Co-Operative Opportunistic Risk Aware Scheme and its Routing Attacks in MANET

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***Abstract*—Mobile Ad-hoc Network (MANET) is an infrastructure less network. Each node will act as a host as well as a router and forwards each other's packets to enable the communication between nodes not directly connected by wireless links. Today, mobile ad hoc networks are mainly helpful in sensing, gaming and also for military purposes. But the steadily wider adoption of wireless technologies in daily life let one foresee the next generation of mobile ad hoc network applications: environmental and medical monitoring, groupware, customer to customer applications, risk awareness management, entertainment including advertising, etc. Data transmission through the network platform is being greatly affected by an important parameters namely routing. We introduce the concept Co-operative opportunistic routing in MANET and compared with the performance of AODV. The concept of link quality using co-operative communications is being implemented with IDS to enhance routing than AODV. This helps in obtaining less traffic overhead. Finally, low power energy consumption with efficient throughput is being obtained and the network lifetime is dramatically increased.**

Keywords—Co-operative communication, AODV protocol, Intrusion Detection system (IDS), Link quality, Live update, Path Finding Algorithm (PFA).

I. INTRODUCTION

A Mobile Ad hoc network is a self-configuring infrastructure less network of mobile devices connected by wireless. Ad hoc is Latin and means "for this particular purpose". Differing with infrastructure wireless networks, in which each user can directly communicate with an access point or base station, a mobile ad hoc network, or MANET, will not rely on a fixed infrastructure for its operation. The network is an autonomous transitory association of mobile nodes that communicate with each other over wireless links. Nodes which is lying within each other's send range can communicate directly and are responsible for dynamically discovering each other [1]. A mobile ad hoc network is a set of mobile nodes able to communicate with other nodes in their surroundings [2]. These wireless communications happen in a peer-to-peer manner, without relying on any predefined infrastructure. Today, mobile ad hoc networks are mainly helpful in sensing, gaming and also for military purposes. Now we will consider a subclass of mobile ad hoc network called "delay tolerant networks" [2]. In this particular type of network, the mobility is hardly predictable and the disruption of connection is a common and normal phenomenon. Traditional topology-based MANET routing protocol (e.g.,

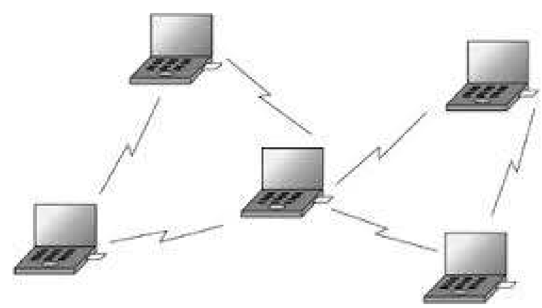

Fig. 1.1 Example of MANET

POR, AODV, DSR) are quite susceptible to the node mobility. The main reasons are due to route. The process of discovery and recovery are also time and energy consuming. Mobile Ad hoc Networks (MANETs) can be defined as autonomous system of mobile nodes connected via wireless links without using any existing network infrastructure. An example of MANET is given in Figure 1. A challenge in the design of ad hoc networks is the development of dynamic routing protocols that can efficiently finding routes among the communicating nodes.

The mainstay of this is to propose and solve the problem of opportunistic data transfer in mobile ad hoc networks. Research on this cooperative communication started to attract interests in the community at the physical layer but more recently its importance and usability have been realized on upper layers of the Network protocol stack. It is purely a network layer scheme that can be built atop off-the-shelf wireless networking unit. Nodes in the network will be using a lightweight proactive source routing protocol to determine a list of intermediate nodes that the data packets should follow en route to the destination. When the data packet is broadcasted by an upstream node and has happened to be received by a downstream node further along the particular route, it continues its way from there and so they arrive at the destination node sooner. This can be achieved through cooperative data communication at the link and network layers. This work will be a powerful extension to the pioneering work of ExOR. A particular new routing protocol for Cooperative transmission among Mobile Ad Hoc Networks called CORMAN [3] is implemented and observed significant performance improvement in varying mobile settings simultaneously they enhance the security to perform efficiently. Thus the security along routing will be evolved.

