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NEW CONCEPTS IN ESTABLISHMENT OF A COMMON TECHNICAL FRAMEWORK FOR MODELING AND SIMULATION AND ADVANCED DISTRIBUTED LEARNING

AUREL SERB

Naval Academy "Mircea cel Batran", Constanta, Romania

Abstract

Modeling and simulation (M&S) and advanced distributed learning (ADL) will provide the Romanian Armed Forces (RAF) a readily available, flexible, and cost-effective means to support defense reform by fundamentally improving its operational, education and training, peacekeeping, and analytical capabilities.

The "Strategic Plan for establishment of a defense simulation capability for the Romanian Armed Forces" is designed to support programming and budgeting decisions by providing a time-phased list of critical implementing tasks and by identifying resources required to conduct each task successfully. The major goals of the RAF M&S and ADL program are to: integrating M&S and ADL capabilities at all appropriate levels of command and staff; increasing the readiness levels and overall proficiency of the armed forces; enhancing military education programs; making training more effective and efficient; using technology and simulations to conduct operational analysis; applying technology to assist in long-term force structure modernization, defense reform, experimentation, and transformation; using M&S technology to increase the ability to operate and integrate within the North Atlantic Treaty Organization (NATO) and with other regional and international forces; developing the capability to participate in, host, and conduct distributed exercises.

The common technical framework provides interoperability standards for modeling and simulation and advanced distributed learning software applications that define technical architectures (including associated application programming interfaces, rules, and conventions) to allow

effective, coherent exchange of information among software tools. Standards for data interchange minimize inefficiency, miscommunication, and confusion that can arise as information is shared.

This communication presents which are some of the new concepts in establishment of a common technical framework for modeling and simulation and advanced distributed learning.

Keywords: *Master Plan, M&S, ADL, HLA, SEDRIS, SCORM*

1 INTRODUCTION

In the last years government, academia and industry are experiencing an unprecedented revolution in science and technology. This revolution and the advances it presents pose both significant challenges and opportunities to the organization and delivery of military education and training. Among other things this is due to the sheer numbers of people that have to be educated and trained, the high demands with respect to proficiency, the heterogeneity of topics and trainee qualifications, the high turnover of personnel, the large geographical dispersion, and the complicated logistics and unpredictability of military operations.

The modern battlefield is a complex and daunting environment that presents imposing challenges to military crews, planners, and leadership. Precision-guided munitions, fire-and-forget self guided weapons, cruise missiles, sub-orbital platforms equipped with a wide array of sensors, unmanned aerial vehicles loaded with sensors and weapons, real-time intelligence data feeds to command centers and in-vehicle systems, global positioning systems, encrypted and anti-jam communications and data links, lethal and mobile air defenses integrated with sophisticated command, control, communication, computer, and intelligence systems, remote sensors spread across the battlefield, stealth technologies, rapidly reprogrammable systems tailored to engage and defeat specific threats, information warfare systems, an enormous volume of electromagnet emissions, and the tried-and-true radio are all part of the modern warrior's reality; the warrior's adversaries are armed with similar systems, all with disruptive and lethal intent. The warrior's perceptions of the battlefield are extending beyond the individual, providing the opportunity for improved decision making. The combination of new technology and the modern warrior allows individuals and units to coordinate attacks with other forces, both similar and dissimilar, against hostile forces with chilling precision and lethality. While the complexity and capability of weapon systems has increased, so too have training requirements for soldiers, sailors, and airmen to ensure that they are able to take full advantage of the vehicles, sensors, weapons, and countermeasures at their disposal. Unit, force, and tactics training are becoming critically important to militaries around the world so that every bit of capability is squeezed out of costly and complex weapon systems.

Infusing technology in routine operations increases the demand for people who can use and maintain it competently. Despite the increasing presence of technology, competent

human performance remains as essential as ever, and its ready availability is a matter of the first importance in all sectors of activities.

Modeling and simulation (M&S) and advanced distributed learning (ADL) will provide the Romanian Armed Forces (RAF) a readily available, flexible, and cost-effective means to support defense reform by fundamentally improving its operational, training, peacekeeping, and analytical capabilities.

