TOWARDS A NATO REFERENCE ARCHITECTURE FOR JOINT MISSION TRAINING THROUGH DISTRIBUTED SIMULATION

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› **OUTLINE**
TOWARDS A NATO REFERENCE ARCHITECTURE FOR JOINT MISSION TRAINING THROUGH DISTRIBUTED SIMULATION

TNO innovation for life

MTDS ADDRESSES TRAINING GAPS

› NATO and nations have a common need for combined and joint collective training to ensure mission readiness

› But there are gaps due to:

  › **Increasing limitations** for Live mission training

    › Operational (space, emissions), environmental, cost

  › **More out-of-area operations**

    › International coalitions, short preparation time

  › Missions in **complex environments** (e.g. littoral, hybrid)

 › **Decreasing availability of Live systems** to support training

INTRODUCTION
BUT MTDS POTENTIAL IS NOT FULLY EXPLOITED

> Complex organization (many actors of different disciplines)

>> Lack of efficient process for planning, preparation, execution, and analysis of training

> Security policies

>> Restricted data exchange between participating assets

> Technical complexity of creating an MTDS exercise

>> Lack of interoperability, mix of technologies

INTRODUCTION
WHAT IS THE SCOPE OF MTDS?
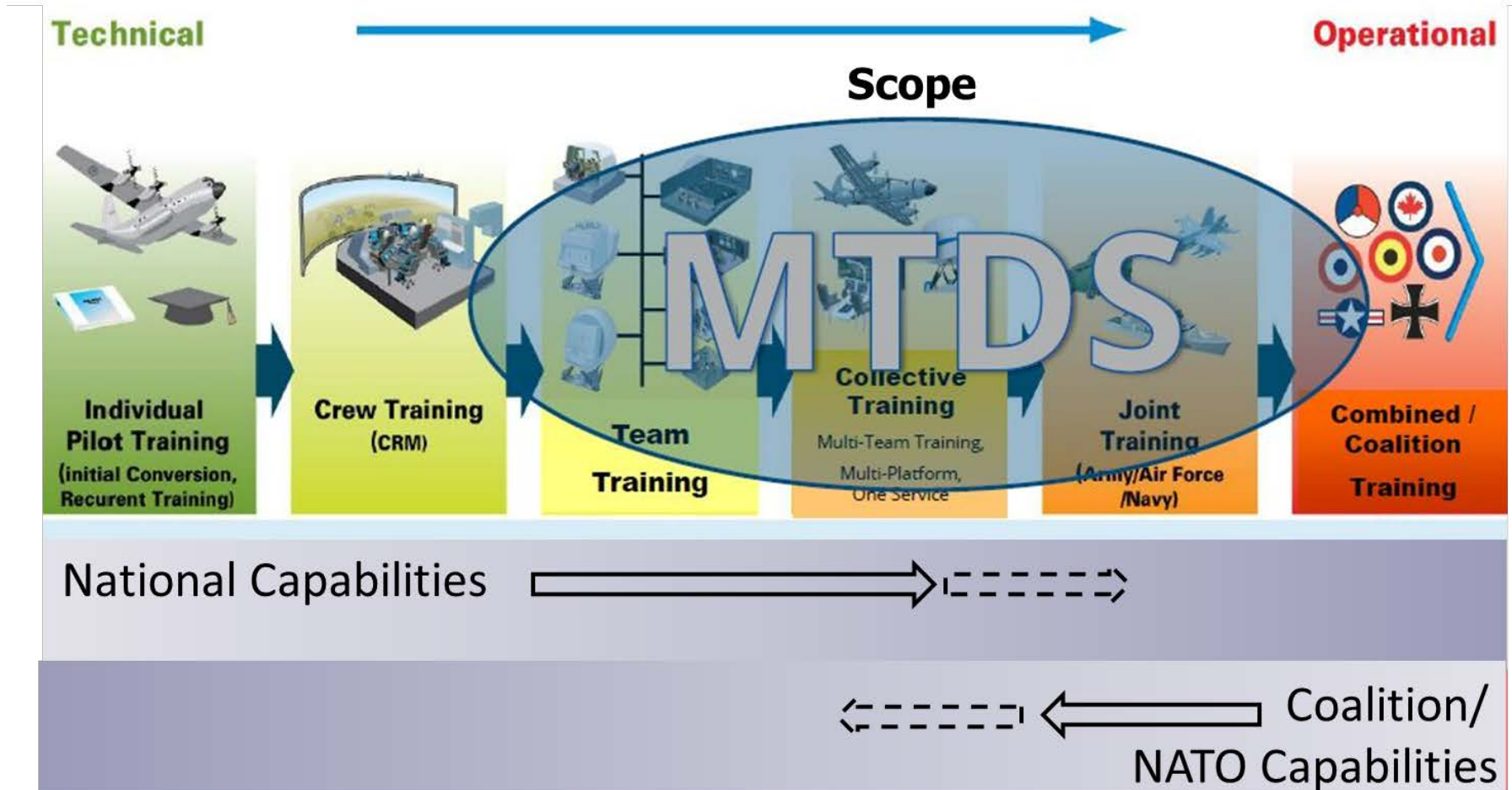
› INTRODUCTION
CHALLENGES

› Every synthetic collective training environment has its own challenges, such as:

