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MANETS through Energy efficient technique

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Abstract: *In versatile adhoc networks (MANET), battery life of hubs is one of the basic segment and arbitrary development of portable hubs inside a district of interest made the plan of MANET more unpredictable. The arrangement to have successive changes in the geography of versatile hubs notwithstanding saving the battery life for longer length is considerably more intricate. This paper tends to hubs battery life issue dependent on pressure instrument incorporated with medium access layer (MAC) convention. The information pressure is accomplished by utilizing the as of late presented continuous example mining based Huffman coding strategy which is incorporated with MAC layer convention and henceforth planned an effective energy utilization MANET framework. Experimentation in the mimicked organized climate uncovers the presentation of the proposed technique. The standard measurements, for example, energy utilization and time to parcel conveyance are assessed to show the presentation of the proposed strategy. A relative investigation is done with the current LZW pressure variation models to uncover the exactness and energy proficiency nature of the proposed strategy.*

Keywords: *Pattern recognization, Huffman Coding, Image C, Energy Minimization, QOS, Mobile Adhoc Networks.*

I. INTRODUCTION

In the recent days, we have seen the integration of data compression as one of the major component while designing the routing algorithms in mobile adhoc networks (MANET). MANETs are wireless infrastructure-less networks which have been explored for various applications including disaster management, environment protection, military, battery field communications, surveillance etc. In MANETs, each node acts a router which is used to find its own routing and also perform data transfer to the intended destination. The battery is one of the critical resource which need to be efficiently managed for the node existence in the network for longer duration, thereby eliminating the need for discovery of alternate routing as well as eliminate the inadvertent effects on the MANET lifetime. The power consumption plays a vital role in MANETS, and we have seen many works for lowering the power consumption in the design of MANETs. Extensive amount of research work has been carried out in order to minimize the energy usage (power consumption), thereby reducing the link failure and hence retain the better throughput as far as packet delivery is concerned. This is also one of the quality of service parameter to be addressed while designing the MANETs.

It is a well-known fact that the MANET is an autonomous system consisting of mobile routers connected by wireless links which forms an arbitrary graph [20]. The nodes are moving randomly and the routing table is updated dynamically, but the swift random movement of nodes depends upon the application in hand. Due to this random movement nature of nodes and also because of frequent modification in the node routing table, packet loss by transmission errors, battery constraints and frequent network partitions, the design of efficient and accurate MANET system is very challenging. Due to the conservation of energy in an adhoc manner, the problems such as network partitions, alternate route discovery etc., exists and hence proper utilization of energy is one of the critical issue. We need to address energy usage in an optimal manner on priority while designing MANETs. The researchers have proposed many solutions to address efficient energy utilization in many ways. The well-known approaches proposed in the literature are broadly classified as follows:

— Minimizing power by reducing link failures
— Specially designed power control techniques
— By modifying cryptographic algorithms
— Data compression techniques

A. REDUCTION IN THE NUMBER OF LINK FAILURES

The link failures in mobile adhoc networks will be occurred due to the random movements of the nodes, although the movement of the nodes is not so swift in many applications. The other reason would be the loss of energy due to excessive battery usage. The sender normally sends the data-packet to the node in the next hop and if it fails to send the data, it is under the assumption that there is a node failure and hence alternate routing has to be established which incurs lot of energy. In addition, a link failure event can be caused not only by user mobility and node failure, but also by link-layer contention. The latter case is also referred to as the false link failure, where the intermediate node that fails to relay the data will also inform the source node to discover a new route by mistakenly assuming that the link is broken. The re-routing process generally incur excessive power and also has an effect on the delivery rate. Attempts are made by the research community to reduce the effect of link failure by keeping the nodes active in many ways. The AODV routing protocol has been proposed by IETF (Internet Engineering Task Force) which provides local repair to recover the route when a link break in an active route occurs. However, local repair is only performed when a node has already detected broken link and the detection consumes too much time. There is another proposal in which the node listens in all frames including data packets and routing control packet to maintain local route cache. The fast route discovery and local recovery is achieved by local route cache when a broken link occurs [17]. The drawback of this scheme is that nodes maintain a backup route which consumes additional energy.

B. SPECIALLY DESIGNED POWER CONTROL TECHNIQUES

In mobile adhoc networks, the nodes are allowed to modify their power in order to accommodate in the network and also to reduce energy consumption. Due to the problem of overhearing in MANET, many alternatives have been provided by the researchers where a node can go to either sleep mode or in active mode [20]. In general, in sleep mode, nodes consume less power and hence are able to increase the lifetime of MANETs. In this regard, topology based routing where different routing paths are established based on remaining energy and power control based routing which consider remaining energy as one of the feature. The topology control is to assign for a node, the transmit power that minimize the maximum transmit power used in the network. In minimum energy routing, it reduces power per packet transmission and the sleep management reduces idle power through duty cycle [20].

