S-100 TSM7 7.2 Annex

IHO MRN Guidance (Draft – TSM7, September 2019)

1. References

IETF RFC 2141 URN Syntax (https://www.ietf.org/rfc/rfc2141.txt)

IETF RFC 5234 Augmented BNF for Syntax Specifications: ABNF (https://tools.ietf.org/html/rfc5234)

IETF RFC 8141 Uniform Resource Names (URNs) (https://www.rfc-editor.org/info/rfc8141)

S-100 4.0.0 Universal Hydrographic Data Model

IALA ENAV17-9.14 Maritime Resource Name.
(http://mrnregistry.org/Maritime%20Resource%20Name.docx)

TSMAD26/DIPWG5_11.7E Uniform Resource Identifiers for S-100.
(https://www.iho.int/mtg_docs/com_wg/TSMAD/TSMAD26/TSMAD26_DIPWG5_11.7E_S-100-URIs.pdf)

S-100WG1-10.11A Request of Unique Identifier (UI) availability in S-100.
(https://www.iho.int/mtg_docs/com_wg/S-100WG/S-100WG1/S-100WG01-10.11A%20Request%20of%20Unique%20Identifier%20function%20in%20S-100%20-final.pdf)

S-100WG TSM5-4.5 Maritime Resource Names (MRN) concept.
(https://www.iho.int/mtg_docs/com_wg/S-100WG/TSG5/TSM5-4.5_MRN_Proposal.pdf)

S-100WG3-6.4 Producer Codes and Naming Convention.

(https://www.iho.int/mtg_docs/com_wg/S-100WG/S-100WG3/S-100WG3-6.4_S-101_ProducerCodes_and_NamingConvention.pdf)

S-100WG4-6.4 Maritime Resource Names (MRN) concept.
(https://www.iho.int/mtg_docs/com_wg/S-100WG/S-100WG4/S100WG4-2019_6.4_MRN_Guidance_for_S100.pdf)

IALA ARM9-10.3 Managing of MRNs.

IALA ARM9-12.3.6 Draft IALA Guideline Ed.1 on Unique Identifiers for Maritime Resources.

2. MRN background

The Hydrographic Standards and Services Committee (HSSC) of International Hydrographic Organization (IHO) has taken note of the Standardization of Nautical Publication Working Group (SNPWG) paper HSSC6-5.4B, which elaborated the problems HOs may be confronted with if the existing light numbering scheme is subject to changes by either the producing HO (national light numbers) or the UKHO (international light number). The HSSC recommended that IALA should be consulted on the issue. In addressing the issue, IALA has developed a Persistent Unique Identifier called Maritime Resource Name (MRN) for maritime resources such as aids to navigation, and recommended that the same concept be used as the Persistent Unique Identifier for other charted features as well as e-Navigation related resources (ENAV17-9.14). Consequently, MRN was adopted into S-100 by the S-100 Working Group (S-

100WG) at its S-100WG1 meeting (S-100WG1-10.11A) as the recommended method for creating Persistent Unique Identifiers for S-100 based products. The use of MRN supports the IMO e-Navigation Strategic Implementation Plan (SIP) solution S3, which calls for improved reliability, resilience and integrity of bridge equipment and navigation information.

The MRN concept is a powerful mechanism for defining Persistent Unique Identifiers. The MRN is based on the concept of Uniform Resource Identifiers (URI) which is a cornerstone of the Internet. Specifically, the URN concept of name spaces is the basic philosophy of MRN. IALA manages the MRN name space. Its flexibility is a major factor for its adoption by several organizations involved in e-Navigation; see https://www.iala-aism.org/technical/data-modelling/mrn/ for more details including a high-level concept introduction and use guidance for MRN . With this flexibility comes the need to create robust rules that govern use, else disharmony between users is a risk that can reduce the usefulness of the MRN concept.

