**FET Consultation - template FET Flagships**

*-* ***please limit proposals to at most five pages*** *-*

**About you**

I am a full Professor of Computer Architectures in the School of Computer Science at the University of Manchester, UK, while also being the Director of Technology and Systems in the Research Group at ARM Ltd. I also recently co-founded Kaleao through the exploitation of FP7 projects and act as their Chief Scientific Officer, a company delivering web-scale, converged micro-servers. I formed the vision and consortium that today are executing on the FETHPC-1-2014 exaNODE, exaNEST and ecoSCALE projects, while also being currently involved with MontBlanc3, EuroLAB4HPC, EUROSERVER and RethinkBIG. In my career I created the first scalable commodity telephony platform, the introduction of the first real-time video and data collaboration tools shipped in Microsoft Exchange 2000, and more recently, the design and introduction of the ARM MPCore multicore processor and associated technologies. Today my roles extend across both academic and industrial research topic, focused around exascale efficient systems and ubiquitous computing in society while also driving forwards the technological vision for the Kaleao product roadmap. This gives me a unique hardware and software background with experience from embedded to the largest of big data and HPC systems. I also sit on various advisory boards at both national and European level and a frequent conference speaker. For this proposal, I act through my role as the Professor of Computer Architectures at the University of Manchester, UK and the School of Computer Science.

**What is the challenge and the vision?**

**Digital Societal Health**

* **Outline**

Despite the significant advancements in the capability and availability of compute across society, the technological systems of today are still very visible and intrusive to the individuals in which they operate.  The deployment and power consumption costs of a cloud server, the programming of the thermostat in the home, searching the internet or email, or extracting a specific record of data from a national database; In each case the person interacts directly and consciously with the data and computer system whether it is the screen of a smart phone or a PC terminal.

The view of pervasive and ubiquitous computing in a modern society is one where the human interaction, the effects and control of computing can be developed in various ways be made unobtrusive and integrated with the actions and operations for which it exists.

Market terms such as Big Bata and Internet of Things, tends to hide the need of computing to develop into a ubiquitous part of society. I therefore propose the need for a new cross-functional area of development as a coordinated flagship that spans across computer science from the individuals that interact with computers, the chips that deliver the services, and the data that must be manipulated to connect people to the technology held together through resolution of specific societal challenges through a new EU Flagship program.

* **Specific Challenges**The challenge of making computing an integrated and ubiquitous part society will require research and innovation across a broad area of technological and societal aspects using a system-wide approach. The challenge of how the systems of big data and associated data analytics can be controlled and accessed by the individuals and organisation that have benefit from the information held within. The form of the chips which are able to interface, communicate and manipulate society’s data.

Data through natural sense’s based data acquisition, or exposed through the haptic touch to an real-world 3D interface of the data, often stored either into big databases or high data rates being collected real time from a sensors of various type and capability, the data will need to be collated, correlated and analysed before its resulting data representation can be provided to a specific segment of interest within society. As wearable technology brings an increasing need for security, it also can provide a view across society that previously was unavailable, how to manage such valuable and private information? How can you extract meaning from the disparate but temporally collated medical data? How can sensors become invisible? How can the associated system learn to warn about potential medical conditions? How can a server that could potentially hold the health data for the entire community be secured and managed appropriately?  How could such a system provide the scalability and compute processing capability to both interfaces with the data connection sources while also processing the vast amount of data power efficiently?  When an individual visits their Doctors, could their data be fully processed and analysed in real-time, potentially with other local sensors at the surgery providing more advanced measurements and evaluation of the individual? The simple idea that computing should be more ubiquitous and integrated into society opens up huge area of research, with any specific topic able to improve a specific aspect of the challenge.

Such ubiquitous societal health computing system will require new platforms and processor architectures to achieve the power and performance efficiencies required for non-obtrusive deployment and manageability. They will need advanced algorithms and data storage structures more suited to the natural world in which they operate, and will require advancements in natural world interfacing and materials with new learning and psychological understandings while ensuring the protection and security of the information.
* **Systems Approach**

A central pillar to the proposed flagship area must be the cross-functional nature required to break through the inherent and artificial interfaces and abstraction that have developed across the fields of computer science, the application of digital technologies and ICT in general. In computing, these interfaces have held in situ costs, assumptions and platforms on how a solution should look, vs. how it would look when only one sub-system in the larger system is addressed. Whether it is the physical energy cost wasted in unnecessary machine communication or the details of the semantics lost in the abstractions of big data, there is a grand-challenge to be addressed in the application of digital supported health of society

**Why is it good for Europe?**

Europe has ICT leadership and industrial strength across embedded computing and its application in industrial and medical applications. Various projects around ubiquitous computing have appeared across many academic research agenda but without an articulated vision towards a unified vision of the benefits it can bring to society and the health of its inhabitants.

As can be seen from a search on related topic, this has been an area of research world-wide for around a decade, <https://scholar.google.co.uk/scholar?q=ubiquitous+computing+in+healthcare> however, the IoT and associated big-data platforms to support the integration and holistic approach required have not been possible.

The premise for this proposal is that from the existing strengths across Europe, this area can be addressed to bring a true step change in the health, assistance and quality of life for its inhabitants while also enabling its industry to expand and grow with the opportunities in developing the technology and systems required.

**What would it take to do it?**

As a flagship, the specific objects will be defined in detail against the outline and challenges of this proposal. Success will be demonstrated, when the digital system in which the population lives is invisible and is a natural part of society and the life of each individual. To accomplish this, there will be various pillars of research and activity required:

* Sensors, Devices, Energy, Nanotechnology, Security, Resilience, Trust, etc.
* Psychological acceptance, Health platforms, Societal integration, etc.
* Data system, analytics, Information system, Intelligent systems, ICT, etc.
* Computing platforms, high-performance, big-data, IoT systems, etc.

To move from today’s discrete sensor and associated platform to a ubiquitous and integrated network of sensors and system could be achieved in 5 years, with an additional 5 years required to be optimized and accepted as part of society.

Europe is internationally recognised across embedded computing systems and biotechnological advances. It has key company such as GSK and Philips as well as various smaller companies delivering health products. The research institutes and universities also have numerous well recognised achievements as highlighted.

Research communities across computing systems, HCI, data analytics, as well as device materials and components in the realization of wearables and associated sensors. Conferences such as <http://pervasivehealth.org/>, Ambient Systems <http://cs-conferences.acadiau.ca/ant-16/> will provide a forum by which the topic can evolve into a new distinct community.

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