Performance Analysis of LLECLAIR versus AODV in wireless networks

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Abstract— TCP/IP protocol suite provides the set of protocols which is defacto standard for communication in the Internet today. TCP/IP protocol provides efficient performance in wired networks. Protocols like AODV in wireless networks faces technological challenges such as 0.42ms delay, 160kbps throughput, 940 pdr, 7.9 joules of energy spent on the simulation of 50 nodes and 10s simulation time.LLECLAIR is a cross layer design approach that increases throughput to 200kbps, and pdr upto 950 and it reduces the delay upto 0.17ms and energy spent to 7.45joules in order to increase the overall performance of wireless networks. LLECLAIR is the combination of LLCLAMP and ÉCLAIR protocols which provides an efficient way to optimize and merge the layers in TCP/IP suite.

Index Terms— Adhoc- on demand Distance Vector routing protocol, Cross Layer Design, delay, energy spent, ÉCLAIR, LLCLAMP LLECLAIR, throughput, Transmission Control Protocol.

1 INTRODUCTION

Cross layer design may be defined as, "the breaking of OSI hierarchical layers in communication networks" or protocol design by the violation of reference layered communication architecture is cross-layer design with respect to the particular layered architecture ". The breaking of OSI hierarchical layers or the violation of reference architecture includes merging of layers; creation of new interfaces, or providing additional interdependencies between any two layers [1].

Cross Layer Design is considered as efficient structure for optimizing the behavior of the wireless network using TCP. Literature review so far indicates authors and developers have proposed so many architectures to support cross layer designing methodologies amongst them some areECLAIR (Efficient Cross Layer Architecutre for wireless protocol stack), LLCLAMP (Link Layer Cross Layer Management Plane), LLE-TCP (Link Layer ARQ Explotiation TCP), C3 TCP (Cross Layer Design for Congestion Control TCP) and many more. All this models provides optimization in order to improve the performance on or more performance parameters such as: -

- **Delay:** -time required for receiving a packet at receivers end from sender.
- **Packet Delivery Ratio:** - ratio of received packets / send packets.
- **Throughput: -** ratio of output /input data transfer per unit time
- **Energy spent: -** amount of energy spent or consumed by the nodes in network
- **Good put:-** application level throughput.
- **Data Transfer rate: -** amount of data transferred per unit time
- **Scalability: -** number of nodes can be added or removed. etc.,

In this paper, we have taken two protocols AODV and LLECLAIR and simulated them with NS2 simulator. AODV being an efficient algorithm in wired network can also be used in wireless network on TCP. Whereas LLECLAIR being the combination of the ÉCLAIR and LLCLAMP provides efficient cross layer design architectural framework on which various Cross layer design can be developed.

This paper is organized as follows: related work for AODV and LLECLAIR is given in section 2; overview of the AODV protocol is given in section 3; overview of LLECLAIR architecture is given in section 4; Simulation setup and results of simulation on AODV and LLECLAIR is given in section 5; Conclusion and summary for the paper is provided in section 6.

2 RELATED WORK

Several researches and compaision of AODV protocol is done with many other routing techniques such as FSR, DSDV, OLSR and DSR which are mentioned in [2] [3] [4] [5]. These research shows that AODV can work in various wireless networks such as MANET, VANET etc., but, the performance of AODV is not as good as it is in wired network. Cross Layer Design approach provided number of approaches for communication in the wireless network .Number of developments has done and still various researches are going on the concept of CLD in wireless network. The standard architecture ECLAIR is developed which provides an efficient way to merge two or more layer is given in [6], and the efficient congestion control mechanisms are developed for communication in wireless networks such as LLCLAMP is given in [7].An efficient architecture is developed using the combined approach of ÉCLAIR and LLCLAMP know as LLECLAIR is simulated in this paper using NS 2 simulator.

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3 OVERVIEW OF AODV PROTOCOL

The Adhoc On –Demand Distance Vector (AODV) algorithm enables dynamic, self starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allow mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destination that are not in active communication. AODV allos mobile nodes to respond to link breakages and changes in network topology in a timely manner.The operation of AODV is loop –free, and by avoiding the Bellmn-Ford" counting to infinity "problem often quickly convergence when the ad hoc network topology changes.

