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Agenda item [[2]](#footnote-2) 3.1

Technical Domain / Task Number 2 ……………………………

Author(s) / Submitter(s) ……CHINA MSA……

PROPOSAL FOR THE REVISION OF GUIDELINE “G1008 REMOTE CONTROL AND MONITORING OF MARINE AIDS TO NAVIGATION”

# Summary

The 78th session of the IALA council approved the work plan of the Committee for the period 2023-2027, and the guideline “G1008 Remote Control and Monitoring of Marine Aids to Navigation” is included the Committee work program. In accordance with the work arrangements of the 20th ENG meeting, the China MSA has put forward amendments to the guideline G1008 for the reference of the ENG Committee.

## Purpose of the document

This proposal aims to refine and supplement the content of Sections 3.1, 7.4.3 and 7.4.4 in the guideline “G1008 Remote Control and Monitoring of Marine Aids to Navigation*”.* In Section 3.1, considering the objectives and purposes of adopting a RCMS System, seven questions are listed but not yet explicitly answered. This proposal provides supplementary suggestions for each of these questions. Additionally, this proposal supplements the section 7.4.3 with emerging communication technologies in cellular telephone communication systems and the section 7.4.4 with application cases of Beidou-3 short message technology in the satellite communication system in the field of remote control and monitoring of maritime AtoN. It offers basic decision-making and performance reference standards for AtoN authorities of all Member States when they are constructing new systems or updating existing ones. This helps readers to gain a foundational understanding of the system and better develop effective modernized systems.

## Related documents

1. G1008 Remote Control and Monitoring of Marine Aids to Navigation (Edition 2.1, June 2009)

# Background

The guideline G1008 was established in 1998. With the rapid development and widespread application of technological advancements, the cost of remote monitoring and control has been significantly reduced. In 2005, the guideline was revised to reflect IALA documents. In 2009, the guideline was updated and reviewed to reflect the progress in the field of monitoring since their compilation. In 2022, the guideline was re-edited and corrected. Some sections of the guideline, which cover the purpose of remote monitoring and control as well as technical aspects, are still in the process of being enriched and perfected.

# Discussion

## Supplement Chapter 3 "Purpose"

In Section 3.1 of Chapter 3, the seven questions that need to be considered when adopting a RCMS System have not yet been explicitly answered. This lack of clarity has not helped the AtoN authorities gain a clear understanding of the purpose, function, and usage standards for adopting a RCMS System. Therefore, the following text attempts to address these questions in sequence, hoping to provide assistance to AtoN authorities when constructing new systems or updating existing ones.

* Why monitor?

It is recommended that the following additions be made:

## 3.1.1 The monitoring of navigational beacons can achieve the following

• Improve the service level of AtoN. The RCMS System can help the beacon management authority to grasp the operation status of beacons within the jurisdiction in real time, providing timely, accurate, efficient, and stable AtoN service for ships within the jurisdiction. This is crucial to the safe navigation of ships.

• Strengthen the internal maintenance management and improve the availability of beacons.

* 1. With remote-control telemetry, the beacon management authority can shift from a passive maintenance approach to proactive prevention,ensuring the full functionality of beacon facilities.
  2. Real-time monitoring data helps minimize navigational risks and ensure that routine maintenance is more targeted. This improves the efficiency of the beacon management department, maximizes the Mean Time Between Failure (MTBF), and reduces the Mean Time to Repair (MTTR).

• Reduce maintenance costs in a more targeted and purposeful manner.

* 1. The RCMS can help the management authority to rationally arrange the maintenance plan and improve the utilization efficiency of maintenance resources.
  2. It reduces the workload of maintenance personnel, the number of unnecessary inspections, and the waste of resources such as manpower, material resources, and ship operation and maintenance. It also decreases the work intensity of maintenance personnel and the time of beacon out-of-service caused by on-site maintenance.

