Optimization of Throughput in Energy Harvested Cognitive Radio Network

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Abstract— *The objective of this work is to optimize the energy that is used up when the data gets transferred from one node to another node. Throughput is achieved only when that energy during transfer is properly used efficiently without much wastage or loss. The default energy drop is reduced by using AODV and DSDV protocol. This work also concentrates on the node failure and identification of the node causing the failure in transmission replacing the conventional proactive and reactive protocol and implementing the Hybrid Protocol, which is the combination of the usual protocols. Hybrid Protocol works on a dynamic basis that keeps a back up of the failure nodes to prevent further failure and also dynamically re-routes the transfer omitting the failure node by changing the path decided in terms of priority using Priority based verification algorithm.*

Keywords *–Energy, AODV & DSDV, Hybrid Protocol,Priority based verification*

I. INTRODUCTION

Wireless communication network is becoming important and has attracted a lot of research interest. It is being applied in more comprehensive scopes. At timeswireless communication works in license-free band. As a result, it might suffer from heavy interference due to other networks sharing the same spectrum. In addition to this, wireless devices perform complex tasks with portable batteries.

However, batteries carry several drawbacks like recharging periodically and the need for replacement. Since the number of electronic devices continue to increase, the reliability on batteries can be cumbersome.To overcome the drawbacks of energy consumption and reliability, cognitive radio has offered promising concept to improve the utilisation of available radio spectrum resources for future wireless communications and mobile computing.

Energy harvesting is considered advantageous since it is being powered by renewable energy (such as wind, solar, thermal) which can alleviate the energy-deficiency, thus becoming more eco-friendly[2]. In comparison with traditional communication devices which are powered by battery, energy harvesting wireless networks provide unlimited energy that is being derived from the environment.

Cognitive radio has evolved to strike a balance between underutilized primary user's spectrum band and the spectrum band scarcity that has raised due to increased wireless applications. The cognitive radio network-RF system provides dual use of both energy delivery and for transporting information. Thus, the wireless devices should not only recognize the spectrum holes for data transmission but also must look for occupied spectrum band in order to harvest RF energy.

II. ROUTING PROTOCOL

a) Proactive protocol

In proactive protocol, matters are solved before they become an issue. It spends more time on optimization like improving security. It makes development more stable but it anticipates wrong future and end up in spending more time in unnecessary issues. In proactive routing protocol, each node updates and maintains one or more tables that contain routing information to other nodes [5].

b)Reactive protocol

Reactive protocol solves the issues as they arise. In this manner it focusses on the progress rather that spending more time on optimization. In this protocol, nodes are not required to keep routing information in the network [5]. When the node sends data to the destination, route generation mechanism will create route based on current network situation.

c) Hybrid protocol

Hybrid protocol is a combination of proactive and reactive protocol. This protocol is based on Distance Vector protocol but contains many of the features of Link State Routing protocol [5]. The performance is improved by selecting either proactive or reactive protocols based on the efficient algorithm that is suitable under the current network status.

III.SIMULATION SETUP

Due to continuous research in the field of wireless sensor network(WSN), it is required to verify the hardware and software design and its modification in the existing design. This verification is in terms of effectiveness, correctness and its ability to use in

different WSN applications. One way to test the use of simulation is to simplify the process instead of implementing everything on real hardware sensor nodes. Hence for any real time, simulation of WSN application is essential.

Since WSN consist of hundreds to thousand nodes, its major requirement is Scalability. The simulation software provides energy model, physical environment model, propagation model and the tool for analysing simulation results to tune the parameters. NS2 is an object oriented discrete event simulator. In the beginning network simulator supported wired network simulations but later wireless support was included. It is an open source which provides online document. NS is referred to NS2 due to its current version number. NS2 is written in languages such as object oriented tool command language (Otcl),C++. It can be applied in various fields such as science, engineering for different purpose.

Application of simulation into networking area such as network traffic simulation is new. In the research area of computer and communication network, simulation is a useful technique as the behaviour of network can be modelled by calculating interaction between different network components using mathematical formulas. After we get the observation data from the simulation, the behaviour of the network and the protocols can be analysed in a series of test experiments. The environmental attributes can also be modified to observe how the network behaves under various parameter combinations.

IV. EXISTING METHODOLOGY

In sensor networks, the nodes have minimum power and therefore infrastructure and algorithm for the collection of data should be developed to preserve the energy in the nodes to maximize the network lifetime.Two protocols such as reactive and proactive are used for this purpose. For a good developer it is essential to switch between these two modes. Reactive protocol is one which uses the past information rather than anticipating the future. In this protocol the problems are rectified immediately as they arise and so it requires more time to rectify it.

In proactive protocol, the problems are solved before they become an issue thus it spends more time on optimization like caching, improved security. Sometimes it anticipates wrong future thus ends up spending more time that is not vital. Activities such as backup, privacy concerns and basic security issues are carried out in proactive mode while exploring new and unproven features are done in reactive mode.

The major drawback in the existing protocol is the black hole attack. Ad Hoc On-Demand(AODV) protocol is a reactive protocol for mobile network which maintains routes to communicate between nodes. AODV is based on DSDV algorithm because it minimizes the number of broadcast by creating the required on demand. It is an on-demand route acquisition system, as the nodes in the selected path maintain the routing information whereas others do not.

