DISASTER INFORMATION IN OPTIMAL ROUTE SELECTION

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ABSTRACT

Cognitive wireless network consisted of multiple different types of wireless interface is one of efficient wireless transmission methods for Disaster Information Network, because it solves single wireless network problems like characteristics of wireless frequency or congestion form the use of same radio frequency. However, even if Disaster Information Network consisted of Cognitive Wireless Network, some of wireless node might be broken after severe disaster is happened. Therefore, it is necessary to consider about additional functions which the system never die. In this paper, we introduce Satellite System for optimal transmission control method in Cognitive Wireless Network in order to consider with severe disaster. First, as our previous study, proper wireless link and route selection is held by Extend AHP and Extend AODV with Min-Max AHP value methods for optimal transmission control in Cognitive Wireless Network. Then, check-alive function, alternate data transmission function, possible alternative route suggestion, and network reconfiguration are introduced to our proposed Disaster Information Network by using Satellite System. In the simulation, ns2 are used for the computational results to the effectiveness of the suggested transmission methods in the hybrid system of cognitive wireless and satellite network system.

KEYWORDS: *Cognitive Wireless Network; QoS; AHP; AODV*

I. INTRODUCTION

In case of Disaster Information System such as the case for earthquake, there is a certain possibility that electric power line is damaged and power energy cannot be supplied to those communication network devices, and eventually those wireless LANs cannot be functioned. Those malfunctions may cause serious damages for human life or lack of important information at the just after the occurrence of disaster. Therefore, Disaster Information System needs a robust Never Die Network (NDN) which will be unaffected by any changes in environment after severe disaster. Satellite Network System is considered to be one of efficient methods to realize [9, 10, 11] NDN, because it is unlikely influenced by such a severe disaster and can be covered wide area transmissions even if some of network devices were broken down.

However, Satellite Network has some problems for QoS like the following; throughput is low, latency is large, sending and receiving data transmission is different, cost is expensive, and so on. Thus, it is not suitable for the transfer of multimedia content and large volume of contents. On the other hand, wireless network can be solved such a problems. However, usual wireless communications consisted of single wireless network might have the following problem. First, the physical characteristics of wireless frequency may cause lack of QoS. When radio is a high-frequency band, high bandwidth communications like video contents are suitable for shorter communication distance. But it is highly influenced by obstacles such as buildings and trees. On the other hand, low-frequency radio communication is suitable for long distance communications and lower influence of obstacles such as trees.

Disaster Information System, wireless network is effective method because it is quickly reconstruct network than wired network. However, usual wireless communications consisted of single wireless network might have the following problem. First, the physical characteristics of wireless frequency

may cause lack of QoS. [9, 10, 11]When radio is a high-frequency band, high bandwidth communications like video contents are suitable for shorter communication distance. But it is highly influenced by obstacles such as buildings and trees. On the other hand, low-frequency radio communication is suitable for long distance communications and lower influence of obstacles such as trees. But it is not suitable for the transfer of multimedia content and large volume of contents. Also, because of the wireless LAN for rapid spread in recent years, there are concerns about the interference on the same radio spectrum between users. IEEE802.11b/g has spread too many houses, and these devices could be interfering to Emergent Communication System like Disaster Information Network.
Moreover, in the actual disaster case, there is certain possibility that electric power line is damaged and power energy cannot be supplied to those communication network devices, eventually those wireless LANs cannot be functioned. That is, Disaster Information System needs a robust Never Die Network (NDN) [1, 10] which will be unaffected by any changes in environment after severe disaster. In order to solve this problem, we introduce the Combination of Cognitive Wireless Network (CWN) and Satellite System for Disaster Information System. CWN is consisted of combining with multiple LANs with different transmission characteristics such as IEEE802.11b, g, j, n, IEEE802.16, and cellular network.
These wireless links are selectively switched by the distance between the wireless network nodes, power density, transmission frequency and their cover area, network transmission speed, and so on. Also, suitable communication environment can be provided even though the communication environment has been changed. Satellite System provides the function of checking wireless nodes' alive and their locations, reconstructing the topology, alternating data transmission if there is no possible activate nodes, and so on. [9, 10]

