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Research paper

A Survey on Cross Layer Design based Routing Protocols in Manets

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Abstract

Mobile AdHoc Network which is abbreviated as MANET is usually outlined as a system or network that has several free or autonomous nodes, typically composed of mobile devices or alternative mobile items, which will prepare themselves in varied ways in which and operate while not strict top-down network administration. Rising attention and permit interested in technology of wireless networking is emphasizing novel experiments in developing optimized communication protocols. Conventionally, architecture of protocols has severe layering principles, which assures ability, rapid organizing, and cost-effective applications. Still, absence of direction among layers bounds the act of such architectures due to the precise experiments postured by communication links of wireless environment. Cross layer method is developed to overcome such drawbacks. The main idea of cross layer method is to allow coordination, interaction among different layers. This paper presents different cross layer plan models, different cross layer based steering conventions created by different researchers in MANETs, and different issues which are under dynamic research.

Keywords: *Cross Layer Design(CLD);Mobile AdHoc Network (MANET); Routing in MANET,*

1. Introduction:-

The Mobile AdHoc Network (MANET) might be unceasingly a network with own configuration and pre arrangement less network in which mobile nodes or devices are connected. Each node or device in manet can move in any way and some what alteration of links to various nodes frequently.

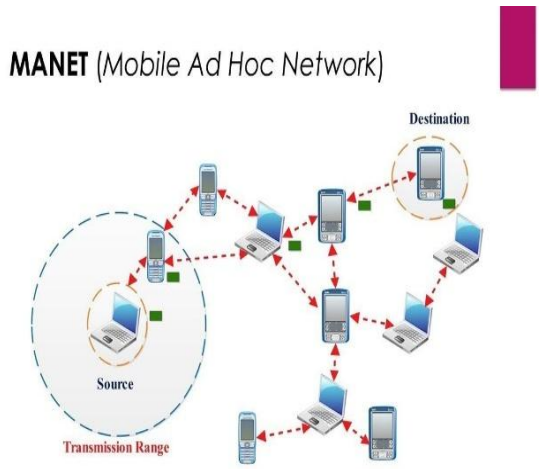


Fig 1: Mobile AdHoc Network

Mobile circumstantial networks is employed in several applications, starting from sensors for surroundings, conveyance circumstantial communications, path care, strength, homebased, peer-to-peer automated messaging, mischance release operations, airborne/land-living/fleet protection, missiles, automatons, etc.

The remaining of the paper is planned as keep an eye on. In division 2 contain protocols for routing in MANETs. In division 3 contain would like of Cross Layer style in MANETs. In division 4 contain varied cross Layer style architectures. In Division 5 contain wiped out cross layer routing protocols in MANETs. In division 6 contains comparisions of various cross layer based routing protocols. In division 7 contain open problems and future scope has been represented. Final division provides a conclusion of the paper.

2. Routing Protocols in Manets

The Process of finding the shortest path or route among available paths which is used to send packets from sender to receiver is known as routing. There are two different steps of routing.Step one is finding Route and step two is sending packets through route that is find in step one. There are two different types of routing protocols named as, Adaptive routing(Dynamic Routing) and Non-Adaptive Routing(Static Routing).The process of allocating paths manually by administrators between sender and receiver to send packetsin the network is known as Non-Adaptive routing. In this type of routing paths are fixed for entire session. The process of allocating paths by

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routers between sender and receiver to send packets in network is known as Adaptive routing. In adaptive routing, routing table is maintained by each router. The routing table changes according to changes in topology. Router plays major role in finding paths from sender to receiver. Adaptive Routing protocols are again classified into 3 types, namely, Reactive protocols, Proactive protocols and Hybrid protocols.

