Research and Application of Real-time Ship Traffic Intelligent Analysis and Calculation Platform under 5G Background

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Abstract. In the current navigation process, ships often encounter ship collision risk due to the lack of real-time channel information. In order to effectively avoid the collision risk of the ship, relevant researchers conduct research and development through VHF communication technology, satellite communication and GPS navigation and other mature technologies, aiming to build a complete marine ship navigation system. Although the application of this technology improves the disadvantageous situation of ship navigation to a certain extent, while it cannot accurately predict the route risk and real-time information about the ship. With the commercial promotion of 5G network technology, by integrating 5G network technology into the process of ship navigation. On this basis, a special 5G communication ship traffic intelligent analysis platform is built, which can fundamentally strengthen the intelligence of ship navigation information collection and information collection. Through the content and construction of the 5G network, the information within the industry and between socially relevant departments can be exchanged and closely connected to avoid the generation of isolated information islands; and the scientific construction of information management can be achieved to effectively avert the risks of maritime navigation and practical to make sure the safety of ships sailing in dangerous waters has been strengthened.

1. Introduction
Currently, there are three main means of transportation in society: sea, land, and air. Among them, maritime transportation is a very important component and has attracted the attention of the traffic management department and related researchers. Moreover, the traffic conditions at sea have a direct impact on the normal navigation of the ship[1].

With the increase of Global trade and the number of ships in recent years, the burden of the sea channel becomes is getting serious, which breeds the risk of maritime traffic. Therefore, it is an urgent problem to further strengthen the construction of waterway safety and improve maritime traffic conditions and strengthen ship safety management [2-3].
2. **5G network technology based on intelligent ship transportation**

The 5G technology and intelligent ship transportation platform are mutually promoting and integrating in technology research and development, which can promote the layout of 5G networks [4]. The integration of 5G networks can promote the development of intelligent ship transportation systems in a more comprehensive and perfect direction, thereby achieving more advanced technical indicators [5]. By meeting more advanced technical indicators, the safety of marine vessels is also ensured. At the same time, the intelligent ship transportation platform will indirectly promote the expansion of 5G network coverage in terms of human resources and technology deployment.

2.1 **Ultra high data transmission rate**

The construction of the intelligent ship transportation platform requires the collection of data on the maritime channel and the real-time combing of this information through the maritime information service platform [6]. In this process, wave height, ship depth, wave warning, ship load, current wind direction and ship heading will be generated. The above information will be transmitted to the processor through the ship sensor, and then transmitted to the wireless communication components through the processor, which has strong effectiveness [7]. Therefore, it is necessary to take advantage of the extremely high data transmission rate of 5G network technology. Through a series of technical measures, ship personnel can know in time that the sea area around the ship meets the needs of the route, and then make technical judgments according to actual needs, and then make technical judgments according to the actual needs to provide a solid technical guarantee for the safety of ship navigation [8].

2.2 **Stable specific base station**

The intelligent ship transportation platform on the basis of 5G network technology is a digital platform system which integrates advanced technologies such as ship identification and route identification. The constant of this system achieved real-time monitoring of various dynamic information of maritime routes, ship routes, and ship trajectories, and continuously sends real-time 3D channel information and changes in the current waters to ships based on the 5G network to Promote the application and development of marine vessel traffic systems.

2.3 **Accurate perception**

In the process of constructing the intelligent ship transportation platform, the ship identification technology, sonar induction and high-definition monitoring will be put into practice to collect diversified real-time information on the sea area where the ship is located. By using big data technology and artificial intelligence analysis technology, the potential route risk factors such as ships, meteorological data, wave height and reef in the sea area are monitored, which seriously threaten the safety of the route. It is necessary to give early warning in time to keep the ships on the route away from the early dangerous position and avoid major maritime accidents. This information should not only be sent to the ships on the route, but also to the local ocean detection system, and make effective route arrangement according to the current route situation.

3. **The basic framework for establishing a 5G ship traffic intelligent analysis platform**

3.1 **Design ideas**

During this stage, many technical R & D personnel and marine managers have started research and development of marine traffic systems. In the process, some marine traffic management technologies have been developed and gained a worthy reference in this research. On that basis, the overall architecture design of the ship traffic intelligent analysis and calculation platform based on the 5G background proposed in this research is divided into three parts: there are control module, data interaction module and data storage module.
3.2 Establish the basic framework of 5G navigation system

The difference between 5G network communication technology and 4G network technology lies in the core technology, which is multi-task frequency division technology. This can achieve 1000Mbps downlink and 100Mbps uplink speed. At the same time, it can also build wireless communication services such as range loop broadcasting. The application of 5G technology avoids the functional limitations of 4G communication in the past, and its biggest advantage is to integrate and develop the technologies of satellite and optical fiber with the help of extremely high operation speed, which has been implemented in the fields of transportation and health at this stage. The key to this research is to use the advanced technical advantages of 5G to integrate GPS to provide navigation technology and route for ships, in addition to providing more advanced digital maps, video messages, and other advanced technical information services. 5G technology not only can realize the real-time communication between land and sea, but also establish efficient communication services between ships. The use of 5G marine transportation intelligent platform improves the accuracy, practicability and functionality of ship information to a considerable extent.

