Cld-Dlpa - Cross-Layer Design of Dynamic Link Prediction Power Control Algorithm in Wireless Ad Hoc Networks

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Abstract

In wireless communication era, Dynamic Link Prediction based Cross-Layer Power Control Algorithm DLP-CLPCA) in wireless ad hoc networks provides a joint solution for the power consumption protocol as well as nodes link availability. The Conventional design of ad-hoc network protocols is built on the standard OSI model which has failed to relate with RSS problems, whereas the physical, datalink, network, and transport layer has been influenced. Due to this, the early unavailability of nodes occurs and frequent route break during the transmission. To overcome the constraint, developed the Dynamic Link Prediction based Cross-Layer Power Control Protocol to forecast the route earlier maximizes the link availability and create the optimum routing path during the transmission. The proposed link prediction algorithm is implemented in NS-2 simulator with the performance metrics like throughput, delay, and energy consumption as a parameter values.

Keywords—Cross-Layer, Dlp-Clpca, RSS, NS-2

I. Introduction

An ad hoc network is a group of small-scale nodes, while the communication occurs without any preexisting infrastructure and framework. In the conventional wireless network, the node itself acts as a host and a router. The network host node transfers the data and establishes a communication path from source to destination for transmitting the packets. Most of the existing systems of ad- hoc networks sustain from the limitations of link unavailability, link error break, limited resources, and frequent route breakage. (3) Because of all those limitations, the energy efficient power consumption is eventually to be exhausted. To provide better functionalities to overcome these drawbacks, proposed the dynamic link prediction cross-layer power control protocol that used the Dynamic Group link prediction (DGLP) algorithm to predict the route earlier before the data communication and also the transmission maintains the routing path throughout the nodes transmissions.

Power control is a crucial and challenging problem in today's wireless communication network. Transmission power protocol is a prototypical paradigm for a cross-layer design, also providing gains in energy and power consumption. In our proposed protocol network system architecture, power control impact on four layers of dynamic protocol stack from the physical layer to the transport layer (1). The performance evaluation of the wireless network applications and energy consumption are certainly for two contradictory research assessment.

CLD is used to support flexible layer design methods in mobile wireless communication. Generally, cross-layer design refers to the protocol layer design done by authorizing layers to exchange state information to get performance gain ratio. Layer Protocols use the state information flowing throughout the layered network stack to adapt their behavior suitably. The term state or network state is used to represent the wide range of passing communication conditions to a node, which can experience in a MANET. Consider for an example, given current channel and energy conditions; the physical layer may adapt rate, power, and coding to meet application requirements (2). The CLD introduces the advantages of distinct layer dependencies in the protocol stack, to cope with the very low poor performance of wireless links, nodes mobile in nature, high error rates, power savings requirements, and QOS.

n Wireless ad-hoc networks, unavailability of nodes may occur, and there is a frequent error route break during the communication. To overcome the above challenges, proposed a Dynamic Link Prediction based Cross-Layer Power Control Algorithm (DLP-CPCA) predicting the route earlier. Route earlier prediction maximizes the link availability of the network and creates the optimum routing path between the communicating nodes. In the proposed system algorithm, proposed the novel lightweight protocol algorithm namely Dynamic link Prediction based cross-layer power control protocol, which used the dynamic group link prediction algorithm to predict the link earlier before the transmission of nodes in the network.

II. Literature Survey

Anita Yadav (4) designed a cross-layer design for the dynamic power control protocol and link prediction (DPCPLP) that optimizes a combined solution for power Conservation of networks as well as link availability of the nodes. By using the AODV routing protocol, the effect of optimum transmit power and received signal strength based link availability estimation was done by the cross-layer approach.

Shyan Hwang et al. (5) has proposed the SBPMR algorithm to examine the system performance in terms of link-state stability, multi-path routing functions, power control, energy consumption, and load balance. The algorithm balances the information of hosts, according to the earlier predicted distance of nodes and forward the direction between two mobile hosts to enable the data receiving the destination hosts. So it's defined that the novel SBPMR algorithm has a higher hop count than DSR

Gerharz et al. (6) have examined the unique concept of identifying stable links in wireless networks deploy on the mobile devices observations of linkage parameter. The outcome expected a residual lifetime of a link varies with its age on the wireless mobility model. Based on these outcome observations, two link stability of sender and the receiver node, link metrics are derived and compared to a performance metric which favors the last oldest link as well as to a current random link. For better communication, choosing the oldest link sometimes works very well, but not often.

