Wireless Communication in the Ruins of an Earthquake

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Abstract: In recent years, earthquakes have occurred in many countries around the world. In the post-disaster rescue process, whether it is to rely on mobile phone positioning to find victims, or search and rescue personnel in the ruins to maintain wireless communication is extremely important. But the wireless environment in the earthquake ruins environment is complex and harsh. It's very different from the wireless environment we normally use. Therefore, the creation of a new wireless propagation channel model is critical. After the channel model in the ruin environment, the performance of each channel varies greatly in different ruins environment. Using intelligent algorithm, according to the current environment, choose the most suitable channel for communication, which can greatly improve the quality of communication.

1. Introduction

Many countries in the world are frequent earthquakes, after the disaster emergency rescue success can save many lives. Destructive earthquakes can damage wireless communication devices, block communication channels, and seismically generated electromagnetic waves can seriously interfere with communication signals. This will seriously affect the efficiency of post-disaster search and rescue. If there is a good quality assurance of wireless communication, can greatly improve the efficiency of search and rescue. The wireless environment in the ruins of the earthquake is very bad, and a new model of the communication environment is needed. According to the characteristics of wireless channel, the signal will be affected by the factors of path loss, multi-path effect, fading and so on in wireless communication. Post-disaster search and rescue is now in urgent need of a mature and stable emergency wireless communication system.

Self-group networkhasing has the characteristics of simple deployment and installation, high stability, flexible structure and multi-hop network. Wireless communication through self-group network is very suitable for post-disaster search and rescue. When one device fails, it does not affect the normal operation of other devices, which can greatly increase the fault tolerance of the emergency communication system. Using intelligent algorithm, selecting the optimal channel for wireless communication will improve the communication quality obviously. This paper introduces wireless communication in the ruins environment from the aspects of wireless communication channel model, self-group network, and intelligent algorithm and so on.

2. Related research

The researchers simulated the channel propagation model in the ruins environment. In [3], the wireless channel parameters in each frequency band were measured in the collapsed environment, and the attenuation was assumed to be linear. The frequency response model of the channel was established. The prediction accuracy of this method is related to the order of the model.[4] focusing on the loss of wireless signals passing through obstacles, various obstacles were measured in a variety of frequency bands, and a signal penetration loss model was established. The data are measured in the laboratory, and the actual situation has some differences.[5] proposed a mobile wireless network location method, so that we can accurately locate the mobile phones under the ruins, we can rely on this method to find the victims.

3. Wireless Communication In the Ruins

3.1 Wireless propagation channel model

The wireless propagation channel model is designed to describe the channel more accurately. Accurate models can avoid the waste of wireless resources and ensure the quality of communication. In different terrain environments, the communication environment is very different, and the communication models are very different. In the ruins of earthquakes, the wireless communication environment is complex and harsh, and it is very necessary to establish the model of wireless communication channel under the ruins.

The average receiving field strength of the propagation environment is predicted, and the field strength change near a certain location is estimated. There are two common models: the large-scale propagation model, which predicts the average field strength and estimates the propagation of wireless coverage, describes the long-distance field force change between the transmitter and the receiver, and the small-scale attenuation model describes the fast fluctuation of the receive field strength over a short distance (several wavelengths) or a short time (seconds) .

The ruins channel measurement focuses on getting the pulse response of the ruin channel. By processing the pulse response, the wireless channel propagation characteristics in the ruin environment can be obtained. The pulse response can be obtained, the output of this communication system can be obtained under the known input signal, and the parameters of the large-scale characteristics and small-scale characteristics of the debris channel can be characterized, such as multi-path component, mean square root delay, power delay distribution, etc. After establishing the debris channel model, the simulation can be carried out, the transmission performance of the ruin channel can be analyzed, and the follow-up research can be carried out.

