

ICT Programme Theme Day: Communications

**Tuesday 24 February 2009
Hilton London Metropole**

Workshop Report

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EPSRC**

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1. Background

In the absence of an up-to-date sub-programme review, each of the ICT portfolio managers produced a sub-programme review poster and presented this to the ICT Strategic Advisory Team in July 2008. Issues concerning funding ratios, community perceptions, the distribution of grants and training were addressed. Following the meeting, it was decided that each sub-programme would benefit from holding individual theme days to discuss sub-programme-specific issues and also to facilitate strategic portfolio management within the new EPSRC structure. The theme days would provide a focussed community perception of the ICT programme and the management of the portfolio, the issues that concern each community and help to address the subsequent balance of portfolios within ICT.

2. Overall aims of the Communications Theme Day:

- Bring together research communities in Networks, RF & Microwave technology, digital signal processing and mobile computing and explore mechanisms for building community cohesion.
- Stimulate innovative approaches to funding and support a constructive relationship with EPSRC.
- Gather and exchange your views on the state of communications research in the UK.
- Learn of the key issues affecting the communications community.
- Contribute to strategy for the ICT programme.

3. Outputs from the day

3.1 Agenda

09:30-10:00	Arrival at Hilton Metropole
10:00-10:30	Registration for delegates
10:30	Welcome - Dr Andy Lawrence, Comms Portfolio Manager
10:40	Introduction - Dr Liam Blackwell, Head of ICT Programme
11:00	Session1: ICT Questions
12:15	Lunch <i>followed by</i> Session 2: ICT Programme poster display
13:30	Session 3: Analysis of UK Communications Research
15:00	Session 4: Exploring New Opportunities
16:00	Next Steps & Q&A
16:30	Finish

3.2 Introduction

The theme day was introduced by Andy Lawrence, the EPSRC Communications Portfolio manager. After a brief outline of the structure of the portfolio and objectives of the day, Liam Blackwell (Head of ICT programme) gave a short presentation that began with an explanation of EPSRC's key messages (including EPSRC's budget over the 2008-2011 spending review and success features which define the allocation of the research budget).

The ICT programme vision was then described (*to invest resource to enable and sustain the best research and people to excel in a global ICT community and maximise benefit for the UK*) and issues concerning the programme were highlighted. These were

- Balancing diversity & excellence

- Ambitious, transformative & multidisciplinary research
- Ensuring supply of researchers
- Collaboration & communication
- Relevance to longer term interests of users
- Support for facilities

Following this, issues specifically regarding the Communications portfolio from EPSRC's perspective were presented. EPSRC's perception is that the breadth of the research areas implies difficulty in identifying a common strategy, there are small numbers of platform and network grants, problems with staff continuity, limitations in recruiting PhD students (particularly from the UK) and the fact that university research has good industry collaboration, but as a consequence proposals can be more focussed on long-term developments rather than highly speculative.

The presentation ended and the focus shifted into the first session.

3.3 Session 1- ICT questions

The theme day was structured around three sessions. The first was intended as a general ICT session and the second and third focussed towards communications-specific issues.

The purpose of the ICT questions session was to gain a broad and consistent view of ICT issues from each of the sub-programme communities within the ICT remit. The set of questions and the structure of the session is identical for all five of the ICT sub-programme theme days. At the communications theme day, answers were sought from the perspective of the attendees to 12 general questions (devised by the ICT team in consultation with the Strategic Advisory Team). This session will help to gauge which are the important issues/qualities within the Communications community and to align the understanding of quality and eligibility criteria for a number of EPSRC schemes. The outputs from each question are detailed below:

1. WHAT WOULD YOU EXPECT TO SEE IN A CV FOR AN INTERNATIONALLY LEADING GROUP?

- ❖ Quality (not quantity) of publications. Highly cited work.
- ❖ Well funded from a variety of sources (EPSRC, EU, Industry, MoD etc)
- ❖ Leaders have fellowships and are well-known
- ❖ Active on Technical Programme Committees and editorials (e.g. IEEE journal/CDF)
- ❖ Active exchange programme with academia/industry
- ❖ Set the agenda – don't follow
- ❖ Substantial international company support
- ❖ Patent portfolio – (depends on focus of group)
- ❖ High quality PhDs who impact industry and academia.
- ❖ Not necessarily located in 'Big University' as many pockets of excellence exist in small universities.
- ❖ Evidence of knowledge transfer/spin outs
- ❖ How many new ideas the group has produced (publications and patent are only part of the story) and evidence of results
- ❖ The group may also have a high public profile, may consulting and advise government and have critical mass.
- ❖ Internationally recognised e.g. awards (IEEE Awards)

