International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-7 Issue-8, May 2018

TRAP: A New Transmission Range Adjustment Protocol for MANET

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Abstract*: MANET is combination of mobile nodes which uses multi hop transmission for communication. Due to highly dynamic topology, routing in MANET is challenging task, moreover presence of malicious nodes makes the overall network very insecure. We study both the availability and the duration probability of a routing path that is subject to link failures caused by node mobility. In this paper we studied of Energy Efficient Cluster based routing Protocol and also proposed a Transmission Range Adjustment Protocol (TRAP) algorithmic approach towards energy efficient clustering. The aim of this algorithm is to build energy efficient cluster formation, so that the re- election of cluster head can avoid. TRAP algorithmic approach effectively uses the knowledge of neighborhood to calculate mobility, energy and signal strength of the nodes. The high value of node is elected as cluster head to keep the head alive for long time that further lead to enhance the overall performance of network and reduce the network overhead. The performance of proposed TRAP (Transmission Range Adjustment Protocol) algorithmic approach is analysis under five metrics such as a Network life time, Energy consumption, throughput, delay, packet delivery ratio. In this algorithm, we will find that node which has highest weight and make it as cluster head node for base station and best efficient path.

***Index Terms*: MANET, Clustering, Mobility, Efficiency, TRAP, Routing Protocols, Cluster Head.**

I. INTRODUCTION

Ad hoc networks consist of hosts interconnected by routers without a fixed infrastructure and can be arranged dynamically [1]. Considerable work has been done in the development of routing protocols in different types of ad hoc networks like MANETs, WMNs, WSNs, and VANETS etc. In recent years, the interest in ad hoc networks has grown due to the availability of wireless communication devices that work in the ISM bands [2]. While designing an ad hoc network in particular we are concerned with the capabilities and limitations that the physical layer imposes on the network performance. Since in wireless networks the radio communication links are unreliable so it is desirable to come up with an integrated design comprising of physical, MAC and network layers. Mobile ad hoc network (MANET) is a type of ad hoc network that can change locations and configure itself on the fly. Because MANETS are mobile, they use wireless connections to connect to various networks.

Manuscript published on 30 May 2018.
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This can be a standard Wi-Fi connection, or another medium, such as a cellular or satellite transmission. In Latin, ad hoc means "for this," further meaning "for this purpose only." They can be set up anywhere without any need for external infrastructure [3]. Clustering is the technique that is exercised to supervise enormous ad hoc network. In clustering nodes are organized in groups and every group is known as cluster. A node with high energy is elected as head node that can direct all the member nodes of same cluster and it aids to make the network more manageable. Figure1 show the architecture of MANET.

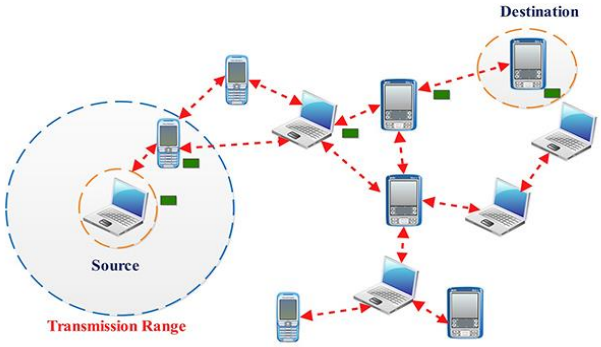

Figure 1 MANET

II. LITERATURE REVIEW

Energy conservation in ad hoc networks is a relatively new field of research. Significant research in this area has been ongoing for nearly 30 years, also under the names packet radio or multi-hop networks. Some of the research works that has been done on this field are as follows: We also studied performance evaluation of routing protocols in based on clustering in that study various QoS parameters used were throughputs, end-to-end delay and network life time. But a real evaluation of performance of protocols must also describe the degree of variability in packet arrivals, which can be caused by network congestion (bursts of data traffic), timing drift or because of route changes.

