Commitment to Privacy and Trust in Internet of Things Security (ComPaTrIoTS) Research Hub

Call type: Invitation for proposals

Closing date: 16:00 on 02 September 2015

If you are planning to apply, please email your intention to submit to digital.economy@epsrc.ac.uk, stating the provisional investigators, institutions and user organisations involved in your proposed bid, by 17:00 Monday 20 July.

Related themes: Digital Economy, Information & Communication Technologies, Partnership for Conflict, Crime & Security, Healthcare Technologies, Mathematical Sciences, Engineering, Energy, Manufacturing the Future, ESRC's Big Data Network

Summary

The Research Councils UK Digital Economy (RCUK DE) Theme, working in close partnership with Innovate UK, the Digital and Future Cities Catapults, NHS England, and with support from the Department of Culture, Media and Sport (DCMS), Government Communication Headquarters (GCHQ), Centre for the Protection of National Infrastructure (CPNI) and Defence Science and Technology Laboratory (Dstl), is seeking to make a step-change in the broad research areas of cyber security, designing in trust, privacy, security and resilience associated with the Internet of Things (IoT). This is part of an integrated £40M endeavour, stretching from the research base towards feasibility and market, to build on UK strengths in technology, security and design and to accelerate the UK lead in the IoT. Lloyd's Register Foundation also has interest in this field and the Research Hub appointed through this call will be invited to explore opportunities to collaborate with the Foundation.

This call aims to invest up to £9.8M over three years to support a small number of leading UK universities working coherently together as a single internationally recognised "Research Hub", across the relevant disciplines, carrying out inter-related and interdisciplinary research. The research focus will be on the challenges associated with privacy, security and trust in the IoT, including the various interactions, policy and governance, beliefs and behaviours between people and the IoT systems. There is an expectation of anticipated matched funding over the lifetime of the hub, cash and in kind, from the host universities and partners.

Please note that it is anticipated the Research Hub will be announced and should be ready to start activities during **January 2016.**

The constituent universities in the Research Hub consortia will work in partnership in an integrated manner, across the relevant disciplines, addressing the research challenges in a coordinated way. They will harness and build on existing multi/interdisciplinary knowledge and skills, and also address intellectually inspiring and user-led challenges arising from the demonstrators and accelerator supported by the associated funding from the other partners in this overall activity. The universities will collectively form a "Research Hub" of a sufficient scope and size to achieve critical mass; that is, it will attract additional support from partners and the host universities. The Hub will also interact strongly with the demonstrators, accelerator and IoTUK Central (run by the Digital and Future Cities Catapults with responsibility for ecosystem development coordination for the IoT in the UK), to help develop committed routes for exploitation as well as grow the pool of trained interdisciplinary researchers.

Ultimately, as well as the economic benefits of leading a major new technology application, UK progress on the IoT will deliver life-changing improvements for citizens and cost and efficiency savings, particularly in the NHS, transportation systems, and UK cities, if designed in a user-focussed and people-centric way. The creation of real usable knowledge and impact (be it economic, societal or cultural) will help to cement the UK's position as a world leader in this area.

Background

There is a growing belief that the Internet of Things (IoT), where everyday objects are connected to a network in order to share their data, represents the start of the next digital revolution. It is, however, as much about people and the information they will be expected to share, as the inanimate objects and/or about technology. Today there are about 14 billion objects connected to the internet. By 2020, industry analysts estimate the number could be anywhere from 20 to 100 billion. It is impossible to anticipate all the social changes that could be created by connecting billions of devices. It is a major area of growth for the global economy; the global value of the IoT sector is estimated to exceed $400 billion (approximately £255 billion) per annum by 2020.

The IoT has the potential to change the way we live by allowing a mould-breaking change in the way information can be assimilated and utilised across a range of business sectors. Using data from a wide range of sensors could, for example, improve quality of life and public services, and make better-informed decisions more quickly. It has the potential to have a transformative effect on society and significant economic relevance. In the first instance, we must understand how we want to improve public services and quality of life through this transformative technology; IoT needs to be shaped around social practices and driven by behaviour. IoT development should be about designing the technology to be engaging.

In 2012, the RCUK DE Theme, the Engineering and Physical Sciences Research Council (EPSRC) Information and Communication Technologies (ICT) Theme, Economic and Social Research Council (ESRC), Arts and Humanities Research Council (AHRC), Innovate UK's IoT Special Interest Group and Knowledge Transfer Networks worked together with business and academics to identify the long-term research challenges for IoT development. Six themes cutting across the multiple disciplines were identified in the "Roadmap for interdisciplinary

research of the Internet of Things[1]"– governance; business; people; trust; data; devices and connectivity, each containing a number of priority areas for research. One tangible outcome of this road-mapping analysis was to help inform the development of the DE Theme's IoT Fellowship priority area[2] entitled 'Advancing the Understanding and Development of the Internet of Things for the Digital economy'; the DE Theme's first five year research Fellowships have recently been awarded against this IoT priority area.