❖ **2. WHAT WOULD YOU EXPECT TO SEE IN A CV FOR AN INTERNATIONALLY LEADING RESEARCHER?**

- ❖ Total funding as PI – most important
- ❖ Keynote speaker or organiser/chair at IEEE conferences.
- ❖ Leadership roles in learned societies (i.e. fellow of RC, RAEng, IEEE)
- ❖ Research monographs (detailed technical books by renowned publishers e.g. Wiley)
- ❖ Key innovations to name over sustained period – seminar paper
 - Publications (IEE) – journals (*)
 - Patents
- ❖ Journal editors
- ❖ Industry awards and major medals (e.g. Nobel prizes?)
- ❖ High citation index (total >~1200)
- ❖ Destination and technical impacts of PhD students (+masters) + (total number)
- ❖ High profile public lecture (e.g. Christmas lectures)
- ❖ International collaboration (including industry)
- ❖ Evidence of being a 'real scholar' with vision

*NOTE- Not all research is published e.g. Govt. or commercial in confidence
Not all research is citable (e.g. ITU. ETS, etc standards).

3. WHAT WOULD YOU EXPECT TO SEE IN A CV FOR AN INTERNATIONALLY LEADING RESEARCHER?

- ❖ Publication quality (citation on index of the journals)
 - Appropriate outlets (e.g. CS workshops)
 - Impact (not bibliometric) journals etc
 - Total # citations + H – index
- ❖ PhD completions and outputs plus successful career of PhD students
- ❖ PDRA output
- ❖ RAE style profile (esteem/environmental and outputs)
- ❖ Patents
- ❖ Disruptive research? – How to measure?
- ❖ Knowledge transfer → spin-offs/exploitation
- ❖ Business/commercial relevance
- ❖ Industrial influence/training etc
- ❖ Enabling new generation economy/commerce
- ❖ Attracting and exploiting funding the full
- ❖ Raising the public profile of ICT both nationally and internationally
- ❖ Spawning new research areas
- ❖ Company spin out
- ❖ Planning and persistence
- ❖ Easily found on Google search (Google scholar)

4. HOW CAN WE IDENTIFY AND SUSTAIN YOUNG/NEW TALENT IN ICT?

- ❖ Identify talented Undergraduates and give them challenging final year projects
- ❖ Expose potential talent to excitement (if doing a PhD in the lab)
- ❖ Raise profile of PhD.
- ❖ Individual fellowships for newly completed PhD (i.e. 2 extra RA years)
- ❖ More industry fellowships
- ❖ More EPSRC international fellowships (PhD's and UGs)

- ❖ Mentoring (invoke Passion)
- ❖ FIRST GRANTS
 - Best paper and best student awards
 - Industrial internships
 - Undergrad (UG)
 - ICT academy
 - Best UG project prizes
 - Work placements in ICT industry and Uni. ICT. Depts.
- ❖ More funding for commercialisation
 - Promote entrepreneurship among – Engineers and Scientists
- ❖ Good salary and incentives (especially in Universities)
- ❖ Promote engineering and computing

5. WHERE DO YOU THINK THE COMPETITION IS GLOBALLY IN YOUR RESEARCH AREA?

- ❖ Networks & Dist Systems: Berkeley, CMU, MIT, Princeton (USA), Washington, ETHE, EPFL
- ❖ Radio Science: USA, same in Europe
- ❖ Digital Signal Processing: USA, IT & FR, Hong King, Rice, EPFL
- ❖ Financial Modelling: City
- ❖ Communications: Minnesota, Stanford, MIT, Berkley, Illinois (Urbana) TU Munich, Aachen, Dresden, ENST, Supelec, NICT(Japan), Rutgers (USA)
- ❖ Pervasive Systems Berkeley, MIT, Georgia Tech, HoKUST, Many EU Universities
- ❖ In General:
 - Today: USA, Europe, Japan – Korea
 - Tomorrow: China, India/Far East??
 - For Mobile : continental esp. Germany, EURECOM
 - Future : Far East, again
 - CS/ICT: MPI, FHG
 - Microsoft research!!
 - MIT
 - AT&T research
 - PARC
 - KAIST
- ❖ Benchmark against the best in the world – whenever that is! But often they are our collaborators, particularly EU.

