

Annual Report 2013 - 2014

EPSRC Centre for Doctoral Training in Communications



Foreword



It is with great pleasure that we bring you this second annual report from the EPSRC Centre for Doctoral Training in Communications.

Since the launch in 2011, our CDT has recruited three intakes, with a total of 32 students now studying in the Centre. The first cohort are now well into their research phase and are already making significant contributions worthy of publication at leading international conferences. Our students have also engaged enthusiastically with Outreach activities, promoting the discipline to school children and to the wider public at events such as Bath Taps Into Science 2014.

As our CDT has grown in size, the scale and importance of our annual student research conference has also grown. This last year, we hosted the conference at The Watershed in Bristol attracting an audience of around 100 people from industry and academia. This event was preceded by the first CDT public lecture given by 'H' Nwana, ex-group Director of Spectrum Policy of Ofcom.

We are grateful for the ongoing support from our industrial partners. Their engagement has been particularly important, not only in providing relevant and challenging research projects, but also in providing complementary skills training, and recently in 2013 helping us to win funding from EPSRC for the continued operation of our Centre.

I hope this report will give you an insight into the personalities and the activities associated with our Centre over the past year or so. Please enjoy reading it and do not hesitate to get in touch if you would like to discuss anything in more detail.

A handwritten signature in black ink, appearing to read 'D. Bull', with a stylized flourish extending from the end.

Professor David Bull
Director, EPSRC CDT in Communications

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Introduction

All our students have a thirst for knowledge and an eagerness to share their understanding with the wider research community.

*Mark Beach,
CDT Manager*

Engagement with Industry

Strong links with industry and related organisations have continued to be key to the success of the Centre over the last 12 months. Industry has engaged via sponsorship of research projects, seminar speakers, provision of specialist training and mentoring.

Recruitment

High calibre students for the UK's only CDT in Communications are recruited from a variety of backgrounds in related disciplines (Mathematics, Electrical and Electronics, Physics or Computer Science).

Training

The taught first year programme reinforces and increases students core knowledge to enable them to undertake the research phase of their PhD. In addition, all students have attended a variety of transferable skills workshops, some organised in association with CDTs across the University.