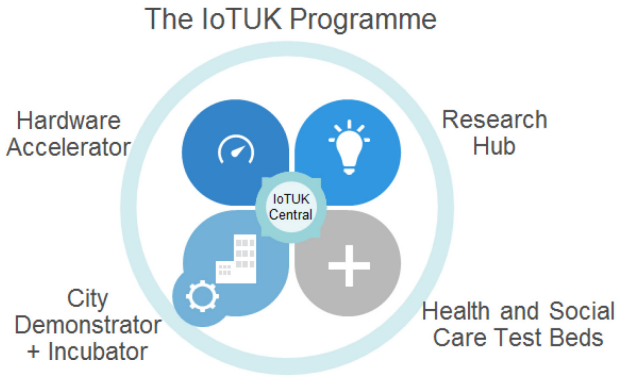
In December 2014, the Blackett Review "The Internet of Things: making the most of the Second Digital Revolution"[3] was published. It explored how the UK can make best use of the IoT.

Although there are many significant research challenges in the IoT space, a fundamental and underpinning issue arising from both the road-mapping analysis and the Blackett Review was the need for research to ensure that appropriate security, trust, ethics and privacy are designed and implemented from the beginning. This is, therefore, the focus of this call.

Funding Available

In total, the DE Theme will provide up to £9.8M at 80% FEC (£12.25M at 100% FEC) for the creation of one Research Hub; this will be an internationally recognised beacon for IoT research leadership, formed from a small number of leading UK universities working together across the relevant disciplines, addressing inter-related and interdisciplinary research (further details of potential funding models are proposed later in this document). It is anticipated that up to £1M of this funding will be used for engaging with other partners of the Research Hub consortia to facilitate best-with-best collaboration in the UK or internationally, both with academic and user partners ("Partnership Resource Fund", see Annex 2).

The Research Hub is part of an overall £40M investment ("IoTUK" will be the name for the programme). This also includes at least two demonstrators, an accelerator and IoTUK Central. All the constituent elements will interact strongly and feedback outputs, outcomes and challenges to each other. The key elements of the programme are shown in the diagram and described below.



[1] https://connect.innovateuk.org/documents/3077922/3726361/IoT%20Research%20Roadmapping%20-%20Final%20Report.pdf?version=1.0
[2] http://www.epsrc.ac.uk/skills/fellows/areas/priorityareas/digitaleconomy/
[3] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/409774/14-1230-internet-of-things-review.pdf
4 http://www.england.nhs.uk/ourwork/innovation/test-beds/

- Large scale demonstrators in health and social care, run by the NHS through test beds, and in cities, to be delivered and managed by InnovateUK through a collaborative R&D competition. The city demonstrator will also include an incubator. These deployments will be a powerful means of de-risking the development of new services, proving models in application of new technologies for others to follow, whilst ensuring that stakeholders and users are involved. It will also have the effect of pulling in additional investment to the UK and stimulating the demand for new services.

- A hardware accelerator programme, giving start-ups access to resources needed to bring down development costs, thus accelerating high-potential companies. This ensures that innovative small companies, start-ups and scale-ups are a key part of the wider investment programme.

- IoTUK Central will be delivered by the Digital and Future Cities Catapult to bring all the elements together into a coherent UK programme and coordinate the wider IoT ecosystem development.

Focus of this Call

The overall aim of this call is to raise UK IoT research to a new level of increased take up and exploitation, within a multidisciplinary setting, to make a step change. Real-world impact and influence will be demonstrable through evidence of adoption by policy makers, service improvements and economic, social and cultural benefits seen in the public, private or third sectors. It will establish new research ecologies between hitherto disparate disciplines, institutions and user communities, thus offering the means for previously unforeseen opportunities to be explored in the long-term.

A coherent research programme will address the key, fundamental, but inter-related and interdisciplinary aspects of privacy, security and trust; interaction between humans and systems relevant to the IoT. This call document is not intended to be overly-prescriptive on the precise research topics selected, but the Research Hub is expected to be of sufficient scale to include aspects covering the ethical, legal, regulatory and business issues, and to ensure data and communications are secure. People are both sources and users of IoT-enabled services and applications. It is therefore essential that the systems, sensors, network and architectures be designed to be resilient, reliable, robust and trustworthy, as well as being people (user)-friendly. There are significant challenges around integrating complex, heterogeneous large-scale systems and dealing with uncertainty while also ensuring that systems have a high degree of interconnectivity in a safe, secure, ethical and responsible manner.

