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Technical Domain / Task Number 2 Radionavigation services / 7.1.2

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Proposal for the design concept of an integrated data model for S-200 PNT station almanac

# Summary

At ENG20, an approach for the integration of S-200 series product specifications in the PNT domain was discussed, and consensus was reached to consolidate the existing S-200 PNT product specifications into the S-20X PNT Station Almanac and S-20X PNT Grid Data. Accordingly, the results of the design concept for the integrated development of the S-200 PNT product specifications are to be shared with the Committee for discussion.

## Purpose of the document

We analysed the current status of PNT S-200 series and S-100 standard for the integrated development of S-200 series data models in the PNT domain and shared the results of the design concept.

## Related documents

* S-100 IHO Universal Hydrographic Data Model (Edition 5.2.0, June 2024)
* S-97 IHO Guidelines for Creating S-100 Product Specifications (Edition 1.1.0, June 2020)
* S-240 DGNSS Station Almanac
* S-246 eLoran Station Almanac
* S-247 Differential eLoran Reference Station Almanac
* ENG20-3.1.2.9 Proposal for the integration of PNT related S-200 series product specification
* ENAV20-13.19 Application case of S-240 DGNSS Station Almanac

# Background

IMO announced at the 108th session of the Maritime Safety Committee (MSC 108) in May 2024 that ECDIS equipped with S-100 functionality may be optionally installed from 2026 and will be mandatory for new systems from 2029. With the advancement of the maritime industry, the development of autonomous and unmanned vessels is being promoted, and the digitalization of maritime information to support these developments is accelerating, increasing the importance of standardization of such information. Accordingly, IALA is responsible for developing and managing S-200 product specifications to digitalize aids-to-navigation (AtoN) information. The ENG Committee is tasked with developing product specifications for AtoN information related to PNT services.

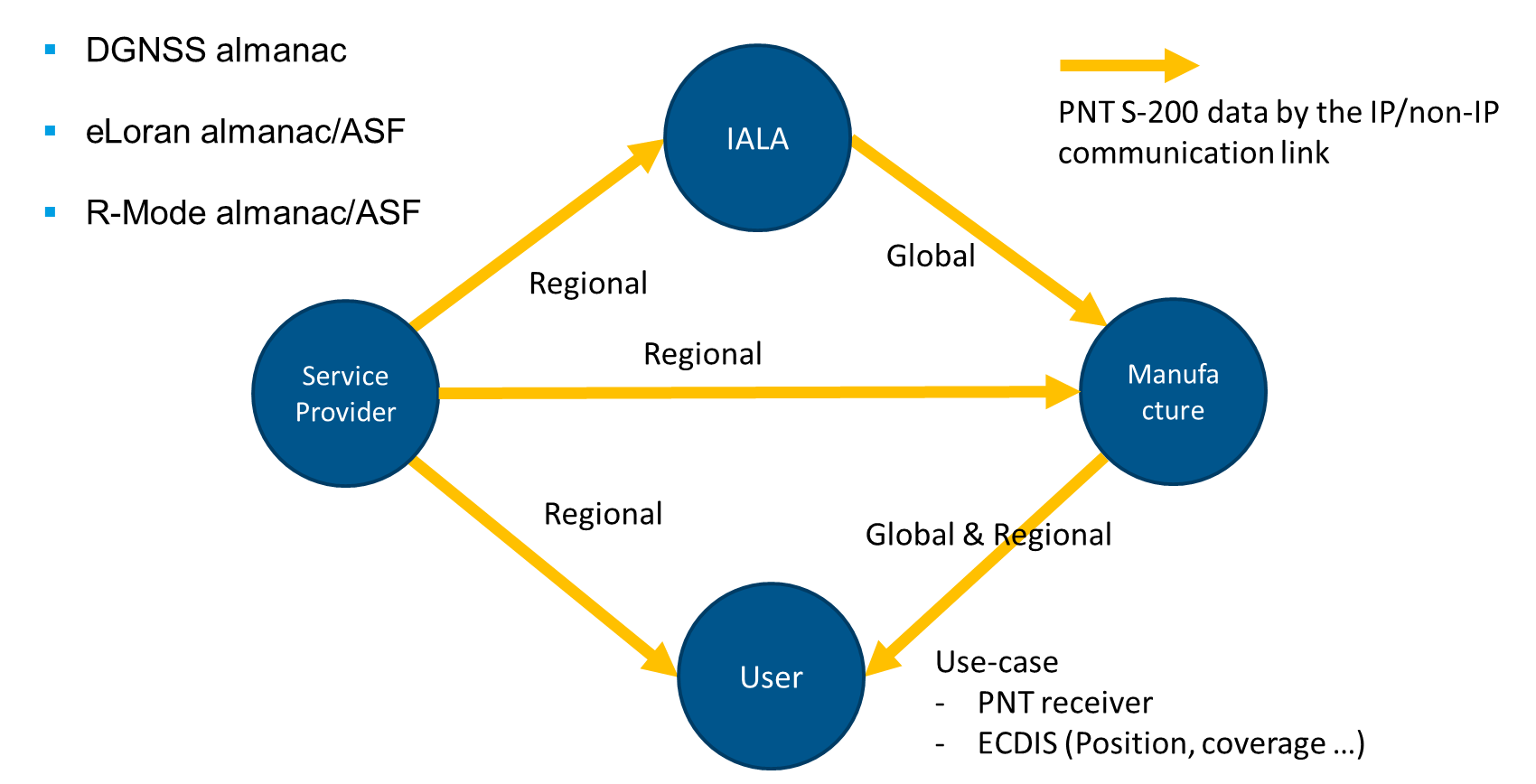
The development of PNT-related product specifications is expected to be useful for the electronic exchange and management of PNT service information, including DGNSS and eLoran. In particular, standardization of information allows a shift from manual management to automated management using machines, reducing human intervention. Furthermore, by minimizing errors in information, the reliability of data can be enhanced. Compatibility with S-100 enables data interoperability with ECDIS, and integration with VTS and MASS is expected to support monitoring and safe navigation. In e-Navigation and Maritime Domain Awareness (MDA) systems, linking PNT service information can also facilitate situational assessment and decision-making.

