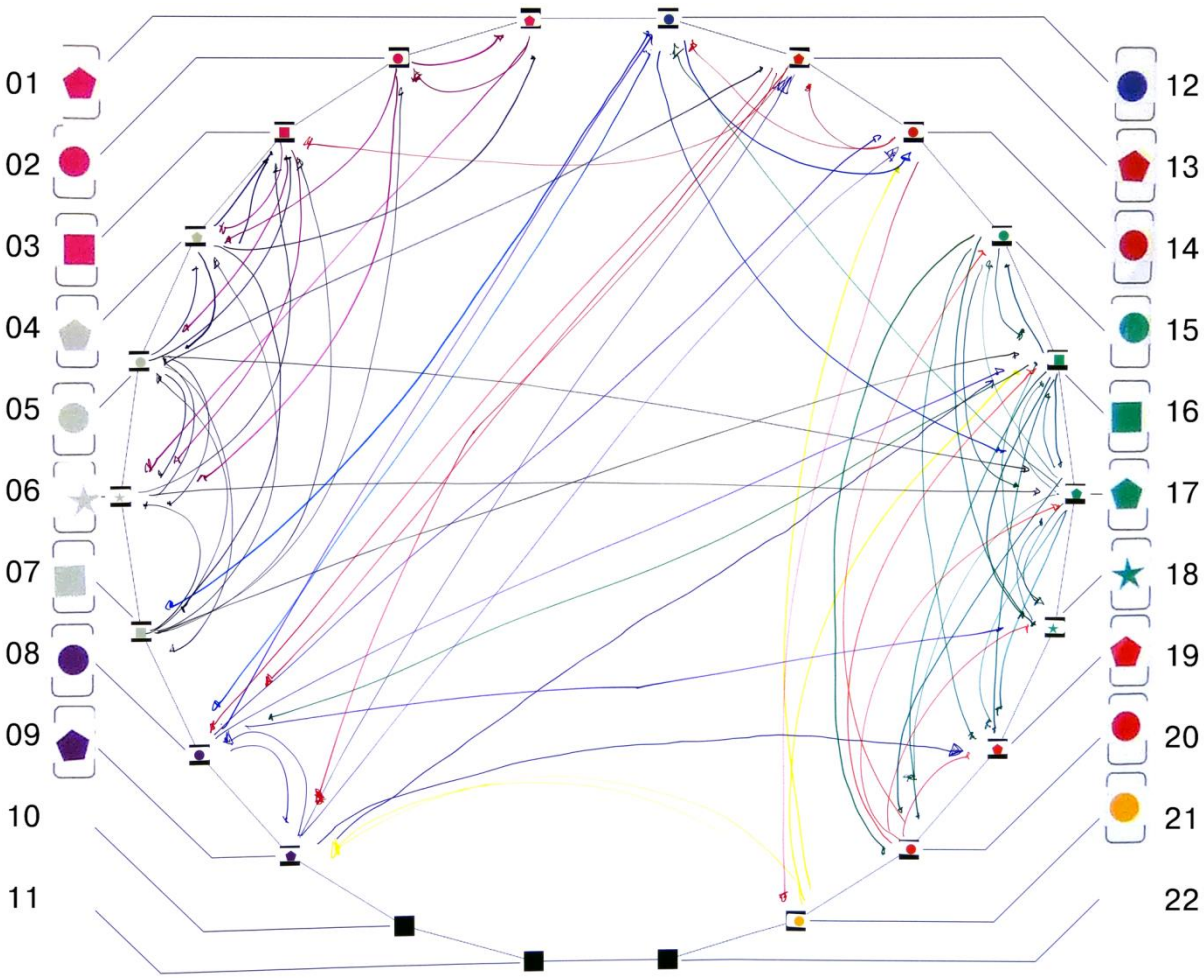
EPSRC Network of Networks Meeting Report

27 March 2014

Draft 001

Meeting Details:
http://www.well-sorted.org/explore/NetworkOfNetworks2014/



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Introduction

The third EPSRC ICT Network of Networks meeting took place on the 27th March 2013 at RIBA, 66 Portland Place, London, and was attended representatives of 19 ICT Networks and EPSRC staff.

The objective the meeting was to develop a conceptual map of research challenges addressed by the ICT Networks in order to aid the development of a better mutual understanding of:

a. the research coverage of the networks;
b. their research challenges and relationships;
c. potential inter-network collaborations; and
d. their coverage of the ICT research landscape.

Prior to the meeting the networks each provided three research challenges that were thought by their members to be critical to the development their research areas. Network representatives were asked to group all of the network challenges into like groups using the online sorting tool: Well Sorted[1]. This resulted in eight groups of challenges that were used both to structure the activities of the meeting and to provide initial documentation and awareness.

At the meeting network representatives were asked to identify which of the challenge groups were most relevant to their networks. Breakout sessions were formed around these groupings. The teams were tasked with agreeing titles for challenge groups and of identifying potential inter-network collaborations.

The groups were merged into four larger groups and each network representative distributed twelve colour shapes (each unique to a network) onto the topic hex-map of the EPSRC ICT portfolio (provided by the ICT Perspectives project[2]). Attendees were again asked to identify overlaps and potential collaborations.

Interaction and networking at the meeting was facilitated by personal and group aid memoir proformas; fast frequent plenary feedback; and plenty of coffee and cake.

The resulting major items of documentation comprise:

a. a structured challenge map;
b. an ICT topic map showing each network's research coverage;
c. a summarising chord diagram and individual network proformas that identify potential collaborations.

The rest of this meeting report contains the above together with supporting documentation.

For further information contact Prof Mike Chantler (m.j.chantler 'at' hw.ac.uk) or see reference [1].

