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Improving Routing in a Cognitive Radio Using Cost Aware Secure Routing Network Protocol

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Abstract* — The lifetime optimization and security are two conflicting design issues for multi-hop wireless sensor networks (WSNs) with non-replenish able energy resources. In this paper, we first propose a novel secure and efficient Cost-Aware Secure Routing (CASER) protocol to address these two conflicting issues through two adjustable parameters: energy balance control (EBC) and probabilistic based random walking. We then discover that the energy consumption is severely disproportional to the uniform energy deployment for the given network topology, which greatly reduces the lifetime of the sensor networks. To solve this problem, we propose an efficient non-uniform energy deployment strategy to optimize the lifetime and message delivery ratio under the same energy resource and security requirement. We also provide a quantitative security analysis on the proposed routing protocol. Our theoretical analysis and OPNET simulation results demonstrate that the proposed CASER protocol can provide an excellent tradeoff between routing efficiency and energy balance, and can significantly extend the lifetime of the sensor networks in all scenarios. For the non-uniform energy deployment, our analysis shows that we can increase the lifetime and the total number of messages that can be delivered by more than four times under the same assumption. We also demonstrate that the proposed CASER protocol can achieve a high message delivery.

Keywords- Routing, Security, Energy Efficiency, Energy Balance, Delivery Ratio, Deployment

I. INTRODUCTION

A computer network or data network is a telecommunications network that allows computers to exchange data. In computer networks, networked computing devices pass data to each other along data connections. Data is transferred in the form of packets. The connections (network links) between nodes are established using either cable media or wireless media. The best-known computer network is the Internet. Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal computers, phones, servers as well as networking hardware. Two such devices are said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other.

The recent technological advances make wireless sensor networks (WSNs) technically and economically feasible to be widely used in both military and civilian applications, such as monitoring of ambient conditions related to the environment, precious species and critical infrastructures. A key feature of such networks is that each network consists of a large number of un-tethered and unattended sensor nodes. These nodes often have very limited and non-replenish able energy resources, which makes energy an important. A properly designed routing protocol should not only ensure high message delivery ratio and low energy consumption for message delivery, but also balance the entire sensor network energy consumption, and thereby extend the sensor network lifetime. Routing is the process of selecting best paths in a network. A routing protocol specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network. Routing algorithms determine the specific choice of route. Each router has a priori knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbours, and then throughout the network design issue for these networks.

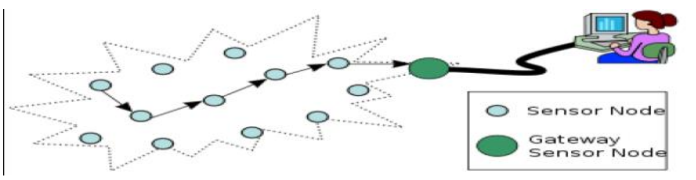


Fig. 1 Wireless Sensor Network

The network router is quickly transforming from a device dedicated to connecting disparate networks to an integrated services device capable of multiple functions beyond routing. More Cisco customers are deploying integrated services routers sophisticated network routers that deliver voice, video, data and Internet access, wireless, and other applications. The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth.

II. LITERATURE REVIEW

As from the rigorous review of related work and published literature it is observed that many researchers have designed different techniques for cognitive radio.

R. Sudha, G. Bakyalakshmi

A wireless sensor network (WSN) of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. CASER tool is used to increase the life time of the networks. Caser tools use two parameters (i) energy balance control and (ii) probabilistic-based random walking. The EBC uses for energy consumption and the other one used for security. We propose non uniform technology in energy balanced consumption. In uniform technology the data's can't be send it for longer nodes to overcome this problem the non-uniform technology is proposed. Then we compared the Sleep awake protocol which is used to send the packet in energy efficient way. We are proposed and studied few protocols and compared the existing with proposed methods. The cost aware secure routing protocol is used to balance the energy consumption and increase network lifetime. Which is also having some drawbacks and it takes more time to send the data. So to overcome this problem we use sleep wake state routing protocol to send the packet in energy efficient way. In future work may be some efficient algorithm can be used to protect the data and send it in secure manner.