Shengming Jiang (7) has developed a link prediction algorithm which examines to predict the probability values that a currently active link between two nodes will be continuously available for a particular predicted period which is acquired based on the current node’s directions. The proposed link prediction algorithm cannot accurately calculate the link availability of the network, but it reflects the general liability of link availability based on the simulation results.

DSJ de Couto et al. (2005) has modeled The ETX (The Expected Transmission Count) metric incorporates the ratio in effects of data link loss, loss of asymmetric between the two directions of each link, and interference between the successive path link.

According to X.Yuan et al. (8) has proposed a genetic algorithm based, self-configuring network system clustering (GASONeC) method that provides furnish a framework to dynamically optimizes wireless sensor node clusters nodes. Compared to the state of the art methodology, gasoline greatly extends the network life in wireless transmission and improvement up to 43.44%. To devise a concise way of encoding nodes and propose fitness functions that include expected energy expenditure, residual energy, base station distance, and node density for an optimal.

According to Sinan Kurt et al. (9) has Proposed sensor model describes a realistic WSN link layer energy dissipation model for Tmote Sky platforms and also for MIP framework to jointly finest the transmission power level and data packet size and also a special attention for the harsh conditions of the SG environments (e.g., high path loss, high BER values and low SNR), but also the practical cases, such as packet retransmission mechanism, packet size changes according to the channel condition and finally enforcing a sensitivity threshold range.

III. Proposed System

Dynamic Link Prediction based on Cross-layer Power Control algorithm (DLP- CPCA) provides a joint solution for power consumption as well as link availability of nodes in the network. This combines the effect of optimal total transmission power, and RSS (Received Signal Strength) based link availability assessment of network with AODV routing protocol using cross-layer design approach. This method proposes to examine optimal transmit power for transmitting the wireless packets to a neighboring node to keep on increasing the battery life of wireless mobile nodes and received signal strength in physical layer based link prediction to increase the availability of the nodes links. The transmit power from sender side and received signal strength of the packets are based on cross-layer interaction parameters to provide the joint solution for network power consumption and reliable route formation with increases the availability of links and then routes amongst sources and destination of the movement of the nodes. The cross-layer design interactions between the non-adjacent layers in the Cross-layer protocol stack. This proposed system architecture improves the throughput, packet delivery ratio by route earlier prediction of link breaks and starts initiating the route repair process. The proposed algorithm also reduces the communication interruption time, overhead in routing, end-to-end delay and power consumption by use of cross-layer interaction

1. **Power control**: At the MAC layer RTS, CTS, DATA and ACK are sending at transmitting power level, enough to sustain a better quality communication during the network traffic. The estimation of power control is done dynamically based on RSS of RTS, CTS, DATA, and ACK packets between the node links; the sender can adjust its own transmission power dynamically at any time.

2. **Link availability**: By Using (RSS) received signal strength of packets from protocol stack physical layer, link availability time can be calculated and then earlier prediction of link break remind the upstream nodes and sources from the network before the path breaks and either upstream nodes or sources can rediscover a new path in before for forwarding the packets.

A. Proposed Dynamic Link Prediction Algorithm

The dynamic link prediction algorithm is used to predict the time after which an activation link will break during the communication. This is done by estimating the time at which received signal strength of the data packets will fall below a threshold power range. The received power level ranges below the threshold value indicates that the two nodes are moving away from each other's radio transmission range. The prediction of link break alert the source before the path breaks, and the source network can rediscover a new path in advance. Each time a data packet is received for communication, the receiving node monitors the link with the following algorithm:

Algorithm Notations:

Pt1,Pt2, Pt3	:	Packets
Prime	**:**	Time
Pbt^{1}:	Break time	
Pnext:	Next node	

DestN : Destination Node

B. Algorithm: Link prediction algorithm

1. For every neighbor node,
2. On the delivery of a packet,
3. Update record of (Power received, time) for last three packets,
4. If ((**Pt1**> **Pt2** and (**Pt2**> **Pt3**) then Prediction (),
5. Prediction ()

6. {

7. Estimate and then update **PTime** the and update the **Pbt**[1] , when a node enters into the critical state before link break

8. }

9. If (current time >= **PTime**)

10. {

11. Sent the warning message to the upstream node,
12. Sleep for a fixed duration of time internal.

13. }

14. On receipt of repair message from the receiver,
15. Set the route and link as soon-to-be-broken,
16. Local route Repair().