According to the field measurement of debris channel in literature [2], the following parameters are obtained: the standard deviation of path loss fluctuates between [1.38db, 4.14db], and the signal penetration loss factor is 0.98db /cm. And it has been obtained that no matter in the free space transmission death through the ruins have a rapid loss, will seriously limit the distance of transmission.

In the ruins environment, the channel performance varies greatly at different frequencies. How to improve communication distance and communication rate, we should start with adaptive selection of the optimal channel.

3.2 Self-organizing network

Wireless mesh network is developed by ad-hoc network, which is the key technology to solve the "last kilometer" problem. In post-disaster search and rescue, 1Km's communication distance is sufficient. Wireless mesh networks have many advantages.

Wireless mesh network can dynamically update the route, with self-balancing and self-repair and so on. It supports high-rate data transmission with 108Mb/s bandwidth, and can guarantee the quality of communication for post-disaster search and rescue. In mine rescue similar to the rescue of debris, wireless mesh network has become a very mature communication system.

The time of search and rescue is urgent, how to quickly build communication system is very important. Mesh network device is easy to carry, and the Mesh network has a powerful self-organizing function, so it is easy to set up a configuration network node.

The overall arrangement of post-disaster search and rescue is very important, and the Mesh network has a strong network management function. Its nodes can change the relevant configuration parameters of the network to manage the entire network.

High-rate data transmission can bring great help to post-disaster search and rescue, and can make rescue more efficient. The Mesh network can transmit high-speed multimedia data, much larger than the traditional ad-hoc and WLAN transmission distances.

Wireless mesh network does not need control node maintenance network operation, so it will not be because the control node failure and network paralysis, its network reliability is high.

The mesh network in the ruins environment has some special needs, the wireless mesh network in the ruins contains many types of nodes, and the performance difference is quite large. And in the rescue, different data types of different data types of transmission requirements, can be optimized data transmission by different data types, can get a greater transfer rate. Because there is no direct quantitative relationship between the network parameters of the emergency network communication system, the evaluation is fuzzy, so the fuzzy theory is optimized to meet the transmission needs of different data, so as to improve the network throughput.

3.3 Channel selection in ruined environments

For the wireless communication needs in the ruin environment, compared to the terrestrial commercial wireless mesh network, there are higher requirements in the following areas: (1) real-time and stability requirements are high (2) flexible network structure

According to the wireless communication needs under the ruins, in a similar mine environment, the MCCA channel allocation strategy is proposed. Under the MCCA policy, each node maintains a list of adjacent links and an interface-channel allocation table, which stores the adjacent link information of the node and the channel allocation information of the interface. By exchanging this information between nodes, this is done distributed. The channel allocation of the links between them. Its channel allocation process consists of three parts: calculating the expected load of the link with the neighbor node, determining the priority of the channel allocation for each link, accessing the link in an order of reduced priority, and completing the channel allocation to the current link with minimal interference. Through the MCCA algorithm, the delay of all kinds of data streams is significantly reduced, and the network throughput has been effectively improved.

Through the effective channel selection algorithm, the communication quality parameters can be improved more obviously. The MCCA algorithm is applied to the mine, and there is still room for optimization in some aspects of the ruin environment. Through the debris channel propagation model constructed in the preceding article, adjusting the channel selection algorithm can make the wireless communication performance in the ruin environment more excellent.

4. Summary and Outlook

This paper introduces the wireless communication channel model, self-group network and channel selection from the ruins. By establishing a precise wireless communication channel model in the ruins environment, the self-organizing network with easy installation, flexible structure and high transmission bandwidth is utilized. According to the specific environment, each node link selects the optimal channel for data transmission. This effectively reduces propagation latency and improves network throughput.

The higher the transmission rate, the more efficient the rescue. We should also study the dynamic distribution of channels and the characteristics of the environment of ruins, and establish a communication model and channel distribution algorithm that can be universal. Algorithm complexity should be reduced, and transmission rate should be further increased so that information can be obtained quickly and accurately.

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