



EPSRC

Engineering and Physical Sciences
Research Council

Workshop Report

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ICT Programme

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1. Introduction

This report summarises the main discussion points, outputs and key conclusions emerging from the WINES workshop held on 23-24th April 2007.

The workshop was attended by 100 people, comprising a mix of Academic researchers, Research Associates, PhD students, and representatives of User organisations. Approximately 70% of the attendees had direct association with one of the WINES projects. A full delegate list can be found in Annex 1.

2. Background

In 2002 EPSRC received financial commitment from EPSRC Council to establish an initiative in the broad area of Wired and Wireless Intelligent Networked Systems (WINES).

Shortly after this time UK Computing Research Community (UKCRC) established their Grand Challenges in Computing Researchⁱ, one of these was focussed on new challenges in Ubiquitous Computing. An EPSRC funded research network, UK Ubiquitous computing network (UK Ubinetⁱⁱ) had formed in response to this grand challenge and brought together academic researchers within the UK to build a multi-disciplinary community covering the broad aspects of ubiquitous computing.

Consequently, in July 2004, the EPSRC Information and Communication Technologies (ICT) Programme launched the first WINES call with the anticipation of forming large, multidisciplinary consortia to tackle the future challenges of autonomic, self-organising and self-managing systems. This call resulted in an investment of £7.8 million across seven projects.

Due to the success (formation of new multidisciplinary consortia) of the first round of projects, additional funding for WINES was secured and the second call launched in July 2005. This call was specifically aimed at cultivating further collaboration between the traditional ICT research disciplines, bridging the gaps between the funded projects from the first call while stimulating new, innovative ways to address challenges in the realm of ubiquitous computing. An additional requirement was that each project had form an appropriate collaboration with an industrial partner. The second call funded six cross disciplinary projects to the value of £8.3 million. Details of WINES funded projects can be found in Annex 2.

Having instigated this initiative, EPSRC invited both grant holders and non grant holders to the inaugural WINES 2-day networking workshop. The event was free to attend, additionally EPSRC offered complimentary overnight accommodation for all attendees.

ⁱ http://www.ukcrc.org.uk/grand_challenges/index.cfm

ⁱⁱ <http://www-dse.doc.ic.ac.uk/Projects/UbiNet/>

3. Aims

The objectives of the event were as follows:

- To share experiences and best practise of the projects funded under the WINES Programme.
- To showcase the funded research and disseminate to the wider community.
- To formulate ideas in preparation for the 3rd Call for WINES.
- To forge new collaborations and partnerships.
- To enable networking between researchers working on the projects.

All projects funded through the WINES programme were invited to attend and present at the workshop. In addition an open call for participation at the event was advertised through the EPSRC website and through the UK Ubinet distribution list. The demand for places at the workshop was overwhelming, demonstrating that there is real enthusiasm in the area to participate at networking events.

4. The Event

The agenda was scheduled over two days as detailed in Annex 3. The first day included presentations from each of the WINES projects, followed by a poster session and competition for researcher associates working on the projects. The first day closed with a gala dinner, where the poster competition winners were awarded prizes.

A café style format was utilised during the second day, where attendees were encouraged to share ideas, form new relationships to prepare for the forthcoming WINES call.

4.1 Overview of Day 1: Dissemination

The first day of the event focussed primarily on dissemination of outputs from WINES projects.

All 13 projects were invited to provide a 20 minute presentation describing a specific outcome from their project. The projects were grouped into sessions with projects from the first and second rounds were intermixed. It is anticipated that the slides used for each of the presentations will be made available through the individual WINES projects websites. For links to some of these websites please see

Annex 4.

In addition to these presentations Professor Tom Rodden, University of Nottingham, provided an overview of the challenges facing Ubiquitous Computing. He generously offered to host workshops in this area, on behalf of the WINES community, through the Equator Interdisciplinary Research Collaboration (IRC)ⁱⁱⁱ.

