Overview of Modelling and Simulation Standards in NATO Federated Mission Networking

MSG-211 Technical Course, Session 1.2

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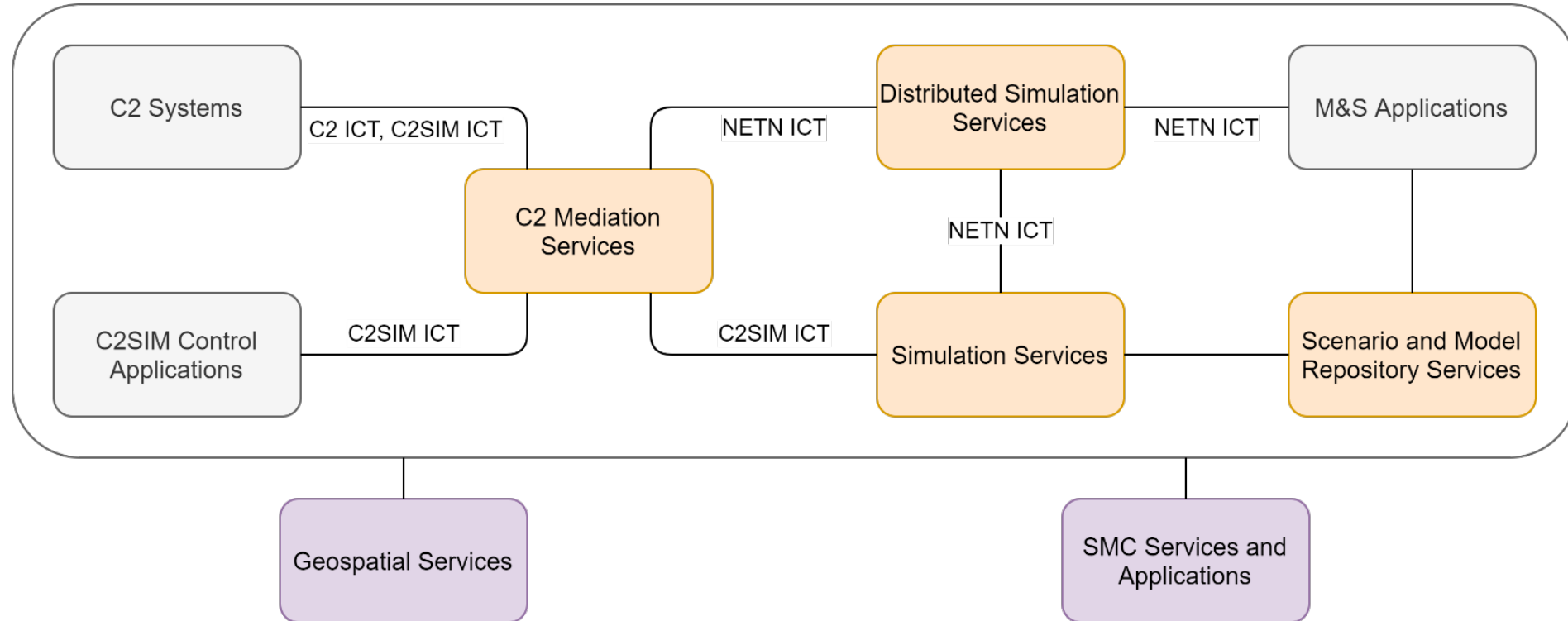Lead, MSG-211

16 October 2023

Outline

- Need for M&S Standards in FMN

- M&S Architecture in FMN

- MSG-211: M&S Standards in FMN

- Command and Control Systems – Simulation Systems Interoperation (C2SIM)

- High Level Architecture (HLA)

- NATO Education and Training Network (NETN) Federated Object Model

- Modelling and Simulation as a Service (MSaaS)

- Summary

Need for M&S Standards in Federated Mission Networking

- Force Readiness and Training – M&S provides the synthetic environment to support collective training

  - Stimulates C2 systems for "train as you fight"

- Support to Operations – M&S provides alternative timings and schemes of maneuver to evaluate current and future plans

  - Mission Planning

  - Wargaming

  - Mission Rehearsal

  - Decision Support

M&S Architecture in FMN

Source: FMN Spiral 5 Service Instructions for Modelling and Simulation, 2022.