S.Mohamed Nisha, S. Ramesh:

A wireless sensor network is a set of specialized transducers with a communications infrastructure deployed in an ad hoc fashion. The potential application of WSN are monitoring of weather conditions, robot control, marine life monitoring, military surveillance etc. In all these applications major conflicting issues are lifetime optimization of sensor nodes and secure transmission of messages is needed for an efficient network processing. In this paper we propose a secure and efficient Cost –Aware Secure Routing protocol to balance the energy consumption and security level using two adjustable parameters: EBC and probabilistic based random walking .In a network topology the consumption of energy is intensely disproportional to the uniform energy deployment, to a great extent it reduces the sensor network lifetime. This issue can be solve by placing sensors in different densities termed as non- uniform energy deployment results in balanced consumption of energy under the same requirements and resources. Simulation results shows that in all the scenarios CASER protocol can provide better proportion between routing and energy balance .Analysis results also show that the life time of sensor networks can be improved and it also anticipate routing trackback attacks.
In this paper, we proposed a secure and efficient CASER(Cost-Aware Secure Routing protocol) for Wireless Sensor Networks to maintain the consumption of energy and results in the increased network lifetime. CASER provides support to multiple routing strategies in forwarding message to maximize the lifetime with increased routing security. CASER result in an excellent routing presentation in terms of energy consumption and routing path distribution for security by calculating theoretical study as well as the simulation results. To maximize the lifetime of the sensor network we also anticipated a non-uniform energy deployment scheme. The results from Analysis and simulation indicate that we can extend the lifetime of sensor networks and the amount of data that can be transmitted under the non-uniform energy deployment by more than four times.

Nilima Walde and Sunita Barve

In this paper researcher is proposed a cognitive Radio (CR) technology is used to solve the spectrum scarcity problem in wireless networks, by using the existing wireless spectrum when they are not in use. CR technology allows sharing of licensed spectrum band in opportunistic and non interfering manner. However it should be aware of spectrum availability and Primary User (PU) activities. Routing and spectrum management are the main challenges in Cognitive Radio Network. The main idea behind this concept is to use an appropriate routing protocol for cognitive network which becomes a major necessity now days. As the available radio frequency for wireless communication gets lesser day by day because of licensing, so we need to have some way to use these frequencies in a more efficient manner. Routing is a fundamental issue to consider when dealing with cognitive radio networks. Geographical concepts like location server is also challenging task to improve the routing problem .Here we focused on the potential routing approaches that can be employed in adaptive. CR networks are envisaged to solve the problem of spectrums capacity by making efficient and opportunistic use of frequencies reserved for the use of licensed users of the bands. To realize the goals of truly ubiquitous spectrum-aware communication, the CR devices need to incorporate the different spectrum related functionalities. The discussions provided in this survey strongly advocate cooperative spectrum-aware communication protocols that consider the spectrum management functionalities.

Adeel Baig And Xingheng Wang:
Cognitive Radio Networks (CRNs) are being studied intensively. The major motivation for this is the heavily underutilized frequency spectrum. CRN has the capability to utilize the unutilized frequency spectrum. Routing in CRN is a challenging task due the diversity in the available channels and data rates. In this paper, we present a survey of the state-of-the-art routing techniques in CRNs. We first outline the design challenges for routing protocols in CRNs followed by a comprehensive survey of different routing techniques. Furthermore we classified these routing protocols into spectrum aware-based, multipath based, local coordination-based, reactive source-based and tree-based routing techniques depending on the protocol operation. Routing in multi-hop CRNs is challenging task due to the diversity in channel availability and data rates, therefore currently researchers from all around the world are focusing to introduce some novel routing techniques for CRNs. In this paper, firstly we discussed the architecture and main routing differences and challenges for CRNs then we presented a comprehensive survey and analytical analysis of available routing techniques for CRNs. The routing techniques are classified into dynamic spectrum aware-based, multipath-based, local coordination-based, reactive source-based and tree-based depending on their protocol operation. We also highlighted the routing operation, as well as the advantages and disadvantages of each routing technique. Although many routing techniques look promising but mostly presented techniques uses the same routing metrics as conventional wireless networks. Therefore, there is need to design new metrics those exploits all the dynamic characteristics of CRNs and based on such metrics novel routing proposals should be presented.

