Secured Hybrid Shortest Path based Algorithms for Mobile Ad Hoc Networks

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Abstract: – Most of the researchers they focus and done the researches in the area of infrastructure less network wireless networks (ad hoc), because not able to communicate properly and efficiently due to ongoing days in the updating world to affect many natural and environmental issues. When use temporary networks improve efficient and also free to use communication in rural area and also short duration meeting conference, class, meeting etc. But this temporary network affect due to some challenge issues such as routing, energy, security, packet drop, packet loss, time delay, mobility and bandwidth etc. To impress of and value of this emerging society issues we focus and doing our work in this area so in this research manuscript we will implement and discussed in one type of cluster based temporary network called Mobile Ad hoc Networks (MANET). MANET is communicated through collections of active temporary nodes that self configured dynamic distributed network. In this report suggested cluster head based energy efficient model using shortest path (CHRN-SHSP) on-demand routing protocol they work secure and shortest path selection between the nodes via intermediate nodes with both obstacles and non obstacles environments specially designed to aware cluster head node energy issue compare to existing relay node protocol, tested various parameters using one of leading simulator called Network Simulation 2 (NS2).

Keywords: MANET, Routing, Cluster Head, RNSR, Security, NS2.

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1. Introduction

Today fast and imprecated (MAGIC) world one of wireless communication is very needful technologies for communication field, wireless communication classified two types: cellular network (infrastructure based) and ad hoc network (infrastructure less). Ad hoc network is circuit switching based self-configure network also divided different design such as Mobile Ad hoc Networks (MANET) its collection of separate mobile nodes that communicate via intermediate active nodes, Wireless Sensor Networks (WSN) its collection of sensor nodes need to communicate via intermediate nodes within network, Wireless Mesh Network (WMN) its collection of various devices like laptop, mobile, router, sensor etc., through eligible nodes and Vehicular Ad hoc Networks (VANET) its in-depended vehicles nodes in network for communication using other nodes also work for both single hop and multi-hop network in figure 1 as shows simple diagram of mobile ad hoc network.

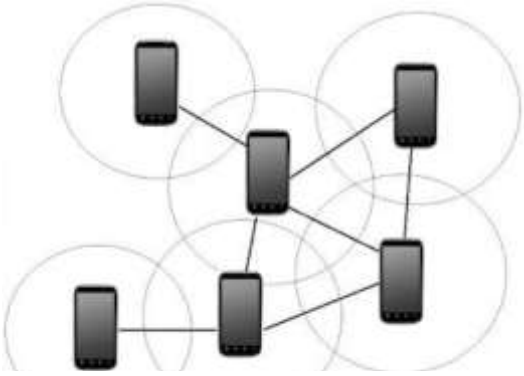

Figure 1 Mobile Ad hoc Network

MANET having some of unique characteristics: self organization nodes that update routing information when automatically change the topology because of distributed networks, peer-to-peer that one–to-one communicate directly, multi hop which nodes contain multiple base stations this is main advantage of this MAGIC world MANET because of every intermediate node act as router, dynamic due to a node move any direction due to structure of network via wireless link, low power because of limited battery capacity of mobile nodes in the network, auto configured due to

dynamically due to change the topology, limited security if a node can join anywhere, any place both active and passive nodes, Inefficiency because of quality output when communicate all the time in this network will be actively working like TX/RX/CH also easy to implement and easy to disconnect the network.

Energy is the one of most issuing parameter because of increasing network lifetime and node life time due to improve battery compare to others parameter, energy is one of the importance risk based task because all other characteristics must depends of energy. Many of existing researcher form reputed institutions, research centers and industrials published more articles with analysis own idea outcome based on some of leading parameters such as throughput, end-to-end delay, packet delivery ratio, quality of service, power control, energy efficient routing, multipath routing, network traffic Control, bandwidth and loss detection and recovery and etc., all the researchers focused and update routing for work above areas to solve the issues. This developed work fully focused on cluster based energy and security, cluster nodes should work to supply property and methods square measure usually multichip, several kinds of mobile spontaneous networks like table driven, on-demand, hybrid Networks. To gift a theme that ends up in head of nodes organizer formation also efficiently utilizes all the resource of mobile ad hoc networks. All the separate nodes initially fix the and produce range of region, next the head of network in the cluster create such as cluster node, last election of the head node that create based on maximum forward and maximum receiving capability of larger life show in figure 2 cluster head in mobile network.