The final session of the day was a poster and networking session. Here, Research Associates working on the WINES projects and related projects were asked to present a poster on their work. These posters were judged by Dr. Timothy Roscoe, ETH Zurich and Professor Tom Rodden, with prizes then awarded during the Gala Dinner. To further encourage networking during this session each poster presenter punched a card of everyone who visited their poster.

4.2 Overview and Outputs from Day 2

Having established the breadth of research covered by the WINES projects, the second day enabled the attendees to network and draw out ideas for future projects. It was anticipated that some of these ideas would be highlighted as potential focus areas for the third WINES call.

The day began with a thought provoking presentation from Dr. Timothy Roscoe, ETH Zurich. He commented on the progress of the projects to date, identified common themes between the projects, the need for the projects to share lessons learned as they progressed and to disseminate results to the wider community.

The morning networking sessions took place in a café environment. Attendees were allocated to small groups around a table and were asked to consider the two questions posed. Attendees noted key points of discussion on the tablecloths provided, and after 20 minutes were asked to move to form new discussion groups. This rotation happened about 3 times for each question.

The first question was aimed at identifying where the gaps and opportunities exist between the current WINES projects. The second question posed was "What common themes can be identified for future projects and what expertise is required?" in order to explore the ideas in more depth.

The information gathered from the table cloth sessions which identified gaps were used to identify eight broad themes and formed the basis of the afternoon breakout sessions and are detailed below:

- [Healthcare](#)
- [Energy and Low Power](#)
- [Sensor Networks](#)
- [Security, Privacy and Trust](#)
- [Scalability](#)
- [Shared Tools and Platforms](#)
- [Adaptability and Reusability](#)
- [Ethics/Societal Issues](#)

Opportunities identified in this session have also been summarised and can be found in Annex 5. These opportunities could be used as the basis for innovative applications in the forthcoming WINES call and larger research projects more generally.

ⁱⁱⁱ www.equator.ac.uk

In the afternoon session, attendees were able to attend breakout sessions on at least two themes of their choice. Here they discussed the theme in more detail, exploring the potential application areas, and the research expertise that a project in this area would need to involve. The main points of discussion were captured and displayed in a market place.

4.3 Outputs from Breakout Session

Healthcare

Although this area was selected as a theme from the morning discussions, the area was considered highly developed and that knowledge needed to be shared between existing projects working in this area, particularly on coding, tools and platforms. It was felt that there was some real need for leading edge research in this area, but not research based purely on sensors. There was some discussion concerning the push towards user driven healthcare, or "selfcare", rather than care delivered by medical practitioners.

Energy and Low Power

Energy and Low power were thought to be important areas due to their relevance to a wide range of application areas, as wireless systems are integrated into infrastructure such as buildings, environmental modelling, asset tracking, and industrial processes.

This discussion highlighted an integrated approach to considering power from the network architecture through to the platform and appropriate sensors. The requirements for new battery storage technology and power management platforms and networks was also discussed, along with the need for a system where front end intelligent processing was incorporated in to the antenna design. A top-down approach to a "WINES system" which performed without using energy e.g. radio usage, was considered.

It was felt that researchers from both hardware and software areas, as well as Engineers, material scientists and those working on wireless technologies and machine learning could all contribute to projects in this area.

Sensor Networks

In this breakout group discussions centred around different aspects of sensor networks and these included:

- acoustic networks,
- actuation,
- energy savaging,
- satellite networks,
- in network processing,
- reliability and dependability,
- collaborative computing or networking (sensing and processing),
- sensory/self diagnostics/calibration,
- autonomous operation for both positioning and localisation,
- sampling,

- modelling, simulation and optimisation.

For research projects in this area experts would be required who were specialists in nanotechnology and Micro electro mechanical systems, sensors and instrumentation, data analysis, control and robotics, ultrasonic's and radio frequency engineers.

Security, Privacy and Trust

Security, privacy and trust appeared to be applicable to all wireless, mobile and ad-hoc networks systems, and could be addressed as a horizontal theme across future projects and applications. This topic was thought capable of uniting applications and theory driven research.

