T0300-BE-IDS-010

REVISION 1

NAVSEA TECHNICAL PUBLICATION

Unmanned Maritime Autonomy Architecture (UMAA) Compliance Specification

Supersedure Notice: This revision supersedes T0300-BE-IDS-010 dated 04 August 2020.

PUBLISHED BY DIRECTION OF COMMANDER, NAVAL SEA SYSTEMS COMMAND

0910LP0030737

30 JULY 2024

RECORD OF REVISIONS

REVISION NO.	DATE	TITLE OR BRIEF DESCRIPTION/PREPARING ACTIVITY
0	04 AUG 2020	Initial issue.
1	30 JUL 2024	Updated to reflect new compliance metric at the component level rather than the service level and adjusted areas to add clarity and make statements more concise.

FOREWORD

This document is the authoritative source within the Unmanned Maritime Systems (UMS) Program Office (PMS 406) under Program Executive Office Unmanned and Small Combatants (PEO USC) for defining the compliance requirements for Unmanned Maritime Autonomy Architecture (UMAA).

This document is intended to define the requirements for compliance with the UMAA standard. The UMAA standard is not intended to prescribe an Unmanned Maritime Vehicle (UMV) system design but rather to define interfaces for common UMV capabilities where a capability is modeled in UMAA as one or more services. The UMAA standard simplifies the integration of new capabilities into a UMV system by providing a consistent set of well-defined services and associated message formats in a publish-subscribe framework. While the UMAA standard guarantees interoperability for the capabilities defined within UMAA at the message level, it does not guarantee the suitability of specific implementations of UMAA capabilities across systems. Even with compatible interfaces, it is not guaranteed that a capability used on one platform would be able to be used on another platform without changes being made. This implementation incompatibility could, for example, be due to the required precision of the data provided and consumed or due to the size, weight, and power (SWaP) requirements of the physical hardware.

A UMAA Component refers to the smallest unit associated with a deployable software, in which no further decomposition into separately managed units can be performed. Components can consist of a variety of entities, including Service Providers (entities that supply resources or solutions) and Service Consumers (entities that interact with a Service Provider to fulfill a specific need). The term 'Service Participant' refers to any type of entity that engages within this pipeline, either providing or using resources, solutions, etc. These definitions are defined in the OASIS Reference Architecture Foundation for Service Oriented Architecture. A Component may be implemented as a single process running on a single processor or as multiple processes running over multiple, possibly networked, processors. Components are typically a combination of UMAA services that are grouped together to create a framework for a functional capability. The compliance of a software system with respect to the UMAA standard is determined by assessing its alignment to the Interface Control Documents (ICD) referenced in Appendix A as well as the component definition to which the software system is required to adhere. As the UMAA Architecture Design Description (ADD) explains, the scope of the UMAA standard is focused on the autonomy that resides on board the UMV, including the autonomy for all classes of UMVs.

The UMAA standard consists of the following key areas:

a. Architecture framework — the high-level context and guidelines for implementing modular, reusable entities that provide functionality associated with UMV autonomy.

b. Key interfaces — the data type definitions and data flow between related entities that provide functionality associated with UMV autonomy.

c. Data model — the organization and standardization of how data elements relate to UMV autonomy key interfaces.

This UMAA Compliance Specification document will detail the requirements for software installed on a UMV to comply with the UMAA standard. Further details and technical information can be found in the UMAA ICDs referenced in Appendix A.

TECHNICAL MANUAL FEEDBACKS

Ships, training activities, supply points, depots, Naval Shipyards and Supervisors of Shipbuilding are requested to arrange for the maximum practical use and evaluation of NAVSEA technical manuals. All errors, omissions, discrepancies and suggestions for improvement to NAVSEA technical manuals shall be submitted via one of the following methods:

1. The preferred method is to submit the Feedback directly into MBPS at https://mbps.navseaplm.navy.mil/Windchill/. MBPS is an unclassified system, do not include U-NNPI or Classified data as attachments to a feedback. See option 5 for classified data. To request a MBPS account submit a ticket to the National Help Desk Service Management (NHDSM) at https://nhdsm.navair.navy.mil/ (DoD PKI Certificate required).
2. Submit a ticket via NHDSM. When submitting the ticket, include a completed copy of NAVSEA 4160/1 (TMDER Form). All data submitted via NHDSM shall be unclassified only.
3. Email a completed copy of NAVSEA 4160/1 to nav_helpdesk.fct@navy.mil. All data submitted shall be unclassified only.
4. For non-Help Desk account holders, submit the feedback via the following link (CAC or ECA Cert Required): https://nhdsm.navair.navy.mil/HEAT/alp.aspx?Scope=SelfService&CommandId=NewServiceRequestByOfferingId&Tab=ServiceCatalog&Template=1DE99338DBF9480D9CD3F6EE57B08124. When submitting the ticket, include a completed copy of NAVSEA 4160/1. All data submitted shall be unclassified only.
5. For NNPI and Classified data, continue to use the paper copy of NAVSEA 4160/1 and submit using the current process.

All feedback comments shall be thoroughly investigated, and originators will be advised of action resulting therefrom. One copy of NAVSEA form 4160/1 is at the end of each separately bound technical manual 8-1/2 x 11 inches or larger.

TABLE OF CONTENTS

Chapter/Paragraph **Page**

CHAPTER 1
COMPLIANCE REQUIREMENTS

1-1 COMPONENT/SYSTEM REQUIREMENTS.

A Component shall consist of one or more Service Participants. A Service Participant is either a Service Consumer or Service Provider.

Compliance with the Unmanned Maritime Autonomy Architecture (UMAA) standard shall be evaluated individually per Component. Each Component shall meet the following criteria:

a. Shall implement all interface messages for all Service Participants defined as part of the Component.

b. Shall not use non-UMAA interfaces that provide duplicative data or control for any Service Consumer defined as part of the Component.

c. Shall implement and interpret all Service Participant operations appropriately as specified by their definitions and by the definitions of their respective messages and attributes.

d. Shall implement the full specification of the Component without the requirement for any external non-UMAA interface, unless the non-UMAA interface is used solely to expose the interface data and control for any Service Provider defined as part of the Component.

e. Shall implement the full specification of the Component without the requirement for any additional Service Consumer that is not defined as part of the Component.

f. Shall implement all specified interface flow control as defined in the flow control section of the associated Interface Control Document (ICD).

The aggregation of all Components that comprise a system shall incorporate all Services that are needed to meet its mission requirements. Any Service included in a system (whose message set and functionality are specified by UMAA ICDs) shall comply with the UMAA ICD. Components shall be delineated outside the UMAA ICDs.

1-2 COMPONENT PERFORMANCE AND DEPENDENCY DOCUMENTATION REQUIREMENTS.

In order to be compliant with the UMAA standard, each Component shall be accompanied by a performance and dependency document detailing the critical Component assumptions, required interfaces, and any dependencies on external Service Providers (both UMAA and non-UMAA) in order for the Component to function as designed.

The performance and dependency document shall provide the following:

a. Data generation and message updates. Documentation detailing the data generation and message update timing are required. This information is necessary for a systems engineer to understand how well a Service Participant can meet timing requirements imposed by other Service Participants when evaluating a system design.

b. Accuracy, quality, and expected error tolerance of data provided. Documentation detailing the expected error tolerance and precision of data provided or consumed by the Service Participant is required. This includes, but is not limited to, any requirements for a specific level of data precision for Service Participants that are consuming data and any error specifications along with factors that may influence the magnitude of this error for data that a Service Participant provides. This information is necessary for a systems engineer to understand how well a Service Participant can meet quality requirements imposed by other Service Participants when evaluating a system design.

c. Functional characteristics. Documentation describing a Service Provider's functional characteristics that are not explicit in the ICD and may vary by implementation is required. This documentation includes functional behavior of the service when operating, such as startup, shutdown, and recovery characteristics. This information is necessary for a systems engineer to understand how well a Service Provider can meet requirements imposed by other Service Participants when evaluating a system design.

d. Object Management Group (OMG) Data Distribution Service (DDS) Quality of Service (QoS) requirements. Documentation detailing the specific QoS requirements for a Service Participant to function correctly is required. This information is necessary for a systems engineer to understand valid QoS settings for a Service Participant when evaluating a system design.

e. Handling of optional and union fields. Documentation detailing how optional fields and unions are handled in accordance with ICDs is required. This information is necessary for a systems engineer to understand how well a Service Participant can meet optional data requirements imposed by other Service Participants when evaluating a system design.

f. OMG DDS Security configuration. Documentation detailing the specific OMG DDS Security configuration that is required. This information is necessary for a systems engineer to evaluate the security requirements of a Service Participant when evaluating a system design.