In black hole attack, defamatory node uses the routing protocol so that it has the shortest path to the destination node or the packet it want to intercept. Therefore, the attacker node will have the availability in replying to the route request and thus intercept the data packet and retain it. Once it is created the node can drop the packets or forward to any unknown address according to its choice.

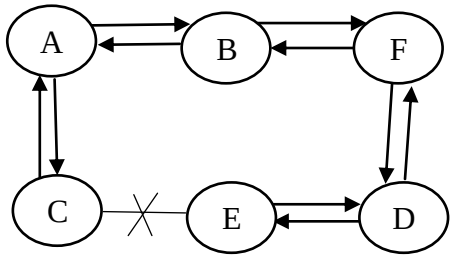


Fig2: **Blackhole attack in AODV**

The above figure provides how the black hole problem arises. When the node A wants to send the data packet to D and creates a route discovery process. If a node C is the hostile node then it will claim it to be active route to the specified destination as it receives RREQ packet. Before sending the information to any other node it will send it to A. Therefore node A will think C to be the active node and thus the active route discovery is completed. Once it is completed, A will start to ignore all other message request and will send the data packets to node C. In this way all the data packets will be lost.

In internal black hole attack it has an internal malicious node which is in between the source and destination nodes of the route. This node is capable of conducting attack in the initial stage of data transmission.This is an internal attack because the node itself belongs to the data route.

In the external black hole attack it has an external malicious node and deny the access to network traffic or creating congestion in network or by disrupting the entire network. When the external attack take control of internal malicious node and control it to attack other node in MANET, it can become a kind of internal attack.

V. PROPOSED ALGORITHM

In the proposed system, hybrid protocol is used which adapts either proactive or reactive protocol based on the efficient algorithm under the current scenario. This protocol is used as an optimization model which takes into account heterogeneous duration of sensors transmission in each time slot [3]. A combination of both Distance Vector and Link State Routing algorithm is used. Though the hybrid protocol is mainly based on Distance vector algorithm, it also contains many of the features of Link state Routing algorithm.

To improve the overall network throughput, a condition is proposed on the distance travelled by sink per time slot which is feasible in practical scenarios of data collection on the path. It associates the energy harvesting aspect with the optimization model. The proposed model determines the number of time slots available to each node as well as the velocity of the mobile sink.

The major contributions of the proposed scheme are (i) The ability to manage the trade off in energy harvesting and transfer of data, (ii) Practical approach to reach a desirable solution, (iii) Adjustable dynamics considering current RF system environment,(iv)Dynamic interactive process in a distributed fashion. By considering the trade-off between energy harvesting and data transmission, each unlicensed device selects particular channel to transmit data or harvest energy.

We focus on the problem of channel selection for dynamic spectrum access in multi-channel CRN-RF system. The performance of the proposed methodology is compared with the existing method and draws the confirmation on the performance dominance using simulation model. The simulation results are obtained on network animator which showcases the performance evaluation of the different protocols that are being used on a network for the data transmission and for energy harvesting.

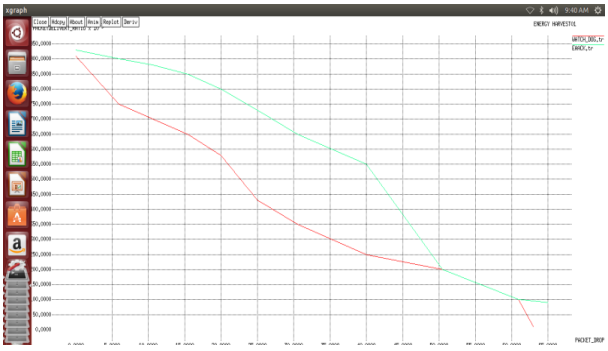
Queue management

Passive queue management algorithm sets a maximum length for each queue at the router. The router decides when to drop the packets and it follows first in first out algorithm. When the queue buffer is filled to its maximum capacity, the packets that are arrived afterwards are dropped until the queue is full. That is, the drop tail will keep discarding the packets until the queue has enough space for new packets. The queue size has been dynamically increased by modifying the drop tail queue. In this modified module, the simple drop tail module drops the packet when it is overflowing. It transmits the packet in FIFO manner.

Hybrid topology management

1) **Reliable:** Unlike the other networks, fault detection and troubleshooting is easy. The fault part that has been detected can be isolated from the remaining network and the corresponding measures can be taken without harming the rest of the network.
2) **Scalable:** It is easy to increase the size of the network by adding new components without affecting the prevailing architecture.
3) **Flexible:** Hybrid network is designed according to the requirements of the organization and optimizing the available resources. When the traffic is high and the chances for the fault are high, special care is given to the nodes.
4) **Effective:** since hybrid technology is a combination of two or more technologies, the design of such a network is made in such a manner that the strengths of constituent topologies are maximised and the weaknesses are neutralized. Consider a ring topology which has good data reliability and the star topology which has high tolerance capacity. So, these two can be fused together as hybrid star-ring topology to effectively increase the performance of the system.

VI. SIMULATION RESULTS



VII. CONCLUSION

In this paper we have focussed on optimizing the energy for efficient transmission of data. The energy drop is minimized and the efficiency is improved in a greater manner. As a future work,we would like to enhance this by capturing the total capacity of the harvested energy getting released out of the nodes.

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