A study on the Robust and Systolic Topology for the Resilient Dynamic Multicasting Routing Protocol

Kangwhan Lee and Sunguk Kim, *Member, KIMICS*

Abstract— In the recently years, there has been a big interest in ad hoc wireless network as they have tremendous military and commercial potential. An Ad hoc wireless network is composed of mobile computing devices that use having no fixed infrastructure of a multi-hop wireless network formed. So, the fact that limited resource could support the network of robust, simple framework and energy conserving etc. In this paper, we propose a new ad hoc multicast routing protocol for based on the ontology scheme called inference network. Ontology knowledge-based is one of the structure of context-aware. And the ontology clustering adopts a tree structure to enhance resilient against mobility and routing complexity. This proposed multicast routing protocol utilizes node locality to be improve the flexible connectivity and stable mobility on local discovery routing and flooding discovery routing. Also attempts to improve route recovery efficiency and reduce data transmissions of context-awareness. We also provide simulation results to validate the model complexity. We have developed that proposed an algorithm have design multi-hierarchy layered networks to simulate a desired system.

Index Terms— Context aware, Architecture, Ad hoc networks, Sensor node, Energy, Rule based, Routing Protocol

I. INTRODUCTION

As an ad hoc network is a mobile self-organized network with dynamic topology. The several years, the dynamic routing protocol research of mobile ad hoc network of research field is actively advanced. From here, the dynamic multicast network topology as focus on technique of multicast routing of ad hoc network protocol is a possibility of seeing [1]. MANET can exhibit very diverse characteristics. The watch form changes in order to disconnect of path of provide. Unique characteristics of an ad hoc network raise several requirements for the routing protocol design: ad hoc network routing must be simple, robust and minimize control message exchanges. Because of routing is performed by generic mobile hosts.

Manuscript received February 9, 2008; revised July 18, 2008. The authors are with Department of electrical and computer engineering, Korea University of Technol-ogy and Education, Cheonan City Chungnam Provi-nce, Korea
(Email: , kwlee@kut.ac.kr, gammax@kut.ac.kr)

The topology of an ad hoc network is inherently volatile and routing algorithms must be robust against frequent topology changes caused by host movements. It will reach and in order to solve ontology technique from the dissertation which it sees and it applies the path search of the optimum which leads a hierarchy path search it sets. This shares with same attribute and it produces the role of the Query function as a property. And location information value of mobile node is provided with the network topology of state value [2], [3].

We should point out that significant work has been done in analyzing the performance of packet radio networks in terms of its delay characteristics, optimum transmission radius. However, to our knowledge, little work has been done in characterizing the reliability of routing protocols based on context-aware of ontology models. We also use simulations to validate our model and validation results look quite promising.

In this paper, we present a new on-demand multicast routing protocol called Resilient Ontology-based Ad hoc network Dynamic Multicast Routing Protocol (RODMRP). It is a robust, low overhead and efficient protocol. We choose to use the mesh infrastructure because resilience against link failures is an important property of ad hoc multicast routing. Specially, RODMRP provides a state of value the network topology [4].

The rest of this paper is organized as follows. In section 2, we discuss about the context-aware. And we contain a description of RODMRP complexity model. We present our context ontology model. In section 3, provides results of simulation experiments. Finally, we end the paper with conclusions and directions for further research in Section 4.

II. A new Proposed Topology

The multi casting algorithms exist from environment of various the MANET. But the formation of the network becomes with difficult with change of the network radius area to the movement of node. Therefore, it can't to maintenance for a data transfer and routing path. It is difficult problem. So, the source node and destination nodes participate to the multicast directly. And, the forwarding nodes connect two nodes. It follows in operation of the forwarding node and the efficiency is controlled. Therefore, excellent algorithm is designed from fundamental comprehension of transmission method for routing information. Mobile Ad hoc multicast routing algorithm divides a tree-based algorithm and a mesh-based algorithm.

Generally, tree-based algorithm is more efficient mesh-based algorithm than from the data transfer side. But, tree-based algorithm is having a weak point to link failure when changes the form of network. It provides one of path between source node and destination node.

The proposed that one of the solution methods applies the ontology technique of artificial intelligence field in new multicast routing network for optimized path search of the hierarchical structure and classified clustering from a same attribute for location information of dynamic node as a context awareness condition, etc.