SMC?? System Monitoring and Control?

C2: Command and Control; C2IS: C2 Information System; C2SIM: C2 Systems – Simulation Systems Interoperation; ICT: Initialization, Control, Tasking and Reporting interactions; M&S: Modelling and Simulation; NETN: NATO Education and Training Network

M&S Standards in FMN

- Information exchange content and protocols are governed by a number of established standards and best practices within NATO and across the international M&S community:
  - Command and Control Systems – Simulation Systems Interoperation (C2SIM), NATO STANAG 4856 Ed 01
  - High Level Architecture (HLA), NATO STANAG 4603 Ed 03
  - NATO Education and Training Network Federation Object Model (NETN-FOM)
  - Modeling and Simulation as a Service (MSaaS)

- MSG-211 will provide instruction in these standards to the NATO community to enable development of needed FMN capabilities
  - Instructors: Dr. Curtis Blais (USA), Dr. Mark Pullen(USA), Magdalena Dechand (Germany), Kevin Galvin (UK), Tom van den Berg (NLD)
  - 2 half-days of lecture and Q&A, with a 3rd half-day for hands-on application of the standards

Command and Control Systems – Simulation Systems Interoperation (C2SIM)

- International standard produced by the Simulation Interoperability Standards Organization (SISO)

  - SISO-STD-019-2020 & SISO-STD-020-2020

  - NATO STANAG 4856 Ed 01

- Specifies information for exchange across C2 systems, simulation systems, and robotic and autonomous systems (RAS)

  - Base data model with methodology for domain extensions, with an example Land Operations Extension

  - Other domains explored or under consideration: Air Operations, Tactical Data Links, Sensor Systems, Cybersecurity Systems, Combat Systems, Electronic Warfare Systems

