JOURNAL OF MECHANICS OF CONTINUA AND MATHEMATICAL SCIENCES
www.journalimcms.org

ISSN (Online) : 2454 -7190 Vol.-15, No.-2, February (2020) pp 180-190 ISSN (Print) 0973-8975

LOAD BALANCED ENERGY EFFICIENT CROSS LAYER BASED ROUTING PROTOCOL FOR ACCUMULATIVE NETWORKS

N Rashmitha[1], M Susmitha[2]

[1]PG Student, Department of Information Technology, VNR VJIET, Hyderabad, Telangana, India.

[2]Assistant Professor, Department of Information Technology, VNR VJIET, Hyderabad, Telangana, India.

https://doi.org/10.26782/jmcms.2020.02.00016

Abstract

It can be easily understood that every relay node in traditional multi-hop (TM) communication networks only attends the previous node that is near to it, which is the difficulty in routing. Using directed graphs, the modeling of these networks is performed well in order to achieve the routing. In the networks of accumulative multi-hop (AM) communication, the routing problem is far-off from understanding and yet rather interested in it. The received data energy from earlier relay transmissions can be acquired by numerous relay nodes that assist communication between a single source and a single destination in the accumulative multi-hop network which is a simple one. At this point, in single-source single-destination accumulative multi-hop networks, the difficulty in finding the optimum paths is studied. A method of Load Balanced Energy efficient cross layer based Routing protocol for accumulative networks are implemented in this paper. The end-to-end network connectivity is enhanced as well as the faults at link or/and node level is reduced in this method. Using an energy efficient neighbor node choosing method, the establishment of a set of various paths is done from the source to the destination. Efficient load balancing is offered at the node and a constant route is discovered between the source and destination that meets the delay requirement. With respect to end to end delay, throughput, and energy consumption, the proposed system is outperformed which is demonstrated in the results of simulation.

Keywords: Accumulative, Multi-hop, Multi-path routing, Cross layer approach, Load balancing, Energy efficiency.

I. Introduction

Starting from the possible amounts towards the routing approach, the introduction of relay abilities within a network strongly impacts on the data flow which is extended towards the overall levels of communication. For the effective protocols designing in the upcoming communication networks, a basic understanding role is occupied by the relays in wireless networks which consume the utmost significance. It can be easily understood that every relay node in traditional multi-hop (TM) communication networks only attends the previous node that is near to it, which is the difficulty in routing. Using directed graphs, the modeling of these networks is performed well in order to achieve the routing. The effective path search algorithm is assured by Dijkstra's algorithm which is an optimality condition by a routing metric criterion considered to find the optimum path that was investigated in [XI] as well as [XIX].

In the networks of accumulative multi-hop (AM) communication, the routing issue is far-off from understanding and yet rather interested in it. The data energy i.e., received commencing earlier relay transmissions can be acquired by numerous relay nodes that assist communication between a single source and a single destination in the accumulative multi-hop network which is a simple one. Mutual-information and Energy accumulation are the twofold major accumulation methods basically used at relays. At the reception nodes such as space time coding otherwise repetition coding [V], [VII], the Energy accumulation might remain implemented. By means of rate less codes, Mutual-information accumulation [I], [VI] such as fountain or raptor codes [XIV] may be achieved. The energy consumption is reduced and reliability of communication is increased by the Accumulation techniques in the present and next generation values.

In order to increase the reliability of communication and to reduce consumption of energy and latency, Accumulative mechanisms are used. By using numerous relays via several hops a single source which interacts towards a particular destination is supported in accumulative system. When the transmitted signal is received by the entire nodes, only single node transmits at every hop and stores the signal after decoding or processing then the signals obtained in earlier hops is incorporated with it. The conditions of optimality of traditional multi-hop networks are insufficient and more attention is required to find the optimum paths in AM networks. For the problem of least energy routing in networks of static AM, the optimality of Dijkstra's algorithm is discussed in this paper which is equipped with optimality positions. Hence, on the basis of decode-and-forward (DF) relaying approaches, it is mainly focussed. From the overall earlier transmissions, by accumulating the information or energy, the source message is decoded completely by the DF relay nodes. The difficulty of this routing problem has been stated before in [V], [VII], as well as [XIV] to [XIII]. With the intention of finding the optimal transmission order,NP-complete are a problem for these networks from [V] as well as [VII].