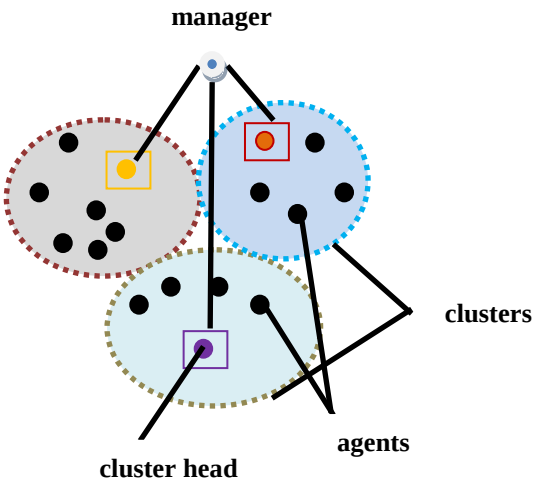

Figure 2 Cluster Head in MANET

Cluster head selection process: Cluster head choice is required in cluster primarily based Network, should analysis have been done on election of cluster head during a cluster atmosphere. In MANET, there's no position to regulate the election method and quality is additionally a problem. Another Cluster Head Election technique was planned supported remaining energy and relative position of the node within the cluster, the cluster head is chosen on the idea of threshold price T, Threshold is calculated by the 3 factors Energy, Distance and site and chance of the node, each node generates a Random range, if it's smaller than a predefined price the node elects itself as a Cluster-head. Another Cluster Head Election technique was planned supported remaining energy and relative position of the node within the cluster, the cluster head is chosen on the idea of threshold price T, Threshold is calculated by the 3 factors Energy, Distance and site and chance of the node, each node generates a Random range, if it's smaller than a predefined price the node elects itself as a Cluster-head.

MANET should need router to communicating for data transmission between source to destination using routing protocol with static and dynamic routing protocol, this protocol is depends on very importance two division called distance vector and link state routing. Mobile routing protocols classified there are three types: first routing is proactive or table driven (all time each nodes they will ready to data transmission because of switch on and broadcast packets to all the times either communication or non-communication within the network other nodes for route request and route replay) but there is more routing overhead, second types is reactive or on-demand routing protocol (data transmission based on needs they will switch on and broadcaster packets for mobile nodes otherwise switch off that means sleep mode) still having main disadvantage is high latency because when nodes communicate that time only network going to switch on nodes, than they start to broadcast and third moreover last type is hybrid routing protocol this one combination of two leading types of routing protocols called table driven and on-demand that short distance communication to used proactive and long distance communication for reactive routing protocols with in networks, reduces impact of drawbacks of table driven and on-demand routing protocols even through main disadvantage of this protocol is more complex than other protocols figure 3 shows some of ISO approved protocol.