Local route Repair()

18. {

19. Find the path to the next node PNext;
20. If (found a path in k-hops within the time interval)
21. Use the previous path for rerouting.
22. Else
23. Find another path to destination DestN;
24. If (Correct path is found)

25. {

26. Route the packet through new path destination,

27. Send a message to sources node to examine the shortest path.

29. }

30. }

1. At source level:

2. {

3. New discovery path message received,

4. Discover the current new path,

5. Redirect the traffic through the current new path.

6. }

IV. Simulation Parameters – (Dlp –Clpcp)

Traffic Pattern	CBR- Constant Bit Rate
Simulation Time	10000 seconds
Total Connections	10,20,30,40, and 50
Packet size	Bytes -512
Velocity	5, 10, 15, 20, 25 and 30 meters/second
Pause Time	20 seconds
Simulation Area	2000m by 500m
Total Nodes	25, 50, 75, 100 and 125

Table 1 - Two-ray radio propagation model is used.

A. Performance Metrics

The performance metrics of protocols have been configured by using the average interruption time, average energy consumption, PDR(packet delivery Ratio), throughput and end-to-end delay as a function based on the mobility of nodes, packets generation rate, and node density. Constant bit rate (CBR) sources are assumed in the network simulation. Average interruption time can be calculated by the time during which ongoing communications are to be interrupted.

Energy consumed (in Joules) per 1-kilobyte data delivered is calculated as the total amount of transmitting and receiving energy consumption overall flows divided by the total data delivered by all the flows. The energy consumption of all the packets RTS, CTS, DATA, and ACK are considered.

Throughput is the number of possible kilobytes transferred successfully by the sender to the receiver successfully per unit time.

PDR- Packet delivery ratio is the ratio of the data packets delivered to the finest destination to those generated by the CBR incoming sources. The higher rate the value better is the performance ratio.

Average end-to-end delay of data packets includes all delays caused by transfer time, buffering during route discovery, retransmission delays at MAC layer, propagation and, queuing at interface queue

B. Simulation Result and Analysis

In Figure 1. the proposed cross-layer protocol is implemented by using the following parameters shows the comparison of the AODV throughput and DLP-CPCA. The status shows that DLP-CLPCA achieves the highest throughput compared to AODV routing. Because DLP-CLPCA uses smaller carrier sensing range compared to AODV routing, therefore a large number of small nodes can transmit concurrently and additionally alternative routes are discovered in advance before a link break failure, and delivers a short message through an alternative route. However, DLP- CLPCA gives increasing throughput as a packet generation rate increases and saturates at a particular time. The throughput remains constant after a particular point, low packet generation rate, less number of packet would be contending for the retransmission and at higher network loads, due to reduction in power also the reduces the number of deferring nodes, and thus, more data can be delivery could be achieved, therefore throughput increases linearly and saturates at the higher packet generation rate.