II. MODULES

- Route recovery
- Disaster detection
- Route selection
- Reconfiguration system

2.1 .Route recovery

Route recovery scheme in ad hoc networks to reduce the time delay and control overhead in the route recovery process. Maintaining connectivity with the sink node is a crucial issue to collect data from sensors without any interruption. While sensors are typically deployed in abundance to tolerate possible node failures, a large number of such failures within the same region simultaneously may result in losing the connectivity with the sink node which eventually reduces the quality and efficiency of the network operation. The idea of this distributed heuristic is based on maintaining the route information at each node to the sink and then utilizing such information for the relocation of the sensors. Route recovery scheme to solve the link failure problem caused by node movement, packet collision or bad channel condition. Since it considers a backup node mobility and conduct route recovery implicitly, it can support fast route recovery and then provide reliable and stable route for routing protocol. Routes need not be included in packet headers Nodes maintain routing tables containing entries only for routes that are in active use At most one next-hop per destination maintained at each node DSR may maintain several routes for a single destination Sequence numbers are used to avoid old/broken routes Sequence numbers prevent formation of routing loops.

- Dynamically maintain the knowledge of necessary neighbourhood information
  - Information from link layer
  - Hello messages
  - Information from information dissemination in support of routing
  - Information from data transmission
- Might include information beyond the 1-hop neighbours for some protocols
  - For example, multi-points relays for OLSR
- Dynamic maintenance of neighbourhood information such as location, direction, ID, resources etc.

2.2. Failure detection

A node along the path fails, causing other nodes to fail or there are collisions along the path.

The whole network appears to be failing when it is the sink that has failed. Failure at the sink may be due to bad sink placement, changes in the environment after deployment, and connectivity issues. Find link state of the neighbor node to communicate with the base station. A challenge in detecting link failures in wireless mobile networking environment is for both ends of failed link to detect and react to the failure independently almost at the same time to avoid service disruption. Our link periodic exchange of failure detection mechanism makes use of small-sized messages between neighboring nodes. A node can infer its receiving link quality based on the messages sent by its neighbors. Each message sent by the node to a neighboring node also serves as an acknowledgment to the messages sent by the neighbor. By indicating to it's sent but failed to neighbors of the hello messages they have show up, its neighbors can assess their transmit link quality. With both inferred receive and transmit link quality available at both ends of a link, the two ends can independently detect link failures almost at the same time.

2.3. Disaster detection

When just after disaster happened, the communication network around the disaster area maybe damaged and must be quickly recovered although the required network throughput is small while at stable and recovery period, the required throughput will be increased as the time is elapsed. Thus, small throughput data transfer by Satellite System is considered to possible alternative route if wireless nodes are damaged by disaster. The initial goal of the disaster detection system project was to create a simulation environment capable of simulating simple seismic activity and implementing software capable of detecting the seismic activity. The environment was based upon a simple model of an ordinary living arrangement, such as an apartment complex or dormitory building. The design consisted of a small-scale, two story building constructed of foam board.

The building was placed on a low-friction surface that allowed the building to be easily shaken and moved, providing simulated earthquake signals that could be measured using a mote placed inside the house. The earthquake detection software consists of two versions and was designed to read the accelerometer on the Tmote Invent so that the data could be transmitted, processed, and displayed in a useful manner. [9, 10, 11]

The two versions of the software are essentially identical, the only difference being the sensor used (x or y) and the corresponding state variable (which is used by the GUI to display the data). The software is based upon the Oscilloscope application provided with the Tmotes, which is capable of sensing and displaying temperature, voltage, light intensity, and two-dimensional motion. The earthquake detection programs have been optimized to use only the necessary components: the accelerometer and the radio.