• Promote the informatization and intelligent construction of beacon system. The RCMS System collects data over time. This data includes information about ports, waterways, environmental impacts, equipment failure frequency, and equipment lifespan. It can identify areas where failures often happen or where equipment is damaged. This information can help improve beacon distribution, technology, resource utilization. It can also guide future investments and improvements.

• Lay the foundation for continuous improvement of beacon quality. Through monitoring data analysis and evaluation, the effectiveness of beacon maintenance quality improvement is continuously adjusted to enhance various procedures of beacon maintenance quality management.

* What aids and systems should be monitored and at which detail level (system components, number of parameters)?

It is recommended that the following additions be made:

## 3.1.2 AtoN and core parameters to be monitored

• AtoN management authorities may prioritize monitoring based on the complexity and the significance of AtoN in navigation services. Key AtoN categories include but are not limited to: fixed aids, floating aids, radio aids (such as RACON and AIS), aids on offshore structures, and aquaculture zone markers. Selective monitoring should follow this priority sequence:

* 1. AtoN in important ports, key waterways, and high-traffic density areas within jurisdiction;
  2. AtoN in high-risk waters, including channel entrances/turning points, narrow channels, reef shoal areas with significant current variations, coastal/island locations, and offshore structures;
  3. AtoN operating in harsh environmental conditions with high damage risks that could significantly affect service availability;
  4. AtoN in waters with inadequate positioning/navigation systems or requiring enhanced visual effectiveness due to unstable radio signals or coverage gaps;
  5. Unmanned aids on offshore structures including but not limited to: oil/gas platforms, offshore wind farms, wave energy converters, aquaculture installations, and meteorological towers.

• Core parameters for AtoN monitoring should establish operational status baselines and alarm thresholds, including but are not limited to:

* 1. Positional data: Latitude/longitude, drift distance;
  2. Light characteristics: Light pattern, color, intensity, and daylight sensor threshold;
  3. Power status: Operating voltage/current of solar panels and battery systems;
  4. Visual appearance: Chromaticity and saturation of markings;
  5. Radar transponder and AIS signal status: Radar coding scheme, communication frequencies.

## 3.1.3 Systems and detailed parameters to be monitored

• The systems to be monitored include, but are not limited to, Supervisory Control and Data Acquisition (SCADA) systems, Automatic Identification Systems (AIS), mobile query systems, other auxiliary subsystems, and database systems. It is recommended to monitor parameters that may be affected by communication issues, environmental factors, data timeouts, etc., including but are not limited to:

* 1. Supervisory Control and Data Acquisition (SCADA)System: Monitor information and data of PLC and RTU, including the rate of RTU installation, installation location, accuracy, operating time, energy status, communication status, communication link availability verification data, hardware failure rate, etc.
  2. Automatic Identification System(AIS): Monitor basic information of AIS AtoN, additional status information,meteorological and hydrological data parameters, etc.
  3. Mobile Query System: Monitor parameters obtained by handheld detectors for AtoN, including lamp replacement status, location, voltage, energy consumption, charging current, etc.
  4. Other Auxiliary Subsystems: Meteorological and hydrological information systems, image recognition technology systems, vessel transit systems, personnel intrusion alarm systems, fire detection equipment, etc. Monitoring parameters include, for example, temperature, humidity, wind speed, physical damage, and corrosion degree, etc.
  5. System Database: Monitor the operating status of data servers (data reception accuracy, data storage capacity, data backup status), data synchronization status, alarm response timeliness, interface compatibility, etc.
* What are the monitoring frequency and tolerable transfer delay?

It is recommended that the following additions be made:

## 3.1.4 The monitoring frequency and tolerable transfer delay

• Suggestions for monitoring frequency:

* 1. Establish clear monitoring frequency requirements for different port and channel grades;
  2. Real-time needs: Adjust dynamically according to vessel traffic and requirements;
  3. Energy consumption and cost: High-frequency monitoring may increase equipment power consumption and network costs.