  › variations in the training environment, risks, maturity, size and complexity of solutions

  › the timing of the training event

  › technology readiness (emerging or legacy)

  › interoperability

  › budget

  › availability of systems and personnel

  › requirements on verification and validation

  › security-related requirements

  › scenario data (such as terrain)
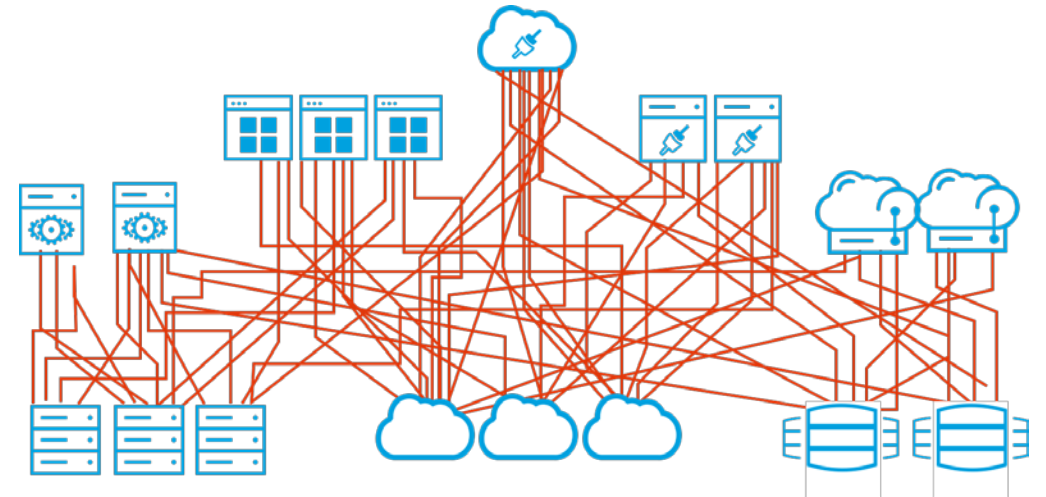
› No single synthetic collective training environment architecture will fit all cases

NEED FOR A COMMON REFERENCE ARCHITECTURE

❭ An **architecture** is needed to manage (technical) complex systems in an effective and efficient way

   ❭ This concerns <u>processes</u>, <u>organization</u>, as well as <u>technical capabilities</u> for performing MTDS

❭ A common **Reference Architecture** will

   ❭ increase efficiency in development of synthetic environments to support Collective Training and Exercises

   ❭ create opportunities for reuse and interoperability between environments in collective training events

ARCHITECTURE CONCEPTS
ARCHITECTURE TYPES

❭ Architectures can be designed at various levels
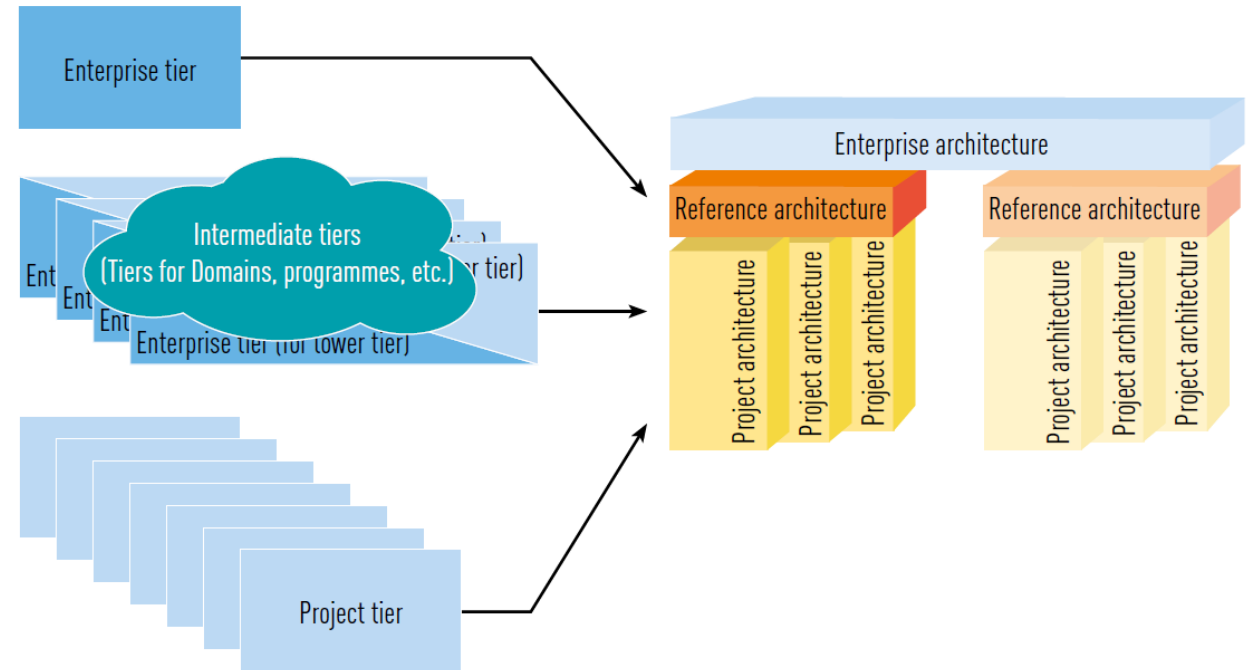
❭ For the purpose of MTDS