It was felt that there was a need to explore the security requirements for next generation systems and also the limitations of existing systems including tools and languages. The reusability of tools was discussed along with establishing best practise in this area. Additionally, concerns about data provenance were highlighted, particularly:

- non-replication
- authentication
- anonymity
- pseudonymity
- privacy
- dependability
- reliability.

The discussion group felt that it was imperative to include social scientists (especially those with an understanding of trust), cryptographers, psychologists, business studies specialists and lawyers for future research projects in this area.

Scalability

The group discussed the concept and definition of scale, models and fundamental concepts of scale and how to manage large scale systems.

Specific questions about scale were raised regarding:

- Who owned data and how it is used,
- What data was being used for and how was it processed and aggregated?
- How to research scalability,
- Whether theory mapped on to the real world,
- Simulation may not match the real world, as large scale systems were unavailable,
- Whether scalability was an issue for the future and whether it was harder to address it now.
- The adaptability of systems at multiple scales.
- What happens to critical functions as system scale?
- How to detect inconsistencies as systems scale.
- Scalability over time.
- Loss of control as systems scale.

Low energy and robust network architectures were identified as potential research areas under the scalability theme. There was a focus on:

- Openness of data through a network,
- Interacting networks at different scales- local to global
- Swarm optimisation

- Biological/Evolutionary systems
- Large scale systems programmed to evolve
- Bio-inspired computing
- Bio-mimetic devices
- Networks where no users, nodes or sinks existed.

The group felt that the density of nodes in a system needed to be addressed and issues were identified around adaptation and openness of systems.

Potential research project partners would include Government or large scale agencies, researchers who work with large data sets, and management and economics researchers. There was agreement that the WINES projects should share data.

Shared Tools and Platforms

The group felt that shared artefacts such as libraries, services, books, data traces, software and hardware were beneficial. Additionally, identifying shared requirements and dependencies could help to reduce duplicated engineering.

Discussion also focussed on suggestions for shaping the success criteria for research proposals submitted under the WINES third call, such that proposals:

- contributing to "infrastructure",
- contributing to shared tools and software,
- collaboratively developing code with other projects,
- delivering shared mechanisms,

were awarded funding. It was felt that engineers were required to work towards producing a shared infrastructure.

Adaptability and Reusability

The discussion groups considered an adaptable system as a system which responded to a change. The group discussed emergent behaviours and the need for intelligent adaptable systems which have the ability to self learn, self validate, self optimise and are robust in extreme events so that data loss was minimised. They felt that software evolution techniques, predictive algorithms and learning's from social networks could be applied to these systems. Cost was an important factor when considering adaptable and reusable systems.

It was thought that middleware, theory, solutions and algorithms could all be reusable, as could knowledge which should be swapped between the WINES projects. Reconfigurable systems which had the ability to self repair, change depending on the task or upgrade would be valuable.

Ethics/Societal Issues

The groups involved in these discussions felt that it was important not to constrain ethics and societal issues to any one application area, rather each future WINES project should contain a specific ethical implication section. However, the social/ethical considerations needed to be carefully balanced by the societal needs to accept/take-up technology. An example used to demonstrate this balance was the ethical impact of mobile wireless devices and biological implanted sensors research versus the ready acceptance of You Tube. The group recognised the need to avoid the next "great societal fear", perhaps by engaging and educating the next generation of consumers and raising public awareness of societal research issues rather than debating these within the confines of the research community.

The groups believed there was a need for a Fellow or Champion or Guru in this area, perhaps similar to the EPSRC Senior Media Fellows who could provide advice to researchers. Future research consortia could build in public engagement activities into their dissemination plans, however these should be tailored to suit the research activity in the proposal rather than presenting a standard mechanism in each. It was felt that the consideration of ethical issues varied across the different research communities, and that lessons should be learnt from colleagues that have embraced ethical challenges. A series of workshops could be used to explore the future WINES societal issues and implications.

5. Conclusions

The WINES workshop fulfilled its aims. Feedback from the workshop was very positive; in particular attendees highlighted the high quality of the presentations and posters and that the workshop provided an excellent forum for networking and sharing thoughts regarding future projects in the area of WINES.