• Tolerable transfer delay refers to the maximum allowable time for data to travel from the collection point to the receiving point, and special and worst-case scenarios should be analyzed and considered. Comparing operational data, it is suggested that:

* 1. Real-time control systems: Typically require extremely low latency;
  2. Data analysis systems: Can tolerate higher latency (e.g: offline analysis).
* Are control functions required?

It is recommended that the following additions be made:

## 3.1.5 Necessity of the control function

The control function can not only enhance the emergency response capacity of AtoN but also improve the flexibility of AtoN management and support intelligent management. It is of crucial importance for improving the efficiency of AtoN management and navigation safety, and is an indispensable part of the RCMS System.

• It includes but is not limited to remotely operating and adjusting AtoN equipment:

* 1. Remotely control to turn on or off the navigation lights, adjust the brightness or flashing frequency of the lights. It can handle some simple system failures such as restarting the equipment and restoring the initial settings, effectively reducing the number of on - site maintenance. Especially in severe weather or remote areas, it can promptly identify the direct causes of AtoN failures, determine the equipment and materials required for on - site maintenance, avoid increasing unnecessary workload, and significantly improve management efficiency.
  2. Remotely control to regularly issue operation instructions to the data collection terminal to check and control the operating status of the AtoN, and achieve remote observation of the on - site equipment conditions. This is helpful for formulating maintenance plans to maximize the Mean Time Between Failures (MTBF) and minimize the time when the AtoN stops service as much as possible.
  3. Remotely control to modify some basic parameters in real - time. For example, adjust the alarm parameters according to changes in the waterway (such as water level, obstacles), so as to flexibly respond to the changeable characteristics of some complex water areas.

• However, the implementation of the control function also needs to consider the importance of AtoN, data security, reliability, and real-time requirements, etc.

* 1. Importance: For high-risk or high-frequency maintenance areas, the control function is indispensable; conversely, it can be implemented in stages, giving priority to ensuring the core monitoring capabilities and reasonably planning the costs.
  2. Security: Adopt encrypted communication (such as HTTPS, MQTT over TLS), multi-level authority authentication, and operation audit logs to prevent illegal operations.
  3. Reliability: Redundant communication links (satellite+4G), local disaster-tolerance mechanism (automatically restore default settings after power failure).
  4. Real - time: The application of the control function requires a large number of actual measurements to ensure the effectiveness and real-time of the operation.
* Which communications system to use?

It is recommended that the following additions be made:

## 3.1.6 Adopted communication system

The RCMS System typically uses wireless communication as the primary method. In specific scenarios, wired communication networks (such as SDH) may also be employed. It may even integrate various communication technologies, such as Beidou satellite communication, VHF-AIS low-power wide-area Internet of Things (LPWAN), and video communication. Each technology has its unique advantages and applicable scenarios. The communication system can be selected according to the data transmission speed and data volume requirements of the RCMS System, as well as the distance between the system and the main communication network, to ensure the communication and reliability in different environments.

• Communication technologies include but are not limited to:

