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**IALA G1037 Data Collection for Aids to Navigation Performance Calculation——Application of video monitoring, telemetry and remote control system for AtoNs**

# **1 Summary**

## This paper provides the information of China MSA on the application of video monitoring, telemetry and remote control technology to the management and maintenance of AtoNs in the coastal waters of Beibu Gulf of South China's Guangxi Zhuang autonomous region. With the application of video monitoring, telemetry and remote control system, the position, light quality, color, structure and other key elements of the AtoNs can be fully grasped. The system can measure, analyze and monitor the performance of AtoNs in a more comprehensive way, and promote the transformation of the management mode of AtoNs from the traditional mode of low efficiency, time consuming and high cost to the new digital mode of high efficiency, fast and low cost.

## **1.1 Purpose**

## This paper will share China's utilization of existing resources and scientific andtechnological means to achieve the construction and application of video monitoring, telemetry and remote control systems for AtoNs through sharing, integration, and technological upgrades with IALA members, and hope that some experience and achievements can provide valuable reference for the revision of G1037.

## **1.2 Relevant document**

IALA G1037 *Data Collection for Aids to Navigation Performance Calculation*

# **2 Background**

According to the working programme for IALA Committees 2023-2027,the Guideline G1037 on *Data Collection for Aids to Navigation Performance Calculation* will be revised to provide more detailed information on the data collection methods for the availability and reliability of AtoNs. The construction of video monitoring, telemetry and remote control system for AtoNs of China MSA, greatly enhanced the timeliness and accuracy of data collection, thereby improving the accuracy of various performance indicators calculation of AtoNs.

# **3 Discussion**

G1037 *Data Collection for Aids to Navigation Performance Calculation* lists six sources of AtoN data: ①Mariner report; ②Keeper report; ③Remote monitoring; ④ Maintenance activities; ⑤ Repair activities on-site, in workshop or at supplier’s site; ⑥Scheduled inspections. The video monitoring, telemetry and remote control system for AtoNs belongs to the remote monitoring method to collect data.

## **3.1 Construction of Video Monitoring and Remote Control System for AtoNs**

China MSA currently manages 734 visual AtoNs in the Beibu Gulf Coast of Guangxi, including lighthouses, light beacons, light buoys, beacons and other types. Due to the large number, variety, wide distribution and scattered waters of maritime AtoNs, a single video acquisition mode can not achieve comprehensive coverage of all AtoNs. Taking into account factors such as construction cost, safety performance, and coverage of water areas, it established a port-wide video remote transmission system, marine light buoy video acquisition and transmission subsystem, and mobile video resources for AtoN inspection. It integrated social video resources and gradually improve the coverage of AtoN video monitoring. At the same time, it integrated four types of video data resources and connected them to the telemetry and remote control system.