In regard to the source and destination, the multipath routing is introduced in the entire methods however more delay has been detected in the routing. The propagation in the parallel path is affected when the neighbouring nodes attempt to strive with one another and when the delay mostly arises in the paths which are parallel. The reliability is increased and the shared resources are reduced in this work by introducing a new multipath scheme in order to overcome this difficulty. By this, the bandwidth is increased and the latency is reduced from an alternative side. Node disjoint paths are frequently utilized in this method. Therefore, the paths are entirely free from one another since there are no nodes existing among the joint paths in the situation of node disjoint paths.

In order to create the forward route for the data packets, this procedure may be utilized. Although some additional nodes are still idle for long period lacking any packet forwarding or processing job, certain routes becomes overloaded that are placed in the centre of the network and the end to end delay is greatly affected in this conventional method. Therefore, for an impressive network like MANET, the conventional technique of routing is unsuitable which discovers the shortest path rather than utilizing a load balanced path. With the advancement of a load balanced protocol for MANET, a cross layered of power effective method is considered by the effect of this kind of imbalanced load balancing between the power deficiency problem as well as MANET nodes.

II. Literature

Earlier in [X, VIII], the condition of Dijkstra's optimality for hypergraphs has been proposed. A more in-detail derivation is delivered at this point. Here, the problem of least energy routing on behalf of the TM, DF AM as well as CB systems is calculated similarly. Nevertheless at this time, the discussion about the DF SAM, DF DAM, PF DAM and DF EAM networks is done primarily.

Here we are finding the problem as well as conditions which are guarantee for the path selection, which gives the lightest path in the accumulative multi-hop networks. In this routing method, we choose the AODV for route level and optimality of the routing process. This helps to single path routing selection.

To conclude, an improved path investigative algorithms on behalf of the DF AM network has been offered in [IX] on behalf of AM networks while this effort mainly deals with the optimum path search procedures.

On the basis of energy efficiency, delay management and cross layer architecture, some of the various intelligent suggestions are proposed by the investigators in the previous centuries. In order to provide real-time as well as QOS necessity of a MANET, resource management, dynamic programing, multipath investigation and velocity are considered by Agbaria1 et al [II] to develop an extrapolation based scheme. Using the method of congestion avoidance routing and load-distributing, an effective algorithm for supporting the Quality of Service (QoS) has been proposed by Siva kumar and Duraiswamy [XVI]. On the basis of link loads, the cost metric is calculated by their presented algorithm. The congestion is avoided by preferring the lighter loads links for the distribution of traffic. The energy consumption in the already exploited as well as underutilised objects is equalised by an energy-effective routing recommended by Srivastava and Daniel [XVII] for improving the usage of link. Bandwidth, Residual energy, hop count and load are some of the main features that are considered by their protocol for discovering the route. Ant colony based load balanced method has been specified in MANET by Ahmed [III] et al. The routing has been analysed by connecting it by the difficulty of resource planning. On the basis of node mobility, the transmission time is reduced and the segment size of their algorithm is attentively adjusted.

With the utmost scalable and multipath routing protocol, various mechanisms are introduced by Bee Sensor-C on behalf of the sensor networks in [IV, XV and XX]. In order to provide routing between the nodes, a novel protocol is intended by considering MANET as the most dynamic versatile structure. By the way for providing more systematic and energy efficient routing, a small number of methods were implemented. Consequently, Bee AdHoc-C, temporary Bee AdHoc-C as well as Load Balanced Energy Enhanced Bee AdHoc-C are the 3 routing algorithms that have been introduced earlier.

In [XII], author presents the improvised Bee Ad Hoc-C, it can provide energy efficient process which is based on cluster routing. Here we take routing process as AODV routing protocol. The drawback of this routing method is systematic process, which makes delay in routing level and no load balancing between all the clusters as MANET which is in dynamic structure.

III. Proposed system

This However, no fair delivery of the traffic is present between the paths in the network. In the routing protocol performance, more dissimilar paths are used by the nodes that are exhausted which lie in denser regions and therefore lead to degradation.

The fair distribution of workload in the network is obtained by the addition of a load balancing factor. In case of a route breakage, backup routes are preserved by the help of AOMDV, which is a multipath routing protocol. In preceding routing algorithm [VIII], multi-level transmissions are there, but this AODV routing protocol cannot support for this due to lack of path availability in the routing table. In proposed method, more paths are available for load level management process by using the cross layer parameters, so we go for multipath routing protocol (AOMDV). The biasness of the path usage in the network can be removed by considering a queue length with the hop count as a parameter for selection of path in the proposed method and after the selection of path and to obtain the division the load among the path, the data is parallelly distributed on the paths.