M&S and ADL will be integrated into a more robust technological infrastructure that will support military organizations at the tactical, operational, and strategic levels. This infrastructure will provide enhanced capabilities to conduct training and exercises, defense planning and analysis, combat and security operations, military support for civil emergencies, research, technology development, and military equipment acquisition.

2 MODELING AND SIMULATION MASTER PLAN FOR THE ARMED FORCES OF THE ROMANIA

The M&S Master Plan (MSMP) serves as the base implementation guide for the RAF in the critical areas of modeling and simulation and advanced distributed learning. As a "living document", this plan is expected to continue to evolve as the RAF proceed with implementation, gain experience and develop additional insights. Subsequent editions will define the actions required to further enhance M&S support to RAF planning, training and operations.

The MSMP:

-Articulates a vision regarding the use of M&S in furtherance of the mission of the RAF;

-Outlines the impact that achieving this vision will have on various aspects of RAF operations;

-Identifies the RAF's M&S requirements;

-Establishes a strategy and a set of key objectives for the RAF to accomplish to realize its vision and satisfy its M&S requirements;

-Identifies the actions required to achieve these objectives in a timely and a cost-effective manner; and

-Assigns responsibilities for accomplishment of the plan.

The scope of this plan covers current, developmental, and future M&S systems. It addresses RAF requirements in the principal application areas of training and exercises, defense planning and analysis, combat and security operations, military support for civil emergencies, research, technology development, and military equipment acquisition.

This plan accomplishes the following: it establishes a methodology for the development of simulations to foster their interoperability and reuse; it lays out a high-level roadmap for acquiring and developing a set of simulations; and it outlines other actions necessary to ensure the cost-effective development and employment of advanced M&S technology.

The RAF have identified capabilities that must be achieved to develop and support a comprehensive M&S and ADL program necessary to realize the RAF M&S and ADL

vision. These capabilities, which are categorized in six objectives and corresponding sub-objectives presented in Figure 1, relate to standards, services, communications, facilities, hardware, software, training, and technological knowledge.

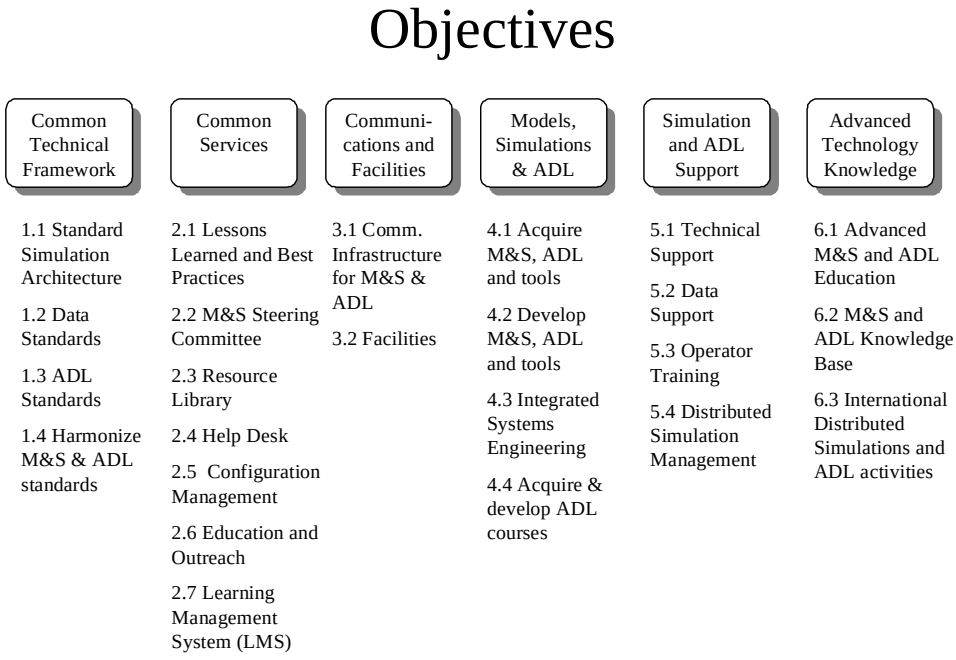

Figure 1

The first objective is that of establishing a common technical framework. A common technical framework provides interoperability standards for M&S software applications that define technical architectures (including associated application programming interfaces, rules, and conventions) to allow effective, coherent exchange of information among software tools. Standards for data interchange minimize inefficiency, miscommunication, and confusion that can arise as information is shared.