C2SIM Concept
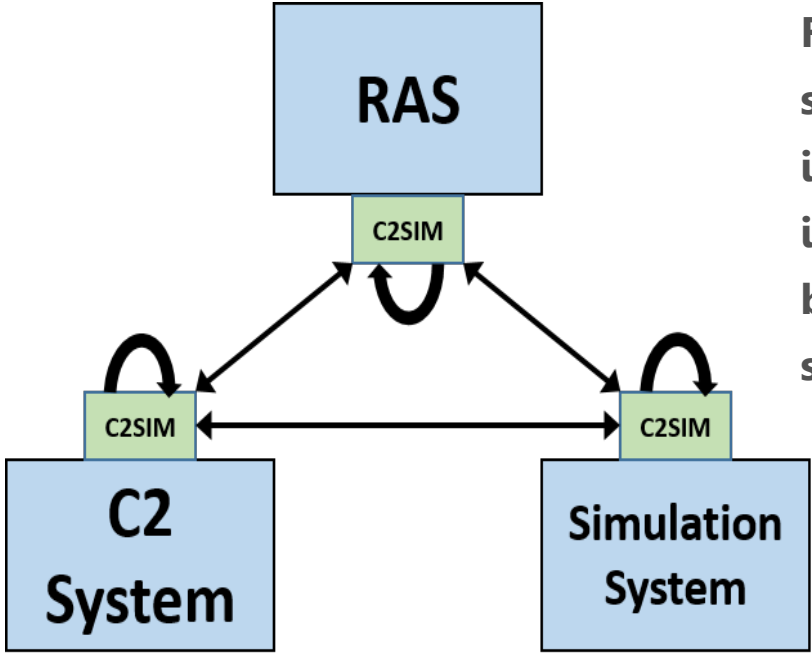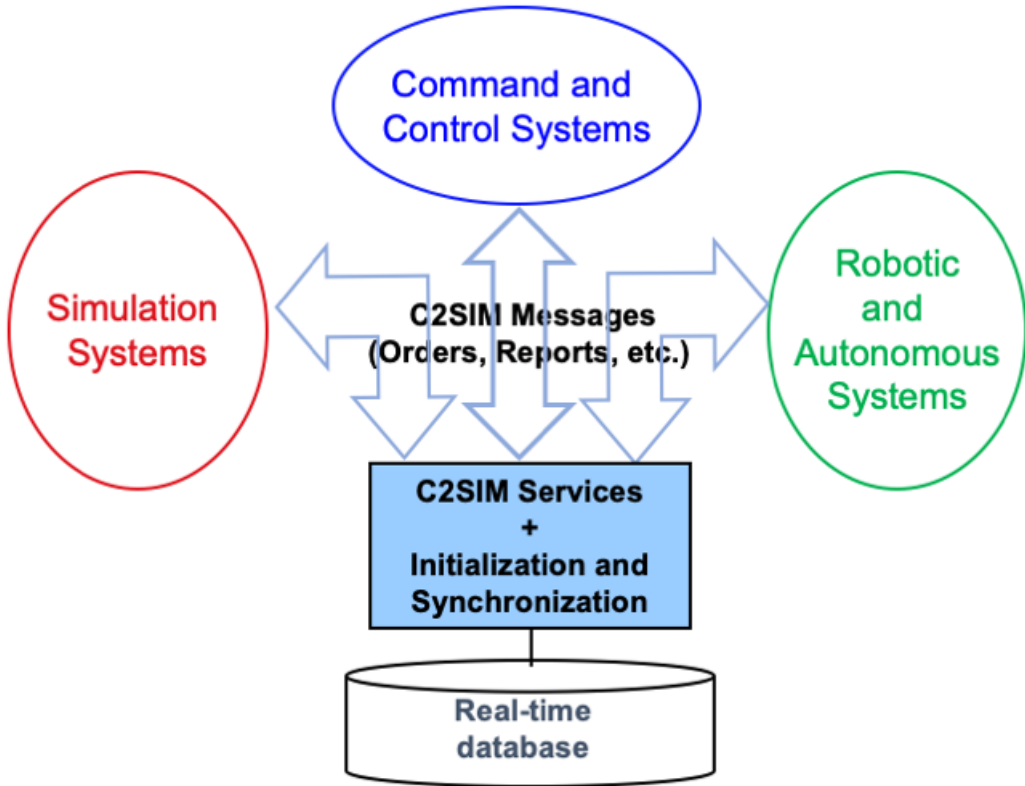
Foundation for specification of information interchange across broad classes of systems

Nine-way interactions
(inter-system and extra-system)

High Level Architecture (HLA)

- International standard produced by SISO through the Institute for Electrical and Electronic Engineers (IEEE)

  - IEEE Standard 1516

  - STANAG 4603 Ed 03: MODELLING AND SIMULATION ARCHITECTURE STANDARDS FOR TECHNICAL INTEROPERABILITY: HIGH LEVEL ARCHITECTURE (HLA)

- Interoperability framework for exchange of data and interactions across distributed simulation systems, including a set of run-time infrastructure services (see next slide)

- Supported by the Distributed Simulation Engineering and Execution Process, IEEE 1730

