Multilateral Interoperability Programme

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Abstract. *The Multilateral Interoperability Programme (MIP) is a voluntary and independent activity in NATO environment by the participating nations and organizations. The MIP concept is based on data exchange in form of common exchange data model to achieve the international interoperability in command and control information systems (C2IS) of the tactical units. The article describes the basis of the MIP organizations, structure, planning and testing processes. The core of the MIP solution is the Information Exchange Data Model (IEDM). The Czech Armed Forces (CAF) MIP process implementation is mentioned. The MIP example is a part of university education process.*

Keywords

Interoperability, Command and Control Information System (C2IS), Multilateral Interoperability Programme (MIP), Joint Consultation Command and Control Information Exchange Data Model (JC3IEDM); data, model, test, CAF, NATO.

1. Introduction

The application of military force in the early 21st century is demanding. It covers a wide spectrum of threats and deployment scenarios that range from conventional general war through limited operations, crises response operations, asymmetric conflict, and terrorism. Unilateral capability is important to nations but most planning is made on the assumption of alliance and coalition operations in scenarios that are difficult to predict and which often arise at short notice. Thus the nature and composition of a force structure to meet military requirements will be specific to requirement and based upon a general and flexible military capability.

To achieve this, an assured capability for interoperability of information is essential. The successful execution of fast moving operations needs an accelerated decision-action cycle, increased tempo of operations, and the ability to conduct operations within combined joint formations. Also, supporting command and control (C2) systems need to pass information within and across national and language boundaries. Moreover, tactical C2 information must be provided to the operational and strategic levels of command including other governmental departments.

2. Multilateral Interoperability Programme

The aim of the MIP is to achieve international interoperability of Command and Control Information Systems (C2IS) at all levels from corps to battalion, or lowest appropriate level, in order to support multinational, combined and joint operations and the advancement of digitization in the international arena. The means to achieve this is known as the MIP solution. It includes the MIP specifications, Standard Operation Procedures and other documentation that is required for implementation of the specifications and for use of the MIP Common Interface (MCI). The MIP solution enables information exchange between co-operating but distinct national C2 systems.

It is not within the scope of programme to specify the C2IS end system functional capabilities; however, the MIP solution has proven to be a valuable source for national C2IS development. Key to this is the fact that national systems need not necessarily conform to any hardware or software standard. Typically systems will be acquired through national or NATO acquisition programmes and their architecture will conform to the national or NATO policy prevailing at the time.

The core of the MIP solution is the Information Exchange Data Model (IEDM). It is a product of the analysis of a wide spectrum of Allied information exchange requirements. It models the information that combined joint component commanders need to exchange. The MIP solution enables C2IS to C2IS information exchange and allows users to decide what information is exchanged, to whom it flows, and when. The concept for the overall end state is such that when the combined joint force can operate as a single, synchronized team in accomplishing its assigned mission in the modern battle space, MIP has achieved its target. In order to achieve that synergy, shared situational awareness between commanders within a combined joint force conducting military operations is required; see Fig. 1. (from the MIP presentation, available at [2]).

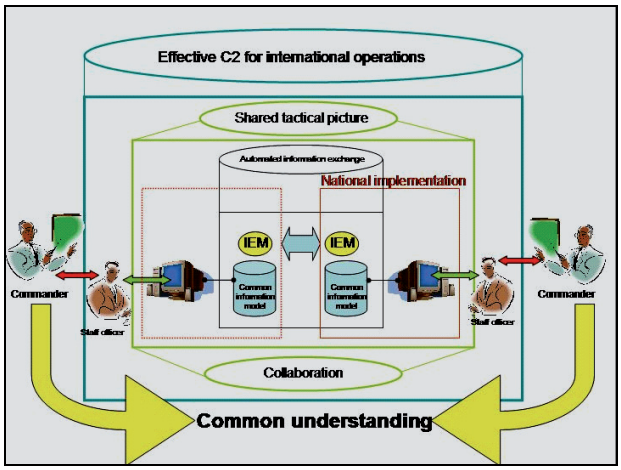

Fig. 1. Concept of the MIP solution.

