Research on the Convergence Application of Satellite Mobile Communication and Wireless Ad Hoc Network

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Abstract: The article analyzes the networking modes and main features of satellite mobile communications and wireless ad hoc networks, and proposes to build a dual-function terminal of satellite mobile communications and wireless ad hoc networks. By merging the respective advantages of the two communication modes, the application range of satellite mobile communication can be further expanded, and finally exemplified typical application scenarios.

1. Introduction

As an important means of space-based communication, the satellite mobile communication system is an important embodiment of a country’s international politics, economy, military, science and technology, and even its overall national strength. It is an important strategic information infrastructure of the country and affects national security and development. It is valued by more and more countries.

With the rapid advancement of the development and construction of China's satellite mobile communication system, China's information and communication service industry has ushered in new development opportunities, and at the same time, it has also put forward new challenges in providing high-quality services to the world. Satellite mobile communication systems have many advantages and application values, but they also have corresponding limitations. Through the deep integration of the multiple advantages of satellite mobile communications and wireless ad hoc network communications, it can effectively compensate for the limitations of satellite mobile communications and expand the capabilities of satellite mobile communications. The scope of application enables the advantages of the satellite mobile communication system to be fully demonstrated, and expands the development space for the market promotion of the satellite mobile communication system [1-2].

2. The networking mode and characteristics of Satellite mobile communication

Satellite mobile communication uses geosynchronous orbit satellites or medium and low orbit satellites as relay stations, and uses the multiple access transmission mode of satellite communication to provide global users with large-scale, mobile and flexible mobile communication services, realizing mobile users or mobile users and fixed users, the way of communicating with each other [3].

2.1. The Networking mode

The "Tiantong No. 1" satellite mobile communication system is China's first-generation autonomous and controllable satellite mobile communication system with independent property rights. The system consists of a space segment, a ground segment and user terminals. The space segment consists of geosynchronous orbit mobile communication satellites. The ground segment consists of a gateway
station, a measurement and control station and a management system. The user terminals mainly include voice terminal, data terminal [4]. The system provides transparent transmission channels between the user and the customs station, and between the customs station and the customs station. The gateway station is the core, and information transmission between users is carried out through a star-shaped network. The typical networking mode is shown in Figure 1.

![Figure 1. Schematic diagram of satellite mobile communication system](image)

2.2. The main feature

From the perspective of the satellite mobile communication system itself, it will not be restricted by the geographical location, and can achieve a wider communication coverage. Not only that, the satellite mobile communication system has a simple system network topology and a very stable and reliable link. Human platforms, etc., implement voice and data related applications. When an emergency occurs, it can implement emergency communications with individual terminal users for users in different industries and fields.

In addition to the above advantages, satellite mobile communication also has its own limitations, which are mainly manifested in four aspects [5]. First, the size, weight, and power consumption of mobile terminal equipment are limited, and the antenna size and shape are limited by the installed carrier (such as airplanes, cars, ships, etc.), and the requirements for handheld terminals are more stringent; second, the satellite antenna beam should be able to adapt to changes in the ground coverage area and keep pointing, the antenna beam of the user’s mobile terminal should be able to keep pointing to the satellite with the movement of the user, or be an omnidirectional antenna beam; third, with the movement of the moving body, when the mobile terminal interacts with the satellite When the link between satellite transponders is blocked, it will produce a "shadow" effect, causing communication interruption; the fourth is a satellite constellation system composed of multiple satellites, which requires the establishment of inter-satellite communication links, on-board processing, and on-board switching, Or it is necessary to establish a gateway earth station with switching and processing capabilities; Fifth, the current satellite communication resources in China are very limited, and both military and civilian use need to be considered, and the cost is relatively high. These conditions will severely restrict the large-scale application of satellite mobile communication systems.
3. The networking mode and characteristics of Wireless Ad Hoc Network

3.1. The Networking mode
The wireless ad hoc network is a distributed, centerless, multi-hop routing and peer-to-peer network. Each site not only has the function of sending and receiving data, but also has the function of routing and relay transmission. There is no master-slave, as long as there is a connection Conditions can be deployed at will, easy to operate. Its networking mode can be mesh network or arbitrary network, as shown in the figure 2.

