



# Overview of M&S as a Service

## MSG-211 Lecture Series on M&S Standards in NATO Federated Mission Networking

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# Outline

- Introduction
- Allied Framework for MSaaS
  - MSaaS Concept of Employment (AMSP-02)
  - MSaaS Operational Concept Description
  - MSaaS Business Model
  - MSaaS Technical Reference Architecture
- Summary

# Motivation for MSaaS: NATO needs

- Modelling & Simulation (M&S) and its integration into information systems is a critical technology for NATO coalitions and its nations:
  - To be integrated into all NATO operations, e.g. training, mission rehearsal, decision support etc.
  - To share models and simulations across nations
  - To ensure increased responsiveness, efficiency, affordability, interoperability and reusability

# Motivation for MSaaS: Technical needs

- Adopted from Service Oriented Architectures (SOA)
  - Approach from the commercial software development sector
  - Opportunities for providing M&S solutions that address the future needs
  - Potential to greatly reduce the barriers of cost and accessibility
- Modernising defence to daily-life expectations
  - To match commercial practices (e.g. ecosystem, on-line on-demand at point of need)
  - By exploiting commercial technologies (e.g. cloud computing, virtual reality, smart phones)
  - Delivering software components as loosely coupled services and applications

# Motivation for MSaaS: Benefits

- **Greater Agility** to meet the demands of fast-changing and complex defence and security environment
- **Greater Effectiveness** through using MSaaS to prepare agile force elements at high level of readiness, to carry out more comprehensive and immersive mission rehearsal, and to support operational decision when planning as well as during prosecuting missions or campaigns
- **Greater Efficiency** through MSaaS taking advantage of commercial practices such as on-line on-demand service based ecosystem, leveraging and adapting commercial technology much quicker, and de-risking capability development, test and evaluation and delivery

# M&S as a Service definition

- Definition
  - *“M&S as a Service (MSaaS) is an enterprise-level approach for discovery, composition, execution and management of M&S services.”*
- MSaaS includes an organizational dimension as well as a technical dimension
  - **Enterprise level:** MSaaS involves various stakeholders or organizations that interact in the multi-government business space
  - **Management level:** MSaaS involves policies for implementation and involves responsibilities to sustain the Allied Framework for MSaaS

# MSaaS Implementation challenges

- Culture changes
- Investment in M&S has to compete with other priorities
- Defence cannot compete for required technical skills with richer non-defence sectors (->leverage technology developed by the commercial sector)
- Security challenges

# Allied Framework for MSaaS

- **MSaaS Operational Concept Description:** identifies stakeholders, describes the intended use and key capabilities
- **MSaaS Concept of Employment:** provides policies and defines responsibilities for implementing and maintaining the Allied Framework for MSaaS
- **MSaaS Business Model:** discusses the concept of an MSaaS ecosystem from a business model perspective
- **MSaaS Technical Reference Architecture:** describes the architectural building blocks and patterns for realizing an MSaaS Capability



# MSaaS Operational Concept Description

- The purpose of the MSaaS Operational Concept Description is to inform relevant stakeholders on the envisioned MSaaS Framework's:
  - Vision and Goals
  - Application Areas
  - Stakeholders and Relationships
  - Key capabilities and key characteristics