❭ **Enterprise Architecture:** the NATO Consultation, Command and Control (C3) Taxonomy

❭ **MTDS Reference Architecture:** defines building blocks and patterns that should be considered for realizing a synthetic collective training environment

❭ **MTDS Project Architecture :** describes the architecture of a specific synthetic collective training environment
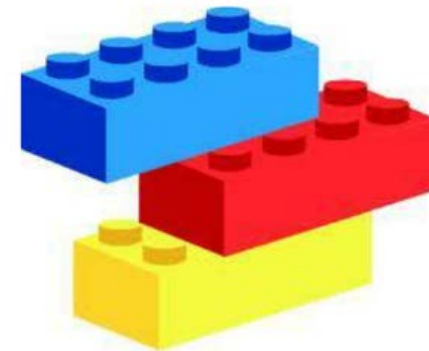
ARCHITECTURE CONCEPTS
WHAT IS THE MTDS REFERENCE ARCHITECTURE?

> The MTDS RA provides **principles** and outlines **requirements** in the form of **building blocks** and **patterns** for realizing and performing synthetic collective training and exercises

Building Blocks
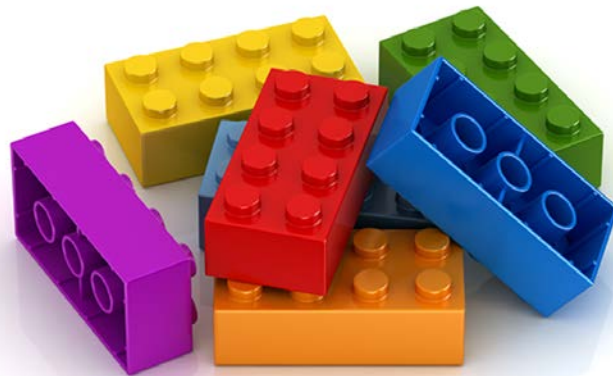
Pattern

composable building blocks

ARCHITECTURE CONCEPTS
ARCHITECTURE PRINCIPLES

❭ **Architecture Principles** govern the process of developing, maintaining, and using the MTDS Reference and MTDS Project Architectures.

❭ Characteristics:

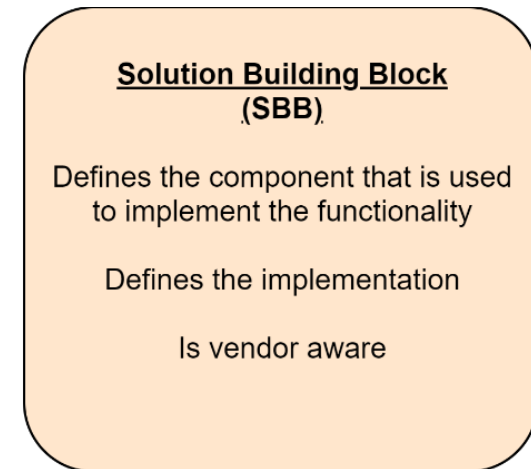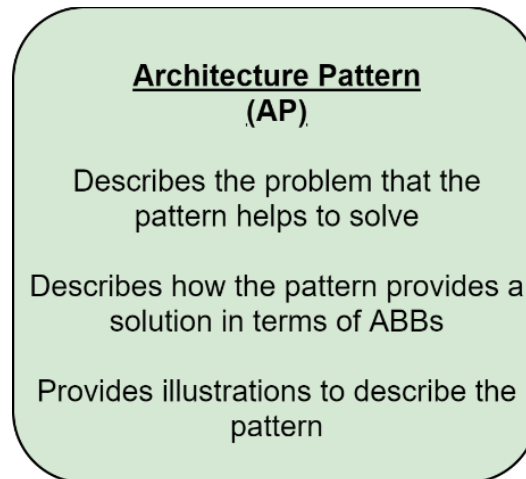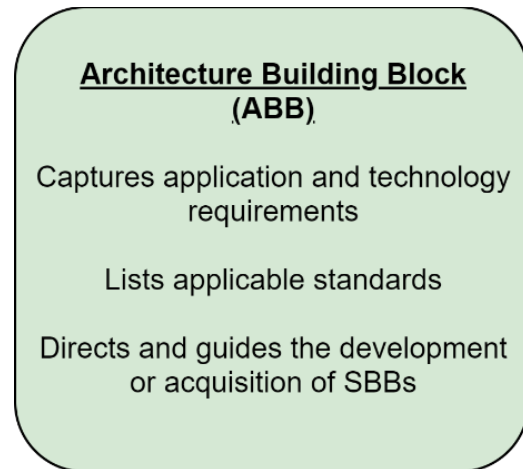| Name	Represent the essence of the rule.
Statement	Should succinctly and unambiguously communicate the fundamental rule.
Rationale	Should highlight the business benefits of adhering to the principle.
Implications	Should highlight the requirements, both for the business and IT, for carrying out the principle - in terms of resources, costs, and activities/tasks.

❭ 10 principles have been defined, for example:

   ❭ *Comply with NATO policies and standards*
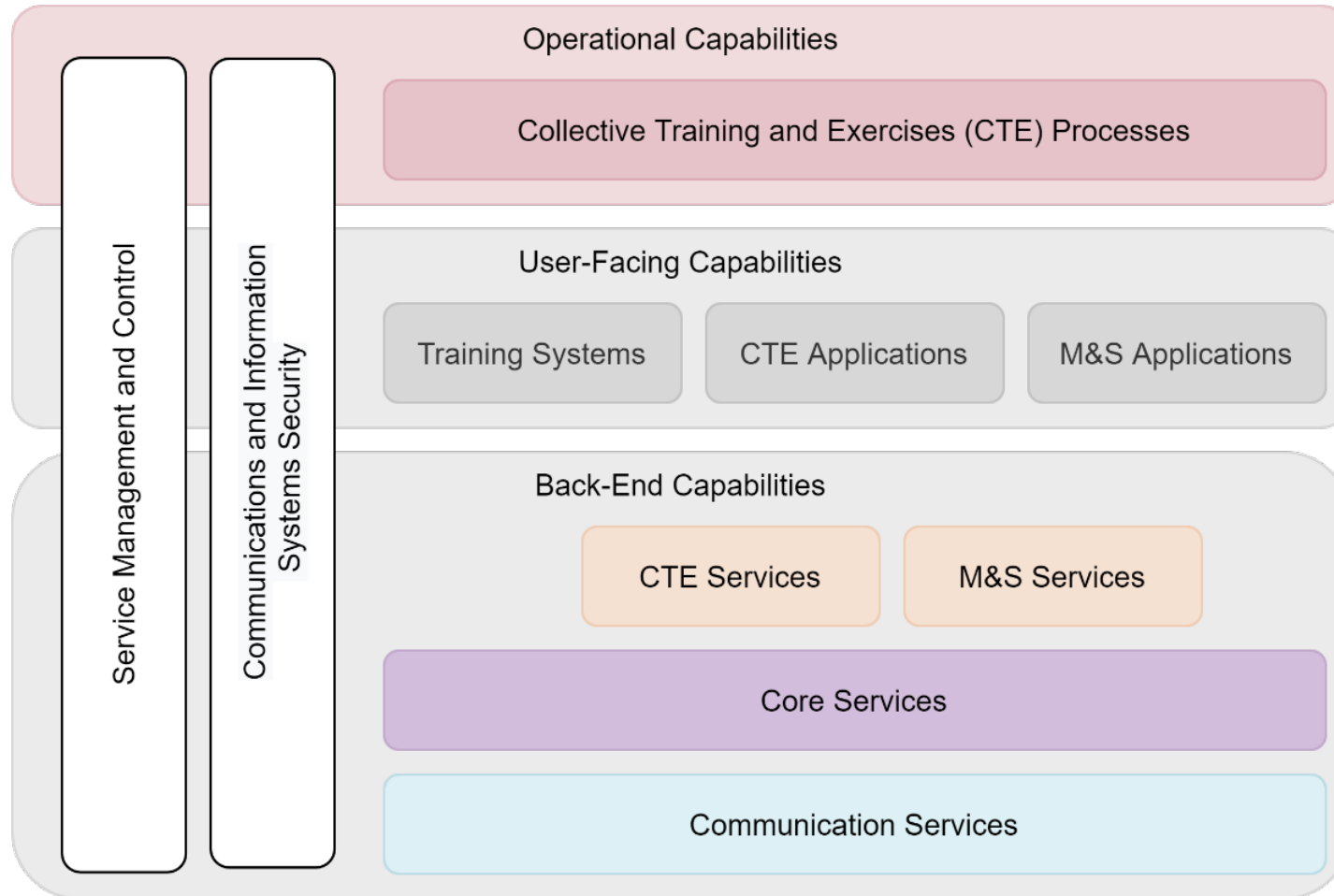
   ❭ *Comply with security rules*