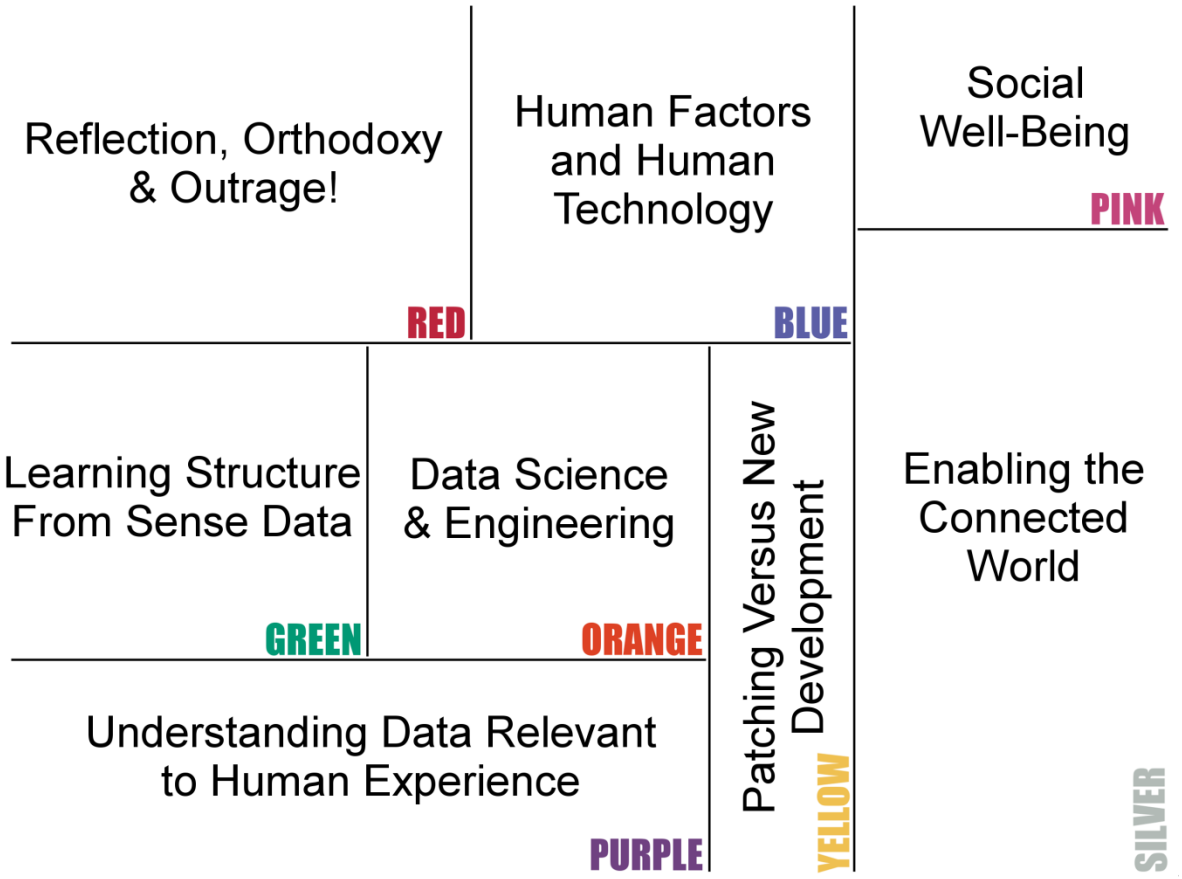
[1] www.well-sorted.org has been developed by the Heriot-Watt Research Perspectives team and is free for academic related use.
[2] www.researchperspectives.org

Acknowledgement

"ICT Perspectives (an ICT Next Decade proposal)" is an EPSRC funded project (EP/I038845/1) project that arose out of the "ICT Next Decade Workshop" organised by EPSRC ICT[3].

[3] http://www.epsrc.ac.uk/newsevents/news/2011/Pages/ictnextdecadereport.aspx

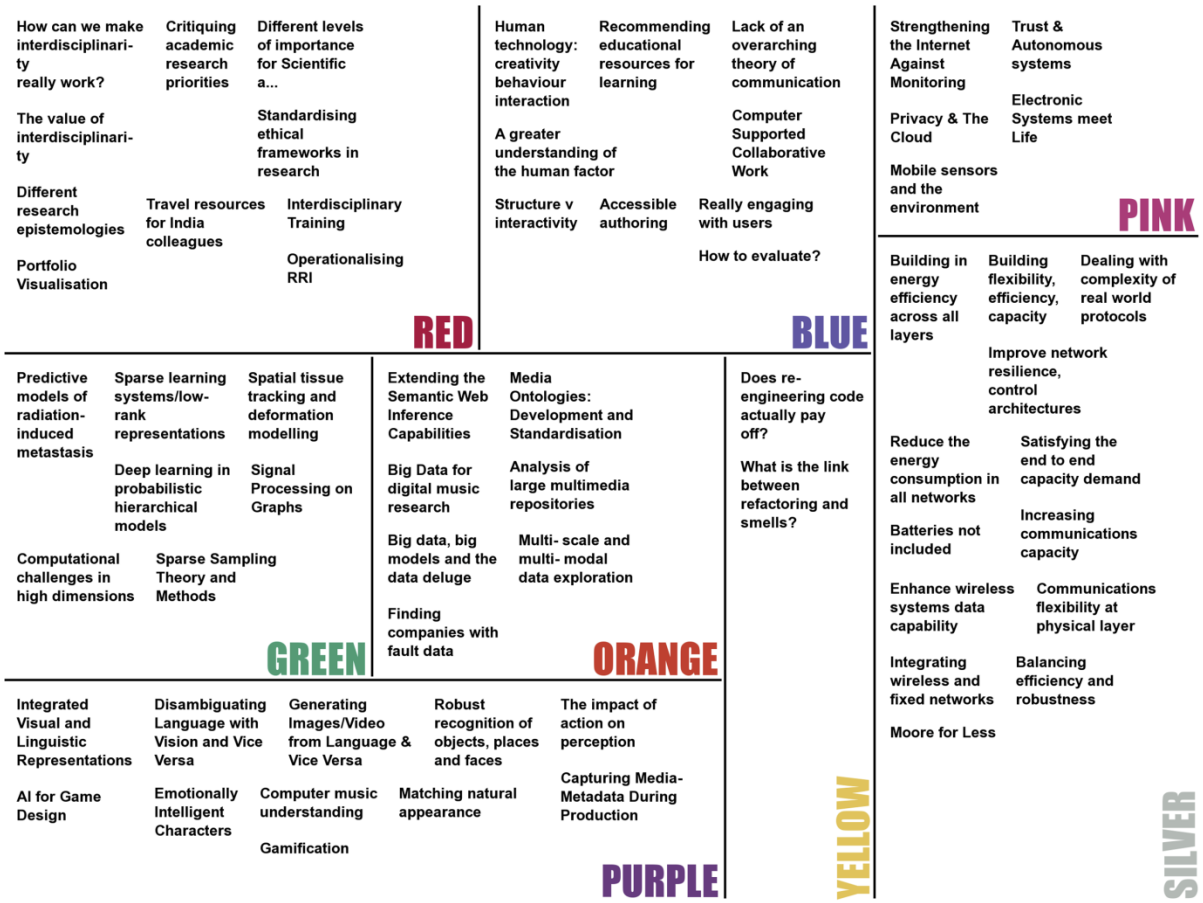
Network of Networks Top-level



This top level diagram gives an overview of the Network of Networks research areas, but it was in fact developed from the detailed landscape (shown overleaf) generated entirely by crowdsourcing the community.

Network of Networks Detailed

This level was created by the community before the meeting using simple crowdsourcing techniques.



Delegates chose one of the above groups to join and develop key points. The output from the groups is shown on the following pages.

Group: Reflection, Orthodoxy + Outrage!

How can we make interdisciplinari-ty really work?

Critiquing academic research priorities

Different levels of importance for Scientific a...

