ICUMT), 2014

- Conference paper: S. Dlamini, M.T. Masonta, D.L. Johnson, Building an argument for Internet expansion in Dwesa - an under-serviced rural community in South Africa, International ICST Conference on e-Infrastructure and e-Services for Developing Countries (AFRICOMM 2014)

Citations

Extracted from <http://scholar.google.co.za/citations?user=88B0Yj0AAAAJ&hl=en>

<u>Citation indices</u>	All	Since 2011
<u>Citations</u>	640	531
<u>h-index</u>	14	14
<u>i10-index</u>	17	14

<u>Title</u> 1–20	Cited by	<u>Year</u>
Simple pragmatic approach to mesh routing using BATMAN D Johnson, N Ntlatlapa, C Aichele	97	2008
Comparison of two routing metrics in OLSR on a grid based mesh network D Johnson, G Hancke Ad Hoc Networks 7 (2), 374-387	93	2009
Evaluation of a single radio rural mesh network in South Africa D Johnson Information and Communication Technologies and Development, 2007. ICTD 2007 ...	54	2007
VillageCell: Cost effective cellular connectivity in rural areas A Anand, V Pejovic, EM Belding, DL Johnson Proceedings of the Fifth International Conference on Information and ...	40	2012
Traffic characterization and internet usage in rural Africa DL Johnson, V Pejovic, EM Belding, G Van Stam Proceedings of the 20th international conference companion on World wide web ...	40	2011
Internet usage and performance analysis of a rural wireless network in Macha, Zambia DL Johnson, EM Belding, K Almeroth, G van Stam Proceedings of the 4th ACM Workshop on Networked Systems for Developing ...	36	2010
The white space opportunity in Southern Africa: Measurements with Meraka cognitive radio platform MT Masonta, D Johnson, M Mzyece e-Infrastructure and e-Services for Developing Countries, 64-73	27	2012
Network traffic locality in a rural African village DL Johnson, EM Belding, G Van Stam Proceedings of the fifth international conference on information and ...	26	2012
Comparison of MANET routing protocols using a scaled indoor wireless grid D Johnson, A Lysko Mobile Networks and Applications 13 (1-2), 82-96	24	2008
Building rural wireless networks: Lessons learnt and future directions	22	2008

<u>Title</u> 1–20	Cited by	<u>Year</u>
DL Johnson, K Roux Proceedings of the 2008 ACM workshop on Wireless networks and systems for ...		
<u>VillageShare: Facilitating content generation and sharing in rural networks</u> DL Johnson, V Pejovic, EM Belding, G van Stam Proceedings of the 2nd ACM Symposium on Computing for Development, 7	<u>21</u>	2012
<u>Building a Rural Wireless Mesh Network</u> D Johnson, K Matthee, D Sokoya, L Mboweni, A Makan, H Kotze Meraka Institute. African Advanced Institute for Information ...	<u>19</u>	2007
<u>Broadband Adoption The Bandwidth Divide: Obstacles to Efficient Broadband Adoption in Rural Sub-Saharan Africa</u> V Pejovic, DL Johnson, M Zheleva, E Belding, L Parks, G van Stam International Journal of Communication 6, 25	<u>17</u>	2012
<u>Kwiizya: local cellular network services in remote areas</u> M Zheleva, A Paul, DL Johnson, E Belding Proceeding of the 11th annual international conference on Mobile systems ...	<u>16</u>	2013
<u>A study of propagation effects in a wireless test bed</u> AA Lysko, DL Johnson WSEAS Transactions on Communications 7 (8), 857-871	<u>12</u>	2008
<u>Building a Rural Wireless Mesh Network: A do-it-yourself guide to planning and building a Freifunk based mesh network</u> D Johnson, K Matthee, D Sokoya, L Mboweni, A Makan, H Kotze Meraka Institutue	<u>10</u>	2007
<u>Overview of the Meraka wireless grid test bed for evaluation of ad-hoc routing protocols</u> D Johnson, AA Lysko	<u>10</u>	2007
<u>Constraints for Information and Communications Technologies implementation in rural Zambia</u> G van Stam, D Johnson, V Pejovic, C Mudenda, A Sinzala, ... e-Infrastructure and e-Services for Developing Countries, 221-227	<u>9</u>	2013
<u>FSL based estimation of white space availability in UHF TV bands in Bergvliet, South Africa</u> AA Lysko, MT Masonta, DL Johnson, H Venter	<u>8</u>	2012
<u>Hardware and software implications of creating Bluetooth Scatternet devices</u> D Johnson AFRICON, 2004. 7th AFRICON Conference in Africa 1, 211-215	<u>8</u>	2004

