MULTILATERAL INTEROPERABILITY PROGRAMME (MIP)

MIP4 Information Exchange Specification (MIP4-IES)

Overview

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1.8.1	IPT4 CM	30 May 2018	MIP4.1 official release. Details of internal versions removed from Version History.
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CONTENTS

1 Overview **4**

2 Specification Structure **6**

2.1 MIP4-IES Core Specification 6

2.2 MIP4-IES Supporting Artifacts 7

2.3 MIP4-IES References 8

3 MIP Community of Interest **10**

4 Overarching Technical Concepts **11**

4.1 Use of Topics 11

4.2 Forwarding 12

5 Glossary **13**

1 Overview

The MIP4-IES is the latest generation of MIP Specifications, exchanging information using standards-based Web Service patterns, with discrete message sets based on semantics derived from the MIP Information Model (MIM). MIP4-IES is extensible to accommodate the addition of future information exchange requirements without impacting existing capabilities.

The MIP4-IES design leverages years of analysis and practical experience (of its member nations) implementing interoperability solutions and working in the multilateral information space. In addition to incorporating national C2 interoperability needs, careful attention was paid to lessons learned from previous MIP specifications (MIP 2.0, MIP 3.1, and ADEM) and applying web service-based, open standard, technology advances. Systems implementing the MIP4-IES interface will be able to exchange a wide range of semantically-rich C2 information with their Coalition partners, ultimately assisting shared situational awareness and improving decision-making for the Warfighter.

MIP4-IES is composed of both Exchange Mechanism patterns as well as comprehensive Information Definitions (the message schemas). Supporting products (test utilities, reference implementations, implementation guidance, and mappings to Symbology standards) are published alongside the MIP4-IES core specification, but are considered as guidance artifacts, are also included, in order to facilitate implementation and validation.

MIP4 employs two Web Service patterns - Publish/Subscribe and Request/Response - to deliver simple and concise XML messages that represent Battle Space Objects (BSOs). In general, the Publish/Subscribe pattern is intended to be used as the primarily means of information exchange, with Request/Response reserved for ‘special requests’, including initialization (retrieval of start-state information) and requests for detailed information about BSOs. It is also possible to exchange MIP4 XML messages via offline means, using the File exchange pattern.

These XML message schemas are defined in the MIP4-IES Information Definition documentation. Each BSO Message is designed to be independent (i.e. the receiving system does not depend on other Messages or existing data in order to interpret the BSO Message), which facilitates routing/processing decisions. Every BSO Message includes an Identifier; a Message carrying the same Identifier but with a more recent timestamp is considered an update to the BSO.

In developing the MIP4-IES, the MIP community has taken an agile, iterative, and streamlined development approach by advancing a strategically focused process, which relies on repeatable and traceable transformations. This method allows the MIP community to quickly react to new information requirements by generating supplemental message schemas from the MIM. The use of scripted transformations also provides a layer of isolation between the MIM and the generated MIP4 Message definitions, allowing the MIM to evolve

independently (i.e. to address other information exchange requirements) without forcing the change on the MIP4 schemas.