2.1 MIP Organization

The MIP programme is not a formal NATO programme. Rather it is a voluntary and independent activity by the participating nations and organizations. The nations and HQs that are active in the MIP programme are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Turkey, United Kingdom, United States, JFC Brunssum and Allied Command Transformation (ACT).

The MIP consists of Full Members and Associate Members. MIP is organized into 7 working groups with an executive management body and a high level steering group for resources, policy and targets; see Fig. 2. (from the MIP presentation, available at [2]). At the working group level, the Multidisciplinary Working Parties (MDWP) with experts from the various Working Groups is the paradigm. Rigor is maintained by the adoption of recognized system engineering practices. In addition to the interface specification and the exchange mechanisms, MIP also produces supporting products covering programme management, security policy, test schedules, configuration management, representative data fills, and international liaison.

2.2 Joint Consultation, Command and Control Information Exchange Data Model

Joint Consultation, Command and Control Information Exchange Data Model (JC3IEDM) is intended to represent the core of the data identified for exchange across multiple functional areas and multiple views of the requirements. Toward that end, it lays down a common approach to describing the information to be exchanged in a command and control (C2) environment.

The structure should be sufficiently generic to accommodate joint, land, sea, and air environmental concerns. The data model describes all objects of interest in the sphere of operations, e.g., organizations, persons, equipment, facilities, geographic features, weather phenomena, and military control measures such as boundaries. Objects of interest may be generic in terms of a class or a type and specific in terms of an individually identified item. All object items must be classified as being of some type. An object must have the capability to perform a function or to achieve an end. Thus, a description of capability is needed to give meaning to the value of objects.

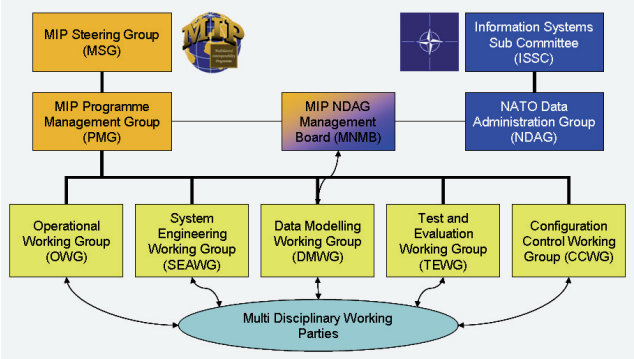

Fig. 2. The MIP organization structure.

It should be possible to assign a location to any item in the sphere of operations. In addition, various geometric shapes need to be represented in order to allow commanders to plan, direct, and monitor operations. Several aspects of status of items need to be maintained. The model must support the specification of current, past, and future role of objects as part of plans, orders, and events. The model must permit a description of the composition of a type object in terms of other type objects. Such concepts include tables of organizations, equipment, or personnel. The model must reflect information about what is held, owned or possessed in terms of types by a specific object item. There is a need to record relationships between pairs of items.

There is no single path that can be followed logically to a conclusion when one is dealing with a relational schema. The inherent use of relationships guarantees that almost any part of the specification depends on one or more of the other parts. Such cross-dependence makes it difficult to organize the document in a sequence that would make it easy to comprehend the material. It may be necessary to move back and forth between chapters and between sections in a chapter. The model in its most abstract sense may be thought of as a metamodel that provides the structural skeleton for broad topics.

The purpose of the JC3IEDM is to provide a description of the common data that contains the relevant data, abstracted in a well structured normalized way that unambiguously reflects their semantic meaning. It is a basic document that nations can use to present and validate functional data model views with their own specialist organizations, a specification of the physical schema required for database implementation. The overall goal is to specify the minimum set of data that needs to be exchanged in coalition or multinational operations. Each nation or agency or community of interest is free to expand its own data

dictionary to accommodate its additional information exchange requirements with the understanding that the added specifications will be valid only for the participating nation, agency or community of interest.

