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An Efficient Power Reduction Mode in Mobile Ad hoc Networks to Reduce the Power Consumption Levels for Improving the QoS

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ABSTRACT
In current conditions, where improvement in technology is increasing, power optimization is a serious concern and mobile conditions are perceived. The goal is to create an effective system to lower energy usage and improve other metrics' efficiency. With the add-on of various remote access mechanisms, heterogeneous wireless systems can control in the next generation wireless networks. A Mobile Adhoc NETworks (MANET) is a network that consumes a considerable amount of energy while binding with other neighbouring nodes within its scope, data transfer and retrieval. Limited battery life is a significant constraint in mobile ad-hoc systems. It is not always possible to reload / substitute a mobile node. Power consumption occurs during data transmission, receipt, mobility and so on. Strom failure affects the entire network life, leading to loss of efficiency. In order to achieve power conservation, several research projects have been proposed. As most mobile hosts use a limited resource battery, the capabilities of a node are limited. In this paper we address the energy consumption reduction models which can be accomplished by algorithms and minimized connection failures. A large number of computational resources including CPU time, battery power, and memory consume the cryptographic / compression algorithms. With a suitable rate, CPU and memory usability increase, but battery technology is slowly moving up. Battery gap is created by the issue of the slower increase in technology. In view of battery usage, the design of effective and reliable protocols for wireless devices should consider how encryption techniques influence battery power consumption with and without data transmission. Furthermore, due to the high mobility of nodes, connection failures play a key role in energy consumption. In this paper, an effective power consumption reduction strategy with Power Reduction Mode (PRM) is introduced that improves the system performance levels by reducing the energy utilization of nodes when they are idle.

KEYWORDS
Network Capabilities, Energy Efficiency, Cryptography Functions, Connection Failures, System Performance, Node Energy Consumption Levels, Power Reduction Mode.

Introduction

In a future computer world consisting of the infrastructure and mobile networks without infrastructure, mobile devices combined with wireless network interfaces will become central. The IEEE 802.11-based wireless local area network is the most popular mobile infrastructure network, where a mobile node interconnects to a fixed base station, thus confining a wireless connection to a single hop between the node and the base station. MANET is a multihop network without infrastructure that communicates, directly or indirectly, with other nodes through intermediates. Therefore, all nodes in a MANET work essentially as mobile routers involved in some of the routing protocols needed to decide the routes.

As MANETs are infrastructure-free, self-organizing, and fast to deploy wireless systems, they are highly suitable for special-access applications such as outdoor communications, wireless infrastructure communications, emergency and natural disaster communications, and military operations. The highly complex and diffuse design of routing is one of the main problems in MANETs. The most important design criteria for MANETs can particularly be energy-efficient routing, since mobile nodes are operated by batteries with small capacity. A mobile node power failure affects the node itself as well as its capacity, on behalf of others, to forward packets and therefore its overall lifetime to the network. This is why a large amount of research has been done to create energy conscious routing protocols.

A mobile ad hoc network combines moving mobile nodes which constitute a temporary network without any central admission or infrastructure, such as a point of access or base stations. The word "ad hoc" is of Latin origin and is "for this reason," which in this case means the network is easy to uninstall (in-the-spot) under special circumstances. All moving knots co-ordinate with each other in MANETs to facilitate communication and to manage routing and resources. This means that each MANET node needs to be smarter so that it can be transmitted as a sender, receives data from another master sender, receives the original message and can be used as a router in which packets can be

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sent to other nodes.

MANETs are very complex, distributed and nodes often operated by batteries with limited power sources; energy usage is therefore a key problem with MANETs, causing often node failures that can impact the network as a whole. If one node runs out of electricity, the chance of network separation increases; consequently, to extend MANET lifetime, we need to consider energy-efficient ways of reducing network energy usage, such as advertising the remainder of a node's energy, which will prevent energy depletion and minimise the risk of grid separation. The structure of a MANET is represented in Figure 1.

