Asian Journal of Science and Applied Technology (AJSAT)
Vol.2.No.1 2014pp 21-26.
available at: www.goniv.com
Paper Received :05-03-2014
Paper Published:28-03-2014
Paper Reviewed by: 1. John Arhter 2. Hendry Goyal
Editor : Prof. P.Muthukumar

AN APPROACH OF ENERGY EFFICIENT AND SECURE DATA TRANSFER USING MULTICAST ROUTING PROTOCOL IN AD HOC NETWORKS

F. Sanjitha Banu[1], D. Saveetha[2]
Department of Information security and cyber forensics,
SRM University, Kattankulathur,
Chennai, T.N., INDIA

ABSTRACT

An Ad-hoc Network is composed of a number of nodes without any infrastructure or centralized administrator. The nodes are self-organized to form a network topology over radio links. Each node acts as a host or router to form the network without any fixed radio base station.These nodes are powered by batteries with a limited energy. Hence we propose a paper for energy efficient and secure data transfer using multicast routing protocol in ad hoc networks. Multicast routing protocol plays an important role in ad-hoc networks, it supports the propagation of data from sender to all the receiver in a multicast group to utilize the bandwidth efficiently. And this paper proposes theconsumption of energy efficiently according to distance and to securely transfer data from source to destination in the network.

Key Words: Ad-hoc Network, Multicast Routing Protocol, Energy **e**fficiency, security.

1. INTRODUCTION

A Wireless network is a type of computer network that uses wireless connections for connecting network nodes. It is a mode of connection for homes, telecommunication networks, business, and enterprises to avoid costly cabling in a building or the connection between various equipment's locations.Eachnode can communicate with another node immediately within their radio range or one which is outside the range using wireless links. One type of wireless networks iscalled ad-hoc networks. Ad-hoc networks have become increasingly relevant in recent years due to their potential applications in battlefield, military, and emergency disaster relief, etc. It is a self-configuring network which consists of a collection of autonomous mobile nodes forming a topology without use of any existing infrastructure. Each mobile node acts as a router or host in a network. The mobile nodes communicate directly with each other and without the aid of access point, and therefore have no fixed infrastructure or centralized administrator. The goal of an ad-hoc network is to broaden mobility into the area of autonomous, mobiles and wireless domains. Whereas each node will change its locations and configure the topology itself.The nodes rely on each other to established communication, thus each node acts as a router or host.Therefore, in mobile ad-hoc networks, packets cantravel from source to destination either directly or through some set of intermediate nodes in the network.

In mobile ad-hoc network nodes are broadcast in nature. So, the lifetime of nodes and energy efficiency is lost by the number of nodes available in the network. However, we are using multicast routing protocol which is independent to unicast routing protocol. Multicast routing protocol works bythe transmission of packets starting from source node and then the messages or packets are received by number of users available in the multicast group. Multicast

routing protocols has many applications in wired and wireless networks like the transmission of same data at one time to multiple receivers such as audio conferencing, video conferencing, collaborative and groupware applications, shared applications, etc.Wireless networks has two popular multicast routing protocol : tree based multicast routing protocol and mesh based multicast routing protocol. The tree based multicast routing protocol is further divided into two types such as shortest-tree based multicast routing protocol and core-tree based multicast routing protocol. In our project we are using shortest-tree based multicast routing protocol to obtain energy efficiency in ad-hoc networks.

The shortest-tree based multicast routing protocol always selects the shortest path from every source to destination. Then the intermediate nodes will mark the status in membership status table while forming the route. Each source node needs to form a root tree by keeping itself as root. So there are a number of routes available from source to destination. But the source node will choose only one shortest path to save the energy of nodes available in the network. Because ad-hocnetworks has limited energy resources, so each node operates in unattended manner. Maximum lifetime or energy efficiency is an important strategy in this recent world. For this shortest-tree based multicast routing protocol is more optimal.Finally security is also a sensitive and an imperative issue in ad-hoc networks than any other network due to the lack of infrastructure, no fixed base station and no centralized administrator. For securing data transfer in ad-networks we useRijndael algorithm for data encryption and decryption process. Using this algorithm we securethe data transfer in multicast routing protocol.