![Figure 2. Schematic diagram of wireless ad hoc network](image)

3.2. The main feature
The biggest feature of the wireless ad hoc network is that it can provide flexible and convenient communication without supporting the traditional infrastructure. However, the communication distance of the wireless ad hoc network is often relatively short and the communication coverage is relatively small. This technology broadens the application field of mobile communication and has broad development prospects. In the event of a major natural disaster, the fixed communication network facilities are damaged or cannot work normally, or working in remote or wilderness areas cannot rely on fixed or predetermined network infrastructure for communication, the wireless ad-hoc network has independent networking capabilities and self-organization Characteristics, communication is the only or best choice under the current situation, especially for military applications.

4. Convergence application of satellite mobile communication and wireless ad hoc network
Satellite mobile communication has outstanding advantages such as wide signal coverage, long communication distance, flexible networking, not restricted by existing ground systems, and less affected by terrain and features, but it has limited resources, high user costs, and strict communication conditions, the network is complex. the wireless ad hoc network communication network is flexible, the channel resources are open, and the communication is simple, which just makes up for the limitations of satellite mobile communication. Therefore, it is possible to consider combining satellite mobile communications and wireless ad hoc networks to give full play to their respective advantages, and to promote the maximum use of terminal equipment.

4.1. Terminal type
It is possible to integrate satellite mobile communication terminal modules and wireless ad-hoc network equipment modules in one terminal. For example, the voice terminal module of "Tiantong No. 1" satellite mobile communication is further integrated in the current narrowband radio station, and in the broadband radio station. Integrating the data communication module of "Tiantong-1" satellite mobile communication, so that a device has two communication modes at the same time, that is, dual-mode terminal. In this case, the terminal is equivalent to the integration of two devices, which can usually be wireless at the same time. Subnet communication and satellite mobile communication. It is also possible to design a new type of terminal, using a unified hardware platform, through software radio technology, loading different waveform software, respectively into the wireless ad hoc network mode and satellite
mobile communication mode, in this case, users need to choose and determine the terminal work according to their needs model.

4.2. The Networking mode
Combining the satellite mobile communication system and the wireless ad hoc network system for distributed integrated networking, its typical networking mode is shown in the figure 4.
4.3 The application scenarios

In military scenarios, airborne troops carry integrated terminals to perform special missions in unfamiliar areas. Team members can rely on the wireless ad hoc network for communication to realize information sharing, and give full play to the advantages of the small communication delay and flexible networking of the wireless ad hoc network; at the same time, when encountering special circumstances, each individual can rely on satellite movement The communication channel quickly establishes contact with the rear command post, completes the forward intelligence return, and realizes the command from the rear to the front.

In the civilian scene, the rescue and disaster relief team carried the fusion terminal to the scene for rescue and disaster relief. The communication infrastructure at the disaster site has often been destroyed and cannot be used. For example, in the 2008 Wenchuan earthquake, the mobile communication facilities had been destroyed at that time, and the site lost contact with the outside world [6]. At this time, in a local area, the drone can be launched to expand the coverage area, complete the fast communication between local users through the wireless ad hoc network mode, and at the same time rely on the satellite mobile communication channel to establish contact with the outside world to achieve the command center's overall on-site Information control.

5. Conclusion

Wireless ad hoc network and satellite mobile communication originally belong to two different communication methods, each with its own advantages and disadvantages. In the process of use, it can be independently networked or integrated. Through complementary advantages, it can achieve different time and space. The high-efficiency application, its application scenarios and functions are highlighted. With the continuous innovation and application of various new communication technologies, the future will be a scenario where everything is interconnected and unmanned. The boundaries of various communication methods are becoming more and more blurred. Based on satellite mobile communications and wireless ad hoc networks. The integrated development of the world will realize the integration of the sky and the ground and bring greater application value to human communication.
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