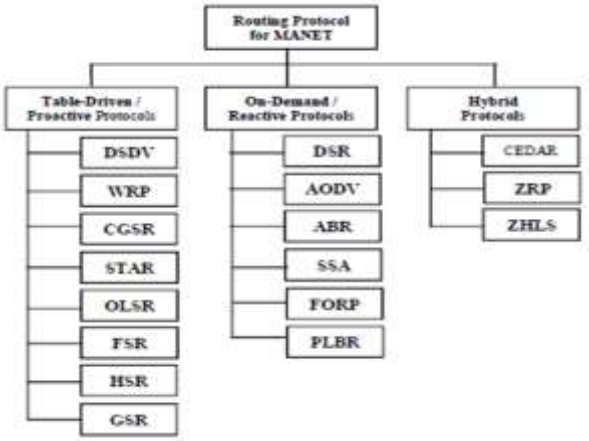

Figure 3 Routing Protocols

2. Related Work

Evaluation of cluster based work and this protocol mainly discussed on head of the network node routing protocol CBRP is proposed by **Yogesh Chaba et al (2009).** Malicious node identification and detection using head node routing called novel cluster based trust aware routing protocol that developed routing protocol prevent the forward and receive packet from misbehaviours hops was discussed by **Haidar Safa et al (2010).** Challenging head node based path selection is a mobile ad hoc network routing task is DWCAIMP was designed by **Naveen Chauhan et al (2011).** Single and double scalar multiplication algorithms were almost always faster than their widely used counterparts were taken by **Jithra Adikari et al, (2010)**. Efficient model called PEER protocol that improves maximized energy is discussed by **Jinhua Zhu and Xin Wang [2011]. Alak Roy et al (2012),** Certificate revocation model they head hop based certificate revocation design called CCRVC scheme that improve the reliability was taken by **Wei Liu et al (2013) and Piyalikar et al (2016). Wang et al, (2013)** have proposed Distributed energy Adaptive location based Cooperative Medium Access Control (DEL-CMAC) to improve the performance of the MANETs was taken by **Jing Zuo, et.al [2014].** Cryptography based new secure communication design that support MANET issues such as like breakage, traffic, throughput and delay is addressed by **Yo Han Park and Young Ho Park (2015).** Efficient Remote User Authentication with Key Agreement Scheme Using ECC was proposed by **Baojun Huang et al, (2015).** Hybrid EAACK (HEAACK) is designed to tackle three of six of six weaknesses of watchdog scheme presence of malicious attacks was designed by **Parth Patel et al, (2016).** Cluster head selection model called trust energy availability based cluster based routing protocol, that developed new design provide better performances of cluster head hop selection

Although these research papers contribute one of most leading mobile ad hoc network issue is energy; we discussed existing suggested technology for energy because of when reduced delay and retransmission also avoided misbehavior automatically throughput maximized so node lifetime and network life time will increased due to increasing remaining energy reason for limited power. Very importance states to consume energy to transmit/receive and Sleep. Maximum energy affected in two layers, data link layer and network layer.

process was developed by **Venkanna and Leela Velusamy (2016).** New hybrid two cluster hop model based routing for to reducing misbehaviour hops in mobile ad hoc network is analysed by **Sengan Sudhakar and Chenthur Pandian (2016) and Farooq Aftab (2017).** One of my best research article **K.Thamizhmaran et al, (2017)** is suggested enhanced acknowledgement based research work EA3EAK. This work mainly focused to reduced routing conjunction during to detect malicious attackers. Transition state MAC protocol compared with existing models static power consumption MAC protocol and dynamic power consumption MAC protocol was analysed by **K. Anish Pon Yamini et al, (2019).** Routing protocol improved network performance with multi path routing is fine tuned based on the spatial temporal was designed by **N.S. Saba Farheen and Anuj Jain, (2020)**. Recent published energy efficient research work is addressed by **Neha et al, (2018)**. **Sally E. El Khawaga (2016) and A. Christy Jeba Malar (2020),** suggested novel energy efficient cluster formation called signal based energy efficient clustering model, that provide should decreasing network node energy costs due to information transferring during head hop formation. Very recently published work by **Yutao Liu et al (2021)** discussed median accuse protocol based cluster selection network, scheme based on cluster hop network that can reducing whole network performance. **Nobuyoshi Komuroa and Hiromasa Habuchi, (2021) and V. Nivedita and N. Nandhagopal, (2021)** is developed effective nonorthogonal Code Shift Keying Spread Spectrum (CSK/SS) ALOHA design that improve throughput and delay under MANET environment. Hybrid routing algorithm with the combination of Emperor Penguin Optimization (EPO) and the Bald Eagle Search (BES) algorithm (EPO–BES) for finding the best-forwarded path to moderate the routing overhead problem in MANET designed model by **K.Bagirathan and Anadhakumar Palanisamy (2022).**