A number of key messages were pulled through. There was a strong desire for the WINES projects to continue to disseminate results to the wider community, share best practise, lessons learned, tools and knowledge between the projects. Indeed some feedback indicated that projects should share staff between projects to ensure knowledge transfer and mobility.

When highlighting new ideas for future calls, participants felt that: the projects should engage internationally; with a wide range of scientists and engineers; that there was a real need for cross cutting projects perhaps with reusable or generic solutions; and that there was potential for riskier projects. Some participants felt that future WINES projects could benefit from steering committees.

Throughout the workshop attendees enthusiastically participated in the sessions, and helped to develop areas of interest for the WINES programme. It is anticipated that future dissemination workshops will continue to stimulate and sustain research in WINES and that there will be an evaluation of the impact of the WINES programme investment.

6. Annex

Annex 1

A list of attendees at the workshop is provided below.

Name	Organisation
Mohamed Abdel-maguid	Staffordshire University
Angeliki Aisopou	Imperial College London
Maaruf Ali	Oxford Brookes University
Hamed Al-raweshidy	Brunel University
Tughrul Arslan	University of Edinburgh
Paolo Ballarini	University of Glasgow
Nikolaos Bartzoudis	University of Essex
Peter Bennett	University of Cambridge
Alastair Beresford	University of Cambridge
Ian Bezodis	University of Wales Institute, Cardiff
Mathew Boon	University of Manchester
Licia Capra	University College London
Matthew Chalmers	University of Glasgow
Lawrence Cheng	University College London
Richard Connor	University of Strathclyde
Costas Constantinou	University of Birmingham
Geoffrey Coulson	Lancaster University
Jon Crowcroft	University of Cambridge
John Davis	University of Manchester
Alan Dearle	University of St Andrews
Giuseppe Di Fatta	University of Reading
Naranker Dulay	Imperial College London
Jaafar Elmirghani	Swansea University.
Ahmed El-Rayis	University of Edinburgh
David Evans	University of Cambridge
Henry Eyoh	University of Strathclyde
Paul Ezhilchelvan	Newcastle University
Maria Farrugia	Vodafone Group
Ava Fatah gen. Schieck	Bartlett, University College London
Xiang Fei	Stirling University
Alvaro Fernandes	University of Manchester
Ixent Galpin	University of Manchester
Philippa Gardner	Imperial College London
Peter Green	University of Manchester
Peter R Green	University of Manchester
Stephen Hailes	University College London
Nakui Haridas	University of Edinburgh
Christian Heath	King's College London
David Holding	Aston University
Andrew Hopkins	University of Essex
Neil Hault	University of Cambridge
Gareth Howells	University of Kent
Brian Hoyle	University of Leeds
Markus Huebscher	Imperial College London
David Ingram	University of Cambridge
Robert Istepanian	Kingston University

Matthew Jadud	University of Kent
Sye Loong Keoh	Imperial College London
Katharina Kinder	Lancaster University
Gerd Kortuem	Lancaster University
Vassili Kostakos	University of Bath
Costis Koumpis	Sensors KTN
Marta Kwiatkowska	University of Birmingham
Hai Li	University of Kent
Anders Lindgren	
Paul Luff	King's College London
Garik Markarian	University of Leeds
Ian Marshall	Lancaster University
Cecilia Mascolo	University College London
Patryk Mazurkiewicz	Imperial College London
Klaus McDonald-Maier	University of Essex
Campbell Middleton	University of Cambridge
Geyong Min	University of Bradford
Ron Morrison	University of St Andrews
Leonardo Mostarda	Imperial College London
Dimitris Moustakas	University College London
Eamon O'Neill	University of Bath
Graham Parkinson	University of Manchester
Gerard Parr	University of Ulster
Xiaohong Peng	Aston University
Alan Penn	University College London
Richard Penty	University of Cambridge
Veselin Rakocevic	City University London
Jon Robinson	University of Sussex
Tom Rodden	University of Nottingham
Timothy Roscoe	ETH Zurich
David Rosenblum	University College London
George Roussos	Birkbeck, University of London
Michele Sama	University College London
Malcom Scott	University of Cambridge
Santosh Shrivastava	Newcastle University
Morris Sloman	Imperial College London
Ben Smyth	University of Birmingham
Kenichi Soga	University of Cambridge
Danae Stanton Fraser	University of Bath
Paul Tasker	Cardiff University
Niki Trigoni	Birkbeck, University of London
Alan Tully	Newcastle University
Ken Turner	University of Stirling
Tanya Vladimirova	University of Surrey
Ian Wakeman	University of Sussex
Lei Wang	Imperial College London
Alan Wilson	The Royal Veterinary College
Xiaofeng Wu	University of Surrey
Erfu Yang	University of Edinburgh
Shaun Yang	Loughborough University
Trevor York	University of Manchester