From this condition, as a network topology inference the recovery in the efficient network topology introduces the escape of dynamic node with the resilient.

2.1 An overview of context-aware

A Context-aware is containing a variety of definition. Actually, that use context to supply appropriate information or service according to user's present context is known as Context-Awareness. Context modeling needs to supply abstract concept of high level about context information. And when offer abstract picture of sensor and actuator, developer can pare down defrayment of various hardware unit and interface.

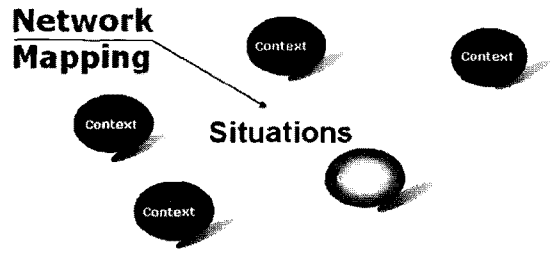


Fig. 1 Context aware architecture

This model supports context knowledge share and reuse in ubiquitous computing environment. Also, Hierarchy context ontology model has created correct low-level ontology to domain using high-level ontology.

And there is a based on the introduction of ubiquitous computing topology that implement of a new demand topology. In this paper, a rule based context aware architecture is designed to perform network clustering foundation and networking routing actualizing. The architecture is shown as Fig.1.

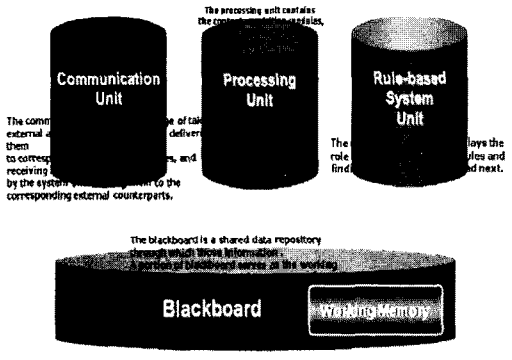


Fig. 2 Rule-based Context aware architecture

2.2 RODMRP algorithm in context-aware

The RODMRP is robust and resilient context aware network topology. Also, RODMRP is dynamic multicast routing protocol that presuppose ubiquitous environment. It can be suitable to context aware based hierarchy layer network that free one node are not specified. Also, used step-parent method of Ontology model techniques to recoverable link failure quickly and route establishment and administration by hierarchy layer attribute of fundamental route search and response message consist. Here, Hierarchy layer attribute refers to each node information and special attribute of network. RODMRP operate by role of become independent hardware protocol that is not dominated according to regional characteristics or communication network environment as property of each nodes .

The network route search and administration operation role division by each node context aware such as group cluster and family group reduce routing overhead being gone make. Recovery about most link damage found method to do recovery to information for narrow area including move route neighborhood in existing protocol. Above mention[4] of operator has two parts, Flooding Discovery Routing (FDR) and Local Discovery Routing (LDR) for re-routing method indwell. As FDR does flooding with node that cluster nodes are different within own radius routing composition do when form surrounding small set that know be executed, and wear form of congestion structure together. And, when form route early or do recovery by link damage is used and transmit control message to all nodes. LDR execute hierarchy layer group or family formation and limited time to manage. Here, using proposed step-parent method is belonged. Behave limited routing being wearing tree structure and control could be available to do not information interference of each node by tree structure.

RODMRP sought together efficiency that robust structure characteristic and tree structure hierarchy ontology context aware method that get using congestion structure flooding control traffic increase. Mesh structure is known that strong than tree, but tree structure is more efficient than mesh in packet routing side. RODMRP selected efficient route using method to precedence to route including proper the number of node formation group and node of hierarchy layer family. So that RODMRP have a node connection of robust more and resilient structure by failure node. That is, group and each head node of family consider context aware interrelation with contiguity node for resilient of failure node. And most contiguity node compose inference network of robust structure to select by step-parent node and resilient by mobility. Now, network of improve trouble node connectivity by mobility can speak as cooperative network technology.

2.3 Routing complexity model

The mobile wireless network continuous path creation and maintenance hazard multi attributes is necessary. This attribute distance and power of reception signal, time etc. It receives one attribute value and it listens to

and the routing value of hierarchical cluster and is classification with context-awareness method.

