

# Modelling and Simulation in NATO Federated Mission Networking

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# Overview

1. Introduction: MSG-193 and FMN
2. FMN Specifications Development
3. Challenges for MSG-193
4. M&S Recommendations for FMN Spiral 5
5. Conclusion

# Introduction

- Federated Mission Networking (FMN)
  - Standards and practices for interoperation
  - Not a network but can be used to build a Mission Network (MN)
  - Will enable a coalition to interoperate
- NATO M&S Group (NMSG) has participated in development of technologies that should be in FMN
  - To achieve this, participating in FMN specification
  - Which requires cooperation between NMSG and NATO operational commands
  - This paper describes how it is happening

## Why FMN

- Multinational interoperability became essential in Afghan Mission Network (AMN)
- Delays implementing AMN led to conclusion that NATO needs a “day zero” capability – usable with no delay
  - Command and control (C2) and other functions
  - Approved in 2016 – being developed incrementally
- Mission: *Enhanced Operational Readiness & Effectiveness Today and in the Future*
  - *Operate Together: Exploit our Strategic Advantage*
  - *Adapt Together: Effectively Transform Capabilities to Maintain our Edge*

# Day Zero Interoperation

FMN Ready Forces need to be achieved

**before a Mission!**



# Why M&S in FMN

- Powerful technology for
  - Mission preparation
  - Operational analysis
  - Training
- Safe, cost-effective means of
  - Reducing risk
  - Providing training
  - Evaluating and developing capabilities, equipment, processes
- Effective when linked to operational command and control (C2)
  - Which is the primary environment for FMN

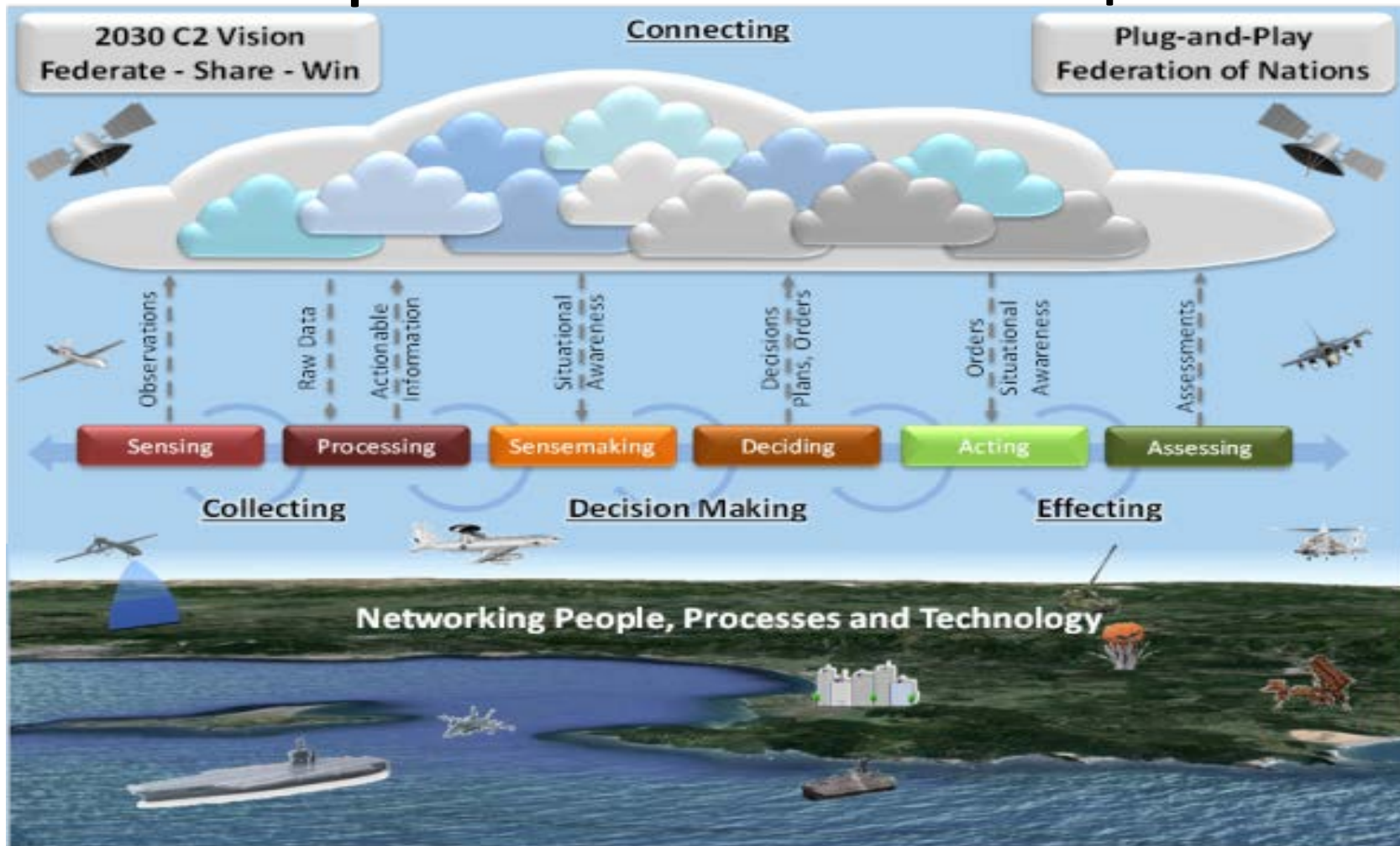
# NMSG Contributing to FMN Specifications