Paper reviews

Between 2009 and 2015, I carried out 26 reviews in International conferences and journals. This included 6 International conferences (2 of which are top International conferences in the field – Mobicom and Sigcomm) and 3 highly-ranked peer reviewed journals (IEEE Transactions on Mobile Computing, ACM Transactions on Parallel and Distributed Systems and IEEE Communications magazine)

2009

- PC ExtremeCom 2009 – Technical Programme Committee member (4 papers)
 - Delay-Tolerant Social Networking
 - Secure authentication and key agreement protocol for Bluetooth using Identity-based encryption
 - Goose: Social Network Services for developing worlds
 - An N4C DTN Router Node Design

2010

- Transactions on Mobile Computing 2010 (1 paper)
 - On The Design of Opportunistic MAC Protocols for Multi-hop Wireless Networks with Beamforming Antennas

2011

- Africon 2011 Technical Programme Committee member (5 papers)
 - Optimal Power allocation for Secondary users in CR networks
 - Performance of a Hidden Markov Channel Occupancy Model for Cognitive Radio
 - Dynamic Spectrum Access In Cognitive Radio Networks
 - Adaptive Transmit-Power Control Scheme for Cognitive Radios
 - IEEE 802.11 OFDM Software Defined Radio Beacon Frame Transmission
- Mobicom 2011 (1 paper)
 - Optimizing Movement and Connectivity in Mobile Networks With Partial Cooperativeness

2012

- Mobicom 2012 (1 paper)
 - PaL: A System for Passive and Local Link Assessments in 802.11 Wireless Networks

2013

- Sigcomm 2013 (3 papers)
 - Ambient Backscatter: Wireless Communication Out of Thin Air
 - Transmit only: An Ultra Low Overhead MAC Protocol for Dense Wireless Systems
 - BigBand: Cheap GHz-Wide Sensing and Decoding on Commodity Radios

- IST-Africa 2013 (1 paper)
 - Internetwork Dual SIM GSM Mobile-Controlled Handover
- ACM Transactions on Parallel and Distributed Systems (1 paper)
 - Cross-Layer Design with Optimal Dynamic Gateway selection for Wireless Mesh Networks

2015

- ACM DEV 2015 (7 papers)
 - Understanding Fiado: Informal credit in Brazil
 - LoRUS: A Mobile Crowdsourcing System for Developing Regions to Efficiently and Scalably Retrieve the Top-k Spatially Relevant Users
 - Leveraging Smartphones to Monitor Attendance in Public Facilities
 - ShonaBondhu: A Sensor-based System to Handle Flash Flood
 - Towards a 2-way communication and analytics platform for emergency response and post-emergency recovery efforts in Sierra Leone
 - Code Generation on Mobile for Mobile Apps
 - Stigma, Community and the Accessibility Infrastructure

2016

- IEEE Communications magazine
 - The TUCAN3G project: Wireless technologies for isolated rural communities in developing countries based on 3G small-cell deployments
 - Towards Enabling Broadband for a Billion Plus Population with TV White Spaces

Invited talks

- 2007: California - Nokia USA, UCSB, UCSC, UCDavis: [A presentation tour of California on the South African Wireless Africa programme on mesh networking](#)
- 2011: California - UCSB: [Presentation to undergraduates on Engineering for Social Change](#)
- 2013: Malawi – Africomm: [Presentation of White Space communication - current research and trials and future outlook for Africa.](#)
- 2015: London – ACMDEV, [Presentation on TV White Spaces in South Africa,](#)

External examiner or Research rating review

- 2008: Masters Thesis by Kevin Duff at Rhodes University
- 2008-2013: Examiner for a number of undergraduate computer science courses at UCSB
- 2014: Reviewed National Research Foundation application for a research rating in Computer Science
- 2015: PhD Thesis: Performance evaluation of Low Cost Smart Mesh Networks

Student supervision and mentoring

- 2005-2008: Co-supervised 4 masters students and 2 PhD students registered at South African universities while leading the Wireless Africa research programme
- 2008-2012: Co-supervised 3 masters students registered at University of California, Santa Barbara while completing my PhD at UCSB
- 2015: Supervising 3 PhD students, 1 Masters student on TV White space mesh networks, mobile phone data usage and localized clouds at UCT. I also hired a Post-Doc at UCT to work on TV white spaces and channel selection strategies.

