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A Successful Progress For Hierarchical Routing Proposal Form In Wireless Ad-hoc Network Through Polychromatic Sets

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***Abstract*: Graph theory is one of the basic tool for analysing computer networks such as wireless mesh network, Adhoc network, sensor networks. Conventional graph theory is not accurately describe the node and link of wireless network so it is not used for modern complex wireless networks and also the random graph and weighted graph theory not clearly illustrate the properties of wireless networks. To overcome these problem a new idea is developed, that is called Polychromatic set. In this paper, I introduced the concept of Polychromatic set theory for describing the node and link in wireless network for efficient routing scheme. The estimation result shows it is simple, effective. The performance is better compare than any other conventional routing method. It can be achieved by ns-2 simulator.**

***Keywords:* weighted graph, Conventional graph, Polychromatic sets, Routing, wireless ad hoc networks.**

I. INTRODUCTION

Graph theory is the study of graph; it's used to model pair wise relations between objects. A 'graph' in this context is made up of 'vertices' or 'nodes' and lines called edges that connect them. A graph may be non directed, meaning that there is no distinction between the two vertices associated with each edge, or its edge may be directed from one vertex to another. The graph theory can be represented by G= (V, E) where V represents a set of vertices and E represents a set of edge. The V and E set is called an element. This paper is based on Adhoc networks, it is the advent of everywhere computing and the proliferation of portable computing devices have raised the importance of mobile and wireless networking. Adhoc is Latin word that defines for this purpose only. The Adhoc term denotes 'can take different forms' and 'can be mobile standalone, or networked'. Adhoc network can able to form' on the fly' and can handle to combine and leaving of nodes. In advent of Adhoc wireless networks, the principles behind this is multi-hop relaying in which messages are transfer from source and destination by relaying through the intermediate hops (nodes). In recent years, many applications in networking area, using graph theory to solve physical and virtual infrastructure work and network problem. It has two types: unit disk graph, weighted graph [1]-[3]. In wireless network, unit disk graph [5], the range of node communication is equal to the radius of the node at centred disk; the communication range cannot be varied. So, they represent the edge distance is exist only when the node is equal to or less than the communication range in one unit. Whereas in weighted graph, a some algebraic weights can be placed on each edge, it exists edge between vertices. The drawbacks in random graph, weighted graph, unit disk graph does not explain the properties of nodes and links such as distances, capacity, location, connection cost, etc., probability and weight. To overcome this problem a new better tool is need in modern complex wireless network. This is invented by V.V.Pavlov, to model the complex network, this is Polychromatic graph (Ps-graph) by using mathematical method called Polychromatic sets (Ps-sets). It defines the basic properties of each element in a whole set. Ps-set theory can describe the network node and link, properties of element for complex designed wireless networks. My proposed method, has advantages in polychromatic set theory is simplicity, fast convergence, high performances, an efficient routing in wireless networks.

II. RELATED WORK

A. Random graph theory

In random graph, it's used for study of reliability in communication networks [9] and large complex networks like social networks[8], wireless sensor networks, mobile ad hoc networks. It generated by random process. It lies at the intersection between graph theory and probability theory. A random graph is obtained by starting with a set of n isolated vertices and adding successive edges between them at random. The main aim is to determine the particular properties of the graph. The different random graph models produce different probability distributions on graph. The network probability matrix models random graphs through edge probabilities, which represent the probability that a given edge exists for a specified time period. It is extensible to model to directed and undirected, weighted and un weighted, static and dynamic. The colouring of random graph is, G of order n with the vertex $V(G)=\{1,.....,n\}$ by the greedy algorithm on the number of colours, the vertices can be coloured with colours 1,2,....(vertex 1 is coloured 1, vertex 2 is coloured 1 if it is not adjacent to vertex 1, otherwise it is coloured 2, etc.,). Random graph not gives the details of network nodes and links such as capacity, location. It needs a some other advances better tool to model the real-time wireless networks [11]-[13].