1-3 DDS REQUIREMENTS.

In order to maintain a common underlying transport layer within a UMAA-compliant Unmanned Maritime Vehicle (UMV), the OMG DDS standard shall be used for all communication between Service Participants unless otherwise specified by the Service definition.

1-3.1 DDS IMPLEMENTATION OPTIONS. UMAA generates OMG DDS standard Interface Definition Language (IDL) in parallel with ICD generation. Any OMG DDS product shall only be used as long as it complies with the OMG DDS specification identified in the UMAA ICDs. The UMAA IDL version is provided as part of the release products.

1-3.2 UMAA IDL FOR COMPILATION. A compliant Component shall be fully compatible with the IDLs provided by the UMAA standard for the corresponding Services contained within the Component.

a. Non-optional fields. All required fields within a Service message shall be populated with a value in accordance with the requirements specified in the corresponding ICD.

b. IDL-defined optional fields. ("Optional" here refers to attributes in IDL structures explicitly annotated as "@optional" as specified in *Extensible and Dynamic Topic Types for DDS*.)

   (1) For Status/Report type messages, any optional field shall be included in the published message if data for that field is available in the Component.

   (2) For Command type messages, if an optional field is required by the Service Provider but not provided by the commanding Service Consumer, the Service Provider shall fail the command. An exception to this is where the description of the attribute indicates that the unset optional field defines a specific command response, such as a default behavior, instead of an unset optional value. As an example, an unset "duration" attribute may provide documentation that when not set the value of the duration is defined to be infinite. For this case, the Service Provider shall not reject the command based solely on the optional field not being provided.

   (3) For Command type messages, if an optional field is not supported by the Service Provider but is provided by the commanding Service Consumer, the Service Provider shall reject the command.

c. Unions. In the case of unions in a command, a Service Provider shall implement one or more options to be compliant.

The corresponding ICD service definitions may override some of these restrictions. Exceptions within a Service shall only be granted if explicitly described in the corresponding ICD service definitions.

CHAPTER 2
RELATED TOPICS

2-1 CYBERSECURITY.

2-1.1 OMG DDS Security Specification. In order to be UMAA-compliant, a UMAA Component shall be capable of implementing, without modification or recompilation of source code, any configuration of the following built-in DDS Security Plugin Interfaces (SPI) as defined in and consistent with the intra-SPI dependencies identified in the OMG DDS Security Specification:

a. Authentication Plugin
b. Access Control Plugin
c. Cryptographic Plugin
d. Logging Plugin
e. Data Tagging

2-2 SYSTEM SAFETY.

The UMAA standard does not directly address system safety. The UMAA standard focuses on consistent messaging through standards defined in the ICDs. Any system-safety-related issues shall be addressed as part of a specific program's system design and implementation and will vary greatly between implementations of the UMAA standard.

CHAPTER 3
SUMMARY

3-1 SUMMARY.

The UMAA standard provides a consistent set of ICD message definitions between Service Participants within a UMV with the primary goal of streamlining Component integration. Message structure alone cannot allow for seamless interoperability, which is why additional documentation specific to each Service Participant is critical. Requirements around data quality, frequency, and accuracy shall be considered when compliant Service Participants are to be combined. Additionally, since the scope of the UMAA standard will not cover all possible Services required within a UMV, the UMAA standard allows non-UMAA Services within the system if they meet the requirements specified in this document.

APPENDIX A
APPLICABLE REFERENCES

A-1 INTRODUCTION.

This appendix briefly describes the documents that make up the UMAA standard. Individual programs that are required to implement the UMAA standard will specify their required documents and associated revision numbers and dates for the documents listed in this appendix.