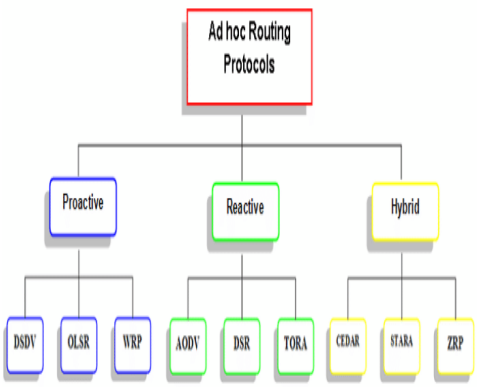


Fig 2: MANETs Routing Protocols

DSDV [1] (Destination Sequenced Distance Vector Routing) is a protocol which comes under Proactive protocol. In this protocol each and every node maintains routing information throughout the network and also send packets without delay by giving essential priority for real time packets (Multimedia data) in environment of network. But, there is a drawback of DSDV protocol which is this protocol doesn't support large network as well as changes in topology is not frequent.

DSR [2] (Dynamic Source Routing)is a protocol which comes under Reactive routing protocol. In this protocol , route is found based on on-demand, that's why this protocol is known as on-demand routing protocol. In this protocol, when communication is going on between two nodes, every route will store records. That's why cost of maintainence of routing reduces. And also, it reduces channel requesting information with help of technology of routing caching. On other hand, length of packet header increases in linear and due to this overhead is added with increase of hops path, more over, routing request abbreviated as RREQ packet implements flooding that extends whole network which very heavy load of network. AODV [3] (AdHoc On-demand Distance Vector) is a protocol which comes under Reactive routing protocol. This protocol primarily centered on DSDV and DSR routing protocols. More over, routing loop is avoided by AODV with help of hop count and sequence number of receiver or destination method.Further more, AODV protocol engages detection of routing as well as preservation of routing in DSDV routing protocol, routing detection and route preservation mechanism in DSR routing protocol. Even though AODV protocol is comparatively fully fledged, this protocol has drawback of routing overhead and delay of network.

3. Cross Layer Design (CLD) in Manets:-

In the original OSI networking model, strict boundaries between layers area unit enforced , wherever information area unit unbroken strictly inside a given layer. Cross layer optimization removes such strict boundaries to permit communication between layers by allowing one layer to access the information of another layer to exchange information and modify interaction. Cross-layer optimization shall contribute to Associate in nursing improvement of quality of services beneath numerous operational conditions.

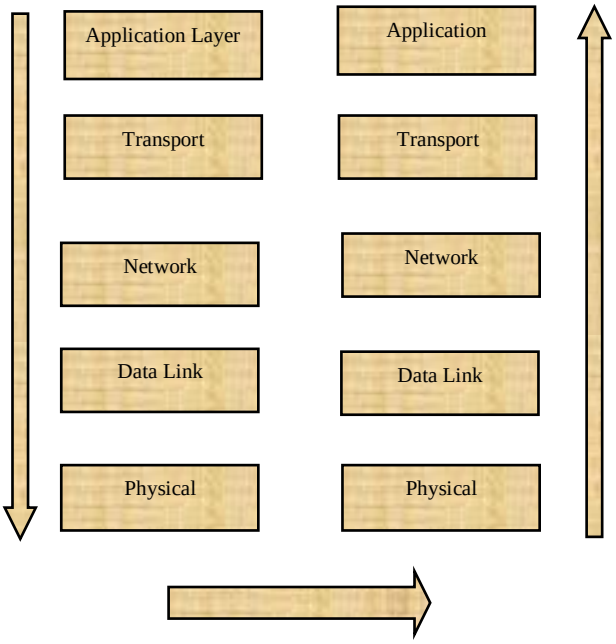


Fig 3: Layered Architecture

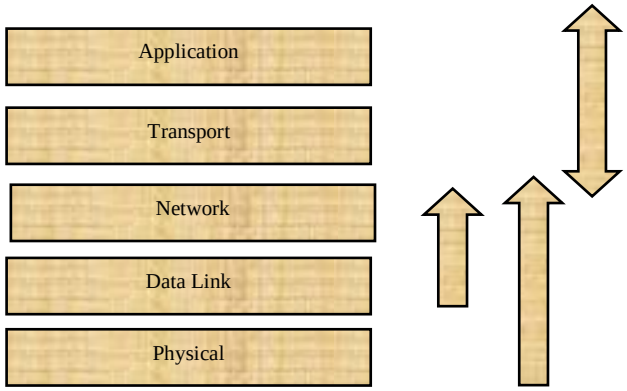


Fig 4: Cross Layered Architecture

4. Cross Layer Design Architectures:-

Various crosslayer communication architectures are developed by scientists.