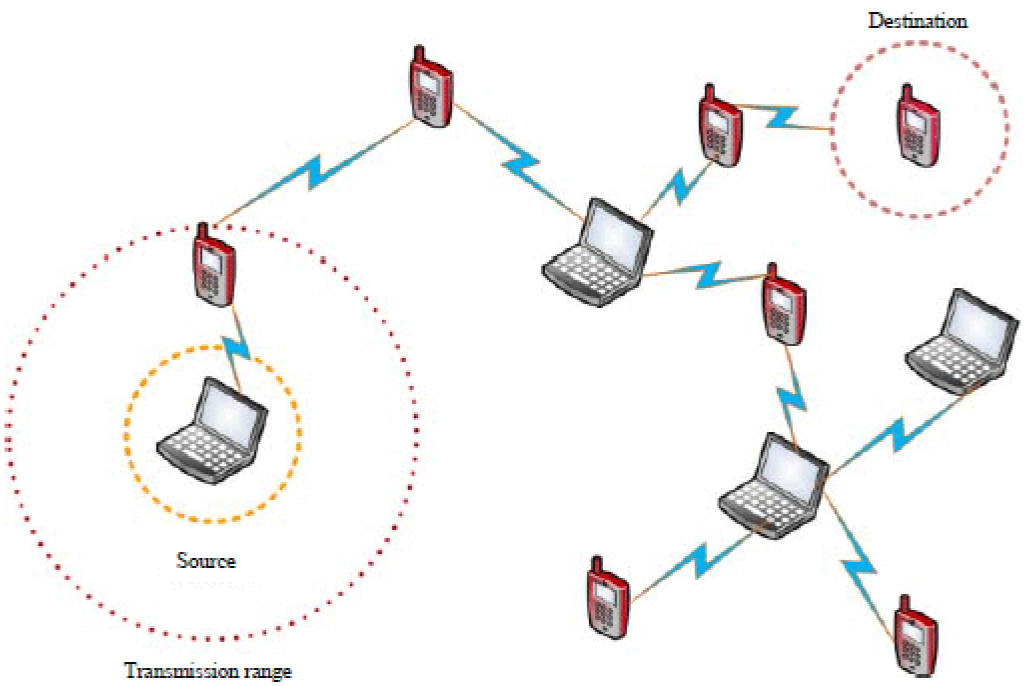

Fig. 1. MANET Structure

The main ways to increase the node's life include efficient battery management, power transmission control and power system management. The management systems handle energy resources by controlling the early exhaustion of the battery, adjusting transmission power to determine the right node power level, and integrating low-energy techniques into the protocols. The most popular metrics used for assessing protocols for ad hoc routing are the shortest hop, the fastest time and local stability. However, these indicators can be negatively affected by MANETs because they lead to a limited group of nodes, decreased nodes and decreased network existence over usage of energy resources. The energy efficiency of a node is determined by the number of packets in a given amount of energy supplied by a node.

There are some explanations for MANET energy management:

- Ad hoc networks have been designed to communicate with an environment that cannot deploy fixed infrastructure.
- Ad hoc networks' nodes have very small battery-powered energy resources.
- It is very difficult, or almost impossible to replace or recharge the battery, in so many cases as in the hostile territory.
- For ad hoc networks as the base station in cellular networks, there is no central coordinator.

Ad hoc networks therefore operate on the principle of multi-hop routing in which intermediate nodes play a role. When the relay traffic is very strong, it quickly depletes the node and if the traffic on a node contributes to network division. If the battery size is very small, the node life will be reduced and if the node's battery size is high, the moving node will increase the weight. Energy management strategies are essential to use it effectively, in order to maintain the standard small battery capacity. The selection of a packet's optimum value is difficult because, as this power increases, battery usage increases but there is an improvement in connectivity. This increases the number of routes to the goal. The transmitting capacity should be selected so that battery power usage is reduced so that simultaneous packet transmission is maximised and communication is conserved.

The energy of the battery is considered an uncommon resource and often affects the contact between network nodes. Communication is made via direct links or multi-hop connections. The lifespan of the node becomes the main challenge to the low energy consumption of mobile nodes. Transmission power control greatly decreases energy usage for transmission of data packets and thus increases network life. The transmission power is adjusted according to the local information by nodes to achieve minimal energy consumption. Energy efficiency is determined by the length of time over which a network can sustain a certain level of output, commonly known as the new work life. The use of electricity usage is not just one condition for energy efficiency conservation. Therefore, it is distinct from minimal power routing to optimise the network's service life. Minimum energy routing attracts more flows as the nodes on this route quickly exhaust the energy. Therefore, since these nodes are failing, the entire network cannot accomplish many tasks. The path with maximum lifetime balances all routes and nodes globally so that those output levels can be maintained for a longer period. Therefore, it is necessary to save energy on broadcasting in order to recover from node failure and to re-route the failed node.