A-2 UMAA ARCHITECTURE DESIGN DESCRIPTION (ADD).

The UMAA ADD provides a high-level overview of UMAA, including its background, origins, and applicability. It covers the architectural guidelines and future path of the architecture definition. The most recent version of the UMAA Documentation can be accessed on the AUVSI website at https://www.auvsi.org/unmanned-maritime-autonomy-architecture.

A-3 UMAA ICDS.

The UMAA ICDs detail the message formats, operations, and data types with which services must align in order to comply with the UMAA standard. The ICDs listed below are available online at https://www.auvsi.org/unmanned-maritime-autonomy-architecture.

A-3.1 ENGINEERING OPERATIONS (EO) ICD. The Engineering Operations ICD focuses primarily on services related to the vehicle's Hull, Mechanical, and Electrical (HM&E) systems. This ICD includes low-level control and status of individual components on the vehicle such as the propulsor, battery, engine, gong, and rudder. It includes physical constraints and specifications of the system and its components. This ICD also includes fault handling and reporting vehicle state data.

A-3.2 MANEUVER OPERATIONS (MO) ICD. The Maneuver Operations ICD focuses on services that provide control of the vehicle for driving. This includes low-level controls, such as heading and speed, and higher-level behaviors for loitering or traversing waypoints. This ICD also includes managing driving constraints such as setting bounds on desired speed range or setting a desired maximum turn rate.

A-3.3 SITUATIONAL AWARENESS (SA) ICD. The Situational Awareness ICD focuses on services providing decision-level information, which includes self (ownship) state information (such as navigation data and self-health); environmental information (both a priori and sensed) such as map or chart data, bathymetry, currents, and weather; and world model data including contact information and classification information (from single or multiple data-fused sources).

A-3.4 SUPPORT OPERATIONS (SO) ICD. The Support Operations ICD focuses on services used across functional boundaries of the UMAA ICDs, such as logging, health reporting, and resource control.

A-3.5 SENSOR AND EFFECTOR MANAGEMENT (SEM) ICD. The Sensor and Effector Management ICD focuses on sensor and effector services often referred to as payloads but can also be organic to the vehicle. Examples include radar systems, sonar systems, manipulators, payload deployments, kinetic effects, and electronic warfare effects.

A-3.6 EXPERIMENTAL SERVICES (EXP) ICD. The Experimental Services ICD focuses on services that are in an experimental state and are in the process of being developed. These experimental services are not required to satisfy compliance with this document.

A-3.7 COMMUNICATIONS OPERATIONS (CO) ICD. The Communications Operations ICD focuses on managing the radios, communications channels, data flow, and message transport between the vehicle and off-board entities such as operations centers, other manned platforms, or other collaborating unmanned vehicles.

A-3.8 MISSION MANAGEMENT (MM) ICD. The Mission Management ICD focuses on services that support performing the overall mission and managing the vehicle in its operating environment. These services would support mission planning, re-planning, and execution as well as managing collaboration with other unmanned and manned vehicles, assessing mission performance, and providing overall control and decision-making.

A-4 OMG DDS.

The OMG DDS standard currently includes the following:

a. High-performance, scalable, secure, and data-centric publish/subscribe abstraction.

b. Completely decentralized architecture with dynamic discovery service that automatically establishes communication between matching peers.

c. Rich QoS characteristics for control over every aspect of data distribution, such as data availability, resource usage, reliability, and timing.

d. Interoperable data sharing, platform-independent extensible data modeling, encoding, and representation.

e. Recent extensions for RPC, security, resource-constrained devices, web integration, and OPC UA integration.

As specified in the OMG Data Distribution Service Specification, DDS is the required middleware for UMAA compliance. Further documentation is available online at https://www.dds-foundation.org/omg-dds-standard/.

A-5 OASIS REFERENCE ARCHITECTURE FOUNDATION FOR SERVICE ORIENTED ARCHITECTURE.

Definitions regarding Service Providers, Service Consumers, and Service Participants are defined in the OASIS Reference Architecture Foundation for Service Oriented Architecture. This document is available online at https://www.oasis-open.org/standards/.

A-6 EXTENSIBLE AND DYNAMIC TOPIC TYPES FOR DDS.