The value of interdisciplinari-ty

Standardising ethical frameworks in research

Different research epistemologies

Travel resources for India colleagues

Interdisciplinary Training

Portfolio Visualisation

Operationalising RRI

RED

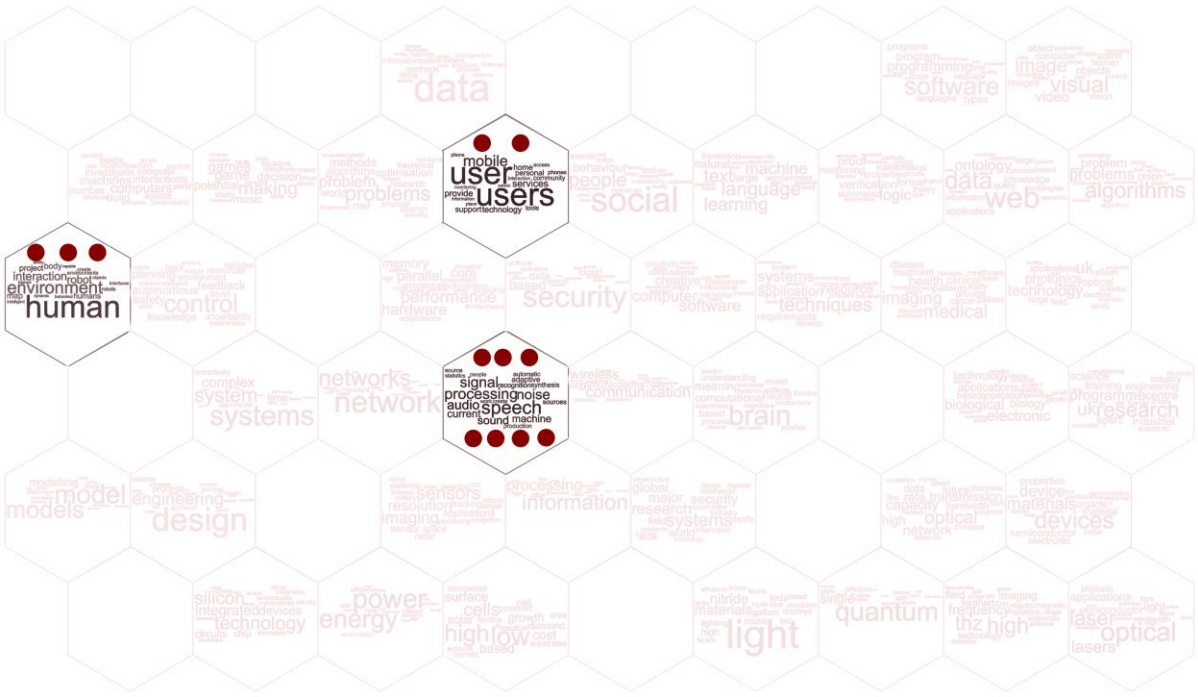
Group Members:

⬟	Marina Jirotka	Framework for Responsible Research and Innovation in ICT
●	Chris Newell	The Creative Speech Technology Network

Key Points:

Seems to be a meta level color / classificate / clustering in the applies to all clusters. Two of us – arts & speech/phys / ICT – have epistemology in common + that insights emerge from working with different research areas. True interdisciplinarity takes time to play out (more mutually influence each others ideas etc) – even then need reward system. How to tease out & reflect on these issues + ethical concerns a key emerge — these ethical issues can be very creative to address – not necessarily a negative, when working with ideas + they change established academic research priorities – should be attended to.

Scope of Group Within ICT Portfolio:



Group Photograph:

Human Factors and Human Technology

Human technology: creativity behaviour interaction

Recommending educational resources for learning

Lack of an overarching theory of communication

Computer Supported Collaborative Work

A greater understanding of the human factor

Structure v interactivity

Accessible authoring

Really engaging with users

How to evaluate?

BLUE

Group Members:

	Daniel Kudenko	RIDERS: Research In Interactive Drama Environments, Role-Play and Story-telling

Key Points:

No discussion

Group Diagram:

Learning Structure from Sense Data

Predictive models of radiation-induced metastasis

Sparse learning systems/low-rank representations

Spatial tissue tracking and deformation modelling

Deep learning in probabilistic hierarchical models

Signal Processing on Graphs

Computational challenges in high dimensions

Sparse Sampling Theory and Methods

GREEN

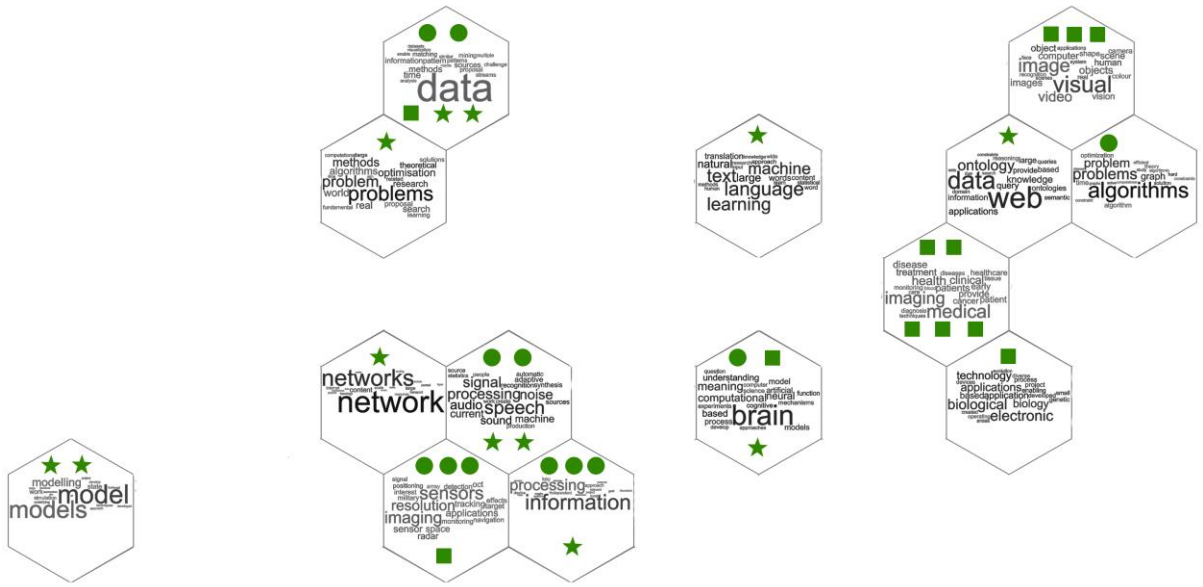
Group Members:

Pier Luigi Dragotti	Network on multiScale Information, RePresentatIon and Estimation -- (INSPIRE)
John Shawe-Taylor	Network on Computational Statistics and Machine Learning
Bogdan Matuszewski	Engineering and Computational Science for OncologyNetwork (ECSON)
Mark Plumbley	Digital Music Research Network

Key Points:

- Sparse representation – guiding principle.
- Optimisation – decomposing into components – message passing.
- Inverse problems.
- Looking for explanatory parameters.
- Learning models at multiple levels – manifold learning, graphs.
- Sensing, sensor optimisation – active sensing.
- Learning from sensor data & signals – machine learning, statistical learning.
- Practicality, roll-out – theory -> applications – real world sensor data.

Group Diagram:



Group Photograph:

Data Science and Engineering

Extending the Semantic Web Inference Capabilities

Media Ontologies: Development and Standardisation

Big Data for digital music research

Analysis of large multimedia repositories

Big data, big models and the data deluge

Multi- scale and multi- modal data exploration

Finding companies with fault data

ORANGE

Group Members:

