NATO Nations Deepen Operation's Field Cooperation With Business Processes

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Agenda

- About NATO Communications & Information Agency
- Coalition Intelligence, Surveillance & Reconnaissance (ISR)
- Model Driven Architecture Development
- ISR Architecture
- Summary
Connects forces, NATO and Nations, where and when required by providing interoperable Communications and Information Systems and services.

Provider of NATO-wide IT services and state-of-the-art C4ISR capabilities by applying industry best practices and providing a full life-cycle approach.

Key pillar of NATO Secretary General's Smart Defence and Connected Forces initiatives.
Our value

- Fully Customer Funded.
- Independent design authority for NATO enterprise.
- Full life-cycle perspective.
- Live and breathe with our customers.
- Unique blend of multinational technical and operational expertise.
The JISR Service Line

• The JISR SL focus = facilitating global interoperability within the JISR COI internal to NATO but also with external COI’s

• The JISR SL will be responsible to its customers for planning and executing all lifecycle management activities in support of the JISR Cycle and associated services, including:
  • Strategy & Policy
  • Standardisation
  • Requirements Analysis
  • CD&E
  • Design & Development
  • Processes
  • Acquisition
  • Implementation
  • Transition
  • Service Operations (O&M)
MAJIIC2 in a nutshell

• Overview
  – 9 NATO Nations
  – NCIA (Technical Management, Subject Matter Expertise and Support)
  – NATO organisations (ACO, ACT, NAEW&C)
  – More than 150 C2ISR systems
  – Active industry involvement

• Process
  – National Funding
  – NATO and National Staffs from Government and Industry
  – Standards based Interoperability
MAJIIC2 The Challenges

- No means for sharing, sensor data, information and intelligence between coalition partners
  - Duplication of collection effort
  - Inability to fulfil information requirements
- Single partner lacks required number and mix of assets
- Incompatible processes and procedures
- Inflexible to change in process and information models
JISR Services in Support of Operations

Multi-national, multi-service, multi-echelon processes
• There must be consistency & traceability between choreography, service and information models.
Choreography – what?

Orchestration

- A central process (which can be another service) takes control of the involved services and coordinates the execution of different operations on the services involved in the operation.
- The involved services do not "know" (and do not need to know) that they are involved in a composition process and that they are taking part in a higher-level business process.
- Only the central coordinator of the orchestration is aware of this goal, so the orchestration is centralized with explicit definitions of operations and the order of invocation of services.

versus

Choreography

- Choreography, in contrast, does not rely on a central coordinator.
- Rather, each service involved or notified in the choreography knows exactly when to execute its operations and with whom to interact.
- Choreography is a collaborative effort focusing on the exchange of messages in public business processes.
- All participants in the choreography need to be aware of the business process, operations to execute, messages to exchange, and the timing of message exchanges.
MAJIIC 2 CIM Information Models
Service oriented architecture Modeling Language (SoaML) for service modeling [http://www.omg.org/spec/SoaML/]

- SOAAML provides support for design process from business processes to service interfaces.
- It defines a UML profile with stereotypes allowing automatic transformation from models to WSDLs.
• Service Specifications are Compact
• Contract First Development (CFD)
• Specifications:
  – Information
  – Interface
  – Behavioural/ Business Rules
  – Exceptional
  – NFR/ SLA
  • E.g.: SPS++ replication – 50 concurrent connections, 5 messages per second, average message size 20KB;
MAJIIC 2 The Challenges

Operational lessons learned:
- Coalition is the norm
- Come as you are
- Bring what you got
- Plug and play (pray)

Coalition Context:
- Limited High Value Assets (Sensors)
- Limit Duplication of effort
- Provide Burden Sharing
- Coordinate processes across Nations, Services, and Echelons

Federation of autonomous partners engaged in a cooperative effort
Multi-national, multi-service, multi-echelon processes
MAJIIC 2 data types

- Product/ Metadata library supporting Discovery, Search, Archiving and Retrieval to support near-real-time and forensic analysis

- Distributed choreographed workflows for requesting information, assigning tasks to sensors and analysts