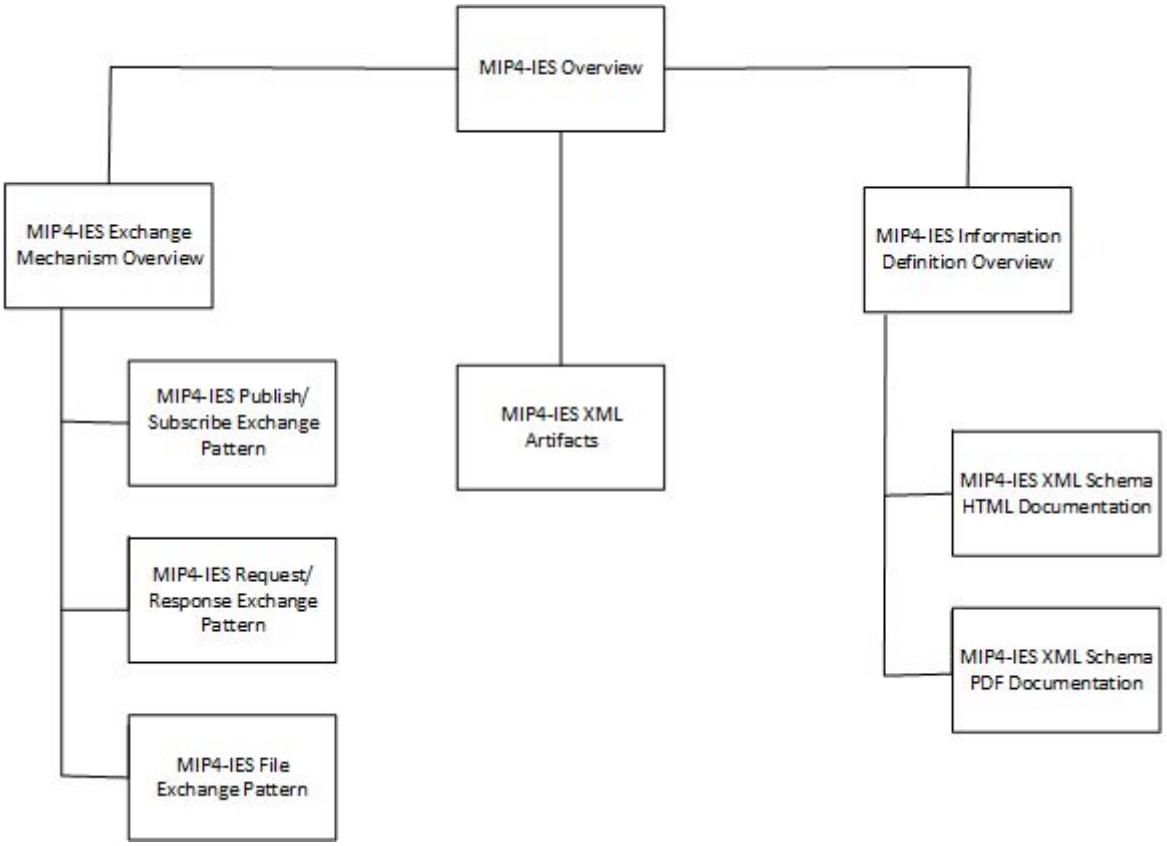
The MIP4-IES solution focuses on a peer-to-peer exchange of information between a Provider and a Consumer system. This does not mean both parties must act as Providers to each other; one system may merely be consuming the data without acting as a Provider in return. Likewise, a Provider system may have multiple Consumers. The MIP4-IES solution is intended to be deployed in an environment with a stable IP network between the Provider and Consumer. It is not intended to directly satisfy the requirement to exchange information over radio nets or tactical links (characterized as low-bandwidth and inconsistent availability); the underlying assumption is that network gateways will exist to manage data traffic (including protocol translation, filtering, and transformations) at the boundary with any tactical networks. That being said, MIP4 Messages are designed in such a way to facilitate this filtering/transformation process (i.e. only a discrete set of Message types may be allowed to transit the gateway).

As was the case with previous MIP specifications, the MIP4-IES focuses primarily on the boundary between C2 systems and not on the interface with the end user (understanding that the interaction between the end user and the C2 system is still important in order to ensure the system-to-system information needs are satisfied).

2 Specification Structure

The MIP4-IES is composed of both 'core' and 'supporting' artifacts. The 'core' artifacts describe the interface specification, while 'supporting' artifacts provide amplifying or clarifying information (or products to simplify common implementation and validation activities).

2.1 MIP4-IES Core Specification



The artifacts that comprise the core MIP4-IES specification are presented in the figure above, and consist of three branches: (i) Exchange Mechanism specification, (ii) Information Definition specification, and (iii) XML Artifacts, as follows:

a) MIP4-IES Overview (this document): high level overview of the specification and a capstone document for all other artifacts.

Exchange Mechanism

b) MIP4-IES Exchange Mechanism Overview: specification for the Exchange Mechanism (EM) portion of the MIP4-IES, addressing all general EM concepts (those not specific to one particular exchange pattern).

c) MIP4-IES Publish/Subscribe Exchange Pattern.
d) MIP4-IES Request/Response Exchange Pattern.
e) MIP4-IES File Exchange Pattern.

Information Definition

f) MIP4-IES Information Definition Overview: specification for the BSO Messages that are exchanged using one or more of the different Exchange Patterns. The definition of these Messages is independent of the means used to exchange them.
g) MIP4-IES HTML Documentation: explanation of the Information Definition schemas in browser-friendly format (leveraging hyperlinks).
h) MIP4-IES PDF Documentation: explanation of the Information Definition schemas in document format.

Common

i) MIP4-IES XML Artifacts: schemas and XML documents that are pertinent to one or more of the Exchange Patterns as well as the Information Definition schemas.

