IMPROVING QUALITY OF SERVICE FOR 4G DEVICES USING MULTIPATH ROUTING ON AD-HOC NETWORK

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***Abstract*— Information and Communication technology try to reach the realistic world in the virtual system via using the 4G communication devices in real time applications. While adopting the 4G communication devices in the exiting environment, various Quality of Services issue occurs to meet the realistic system. QoS issues include the device availability, accessibility and its performance in the applications. The device availability based on the network infrastructure and its environment. The accessibility based on the procedure used to determine the device and identify the same. There are various techniques and technical protocol issues are involved in the device identification and its utilization or performance. The routing process involved the accessibility and performance of device in the network. This research initiated to study the exiting routing protocol algorithms for the 4G devices in the ado-hoc network and optimize the same. Through the optimization of Routing algorithm for 4G devices, the accessibility and its performance will strengthen the Quality of Service for the 4G device users in the Ad-hoc Network.**

Keywords-4G communication, routing, QOS

I. INTRODUCTION

Today, Communication world enhance its facilities as like real time environment with the modern equipments and technology. Fourth Generation devices are adopted in our day-today applications of Information and communication technology. This research process initiated to determine the Quality of Service Issues in-line with the routing optimization while using the 4G devices in ad-hoc network. The ever-increasing growth of user demand, the limitations of the third generation of wireless mobile communication systems, and the emergence of new mobile broadband technologies on the market have brought researchers and industries to a thorough reflection on the fourth generation. Many prophetic visions have appeared in the literature presenting 4G as the ultimate boundary of wireless mobile communication without any limit to its potential, but in practical terms not giving any design rules.

The fourth generation will encompass all systems from various networks, public to private; operator-driven broadband networks to personal areas; and ad hoc networks as showed in the above figure 1.0. The 4G systems will interoperate with 2G and 3G systems, as well as with digital (broadband) broadcasting systems. In addition, 4G systems will be fully IP-based wireless Internet. This all-encompassing integrated perspective shows the broad range of systems that the fourth generation intends to integrate, from satellite broadband to high altitude platform to cellular 3G and 3G systems to WLL (wireless local loop) and FWA (fixed wireless access) to WLAN (wireless local area network) and PAN (personal area network), all with IP as the integrating mechanism. The Voice networks and data networks used for totally different works and it completely different in their design as well as other application. Traditional voice networks are comprised of

circuit-switched connections over Public Switched Telephone Networks (PSTN). Packet-switched network is used by two different modes of transmission: They are Connection-oriented or virtual circuit networks is a trustable and mainly designed to imitate circuit switched functionality over the packet-switched Internet. Connectionless or data gram networks never initiate session, but packets are delivered independently to the receiver with the usage of different paths. Guaranteed delivery is provided by connection-oriented transport layer protocols that always operate over connectionless mode of transmission such as the Transmission Control Protocol (TCP). For delay tolerant applications such as web browsing or file downloading this type of reliable transmission is an adequate. Generally the video voice and other multimedia results requiring different levels of bandwidth allocation, delay and tolerable packet loss in highly diverse traffic. For this type of time sensitive applications is not fully supported by TCP (Transmission control protocol). Voice applications originate from PSTN, and the behavior is deterministic. Voice traffic experiences a low and fixed amount of delay with effectively no loss is the main advantage is In PSTN. A variable and unpredictable amount of delay is introduced with some voice packets being dropped during congestion periods, when a voice is transported over an internet protocol network. As a result the voice application requires is not supported by traditional IP network. To address the issue, the Quality-of- Service concept was developed with the following four design objectives: Delay characteristics and Improve loss, Maximize network utilization, Support dedicated bandwidth, Set traffic priorities across the network.