Stefan Rüger	Multimedia Knowledge Management Network
Mark Sandler	Semantic Media

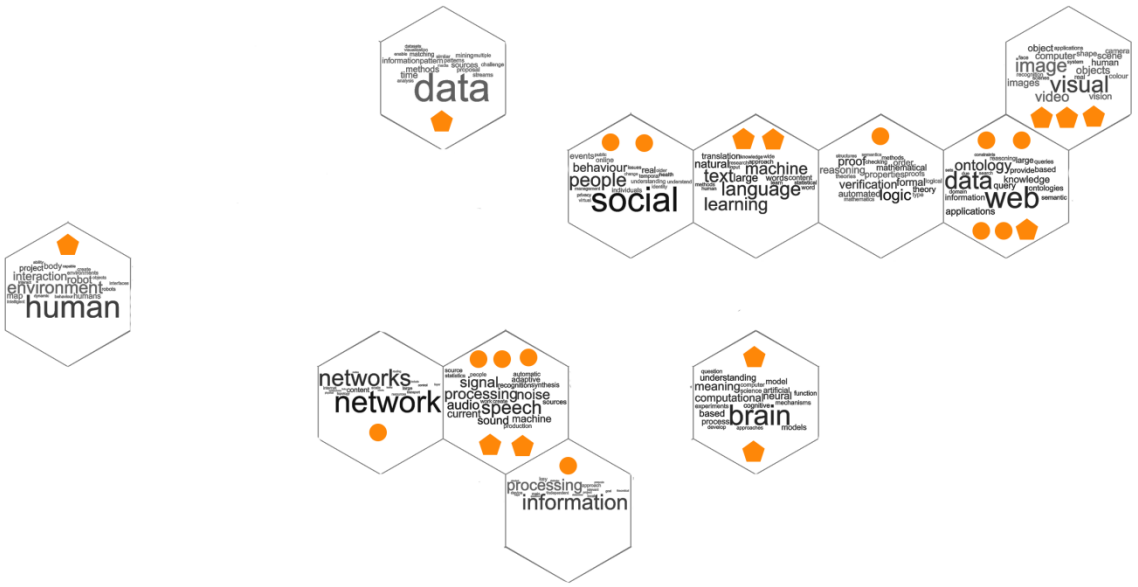
Key Points

- Open Data
- Data -> Information -> Knowledge
- User interaction, user experiences with data
- Data exploration, navigation.
- Knowledge representation

- Data Science
- Data - driven
- Model – driven

- Machine learning and Statistical methods.

Group Diagram:



Group Photograph:

Understanding Data Relevant to Human Experience

Integrated Visual and Linguistic Representations

Disambiguating Language with Vision and Vice Versa

Generating Images/Video from Language & Vice Versa

Robust recognition of objects, places and faces

The impact of action on perception

AI for Game Design

Emotionally Intelligent Characters

Computer music understanding

Gamification

Matching natural appearance

Capturing Media-Metadata During Production

PURPLE

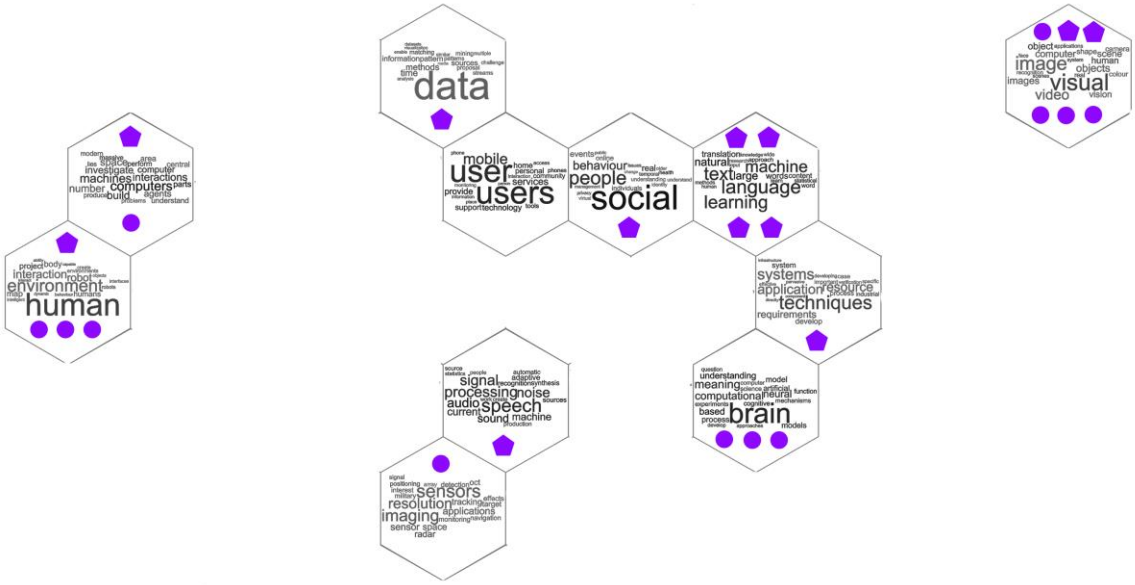
Group Members:

Daniel Kudenko	RIDERS: Research In Interactive Drama Environments, Role-Play and Story-telling
Anja Belz	EPSRC Network on Vision and Language (V&L Net)
Andrew Schofield	Visual Image Interpretation and man and Machine
Steve Counsell	REFactoring and TESTing ('REFTEST') Network

Key Points:

- Improving our (Engineering / Machine learning) understanding of Visual / Music / Language / Games data in relevance to human experience.
- Multimodality – cross modal understanding
  Generation of language and games / music / visual content.

Group Diagram:



Group Photograph:

Patching Versus New Development

Does re-engineering code actually pay off?

What is the link between refactoring and smells?

YELLOW

Group Members:

Steve Counsell

REFactoring and TESTing ('REFTEST') Network

Key Points:

- Continually “patching” is expensive & time consuming (faults cost park around 100’s million pounds).
- Alternative is to “start again”.
- But, this is also expensive!!!
- So the question is:
  -> Is it worth starting over or living with “smells” ?

- Big company interest.

Group Diagram:

Group Photograph:

Social Wellbeing

Strengthening the Internet Against Monitoring

Trust & Autonomous systems

Electronic Systems meet Life

Privacy & The Cloud

Mobile sensors and the environment

PINK

Group Members:

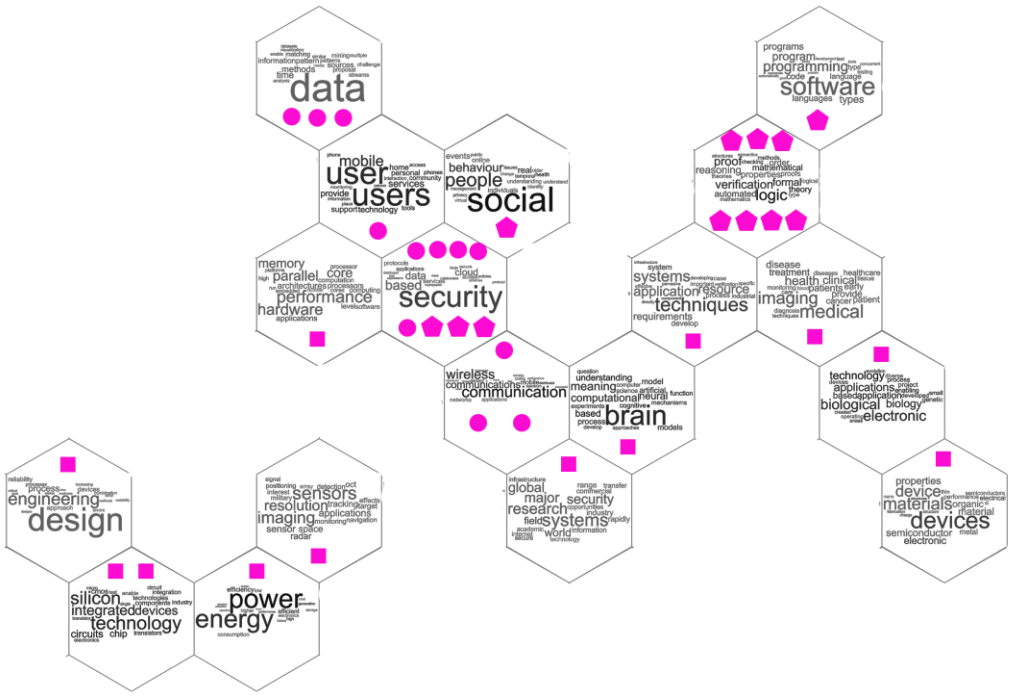
Eric Boiten	Formal Methods and Cryptography: The Next Generation of Abstractions (CryptoForma)
Anthony O'Neill	E-Futures and E-Futures XD
Muttukrishnan Rajasan	Network of Excellence in Digital Identity Management

Key Points:

- Security, trust & privacy.
- Autonomous Electronic Systems (Energy budget).
- Health.
- More data from smart mobile sensors.
- Big Data.