Literature Survey

Wireless data transmission energy consumption plays a major role in handheld wireless applications. It depends on context, i.e. on internal and external circumstances, such as the workload of applications and the intensity of the wireless signal. Santiago et al. [1] proposed an event based power management system for the communication of mobile devices. In line with the event-condition-action rule (ECA) defined by the developer to define the power management system, this structure adjusts the behaviour of a device or application to certain changes in contexts. It facilitates dynamic event processing by combining different events with the discovery of complex, energy-related events.

Local networking data is extremely significant in the creation and maintenance of road connections on mobile ad hoc networks. Periodic Hello messaging is a popular way to acquire information on local connectivity. However, if mobile devices are not used unnecessary messages will drain their battery power. Necip Gozuacik et al. [3] provides an interactive message system to remove unwanted messages with Hello until broken connections are detectable. The results of the simulation show that, without an explicit difference in performance, the proposal decreases energy consumption and overhead networks. This programme sets Hello intervals dynamically and does not raise the probability that a broken relationship will submit the packet. Average time gaps between two consecutive events are found to calculate the unavailability of links between nodes. The condition of a node can be calculated by tracking the event intervals.

Sang Hyun Park et al. [4] proposed in direct point-to-point wireless communication with the effects of ECC and packet loss and transmission power levels, and proposed a two-phase approach in order to optimise these two options to reduce transmission energy while complying with transmission error needs. The work to be carried out in the future is a network of energy efficient communication, which is the wording and approach to solving this basic issue. Algimantas Venckauskas et al. [5] utilized the New algorithm based on the Minimum Stone Tree. The nodes and transmission power at ideal and sleeper nodes are explained in this document. An energy contrast in MPCP and min-capacity routing is performed. Future work involves maximising machine life, reducing network dispute and estimating data rates.

Belghachi Mohamed et al. [7] introduced several energy-restrictive routing technologies in ad hoc mobile networks. The fundamental principle was that nodes with the least residual energy and the highest probability of showing a handicap should not be taken into consideration when forwarding the data packet in the network. Appiah t al. [11] suggested understanding how long the node lasts. The traffic route can be redirected, if necessary, to prevent nodes from failing because of sufficient energy. The author proposed a new battery-life prediction routing metric, i.e. energy drain rate, calculated using exponentially weighted moving average and estimated energy consumption per second.
Bakalis et al. [12] proposed a technique to improve the delay due to the resulting interconnection that enabled the

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discovery of the path. The power levels of the participating nodes were calculated using this methodology. During traffic transmission The node predecessor will be sent the alert message to determine the alternate route for forwarding the data packets to the destination node if the relevant node power level falls to a certain threshold value. The efficiency of the preventive routing DSR protocol was assessed. The threshold of the signal intensity is used for generating the alert node to discover the alternate route for the efficient delivery of data packs

Banerjee et al. [13] suggested that the router should be handled with a technique to weak the connection power. It is calculated by taking into account the power differential table and the power list which all the participating network node maintains. On the basis of the above, alert nodes decide the neighbour node that is reachable both from the source node and the target node to divert the data across the specific path, and a hand-off packet containing the address of the previous path and the following node to be used to perform the journey.

Hamzaoui et al.[15] proposed an optimal transmission range that is influenced more by the density of the node than by the area of the network. The optimum transmission ranges over the spectrum of node densities examined are observed when the path-loss exponent is four. However, with the rise in node density, the ideal transmission range decreases considerably when the pathless exponent is only two. The authors suggested a furious adaptive range of transmission and a fuzzy-based energy threshold for location-supported routing protocol. In this protocol, the energy of a mobile node is retained through the application of fugitive adaptive power controls according to the minimum number of neighbouring nodes to preserve network connectivity and powerful routing based on the fugitive energy threshold.