3. Proposed Scheme

Part of In this research writing we discussed our new developed design which improves remaining energy for cluster head in same network in terms of reducing end-to-end delay, so special designed for mobile ad hoc network called Cluster Head selection based Relay

- ✓ Idle: node can't send and receiving it's simply stays idle node that consume more energy.
- ✓ Transmit: node can throw out data, hello message or acknowledgement packets using transmitting energy.
- ✓ Receive: node can accepting various packets from other nodes using receiving energy.
- ✓ Sleep: node can going to off state so no energy used (idle, transmit and receive) due to no transmission.
- ✓ Pre-Idle: It's a virtual state during transformation from inevitably idle state.
- ✓ Pre-Transmit: It's a virtual state that inevitably transmits state.
- ✓ Pre-Receive: It's a virtual state that inevitably receives state. Our design aim going to develop an Node Selection Randomly (CH-RNSR) compare to existing developed model as shown in figure 4.

Relay Node Selection Randomly (RNSR) for MANET:

RNSR processing starts with help of different state node levels.

algorithm that uses energy for communication and control packets. The design of energy protocol assumptions is characterized as follows:

- Same initial energy for all nodes.
- Energy of node's is below above depends on threshold from the relaying process.
- Current state of all the node energy level must update its post each transmission.

➢ Source node sends hello packet with active nodes from S to D through active intermediate nodes.

- ✓ Selection of active nodes
  - Every single sending intermediate node.
  - Transmission capacity
  - Receiving capacity
  - Finding misbehaviour nodes

Flow Chart of Relay Node Selection Randomly (RNSR) for MANET:

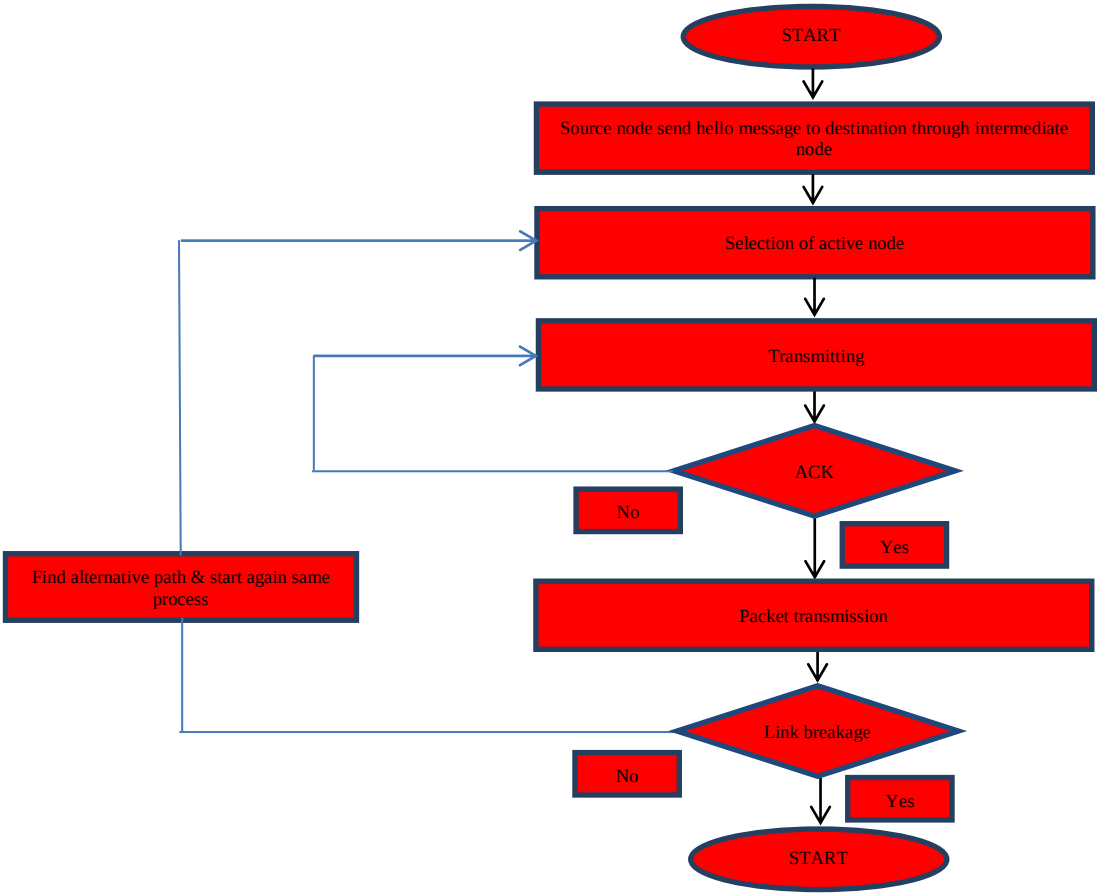

Figure 4 Flow Chart of RNSR

(Before transmit the data packed find malicious node for trust path)

- So sender nodes require transmitting packet to destination with above following characteristics.
- The entire receiving node need to sends ACK packet ID to initial via same route with details of characteristics.
- If source node receives this node details such as acknowledgement packet from destination node.
- Each sender done following process with predefined time period, successfully completion of this process maximum number of misbehaviors will be identified and detected after the original data to target.
- If user S, N_1, N_2, N_3, N_4, N_5…….. D.

During the transmission any link breakage or not receiving ACK packet, once find same procedure and follow step2.

PRIMARY AND SECONDARY CLUSTER HEADS SELECTION FORMATION:

{
Received node info from all its neighbour
First max weight primary = max (weight [node (id)]) and P-Chid = node (id)
Second max weight secondary = max (weight [node (id)]) and S-Chid = node (id)
IF CHid> 1 Then
IF CHid = 1 Then
CHid = Lagest Value ID
SEND "Construct CH advertisement message and broadcast"
END IF
}
CLUSTER CH PRIMARY and SECONDRY NODES (higher forward capacity)
{
Old P-CH Received Hello from New S-CH
Delay timer =delay period
Max limt=Tran Range/2*node speed
Request interval = transmission time delayed cluster head change for delay timer.
IF S-CH is in the same radio range P-CH
WHILE delay time<=Max limt
P-CH Priority factor=Max degree ch+Battery life
P-CH Priority factor Max degree CH+Battery life
IF S-CH Priority factor>P-CH Priority factor
S_CH=1
P_CH=0
Exit (0)
ELSE
delay_time=delay_time+hello_interval
END IF
ENDWHILE
IF Pch_ID<=Sch_ID
S_ch=1
P_ch=0
Exit (0)
END IF
}

ALGORITHM DESCRIPTION: ENERGY AWARE CLUSTERING

Transmitted Energy eitxðΔtÞ ¼ P tx _ txtime; ð1Þ (1)

Receiving Energy eirxðΔtÞ ¼ P rcv _ rcvtime; ð2Þ (2)

Idle Energy eiidleðΔtÞ ¼ P idle _ idletime; ð3Þ (3)

eitotalðΔtÞ ¼ eitxðΔtÞ þ eirxðΔtÞ þ eiidleðΔtÞ; ð4Þ (4)

EiðtÞ ¼ Eiðt−ΔtÞ – eitotalðΔtÞ ð5Þ (5)

Where

Tx-time Transmitting time for a packet,

Rx-time Receiving time for a transmitted packet

Idle-time Time where a node is in the idle state

Ei(t) Residual energy at a given time t

Ei (t−Δt) Residual energy total at t-Δt

eitotal (Δt) total energy consumption during the interval[t−Δt ,t].