Sub-objective 1.1: Adopt a Standard Simulation Architecture

Simulation architectures are the major functional elements, interfaces, and design rules, pertaining as feasible to all simulation applications, and providing a common framework within which specific system architectures can be defined.

Adopting an internationally accepted standard simulation architecture (e.g., High Level Architecture [HLA]) will allow reuse and interoperability across large numbers of different types of simulations.

Sub-objective 1.2: Adopt Data Standards

Data standards are used to establish, promulgate, and oversee policies, procedures, and methodologies for M&S data requirements; data interchange standards; data verification, validation, and accreditation; authoritative data sources (ADS); and data security to provide quality data as common representations of the natural environment, systems, and human behavior.

Data standards enable data suppliers to provide the M&S community cost-effective, timely, standardized, and authoritative data to promote reuse and sharing of data; interoperability of models and simulation systems within themselves and within command, control, communications, computers, and intelligence (C4I) systems; and improved credibility of M&S results.

Sub-objective 1.3: Develop or Adopt ADL Standards

Adopting ADL standards will facilitate development of high quality education and training, tailored to individual needs, delivered cost-effectively anywhere, anytime.

Adopting international ADL standards will secure the benefits of ADL early in the development program and ensure compatibility with international programs. Some Romanian unique standards requirements may emerge, over time, but this will likely be a minimum part of the effort. One good international example is the U.S.-developed Sharable Content Object Reference Model (SCORM), which defines a web-based learning "Content Aggregation Model" and "Run-Time Environment" for learning objects. The SCORM is a collection of specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility, and reuse of web-based learning content. This reference model aims to coordinate emerging technologies and commercial and/or public implementation.

Sub-objective 1.4: Harmonize M&S and ADL Standards

Harmonizing M&S and ADL standards is a planned effort to ensure that existing and developing standards in both disciplines are as compatible as possible.

Simulations offer dynamic capabilities for enhancing the learning potential of ADL courses. ADL offers a very flexible venue for providing education to simulation practitioners. The two need to be as compatible as possible for ease of use.

3 INTEOROPERABILITY BY STANDARDS

3.1 Introduction

Interoperability is the ability of systems, units, or forces to provide services to, or accept services from, other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. Interoperability as defined above focuses on information exchange as applicable to system information needs. On the other hand, the interoperability represents the conditions achieved among communications-electronics systems, or items of communications-electronics equipment, when information or services can be exchanged directly and satisfactorily between them or their users. The

degree of interoperability should be defined when referring to specific cases. ISO 9126 defines the interoperability as attributes of software that bear on its ability to interact with specified systems.

Interoperability, as applied to M&S, is the ability of a model or simulation to provide services to, and accept services from, other models and simulations and to use the services so exchanged to enable them to operate effectively together.

The intention of the HLA and SEDRIS is to provide a common architecture for modeling and simulation, and to offer a structure that will support the reuse and interoperability of simulations.

SCORM is a set of specifications for developing, packaging and delivering high-quality education and training materials whenever and wherever they are needed. SCORM-compliant courses leverage course development investments by ensuring that compliant courses are:

-Reusable: easily modified and used by different development tools,

-Accessible: can be searched and made available as needed by both learners and content developers,

-Interoperable: operates across a wide variety of hardware, operating systems and web browsers, and

-Durable: does not require significant modifications with new version of system software.

3.2 High Level Architecture

Sub-objective 1.1 is the adoption of the High Level Architecture (HLA) as the NATO standard technical architecture for simulation applications.

Simulations are abstractions of the real-world. Different needs dictate the representation of different entities, attributes and interactions, implemented in different ways. No single, monolithic simulation can satisfy the needs of all users. NATO and its member nations, however, cannot afford to build many stand-alone simulations with redundant representations, for the cost would be prohibitive.