1) Signaling pipe by Interlayer :-In layer communication pipe transmission of communication messages layer-to-layer beside packet knowledge propagation inside the stack of protocol. It may be in from top to down or from bottom to up type of behavior.

There square measure 2 strategies of composition the info into packets that square measure transmitted by victimization given protocol from one layer to a different layer, i.e. packet structures or packet headers.

• Packet structures - during this methodology, precise segment of structure of packet is entered by signal knowledge. once protocol stack produces packet then allocation of corresponding organization happened. Packet connected info is enclosed during this structure.

• Packet headers – This methodology is employed as message driver for inter-layer. Disadvantage of packet header is that restriction

of signal for packet flow direction that'snot applicable for cross layer design. Cross layer theme need direct communication between other way set layers. Another disadvantage is said to overhead of protocol stack process.

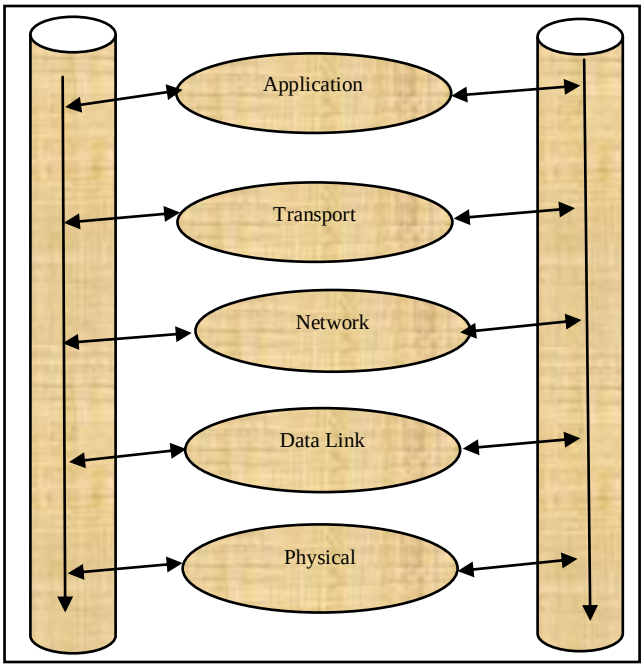


Fig 5: Signaling Pipe by Inter Layer

2) Exchanging of data using direct inter-layer – Internet control message protocol (ICMP) is pattern of straight inhume layer communiqué. Net management message protocol performed at any of the protocol stack, it's not express.

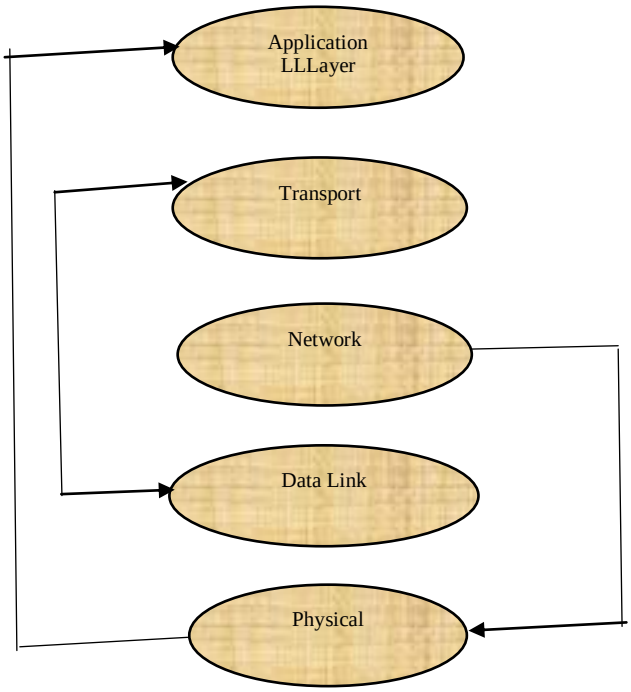


Fig 6: Communication by direct interlayer

3) Plane of middle cross-layer – If such type of plane implemented in parallel structure type then, this is most widely used architecture of cross-layer signaling. Middle plane of cross layer also known as Server of Cross-layer which imparts through clients mean protocol's at different layers.

