Optimum Route Life Time Prediction Of Trusted Dynamic Mobile Nodes in Large Scale Manets

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ABSTRACT

One of the important and challenging problems in the design of ad hoc networks is the development of an efficient routing protocol that can provide high-quality communications among mobile hosts for that proposing new protocol to evaluate the node lifetime and the link lifetime utilizing the dynamic nature, such as the energy drain rate and the relative mobility estimation rate of nodes. Integrating these two performance metrics by using the proposed route lifetime-prediction algorithm select the least dynamic route with the longest lifetime for persistent data forwarding and based on quadrant. our proposed route Lifetime-prediction protocol in a exploring dynamic nature routing for large scale network (LEDNR) protocol environment based on Ad hoc on demand distance vector routing (AODV) In addition, establishing and quantifying behavior of nodes in the form of trust is essential for ensuring proper operation of MANET. This is done by various trust computations.

KEYWORDS

Lifetime prediction, link lifetime (LLT), mobile ad hoc networks (MANETs), node lifetime, route discovery, routing protocol, trust computations

1. INTRODUCTION

A Mobile ad hoc network (MANET) consists of many mobile nodes that can communicate with each other directly or through intermediate nodes. Often, hosts in a MANET operate with batteries and can roam freely, and thus, a host may exhaust its power or move away, giving no notice to its neighboring nodes, causing changes in network topology. One of the important and challenging problems in the design of ad hoc networks is the development of an efficient routing protocol that can provide high-quality communications among mobile hosts. These studies often attempt to find a stable route that has a long lifetime. We can classify these solutions into two main groups: node lifetime routing algorithms and link lifetime (LLT) routing algorithms.

2. RELATED WORK

By considering the energy state of nodes, such as residual energy and energy drain rate, the node lifetime routing algorithms often select a path consisting of nodes that may survive for the

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longest time among multiple paths. Shrestha and Mans [3] mentioned that the energy drain rate of a node is affected not only by its own but by its neighboring data flows as well. Marbuhk and Subbarao [4] aimed to preserve network connectivity by choosing a route according to the remaining battery life of nodes along the route. Toh [5] proposed selecting a path with minimum total transmission power when there exist some possible paths, and all nodes through these paths have sufficient residual battery power. Misra and Banerjee [6] proposed selecting a path that has the largest packet transmission capacity (the residual energy divided by the expected energy spent in reliably forwarding a packet) at a "critical" node among multiple paths. The critical node is the node that has the smallest packet transmission capacity in a path. The above algorithms are well-defined metrics to evaluate the lifetime of nodes. However, they are more suitable for static networks.

The LLT routing algorithms are used to estimate the lifetime of wireless links between every two adjacent nodes and then to select an optimal path. In the associativity-based routing algorithm, a link is considered to be stable when its lifetime exceeds a specific threshold that depends on the relative speed of mobile hosts.

3. SYSTEM ARCHITECTURE

3.1. Description Of System Architecture

Since DSR [16] is one of the most popular routing protocols in MANETs and it is easy to extend the routing control message format of DSR, we implement the proposed route lifetime-prediction algorithm in the DSR protocol. The proposed algorithm consists of the following three phases: route discovery, data forwarding, and route maintenance. There are three main differences between the EDNR and the DSR

First, in the EDNR protocol, every node saves the received signal strength and the received time of the RREQ packet in its local memory, and adds this information into the RREP packet header in a piggyback manner when it receives the RREP for the corresponding RREQ packet to meet the requirement of the connection lifetime-prediction algorithm. Second, node agents need to update their predicted node lifetime during every period.