C. MODIFICATION OF CRYPTOGRAPHIC ALGORITHMS

The cryptography based solutions are also gaining attention in the design of MANETs due to their robustness nature against the malicious attacks by the intruders. The cryptography based solutions helps in eliminating the side- effects occurred due to intruders and efforts are made by the research community to have a provision for intrusion detection system. However, it is observed that the intrusion detection system (IDS) incurs power consumption and it is good if we could integrate the IDS at the nodes which have higher computing capabilities. In addition, it is quite difficult to implement cryptographic techniques at node level due to the random movement of nodes apart from battery usage. The design of efficient secure protocols for wireless devices from the view of battery consumption needs to understand how encryption techniques affect the consumption of battery power in data transmission [10].

D. DATA COMPRESSION BASED TECHNIQUES

Data compression is emerged as one of the simplest and powerful technique to overcome the problem of energy crunch in MANETs. The overall utilization of energy resource is reduced due to less number of packets to be transmitted in the network and hence the throughput, energy utilization, packet drop-outs due to energy consumption etc. could be improved significantly. However, it all depends upon the application on hand. We need to be careful in choosing the compression algorithm which is supposed to be efficient and as well preserve the data as much as possible. It is a known fact that the compression helps in reducing the number of bits that can be transmitted over the network and hence the energy and bandwidth consumption can be made more efficient. Also, the compressed text resembles a scramble message and hence acts as intrusion detection system too. Therefore, the data compression not only reduces the size of the original text, but also provides data security. Efforts are made by the research community to explore different data compression techniques integrated with the MANETs system and hence to reduce the data traffic thereby increasing the energy utilization and life time of the MANET.

In this regard, we have made an attempt to come out with an integrated system which include best text compression algorithm known as frequent pattern mining based Huffman coding algorithm. Oswald and Sivaselvan [11] proposed a novel frequent pattern mining based Huffman encoding algorithm for text data and employs a Hash table in the process of frequent pattern counting. The proposed algorithm operates on pruned set of frequent patterns and also is efficient in terms of database scan and storage space by reducing the code table size. The pruned set of patterns are employed in the encoding process instead of character based approach of

Conventional Huffman. Experimental results over 18 benchmark corpora demonstrate the betterment in compression ratio ranging from 18.49% over sparse datasets to 751% over dense datasets. It is also demonstrated that the proposed algorithm achieves pattern space reduction ranging from 5% over sparse datasets to 502% in dense corpus.

Keeping the above class of energy minimization approaches, we were motivated to design the compression based energy minimization approach suitable to MANET system and the proposed approach is based on Oswald and Sivaselvan [11] compression approach and it is integrated with MANETs routing protocol to achieve energy efficiency. The remaining part of the paper is organized as follows. In Section II, we have provided a literature survey focusing on efficient algorithms proposed for energy utilization and also on the compression techniques which are integrated with MANETs to achieve better Quality of Service (QoS). The proposed method which is an integrated version of frequent pattern mining based Huffman coding compression technique with a well- known AODV/DSR protocol is presented in Section III. Experimental evidences are provided in Section IV and conclusion are given in Section V.

II. LITERATURE REVIEW

The domain of MANET is growing extensively due to its wide-spread applications and there are ample amount of research works are being carried out which address clustering and routing protocols. For conserving energy, many energy-efficient routing protocols have been proposed. These protocols can be generally classified into two categories: minimum energy routing protocols and maximum network lifetime routing protocols. Minimum energy routing protocols search for the most energy- efficient path from the source to the destination, while maximum network lifetime routing protocols attempt to balance the remaining battery-power at each node when searching for the energy-efficient path. Since minimum energy routing scheme is also an important part in most recent maximum network lifetime routing protocols such as Conditional Max-Min Battery Capacity Routing (CMMBCR) and Conditional Maximum Residual Packet Capacity (CMRPC) routing, we have considered the design of an efficient minimum energy routing protocols in this research work.

In [6], the authors proposed a classification algorithm in the context of MANETs which minimizes the energy utilization of nodes in the clustered network. The weight based clustering algorithm is proposed in [12]. A distributed weighted clustering algorithm for MANET which confines configuration and reconfiguration of clusters and constraints on CHs in terms of power requirement is proposed in [4]. In [3], a novel version of the weighted clustering algorithm has been proposed called Enhancement on Weighted Clustering Algorithm (EWCA). The parameters considered for the selection of cluster heads (CH) are transmission power, transmission range, mobility, and battery energy. Here, the average number of cluster formation instances is reduced by avoiding the dynamic change of CHs. The load balancing and stability of clusters in MANET is preserved in this approach.