This attribute value is called a routing systolic.

Here, the attribute value for necessary to the cluster routing topology comes to be calculated by expression of routing complexity.

$$O(N) = O(D\log_L N - O(k) \quad (1)$$

Where, D is attribute value of depth and k is value of routing systolic, L is number of hierarchical layer and N is number of node.

It controls the hierarchical attribute structure and the tracking of the path to be easy and becomes the traffic of the appropriate packet.

2.4 Creation of hierarchy layer routing

Network composed flooding from source node to neighborhood by on-demand algorithm. First time, let's decide to examine process that create network. With early flooding structure composed connectivity of network. There must get into hierarchy layer routing structure to compose network connectivity and change of node by robust structure. As see in Fig. 3, RODMRP topology determination compose hierarchy layer of context aware after is ranged by node that have simple hierarchy depth in distributed network. Therefore, if network hierarchy number is L, top-level node of L*D unit is selected. If top-level node of nodes is selected, we called head node, message of own informs top-level node does broadcasting to nodes in network radius. Here, node refers to group (parent) node. And each parent node calculates interrelation with contiguity node for recovery of connection. Most contiguity node compose network of more robust structure to registering by step-parent node. There linked high-level node and low-level nodes limit to flooding as much as 2D depth. Quantity of packet reduces, and improves recovery by mobility. This depth (D) and receive message nodes confirm top-level node. If top-level node is not, adopt nearest hierarchy layer the node by high-level node and register by Hierarchy Layer Member (HLM-REQ). The Own node is not hierarchy layer member exceptionally, and is registered by Non-Hierarchy Layer Member (N-HLM-REQ) when is state that disconnect with other node. Therefore, network structure expressed with Fig. 3 by hierarchy tree structure of systematic structure. The algorithm of RODMRP is the Resilient Ontology-based Dynamic Multicast Routing Topology for ad hoc network. This topology combined the tree-based structure and mesh-based structure.

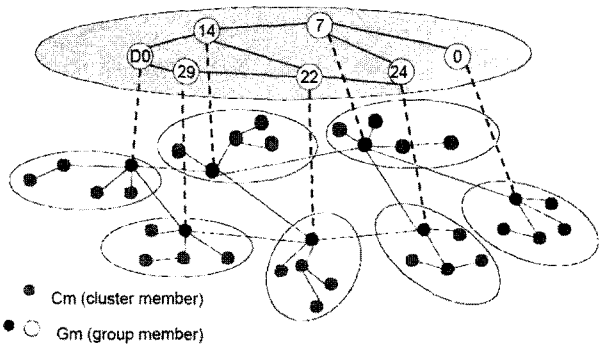


Fig. 3 Hierarchy Layer structure model For RODMARP Topology Scheme

As shown this topology, there are two family nodes in this structure network. The nodes in the same family are layer tree-based structure, in the same Depth, the connection mode between each node is peer-peer. Otherwise, RODMP is cluster-based structure, the nodes in the same nodes as a cluster member node, the parents nodes are defined as Group member, the normal nodes are defined as cluster members. Besides, among the two families, the group nodes connect based mesh structure.

2.5 Maintaining of Hierarchy Layer Routing

Composed of each HLM group member does HLM-REQ packet update periodically. That is can easily recovery to failure by transfer of node using HLM-REQ. Figure 3 and Figure 4 is picture a failure of node process recovery.

Failure recovery of node keeps in state that FDR and LDR are suitable because cooperate and consider transfer location measure etc. of node each other.

Hierarchy tree structure change newly according to information of node, and changed HLM-REQ delivers to HLM.

The following recognizes about FDR and LDR,

Case 1, Flooding Discovery Routing (FDR) :

This method keeps up connection of node in broadcasting of single layer.

Case 2, Local Discovery Routing (LDR):

This method recovered node link failure by step-parent node in hierarchy layer tree structure. To explain comprehension expressed from Fig. 4, as suppose that transmit data by node 23, 25 (destination node) in node 2 (source node), hierarchy tree route through neighborhood family member node 29 of top-level family member node is formed.