III. PROPOSED WORK

We describe the proposed CASER protocol. In this scheme, routing assessments can vary to put emphasis on multiple routing schemes. In this paper, we will concentrate on two different routing strategies for transmission of message they are shortest path message forwarding, and secure message forwarding over and done with random walking to generate routing path unpredictability for secure transmission and to reduce congestion. As termed earlier, we are fascinated in routing schemes that can balance consumption of energy.

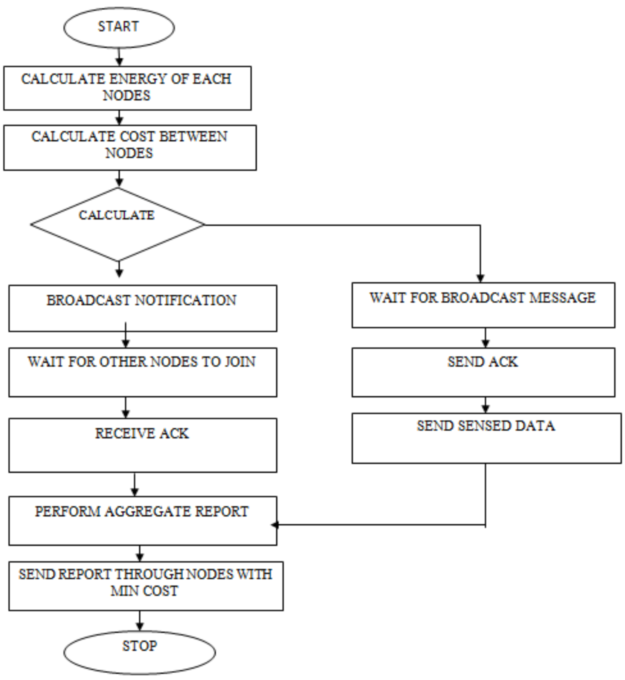


Fig 2. Flow chart: Defines the flow that takes place while executing the Caser protocol

3.1 Caser Routing

This module gives directing way unconventionality and security. The directing convention contains two alternatives for message sending: one is a deterministic briefest way steering lattice determination calculation, and the other is a safe directing network choice calculation through arbitrary strolling. In the deterministic directing methodology, the following jump matrix is chosen from NA in view of the relative areas of the lattices. The lattice that is nearest to the sink hub is chosen for message sending. In the protected steering case, the following jump framework is arbitrarily chosen from NA for message sending. The circulation of these two calculations is controlled by a security level called [0, 1] conveyed in every message. At the point when a hub needs to forward a message, the hub first chooses an arbitrary number [0, 1], If then the hub chooses the following jump lattice taking into account the most brief directing calculation; generally, the following bounce matrix is chosen utilizing irregular strolling. The security level is a flexible parameter. The Value of is little the outcomes in a shorter steering way and is more vitality effective in message sending. Then again, a bigger gives additionally steering differing qualities and security.

