**Architectures and operating systems**

This research area explores the operational structure of a system and the software which abstracts a system’s hardware. It presents a precise interface to higher levels of software and applications.

Encompassing hardware and software aspects of computing systems, this research area aims to ensure, for example, correct resource management and efficient execution. This research typically explores:

* process
* file and storage management
* security
* fault tolerance
* parallel, heterogeneous and reconfigurable architectures
* virtualisation
* novel approaches to high performance computing
* distributed and autonomous systems.

Our current aims are outlined below.

### Researchers working across hardware and software interfaces

We aim to strengthen the overlap between research areas such as:

* [Microelectronics design](https://www.ukri.org/our-work/browse-our-areas-of-investment-and-support/microelectronics-design/)
* [Programming languages and compilers](https://www.ukri.org/our-work/browse-our-areas-of-investment-and-support/programming-languages-and-compilers/)
* [Software engineering](https://www.ukri.org/our-work/browse-our-areas-of-investment-and-support/software-engineering/).

This is an opportunity for researchers to contribute to the aim of EPSRC’s Cross-Disciplinarity and Co-Creation cross-ICT priority.

### Research supporting advances in intelligent systems

We aim to have a portfolio of research in this area which underpins new advances in intelligent systems by ensuring safety and reliability of decision-making technologies, contributing to EPSRC’s Future Intelligent Technologies cross-ICT priority.

### High level of expertise

ESPRC intends to maintain the high level of UK expertise in parallel hardware architectures, distributed computation and managing performance of software systems which provide the capacity to respond to emerging challenges (for example performance, scalability, resilience, security, virtualisation, reliability and energy efficiency).

### Address significant challenges

Our goal is to maintain a portfolio of projects and researchers able to address the most significant challenges in cybersecurity and safe, secure ICT, and develop systems that are reliable and robust in the face of unpredictable events. Researchers should reflect on how they can address the challenges described in EPSRC’s Safe and Secure ICT priority.

Find out more about EPSRC’s ICT priorities in the [Information and communication technologies (ICT) theme](https://www.ukri.org/our-work/browse-our-areas-of-investment-and-support/information-and-communication-technologies-theme/).

This research area is important for the creation of safe, secure, scalable, robust and reliable systems. The UK currently has the capacity and expertise to make transformational contributions, particularly in relation to parallel and distributed architectures, heterogeneous systems and autonomous systems.

Demands on processing (scale and speed) mean that conventional architectures are being stretched to their limits and new architectures (in hardware and software) are needed. This research area supports an emerging transition towards computer systems with energy-efficient parallel architectures. It underpins research areas including:

* [Software engineering](https://www.ukri.org/our-work/browse-our-areas-of-investment-and-support/software-engineering/)
* [Programming languages and compilers](https://www.ukri.org/our-work/browse-our-areas-of-investment-and-support/programming-languages-and-compilers/)
* [Operational research](https://www.ukri.org/our-work/browse-our-areas-of-investment-and-support/operational-research/).

This is an area with a high level of international collaboration, as evidenced by the prominence of UK researchers in international projects such as the [European Network on High Performance and Embedded Architecture and Compilation (HiPEAC)](https://www.hipeac.net/vision/#/latest/). The UK hosts a centre of excellence in HPC and a portfolio of HPC facilities that can support research in this area (for example in enabling robust comparison of architecture performance). The UK is also involved in global collaborations on middleware and architecture tools.

Major industrial partners such as ARM, Microsoft, AMD, Amazon, IBM, Intel and Samsung choose to work with UK researchers, demonstrating the high quality of UK research in this area. The UK has particular strength in parallel hardware architectures, distributed systems, autonomous systems and increasing complexity associated with organising and managing software systems. There is potential for transformative research, particularly in relation to big data, machine learning and parallel architectures.

The Architectures and Operating Systems research area has great potential to influence cybersecurity, as determined [in consultation with the UK cybersecurity research community](https://www.nao.org.uk/wp-content/uploads/2013/03/Cyber-security-Full-report.pdf).

The increasing importance of cybersecurity due to the internet of things and pervasive and ubiquitous computing will present a huge range of challenges to researchers in this area which they will need to address. Architecture is crucial to providing the capacity for robust systems, and maintaining UK expertise in this field is deemed particularly important for UK cybersecurity.

The UK has a good level of student support in this area. Centres for doctoral training include strong links with software engineering and industry. A number of students are also funded through Industrial Collaborative Awards in Science and Engineering. The UK’s current research capacity in this area is considered appropriate to address the research challenges.