The Internet of Anything and Sustainability

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Two terms have all but surpassed the cliché stage in our current lexicon: the Internet of Things (IoT) and sustainability.

The notion of the IoT, or the Internet of Anything (IoA),[1] as we prefer to call it, is widely prevalent. Taken to extremes, the IoA subsumes drones, smart swarms, the smart grid, intelligent buildings, and autonomous cyber-physical and cyber-biological systems, each of which has achieved or is about to achieve mega-cliché status on its own merit. The IoA is supported by the cloud, big data, mobile computing, and bring your own device (BYOD).

By entirely different semantic channels, the notion of "sustainability"—of our environment, our growth, our social well-being, and our economy—has also reached worldwide cliché status. Together with resilience, the concept of sustainability demands an urgent call to action.

The IoA and sustainability, taken as coevolving concepts, nonetheless result in some useful speculation about the art of the possible. This convergence is occurring in a world that can no longer be viewed in terms of often mechanistic and static precision characteristics, as was the thinking of our recently industrialized era. This special issue examines and reinforces this vital union and explores its potential.

IoA and Sustainability: Coevolution

Given that the world's scientists place a collective 97.2 percent level of confidence on the concept of climate change and all that it implies,[2] sustainability becomes a metaphor for coping with new dynamics of unknown dimensions. Speculation abounds concerning increasingly unusual and often violent weather in the most unexpected places, unprecedented drought and wildfires in other unlikely places, food instability, pandemics, and growing disparities leading to constant global unrest, hostility, and disruption. Although we are only glimpsing the forerunners of dramatic change, the early signs are present and seemingly deepening with the passage of time.

Is there hope for achieving true sustainability? And what does this have to do with the IoA?

In the face of massive disruptive technological change, some might argue that the status quo has no foothold. Certainly, the electronic book, for example, has led to the demise of many venerable bookstores. iTunes forever changed the landscape of popular music. Nonetheless, the time-honored acts of reading books and consuming music continue apace. Only the distribution channels were disrupted, not literate or auditory behavior. Sustainability then implies a shift in

 Published by the IEEE Computer Society

formerly status quo activities to achieve an enduring goal under new circumstances.

The IoA will clearly move the world ever faster toward adopting new sustainable markets. It will usher in autonomous systems that can't exist without vast network interactions among a multitude of widely distributed sensors and control mechanisms, called actuators. It will permit self-regulating and self-repairing smart grids that are ideally optimized for maximum efficiency in highly volatile environments. It has the potential to revolutionize how we approach energy usage and the geo-political unrest energy ownership creates.

Simply put, the IoA has all the potential to harness powerful forces for sustainability in a rapidly changing world. This implies that the notion of sustainability be joined with the IoA, both acting as dynamic agents of change, neither supporting the status quo.

Such a union gives rise to a hope that technology can and should play a vital role in balancing an increasingly unbalanced world. It also brings some significant ethical issues to bear that promise to amplify current cybersecurity concerns. Earth-changing issues exist that serve to reinforce a need for enhanced security and privacy. But don't be deceived—an Internet with anything tied to it is a recipe for anything happening, the good, the bad, and the ugly.

In This Issue

This special issue of *IT Professional* examines articles focusing on IoA trends, smart grids in the built infrastructure, security and privacy concerns, cloud architecture, and other issues related to sustainable IoA.

The From the Editors column from Arpan Pal sets the stage for the IoA as a sustainability-enhancing entity by defining six elements to move it beyond the hype stage of maturity.

In their overview of emergent and potentially sustainable IoA trends in the energy industry, "Intelligent Energy Industrial Systems 4.0," Patricia Robison, Manjusri Sengupta, and David Rauch build a case for the importance of smart grids. Then, in "Security, Privacy, and the Built Environment," Hugh Boyes explores the IoA's impact on the built infrastructure, focusing on smart buildings and their implications for security and privacy. Privacy and security concerns are further reinforced by "Big Data Privacy in the Internet of Things Era," in which Charith Perera, Rajiv Ranjan, Lizhe Wang, Samee U. Khan, and Albert Y. Zomaya examine the privacy of big data in the IoA.

Other aspects of the IoA are important considerations for future sustainability and their ultimate relationship to cyber-ethics and cybersecurity. Accessible platforms for the IoA will necessitate rethinking the conventional cloud environment. In "Designing a Cyber-Physical Cloud Computing Architecture," Eric Simmon, Sulayman K. Sowe, and Koji Zettsu examine a conceptual cloud architecture to sustain IoA-enabling cyber-physical systems (CPSs). Further extending the human component of the cloud, Bin Guo, Chao Chen, Zhiwen Yu, Daqing Zhang, and Xingshe Zhou look at mobile crowd sensing computing (MCSC) as it supports the eventual fusion of human and machine intelligence in their article, "Building Human-Machine Intelligence in Mobile Crowd Sensing."

As expert opinion, this issue also offers a Spotlight article on two IoT perspectives: Ram Sriram's "Smart Networked Systems and Societies: A Research Agenda" discusses the development of a trusted, secure, reliable, and interoperable net-centric computing environment. Amit Sheth presents "Smart IoT: IoT as a Human Agent, Extension, and Complement." Both discussions include links to accompanying videos.

Readers can also refer to the IT Trends department by Saeid Abolfazli, Zohreh Sanaei, and Irena Bojanova, which discusses the Internet of Cores (IoC), envisioning a ubiquitous cloud of heterogeneous granular computing and storage.

We believe this issue, with its varied articles, furthers the dialogue on the IoA, especially as it could help drive future sustainability. Indeed, the IoA calls for our best effort, particularly as unprecedented change relentlessly summons the utmost in sustainability.

The IoA boils down to "things" that make or use data, and to use data relies on computing. The IoA is a spider's web of sensing, computation, and communication. It's a juggernaut of data, algorithms, and things rolling down a hill, blended with a huge amount of uncertainty, given that its key actors almost certainly lack any

pedigree related to trust. It's a space to closely monitor, but in the meantime, enjoy the ride.

References

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