- Distributed, shared structured information

- Streaming Data (GMTI, Tactical Data, Video)
MAJIIC 2 Objectives

Change quickly to meet new requirements
- New Units, Sensors, Systems, Processes

Integrate with legacy and evolving capabilities
- Disadvantage Units, Legacy Units, Evolutionary Capabilities (AMN)

Share data with other Communities of Interest (COI)
- Operations, Plans, Logistics
The fallacies are summarized as follows:
1. The network is reliable.
2. Latency is zero.
3. Bandwidth is infinite.
4. The network is secure.
5. Topology doesn't change.
6. There is one administrator.
7. Transport cost is zero.
8. The network is homogeneous.

Architectural Principles

- National Sovereignty of Implementation/ Technology Choice
- Re-use
- Observe Standards
- Federation
- Service Oriented & Event Driven/ Loose Coupling/ Message Orientation
- No Vendor Lock In
- Specification Driven/ Wire Protocol/ Contract First Development
- Design for Unreliability
- Minimum Mission Footprint vs Autonomy
- Location Independence
- Continuous Development and Test (Environment)
Architectural Decisions

- Employ Hybrid (Opportunistic) Data Replication
- Multi Master Distributed Write Scheme
- Asynchronous Propagation
- Multi Version Concurrency Control
- Query & Update fine-grained MAJIIC 2 Data
- SPARQL & RDF Store
- UML model for MAJIIC 2
- Event Driven Architecture
- Entity Representation
- Layered Architecture
MAJIIC 2 in context of NATO Enterprise Architecture (C3 Classification Taxonomy)
Distribution of Nodes (Federation of Service Stacks)
Plug and Play

Mission Composable Plug and Play Architecture
A new replication mechanism required for MAJIIC 2 it should be:

- Basically Available, Soft State and Eventually Consistent (BASE not ACID)
- Partition Tolerant, Available and *Eventually* Consistent (CAP)
- Asynchronous, queued & message oriented
- Multi-Master Write
- Low write latency/ non blocking
- Realise a distributed shared information space
- Support Choreographed Distributed Process
- Introduces the concept of Storage-as-a-Service
• C3 Classification Taxonomy for *Information Products*

• Subscribe to trees of echelons or types
  – xmlns:topns="urn:int:nato:C3ClassificationTaxonomy"
  – topns:Information_Products/Resource_Status/SystemStatusUpdate/MCC
  – topns:Information_Products/Resource_Status/Organization/SystemStatusUpdate/*
  – topns:Information_Products/Requests_And_Responses/Request_for_Information_RFI
  – topns:Information_Products/Resource_Status/Organization/SPSPluSPluS

• State transitions

• Enterprise Event Relay

• MAJIIC 2 Notification Envelope
  – Meets minimum metadata standards
  – Enforces cross domain mandatory metadata
Plug and Play in Practice

• Not vapour-ware!
• Scenarios Evolved Verified and Validated
  – MAJEX 12
  – TEI13 - MAJEX13
  – TIE14-A - UV14 - TIE14-B
• Interoperability across combinations of
  – Organisational Structures/ Echelons
  – COI
  – NATO, Nations (9) and Industries (30+)
  – Implementations (upto 5)
  – Platforms
  – Layers
Theatre services
- NATO/National CoreGIS
- WISI Service (ICC at ACC/CAOC)

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Nationally provided Service hosted on NCIA VM
Runtime Choreography Monitoring

KPI: Choreography adherence
Choreography KPIs

System operational status

KPI: Task choreography adherence  Message frequency
Choreography Monitoring Conceptual

Maritime

Air 1

Land 1

Land 2

Air 2

Land 2

RFI

IRM CM

Exploitation

Ground Control

Motion Imagery

RFI Task (to Sensor)

Motion Imagery

Choreography Monitoring Conceptual

NATO UNCLASSIFIED
Summary

1. Model Driven Architecture development
2. Service Contract First Development
3. Combination of SOA/ ROA/ EDA
4. Storage-as-a-Service
5. Working Methodology and Framework as well as an ISR solution
6. Evolutionary & Agile
7. Extensibility by design
8. Continuous Regression Test Environment