B. Weighted graph theory

The weighted graph is defined as a graph where vertices have some weights or values [7]. A graph where edges have some weights or values or where edges and vertices have some weights or values. The graph where neither edges nor vertices have any weights or values. If the weight is placed on each edge between vertices in the graph. Weights are usually real numbers; it restricted to rational numbers integers. The weight of a path or weight of a tree is equal to the sum of the weights of the selected edges. Sometimes cost is also used as weight. It associates a label with every edge. Weighted graph covers the multipurpose properties of message links in computer networks. On the other hand it is silent outlying from the representation of synchronized wireless networks. In wired networks each bandwidth path is different, whereas in wireless networks each nodes have same capacity, speed of transmission and coverage range is same but signal-to-noise ratio is vary, so it differ in attenuation, fading, interferences from its individual networks. So it causes various transmission speeds. So it cannot be used for complex networks.

C. Unit disk graph

A collection of unit circles and the corresponding unit disk graph. A unit disk graph is the intersection graph of a family of unit disks in the Euclidean plane. It form vertex for each disk and connect two vertices by an edges whenever the corresponding disks have non-empty intersection. The intersection graph of equal - radius circles or of equal-radius disks. A unit disk graph formed from a collection of equal-radius circles in which two circles are connected by an edge if one circle consist the centre of the other circle. A graph consists of a collection of points in the Euclidean plane, in that two points are associated if their distances is below a permanent threshold. Every induce sub graph of a unit disk theory is also a unit disk graph. It is used to model the topology of ad hoc wireless communication networks. In this purpose, nodes are associated through a direct wireless connection through a direct wireless connection without a base station. It's assumed that all nodes are homogeneous and equipped with unidirectional antennas. Nodes locations are modelled as Euclidean points and the area within a signal from one node can be received by another node are modelled as a circle. If all nodes transmitters of equal power, these circles are all equal communication range [5]. Random geometric graphs formed as unit disk graph with randomly generated disk centres. This graph is used for construct the various types of networks and develop various algorithm, such as connected dominating set [6]. A good research is found, it is distant away from many applications.

D. Conventional graph theory

In conventional graph theory, a set can be represented as a group of fundamentals [10], such as,

S={s1,s2,s3,.........,sn} (1)

Where s is represents set and s1,s2,.......,sn are represent the element of set S having similar properties. For example, if I consider a set s as vegetables, in that all the different types of vegetables comes under the set s. But the drawbacks in conventional graph theory is, for examples if I consider bitter guard, beetroot it comes under set s, but the properties of both vegetables is different. Beetroot comes under the sweetness taste vegetable whereas bitter guard comes under bitterness taste vegetable. The difference of these two vegetables is not notified in the set. So, the conventional set theory does not describe the properties of each element in the set. This leads to the development of Polychromatic sets in modelling wireless networks, which defines the each property in set.

III. PS-SETS THEORY

The drawbacks in random graph, unit disk graph, weighted graph, conventional graph theory, to overcome this PS-set theory is introduced. PS-sets is defined as a collection of elements in set B, it was initiated by George Cantor in 1894 [14], as

$$B=\{b_1,.......,b_i,......,b_n\} \quad (2)$$

Where B is a set, b_i is an element of set B, n is the number of element. If b_i is a element of set B, suppose bi is belong to B, b_i € B, otherwise b_i € B. PS-sets theory define the element and also the properties of each element in whole set. This property is called as colour. If all elements in the set is painted with various colours, with each element and the set having multiple of colours [15]-[17].

$$\begin{array}{cccc} B = & \{b_1,......, & b_i,......, & b_n\} \\ \downarrow & \downarrow & \downarrow & \downarrow \\ F(B) & F(b_1) & F(b_i) & F(b_n) \end{array} \quad (3)$$

Fig.1.Relation between element, set and coloured element and set.