Annex 2

A complete list of the projects funded through the WINES programme can be found below:

BiosensorNet: Autonomic Biosensor Networks for Pervasive Healthcare	Imperial College London	Professor Morris Sloman
Design, Implementation and Adaptation of Sensor Networks through Multi-dimensional Co-design	University of Glasgow	Professor Joe Sventek
	University of Manchester	Dr Alvaro Fernandes
	University of Kent	Professor Ian Marshall
	University of Strathclyde	Professor John Dunlop
Networking of Distributed Sensors for Proactive Condition Monitoring of Wind Turbines	University of Kent	Professor Ian Marshall
	University of Stirling	Professor Ken Turner
	University of Strathclyde	Professor Ivan Andonovic
A Transport Information Monitoring Environment (TIME): Event Architecture and Context Management (TIME-EACM)	University of Cambridge	Professor Jean Bacon
	Birkbeck, University of London	Dr Niki Trigoni
Cityware: urban design and pervasive systems	University of Bath	Dr Eamonn O'Neill
	Imperial College London	Dr Naranker Dulay
	University College London	Professor Alan Penn
NEMO: Networked Embedded Models and Memories of Physical Work Activity	Lancaster University	Dr Gerd Kortuem
ESPACENET: Evolvable Networks of Intell't & Secure Integrated & Dist'd Reconfigurable System-On-Chip Sensor Nodes for A'space Based Monitoring & Diag'	University of Edinburgh	Professor Tughrul Arslan
	University of Kent	Dr Klaus D McDonald-Maier
	University of Surrey	Dr Tanya Vladimirova
SESAME: Sensing for Sport and Managed Exercise	University College London	Dr Stephen Hailes
	University of Cambridge	Professor Andy Hopper
	University of Wales Institute, Cardiff	Professor David Kerwin
	The Royal Veterinary College	Dr Alan Wilson

UBIVAL: Fundamental Approaches to Validation of Ubiquitous Computing Applications and Infrastructure	University College London	Professor David Rosenblum
	Imperial College London	Dr Naranker Dulay
	University of Birmingham	Professor Marta Kwiatkowska
The Intelligent Airport (TINA)	University of Cambridge	Professor Ian White
	University College London	Professor Alwyn Seeds
	Swansea University	Professor Jaafar Elmirghani
Pervasive Computing Support for Market Trading	University of Sussex	Dr Ian Wakeman
	University College London	Dr Stephen Hailes
	King's College London	Professor Christian Heath
Smart Infrastructure: Wireless Sensor Network System for Condition Assessment and Monitoring of Infrastructure	University of Cambridge	Dr Kenichi Soga
	Imperial College London	Professor Nigel Graham
Wireless Sensor Networks for Industrial Processes	The University of Manchester	Professor Trevor York

Annex 3

WINES Workshop Agenda

Day 1 - Monday 23rd April

10:00 Registration and Coffee

Session One (Chair – Dr. Lesley Thompson, EPSRC)

10:30 Introduction and Welcome – Dr. Lesley Thompson, EPSRC

10:40 BIOSENSORNET, Dr Lei Wang, Imperial College London

11:00 Wireless Sensor Networks for Industrial Processes, Peter Green, University of Manchester