Possible Research Challenges around Security, Trust and People in the IoT World

1. Addressing Privacy and Trust

If almost any physical object could be connected to a network, value would be generated from aggregating and analysing large quantities of data. The scale of personal data/information, particularly locational, health and financial information, would increase markedly. There are significant challenges in the sensitive area of personal identity and privacy as well as a requirement for assurance of the provenance of that data.

It is possible that the public will be concerned about privacy, safety and security and related demands for accountability and (anticipatory) governance. Related to this are issues of the public's understanding of terms and conditions and who owns the data, which are integral in gaining informed consent. The public's understanding of who owns the data, and how it could be used, could affect the uptake of commercial IoT technologies. After all, consumers and businesses would be more inclined to use trustworthy systems with good data provenance. Research is needed not only into novel techniques to secure connected devices, networks and data individually, but also personal identity and privacy, and to protect whole systems. Furthermore, consideration must be given to the design of the data and the relationship between people and the connected objects, and where the objects themselves can be designed to maximise trust.

2. Security and Safety

Billions of additional connected devices in new locations and applications mean that the IoT world has increased the complexity of systems. The security and safety of such systems can be compromised by a wide range of hazards, both foreseeable and unforeseeable, therefore system resilience should be a strong consideration. For example, the risk of cyber or physical attack, criminal subversion and terrorism is increased by creating multiple new points of vulnerability and new targets. These include interception of wireless data communications (and leakage of possibly confidential information), and virus and Trojan implantation at a device level. For example, in a building, malicious cyber-attacks, focused on the wireless networks and sensors (such as thermostats, fire alarms, CCTV or door locks) could create a false impression to those responsible for security. There is a need to consider retro-fit systems and the ability of the user to audit/interrogate their own devices.

Weak security issues and poor security behaviours (such as people using the same password for multiple accounts) need to be considered from the outset and resilience designed in, in both individual devices and whole systems. How can nuisance hacks on personal data and complex organised attacks on systems (such as taking over the control of steering and braking of a car, or hacking healthcare devices) be designed out? How can safety, resilience and good security practice be supported by robust system design? How can resilient characteristics of the system, such as resistance, robustness and adaptability be incorporated? How can data be prevented from being misused? How can these be delivered, and where possible automated, to ensure a cost-effective and user-friendly security approach? For example, it could determine aspects of the users' lifestyle, such as indicating whether they are at home or not.

3. Adoption and Public Acceptability

The adoption of IoT technologies will of course be dependent upon costs for both businesses and individuals; this is a research challenge in itself. Nevertheless, cost itself will no doubt be secondary to the issues of public awareness, acceptability and adoption. Trust is fundamental to acceptability and adoption; trust should therefore be understood from a systems level, and enhanced by ensuring innovation that is socially and culturally acceptable as well as technically robust. Perhaps scenarios involving the IoT in everyday life would be a good way to a) outline the research challenges and b) enable a more comprehensive understanding of the key issues. A major data breach or cyber-attack is likely to have extremely damaging consequences on public attitudes. Providers and operators will need to demonstrate that they are trustworthy, or

have sufficient checks built into their business models that ensure safety and security. A research opportunity as part of this integrated IoT package concerns how the public perceive IoT technology and its risks once it is deployed in the demonstrators. The ability to access and exercise control over one's own data is central to this challenge. Research should be considered to build upon public perceptions of privacy, and to look at the future legal, corporate and governmental frameworks needed to ensure individuals have access to and control over their own data. As an example, this could take the form of a collaborative project with the healthcare demonstrator to address whether people actually do feel safer and more secure, or whether they in fact resent the monitoring.

4. Standards, Interoperability and Supervisory Control

One major area of development for IoT revolves around interoperability and standards. The IoT requires that several layers of software and devices are able to communicate with each other. The ability to upgrade them remotely, with security patches and other fixes, will be essential. Effective device authentication at low power will further enable secure access to networks. At the current, relatively early stage of development of the IoT, there are not yet any clear 'winners' on the appropriate networks to use or what protocols should be in place to allow devices to communicate with one another. How these evolve will determine the eventual ecosystem of the IoT.

An extension of security and standards is the ability of the network to be controlled remotely by the user. The IoT opens up the attack surface for hackers and other attackers to gain access to networks and feed in malicious information. Ultimately, in the event of an attack, supervisory users will need to exercise some element of control over the IoT network in a safe and secure way.