In this case, the selected route becomes as,

(S2->D23) = {2, 0, 7, 14, 19, 29, 22, 24, 23}
(S2->D25) = {2, 0, 7, 14, 19, 29, 22, 24, 25}

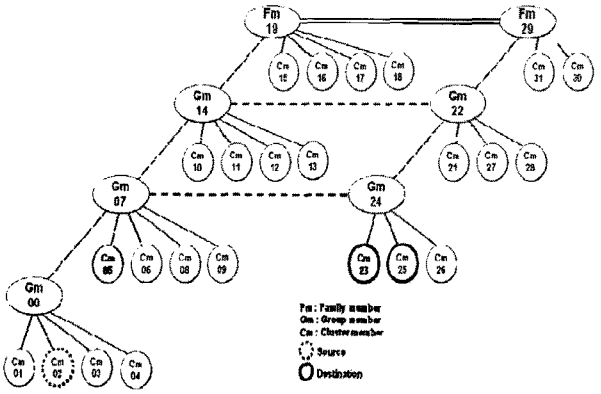


Fig. 4 Hierarchy Layer Link failure model

If group node 7 of route node of preceding descriptions was moved, linked low-level node of this node may lose all routes. Structure of network becomes congestive; more data transmission may be felt constraint. Reconstruct adamantine network that use discovery routing technique like that explain in front to recover structure of this network more rapidly. This time, if alternate by other group node of very near relation with moved group node 7, connection of low-level node is available preservation of present state. In preceding descriptions, alternated group node becoming step-parent, achieve above role. If speak that step parent node of group node 7 is group node 24, connection collapse about secession of node can escape with Figure 5.

Therefore, reconstructed route becomes.

$$(S2\text{->}D23) = \{2, 0, 7, 24, 23\}$$
$$(S2\text{->}D25) = \{2, 0, 7, 24, 25\}$$

And, if remove group member node 7, obtain shortest important position that lay more than hierarchy tree route. As this, conduct proposed RODMRP resilient network rescue.

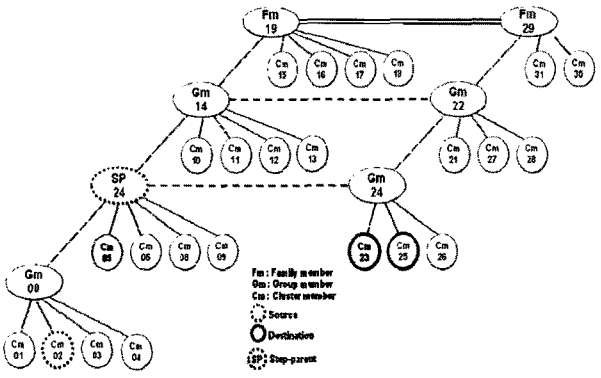


Fig. 5 Hierarchy Layer Recovery model

2.6 Maintaining Robustness routes

The basic layout of normal flow chart in RODMRP is as follows:

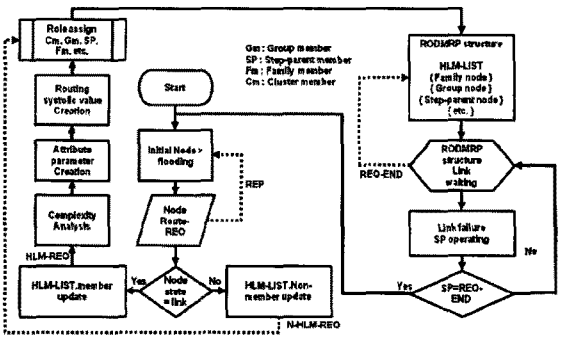


Fig. 6 Maintaining routes flow chart

From Fig. 3 and Fig. 5, RODMRP has robust and flexible tree structure network. And, show network structure created essentially flow chart .