Basic concept in data specification is an entity, i.e., any distinguishable person, place, thing, event, or concept about which information is to be kept. Properties or characteristics of an entity are referred to as attributes. The attributes make explicit the data that are to be recorded for each concept of interest. The entire structure is generated from 15 independent entities, that is, entities whose identification does not depend on any other entity, see Fig.3. All other entities are dependent entities (nearly 300).

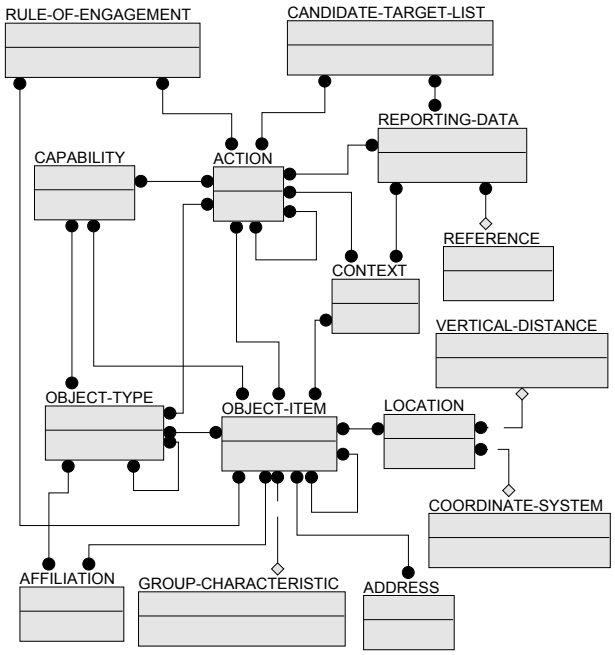

Fig. 3. The set of independent entities in IEDM.

2.3 MIP Planning Process and Scope

The programme has gone through all the stages of Operational analysis: Concept, Feasibility, Definition, Development and Demonstration along its history. MIP had a formal methodology, generated from Unified Process, based on Blocks. Each Block has the following phases: Inception, Elaboration, Construction, Integration, Operational Test, and Transition. During this period the Baseline Specifications and Documents are released. Due to fielding considerations, the Block concept has evolved into a Release concept. The programme is focused on delivering capability in an incremental manner.

Currently MIP will be predominantly deployed in the Land Environment, from where the requirement arose. However, MIP has used Joint references for defining its structures, and so may be exploited by other environments in the near future. MIP must ensure that its interfaces to other communities of interest and programmes are open to enable exploiting the full Command and Control capability.

2.4 The MIP Testing Process

The MIP testing approach follows the test engineering discipline defined in the MIP Integrated Framework. The objective is that, after conducting testing, nations will be confident that the MIP solution is viable for interoperability. The Test and Evaluation Working Group (TEWG) has overall responsibility for ensuring that the test engineering discipline is performed in a consistent, complete and coherent manner, with the Operational Working Group, Data Modeling Working Group (DMWG) and System Engineering and Architecture Working Group providing support when needed. The activities associated with the test engineering discipline are divided into the following areas:

- Test development - encompasses the development of all input criteria, technical specifications, test data, test suites and test cases for the verification and validation of a MIP system.
- Test management - administration of tests after they have been developed, including the analysis of the results. This is the responsibility of the TEWG.
- Test execution - planning and controlling of the test events.

Typically, testing activities are classified as functional, performance and reliability:

- **Functional testing.** Validation of business functionality is the goal of functional testing. For functional testing the most critical areas of the system should be given priority. Different functionality must be tested at each phase to increase test coverage.
- **Performance testing** is a class of tests implemented and executed to characterize and evaluate the performance-related characteristics of the target-of-test, such as the timing profiles, execution flow, response times, and operational reliability and limits.
- **Reliability testing** is defined as: “The ability of a system or component to perform its required functions under stated conditions for a specified period of time."