II. Related work

In this section, we reveal existing different routing algorithm and their performance which are classified based on several parameters.

Routing in wireless networks is very challenging mainly due to variable and unreliable wireless channel conditions. Traditional routing schemes for multi-hop wireless networks have followed the concept of routing in wired networks by abstracting the wireless links as wired links, and finding the shortest path between a source and destination.

Zehua Wang, Cheng Li, and Yuanzhu Chen [4], described about a new Proactive Source Routing (PSR) protocol that has a very small communication overhead but it provides nodes with more network structure information than distance-vector based protocols. The value of this source routing protocol includes:

- Better control of path selection by the source nodes for avoiding congestion and load, balancing energy consumption, and bypassing untreated areas,
- Alleviating IP forwarding at the intermediate nodes, and
- Supporting for opportunistic data forwarding**.**

In this article, they present the working and performance evaluation of a new proactive source routing algorithm called PSR. PSR is built on the similar idea of spanning tree as in STAR. It has the following distinct features. First, we do not timestamp links. Instead, only the topological information is used for tree updates in order to reduce the communication overhead. Second, PSR always maintains a breadth-first spanning tree at each and every node, for providing responsive data transportation services. Third, we utilize both full dump and differential updates to strike the balance between efficient and robust network operations. Last, we use source routing to forward data rather than IP forwarding as in STAR, which can potentially support opportunistic data transfer in MANETs.

S. Yang, F. Zhong, C. K. Yeo, B. S. Lee, and J. Boleng[5], proposed about novel protocol called Position based Opportunistic Routing (POR) which takes full advantage of the broadcast nature of wireless channel and their feature opportunistic forwarding. The data packets are transmitted as a way of multicast with multiple forwarders. A forwarder list which is determined by previous hop according to local position information is inserted into the IP header and these candidates take turn to forward the packet based on their particular predefined orders. This redundancy and randomness will make it quite efficient and robust. In addition, POR's control overhead is almost negligible which justifies its good scalability**.** Route discovery and establishment process inevitably introduce a variety of control messages which can become an attacker's target and can be easily intercepted, modified or just dropped. The QoS of the communication is thus degraded and even worse, the transmission could never be established.

Most existing mechanisms that protect the routing protocol from attack focused on protection of control messages, such as authentication of control packets, protection of mutable information in control packets. From this point of view, the control messages, which originally took the role of facilitating the establishment of communication, now become the source of vulnerability of routing protocols in adverse or even hostile environment.

Zehua Wang, Yuanzhu Chen, and Cheng Li [6], they describe about the effectiveness of ODF in wireless networks which is heavily depended on the choice of proper routing protocols which can provide effective source routing. In this paper, they propose a new routing protocol named PSR for ODF in mobile ad-hoc networks. PSR is featured by proactive source routing, which is loop free, and having extremely small routing overhead. Compared with the existing routing protocols, there is no need for timestamp routing updates in PSR and the update messages are harmoniously integrated into their tree structure, so that these overhead can be significantly reduced.

Opportunistic data forwarding (ODF) represents one of the most promising solutions to this initiative. One of the initial work on ODF is the selective diversity forwarding (SDF) proposed by Larsson. In their work, a transmitter picks the best forwarder from the multiple receivers which successfully received its data, and explicitly request the selected node to forward data. However, its overhead must be significantly reduced before it can be implemented in any practical networks. ExOR provides a solution to this problem and it is the first work which effectively used the concept of ODF. In ExOR, nodes are enabled to overhear all packets on the air, so a multitude of nodes can potentially forward a packet as long as they are included in the forwarder list carried by the packet. Furthermore, ExOR fuses the MAC and network layers so that the MAC layer can determine the actual next-hop forwarder. In this way, the forwarder in the list which is *closer* to the destination will access the medium more aggressively so as to better utilize the long-haul transmissions. The idea of ExOR inspired a number of interesting extensions. MORE enhanced ExOR to further increase the spatial reuse via intra flow network coding. In this paper they have proposed a new source routing protocol for ODF in MANETs. By using compact tree representation and joint full-dump/differential messages in routing update, the overhead in PSR has been greatly reduce. Moreover, we have proposed an improvement scheme to further reduce the overhead. Performance study shows that PSR clearly outperforms other routing protocols, including DSDV and OLSR.