Pushpita Chatterjee [6] describe a game theoretic routing model. Two mechanisms Credit and reputation are to force the nodes to work honestly. This model mainly proposed to overcome the problem of selfish behaviour of node, where the node behave idle and stop the transmission. Cost of forwarding packet for intermediate nodes are calculated using Procurement and Dutch mechanism. STACRP find selfish nodes and force them to cooperate, so that the throughput of network can be increased. M. Jiang et al. describes Cluster-based routing protocol (CBRP).

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In CBRP [7] cluster based routing protocols nodes are arranged cluster form. Each cluster has a cluster-head, which coordinates the data transmission within the cluster and to other clusters. Mehran Abolhasan et al. describe multimedia support in mobile wireless networks (MMWN) [8]:In MMWN routing protocol [8] hierarchical clustering is used to sustain the structure of network and information is stored in dynamic distributed database. Cluster formation is done using switches, endpoints and a location manager (LM). In MMWN [9] the location of each cluster is managed by Location Manager.

C.-C. Chiang describe Cluster-head gateway switch routing (CGSR). CGSR [10] is a hierarchical routing protocol in where nodes are arranged in cluster. CGSR elects a cluster head, node that having high energy and less mobility and rest of the nodes as member nodes. Maintenance of cluster hierarchy is not required as cluster is maintained by cluster head. The cluster head controls over transmission medium and inter cluster communication. In CGSR member node maintain routes to its cluster head only that lead to reduce overhead.

Anderegg et al.[11] introduce a protocol VCG- a truthful and cost efficient routing protocol, that works on top of the dynamic source routing (DSR) [15]. This estimates the cost of forwarding the packets of other node using the cost-of-energy parameter. This provide means of cheat as nodes have to indicating signal strength at with they emit and forwarding information about their neighbour received signal strength. Author proved that this protocol is feasible only when one cheating node exists.

Yang et al. [13], introduce a scheme that protects both routing and packet forwarding in the context of the AODV [9]. It is self-formed, without assuming any a-priori trust between the nodes or the existence of any centralized trust entity. It isolates the misbehaving nodes and employs threshold cryptography to enhance the tolerance against these nodes. The scheme is fully localized (one hop), and its credit based strategy produces overhead that is significantly decreased when the network is not harmed.

In CBRP routing information is transferred through cluster head only, thus the number of control overhead carried through the network is far less as compared to the convention flooding techniques.

III. PROPOSED WORK

3.1. Transmission Range Adjustment Protocol (TRAP) Architecture:

Over the past few decades, many approaches come to improve the performance of MANET. Clustering is one of the best approaches to manage all nodes in network. Every researcher tried to build efficient MANET using different scenarios. Some methods were concerned about the security of network. Some of those were taking care of energy of network. Some was on comparison based on existing protocol and algorithm. Transmission Range Adjustment Protocol is designed to reduce the energy consumption of MANET and to enhance the life span of network. TRAP depends upon the distance travelled by a node. A unique key has been defied in this paper. A is defined as unique key if it comes under transmission range and the key itself depict that its ready to communicate.

There are various factors that are affected by distance travel by a node in the network. These factors are mobility, energy and signal strength. A proposed algorithm, TRAP cover a region of transmission by calculating the mobility, energy and signal strength.

3.2 Framework/Structure of Algorithm:

Step 1. Hello message is broadcasted in the network.

Step 2. Message check the status of neighboring node.

If the node is under transmission range it would be assigned as unique key.

Step 3. Signal strength and energy status will be checked of all unique key in table. On that basis cluster formation would be done.

Step 4. High signal strength and high energy value node would be assigned as cluster head.

Step 5. A node which as high signal strength or low energy and vice-versa would be assigned as member node.