6. WHAT WOULD YOU EXPECT TO SEE IN A GOOD FIRST GRANT?

- ❖ Achievable aims
- ❖ Meaningful – internal review before submission (=support)
- ❖ Bounded expectations e.g. collaboration, **not** requiring industrial support
- ❖ Evidence of mentoring from institution - aids developing collaboration with research community and/or industry
- ❖ Evidence of innovation
- ❖ Small and succinct?
- ❖ Some track record already, in the field
- ❖ Should be focused on → funding a PhD student → no time limit but cash limit!
- ❖ Be nigh efficiency
- ❖ Follow on to first grant if successful planning for outcomes and next grant
- ❖ ORIGINALITY AND JUSTIFICATION

- ❖ Treat as extension of training rather than focussing exclusively on research

7. WHAT IS THE EXPLOITATION BY INDUSTRY LIKE IN YOUR AREA? IS THIS AN ISSUE?

- ❖ Relatively good – depends on the work
- ❖ Yes, service providers and operators
- ❖ No, manufacturers (none really left in UK?) companies are international
- ❖ Large SME base in UK, but not able to exploit (or fund) research
- ❖ Mobile VCE is a good example - has attracted companies to the UK
- ❖ KTPs are difficult to set up (lots of red tape) - relationship with UKTI
- ❖ There is now the DC-KTN which aims to involve universities with the Communications Companies (EPSRC is an observer)
- ❖ How to improve this :
 - Joined up activity w/ regional level agencies
 - Better tax breaks - lacks the scale for real impact (also patents).
 - Encourage more spin-offs, esp. now (in economic recession)
 - Move corporate R&D in the UK (EPSRC → BERR/DIUS → UK Gov)
- ❖ Lack of bridge – funding

8. WHAT IS THE NEXT QUANTUM LEAP FOR RESEARCH IN YOUR AREA?

- ❖ Body – area networks
- ❖ Cognitive antenna systems
- ❖ Cause/ITS automated distributed collision area.
- ❖ Perfect internet privacy and security
- ❖ Millimetre wave broadband radio to the home
- ❖ Electromagnetic cloaks metamaterials
- ❖ THz remote sensing
- ❖ Converged/future networks and internet
- ❖ Cognitive/software radio
- ❖ Smart dynamic radio
- ❖ Smart spectrum utilisation
- ❖ Mobile social networks
- ❖ Cooperative networks/distributed N/W mega networks
- ❖ Quantum communications
- ❖ Quantum cryptography
- ❖ Security in ubiquitous comms
- ❖ High bandwidth access networks
- ❖ We need a quantum leap in software development
- ❖ Green ICT
- ❖ Short range tetra hertz comms
- ❖ Efficient comms systems – energy
- ❖ Seamless systems
- ❖ Efficient connect and route
- ❖ Molecular/nanoelectronics
- ❖ Integration of electronics and photonics
- ❖ Materials to offer 'DSP like flexibility' for antennas and RF filters
- ❖ Materials batteries
- ❖ Green radio
- ❖ Cognitive networks
- ❖ Cognitive winter healthcare
- ❖ Biodegradable electronics autonomic networks (ie self –managing)
- ❖ Techniques for ultra–high availability networks

- ❖ End-to-end Qos, mobility and security for ubiquitous internet
- ❖ Super conductors
- ❖ Multi spectral body screening
- ❖ Optical computing