Proposed Model

The Power Reduction Model protocol is completely located in the network and activated when the network is established. This protocol is carried out because the source node has a good understanding of its neighbours and the location of the destination node. The metric used is the cost of the connection. If sender node S wants to connect with receiver node R it can decide on a 2-hop track by its neighbours. The source lacks the ability in the PRM protocol to identify the optimal route, but can choose the next hop which ultimately leads to a global power reduction. The key disadvantage is that electricity usage and latency are more directly related to indirect transmission. This is because if connection errors occur in path to direct transmission more transmissions will be generated.

MANET is a wireless mesh network in which every node is linked to every other node in a network. As a result, a node's failure does not affect the entire network's communication; rather, it affects communication to that specific node. Every node in a MANET performs packet transmission, packet forwarding, packet reception, and packet processing. As a result, it goes through three different states: sending, receiving, and sleeping. The amount of energy consumed by each state varies. The transmitting state consumes the most energy since the majority of the node's energy is lost in transmitting packets, which can be reduced using the methods described in the proposed model.

The receiving state absorbs energy as well, but at a lower rate than the transmitting state. The sleeping state is also known as dozing or listening state. It can listen to the channel but not send or receive any signals from other nodes while in this state. In certain networks, a wakeup message is sent to wake up the node from its sleep. Power management is a power-saving technique in which a node switches between active and deactive states to minimise power consumption and extend the network's life. If all of the nodes are on the same clock, the power management technique is simple. Since nodes can join and leave the network at any time, maintaining synchronisation between all nodes is impossible in MANET. Asynchronous networks are known as MANETS. Power management in asynchronous networks is a challenging job.

The process of managing the energy sources and consumers in the node or the network as a whole is known as the process in order to improve the network's lives. Shaping the node's battery's energy discharge pattern to maximise its battery life, identifying routes leading to minimal energy consumption across the network, using a distributed scheduling scheme in order to increase battery life, and using the processor and interface devices to reduce electricity consumption are some of the energy management functions. The proposed PRM model initially verifies the routing process, the nodes involved in routing and then activate or deactivate the nodes based on their responsibilities. The node if idle will enter into deactivated state which does not require any power until it is activated after a threshold time interval. The process of PRM algorithm is explained here.

Algorithm Power Reduction Mode (PRM)
{
Step-1: Initially calculate the energy levels of all the nodes involved in routing and initiate the routing process.
Step-2: Assign a Threshold Energy Level (TEL) in which if the threshold value is reached by any node, it will be deactivated or its task is immediately completed to avoid failures in the network.
Step-3: Every node is allotted a time slot in which the node has to complete its task in that specified time and then enters into deactivated mode and the node will be in that state for the threshold time interval. This process is repeated for all the nodes to avoid power consumption.
Step-4: Each node energy levels are calculated as
EL(N(i)) = Allotted Energy Level (AEL)- Remaining Energy Level (REL)
If EL(N(i)) > TEL
{
Step-5: Sender nodes transmits the data packets to the neighbour node based on routing table up to a specific time interval and the sender node enters into de activated mode.
Step-6: The neighbour node will transmit the packets to its neighbour node upto specific time interval and enters into deactivated mode.
Step-7: The node that performs key generation will generate the keys and then deactivated for a threshold time interval.
Step-8: The node that detects the malicious activities only will be in activated mdoe till the communication is completed.
Step-9: After the threshold time is completed, the nodes again will be activated and the process of data transmission, key generation will be continued.
Step-10: The PRM verifies the nodes energy levels after every iteration and the Step-4 is performed.
}
Else
{
Complete the task of the node N(i) and remove the node from the communication.
}
}

The energy used in the network is largely affected by PRM algorithm. The energy model evaluates the nodes' energy consumption. Furthermore, the user-defined energy model allows the user to determine the threshold value in order to limit the usage of resources. The battery model presents a summary of the node operation period and the residual battery charge for the nodes connected to it. Power Reduction Mode uses the time frames to store information about a power-saving station. The access point broadcasts the lightning frames containing the node address for which the data is stored.