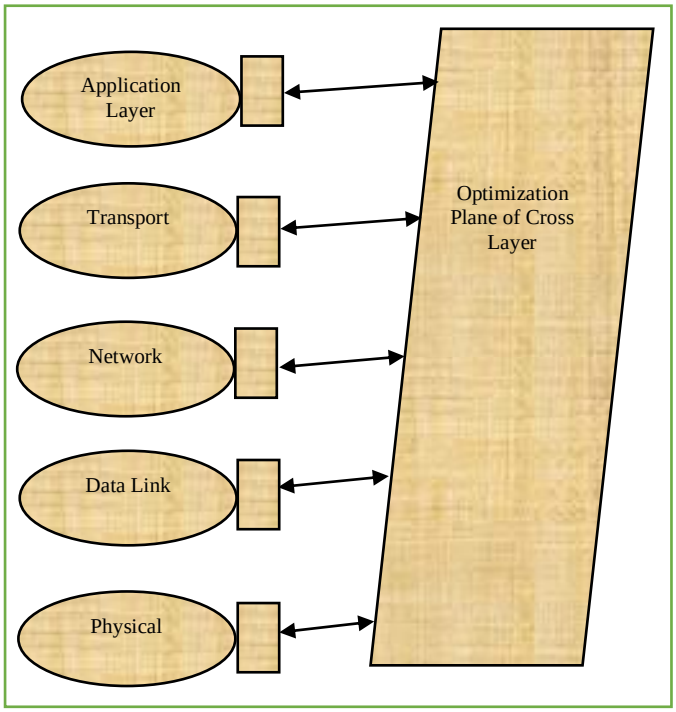


Fig 7: Plane of middle Cross Layer

4)Cross layer communication by Network-wide – At distinct protocol layers of distributed network nodes cross layer optimization is obtained known as network wide cross layer communication.