On the other hand, several models exploit pre-existing knowledge on MANET topology in order to operate in an energy-efficient way. In the case of WSN, the model in Lee et al. [9] is based on de-Bruijn and Voronoi diagrams for routing and data aggregation. This model requires training in order to construct the routing tables and, therefore, computational effort. In addition, the model in Ren et al. [16] uses data aggregation for eliminating data redundancy based on the attributes (type of contextual parameters) of the sensed information. The idea behind the model in Ren et al. [16] is that pieces of data produced by the same type of sensors demonstrate significant redundancy; thus, only data samples with the same attribute can be aggregated. Moreover, the discussed model does not take into consideration the complexity (energy) cost per CPU instruction for evaluating the degree of importance for each received message. Furthermore, the model in [2] exploits linear extrapolation methods for forwarding univariate contextual values. Nevertheless, it is worth noting that for all these approaches the transformation of the sensed data with respect to PCs is performed in a centralized way in the sink. In [8], each node performs PCA by projecting its local data along the principal components and applies a clustering algorithm on this projection.

Subirkumar, et al, [19] discussed the merits and demerits of MANETS and recent developments with applications in ad hoc networks. Ravindra et al, [15] proposed the mechanism of link failure prediction. This performs local route repair if the signal strength is below the threshold value. The method is suffering from route re- building time. DiaaSalama, et al, [7] proposed energy consumption of different common symmetric key encryptions on handheld devices. It is found that after only 600 encryptions of a 5 MB file using Triple-DES the remaining battery power is 45% and subsequent encryptions are not possible as the battery dies rapidly.

The research in the domain of data compression is very vast and their basic philosophy is to provide an environment for secured and efficient usage of limited resources which are to be consumed optimally and hence to minimize the size of data being stored or communicated. The data compression concept results in effective utilization of available storage area and communication bandwidth, and hence numerous approaches were developed which suits to different applications. The data compression techniques can be classified into lossy and lossless compression techniques. The lossless compression method results in no information loss due to

decompression whereas lossy compression results in information loss during de-compression. But, the Lossy compression techniques achieve a high compression ratio that may exceed 70:1 while preserving the quality of reconstructed data. Otherwise, lossless achieves a less compression ratio compared with lossy that can reach up to 3 or 4 times of original data. The benefit of lossy over lossless is to decrease encoding/decoding time, energy usage in case of power constrained applications and increase in compression ratio.

The MANETs have has gained a wide attention on such networks which have been used for many applications such as military, traffic surveillance, security monitoring, health care, machine failure diagnoses, chemical and biological detection, plant monitoring, agriculture and transportation. Compared to conventional wired networks and scalar data Wireless Sensor Networks (WSNs), MANETs encounter more problems due to their limited resources in memory, processing, bandwidth, complexity, and power consumption. As a result of massive data being transmitted over MANETs, more power dissipation per each node, and consequently data compression are needed to decrease data size.

Power consumption is the main performance metric in MANETs as it would affect the QoS metrics too. It is observed that the multimedia data requires massive storage space and large bandwidth that consumes more and more power. Transmission power is required for MANETs nodes to manipulate visual flows, and energy-aware compression algorithms that reduce network life time. Therefore, adjusting processing complexity, transmission power reduction and minimizing data size will save the energy that represents the main performance criteria in compression based MANET systems.

The data compression techniques are generally designed based on either transformation or non-transformation. The Transform based techniques are based on converting input vector X through some transform function f into another form Y which is less correlated than X. The DCT [14] is the most widely used transform coding technique and the well-known compression scheme based on DCT is JPEG standard [21]. The Discrete Wavelet Transform (DWT) [1] represents a signal with good resolution in time and frequency using a set of basis-functions called wavelets. There exists several data compression techniques which explore DWT. The Non-transform based techniques are based on vector quantizer as quantization process in lossy compression techniques has two types of quantizers namely scalar quantizer and vector quantizers [23].

The dictionary based coding approaches find useful in situations where the original data contains more repeated patterns. When a pattern comes in the input sequence, they are coded with an index to the dictionary. When the pattern is not available in the dictionary, it is coded with any less efficient approaches. It can be divided into two classes such as frequently and infrequently occurring patterns. This method will be efficient by considering shorter code- word for frequently occurring patterns and vice versa. The two types of available dictionaries are static and dynamic dictionary. Static dictionary is useful when the prior knowledge of source output is available. When the prior information of the original data is not available, dynamic dictionary will be used. Lempel–Ziv algorithm (LZ) is a dictionary based coding technique commonly used in lossless file compression. This is widely used because of its adaptability to various file formats. It looks for frequently occurring patterns and replaces them by a single symbol. It maintains a dictionary of these patterns and the length of dictionary is set to a particular value. This method is much effective for larger files and less effective for smaller files. In the year 1977 and 1978, two versions of LZ were developed by Ziv and Lempel named as LZ77

[24] and LZ78 [25]. These algorithms vary significantly in means of searching and finding matches. LZ77 algorithm basically uses a sliding window concept and searches for matches in a window within a predetermined distance back from the present position. LZ78 algorithm follows a more conservative approach of appending strings to the dictionary. Lempel–Ziv-Welch (LZW) is an enhanced version of LZ77 and LZ78 which is developed by Terry Welch in 1984 [22]. The encoder constructs an adaptive dictionary to characterize the variable-length strings with no prior knowledge of the input. The decoder also constructs the similar dictionary as encoder based on the received code dynamically. UNIX compress, GIF images, PNG images and others file formats use LZW coding whereas LZ77 is used in Gzip and ZIP. We have seen the compression based algorithms such as [17, 18] which explore LZW and its variant in order to achieve efficiency in energy resource utilization and thereby increasing the lifetime of MANETs.