Results

MANET devices work with restricted CPU capabilities, battery life constraints, insufficient bandwidth support, limited storage, etc. In MANETs, the nodes can also move freely and only communicate with their immediate neighbouring nodes (i.e., the nodes which are in its transmission range). However, it is undeniably possible that this random move often breaks contact ties. This leads to complex shifts in the topology of the network and hence to more complicated forwarding. Both nodes must, in addition, communicate on wireless networks with high error, reduced capacity and extremely restricted bandwidth. A node whose energy levels are less will have less computational capabilities and may cause node failures.

The proposed Energy Consumption Reduction model uses a Power Reduction Mode (PRM) implemented in NS2. The proposed model is used for improving the performance levels of the network. The parameters used in the simulation is depicted in Table 1. The proposed PRM mode is compared to the existing Energy Efficient Routing Model (EERM) in terms of Energy Consumed during Routing, Energy Consumed while encryption, Energy Consumed while Decryption, Energy Consumed during Key Generation, Energy Consumed for Malicious Node Detection, Total Energy Consumption Levels. The energy levels are considered in Joules in the proposed model.

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Table 1. Power Reduction Mode Parameters

Simulator Used	NS-2.31
Number of nodes	50
Dimension of simulated area	800m×600m
Routing Protocol	AODV
Simulation time	100
Traffic type	CBR(3pkts/s)
Packet size	512 bytes
Number of traffic connections	4 / 25
Node movement at maximum Speed (m/s)	random
Transmission range	250m
Threshold value	10 J
Transmit power	1.5 mJ
Receiving power	1.0 mJ
Idle power	.17 mJ
Sleeping power	.047 mJ

MANETS are made up of various devices that communicate using infrastructure that is built on the fly. Since human interference is not necessary in environments where these devices are used, such as the battlefield, emergency, and rescue operations, battery power must be effectively used to extend the life of each unit. There are several methods for reducing the amount of power used by network nodes. The energy levels consumed during the process of routing for both traditional and proposed models are indicated in Figure 2. The energy consumption of the proposed model is low when compared to the traditional method.

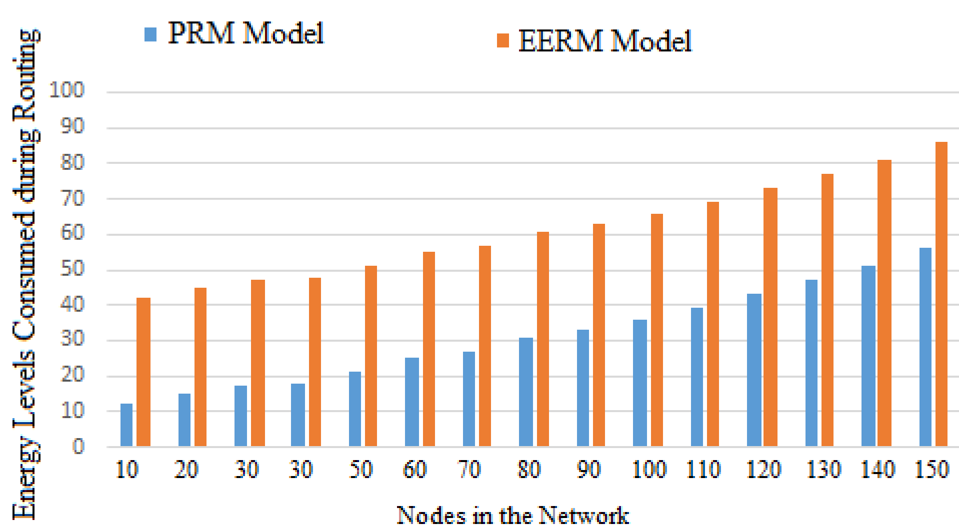

Fig. 2. Energy Consumed during Routing

The advent of battery-operated systems, energy efficiency has gotten a lot of attention from researchers. Since nodes in mobile ad hoc networks (MANETs) are battery-powered, energy efficiency is one of the most important design criteria. When a node's battery runs out, it loses its capacity to route traffic. This has a negative impact on the network's lifespan and results. The lifespan of a network can be extended by reducing power consumption and/or optimising the battery power of each node. The proposed and current methods' energy consumption levels during the

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encryption process are depicted in Figure 3.