* 1. Public and private networks: PSTN (Public Switched Telephone Network), Ethernet, Internet, private lines, and ISDN (Integrated Services Digital Network).
  2. Radio links: Transmission is carried out by radio waves. Applications in AtoN usually include very high frequency (VHF), ultra-high frequency (UHF), and microwaves, etc. The VHF-AIS communication method is mainly used for communication between ships and AtoN. The wide-area Internet of Things (LPWAN) has the advantages of low power consumption and low cost, but its transmission rate is low and its real-time performance is weak. It is suitable for AtoN with low power consumption and long endurance requirements, such as battery-powered AtoN that send small data packets regularly.
  3. Cellular mobile communication: GPRS (General Packet Radio Service) and GSM (Global System for Mobile Communications) are network technologies widely used in mobile communication. 3G (Code Division Multiple Access, CDMA), 4G (Worldwide Interoperability for Microwave Access, WiMax), and 5G (the fifth generation of mobile communication technology) have higher data transmission rates, lower latency, and stable wireless communication technologies. They rely on base station coverage and are suitable for offshore or inland waterway AtoN with high data volume requirements.
  4. Satellite communication systems: They have the functions of navigation and short message communication, and are characterized by higher costs of terminal equipment and lower data transmission rates. They are suitable for remote areas or places where the coverage of GPRS/GSM/CDMA signals is insufficient. The Beidou system can provide reliable communication guarantees to ensure the real-time transmission of aids-to-navigation data.
  5. SDH (Synchronous Digital Hierarchy) wired communication network: It has the characteristics of high bandwidth and low latency. It is suitable for scenarios with large data volumes or high requirements for data transmission quality.
  6. Video communication: It is suitable for situations where there are personnel on duty or the operation status of AtoN can be observed through video surveillance.
  7. Hybrid communication systems: When adopting a hybrid communication system, it is necessary to conduct an evaluation in combination with geographical location, data requirements, cost, and maintenance, etc. For example, in the combination of satellite + 4G, it will automatically switch to satellite communication when the 4G signal is lost. Multi-mode communication can improve communication reliability.
* How should it be used - user interface requirements?

It is recommended that the following additions be made:

## 3.1.7 User interface requirements

The system user interface should comply with the interface design principles and the prioritization criteria for each module. The interface design is generally open, simple and intuitive, easy to operate and understand, and has a complete security mechanism. Different permissions are set for different users to ensure data security. The priority of the modules should be prioritized, with priority given to the navigation beacon telemetry and remote control alarm module, real-time data module, prediction information module, and data statistics and analysis module.

• Interface design principles include but are not limited to:

* 1. Simple and intuitive: The interface is clear and easy to understand, avoiding an overabundance of elements and complex layouts.
  2. Information visualization: Intuitively display the navigation beacon status and data through graphics, charts, etc., such as the navigation beacon’s position, light status, etc.
  3. User-friendly: The operation process should be simple and easy to understand, in line with user habits, allowing users to set alarm thresholds such as voltage, current, and position according to actual conditions, while providing necessary prompts and help information.
  4. Real-time and responsiveness: The interface should be able to update the status information of the navigation beacon in real time and respond promptly to user operation instructions.
  5. Security and authority management: The interface should have a complete security mechanism, setting different authorities for different users, and ensure data security.
  6. Scalability: The interface design should consider future functional expansion to facilitate the subsequent addition of new modules and functions.
  7. Standardization and consistency: The layout, color, font, etc. of the interface should be consistent and comply with relevant standards and specifications.
  8. Help and support: Provide detailed user guides and operation manuals to assist users get started.

• Module priority principle includes, but is not limited to:

* 1. Core function priority: Modules such as navigation mark status monitoring, data collection and reporting, remote control command sending, etc. should be designed and implemented first to ensure the basic functions of the system.
  2. Key data priority: Key operating data of navigation marks, such as location, light quality, energy status, etc., should be displayed and processed first to ensure that users can obtain important information in a timely manner.
  3. Security and alarm module priority: Security-related modules, such as instant alarm, abnormality monitoring, etc., should have a higher priority to ensure that users can be reminded in time when abnormalities occur.
  4. User interaction module priority: Modules that directly interact with users, such as query, setting, control, etc., should be optimized first to improve user experience.
  5. Data storage and management module priority: Data storage and management modules should be efficient and reliable to ensure data integrity and traceability.
* Which records should be kept and for how long?

It is recommended that the following additions be made:

## 3.1.8 Recorded Content and Time Period

The recorded content of the RCMS System aims to achieve "information three-dimensional, rapid response, telemetry automation, and standardized management". Data records not only assist the AtoN management authorities in evaluating the effectiveness of AtoN, maintenance efficiency, cost reduction, and subsequent decision-making but also provide data support for the daily management, optimization, and maintenance of the system. Therefore, it is recommended that the recorded data include but are not limited to real time data, traceable data, comprehensive data, sustainable data, etc.