Oswald and Sivaselvan [11] utilized data mining tools in the domain of text compression. Here, Huffman coding is enhanced by the combination of frequent item-set mining (FIM). It is based on the idea assigning shorter code-words to repeatedly occurring patterns. (Oswald and Sivaselvan, [11] used a graph-based method to mine sequence of characters involved in the compression process. This method constructs a graph in once pass of the text and mine all patterns which are mandatory for compression in one pass of the graph. Oswald and Sivaselvan, [11] further modified the FIM based Huffman coding technique using hash table (FPH2) to compress text in the process of frequent pattern counting. Optimal set of patterns is used in FPH2 while character based approach is involved in traditional Huffman coding. This method is tested against a set of 19 benchmark dataset and the results are compared with gzip, LZW, LZSS and FP Huffman in terms of compression ratio.

Thus, we have seen that the research in the field of MANETs to enhance the lifetime is partly due to integration of compression methods with routing techniques too. In our work, we have adopted a text based compression method called frequent mining based Huffman coding integrated with a routing protocol to design an energy efficient MANET system which also is found to be non-vulnerable to attacks due to data security.

III. PROPOSED METHODOLOGY

The proposed methodology workflow is as follows:
The SOURCE is the node here and before transmitting the data over the identified route, the node compress the data and subsequently transmit the data based on the identified routing protocol. The details of compression algorithm explored in our work is presented below.
[SOURCE - <data>] → compressor → transmitter →

de-compressor →[DESTINATION - <data>]

Fig. 1. The MANET system.

A. FREQUENT PATTERN MINING BASED HUFFMAN ENCODING ALGORITHM.

A novel frequent pattern mining based Huffman Encoding algorithm for text data is integrated with the MANET system. The algorithm employs a hash table in the process of frequent pattern counting and operates on pruned set of frequent patterns and also is efficient in terms of database scan and storage space by reducing the code table size. Optimal (pruned) set of patterns is employed in the encoding process instead of character based approach of conventional Huffman.

The proposed algorithms works on the principle of mining frequently occurring and lengthier patterns from the input text **T** thereby using them to encode the text in an optimal manner. The approach has two phases. Phase 1 concentrates on mining frequent patterns with their absolute frequency and phase 2 focuses on frequent patterns with their modified counts. Input text **T** is stored in a hash data structure with separate chaining, which minimizes the time to generate patterns in an efficient way. The size of the Hash Table is 128 ASCII characters, which are arranged in an ascending order to access the characters in the Hash Table in an efficient way. ASCII values are taken as keys, for the location of 1-length characters. **T** is scanned once and the indices of the characters are added to their respective separate hash chains. The FPH2 strategy is explained in *algorithm* and the overall flow of the work is given in Figure 2. The method performs efficient compression by assigning shorter codes to frequently occurring patterns which are phrases and longer codes to infrequent patterns. This greatly reduces the size of the encoded text when compared with other approaches. The approach prunes patterns which are not useful in the encoding method, thereby reducing the size of the code table significantly.

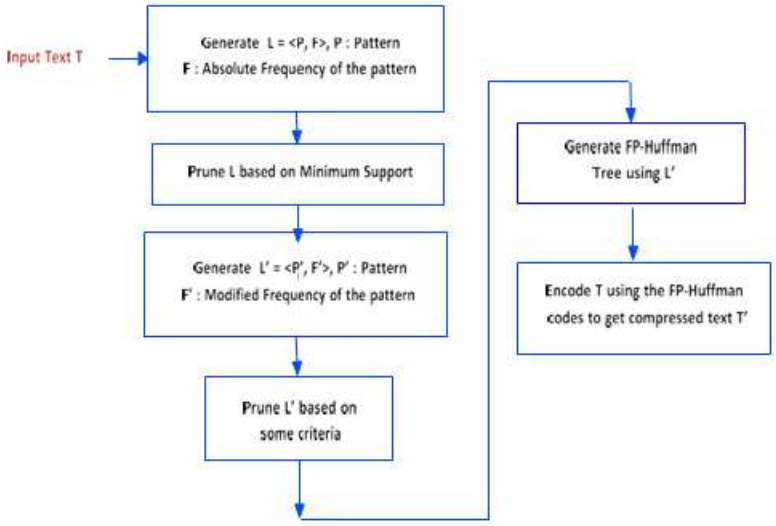

Fig. 2. Flow diagram of frequent pattern mining based Huffman coding technique.
(Courtesy- Oswald and Sivaselvan, 2018 [11]).