Serving on steering committees and TPCs

- Sweden: ExtremeCom 2009 Technical programme committee
- France: Mobile and Wireless Networks Security (MWNS) 2009.
- Zambia: Africon 2011 - co-organized a special session on cognitive radio at Africon 2011, the first research forum on the topic in Africa – two of the papers submitted to the session received "the best paper" award at Africon 2011
- London: ACMDEV Technical Programme Committee 2015
- Cotonou, Benin: Africomm Steering committee 2015
- Addis Ababa, Ethiopia: Africon Technical Programme Committee 2015
- ACMDEV Technical Programme Committee 2016
- GAIA workshop Technical Programme Committee 2016

Contributing to standards

- Contributing author for IETF Global Access to the Internet for All Internet Draft, <http://www.ietf.org/id/draft-manyfolks-gaia-community-networks-02.txt>

Influencing trends in R&D at a national level (South Africa)

Between 2004 and 2007, I was a key initiator of wireless mesh networking research and development in Meraka and amongst other SA Universities. My early research and trials and experiments with mesh networking protocols eventually became part of the mesh networking devices that are used in many national level projects such as the BB4All project. Through our studentship programme with Tshane University of Technology, University of Johannesburg, Rhodes University, University of Zululand and University of Pretoria, I was able

guide many students on mesh networking topics and provide research leadership for University programmes around the country interested in mesh network research; many of these programs continue today.

Between 2013 and 2015 I was a key contributor to the broadband expansion strategies in South Africa for the Eastern Cape province and for the country as a whole. My role was to come up with innovative ways to expand fibre to all public facilities (schools, clinics, libraries etc.) in the country to match the National Broadband targets, where all public facilities are connected by 2020.

Leading formation of R&D strategies

In 2007, I oversaw the development of a 3 year research and development road map for wireless mesh networking research that was be undertaken by researchers and developers in the Wireless Africa programme of Meraka. In 2012 I developed the strategy for a new research group, “Cognitive Radios for Emerging Regions” in the Networks and Media competency area of Meraka.

At UCSB I contributed much of the technical content for a large \$1.2 million multidisciplinary research grant that spanned computer science and media studies. I also played a key leadership role in providing a bridge between UCSB and a rural network in Zambia – facilitating the complex interplay of culture and technology in the project.

Teaching experience

Visiting lectures given at South African Universities

- [2004: Bluetooth lecture for post-graduate course on network security at University of Pretoria](#)
- [2004: Bluetooth lecture for wireless symposium at Tshwane University of Technology](#)
- [2004: Wifi lecture for wireless symposium at Tshwane University of Technology](#)

Course presented at Meraka Institute

- [2005: uClinux \(embedded linux\) course](#)
 - Day 1: Survey of embedded operating systems - why uClinux, The uclinux environment - the directory structure
 - Day 2: Using the configuration tools for the kernel and user applications, Adding user application to uClinux
 - Day 3: The cross compiling tool chain (gcc, as, ld, objdump, objcopy), Memory architecture of the arm7tdmi processor - configuring uclinux for the arm
 - Day 4: To "Boot loader" or not to "Boot loader, Hardware access and device drivers
 - Day 5: Debugging applications with gdb, Downloading applications to the development kit using JTAG
- **2007:** How to build a Mesh network - Training for Linknet Zambia - DIY guide on which training was based is available [here](#).
- [2009: Indoor massive mesh network and Click router tutorial](#)
 - Day 1: Learning the massive mesh lab toolset
 - Day 2: The click modular router
- [2011: 8 week course on Unix C/C++ programming](#)
 - Week 1: C: Formatting output, constants, functions, scope
 - Week 2: C: Compile, link and make, C pointers
 - Week 3: C: Parameter passing, allocating memory, pointers to pointers and arrays of pointers
 - Week 4: C: Line input and output, structures and unions, library functions
 - Week 5: C++: Namespace, new constants, casting, default function arguments, reference variables,
 - Week 6: C++: Dynamic memory Formatting, Arrays, C++ structures, Classes
 - Week 7: C++: Constructors, Destructors, 'this' object
 - Week 8: C++: Inheritance, Static members, Friends, exceptions, function overloading, operator overloading