An application could specify a set of parameters essential to guarantee its application level performance by deploying Quality of Service provisioning mechanisms in an IP network. These Quality of Service parameters always not specific, it may range from bandwidth and packet loss to delay and jitter, but not same for all traffic it always depending on the specific traffic characteristics. This RSVP-MP is responsible for RSVP message handling and within the access networks this RSVP-MP always it isolates signaling and relies on hierarchical mobility architecture. HMIPv6 supports MOBILE NODE to have two IP addresses. They are RCoA for communication with external nodes, LCoA for internal communication within the access network. This research aimed to develop a optimization for existing networks with a single worldwide cellular 4G network completely standardized based on the (Internet Protocol) IP for video, packet data utilizing Voice over IP (VoIP) and multimedia services. The proposed networks routing optimization algorithm would provide uniform video, voice, and data services to the cellular handset or handheld Internet appliance, based entirely on IP (Internet Protocol). In their research we are highlighting the network size growth, multi hopping over several intermediate devices to reach final destination becomes prevalent because of obstacles, spatial spectrum reuse and power saving consideration. Mobility also common in ad-hoc network because of the nature of applications they are designed of support. Multi hopping, mobility, large network size combined with device heterogeneity and bandwidth make the design of adequate routing protocols major challenges. So this research proposal also helps to determine the routing techniques for ad-hoc network.

II. EXISTING WORK

These Quality of Service parameters always not specific, it may range from bandwidth and packet loss to delay and jitter, but not same for all traffic it always depending on the specific traffic characteristics. To manage network resources by the Quality o Service mechanism always done by setting certain routing priorities and traffic shaping in order to ensure that the services are delivered in an acceptable form to the end user. Two services have been developed from the Internet research community, two with regards to Quality of Service provisioning. These two services are Differentiated Services (DiffServ), Integrated Services (IntServ). The first service differentiated services model always follows a flexible approach in classifying its datagrams. Here specific DiffServ code point is used and the packets are marked individually by setting specific DiffServ Code Point (DSCP,) values i.e an 8-bit field in the IP packet header and are forwarded in a connectionless manner by routers in the network. Per-Hop Behavior (PHB) is defined by the way packets are forwarded by the routers since no end-to-end sessions are set up. DiffServ provides a high level of scalability and is well suited to manage resources in core Internet protcol networks but IntServ, abides by a two classification system: Classification 1 is network resources are explicitly identified and reserved, and classification 2 is datagram's are treated in a clear flow manner. A robust signaling protocol developed to operate within the IntServ model is Resource Reservation Protocol (RSVP). It explains the way of reservations placed by an application and how they can release the reserved resources once an established Resource. Reservation Protocol session is terminated. Along the end-to-end path, Resource Reservation Protocol operation generally results reserved in each node even though it can function through non Resource Reservation Protocol routers along the way. While Quality of Service mechanisms ensure application level performance, while maintaining IP connectivity Internet protocol mobility generally allow a node to move easily across different networks as well as subnets.

Mainly in a wireless environment the mobility protocol i.e Mobile IP (MIP) is very standardized mobility protocol defined by the group of Internet Engineering Task Force (IETF).