The software periodically reads the accelerometer, packets the data, and transmits the data packet to other motes via the radio. In order to provide sensor readings faster and more efficiently, no processing of data is performed on the motes. Listing 1 shows the pseudo-code for the earthquake detection motes.

```
Set timer for 100ms;
State = X|Y;
When_timer_fires {
data = gather_data(X|Y_sensor);
}
When_data_ready {
send_to_base(state, data);
display_on_leds(data);
}
```

Listing 1: Pseudo-code for earthquake detection

2.4. Route selection

In the current cellular systems, which are based on a star-topology, if the base stations are also considered to be mobile nodes the result becomes a 'network of mobile nodes' in which a base station acts as a gateway providing a bridge between two remote ad hoc networks or as a gateway to the fixed network. This architecture of hybrid star and ad hoc networks has many benefits; for example it allows self-reconfiguration and adaptability to highly variable mobile characteristics (e.g. channel conditions, traffic distribution variations, and load-balancing) and it helps to minimise inaccuracies in estimating the location of mobiles. Together with the benefits there are also some new challenges, which mainly reside in the unpredictability of the network topology due to mobility of the nodes; this unpredictability, coupled with the local-broadcast capability, provides new challenges in designing a communication system on top of an ad hoc wireless network. The following will be required:

a) Distributed MAC (medium access control) and dynamic routing support
b) Wireless service location protocols
c) Wireless dynamic host configuration protocols
d) Distributed LAC and QoS-based routing schemes.

In mobile IP networks we cannot provide absolute quality-of-service guarantees, but various levels of quality can be 'guaranteed' at a cost to other resources. As the complexity of the networks and the range of the services increase there is a trade-off between resource management costs and quality of service that needs to be optimised. The whole issue of resource management in a mobile IP network is a complex trade-off of signalling, scalability, delay and offered QoS.

2.5. Reconfiguration system

A reconfiguration plan is defined as a set of links' configuration changes necessary for a network to recover from a link failure on a channel, and there are usually multiple reconfiguration plans for each link failure. [9, 10, 11]ARS systematically generates reconfiguration plans that localize network changes by dividing the reconfiguration planning into three processes—feasibility, QoS satisfiability, and optimality—and applying different levels of constraints. ARS first applies connectivity constraints to generate a set of feasible reconfiguration plans that enumerate feasible channel, link, and route changes around the faulty areas, given connectivity and link-failure constraints. Then, within the set, ARS applies strict constraints (i.e., QoS and network utilization) to identify a reconfiguration plan that satisfies the QoS demands and that improves network utilization most.

III. NS FEATURES

- NS is an object oriented discrete event simulator
- Simulator maintains list of events and executes one event after another
- Single thread of control: no locking or race conditions
- Back end is C++ event scheduler
- Protocols mostly
- Fast to run, more control
- Front end is OTCL
- Creating scenarios, extensions to C++ protocols
- fast to write and change

IV. THE COGNITION CYCLE

4.1. Observation Stage:

In this stage, the system observes application types in order to decide user policy which is depending on the specific services or media. Also, physical characteristics like coding, PER, throughput, delay, jitter, BER, and electric field strength are observed. Network data is continuously observed through each layer at this observation stage. [9, 10, 11]

4.2. Decision Stage:

Decision making is held to maintain QoS in this decision stage. We introduce AHP for the calculation of link, and extend AODV for the decision of suitable route.

4.2.1. Link Selection:

When the suitable link between neighbour nodes is solved by AHP, the hierarchy of the problem is first structured. Then, paired comparisons of criteria and alternatives are calculated for the priority value on AHP.

Total value of AHP is calculated by each priority value of criteria and alternatives. Here, total value of alternative is calculated by alternative priority multiplied with criteria priory, and the link with largest value will be decided as the best suitable link.