9. WHAT IS YOUR PERCEPTIONS OF MULTIDISCIPLINARY WORKING?

- ❖ Advantages:
 - Expanding scope/horizons of research activity
 - Bigger "impact"
- ❖ Disadvantages:
 - Gaining funding can be more difficult
 - Talking to new communities
 - language can be challenging, e.g. bio-medicine
- ❖ Challenging but fun
- ❖ Best when grown organically and not "forced"
- ❖ Critical mass major funding
- ❖ Key applications in UK that need focus e.g. health transport (assisted living)
- ❖ Over stressed
- ❖ A good idea in principle – in practice proposals less likely to be funded - Not necessarily – but there must be a real need to collaborate
- ❖ EE/CS boundaries should be broken down
- ❖ Shouldn't be a religion
- ❖ Should be naturally grown – not forced
- ❖ EE/physics and chemistry → materials needs exploiting - Not just in materials area
- ❖ Good to have some of this, but should not become a necessity
- ❖ We do nothing else!
- ❖ Trust
- ❖ Difficulty to get good evaluations! (e.g. promotion cases, proposals)
- ❖ Symmetric and asymmetric (discipline $a \rightarrow b$ v $a + b$)

10. OF ALL OUR FUNDING MECHANISMS (FELLOWSHIPS, FIRST GRANTS, PLATFORM GRANTS, NETWORKS) WHICH DO YOU THINK ARE MOST EFFECTIVE AND WHICH NEEDS TO BE ENCOURAGED MORE?

- ❖ First grant – good idea, but not achieving its aim – should put back restriction on more money for response mode – so that the fundable line approaches the funded one - Agree, but clear guidelines
- ❖ Networks – to encourage inter-disciplinary activity – good value for money (profile too) – agree (not virtual) – but not only 'interdisciplinary'
- ❖ Fellowships
- ❖ There haven't been many specific calls in the comms area (e.g. under Digital Economy)
- ❖ More opportunities for smaller grants - with light touch process
- ❖ How many fellowships are supported in comms? (e.g. RF technologies etc)
- ❖ Core funding to allow continuity beyond PhD cycle
- ❖ Less bid overhead – high success rate by filtering
- ❖ We must split radio comms from competing areas
- ❖ Lose the impact statement!

11. WHAT SHOULD THE BALANCE BE BETWEEN FUNDAMENTAL/APPLIED, HARDWARE, SOFTWARE RESEARCH IN THE ICT PROGRAMME?


- ❖ First identify research challenges and the balance between flavours should follow!
- ❖ Fundamental research should come first
- ❖ Applied (non-industry fundable) should come second
- ❖ Hardware/software are just tools/means to an end
- ❖ Tools need to be developed in research programmes sometimes
- ❖ Key importance is originality – plus potential impact
- ❖ We can only decide on fundamental vs. applied, but the decision should be on originality and potential impact
- ❖ Most projects include elements of both fundamental and applied
- ❖ Surely has to have potential application – but not necessary in immediate term (i.e. not necessary industrially supported)
- ❖ Strategic partnerships between universities to address fundamental research

12. WHAT ARE THE BARRIERS TO INTERNATIONAL COLLABORATION?


- ❖ No established ways to fund joint, international collaboration i.e. UK and US and Asia especially EPSRC and NSF and Canada
- ❖ Double jeopardy ---→ Where is Europe?
- ❖ Time/travel distance make collaboration/discussion/meetings difficult
- ❖ Copy Marie Currie EU programme
- ❖ Lack of NFS like funding for students to participate in conferences (ACM and NFS) mobicom infocom
- ❖ Identify emerging areas of research. That are of mutual interest to UK an Int. collaborators ex. USA, Canada etc
- ❖ High overhead for EU projects discourage international collaboration
- ❖ More links needed between EPSRC and other national funding agencies
- ❖ National barriers (US export, UK defence, etc)
- ❖ $P(\text{success})^2$
- ❖ Culture differences between nations
- ❖ Ability to obtain funding in a timely manner – need to match up with O/S partners.

3.4 Session 2 - Perceptions from the Communications Community

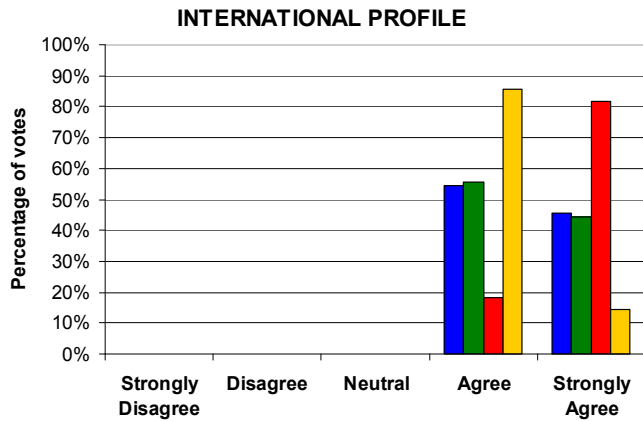
In this exercise, the delegates of the workshop were invited to provide a perception of how their area of research measures up to key criteria, defined by EPSRC. The topics represent the areas of research within the communications portfolio and delegates were asked to provide 'votes' in their area of expertise.

