재난 상황에서의 효율적이고 안정적인 애드혹 멀티 캐스트 기법

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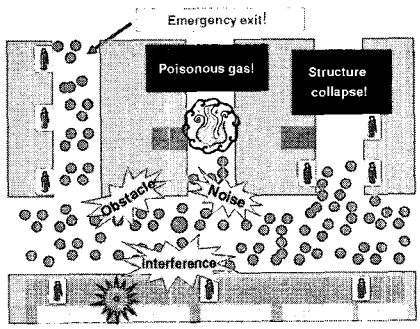
◈ 목 차 ◈

1. Introduction

Ad-Hoc network is not a network to have been fixed but it to communicate with mobile host. So, Ad-hoc network is suitable to the case that is hard to compose a wired network or is used for short period after composing a network. As there is not a restriction to a movement of hosts and it doesn't need a wired network and base station, network can be constructed fast and has an economical merit.

When a backbone network does not operate by wars,the disaster, etc., necessity of Ad-Hoc network comes to the front. As use of a backbone network is impossible and each host continuously moves in situations as mentioned above, Ad-hoc network is an excellent solution.

But, an Ad-hoc network study hastwo large problems - Efficiency of wireless multicast communication and reliability enhancement - that mentioned at this paper is considerable. An efficient and reliable Ad-Hoc network system is applied to a lot of fields, and can be used effectively.



(Fig. 1) A subway station under disaster environment

For example, Figure 1 is show a situation that accident in a subway station under disaster environment. In this situation, people will be very confused and embarrassed. So, we need to apply Ad-hoc network to this.

If an Ad-Hoc function is built-in to cellular phones of passengers using a subway, and a system for Ad-Hoc network configuration preparing for a disaster accident is equipped every subway station, we may more effectively cope with disasters accident such as a subway fire or underground structure collapse etc.

The probability that the wire-based Internet network and cellular phone networks do not run well is large in these disaster situations. Therefore the information transmission through wireless Ad-Hoc network becomes effective solution.

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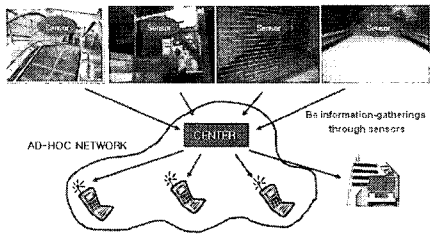
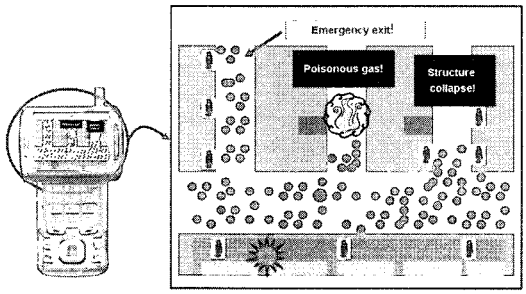


(Fig. 2) A network construction preparing for a disaster about an underground structure disaster situation

As a system is composed to the sensor network that used Ad-Hoc linking a central headquarters in the subway, emergency services centre with sensors installed at each place in subway station like Figure 2, it can be exactly judged that the situation in the inner station in case of the urgent situation occurrence. Also as information of inner station collected in this way exactly transmits to the passengers who were connected to an Ad-Hoc network, it can reduce a lot of personnel injury when an underground disaster occurs.

Figure 3is example to show to a screen to be able to see through cellular phones of the passenger who was connected to an Ad-Hoc network, in the case an unexpected disaster occurred during subway use. Even if wired network or mobile communication network cannot work by fires and structure collapse etc, the currentsituation of inner subway station is transmitted through wireless Ad-Hoc networks. So safety evacuation of passengers can be lead.



(Fig. 3) An example of evacuation guidance system at the underground structure disaster situation

In this paper, we review recent multi-hop routing techniques and wireless single-hop multicast techniques, then considerate the probability of an efficient wireless multi-hop multicast study. Also we have made a foot steps for reliable Ad-hoc network configuration comparing various techniques to raise reliability of wireless communication.

This paper is composed as follows. In a chapter 2, we introduce multicast ways of MAC level that were studied. And we explain about various techniques which is improved a reliability of wireless network in a chapter 3. In a chapter 4, we present a study directions and a plan to progress in the future. Finally, we summarize and conclusion this paper in a chapter 5.