2. AD-HOC NETWORKS IN MULTICAST ROUTING PROTOCOL

An Ad-hoc network is a wireless network. It uses high frequency radio waves for nodes or device communication, which increases mobility but decreases the range rather than using communication cables between the nodes. Ad-hoc network consists of no infrastructure and no fixed base station and centralized administrator. So, each node in this network acts as a router or host for direct communication with each other. Then the nodes move freely from one place to another place and it forms aown topologyby themself.And each node is powered by batteries with a limited energy, wherein each node stops functioning when batteries get drained.For energy efficiency and maximizing the lifetime of nodes we introduce a new techniqueaimed to minimize power consumption of all nodes by using multicast routing protocol.

Multicast routing protocol is independent of unicast routing protocol. Multicast source node or root node will transmit packets or data to number of receivers' node in the network. The source node first time broadcast the message and second time it unicast the packet to destination. Before transmitting packets all receiver nodes and source node first identifies the multicast group nodes in that network. So we introduce a technique to identify the neighbor nodes for multicast group using distance of each node.

2.1 Identification of neighbor node:

Multicast routing protocol consists of unremitting sending the message from source to multiple destinations. It is used in ad-hoc networks. And this multicast routing protocol is more efficient way to increase the lifetime of nodes. Thus, nodes will communicate with each other. So, each node should identify the neighbor node for communication within the network or outside the radio range. Hence we introduce distance method to calculate the number of nodes available within this radio range. For example consider each node network coverage distance is 100. And initial distance of one node is started from 50. And randomly consider the distance for each node. For e.g.: the random distance is 234 now i need to found the neighbor nodes in the network. So, the calculation is 234+100 and 234-100 between these ranges nodes are considered as a neighbor node for communication using multicast group.

E.g:

Distance=234, Network Coverage Distance=100

Val1=distance + network coverage distance (NCD)

Val2=distance-network coverage distance (NCD)

```
If(val1>val2)
{
    Printf ("print the neighbor nodes");
}
```

If this above condition is true then it will display the number of neighbor nodes between theseranges from 134 to 334. So, now we discovered the number of neighbor nodes available within this wireless ad-hoc network.

2.2 Multicast tree initialization:

Multicast routing protocol is sovereign of unicast routing protocol. The unicast protocol will transmit the packet from one source to one destination. It utilizes whole bandwidth of the network. But multicast routing protocol will diffuse packet from one source to many receivers in the network. For this communication it reduces the bandwidth compare to unicast routing protocol. The multicast routing protocol is categorized into two schemes: tree based multicast routing protocol and mesh based multicast routing protocol.

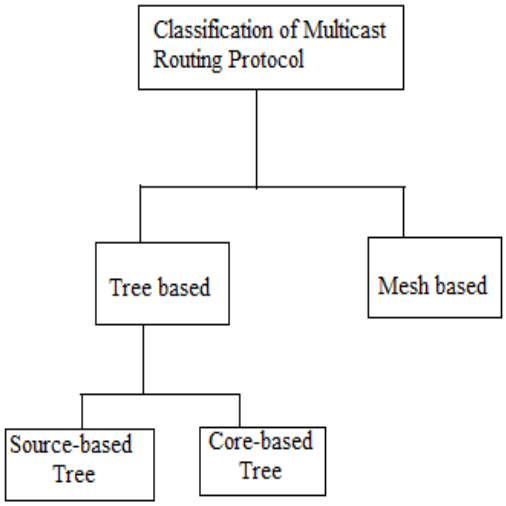


Figure 1: Classification of Multicast Routing Protocol

Tree based multicast routing protocol is based on how to distribute the paths among group members in multicast network. It's further divided into two types. Shortest-tree based multicast routing protocol and core-tree based multicast routing protocol. The shortest-tree based multicast routing protocol always chooses the shortest path between source to destination. The source node is the root node it must always know the topology information and address of its entire receiver in the multicast group. Core-based multicast routing protocol will produce single tree per group and it's shared by all the groups of senders and receivers.