Petros Spachos, Liang Song, and Dimitrios Hatzinakos [7], proposed about the performance of wireless sensor networks (WSN). In opportunistic routing, the intermediate nodes collaborate on packet forwarding in order to achieve high throughput in the face of the flossy links. That will make the next node selection process very crucial. In this paper, we are presenting an efficient opportunistic routing protocol for wireless sensor networks. They also examine three extensions of that protocol, which is based on different next node selection criterion. They illustrate how this each extension works and they evaluate and also compare their performance in terms of the energy consumption, delivery ratio and packet latency. Usually, these sensor networks are designed to operate unattended for about long periods of time because battery replacement is sometimes very infeasible or impossible. Therefore, the battery charge must be conserved to extend the life of each sensor and the entire sensor network.

When applying a routing scheme, the impact that this scheme has on the lifespan of the network should always be considered. The energy required to transmit related routing data should always be considered when implementing a protocol within a sensor node. The communication range of sensor nodes is also limited in order to conserve energy. A great reduction in the transmission power can save sensor node energy.

However, it reduces each sensor node detection probability and communication range. Opportunistic routing tries to take advantage of the broadcast nature of wireless communication and increase network performance. Every opportunistic routing protocol is subjected to its next node selection criterion. In this paper, they presented an opportunistic routing protocol and they introduced three extensions of that protocol with different next node selection criterion.

I. Chlamtac, M. Conti, and J.N. Liu [8], proposed about distributed systems that comprise wireless mobile nodes that can freely and dynamically self-organize into arbitrary and temporary, ‘‘ad-hoc’’ network topologies, which allows people and devices to seamlessly internetwork in particular areas with no pre-existing communication infrastructure, e.g., disaster recovering environments.

Traditionally, tactical networks have been the only communication networking application that followed the ad hoc hypothesis. More recently, the introduction of new technologies such as the Bluetooth, IEEE 802.11 and Hyperlan are helping the enable of eventual commercial MANET deployments outside the military province. These particular evolutions have been generating a renewed and growing interest in the research and progress of MANET. This paper is attempting to provide a comprehensive overview of this dynamic pasture. It first explains about the important role that mobile ad hoc networks play in the evolution of future wireless technologies.

This paper demonstrates the impetus behind mobile ad hoc networks, and presents about the representative collection of technology solutions used at the different layers of the network, in particular these presenting algorithms and protocols are unique to the operation and dynamic configuration of mobile ad hoc networks. Mobile ad hoc network (MANET) literature is already too extensive to be covered and analyzed in detail in this article. They therefore, present the main research areas in the MANET literature and inside each survey of the main research directions and open issues. MANET WG proposes a view of mobile ad hoc networks as an evolution of the Internet. Other promising directions have been identified. The use of the IP protocol has two main advantages: it simplifies MANET interconnection to the Internet, and it will guarantee the independence from wireless technologies. On the other hand, more efficient and lightweight solutions can be obtained.

III. PROPOSED CONCEPT

The proposed model involves with the comparative analysis of protocols namely, CORMAN and AODV to expose the benefits of this new concept CORMAN which helps in enhancing the routing process within MANET. We use a lightweight proactive source routing protocol ‘P’ for the comparative analysis of both CORMAN and AODV so that each node has complete knowledge of how to route data to all other nodes. When a flow of different data packets are forwarded towards their destination, the route information carried by them will be adjusted by intermediate forwarders.