- NMSG interest in FMN grew for C2 – Simulation (C2SIM)
  - Development fostered by MSG-048, 085, and 145
  - Partnered with Simulation Interoperability Standards Org (SISO)
  - Realized C2SIM should be integral to FMN
  - Form MSG-193 Specialist Team to investigate
- FMN Specifications are developed incrementally in “Spirals”
  - 6-years each involving Draft, Candidate, Proposed and Final specs
  - Overlapped; Spirals 1, 2, 3, 4 have reached Final
  - Spirals 5 and 6 expected to include M&S – needed expertise
  - Spiral 5 include Mission Rehearsal – good starting point for M&S
  - Specialist Team chartered by NMSG for one year “test the water”



# NATO's 2030 C2 Vision

## conceptual framework for FMN development





# Key Aspects of FMN Specification

- Governance
  - Overall management structure & processes
- FMN Framework
  - of policy, design, architecture, testing, accreditation, support tools, processes, etc. needed for creating MN
- MN Instances
  - The actual FMN-compliant networks
  - Create and test in annual *Coalition Warrior Interoperability Exploration, Experimentation, Examination and Exercise (CWIX)*

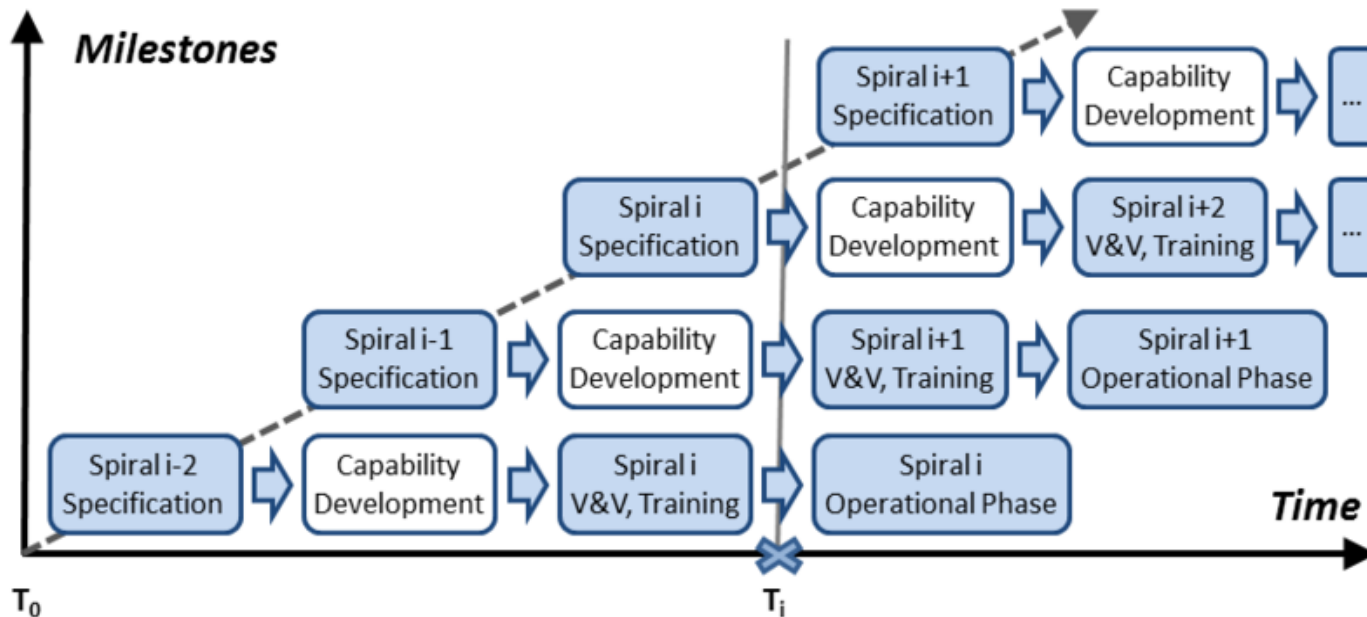
# FMN Management Structure

- Overall management group
- Supporting secretariat staffed by ACT
- Operational coordination working group (**OCWG**) linking to NATO commands
- Multinational CIS security management authority working group (**MCSMAWG**)
- Capability planning working group (**CPWG**) and syndicates
- Change and implementation coordination (CICWG) working group
- Coalition interoperability assurance and validation (**CIAV**) working group