To support the digitalization of maritime information in the PNT domain, the IALA ENG Committee has developed trial versions of S-200 series product specifications. PNT-related S-200 specifications include S-240 (DGNSS Station Almanac), S-246 (eLoran transmitting station), and S-247 (dLoran station) for Station Almanac, and S-245 (eLoran ASF data) for grid data. As additional PNT-related product specifications, such as R-Mode, are expected to be developed in the future, the integration of similar product specifications has been proposed to facilitate maintenance and improve information management efficiency. At ENG20, the Committee discussed approaches for integrating PNT-related product specifications, including their architectural design.

Figure 1 illustrates the architecture of S-200 product specifications related to PNT, comprising IALA, service providers, manufacturers, and users. Service providers generate, provide, and manage data for PNT services in their respective regions. IALA collects PNT data from regional service providers and manages and distributes global PNT data. Manufacturers produce PNT-related systems and devices, obtaining the necessary PNT data from service providers and IALA. Users are the end users of PNT data, which may include PNT receivers or ECDIS. More broadly, users may also include any institutions or systems requiring PNT data.

The currently developed product specifications share the same architecture as shown in Figure 1, and their data aspects also share similarities, particularly the Station Almanac, making integration of product specifications feasible. However, S-245 differs from the Station Almanac as it represents grid data, requiring a separate product specification. Based on these discussions, ENG20 reached a consensus to consolidate PNT product specifications into two main categories: PNT Station Almanac and PNT Grid Data.

Therefore, this input paper proposes and seeks to discuss a design concept for the integration of the data model for PNT Station Almanac.



1. Architecture of PNT S-200 series

# Discussion

## Data Model for Stations in the S-101 ENC Standard

S-101 ENC includes feature types for various topographic and hydrographic objects and is considered the base product in shipborne navigation systems, such as ECDIS, interoperable with the S-100 series developed by IHO and the S-200 series product specifications developed by IALA.

However, the Station Almanac product specifications developed to date by the IALA ENG Committee have shown limited consistency with the S-101 ENC data model. Therefore, the current Station model in S-101 ENC can be taken into account to explore an integrated data model for PNT Station Almanac.

In S-101 ENC, the Radio Station feature type is used to represent stations that transmit radio signals. The definition of the Radio Station feature type, as registered in the IHO GI Registry, is as follows:

* Radio Station: A place equipped to transmit radio waves. Such a station may be either stationary or mobile, and may also be provided with a radio receiver.