2.7 Basic packet format

The basic layout of delivery packet in RODMRP is as follows (omitting IP and PHY headers):

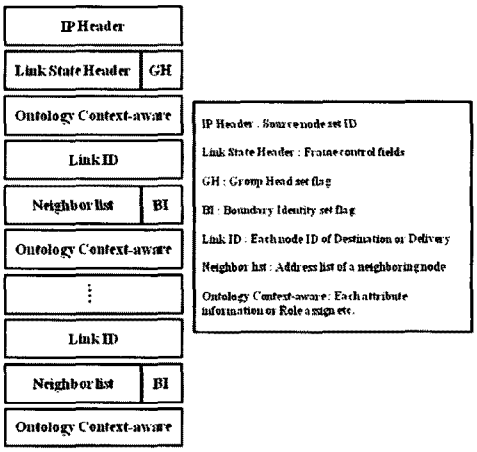


Fig. 7 Packet structure of RODMRP

From Fig. 7 shows RODMRP packet structure. Each explanation can know that refer right box of picture, and structure of packet has very simple and soft form than other algorithm. If node becomes some cluster group node, set this group entry relationship "BI". If node became some Cluster group step-parent, do setting to "Ontology Context-aware". All nodes reproduction of data packet to be feeler and find route discovery packet Ontology Context-aware each manage.

2.8 Selection of hierarchy member

A. HLM participation and escape

When some node wants to attend in group by receiver node, node waits for REQ-END that Route-REQ arrive. If there is node (the group cluster node or group step-parent node or from cluster 2 depth when is away) that want to take part in group newly, Route-REQ receiving in-coming route to the cluster node compose.

When new receiver node does not receive Route-REQ, it broadcasts HLM-REQ. And, because of new receiver node

who transmit HLM-REQ is away more than 2 depth at least from source node. If new receiver node does not receive any REP within timeout broadcast HLM-REQ. Several REP about HLM-REQ may increase more than that need number of routing node. But, this problem receiver node route discovery receive and can be solved by timeout because when send response about it only one route is updated. RODMRP can supply method to leave from group without sending control message automatically because use Ontology Context-aware algorithm. That is when node leaves group the node can leave from group doing not send REP for route discovery after.

B. Family member starting in advance.

Family node to cluster head of top-level is defined by nodes that have the short address value to HLM-LIST. Because all group nodes send HLM-REQ packet periodically, family node has latest information for group nodes. When group node received HLM-REQ from other group node of same family, the group node updates HLM-LIST that includes address of all group nodes. Have this information, and family node can decide whether have short address value by oneself.

III. Simulation Results

3.1. Simulation environments

The proposed RODMRP was used for *ns*-2 simulator of performance simulation in modern many treatises. Comparison estimation compared ODMRP of uniformity standard. Computer simulation composes net of 50x50 size for arrangement of node, and nodes were arranged to do random in map. Transmission speed of each node gave equal value. The size decided by 10, and motion of 50 nodes free arrangement select. Until packet that create multicast packet and happen from transmission of a message node arrive in reception node, did packet broadcast. Prescribed to next assumption to compare performance for proposed of RODMRP. Traffic supposed that is not except multicast packet within network. Mobility of nodes supposed to 1m space. This paper executed two experiments. First experiment estimated the solubility of most important parameter that select existing and stable route. Second experiment estimated average route usefulness and stability the case do not consider special route between different two nodes.

3.2. Simulation result

As shown in Fig. 8, however, control overhead decreases by more than 38% regardless of the number of sources. Route efficiency of RODMRP also enables large improvement (up to 38%) in terms of data transmissions, as shown in Fig. 8 that the decreased number of packet transmissions leads to reduced end-to-end delay. RODMRP are reduced by more than 38%, compared to those in ODMRP. It is because more frequent link failures cause more unnecessary nodes to be forwarding nodes temporarily. From this experiment, we can conclude that RODMRP does not show noticeable performance degradation due to high mobility.

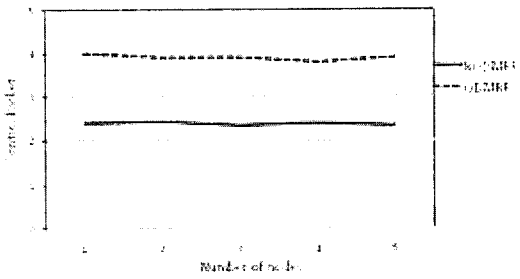


Fig.8 Data packet transmissions complexity

IV. Conclusions

In this paper, proposed to new multicast routing protocol of MANET. This algorithm be performed to flexible operation method of depend on the context. Therefore, data transmission rate have control of proper capacity and packet frame simplify to reduce packet overhead. The basis conception minimized network connection and discovery to context-aware. That is a robust and a variation depend on the context of family member set consist depend on the group member set and group attribute. This leads to reduction in data packet of proper transmissions and further to decreased data transmission delay due to less contention in a network of quickly recovery and robustly maintenance. The Simulation results reveal that RODMRP effectively routes data packets of robust and flexible recovery.