ARCHITECTURE BUILDING BLOCK AND ARCHITECTURE PATTERN

› **Architecture Building Block** (ABB) and **Architecture Pattern** (AP) are the foundation elements of the RA

› A **Solution Building Block** relates to a specific solution (and hence project architecture) that may be procured or developed

Architecture Building Block
(ABB)

Captures application and technology requirements

Lists applicable standards

Directs and guides the development or acquisition of SBBs

Architecture Pattern
(AP)

Describes the problem that the pattern helps to solve

Describes how the pattern provides a solution in terms of ABBs

Provides illustrations to describe the pattern

Solution Building Block
(SBB)

Defines the component that is used to implement the functionality
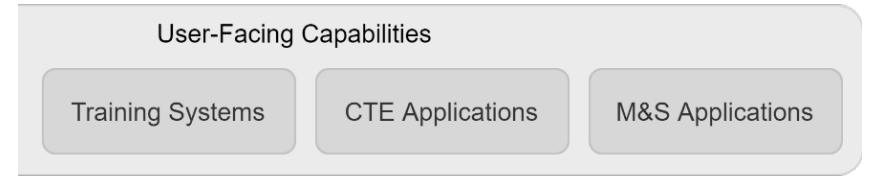
Defines the implementation

Is vendor aware

ARCHITECTURE CONCEPTS
ARCHITECTURE LAYERS

USER-FACING CAPABILITIES
CTE AND M&S APPLICATIONS

> **Training Systems**

> > are national assets

> > range from relatively simple single-element systems, such as dedicated CGF applications, to more complex multi-element systems, such as full mission simulators

> **CTE and M&S Applications include**

> > **Scenario Development Applications** (for the development of conceptual and executable scenarios)

> > **Synthetic Physical Environment Applications** (for the development of environmental data products)

> > **Exercise Control Applications** (for the control of the scenario execution)

BACK-END CAPABILITIES
M&S AND CTE SERVICES

Back-End Capabilities

CTE Services   M&S Services

› Training Systems and Applications interact with these Back-End Capabilities, such as

› **M&S Message Oriented Middleware (MOM) Services** enable the interoperability of Applications and Services, as well as Training Systems

› **Scenario Distribution Services** provide the initial simulation scenario for the simulation execution