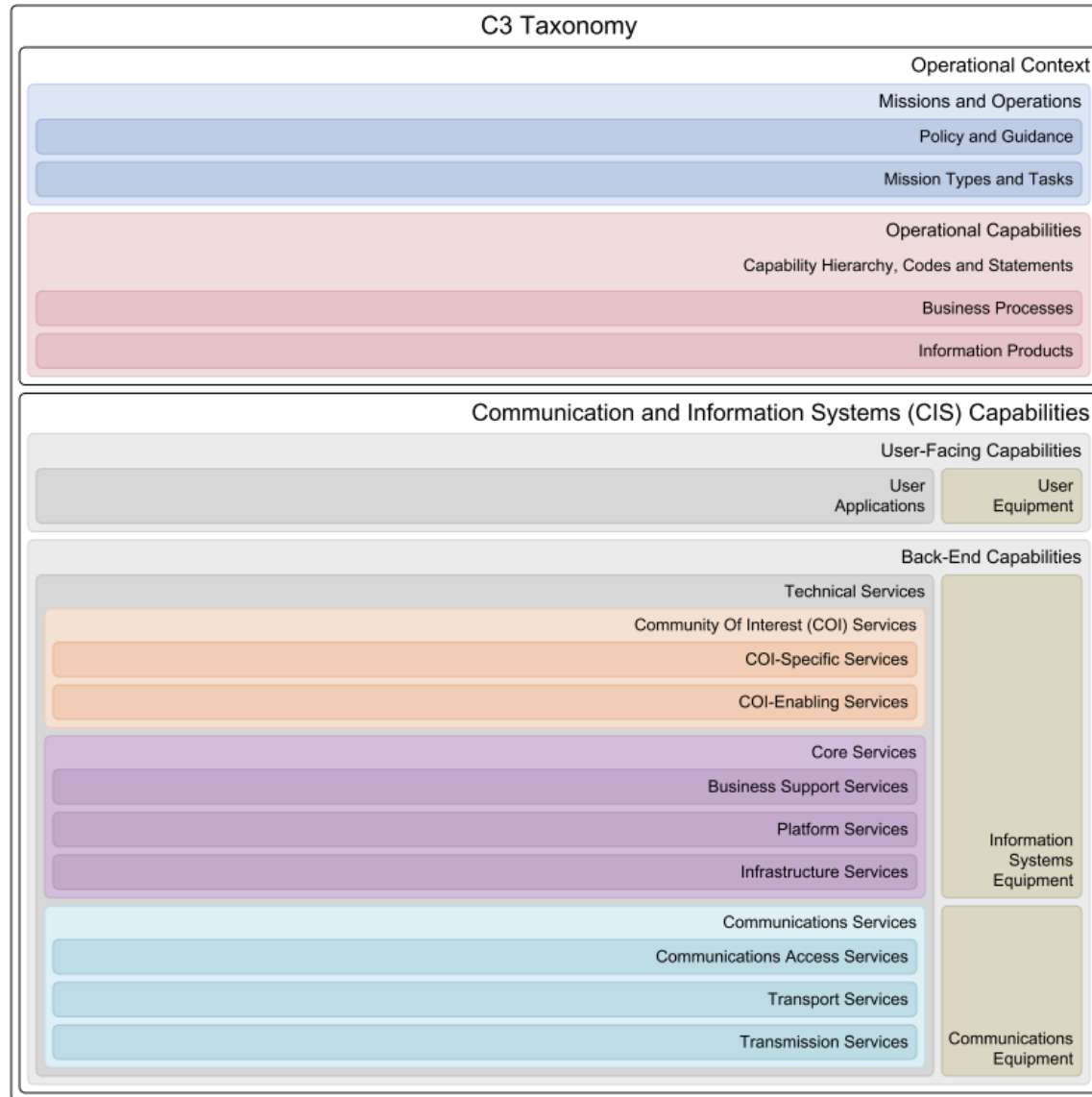
**MSG-193 works closely with those highlighted**

# FMN Spirals and Roadmaps

- Like commercial development with repeated cyclic phases
  - But specification phase lasts 2 years working with 30+ nations
  - Overlapped with development/deployment of earlier spirals
  - Process based in standards and well-documented procedures
  - Annual Roadmap lays out goals and activities for next year



# NATO C2 Taxonomy



## Challenges for MSG-193

- S&T Perspective vs Operational Perspective
  - Significant culture gap
- MSG-193 as FMN M&S Syndicate
- Interactions with FMN Working Groups
- Drafting Procedural Instructions (Operational Specification)
- Drafting Service Instructions (Technical Specification)
- FMN in Computer Assisted Exercises (CAX)

# Syndicates

- “syndicates are informal working bodies - often already existing as collaborative undertakings for a specific subject, product or community of interest - focused at providing expert advice and tangible input for one or more FMN working groups.”
  - Allied Command Transformation, *FMN Syndicates*
- Extension to bureaucratic structure of FMN management
- Allows for participation of
  - technical laboratory staff
  - industry experts
  - academics



# Interactions with FMN Working Groups

- OCWG:
  - Draft Procedural Instruction operational specification
- CPWG
  - Draft technical specifications
- MCSMAWG
  - Ensure systems will be appropriately secure
- Later CIAV
  - Ensure systems are functional and reliable
  - Likely outcome of CWIX

# Drafting Procedural Instructions

## 1. Introduction

Purpose and Intended Audience

Aim

Scope

Structure of the Document

Resolved Issues

## 2. Context of FMN M&S

Capability Need

Information Sharing Construct (MR  
etc.)