Algorithm: Frequent Pattern Mining based Huffman Encoding Method
Input: An input text, T and
Output: Compressed Text T′, Root of the Huffman Tree
Method:
1. Create a hash table for the input text (HT)
2. Generate patterns using modified
apriori algorithm (P)
3. Generate modified frequency and add patterns to P′ (P′)
4. Initialize the code to NULL and
5. Store the codes in code table and update the root using P′.
6. Encode T using the code table (T′)
7. Return the root and T′

It is noted that the compression ratio of FPH2 algorithms achieves high compression ratio, encoded size with a compression efficiency of 18–751% in FPH2 spanning across both sparse and dense benchmark datasets.

B. INTEGRATION OF FPH2 WITH MANET SYSTEM

The Media Access Control (MAC) layer is a sub layer of the data link layer which is responsible for providing reliable service to upper layers for the point-to-point connections established by the physical layer. The MAC sub layer interfaces with the physical layer and is represented by the protocols that define how the shared wireless channels are to be allocated among a number of mobiles. In MANETs, in order to enhance the network life time, the usage of relays has been employed. Relays helps in the transfer of packets from source to destination which can be separated by some considerable distance. Usage of relays can help in the reduction of overhead caused by the complications involved in MAC and hence the transmission efficiency of nodes will be enhanced. By considering the overheads and interference due to cooperation, as well as the energy consumption on both transceiver circuitry and transmit amplifier, DEL-CMAC

[13] is proposed which can significantly prolong the network lifetime. A distributed energy-aware location- based best relay selection strategy is incorporated, which is more reasonable for MANETs comparing with the existing schemes based on channel condition. For a desired outage probability requirement, a cross layer optimal transmitting power allocation scheme is designed to conserve the energy while maintaining certain throughput level. The main aim in usage of DEL-MAC protocol is to increase the network life time.

The EC-MAC (Energy Conserving-Medium Access Control) protocol [5] on the other hand, was developed with the issue of energy efficiency as a primary design goal. The EC-MAC protocol is defined for an infrastructure network with a single base station serving mobiles in its coverage area. This definition can be extended to an ad hoc network by allowing the mobiles to elect a co-coordinator to perform the functions of the base station. At the start of each frame, the base station transmits the frame Synchronization message (FSM) which contains synchronization information and the uplink transmission order for the subsequent reservation

phase. During the request/update phase, each registered mobile transmits new connection requests and status of established queues according to the transmission order received in the FSM. In this phase, collisions are avoided by having the base station that send the explicit order of reservation transmission. New mobiles that have entered the cell coverage area register with the base station during the new-user phase. Here, collisions are not easily avoided and hence this may be operated using a variant of Aloha. This phase also provides time for the base station to compute the data phase transmission schedule. The base station broadcasts a schedule message that contains the slot permissions for the subsequent data phase. Downlink transmission from the base station to the mobile is scheduled considering the QoS requirements. Likewise, the uplink slots are allocated using a suitable scheduling algorithm.

Energy consumption is reduced in EC-MAC because of the use of a centralized scheduler. Therefore, collisions over the wireless channel are avoided and this reduces the number of retransmissions. The mobile receivers are not required to monitor the transmission channel as a result of communication schedules. The centralized scheduler may also optimize the transmission schedule so that individual mobiles transmit and receive within contiguous transmission slots. The priority round robin with dynamic reservation update and error compensation scheduling algorithm described in provides for contiguous slot allocation in order to reduce transceiver turnaround. Also, scheduling algorithms that consider mobile battery power level in addition to packet priority may improve performance for low-power mobiles. The frames may be designed to be fixed or variable length. Fixed length frames are desirable from the energy efficiency perspective. The power allocation is important in the proposed scheme, and hence optimal power allocation can be done. The above scheme can be done by using either by direct transmission or by cooperative transmission. The main sources of power consumption, with regard to network operations, can be classified into two types: communication related and computation related. The communication involves usage of the transceiver at the source, intermediate and destination nodes. The transmitter is used for sending control, route request and response, as well as data packets originating at or routed through the transmitting node. The receiver is used to receive data and control packets – some of which are destined for the receiving node and some of which are forwarded. Hence, we proposed to integrate the data compression technique is used along with EC-MAC protocol. By using compression technique, packets loss is reduced. The compressed data is delivered to destination with the short span of time. The destination uses an EC- MAC FPH decompression technique to decompress the received original data. For example 40MB is decompressed to 90MB. As a result the destination gets the original data without any loss in the fastest and safest delivery. So the nodes use lesser energy level to transmit the data and gains more energy. In the proposed system, FSH data compression technique is used along with the EC- MAC protocol, which is the extension of DEL-CMAC protocol. Source node compress the sending data using FSH compression technique, which results in fastest delivery of high bits of data in short span of time that seems to increase the node energy level. After the completion of data transmission process, it decompress the data and retrieve the original data, and each node calculates its remaining energy level and energy consumption, by analyzing those energy levels; we can evaluate the performance of the network life time. Since, the FSH compression achieves higher compression ratio when compared to other recently proposed compression techniques such as Huffman Encoding, LZ77, LZW, GZip, RAR, etc, we could achieve greater energy gain and hence results in increased lifetime of the MANET system which is revealed in Figures 3, 4 and 5 respectively on alphabet corpus, adult corpus and census corpus of textual data.