5. Harnessing the Economic Value of IoT Data

There is a question of how new business models can be built around ideas and regulations that encompass privacy, security and trust in their use of data. It is important that IoT data be protected from misuse and the integrity of the data be maintained. In addition to the privacy aspects of data protection, there is a need to consider the economic implications of the vast amounts of data generated. Ultimately, a value chain will be created by the aggregation, exchange, integration and analysis of these large, heterogeneous datasets and the challenge lies in finding secure and legal methods for doing so. IoT data exchange mechanisms can only be understood by confronting the challenges of complex market design and structure, data provenance, competition, IP and regulatory issues. As well as enhancing privacy, the design and implementation of secure, efficient and transparent data exchanges across the whole data "lifecycle" could stimulate innovation and realise the economic potential of the IoT.

The Research Hub Management and Coordination with Other Partners in the IoT Activity

The research will be delivered through the establishment of a critical mass-sized Research Hub. This is expected to comprise a small number of leading UK universities, each funded individually (although please see suggested models below), working together in a coherent programme across the relevant disciplines, carrying out inter-related and interdisciplinary research. **Please**

note: It is expected that each university or research organisation will only feature in one proposal. This is intended to ensure that university attention and activity is focussed on combining its expertise to be involved in the strongest bid possible.

The Research Hub will:

- Be of sufficient scope and size to achieve critical mass; that is, it will attract additional support from user partners and the host universities. There is evidence that such a Hub-like arrangement can exert the influence and scale to really make a difference and do work to deliver real impact (see DE Impact Review, 2012[5]).

- Create internationally recognised research leadership for the UK in the scope of this call.

- Be formed of constituent universities working in partnership in an integrated manner, across the relevant disciplines, addressing the research challenges in a coordinated way. This is fundamental to providing a platform to move the entire digital area forward.

- Have a research programme that fits together to respond to challenges arising from this integrated IoT activity.

- Be creative in the use of various mechanisms, such as "in the Wild" (see below – Activities Supported section). This will include research into business, consumer, design and user acceptance and behaviour and include interactions with other relevant research and innovation activities in this area, such as in Robotics and Autonomous Systems.

- Harness and build on existing activities (such as ESRC's Big Data Network). The Hub should build on and adopt new multi/interdisciplinary, knowledge and skills establishing new research ecologies between hitherto disconnected disciplines, institutions and user communities offering the means for previously unforeseen opportunities to be explored in the long-term.

- Grow the pool of trained interdisciplinary researchers with the appropriate skills for the IoT. This could include, for example, transitioning more early-career researchers into positions of academic and industry leadership and scaling up both economic and societal impact. These researchers will understand ways of working across disciplines and of co-creating research with users. The host universities will be expected to provide on-going people support (an example of such support may be in the form of transitional fellowships) to ensure that user-led interdisciplinary research continues beyond the life of the Research Hub.

- Interact strongly with the other elements of the IoTUK Programme, as described above in the "Funding Available" section.

- Address intellectually inspiring and user-led challenges arising from the demonstrators and accelerator, in order to increase the impact of the work from the Hub. The feedback of user-inspired research challenges to the Research Hub and new knowledge from the research supported by the Hub will all help to develop committed routes for exploitation.

- Have a strategy for showcasing the outputs and outcomes of the work to a wider audience and undertaking public engagement. This includes working with IoTUK Central. LRF may be able to provide support for international engagement activities.

- Engage with partners (of various kinds, including the accelerator and demonstrators funded by Innovate UK and NHS England) and grow the knowledge base for better exploitation of the research.

- Have a Steering or Management Board, to coordinate the overall research endeavour. It will, for example, agree on the prioritisation and allocation of projects and resources and act as a point of contact between the Digital and Future Cities Catapults' coordination body, IoTUK Central. The Steering or Management Boards should have representatives from the demonstrators, accelerator and IoTUK Central.

- Allocate up to 10% of funding in a flexible "partnership resource fund" (see Annex 2) to help engagement with industry, particularly SMEs. This will also help to support the user-inspired research challenges arising from the partner demonstrators and accelerator.

- The Hub has certain performance indicators (see Annex 1).

Activities supported in the Research Hub

Because the Research Hub is part of an integrated series of activities with the accelerator and demonstrators, the expectation is that the research supported will be more applied than blue sky. That is, research where the 'real world' applications, users and potential impacts are more immediately apparent. The Research Hub must be interdisciplinary and have strong and significant partnerships with a range of commercial and public users, including the third sector.