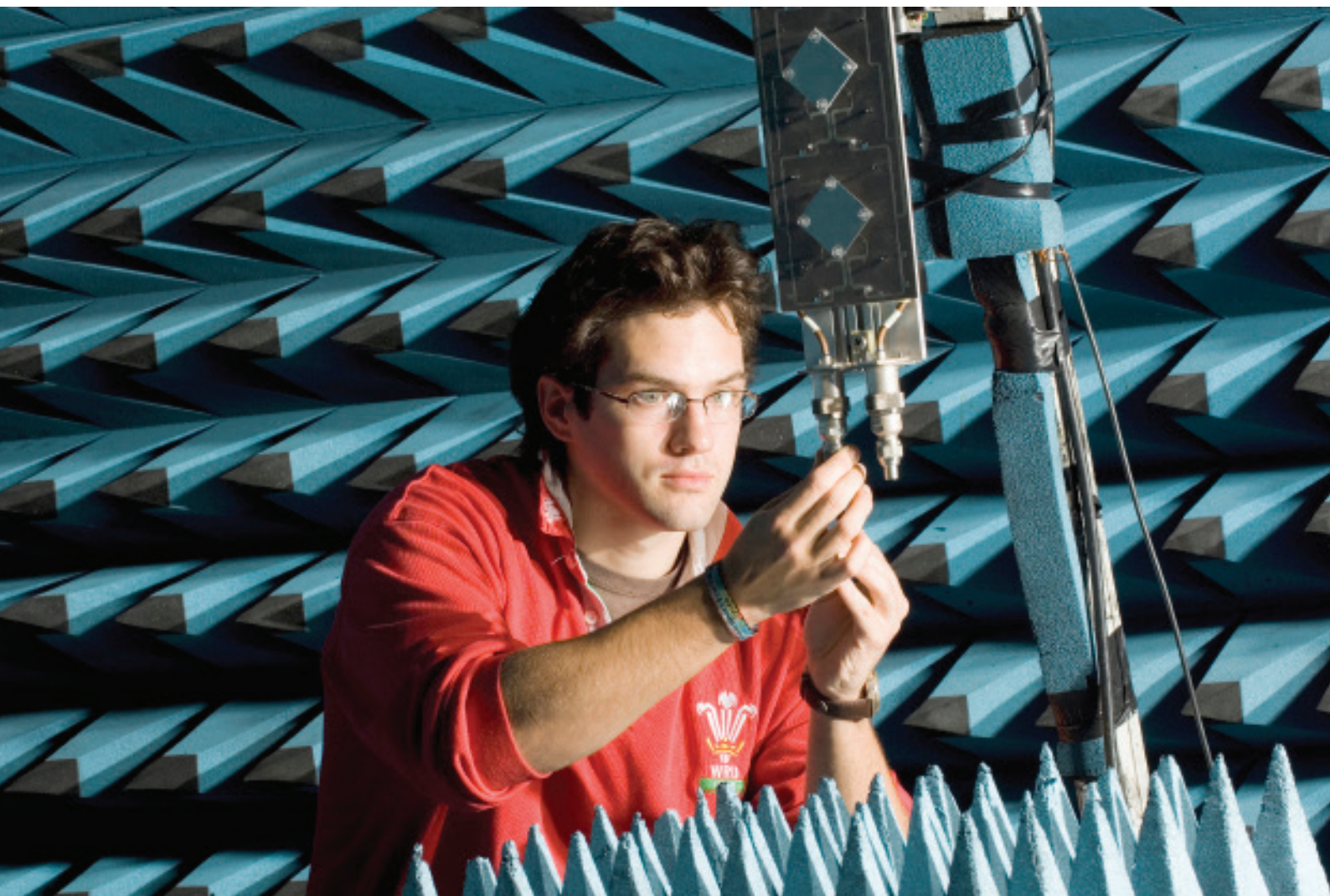
Student Activities

The students within the CDT are very proactive in their approach to engaging with new learning approaches, workshops, assisting one another across cohorts with research and study, and are always keen to learn new research concepts.

They also provide valuable feedback to staff on ways in which the programme can be improved.

Staff

Staff associated with the Centre are based in either the Engineering or Science faculties at Bristol. They are experts in their fields and use their years of experience to guide the postgraduate students in developing their research and broad skills. As the number of students involved in the Centre grows the pool of academic expertise has also widened to include new research topics.



Recruitment

My main reason to choose University of Bristol was because of its outstanding research reputation, close industrial collaborations and excellent course structure.

Jaya Thota, student

2013 was another successful year in recruiting talented students. The academic backgrounds of the new cohort can be seen in the table (right), and reflects the Centre's policy of recruiting highly qualified enthusiastic graduates from a broad range of related disciplines.

In addition to the core funding provided by EPSRC (Engineering and Physical Sciences Research Council), complementary support is provided by industry, with scholarships to support their studies being available to resident UK citizens and some EU citizens.

The Centre's mission is to produce graduates who are highly employable in either industry or academia, and who have a strong mathematical understanding of Communications.

We also strive to attract more female students, and returners to education after a period in industry to the programme.

Computer Science	1
Electrical & Electronic Engineering	7
Mathematics	2
Physics	1

Degree discipline - September 2013 recruits

In November staff, current students and supporting organisations were delighted to learn that its application to EPSRC for further funding to enable it to operate until 2022 was successful. As a result, the Centre will have over 80 students benefitting through this extended training programme. This

funding will build on the successes of Bristol's existing Centre to train PhD graduates who are intellectually leading, mathematically rigorous, creative, and who understand the commercial implications of their work – people who will become the future leaders in the sector.

The Centre offers a great opportunity to obtain a strong foundation across many fundamental areas of communication and skills, allowing me to broaden my knowledge before focusing on a specific research project.

Michael Collett, student



Taught Phase

The programme has been designed to provide the essential skills necessary to develop as the communication engineers of the future. Students are required to take a number of core units together with optional units to match their particular interests and also as preparation for the PhD stage of the programme.

In the first year of the programme all students pursued assessed taught units (written examinations and lab work).

Following feedback from students, the content of the taught element of the programme has been subject to minor changes. Since 2013, the group research project has moved to the spring term and the time for the individual research project has been extended to cover the whole summer period. The number of core units has been reduced, and the choice

of option units increased to allow greater flexibility.