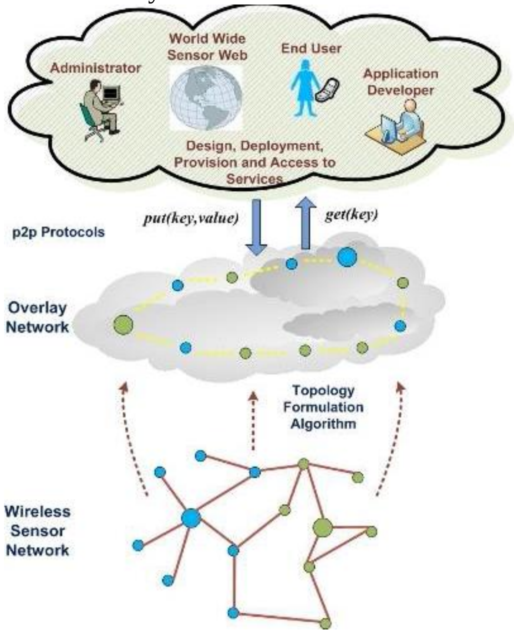


Fig. 3 Caser Routing

3.1.1 CASER Protocol Working Mechanism

A. Network Development

In this module the system is framed for secure directing. The systems are made out of an expansive number of sensor hubs and a sink hub. Every sensor hub has an exceptionally restricted and non-recharge capable vitality asset. The sink hub is the main destination for all sensor hubs to send messages to through a multi-bounce directing methodology. The system is equally isolated into little networks. Every framework has a relative area in light of the matrix data. The hub in every network with the most elevated vitality level is chosen as the head hub for message sending. Every hub in the network will keep up its own properties, including area data, remaining vitality level of its framework, and in addition the characteristics of its nearby neighboring lattices. The data kept up by every sensor hub will be over hauled intermittently.

B. Energy Balance Control

This module send message from sensor to sink utilizing EBC (Energy Balance Control) parameter [0, 1]. Hub keeps up its relative area and the remaining vitality levels of its prompt contiguous neighboring networks. For hub An, indicate the arrangement of its quick contiguous neighboring matrices as NA and the remaining vitality of matrix i as Eri , i NA. With this data, the hub A can process the normal remaining vitality of the matrices in NA.

Cost-Aware Secure Routing (CASER) convention for WSNs. Taken a toll mindful based steering techniques can be connected to address the message conveyance prerequisites. Inspired by the way that WSNs steering is regularly topography based, propose geology based secure and effective Cost-Aware Secure directing (CASER) convention for WSNs without depending on flooding. CASER permits messages to be transmitted utilizing two directing techniques, irregular strolling and deterministic steering, in the same system. The convention additionally gives a protected message conveyance choice to boost the message conveyance proportion under antagonistic assaults. What's more, we additionally give quantitative secure examination on the proposed steering convention in view of the criteria proposed. Devise a quantitative plan to adjust the vitality utilization so that both the sensor system lifetime and the aggregate number of messages that can be conveyed are boosted under the same vitality arrangement. Give an ideal non-uniform vitality sending system for the given sensor systems in view of the vitality utilization proportion. It guarantees adjusted vitality utilization of the whole sensor arrange so that the lifetime of the WSNs can be boosted. CASER convention bolsters different steering techniques in view of the directing necessities, including quick/moderate message conveyance and secure message conveyance to avoid directing traceback assaults and malignant movement sticking assaults in WSNs. This paper proposes a safe and proficient Cost-Aware Secure Routing (CASER) conventions that can address vitality adjust and steering security simultaneously in WSNs. In CASER convention, every sensor hub needs to keep up the vitality levels of its quick nearby neighboring frameworks notwithstanding their relative areas. Utilizing this data, every sensor hub can make changing channels in view of the normal outline exchange off amongst security and effectiveness. The quantitative security examination shows the proposed calculation can shield the source area data from the foes legitimized.