Current M&S Capability Gaps

Use Cases/Scenarios

## 3. Processes

MR Processes in Operational CIS  
Environment

MR Processes in Tactical CIS  
Environment

## 4. Technology

## 5. Requirements

Functional Requirements

Non-functional Requirements

Information Exchange Requirements

## 6. List of Abbreviations

# Drafting Service Instructions

## 1. Introduction

Aim

Scope

## 2. Changes

## 3. References

## 4. Context

## 5. Interoperability Architecture

Interactions

Architecture Items

Procedures

## 7. Standards

## 8. Service Functions

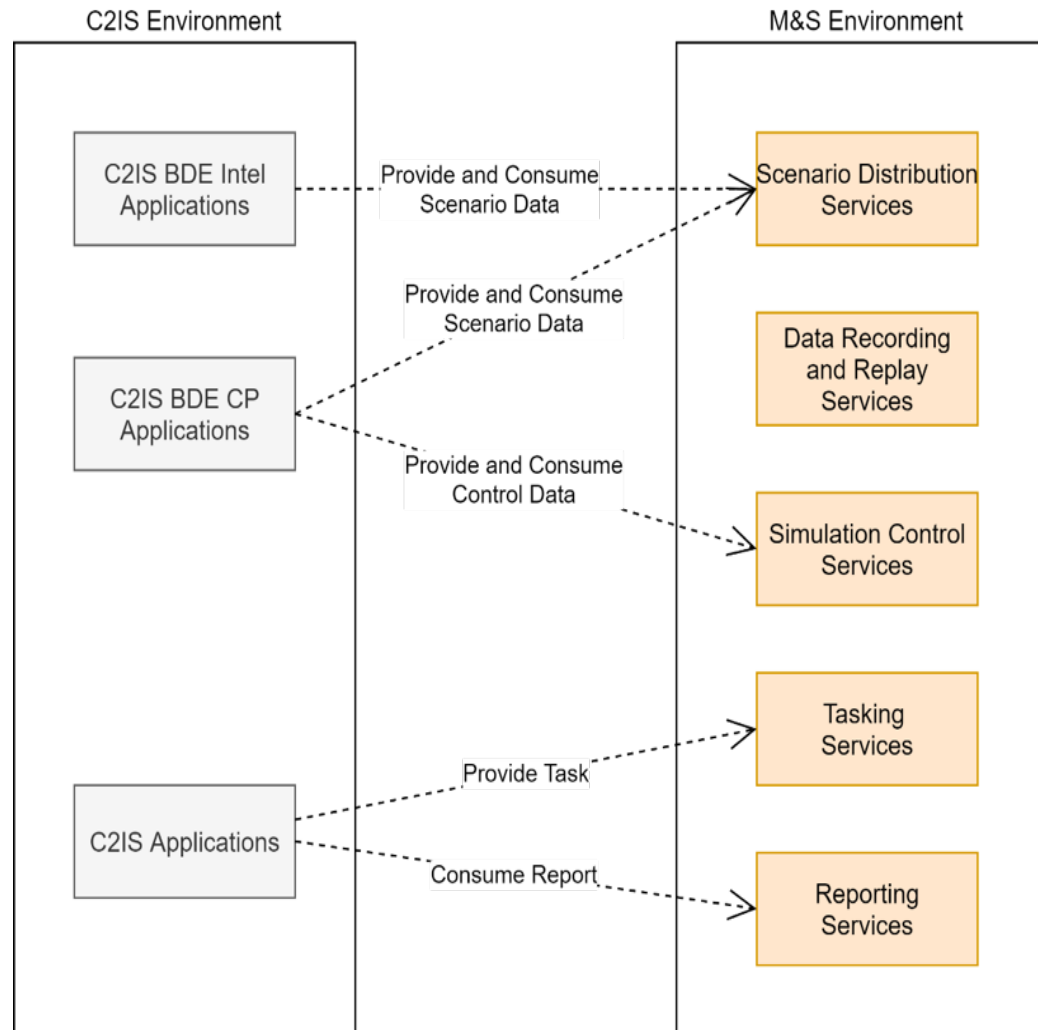
## 9. Dependencies

## 10. Requirements

## 11. Roles and Responsibilities

## 12. Configuration Options

# From Spiral 5 SI Draft: External Interfaces in M&S Systems



# Role of FMN in CAX Support

- CAX is a particular Synthetic Exercise where a Command Post Exercise (CPX) is executed with the support of computers
  - Simulating the operational environment, providing event resolution
  - Can be distributed, not-distributed, or a combination of both
- CAX support tools:
  - Planning and management tools
  - Constructive simulation system sand ancillary tools