The IALA Aids to Navigation Requirements and Management (ARM) Committee, at its 9th meeting, created a draft guideline for the use of MRN for defining Persistent Unique Identifiers for data generated within IALAs remit. This document is harmonized with the IALA MRN guideline according to the S-100WG recommendation in action S-100WG4-12.

3. Guideline for the management of the IHO MRN namespace

The IHO has been granted the urn:mrn:iho namespace and the IHO Secretariat is responsible for its management. The Maritime Resource Name (MRN) syntax is based on the Uniform Resource Name (MRN) as described in RFC 2141 published by the Internet Engineering Task Force (IETF). All URNs have the following syntax (phrases enclosed in quotes are REQUIRED):

<URN> ::= "urn:" <NID> ":" <NSS>

where <NID> is the Namespace Identifier; and <NSS> is the Namespace Specific String. The leading "urn:" sequence is case-insensitive, but is conventionally written in lower case. The NID namespace for the maritime domain is MRN, therefore:

<URN> ::= "urn:mrn:" <NSS>

The namespace, “mrn” is case-insensitive in processing but is conventionally written in lower case.

3.1. Rules that apply to all MRN namespaces

The urn:mrn namespace is fixed and is administered by IALA. The identifier has a hierarchical syntax. MRN defined using the Augmented Backus-Naur Form (ABNF) as specified in [RFC5234] is described below. Anyone wishing to utilize the concept, must apply for a governing organization namespace also called Organizational ID (OID) with IALA. Any sub namespace after the OID is administered by the owner of the OID.

The OID and OSS namespaces are equivalent to the NSS namespace in RFC 2141, therefore:

"urn:mrn:"<NSS> is equivalent to “urn:mrn:” <OID> : <OSS>

where NSS is the Namespace Specific String composed as follows:

<NSS>::=<governing-organization>":"<type>":"<type-specific-part>

<MRN> ::= "urn" ":" "mrn" ":" <OID> ":" <OSS>

[rq-components]

["#" f-component]

where:

<OID> ::= (alphanum) 0*32(alphanum / "-") (alphanum) ; Organization ID

<OSS> ::= <OSNID> ":" <OSNS> ; Organization-specific string

<OSNID> ::= (alphanum) 0*32(alphanum / "-") (alphanum) ; Organization-specific namespace ID

<OSNS> ::= pchar *(pchar / "/") ; Organization-specific namespace string

For MRN identifiers created under IHO the *<governing-organization>* is always “iho”, therefore:

<URN> ::= "urn:mrn:iho:" <type>”:”<type-specific-part>

Rules not defined here:

- alphanum and pchar as defined in [RFC3986].

rq-components and f-component as defined in [RFC8141].
Q-component, F-component and R-component are not generally defined by this specification.
Organization specific namespace strings might choose to make use of them where applicable.

3.1.1. Character set available

<NSS> ::= 1*<URN chars>

<URN chars> ::= <trans> | "%" <hex> <hex>

<trans> ::= <upper> | <lower> | <number> | <other> | <reserved>

<hex> ::= <number> | "A" | "B" | "C" | "D" | "E" | "F" | "a" | "b" | "c" | "d" | "e" | "f"

<other> ::= "(" | ")" | "+" | "," | "-" | "." | ":" | "=" | "@" | ";" | "$" |"_" | "!" | "*" | "'"

<upper> ::= "A" | "B" | "C" | "D" | "E" | "F" | "G" | "H" | "I" | "J" | "K" | "L" | "M" | "N" | "O" | "P"

|"Q" | "R" | "S" | "T" | "U" | "V" | "W" | "X" |"Y" | "Z"

<lower> ::= "a" | "b" | "c" | "d" | "e" | "f" | "g" | "h" | "i" | "j" | "k" | "l" | "m" | "n" | "o" | "p" |

"q" | "r" | "s" | "t" | "u" | "v" | "w" | "x" | "y" | "z"

<number> ::= "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"

<reserved> ::= '%" | "/" | "?" | "#"

The <reserved> set is reserved from normal use as specified in RFC 2141. The '%' character is used for encoding the escape sequence of an octet. If a reserved character is used in an MRN, it must be encoded using the appropriate %-encoding. While permitted, the use of a character from the <reserved> set in MRNs is discouraged, except that they may be used with r-, q-, or f-components as specified in RFC 8141.