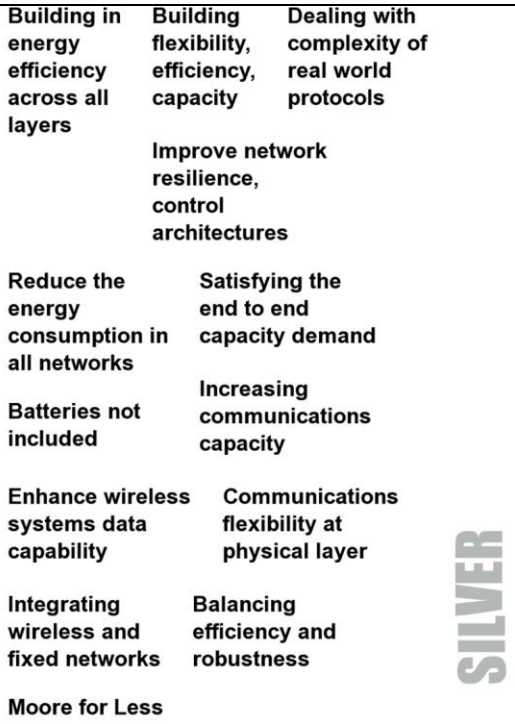
- Physical layers -> design -> system -> security -> data.

Group Diagram:



Group Photograph:

Enabling the Connected World



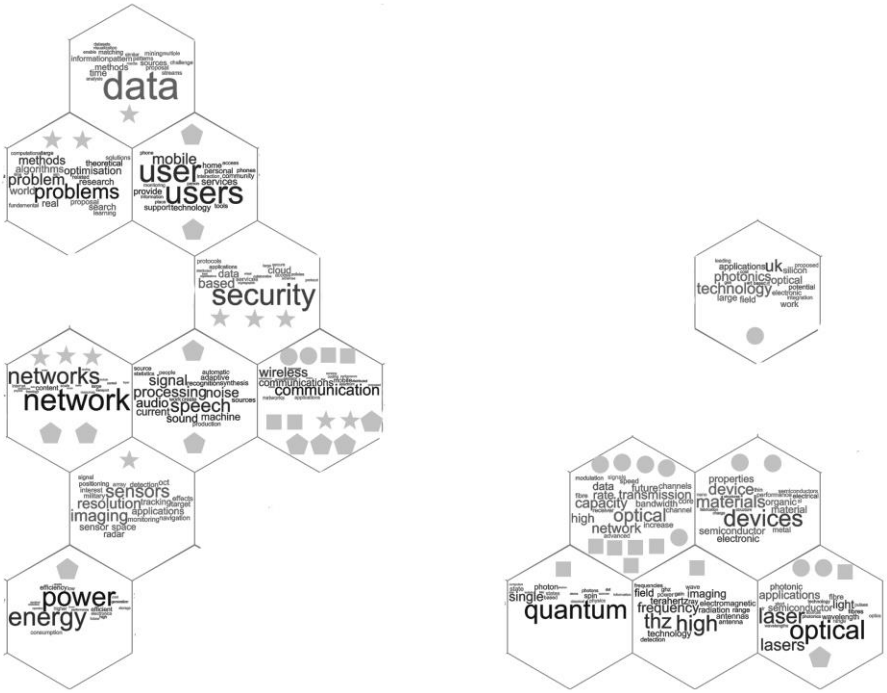
Group Members:

Ian Henning	UK Photonics Systems Outreach Network
Gerard Parr	EPSRC NETWORK in Next Generation Networks Systems and Services - Enablers for the Digital Economy
Peter Grant	Comm-Net
Alwyn Seeds	AURORA - UK Dark Fibre

Key Points:

- Creating future communications fabric that will enable new capabilities (IOT, MON, Smart connected communities, etc.).
- Research Challenges:
  1. Coping with scale (Nodes & data) – data deluge (orange).
  2. Energy efficiency (e.g. not always on).
  3a. Node – Node design (wireless & optical).
  3b. Intelligent management across layers.
  4. Flexibility with resilient & reconfigurability

Group Diagram:



Group Photograph:

Appendix A - Crowdsourced Terms

Below are all of the (full) research topics crowdsourced from the Network of Networks prior to the meeting. The short labels were provided by the Network of Networks leads to aid manipulation in the grouping interface.

Group Colour	Research Challenges	Strapline
Red	How can we make interdisciplinarity really work?	Interdisciplinarity amongst the sciences and social sciences and also between the sciences and social sciences is relevant and necessary in cybersecurity but the challenge is to make it happen.
	The value of interdisciplinarity	How can highly speculative and extreme interdisciplinary design processes catalyse technological progress by illustrating new possibilities and seeding new discussions? Can these processes be reliably theorised, documented and repeated?
	Interdisciplinary Training	RefNet focusses on reference. Reference (like many phenomena in Cognitive Science) is best studied by a combination of techniques from different disciplines. Mastering this diversity of techniques is a major challenge for any researcher in this area.
	Critiquing academic research priorities	Are the current academic priorities for VOCA development emotion, appropriateness, adaptability, contextual awareness the right ones? Can an interdisciplinary network help to rank research priorities?
	Different research epistemologies	There seems to be some fundamental differences in how a research problem gets formulated and tackled in both countries. This perhaps boils down to what is considered acceptable research problems for funding bodies in each country. Most often our indian...
	Different levels of importance for Scientific a...	There is a greater interest within Indian colleagues of our network to work on societal and economic problems, sometimes at the risk of loosing scientific impact whereas there is a strong desire from UK colleagues to explore scientific impact with impo...
	Travel resources for India colleagues	Our Indian colleagues always find it difficult to find resources to travel to UK for network activities. We are able to find resources to travel from UK to India but not the other way around.

	Operationalising RRI	Within funding councils and across scientific disciplines. How do we engage public at the research strategy formation stage and how do we shape shape RRI frameworks for specific disciplinary concerns.
	Portfolio Visualisation	How do you provide tools for visualising RCUK, NSF, and CORDIS portfolios in order to aid navigation, browsing and visualisation of trends and state of the art research. Ditto for conferences and academic publications.
	Standardising ethical frameworks in research	Ethical frameworks vary between science research and also social sciences and the challenge, especially in the field of cybersecurity, is to standardise them in order to produce meaningful research.
Blue	How to evaluate?	How to evaluate/compare IDS systems and realisations. What is a 'good' system; what is a 'good' Interactive Digital Story?
	Recommending educational resources for learning	Deciding which educational resources and activities are suited to educational goals and current skills through automated assessment and recommendation could scale learning well beyond the traditional limits of classrooms and class sizes.
	Structure v interactivity	How to reconcile structure with interactivity in IDS (Interactive Digital Story-telling)
	Human technology: creativity behaviour interaction	Place musical experience at centre of digital music research, shift from science-led to interdisciplinary arts-led / practice-based approaches. Needs design thinking, high quality software, integration of people, creativity & society into EPSRC remit.
	Really engaging with users	Is the network successfully listening to users of Voice Output Communication Aid (VOCA's) or merely paying lip service to them? Can an academic network be designed that users want to contribute to rather than are coerced to contribute to.
	A greater understanding of the human factor	In computing, the challenge is to develop a greater understanding of the impact of the human factor and its implications for research. For example, understanding and accurately identifying rule breaking insiders.