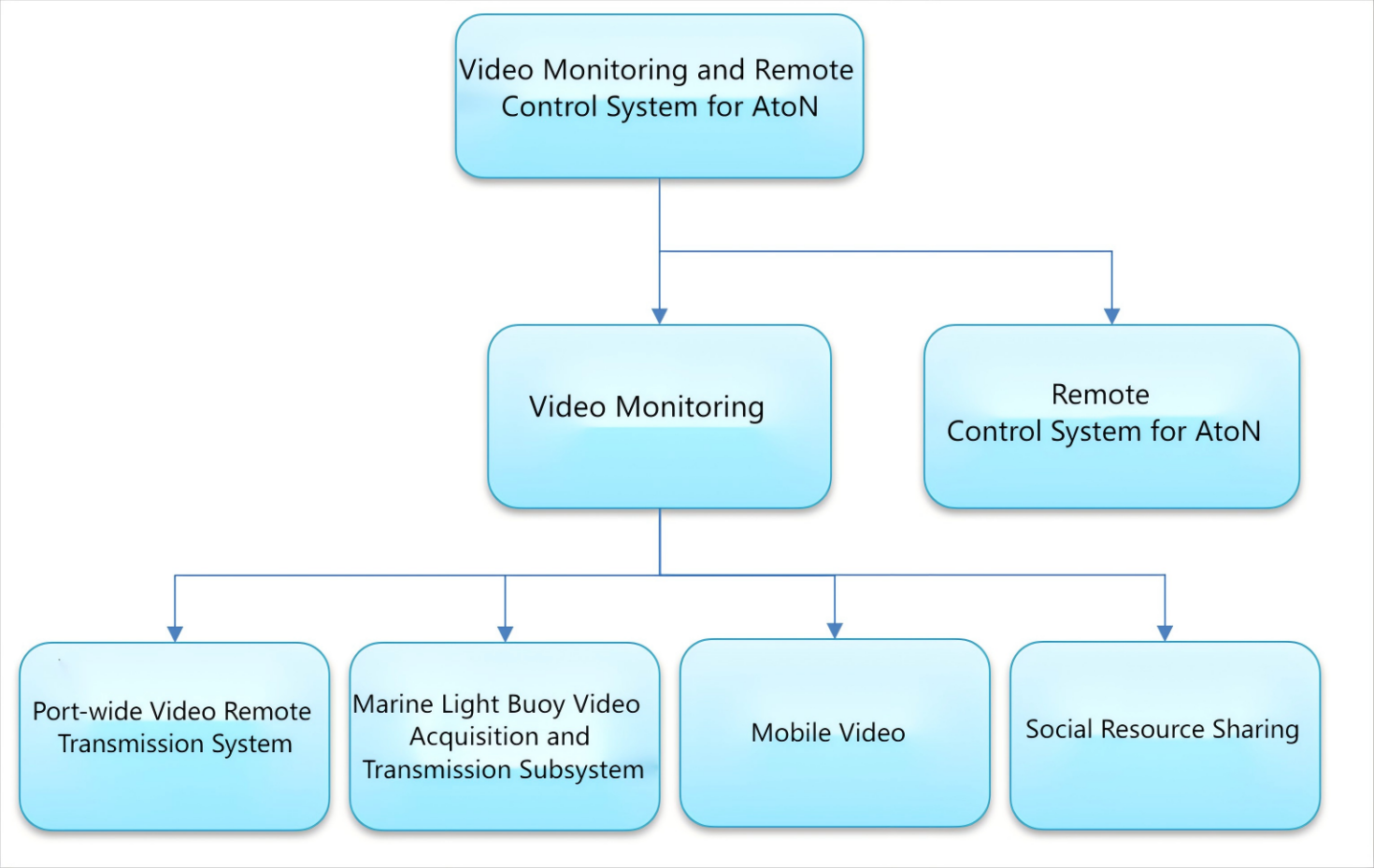


Figure 1 Structure diagram of video monitoring, telemetry and remote control system for AtoNs

## **3.2 Port-wide Video Remote Transmission System**

## Port-wide video remote transmission system is mainly built in the port, wharf or lighthouse and other high points with ultra-long distance video acquisition equipment. Considering the cost performance of video capture equipment in the current market, cameras with a viewing distance of more than 10 nautical miles, 360° continuous rotation, and unlimited bits were chosen. One set has been installed in the four ports of Fangcheng Port, Qinzhou Port, Beihai Port and Tieshan Port respectively to realize the monitoring of key AtoNs in the main waterway. This mode is suitable for AtoNs inspection in waterways, port pool turning area and other waters. According to the actual situation of waters, a single camera can cover 60 ~ 70 AtoNs.

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Figure 2 The coverage images of the port's wide video remote transmission subsystem



Figure 3 The monitoring images of the port's wide video remote transmission subsystem

**3.3 Marine light buoy video acquisition and transmission subsystem**

Marine light buoy video acquisition and transmission system is to upgrade the existing AtoN light, using buoys as the carrier to enable the buoys to have 360° video collection function, and transmit the collected video data via 4G/5G. The buoy management personnel can use this system to obtain real-time data on buoys, ships, and sea conditions within a 0.5 nautical mile radius of the buoy. Due to the limited space on floating buoys and the inability to provide long-term energy for video collection equipment, the equipment is only activated in remote control, scheduled, and triggered by approaching vessels modes to reduce energy consumption. This system can meet the needs for patrolling and inspection of surrounding buoys, and a buoy is triggered to open when a vessel approaches, providing a basis for subsequent claims in case of collisions between ships and buoys. Buoys with marked navigation aids and others in areas not currently covered by video surveillance can use this mode.