ACKKNOWLEDGEMENT

This research was financially supported by the Ministry of Education, Science Technology (MEST) and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Regional Innovation.

REFERENCES

[1] Charles E. Perkins, "AD HOC NETWORKING," Addision Wesley 2002

[2] Charles E. Perkins, "AD HOC NETWORKING," Addision Wesley 2002

[3] S. Corson, J. Macker, Mobile ad hoc networking (MANET) : routing protocol performance issues and evaluation considerations, RFC 2501, IETF, Jane 1999

[4] Sunguk Kim, Sam-hyun Chi, Kangwhan Lee, , "A Study on the Inference Network Based on the Resilient Ontology-based Dynamic Multicast

Routing Protocol," J. of KIMICS, vol.11, No. 6, pp 1214-1221, 2007.

[5] Seungjoon Lee, Chongkwon Kim, "Neighbor Supporting Ad hoc Multicast Routing Protocol," the Republic of Korea, June 2000

[6] P. Johansson, T. Larsson, N. Hedman, B. Mielczarek, M. Degermark, "Scenario-based performance analysis of routing protocols for mobile ad-hoc networks," *MobiCom* 99, Aug. 1999

[7] Chunchieh Huang, Minghuang Guo, Ruayshiung Chang, "A weight-based clustering multicast routing protocol for mobile ad hoc networks," Int. J. Internet Protocol Technology, Vol. 1, No. 1, 2005

[8] S.W Lee, J.T Kim, B.K Sohn, K.M Lee, J.D Cho, J.H Lee, J.W Jeon, "Real-Time Rule-Based System Architecture for Context-Aware Computing," the Republic of Korea, March 2004

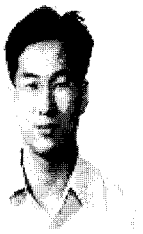
[9] Heonman Jung, Junghyun Lee, "Probability-annotated Ontology Model for Context Awareness in Ubiquitous Computing Environment," the Republic of Korea, July 2006

[10] J. Broch, D. A. Maltz, D. B. Johnson, Y. Hu, and J. Jetcheva, "A performance comparison of multi-hop wireless ad hoc network routing protocols," Proceedings of the Fourth Annual ACM/IEEE International Conference on Mobile Computing and Networking, ACM, Dallas, TX, Oct. 1998

[11] Zhenqiang Ye, Srikanth V. Krishnamurthy, Satish K. Tripathi, "A routing framework for providing robustness to node failures in mobile ad hoc networks," USA, July 2003

[12] Alejandro Quintero, Samuel Pierre, Benjamin Macab_eo, "A routing protocol based on node density for ad hoc networks," Canada H3C 3A7, April 2004

[13] Avinash Shenoi, Yelena Yesha, Yaacov Yesha, Anupam Joshi, "A framework for specification and performance evaluation of service discovery protocols in mobile ad-hoc networks," USA, March 2004



Sunguk Kim
received her B.S. degree in computer engineering from Chungju University, Korea, in 2000. Now he is a M.S course at the School of information Technology of Korea University of Technology and Education. He master major is computer engineering, and now is studying the routing path topology in MANET and context aware system for wireless UoC(Ubiquitous on Chip) system design. His email address is gammax@kut.ac.kr.

Kangwhan Lee
received his B.S. and M.S. degrees in electronics engineering from Hangyang Univer-sity and Chung-Ang University, Korea, in 1987 and 1989, respecti-vely. He earned his Ph.D. in electronics engineering from Chung-Ang University, Korea, in 2002. And he has finished course work from Korea Advance Institute Technology(KAIST) in 1996. Also, he has work as a invited professor on CICA(Center of Institute Communication Association), France in 1997.
Since 1989, he has been a member of senior technical staff at video communications section of Electronics and Telecommunications Research Institute(ETRI), In 2005, he joined the faculty of Korea University of Technology and Education, where he is currently an Associate Professor of electrical and computer engineering. His research interests are in the area of VLSI system design, FPGA/ASIC & Wireless Communication for SoC including UoC(Ubiquitous on Chip) for ubiquitous sensor network.