Activities that maximise impact and enable cross-partner working will be expected. Some suggestions for the form these impact activities could take include:

- Applied and translational research that has clearly identified and engaged stakeholders (for challenge, evaluation, and possible adoption), particularly that arising from the accelerator and demonstrators;

- Knowledge exchange and early stage 'proof-of-concept' activities that are essential to securing credible and engaging impact and commercial opportunities of all kinds. Where appropriate, it could help researchers to bridge the funding gap between traditional research grants and commercial funding and attempt to move the outcomes and outputs of this work to the next stage of impact. Activities will generally be considered 'early stage' where they are prior to a full laboratory demonstration of the idea, are pre-production and prototype and where commercial funds for development are not available. However, in some cases such work may be appropriate to be passed to the demonstrators;

- 'In the Wild' deployment and evaluation, to realise more effectively the impact of the research. This could either cover the testing of new technologies and methods with potential beneficiaries or in the user(s)

domain or looking at new ways of using existing technologies/methods. 'In the Wild' is intended as a research methodology, where some of the design is through usage; this is particularly important in the IoT. Applicants are encouraged to be creative in use to understand the implications.

Given the nature of the call, the Research Hub **will not** be expected to support the following:

- Applied research for private companies;
- Associated intellectual property costs e.g. patent costs.

Funding Model

Two main funding models for the Research Hub could be used:

1. Hosted by a single organisation (university) with the expectation that it will involve a number of organisations working in close collaboration (i.e. hub and spoke model). A single Je-S form would have all the details and the funding would go to the main, lead, university to be distributed to the partners.

2. An Organisation (university) takes the lead of a coherent bid by completing the application on behalf of all partners, but each university partner seeks the proportion of funding for their own costs and activities by submitting their own Je-S form (i.e. as "joint" proposals).

Applicants may wish to make the case for other models if this better suits their approach to deliver the activities of the Research Hub.

Exploration of Opportunities to Engage with the Defence and Security Agencies and Lloyd's Register Foundation (LRF)

1. The defence and security agencies Dstl, CPNI and GCHQ wish to work in partnership with the academics involved in the Research Hub. They can offer advice on the technical issues and challenges they face as well as discussing opportunities to collaborate. Their contributions of time and resources (in-kind and possibly cash) will help towards the KPI requirement for the Research Hub to secure matched funding.
   To help facilitate these discussions and to allow interested academics an easier line of communication with the relevant government agency, the lead academic researcher from the proposed Research Hub consortium should contact Tracy Keys (tracy.keys@epsrc.ac.uk), the EPSRC point of contact, who will be able to discuss and share challenges and issues with the relevant people in the participating agencies. This will also facilitate discussions on potential collaboration opportunities within CPNI, GCHQ or Dstl. Should a partnership be agreed, any contribution in kind (or cash) associated with taking this work forward with the academic could be included in the grant costings.

2. Lloyd's Register Foundation is a charity with a mission to protect the safety of life and property and to advance transport and engineering, supporting public education and research, seeking to improve the safety of the critical infrastructure on which modern society relies. The IoT will increasingly intersect with such infrastructures. The Foundation's strategic funding priorities include systems performance and resilience engineering.

The Research Hub appointed through this call will be invited to explore opportunities to collaborate with Lloyd's Register Foundation. The lead academic researcher from the proposed Research Hub consortium should contact Tracy Keys (tracy.keys@epsrc.ac.uk), the EPSRC point of contact, if you would like to find out more.

Equipment

Where possible, researchers are asked to make use of existing facilities and equipment, including those hosted at other universities. If equipment is needed as part of the research proposal, applicants must follow RCUK's rules for requesting equipment over £10,000 in value. Individual items of equipment up to the current OJEU (Official Journal of the European Union) procurement threshold can be included on research proposals submitted through this call, but research organisations will be expected to make a contribution to the cost. All requests for single items of equipment above the current OJEU threshold will need to go through a separate process which will assess the strategic need for the equipment and how to ensure maximum usage. These proposals will be assessed through the separate Strategic Equipment peer review process.

For more information on equipment funding, please see: http://www.epsrc.ac.uk/research/ourportfolio/themes/researchinfrastructure/subthemes/equipment/.

The current OJEU threshold can be found at: http://www.epsrc.ac.uk/research/facilities/equipment/process/

Eligibility

This call is being managed by EPSRC on behalf of the RCUK Digital Economy Theme, and the other Research Councils involved – AHRC and ESRC.

For information on the eligibility of organisations and individuals to receive EPSRC funding, see the EPSRC Funding Guide: http://www.epsrc.ac.uk/funding/howtoapply/fundingguide/

As this call is a targeted funding opportunity provided by EPSRC, higher education institutions, and some research council institutes and independent research organisations are eligible to apply. A list of eligible organisations to apply to EPSRC is provided at: http://www.rcuk.ac.uk/funding/eligibilityforrcs/

Applicants may apply for up to £9.8M at 80% FEC for their centre but please note the leveraging and matched funding requirements (based on the 80% FEC value of the Hub, see below) that need to be put in place and will form part of the assessment criteria.