By considering the foremost issues, a Load Balanced Energy efficient cross layer based Routing protocol is proposed where the method of AODV route detection is upgraded for the involvement of various path weight, queue length, sequence number, expire time, load and the residual energy parameters. A constant path is discovered by the protocol among the source and destination on the basis of received signal strength and load balancing is provided at each node with the addition of certain constraints such as path weight, queue length, sequence number, expire time, load and the residual energy earlier to the discovery.

The establishment of various routes among the source node and destination node is defined as Multipath routing. Although a failure occurs at the node in the duration of a fault tolerance, the source nodes are efficient to maintain connections because of multipath routing. The failures of data transmission and the delay times due to route disconnection are reduced with the help of multipath routing protocols.

Route Discovery

The extended RREQ message is initiated by the source node towards the destination in route discovery stage. Route Reply (RREP) packet is produced as well as returns towards source node during the reception of the Route Request (RREQ) packet from the destination node. In a wireless transmission range, the intermediate nodes receive the RREQ packet.

The RREQ is forwarded when the nodes are unmeasured as destination as well as when RREQ is not received by the same packet ID. An energy threshold functions are applied in the proposed system during the route discovery process for filtering the nodes by inferior residual energy in addition to the operations of broadcasting are reduced in this paper. Calculation of an energy value becomes larger when compared with threshold energy value and RREQ is forwarded towards adjacent neighboring node or it would be discarded.

The calculation of the transmitted power is done at each node. Within the entries of routing list, the simplification of transmission power and residual energy is achieved during arrival of message of RREQ by adjacent node. The extended RREQ message is initiated towards the destination node in the route discovery stage. The RREP packet is produced and returns to the source node during the reception of the RREQ packet from the destination node.

Route Selection

During the stage of route selection, when the source nodes receive the RREPs packets from the neighboring nodes, a timer is started and the RREPs are collected during the period. On the basis of corresponding records in RREPs, the calculation of the path load and node level weight is initiated by the source node. In addition to that, the path with the least load as well as weight is selected as the optimal route. Lastly, by recording the transmission power in RREP, the transmission of the data packets is done via this path.

Route Maintenance

If a route failure is discovered by a node, a route error (RERR) packet is referred towards previous node for indicating breakage of a node. The RERR message is received by the intermediate node and sends information regarding it to the source node. At that time, the equivalent item is abstracted from the routing table as well as switches towards an alternative path.

The total queue length of the path is carried by the queue length field along with which it has travelled is added in RREQ packet. In relation to the request's buffer size, the path is carefully chosen. Although additional nodes are not involved on a routing path, only a few nodes are asked to wake-up that are concerned about the real-time transmission of data and therefore uninvolved in any actual transmission. Addition of a field equivalent towards a final destination address is achieved in substituting RTS as well as CTS packets by means of a cross layer method. While the sleep time of the additional nodes is extended, the wake-up time of the neighborhood nodes is prolonged that belongs to the path. An RTS packet is transmitted towards his neighborhood in order to specify that it contains a packet to transmit, when the transmission is initiated by a node. Every neighborhood node chooses to take part in communication on receiving an RTS packet.

However, the difference between the CTS as well as using the receiver node, the RTS lies in the interpretation. Similar network is ensured by both CTS & RTS, which is very significant to consider.

Therefore, whenever the receiver is:

- Next node: the transmitter transmits a RTS transmitted message.
- Previous node: the message is considered as CTS that is arriving from the transmitter in place of an RTS feedback.
- Any other node: the behavior of the node is controlled by the message and forces it to stay in sleep mode.

By mentioning towards its routing table, the sender can recognize a receiver node. The entire data i.e., (hops, distance, load, previous node identifier, number of every additional path, and path load) related to the sender and the receiver path is enclosed in this table. By implementing Dijkstra's algorithm, the short path method is applied in network layer in this situation.

Algorithm:

Step1: Random node deployment

Step2: Broadcasting process for select the next hop nodes

Step3: optimal path selection

Step4: Calculate distance d(i), residual energy E(resd) and load

Step5: If d(i) = low && E(resd) = high && LD = low, then

Step6: Select the path for routing

Else

Go to step 5

Step7: Optimal path broadcasts its selection

Data transmission

Step8: Cross layer approach

Step9: Broadcast RTS packet to neighbors

Step10: Check the verification at receiver while using CTS packet

Step11: update the optimal path selection nodes

Step12: compare RTS and CTS packets for confirming the data access

Step13: If CTS accept the RTS packet

Step13: source node send the data to destination

Else

Go to step 10

End.