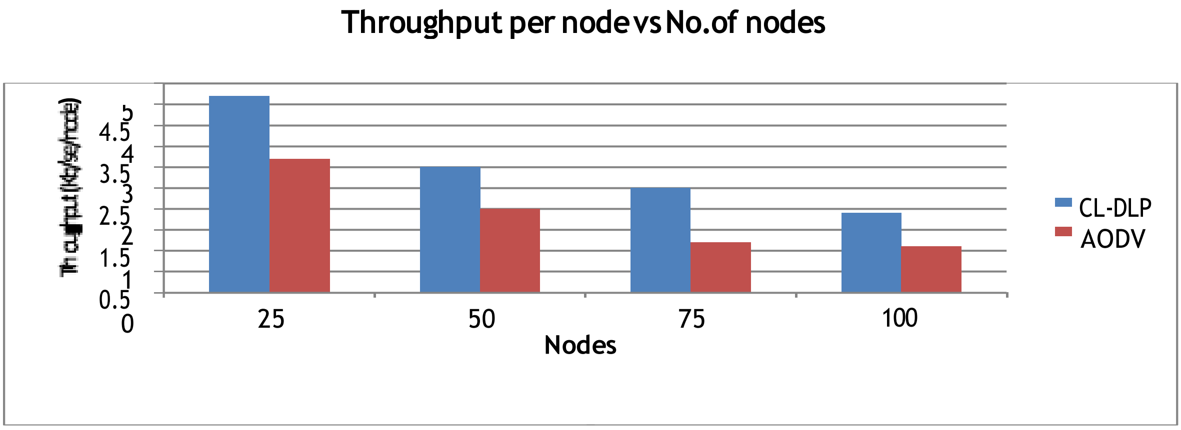

Figure 1. Throughput vs. packet generation rate

Figure 2. Variation of packet delivery ratio with increasing node density parameter. Shows that the packet delivery ratio is best DLP-CPCA is to be compared to AODV. Happens only because, in DLP-CPCA, concurrent transmission takes place due to spatial reuse of the channel condition resulting from lower transmit power of the packets, in addition to DLP-CLPCA schemes discover another alternative routes before the route failures, and then more data is successfully delivered to the destination node. However, DLP-CLPCA compares to AODV give decreasing delivery ratio as node density continuously increases, results in more contentions and collision due to more neighboring nodes in the vicinity. Decreases delivery ratio by retransmitting the packets more than once at a time.

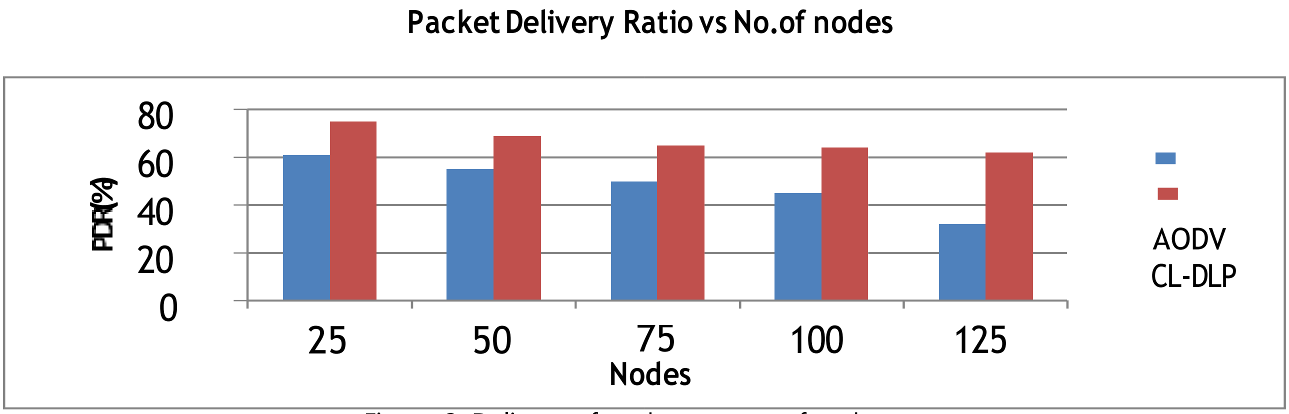

Figure 2. Delivery of packets vs. no. of nodes

Figure 3. shows the energy consumed per successful communication of 1 kilobyte of data sent with an increase in the packet generation rate. Results show that power consumption per successful communication of 1 kilobyte of data is lowering DLP-CPCA, compared to AODV. DLPCLPCA is least very low power consuming as compared to other schemes as it uses lower power for communication of RTS, CTS, DATA and ACK packets and link successes are also examined and avoiding retransmissions of packets. However, DLP-CPCA, AODV provides increasing average energy consumption as network load increases, since many more packets are generated and contending in the network, and thus these packets are sent to the destinations network. Therefore, more energy is consumed in successful communication of packets in the wireless network.