Enery consumption modelseach node:

Transmission power =P_tx.

Receiving power =P_rcv.

Idle power =P_idle.

P idle < P rcv< P tx ð6Þ

Thus, every node will discover network conditions favourable to vary its mode.

- If criteria one (Ei≥E) is true, the node moves from Undecided to cluster head mode.
- If criteria two (Ei<E) is true, the node moves from Undecided to Member.

Election algorithmic program of cluster heads in a much clustered CH-RNSR network, every node will be in one amongst 3 modes:

Undecided: once a node has simply arrived or it's simply left its cluster and has no neighbour in its neighbourhood, its standing isn't set however. There's no cluster heads or cluster member. It should anticipate the receipt of greeting messages.

Cluster head: The node changed greeting messages, and it's the very best worth of residual energy. It creates a cluster during which it had been appointed head of the cluster.

Member: The node has changed greeting messages; its residual energy is a smaller amount comparison to its neighbour nodes and is an element of the cluster members.

4. Result and Discussion

Performance of routing protocol of MANETs in an open environment is evaluated for in this section, the MANET protocols are simulated using this network simulator 2.34 by varying the number of nodes. The IEEE 802.11 distributed coordination function is used as the medium access control protocol and the traffic sources are used to user datagram protocol. The simulation parameters are specified below table 1.

Table 1 Simulation Parameters

Parameters	Values
Simulation area	750m * 750m
Protocol	CH-RNSR
Number of nodes	60
Average speed of nodes	0–25 m/sec
Mobility model	Random Waypoint
Number of packet senders	30
Transmission range	250m
Constant bit rate	2 (Packets/Second)
Packet size	512 Bytes
Initial energy/node	100 joules
Antenna model	Omni directional
Simulation time	500sec

A different packet type in different schemes in CH-RNSR, 2 b of the different types of packets is used. Details of different packet types are listed in Table 2

Table 2 simulation result of packet type indicators

Packet type	General Data	ACK Packet	Dropped Packet	RNSR Packet
Packet flag	00	01	10	11

In this emerging research work, the misbehaviour nodes are possible to provided warning acknowledgment packets, this way, the network lifetime will be decrees due to utilization energy will increased because of malicious nodes simply drop all the packets that they receive and send back forged positive acknowledgment packets to their previous nodes whenever necessary. This is a common method for attackers to degrade network performance while still maintaining their reputation. The proposed approach relay node selection randomly is designed to tackle weaknesses of traditional routing protocol. The proposed approach CH-RNSR is designed to tackle weaknesses of traditional routing protocol, in this paper compare with base paper of this work is existing research work of traditional Dynamic Source Routing (DSR).

Table 3 simulation result of end-to-end delay vs number of nodes

RP/NN	10	20	30	40	50	60
DSR	0.50	0.46	0.41	0.33	0.26	0.19
CH-RNSR	0.32	0.28	0.23	0.19	0.14	0.06

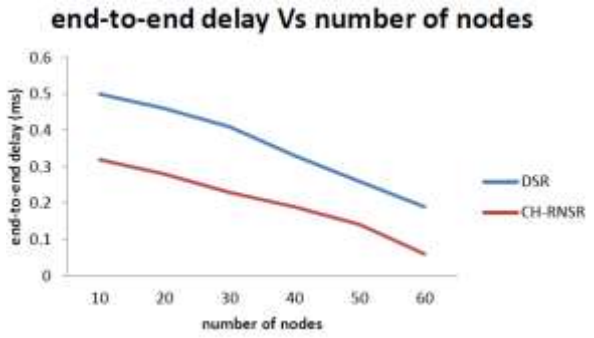

Figure 5 end-to-end delay

The end-to-end delay performance of the proposed CH-RNSR and existing dynamic source routing protocols are compared. New develop design has reduced end-to-end delay with the number of nodes increased compared to the existing protocol. According to figure 5 and table 3, the proposed scheme surpasses the performance of DSR in minimizing average end-to-end delay by 15.5%, when there are 10 to 60 nodes in the network. As the proposed relay node selecting randomly scheme motioned two different short routes and minimum link breakage path every time frequently update the table, it is possible to minimize the delay.