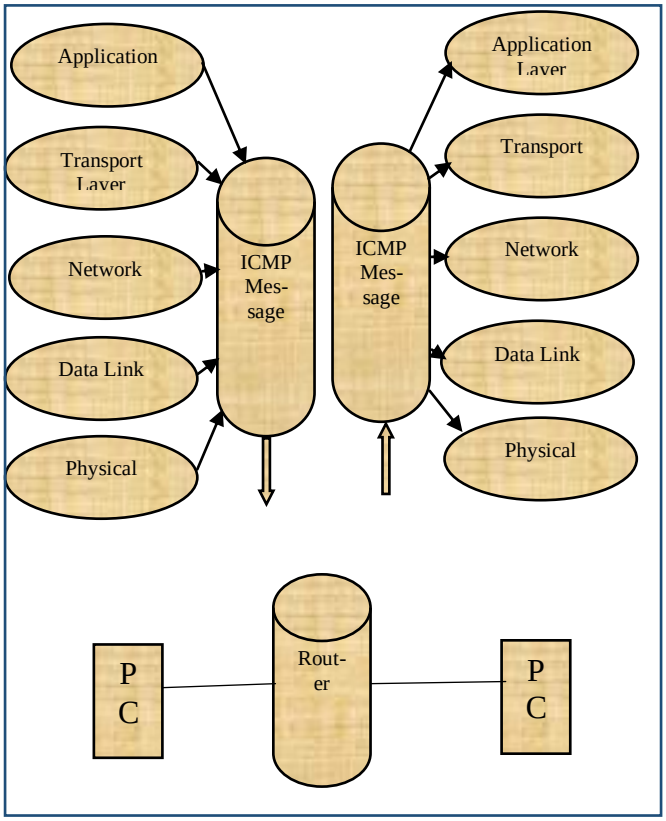


Fig 8: Cross Layer Communication by Network Layer

5. Cross Layer based Routing Protocols in Manets

Bearing in mind the prominence of cross layer style numerous researchers have prompt the crosslayer style for Manet. Consequently, this division provides the summary of the current routing algorithms based on cross layering of MANETs.
In view by the reference to the papers published below :
[A] QoS[1] based Multipath Routing in MANET : A CL[2] Approach [4],
[B] CLD[3] Approach for CC[4] in MANETs [5],
[C] A CLD[3] Approach for Intelligent Routing in MANETs [6],
[D] CLD[3] for Multihop MANETs Utility Optimization with AQM[5] [7],
[E] CL[2] based QoS[1] Platform for Multimedia Transmission in MANET [8],
[F] An Efficient CC[4] Scheme using CL[2] Approach and comparision of TCP variants for MANETs
The above are cited and explained as follows:-

With reference to [A]: Mahadev A. Gawas, Khushal Modi, Palashhurkat and Lucy J. Gudino [4] in 2017 prescribed QoSweight based on demand Multipath Routing (QMR) protocol to upgrade Quality of Service (QoS). QMR depends outline of cross layer, which collaborate in distribution system position data inside of various layers of convention but keeping up layers detachment to enhance generally speaking system execution. So as to plan QoS based multipath route for MANETs, this one is basic to reflect different QoS measurements that ensure the system execution change. QoS factors considered by QMA convention are Route Signal Strength for Data Transfer(RSSDT), Route Remaining Energy (RRE), and BandWidth(BW). To settle on a route choice thinking about the three factors, various layers of the convention stack needs to coordinate all together trade the practical data actualized onto each layer. The physical layer signal strength accessible in physical layer and node energyat MAC layer can be helpful to next node choice of network layer. QMA gives inter layer correspondence among physical, MAC and network layer to enhance network execution. QMA convention works in three stages: 1) QoS Route Discovery 2) QoS Route Response (3) Route Maintainence . Each intermediate node in network figures and updates RSSDT, RRE, BW esteems in RREQ packet it got and advances to the aforementioned neighbors. In this manner routerequest process depends on cross layer weight which is figured as takes after:

$$Cw = \sigma\ RSSDT + \rho\ RRE + \omega\ BW \quad (1)$$

where , $\sigma + \rho + \omega = 1$ are consistent smoothing factor somewhere in the range of 0 and 1.
Presently route is chosen with most extreme Cw esteem i.e. most astounding signal quality, greatest residue energy and greatest data transfer capacity. This chose route is presently utilized as essential route for information exchange.

With reference to [B]: Mazher Khan , DhatShital M , and Dr. Sayyad Ajij D [5] in 2016 suggested new calculation with blend of AdHoc On Demand Distance Vector(AODV) and cross layer approach which is reffered as Congestion Control AdHoc On demand Distance Vector (CCAODV) approach. AODV is receptive convention which gives unicast, broadcast and multlicast correspondence in adhoc systems. AODV chips away at OSI arrange show. In light of absence of coordination among layers, the execution of system diminishes. CCAODV convention gives cross layer correspondence specifically between physical layer and system layer with the end goal that network execution increments. Received Signal Strength (RSS) is utilized as cross layer outline factor. RSS is computed in view of power of transmission of node and two nodes distance.

$$Pr=Pt/d \quad (1)$$

where Pt is power of transmission and d is two nodes distance.
In cross layer plan RSS esteem is in use from physical layer and sent to network layer. This data chooses whether current node is consumingsignal strength value with low or high. Every node in network figures RSS esteem and communicate this incentive to neighbors by Hello packets. At that point every node figures the RSS esteems of neighbors average. Esteem limits of three are computed as Avg_RSS, Low_RSS, High_RSS. So when source node communicate to its neighbor through RREQ packet, thencorresponding neighbor will choose whether torebroadcast the RREQ packet or not. On the off chance that node having RSS esteem >low_RSS , then retransmission of RREQ packets to goal node is done. Consequently CCAODV convention makes solid and steady routeas a result of utilizing quality of signal node and furthermore CCAODV convention causes all nodes to anticipate connect break well ahead of time.

