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PROPOSALS ON FURTHER IMPROVING THE CONTENT OF DIGITAL WATERWAY GUIDELINE

# 1 Summary

The DTEC Committee is currently developing a new guideline on digital waterways, and after several meetings, great progress has been made in the development of the guideline as of the latest inter-sessional meeting of the DTEC 3 held in November 2024. While most of the draft guideline has been completed, but there are still a few parts need to be improved.

## 1.1 Purpose of the document

This paper aims to supplement and improve the draft digital waterway guideline formed in the latest inter-sessional online meeting of DTEC Committee WG1 held in November 2024.

## Related documents

Draft guideline on digitalization of waterways formed in the latest inter-sessional online meeting held in November 2024.

# Background

According to the IALA work programme 2023-2027, the DTEC Committee plans to develop a new guideline on digital waterways, which has initially formed a framework and is at the stage of supplement and improvement.

# Discussion

This paper aims to supplement the content of Chapter 7 on the basis of the latest draft guideline formed in November 2024 and suggest that the new contents be included in the draft guideline

## 3.1 Supplement the Content of Chapter 7.1

Chapter 7.1 of the latest draft guideline aims to explain the concept of electronic fence. This paper suggests that electronic fence can be defined as follows:

Electronic fence: The application system of water electronic fence is a new model of AtoN services. It can provide intelligent navigation assistance, warnings or alerts to ships by setting up perception methods such as AIS, radar and CCTV, thereby increasing the content of AtoN services, diversifying maritime supervision and management methods, and further ensuring the safety of ship navigation in water areas.

At the same time, Chapter 7.1 of the latest draft guideline hopes to discuss whether the term "intelligent AtoN" or "digital AtoN" should be used to describe future AtoNs. This paper suggests to go with "digital AtoN" for the following reasons:

a. According to the current development status of AtoNs, it still focus on collecting all kinds of environmental data that is helpful for ship navigation through the installation of various sensor devices, which needs to be judged manually, and has not yet reached the stage of intelligent analysis and processing.

b. This guideline is mainly about the digitalization of waterways, and choosing "digital AtoN" is more in line with the theme of this guideline.

## 3.2 Supplement the Content of Chapter 7.3

Chapter 7.3 of the latest draft guideline mainly discusses digital/intelligent AtoNs. The framework of the chapter has been established, but many specific contents still need to be supplemented. This paper suggests that the vacant contents of this chapter can be supplemented as follows:

(1)Technical advantages of digital/intelligent AtoNs

There are few fixed objects in the sea, especially in coastal waterways, and floating AtoNs are generally set within the waterways. Digital/intelligent AtoNs utilize the existing point resources of navigation aids and possess inherent resource advantage. Digital/intelligent AtoNs are generally set in important water areas such as entrances, turning points, and warning zones. Compared with remote sensing and modeling, digital/intelligent AtoNs can more directly and accurately collect real-time water depth, water quality, hydrology, meteorology, visibility, and related information of ships by installing sensor facilities on traditional AtoNs.

(2) Application scenarios

a.Navigation assistance function: By installing hydrological and meteorological sensors on AtoNs, the navigation assistance function of AtoNs can be extended to collect relevant information and provide hydrological and meteorological navigation assistance services such as wind speed, wind direction, current speed, and current direction for surrounding ships.

b. Monitoring function: According to the requirements, CCTV, small radars, sonars, and other sensor facilities can be installed on AtoNs to utilize them as important monitoring points on the water to identify ships, offshore facilities, and marine organisms to provide monitoring information services to relevant users.

c. Decision support function: Installing small AIS base stations on AtoNs in the edge waters of AIS base station coverage or in waters with weak AIS signals can expand the coverage of AIS, avoid time slot conflicts in waters with high ship density, prevent the occurrence of "invisibility" situations, and achieve traffic flow observation, which can provide decision-making references for maritime VTS. In addition, hydrological, meteorological, visibility, wave height, and other navigation assistance service information can provide decision-making references for ship management, dispatching, emergency search and rescue, etc. It can also provide important decision-making information for pilotage and maritime management departments to determine whether to enter or leave the port, berth or unberth, and whether pilots should board or disembark. Decision support also includes dredging decision support, seabed evolution analysis and dredging area positioning.

d. Application of digital wireless access communication system in the transmission of digital/intelligent AtoNs: Maritime communication mainly utilize satellite communication, combined with the application of VHF to achieve the communication between ships and shore. Due to the high cost of satellite communication and the limitation of VHF in data transmission, communication between shore and ships has always been the main bottleneck of maritime communication systems. Based on the demand for maritime communication, coastal AtoNs have the characteristics of wide distribution within the waterway range, proximity to the waterway, and existing energy supply, they have natural advantages as a platform for carrying maritime communication sub-base stations, and can serve as a platform for maritime communication base stations to establish a high-speed data transmission network covering the entire maritime waterway.