 Networks and Distributed Systems

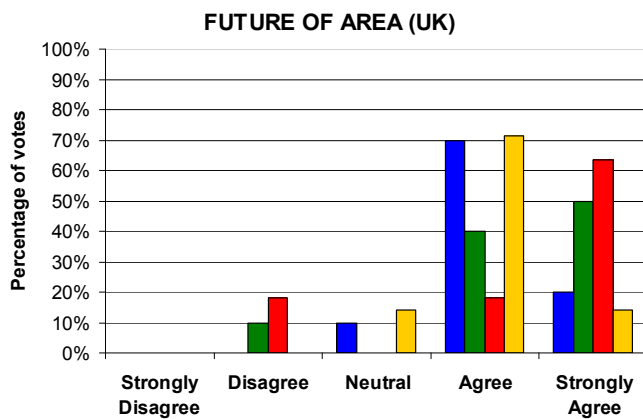
 Digital Signal Processing

 Radio Frequency and Microwave Technology

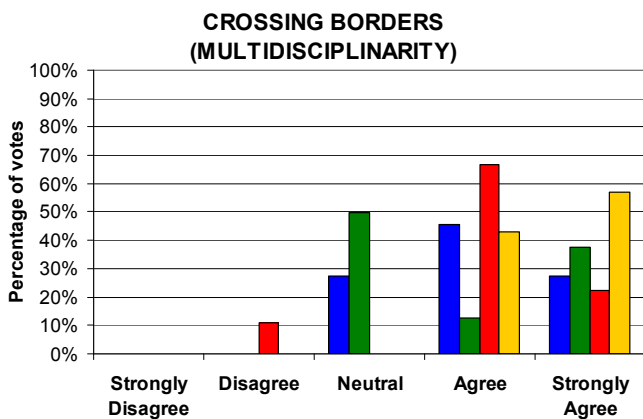
 Mobile Computing



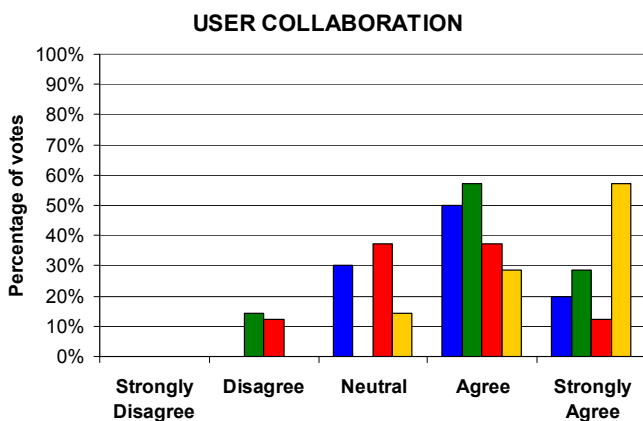
UK research area is of high international standard, with researchers collaborating extensively internationally and the researchers are recognised as world leaders.



Research area has a bright future, with plenty of novel and adventurous research and without areas of stagnation.

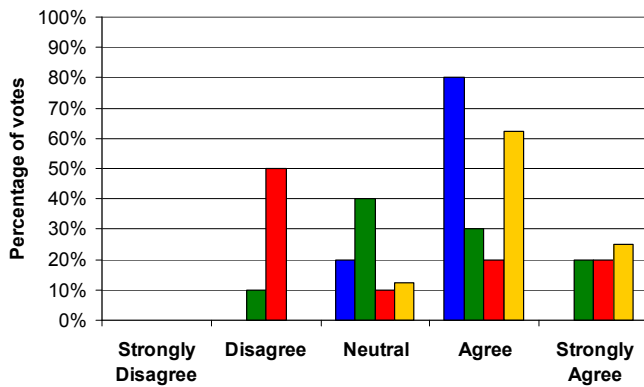


Research area crosses borders between disciplines where necessary, as evidenced by many multi-disciplinary projects and good engagement with other research councils.