With reference to [C]: Ibrar Ali Khan, Muhammad Haroon, SundusNajib, Majid Ashraf [6] in 2016 proposed CLD-AODV protocol for improved effectiveness in MANETs. The CLD-AODV functions as customary with small up gradation of AODV through instilling the metric of routing into AODV protocol. The foundation of route for CLD approach in which physical and MAC layer parameters are bolstered in the direction of the network layer for the finding path or route selection metric of MANET steering conventions. Two measurements are engaged at data link layer: (1) unstable queuing delay among ACs(queuing time) and (2) During contention period what are the delays encountered(contention time). At physical layer one metric is engaged: (1) Average transmission rate(Transmission time or Propogation time). The procedure of the route locating is finished by utilizing route request(RREQ) and route reply(RREP) driven at intermediary stations by nodes at the either of the end. Each station ought to know about (Queuing Contention Propogation) QCP delays. RREQ message is refreshed by QCP delays to enable the node preparing the RREQ to pick up the path metric data for following the method back to source. RREP message made in response to a RREQ message at that point comprises the path metric potentials shaped through QCP delays since goal to source. The MANET path metric steering convention at a node creates the sum of the delay of queuing, contention and transmission looked by means of a frame however at the same time being conveyed to proposed destination.

$$\text{Route Metric}=\Sigma(Tqi+Tci+Tpi),\ i=1 \text{ to } TNH \quad (1)$$

whereTq= Queuing Time
Tc=Contention Time
Tp=Transmission Time
TNH= add up to bounces amongst source and goal
Each station represents route metric/link metric qualities for every one of the four Access Categories(ACs) i.e levels of need of information, which are AC-VO, AC-VI,AC-BE and
AC-BK. The specific AC metric from home ie source or sender to goal remains figured by totaling of every single metric estimation of intermediate nodes included. Along these lines route is chosen with nodes which are having least connection metric incentive from source to destination.

With reference to [D]: Ammar Alhosainy and Thomas Kunz [7] in 2017 suggested Cross Layer Design(CLD) to combine maximum

network utilization problem and an efficient Active Queue Management(AQM) method. Utility maximization problem is decomposed into three sub problems. Two sub problems, speak to the transport layer to enhance the total session rates and the linkage utility portion of each session. The third sub problem speeches the MAC layer to enhance the transmission chance given to individually link in the same area of contention, finally total system or network return, utilities of the user is maximized. The implementation of CLD can be done without refining the restrictions among network layers and with negligible effect on some other network protocols. The CLD is separated into sub-modules which is independently applied in each layer. Foe exchanging prices the modules will talk or communicate with each other. Individually layer based on prices takes its peculiar judgments.

With reference to [E]: MamataRath ,BibudhenduPati and Binod Kumar Pattanayak [8] in 2017 recommended PDO-AODV based Quality of Service design by means of communication among inter layer with a enormously well-organized real time scheduler algorithm named as Round Robin with Deadline based Shortest Remaining Time(RR-DSR) at network layer and an upgraded channel access technique using Low Latency Queuing(LLQ) algorithm called L-HCCA at DLL. RR-DSR competently schedules numerous real time applications however not missing of deadlines. L-HCCA algorithm certainly not permits a queue with low precedence to go to a be malnourished period.