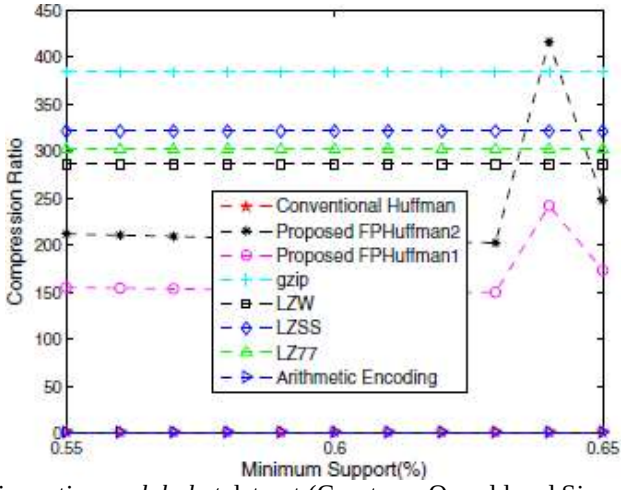

Fig. 3. Compression ratio on *alphabet* dataset (Courtesy- Oswald and Sivaselvan, 2018 [11]).

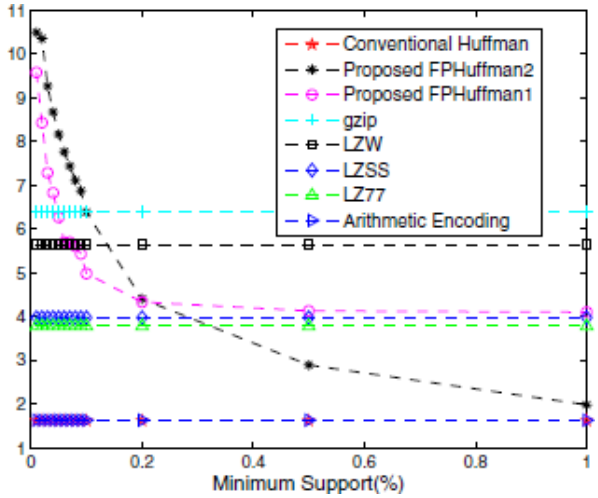

Fig. 4. Compression ratio on *adult* dataset (Courtesy- Oswald and Sivaselvan, 2018 [11]).

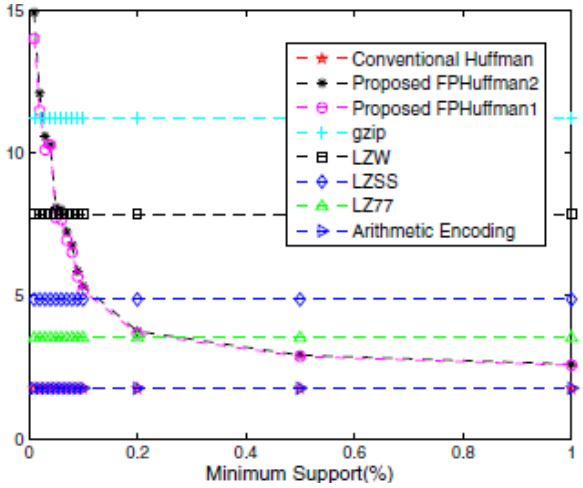

Fig. 5. Compression ratio on *census* dataset (Courtesy- Oswald and Sivaselvan, 2018 [11]).

We have integrated the Oswald and Sivaselvan (2018) compression method with the MANET system and the experiments are conducted considering the standard set-up and also compared with some of the recently proposed compression based MANET methods which addresses energy efficiency issue and also the lifetime of MANET network. The details are provided in the following section.

IV. EXPERIMENTAL RESULTS

In order to evaluate the energy efficiency in MANET system, the performance of the proposed work is simulated using Global Mobile Information System Simulation (GloMoSim). It is a scalable simulation environment. For larger wireless network systems, we use parallel discrete event simulation capability provided by C based Parallel Simulation Environment for Complex System (PARSEC). The proposed method is simulated considering the following parameters as shown in Table I.

Table-I: Parameters considered for experimentation.