One distinguishing feature of AODV is its use of a destination sequence number for each route entry. The destination sequence numer is created by the destination to be included along with any route information it sends to requesting nodes. Using destination sequence numbers ensures loop freedom and is simple to program. Given the choice between two routes to a destination, a requesting node is required to selet the one with the greatest sequence number. Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. These message types are received via UDP, and normal IP header Processing applies.

4 LLECLAIR ARCHITECTURE

The proposed system LLECLAIR in [8] is a combination of the above mentioned ÉCLAIR and LLCLAMP. ÉCLAIR architecture is best for designing the cross layers on the sender and receiver sides, whereas the LLCLAMP architecture provides an efficient congestion free mechanism for communication.

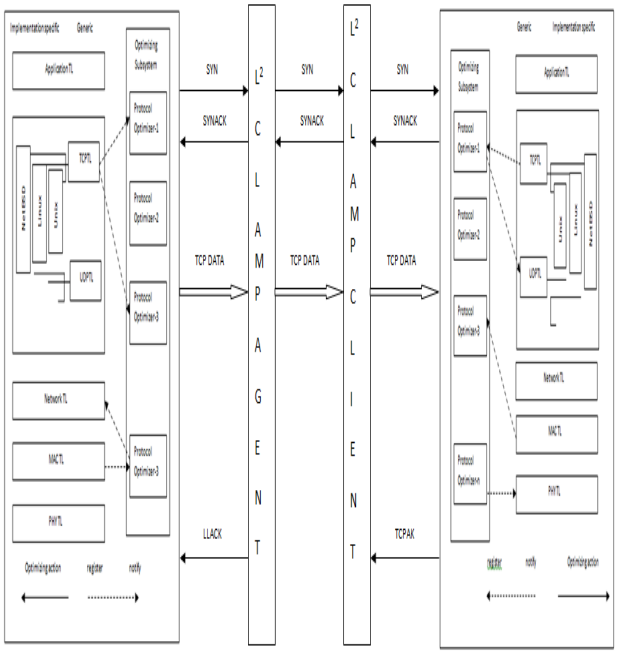

Fig 1.LLECLAIR architecture

In the proposed protocol we have developed the ÉCLAIR protocol on the extreme ends where the actual sender and receiver are located and the LLCLAMP agent and LLCLAMP client modules are used for the purpose of communication between the sender and receiver. The following Fig 1 shows the architecture of the LLECLAIR protocol.

LLECLAIR architecture provides dual benefit for communication in wireless ntwork using the concept of cross layer design. LLCLAMP provides better congestion control mechanism but using CLAMP can only reduce the problem of congestion control. Every mobile wireless node present in wireless nework will first develop the ÉCLAIR architecture on them. This architecture will provide the tuning layer and OSS to every node.

Fig 2 below shows a simple example of wireless nodes communicating using the LLECLAIR protocol. Fig 2 shows there are 10 nodes and node N1 is communicating with node N5 and node N3 is communicating with node N10. All these are wireless or mobile nodes which keeps on changing there location. Now if node N1 is communicating with node N5, firstly these nodes have to decide upon which layers and which protocols they would required for the communication. Suppose if node N1 uses the IP protocol of Network layer and ATM protocol from Datalink layer, then by using the Tuning layer and Optimization Subsystem layers of the LLECAIR both the layers are merged with each others and the required data structure is created for the same which includes the type of packets, type of message queue, size of packets and others. Once the ÉCLAIR layer from LLECLAIR protocol develops the data structure and merges the required layers with the nodes, the commmuication process moves ahead considering the congestion controlled technique of the LLCLMAP.

