

Scientific foundation for global computing

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The UK Computing research Committee has launched a programme of Grand Challenges, to focus the long-term aspirations of the computing research community (national and international) both in science and in engineering. At present there are seven proposals for such challenges, arising from ideas submitted to a workshop in 2002. For each proposal there is a core group of researchers aiming to form a road-map.

Two of these proposed Challenges involve what may be called the Global Ubiquitous Computer; it subsumes both the Internet and instrumented environments. Its name reflects the reasonable prediction that, within two decades, virtually all computing agents (heart-monitors, satellites, laptops, ...) will be interconnected, forming an organism that is partly artifact and partly natural phenomenon -- in either case one of the most complex ever constructed or studied. What models help us to understand it? What engineering principles can cope with the vast range of magnitudes involved?

My lecture will consider how to begin to address these two Challenges. Very many concepts are involved. They include authenticity, beliefs, connectivity, compilation, continuum, data-protection, delegation, duties, provenance, failure, intentions, locality, model-checking, mobility, obligations, reflectivity, security, simulation, specification, stochastics, trust, and many more.

Models are needed that explain and implement some of these concepts in terms of others. I shall end the lecture by describing some of my own work in modelling connectivity, locality and mobility. These notions arise naturally out of our existing models of concurrent computation, and can help to lay a foundation for global ubiquitous computation.