Group Research Project

Students are required to complete a group research project which is currently based on the topic of 'white space' with inputs being provided by one of our collaborators, Ofcom. Students work in two teams to devise a proposal on the subject.

Research undertaken has since been included in a paper presented by students at the *IEEE World Forum on the Internet of Things* held in South Korea in March 2014.

Individual Research Project

During the summer period, students undertake an assessed individual research project. In most cases these projects are on topics proposed by

industry and involved a mentor from the sponsoring company. The work is assessed by a detailed report, and an academic research poster presented at the annual student research conference (see page 9).

Enterprise

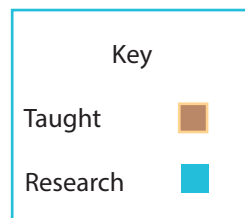
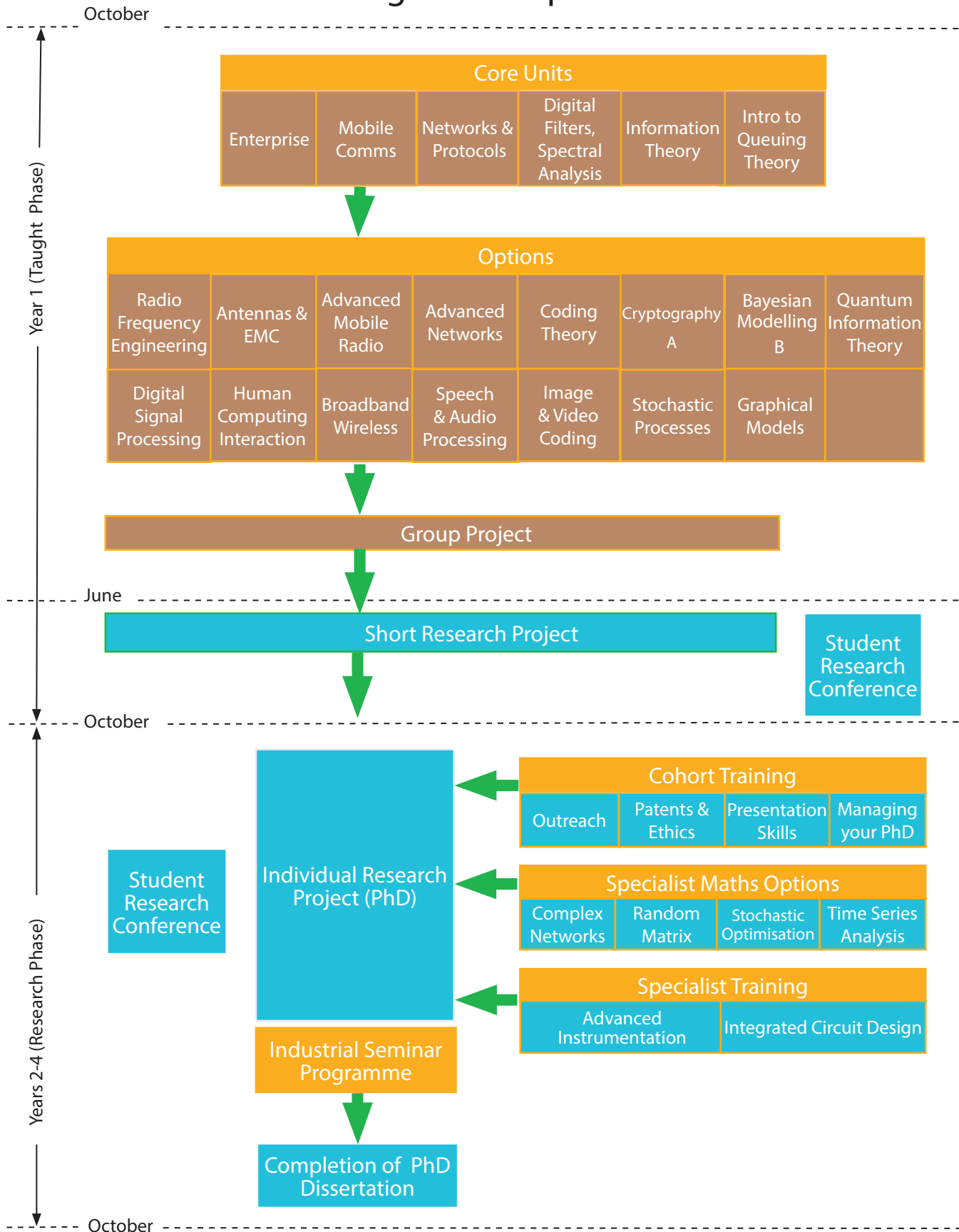
All students participate in a bespoke unit on Enterprise during the first term which is led by Dr Greville Commins, Entrepreneur in Residence at the University of Bristol. The activities include studying business modelling, the analysis of business plans and finance. The Unit is unique to the CDT in Communications with case studies from the communications sector used. The final stage of the activities is for students to participate in a 'dragon's den' style event where they are given 5 minutes to pitch to a panel of experts their critique of a business plan.