NATO must be able to reuse existing simulations and other resources (e.g., data) to the maximum possible extent, building new simulations only where required. NATO simulations must also be able to link both constructive simulations and virtual (humans-in-the-loop) simulators with real-world equipment (e.g., CIS) in a flexible, cost-effective way. NATO needs, therefore, a composable approach to constructing simulated mission spaces. Interoperability must be "built in" to simulations to the maximum possible extent. This approach requires the establishment of a common, open-standard technical architecture. To be broadly useful and enduring, this architecture must recognise that all uses of simulations and useful ways of combining them cannot be anticipated in advance. In addition, the architecture must accommodate future technological capabilities and a variety of operating configurations. Following careful examination of the alternatives, the High Level Architecture was identified as the best technical architecture to accomplish NATO goals.

The High Level Architecture comprises three components: the rules, the interface specification, and the object model template.

-High Level Architecture Rules are a set of rules that must be followed to achieve proper interaction of federates during a federation execution. These describe the responsibilities of federates and of the Runtime Infrastructure in High Level Architecture federations.

-The Interface Specification defines the standard services and interfaces to be used by federates in order to support efficient information exchange when participating in a distributed federation execution and the reuse of the individual federates.

-The Object Model Templates prescribes the format and syntax for recording the information in High Level Architecture object models, for each federation and federate.

The basic components of the High Level Architecture are the simulations themselves, or more generally, the federates. The High Level Architecture requires that all federates incorporate specified capabilities to allow the objects in the simulation to interact with objects in other simulations through the exchange of data supported by services implemented in the Runtime Infrastructure. The Runtime Infrastructure is a distributed operating system for the federation which provides a set of general purpose services that support federate-to-federate interactions and federation management and support functions.

3.3 Synthetic Environment Data Representation and Interchange Specification

Sub-objective 1.2 establish to adopt data standards for M&S applications. Users need a common understanding of the data that is exchanged among simulations and live systems in order to foster a meaningful exchange. NATO should standardize, therefore, on the form of data to be exchanged among models, simulations and live systems to foster interoperability and reuse during development, execution and post-execution analyses of simulated mission spaces. Examples of data to be interchanged include terrain databases, state updates during runtime, orders of battle, tasking orders, etc. Data interchange standards (e.g., data element definitions in a data dictionary, data interchange formats, etc.) are established in compliance with NATO policy. An important step is the definition of requirements for supporting data and data standards in databases distributed within the Alliance or provided to the Alliance by other nations. Also, the prioritization of data classes to be standardized, the leveraging of established standards and the making standards available by automated means represent the directions of this action. The preparation of scenario-specific databases necessary to run simulations is currently a very time-consuming and expensive task. Technology developments (e.g., rapid feature extraction) and emerging data interchange standards (e.g., Synthetic Environment Data Representation and Interchange Specification (SEDRIS)) hold promise to reduce this expense. For political and security reasons, geo-typical (vice geo-specific) environmental databases and notional adversary orders-of-battle may be required.

The Synthetic Environment Data Representation and Interchange Specification objectives are to:

-Articulate and capture the complete set of data elements and associated relationships needed to fully represent the physical environment.

-Support the full range of simulation applications (e.g., computer-generated forces, manned, visual, and sensor systems) across all environmental domains (terrain, ocean, atmosphere, and space).

-Provide a standard interchange mechanism to pre-distribute environmental data (from primary source data providers and existing resource repositories) and promote data base reuse and interoperability among heterogeneous simulations.

3.4 Sharable Content Object Reference Model

SCORM is a specification published by ADL as a standard means of constructing and packaging distributed learning courses. The basic components of SCORM are Content Aggregation Model and Run-Time Environment.

-The purpose of the SCORM Content Aggregation Model is to provide a common means for composing learning content from discoverable, reusable, sharable and interoperable sources. The SCORM Content Aggregation Model further defines how learning content can be identified and described, aggregated into a course or portion of a course and moved between systems that may include Learning Management Systems (LMS) and repositories. The SCORM Content Aggregation Model defines the technical methods for accomplishing these processes. The model includes specifications for aggregating content and defining meta-data.

-The purpose of the SCORM Run-time Environment is to provide a means for interoperability between Sharable Content Object-based learning content and Learning Management Systems. A requirement of the SCORM is that learning content be interoperable across multiple LMSs regardless of the tools used to create the content. For this to be possible, there must be a common way to start content, a common way for content to communicate with an LMS and predefined data elements that are exchanged between an LMS and content during its execution.

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