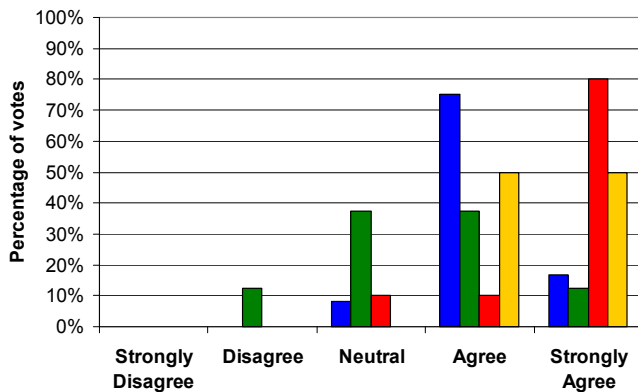
The level of collaboration and two-way knowledge flow with users, both in terms of quantity and quality is sufficient to assure that the knowledge generated makes a difference.

FUTURE RESEARCH LEADERSHIP



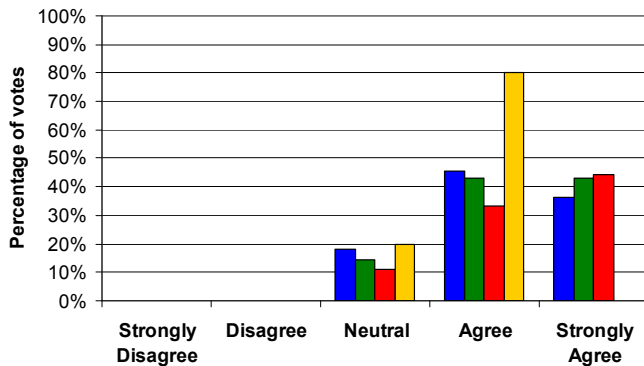
There is a rising generation of future research leaders in this area, suitable to ensure its future development, evidenced by numbers of Career Acceleration/Postdoctoral Fellows, First Grants...

CREATIVITY AND ADVENTURE



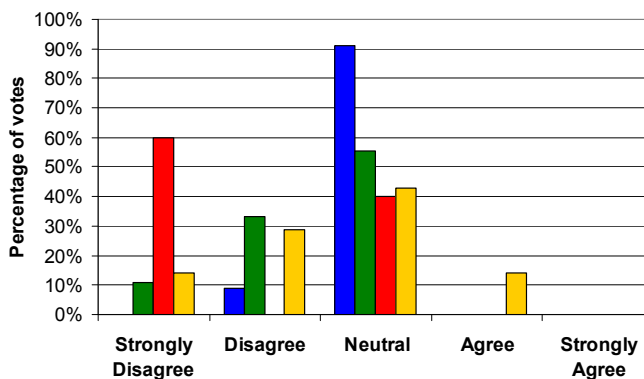
Research area is highly creative and adventurous with potential to lead to a step change, resulting in new areas of research.

SOCIO-ECONOMIC BENEFITS



Research area is addressing topics of potential value to both UK society and the UK economy and will increase the global competitiveness of the UK.

RESOURCES



Researchers in this area are sufficiently resourced in terms of facilities, equipment and availability of non-EPSRC funding, ensuring maximum leverage of EPSRC funds.

3.5 Session 3- Analysis of UK Communications Research

The objectives for the afternoon sessions (sessions 3 and 4) were to gather information and obtain a greater knowledge of Communications community issues and build an accurate picture of current state-of-play of Communications research in the UK. These output from the SWOT analysis in session 3, will be used to identify 'Opportunities' for the community to suggest in final session.

STRENGTHS

The view is that the UK has many large, coherent groups right across communications disciplines. Several groups are world-leading and these 'pillars of excellence' have a strong international reputation. Also, this experienced community consists of motivated and eager researchers that easily attract rising stars from overseas.

With the UK's excellent track record of innovation and exploitation there is strong collaboration with industry in specific areas, as the field has lots of practical relevance. In addition, there are many small telecom companies in the UK that do valuable work. Specific research strengths were identified as RF/antenna, signal processing, wired/ wireless, networking, coding theory and electromagnetics.