3.3 Establish the basic framework of 5G navigation system

Once the vessel is sailing in the potential risk sea area, the 5G ship traffic intelligent analysis and calculation platform will send the warning signal in real time. In this process, it can send some sea area information to the ship's personnel, and then helps the driver judge the ship's navigation risk level and the collision possibility of further navigation. The analysis of this system is mainly from the probability parameters of ship collision and the risk level of sea area to automatically analyze the ship's channel safety. For accurate judgment and analysis, it is necessary to analyze the ship's course, speed, sea area terrain and meteorological data as a whole. Through these data, it is necessary to analyze whether there are potential risk factors in the ship's route. The 5G ship traffic intelligent analysis and calculation platform issued by the ship collision risk coefficient is that after the ship's personnel have determined that the ship is likely to collide, how long or how far the risk could be...
avoided as much as possible. With the help of 5G traffic intelligent analysis and calculation platform, multiple targets in the sea area near the ship are predicted and screened, dangerous ships are found in time, and ship operation safety is ensured and accidents are avoided.

3.4 Implementation of simulation system

In the process of constructing a 5G simulation system, the system functions must be realized through the intelligent software of the 5G network terminal. Then, the related data information is used to verify the validity of the basic framework of the system in this study. In addition, the relevant data have to be set in line with the planned route of the ship and the digital method is used to test the safety performance and operating speed of the 5G ship transportation intelligent platform[9].

3.5 Ship AIS intelligent control system based on 5G

Through the AIS intelligent control system, the following functions are mainly realized:

1. When the system is in the unguarded state, the system will constantly exchange data to the local control center and the nearby sea area, including the ship function, route, location, navigational speed, ship working status and other relevant data.

The AIS intelligent system can systematically process the information of vessels in the sea area, and automatically arrange and feedback the vessel information.

The current mainstream test equipment is integrated inside the intelligent system.

The realization of data exchange will be realized efficiently with the help of 5G networks.

It can automatically identify the trajectory of the ship.

Automatically simplifies the data fed back by the ship to improve the system operation rate.

7. Automatically release route risk information to vessels to avoid collisions.

The core modules of AIS are 5G technology module, signal collection module, data processing module and digital display module. The connectivity of the above technologies is based on 5G digital communication, timely broadcasting of ship information is constructed at last and sensing signal part, the position information will be automatically decoded, then the data will be converted into digital signals, and transmitted to the CPU to process.

![Intelligent AIS framework](image)

Figure 2. Intelligent AIS framework.

The process of important information will be dealt with by the ARM microprocessor of the system control center; the system display module will feed back the status information of the ship in real time.

The processing flow of the AIS intelligent system is shown in Figure 3. After finishing the initialization, the sensor is used to conduct information collection. After each frame is collected, it will automatically analyze the accuracy of the data, and then the system conversion work is carried out. In the process of this work, AIS data diagnosis is carried out during the same time to make sure the final integrity of the data; the information display link can provide the real-time change of the system status.
3.6 In ship network architecture
Aiming at the different characteristics of each ship, a 3.5-band router is used to apply "one ship, one plan", in order to meet the daily data transmission of ships. See Figure 4 for the specific network planning of a typical ship [11].

4. Disaster recovery framework of ship traffic intelligent analysis and calculation platform
The disaster recovery architecture of the platform will be applied based on virtual memory database and other processing mechanisms to ensure the operation correctness of VTS, as displayed in Figure 5. The cluster processing of the platform is based on two groups of processors. The server will install the software system such as ocean target data processing to synchronize the target data processing through the database. The processing data of the working process will be synchronized to other servers in the cluster in real time, ensuring that once any of the servers fails, the other servers can automatically replace the failed servers in the cluster management software.
In order to improve the reliability of the system effectively, more than two data nodes are applied to create a disaster recovery mechanism, on the basis of the memory database, to achieve the synchronization of incremental data processed in real time between the primary and secondary nodes, as well as the synchronization correctness verification between the primary and secondary nodes, the monitoring of the primary and secondary status, and the switch control management system. According to the different requirements of users for the system reliability, one primary and secondary can be set One standby, one active and two standby, or one active and multiple standby See Figure 6 for disaster recovery backup between nodes.
5. Conclusion
With the development of 5G network, artificial intelligence, big data and other advanced technologies force shipping industry move towards the path of more intelligent in the future [12]. The extensive application of new technologies will be widely implemented. The development mode of “intelligence + big data + Internet + shipping”, “intelligence + big data + Internet + port” has already begun to take their origin shape of China's shipping industry.

The promotion and application of 5G technology will definitely change the shipping system to reform especially in ship information, data collection, data processing, information release, and data application as well. Through the characteristics of 5G technology and future industry advantages, it is based on the development of system applications, infrastructure, management and control systems and development of intelligent shipping information standards. Establish an intelligent shipping system to provide efficient information services to multiple parties such as ports, shipowners, customs, ports. And provide data technology and centralized mining services to customers in the shipping industry, thereby realizing the “intelligent” upgrade of the shipping industry, and building intelligent ships service system at the end.

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