The entire URN is case-insensitive.

4. IHO Maritime Resource Name syntax

The identifier has a hierarchical structure as follows:

urn:mrn:<NSS>

The "urn" identifies this to be a special case of a Universal Resource Name (URN), while the "mrn" identifies a unique namespace within the URN.

<NSS> is the Namespace Specific String composed as follows:

<NSS> ::='<governing-organization>':'<type>':'<type-specific-part>'

Inserting 'iho' as <governing-organization> creates a namespace where IHO can define unique identifiers. The <type> namespace must contain a minimum of 3 lower case alphanumeric characters:

urn:mrn:iho: '<type>':'<type-specific-part>'

Examples of 'types' include: pub (IHO publications), prod (IHO products), hydro (hydrographic elements), npub (nautical publication elements).

Within the IHO namespace and all sub namespaces, the ':' character is reserved for use as a separator between name spaces.

The table below shows where more information of the different types can be found.

ID types	Syntax constrains
IHO Publications	Annex B
IHO products	Annex C
Hydro products (member state level)	Annex D
Nautical publications (member state level)	Annex E

Additional types may be added based on future requirements	

The identifiers use a scheme allowing for decentralised management of their identifiers. Decentralised management is enabled by using S-62 codes as the first namespace after type, which enable the owner of the S-62 code to indicate that they administer anything after the code, that is, <S62>:<nationally managed name spaces>. For example urn:mrn:iho:hydro:us:1234-5

Note: the <S62> identifier uses the IHO S-62 standard's codes for the producers. In the future, the S-62 format may change, see S-100WG3-6.4.

It is envisaged that for <nationally managed name spaces> all existing naming/numbering schema within a National Authority could be used. See Annexes for further detail.

5. Global rules for use of MRN in IHO

The successful management of the IHO MRN requires some overarching rules and management of these rules. Below is a set of rules for the management of the IHO MRN namespace. IHO have set up a public location for publishing the assigned MRN namespaces at http://www.iho.int/???? to permit easy discovery of the assigned namespaces and who owns or administer these.

Commented [EM1]: To add when IHO set up the space.

5.1. Registry of reserved codes

To avoid redundancies and improper use of elements that make up an MRN, it is recommended to establish ranges of reserved codes, such as producer codes, and other codes as appropriate for use during development of specifications and test data creating. For example, "JS" is a reserved producer code for "Jussland" test datasets. Similarly, "object" is a reserved wildcard for use where it is unknown or impractical to assign another type to an instance.

5.2. Maximum length of an MRN

The MRN specification gives no limit to the length of an MRN. However, the length of an MRN adds to the size of a dataset, and longer MRNs add more than shorter ones. The urn:mrn:iho: part is 12 characters, and additional characters will add to the size of a dataset multiplied per instance. Some flexibility may be useful in the length to give sufficient space for different cataloging purposes such as prefixing existing identifier schemas. It is recommended that the maximum total length of any MRN should be no more than 128 characters.

5.3. Preservation of MRN

It is recommended that, as far as possible, MRN Persistent Unique Identifiers be preserved throughout a functional object's lifetime. This should be done also when that functional object is reused in products other than where it originated, including when an object is imported into use in an IHO product from a different domain. Preservation of the MRN Persistent Unique Identifier supports the traceability of an object to its source and also enables user systems to link instances of the same object across products, maintaining the integrity of data interpretation.

Note: The term functional object is used to account for an object possibly having different identifiers depending on the use or interest of a user. For example, a lateral buoy at a particular place in a channel may be assigned an identifier for the location, while the buoy equipment may change with seasons, such as winter buoys. The buoy equipment itself may also have identifiers, but for navigation use the equipment identifier may not be interesting, while the functional object identifier will certainly be interesting.

