



## OFFICE OF THE DEPUTY ASSISTANT SECRETARY OF DEFENSE SYSTEMS ENGINEERING

### System of Systems Engineering Collaborators Information Exchange (SoSECIE)

Tuesday, December 11, 2012  
11:00 a.m. to Noon EDT

#### Patterns and Pattern Languages for Systems of Systems

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#### Abstract

A software design pattern provides a solution to familiar interaction problems by providing a stable template that can be reused in different situations. It is not a complete body of code that can be plugged into software component; it is, rather, a description of a problem that is likely to occur and the rules that solve the problem. Each pattern is defined by a template defining the problem, the context, the rules that apply to provide a solution, and some example solutions. A pattern language describes how to combine a set of such patterns to support an architectural style for building more complex interacting components. Pattern languages are often developed specifically to support the building of large, complicated systems, documenting each potential problem and its solution into a knowledge base for all programmers on the team to use and apply. These concepts have been generalized to system patterns, and system pattern languages. Cloutier (1) and the Open Group (2) have defined very similar templates for capturing such system patterns and languages. In both the software and systems approaches, the quality attributes (performance, availability, modifiability etc.) play a background role in both the patterns and the pattern language. Over the past few years, we have applied the concept of quality attributed augmented end-to-end mission threads in SoS contexts. We are currently investigating the application of patterns and pattern languages to SoSs, by mining existing SoS development efforts for SoS patterns and pattern languages. We believe that the quality attributes deserve a much more prominent role; and are focusing on the quality attributes relationships within each pattern template and in the pattern language to combine patterns to satisfy overall quality attribute architectural drivers. The pattern template we have adopted is a slight variant of the templates from the Open Group and Cloutier. It has been extended to incorporate a more thorough description of the quality attributes, and to explicitly capture pattern variants. We have started by focusing on an important end-to-end SoS capability, situational awareness (SA), which involves many distributed nodes over a wide geographical area. We have developed an interview questionnaire, and a template for capturing the architect's responses on-line. We have used these to successfully conduct interviews with SA architects of existing military SoSs, and have developed some draft patterns from these interviews. We are currently investigating the characteristics of a pattern language to combine them. We have identified a number of quality attributes that apply to SA (performance, availability, security, data integrity and location transparency) and have also discovered that variances in capabilities, behavior, and quality attribute characteristics play a significant role in describing the patterns and the pattern language for combining them. Our approach is to identifying the SA patterns incrementally via interviews. When we complete drafting our SA patterns and pattern languages based on the initial interviews, we will conduct a further series of interviews on SA to confirm our initial findings



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and to adjust the patterns and pattern language. This briefing will quickly overview the concept of patterns and pattern languages, describe our process as it applies to SoS, and show and display our results as they apply to Situational Awareness in a Military SoS.

### References

1. Robert Cloutier: Applicability of Patterns to Architecting Complex Systems, VDM, Germany, ISBN-13: 978-3836485876, July 2008
2. Open Group: TOGAF Architectural Patterns ([www.atallc.net/togaf9/chap25.html](http://www.atallc.net/togaf9/chap25.html))

### Biography

Mr. William Wood has worked at the SEI for the past twenty five years, and has held various technical and managerial positions over this time period; performing a combination of research activities and customer-interactive activities. He currently works in the Research, Technology and System Solutions Program at the SEI with a focus on developing and implementing methods that can be used to expose risks in a System-of-Systems Architecture and/or a System Architecture.