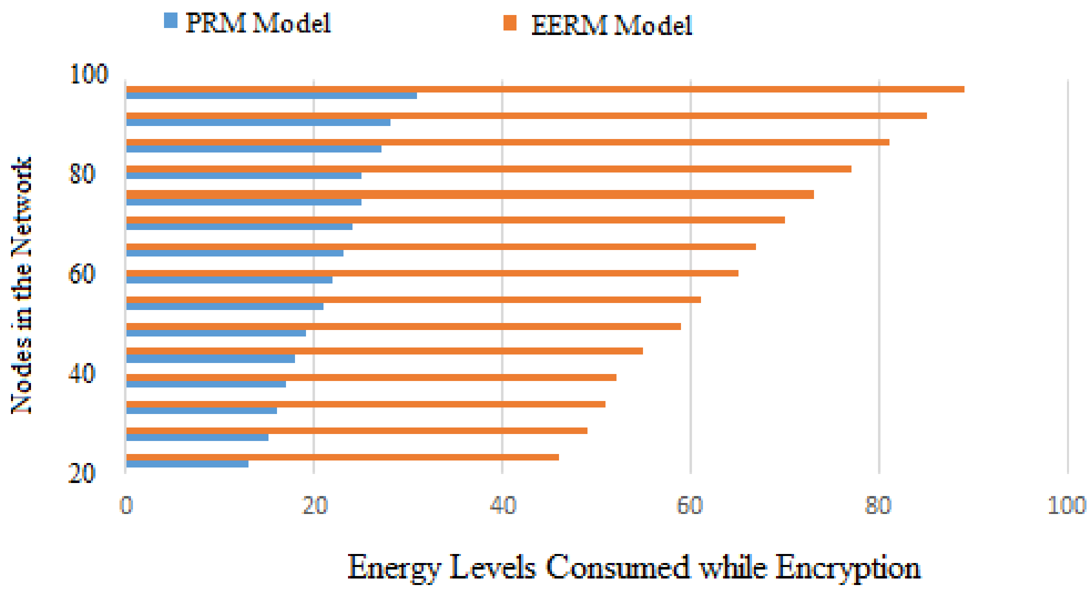

Fig. 3. Energy Consumed while Encryption

The majority of the mobile nodes are powered by a battery. Battery replacement or recharging is not possible in some applications. When the battery runs out, the unit stops working. Since the battery capacity is reduced, certain energy conservation techniques must be used to extend the device's lifetime. The energy consumption levels during the decryption process of the proposed and existing methods are represented in Figure 4.