(3) Considerations for service provision

a. Data flow: Information collection terminals collect information around the AtoNs and transmit the information to the information integration terminal in a centralized manner.The information integration terminal decodes and preprocesses the data information generated by each information collection terminal on the AtoN. According to the needs, the required data can be re-encoded and forwarded to specific local information communication terminals, and all data can be encrypted and transmitted to the information service system through 4G/5G mobile communication terminals. Navigation function-related information can be broadcast or addressed to surrounding ships through the AIS terminal. The energy system is connected to the information integration terminal, which supplies power to the information collection terminal and the information communication terminal, and the information integration terminal can manage each power-consuming device. The shore-based data center receives and stores the complete data flow and can provide it to third parties for retrieval through the API data service interface of the data center as needed.

b. Service mode: Based on the standardization and universality of AIS, the AIS short message service mode should be adopted to offer extended navigation assistance services to regional ships.

c. Information Category: The navigation-related information of digital/intelligent AtoNs can be mainly broadcasted through physical AIS AtoNs by the following messages to provide extended navigation services for nearby vessels:

1) Message 21 - Identification of AtoNs and current geographical position status ;

2) Message 8 - Meteorological and hydrological data or other IMO information;

3) Message 12 and 14 - Navigation hazard information;

4) Message 6 - Binary custom message information.

d. Information Transmission Frequency : According to the AIS message transmission rules that vessels must receive a message at least once during their passage through an AtoN, the following transmission frequencies are recommended:

Figure 1 AIS message transmission frequency

|  |  |  |  |
| --- | --- | --- | --- |
| NO. | Message type | Recommended sending interval（minutes） | Optional recommended interval（minutes） |
| 1 | 21 | 3 | 3，5，6，10 |
| 2 | 8 | 10 | 3，6，10，15，30 |
| 3 | 12 | 10 | 3，6，10，15，30 |
| 4 | 14 | 10 | 3，6，10，15，30 |
| 5 | 6 | 10 | 3，6，10，15，30 |

e. Data Service Interface: After receiving the sensor data collected by one or more digital/intelligent AtoNs, the shore-based data center should store the data according to their positions and the information content collected by the sensors. Meanwhile, API interfaces should be developed in the background system to provide location-based multi-information services to other relevant users on the shore.

f. Information Security: It is recommended to refer to the ISO27001 document "Information Security Management System" for management.

(4) Design Requirements

a. Adaptability principle: Digital/intelligent AtoNs should adapt to the current situation, development needs and planning of the waterway. They should conform to the characteristics of the waterway area, be planned in a coordinated manner, be adapted to local conditions, focus on practical results, and be moderately advanced.

b. Functionality principle: The design of digital/intelligent AtoNs should fully consider the direction and depth of the waterway, while also taking into account the correlation and support of port conditions, meteorological environment, hydrological characteristics, and vessel types. The functions of the waterway, vessels, and shore-based facilities should be linked and coordinated.

c. Economic principle of: Under the premise of ensuring the basic functions and performance of digital/intelligent AtoNs, cost-effectiveness should be fully considered. New technologies, materials, and processes should be utilized to optimize the design plan and select cost-effective facilities and equipment, ensuring the rationality of investment and the sustainability of returns, and meeting the sustainable development needs of digital waterway management and vessel operations.

d. Expandability principle: Digital/intelligent AtoNs should not only have the current required functions but also have expandability and extensibility. They should have the ability to upgrade technology and expand functions to meet the possible new application needs in the future and adapt to the changes in future technological development and waterway management requirements.

e. Standardization principle: Uniform design specifications, management and maintenance, and technical standards should be followed, as well as the involved status information, communication protocols, data formats, and equipment interfaces, to ensure seamless connection and data exchange between different manufacturers and types of digital/intelligent AtoNs. The data and transmitted information of digital/intelligent AtoNs should be uniformly encoded and standardized to facilitate information identification, processing, and analysis.