In network at least one source node and one destination node is available. And it does not known the route information. So, source node will send the MULTICAST JOIN REQUEST MESSAGE (MJRQM) to all the nodes available in the network. This MJRQM message is broadcast to all the receiver nodes in the network. Then intermediate node will forward this message to next neighbor node. This MJRQM message is forward until it's reached to destination.And each node will send MULTICAST JOIN REPLY MESSAGE (MJRPM) message to all previous hop node. The destination node also needs to send MJRPM message to the previous node in the network. Each previous node is considered as *pater* node. If the nodes are willing to join this multicast group then it will send MJRPM message to source node by unicast way.

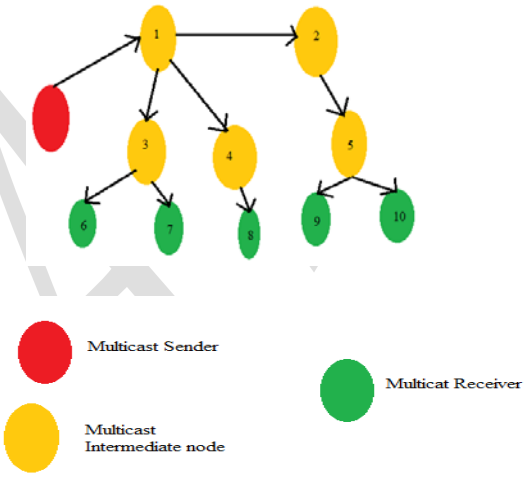


Figure 2: Multicast Join Request Message (MJRQM)

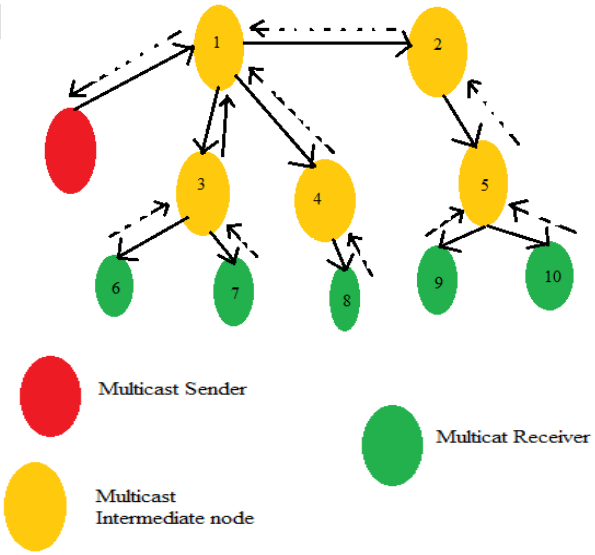
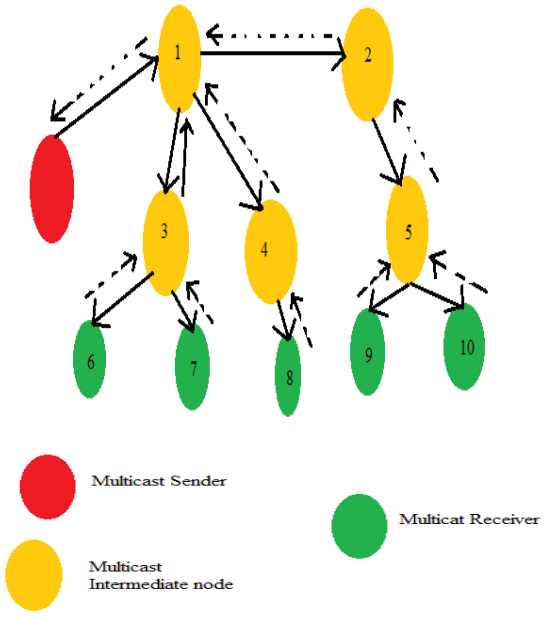


Figure 3: Multicast Join Reply Message (MJRPM)

2.3 Multicast tree Maintenance:

Each node will send the MJRPM message by unicast way to its *pater* node. Then finally it reaches the sender node. Then sender node and all intermediate nodes should record the information of route from its next neighbor node.Finally the multicast group and route for transmitting the data from source to destination will establish. To record or maintain this information of route is stored using *membership status table*. This *membership status table* contains the information about node name, pater node, neighbor or next node and destination node. Using this *membership status table* information each node will forward packet to its correct destination. Forwarding packets information is originated by some other node than the pater node means it's just discard the packet and it won't forward to next hop in multicast group.