Parameter	Value
Simulation area	2000 X 2000
Number of Nodes	200
MAC Protocol	802.11
Transport layer	UDP and TCP
Traffic Generator	CBR
Mobility	Random way point
Node placement	Random

Routing Protocol	AODV
Simulation time	500s
Bandwidth	2 Mbps

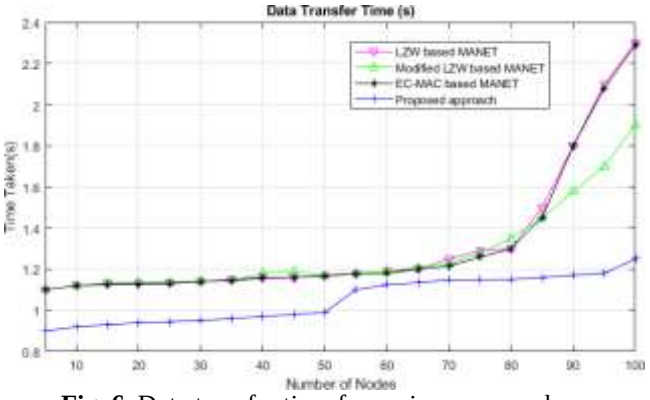

Fig. 6. Data transfer time for various approaches.

In Figure 6, we have presented the time consumed by various approaches. Here, the numbers of nodes through which the text is transferred is plotted in the x- axis, whereas time taken ("seconds") to transmit the specified data from the source node to destination node is plotted in the y-axis. With the implementation of LZW compression algorithm [17], it is observed that the time taken to transmit data packets is much higher. The MLZW algorithm [17] requires little bit less time compared to LZW algorithm. On the other hand, the proposed algorithm consume less time when compared to either LZW or MLZW based approaches. The comparative analysis is also provided with EC-MAC based approach [18] and the consolidated experimental analysis on the time taken by each method along with varying number of nodes is presented in Figure 6. It shall be observed from Figure 5 that the time consumed by the proposed approach is less than LZW based and modified LZW based approaches.

We have presented in Figure 7, the energy consumed by different approaches. The number of nodes through which the text data is transmitted is plotted in the x-axis, whereas power consumed (in "Milli-Watts") in transmitting the specified data is plotted in the y-axis. Different data packets, of different sizes are sent through the different nodes in the network. The power consumed for transmitting the data from the source to destination is noted down. It is observed that when the original data bits are transmitted without any compression, it requires more power. By using LZW and MLZW algorithms [17], the power required to transmit the data is less. The EC-MAC algorithm [18] produces almost the same result as produced by the LZW based method. The energy consumed due to the proposed approach is much higher than any of these methods and hence, we claim that the proposed approach is quite useful in energy minimization thereby increase in the network lifetime of MANET.

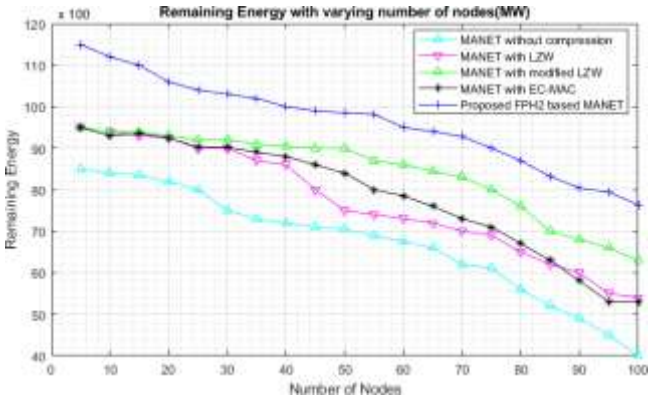

Fig. 7. Residual energy with varying number of nodes due to data transmission.

V. CONCLUSIONS

In this work, we have presented an efficient energy usage model in MANET and we have made an attempt to come out with one such approach based on image compression. The frequent pattern mining based Huffman coding technique is explored for data compression as it is found to be one of the best text data compression technique in the recent days. The compressed information is transmitted in the network and hence

we integrated with MAC layer protocol to achieve the same. Experimentation is conducted by considering the standard simulated networked environment exhibit the performance of the proposed method. The standard metrics such as energy consumption and time to packet delivery are presented to exhibit the performance of the proposed method. A comparative analysis is carried out with the recently proposed LZW compression variant models and EC-MAC method to reveal the accuracy and energy efficiency of the proposed method. In our future work, we planned to explore the multimedia based compression technique along with a mechanism to avoid attacks to the MANETs.

REFERENCES

[1]. Akansu, Ali N., Haddad, and A. Richard. (1992). Multi-resolution Signal Decomposition: Transforms, Sub-bands, Wavelets. San Diego: Academic Press. ISBN 978-0-12-047141-6.

[2]. Anagnostopoulos, C., T. Anagnostopoulos, and S. Hadjiefthymiades. (2010). An adaptive data forwarding scheme for energy efficiency in wireless sensor networks. In Proceedings of IEEE Conference on intelligent Systems. 396–401.

[3]. Bednarczyk, W. and P. Gajewski, (2013). An enhanced algorithm for MANET clustering based on weighted parameters," Universal Journal of Communications and Network, vol. 1, no. 3, pp. 88– 94.