Figure 4 Light buoy video acquisition of nearby AtoN data

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**3.4 Mobile video**

# In some water areas such as estuaries and islands, due to the existence of factors such as occlusion and turning points, the construction cost of cameras with ultra-long distances is high, the number of monitoring AtoNs is small, and the buoy video acquisition equipment is restricted by factors such as monitoring distance. For these AtoNs, installing a camera viewing distance of 1 to 2 nautical miles on the beacon is recommended, so as to carry out patrol inspection of the beacon near AtoNs. Generally a single device can carry out video monitoring of 3 to 5 AtoNs.



*Figure 5 Maoling River is covered by 16 AtoNs in the whole navigation channel*

**3.5 Social resource sharing**

Due to the large number and scattered locations of AtoNs, it is necessary to build a large number of front-end video acquisition equipment to meet the full coverage of AtoNs. In order to reduce the construction cost, it is necessary to integrate the existing CCTV resources of various ports and terminal operators, which have built CCTV systems that can cover most coastlines. The video monitoring of most of AtoNs in the water areas such as wharves, harbor pools and special waterways has been realized, which fully implemented the concept of shared development, avoided repetitive construction, and saved later system maintenance costs.

**3.6 System integration**

## Navigation Aids Department made full use of the land building resources near the coastal waterway, and used the Port-wide Video Remote Transmission System to install remote camera ball machines at the 300,000-ton wharf of Qinzhou Port, the Guantouling Lighthouse, the Maoling River Lamp Pile and the Fangcheng Differencing Tower, etc., to achieve real-time monitoring of multiple waters and multiple navigational beacons. At the same time, the short-range monitoring characteristics of Marine light buoy video acquisition and transmission subsystem and the mobile video set on the navigation mark in the waters such as the estuary and island are used as a supplement to the remote monitoring to fill the monitoring blind area. In order to monitor AtoNs as much as possible and their waters in the jurisdiction as widely as possible, Navigation Aids Department has played its role as a working mechanism for the integrated development of maritime supervision and navigation support, signed an agreement with the Guangxi Maritime Safety Administration to share video resources and services for coastal monitoring in the Beibu Gulf, strengthen business cooperation while improving the utilization rate of video monitoring resources, and jointly provide high-quality public services for marine users. In addition, Navigation Aids Department also strengthened external exchanges, communicated with the tower company, some port terminals and other units, fully integrated and utilised their existing CCTV to monitor part of the beacons for fixed-point viewing. At the same time, they integrated the video data to the telemetry and remote control system, directly viewed the key elements like beacon position, light quality, color, structure, etc., so as to achieve the effect of reducing cost, improving efficiency and resource utilization.

## **3.7 Achievement**

At present, China MSA has realized the electronic inspection function of 606 AtoNs in the coastal waters of Beibu Gulf of South China's Guangxi Zhuang autonomous region, reaching 83.7% of the total number of visual AtoNs under management. Uncovered AtoNs are mainly far offshore, and there is no 4G signal in the waters. In the next step, with the improvement of maritime communication technology, the video monitoring coverage of AtoNs will gradually increase and eventually achieve full coverage.

*Figure 6 Video Monitoring Coverage of AtoNs in Jurisdiction*

**3.8 Advantages**

The data collected by video monitoring, telemetry and remote control system covers key elements such as position, light quality, color and structure of the AtoNs. Compared with other 5 data sources of the AtoNs listed by G1037, the data has the advantages of fast speed, high precision, low cost and high timeliness, which makes the calculation of the performance indicators of the AtoNs, such as reliability, integrity, mean time between failures (MTBF), mean time to maintenance (MTTR) and others, more accurate. The application of this system also improves the efficiency of AtoNs maintenance, reduces labor intensity, saves maintenance costs, enhances the emergency response ability of AtoNs, and promotes the transformation and upgrading of AtoNs management mode.

# **4 Action requested of the Committee**

The ENG Committee is requested to note the information in this document.