• Real time data needs to be recorded in real time:

* 1. Monitoring parameters of AtoN operation include, but not be limited to light status (working voltage, current, light health status), RTU (intelligent terminal)status,position information,drift distance,environmental parameters (such as light intensity, temperature), and fault alarm information, etc.
  2. All remote control operation instructions for AtoN issued through the system, including but are not limited to operation time, operators, operation objects (AtoN numbers), and operation content (such as turning lights on/off, adjusting parameters), etc.; The above data assist managers in monitoring the operation status of AtoN,maintenance plan formulating, fault analysis and prevention, accident claims, accident liability determination, remote control operation, etc.

• Traceable AtoN maintenance and user operation logs need to be recorded in real time:

* 1. The operation log of beacon maintenance includes, but is not limited to, records of beacon inspection time, inspectors, problems found, treatment measures (such as replacing batteries, cleaning lamps), information of maintenance personnel, and comparison of parameters before and after maintenance.
  2. User operation log includes but not limited to administrator login time, operation instructions (such as remote restart terminal), maintenance records, data modification records. The above logs are helpful for accident claims, internal management, evaluation of the actual effect of the system on extending the inspection cycle, and user behavior analysis and authority management.

• Comprehensive data should be stored for a period that matches the life cycle of the telemetry telecontrol system, or even longer, as historical data. Record the basic database of the characteristics of each beacon and the inventory of turnover equipment, including but not limited to the basic configuration of each beacon and the inventory of beacon equipment. This data storage helps users to have a more comprehensive understanding of beacon information, which can assist decision-making and closed-loop management of beacon maintenance.

• Sustainable data needs to be recorded regularly, including but are not limited to:

* 1. The status of the communication link, including but are not limited to communication time, data transmission amount, data transmission success rate, communication link stability (such as GPRS/GSM signal strength), packet loss rate, and energy consumption, etc.
  2. System performance data, including but are not limited to the response time of the data management platform, database storage status, interface compatibility, system availability, various events during system operation (including system startup, shutdown, abnormal interruption, software update, user login, etc.).
  3. Environmental data, including but are not limited to environmental parameters such as the temperature, humidity, wind speed, wave height, salt spray corrosion in the water where the AtoN is located. The above records are used to analyze the stability of communication links and troubleshoot faults, evaluate system performance, and assess the water environment around AtoN, helping to formulate AtoN management plans.

## Supplement Chapter 7 “Communication Links”

**3.2.1 Cellular telephone systems**

In Section 7.4.3 of Chapter 7, considering that cellular communication has undergone multiple generations of evolution from 2G to 5G, and that 5G technology has become increasingly mature and is being widely deployed globally, it is recommended to add "5G (the fifth generation of mobile communication technology, characterized by higher data transmission rates, lower latency, and greater device connection capacity)" after "Cellular communication can be broken down into the following generations or standards: 2G (GSM, GPRS, EDGE), 3G (CDMA, HSDPA), 4G (WiMax)."

**3.2.2 Satellite communications systems**

Considering that the Beidou Navigation Satellite System offers functionalities including providing positioning, group user management, and precise time service，it not only provides accurate positioning, navigation and time service but also has the function of bi-directional short message communication (Beidou-3 short message service), which can effectively reduce the radio interference problem of AIS broadcasting. Its satellite signals have achieved seamless coverage in all parts of China and most parts of the Asia Pacific region, and can achieve data transmission in areas beyond GPRS signals. It has significant advantages in monitoring range and data reliability, and meets the remote measurement and control management requirements of RCMS System for remote AtoN.

It is suggested to add the following content after section 7.4.4 of Chapter 7, "A number of operators offer services for data transmission via satellites that can be used to provide all the requirements of a remote control and monitoring system. The cost of data transfer has decreased significantly in recent years, making it a more feasible communications option.”