4.2.2. Route Selection:

AODV builds routes using a route request (RREQ) and route reply (RREP). When a source node requires a route to a destination for which it does not have a route, the source node broadcasts RREQ packets across the network. When the other nodes receive those packets, and then update their routing information for the source node and set up backwards pointers to the source node in the route tables. RREQ packets reaches to a destination node, routing table with AHP values is listed. Minimal values of AHP are firstly selected within each possible route, and then a max value of those minimal values is selected as a suitable route. RREP packet is returned through this selected route, and suitable route is selected and reconfiguration is held in acting stage. [9, 10, 11]

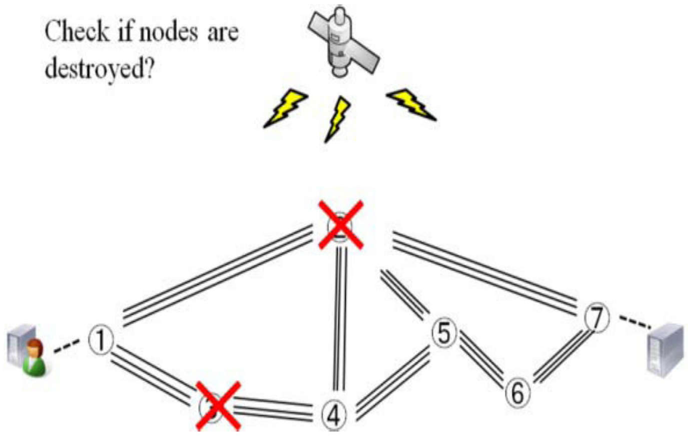

Fig.1. Check Alive Function of Satellite

4.2.3. Acting Stage:

After the decision making of the suitable link or the route, a link or route will be changed in the acting stage. A control link is set to the lowest frequency bandwidth, and a node sends the information with a suitable link to the next node through the control link. Then, both nodes act the link change at the same time.

4.2.4. Communication through Satellite:

Parameters like observed network conditions or AHP results are transferred by Satellite System as link. The message of prefer link or route is sent through link0, and a reconfiguration procedure is acted at both sender and receiver nodes. Secondly, wireless nodes are checked whether nodes are destroyed or not after disaster through Satellite System. If some wireless nodes are destroyed by severe disaster, a sender node collects all alive information of node, and then this information will be used for reconstruction of topology or alternative data transmission by satellite. The data transmission is not possible; satellite system alternates data transfer instead of wireless links. Therefore, proposed network system is possible to send data like resident safe information even throughput is low until topology is reconstructed. Live nodes are known as the previous function, the message of new possible route is send through satellite. [9, 10, 11]Then, link and route selection is occurred in cognitive wireless network. If supposed wireless network cannot transfer data, new possible wireless location is calculated by GPS information of each node.

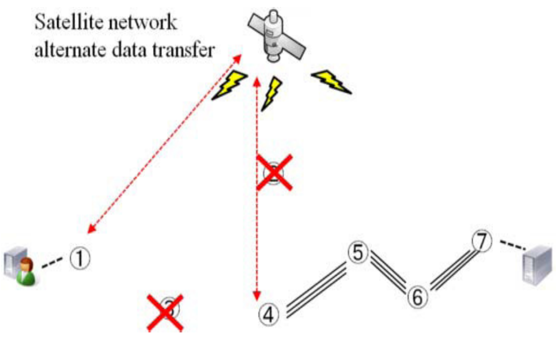

Fig.2. Alternative Transfer Function of Satellite

The Fresnel Zone [8] is the area around the visual line-of-sight that radio waves spread out into after they leave the antenna. It is said that wireless network consider to be free space model if the 80% of the Fresnel Zone is clear. In our proposed method, location and height of wireless nodes are known GPS information as the previous and geographical location and height of mountains. The calculation of Fresnel Zone is held toward a sender node along roads with certain distance like 10m each. If possible location is found along road, a next near mobile node will be calculated as the same way until a destination node. Finally, suitable route selection is held among all possible routes as mentioned in previous section, and the suitable topology is send to Disaster Centre and mobile nodes are moved to requested locations for rebuilding wireless connections. [8]