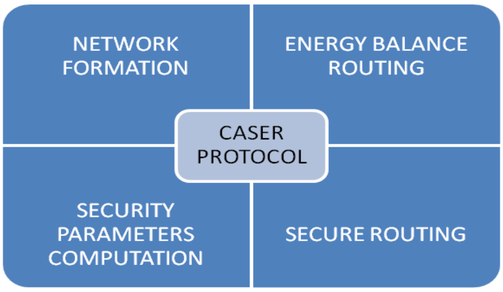


Fig 4. Architecture of CASER Protocol

C. Maximum Lifetime Routing in Wireless Sensor Networks

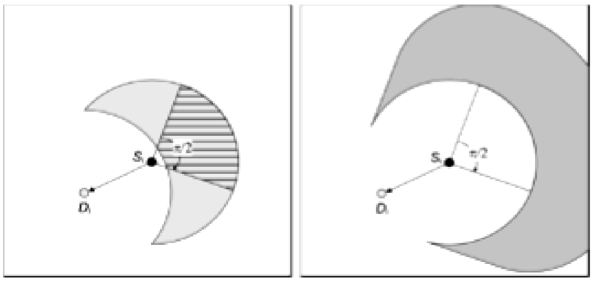
The problem of routing messages in a wireless sensor network so as to maximize network lifetime is NP-hard. In our model, the online model, each message has to be routed without knowledge of future route requests. Here develop also an online heuristic to maximize network lifetime. Our heuristic, which performs two shortest path computations to route each message, is superior to previously published heuristics for lifetime maximization– our heuristic results in greater lifetime and its performance is less sensitive to the selection of heuristic parameters. Additionally, our heuristic is superior on the capacity metric.A new online heuristic–OML–for lifetime maximization. Extensive simulations show that new heuristic is superior to previously published heuristics for lifetime maximization both in terms of providing larger lifetime and in terms of sensitivity to algorithm parameters. Additionally, proposed heuristic provides larger network capacity than provided by competing heuristics.

- **Quantitative Security Analysis of CASER**

In, we introduced criteria to quantitatively measure source-location privacy for WSNs.

Definition 1 ([1] Source-location Disclosure Index). SDI measures, from an information entropy point of view, the amount of source-location information that one message can leak to the adversaries. For a routing scheme, to achieve good source-location privacy, SDI value for the scheme should be as close to zero possible.

Definition 2 ([1] Source-location Space Index). SSI is defined as the set of possible network nodes, or area of the possible network domain, that a message can be transmitted from. For a source-location privacy scheme, SSI should be as large as possible so that the complexity for an adversary to perform an exhaustive search of the message source is maximized.



(a) Random walking (b) Deterministic routing

Fig 5 Routing Source Trace back Analysis

To probabilistic distribution of random walking and deterministic routing, at each intermediate node, neither the original packet source direction, nor the hop distance can be determined through routing traceback analysis. In fact, the adversary is infeasible to determine the previous hop source node through routing traceback analysis. Moreover, the probability for the adversary to receive multiple messages from the same source node continuously is negligible for large sensor networks.

First, in CASER, according to our assumption, a dynamic ID is used for each message, which prevents the adversary from linking multiple messages from the same source or linking the message to the source direction using correlation based techniques.

3.2 Working

Proposed work depends on routing in a cognitive radio that verifies node based on CASER algorithm which includes nodes which we will register during operation for communication with the CASER. We are using NS-2.34 for simulation which contains the combination of the Tool command language and the C++ file by using this we can run the simulation. TCL file have frontend scenario which contains information related to network define options like number of node, routing protocol, dimension of topography etc. and programming, while in C++ file coding for CASER is used and contains backend programming. The TCL file helps to see the simulation using Network Animation (NAM) file and also we can trace the various factors like send packets, received packets, delay etc. using trace file. So, when the AWK file is applied on the trace file then using that data the AWK file shows output for that particular parameter.
After forming a network using method which described above the packet is gone through CASER from source to destination using the TCP and null agent protocols. Direct sending of data between source to destination is not attainable.

IV. SIMULATION RESULTS

4.1 Performance Evaluation

The proposed algorithm is implemented in NS-2 and the performance is evaluated in terms of network energy, attack detection, throughput, delay and jitter by calculating their mean values.

Table: 1 Simulation Parameters

PARAMETERS	***VALUES***
SIMULATOR	***NS-2.34***
CHANNEL TYPE	***WIRELESS CHANNEL***
MAC TYPE	***MAC/802.11***
AREA	***100mx100m***
PACKET	***TCP***
QUEUE TYPE	***DROP TAIL***
PROPOGATION MODEL	***TWO RAY GROUND***
PROTOCOL	***CASER***

4.2 Simulation Result

In this section, the performance of proposed work is shown with the help of graph between single GI and multiple GI in the group and the analysis of the obtained result will discuss in next section.