Additional funding and leveraging requirements for the Research Hub

A compulsory feature of this call is that there must be demonstrable support for the research from user partners (public, private or third sector) from the start of the project. The onus is on applicants to make the case to peer review that adequate leveraging and funding arrangements have been agreed. Ideally co-funding and leveraging will be in place up front but user partners can have flexibility to back-load their commitment and support over the life of the Research Hub. **A demonstration of 100% matched funding (either cash or**

in kind) are expected to be in place by the end of the project. The host organisation(s) will also be expected to demonstrate substantial support for the Hub through cash and/or in-kind contributions **(please note 20% FEC contribution to any funded grant *will count* towards the consideration of matched funding).**

Research Hub Requirements

In summary, successful applicants must demonstrate:

1. **Critical mass, breadth and interdisciplinary nature.** It is important that the Research Hub consists of university partners with the appropriate disciplinary coverage across the diverse aspects of the research topic area.

2. **Creation of internationally recognised leadership** for the UK in this area

3. **Strong interaction with the demonstrators, accelerator and IoTUK Central.** Address intellectually inspiring and user-led challenges arising from the demonstrators and accelerator.

4. **How impact will be maximised through the centre's specific project plans,** for example by addressing clearly defined research challenge(s), demonstrating how they have been co-created with the end-user(s), through undertaking research 'in the wild' and appropriate knowledge exchange and early stage 'proof of concept' activities.

5. **Leveraging and additional funding**. Substantial support from university and user partners must be demonstrable, as discussed above, as well as collaboration and engagement with innovative businesses including SMEs.

6. **Strong people support.** Demonstrate that mechanisms are in place within the centre to grow and develop the pool of trained interdisciplinary researchers, including transitioning early career researchers into academic and industry leadership posts, ensuring that user-led interdisciplinary research and culture is maintained beyond the life of the centre.

7. **Partnership resource fund** of up to 10% of funding in a flexible manner to help engagement with industry, particularly SMEs and responding to user-inspired challenges from the demonstrators and accelerator.

Responsible Innovation, Societal Implications and Ethical Issues

It is recognised that some areas of the Digital Economy have the potential to raise societal, ethical, philosophical, legal and regulatory issues and risks. Consideration of these issues is essential to ensure that the research carried out is considered within a societal context and that any such issues that are raised are fully explored as the research develops. For further information on responsible innovation and ethical requirements, applicants are referred to the following guidance documents:

http://www.epsrc.ac.uk/ research/framework/

http://www.esrc.ac.uk/about-esrc/information/framework-for-research-ethics/

http://www.mrc.ac.uk/research/research-policy-ethics/

How to Apply

Please note: if you intend to submit a proposal, please email the following information, albeit provisional, to digital.economy@epsrc.ac.uk, by 17:00 Monday 20th July:

- Details of the proposed investigators and brief information on how they will contribute to the multidisciplinary endeavour;
- Which research organisations/universities will most likely form the Research Hub partner consortia;
- Details on which user organisations you hope will be involved in the proposed bid, and with which you hope to work in partnership. It would be useful to gain an understanding of the degree of commitment shown by the partners (for example, on a range spanning from '*vague'* to '*fully on board'*).

This information will be used to gauge an expectation of the likely demand and will help ensure that the peer review process can progress smoothly and with maximum efficiency.

Submitting application

You should prepare and submit your proposal using the Research Councils' Joint electronic Submission (Je-S) System (https://je-s.rcuk.ac.uk/).

When adding a new proposal, you should select:

- Council 'EPSRC';
- Document type 'Standard Proposal';
- Scheme 'Standard';
- On the Project Details page you should select the 'Privacy and Trust in Internet of Things Security (PaTrIoTS)' call.

Note that clicking 'submit document' on your proposal form in Je-S initially submits the proposal to your host organisation's administration, not to EPSRC. Please allow sufficient time for your organisation's submission process between submitting your proposal to them and the call closing date. EPSRC must receive your application by 16:00 on 02 September 2015.

Guidance on the types of support that may be sought and advice on the completion of the research proposal forms are given on the EPSRC website (http://www.epsrc.ac.uk/funding/) which should be consulted when preparing all proposals.

Guidance on writing application

As well as the Je-S form, the following documents should be submitted:

- Case for Support: should be up to 12 pages in total, to include a two-page track record detailing the relevant expertise of each investigator(s) and

main project partner(s) involved in the research project, and ten-page description of the proposed activities of the centre. This must include a description of:

  - How the Research Hub will maximise impact through its activities; including the research challenge(s) being addressed, its specific context in the real world and how the research challenge has been co-created with the end-user(s);
  - The leveraging of funding and substantial support for the Research Hub from both university and industrial partners;
  - The strong people support mechanisms in place to support the trained interdisciplinary researchers;
  - Management and leadership of the hub.