Node	Next Node	Pater Node	Destination Node
1	2,3,4	Sender Node	9
2	5	1	9
3	6,7	1	9
4	8	1	9
5	9,10	2	9

Table 1: Membership Status Table

3. ENERGY EFFICIENT USING MULTICAST ROUTING PROTOCOL IN AD-HOC NETWORK

Ad-hoc network is a lack of infrastructure and no centralized administrator. So, each node in the ad-hoc network is powered by batteries. Batteries are in limited energy and nodes will stop functioning when the batteries get drains. To maximize the lifetime of nodes using multicast routing protocol. This multicast routing protocol will minimize the transmission power of nodes in network.In this project we obtain energy efficient using one principle.

I.e. Distance $\propto$ Forward Energy

Here, calculating the energy according to distance travelled by each nodes in this network. The source node will always choose shortest path for packet transmission from source to destination. So, the distance also curtail for packet transmission and energy also used efficiently for other purpose by nodes. And this each node involved in the packet transmission will save the energy and increase the lifetime of the network. It utilizes the bandwidth efficiently. By, this way we are increasing the maximum lifetime of nodes offered in the ad-hoc networks.

4. SECURE DATA TRANSMISSION IN AD-HOC NETWORKS

Secure data transmission is a major apprehension of wireless ad-hoc networks. An ad-hoc networks will broadcast data and also dynamic in nature. In ad-hoc network multicast routing protocol taken into accounts and have many applications like military (battlefield), audio conferencing, video conferencing, and emergency operations. And this secure transmission of packet around the network through routing protocol is a major challenging aspect in this recent world. All the nodes in this network will act as router. So, for secure data transmission we encrypt and decrypt the data using Rijndael algorithm and make transmit using multicast routing protocol in ad-hoc network.

4.1 RIJNDAEL Algorithm:

May 26, 2002 the National Institute of Science and Technology (NIST) selected a block cipher called Rijndael created by Vincent Rijmen and Joan Daemen. And Rijndael was originally a variable block size(16, 24, 32) bytes and variable key size (16, 24, 32)bytes of encryption and decryption algorithm. Advanced Standard Encryption (AES) also called the Rijndael algorithm. AES ismost usefulencryption algorithm and

its reversible. And its operates on fixed number of bytes with secret key.

The operations of algorithm are:

1. Add Round Key
2. Byte Substitution
3. Shift Rows
4. Mixed Column

In this project we are using 16 bytes of variable block size and 16 bytes of variable key size. This iteration is repeated up to 10 rounds. And these above iteration steps called rounds. The rounds are:

4.1.1 Add Round Key:

Each 16 bytes of the state is XORed with 16 bytes of expanded key for the current round. Once the first 16 bytes are XORed against the first 16 bytes of the expanded key is never used again. Next time it will use 17-32 bytes XORed against the state. Then decryption process is reversed of encryption process.

4.1.2 Byte Substitution:

During encryption process each value of the state is replaced by corresponding SBOX value. Refer S-Box value for this byte substitution process. Consider example: HEX 25 is replaced by corresponding SBOX value is 3F. And decryption process is just inverts of SBOX value. I.e. HEX 3F is HEX 25.

4.1.3 Shift Row:

The state is arranged like a matrix and perform circular shift. The circular shift is based upon the rows number. Suppose if row number is 1 then shift one position then 2nd position number will come to 1st position and 3rd will goes to 2nd position. And then arrange the matrix in 4x4order.

For Example: The bytes are 1 5 6 7 8 2 4 9 0 3 11 19 20 23 75 13

The 4x4 matrix is

1 80 20
5 2 3 23
6 4 11 75
7 9 19 13

And each row is shifted like 0,1,2,3 spaces over right side then the result is

1 8 0 20
2 3 23 5
11 75 6 4
13 7 9 19

And decryption process is just reversed of encryption, but we have to shift left side.

4.1.4 Mix Column:

In mixed column the states are multiplied by the parts of matrix. Then 4x4 matrix multiplication is performed one column at a time. Each value in column is multiplied against the every value of the 16 byte matrix. Then the result of these multiplications is XORed together to produce only 4 bytes of results.