At present, the application of Beidou-3 data transmission in navigation support has been realized in most regions of the Asia Pacific region, providing stable and reliable message communication services for users in the Asia Pacific region.It can realize the real-time transmission of data such as AtoN site location, AtoN working status and surrounding environment to the shore base, which will greatly improve the efficiency of AtoN operation, and meet requirements of RCMS System for controlling remote AtoN.

(See Appendix for details)

# References

1. G1008 Remote Control and Monitoring of Marine Aids to Navigation (Edition 2.1, June 2009)

# Action requested of the Committee

The ENG Committee is invited to consider the recommendations in section 3 on the revision of the guideline “G1008 Remote Control and Monitoring of Marine Aids to Navigation” and take actions as appropriate.

**Appendix**

APPLICATION OF BEIDOU-3 SHORT MESSAGE TECHNOLOGY IN REMOTE CONTROL AND MONITORING FOR NAVIGATION SERVICE

# Summary

This article introduces the application of the Beidou satellite navigation system (hereinafter referred to as the Beidou system), which is independently constructed and operated by China, to support remote control and monitoring for maritime navigation along the coast of China. The Beidou system innovatively integrates navigation and communication capabilities and has the ability to provide message communication services. In July 2020, the Beidou-3 short message service system was officially launched and operated, which can provide users in the Asia-Pacific region with stable and reliable message communication services. The maritime navigation application based on BeiDou short message technology will realize the real-time transmission of data such as AtoN site location, AtoN working status and surrounding environment to the shore base, which will greatly improve the efficiency of AtoN operation, maintenance and promote the application process of Beidou-3 data transmission technology in the field of maritime navigation.

# BeiDou short message technology

The BeiDou Satellite Navigation System (BDS) is a satellite navigation system designed, developed and operated independently by China, with high-quality positioning, navigation and timing services, and is also one of the components of the current global navigation satellite system. BeiDou-3 short message technology is an important feature that distinguishes BeiDou satellite navigation system from other foreign satellite navigation systems. BeiDou short message service has a two-way communication function, which can accurately locate the user's position and report the user's position to the external system at the same time, so as to achieve the purpose of effective combination of positioning and communication. At present, Beidou short message technology has been effectively applied in many different industries. The user identification method of Beidou is card number identification, thus it can effectively receive information within Beidou service range and avoid interference from other users, which is an obvious advantages compared with traditional communication methods.

# Application of Beidou-3 short message technology in RCMS SYSTEM

The BeiDou short massage technology is applied to the construction of RCMS System, which has the function of dynamically grasping the operation status and parameters of the AtoN, and is more conducive to its management. In the communication of AtoN remote control and monitoring system, AIS base station link and communication operator public network are usually utilized, but the areas not covered by both of them have relatively weak signals, which will cause difficulties in the use of remote control and monitoring. The application of BeiDou AtoN remote control and monitoring system can effectively improve the above problems, and has significant advantages in monitoring range and data reliability. During the working process, the voltage, current and position information of lights can be collected, and the above information will be processed by the BeiDou remote monitoring terminal and finally sent to the monitoring center by BeiDou satellite. Through BeiDou AtoN remote control and monitoring system, AtoN management department can monitor AtoN remote monitoring data in time. China has realized 100% installation rate of Beidou for AtoN on public artery, and the number of Beidou remote monitoring AtoNs installed at present is more than 8000.

## Construction of BeiDou short message service system

Before carrying out the BeiDou short message communication service, it is necessary to carry out the construction of the BeiDou short message service system, which receives BeiDou short message information through the BeiDou commanding aircraft and the ground link, and is capable of carrying out services such as short message information forwarding, remote control&monitoring, information sharing, and make effective management and inquiry of user information. The BeiDou short message service system can provide navigation services, formulate a unified framework agreement according to the management requirements, and establish effective links with other industries. For example, it can utilize the BeiDou command aircraft array to interact with the user's cell phone to provide emergency communication support.