With reference to [F]: SnehaV .Sangoli, JayavigneshThyagarajan [9] in 2014 proposed a productive congestion control technique utilizing cross layer approach and furthermore demonstrated that different TCP calculations utilized controlling congestion using cross layer method in MANETs. Lossing of packets is done in wireless networks because of multiple path blurring, Doppler move, overflow of buffer, conflict of link layer and errors of the channel. Yet, the current TCP calculations reflect packet misfortune for instance congestion because of buffer over flow and congestion control calculations are called. Therefore the situation is to distinguish the event of the network and afterwards taking suitable action based on event of the network recognized. The event of the network proof would be likely by cross layer design. The conceivable occasions in organize that reason packet loss are : 1) disconnection , 2) link layer dispute and 3) buffer overflow. The network events should be recognized accurately, to make correct action so as to continue the ordinary data communication. This desires the cross layer assistance flagging accomplished through shared enhancement of upper transport layer by means of bring down system , interface and physical layers. As cross layer method aimed at TCP, plan of averaging exponential which is window based [10] is utilized to detect link disconnection event by acquiring data of the power of the signal starting physical layer and it is extracted with a specific end goal to enhance execution of TCP. As per cross layer approach for routing, well-organized routing protocol of position limited energy [11] aimed at MANETs is utilized. Here optimal next hop node calculation is done which is utilized to locate the following hop. The measurements incorporate LQR(Link Quality Ratio), speed of the packet and power of the battery that is residual. Link quality is anticipated by analyzing physical layer and battery power is anticipated by analyzing link layer. optimal next hop node is figured for each neighbor of one-hop. At that point packet is directed to the optimum succeeding hop node.

6. Comparision of CLD based Routing Protocols in MANETs

Table 1: comparison of CLD based routing protocols in MANETs

Routing protocol	Inter Layer Communication	Input Parameters	Output Parameters	Network Simulator	Performance in MANET
QMR[6] protocol	Physical Layer, MAC Layer, Network Layer	RSSDT[10], RRE[11], BW[12]	Cross Layer Weight(Cw)	NS2	PDR[13], End-to-End Delay, Throughput
CCAODV[7] Protocol	Physical Layer, Network Layer	Transmission Power(Pt), distance(d)	Received Signal strength(RSS)	NS2	Overhead, Loss, Throughput, PDR[13]
CLD-AODV[8] protocol	MAC Layer, Physical Layer	Queuing Time(Tq), Contention Time(Tc), Propogation Time(Tp)	Route Metric(RM)	OPNET	Delay
AQM[5] protocol	Transport Layer, MAC Layer	Queue-length based Factor(QF)	Capacity(C)	NS3	Delay, Overhead, Packet Loss
PDO-AODV[9] with QoS[1] protocol	Physical Layer, MAC Layer, Network Layer	Residual Battery ,power, Delay	Least Deadline	Net Sim	PDR[13], Jitter Analysis
Window based exponential averaging protocol	Physical Layer, Data Link Layer, Network Layer, Transport Layer	Link quality Ratio(LQR), Packet Velocity, Remaining battery power	Optimal Next Hop	NS2	PDR[13], Throughput

7. Open Issues and Future Scope

Lot of work has been accounted for in the section V identified with the cross layer directing conventions. Considering the benefits and openings accessible in the approach of configuration, open issues and future extension has been displayed:-

Cross layer approach is the answer for conquer the different restrictions of MANET. Numerous analysts proposed different steering conventions using cross layer approach. There are numerous favorable circumstances of different conventions yet these conventions are not basically utilized. The principle reason of this is for the most part every application require diverse cross layer approach which is unfeasible.

In future this issue can be overwhelmed by utilizing the blend of various cross layer directing conventions and some more parameters can be utilized to make these conventions more viable.

8. Conclusion

This paper has checked out the present movement in the zone of cross-layer outline. In the wake of proposing a definition, this gives the short presentation of the cross layer outline and different proposed work of cross layer steering conventions. It portrays the different favorable circumstances of cross layer directing conventions and what are open issue and how it might survive. The entire paper concluded that cross layer routing protocols are very important.

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Abbreviations

1. QoS[1]- Quality of Service
2. CL[2] – Cross Layered
3. CLD[3] –Cross Layer Design
4. CC[4] –Congestion Control
5. AQM[5] –Active Queue Management
6. QMR[6]-QoS[1] based on demand Multipath Routing
7. CC-AODV[7]- Congestion Control AdHoc On demand Distance Vector
8. CLD-AODV[8]-Cross Layer Design-AdHoc On demand Distance Vector
9. PDO-AODV[9]-Power and Delay Optimized AdHoc On demand Distance Vector
10. RSSDT[10]–Route Signal Strength for Data Transfer
11. RRE[11]-Route Remaining Energy
12. BW[12]-BandWidth
13. PDR[13]-Packet Delivery Ratio