2.2 MIP4-IES Supporting Artifacts

In addition to the core specification, MIP provides a suite of supporting documents and products for the MIP4-IES. The development and evolution of these supporting artifacts follows the release of the Core Specification, as they provide additional clarification and guidance for use/implementation. The list of supporting artifacts may expand over time, but currently includes:

a) MIP4-IES Symbology Mapping: A mapping between MIP4 BSOs and various Symbology standards (e.g. APP6-A, MIL-STD-2525B), to facilitate implementation and to provide recommended default mappings. Note: these mappings are for guidance purposes only; technical interoperability between systems does not depend on rendering the same symbol.
b) MIP4-IES Default Managed Code Lists: A default set of values that can be used (if desired by the particular CoI) to populate the various Managed Code Lists used by different MIP4 schemas.
c) MIP4-IES Implementation Guidance: A document targeting implementers with helpful hints and suggestions gathered from the experience of the MIP community. Includes directions to access the MIP4 Reference Implementations (.Net and Java).
d) MIP4-IES Configuration Form: A list of information that should be provided by a MIP4-compliant system prior to joining the network (either for validation or operational purposes).
e) MIP4-IES Information Definition Transform Documentation: A description of the transformation process that generates the MIP4-IES Information Definition schemas

from a local copy of the MIP Information Model (MIM).

f) MIP4-IES Validation Repository: A suite of test cases, test data and test utilities to support unilateral (self-test) and bilateral (between two partners) validation of the MIP4-IES implementation.

2.3 MIP4-IES References

Throughout the MIP4-IES suite of documents, references will be made to other MIP4-IES artifacts (described in section 2.2, above). The following list provides the authoritative list of these artifacts, including the referenced version, and applies to all documents that comprise the MIP4-IES.

Note: only the major and minor (X.Y) portion of the artifact version number is listed. This is intentional, as the third position (.Z) only represents consistency/presentation improvements, with no change to core content.

N°	Title	Version
REF-MIP-01	MIP4-IES Overview	v1.19
REF-MIP-02	MIP4-IES Exchange Mechanism Overview	v1.12
REF-MIP-03	MIP4-IES Publish/Subscribe Exchange Pattern	v1.15
REF-MIP-04	MIP4-IES Request/Response Exchange Pattern	v1.14
REF-MIP-05	MIP4-IES File Exchange Pattern	v1.8
REF-MIP-06	MIP4-IES XML Artifacts	n/a
REF-MIP-07	MIP4-IES Information Definition Overview	v1.18
REF-MIP-09	MIP4-IES HTML Documentation	n/a
REF-MIP-10	MIP4-IES PDF Documentation	n/a
REF-MIP-11	MIP4-IES Configuration Form {supporting artifact}	
REF-MIP-12	MIP4-IES Symbology Bindings {supporting artifact}	

REF-MIP-13	MIP4-IES Default Managed Code Lists {supporting artifact}	
REF-MIP-14	MIP4-IES Information Definition Transform Documentation {supporting artifact}	
REF-MIP-15	MIP4-IES Validation Products {supporting artifact}	
REF-MIP-16	MIP4-IES Implementation Guidance {supporting artifact}	
REF-MIP-17	MIP4-IES XML Helper Artifacts {supporting artifact}	n/a
REF-MIP-18	MIP4-IES Operating Procedures (MOP) {supporting artifact}	n/a
REF-MIP-19	MIP4-IES Operator Handbook (MOH) {supporting artifact}	n/a
REF-MIP-20	MIP4 - MIP3 Bridging (supporting artifact}	n/a

3 MIP Community of Interest

The MIP Community of Interest (CoI) is a long-established multi-national program of materiel developers that maintains interoperability specifications for the automated exchange of data between heterogeneous Command and Control (C2) systems. As of 2017, the MIP CoI comprised twenty-five different nations and two agencies (NATO's Allied Command Transformation (ACT) and the European Defence Agency (EDA)), each contributing various experts in the C2 realm (operational, engineering, information modeling, validation, program management).

In addition to its role as a specification development organisation, the MIP CoI also has an extensive history of providing support to its members through validation utilities, an extensive test case repository, and collaborative environments for communication and reporting. By incorporating concrete feedback from fielded C2 systems, the MIP CoI ensures its specifications are practical and applicable to the constantly evolving challenge of Coalition operations.