The attributes used to describe the Radio Station feature type are as follows, with the definition of each attribute registered as indicated:

* Interoperability Identifier: A common unique identifier for entities which describe a single real-world feature, and which is used to identify instances of the feature in end-user systems where the feature may be included in multiple data product types.
* Status: The condition of an object at a given instant in time.
* Periodic Date Range: The active period of a recurring event or occurrence.
* Frequency Pair: A pair of frequencies for transmitting and receiving radio signals. The shore station transmits and receives on the frequencies indicated.
* Fixed Date Range: An active period of a single fixed event or occurrence, as the date range between discrete start and end dates.
* Feature Name: Provides the name of an entity, defines the national language of the name, and provides the option to display the name at various system display settings.
* Estimated Range of Transmission: The estimated range of a non-optical electromagnetic transmission.
* Communication Channel: A channel number assigned to a specific radio frequency, frequencies or frequency band.
* Category of Radio Station: Classification of radio services offered by a radio station.
* Call Sign: The designated call-sign of a station (radio station, radar station, pilot, ...).

The Radio Station feature may include thematic attributes that provide detailed information that include an identification number, status, radio signal frequency, name, estimated coverage range, communication channel, and call sign. In particular, the types of radio stations have been identified as follows:

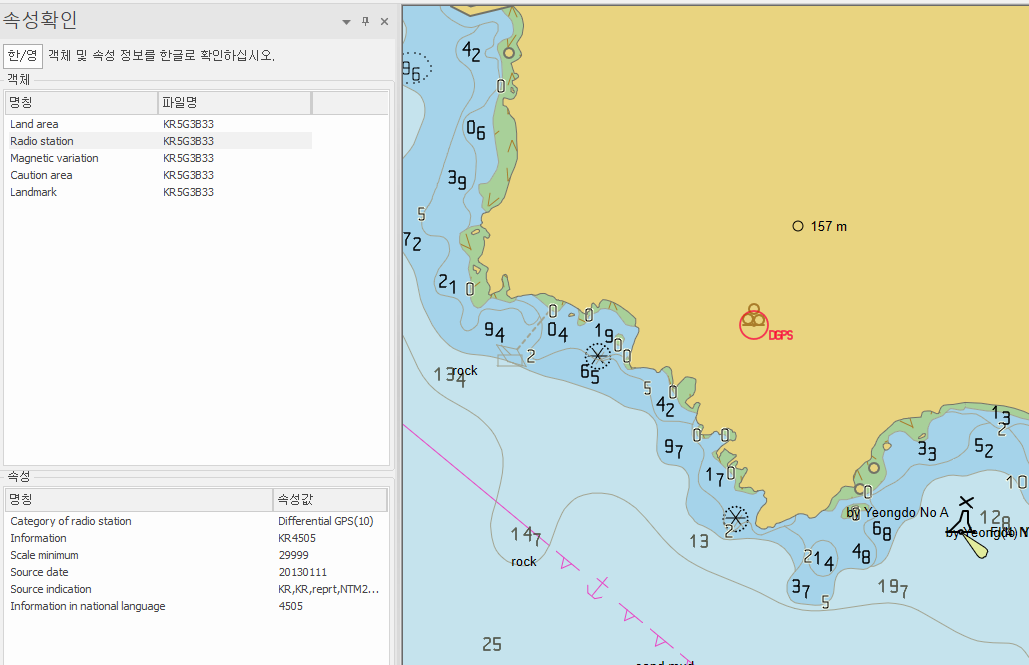
* Category of Radio Station

|  |  |  |  |
| --- | --- | --- | --- |
| **Code number** | **Enumerated value Name** | **Code number** | **Enumerated value Name** |
| 1 | [Circular (Non-Directional) Marine or Aero-Marine Radiobeacon](https://registry.iho.int/fdd/view5.do?idx=2670&type=5&valueType=0) | 2 | [Directional Radiobeacon](https://registry.iho.int/fdd/view5.do?idx=2675&type=5&valueType=0) |
| 3 | [Rotating Pattern Radiobeacon](https://registry.iho.int/fdd/view5.do?idx=2713&type=5&valueType=0) | 4 | [Consol Beacon](https://registry.iho.int/fdd/view5.do?idx=2672&type=5&valueType=0) |
| 5 | [Radio Direction-Finding Station](https://registry.iho.int/fdd/view5.do?idx=384&type=5&valueType=0) | 6 | [Coast Radio Station Providing QTG Service](https://registry.iho.int/fdd/view5.do?idx=2671&type=5&valueType=0) |