# MSaaS Operational Concept Description

## Vision Statement and Goals

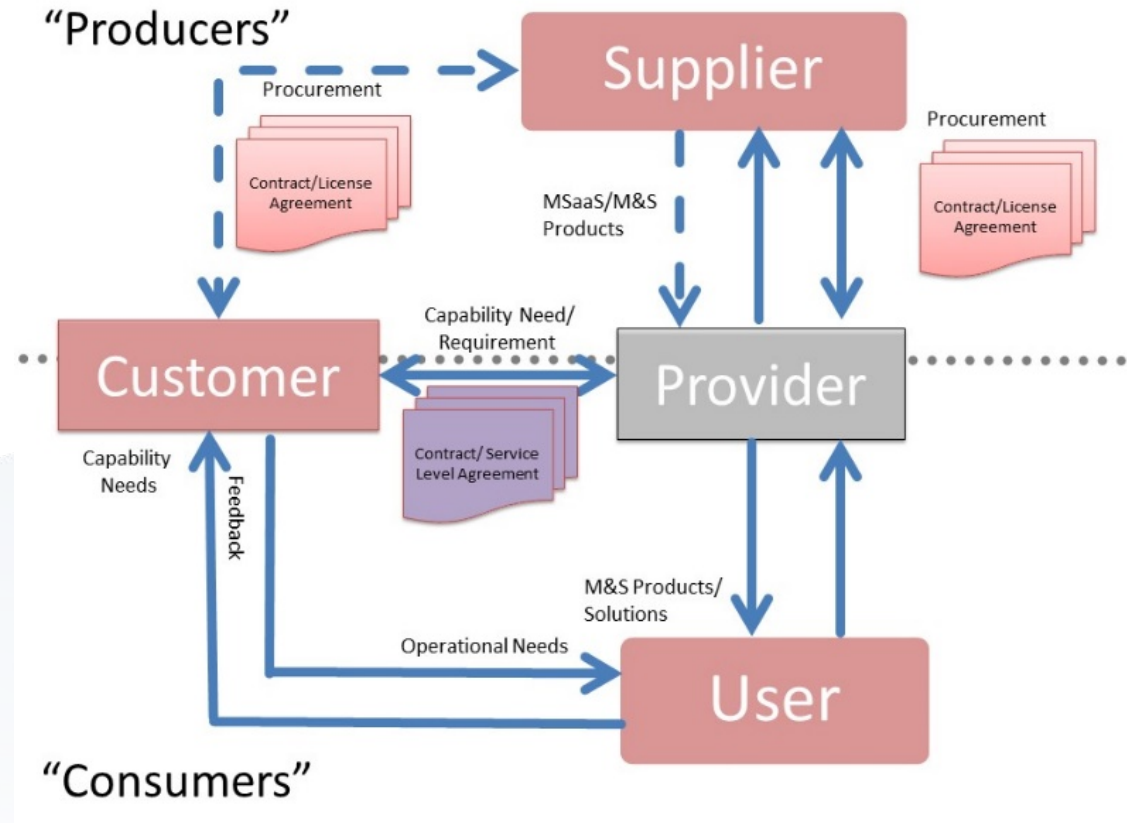
- Vision:
  - M&S products, data and processes are conveniently accessible and available on-demand to all users in order to enhance operational effectiveness
- Goals:
  - provide a common, consistent, seamless and fit for purpose M&S capability
  - make M&S services available on-demand to a large number of users
  - make M&S services available in an efficient and cost-effective way
  - provide the required level of agility to enable convenient and rapid integration of capabilities

# MSaaS Operational Concept Description

## Application areas

- Training (collective training, individual training)
- Support to Operations Planning
- Capability Development
- Mission Rehearsal
- Procurement/Acquisition

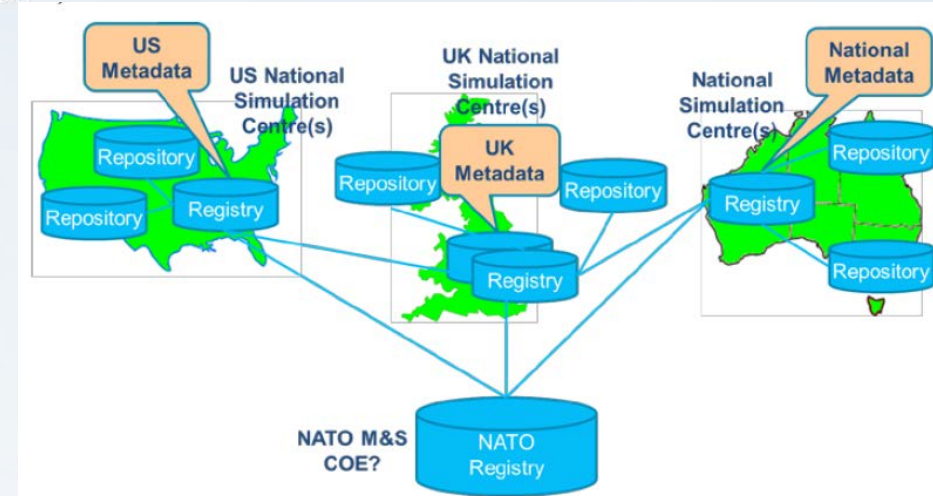
# MSaaS Operational Concept Description Stakeholders and Relationships



# MSaaS Operational Concept Description

## Key capabilities

- Discover Services
  - The Allied Framework for MSaaS provides a mechanism for users to search and discover M&S services and assets (e.g., Data, Services, Models, Federations, and Scenarios)
- Compose Services
  - The Allied Framework for MSaaS provides the ability to compose discovered services to perform a given simulation use case
- Execute Services
  - The Allied Framework for MSaaS provides the ability to deploy the composed services automatically on a cloud-based or local computing infrastructure



# MSaaS Concept of Employment

MSaaS Concept of Employment (AMSP-02) defines policies for MSaaS implementations and responsibilities on how to sustain (maintain and update) the Allied Framework for MSaaS. It includes:

- General Policies
- Organizational Policies
- Security Policies

# General policies

- An MSaaS implementation SHALL
  - conform to the principles as identified and established in the NATO M&S Master Plan
  - be aligned with the NATO M&S Standards Profile AMSP-01
  - conform to the practices, architectural principles, and operating procedures as identified and established by this document
- An MSaaS solution architecture SHALL
  - comply with the MSaaS Technical Reference Architecture
- An M&S service from a NATO MSaaS implementation SHOULD
  - comply with the policies defined in this document as formalised by its related STANREC
- The federated MSaaS ecosystem SHALL
  - include a NATO MSaaS Portal provided by a NATO assigned organization

# Organizational Policies

- Service Level Agreements
  - the conditions under which a service may be used, according to a template provided in the Concept of Employment
- Service Description
  - a description of the service, according to a template provided in the Technical Reference Architecture
- Business Model
  - ...



# Security policies








These policies address security concerns of all MSaaS stakeholders by employing a secure environment, for their services, data, account information and personally identifiable information. They include:

- Any MSaaS implementation SHALL
  - be compliant with the hosted security environment measures.
- Any MSaaS implementation SHOULD
  - adhere to the MSaaS Technical Reference Architecture, to provide specific end-to-end data flow examples of where specific security controls (e.g., Cross Domain Security (CDS) solutions) shall be imposed.
- The stakeholders involved in managing an MSaaS implementation and in providing technical services SHALL
  - be responsible for ensuring they address the users' areas of concern regarding security and secure hosting infrastructure
  - apply best practices for security and comply with specific regulations from involved accreditation authorities

# MSaaS Business Model

- MSaaS Business Model (BM) is to inform relevant stakeholders on how MSaaS will operate in the multi-government business space for the sharing of M&S technologies.
- MSaaS BM is developed using Osterwalder and Pigneur's (2010) Business Model Canvas
  - Strategic management template for developing new or documenting existing business model
  - Visual chart with elements that describe the organizations value proposition, infrastructure, customers and finances

# Business Model Canvas

<p><b>Key Partners</b> </p> <ul style="list-style-type: none"> <li>• Industry (simulation products and technology)</li> <li>• NATO M&amp;S developer and agencies</li> <li>• Nations, M&amp;S centers</li> <li>• Academia</li> <li>• Standardization bodies</li> <li>• Infrastructure providers</li> <li>• System integrator</li> <li>• Data suppliers (systems data, terrain ...)</li> </ul>	<p><b>Key Activities</b> </p> <ul style="list-style-type: none"> <li>• To collect requirements</li> <li>• To provide a user-friendly front end</li> <li>• To provide M&amp;S services for each customer segments</li> <li>• To assess M&amp;S and enabling tools</li> <li>• To provide an operating environment</li> <li>• To provide consulting an technical services</li> <li>• To provide pricing framework</li> <li>• To specify hardware and software</li> </ul>	<p><b>Value Proposition</b> </p> <ul style="list-style-type: none"> <li>• Agility</li> <li>• Accessibility</li> <li>• Usability</li> <li>• Affordability</li> <li>• Security</li> <li>• Sustainability</li> </ul>	<p><b>Customer Relationships</b> </p> <ul style="list-style-type: none"> <li>• Self service and Automated services</li> <li>• Communities (cf. segments)</li> <li>• Q&amp;A</li> <li>• Business relations managers</li> <li>• User groups</li> </ul>	<p><b>Customer Segments</b> </p> <ul style="list-style-type: none"> <li>• Operations (operational planning, analysis, decision-making)</li> <li>• Capability development (defense planning, concept development &amp; experimentation)</li> <li>• Mission rehearsal</li> <li>• Training and education (exercise)</li> <li>• Procurement</li> </ul>
<p><b>Cost Structure</b> </p> <ul style="list-style-type: none"> <li>• Multi-level security</li> <li>• Services, models, data and simulations (to include licensing)</li> <li>• IT Infrastructure and facilities</li> <li>• Subject matter experts (modellers, simulators, IT, security, commercial, procurement ect.)</li> </ul>	<p><b>Revenue Streams</b> </p> <ul style="list-style-type: none"> <li>• NATO</li> <li>• Nations</li> <li>• Industry</li> <li>• Contributed services</li> </ul>			

# MSaaS Business Model - Key partners and key activities

Stakeholder	Activities
User	<ul style="list-style-type: none"> <li>• Defines the capability needs to the Customer</li> <li>• Consumes M&amp;S products and services</li> </ul>
Customer	<ul style="list-style-type: none"> <li>• Helps user to capture the capability needs</li> <li>• Defines technical requirements to meet the capability needs</li> </ul>
Provider	<ul style="list-style-type: none"> <li>• Engages with the Supplier to acquire and integrate M&amp;S products</li> <li>• Captures feedback on the deployment, integration and execution</li> </ul>
Supplier	<ul style="list-style-type: none"> <li>• Responds to requests from the Provider (or Customer) for M&amp;S products and services</li> <li>• Delivers M&amp;S products and services – with online contracting or licensing</li> <li>• Captures feedback on delivered M&amp;S products and services, and improves</li> </ul>

# MSaaS Business Model - Value Proposition

Agile and user-friendly services that are readily accessible to compose and execute the required modelling and simulation environment that is sustainable, affordable, scalable and secure.