By, using these above process we secured the data before transmit through the multicast routing protocol in the network. After encrypt the data its ready to transmit in the ad-hoc networks. Using these ways we secured the data transmission in multicast routing protocol and efficiently using the energy.

5. CONCLUSION

An energy efficient and secure data transmission is more important parts in ad-hoc networks. An ad-hoc network is lack of infrastructure, no fixed base station and no centralized administrator. So in order to obtain secure and reliable communications, routing protocol is necessary and it's helpful to discover the routes in the network. In this paper we propose energy efficient multicast routing protocol and secure multicast routing protocol using Rijndael algorithm. And this protocol provides secure data transfer from source to destination by choosing shortest path to destination. As in ad-hoc networks,every nodes are charged by batteries with limited energy and nodes functioning will stop when battery get drains. So we used shortest tree based multicast routing protocol to minimize the bandwidth and maximize the lifetime of nodes around the networks. By using this ways we utilized the energy efficiently.

REFERENCES

[1]TanuPreet Singh, Neha and Vikrant Das, "MULTICAST ROUTING PROTOCOLS IN MANETS", International Journal of Advanced Research in Computer Science and Software Engineering Volume 2, Issue 1, January 2012

[2] Busola S. Olagbegi1 and NatarajanMeghanathan, "A Review Of The Protocols For Mobile Ad Hoc Networks Energy Efficient And Secure Multicast Routing", International journal on applications of graph theory in wireless ad hoc networks and sensor networks (GRAPH-HOC) Vol.2, No.2, June 2010

[3]C. Yu, B. Lee and H. Y. Youn, Energy Efficient Routing Protocols for Mobile Ad Hoc Networks,

Cleveland State University, EFFRD Grant No. 0210-0630-10.

[4] V. Rishiwal, M. Yadav, S. Verma, S. K. Bajapai, Power Aware Routing in Ad Hoc Wireless Networks, Journal of Computer Science and Technology, vol. 9, no. 2, pp. 101-109, October 2009.

[5]D. T. Ahmed and S. Shirmohammadi, Architectural Analysis of Multicast Routing Protocols for Wireless Ad Hoc Networks, Proceedings of the 6th International Conference on Networking, p. 21, 2007.

[6]M. Abolhasan, T. Wysocki, and E. Dutkiewicz. A Review of Routing Protocols for Mobile Ad hoc Networks, vol. 2, no. 1, pp. 1-22, Ad Hoc Networks, January 2004.

[7] X. Chen, J. Wu, Multicasting Techniques in Mobile Ad-hoc Networks, Computer Science Department, SouthWest Texas State University, San Marcos, The Handbook of Ad-hoc Wireless Networks (2003) pp. 25–40.

[8] M. Maleki, K. Dantu and M. Pedram, Power-Aware On-Demand Routing Protocols for Mobile Ad Hoc Networks, Proceedings of the International Symposium on Low Power Electronics and Design, pp. 72-75, 2002.

[9] E. Wieselthier, G. D. Nguyen, and A. .Ephremides, Energy-Efficient Broadcast and Multicast Trees in Wireless Networks, Mobile Networks and Applications (MONET), vol. 7, no. 6, pp. 481-492, December 2002

[10] P. Papadimitratos and Z. J. Haas, Secure Routing for Mobile Ad hoc Networks, Proceedings of the SCS Communication Networks and Distributed Systems Modeling and Simulation Conference, January 2002

[11] S.Doshi, T. X. Brown, Minimum Energy Routing schemes in Wireless Ad hoc networks, IEEE INFOCOM 2002

[12] I.Stojmenovic and X. Lin, Power Aware Localized Routing in Wireless Networks, IEEE Transactions on Parallel and Distributed Systems, vol. 12, no. 11, pp. 1122-1133, November 2001.

[13] PAVAN PICHKA, H.SANTHI* and DR.N.JAISANKAR, "A Comprehensive Study of Existing Multicast Routing Protocols Used In Mobile Ad Hoc Networks" PavanPichka et al. / International Journal of Engineering Science and Technology (IJEST)