[4]. Choi, W. and M. Woo, (2006). A distributed weighted clustering algorithm for mobile ad hoc networks, In Proceedings of the IEEE Advanced International Conference on Telecommunications and International Conference on Internet and Web Applications and Services (AICT/ICIW '06), pp. 1–6.

[5]. Chuang PJ., and Lin CS. (2007) Energy-Efficient Medium Access Control for Wireless Sensor Networks. In: Lee YH., Kim HN., Kim J., Park Y., Yang L.T., Kim S.W. (eds) Embedded Software and Systems. ICESS 2007. Lecture Notes in Computer Science, vol 4523. Springer, Berlin, Heidelberg.

[6]. Dagdeviren O., Erciyes K., and Cokuslu D. (2005) Merging Clustering Algorithms in Mobile Ad Hoc Networks. In: Chakraborty G. (eds) Distributed Computing and Internet Technology. ICDCIT 2005. Lecture Notes in Computer Science, vol 3816. Springer, Berlin, Heidelberg.

[7]. DiaaSalama, Hatem Abdual Kader, and Mohiy Hadhoud, (2011). Studying the effects of Most Common Encryption Algorithms", International Arab Journal of e-Technology, Vol. 2, No. 1.

[8]. Kargupta, H., W. Huang, K. Sivakumar, and E. L. Johnson. (2001). Distributed clustering using collective principal component analysis. Knowledge and Information Systems 3, 4, 422–448.

[9]. Lee, H., A. Klappenecker, K. Lee, and L. Lin. (2005). Energy efficient data management for wireless sensor networks with data sink failure. In Proceedings of IEEE International Conference on Mobile Ad-hoc and Sensor Systems 7, 210.

[10]. Nishani, L., and Biba, M. (2016). Machine learning for intrusion detection in MANET: a state-of-the-art survey. J Intell Inf Syst 46, 391–407. https://doi.org/10.1007/s10844-015-0387-y.

[11]. Oswald, C., and Sivaselvan, B. (2018). An optimal text compression algorithm based on frequent pattern mining. J Ambient Intell Human Comput 9, 803–822. https://doi.org/10.1007/s12652-017-0540-2.

[12]. Piyalikar, Pritam Kar, Mrinal Kanti Deb Barma, Forecast, (2016). Weighted Clustering in MANET, Proceedia Computer Science, Vol. 89, pp. 53-260, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2016.06.054.

[13]. Priyanka Das, and Veena A. Gulhane, (2015). DEL-CMAC Protocol together with Cross-Layer Cooperative Diversity Approach to Improve the Network Lifetime of MANET, International Journal of Scientific & Engineering Research, Volume 6, Issue 4, 814-821.

[14]. Rao, K., and Yip, P.: Discrete Cosine Transform, Algorithms, Advantages, Applications. Academic Press, London, 1990.

[15]. Ravindra .E, VinayaDatt V Kohir and V. D Mytri, (2011). A Local Route Repair Algorithm Based On Link Failure Prediction In Mobile Ad Hoc Network, World Journal of Science and Technology.

[16]. Ren, F., J. Zhang, Y. Wu, T. He, C. Chen, and C. Lin. (2013). Attribute-aware data aggregation using potential based dynamic routing in wireless sensor networks. IEEE Transactions on Parallel Distributed Systems 24, 5, 881–892.

[17]. Ruxanayasmin, B., B.Ananda Krishna and T.Subhashini, (2013). Implementation of Data Compression Techniques in Mobile Ad hoc Networks", International Journal of Computer Applications, Volume 80, No. 08.

[18]. Shafna and S. Pathur Nisha. (2014). Enhancement of Energy and Network Lifetime of MANETs through EC-MAC Protocol, International Journal of Science and Research (IJSR), vol. 3(4), 275- 278.

[19]. Subirkumar S, T.G. Basavaraju, C. Puttamadappa, (2007). Ad hoc mobile wireless networks, Principles, Protocols and Applications", Auerbach Publications, Boston, MA, USA.

[20]. Sunho, L., Chansu, Y., and Das, C. R. (2009). RandomCast: an energy-efficient communication scheme for mobile ad hoc networks. IEEE Transactions on Mobile Computing, 8, 8, 1039- 1051.

[21]. Wallace, G.K: The JPEG Still Picture Compression Standard.

[22]. Comm. of the ACM 34(4). 1991
[23]. Welch, Terry (1984). A Technique for High-Performance Data Compression, Computer. 17 (6): 8–19. doi:10.1109/MC.1984.1659158.
[24]. Wu, Z., and Yu, J. (2019). Vector quantization: a review. Frontiers of Information Technology and Electronic Engineering, 20, 507– 524. https://doi.org/10.1631/FITEE.1700833.
[25]. Ziv J, and Lempel A (1977) A universal algorithm for sequential data compression. IEEE Transactions on Information Theory, 23(3):337–343.
[26]. Ziv J, and Lempel A (1978) Compression of individual sequences via variable rate coding. IEEE Transactions on Information Theory, 24(5):530–536.