  - Interfaces to C2 systems and functional area services
  - Experimentation and analysis tools
- FMN is highly relevant to supporting M&S tools for CAX
  - And therefore to the MSCoE

## M&S Focus for FMN Spiral 5: Mission Rehearsal (MR)

- Early operational requirement for FMN
- Conducted at all levels of military organization to familiarize coalition forces prior to planned operation
- Defined mission in a specified operational context
  - Risk reduction, not training
- Follows the organization's stated policies and processes
- Most effective when most similar to expected actual situation
- Supportable by collective training simulations with adjustment
  - Logging in simulation and in C2 reporting aids after action review
- MSG-193 decided to start with MR in Operation C2 Environment
  - Network like today's Internet and multi-domain security



## M&S Standards and Procedures for MR

- Command and Control – Simulation Interoperation (C2SIM)
- High Level Architecture (HLA) for Modeling and Simulation
- NATO Education and Training Network (NETN) FOM
- Modeling and Simulation as a Service (MSaaS)

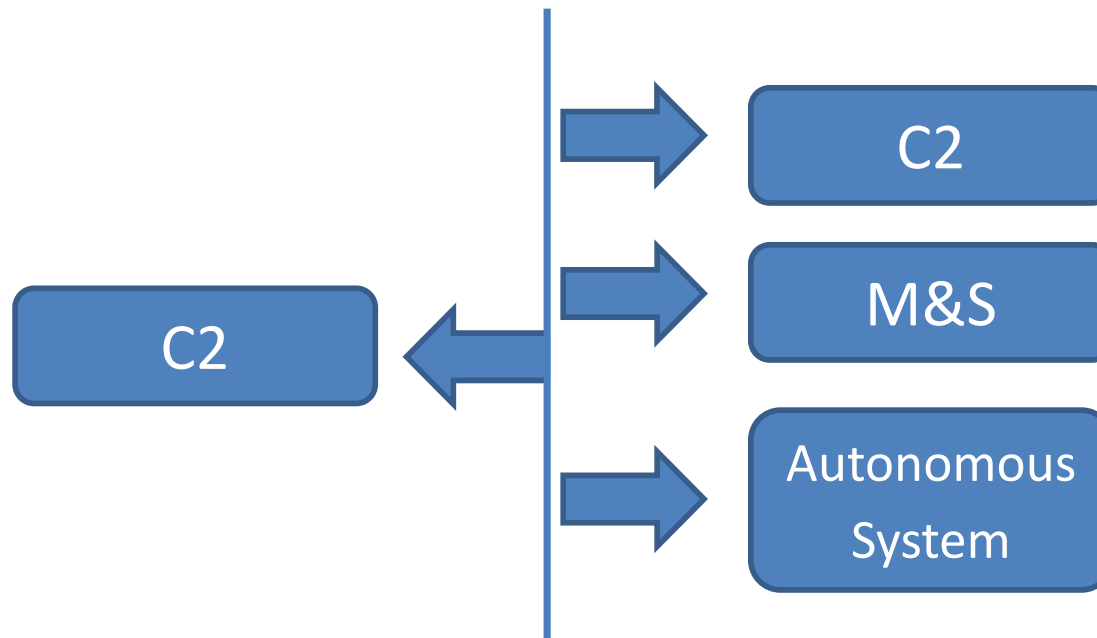
These will also form a good basis for FMN Spiral 6