(5) Location Selection

a. Important ports, waterways, and navigation routes: Important ports and waterways have high vessel traffic volume and navigation density. The installation of digital/intelligent AtoNs helps optimize vessel passage routes, reduce waiting time, improve waterway navigation efficiency, enhance the navigation capacity and service level of important ports to promote the prosperity and development of port economies.

b. The narrow waterways: Narrow waterways have limited space, and vessel navigation often requires waiting, coordination, or may lead to accidents such as collisions and grounding. Digital/intelligent AtoNs can monitor waterway boundaries and vessel traffic in real time, promptly detect and handle potential problems, and ensure the smooth and safe passage of the waterway.

c. Entrances and turning points: Waterway entrances are critical areas for vessels to enter or exit the waterway, often with complex currents and heavy traffic. Digital/intelligent AtoNs can provide real-time information on the position, width, and depth of waterway entrances, helping vessel operators accurately identify the entrance location and guide vessels to enter or exit the waterway smoothly, reducing the time spent waiting and wandering in the entrance area and avoiding entering dangerous areas or collisions. At waterway turning points, vessels need to adjust their course to adapt to the new waterway direction. Digital/intelligent AtoNs can provide accurate information on the position, turning angle, and conditions of the waterway ahead, helping vessel operators prepare in advance and adjust their course to ensure a smooth and safe passage through turning points.

d. Areas with significant changes in water flow such as reefs and shoals: The water flow in reef and shoal areas is complex and varied, and there may be obstacles such as hidden reefs and shallow areas, posing a threat to vessel navigation. Digital/intelligent AtoNs can provide real-time key navigation information such as water depth, current, location of obstacles, and flow velocity and direction in these areas, helping ship operators identify dangerous waters, determine current changes, accurately assess the waterwayand its surrounding conditions, plan and formulate safe and efficient navigation routes, and effectively avoid incidents such as collisions and grounding.

e. Areas with environmental monitoring requirements: Some areas of the waterway have complex natural conditions and sensitive ecological environments. Digital/intelligent AtoNs integrate multiple sensors and can monitor environmental factors such as water quality in real time, providing accurate environmental data support for management departments. This helps prevent pollution spread, strengthen the protection of the ecological environment around the waterway, and is of great significance for assessing the environmental conditions of the waterway, predicting environmental changes in the waterway, and formulating environmental protection measures.

f.Accident-prone areas: Digital/intelligent AtoNs can monitor navigation information such as water flow, wind direction, visibility, and the navigation trajectories of ships in real time. In accident-prone areas, obtaining navigation information will help ships identify risk factors, issue warning signals to ships, and conduct targeted ship maneuvering, effectively avoiding or reducing the occurrence of accidents. The use of digital/intelligent AtoN sensors and data analysis technology can also provide an important basis for management departments to discover accident patterns, judge accident trends, quickly dispatch rescue forces, shorten rescue time, improve rescue efficiency, provide accident analysis data, and determine maritime liability for accidents.

g. Dense traffic areas: In dense traffic areas, the volume of ships is large, and the navigation risk increases accordingly. Digital/intelligent AtoNs, based on real-time monitoring of traffic volume and ship dynamics, can also integrate traffic management systems to monitor the volume and navigation status of ships in the waterway in real time, guiding ships to pass through traffic-intensive areas more efficiently and orderly, reducing navigation delays and traffic congestion, which can help improve the passage capacity and utilization of the channel.

h. Waterway warning areas: Setting digital/intelligent AtoNs in warning zones can clearly mark dangerous areas or elements that require special attention, guiding ships to travel along the designated route and speed, reducing the crossing and mutual interference between ships, which can remind ship operators to operate carefully to avoid collisions, grounding and other accidents.

# 4 PROPOSALS

To sum up, this paper puts forward the following suggestions for improving the content of the draft digital waterway guideline:

a. Considering the explanation and definition of electronic fence provided in this paper, it is proposed to include it in Chapter 7.1 of the draft guideline.

b. Considering the explanation for the selection of the term “digital AtoN” in this paper, it is suggested that the relevant terms in the guideline should be uniformly revised to "digital AtoN".

c. Considering the supplementary content of this paper on the application scenarios, service provision considerations, design requirements and location selection of digital AtoNs, it is suggested to include these supplementary contents in Chapter 7.3 for description. The revised text is shown in the annex.

# 5 REFERENCE

Draft guideline on digital waterways developed at the latest inter-sessional online meeting held in November 2024.

**6 Actions requested OF the CommiTTEE**

The committee is invited to consider the discussion and proposals above when developing the new draft guideline on digital waterways, and take actions as appropriate.

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