	Lack of an overarching theory of communication	The study of reference would benefit enormously if the research community had a better, computationally precise, understanding of human communication, encompassing the different communicative goals associated with a given utterance context.
	Accessible authoring	How to make authoring IDS feasible and accessible for creatives so they need not know about the technical innards of the target IDS system
	Computer Supported Collaborative Work	What future tools and methodologies do we need to aid the Working Together Initiative and other group collaborations, e.g. Networks of academics
Green	Computational challenges in high dimensions	Sparse Representation solves an optimization problem often intractable using convex relaxation techniques. This needs to be extended to many other high dimensional inference problems. E.g., Solutions to inverse problems such as deconvolution of 3D dataset
	Deep learning in probabilistic hierarchical models	Constructing hierarchical probabilistic models with many layers of hidden variables that interact in a non-linear fashion, and provide theoretical guarantees on what we can learn about these multi-layer structures.
	Sparse learning systems/low-rank representations	Developing automatic methods of exploiting decomposition of sparsely interacting learning systems.
	Signal Processing on Graphs	Traditional signal processing deals usually with signals defined on well-structured grids. As data-collection methods improve, signals are better assumed to be defined on graphs. The challenges is to extend signal processing methods to signals on graphs.
	Sparse Sampling Theory and Methods	Sparse sampling theory and compressed sensing are revolutionizing the way we acquire data. The challenge is to take Sparse sampling ideas to correctly fit real world sensing problems.
	Spatial tissue tracking and deformation modelling	To advance development of dynamic 3D sensing and modelling of tissue tagged displacements with the focus on optical measurements of surface and sub-surface tissue. To combine such measurements with deformation models to establish correspondence at depth

	Predictive models of radiation-induced metastasis	This challenge aims to promote the development of software tools which may be used to predict radiation-induced cancer cell migration, through modelling changes to the mechano-structural properties of cancer cells as a function of ionising radiation dose
Orange	Extending the Semantic Web Inference Capabilities	To increase the applicability of Semantic Web technologies in non-textual domains, a major goal will be to develop native extensions that support an efficient representation and inference of fuzzy relationships between concepts.
	Analysis of large multimedia repositories	What can computers learn from "watching" news streams, television programmes or user generated videos with respect to human nature and culture? Will machine learning and data analytics give deeper insights from masses of available multimedia repositories?
	Big Data for digital music research	Access to and licensing of industry-scale multi-modal digital music datasets (audio, video, scores, metadata, social), plus computational resources, for research into scalable methods for analysis, representation, exploration and new business models.
	Big data, big models and the data deluge	Developing methods that can cope with the scale, diversity, and uncertainty within increasingly large data sets - in terms of the number of observations, the number of dimensions and the complexity of the statistical models.
	Multi-scale and multi-modal data exploration	To integrate analytical, computational and engineering methods, including machine learning and interactive visual techniques to facilitate exploration of multi-scale, multi-modal and high-dimensional data to improve diagnosis and treatment of diseases
	Media Ontologies: Development and Standardisation	To support a structured, machine-readable representation of data and metadata in media collections, a major goal will be develop new media-focused ontologies, harmonise them with existing ontologies and formalise the results as an international standard.
	Finding companies with fault data	One of the biggest problems in the area of refactoring code is finding companies willing to share their fault data; the sensitivity of the data is the barrier here - since companies have competitors and an image to protect.
Purple	Computer music understanding	Analyzing and describing musical compositions, performances, interactions and discussions in human terms, such as instruments, notes, chords, sections, performers, styles and preferences, informing new tools for understanding and experiencing music.

	Capturing Media-Metadata During Production	To increase the quality and level of detail of annotations derived from media data using signal processing methods, a central goal will be to develop novel approaches that analyse the data during its production to exploit available prior knowledge.
	Integrated Visual and Linguistic Representations	Most important challenge by far; feeds into the other two. Unifying models and annotation schemes that can capture both visual and language-based features to allow inference simultaneously on both sources of data. Unifying visual and linguistic salience.
	Disambiguating Language with Vision and Vice Versa	E.g. using images to resolve word-sense disambiguation in associated text, or vice-versa; using text to help solve ill-posed vision problems.
	Generating Images/Video from Language & Vice Versa	Both directions require a unified model, but also a certain dependency such that ambiguities in one modality can be resolved with information from the other.
	Matching natural appearance	How can we best measure the properties of natural objects and then efficiently render their key properties in either physical artefacts or as computer simulations such that human cannot tell the real from the artificial?
	Robust recognition of objects, places and faces	Can we build artificial recognition systems that can match the robustness of biological systems for recognising objects, scenes, places and faces in natural, cluttered environments?
	The impact of action on perception	How does being able to move and to interact with the surroundings affect the way active agents perceive the world? How should such agents integrate information across scenes, sensors, and time? How should spatial relationships be encoded by active agents?
	AI for Game Design	To develop more effective systems to generate in-game content (such as levels and quests) and also to invent novel games and explore the effects of varying the rules of existing games. The systems may operate autonomously or as a design aid.
	Gamification	To efficiently utilise the vast amount of time and effort people spend playing games, in order to address a range of questions of importance to science and society without detracting from the fun and efficiently mining the big data that ensues.