HLA Concept
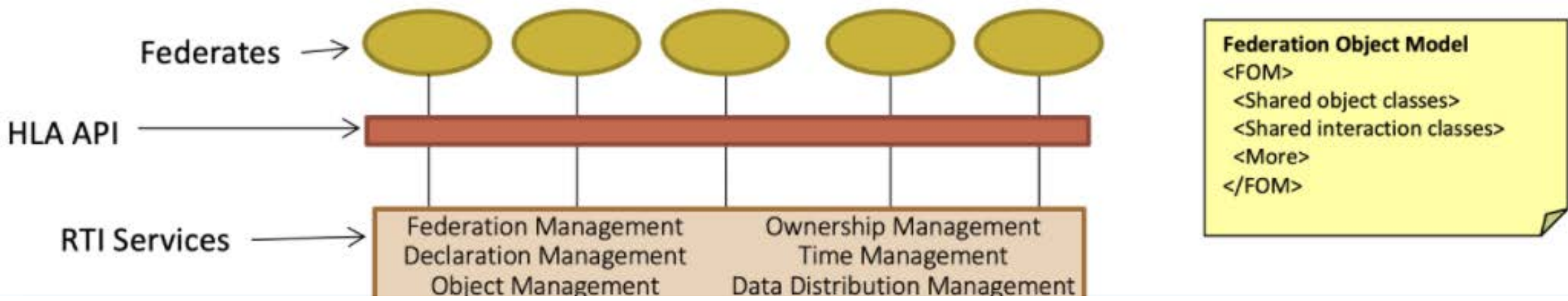
Source: 2021 Simulation Innovation Workshop HLA Tutorial

API: Application Program Interface; FOM: Federation Object Model; RTI: Run-Time Infrastructure

NATO Education and Training Network Federation Object Model (NETN-FOM)

- Data model for exchange of data and interactions across a NATO federation of simulations running under HLA

- Designed as a set of function-specific modules (see next slide)
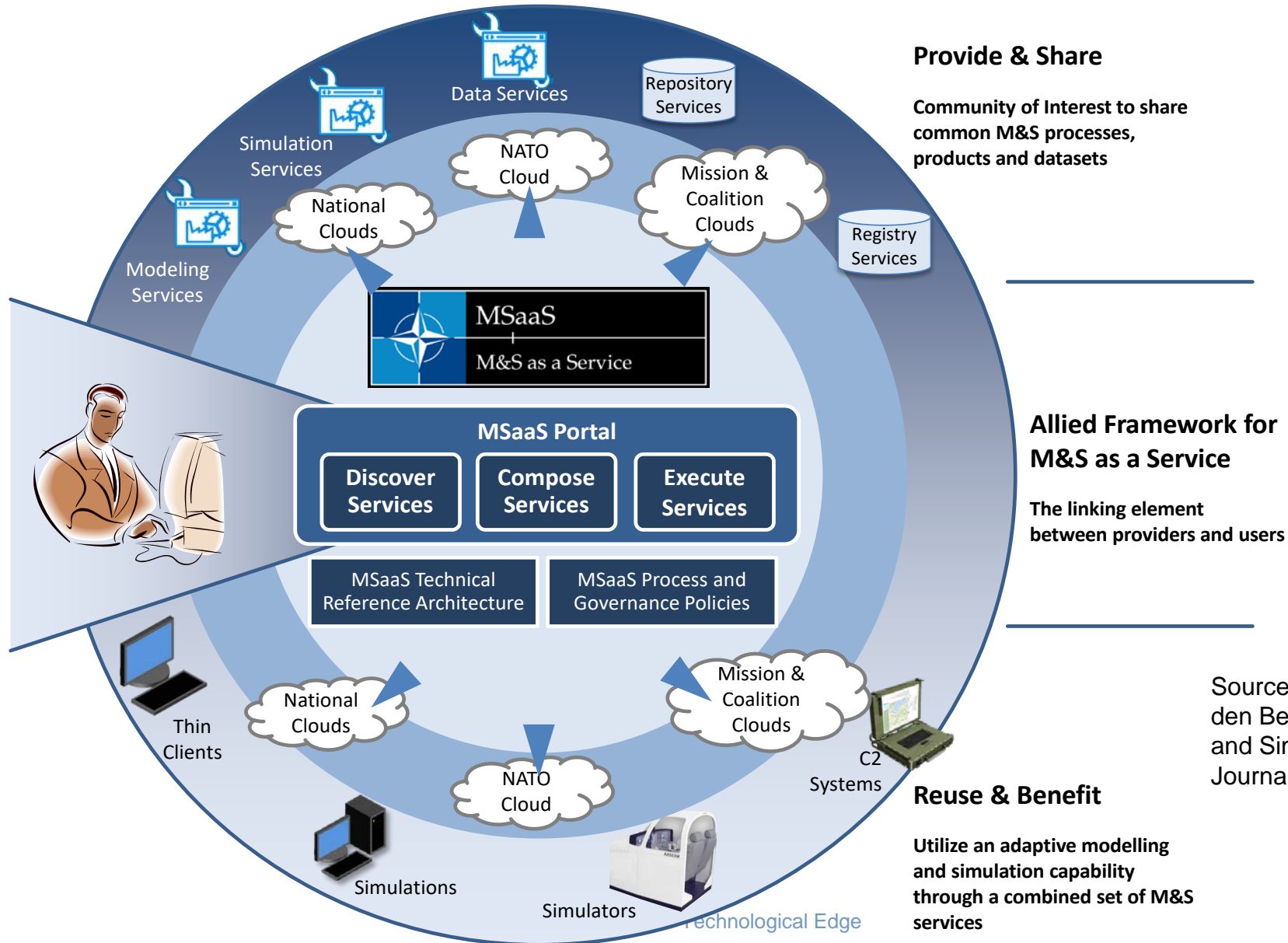
NETN-FOM Data Architecture