2. Efficient MAC layer Multicast

2.1 Broadcast Medium Window (BMW)

It sends the broadcast packets sequentially asunicast packets to each neighbor nodes from overhearing the communication. The nodes which are not their turn overhear the data transmissions and save for the other nodes. And by receiving the rest of the data when their turns come, it improves the multicast transmission efficiency [4].

Consequently, overhearing is key point of this multicast technique.

An average delay of transmitting a data to all receivers, Td is defined by

$$T_{frame} = T_{RTS} + T_{CTS} + T_{DATA} + T_{ACK}$$
$$T_d = T_{cp} + T_{frame} + \text{sum}\ (\ r=1,\ N,\ {}_NC_r p^{N-r}(1-p)^r\ T_{frame} r/p\ )$$

In this definition, p means probability for a receiver a data successfully, and Tcp is contention delay.

2.2 Batch Mode Multicast MAC (BMMM)

This is the method which reduces the number of contentions by assembling RTS, CTS, RAK, ACK and transmitting them at once. Since it follows the IEEE 802.11 specification, there is no need to change devices and it prevents the possibility of occurring contentions by sending RTS and RAK continually while the data is transmitted so that it leads to the reliable transmission. However, the overhead of control frames will go up as the number of nodes in a group increases [4].

An average delay of transmitting a data to all receivers, T_d is defined by

$$T_{frame}(r) = r (T_{RTS} + T_{CTS} + T_{RAK} + T_{ACK}) + T_{DATA}$$

$$T_d(N) = T_{cp}+T_{frame}(N) + sum (r=1, N, {}_NC_r p^{N-r}(1-p)^r T_d(r))$$

In this definition, p means probability for a receiver a data successfully, and Tcp is contention delay.

2.3 Location Aware Multicast MAC(LAMM)

This is the method which checks the locationof nodes in their groups by using the mobile station location aware system and minimizes the number of nodes sending RTS. By taking out nodes which do not really need to send RTS or RAK, it reduces overhead that followed the number of nodes in BMMM [4].

2.4 Broadcast Protocol with Busy Tone (BPBT)

This is the method which solves several problems in wireless multicast situations to use a busy tone channel that use of a channel besides channel for data transmission. Using busy tone classifies exactly state of receiving node which cannot classify in RTS/CTS mechanism and raises reliability of data transmission [10].

2.5 Reliable Multicast MAC (RMAC)

Reliable Multicast MAC(RMAC) is method to be satisfied both efficiency and reliability of data transmission, to use two busy tone; Receiver Busy Tone (RBT) and Acknowledgment Busy Tone (ABT). Using RBT, reduced receiving time of CTS which should receive from all nodes. And using ABT, raised reliability of ACK.

These methods lead an efficient and reliable multicast transmission using the features only radio has effectively. However these should be studied more, because of to be taken single hop transmission into consideration, so that these used to Ad-Hoc network composed of multi-hop [6].

3. Reliability Enhancement Techniques

This is method to be satisfied both efficiency and reliability of data transmission to use two busy tone; Receiver Busy Tone (RBT) and Acknowledgment Busy Tone (ABT). Using RBT reduces receiving time of CTS which should receive from all nodes. And using ABT raises reliability of ACK.

These methods lead an efficient and reliable multicast transmission using the features only radio has effectively. However these should be studied morefor using in Ad-Hoc network composed of multi-hop, because of to be taken single hop transmission into consideration

3.1 Forwarding Error Correction

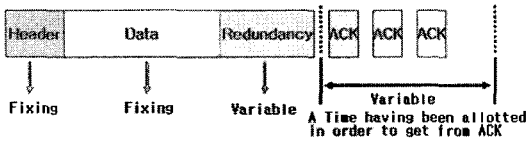
The probability of data error generated in wireless network is higher than that in wired network, because the radio suffers from an interference, distortion or fading. These errors can be detected and corrected using

the error detection/correction code. Among them, the Reed Solomon(RS) code is the most popular which is superior the correction ability to added cost.

The RS code is a kind of non-binary BCH code that is powerful to correct the robust error. Also, it is used with a convolution code which is outstanding the ability of correction spreading errors.

3.2 Re-transmission

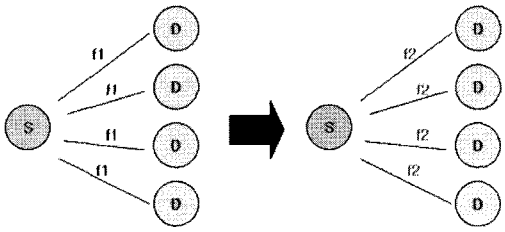
The data transmission can be more reliable as a receiver requires re-transmission ofthe data having errors out of receiver's correction capability. The general re-transmission techniques suffer from a delay caused by re-transmitting whole data lost. On the other hand, there is a technique using redundant space for re-transmission.