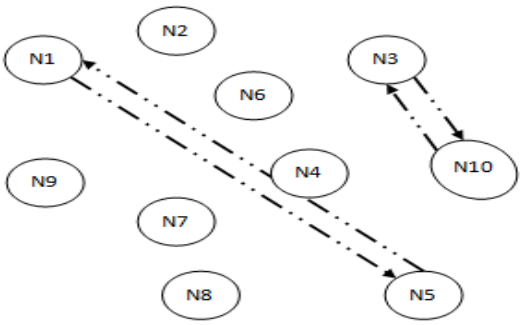

Fig 2. Communication using wireless mobile nodes

Node N1 and N5 first will setup the data structure as mentioned above after which the sender N1 will send the SYN packet to the receiver N5, LLCLAMP agent and LLCLAMP client acts as the intermediate layer for communicating between the ssender and receiver.N5 sends the SYNACK in response with the SYN bit sent by the N1. If both nodes are ready to transmit the data is send from the sender to receiver. LLCLAMP agent and LLCLMAP client provides reliable communication between two nodes. As the nodes are mobile LLCLAMP also locates the sender and receiver for the data transmission. Whenever the packets are received by the re-

ceiver the LLCLAMP client will send the ACK packet to the LLCLAMP agent and no hence no need of generating of the ACK packets by the receiver which saves even the communication time.

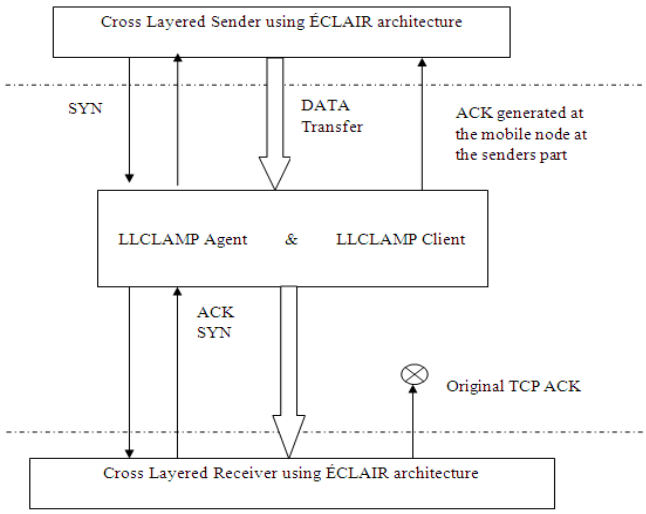

Fig 3. LLÉCLAIR communication flow

The communication flow of LLECLAIR protocol is shown in the Fig 3 above.

5 Simulation Setup and Results

Here the following simulation setup is used:-

TABLE 1
SIMULATION SETUP

Parameter	Value
Area of simulation	500X500
Channel Type	Wireless
Propagation model	Radio-propagation model
Number of Nodes	50 Nodes
Receiving Power	0.3
Transmitting Power	0.3
Initial Energy	90 Joules
Packet s.ize	100 bytes
Window Size	150bytes
Simulation Time	10s

5.1 Results for simulation

Simulation is done using NS-2 simulator considering the simulation setup as mentioned in the Table 1, 50 wireless mobile nodes were created and simulation was carried out individual on parameters such as throughput, average delay, pdr and energy spent. The total duration of simulation was about 10 seconds the behavior of AODV and LLECLAIR is represented in the following figures.

Fig 4 shows the simulation environment using the above mentioned setup.

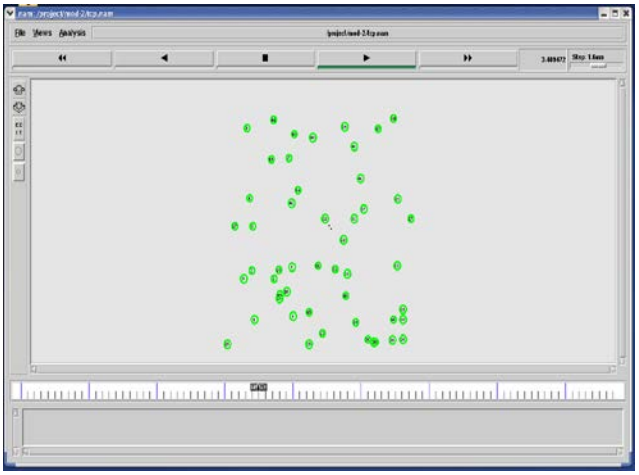

Fig 4. Simulation using NS-2 for Communication between wireless mobile nodes

5.1.1 Throughput measurement in AODV vs LLECLAIR

Fig 5 shows the comparision of throughput between LLECLAIR and AODV from figure it is clear that for 50 mobile nodes and for 10 sec simulation time AODV has throughput of 160kbps where as LLECLAIR has 200kbps.Throughput in LLECLAIR shows a linear behavior with time with respect to AODV, whereas AODV shows a constant behavior with respect to time.