The first year taught elements gave me a chance to study numerous subjects beyond the scope of my undergraduate degree and obtain a good footing in the general area of communications.

Odysseas Pappas, student



Programme Specification



Research

Through our strong connection with the EU COST IC1004 action on Cooperative Radio Communications for Green Smart Environments, CDT researchers have taken advantage of the Summer and Winter schools on 'Interference Management for Tomorrow's Wireless Networks' (Sophia-Antipolis, France), 'Tools for Cooperative Communications' (Prague, Czech Republic), and 'Beyond 4G Networks in Cities: From Theory to Experimentation and Back' (Barcelona, Spain).

Several of our students were also awarded travel grants through the EU COST office to assist with the costs of attendance at these highly acclaimed training schools.

Specific advanced mathematical skills training in random geometric graph theory, through the Netadis summer school (Copenhagen, Denmark), was gained by Alex Giles attending.

In June 2013 we hosted the EPSRC CommNet Summer School which provided a week-long training event to some 25 PhD students, including 4 CDT researchers, engaged in RF and wireless research across the UK academic community (Cambridge, Cardiff, Edinburgh, Heriot Watt, Leeds,

Liverpool, Queen's, Sheffield and Surrey). This was delivered by both academic and industrial experts from the sector, and included hands-on training in the use and application of both software and hardware tools in common use by industry. The industrial sessions included 'Modem Design using NI Labview and USRPs' by Ben Lavasani, 'RF System Architecture Performance Analysis using Agilent tools' instructed by Stephen Slater and 'Network Simulation through NS-3' delivered by Raymond Kwan of Ubiquisys. Sessions led by academics included 'Wireless System Design' by Andrew Nix, 'Antenna Fundamentals' by Geoff Hilton, 'Analogue Circuit Design' by Paul Warr, 'VHDL Transceiver Design' by Louise Crockett and 'Design and Optimisation of Protocols in wireless Networks' by Tim O'Farrell.

The Summer School was co-located in Bristol in collaboration with a postgraduate research event organised by the UNISON EPSRC network. Several joint activities, including key notes from Simon Fletcher (NEC) and Matthew Webb (Sony), a conference dinner and poster event were organised and provided a unique opportunity for researchers from the wireless

and wired disciplines to integrate and network as well as discuss their PhD research. The poster event was also attended by Dr Liam Blackwell (EPSRC) who commented "*Industrial and academic employers value both in-depth technical or hard skills as well as soft skills such as networking and presentation skills. This event offers unique opportunity to discuss your research and learning from others across the academic disciplines in the wired and wireless domains*".

With our first cohort of students deeply engaged in their research many are now attending and presenting at conferences and workshops. This has included the PGNet annual symposium on 'The Convergence of Networking, Broadcasting and Telecommunications' and events organised jointly by the ICT KTN and Cambridge Wireless.



Annual Student Research Conference & Public Lecture

On the 27th September 2013, industrial sponsors, academic supervisors and CDT students participated in the first Annual Research Conference held at The Watershed in Bristol. Second year students presented their research, on a wide range of topics from chaos theory to PA linearisation technology, to a large and enthusiastic audience. The event provided a great opportunity for industrialists, students and academics to discuss the latest developments in the field. The new cohort of students, who had only registered earlier in the week, also had the opportunity to meet the 'old hands' and see what would be expected from them over the next four years.

Students completing the first year of study presented posters on their short research project, which in most cases developed into their PhD project.