It is possible to represent all other feature in the set. The colour set $F(b_i)$ corresponding to all element b_i € B and the colour set F(B) corresponds to entity of B,

$$F(B)=(F_l,.....,F_g,.....,F_m) \quad (4)$$

Pigmentation is defined as the colour constituent of its element $F(b_i)$, they are belong to combined colour set.

$$F \geq F(B),\ F(b_i),\ i=1,2,....,n \qquad (5)$$

PS-sets theory defines a colour set by F, if elements b_i € B, then b_i is denoted as,

$$F(b_i)=(F_1(b_i),....,F_g(b_i),....,F_m(b_i)) \qquad (6)$$

Where m is overall amount of properties in element b_i. The whole set can be coloured is denoted as,

$$F(B)=(F_1(B),....,F_k(B),...,F_p(B)) \qquad (7)$$

Where p is the quantity of properties of set B.The equation (4) and (5) is represent by different colours. The colouring set $F(b_i)$ which be in the right place to elements in set is called individual pigmentation sets, it can be represented by Boolean matrix form, that is:

$$\| S_w(j) \| = [B \times F(b)]$$

$$\begin{matrix} F_1.......F_g........F_m \end{matrix}$$

$$= \begin{pmatrix} b_1(1)....b_1(g)....b_1(m) & b_1 \\ b_i(1)....b_i(g)....b_i(m) & b_i \\ b_n(1)....b_n(g)....b_n(m) & b_n \end{pmatrix} \qquad (8)$$

If $S_w(j)=1$ then Fg € $F(b_i)$,

$$F(b) = \sum_{i=1}^{n} F(b_i) \qquad (9)$$

The relationship between F(b) and F(bi) as follows,

$$F(b) = \sum_{i=1}^{n} F(a_i) \qquad (10)$$

Where $S_w(j)$ is reasonable variable, its defined by,

$$S_w(j) = \begin{cases} 1, \text{ if } F_g \text{ € } F(b_i) \\ 0, \text{ if } F_g \text{ € } F(b\!\!\!/_i) \end{cases} \qquad (11)$$

Individual colour of polychromatic set is represent by Boolean matrix,

$$\| S_l(j) \| F_{(b)},F_{(B)} = [F(b) \times F(B)] \qquad (12)$$

The correlated form this individual colour is,

$$\| S_w(j) \| = [B \times F(B)] \qquad (13a)$$

$$\| S_w(k) \| = [B \times F(B)] \qquad (13b)$$

Therefore, the six components representation in PS-sets is,

$$PCS=\{(B,F(b), F(B), [B\times F(b)], [B\times F(B)], [B\times B(F)]\} \qquad (14)$$

It is not included in all practical application.

IV. IMPLEMENTATION OF WIRELESS ADHOC NETWORKS

In wireless network, each node can be split into several numbers of clusters, in that each node cluster head (CH) it depends on its significance index. The new cluster is selected as a CH at a higher level from the lower level. By applying PS-set theory in hierarchical model, the element in the set F(b) can be defined as,

$$<b_i,F(b_i)>,i=1,2,....,n \qquad (15)$$

In this model, a new node is defined by $b(k,i_k,j_{k-1})$ where k is represents the node point, i_k denotes the i^{th} node at level 1, and j_{k-1} defines the j^{th} node at level k-1. If $F[b(k,i_k,j_{k-1})]$ shows the properties of node like index, parent node, child node and soon.