Courses presented at University of Cape Town

- **2015:** 3rd quarter honours course on Networking for Development:
 - This course will introduced students to the challenges of building computer networks in developing regions and worked through novel networking solutions used over the past decade to overcome these challenges. The content involved:

- Framing the problem of Networks in developing regions (Constraints in developing regions (Environmental, infrastructural constraints, regulatory, cultural, economic, political, language, technical))
- Connectivity options for developing region (Wireless Mesh networks, TV white spaces, community GSM networks, delay tolerant networks)
- Network performance, Traffic analysis and network maintenance in developing regions
- Network architecture options for developing regions (networks acceleration techniques, smart caching, co-located sharing)
- Case studies of design, usage and performance of networks in developing regions (BB4All project, VillageTelco project)
- **2016:** 2nd quarter honours course on Networking for Development:

Teaching assistant for at UCSB. (*This involves, giving tutorials, marking assignments and answering student questions during allocated office hours*)

- **Fall 2008: CS12:** Programming Methods in C: Introduction to the UNIX system, C programming language, and data structures. Topics include: introduction to the UNIX system, C shell and shell scripts; UNIX file system and utilities; stacks, queues, lists, and trees
- **Spring 2009: CS130A:** Data Structures and Algorithms I: The study of data structures and their applications. Correctness proofs and techniques for the design of correct programs. Internal and external searching. Hashing and height balanced trees. Analysis of sorting algorithms. Memory management. Graph traversal techniques and their applications
- **Fall 2009: CS60:** Introduction to C, C++, and UNIX: Advanced topics in object-oriented computing. Topics include encapsulation, data hiding, inheritance, polymorphism, compilation, linking and loading, memory management, and debugging; recent advances in design and development tools, practices, libraries, and operating system support.
- **Spring 2010: CS40:** Introduction to the theoretical underpinnings of computer science. Topics include propositional predicate logic, set theory, functions and relations, counting, mathematical induction and recursion (generating functions).

Relevant Project experience listed chronologically

1996: Software metrics	Built a software metric analysis tool
1997-1998: Investment Process Tool	Designed and Rolled out a 3 tier Client/Server Financial Application to allow Corporate to manage their government funding more effectively
1998: Production Planning	Created software to optimise production planning in Sawmills using linear

	programming
1999:Radio coverage measurements	Carried out Radio Coverage Measurement and planning work for 3rd Cellular Operator equipment suppliers (Lucent and Nokia) and for a SCADA systems in South Africa
1999:MTN measurement vehicle software	Designed and implemented a Measurement Vehicle software system for use in CSIR's radio coverage vehicle and 2nd Cellular Operator's vehicle
1999:Low altitude communication platforms	Assisted in the feasibility study of using a low altitude communications platform in South Africa.
1999:Baby monitoring RF tags	Involved in embedded programming for RF tags and control software for a RF track and trace system
2000:Language interpretation call center	Assisted in technical study of Call Centre technology for a language interpretation service
2000:Vodacom spectral efficiency study	Designed Spectral efficiency measurement methodology and Analysed Spectral efficiency and Capacity of the 1st cellular network operator in South Africa and compared this with other operators in Europe for use in a court case to obtain a license to operate in the GSM1800 band.
2000:GSM heart rate monitoring	Designed a remote heart rate monitoring system using a GSM modem, a Polar heart rate pickup and a micro-controller.
2000-2001:Bluetooth mortar firing system	Designed an embedded multiple slave Bluetooth radio network for controlling a mortar firing system. Cambridge Silicon Radio Bluetooth radio modules were used using Bluelab 2.0.
2000:Bluetooth HF radio audio gateway	Built a bluetooth audio gateway for an HF radio to enable voice communications to a standard commercial bluetooth headset
2001:Bluetooth voting system	Wrote the concept for a bluetooth voting system which allows 255 keypad devices to wirelessly connect and send a keypress to a Central PC
2000:2001Bluetooth access point	Designed a bluetooth access point using an open source embedded operating system (uC-linux some experience in eCos), open source bluetooth stack