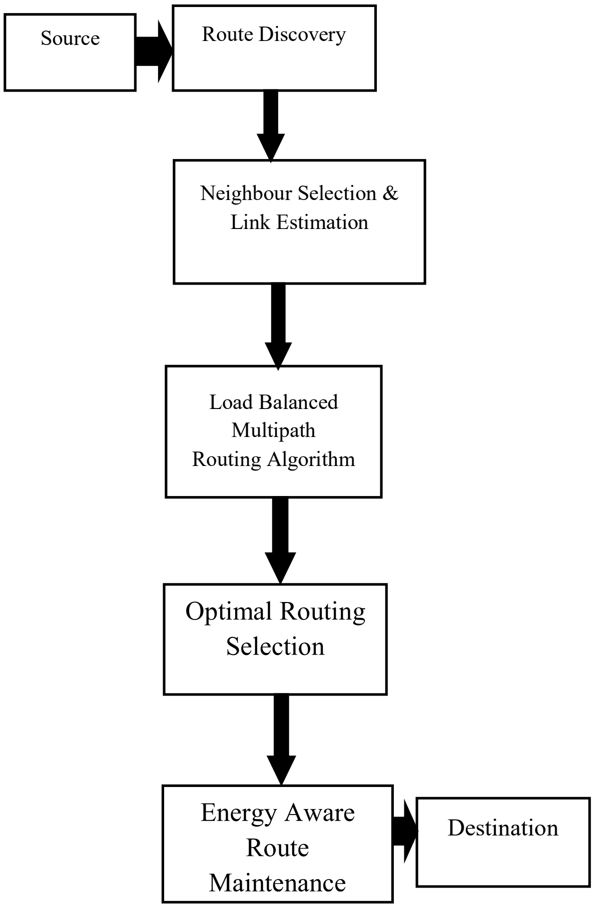

Fig. 1: Flowchart of Proposed system

The advantages exceeding the existing systems are presented by the proposed system in figure 1. 1) With respect to energy consumption, throughput and average end to end delay, the performance of the proposed system is implemented. 2) Next hop, weight, sequence number, expiry period, residual energy are the motion parameters that are acquired. On the basis of these parameters, the path is selected for transmitting the data packets among the nodes. 3) On the basis of the overall parameters, this method is an optimum path that is selected. In addition to that, the battery levels of the nodes are also considered. Enhanced throughput and improved efficiency are achieved by this network.

IV. Result and Discussion

The NS-2(Network Simulator 2) is used in order to implement the proposed method and is analysed by considering various parameters such as throughput, energy consumption and end- to-end delay. By increasing the throughput as well as energy consumption, a constant route is selected for reducing the fault tolerance and packet loss.

The applications are written in NS-2 by OTcL and the simulation results may be observed with the help of network Animator (NAM) and Xgraph.

The parameters employed in the simulation are represented in table 1.

Table1: Simulation Parameters

Parameter	Value
Application traffic	CBR
Transmission rate	1000 bytes / 0.5ms
Communication range	250m
Data Packet size	8000 bits
Number of sensor nodes	40
Simulation time	50s
Number of simulation iterations	180
Initial energy	100j
Network area	1000x1000
Transmission Protocol	UDP
Routing methods	LBEEC-MR, OAD, IBAC
Routing protocol	AODV, AOMDV

For investigating and for analysing the proposed method, a simulation tool named as Network Simulator 2(NS-2) is implemented. By using Ubuntu as the interfacing software and is implemented in Linux working method. Over a region 1000 m x 1000 m, 40 nodes are comprised in the Simulation context. For an ideal unstructured format, the range of transmission is set to 250m and the usage of Random Way Point (RWP) is done. The limitation of the node's mobility is 8ms. Random traffic is generated by implementing the CBR (constant bit rate). Intended for the overall investigations, the Simulation period is set to 50 s.

1) Throughput: It is defined as the sum of packets that are received effectively within a unit interval of time. It is measured in bps.
2) End-to-End delay: the time taken by a node to transmit a data packet from source to destination.
3) Energy consumption: the energy used up by entire network for transmitting and processing the data packets.