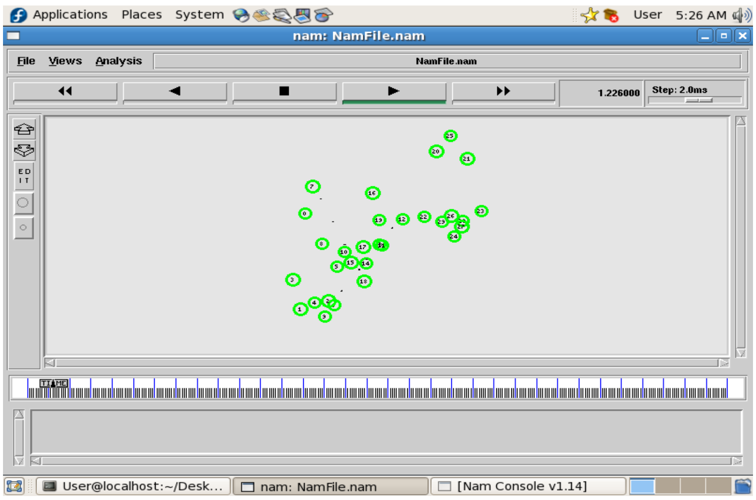


Fig 6 communication between nodes

4.2.1 Energy Mean

The Figure 7 shows mean energy consumption in mJ for a given number of nodes is within the network. X- Axis represents no. of nodes and y- axis represents energy consumption.

Fig.7 Energy Mean

The graph shows the energy consumption of network having 30 nodes, 50 nodes. The graph shows that when there is only one CASER in the network then energy consumption is higher than the multiple compressor. The energy is nothing but the power multiplied by amount of time which is represented in Joules. The mean value of energy can be calculated by summing all nodes energy dividing it by no. of nodes. Mean energy consumption of nodes is shown as a function of the number of nodes. From the plots, we can see that with the increase in the number of nodes, the energy consumption also increases. This is because of the increase in the number of hops and thus transmissions.

4.2.2 Delay Mean

In Fig. 8 X-axis denotes number of nodes and Y-axis denotes mean end to end delay. Delay is the difference between the time at which the sender generated the packet and the time at which the receiver received the packet. Delay is calculated using awk script which processes the trace file and produces the result. And by using this value we can calculate average delay by summing all nodes values. The graph shows mean delay in network by comparing single CASER and multiple CASER. As shown in the above graph, the delay of multiple CASER is lower than single CASER.

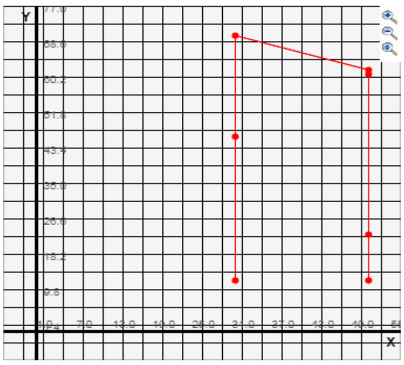


Fig 8. Delay Mean

4.2.3 Jitter Mean

In X-Axis represents no. of nodes and Y-Axis represents Jitter in sec. As shown in graph the jitter of multiple CASER is lower than that of single CASER. Jitter is simply the difference in packet delay.

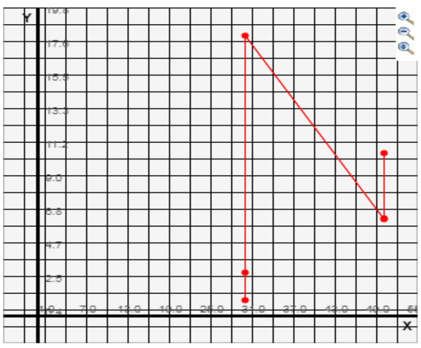


Fig 9. Jitter Mean

In other words, jitter is measuring time difference in packet inter-arrival time. Mean jitter can be calculated by summing all values for difference in packet delay. It is a specific phenomenon that normally exists in bigger packet switched networks. As a time shift phenomenon it usually does not cause any communication problems. Actually, TCP/IP is responsible for dealing with the jitter impact on communication

4.2.4 PDR

The CASER in % for a given network. It showing result for fixed no. of malicious Pdr in both modes. X- Axis represents number of nodes and y- axis represents attack detected. The graph shows the attack detection of network for 30 nodes, 50 nodes. The graph shows that when there is no security is activated in the network then attack is not detected and as caser security is activated then the attack will be detected in the network.