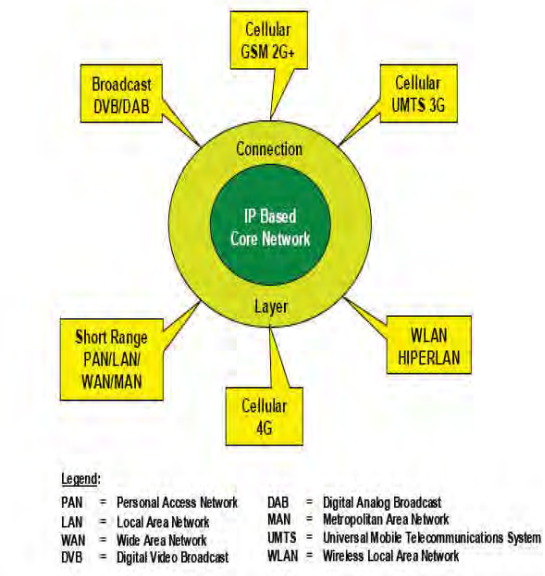

Figure 1. 4G seamless connections

The main driving force behind developing MIP is the drawback of traditional IP addressing and routing. Each host maintains at least one unique IP address in an Internet protocol network. A network prefix and a host suffix is the unique two parts of an IP address. The main advantage of an IP address is used to find path from other host in other subnets and used to identify the destination host. If IP subnet changes due to mobility then the close coupling of the IP address is happened and its current IP address should be considered invalid . So this address will not reflect its new location at the newly connected subnet. Mobile node (MN) is defined by an MIP addresses by allowing a host, in MIP parlance, and it have two Internet Protocol addresses: The first one here is permanent Home Address (HoA) and the second one here defined as a Care-of-Address (CoA), which is associated with the foreign subnet. While maintaining connectivity using MIP there is transparency at the application level, and the nodes may move across different subnets. A new MIP standard named Mobile IPv6 (MIPv6) is proposed with the introduction of IPv6 networks. Here Hierarchical Mobile IP (HMIPv6) and Fast Handovers for Mobile IP (FMIPv6) are the most gift in the mobile technology generation. Due to its standardization, various deficiencies have been addressed and proposed as extensions.

Figure 2. Packet-switched datagram's over the Internet is relayed by the data networks

III. PROPOSED WORK

An architectural consideration in the IP layer is taking vital role to 4G success. Both vertically and horizontally 4G mobile terminals are roaming easily and fastly across different wireless systems. Basically two contradicting demands are exist in 4G wireless networks. The first one is ubiquity and the second one is diversity. Always end users expect to deliver a large variety of services across a diverse platform of mobile and wireless access technologies with high quality of service. This Figure shows the concept of vertical and horizontal handoffs. When a mobile terminal changes from one access point to another access point within the same wireless system then the horizontal handoff happens. But when a mobile terminal moves from one wireless system to

another then vertical handoff occurs. We mainly focus on two main network-level issues related to 4G: The First one is

A. Seamless Mobility –

Handoff execution should be seamless at the application that is with minimal disruption a mobile terminal should be able to roam across different access points.

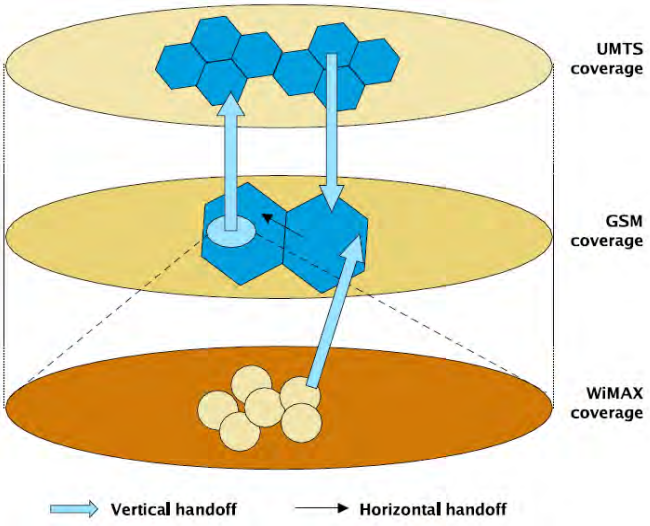

Figure 3. Packet-switched datagram's over the Internet is relayed by the data networks

B. Resource Controly –

After the completion of handoff with minimum mistakes or problems the active application should be restored to an acceptable level of performance in Quality of Service. Quality of Service guarantees managing application-level performance in heterogeneous wireless network system. Using the Session Initiation protocol (SIP) usually supports to the end users , so that they can make and receive VoIP phone calls within the range of Wi-Fi.

C. Mobility and Quality of Service Support in Wireless All-IP Networks–

Based on RSVP (Resource Reservation Protocol) based approaches, and handoff-based approaches we categorized into 2 sections.