Finally, the node-lifetime information in the RREP packet is updated when the RREP packet is returned from a destination node to the source node At every EDNR node agent, a variable NLT, which represents the node lifetime, is added to represent the estimated lifetime of this node, and it is updated by the algorithm in Section II-A. For the lifetime of a link Ci, there are two sample packets exchanged between nodes $Ni-1$ and Ni (packet 1: $Ni-1$ RREQ $----\rightarrow$ Ni; packet 2: $Ni-1$ RREP $\leftarrow----$ Ni) .To implement this, every node agent needs to maintain a data structure called RREQ_Info table in its local memory. This structure includes the RREQ id, the forwarding RREQ time, and the RREQ received signal strength. For a path sequence $S, \ldots, Ni-1, Ni, Ni+1, \ldots, D$, when an intermediate node Ni receives an RREQ packet from $Ni-1$, it adds this RREQ id, the current time, and the received signal strength to its RREQ_Info table before it continues to forward this RREQ packet.

Similarly, node $Ni+1$ also saves the RREQ_Info from node Ni in its local memory. In the returning RREP period, when node Ni receives an RREP packet from node $Ni+1$, the RREQ_Info from Ni (information of Ni RREQ $----\rightarrow$ $Ni+1$) has been added to the RREP header by$Ni+1$ before node $Ni+1$ sends an RREP packet to node Ni. Simultaneously, node Ni knows the RREP time and the RREP received signal strength from node $Ni+1$ (information of Ni RREP $\leftarrow----$ $Ni+1$). Thus, it can obtain the second sample packet that is delivered between the corresponding two nodes ($Ni, Ni+1$), and, thus, we can calculate the connection time TCi using the connection lifetime-prediction algorithm and then update the local LLT value.

Similarly, node Ni should add the RREQ_Info entry that is received from node$Ni-1$ to the RREP header before sending the RREP to node $Ni-1$, and then node $Ni-1$ calculates the LLT between nodes ($Ni-1$,Ni). Three new entries, i.e., *path lifetime* (PLT), *RREQ time*, and *RREQ signal strength*, are added to the common header of an RREP packet. The PLT represents the predicted lifetime of the source route in this packet header and can be updated when RREP packets are forwarded from the destination node to the source node in the route-discovery phase. The *RREQ time* and the *RREQ signal strength* represent the RREQ_Info of the previous RREQ node.

The EDNR node agent only updates the PLT value in the common header of the RREP packet with a local NLT value or LLT value, if NLT < PLT or LLT < PLT, before forwarding this RREP packet. When this RREP packet reaches the source node, the PLT becomes the minimum value of the estimated lifetime of all nodes and links through the route from the source node to the destination node, as described in (2).In the persistent data forwarding period, a source node tends to select the path with the longest lifetime (the path with the maximum PLT value) from multiple paths as a source route for data forwarding.