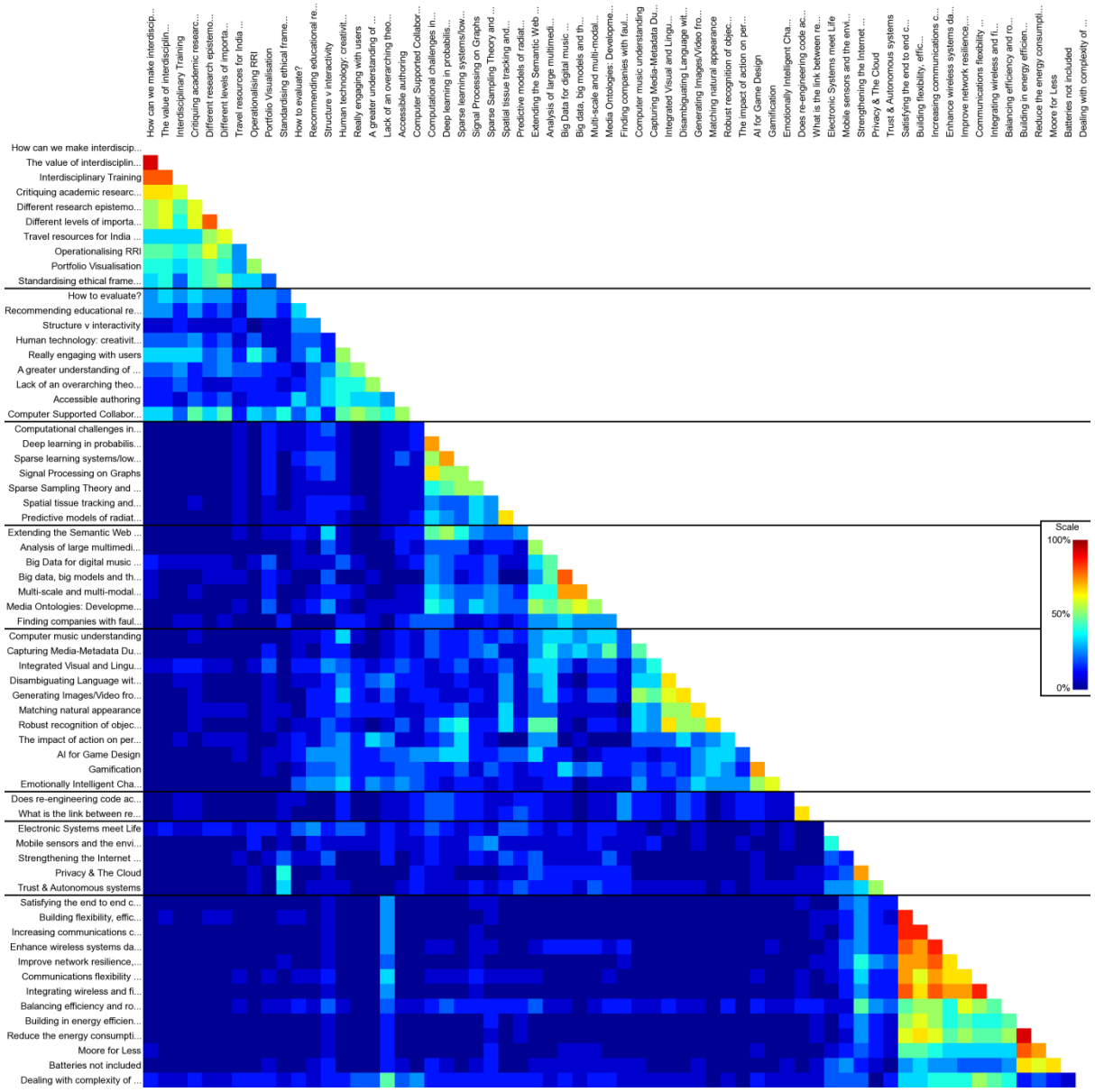
	Emotionally Intelligent Characters	To develop in-game agents that possess emotional intelligence and can display complex and appropriate behaviour in a wide range of situations; able to interpret a player's speech, facial expressions and body language.
Yellow	Does re-engineering code actually pay off?	Developers are encouraged to re-engineer their code as often as possible, but yet concrete data on the benefits of doing is elusive. So - is it worth the investment of their time or should they just leave their code to decay?
	What is the link between refactoring and smells?	Code smells are parts of code that are so bad they give off a bad aroma. Does getting rid of smells through refactoring practice quantifiably provide benefits? Should we be seeking out smells or should we just leave them?
Pink	Electronic Systems meet Life	Interface electronics to biology: non-invasive determination of personal biodata. New systems to track/report patients' conditions & alert them to take medication, offer remote early diagnosis & treatment where access to medical assistance is limited.
	Mobile sensors and the environment	How can mobile computing and sensors enable smarter and healthier living? Eg, detecting food type, volume and calories in photographs of meals. How to apply them for better safety, security, social games or citizen science. Where are the limits?
	Strengthening the Internet Against Monitoring	Reports of ever more intrusive internet monitoring continue to come in. Cryptographic solutions are among the most promising, with formal methods potentially providing additional confidence.
	Privacy & The Cloud	As more information is shared in the cloud and through social media how do we respond privacy concerns. Is there a conflict between improved performance and loss of privacy, particularly if the device is not self-contained, but shares data in the cloud.
	Trust & Autonomous systems	In TeleHealth a system might tell the patient when they need to take pills. To what extent should patients trust these systems? What happens if its advice is flawed? Other examples include the use of drones in urban environments other software agents.
Silver	Satisfying the end to end capacity demand	First priority response from the UNISON network reflecting the need to anticipate the accelerated demand for capacity and associated limitations on existing solutions across optical, wireless networks and the interface between such infrastructures.

	Building flexibility, efficiency, capacity	Third priority response from the UNISON network mainly focusing on enhancing optical network capabilities with respect to capacity, overall efficiency and flexibility.
	Increasing communications capacity	Internet traffic continues to grow by an order of magnitude every four years. To meet this requirement we must find ways of providing increased wireless capacity for access and increased optical communications capacity for metro and core at lower cost.
	Enhance wireless systems data capability	Solve the frequency crunch imposed by 1000 times more mobile data by 2020 New wireless technologies required to enhance mobile rates up to 100 Mbit/s individual users & fixed network user rates to 1 Gbit/s to support continous applications innovations
	Improve network resilience, control architectures	Need ethical infrastructure & services that are resilient, secure & trustworthy Need autonomous control with dynamic re-configuration of infrastructures & fast service composition Network segmentation introduces flexibility to support new applications
	Communications flexibility at physical layer	At the physical layer most communications networks are configured with fixed capacities and routings. To use physical layer capacity more efficiently it is desirable to create software defined networks, reconfigurable at the physical layer.
	Integrating wireless and fixed networks	The wireless and fixed networks use different protocols and have evolved separately. Wireless back-haul is becoming a major technical and cost challenge as wireless data rates increase. Finding better ways to integrate these networks could reduce costs.
	Balancing efficiency and robustness	In real world security protocols, there is a trade-off between efficiency (speed and resource usage) and robustness. How to find a good balance in this?
	Building in energy efficiency across all layers	Second priority response from the UNISON network addressing increasing requirements to design energy efficient system and network solutions considering not only single technology domains but the overall energy consumption across domains and network layers
	Reduce the energy consumption in all networks	Mobile and fixed communications networks must reduce to 50% of the energy consumed today Need energy efficient architectures for personal wireless for 5G and beyond Enhance energy efficiency of fixed broadband for both domestic & business WiFi systems

	Moore for Less	Performance driven design & technology for electronic systems. Integration of new materials, improvements in component density, performance, cost/function, functionality, while reducing power for mobile electronic devices and environmental concerns.
	Batteries not included	Electronic systems capable of sensing, thinking & communicating, whilst taking care of their own energy requirements, so consuming zero net power. High energy consumption & short lifespan of batteries limit the potential of what is possible within ICT
	Dealing with complexity of real world protocols	Research into real world protocols is occurring in different subcommunities, but it appears hard to bring it all together.

Appendix B – Similarity Data

Each delegate was asked to sort the terms shown in Appendix A into groups using a web application. All of these groupings' data were then used to produce the similarity matrix shown below. Clustering was performed on this matrix in order to get 7 groups.