The question of whether one data object is the same as or different from another may in some instances be quite complex. Different data products or different versions of the same product may add or remove attributes, coordinates may be constructed differently at different scales; the number of points in a curve, surface boundary, multipoint, or grid may be different at different scales; the nature of spatial primitive may change as scale increases or decreases (area geometry becoming point geometry at a smaller scale); or feature geometries may be merged at some scale (for example, an islet merging with a nearby land area). Due to these different factors, a firm set of universal rules is difficult to establish. The Product Specification authors (or in the last resort, the data producer) should therefore establish rules as appropriate for their data product (or production process) considering the various aspects that may impact data production. An overarching goal should be to improve overall consistency, where needed, over time.

6. Product Specification developer guidance

Product Specification developers should include guidance describing how to use MRN Persistent Unique Identifiers when creating compliant data products. It is further recommended that the producer code is specified as the first namespace after the '<type>' namespace.

urn:mrn:iho: '<type>':'<type-specific-part>'

<type> ::= 'pub', 'prod', 'hydro', or 'npub'

<type-specific-part> ::= '<S62>':'<producer namespace>'

For harmonization purposes a common structure should be considered for MRN identifiers for object instances. This enables a predictable upper level MRN Persistent Unique Identifier namespace (which predictability can be leveraged for reducing total data volume) that can be defined for each IHO Product Specification. Moreover, the producers of data are given flexibility over how they wish to manage their producer namespaces and how to assign MRN identifiers to the data objects under their remit. The structure provides a clear delineation between the fixed upper level (urn:mrn:iho) and flexible (Product Specification developer defined) lower level of the MRN identifier. Further, each namespace component in the MRN (between successive ":" characters) unambiguously indicates the naming convention that applies to the following portion (normally only the immediately following component, but this is not a hard requirement). A drawback with the flexibility given to the producer namespace is that applications cannot depend on a uniform structure of the MRN below the S-62 namespace. Product Specification developers should consider this during the development process.

It is important to note that some data formats that use URI namespaces (GML, XML, RDF, OWL) may give specific meaning to parts of the MRN ID, such as GML where the colon has special significance. MRNs therefore cannot be used verbatim for GML identifiers ("gml:id") or tags. Instead, for GML formats, either MRNs should be used as values for an attribute designed to carry identifiers, or translated into a format compatible with GML, or rules for mapping GML identifiers to MRNs should be

defined (the Product Specification should pick one method and define the mapping to MRNs for all compliant datasets). Product specifications that use another encoding with limitations similar to GML must define sufficient guidance to link MRN IDs to objects.

Example of one method of translating a URN identifier into a GML accepted identifier;

URN ID example	GML acceptable ID version
urn:mrn:iho:hydro:DK:DMA:NW:C:034.17	DK.DMA.NW.C.034.17

The ':' (colon) character has been translated into a '.' (punctuation), and the urn:mrn:iho:hydro part has been omitted as this part would always be fixed in the product. Additional parts of the URN ID could be omitted, but the retained parts yield an ID that is still human readable as well as machine-processable in the same way as the original MRN.

6.1. Object instances in data products

A structure like urn:mrn:iho:<type>:<S62>:<producer namespace> gives predictability to the fixed part of the MRN Persistent Unique Identifier, permitting byte saving schemes, such as having the fixed part stated in metadata or as a namespace within the Product Specification. If a byte saving scheme is implemented in a Product Specification, a function for re-creating MRN Persistent Unique Identifiers is needed in user and production software to permit systems to identify objects (for example feature instances) across products.

A Product Specification should also include rules for how to preserve MRN Persistent Unique Identifiers of objects that originate elsewhere, for example checks can validate if an MRN Persistent Unique Identifier that has an origin elsewhere[1] from the producer, is from a permitted source by checking the MRN structure against permitted sources. In all other cases the MRN Persistent Unique Identifier should begin with the code of the dataset producer. These rules can be configured with a list of permitted MRN name spaces to ensure that only permitted inputs are used and help identify erroneous MRNs. It is also recommended to create rules for the preservation of MRN Persistent Unique Identifiers of objects that originate elsewhere.