## Data types of the Beidou Application Service System

The data types of the Beidou application service system include but are not limited to:

1. Monitoring data, including data monitored by AtoNs, buoys, mobile mapping carriers and so on. Relevant monitoring data are collected and generated by sensors, and monitoring data can be transmitted via mobile communication networks when mobile communication networks are normal, or via the Beidou satellite network, or via the Beidou satellite network when mobile communication networks are interrupted.
2. Control data, including starting and stopping the Beidou communication module on the monitoring equipment, adjusting the frequency, and calling up camera data. Each business system can call the data transmission function of Beidou short message according to the demand, so as to achieve the sending and receiving of control data through the Beidou satellite network when the mobile communication network is interrupted.
3. Basic data, including archival information of water transport objects, user data of management units, administrative division data, management relationship data, Beidou IC card data, real-name information data and Beidou terminal data. Relevant data are generated through system entry or sharing of data from internal and external systems in the relevant industries for the operation of the Beidou application service system.
4. Spatial data, including electronic nautical charts, monitoring point locations, water traffic Beidou terminal locations, AIS locations and other data.
5. Emergency communication data, including three types of data: Beidou short message, short voice and small image. The relevant data are generated by Beidou terminals, compressed and encoded, and then sent to the Beidou application service system through the Beidou satellite network and interconnected with the public network mobile communications.
6. Status monitoring data, including platform operation status, communication link status and other data. The relevant monitoring data are generated by the platform operation management software to realize the monitoring of the overall operation status of the Beidou application service system.

Table 1 Table of data transmission sources

| Number | Source of Data | Data Type | Data Item |
| --- | --- | --- | --- |
| 1 | waterborne transport object | Monitoring of data, transparent transmission of data | AtoN monitoring data, buoy monitoring data, ship position data, ship alarm data, ship-to-shore short message communication data, hydrographic monitoring data |
| 2 | Beidou application service system | Control data | Control data, start/stop data, adjustment frequency data, call camera data, etc. |
| 3 | Waterborne traffic management systems, Beidou application service system | Basic data | Water transport object information, management unit user data, administrative division data, management relationship data, Beidou IC card data, real-name information data, Beidou terminal data, etc. |
| 4 | PRC Ministry of Transport (MOT) | Spatial data | Spatial base map data, geographic information data |
| 5 | Beidou terminal | Emergency communication data | Beidou short message, short voice, small image |
| 6 | Beidou application service system | Condition monitoring data | System operation status data, communication link monitoring data, etc. |

The data resource transmission modes of the Beidou application service system mainly include two modes, real-time data exchange and timed data synchronisation. According to the characteristics of the existing data sources of various types and the requirements for data updating and exchange, and with comprehensive consideration of the network conditions, it is determined that different types of data are transmitted in different data transmission modes, as shown in the table below:

Table 2 Summary of data transmission methods

| Number | Data Type | Transmission Method | Update Frequency |
| --- | --- | --- | --- |
| 1 | Monitoring data | TCP service | RTX |
| 2 | Control data | TCP service | RTX |
| 3 | Basic data | WebService interface | timing synchronisation |
| 4 | Spatial data | File synchronisation, WebService interface | timing synchronisation |
| 5 | Emergency communications data | TCP service | RTX |
| 6 | Condition monitoring data | TCP service | RTX |

The Beidou application service system provides short message basic services for various types of Beidou-3 short message terminals applied in the field of water transport, mainly including Beidou-3 navigation AtoNs, Beidou communication and navigation terminals for ships, MOB equipment for crews, and Beidou-3 hand-held law enforcement terminals used by mobile personnel.

# Form of Beidou-3 short message technology application

# At present, Beidou short message is widely used on the AtoNs, the number of which reaches more than 10,000, mainly including two forms of use.