# MSaaS Business Model - Customer Segments

- The customer segments and their operational needs are recognized in accordance with the NATO M&S Masterplan (NMSMP) application areas:
  - Operations (Operational Planning, Analysis, Decision-Making)
  - Capability Development (Defence Planning, Concept Development & Experimentation)
  - Mission Rehearsal
  - Training and Education (Exercises)
  - Procurement
- The different application areas will all be able to benefit from the MSaaS proposition; specific needs or constraints may be different or stricter (e.g., security requirements for mission rehearsal) depending on the domain

# MSaaS Technical Reference Architecture

MSaaS Technical Reference Architecture provides the following to realize MSaaS Capability:

- technical guidelines
- recommended standards
- architecture building blocks
- architecture patterns

# Architecture Building Blocks

## Architecture Building Block (ABB)

- Captures application and technology requirements
- Lists applicable standards
- Directs and guides the development or acquisition of SBBs

### Examples

- Message Oriented Middleware Services; standards include HLA IEEE 1516-2010
- M&S Repository Services for virtual images

## Solution Building Block (SBB)

- Defines the component that is used to implement the functionality
- Defines the implementation
- Is vendor aware

### Examples

- MaK HLA-RTI, Pitch HLA-RTI
- Docker OCI Container Registry



# M&S Portal Applications and M&S Enabling Services

- ABBs that define capabilities to enable the discovery, composition, and execution of Simulation Services and M&S User Applications within an MSaaS Capability
- Includes:
  - Integrator Portal Applications (for creating compositions and deployment descriptions)
  - Supplier Portal Applications (for providing M&S Resources and associated metadata)
  - M&S Repository Services (for managing and exchanging M&S Resources)
  - M&S Registry Services (for managing and exchanging M&S Resource Metadata)

# M&S User Applications and Simulation Services

- ABBs that define capabilities for the synthetic representation of (real-world) objects and events
  - For these there are many; the NATO C3 Taxonomy provides a categorization of potential Simulation Services
  - For instance, Route Planning Services, Weapon Effects Services, Tactical Data Link Services, Radio Communication Services, Cyber Effects Services, Electronic Warfare Services, Vantage Point Services, Track Generation Services, Platform Generation Services, Meteo Services, C2 Mediation Services, .....

# Simulation Services description

The description (or the content) of the ABB for Simulation Services must include:

## Simulation Services (ABB)

### **For Supplier:**

Functional/non-functional requirements

### **For Integrator:**

Interface description (syntactic interoperability)

Contract description (semantic interoperability)

# Service Management and Control Applications and Services

- ABBs to coherently manage components in a federated service-enabled information technology infrastructure, such as:
  - Metering Services to measure the levels of resource utilization by M&S User Applications and Simulation Services
  - Monitoring Services to provide information on the actual utilization and performance of monitored M&S User Applications and Simulation Services
  - Logging Services to capture, filter and save information about message exchanges between M&S User Applications and Simulation Services
  - Verification Services to verify the correct functioning of M&S User Applications and Simulation Services

# CIS Security

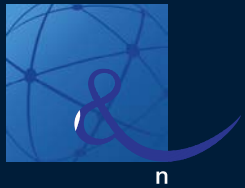
- Concerns ABBs related to Security, and security-related requirements in other ABBs
- The MSaaS Provider is responsible for the security of an MSaaS Capability; security considerations are:
  1. The MSaaS Capability itself must be secured by the Provider
    - Security Classification Level of an M&S execution event
    - Access to M&S resources
    - Security of M&S Mediation and Message Oriented Middleware Services
    - Security Monitoring of Service Management and Control
  2. If the MSaaS Capability is federated with another MSaaS Capability, the group of Providers must coordinate security
    - Authentication and authorization between MSaaS Capabilities
    - Trust between MSaaS Capabilities
    - Networking and Encryption
    - Cross Domain Security solutions

# Summary

- M&S as a Service (MSaaS) is a new concept of providing and consuming M&S Services
- The concept includes
  - service orientation
  - provision of M&S applications via the as-a-service model of cloud computing
  - an organizational dimension as well as a technical dimension
- The concept has the potential to greatly reduce the barriers of cost and accessibility, and to result in greater utility of M&S throughout NATO and the nations



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