System of Systems Engineering Collaborators Information Exchange (SoSECIE)

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The Evolution of Emergent Architectures

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Abstract
Today's defense programs are challenged by changing mission needs and rapidly evolving technology. In the commercial world new capabilities can be deployed widely in less than a year and a new generation of technology may be available in as little as six months with products facing obsolescence in a period as short as two years. Contrast this with DoD programs that have a life cycle measured in decades. This results in capabilities and technologies being several generations behind by the time a program is fielded, precluding taking advantage of the latest functionality, performance increases and cost reductions. Supporting decades old technology through the end-of-life presents its own challenges and is often costly.

This briefing looks at a variety of system architectures which are increasingly able to handle the dynamics of today's problems, including: Complicated Systems, Complex Adaptive Systems, Resilient Systems, Weak Emergent Systems, and Strong Emergent Systems. The qualities of each of these types of systems will be compared along with examples. The focus will be on Emergent Architectures which include resilient and complex adaptive properties. This brief will then discuss the approach to developing emergent architectures, which has significant differences from current methodologies. Whereas the focus of current methodologies is to start at the top and decompose/specify everything down to the smallest details, emergent architectures focus on the minimum specifications for a framework in which capabilities emerge. The interfaces need to be specified to allow interoperability between various systems. New capabilities can then be enabled by adding new functions or repurposing existing functions. One of the key differences of natural emergent systems and emergent architectures is that of timescale. The Law of Requisite Variety and the selection process become critical to developing emergent architectures in a timeframe to be beneficial.

Biographies
Claudia Rose (BBII president, a Certified Enterprise Architect, 2012 winner of the San Diego National Association of Women Business Owners Signature Award) has over 15 years of industry experience. She has served on boards of directors for several organizations including The Association of Enterprise Architects, INCOSE San Diego, NDIA small business forum, AUVSI and the La Jolla Cove Swim Club. She has presented papers on systems engineering to aEA, INCOSE, NDIA, AFCEA, and the Naval Postgraduate School Center for Cyber Warfare. She has presented papers on health development policy and consulted on health and development projects at The World Bank and USAID. She holds a MAIT from George Mason University, with studies at Tribhuvan University Kathmandu, and a B.A. from the University of Wisconsin-Madison. She has taught and supported enterprise and systems engineering and cloud computing architectures. She has taught enterprise architecture bootcamps for aEA and the Air Force. She has taught at Boston University, UCSD, Texas State Technical Colleges and Nanyang Technical University. She has developed and implemented training protocols for NASA, ViaSAT, Praxis, Bombardier Transport, United Pan European Communications and Northrop Grumman. She is also co-author of *Architecting the Cloud: Patterns in Enterprise Architecture for Cloud Computing*.

Mr. Alan Brenner has over 35 years experience developing increasingly complex systems. He has developed and reduced to practice products and technologies decades ahead of broad commercialization. Defense-related engagements span C4ISR systems ranging from collection sensors to land, sea, and air and space platforms. Mr. Brenner is an expert in advanced computing using virtualization and cloud-based computing to create Service Oriented Architectures (SOA) and traditional deployments. This expertise culminates in the ability to develop Emergent System Architectures and transformational Enterprise Architectures for NASA, multiple prime defense contractors, and the Cross Border Institute for Regional Development and cities. He has an educational background in math and physics from MIT.