Additionally, as these packets are being forwarded along the new route, such updated information is propagated upstream rapidly without any additional overhead. The equations for this protocol is given in (1) as follows,

$$P = \sum_{i=1}^{N} m_i . p_i \quad (1)$$

Where, $P_{unicast}$ is given in (2) as follows,

$$P_{unicast} = \sum_{i=1}^{N} m_i . p_i(1-x)^{i-1} \quad (2)$$

As a result, all upstream nodes learn about the new route at a rate much faster than via periodic route exchanges. We take opportunistic data forwarding to another level by allowing nodes that are not listed as intermediate forwarders to retransmit data if they believe certain packets are missing. These protocols are again said to incorporate with different algorithm to improve the routing performance than the existing concept.

A. Large Scale Live Update

When data packets are received by and stored at the particular forwarding node, the node will have different view of how to forward them to the destination from the forwarder list carried by the packets. Since many node is closer to the destination than the source node, such a kind of discrepancy usually means that the forwarding node has more updated routing information. In this particular case, the forwarding node updates the part of the forwarder list in the packets from this point on towards the destination according to its own and its present knowledge. When the packets with this particular updated forwarder list are broadcast by the forwarder, the update about the network topology change propagates back to its own upstream neighbor. Then the neighbor incorporates the change to the packets in its cache as shown in Fig 3.1. When these cached packets were broadcasted later, the update is further propagated towards their very own source node. Such an updating procedure is significantly faster than the rate at which a proactive routing protocol disseminates the routing information. The route updating procedure is clearly depicted in the following Fig. 2.1 as follows,

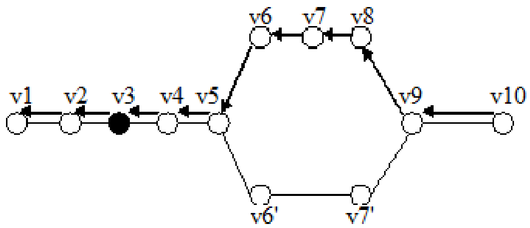

Fig. 2.1 Route update

B. Small Scale Retransmission Algorithm

A short forwarder list forces packets to be forwarded over long and possibly weak links. In order to increase the reliability of the data forwarding between the two listed forwarders, CORMAN allows the nodes that are not on the forwarder list but are being situated between the two listed forwarders to retransmit the data packets if the downstream forwarder has not received these particular packets successfully. Since there may be multiple similar nodes between a given pair of listed forwarders, CORMAN will coordinate retransmission attempts among them extremely efficiently.

The following terms are defined in ExOR [9] to describe similar concepts involved in CORMAN for its performance:

• *Batch size* — number of packets in a batch. It has the same value for all packets in a given batch.

• *Forwarder list size* — number of forwarders on the forwarder list. It has same value for all the packets in a given batch.

• *Packet number* — index of the packet in the batch.

• *Forwarder number* — index of the forwarder on the forwarder list. It is indicating in which node on the list has just transmitted the data packet.

• *Batch map* — an array whose size equals the batch size. Each element of the map is indexed by the packet number, and its value is the forwarder number of the highest priority forwarder that this packet has reached.

• *Fragment* — a subset of packets in the current batch which are sent together from a given forwarder.

C. Path Finding Algorithm

PFA uses predecessor information to eradicate hidden paths from its distance and routing tables without any excessive overhead. It significantly reduces the number of cases in which routing loops may occur. Each node will maintain the shortest-path spanning tree reported by their neighbours, and uses this information and the information concerning the cost of the adjacent links to generate its own shortest-path spanning trees.

In addition to this, PFA also has an efficient updating method. Each time when an update is received by a router, the distance table and the routing table entries are being updated to the change in the network state and thus it maintains correct path information to all their destinations. This distance entry of that path is also being updated and given in (3),

$$D_{jb}^{i} = D_{kb}^{i} + D_{j}^{k} \quad (3)$$

Also the predecessor is updated expressed in (4),

$$P_{jb}^{j} = P_{j}^{k} \quad (4)$$

IV. PERFOMANCE ANALYSIS

The Network simulator (ns-2) tool is used for simulating the performance results. In this sector, we will disclose the performance of the proposed concept CORMAN within its network dimension and velocity. The parameters such as, delay, jitter and PDR (Packet Delivery Ratio) are being analyzed according to their dimension and velocity. The following graphs are depicting the relative plotting of AODV and CORMAN protocols. Specifically, a source node generates 50 packets, with of payload of 1000 bytes. This also translates a traffic rate of 400 kbps infused by a node.