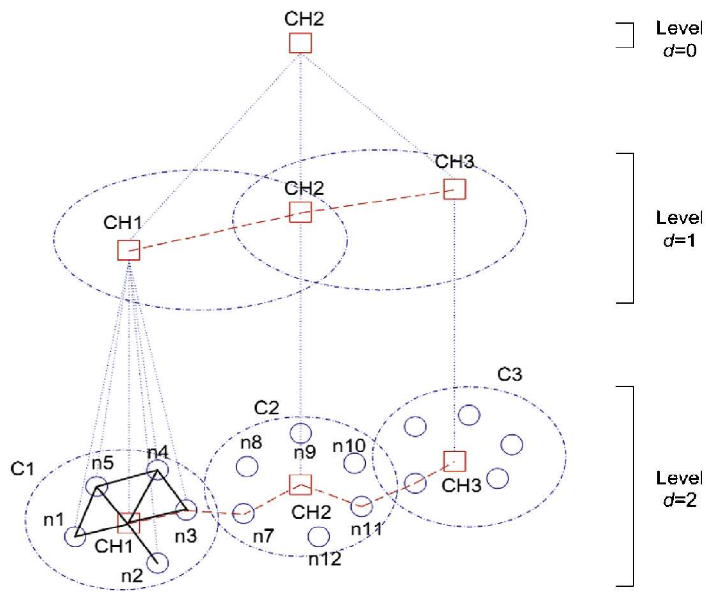

Fig.2. Representation of hierarchical model in PS-sets.

It is represents as,

$$< b(0,0,0), F(b(0,0,0)) >= \sum_{i=1}^{n-1} < b(1,i_k,0), F(b(1,i_k,0)) > \qquad (16)$$

Where < b(0,0,0), F(b(0,0,0)) > denotes the root node of this model. All the chid node of $b(c,i_c, j_{c-1})$ can be shown as,

$$<b(c,i_c,j_{c-1}),F(b(c,i_c,j_{c-1}))>= \sum_{i(k+1)=m(c+1)}^{n(d+1)} <b(c+1,i_{c+1},i_c),F(b(c+1, i_{c+1},i_c)) > \qquad (17)$$

The various colour set can be shown as,

$$F(B)=\{b,k_i(b),k_p(b),k_c(b),k_{CH}(b)\} \qquad (18)$$

Where F(b) contains the element of set B, $k_i(b)$ is the node i_c, $k_p(b)$ is the prior node of b, $k_c(b)$ represent the cluster i_c, $k_{CH}(b)$ denotes the cluster head node in the cluster.

Finally the description of colour is,

$$F(B)=\{b,k_i(b),k_p(b),k_c(b),k_{CH}(b)\} \quad (19)$$

In wireless networks, I acclimatize the polychromatic set theory; in that let us consider 20 nodes and split the node into 3 clusters. In 1st cluster if it has 6 nodes. The new link in matrix representation is denoted by Boolean value 1, or it will become 0. In cluster 2, Adhoc- On- demand Distance Vector routing algorithm [4] is in incorporated colour. If cluster head observe the all other nodes in a cluster. The model representation of nodes where the lower layer contains clusters and in the next layer the cluster heads of the lower layer it undergoes the single cluster form at the particular level. Let us easily establish the nodes by $b(l,i,j_{i-1})$. For example, b(5,4,3) represents the node is at level 5 where as the priest node is at level 4 and it is at cluster 3. The unified colour kp defines the prior nodes of a particular node. B_1 is the basis node, B_3 is a target node of a cluster 1. B_6 is previous node to S_1. k_{CH} is used for child nodes calculation. B_6 is the cluster head (CH). By the similar way the other cluster in the network area can be determine.

V. POLYCHROMATIC SET ROUTING SCHEME MODEL

In wireless sensor network, the flat routing scheme is taking as the hierarchical model [19]. Each node maintain universal routing information such as link status, sequence number, and it can exchange the routing information between nodes, which is used for reduce the equality and construct it as simple protocol. It can be classify into two types: 1. Dynamic hierarchical routing scheme, such as fisheye state routing and Inter-zone routing protocol. 2. Static hierarchical routing scheme, such as CH gateway switch routing. In flat routing scheme, large quantity of packet overhead is generate, swamped over along the network is occur. It is used for uncomplicated and minute networks. The cluster head acting an imperative role and its node selection is based on the link quality of the networks. In most of the application in polychromatic sets, hierarchical model is preferred. The new network topology can be modifying by accumulation or deleting a node.