	(AXIS), ARM7TDMI microprocessor, CSR bluetooth module and Linux Gnu toolchain.
2001: GSM tracking system for skiing and cycling	Designed a tracking system for tracking outdoor adventure sports using a GSM modem, a GPS and a micro-controller. Implemented the entire embedded C code for the micro-controller to respond to SMS requests and other inputs. This was used for the Argus cycle tour in 2001
2001:Cricket Bluetooth heart rate monitoring	Designed a heartrate over Bluetooth system which was used by the Supersport for the 20/20 cricket series in April 2004
2002:Dumelang (assistive communication device)	Contributed to the Bluetooth component of an augmentative communication device for the speech impaired.
2002:Bluetooth and WiFi course	Presented courses on Bluetooth and WiFi at Tshwane University of Technology, University of Pretoria and a Telecommunications workshop
2003:WiFi security project	This project aimed at attempting to hack into WiFi-based wireless networks and Bluetooth-enabled phones and also look at mechanisms to protect the network. I was particularly involved in a solution for a laptop which shut itself down if a wireless network was activated without proper authorization.
2003:Embedded linux course	Presented a 3 day course on uClinux, an embedded linux operating system, to CSIR staff.
2004-2008:Government research project on seeding critical mass research in wireless networking.	Helped define and manage research activities for a 3 year research project around building a critical mass research group around wireless networking.
2004-2007:First mile first inch project	Providing technical leadership for a mesh networking sub-project in an IDRC funded project called the "First Mile First Inch" projects which looks at sustainable connectivity solutions for rural areas around Africa.
2004-2007:Community owned wireless networking testbeds	Developed and installed a wireless mesh testbed network across Pretoria East to test various ipv6-based mesh networking protocols and applications. Installed a Africa's first rural wireless mesh testbed in Peebles valley near white

	river in Mpumalanga with the view of this eventually becoming a self-sustaining network.
2006-2007:Indoor massive mesh	Developed a 7x7 grid indoor wireless grid for carrying out mesh networking protocol benchmarks. This includes building netboot kernels, setting up boot up scripts and various perl scrips to run wireless experiments and designing the lab architecture which allowed full remote control of all 49 wireless-enabled computers.
2006:Ipv6 network conversion on experimental city mesh network	Wrote embedded code on OpenWRT (Linux-based) Linksys wireless routers to enable Ipv6 to run on an experiential city wireless mesh network. This included tasks like setting up Auto IP configuration scripts, Ipv4 over Ipv6 tunneling.
2007:Bandwidth management tool	Wrote a bandwidth management tool for a Linksys WRT54G which allows mesh gateway provider sub-cap each user on the network. This is especially useful when connecting a mesh to an expensive Internet connection using satellite in a rural area.
2007:Strategic Resource Programme funding proposal on energy efficient mesh networks	Together with 2 other senior researchers, wrote a R6 million Rand research proposal on how build energy efficiency into wireless mesh networks. This includes everything from smart antennas to improved mesh routing protocols.
2007: 3 year research and development road map for Mesh networking	Using a series of strategy sessions I led a process to develop a road map for all the future mesh networking research and development in the Wireless Africa Research and Development group in Meraka over a 3 year period.
2007: DIY mesh network guide	Based on experiences in deploying mesh networks in rural regions, we wrote a DIY guide on installing and operating mesh networks for other communities around the world to use. The book was published online using a creative commons license. Many users from around the world have commented on its usefulness and provided valuable feedback.
2008: Gateway aware routing extension to BATMAN mesh protocol	As part of a UCSB course project, extensions were added to the popular

