Automatic Message Forwarding System Based on Directional Transmission Networking

Zhengqin Xu*, Wendong Zhao*, Laixian Peng* and Xiaojing Chu

Institute of Communications Engineering, Army Engineering University of PLA, Nanjing, China, 210007
Email: 155267201@qq.com
Email: nj_mouse@163.com
Email: lxpeng@hotmail.com
*Corresponding Author

Abstract. With the rapid development of multi-functional radio frequency technology and software radio technology, radar has become an independent node of wireless communication, which can make multi-platforms form the function of ad hoc network. This paper designs and implements an automatic message forwarding system based on directional transmission networking. The prominent feature is directional transmission. Secondly, information processing and forwarding are accomplished based on algorithm structure. This system can realize the functions of radar wireless ad hoc network, mutual detection and target information fusion, and enhance the flexibility of equipment.

1. Introduction

Radar self-communication system refers to a system that uses radar RF front-end and special modem equipment to communicate in addition to scanning control resources. It consists of application system, cooperative scheduling, networking node, modem, IF matrix switch and scene message automatic forwarding system.

Aiming at the problems of slow transmission speed, poor confidentiality and weak real-time controllability in radar information transmission, an integrated technology of radar communication based on directional transmission is proposed, which makes radar have real-time communication function. The prominent feature of the software design of this subject is directional transmission, followed by information processing and forwarding based on algorithmic structure. Directional transmission meets the urgent need of directional transmission for the development of high-speed, large-capacity, long-distance and anti-jamming communication. It can effectively improve the network throughput and transmission performance, further realize the functions of radar wireless ad hoc network, mutual detection and target information fusion, enhance the flexibility and mobility of equipment, not only for radar self-communication system, but also for long-term use. Distance unmanned system communication.

In this project, the message automatic forwarding system based on directional transmission network receives the location information and slot scheduling information of each node from cooperative scheduling, calculates the related topological connection relationship, and controls the IF matrix switch, thus forming the directional transmission path. The integrated radar communication network can meet the transmission requirements of large quantities of data.
2. **Functional Design**

The IF matrix switch device is used to simulate the wireless directional transmission channel, and the message automatic forwarding system based on directional transmission network is used to control the connection relationship and channel error of each channel in the IF matrix switch.

![Device Composition and Data Flow](image)

**Figure 1.** Device Composition and Data Flow

The message automatic forwarding system based on directional transmission network adopts centralized control mode in the whole system. It receives slot scheduling information and node navigation information from coordinated scheduling of each node through multicast, calculates the on-off relationship of each node by combining beam width and communication distance, and converts it into control information, which is transmitted to matrix switchgear by UDP Socket unicast. Control the connection of each channel. As can be seen from Figure 1, there are two interfaces for message automatic forwarding system based on directional transmission network, one is between cooperative scheduling and the other is between matrix switchgear.

3. **System Architecture**

3.1. **system design**

The message automatic forwarding system based on directional transmission network receives slot scheduling information and node navigation information from coordinated scheduling through multicast interface in the whole system. Node navigation information and slot scheduling information are positional information with high latitude and longitude. slot scheduling indicates the direction of radar radiation for the node, and finds the node within the range of beam width of radar radiation. Other interconnected nodes are computed by software internal algorithm and converted into task scheduling information, which means that the on-off relationship between nodes is expressed by matrix.
Figure 2. Internal function diagram of message automatic forwarding system based on directional transmission network

When node 2 is in the range of 1.5 degrees and 20 km, it is regarded as the relationship between node 1 and node 2, which is marked as "1" in matrix information, and "0" without any relationship. The relationship between node 1 and node 2 shown in the figure 3 is marked as "1".

Figure 3. Radiation distance and beam width

In order to facilitate the calculation, the longitude and latitude height should be converted into geocentric rectangular coordinates, and then the on-off relationship can be calculated by the distance algorithm and the angle algorithm. After the calculation, the matrix information is transmitted to the matrix switchgear by unicast.

3.2. Conversion between Longitudinal and Latitude Coordinates and WGS-84 Coordinates

In this project, we need to transform the location information of longitude and latitude height from coordinate dispatch into geodetic rectangular coordinate system by algorithm, which is convenient for other distance and angle algorithms to calculate the intermittent relationship between nodes. Here we use the geodetic rectangular coordinate system WGS-84 (World Geodetic System-1984 Coordinate System), whose origin is the earth, and Z axis points to BIH (1984.0). The direction of the Earth Pole (CTP), CIO, is recommended by IAU and IUGG. The X-axis points to the zero degree defined by BIH and the intersection of the CTP equator. The Y-axis and Z-axis and X-axis constitute the X-axis.
Cartesian coordinate system in centroid space right-handed coordinate system on meridian plane of origin

![Geodetic coordinate system](image)

**Figure 4. Geodetic coordinate system**

### 3.3. System Module Function

![Software module composition diagram](image)

**Figure 5. Software module composition diagram**

The module of message automatic forwarding system based on directional transmission network is divided into three layers as shown in figure 7: interface and information processing layer, control information computing layer and parameter setting and storage layer. Interface and information processing layer can complete the interface communication and information processing functions between "up" (cooperative scheduling) and "down" (matrix switching equipment), including multicast interface, unicast interface, slot scheduling information storage, task information generation and other modules; control information computing layer is the core layer of software, which completes matrix switching connection according to node and simulation scene parameters. The calculation of system and attenuation includes the modules of connection relation calculation, link quality calculation, connection
anomaly judgment and other interface information processing; parameter setting and storage layer provide various parameters for control information computing layer by receiving and storing node navigation information sent by cooperative scheduling and scene parameters set by users.

This project mainly takes matrix development control software (message auto-forwarding system based on directional transmission network) as the main body, and cooperative scheduling software as the assistant. It builds the overall framework structure, realizes cooperative scheduling to multicast transmission of data between message auto-forwarding systems based on directional transmission network, and calls algorithm calculation at the same time.

4. Summary
The main achievements of this paper are: (1) Developing and debugging the upper computer control software (2) Interface and information processing layer can complete the interface communication and information processing functions between upper (cooperative scheduling) and lower (intermediate frequency matrix switch), including multicast interface (3) parameter setting and storage layer through receiving and storing node navigation information sent by cooperative scheduling and user settings. The scene parameters are set to provide various parameters for the control computing layer. (4) The control information computing layer completes the connection of matrix switches according to the node and simulation scene parameters. At present, the software is in the preliminary design stage. When testing the user requirements of the software, each functional module can run normally.

5. Reference
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