Editorial

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Biographical notes: Dinesh C. Verma, an IEEE Fellow, is a researcher and department group Manager of the IT & Wireless Convergence area at IBM Watson Research Center. He received his Doctorate in Computer Networking from University of California, Berkeley in 1992, the Bachelors' in Computer Science from Indian Institute of Technology, Kanpur, India in 1987, and Masters in Management of Technology from Polytechnic University, Brooklyn, NY in 1998. He has authored over 45 US patents, 90 papers and nine books. His research interests include mobile networks, network management and distributed computing systems.

Many leading computer companies have embarked upon programmes that use IT and sensor networks to improve operations and processes in society. The most well known among these programmes is the Smarter Planet initiative from IBM. Several other companies have also introduced similar initiatives, e.g., the Central Nervous System for Earth (CeNSE) project of HP, and the Ericsson Vision 2020 for interconnection of fifty billion devices. Although different in some aspects, all these initiatives share a basic common goal.

At its essence, initiatives like Smarter Planet refer to intelligent distributed computing environments which leverage information technology and communication networks to create new capabilities and provide more intelligent way to perform common functions in the society. Examples of such smarter planet systems include systems that improve water management, create more efficient utilities, or reduce congestion on transportation networks like roadways and railway systems. In general, smarter planet systems are built using instrumentation data collected from ubiquitous sensor deployments, retrieving sensor data using intelligent techniques for data collection, and then applying data analytics and artificial intelligence to create an intelligent end-to-end system. Over the last couple of years, several smarter planet systems have been built and deployed at different locations across the world.

At the core of building smarter planet systems is the concept of a smarter network. The smarter network enables new types of interconnection architectures, and provides energy-efficient secure means to instrument the physical world so that it can create an intelligent end-to-end solution. This special issue looks at some of the challenges that are involved in creating a smarter network. Each of the fiver papers in this special issue looks at some aspect of creating and improving the existing network infrastructure.

One new issue emerging in creating smarter planet solutions is that of localisation in indoor environments. Several of the emerging smarter planet systems require position information in order to improve their operations. In outdoor environments, the global positioning satellite (GPS) system provides a good solution to localisation. However,

inside a building, the GPS signals are usually too weak to be useful. Nevertheless, building a smarter planet system requires that the localisation information be provided not only for outdoor devices, but also for those that are located indoors. In order to address those needs, frameworks that can support indoor localisation are needed. The first paper in this special issue, 'Self-organised localisation in indoor environments using the ALF framework' provides one such framework.

As we build smarter planet systems, the technical community is coming to the realisation that the concept of a network is not restricted only to computer communications. Recent initiatives such as network science have shown that the concept of interconnection networks needs to be applied to domains such as collaboration among people and the exchange of information. The field of network science has introduced the concept of information networks – networks that exist between the information or content maintained in a distributed system, which may have a structure very different than that of the physical network which connects the sources of that information.

The second paper in this special issue deals with some of the challenges in attaining and creating information networks and their interactions with the underlying physical network. The task of content management is especially difficult when the underlying network is dynamic, e.g., in the context of a mobile ad-hoc network with changing topologies. The paper explores new approaches for strategic content placement in mobile ad-hoc networks.

In order to make progress towards the goal of creating a smarter planet system, new approaches looking at emerging areas such as indoor location management, or improved information networks are extremely important. Equally important, though sometimes overlooked, are the challenges involved in improving the algorithms in technology areas that are well-established. One such established area, which has a significant impact on the efficiency of the end-to-end-system, is the task of network planning.

The third paper in this special issue looks at the subject of network topology planning, and proposes a new approach of using delay-cost sink trees to design the right topology for any network. The approach can handle four competing bandwidth and cost constraints into a single model to ease the task of network planning. While the focus of this paper is on improving the algorithms that are already well-understood, it underscores the point that building a new smarter planet system requires combining the insights from new and emerging fields of networking with improvements in existing areas.

One of the key challenges in building any type of smarter instrumentation needed for a smarter planet system is that of energy efficiency. Sensors that are needed to instrument and collect information are usually battery operated and thus energy is at a premium. Energy-efficient routing mechanisms are of crucial importance in such systems. The fourth paper in this special issue examines energy efficient multipath routing mechanisms using an analytical modelling approach.

Last, but not the least, security remains a pressing concern for all networks, including the traditional networking systems as well as the emerging wireless sensor infrastructure that will be needed to create new smarter planet systems. The fifth paper in this issue presents a new security framework for wireless sensor networks that is much more power efficient than standard security techniques.

Together, these five papers present a snap-shot of some of current research that can be used to improve the interconnection aspects of smarter planet systems, and create smarter networks. While this does not provide a complete and holistic coverage of all aspects of the principles that underlie the development of smarter networks, these papers

provide us with some very good insights on how to improve the interconnections among the different smarter planet systems and to make progress in the scientific quest for a smarter network.