	BATMAN mesh protocol
2009: Spectrum auction system	As part of a UCSB course project, I built a micro spectrum auctioning concept for accessing wireless spectrum on a short-term basis.
2009: Music coach for smart phones	Music coaching software developed for a Nokia smart phone which does pitch and rhythm recognition in order to evaluate a musical performance of a musician – the code is available online on google code.
2010-2011: Rural network traffic analysis	Carried out network traffic analysis of a rural network providing Internet to 300 users in Macha, Zambia. This included URL analysis, mesh network performance, diurnal network patterns and network anomalies such as time-outs. This work was published in 2 conference papers and 1 journal paper.
2011: Locality of Interest and instant message topic extraction in rural networks	Analyzed the degree of local traffic in a rural network in Macha, Zambia. Making use of Facebook Online social network traffic, the amount of instant message traffic sent between two local users was extracted as well the the degree locally generated images shared between local users. Data mining techniques were also used to extract topics in instant message conversations. This work was published in 1 conference paper and 1 journal paper.
2010: NSF proposal on VillageNet (Funded in 2011)	Helped write technical sections of a \$1.2 million NSF proposal called VillageNet on networking solutions for rural regions. The project consisted of 3 component sub-projects: VillageLink, a white space network for rural regions, VillageCell, A local low-cost GSM solution, and VillageShare. an application that facilitates local file sharing amongst local users.
2010: Inexpensive spectrum monitoring platform	Made use of low-cost Ettus USRP software-defined radios to build an inexpensive spectrum monitoring system. This was submitted and accepted as a CSIR technology demonstrator in December 2010.
2011: White space Spectrum scans in USA and Southern Africa	Making use of the inexpensive spectrum monitoring platform, spectrum scans in urban and rural areas of California as well as urban and rural areas of South Africa

	and Zambia where carried out to check the amount of available white space spectrum in these areas. This work was published in 1 conference paper.
2011: VillageShare (deployed in 2012)	VillageShare was developed to facilitate content sharing between local users without using the slow, expensive Internet gateway. The system was built using a Facebook component and a local cloud computing platform. This system was deployed and tested in Macha, Zambia in July 2012. This work was published in 2 conference papers.
2011: VillageLink	An extension to the 802.22 white space protocol was developed to enable white space radios to make use of channel sounding across the white space frequency range to check the effect of the environment on the channel at different TV frequencies as well as the degree of interference between white space radios. Gibbs sampling was used to allocate channels which maximize the quality of the channel to clients but minimize the interference between white space base stations. This work was published in 1 conference paper.
2011: Indoor cognitive radio test bed	A set of 4 USRP software defined radios and associated PC with GnuRadio software were configured and deployed in the Meraka building and UCSB. These two test beds were identical which allowed researchers to easily collaborate between South Africa and the USA.
2011: Outdoor cognitive radio test bed	USRP radios were connected to standard TV antennas and a 3km link was built between the CSIR and a home in the East of Pretoria. This link was used to test various channel sounding ideas and digital communication building blocks that form part of VillageLink.
2011: Auto-scaling and cloud bursting service	An extension to Eucalyptus – a local cloud hosting service – was built to automatically instantiate new virtual machines when thresholds are reached on specific resources such as memory or CPU usage. Once all local resources are used up, the auto-scaling engine can instantiate VM instances on the Amazon EC2 commercial service.

2012: VillageCell (deployed in 2012)	VillageCell enables free low-cost local cellular access for rural villages. It makes use of an open source GSM stack – OpenBTS as well as an open source switch – called FreeSwitch. A instant message to SMS extension was added to these existing building blocks. Two base stations interconnected with an existing WiFi network were deployed in Macha, Zambia in July 2012. This work was published in 2 conference papers.
2013: Smart antenna for mesh networks	Contributed to developing a set of mesh networking experiments to test the performance of a WiFi smart antenna for mesh networks. The output of this project was a technology demonstrator: Submitted and accepted as a technology demonstrator in March
2014: White Space High Performance Mesh Node	A down-converted WiFi radio was integrated into the Mesh multi-radio device called the HPN that normally only offered WiFi services on 2.4 GHz and 5 GHz. This was expanded to TV White spaces with the ability to build mesh networks over White Spaces.
2014: Eastern Cape broadband plan	Wrote portion of the broadband plan which summarizes the current state of broadband in the province using GIS maps. Wrote algorithms to calculate optimal fibre routes to provide broadband connectivity to public facilities in the Eastern Cape province. Wrote conversion routines that converted raw Geo-referenced, statistical census data and raster maps into GIS shapefile format.
2015: Programmable Network Interface Unit	The PNIU is an edge device placed at various government clinics and schools around the country to monitor traffic and configure networking rules. The device will use software defined networking tools such as OpenFlow and NetConf for configuration.
2016: TV White Space regulation	Contributed to the development of a draft position paper on TV White Space regulation in South Africa. My contribution involved analysing industries technical and legal concerns and providing rebuttals to arguments against the use of TV white spaces.