# Interdependency of NATO and SISO

NATO MSG depends on SISO for open industry-based standards

SISO depends on NATO Technical Activities to field and validate C2SIM technology

# Command and Control – Simulation Interoperation (C2SIM)



## C2SIM Vision Parallels FMN

*We are working toward a day when the members of a coalition interconnect their networks, command and control (C2) systems, and simulations simply by turning them on and authenticating, in a standards-based environment.*

A C2SIM Coalition is a system of systems.

## Video Introduction to C2SIM

[https://www.youtube.com/watch?v=3L\\_Hhxuh6Zc](https://www.youtube.com/watch?v=3L_Hhxuh6Zc)

## High Level Architecture (HLA) for M&S

- HLA is an IEEE simulation interoperability standard developed by SISO that has been adopted as NATO STANAG 5603
- Uses an object model approach to define the information that may be exchanged between simulations
  - Objects (persistent items such as physical entities)
  - Interactions (usually transient events such as weapon detonations)
- Very suitable for FMN's federated environment
- Interfaces and underlying services are provided by supporting software known as the Run-time Infrastructure (RTI)
- Objects, interactions and associated ancillary information are defined in a Federation Object Model (FOM)



# NATO Education and Training Network (NETN) FOM

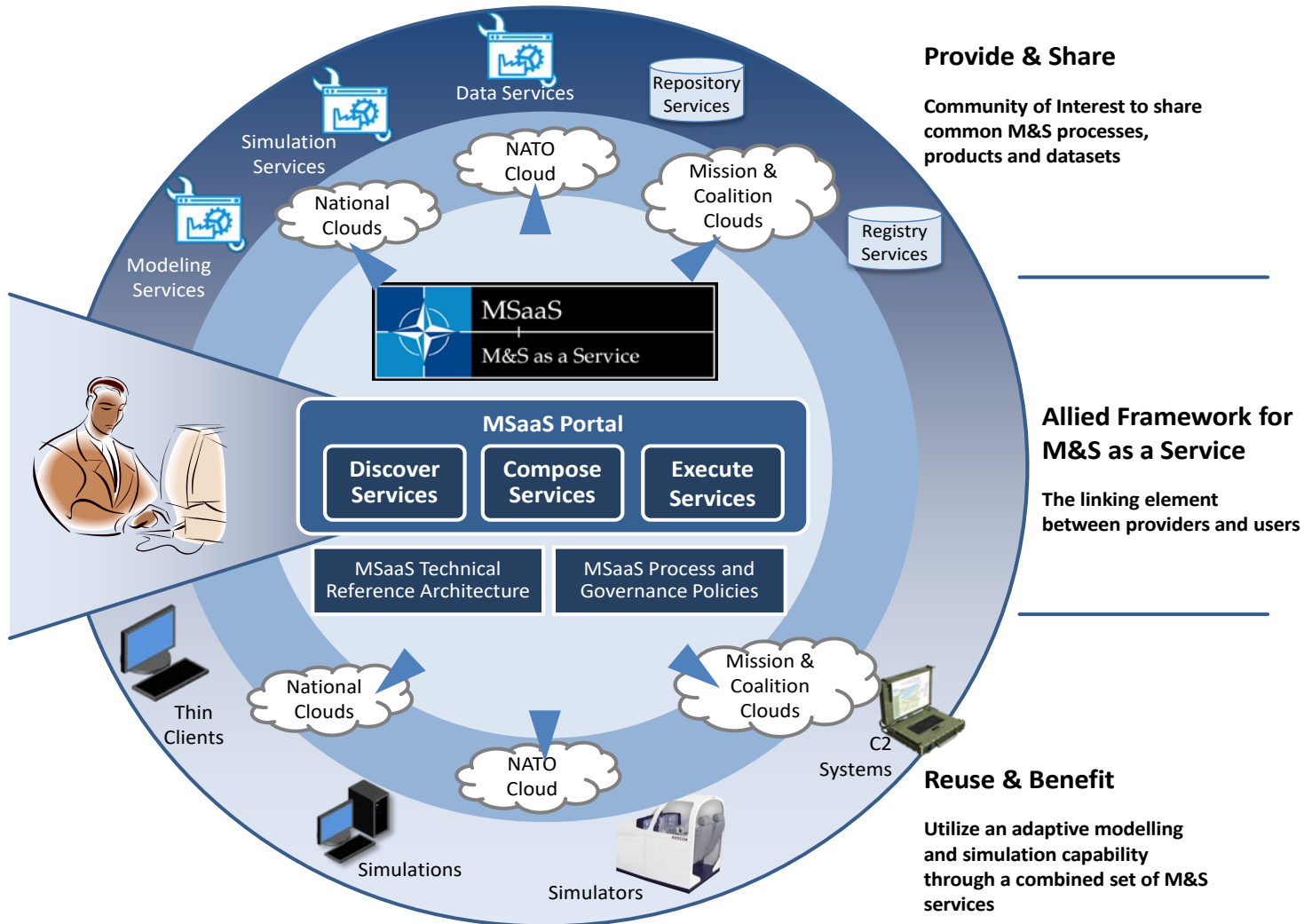
- To employ HLA must have a FOM
- NETN modules address many aspects of simulated environment
- NETN is developed by a series of NMSG activities and proven in exercises.