7. Producer level guidance

This section contains guidance for the management of the sub-level namespace '<producer namespace>', such as for countries or producer organizations that generate data in compliance with IHO Product Specifications.

It is recommended that all namespace owners (<producer namespace> part) develop a guideline for managing their name spaces. This guidance should, as far as possible, be consistent over all products that the producer is responsible for. The following paragraphs should be considered as a draft guideline that provides the starting point for implemented guidelines.

When creating source data, data producers may not know beforehand what type of dataset a new object will be utilized in, for example when using source databases that store objects once and utilize

[1] Checks can be designed to look for permitted sources and flag all cases that do not meet the condition.

them multiple times. Similarly, it may be known that a source object will be used in different data products which conform to different Product Specifications. In such cases it is recommended that the data producer assigns the type of the first product the object is used in, or use the wildcard of “object”. (Note that if the wildcard is used, it may become more difficult to assess the object for MRN preservation purposes.)

The recommended maximum total length should be no more than 128 characters, meaning 12 characters are set aside for the upper level name spaces (urn:mrn:iho:), leaving up to 116 characters for type namespaces and organization specific identifiers. In an effort to reduce file sizes of products, the length of MRNs should be kept to a minimum.

It may be advantageous for some producers to subdivide the producer namespace part of MRN IDs. Reasons can be to fit existing IDs or where more than one office produces data in a particular domain inside one country or jurisdiction, or several contractors are granted work in producing products. For example, IDs can be subdivided at a national level by states or provinces, by projects or by topics where a specification contains several topics, such as ENC. It is up to the producer to decide if such sub division is useful, and to specify how it is done.

The data production process should include functions to preserve MRN IDs of scale independent features from original source to all derived products. The process should consider the intent of objects, for example, if the purpose is to describe the same physical phenomenon, and the instance uses the original feature as a starting point, the ID should be preserved. It is not required to preserve the MRN of scale dependent features, unless the Product Specifications or data producer considers such preservation useful.

Annex A - Example

Examples of how MRN Persistent Unique Identifiers from another domain may look when included among the MRN IDs generated by the product producer;

Feature: Recommended Track
- *Attribute*: category of recommended track: Based on a system of fixed marks
- *Attribute*: orientation: 270 degrees
- *Attribute*: MRN: urn:mrn:iho:hydro:jsho:12345678

Feature: Navigational Line
- *Attribute*: category of navigation line: leading line bearing a recommended track
- *Attribute*: orientation: 270 degrees
- *Attribute*: MRN: urn:mrn:iho:hydro:jsho:87654321

Feature: Landmark
- *Attribute*: category of landmark: tower
- *Attribute*: function: light support
- *Attribute*: MRN: urn:mrn:iala:aton:jscg:54321678

Feature: Light
- *Attribute*: category of light: leading light
- *Attribute*: colour: white
- *Attribute*: MRN: urn:mrn:iala:aton:jscg:45678123

Feature: Range System
- *Attribute*: name: Micklefirth approach range
- *Attribute*: MRN: urn:mrn:iho:hydro:jsho:23456781
- *Aggregation*: Range System Aggregation
  - Consists of: MRN: urn:mrn:iho:hydro:jsho:12345678
  - Consists of: MRN: urn:mrn:iho:hydro:jsho:87654321
  - Consists of: MRN: urn:mrn:iala:aton:jscg:54321678
  - Consists of: MRN: urn:mrn:iala:aton:jscg:45678123

Annex B - IHO Publications

It is recommended that IHO assign MRN identifiers for IHO Publications. It is recommended to have a distinct sub-namespace for publications, followed by a few distinguishing characteristics for the individual publication to make the MRN ID globally unique. The following MRN format is recommended:

urn:mrn:iho:pub:<publication type>:<publication name and/or number>:<edition number>:<revision number>:<clarification number>:<optional and additional version information>.