C.1. Resource Reservation Protocol–

RSVP is a network protocol model is defined by the Internet Engineering Task Force [IETF] .This protocol is a network-control protocol and it provides a definite guarantee of Quality-of-Service for all real time applications. This RSVP is a receiver initiated protocol and here receiver has to accept the initial connection. Thus this protocol is a completely receiver based protocol and this receiver based protocol provides large multicast broadcasts for different receiver. So it may provide different levels of quality of service. This Resource Reservation Protocol also permits merging of multiple reservations that helps to increases its scalability for all different types of broadcast applications. In 4G mobile networks mainly focused uni-cast communications, so in this work I mainly focused only uni-cast communication. This RSVP is always depending on User Datagram Protocol or Internet Protocol, because this RSVP is always transported over UDP or directly over IP. Totally there are 2 different types are available in RSVP. They are

a) Path message

b) Resv message

In the first path message starts from the sender when it establishes an RSVP session by sending a Path message which contains three important pieces of an Objects. The first object is Sender Template, it mainly used to identify packets address and port number based on senders IP that belong to the sender's data flow. The second object is Sender Tspec, it always used to provide the characteristics of the traffic to be sent from the sender's side, and hence the Quality of Service level from the sender side. Store the IP address of the previous hop router is done by the third object, which one is hop router (PHOP). To do this work PHOP using path message. For doing this PHOP path message never think about the reservation of resource but rather installs with the help of Path *State* in every intermediate router. The Path State is used to store the IP address

of the previous hop (PHOP) router. In the receiver side after this path message comes to the destination, there are two possibilities. They are may be the receiver accept the connection or it may reject the connection. For the acceptance then a new message is being created, this is Resv message. It has the below said two components. They are

a) FlowSpec: This is the most important object is used to be assigned to the data flow and explains the better quality of service Resv message.

b) FilterSpec: Based on the information provided by this object, the identity of the sanders data flow is assured.

D. Approaches for Quality of Service in Wireless Networks–

The Internet protocol is used work not only in wired also in wireless network with the help of a stable internet protocol address. But if we assigned the internet protocols address dynamically then the behavior of the internet protocol address is also changing. This protocol supports mobility and quality of service independently of each other. Based on this concept two approaches are developed. The first one is the RSVP-based approach, and the second one is Handoff-based approach. In RSVP-based approach used to modify RSVP in order to improve the wireless scenarios with more efficient and feasible. The Handoff-based approach is used to modify the Quality of Service signaling in mobile signaling.

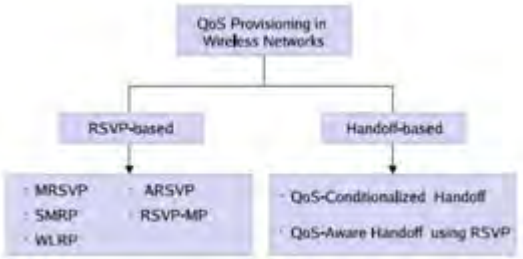

Figure 4. RSVP-based Approaches

D.1. Mobile Resource Reservation Protocol (MRSVP)–

This Mobile Resource Reservation Protocol is the one of the first developed version to Resource Reservation Protocol. It is very feasible in all types of wireless networks as well it is used to provide good deployment facility to all wireless networks. This Mobile Resource Reservation Protocol always provides a good support for reservations. They are

a) Active reservations
b) *Passive reservations*

Also this Mobile Resource Reservation Protocol (MRSVP) talks about three different types of messages. They are

a) MSpec message
b) Passive Path message
c) Passive Resv message

All of the above said messages are used to establish active as well as passive session between sender and the receiver. The passive path message is send by the sender to the receiver. Now the receiver replies to the sender with the Resv message, so the session is established. So using the Passive Path and Passive Resv messages passive reservations is established. Finally a new RSVP session is established. Even though it establishes session there are lots of draw backs.

a) The mobile networks movement is deterministic, but for real time applications it is difficult to use.
b) This passive reservation always gives large affects to the network's bandwidth usage.
c) There is a long waiting time for all MOBILE NODE.
d) For this type of passive session always the complexity of the network is high.

So generally the passive reservations always can be used for best-effort services.