The students had enormous confidence in the presentations and this a great endorsement of the training.

Dr John Haine,
u-blox Melbourn



On the 26th September, 'H' Nwana, ex Group Director of Spectrum Policy at Ofcom, gave the CDT's first annual public lecture. He spoke on the topic 'The UK 4G Spectrum Auction: Fusing Economic Regulation and Engineering' to a large audience of staff and students from across the University, industry and the public.

The lecture considered what made the auction a triumph of good economic regulation, the solid engineering underpinning it, how UK consumers and citizens are already benefiting from it, the principles of good economic spectrum regulation and how a regulator interprets its duty to regulate.

He argued that multi-disciplinary training, such as that provided by the Communications CDT, is vital to engage such real-world and complex projects eg. designing and running a complex auction or running good spectrum policy for the UK in general.

Skills Training & Outreach

Skills Training

Over the last 12 months the CDT in Communications at Bristol has hosted several collaborative training events which have attracted generous donations of time and effort from industry to enrich the technical training of our researchers. Although specifically organised for Communications CDT researchers in their research phase, many of these events have been made available to non-CDT PhD students at Bristol and at other UK academic institutions.

Industry also kindly provided further access to specialist training for Bristol-based researchers in 'Advanced NI Labview (Core 1) skills', 'Applied RF & Wireless Design' and 'Modern Radar Systems' through the Rohde & Schwarz RF and Wireless professional course programmes. Some 20 students, including 6 CDT researchers, attended the 2-day Labview course held in Bristol which was delivered by 2 NI staff and included significant hands-on activities. Leo Laughlin, Kibrom Gebremicael and Tim Pelham also attended the offsite training provided by Rohde & Schwarz at their facility in Fleet (Hampshire) as these courses align well with their

PhD specialisation in RF. NI have also provided a further USRP hands-on for students in cohort 2 who may wish to use this platform in their research.

Many of our students have taken advantage of generic skills training events which build on the Enterprise Unit delivered by Greville Commins in year 1 of the programme. This included events on 'Developing your Research Elevator Pitch' and 'Effective Research Networking'. More recently several researchers have attended the 'Creative Researcher, Communication & Influence: Theories & Approaches' and 'Design Thinking for Researchers' short course organised by Dave Jarman in the University's Enterprise Education Unit.

Students have also participated in a wide range of workshops organised by the Faculty of Engineering, the CDT in Communications and other CDTs at Bristol on a variety of broad skills. These included topics such as 'Networking', 'Poster and Abstract Writing', 'Outreach', 'Media Engagement', 'Presentation Skills', 'Communicating Effectively with your Supervisors' and 'Managing your PhD'.

A variety of specialist skills workshops such as the USRP training provided by NI, held within the University and offsite organised by COST and ComNet have been available for students to become involved in.

Outreach

The CDT has now formed a student-led Outreach Committee which will co-ordinate activity in Public Engagement for the Centre. We believe that this has a vital role to play in raising the profile of the Centre and of the discipline, as well as providing useful transferable skills training for the students themselves.

The Outreach activity is based around two distinct strands. Firstly, the students have developed exhibits to engage young children at the Bath TAPS into Science Festival 2014. Secondly, building on links with Colston Collegiate School, they are planning a number of secondary school visits in 2014.

We would be very interested to hear from companies who are interested in supporting or participating in the Centre's Outreach activities.



Skills Training & Outreach



	Year 1	Year 2	Year 3	Year 4
Innovation & Enterprise	Comms Enterprise Taught Module	Comms Enterprise Workshops	Comms Enterprise Workshops	Comms Enterprise Workshops
Public Engagement	STEM Ambassador Training	STEM Ambassador Training	Engagement Activities	Engagement Activities
	Engagement Activities	Engagement Activities	Conference Attendance	Conference Attendance
		Introduction to Public Engagement		
Communication Skills	Comms Enterprise Module: Personal Communications	BEN/iNET Events *	BEN/iNET Events *	BEN/iNET Events *
		Managing your PhD Workshop	Comms Enterprise Workshops	Comms Enterprise Workshops
		Generic Skills training Workshops, including Communicating Effectively, Writing for Publication	Generic Skills training Workshops, including Presentation Skills, Innovation	Generic Skills training Workshops, including Completing your PhD, Preparing for your Viva
	Non Disclosure Agreement Training	Conference Attendance	Conference Attendance	Conference Attendance
Careers	CV Preparation for Industry Engagement	Career Seminars	CV Preparation for Employment	Interview Skills Training
		Postgraduate Teaching Assistant Duties	Postgraduate Teaching Assistant Duties	Postgraduate Teaching Assistant Duties
	Seminars/meetings with Industry	Seminars/meetings with Industry	Seminars/meetings with Industry	Seminars/meetings with Industry