To assess the quality of a system, maintainability, supportability and sustainability are typically measured. These are considered outside the scope of testing and therefore a national responsibility. MIP Integrated Framework defines three levels of tests: implementation, system, and operational level tests.

The operational tests are planed as a part of the NATO military training, for example in exercises CWID, Combined Endeavor etc. The exercises are the best way for MIP solution testing before the fielding phase.

3. The Czech Approach by Implementation of the MIP

There is an effort to be in a tight contact with the MIP solution from the beginning of the realization GF-TCCS

(Ground Forces Tactical Command and Control System). The second stage of the MIP realization within the GF-TCCS has started in 2004. CAF has to increase its MIP participation due requirements of MIP interoperability realization in the GF-TCCS. This stage was finished by the study "Analyses of interoperability solution in GF-TCCS by MIP". The study depicted basic problems, defined parts of the solution and designed concept of realization. There are three parts of the solution:

- Czech MIP gateway (MCIcz).
- GF-TCCS changes and accommodations.
- Interface-Data exchange between GF-TCCS and MCIcz.

MCIcz will be built in accordance with MIP specification, which is described in MIP baseline documents. Realization of some MIP requirements will accommodate changes in GF-TCCS, CAF Standard Operation Procedure, using GF-TCCS applications, personal and material provision, etc. Interface between MCIcz and GF-TCCS has to facilitate data exchange in both directions.

The third stage implementation of MIP MEM (Message Exchange Mechanism) has begun and MIP DEM (Data Exchange Mechanism) is analyzed in more details to make implementation design. Big effort has to be made by all parties involved to achieve MIP solution for GF-TCCS. It encompasses preparation, communications, material, personal, and participation Czech team in the MIP development and testing process. The data, received through different interoperability interfaces, have to be managed and accessed in one way in GF-TCCS for various purposes.

The CAF do not have implemented MIP baseline 2, but it is prepared implementation MIP baseline 3 (above mentioned strategy). The way ahead in implementation is oriented to MIPcz development and testing. The process is in awaiting phase by reason on insufficient budget.

4. Conclusion

The MIP solution is a very good example of the interoperability solution and there is probably the largest project of the military interoperability at the moment. Most of the ideas in the MIP come out from the commercial sphere. The final state of the C2IS interoperability is waiting with connection to Network Enabled Capability (actual NATO transformation concept) and it takes still a long time. Information technology will act as a force multiplier to enhance operational effectiveness at each level of command by enabling the sending, receiving, filtering, fusing, and processing of ever-increasing amount of digital information.

The CAF makes progress to implement MIP interoperability solution. The finally testing and implementation process is waiting in 2009-2010. The MIP solution is a good example in IS interoperability field and is a part of the subject "Interoperability and NATO" in the University of Defense and subject "Information management" in Tomas Bata University.

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[2] http://www.mip-site.org/.

About Author

Ladislav BUŘITA was born in Kutná Hora in 1945; studied at Military College in Vyškov; since 1970 has been holding command positions; 1970-1975 graduated from the Military Academy in Brno in the field of computer science; in 1975-1980 worked at the General Staff Computer Centre in Prague and in 1980-1987 at the Research Institute of the Military Topography Survey in Prague. Since 1987 has been working at the CIS Department at the Faculty of Military Technology (FMT), University of Defense (UoD) in Brno as an assistant professor, head of section, head of department, and academic worker (pensioner). Since 2007 has been a member of Thomas Bata University in Zlín, Faculty of Management and Economics. Finished his academic studies (for CSc. degree) in 1985; became an associate professor in 1991 and a professor in 2003. A member of the UoD and FMT Academic Board, a member of the MoD Board for Defense Research; has been in charge for the FMT Research Program and Defense Research Project MENTAL; has published several university textbooks and books in the fields of informatics, interoperability and project management; publishes papers and gives presentations at national and international conferences.