› **Simulation Services** provide both ground truth and non-ground truth data to stimulate Training Systems with (simulated) air, land or maritime platform or aggregated information
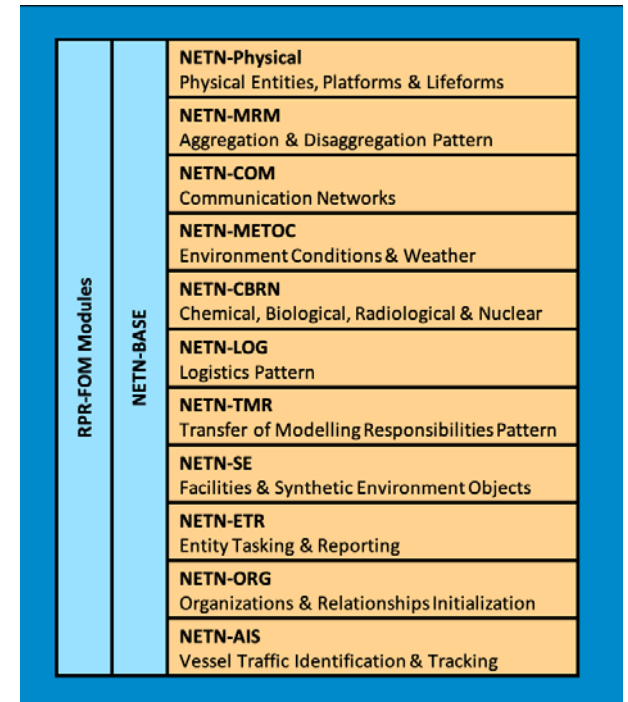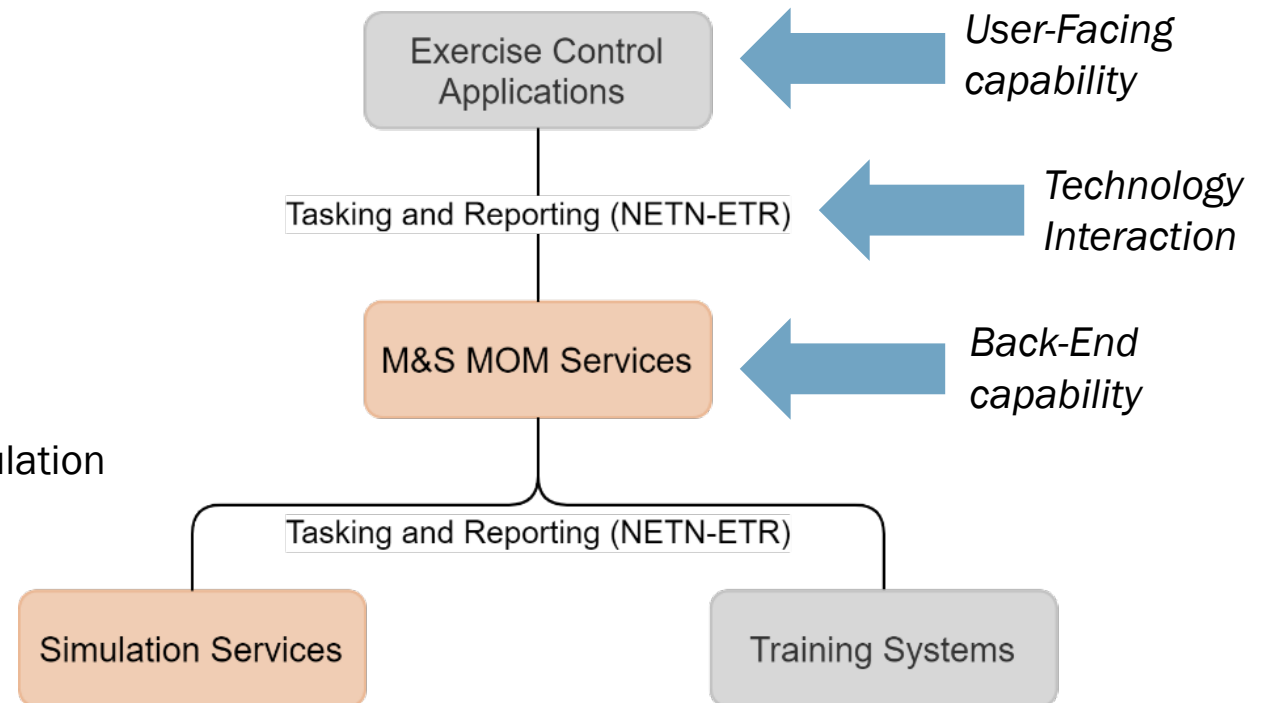

AMSP-04 NETN

ARCHITECTURE PATTERNS
TASKING AND REPORTING

› An **Architecture Pattern** provides information on how building blocks may be combined

› Interactions between building blocks

  › convey the information exchanged

  › refer to interoperability standards

› Example: **Exercise Control pattern** for the tasking of simulation entities from Exercise Control Applications:

Exercise Control Applications ← *User-Facing capability*

Tasking and Reporting (NETN-ETR) ← *Technology Interaction*

M&S MOM Services ← *Back-End capability*

Tasking and Reporting (NETN-ETR)

