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A New OLSR Routing Protocol in Cognitive Wireless Mesh Networks

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Abstract
Ad hoc On-Demand Distance Vector (AODV) is a reactive routing protocol that establishes a route based on a requirement. By avoiding counting-to-infinity problem it performs better when compared to most common routing protocols of the Internet such as IGRP, EIGRP, OSPF, RIP, and IS-IS. Though reactive and on-demand, AODV cannot capitalize on all available dynamic spectrum resources in cognitive wireless mesh networks yet maintaining a high throughput to route packets. For that reason in our paper we propose an enhanced AODV protocol named AODV-COG that provides an interface to a route for efficient usage of the spectrum and finding a path with high throughput among the paths with same hop count. Simulations in NS-2 require changes to support cognitive wireless mesh network conditions. In this paper we are focusing on Optimized Link State Routing Protocol (OLSR).

Keywords-Cognitive mesh networks, routing protocol, AODV, OLSR.

1. Introduction
Today wireless communication industry is growing very fast. The inconsistency between the limited spectrums of wireless applications becomes more and more important. The resources which are used by the users are not given full licensed. According to the Federal Commission FCC data, the utilization rate of allocated spectrum is only 15% -85%. Cognitive radio technology will manage to resolve the issue. In mesh networks to improve the capacity and network throughput will cognitive radio technology.
In this research, the cognitive wireless mesh networks mainly addresses on the sensing technology and spectrum sharing scheme and the routing for utilization of multiple channels in multi-hop cognitive mesh networks will face several problems. In multiple channel networks, the set of channels available for each node is not static. In this paper, we are using the advanced AODV that uses the routing request and response messages from node to node SOP(Spectrum Opportunities) information will explore the calculated information of the routes. In this paper, we use equal number of interfaces and channels. In this design will create the channel for each interface. For the cognitive radio condition will use network simulator 2 (NS-2). The protocol which we are using will select the best path. The contribution of the paper

- We modify the Network Simulator 2(NS-2) to support the cognitive function; the readers can also use our architecture to evaluate their own routing protocol for cognitive mesh networks.
- We implement the AODV to increase the throughput and performance in the cognitive mesh networks.

Many researchers in the past have compared the before mentioned protocols considering the standard wireless ad hoc networks. But mesh networks are different from the other networks. Here we are explaining the problems in the mesh networks and solving the problems. One of the critical issues of the mesh networks is scalability. In this paper we are improving the scalability and throughput using OLSR routing protocol to reduce the overhead and then compare the OLSR to AODV in terms of packet delivery ratio.

2. Related Work
After researching many protocols will use the extension for the AODV is OLSR. First we will identify the most popular ad hoc routing protocols that are having direct candidates for the routing protocols in wireless mesh networks. The routing protocol is suitable for small. Large-scale wireless mesh networks. The ad hoc networks traditionally divided into two categories: on-demand (reactive) and table driven (proactive) protocols. In the reactive protocols the route path is finalize only when the node is transferring data packets to send. All the results we will show using NS-2 simulator.

3. The ETX metric
AODV-COG uses the ETX metric in its main two functions, so let us introduce the ETX metric and our own approach to get the parameters those are used to calculate the ETX first. The ETX determine routes with the fewest excepted number of transmissions required to deliver a

packet to its destination, including re-transmissions. It aims to choose routes with high end-to-end throughput. ETX's effectiveness has been proved in [8]. We use the forward and reverse delivery ratios of a link to calculate the ETX. The forward delivery ratio, d_f, is the measured probability that a packet successfully arrives at the destination; the reverse delivery ratio, d_r ,is the probability that the ACK packet is successfully received [8].

Our method to get the d_f, d_r and calculate the ETX is as follows:

1). In AODV protocol, the nodes broadcast hello message every HELLO_INTERVAL milliseconds. In our protocol, we set the HELLO_INTERVAL as definite value milliseconds. Then every millisecond, every node sends a hello message through all channels. Because the Hello messages are broadcast, 802.11 protocols do not acknowledge or retransmit them. We define a two-dimensional array *Numhello[i][j]* for every node to record the number of hello messages sent by its neighbor node *i* using channel *j*.

2). Every *t* milliseconds, we calculate the d_r for each node on each channel. We define another two-dimensional array d_r *[i][j]* to record the delivery ratio from the neighbor node *i* through channel *j* :

$$d_r[i][j] = \frac{Numhello[i][j]}{m/t}$$

m is the number of hello messages that should have been received during last *t* milliseconds.

3). We can see that the *Numhello[i][j]* stored in node *k* should also be used to calculate d_f *[k][j]* for node i ,so every *t* milliseconds, we send a new packets named hello-ack packets which carry the *Numhello[i][j]* information back to the node *i*. Then the node *i* should calculate the d_f .After the unicast transmit of the hello-ack packets is complete, we clear the array *Numhello[i][j]* for next *t* period.

4). When we get the d_f, d_r, we should calculate the ETX using the following function [8] to calculate the ETX:

$$ETX = 1/(d_f \times d_r)$$

4. AODV-COG Protocol

Our routing protocol is based on the Ad-hoc On-Demand Distance Vector (AODV) protocol.. The AODV-COG modifies the AODV protocol mainly in two parts: One is the path selection function, which is used to fine a path with higher throughput. The other is the interface assignment function, which is used to select an interface to route packets.