*Bristol Enterprise Network

Skills Roadmap

Industry Support

In addition to the professional training courses provided by industry to our students (see page 10), we now have 9 industrial sponsors and mentors for cohorts 1 and 2 encompassing the full range of the collaborative mechanisms we offer our members. These include full sponsorship, iCASE assignment and Case conversion.

Our current research project sponsors include BAE Systems, BBC, Chemring (formally Roke Manor), GCHQ, NEC, Ofcom, Thales, Toshiba, u-blox and UK MoD. There are also negotiations on-going with new industrial sponsors.

Some student research projects have also been aligned with major collaborative research projects, including the EPSRC funded IRC

SPHERE (Sensor Platform for HEalthcare in a Residential Environment) project, and the EU FP7 GHOST project.

Leading industrialists contributed to the delivery of our Enterprise module in year 1. These included:

- Steve Allpress, nVidia on the 'Icera story from founding, investment raising, the product cycles, the market changes and the exit'
- Rich Chapman (iNET SouthWest) on 'product strategy and IP protection'
- Dr Simon Scott (Founder of Kindle Ideas Ltd) on 'market research and marketing'

- John Gill (TLT) on 'due diligence'
- Richard Churchill (ITFin Ltd) on 'corporate finance'
- Members of the Alacrity Foundation provided coaching on presentation skills

Steve Allpress, Rich Chapman and Graeme Hobbs (Motorola) were the industrial members of the assessment panel for for the Enterprise project.

Dr Gary Clemo (Ofcom) continues to support the group project activity with overall task setting in the field of white space communications, scene setting in terms of spectrum regulation and final assessment of the group presentations.

I recently took part in a panel providing feedback to students of their due diligence analysis of a proposed business plan. In my view, because the initiative provides students an insight into the real world combining pure business skills with both engineering and technology-driven aspects, it is of huge value and ultimately good both for our business and for the future of UK plc.

Graeme Hobbs FEng
Chairman, Motorola Solutions UK Ltd

Industrial Secondment



Leo Laughlin, a postgraduate in the first cohort and now in the research phase of his postgraduate studies, has recently spent a period in industry with his sponsor (u-blox).

'Spending several weeks at u-blox Melbourn was an excellent opportunity to meet their engineers, learn about the business, and gain more exposure to their development activities in my field. This has helped me develop a better understanding of how my research is relevant to their product roadmap and has further developed our working relationship allowing us to align our work here at Bristol with their product development activities for mutual benefit. All in all, this was an enjoyable, productive, and highly beneficial experience – both for research and for personal development.'



Our Supporters & Collaborators



Future Plans

Centre Awarded Continued Funding by EPSRC

We are delighted to announce that, in November 2013 with the support of some 25 partner organisations, our CDT was successful in being granted continued funding from EPSRC. This further award of £3.0M guarantees the operation of our Centre until 2022, with funding for an additional 3 cohorts of students starting in 2016, 2017 and 2018. £3.8M of industrial funding has also been pledged to support this award.

The 2014 CDT Annual Lecture

The 2014 CDT public lecture will be given by Howard Benn, Head of Standards and Industrial Affairs at Samsung R&D Institute, on 'Millimeter Wave as a Key New Element in 5G Cellular Networks'. The lecture will be on Thursday 25th September 2014 at 5.15pm.

This will be preceded by a meeting of the Industrial Advisory Board.

The 2014 Student Research Conference

Building on the success of the 2013 event, the 2014 CDT conference will be held at MShed in Bristol on the 26th September. This year's conference will be expanded to run over a full day with the work of cohort 1 (2011 entry) and cohort 2 (2012 entry) and cohort 3 (2013 entry) being presented. There will be a mixture of oral and poster presentations from our research students.