Table 4 simulation result of remaining energy vs number of nodes

RP/NN	10	20	30	40	50	60
DSR	0.84	0.76	0.71	0.67	0.63	0.59
CH-RNSR	0.97	0.91	0.86	0.82	0.78	0.74

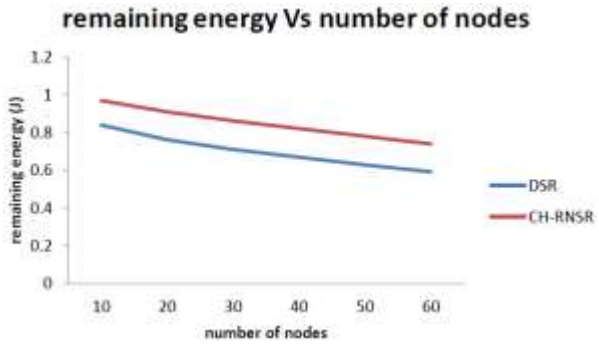

Figure 6 remaining energy

Simulation results are obtained by varying the number of nodes from 10 to 60. The performances of the proposed model and the existing model are compared. Figure 6 and table 4 shows the proposed model with improved packet delivery ratio, when number of nodes is increased from 10 to 60 compared to the existing method. It is clear that out of CH-RNSR design surpasses DSR performance by 14.67% when there are 10 and 60 of nodes in the network. From the results, it is concluded that the randomly selection based scheme is able to detect malicious node with avoid link breakage and also fine minimum distance route in the presence of false misbehaviour nodes, so delivery ratio increased from start to end of the network with proof from above statement receive more packets from active nodes.

Table 5 simulation result of packet delivery ratio vs number of nodes

RP/NN	10	20	30	40	50	60
DSR	0.82	0.74	0.69	0.65	0.61	0.57
CH-RNSR	0.91	0.85	0.80	0.76	0.72	0.68

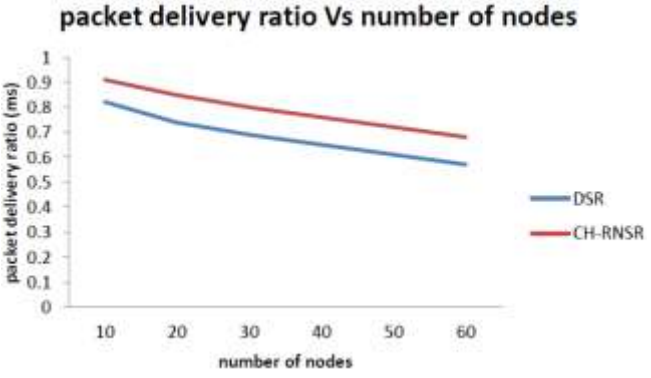

Figure 6 packet delivery ratio

Simulation results are obtained by varying the number of nodes from 10 to 60. The performances of the proposed CH-RNSR and the existing DSR are compared. Figure 6 and table 5 shows the proposed model with improved packet delivery ratio, when number of nodes is increased from 10 to 60 compared to the existing method. It is clear that out of CH-RNSR design surpasses DSR performance by 10.67% in the network. From the results, it is concluded that the randomly selection based scheme is able to detect malicious node with avoid link breakage and also fine minimum distance route in the presence of false misbehaviour nodes, so delivery ratio increased from start to end of the network with proof from above statement receive more packets from active nodes.