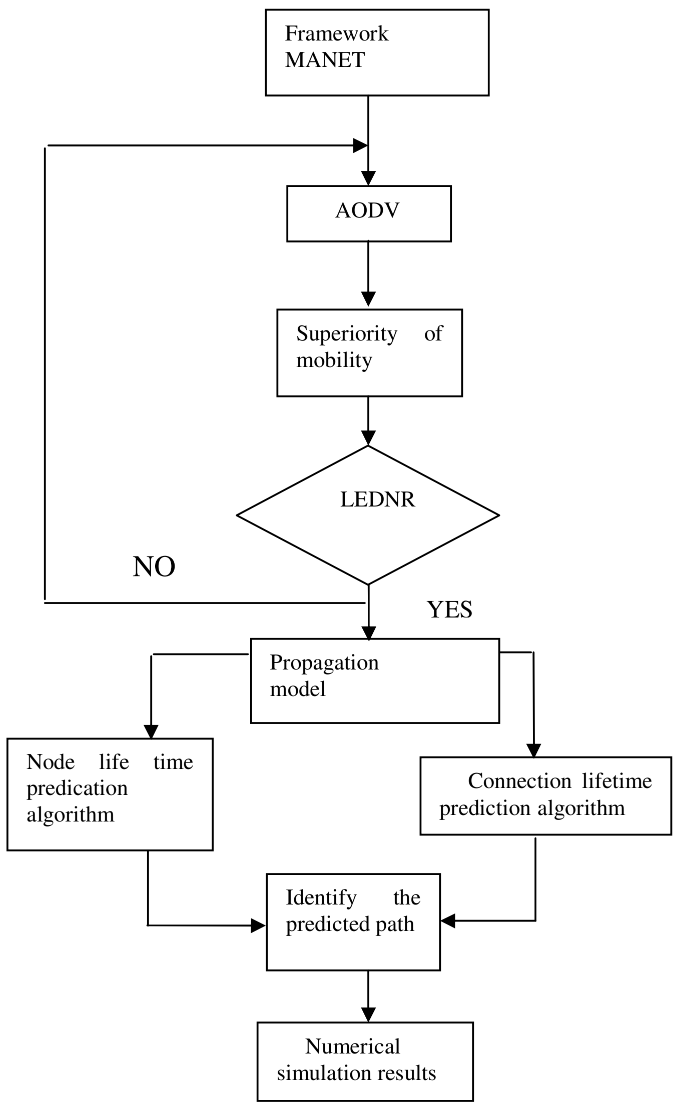

Figure 1. Flow Diagram

4. ALGORITHM OF INTERMEDIATE NODE

Predict its lifetime
If its lifetime < Min-lifetime
Replace Min-lifetime with its lifetime
If Sequence Number exists
Compare Min-lifetime of current RREQ with Min lifetime of existing one.
If new Min-lifetime <= old Min-lifetime
Discard new RREQ
If new Min-Lifetime >old Min-lifetime
Replace old Min-Lifetime with new Min lifetime
Forward new RREQ
If Sequence Number does not exist
Save this Min-lifetime
Forward RREQ

4.1. Description of Algorithm

4.1.1. Node Lifetime Prediction:

If there are two nodes that have the same residual energy level, an active node that is used in many data-forwarding paths consumes energy more quickly, and thus, it has a shorter lifetime than the remaining inactive node. the node lifetime that is based on its current residual energy and its past activity solution that does not need to calculate the predicted node lifetime from each data packet .We use an exponentially weighted moving average method to estimate the energy drain rate *evi*. *Ei* represents the current residual energy of node i, and *evi* is the rate of energy depletion. *Ei* can simply be obtained online from a battery management instrument, and *evi* is the statistical value that is obtained from recent history. the estimated energy drain rate in the nth period, and $ev(n-1)\ i$ is the estimated energy drain rate in the previous $(n-1)$th period. α denotes the coefficient that reflects the relation between evn and $evn-1$, and it is a constant value with a range of [0, 1].

4.1.2. Connection Life Time Prediction:

We are only concerned with the minimum node lifetime or the connection lifetime in a route from two nodes of a stable connection are within the communication range of each other, the connection lifetime may last longer, and they are not a bottleneck from the route to which they belong. It is easier to model the mobility of nodes in a short period during which unstable connections last. Reasonably and simply that the nodes move at a constant speed toward the same direction in such a short period. Easy to measure the distance between nodes Ni and $Ni-1$ when we use Global-Positioning-System-based location information. Senders transmit packets with the same power level a receiver can measure the received signal power strength when receiving a packet and then calculates the distance by directly applying the radio propagation model.

If the received signal power strength is lower than a threshold value, we regard this link as an unstable state and then calculate the connection time. Our proposed method requires only two sample packets, and we implement piggyback information on route-request (RREQ) and route-reply (RREP) packets during a route-discovery procedure with no other control message overhead, and thus, it does not increase time complexity.

5. SIMULATION RESULTS

To evaluate the performance of the EDNR, we compare the performance of the EDNR with those of the following three routing protocols: 1) the original DSR, in terms of network throughput, routing failures, and control packet overhead. The original DSR tends to find the shortest path from the source node to the destination node, ignoring the node lifetime and wireless LLT.

Figure. 4 shows the throughput performance in terms of the number of packets for the four routing protocols. The proposed EDNR protocol outperforms the remaining three protocols in varying node velocity environments. Its throughput enhancement is achieved by approximately 79.2%, 14.2%, and 13.8%, compared with that of the original DSR.