4.1 Path selection function

The AODV protocol determines the routes using the minimum hop-count metric which is not always finds the path with the largest throughput. Even if the best route is a minimum hop-count route, there may be another route with the same hop counts but achieves larger throughput. Our protocol aims to find the route which gains the highest throughput among the routes with the same minimum hop counts, that is to say, we hope to find a route which is the shortest path route and meanwhile the one with the largest throughput. We combine the ETX and the minimum hop-count in AODV-COG to achieve our goal. We only describe the differences between our protocol and the AODV:

1). We add a new field *rq_sumetx* in the RREQ packet. It is used to record the sum of links' ETX of the path which the RREQ passing through. A new field *route_etx* is also added in the route table. The *rq_sumetx* and *route_etx* are initialized to 0. When a node needs to send a route request, it broadcasts the RREQ on all available channels without dependence on the common control channel.

2). When the intermediate node receive RREQ messages, firstly, it use the function (2) to calculate the ETX and then add the *rq_sumetx* by the result, for instance, when the node *k* receives a RREQ message from node *i* through channel *j* then the $rq\_sumetx_{after} = rq\_sumetx_{before} + 1/(dr[i][j]\, X d_f[i][j])$

Secondly, the node will check the RREQ to determine whether to update the route table. The route is only updated if:

(i) The sequence number stored in the RREQ is either higher than the destination sequence number in the route table, or

(ii) The sequence numbers are equal, but the hop count (of the RREQ) is smaller than the hop count in the routing table, or

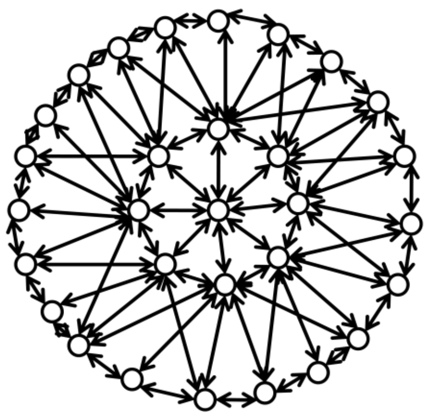
(iii) The sequence number and the hop count is equal but the *rq_sumetx* is smaller than the *route_etx* in the route table. If the node retransmits the packet, it transmits on all available channels. The information of ETX which is piggybacked by RREQ messages is forwarded in the broadcast process.

3). Like we have done in RREP, we also identify a new field *rp_sumetx* in RREP packet, if the node receives a Route Reply packet (RREP), it updates the *rp_sumetx* in the RREP and then use the same regulation as 2) to update the route table.

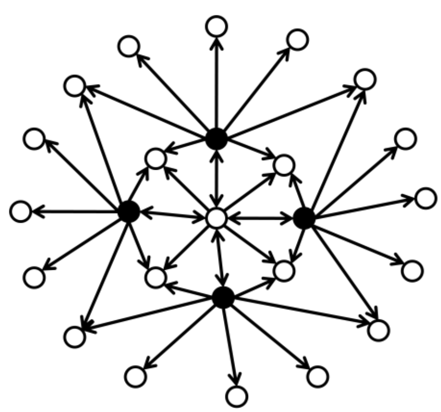
5. Optimized Link State Routing Protocol

The information in this section concerning the Optimized Link State Protocol is taken from its RFC 3561. Optimized Link State Protocol (OLSR) is a proactive routing protocol, so the routes are always immediately available when needed. OLSR is an optimization version of a pure link state protocol. So the topological changes cause the flooding of the topological information to all available hosts in the network. To reduce the possible overhead in the network protocol uses Multipoint Relays (MPR). The idea of MPR is to reduce flooding of broadcasts by reducing the same broadcast in some regions in the network, more details about MPR can be found later in this chapter. Another reduce is to provide the shortest path. The reducing the time interval for the control messages transmission can bring more reactivity. OLSR uses two kinds of the control messages: Hello and Topology Control (TC). Hello messages are used for finding the information about the link status and the host's neighbors. With the Hello message the Multipoint Relay (MPR) Selector set is constructed which describes which neighbors has chosen this host to act as MPR and from this information the host can calculate its own set of the MPRs. the Hello messages are sent only one hop away but the TC messages are broadcasted throughout the entire network. TC messages are used for broadcasting information about own advertised neighbors which includes at least the MPR Selector list.

How the OSLR works in the NS-2



Flooding a packet in a wireless multi-hop network the arrows show all transmissions



Flooding a packet in a wireless multi-hop network from the center node using MPR's(black) The arrows show all transmissions

6.The Performance Evaluation in NS-2

The verity of needs we are having with Network simulators. Compare with the other containing multiple networked computers, routers and data links, network simulators are fast and inexpensive. Network simulators are particularly use for the researchers to test new networking protocols or changes to existing protocols in a controlled and reproducible environment. The network simulator is a software or hardware that estimates the behavior of a network. NS2 will give the support between networking research and education. We can design the protocol and the study of the traffic in the different types of networks. The protocol that we are using will compare the show the results effectively. We can implement the any of the new architecture designs are also supported which will make easy to implement. NS2 will provide the collaborative environment which will be the freely distributed to all the users, and it is the software which is open source. Using NS2 as the software we can show the result very effectively and accurately the user get the confidence of showing their results.

In this paper we are implementing the AODV and OLSR protocols for the increasing the throughput and efficient of packet transfer. We can easily build the network structure and topology which is just the surface of your simulation. Here we can configure the network parameters very easily.

7. Conclusion

In this Existing we use a novel cognitive routing protocol (AODV-COG). It has two parts: one is the path selection function that combines the min-hop metric and the ETX metric to find the best route and the other is a Channel assignment module that can perceive the dynamic SOPs periodically and change the interface if necessary .We also add a new module named Send Control Module in the NS-2 simulator to support the simulation of cognitive routing protocol. Based on the simulation results, AODV-COG is able to increase the overall throughput in the cognitive mesh network. In this proposed based on the simulation results with OLSR compare with AODV-COG we will able to increase the overall throughput in the cognitive mesh networks.

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