Source: NATO Standardization Office, NATO Education and Training Network Federation Architecture and FOM Design (NETN FAFD), Allied Modelling and Simulation Publication AMSP-04 github site, NETN-FOM, https://github.com/AMSP-04/NETN-FOM/blob/master/NETN-FOM.md, last visited 22 September 2023

Modeling and Simulation as a Service (MSaaS)

- Cloud computing technology and service-oriented architectures offer opportunities to better utilize M&S capabilities to satisfy NATO critical needs

- M&S as a Service (MSaaS) combines service orientation and the provision of M&S applications via the as-a-service model of cloud computing to enable more composable simulation environments that can be deployed and executed on-demand (see next slides)

- NATO has established the Allied Framework for MSaaS:

  - Operational Concept Document: intended use, key capabilities and desired effects of the Allied Framework for MSaaS from a user's perspective

  - Technical Reference Architecture: architectural building blocks and patterns for realizing MSaaS capabilities

  - Governance Policies: MSaaS stakeholders, relationships and guidance for implementing and maintaining the Allied Framework for MSaaS

Source: Siegfried, R., J. Lloyd, T. van den Berg, "A New Reality: Modelling and Simulation as a Service," CSIAC Journal, 6:3, November 2018.

MSaaS Concept

Provide & Share

Community of Interest to share common M&S processes, products and datasets

Allied Framework for M&S as a Service

The linking element between providers and users

Reuse & Benefit

Utilize an adaptive modelling and simulation capability through a combined set of M&S services