Step 6. A node with low energy and low signal strength would be rejected

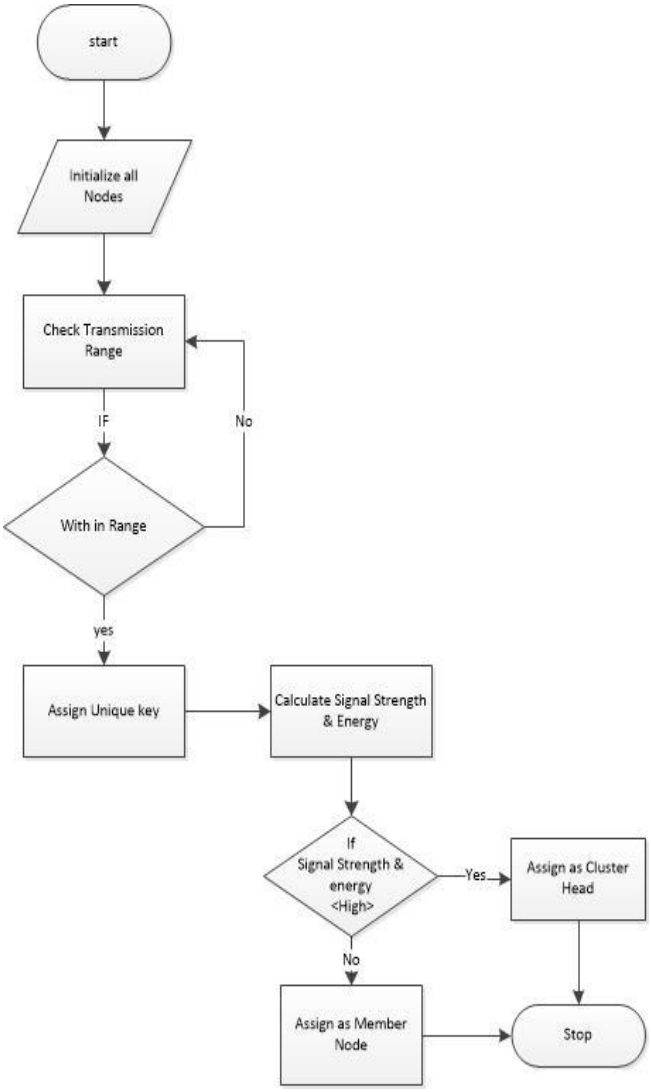

Figure 2. Flow chart Representation of TRAP

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3.3 TRAP Hello Packet Formation:

Table 2, Represent the proposed Transmission range adjustment protocol (TRAP) Hello Message Packet Formation. In hello packet formation each node updates the Record in new Trap hello packet formation like their Node Status, Energy level and Signal Strength etc.

Table 1. TRAP Hello Packet Formation

Node β	Node Status	Signal Strength	Energy Level
……	……	……	……
Neighbor ID	Neighbor Status/ detection	Signal status/updates	Energy status/updates
…….	……	……	……

3.4 Design of TRAP is Divided Into Following Two Parts.

1. Cluster Formation
2. Cluster Maintenance

3.4.1 Setting Up of Cluster Formation

Cluster formation divided into two parts
Calculate the distance between nodes
Calculate the relay cost of the node.

Calculate the distance between nodes:

Probability of successful transmission of packet is directly proportional to $Range_{distance}$ between the nodes.

Throughput $\propto R_d$
Or
Successful $Packet\ _{Transmission} \propto R_d$

Probability of Range = 1 / HMI * TTL_{link} * n no. of Hope

Calculate the relay cost of node

Depends upon he cluster energy, signal strength and distance travel by a node.

$$C_R = C_E^{RP} + C_{SS}^{RP} + C_D^{RP}$$

DATA DICTIONARY

HMI	Hello Message Interval
TTL	Time to Live
C_R	$Cluster\ \ Reliability$
C_E^{RP}	Cluster energy w.r.t Routing
C_{SS}^{RP}	Cluster signal strength w.r.t Routing Protocol
C_D^{RP}	Distance travelled by a node in cluster w.r.t Routing Protocol

3.4 Cluster Maintenance

Cluster is maintained on the basis of chosen of network nodes. Nodes are chosen on the base of 3 prestigious parameter, only those nodes are selected as cluster formation which as in transmission range, in this way node has to travel lesser distance and energy of node would be auto saved. More energy a node has longer a life of node which leads to longer life of cluster and further more life span of network. Nodes with high signal strength and high energy is assigned as CH. More the signal strength a node has, lesser energy would be consumed by a node while transmission of data. Less consumption of energy means cluster would be maintained for longer time and the network life span would be more than the usual.