Two significant key steps for hierarchical routing scheme,

i). Partitioning and clustering of network

ii). Routing within the group and cross clusters

It develop the low-complexity and suitable for large scale WSNs.

A. Partitioning and clustering of network

Partitioning of network means splitting of node into multiple clusters, it was developed in the previous research work [18]. 1-hop neighbouring nodes u_i,u_j link weight can be calculated as,

$$P_l(u_i,u_j)= H(u_i.u_j)/\sum_{j=1}^{|Ni|} I(u_i,u_j) \quad (20)$$

If n-hop weight can be calculated by using this formula,

$$P_l(u_i,u_j)= \prod^{u}_{i=1} P_l(u_i,u_{i+1}) \quad (21)$$

B. Routing

The next important key is routing. It this, AODV [4] routing protocol is used for providing a better communication between the source and destination nodes. The source node sending request message to cluster node for find out intention node is found within the cluster node or not. If each node present within the cluster, it check the neighbouring link. In this, any new node adding or leaving from the cluster it will update in polychromatic set model. AODV is a reactive unicast routing protocol. The advantage of AODV is highly dynamic network. It is bidirectional route from resource and end node. FSR is a proactive unicast routing protocol. It based on the link state routing algorithm. The advantages are better scalability. It does not provide the correct sequence about the target. AODV and FSR are the two level networks.

VI. PERFORMANCES EVALUATION

The simulation result of my proposed system is following the below, by using the ns-2 simulator environment. The various parameters are consider,

TABLE 1

Simulation parameters

PARAMETRS	VALUE RANGE
Buffer size	10 packets
Carrier sense range	500m
Communication range	100M
Packet size	512 Bytes
Data rate	3mb/s
Simulation time	300s
Network size	250×250m

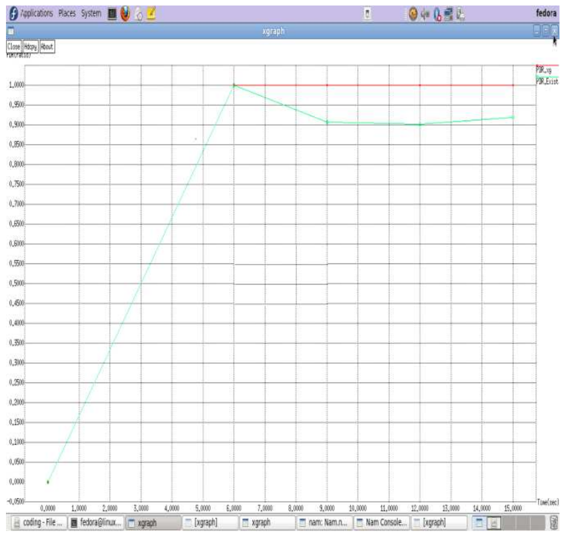

Fig.3. Packet delivery ratio

In Fig.(3) the comparison between the packet delivery ratio versus network size. The extreme changes occur between AODV and FSR protocols.

Fig.4. Average Energy Consumption

In Fig.(4) I compare the result of AODV (Adhoc- On-demand Distance Vector routing), with FSR (Fisheye state routing), the comparison result shows the energy remain constant for AODV over the FSR.

Fig.5. Packet Drop Ratio

In Fig.(5) the comparison between packet drop ratio to node degree in time. From my proposed scheme the nodes in the network area can be exposed well in diminutive period of time in AODV when compare to FSR protocols. The packet drop ratio is reduced.

VII. CONCULSION

In this paper, a new scheme is I introduce that is polychromatic set in hierarchical model (PCHM).It is used for improving flexible routing in wireless network, since discovering the nodes in wireless sensor networks is an confused task. Simulation result shows validate that my proposed scheme outperforms hierarchical routing. In future I desired to implement in the large complex networks which comprise large number of levels and compare the polychromatic set routing with DSR.

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