(Fig. 4) A technique using ACK for improved reliability

Figure 4 show the data frame using the Redundancy. A sender does not use the Redundancy usually. But the sender transmits a data containing some of lost data in Redundancy when a receiver requests re-transmission.As the redundant space is wider, the number of re-transmission becomes smaller and the network is more reliable. So reduction of the allocated time for ACKs may be critical issue. Because it has the merit that doesn't need the added delay for re-transmission, this technique is proper to real-time communication. Moreover if the sending data has same size is generated periodically, it is more efficient.

3.3 Frequency Hopping



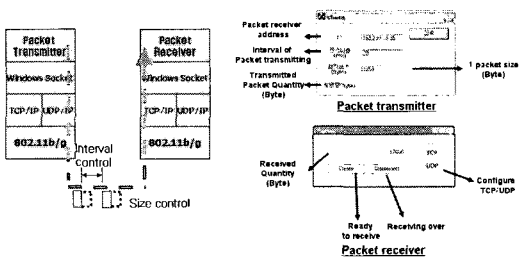
(Fig. 5) A technique using automatically changed frequency

In wireless network, the each condition of channels may be different according to the time and the state of each frequency. It says that when the state of current communicating channel is bad, the other channel may have a good condition. Because the radio has a feature have to broadcast, the other node can overhear. The techniques about frequency hopping have been studied to overcome and use efficiently that features of the radio.

The methods to calculate the timing of hopping and synchronize between the other nodes are the main issues. Especially in multicast, the synchronization issue is hard to solve and important. If only one node in multicast group mistake the frequency hopping timing, all of other nodes that calculate correctly are badly affected.

The study for establishing reliable Ad-hoc network as combining the techniques for reliable communication in wireless multicast is needed.

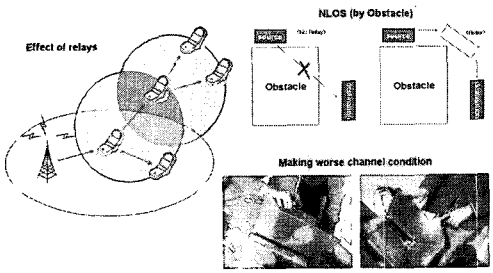
4. Future Work



(Fig. 6) Evaluation of reliable multicast techniques under disaster environment

We plan to study about more efficient Ad-Hoc routing algorithm for a development of integrating Ad-Hoc network system. And we plan to apply MAC Layer multicast methods, so we proceed to develop a special protocol for a wireless multi-Hop multicast transmission. We have plans to implement of a program that can apply to this, we will measure performance of the developed Ad-Hoc network protocol.

Figure 6 is example of program which can create the traffic of network optionally by user. This program can select a frequency of traffic, transmit rate, protocol. So, we can evaluate reliable multicast techniques under disaster environment. Figure 7 is an example of set up test bed for this.



(Fig. 7) Test-bed setup for evaluation

Also, we study continuously about methods to have high reliability in a wireless network. Through the study of this, we will develop algorithms for constructing of a reliable network and maintenance of a good transmission status. This algorithm will be applied to advance stability of the Ad-Hoc network system that is developed in the future, and it is the ultimate goal to establish a reliable Ad-Hoc network system that can be applied in real life.

5. Conclusion

In this paper, We analyzed about necessary study fields for efficient and reliable Ad-hoc network systems. The Ad-hoc network is a wireless communication, so we must understand different characteristics of wired and wireless network. if we develop more effective algorithms by a foundation to a wireless routing technique studied and introduce a MAC-layer multicast to enable efficient link usage, we construct the Ad-hoc network system to have better performance. Also if we develop techniques to improve reliability of wireless communication, it will be able to apply more stably in real life. We expect the efficient and reliable Ad-hoc network system be helpful in real life.

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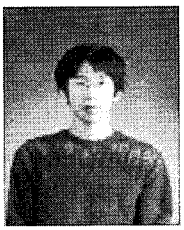

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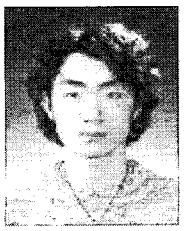

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