- Pathways to Impact document (up to 2 pages). This should include:
  - User Engagement Strategy - RCUK now require all successful applicants to develop and execute a strategy for engaging with potential users of the research funded in the project (resources for this activity can be requested as part of the Pathways to Impact and must be justified in the application). This strategy should be reviewed and updated regularly as part of the formal management of the grant. The strategy should cover:
    - How and when potential users have been/will be identified;
    - What form the engagement will take;
    - What steps will be taken to ensure that outputs of the research are made available to potential users;
    - Suitable metrics for determining the success of the strategy in delivering value to users.
  - Details on methodologies and resources needed to involve end user(s) in the Research Hub and research project;
  - Details on methodologies and resources required to realise the impact of the Research Hub. This can include training for staff, professional services to visualise research outcomes, publicity, public engagement activities and social media. For more details, please refer to the EPSRC website (https://www.epsrc.ac.uk/innovation/fundingforimpact/pathwaystoimpact/) or ESRC's Impact Toolkit (http://www.esrc.ac.uk/funding-and-guidance/impact-toolkit/index.aspx).
  - Details of how committed routes for exploitation will be developed.
- Justification of Resources (up to 2 pages);
- Host Organisation statement (up to 2 pages);

    - Details on how the host organisation will be an engaged key partner, providing substantial and dedicated support to the centre and its researchers.

- Diagrammatic Work Plan (1 page);
- Statements of Support from any Project Partners (no page limit).

For advice on writing proposals see:

http://www.epsrc.ac.uk/funding/howtoapply/preparing/

Any additional documentation provided will be discarded and not used in the assessment process.

Resources that can be requested under this call include:

- Investigator and researcher time;
- Travel and subsistence appropriate to delivery of the project;
- Costs associated with the practicalities of carrying out research in the wild;
- Equipment;
- Appropriate estates and indirect costs.

Resources to fund Project Partners are not allowable (this includes sub-contracting to a Project Partner).

Assessment

Assessment Process

Stage 1: Postal Peer Review

Proposals will be reviewed as per conventional peer review. If a proposal receives sufficiently supportive reviewers' comments, they will go forward to stage 2 of the assessment process. Please note: the DE Theme reserve the right to sift reject any full proposals that it deems not to have received sufficiently supportive reviewers' comments at stage 1 and as such will not be competitive at stage 2 interviews.

Stage 2: Interview Panel

If the reviews are sufficiently supportive, the proposal will go on to the interview stage and applicants will have the opportunity to respond to reviewers' comments prior to interview. Specific details and guidance for this process will be issued to invited applicants nearer the time. The interview process would include the review and assessment of the documentation, reviews and PI response, and subsequently the panel would prioritise application against the call assessment criteria.

Assessment Criteria

Applicants will be assessed at interview and proposals reviewed and ranked according to the following assessment criteria:

- **Relevance to the objectives of the call, in particular;**
    - The Hub can demonstrate the critical mass and coherence needed to address the interdisciplinary research requirements
    - The Hub undertakes activities designed to maximise impact and user engagement (for example demonstration of research challenge(s) being co-created by end-user(s)) and has specific project plans in place to deliver this;
    - Degree of partnership support, leverage and funding;
    - People support mechanisms are in place to grow and develop the pool of interdisciplinary trained researchers, ensuring the sustainability of user-led interdisciplinary research and culture beyond the life of the centre;
    - Networking across the other partners (demonstrators and accelerator) and with the Digital and Future Cities Catapults and other relevant organisations in a coordinated manner.
- **Quality of research, including:**
    - Novelty, relationship to the context, and timeliness;
    - The ambition, adventure and transformative aspects identified;
    - Appropriateness of proposed methodology;
    - Intersection of intellectual challenges, including with those identified by the hub partners;
    - Synergy and added value of proposed research strands.
- **National importance including:**
    - Contributes to, or helps maintain the health of other disciplines; contributes to addressing key UK societal challenges and/or contributes to future UK economic success and development of emerging industry(s);
    - Meets national needs by establishing/maintaining a unique world-leading activity;
    - Complements other UK research already funded in the area, including any relationship to the EPSRC portfolio.
- **Potential research impact, including:**
    - Relevance and appropriateness of any beneficiaries or collaborators (e.g. upstream engagement/co-design);
    - Plans for dissemination and knowledge exchange;
    - Plans for promoting cross-disciplinary culture.
- **Ability of applicant team to deliver the research, including:**

- Track record of the team, the leadership quality of the Principal Investigator;
- Balance of skills of the project team and integration of different methodologies and approaches.

