Ubiquitous Reconfigurable Computing for Net-Enabled Capabilities in Commercial and Military Systems: Technology, Social, and Economic Perspectives

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Abstract

Current research into advanced networked computing capabilities offers the promise of substantial improvements over traditional point-to-point data exchange between essentially standalone computers. This talk explores the technical, social, and economic implications of an intelligent fabric concept that could provide large enhancements over traditional networked computing concepts (such as the Internet) for both military and commercial enterprises. The intelligent fabric concept advances net-enabled capabilities through the use of ubiquitous and adaptable computing and communication networks whose nodes have been enhanced with advanced embedded hardware and software. However, it requires new approaches to nodes on the network, such as "thin applications" (where the software on each node has just enough capability to use the information and knowledge processing power of the fabric) and trust in the availability, integrity, and security of the intelligent fabric. From a technology point of view, we present general trends for intelligent fabric using reconfigurable computing resources that can scale from global network to chips exploring the needs of low power and low cost network-centric system solutions and further helps in optimizing the fabric performance. The reconfigurable fabric elements that support this intelligent fabric are flexibly coupled, in which they share many of the attributes of a loosely coupled network, including the ability to be disconnected and reconnected dynamically and creating an environment where the address space across the processing elements appear to be homogenous to the applications running on the intelligent fabric. From a system point of view, it requires careful attention to semantic interoperability, given different languages, context, and meanings of the information and knowledge handled via the intelligent fabric. It enhances emergent behavior in the collaboration of users of the network-centric system if they adapt their "computing culture" to take full advantage of the intelligent fabric. This can result in large economic impacts (both positive and negative) as global societies continue their transition from the Industrial Age into the Information Age.

Dr. Tirumale K Ramesh is a Boeing Technical Fellow and Chief Technologist-AMSE Virtual Operations at The Boeing Company. Dr. Ramesh's current work at Boeing involves leading a Live, Virtual, Constructive (LVC) Architecture Capability Team for AMSE-Virtual Operations. As a member of NCOIC, he is working on several technical initiatives for NCO technical development. Dr. Ramesh also led a Boeing Corporate Research on Advanced Embedded Computing and Network research funded by NCO Thrust. His corporate research on new generation of high performance reconfigurable embedded computing and sensor computing has vast relevance both in the military and commercial domains. He has held Senior Technical positions at Lockheed Martin Corporation and IBM. As an IPT lead for a major missile launching system product program at Lockheed Martin, he was responsible in overseeing electronics systems design, development, testing and integration. As a Senior Technical lead at IBM Systems and Technology Division, he led a ASIC High Speed Serial Bus system solutions using high speed Network ASIC core for key network interfaces. Dr. Ramesh started his career at Indian Institute of Science, Department of Aerospace Engineering and Electronics Communications Engineering as a Project Associate from 1975-77 and later he joined Indian Space Research Organization (ISRO) working in the early part of Indian Space Program from 1977-81 He has been granted US and UK patents and has several patents pending. He has over 50+ technical publications in IEEE sponsored conferences and journals. Dr. Ramesh is an active Senior Member of IEEE and IEEE Computer Society and serves on Technical and Conference Board of IEEE Computer Society. He was instrumental in providing leadership for HPC User Symposium at the HiPC Conference in India.

Kenneth Cureton is a Senior Network-Centric Systems Engineer and Engineering Manager for NCO System-of-Systems Architecture Integration, a business area of The Boeing Company that is responsible for developing a Boeing-wide strategic communication and information architecture; for deploying this architecture in all Boeing systems; and for certifying that all Boeing systems interoperate. NCO Architecture Engineering is part of Boeing's Integrated Defense Systems (Advanced Systems). He is currently assigned as the Technical Lead for Boeing in the NCO Industry Consortium (NCOIC), and serves as the Chair of the Engineering Processes Functional Team. In his prior role, Cureton managed Strategic Architecture development efforts, including systems engineering and ongoing development of a common interoperable, network-centric architectural reference models. His prior Boeing assignments included leadership of the Control Segment Team for GPS Block III, the next-generation of Global Positioning Satellites, as well as prior leadership of the systems architecture, systems engineering, design, production, integration, and test of navigation payload systems and software for GPS Block IIF. Before that he supported the conversion of aerospace and defense systems for Emergency Management System applications, with special emphasis on analysis and design of computer hardware, software, and data/voice communication systems for wildlands firefighting. Prior to joining Boeing in 1987, Cureton served as Vice President, Research and Development for Computer Systems at Command Computer Service, Inc. in La Mirada, Calif. Other positions held during his pre-Boeing career included Principal Analyst, Microprocessor Systems and Software Design at Dialogue Computer Science; Senior Systems Analyst, Timesharing Operating Systems Support, in the Office of the Chancellor, California State University and Colleges, where he began his career as a programmer/analyst in Operating Systems Support. Cureton also serves as Adjunct Faculty at the University of Southern California (USC) teaching in the network-centric systems program.