Simulation Services
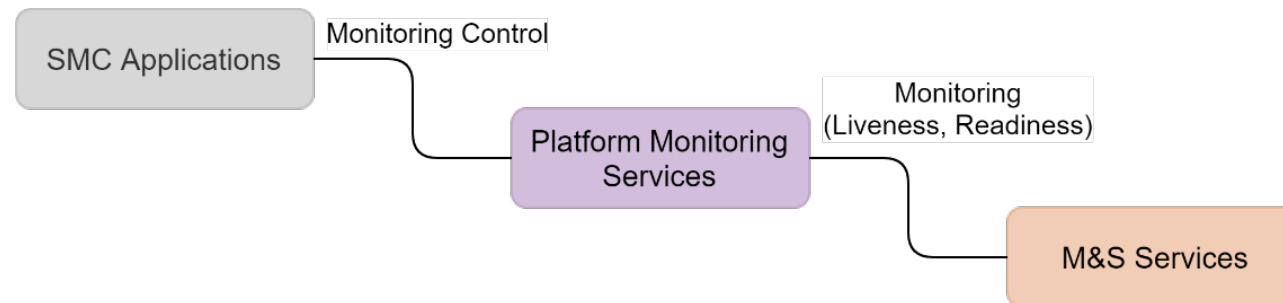
Training Systems

CIS SECURITY
CROSS DOMAIN SECURITY

❭ Building blocks for

　❭ security-enforcement and

　❭ management and monitoring of cross-domain simulation data exchange
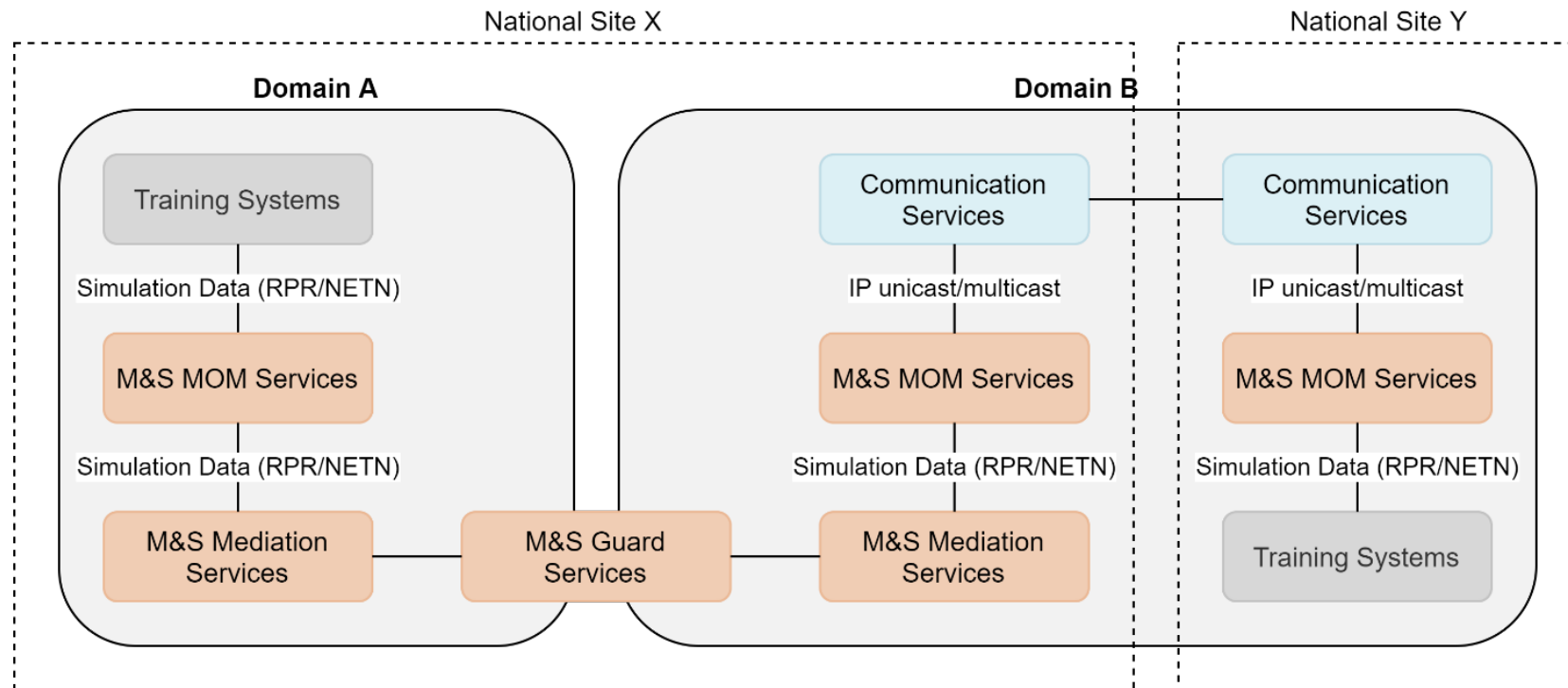
SERVICE MANAGEMENT AND CONTROL
COHERENTLY MANAGE COMPONENTS

❭ Building blocks to coherently manage components in a (federated) synthetic collective training environment