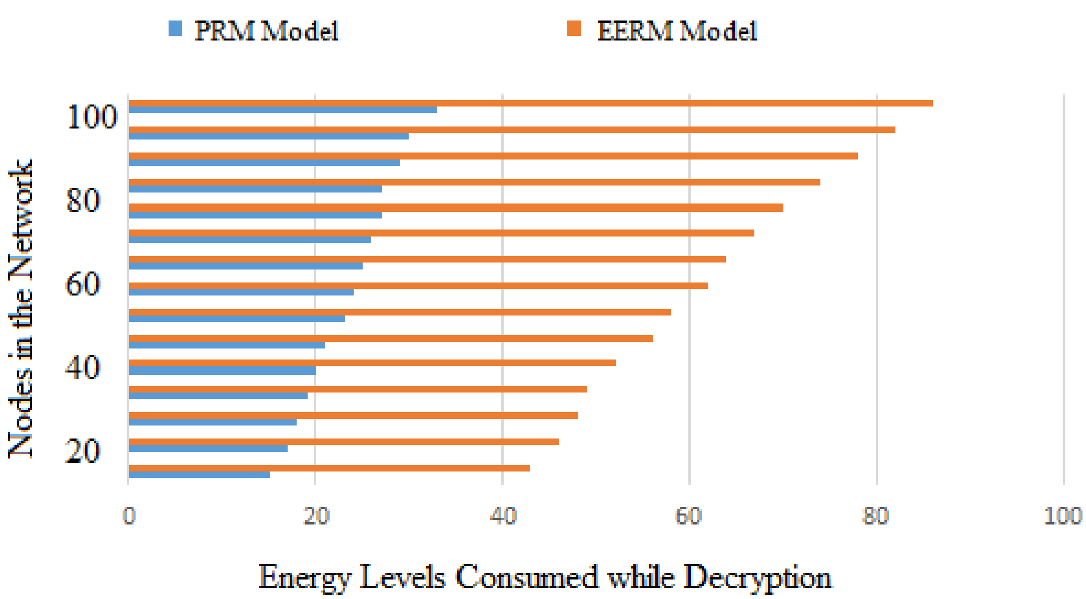

Fig. 4. Energy Consumed while Decryption

Since most mobile nodes have limited battery resources, energy consumption is a major concern in mobile ad hoc wireless networks. Existing models for assessing power usage in a MANET have shown that the different components of energy-related costs involve both transmission and reception capacity. The energy consumption levels during the key generation process of the proposed and existing methods are represented in Figure 5.

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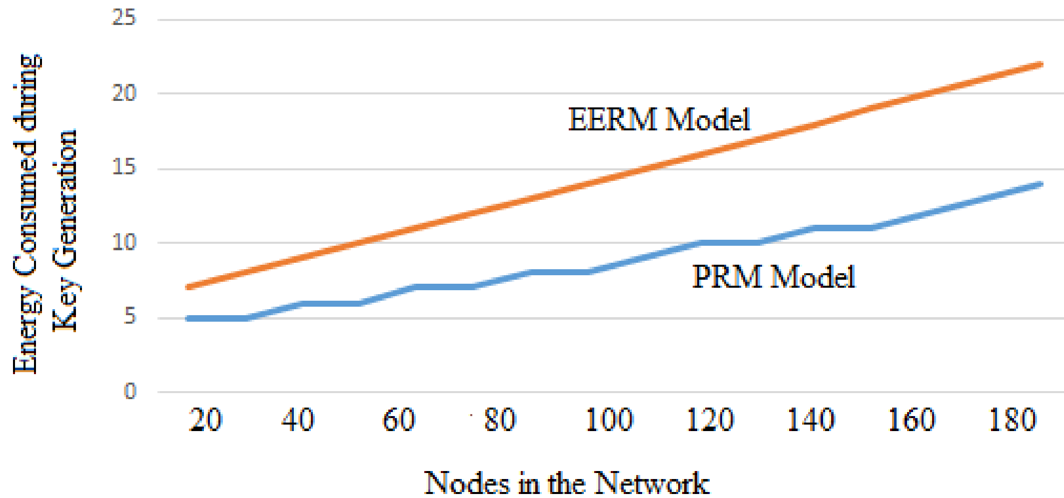

Fig. 5. Energy Consumed during Key Generation

Optimization of power consumption has a greater effect on MANETs since it directly correlates to network lifespan. Transmission and reception power are two factors that contribute to the network's energy consumption. Power consumption can be minimised at the system level, at the transmission level, or by the use of a power conscious routing protocol or another power management technique. The proposed and current methods' energy consumption levels during the malicious node detection process are depicted in Figure 6.