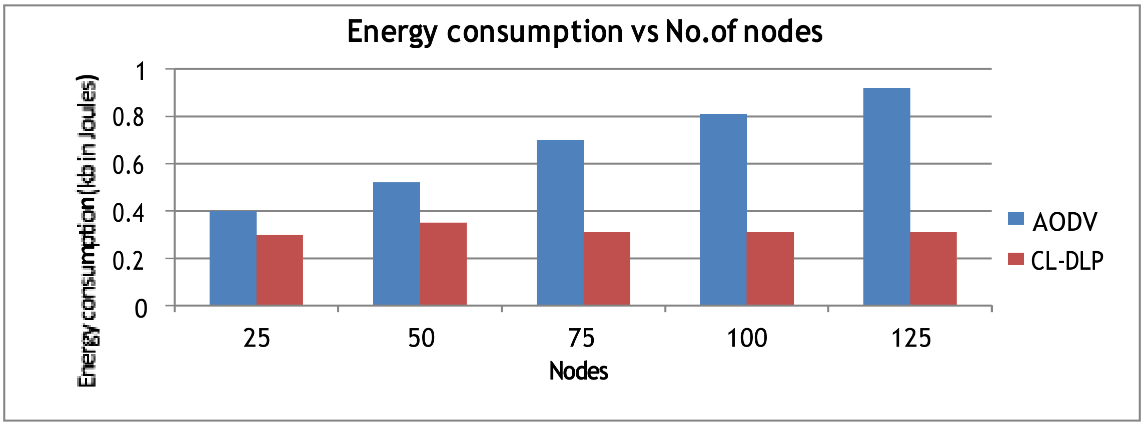

Figure 3. Average energy consumption (in Joule) per communication of 1Kbyte of data vs. packet generation rate

Figure 4. shows The end-to-end delay is an average of the difference between the time a data packet is originated by an application, and the time the data packet is received at its destination. F shows a lowest end-to-end delay in DLP- CPCA as AODV because DLP-CLPCA takes care of the concurrent transmission of packets due to lower transmit power for RTS, CTS, DATA, and ACK in addition to prior route discovery in case of route failures. At low density, the delay is low in all schemes, and it increases with increase in density because high node density increases contention and collisions, thus result in the retransmission of packets.

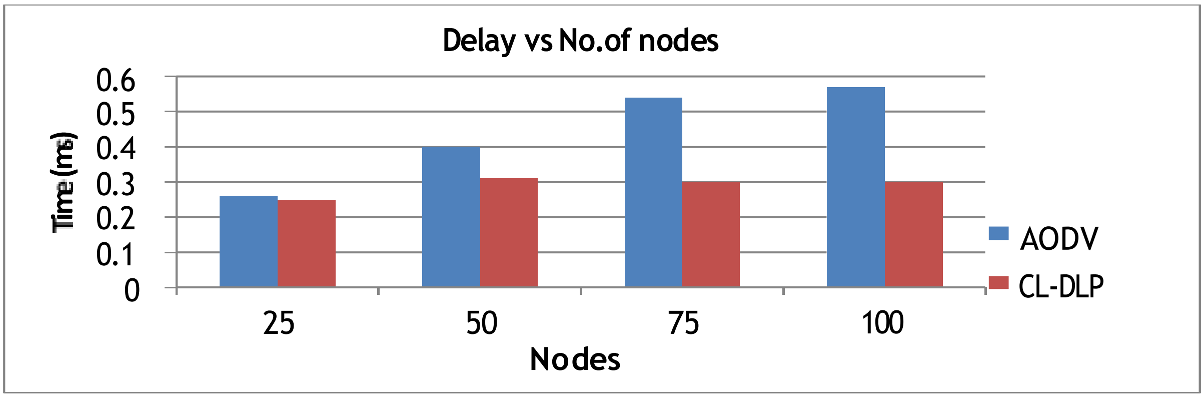

Figure 4. End-to-end delay vs. No. of nodes

V. Conclusion nd Future Work

The increased performance of the proposed Dynamic Link Prediction based Cross-Layer Power Control Algorithm DLP-CLPCA performs better as compared to AODV routing protocol. This results in better throughput, energy consumption thus longer battery life and good delivered network because of least overhead routing packets and average interruption time due to use of optimal (lower) transmit power and prior route repair processes. Therefore, it will improve networks and nodes' lifetime and capacity to support Quality-of-Service(QoS). The Performance of link prediction routing can be evaluated for acts traffic is implemented using the NS-2 simulator. A lot of research can also be done in the other layers of the protocol stack functions, and therefore, this study can be extended to design better protocols with other schemes to achieve improved efficiency.

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