Source: Siegfried, R., J. Lloyd, T. van den Berg, "A New Reality: Modelling and Simulation as a Service," CSIAC Journal, 6:3, November 2018.
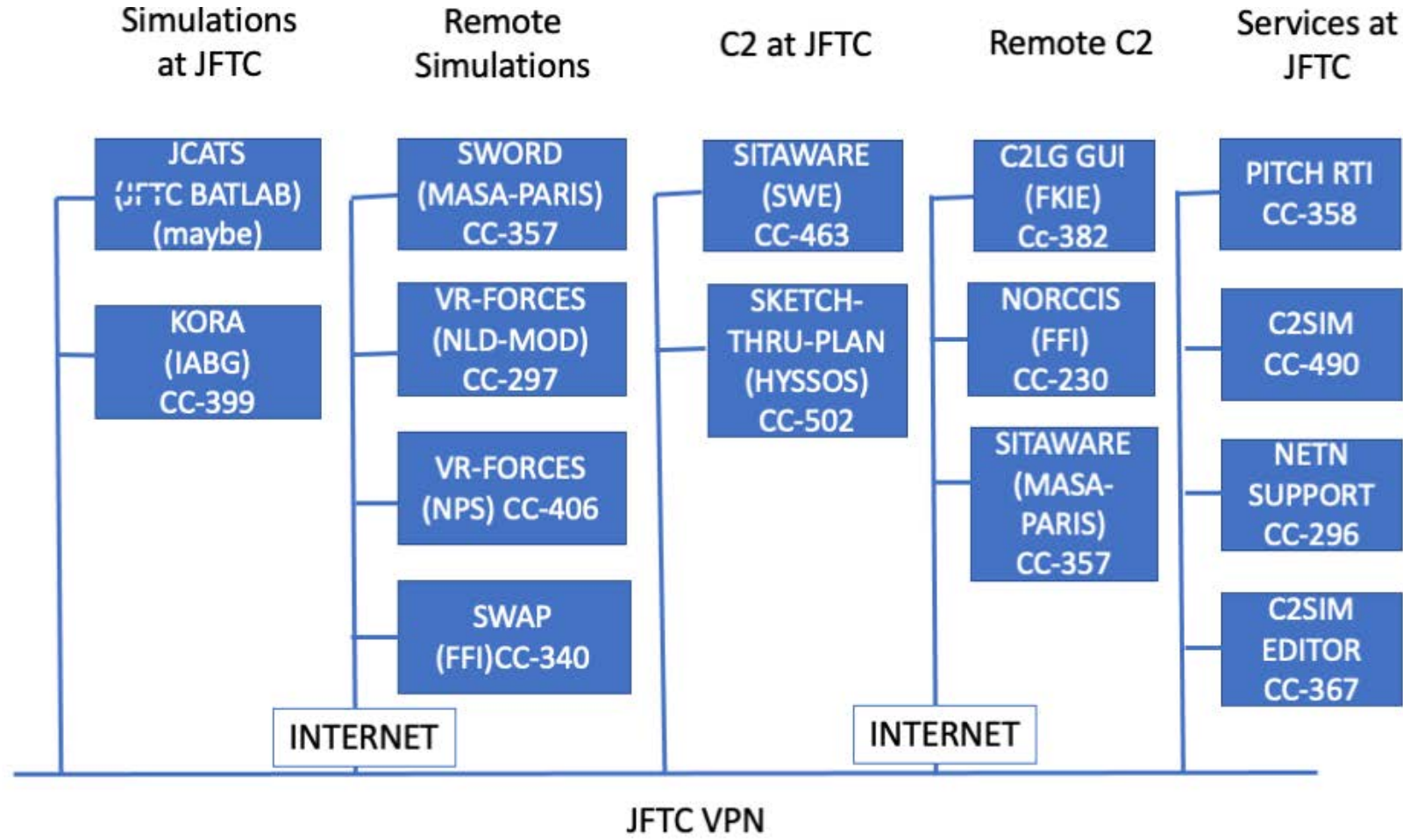
MSaaS and FMN
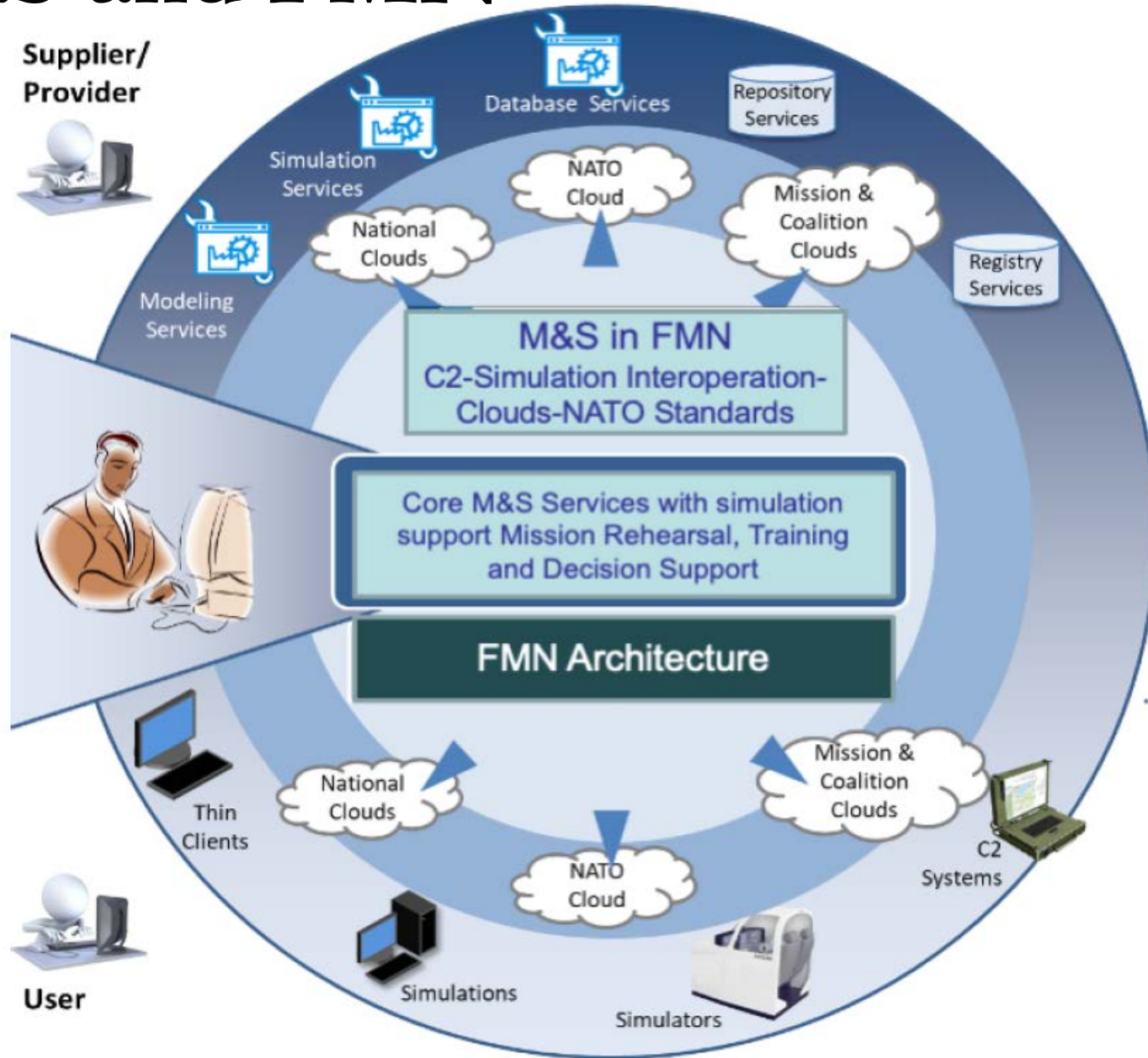
Source: FMN Spiral 5 Procedural Instructions for Mission Rehearsal, 2022.
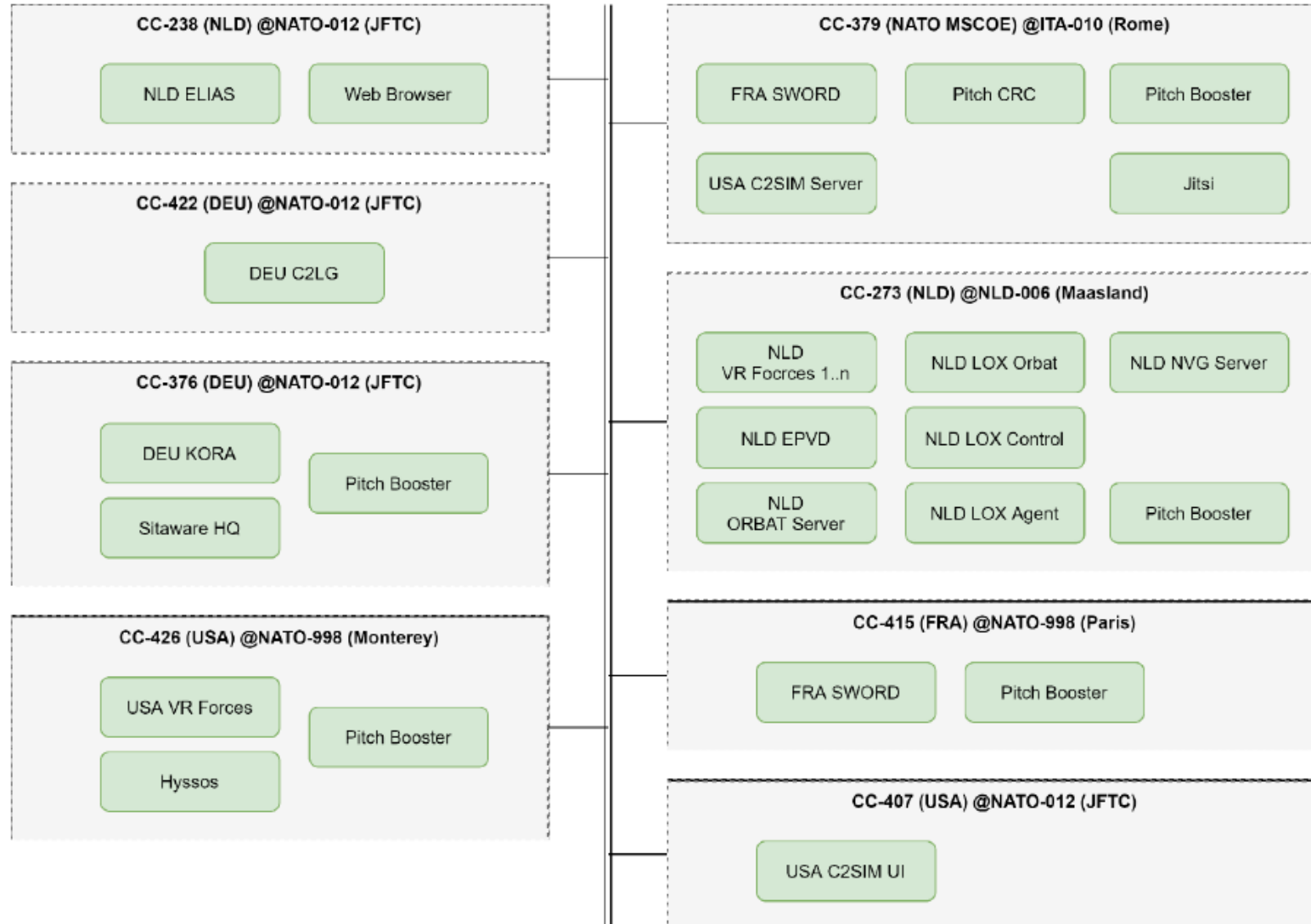
Source: Pullen, et al., "Validating M&S Standards Interoperation in CWIX 2022," STO-MP-NMSG-197, October 2022.

* Or, more completely, Exploration, Experimentation, Examination Exercise

CWIX 2023 Configuration

Summary

- Modelling and Simulation (M&S) supports military operations through training, analysis, testing, planning, and execution

- M&S is an identified requirement for Federated Mission Networking (FMN)

- Interoperability is achieved through application of established standards

- Instruction in "M&S Standards for NATO FMN" by the MSG-211 team will equip FMN developers and users in essential knowledge to ensure success

  - First course presentation in October 2023 during NMSG in Monterey, CA

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