System of Systems Engineering
Collaborators Information Exchange (SoSECIE)

July 28, 2015
11:00 a.m. to Noon Eastern Time

Maintaining Emergence in Systems of Systems Integration:
A Contractual Approach using SysML

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Abstract

This briefing describes a pilot study in the use of model-based techniques in System of Systems (SoS) engineering. The focus is on the derivation of specifications for new constituent systems that are to be integrated with an existing SoS. The pilot study is based on a commercial application in the home audio/video domain and illustrates the application of architectural modeling guidelines to the description of a content-streaming SoS using SysML and the formal COMPASS Modeling Language (CML). Analysis of the models leads to the derivation of a specification sufficient for constituent systems to guarantee a key leader election property of the SoS.

Biography

Dr. Jeremy Bryans is a Senior Research Associate in the School of Computing Science at Newcastle University, UK. His research concerns the modelling and analysis of collaborating systems, and in the development of trustworthy policies for their safe and secure interaction. He obtained a PhD to formal semantics from Reading University in 1997 and recently worked on the COMPASS project, developing semantic foundations for a modeling language for Systems of Systems. He currently leads a project on Smart Grid Infrastructure modelling, and contributes to a large EU project on Cyber-Physical Systems. He is a member of INCOSE and the BCS.

Prof. John Fitzgerald is a full Professor in Computing Science at Newcastle University, UK, where he leads the research group on Advanced Model-based Engineering, focusing on rigorous methods for the design and validation of challenging systems. Over the last 20 years, he has helped to develop several such methods from formal logical foundations to industrial applications in areas as diverse as options trading, firmware development and the design of production machinery. His current research focuses on the challenges of cooperative engineering involving multiple disciplines. He recently led the COMPASS consortium, which developed model-based methods and tools for engineering Systems of Systems, with applications in the audio/video and emergency response sectors. He now leads Newcastle's work on four new research and innovation projects design for Cyber-Physical Systems (CPS). He is currently establishing a new CPS laboratory at Newcastle University, as part of an $80m development of

former industrial land in the heart of the city, as a centre for multidisciplinary research and public engagement in digitally enabled urban sustainability.

Dr. Richard Payne is a Research Associate in the School of Computing Science at Newcastle University, UK. Following his PhD (Newcastle University 2012) on models of dynamic reconfiguration, he worked on projects in architectural modelling in Systems of Systems (SoSs). He is currently working on SoS and Cyber-Physical System (CPS) projects, including the EU H2020 INTO-CPS project which is aiming to produce a model-based tool chain for CPS design and development. His research interests include architectural modelling, dynamic architectural reconfiguration, the pragmatic application of formal modelling, and SoS/CPS engineering.

Mr. Klaus Kristensen (MSc cum laude Computer Science with Mathematics, University of Aalborg, Denmark) has over 18 years' experience working as a software engineer and software architect in companies including Bang & Olufsen, Motorola and LEGO, and is an expert in Audio/Video systems engineering. In the COMPASS project, he led work on the instantiation and evaluation of model-based SoS engineering methods in the AV domain.