How to Get Involved

Our goal, in partnership with industry, is to train and educate the next generation of innovators for the telecommunications sector; producing some 80 technical experts in the field capable of leading and inspiring others.

Industry

We welcome research project topics and sponsorship (fully funded studentships, iCASE assignment and Case conversion) from industry,

both existing and new collaborators, to secure our mission and maintain alignment with the needs of industry.

We are also keen to develop the specialist training courses available to our students and ensure the provision of state-of-the-art test and measurement equipment. If you wish to become a partner in the Centre please contact Professor Mark Beach, Centre Manager (email: M.A.Beach@bristol.ac.uk).

Prospective Students

Applications from potential students are accepted from October each year for entry in the following September. Applicants should have, or be expecting to be awarded a minimum 2.1 degree in a relevant degree subject.

Please contact Dr Simon Armour, Admissions Tutor (email: Simon.Armour@bristol.ac.uk) if you would like to discuss opportunities for study.

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Student Profiles & Research Projects - 2012 Recruits

Tom Barratt



Tom graduated in 2012 from De Montfort University with a degree in Software Engineering.

He is now working with Professor Mark Beach on millimetre wave prediction. Given that the number of wireless enabled devices is forecast to dramatically increase by 2020, providing sufficient radio spectrum for such systems has now included the potential use of millimetre wave bands (30 to 300GHz). The propagation characteristics of these frequency bands and the directive nature of the millimetre wave antennas is very different to that synonymous with wireless communications below 3GHz. The wireless research community is proactively investigating the new channels in terms of path loss and dynamic characteristics. Tom is addressing system coverage for both point-to-point fibre extension and end-user gigabit wireless delivery based on channel models published in the literature and conducting 60GHz channel measurements. Key issues include assessment of path loss, shadowing, impact of partial blockage of directive antennas and the dynamic variability of the channel when near by objects are in motion.

Michael Collett



After completing his physics degree at Imperial College in 2004, Michael worked as a Research Scientist in the Communication Technologies group at the National Physical Laboratory.

He is now working with Professor Martin Cryan to develop optically reconfigurable microwave components for communications. Modern communications systems require increasingly sophisticated and flexible components but current methods have several drawbacks (such as slow switching speeds and the need for biasing circuitry). When sufficiently energetic photons are absorbed by a semiconductor, charge carriers are created, forming a conducting plasma region within the insulating semiconductor. This can be exploited in the design of reconfigurable components such as switches, filters and antennas, which can be frequency tuned, steered or otherwise modified. In addition to carrying out characterisation of this effect (through the measurement of carrier lifetime and diffusion), Michael is developing and fabricating antennas and filters which will be ultimately incorporated into working systems.

Kibrom Gebremicael



Kibrom graduated in 2005 with an MSc in Communication Engineering from Addis Ababa University.

Power Amplifiers (PAs) are among the most fundamental components in RF communication systems. They are the main power consuming and distortion contributing elements in RF transmitting blocks. Present modern wireless communications require PAs to offer high Power-Added Efficiency (PAE) and linearity performance. These requirements are contradictory and can be considered as mutually exclusive. Wideband multi-carrier modulation techniques pose major challenges to the PA due to high Peak-to-Average Power Ratios (PAPR) and very large dynamic range. Carrier aggregation in 4G LTE-Advanced UE/eNB presents even more challenges as each carrier component will have its own different PAPR values. The research project, supervised by Professor Mark Beach and Dr Kevin Morris, will improve the linearity of the ultra-broad PA and investigates the linearity performance in terms of Error Vector Magnitude (EVM) and Adjacent Channel Leakage Ratio (ACLR).

Tom Kealy



Tom graduated in 2009 with a degree in Theoretical Physics from Imperial College London, and subsequently worked as an IT consultant.

The digital TV switchover has made a significant amount of new spectrum available for use by secondary users which will be open access and must be dynamically assigned. These secondary users (cognitive radios) must respect each other, requiring them to sense over a wide bandwidth. This challenges traditional Nyquist sampling techniques, as the sampling rates required are not currently technically feasible. However, TV white spaces can be viewed as a single wideband channel with a sparse spectrum. This means that modern sampling and recovery techniques, such as Compressive Sensing and Group testing, can recover the spectrum more efficiently.