Figure. 5 shows the advantage of the EDNR protocol in terms of the number of routing failures. To adapt to dynamically varying network topology environments, the EDNR, protocols do their best to find a more stable route, reducing the number of routing failures by 21.2%, 15.6%, and 14.2%, respectively, compared with that of the original DSR.

Routing overhead is defined as the amount of routing control packets, including RREQ and RREP. Figure. 5 shows the routing overhead of the four routing protocols. The EDNR protocol yields a significant improvement with the help of our proposed route lifetime-prediction algorithm, and its overhead is reduced by 25.6%, 9.4%, and 6.3% However, the length of RREP packets is 3 × 4 B longer than that of the DSR

A. **S**imulation Parameters

Simulation Time	1000s
Topology Size	1000m x 15000m
Number Of Nodes	250
MAC Type	MAC 802.11
Radio Propagation Model	Two Ray Model
Radio Propagation Range	250m
Pause Time	0s
Max Speed	4m/sec-24m/sec
Energy Model	Energy Model
Initial Energy	100J
Transmit Power	0.4W
Receive Power	0.3W
Traffic Type	CBR
CBR Rate	512 bytes x 6 per second
Number of Connections	50

Table 1- Simulation Parameters

B. Result Analysis

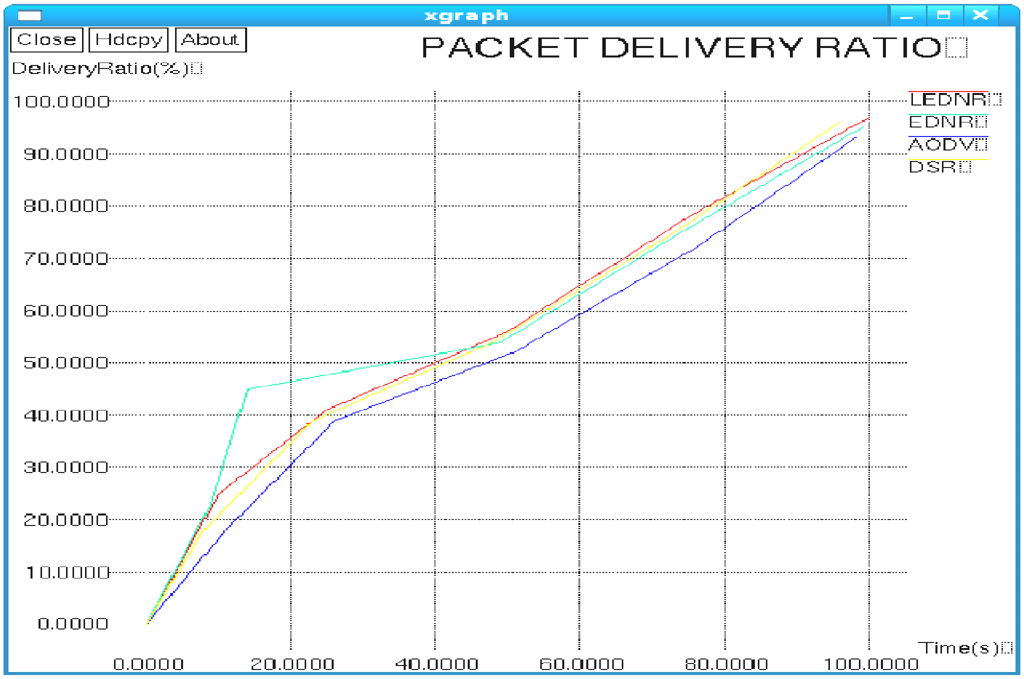

Figure 2. Packet Delivery Ratio

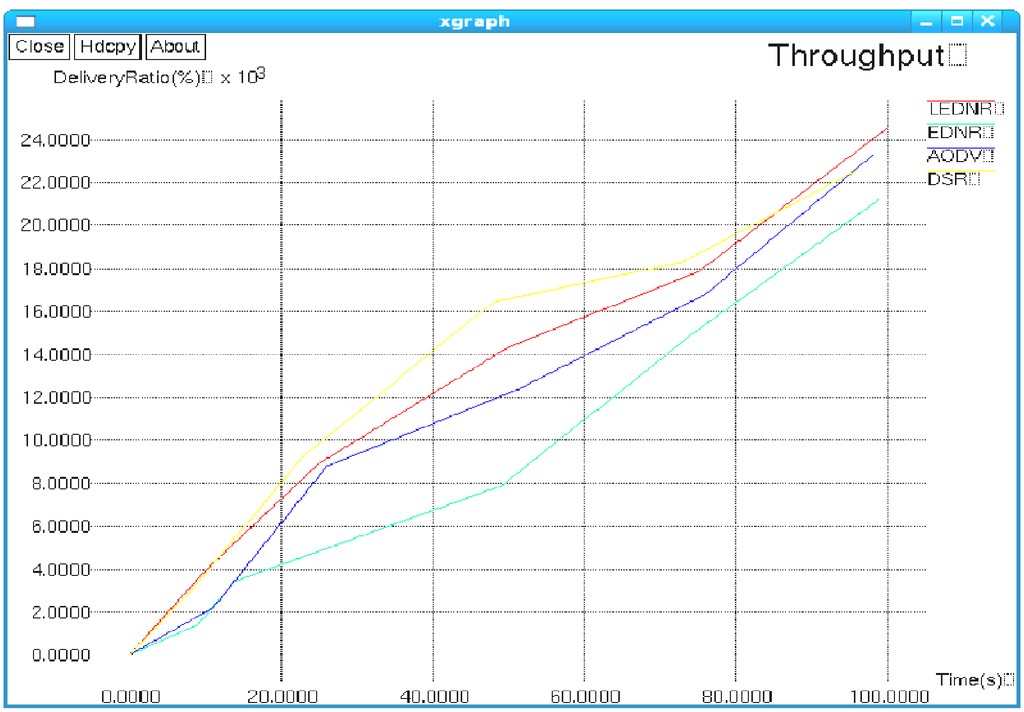

Figure 3. Throughput

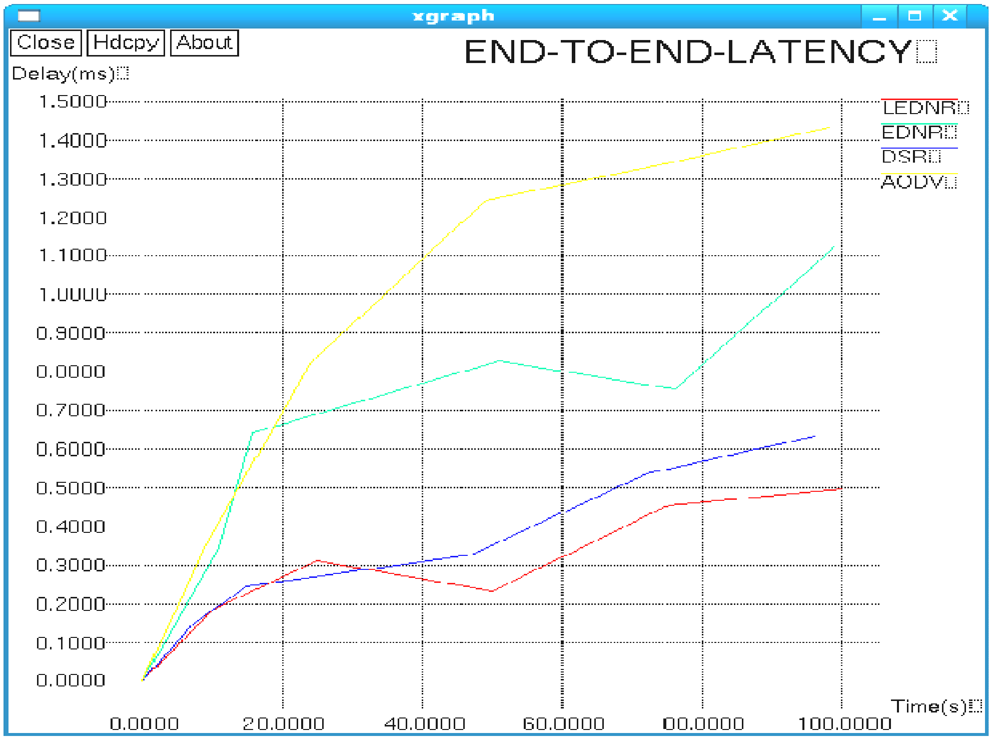

Figure 4.End to End Latency

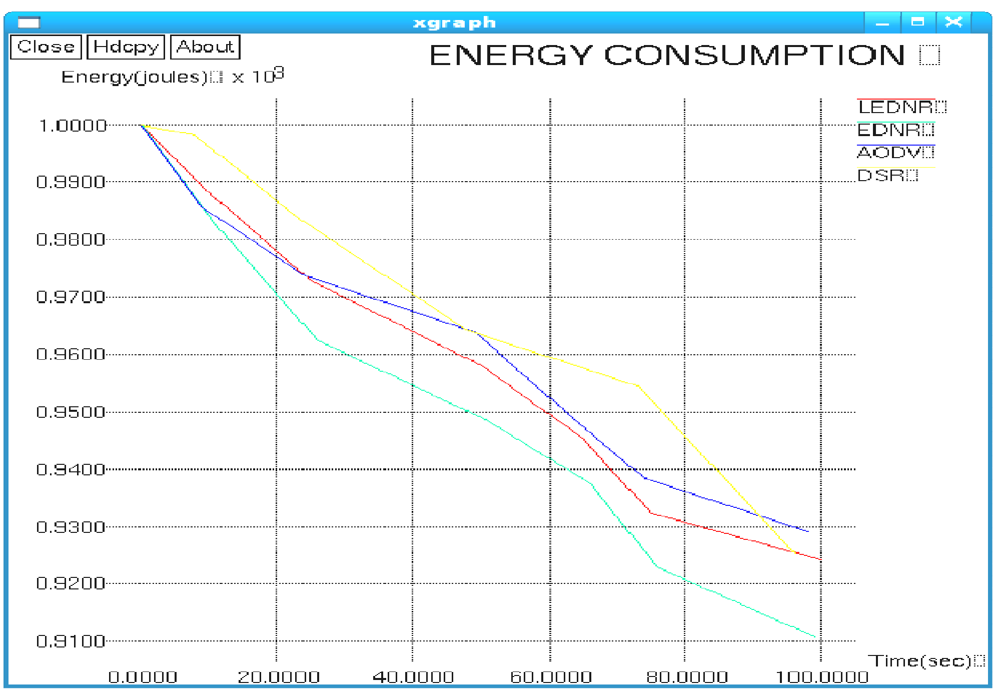

Figure 5.Energy Consumption

Parameters	**Routing Protocol**	
	Min	**Max**
Throughput	EDNR	LEDNR
Energy Consumption	EDNR	DSR
End to End Latency	LEDNR	AODV
Packet Delivery Ratio	AODV	LEDNR

B. Large Scale-Routing Protocol Performance Evaluation

6. TRUST COMPUTATIONS

Trust is an important aspect of mobile adhoc networks (MANETs). It enables entities to cope with uncertainty and uncontrollability caused by the free will of others. Trust computations and management are highly challenging issues in MANETs due to computational complexity constraints, and the independent movement of component nodes. This prevents the direct application of techniques suited for other networks. In MANETs, an untrustworthy node can weak considerable damage and adversely affect the quality and reliability of data. Therefore, analyzing the trust level of a node has a positive influence on the confidence with which an entity conducts transactions with that node.