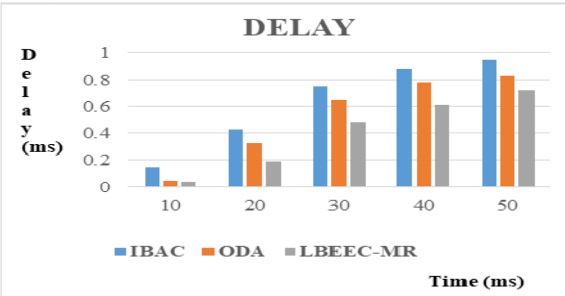

Fig. 2: End to End Delay

In figure 2, this graph would be showing and representing the Delay. It shows the delay in the network. Here, in IBAC [XII], OAD [X, VIII] and LBEEC-MR, the verification of this says that LBEEC-MR shows the reduction of delay in the network, than the previous. With the AOMDV protocol we are managing the load level at the nodes with the help of multi-paths availability by maintaining the delay between nodes.

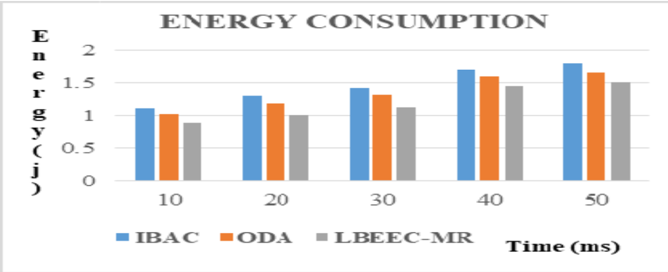

Fig. 3: Energy Consumption

In figure 3, this graph would be showing and representing the Energy Consumption. It shows consumption of energy in a network. Here, in IBAC [XII], OAD [X, VIII] and LBEEC-MR, the verification of this says that LBEEC-MR shows the less consumption of energy in the network, than the previous. AOMDV protocol uses the cross layer parameters by using the multipath routing, by maintaining and using the energy level routing at nodes.

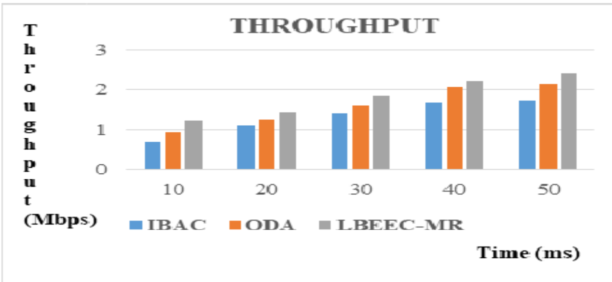

Fig. 4: Throughput

In figure 4, this graph would be showing and representing the Throughput (Network performance). It shows the network performance. Here, in IBAC, OAD and LBEEC-MR, the verification of this says that LBEEC-MR shows the better performance than the previous. AOMDV protocol is mainly used and maintained the good data transmission between nodes by this we can receive more data by managing the load level at nodes and based on different Quality of Service (QoS) parameters with the help of multipath routing.

V. Conclusion

The accumulative multi-hop networks routing problem is studied in this paper. A hypergraph is required for modeling the network for accumulative network routing and presented that the network is well modeled by a graph, since it is against traditional multi-hoping. The optimum path in the networks can be found by the definite properties of Dijkstra's algorithm, and necessary circumstances like path load, path weight as well as path availabilityareoffered in order to obtain the optimality is studied. In addition to parity-forwarding relays, decode & forward relays as well as on behalf of cut-set bound, for the problem of minimum energy routing, these circumstances are required. Using the cross layer approach, effective load balancing is provided and a constant route is discovered among source as well as destination that disables delay with the AOMDV routing protocol. The performance of LBEEB-MR is better than that of the existing IBAC and LBEE with respect to the simulation results.

References

I. A. Molisch, N. Mehta, J. Yedidia, and J. Zhang, "Cooperative relay networks using fountain codes," in Proc. IEEE Global Commun. Conf. (GLOBECOM), Nov. 2006, pp. 1.

II. Agbaria, A.; Gershinsky, G.; Naaman N. &Shagin, K. Extrapolation-based and QoS-aware real-time communication in wireless mobile ad hoc networks. In the 8th IFIP Annual Mediterranean Adhoc Networking Workshop, Med-Hoc-Net 2009. pp.21-26. doi: 10.1109/MEDHOCNET.2009.5205201.