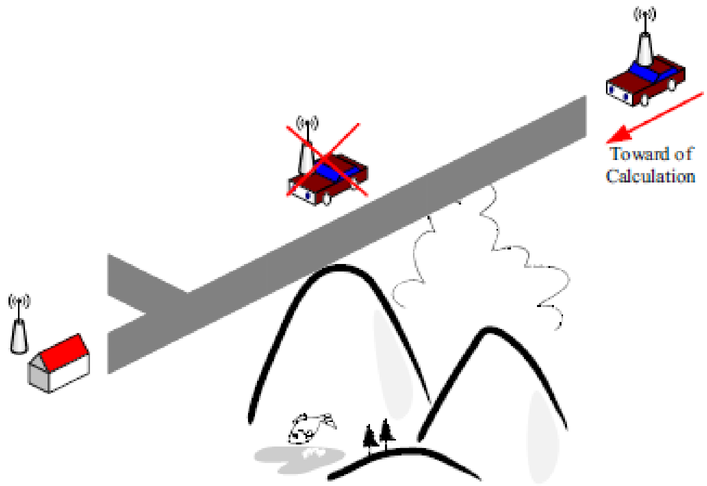

Fig.3. calculation toward for alternative access point

The parameters are considered for this process like jitter, throughput, BER, PER, etc. from these the following graph for transmission from different nodes at different interval is obtained like as follows below is found for Throughput.Fig.4.

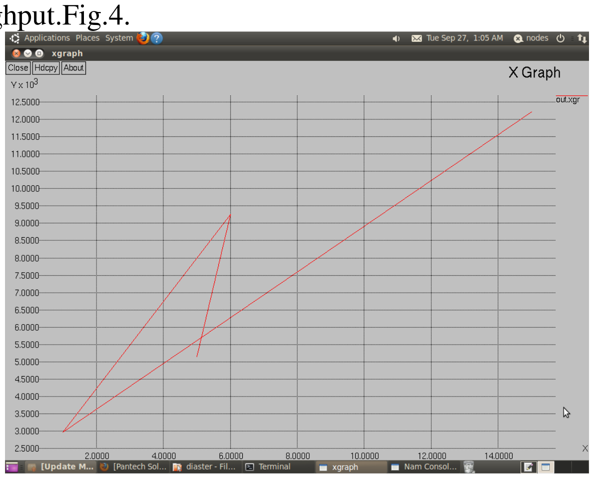

Fig.4. Throughput Graph

V. EXISTING VS. PROPOSED SYSTEM

- Monitoring SHM in a large-scale wireless sensor networks (WSN) is very difficult, not only because it is large and complex, much of difficulty comes from the lack of visual analysis tools. With the development of WSN, the networks become larger and larger and with the increasingly wide range of its application, many customize protocols are made. These factors make the monitoring of WSN become very difficult. The wireless links are selectively switched by the distance between the wireless network nodes, power density, transmission frequency and their cover area, network transmission speed, and so on.
- Never Die Network with combination of Cognitive Wireless Network and Satellite System this combination is supposed to be effective because data transmission keeps even after severe

disaster happened. Wireless links are selectively switched by user policy. Also, suitable communication environment can be provided even though the communication environment has been changed. To realize these functions, extend AHP with Min-Max method and extend AODV with GPS method are proposed for wireless link and route selection Satellite System provides the function of checking wireless nodes' alive and their locations, reconstructing the topology, and alternating data transmission if there is no possible activate nodes.

VI. CONCLUSION

Never Die Network with combination of Cognitive Wireless Network and Satellite System is proposed. In case of our proposed Disaster Information System, this combination is supposed to be effective because data transmission keeps even after severe disaster happened. Wireless links are selectively switched by user policy. Also, suitable communication environment can be provided even though the communication environment has been changed. To realize these functions, extend AHP with Min-Max method and extend AODV with GPS method are proposed for wireless link and route selection in this paper. Also, we proposed that Satellite System provides the function of checking wireless nodes' alive and their locations, reconstructing the topology, and alternating data transmission if there is no possible activate nodes. The simulation result based on the video transmission shows that the proposed methods can change to the best suitable link and route to maximize the transmission rate based on user policy by AHP. Therefore, the proposed method is shown in practical, efficient and reliable to support data transmission.

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