While not a NATO entity, the MIP has maintained a close relationship with NATO - and other multi-national interoperability organisations/efforts - over the years, including the alignment of requirements, information modeling and validation exercises.

4 Overarching Technical Concepts

4.1 Use of Topics

Central to the exchange of information via MIP4-IES is the use of ‘Topics’. In essence, Topics provide a high level means of distinguishing between categories of information, and are expected to be based roughly on capabilities of C2 systems (e.g. a 'CBRN' Topic or an 'Air Picture' Topic).

While MIP4-IES communication leverages Topics, it intentionally does not define the list of Topics to be used. The intent is that each Community of Interest (CoI) using the MIP4-IES to exchange information would maintain a list of Topics that best represents the organization of information within that CoI. Each Topic in this list would need to be accompanied by descriptive text that explains the expected information usage in terms that apply to the CoI. As capabilities and information needs evolve over time, the CoI has the option to extend and/or modify this set of Topics (e.g. some general Topics may be replaced by more granular ones if there is a benefit to separating different types of information).

There should be no expectation that all systems participating in an operation will necessarily publish to or subscribe to the exact same set of Topics. Rather, during the mission preparation phase, planners would indicate the subset of CoI-defined Topics they expect to publish and the subset of Topics they plan to consume (based on system specialization, role in the mission, etc). For example, an Army Unit operating in a coastal region may subscribe to a ‘Maritime Picture’ Topic, but would not necessarily publish information on this Topic. The MIP4-IES does not specify how systems will implement mappings between internal information structures and MIP4 Topics, either as Producer or Consumer. Systems are likely to implement different mechanisms, reflecting their specific capabilities and internal business processes; some may implement strict mapping rules, while others may allow for more customization to support adaptability. Some systems may expose the Topic routing logic to the end user, while others could employ algorithms or user-defined rules. And the routing/mapping on the Producer side (from internal information structures to MIP4 Topics) may not necessarily be identical to the mapping on the Consumer side (e.g. a Consumer may choose to combine information from multiple Topics, or apply additional logic to further categorize information associated with a MIP4 Topic).

While the MIP4-IES intentionally does not define strict rules for what information content is permitted (or not permitted) in a given Topic, the expectation is that Provider systems will implement mappings to the CoI’s MIP Topics to the best of their ability. The better systems become at achieving this, the greater the positive impact on end-to-end understanding. Note, the mapping challenge will likely be greater with ‘general purpose’ C2 systems (or systems that satisfy a variety of C2 functions); specialized C2 systems may only publish or subscribe to one MIP4 Topic (e.g. an indirect fire system may only publish information to a ‘Fire

Support' Topic).

It is also worth noting that the same information may be applied to multiple MIP4 Topics concurrently. For example, a Helicopter may be included in both the 'Friendly Forces', 'Medical' and 'Air Picture' Topics exposed by a particular system.

Due to the fact that the exact set of MIP4 Topics that will be available may not be known until deployment time (or during the deployment planning process), systems should ensure they implement the appropriate flexibility to accommodate this as Consumers.

4.2 Forwarding

For the purpose of MIP4-IES, 'Forwarding' refers to the situation where a Provider system publishes data for which they are not the controlling authority for the data source (the concept of 'source' is defined in the *MIP4-IES Information Definition Overview* [REF-MIP-07]). The use of forwarding in a deployment increases the risk of complications related to data looping, data manipulation (intentional or unintentional), inconsistent filtering, and other errors.

In the interests of simplicity, the MIP4-IES does not support forwarding. To avoid unexpected issues in deployment, implementations should ensure that Provider systems do not forward data.

If at some point in the evolution of the MIP4-IES there is a clear need to support forwarding, the expected functionality will be clearly defined, potentially in the form of a special profile (e.g. a 'Forwarder' or 'Hub' node).

5 Glossary

Term	Definition
ACT	Allied Command Transformation
BSO	Battle Space Object
C2	Command and Control
CoI	Community of Interest
EDA	European Defence Agency
EM	Exchange Mechanism
HTML	Hyper Text Markup Language
ID	Information Definition
IES	Information Exchange Specification
IPT4	Integrated Product Team 4
MIM	MIP Information Model
MIP	Multilateral Interoperability Programme
MPMP	MIP Programme Management Plan
MSG	MIP Steering Group
NATO	North Atlantic Treaty Organisation
PDF	Portable Document Format
PMG	Program Management Group
XML	eXtensible Markup Language