The Fig 4.1, 4.2, and 4.3 depicts the relative plotting of CORMAN and AODV with their performance in terms of network dimension Vs delay, jitter, and PDR respectively. For each dimension scenario, we test CORMAN capabilities in transporting CBR data flows between a randomly selected source-destination pair. We measure the PDR, end-to-end delay, and delay jitter for AODV protocol and average them over the 5 repetitions of each scenario, as plotted in following figures.

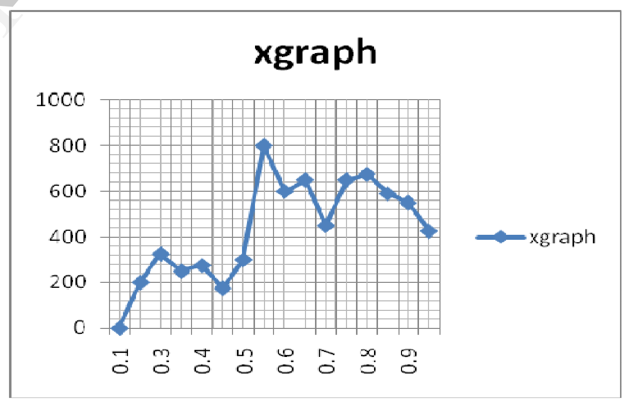

Fig. 4.1 Dimension Vs Delay

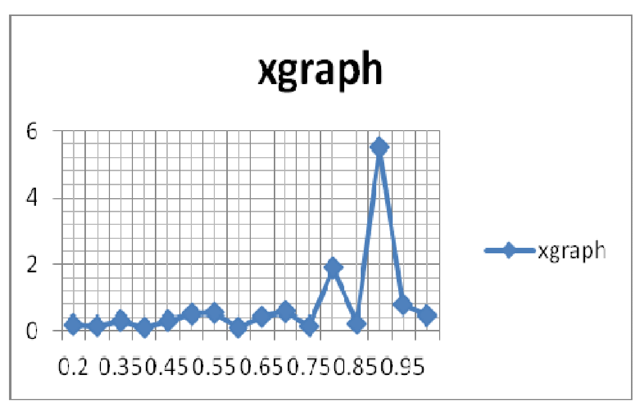

Fig. 4.2 Dimension Vs Jitter

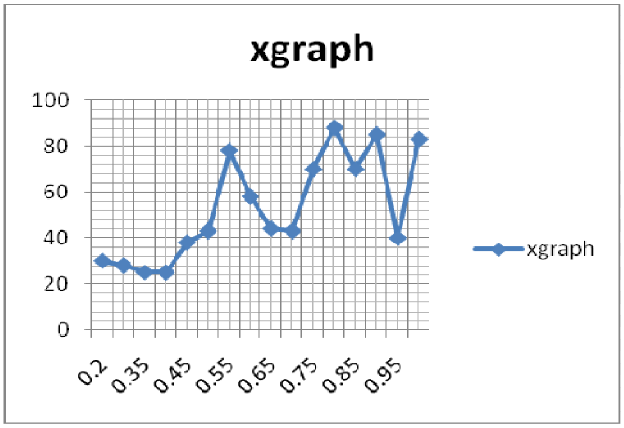

Fig. 4.3 Dimension Vs PDR

We observe that CORMAN has a PDR (Fig 4.3) of about 95% for dense networks (*i.e.*, 250 ≤ *l* ≤ 500 m). As the node density decreases, this rate gradually goes down to about 60%.