Table 6 simulation result of routing overhead vs number of nodes

RP/NN	10	20	30	40	50	60
DSR	0.11	0.16	0.20	0.31	0.36	0.42
CH-RNSR	0.06	0.12	0.16	0.24	0.32	0.38

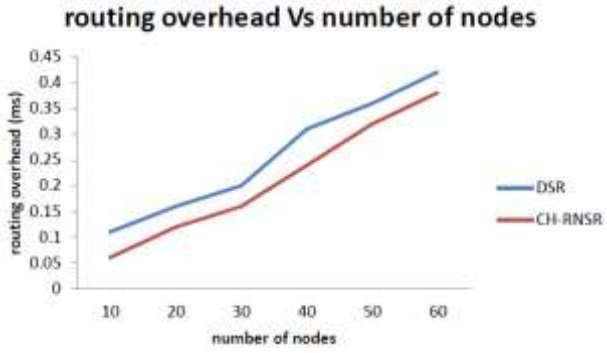

Figure 7 routing overhead

Figure 7 and table 6 compare the routing overhead performance of the proposed CH-RNSR and existing on-demand routing protocol scheme. New scheme has reduced routing overhead with the number of nodes from 10 to 60 when compared to the existing method as show in figure 7 suggested new method has the reduce routing overhead by 4.67% than DSR, although suggested scheme requires to avoided unwanted passive nodes reason of this decreasing conjunction from throughout network due to selection two active relay nodes with randomly.

Table 7 simulation result of throughput vs number of nodes

RP/NN	10	20	30	40	50	60
DSR	0.39	0.35	0.31	0.27	0.23	0.19
CH-RNSR	0.58	0.53	0.48	0.43	0.38	0.33

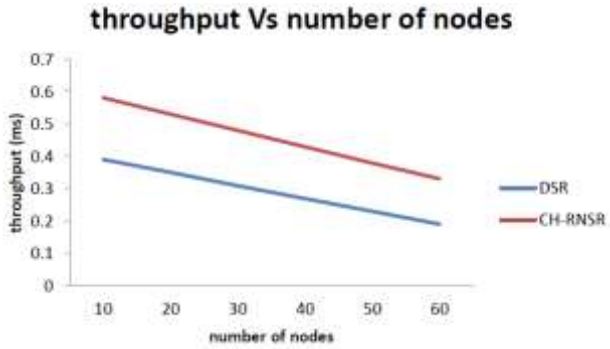

Figure 8 throughput

Simulation results are obtained by varying the number of nodes from 10 to 60. The performances of the proposed CH-RNSR and the existing DSR are compared. Figure 8 and table 6 shows the proposed model with improved successfully delivery ratio (throughput), when number of nodes is increased from 10 to 60 compared to the existing method. It is clear that out of CH-RNSR design surpasses DSR performance by 16.5% when there are 10 to 60 of nodes in the network. From the results, it is concluded that the randomly selection based scheme is able to detect malicious node with avoid link breakage and also fine minimum distance route in the presence of false misbehaviour nodes, so delivery ratio increased from start to end of the network with proof from above statement receive more packets from active nodes.

5. Conclusion

Cluster head model based primary and secondary selection transmission scheme becomes essential and is very safe with high security. In this research, a proposed routing protocol named energy consumed CH-RNSR with random selection work, the simulation results minimizing average end-to-end delay by 15.5% when there are 10 to 60 nodes in the network, increased delivery ratio performance by 10.67%, throughput performance by 16.5% when there are 10 and 20 nodes in the network respectively, 10 to 40 when compared to the existing method and suggested new method has the reduce routing overhead by 4.26% when there are 10 to 60 nodes in the network and it is clear that the proposed approach maximized remaining energy by 14.67% with the number of nodes 40 through the NS 2. Developed new model not only reduces overhead, but also solves packet dropping problem using relay algorithm. Plan to investigate the following issues in our future research.

- The same concept can be tried to implement in satellite to save more energy.
- The possibilities of adopting the cluster based network to eliminate the delay.
- CH-RNSR can be tested in real time network environment.

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