| 7 | [Aeronautical Radiobeacon](https://registry.iho.int/fdd/view5.do?idx=2667&type=5&valueType=0) | 8 | [Decca](https://registry.iho.int/fdd/view5.do?idx=2674&type=5&valueType=0) |
| 9 | [Loran C](https://registry.iho.int/fdd/view5.do?idx=2696&type=5&valueType=0) | 10 | [Differential GNSS](https://registry.iho.int/fdd/view5.do?idx=385&type=5&valueType=0) |
| 11 | [Toran](https://registry.iho.int/fdd/view5.do?idx=386&type=5&valueType=0) | 12 | [Omega](https://registry.iho.int/fdd/view5.do?idx=2703&type=5&valueType=0) |
| 13 | [Syledis](https://registry.iho.int/fdd/view5.do?idx=2717&type=5&valueType=0) | 14 | [Chaika](https://registry.iho.int/fdd/view5.do?idx=387&type=5&valueType=0) |
| 19 | [Radio Telephone Station](https://registry.iho.int/fdd/view5.do?idx=388&type=5&valueType=0) | 20 | [AIS Base Station](https://registry.iho.int/fdd/view5.do?idx=389&type=5&valueType=0) |

The “Category of Radio Station” attribute, which identifies the type of Radio Station, currently includes DGNSS but does not cover eLoran stations. It is analysed that by adding the following new codes, the Radio Station feature model used in the S-101 ENC product specification could be leveraged to integrate the S-240, S-246, and S-247 product specifications.

* 21: enhanced Loran Station

Meanwhile, the input of the Radio Station feature in ENC and its symbol representation in ECDIS were examined as follows. The DGPS station located in Busan Port, Republic of Korea, is entered using the Radio Station feature with the “Category of Radio Station” attribute value set to Differential GPS (10), and the corresponding DGPS symbol is displayed on the ECDIS screen.



1. DGPS Station Symbol Display in ECDIS

## Design concept for integration of PNT Station Almanac Product Specifications

To develop an integrated data model for the PNT Station Almanac, including S-240, S-246, and S-247, it is necessary to consider the characteristics of each PNT Station. The DGNSS Station in S-240 and the eLoran Station in S-246 act as transmitting stations that broadcast error correction information or navigation signals, whereas the DLoran Station in S-247 calculates error correction information but does not transmit it directly, instead transmitting through eLoran transmitting stations. These characteristics must be taken into account when designing the data model.