IV. SIMULATION ENVIRONMENT

We carried out simulations on NS2 [17]. NS2 is a free simulation tool, which can be obtained from [9]. It runs on various platforms including UNIX (or Linux), Windows, and Mac systems. Being developed in the Unix environment, with no surprise, NS2 has the smoothest ride there, and so does its installation. Unless otherwise specified, the discussion in this book is based on a Cygwin (UNIX emulator) activated Windows system. NS2 source codes are distributed in two forms: the all-in-one suite and the component-wise. With the all-in-one package, users get all the required components along with some optional components. This is basically a recom- mended choice for the beginners. This package provides an "install" script which configures the NS2 environment and creates NS2 executable file using the "make" utility. An NS2 simulation script (e.g., myfirst_ns.tcl) is referred to as aTcl simulation script . • C++ and OTcl class hierarchies, which have one-to-one correspondence, are referred [18] to as the compiled hierarchy and the interpreted hierarchy, re- sportively. Class (or member) variables and class (or member) functions are the variables and functions which belong to a class. In the compiled hi- erarchy, they are referred to simply as variables and functions, respectively. Those in the interpreted hierarchy are referred to as instance variables (in- stvars) and instance procedures (instprocs), respectively. As we will see in Section 3.4.4, command, is a special instance procedure, whose implementation is in the compiled hierarchy (i.e., written in C++). An OTcl object is, therefore, associated with instance variables, instance procedures, and commands, while a C++ object is associated with variables and functions.

Qos parameter for clustering evaluation are following:

(a) Network Life Time - Time until the head node or Cluster head nodes in the network runs out of energy.

(b) Throughput of Network-Throughput is defined as; the ratio of the total data reaches a receiver from the sender. The time it takes by the receiver to receive the last message is called as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec).

(c) Packet Delivery Ratio- Packet delivery ratio is the fraction of packets sent by the application that are received by the receivers and is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source

(d) End-to-End Delay-The packet End-to-End delay is the average time that packets take to traverse the network. This is the time from the generation of the packet by the sender up to their reception at the destination's application layer and is expressed in seconds.

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(e) Energy Consumption- The energy consumption is measured by the transmitting power or receiving power multiply the transmitted time.

Energy = power × time (1)

The Simulation parameters are summarized in table 2.

Table 2. Simulation Parameters

Statistic	Value
Simulator	NS2
Routing Protocols	CBRP
Application Traffic	Constant Bit Rate
Data rate	11 Mbps for 802.11
Transmit Power	0.005
Performance Parameter	Network Life Time, Throughput, Packet Delivery Ratio, Delay
Channel Type	IEEE 802.11 Wireless channel
Simulation Time	15 minutes
Scenario Size	100*100m
No. of Nodes	32 nodes

V. ANALYSIS OF SIMULATION RESULTS

We compare our proposed approach (TRAP) with a widely used Cluster Based Routing protocol to demonstrate the effectiveness of transmission range adjustment protocol in MANET. The results are analysis in terms of throughput, packet delivery ratio, delay, network life time and average energy consumption. by the network nodes.