❭ SMC capabilities provide the means to

   ❭ Test Training Systems and test Applications and Services

   ❭ Initialize and start the Applications and Services

   ❭ Supervise Applications and Services w.r.t. health and operating status

   ❭ Monitor the status of Training Systems

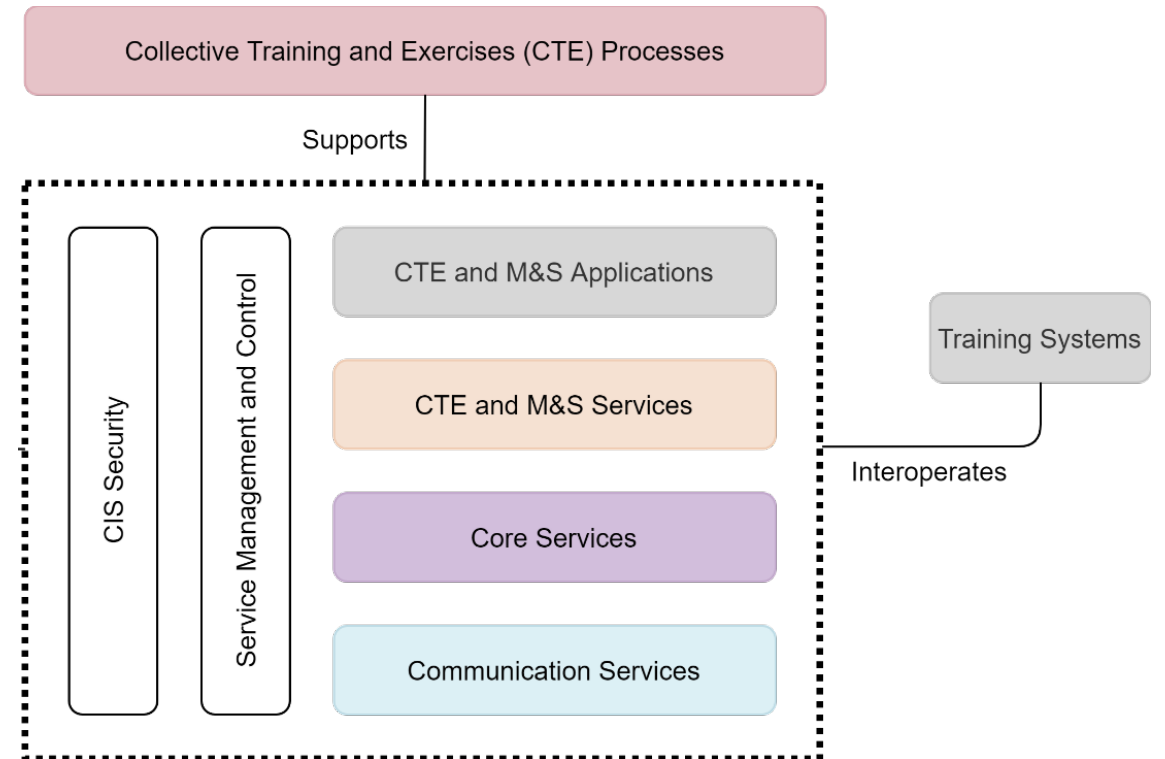   ❭ Terminate Applications and Services

MTDS TECHNICAL FRAMEWORK

MTDS Technical Framework provides the <u>technical</u> requirements for integrating Training Systems in a (federated) synthetic collective training environment.

❯ The MTDS Technical Framework:

   ❯ supports the activities in the CTE processes

   ❯ provides the ability to securely and coherently exchange information between Training Systems at different sites

   ❯ provides the ability to collect, store and process training and exercise related data

   ❯ provides the ability to stimulate Training Systems with information generated by M&S Applications or M&S Services

Collective Training and Exercises (CTE) Processes

Supports

CIS Security

Service Management and Control

CTE and M&S Applications

CTE and M&S Services

Core Services

Communication Services

Training Systems

Interoperates

TNO innovation for life

SUMMARY

> A source of reference and direction regarding the design, development and implementation of a synthetic collective training environment for MTDS:

> > described in terms of **Architecture Building Blocks** and **Architecture Patterns** grouped in layers

> > providing requirements and standards

> > and providing **Architecture Principles** to guide the development, maintenance, and use

> The RA provides:

> > (1) a **framework and structure** of which

> > (2) the **content** (that is, ABB and AP descriptions) can continuously be improved and enriched as demand and insights evolve over time

> The present RA version developed by MSG-165 already provides a baseline with several ABBs and APs

RECOMMENDATIONS

› **To nations and NATO:**

› Use the RA as the reference for implementing synthetic collective training

› **To the NMSG:**

› Use the RA as the reference for synthetic collective training against which technology and requirements can be developed, standards identified, guidelines provided, and more detailed levels of specificity defined

› Adopt the RA and promote its use by nations when implementing MTDS

› **Evaluate the integration of the RA in AMSP-03, updating and evolving this profile toward a profile for Joint-MTDS**

Already ongoing

› **To integrators and product vendors:**

› Align products with the requirements and standards listed in the RA

THANK YOU FOR YOUR ATTENTION