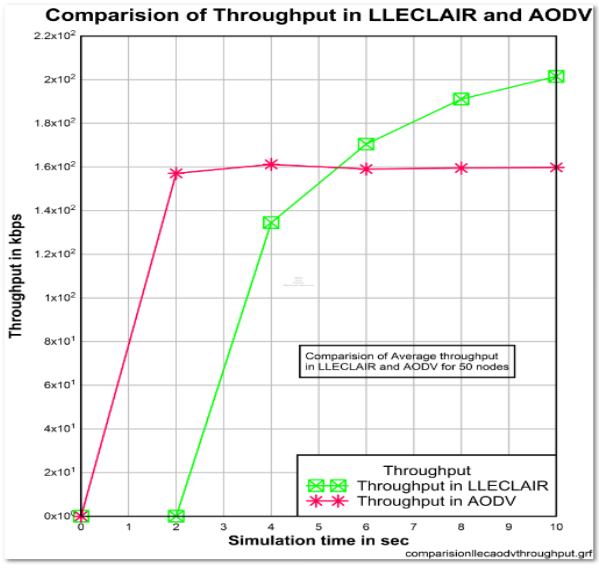

Fig 5. Comparison of throughput in AODV versus LLECLAIR

5.1.2 Delay measurement in AODV vs LLECLAIR

Fig 6 shows the comparision of delay between LLECLAIR and AODV from figure it is clear that for 50 mobile nodes and for 10 sec simulation time AODV has delay of 0.42ms where as LLECLAIR has 0.17ms. Delay in LLECLAIR is less with respect to AODV, and it becomes nearly constant once the maximum possible amount of delay is reached.

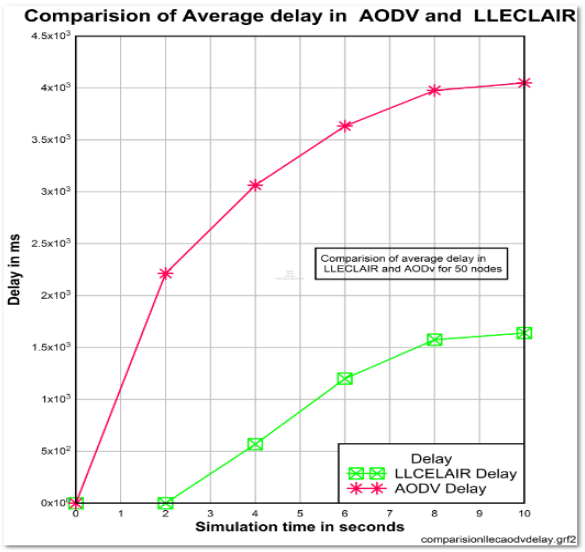

Fig 6. Comparison of average delay in AODV versus LLECLAIR

5.1.3 Energy spent measurement in AODV vs LLECLAIR

Fig 7 shows the comparision of energy spent between LLECLAIR and AODV from figure it is clear that for 50 mobile nodes and for 10 sec simulation time AODV have average energy spent of 7.9Joules where as LLECLAIR has 7.45joules. Energy spent in the LLECLAIR shows a linear behavior but its less with respect to the AODV.