- **Resources and management, including:**
  - Effectiveness of planning and resource management strategy;
  - Appropriateness of resources requested.

Information about the EPSRC peer review process and guidance for reviewers can be found at: http://www.epsrc.ac.uk/funding/assessmentprocess/review/

Additional Grant Conditions

Please note that the Research Hub funded through this call will be monitored and assessed over the lifetime of its grant funding. Further details of the EPSRC mechanisms in place for review and continued support will be included in addition to the standard terms and conditions for grants.

Key dates

Activity	**Date**
Call Launched	01 June 2015
Intent to submit	20 July 2015
Closing Date – Full Proposal	02 September 2015
Prioritisation Panel	November/ December 2015
Funding Decision	December 2015
Expected start of Research Hub	January 2016

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If you experience any problems submitting the proposal through the Joint Electronic Submission (Je-S) System, please contact the Je-S System Helpdesk, JeSHelp@rcuk.ac.uk, 01793 444164.

We would also suggest applicants contact their university research office for advice and guidance on writing their proposals, and would remind applicants that clicking 'submit document' on your proposal form in Je-S initially submits the proposal to your host organisation's administration, not to EPSRC. Please allow sufficient time for your organisation's submission process between submitting your proposal to them and the call closing date.

Change log

Name	Date	Version	Change
John Baird	18 May 2015	1	N/A

Annex 1

Key Performance Indicators (KPI)

The Research Hub will have to meet the following KPI framework which is designed to measure progress in taking research to real-world demonstration.

Research activity

Description	**Target**
End user and industrial partners engaged in research activity	At least 2 partners per project – i.e. 40 partners engaged
Value of external match funding	1:1 ratio to spend
Number of pilot projects generated by the academic hub	20 pilot projects over three years
Qualitative measure of value and relevance of pilot projects	80% agree relevance in evaluation
Relevance of research to demonstrators	At least 4 ideas or prototypes from academic hub pilot projects are tested or deployed in the demonstrator.

Annex 2

Research Hub: Guidance for the Approximate Allocation of Resources and the Partnership Resource Funding

The funding for the Research Hub and spokes will be a total of £9.8m. The Hub will be situated on existing university campuses.

The £9.8m is at 80% of the Full Economic Costs typical of Research Council grants. This means the remaining 20% will be funded by the host universities, thus giving an actual value at 100% of £12.25m.

The programme spend will be spent on a range of activities necessary to support the hub. The experience gained from the three RCUK Digital Economy Research Hubs funded in 2009 suggests that the majority of the spend (around 40%) will be on Research Staff. These include the Principal and co-Investigators (which could total up to 10, depending on how many other universities are involved as "spokes"). Junior and Senior Research Assistants (possibly over 20) form the backbone of the research endeavour. These people would span across a broad range of disciplines, including Mathematics, Computer Science, Engineering, Physical Science, Psychology, Social Science, Economics, Business School and Legal and Humanities, necessary to have a large, critical mass sized investment to provide such interdisciplinary span at a sufficient depth and breadth to really make a difference. A number of technical, coordination and business outreach people (up to 5) are required to ensure the research programme is delivered and outputs and outcomes disseminated to partners and interested parties.

Equipment and consumables, e.g. laptops, computer accessories, specialist devices, sensors and software may be necessary (at about 7%).

Travel and Subsistence to attend scientific meetings and liaise with the Hub's spokes and user partners is essential (at about £0.3m).

Partnership Resource Funding (PRF): A successful feature of the DE Theme Hubs was implementation of a dedicated Partnership Resource Fund (PRF). This is a flexible source of funding that can be deployed by the Hub to engage partner organisations during the life of the grant and to support people, travel and possibly equipment; these partners can be academic institutions, businesses, public or third sector bodies. Examples of activities include: projects, innovation funding, internships, secondments, sandpits/workshops. An important constraint on the use of this resource is that there must also be a contribution from another partner, however this can be 'in kind'. A total of up to £1M will be dedicated to the PRF within the Hub's grant funding for engaging with other partners to facilitate best-with-best collaboration in UK or internationally (academic and user). Funding for subcontracts will probably be best included in the "Directly Incurred" heading.

University Estate Costs and Indirect Costs comprise the remaining £3.5m (35% of the Hub costs). Estate Costs include building and premises costs, basic services and utilities and any clerical staff and equipment maintenance or operational costs. Indirect Costs are the costs of administration, such as personnel, finance, library and some departmental services. Like Estates Costs, they are calculated by the host university.