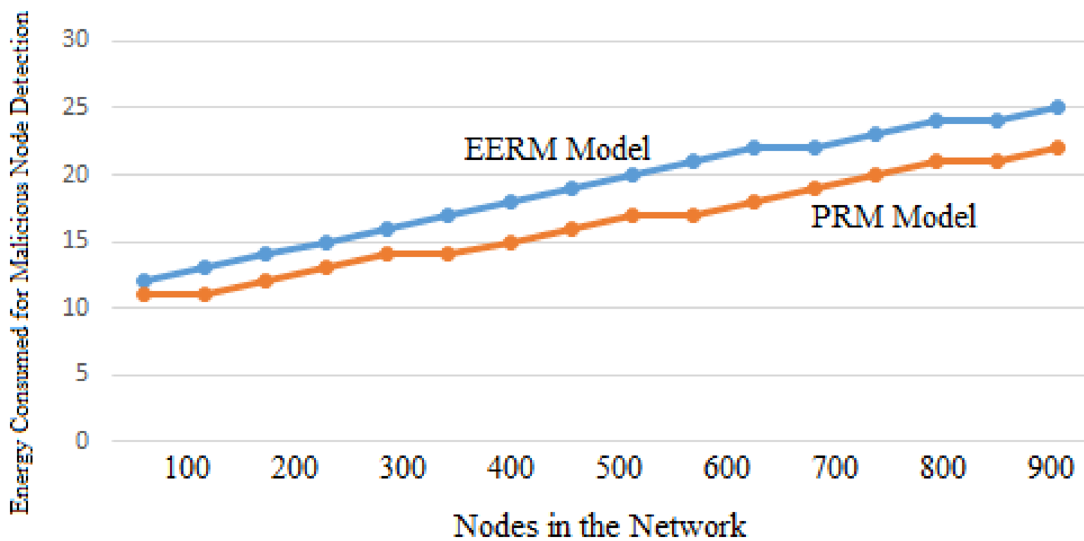

Fig. 6. Energy Consumed for Malicious Node Detection

There are many explanations for the power restriction in MANET, including limited charge cycle per node, restricted transmission range per node, and limited bandwidth. As a multi-hop network, MANET allows communication between two hops. If the range between transmitting nodes is greater than it increases the amount of power consumed or reduces the network's total life time. This implies that power consumption is proportional to the length of the road. The power consumption will increase as the nodes that forward packet to their neighbour. The total energy consumption levels of the proposed and existing methods are represented in Figure 7.

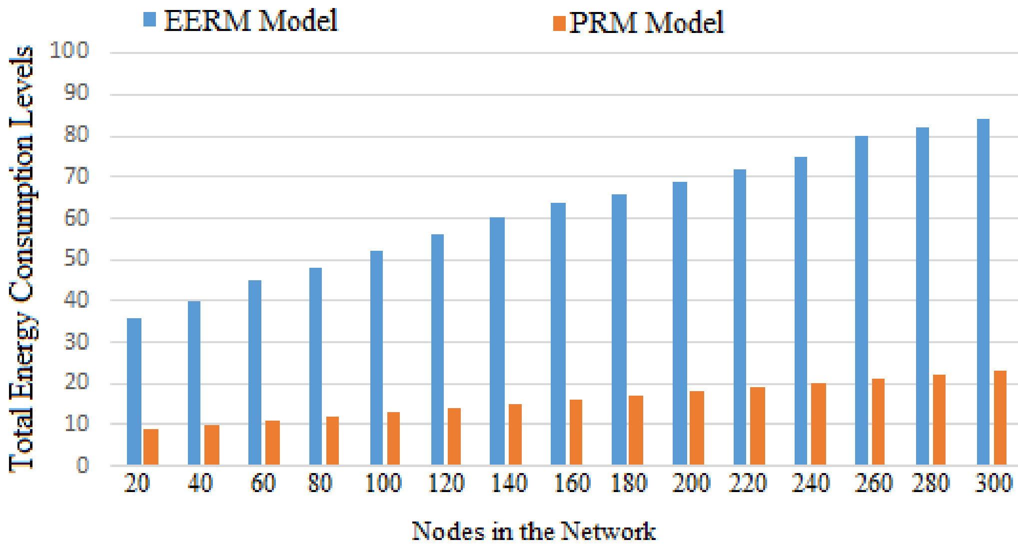

Fig. 7. Total Energy Consumption Levels

Conclusion

The distance between the source and destination nodes, referred to as the transmission range, determines the intensity of the transmission signal generated from source to destination. A number of studies have looked into the issue of reducing power level or using the variable transmission range system to save energy. From the protocol simulation results it is proved that the performance of the proposed model in power consumption reduction is better. All the approaches are energy-saving and can be accomplished by cross-sectional techniques with high energy conservation and improved network life. Energy performance, particularly in the design of a Routing Protocol, is one of the main problems at MANET. In the proposed work, the problem of energy consumption reduction is solved effectively. In certain instances, comparing several models is difficult since each strategy aims differently and uses different ways of achieving the target. For example, the optimal power adjustment for energy saving, but also for interference control is important when controlled by transmission power. An analysis can therefore be carried out using results generated, suggesting that significant energy has been maintained and plays an important role in prolonging the life of the mobile device battery. This system will continue to be extended and increase the Quality of Service (QoS) of the heterogeneous model through a reduction of power consumption.

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