Training History

Courses taken after Undergraduate degree

Private courses

1998

- C++ and object oriented programming course

Courses for Masters at University of Pretoria

2003:

- ERS280: Software Management and economics

2004:

- ERN270: Computer Networks
- ENA732: Research Methodology

2005:

- ERV780: Advanced Microprocessor system design

Courses for PhD at UCSB

Fall 2008:

- CS276: Advanced Topics in Networking
 - [Project: Devising a gateway location metric for B.A.T.M.A.N in rural areas](#)
- CS279: Advanced Topics in Security
- CS595n: Seminar on social computing
 - [Talk: Reflection on ICT projects in rural areas](#)
- CS501: Techniques of Computer Science Teaching:

Spring 2009:

- CS270F: Cognitive wireless networking, strategy, economics and social behaviors
 - [Project: An online spectrum auction system, bridging the implementation gap](#)
- CS230: Approximations, NP-Completeness and Algorithms

Fall 2009:

- CS225: Information Theory
 - [Final paper: Network Information theory for a multi-node network](#)
- CS290I: Multimodal Interaction on Mobile Computing Platforms
 - Project: Musiccoach - Realtime evaluation of music performance
 - [Final paper](#)
 - [Final presentation](#)
 - [Code](#)

Winter 2010:

- CS290F: Networking for Multimedia
 - [Project: Internet usage and performance analysis of a rural wireless network in Macha, Zambia](#)

Spring 2011:

- CS290D: Advanced Data Mining Techniques
 - [Final project: Instant Message locality and topic extraction in rural networks](#)

Fall 2011:

- CS290C: Virtualization and Cloud Computing Technologies
 - [Project presentation: Auto-scaling and cloud bursting service for Eucalyptus](#)

Skills Inventory

Keywords: Mesh networking, rural networks, cloud computing, embedded programming, software defined radios, TV white spaces, GIS, digital communication, RF engineering

Leadership skills

Managing small research/development teams (< 8 staff/students)
Road mapping workshops
Leading research/development projects (University / CSIR)

Operating Systems (Strongest skills and preferred OS shown in bold)

Embedded operating systems (uclinux, ECos, **OpenWRT**)
DOS
Windows XP,2000/98/95
Windows CE
Mac OS
Linux
FreeBSD

Database Management Systems

Oracle
MySQL

Cloud Computing

Eucalyptus
Amazon EC2

Programming Languages	<p>Apple][Applesoft Basic (Back in the 80s)</p> <p>6502 machine language (Back in the 80s)</p> <p>Visual Basic</p> <p>C/C++ (mostly Gnu C/C++ for Linux but historically Borland C++)</p> <p>Qt graphics development</p> <p>PIC C</p> <p>Perl scripting</p> <p>Shell scripting</p> <p>Python</p>
Packaged Application Software	<p>Orcad circuit board layout tool</p> <p>Radio mobile radio planning tool</p> <p>Matlab mathematical modeling tool</p> <p>Eucalyptus cloud computing software</p> <p>GnuRadio for software defined radios</p>
GIS Software	<p>ArcGis</p> <p>Grass</p> <p>Python for GIS</p>
Simulation tools	<p>NS2 network simulator</p> <p>Omnnet++ network simulator</p> <p>Click network protocol/routing tool</p>
Communication protocols	<p>GSM (SMS, GPRS, AT command sets)</p> <p>Bluetooth (taught courses on Bluetooth)</p> <p>WiFi (802.11 a/b/g/n)</p> <p>White spaces</p> <p>TCP/IP networking</p> <p>Mesh/ad-hoc networking protocols (Masters on mesh networks)</p>
RF engineering	<p>Radio propagation prediction</p> <p>Building software that interfaces with scientific instruments</p> <p>Software defined radio with Gnuradio on USRPs</p>

Hobbies and interests

Windsurfing, Mountain Biking, Rock climbing, Hiking, Photography, Making movies - especially comedies, Music (Playing various instruments Piano, Cello, pennywhistles, recorders, melodicas), Landscaping, Owner building and house restoration, Vintage computers, Community owned wireless networks, Collecting and restoring old cars – especially Volkswagens.