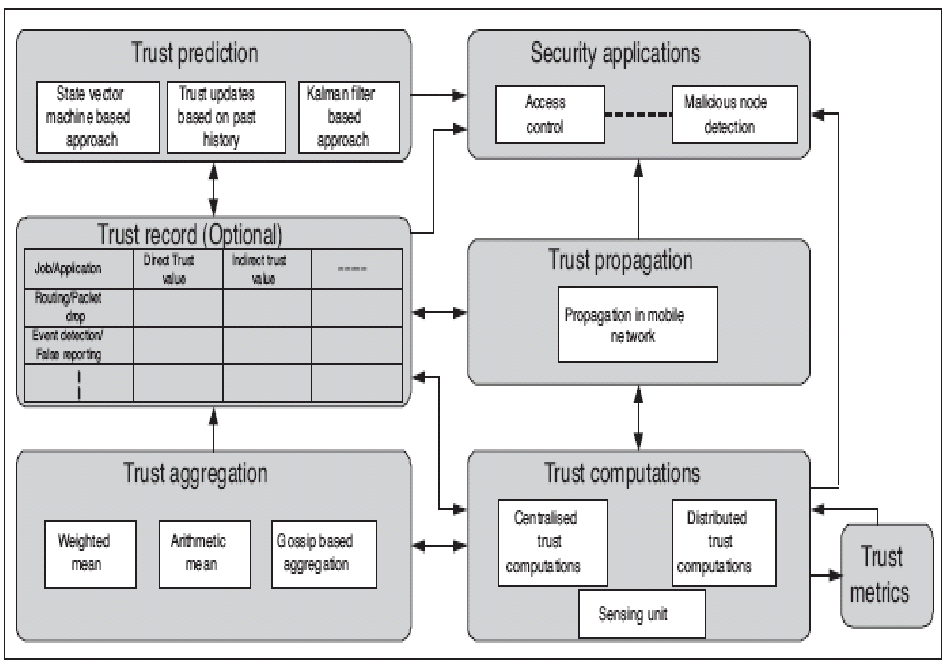

Figure 6. Relationship among various trust blocks

Our proposed MANET trust system contains the following functional blocks as shown in Fig. 6:

- Trust computations based on metrics and definitions
- Trust propagation

- Trust aggregation
- Trust prediction
- Trust applications

First of all trust value of the node will be computed (trust computations) based on some metrics or recommendations. This trust computation can be centralized or distributed as shown in Trust computations block of Figure 6. These computed trust values will be propagated in the network so that the trust can be established between nodes which are not in immediate contact. While propagating the trust, trust values from multiple paths will be aggregated to get a combined trust value which can be stored in the history. The stored trust value will be used in the trust predictions and this predicted trust value will be further used in the applications that need security. The stored trust value can also be used in the trust computation block in the form of feedback knowledge. Therefore, trust computations, trust propagation, trust aggregation and trust prediction blocks are closely interconnected in our envisioned trust system.

7. Conclusion

In MANETs, a link is formed by two adjacent mobile nodes, which have limited battery energy and can roam freely, and the link is said to be broken if any of the nodes dies because they run out of energy or they move out of each other's communication range. In this paper, we have considered both the node lifetime and the LLT to predict the route lifetime and have proposed a new algorithm that explores the dynamic nature of mobile nodes, such as the energy drain rate and the relative motion estimation rate of nodes, to evaluate the node lifetime and the LLT. Combining these two metrics by using our proposed route lifetime-prediction algorithm, we can select the least dynamic route with the longest lifetime for persistent data forwarding .Finally, we have evaluated the performance of the proposed LEDNR protocol based on the AODV. Simulation results show that the AODV protocol implemented with LEDNR outperforms the DSR protocol implemented with EDNR mechanisms. Trust system can be used in assessing the quality of received information, to provide network security services such as access control, authentication, and malicious node detections and secure resource sharing .For this, we analyzed various trust computing approaches.

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