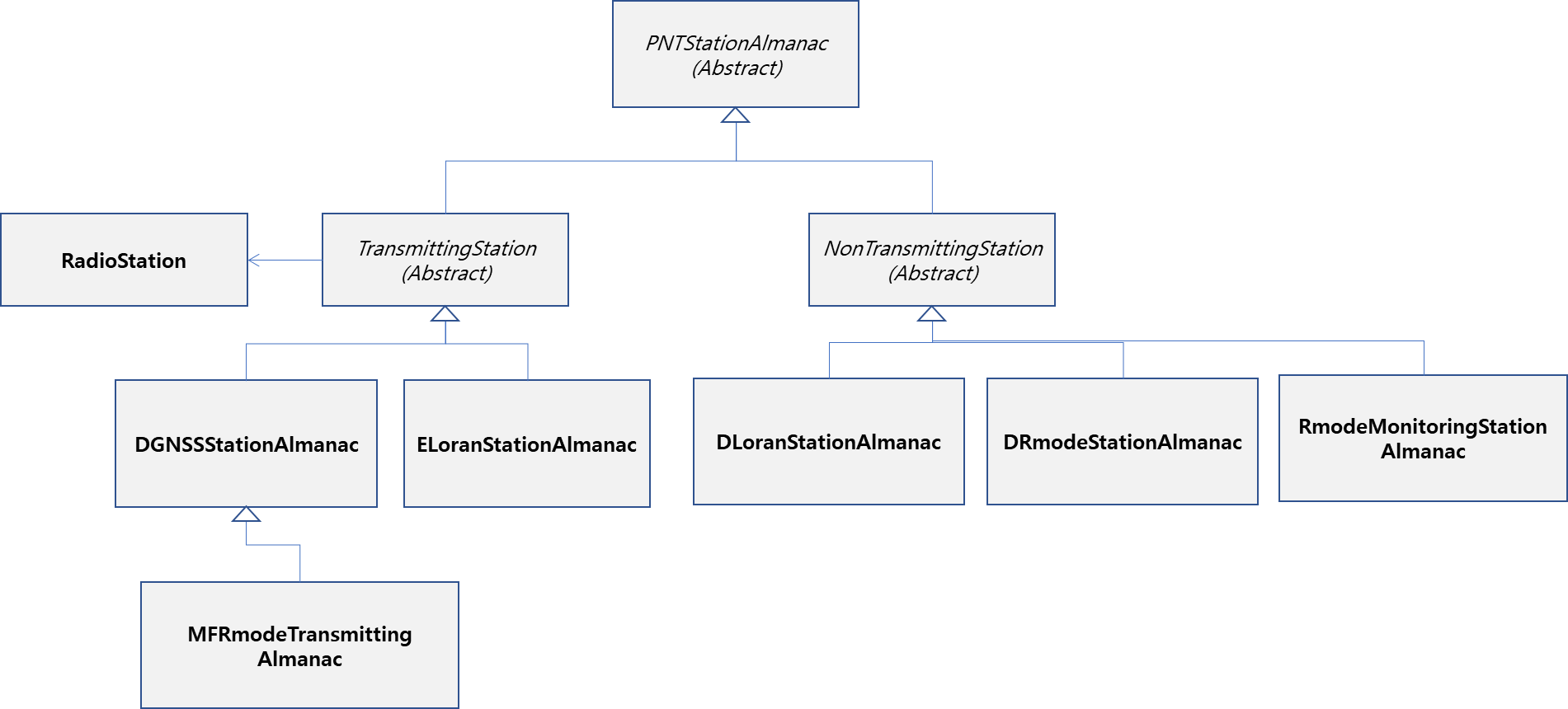
For the integrated PNT Station Almanac data model, a top-level PNTStationAlmanac feature can be defined to include common attributes for all PNT Station Almanacs, allowing inheritance. Depending on whether a station transmits position correction information, abstract classes TransmittingStation and NonTransmittingStation can be established.

Since the transmitting station feature is defined as Radio Station in the S-101 ENC and S-201 AtoN Information data models, all features inheriting from TransmittingStation can be associated with the Radio Station feature. As in the existing S-240 and S-246 data models, the contents of the abstract TransmittingStation feature are inherited to define DGNSSStation Almanac and ELoranStation Almanac features.

Furthermore, since DGNSS Stations may operate as MF R-Mode transmitting stations, a new MF R-Mode Transmitting Station Almanac feature is defined, inheriting from the DGNSS Station Almanac feature in S-240, to accommodate this functionality.

Considering the characteristics of the S-247 DLoran Station, an abstract NonTransmittingStation feature is defined, which can be inherited by features that do not transmit position information. The DLoranStation Almanac is defined as inheriting from NonTransmittingStation.

Additionally, to accommodate the introduction of R-Mode system components, definitions for DR-Mode Station Almanac and R-Mode Monitoring Station Almanac are required. Since these stations do not transmit signals, they can also inherit from NonTransmittingStation, similar to DLoran Stations. Figure 3 presents a proposed design of the integrated PNT data model, which is submitted for discussion.



1. Proposed Integrated Data Model Design for PNT Station Almanac

## Future Plan

As reported at ENG20, the following development schedule is being considered for the integrated PNT Station Almanac Product Specification:

* ENG22: Development and review of the proposed integrated PNT Station data model
* ENG23: Development and review of the proposed PNT Station Almanac Product Specification
* ENG24: Production and verification of S-200 data for the PNT Station Almanac
* ENG25: Development and approval of the operational version of the PNT Station Almanac Product Specification

# Action requested of the Committee

The Committee is requested to consider this input paper, and take actions as appropriate.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-2)
2. Leave open if uncertain [↑](#footnote-ref-3)