This makes 'pub' a designated namespace for publications, and means that any parts of the identifier that comes after indicate the type and name of the IHO publication. The optional section and additional version information may be used for additional namespaces as needed, or omitted.

IHOs current publication types and proposed codes for these are:

- Bathymetric Publications - bathy;
- Capacity Building Publications - cb;
- Miscellaneous (Base Regulatory Publications) - reg;
- Periodic Publications - per;
- Standards and Specifications - spec.

Example:

The standard S-57 edition 3.1 with supplement 3 would be given the following MRN identifier:	urn:mrn:iho:pub:spec:s57:3:1:supplement3

Note that S-57 uses a version numbering system that is different from S-100.

Annex C - IHO products

For IHO data products it is recommended to have a namespace for products. The following MRN format is used:

urn:mrn:iho:prod:<product name>:<edition number>:<revision number>:<clarification number>:<optional and additional information about related specification>.

This makes 'prod' a fixed namespace for products, and means that any part of the identifier that comes after, indicate the type and name of the IHO product. The optional section and additional version information may be used for additional namespaces as needed, or omitted.

Examples:

For S-64 ENC test dataset version 3.0.1, unencrypted, used for the power up check the ID could be:	urn:mrn:iho:prod:s64tds:3:0:1:unencrypted:powerup
For IHO INT3 version 3.5, Lowesmouth to Port Rimon panel, scale 1:19000, the ID could be:	urn:mrn:iho:prod:int3:3:5:19000

Note that the MRN for the Product Specification should be included in the specification.

Annex D - Hydro products (member state level)

A unique identifier for hydrographic related elements should be assigned by the responsible Authority on a national basis.

When referenced outside the context of the producer/authority, the identifier should be prefixed using the Maritime Resource Name syntax, with the prefix:

urn:mrn:iho:hydro:<S-62>:<NationalIdentifier>

where the <S62> identifier uses the IHO S-62 standard's codes for the producers.

The National authority responsible for hydrography must ensure, that the <NationalIdentifier> is unique within the national domain, and that the syntax of the <NationalIdentifier> complies with the general MRN guidelines.

Example:

urn:mrn:iho:hydro:us:va:1234-5

denotes the hydrographic element with identifier 1234-5 in the state of Virginia, defined by the hydrographic authority of the United States of America.

When referenced within the context of the national authority, only the national identifier is required (e.g. va:1234-5).

Product Specifications that relate mainly to hydrography may give additional guidance for how to manage identifiers for related elements.

Annex E - Nautical publications (member state level)

A unique identifier for nautical publication related objects should be assigned by the responsible Authority on a national basis.

When referenced outside the context of the producer/authority, the identifier should be prefixed using the Maritime Resource Name syntax, with the prefix:

urn:mrn:iho:npub:<S-62>:<NationalIdentifier>

where the <S62> identifier uses the IHO S-62 standard's codes for the producers.

The National authority responsible for nautical publications must ensure, that the <NationalIdentifier> is unique within the national domain, and that the syntax of the <NationalIdentifier> complies with the general MRN guidelines.

Example:

urn:mrn:iho:npub:us:md:1234-5

denotes the nautical publication object with identifier 1234-5 in the state of Maryland as defined by the nautical publication authority of the United States of America.

When referenced within the context of the nautical publication authority, only the national identifier is required (e.g. ma:1234-5).

Product Specifications that relate mainly to nautical publications may give additional guidance for how to manage identifiers for related elements.

Annex F - Registry of reserved codes

The following codes are reserved from other use within the urn:mrn:iho name space.

JS – Reserved producer code meant to represent the fictitious nation of Jussland use for test data. Code follow the present (2019) format of S-62.

JS01 - Reserved producer code meant to represent the fictitious nation of Jussland use for test data. Code follow the proposed new format (S-100WG3) of S-62.