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Modeling Service Oriented Architectures in a Command and Control Application Context

Topics: Networks and Networking, Modeling and Simulation, Network-Centric Experimentation and Applications, C2 Technologies and Systems

James Solderitsch
Gestalt, LLC
680 American Ave.
King of Prussia, PA 19406
610-994-2860
jsolderitsch@gestalt-llc.com

Abstract

Service Oriented Architectures (SOAs) hold promise for use in Command and Control (C2) application domains and contexts but this promise remains essentially un-tested and un-validated. This un-tested and largely un-realized promise is particularly true in the context of systems on the Edge where system connectivity is problematic. Gestalt and Villanova University are partners in the Applied Research for Computing Enterprise Services (ARCES) program under sponsorship of the Air Force Electronic Systems Group (ELSG/KI) at Hanscom Air Force Base. ARCES has spent significant effort in trying to understand aspects and features of both SOAs and their applications to C2. As part of this effort, executable models have been developed to help evaluate SOA-based approaches and architectures. This paper presents ARCES' findings to-date, introduces several SOA models, discusses how these models are verified and validated, and shows the direct application of these models to investigating the utility and practicality of SOA solutions to C2 problems.

Classification

The material in this paper is unclassified.

Paper Outline

1. Introduction

Service Oriented Architectures (SOAs) hold promise for use in Command and Control (C2) application domains and contexts but this promise remains essentially un-tested and un-validated. This un-tested and un-tried promise is particularly true in the context of systems on the Edge where system connectivity is problematic.

Gestalt and Villanova University are partners in the Applied Research for Computing Enterprise Services (ARCES) program under sponsorship of the Air Force Electronic Systems Group (ELSG/KI) at Hanscom Air Force Base. ARCES has spent significant effort in trying to understand aspects and features of both SOAs and their applications to C2. To that end, executable models are being developed to help evaluate SOA-based approaches and architectures. One important modeling technology being employed is called MESA: Modeling Environment for SOA Analysis. MESA was created by the Mitre corporation under DISA sponsorship and allows the creation of executable architectural models through which the stressful conditions, under which C2 applications (realized in a SOA) are expected to be deployed and operate, can be examined and experimented with.

This paper will present the preparatory work that ARCES has performed and discuss several models and laboratory experiments conducted to validate the models. In these models, ARCES attempts to define as-is and to-be architectures and their interplay in a large-scale communication network that ARCES terms a C2 fabric. The fragileness and unpredictable nature of this fabric is of particular importance and modeling these aspects such as low bandwidth and intermittent communication links is an important feature of these models. The use of compression technologies to overcome some of these constraints has proven to be a fruitful avenue of research and model representation and this work is discussed in the paper.

Along with models, ARCES is also concerned with evaluating and experimenting with particular ESB (Enterprise Service Bus) implementations ranging from commercial tools such as BEA's AquaLogic to open source technologies such as the Apache ServiceMix project. In fact, ARCES uses these technologies to build a laboratory test bed in which the ideas and approaches incorporated in the SOA models can be demonstrated and used to verify and validate the models themselves. At the same time, the suitability and maturity of the ESB products are examined to see how well they are equipped to support C2 SOA needs and concerns.

More recently, ARCES has started to examine the difficult problem of service discovery from a Net-Centric Warfare viewpoint and is beginning to develop models to help understand and document this problem and potentially outline solutions whose effectiveness can be demonstrated in these models.

2. Overview of MESA Technology

3. Model Verification and Validation
4. Important C2 Domain Constraints and Concerns
5. ARCES ESB Fabric and Compression Model
6. Validating the ESB Fabric and Compression Model
7. ARCES C2 Service Discovery Model
8. Summary and Conclusions