III. Ahmed, M.; Elmoniem, Abd; Ibrahim, Hosny M.; Mohamed, Marghny H. &Hedar, Abdel Rahman. Ant colony and load balancing optimizations for AODV routing protocol. Int. J. Sensor Networks Data Commun., 2012, 1. doi: doi:10.4303/ijsndc/X110203.

IV. Cai, X., Duan, Y., He, Y., Yang, J., Li, C.: Bee-Sensor-C: an energy-efficient and scalable multipath routing protocol for wireless sensor net-works. Int. J. Distrib. Sensor Netw. 26 (2015).

V. I. Maric and R. D. Yates, "Cooperative multihop broadcast for wireless networks," IEEE J. Sel. Areas Commun., vol. 22, no. 6, pp. 1080–1088, Aug. 2004.

VI. J. Castura and Y. Mao, "Rateless coding over fading channels," IEEE Commun. Lett., vol. 10, no. 1, pp. 46–48, Jan. 2006.

VII. J. Chen, L. Jia, X. Liu, G. Noubir, and R. Sundaram, "Minimum energy accumulative routing in wireless networks," in Proc. IEEE INFOCOM, vol. 3. Mar. 2005, pp. 1875–1886.

VIII. J. Gómez-Vilardebó, "Routing in Accumulative Multi-Hop Networks," in *IEEE/ACM Transactions on Networking*, vol. 25, no. 5, pp. 2815-2828,Oct. 2017. doi: 10.1109/TNET.2017.2703909.

IX. J. Gomez-Vilardebo, "Heuristic routing algorithms for minimum energy cooperative multi-hop wireless networks," in Proc. 20th Eur. Wireless Conf., May 2014, pp. 1–5.-12

X. J. Gomez-Vilardebo, "Routing in accumulative multi-hop networks," in Proc. IEEE Conf. Comput. Commun. (INFOCOM), Apr. 2015, pp. 1814–1821.

XI. L. Sobrinho, "An algebraic theory of dynamic network routing," IEEE/ACM Trans. Netw., vol. 13, no. 5, pp. 1160–1173, Oct. 2005.

XII. Mohapatra, S., Siddappa, M.: Improvised routing using Border Cluster Node for Bee-AdHoc-C: an energy-efficient and systematic routing protocol for MANETs. In: International Conference On Advances in Computer Applications, IEEE ICACA-2016 (2016).

XIII. R. Yim, N. Mehta, A. F. Molisch, and J. Zhang, "Progressive accumulative routing in wireless networks," in Proc. IEEE Global Commun. Conf. (GLOBECOM), Nov. 2006, pp. 1–6.

XIV. S. C. Draper, L. Liu, A. F. Molisch, and J. S. Yedidia, "Cooperative transmission for wireless networks using mutual-information accumulation," IEEE Trans. Inf. Theory, vol. 57, no. 8, pp. 5151–5162, Aug. 2011.

XV. Saleem, M., Farooq, M.: Beesensor: a bee-inspired power aware routing protocol for wireless sensor networks. In: Workshops on Applications of Evolutionary Computation, pp. 81–90. Springer Berlin Heidelberg (2007).

XVI. Siva, K. & P. Duraiswamy, K. A QoS routing protocol for mobile ad hoc networks based on the load distribution. In the IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), 2010, pp.1-6. doi: 10.1109/ICCIC.2010.5705724.

XVII. Srivastava, S.; Daniel, A.K.; Singh, R. &Saini, J.P. Energyefficient position based routing protocol for mobile ad hoc networks. In the IEEE International Conference on Radar Communication and Computing (ICRCC), 2012, pp.18- 23. doi: 10.1109/ICRCC.2012.6450540.

XVIII. T. Girici and A. C. Kazez, "Energy efficient routing with mutual information accumulation," in Proc. 10th Int. Symp. Modeling Optim. Mobile, Ad Hoc Wireless Netw. (WiOpt), May 2012, pp. 425–430.

XIX. Y. Yang and J. Wang, "Design guidelines for routing metrics in Multi-hop wireless networks," in Proc. IEEE INFOCOM, Apr. 2008, pp. 1615–1623.

XX. Yu, J.Y., Chong, P.H.J.: A survey of clustering schemes for mobile ad hoc networks. IEEE Commun. Surv. Tutorials 7(1), 32–48 (2005).

XXI. Z. Yang and A. Høst-Madsen, "Routing and power allocation in asynchronous Gaussian multiple-relay channels," EURASIP J. Wireless Commun. Netw., vol. 2006, no. 2, p. 35, 2006.