11:20 CITYWARE, Dr Eamonn O’Neil and Dr Vassili Kostakos, University of Bath

11:40 Smart Infrastructure, Dr Kenichi Soga, Cambridge

12:00 NEMO, Dr Gerd Koteum, Lancaster

12:20 Lunch

Session Two (Chair – Dr. Timothy Roscoe, ETH Zürich)

13:30 Prof. Tom Rodden, University of Nottingham

13:50 DIAS-MC, Prof. Ron Morrison, St. Andrews

14:10 UBIVAL, Prof David Rosenblum, UCL

14:30 TIME-EACM, Dr. Niki Trigoni, Birkbeck, UoL

14:50 Pervasive Computing Support for Market Trading, Dr Ian Wakeman, University of Sussex

15:10 Break

Session Three (Chair – Mr. John Hand, EPSRC)

15:30 TINA, Prof. Richard Penty, University of Cambridge

15:50 PROSEN, Prof. Ken Turner, University of Stirling

16:10 SESAME, Dr. Stephen Hailes, UCL

16:30 ESPACENET, Prof. Tughrul Arslan, University of Edinburgh and Dr Tanya Vladimirova, University of Surrey.

16:50 Introduction to Poster Session – Dr. Nafeesa Simjee,
EPSRC

Session Four

1730 - 1900 Poster Session and Drinks Reception

1930 Dinner

Day 2 - Tuesday 24th April

09:30 Dr. Timothy Roscoe, ETH Zürich

09:50 Introduction to the day – EPSRC

10:00 WINES Café Session One – Where are the gaps and
opportunities?

11:00 Break and informal discussion

11:35 WINES Café Session Two – What common themes can
be identified and what expertise is needed?

12:15 Lunch

13:15 Introduction to Afternoon Session - EPSRC

13:25 Breakout groups 1

14:05 Breakout groups 2

14:45 Marketplace

15:20 Summary – Mr. John Hand, EPSRC

15:30 Close

Annex 4

Web links to presentations of WINES projects.

CITYWARE

http://www.cs.bath.ac.uk/~vk/files/pres_wines07.pdf

SESAME

http://www.sesame.ucl.ac.uk/SESAME_Presentation_short.pdf

Smart Infrastructure

<http://www.winesinfrastructure.org>

NEMO

http://pervasivelab.org/nemo-lancaster_university.pdf

UBIVAL

<http://www.cs.ucl.ac.uk/staff/D.Rosenblum/Research/ubival-wines2007.ppt>

Annex 5

Opportunities identified in the morning session.

Sharing/Multidisciplinary approach to WINES

- Rewards for cross-disciplinary work
- Sharing knowledge and dissemination between projects
- Share goals/results and tools.
- Date management across the projects.
- Sharing or collaboration across projects is rewarded.
- Sharing common components
- Sharing activity/traffic logging techniques and data traces
- Community – building and exchange knowledge e.g.
 - forum for people to meet
 - facility for sharing outputs: code, tools and lessons learned.
- Generic toolsets
- Re-use WINES I & II output in new WINES III applications.

Dissemination

- Develop a WINES road map, to help disseminate ideas to the User community.
- Build a set of best practice or an information database to support communication across projects e.g. WINES Wikipedia
- RSS feeds or white papers from all projects (newsletter with pdf's or papers)c or "Techniques and Methodologies" Newsletter.
- Broadcast WINES III to a wider audience.

International

- More international collaboration encouraged by the WINES projects.

Multidisciplinarity

- Target interface between disciplines in a multidisciplinary project and end users.
- Multidisciplinarity approach highly encouraged
- Remove boundaries between disciplines (- funding agencies).

Balance

- Balance between applicability and non-duplication of effort.
- Balance generic solutions and bespoke applications.
- Fund small-scale projects in WINES III.

Users

- Stronger engagement from the industrial community and stakeholders/clients/customers
- Use professional bodies IET, RAEng to engage community.