<b>RPR-FOM Modules</b>	<b>NETN-BASE</b>	<b>NETN-Physical</b> Physical Entities, Platforms & Lifeforms
		<b>NETN-MRM</b> Aggregation & Disaggregation Pattern
		<b>NETN-COM</b> Communication Networks
		<b>NETN-METOC</b> Environment Conditions & Weather
		<b>NETN-CBRN</b> Chemical, Biological, Radiological & Nuclear
		<b>NETN-LOG</b> Logistics Pattern
		<b>NETN-TMR</b> Transfer of Modelling Responsibilities Pattern
		<b>NETN-SE</b> Facilities & Synthetic Environment Objects
		<b>NETN-ETR</b> Entity Tasking & Reporting
		<b>NETN-ORG</b> Organizations & Relationships Initialization
		<b>NETN-AIS</b> Vessel Traffic Identification & Tracking

# Modeling and Simulation as a Service (MSaaS)

- NATO approach to provide a means of delivering reusable, composable simulation to the user using a service-based architecture
  - M&S in the Cloud
- Three-stage process:
  - Discovery phase uses searchable simulation repositories to find simulations appropriate for the simulation task in hand
  - Composition builds and configures the simulation from discovered components; composability has the advantage that ‘best-of-breed’ or new models may be used
  - Deployment/execution is the final phase where the configured simulation is ready to be used.

# MSaaS Phase 2



## Conclusions

- FMN is a major step forward in preparing the NATO Coalition for multinational deployments
  - “Day Zero Interoperability” concept of FMN is well suited to incorporation of a variety of modeling and simulation standards as described above
  - NMSG is participating in the FMN Spiral process to help achieve this, in order that NATO will have capabilities necessary to continuing its role of sustaining international peace
  - Providing M&S Syndicate of experts to support specification
  - Operational use of M&S will extend the capabilities of NATO coalition forces
  - A highly leveraged opportunity for NMSG

## Spiral 6 M&S

- Most of the FMN M&S applications remain to be specified, in particular:
  - Collective Training
  - Decision Support (including Course of Action evaluation)
  - Mission Rehearsal using tactical networks
- However, the standards and practices that carry over from Spiral 5 will form a good core for others
- NMSG is considering whether to start a new three-year Technical Activity to finish Spiral 5 and provide Spiral 6 M&S inputs