WEAKNESSES

There is a perception that there is a lack of community spirit caused by different research cultures (communications research is made up of both computer scientists and engineers). It is believed that the UK has reduced funding with respect the EU countries and smaller group size with respect to USA (in certain cases, this may be too small to make an international impact). In academia, there is poor visibility of the impact of the research and a lack of university-to-university collaboration.

There is no doubt that the industry perspective dominates and dictates the research direction and consequently there is a lack of balance between interdisciplinary and fundamental research (i.e. a reduced investment in fundamental research). There is also a lack of corporate R&D centres (or testbeds) and little or no major manufacturing in the UK (industry is too much of a service industry). Despite there being a large amount of SME's in this area, they are hard to engage as SME's cannot support research.

UK Comms research focuses on narrow questions as opposed to system issues, compounded by a lack of a national cohesive R&D programme. There is a distinct lack of home PhD students and staff continuity is a continual problem. Specifically, there is a lack of radio science funding and hardware (but a large resource is needed for this).

THREATS

The current economic climate has greatly reduced industry sponsorship, and this is leading to a weaker industry. Also, a decline in UK students and researchers means that there are also falling rates of suitably qualified graduates (to recruit through DTA/DTCs) and this lack of PhDs (particularly UK) stems from students perceptions of ICT (i.e. that industry do the research already) and industry itself does not advance the students. There is also a threat that the overcritical reviewer culture threatens RC funding (peer review 'assassination') and funding from the research councils is flat or reducing.

It is believed that both of these criteria have an impact on the success rate of responsive mode proposals in this area which may give contribute to a weakened communications research base. Also, signposting is moving away from comms. The lack of geographic scale experiment for network research and lack of a coherent national strategy threaten communications research in the UK. There is a real threat that we will be overtaken by the China/India research base as policy makers have perceptions that everything is done.

OPPORTUNITIES

Opportunities to exploit the weaknesses and threats focussed around identifying key signposts, building a cross-disciplinary research community and encourage funding for fundamental subjects and multidisciplinary approaches. People involved in research should take advantage of current government policy support and societal impact to create greater exposure (providing more success stories to EPSRC to demonstrate KT and economic impact would help). In addition there could be a greater link to learned bodies such as the IET for colloquia and opportunities to educate peer review community. There was also a suggestion to bridge the gap between HEFGE and EPSRC (with regard to training issues).

Some of the key opportunities were expanded in the final marketplace session. Each opportunity generated a contact list of interest (including some suggested recommendations of academics not in attendance), with the possibility that these would be taken forward and supported beyond the theme day:

Opportunity	Future Internet
Relevance/ Need	Integrate wired- wireless technologies and protocols.
Vision/ Aims	Bring EE and CS communities together on a major national scale initiative. Promote interdisciplinary research across major applications.
Resources needed	Identify core components/ technologies Strategic partners
Management strategy	Needs initial central lead e.g. centre
Contact list	See 'testbed' list STFC

Opportunity	Green Technology
Relevance/ Need	CO2 reduction and environmentally friendly ICT
Vision/ Aims	A distributed very low energy consumption radio network that could be powered by sustainable energy sources (solar panel and wind turbine).
Resources needed	Resource for a workshop (brain storming) to come up with research proposal
Management strategy	Man management
Initial contact list	Hamid Aghvami Barry Evans, Fu Zheng, Mark Beach,

	John Thompson, Izzat Darwazeh, Bahram Honary, James Irvine, Lajos Hanzo, Madjid Merabti, Sunil Vadgama, Alistair Burr, Saleem Bhatti, Nigel Jeffries, George Goussetis.
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Opportunity	Network of Networks
Relevance/ Need	Vital to bring communities together
Vision/ Aims	Summer schools to address skills and training Technical Fora to identify key research issues and develop consortia/ ideas/ proposals. Security of a network of networks
Resources needed	Funding to support summer schools and meetings Contacts with IET
Management strategy	Wide community Bring back PREPs, coordinate with IEEE and refer to successful examples overseas.
Initial contact list	(Peter Grant, not in attendance) Alistair Burr, Fu Zheng, Lajos Hanzo, Madjid Merabti, Tim O'Farrell, George Goussetis, David Linton.

