Maximizing Flexibility without Impacting Operational Responsiveness in SOA-based Satellite Ground Systems

GSAW 2008

Richard Anthony
richard.anthony@gdc4s.com
April 2, 2008
Objectives

- Describe how Service-Oriented Architecture (SOA) can be applied effectively in Satellite Ground Systems
  - Focus on how to achieve benefits of SOA without affecting ground system responsiveness and effectiveness
- Use a set of generic Satellite Ground System architecture views to illustrate
  - Represents a typical software architectural evolution as more is learned about SOA capabilities and applicability
  - Includes SOA applied inside the ground system and SOA also used for external interfaces
  - Views not intended to be specific to Web Services based SOA
- Based on knowledge gained in:
  - Contracted Programs
  - Studies
  - Proposal-related activities
  - IR&D Activities
Satellite Ground System Conceptual SW Architecture (distributed, non-SOA)

- System Mgmt
- Commanding
- Telemetry
- Communications
- Orbit Analysis/Deter.
- Planning
- Situational Awareness
- External SA Client

Satellite Operations Center
General Dynamics C4 Systems SOA Approach

Customer/Project Requirements
- DOD
- DHS
- Civil
- Intel

Inputs
- Requirements
- Motivation
- Goals

Technology / Business Partners

C4 Systems SOA Architecture

Architecture • Technology • Governance • Process

Common SOA Artifacts
- Documentation
- SDK
- Tools
- Processes

Deployed Project / Customer Solutions

Project/Customer Specific Implementations

General Dynamics C4 Systems SOA Architecture

• Documentation
• SDK
• Tools
• Processes

© 2008 General Dynamics, All Rights Reserved
Benefits of SOA

- Plug and Play of Services with no disruption of operations (agility)
  - Add / Replace a Service
  - Upgrade a Service
- Loose Coupling
  - Reduces dependencies and direct connections
- Open Standards based (Avoid SOA solutions that are not)
  - Minimizes dependencies on vendor proprietary implementations
  - Ultimate plug and play is to replace the SOA framework
  - Implementation Should be platform independent (reduces lifecycle costs)
- Orchestration
  - Mission Logic - Intelligent Sequencing, Workflow
  - Building coarse-grained services from fine-grained services
- Mediation
  - Translation between Different data structures and protocols (JMS, CORBA, SOAP, etc.)
  - Intelligent Routing (Content / Identity based routing)
- SOA Governance
  - Administration and management of services
- Reuse
  - Use externally provided service rather than a custom application
  - Typical problems of reuse still exist
How SOA Impacts Operational Responsiveness

- Implementing everything as a SOA service could inhibit system performance and responsiveness
  - Processing real-time Telemetry (TLM)
  - Alarms
  - Command (CMD) Processing
  - Orbital Data Processing
  - Enterprise Management
  - Processing / Providing data on external interfaces
- Interfaces to existing TLM / CMD / Orbital Processing Products may need to be adapted
- Security mechanisms may inhibit system responsiveness
- Without proper design updates to services may cause delays
- Services need to be developed/deployed with reliability and availability in mind
- Management of the SOA Framework can add complexity
A First Approach: Initial SOA-based SW Architecture, no SOA Framework

Satellite Operations Center

- **Sys Mgmt**
- **CMD**
- **TLM**
- **Planning**
- **OA/OD**
- **Comms**

**External SA**

- **External SA Client**
- **SA**
- **Service Registry**

**External Clients** lookup, then access services

Some Decoupling via location lookup

Service clients lookup, then directly access services
Second Attempt: SOA-based Ground System Architecture, Framework-Based

- External SA Client
- SOA Framework
- System Management (Sys Mgmt)
- Command (CMD)
- Telemetry (TLM)
- Planning
- SA
- OA/OD
- Comms Adapter
- Decoupling via framework

Satellite Operations Center

- External Clients use protected framework
Where is SOA Applicable and Not Applicable in Satellite Ground Systems?

- SOA is applicable where benefits of SOA can be achieved and responsiveness is not impacted
  - TLM / CMD history query and publish/subscribe services
  - Situational Awareness (SA) services
    - Satellite subsystem status
    - Link status
    - Network Element status (high-level)
    - Critical Alarms
  - Planning and Scheduling interfaces
  - External information query services
    - External Satellite SA
    - Mission data processing status / query
  - Utility Services
    - XML transforms, logging, alerts, etc.

- Not Applicable where SOA impacts operational responsiveness
  - Real-Time TLM / CMD Processing
  - In the middle of intensive tasks such as Orbital Data Processing
  - Direct feed to/from earth terminals
A Potential SW Architecture: SOA Where it Makes Sense

Satellite Operations Center

All HW

<<service>>
Sys Mgmt
<<framework>>
SOA Framework

<<service>>
CMD
<<service>>
TLM

<<service>>
Planning
<<service>>
OA/OD

<<adapter>>
Comms Adapter

<<external>>
External SA Client

<<framework>>
SOA Framework

OK to Wire around framework where needed
Guerilla SOA: Evolution of SOA
(Jim Webber, ThoughtWorks)
Conclusions / Looking Ahead

- Use SOA where it makes sense
  - When SOA can provide benefits, e.g. agility
  - Where Operational Responsiveness is not impacted
  - It’s OK to wire around the SOA Framework where necessary, usually for performance reasons
    - First, make sure there really is a performance issue
- The approaches discussed here can also be applied to other types of ground systems
- Other technologies to consider for ground system architectures
  - Database technologies
  - High-speed networking
  - Server and storage technologies
- For further information Contact: richard.anthony@gdc4s.com