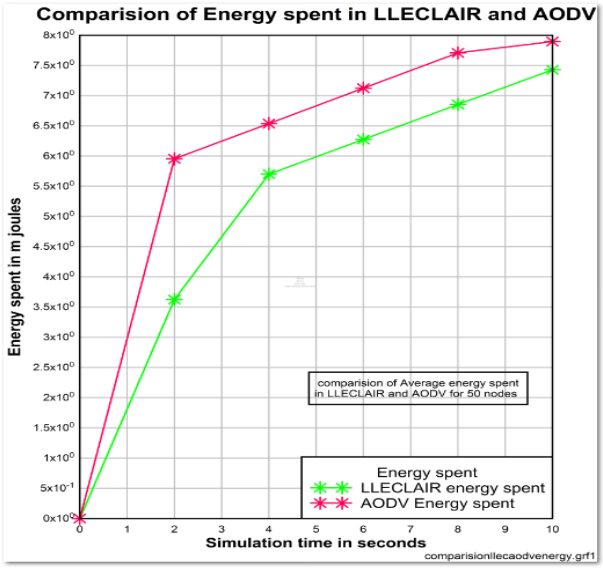

Fig 7. Comparison of energy spent in AODV versus LLECLAIR

5.1.4 Packet delivery ratio measurement in AODV vs LLECLAIR

Fig 8 shows the comparision of average packet delivery ratio between LLECLAIR and AODV from figure it is clear that for 50 mobile nodes and for 10 sec simulation time AODV has average packet delivery ratio is 940 where as LLECLAIR has 950.

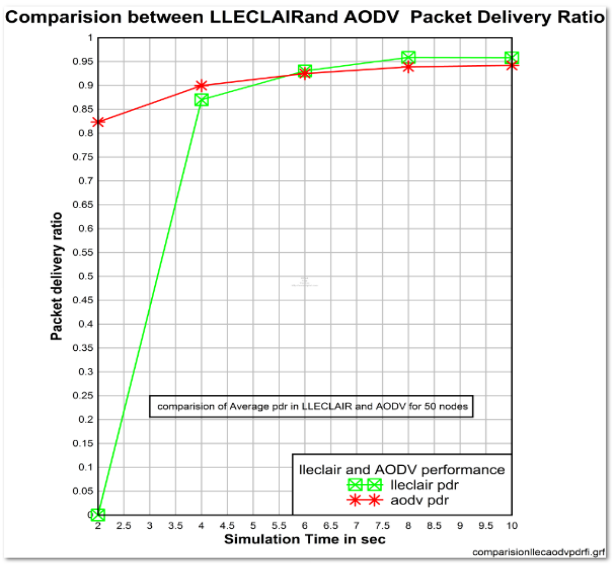

Fig 8. Comparison of packet delivery ratio in AODV versus LLECLAIR

5.2 Summary of Results

From the Table 2 it is very much clear that for the optimization of the performance in the wireless networks cross layer designs works better. The comparision of LLECLAIR a cross layer design technique, with the AODV protocol shows that

TABLE 2
SUMMARY OF SIMULATION RESULTS FOR AODV AND LLECLAIR

Parameters	AODV	LLECLAIR
Delay	0.42 ms	0.17ms
Throughput	160kbps	200kbps
Energy Spent	7.9 joules	7.45 joules
Packet Delivery Ratio	940	950

LLECLAIR optimizes the throughput, increases the packet delivery ratio, and decreases the delay and the energy spent in the wireless mobile networks.

6 CONCLUSION AND FUTURE SCOPE

In this paper, a method is investigated which is an application of the Cross Layer Design for the TCP/IP performance improvement in wireless networks. The TCP /IP protocol suite, which is the de facto standard for communication in Internet

today, is originally designed for traditional wired networks. As a result, TCP/IP shows poor performance in wireless networks environment due to the limitation of wireless medium in terms of energy spent, throughput, delay, packet delivery ratio.

The Cross Layered Architecture of LLECLAIR considered in the paper take into account performance parameters such as delay, throughput, energy spent and packet delivery ratio and shows a better performance when compared to Layered architecture protocol AODV. The overall result as shown in section 5 of this paper tells that Cross layer design methodology proves a best solution for communication in wireless network. It is also seen that the ECLAIR architecture, part of LLECALIR architecture provides a facility to use any two or more layer together to act as a cross layer design approach. Whereas the LLCLAMP architecture provides the best way avoid congestion and increase the performance parameters like throughput, delay, packet delivery ratio and energy spent.

In the proposed system a Cross Layer Design has been implemented for optimizing only four performance parameters mainly delay, throughput, packet delivery ratio, and energy spent in future the above protocol can be expanded for the various other parameters like congestion control, scalability, good put, data transfer rate etc.,

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