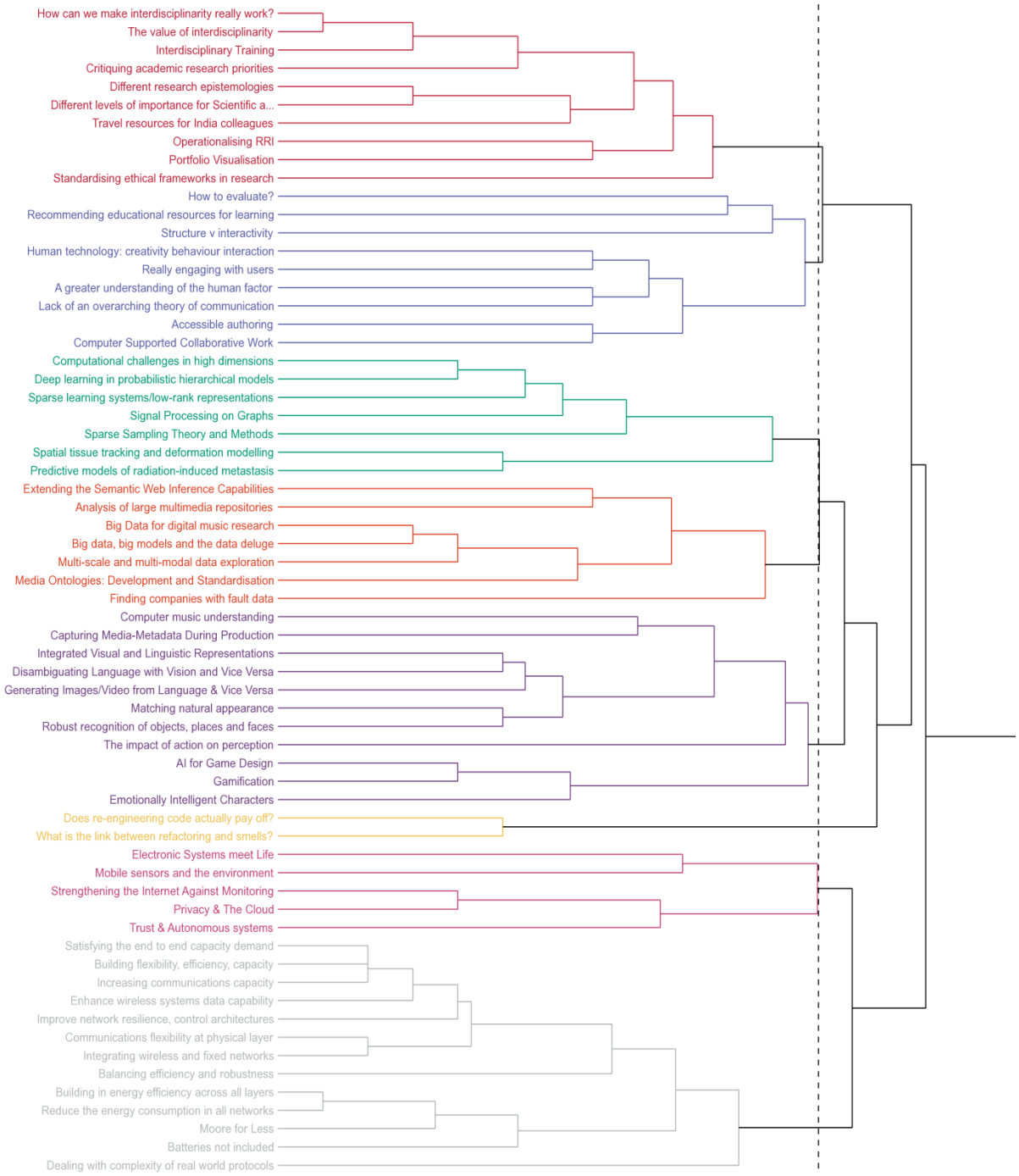


Clusters were generated using the Average Linkage Cluster Analysis algorithm.

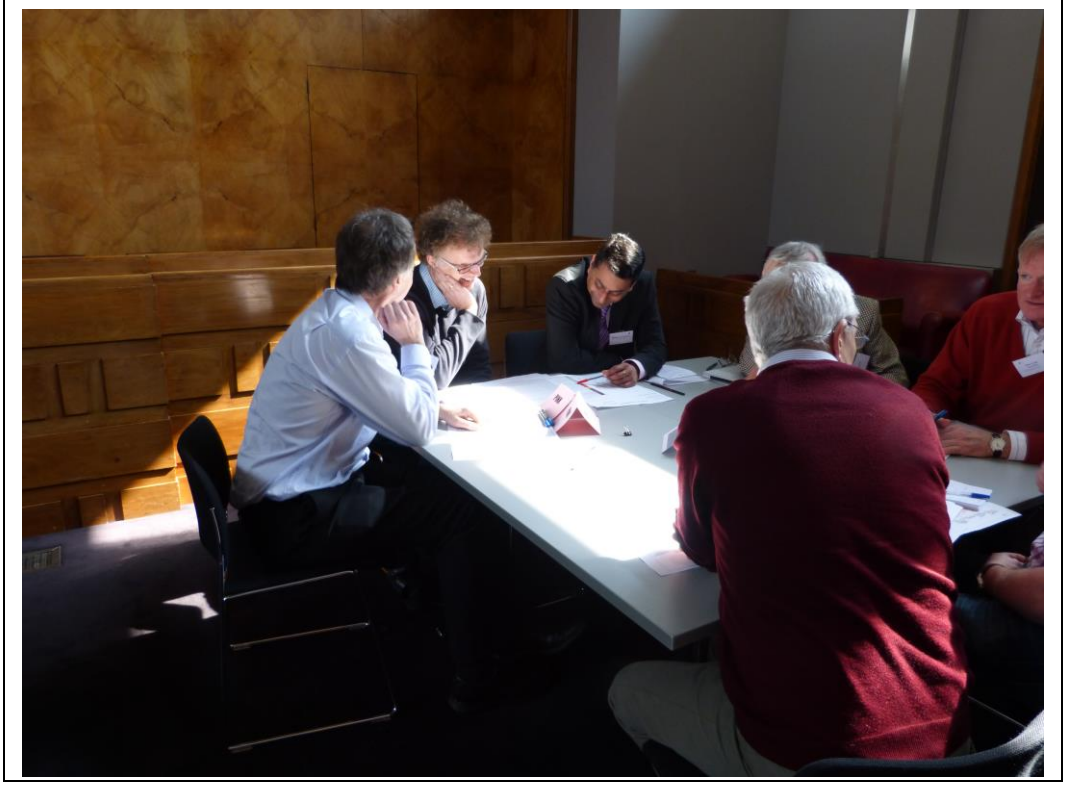
Appendix C - Dendrogram

A dendrogram (a type of tree diagram useful for displaying hierarchical clustering data) of the similarity matrix data shown above is provided below.

It allows interested readers to examine how close (or distant) the average participant thought that groups of terms were from each other. The closer two topics on the left join, the more similar participants thought they were.



Appendix D - Meeting Pictures



Appendix E - Meeting Agenda

9.30	Registration / Coffee
10.00	Welcome – presentation by Zoe Brown, ICT Theme, EPSRC
11.00	Networks Challenges – Let by Mike Chantler, ICT Perspectives Project
11.15	Coffee break
11.30	Networks Challenges – Let by Mike Chantler, ICT Perspectives Project
12.00	Lunch / Networking
13.45	Networks Coverage and ICT Mappings
14.30	Coffee break
14.45	Network ICT coverage - Round Table Discussion.
15.45	Wrap up and conclusions – Future resourcing and IT for meetings in the future.
16.00	Meeting End

Appendix F - References

[1] Methven, T. S., Padilla, S., Corne, D. W., & Chantler, M. J. (2014, February). Research Strategy Generation: Avoiding Academic 'Animal Farm'. In *Proceedings of the companion publication of the 17th ACM conference on Computer supported cooperative work & social computing* (pp. 25-28). ACM.