The Figure 4.4, 4.5, and 4.6 depicts the relative plotting of CORMAN and AODV with their performance in terms of velocity Vs delay, jitter, and PDR respectively. CORMAN's PDR is constantly around 95%. The variations are due to the mobility of the nodes.. This involves with some advantage that the mobility supports infrastructure less environment for routing.

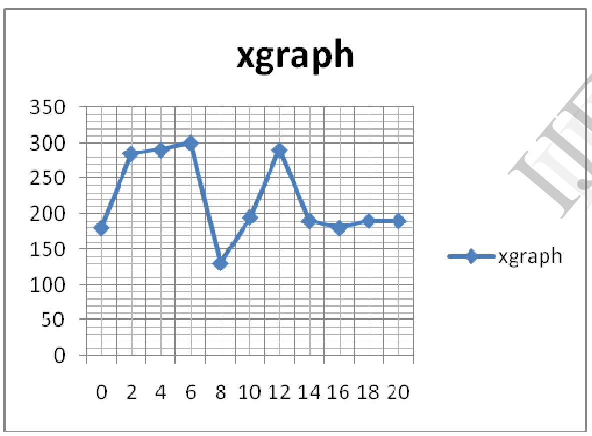

Fig. 4.4 Velocity Vs Delay

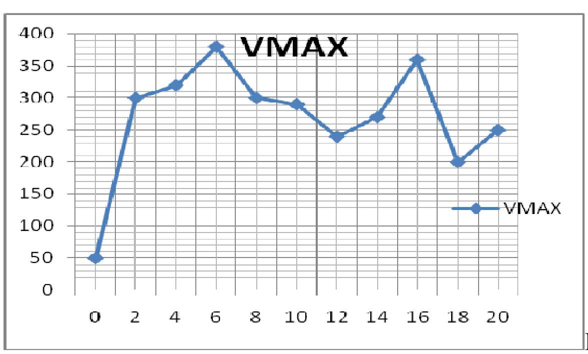

Fig. 4.5 Velocity Vs Jitter

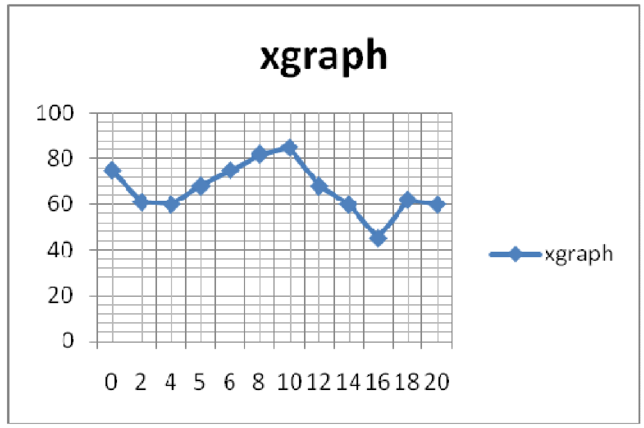

Fig. 4.6 Velocity Vs PDR

TABLE I. SIMULATION PARAMETERS AND THEIR RESPECTIVE VALUES

S.No	Simulation Parameters with their Values	
	Simulation Parameters	***Values***
1.	Users	50
2.	Payload per Packet	1000 bytes
3.	Traffic Rate	400 bytes
4.	PDR[a]	95%

**PDR (Packet Delivery Ratio)*

CONCLUSION AND FUTURE WORK

In this paper, we have analyzed the metrics of CORMAN with AODV protocol in terms of their performance along with this we also studied different parameters and analyzed the performance variations between the delay, jitter, and PDR to understand the betterment of CORMAN. Finally, we conclude this analysis by saying that the CORMAN protocol is having efficient performance along delay, jitter and PDR within MANET and are said to have low power consumption.

This concept can further be improved by analyzing the performance of routing within CORMAN and AOMDV to support multihop users which shows better results than the AODV. Security can also be enhanced by upgrading the risk awareness with the help of Dempster-shafter mathematical theory of evidence which involves in providing secured environment.

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