Opportunity	Spectrum/ Energy Utilisation
Relevance/ Need	10x improvement in spectrum efficiency usage
Vision/ Aims	Develop technologies to access/ revise spectrum to support 'future internet' (leveraging 1-4GHz spectrum).
Resources needed	One day workshop to 'brain-storm'
Management strategy	Identify key topics and scope for proposals
Contact list	John Thompson Barry Evans, Alister Burr, Fu Zheng, Mike Willis, Make Beach, Costas Constantinou, Yang Hao, Hamid Aghvami, Xiaohou Peng, Sunil Vadgama, Nigel Jeffries, George Goussetis, David Linton, Mark Leeson, Tim O'Farrell.

Opportunity	National network of excellence
Relevance/ Need	Areas of national strategy
Vision/ Aims	Generate funding mechanisms for fundamental research in key areas; physical layer, theoretical aspects, spectrally efficient systems and RF engineering.

Resources needed	Network seed funding to lead to collaborative projects/ funding
Management strategy	Facilitated by EPSRC
Contact list	Izzat Darwazeh Barry Evans, Bahram Honary, Madjid Merabti, Lajos Hanzo, Mark Beach, Morris Sloman, Yang Hao, Hamid Aghvami, Saleem Bhatti, Peter Hill, Alister Burr, George Goussetis, Mark Leeson, Tim O'Farrell.

Opportunity	National Facility/ testbed
Relevance/ Need	Major player in future internet
Vision/ Aims	Flexible platform at all layers (technology agnostic)
Resources needed	Identify what is needed infrastructure/management
Management strategy	EPSRC managed facility (multi-site, Digital Economy)
Contact list	(Rahim Taffazolli, not in attendance) Mark Beach, Izzat Darwazeh, David Hutchinson, Steve McLaughlin, Saleem Bhatti, John Crowcroft, Joe Sventek, Costas Constantinou, Alister Burr, Mike Willis, Bahram Honary, Fu Zheng, Kin Leung, Madjid Merabti, Tim O'Farrell, Nigel Jeffries, Sunil Vadgama.

3.6 Conclusions

In the concluding message of the workshop, Liam Blackwell announced that it is up to the community to follow-up the opportunities presented and EPSRC will provide assistance and guidance where appropriate (i.e. for potential programme or network grants). LB also mentioned that there also may be extra scope for further workshops, depending on the need and requirements of the ICT community in general.

Outputs of the workshop (contained in this report) will help contribute to ICT strategy and more specifically, to the review of the communications portfolio. Consequently, this document will be sent to all delegates and relevant members of the community. Overall, the workshop appeared to be well-received by a majority of the delegates and feedback suggested that it provided a useful networking opportunity to those invited.

4. Attendance List- Communications Theme Day 24 February 2009

Hamid	Aghvami	King's College London
Mark	Beach	University of Bristol
Saleem	Bhatti	University of St Andrews
Alister	Burr	University of York
Jonathon	Chambers	Loughborough University
Costas	Constantinou	University of Birmingham
Jon	Crowcroft	University of Cambridge
Izzat	Darwazeh	University College London
John	Dunlop	University of Strathclyde
Barry	Evans	University of Surrey
George	Goussetis	Heriot Watt University
Lajos	Hanzo	University of Southampton
Yang	Hao	Queen Mary, London
Peter	Hill	Cranfield University
David	Holding	Aston University
Bahram	Honary	Lancaster University
David	Hutchison	Lancaster University
Robert	Istepanian	Kingston University
James	Irvine	Strathclyde University
Nigel	Jefferies	Vodafone
Richard	Langley	University of Sheffield
Mark	Leeson	University of Warwick
Kin	Leung	Imperial College London
David	Linton	Queen's University of Belfast
Cecilia	Mascolo	University of Cambridge
Joe	McGeehan	University of Bristol
Stephen	McLaughlin	University of Edinburgh
John	McWhirter	Cardiff University
Madjid	Merabti	Liverpool John Moores University
Cathryn	Mitchell	University of Bath
Tim	O'Farrell	Swansea University
Morris	Sloman	Imperial College London
Joe	Sventek	University of Glasgow
John	Thompson	University of Edinburgh
Sunil	Vadgama	Fujitsu
Michael	Warrington	University of Leicester
Michael	Willis	STFC, RAL
Zhipeng	Wu	The University of Manchester
Fu-Chun	Zheng	University of Reading
Martin	Tillin	Sharp