Tom is investigating with Dr Olly Johnson and Dr Rob Piechocki whether modern sampling and recovery techniques such as Compressive Sensing and Group testing can recover the spectrum more efficiently.

Themis Omirou



Themis graduated in 2008 with a BSc in Computer Science from the University of Cyprus, and in 2009 with an Msc in Internet Technologies with Security from the University of Bristol.

Themis is working with Professor Sri Subramanian and Dr Mike Barton to develop a system which will use levitation techniques to allow data to be represented and manipulated in 3D space, where every action performed will have an effect on the digital data and vice versa. Multiple users will be able to view the data representation from different angles and provide input to the system. A traditional HCI system may have a lot of useful functionalities but its complexity might limit its use. New HCI techniques are being developed in order to enhance user experience, ease of use, and collaboration for problem solving, and all these as closer to real life interactions as possible.

Odysseas Pappas



Odysseas Pappas received his MEng in Electrical and Electronic Engineering from the University of Bristol in 2012.

He is working with Professor David Bull and Dr Alin Achim to develop a vision-based collision avoidance system (Sense and Avoid) incorporating state-of-the-art signal processing techniques for use with Unmanned Aerial Vehicles and other aircraft. The low cost, power consumption and weight of visual sensors make them an interesting model for implementation of a Sense and Avoid system on small aircraft. This will allow UAVs to become completely autonomous, opening up the path for their civilian & military usage in a plethora of environments and situations. Until now, research in the field has been limited and has been undertaken by government/military organisations and the defence industry.

Tim Pelham



Tim graduated with an Masters of Physics degree from the University of Surrey, following a research year at the Holifield Radioactive Ion Beam Facility at the Oak Ridge National Laboratory in Tennessee.

Under the supervision of Dr Geoff Hilton and Professor Chris Railton, Tim is investigating the performance trade off between high performance antenna arrays with standard element spacing and configuration versus space constraints. The technique uses Finite Difference Time Domain modelling techniques, broadband antenna design and array theory to develop a conformal array design process and prototype, and will investigate the problems of maximum directive gain and wide angle coherent beam steering. The space constraints imposed by a sharply curved conformal array on the signal distribution architecture will also be considered in light of new technology developments such as RF-over-Fibre.

Jaya Thota



Jaya graduated in 2003 with a MSc in Mobile and High-speed Communications from Oxford Brookes University and worked in various companies for 8 years as a Senior engineer.

She is currently working with Dr Angela Doufexi, Dr Simon Armour and Professor Andrew Nix to propose novel techniques in LTE PHY layer for Intelligent Transport Systems (ITS), infotainment and Location aware Services. This will enable a strong reduction in casualties and fuel/time efficiency of commuting by exchanging information between vehicles in safety relevant scenarios (eg. street crossings, merging lanes, or congestion) using cost, spectrum, and energy efficient radio access technology communicating via a high capacity LTE/advanced LTE network in high vehicle speeds. The project will utilise the latest developments in the physical layer and future developments may include novel algorithms for virtual MIMO and antenna selection in the physical layer and raptor codes in the application layer.

Paul Worgan



Paul graduated in 2009 with a BSc in Physics from the University of Exeter, and in 2012 was awarded an MSc in Computer Science from the University of Bristol.

His research on wearable health sensing is under the supervision of Dr David Coyle and Professor Ian Craddock, and is part of the SPHERE project. The project is considering how to support patients with long term conditions, specifically osteoarthritis, and provide relevant data to their clinicians. The project aims to seamlessly integrate healthcare sensors into patients everyday lives and support clinical decisions through data capture.

Students - 2013 Recruits



The Team



Professor Joe McGeehan
Chairman



Professor David Bull
Director



Professor Mark Beach
Centre Manager
& Year 1 Tutor



Dr Simon Armour
Admissions Tutor



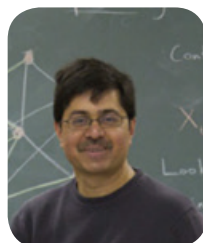
Dr Kevin Morris
Director of Studies
& Year 1 Tutor



Dr Robert Piechocki
Individual Project
Co-ordinator



Dr Oliver Johnson
Years 2-4 Tutor
& Outreach



Dr Ayvandi Ganesh



Professor Sri Subramanian



Professor Mike Fraser