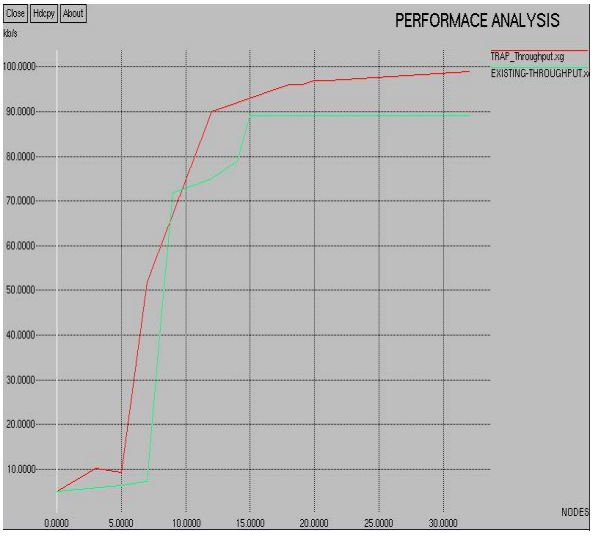

Figure 3. Throughput.

Figure 4. Packet Delivery Ratios

The figure 2 & Figure 3 clearly represent that TRAP approach produce better result of throughput and packet delivery ration in comparison of existing cluster-based routing protocol.

Figure 5. Average Delay

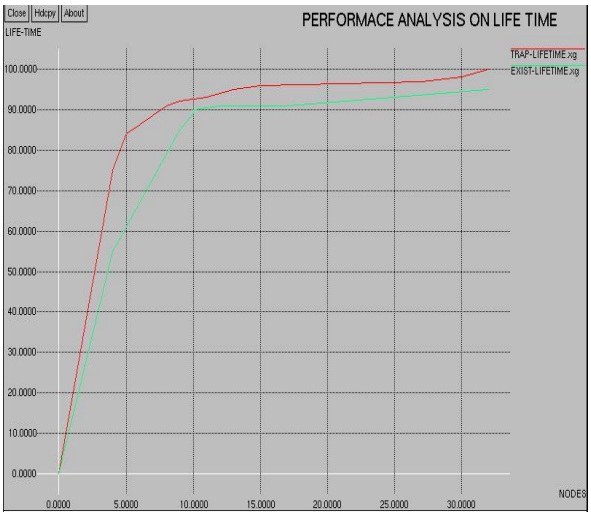

Figure 6. Network Life Time

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The figure 5 & figure 6. clearly represent that TRAP approach produce better result in comparison to existing cluster-based routing protocol, when we compare average delay in network and total life time of network.

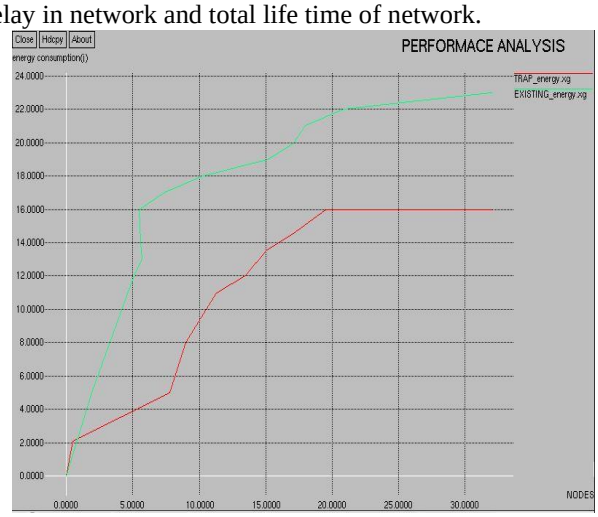

Figure 7. Average Energy Consumption

Above figure 7 represent the average energy consumption of the network. The proposed approach TRAP consumes less energy as compared to exiting clustering protocols that present the effectiveness of TRAP.

VI. CONCLUSION

In this paper, we propose a method that is design routing protocol-based clustering that can effectively detect good path and nodes. Energy based clustering algorithm has been proposed that uses the node mobility and its available battery power for calculating the node weights. The proposed scheme uses both wireless communications consume significant amounts of battery power, therefore, the limited battery lifetime imposes a severe constraint on the network performance.

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