Pdr

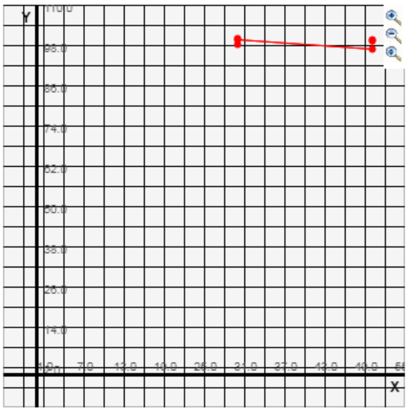


Fig. 10 PDR

4.2.5 Throughput Mean

Throughput or network throughput is the rate of successful message delivery over a communication channel. The data these messages belong to may be delivered over a physical or logical link, or it can pass through a certain network node. Throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second (p/s or pps) or data packets per time slot. The mean throughput or aggregate throughput is the sum of the data rates that are delivered to all terminals in a network

Throughput

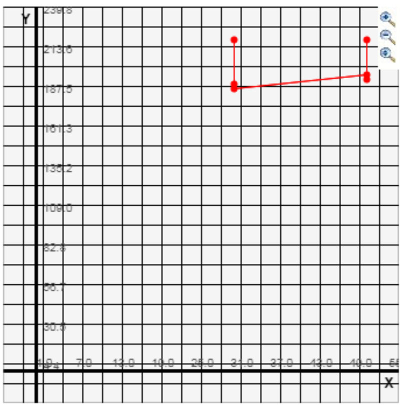


Fig 11 Throughput Mean

The throughput of a communication system may be affected by various factors, including the limitations of underlying analog physical medium, available processing power of the system components, and end-user behavior. When various protocol overheads are taken into account, useful rate of the transferred data can be significantly lower than the maximum achievable throughput. X- Axis represents number of nodes and y- axis represents mean throughput. The above graph shows the different values of throughput for single CASER and multiple CASER. The mean throughput of single CASER is higher than that of multiple CASER, because in the multiple CASER the overhead is increased which slows things down.

V. CONCLUSION & FUTURE SCOPE

In this, we presented a secure and efficient Cost- Aware Secure Routing (CASER) protocol for WSNs to balance the energy consumption and increase network lifetime. CASER has the flexibility to support multiple routing strategies in message forwarding to extend the lifetime while increasing routing security. Both theoretical analysis and simulation results show that CASER has an excellent routing performance in terms of energy balance and routing path distribution for routing path security. We also proposed a non-uniform energy deployment scheme to maximize the sensor network lifetime. Our analysis and simulation results show that we can increase the lifetime and the number of messages that can be delivered under the non-uniform energy deployment by more than four times. In this we exhibited a protected and proficient Cost-Aware Secure Routing (CASER) convention for WSNs to adjust the vitality utilization and expansion system lifetime. CASER has the adaptability to bolster different steering procedures in message sending to amplify the lifetime while expanding directing security.

Technological evolution has lead to a the great demand for mobility and connectivity with the development of the pioneer and promising sector of Wireless Networks playing a major role in this field. In the previous sections, existing technological and scientific approaches are presented, introducing several issues and challenges in important topics of wireless networks. A variety of innovative algorithms with efficient mechanisms and protocols are proposed and implemented for addressing these challenges. In addition, optimization methods are described, enhancing existing techniques and protocols. Although the results are quite satisfactory, but for the future work the extension of the present implementation is required, in order to support dynamic addition of new mobile sensor nodes and testing the framework under CASER a more dynamic network. Also experiments should be contacted based on advance unique ID generation for securing each node, which is quite complex to implement. Finally further implementation and trail work is essential to assess the proposed scheme, in terms of communication and energy efficiency.

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