# The first form is to use the short message digital transmission terminal machine, through the external power supply, using the serial port for data sending and receiving, generally used for lamp posts, lighthouses and some large buoys, as shown in the figure below:



Figure 1 Beidou application scenario (Buoy)

The second form is to use the Beidou short message module, which is integrated into the AtoN light equipment, as shown in the figure below:



Figure 2 Beidou application scenarios (Buoy)

# Typical Equipment Application Cases

# Beidou-3 short message terminal equipment can be divided into the following two types according to different application scenarios, from the most basic functional use to more complex practical applications.

## Single application - upgrading of AtoN remote control and monitoring systems with integrated Beidou lamps

# The navigation service application terminal of Beidou-3 data transmission is installed on light buoys for relevant image monitoring equipment to transmit data such as voice and pictures, real-time picture transmission, and then realize the upgrading of remote control and monitoring management of AtoNs.



Fig. 3 Beidou integrated lamps

With the latest low-power design and excellent energy management system, the Beidou Integrated lamp is highly integrated, lightweight and compact. The excellent optical lens design makes it have better optical performance with larger range and vertical dispersion angle compared with the previous generation. The lamp integrates Beidou-3 AtoN remote control and monitoring terminal, which can monitor the working status of the lamp in real time.

## Multi-functional Application - Digital/Intelligente AtoN Terminal Enriching AtoN Information Acquisition

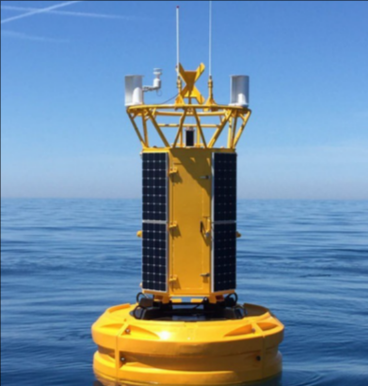


Figure 4 Multi-functional AtoNs

Beidou-3 generation data transmission navigation service application terminal is installed on multifunctional AtoNs integrated with multiple data sensors, such as isolated island light piles or light buoys, and the communication capability of multifunctional AtoNs will be upgraded, while obtaining dynamic data of AtoNs, visibility of the sea area in which the AtoNs are situated, meteorology, hydrography, waves and other data, it will also collect live information such as images of attachments, which will not only realize the function of AtoNs' patrols, but also make use of limited detection resources and adopt an efficient configuration scheme to extend the observation range in time and space. It not only achieves the function of AtoN patrol, but also makes use of the limited detection resources and adopts the efficient configuration scheme to expand the observation range in time and space. It not only fulfills the task of marine environment detection to the maximum extent, but also confirms the forecast of marine weather and sea state through pictures in real time, which changes the data of traditional video monitoring system (image information).

The multifunctional AtoN terminal equipment is designed as an integrated whole structure, which can achieve rapid deployment while effectively guaranteeing the reliability of the system. The equipment integrates AIS, VHF voice, Beidou-3 satellite communication, cellular data communication, edge computing and processing module and power supply system, adopts ultra-low power consumption design, integrates solar energy and battery module, doesn't need external power supply, and can work continuously for more than 25 days in cloudy and rainy days. Intelligent maritime safety service system in multiple devices can achieve data processing through the Beidou or cellular data network, and also compatible with radar, video, sound and light alarms and other functions.

The system can automatically receive the AIS information of the surrounding ships and the water environment information, independently complete the reception, judgement and warning work without relying on the public network, process them in real time at the front-end, and at the same time information can be sent to the back-end data center server through the cellular data network to realize the presentation of the data by the application system. Intelligent maritime navigation system integrates Beidou-3 satellite communication terminal, which can send the working status of the equipment and the navigation data of the neighbouring ships back to the data platform without the coverage of cellular data network.

The system can automatically send AIS safety warning information and hydro-meteorological information to ships; broadcast point-to-side warning reminders and virtual AIS AtoNs on VHF Ch.16 and send them to the backstage data center in real time through the public communication network.

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