This specification defines a model of the data types that can be used for DDS Topics. This document is available online at https://www.omg.org/spec/.

APPENDIX B
ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

B-1 ACRONYMS AND ABBREVIATIONS.

ACRONYM	TITLE
ADD	Architecture Design Description
AUVSI	Association for Uncrewed Vehicle Systems International
DDS	Data Distribution Service
HM&E	Hull, Mechanical, and Electrical
ICD	Interface Control Document
IDL	Interface Definition Language
OMG	Object Management Group
PEO USC	Program Executive Office Unmanned and Small Combatants
PMS 406	Program Manager Ships 406 Unmanned Maritime Systems Program Office
QoS	Quality of Service
TMDER	Technical Manual Deficiency/Evaluation Reports
SWaP	Size, Weight, and Power
UMAA	Unmanned Maritime Autonomy Architecture
UMS	Unmanned Maritime Systems
UMV	Unmanned Maritime Vehicle

B-2 DEFINITIONS.

TERM	DEFINITION
Component	The smallest unit associated with a deployable software, in which no further decomposition into separately managed units can be performed.
Interface	Messages, languages, and codes that components use to communicate with other components, software, and hardware. Interfaces may be internal to a component. This document is primarily concerned with the distinction between UMAA and non-UMAA interfaces. All UMAA interfaces are between components.
Service	A resource that enables access to one or more capabilities where a capability is the ability to provide data or effect change within a system. A Service is defined by its message set and functionality as specified by Unmanned Maritime Autonomy Architecture (UMAA) Interface Control Documents (ICD).
Service Consumer	An entity that interacts with a Service Provider to fulfill a specific need.
Service Participant	Any type of entity that engages within this pipeline, either providing or using resources, solutions, etc., either as a Service Provider or Service Consumer.
Service Provider	An entity that supplies resources or solutions in the form of a service.

Ref: NAVSEAINST 4160.3 NAVSEA S0005-AA-PRO-010/TMMP

NAVSEA/SPAWAR TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)

INSTRUCTIONS: Continue on 8 ½" x 11" page if additional space is needed.
1. Use this report to indicate deficiencies, problems and recommendations relating to publications.
2. For **NOFORN** TMDERs mailing requirements, see OPNAVINST N9210.3.
3. For **CLASSIFIED** TMDERs mailing requirements, see SECNAV M-5510.36.
4. For TMDERs that affect more than one publication, submit a separate TMDER for each.
5. Submit TMDERs at web site https://nsdsa.dc3n.navy.mil or mail to: **COMMANDING OFFICER, CODE 310 TMDERs, NAVSURFWARCENDIV NSDSA, 4363 MISSILE WAY BLDG 1389, PORT HUENEME CA 93043-4307**

CLASSIFICATION

1. PUBLICATION NUMBER	2. VOL/PART	3. REV/DATE OR CHG/DATE	4. SYSTEM/EQUIPMENT ID

5. TITLE OF PUBLICATION	6. REPORT CONTROL NUMBER (6 digit UIC-YY-any four: xxxxxx-10-xxxx)

7. RECOMMEND CHANGES TO PUBLICATION

7a. Page #	7b. Para #	7c. RECOMMENDED CHANGES AND REASONS

8. ORIGINATOR'S NAME AND WORK CENTER	9. DATE	10. ORIGINATOR'S E-MAIL ADDRESS	11. TMMA of Manual (NSDSA will complete)

12. SHIP OR ACTIVITY Name and Address (Include UIC/CAGE/HULL)	13. Phone Numbers:
	Commercial (___) ___-____ DSN ___-____ FAX (___) ___-____

FOLD HERE AND TAPE SECURELY
PLEASE DO NOT STAPLE

INCLUDE COMPLETE ADDRESS

USE
PROPER
POSTAGE

FOR OFFICIAL USE ONLY

COMMANDING OFFICER
CODE 310 TMDERs
NAVSURFWARCENDIV NSDSA
4363 MISSILE WAY BLDG 1389
PORT HUENEME CA 93043-4307

FOLD HERE AND TAPE SECURELY
PLEASE DO NOT STAPLE

T0300-BE-IDS-010