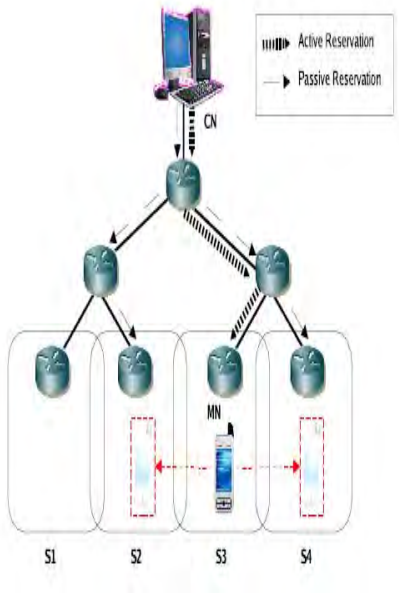

Figure 5. Reservations

To solve the first drawback Mahmoodian *et al* proposed as an extension to MRSVP another new *Progressive Resource Registration* mechanism. Here instead of use MSpec to send a Passive Resv message the MA acts as an RSVP sender and distributes a Path message to all neighboring mobile proxies.

So all neighboring MA could then either reply with a Resv message if they establish a passive session or reject the reservation with a ResvErr message.

D.2. Sender-initiated and Mobility-support Reservation Protocol (SMRP)–

Shangguan *et al.* proposed Sender-initiated and Mobility-support Reservation Protocol (SMRP) suitable for unicast communication, because RSVP is designed only for multicast groups here receiver makes its own reservation based on the information advertised by the sender. Here the resource reservation and path selection is combined into one process instead to multiple processes. Here same like other by sending a *Request* message to the receiver SMRP sender initiates a session. It will be done with the support of other intermediate router. This SMRP is improved version. Here there is no need to check periodically request messages send by the sender. Request messages are only required if there is no data is being sent to the receiver.

An SMRP sender initiates a session by sending a *Request* message to the receiver, after this receiver receive this message it may send Echo message sent back to the sender. This message is processed by every intermediate router along the way, checking for the available resources. This echo message is giving the information back to sender, whether it received or not in a proper way. This echo message is helping in this way to the sender. Each receiver makes its own reservation based on the information advertised by the sender. This detachment of the path-finding process and reservation-setup is reflected in RSVP's implementation. Every router stores the reservation request as a success or a failure, modifies the Request message accordingly and forwards the message downstream to the receiver. For the success deployment of SMRP always this SMRP Agent needs to be installed between the sender and receiver in all nodes along the end-to-end path.

D.3. Wireless Lightweight Reservation Protocol (WLRP)–

This Wireless Lightweight Reservation Protocol (WLRP) is used to increase the probability to establish a successful reservation. This Wireless Lightweight Reservation Protocol always utilizes passive reservation.

This WLRP continuously send 2 messages. They are

1) *Mobility Profile*
2) *Application Profile*

Both the messages consist of list of parameters. They are

a) *LProfile* - It indicates Loss Profile
b) *QHO* - It indicates levels of service
c) *Br*- It indicates application data rate
d) *LNEG*- It indicates loss negotiability

WLRP the reservation is always active and there are no refresh message is required here. This active reservation is always hard state. But the passive reservation is always in a soft state. The Mobility Agent (MA) monitors the periodically received Mobility Profile and to send passive reservations to the nominated subnets. Here the passive reservations results may be success or failure. This result is fed back to the MOBILE NODE, so the chance for getting Quality of Service to the surrounding subnets is more efficient. If the passive reservation fails then user has to change its route. In some application like Voice and Video there should be an acceptable level application performance in Quality of Service parameters. The main advantage in RSVP is in some situations, since the MOBILE NODE would not have sent a Teardown message to the subnet an active WLRP reservation would theoretically be held for an indefinite amount of time.

D.4. Adaptive Resource Reservation Protocol (ARSVP)–

Adaptive Resource Reservation Protocol was mainly proposed to incarcerate the RSVP re-establishment process. Here the next hop router address is recorded by all the routers. This Adaptive Resource Reservation Protocol consist of all the messages same like RSVP and have one extra message named as Search. This message is used to identify the changed nodes in the event of handoff. If handoff occurs between the sender and receiver, then only that particular path between the sender and receiver is affected. Other remaining session will be an active state. But in RSVP a new session is being formed between the entire end to end paths. When an old RSVP with MOBILE NODE is getting disconnect then the following steps is proceed.

1. From its old Access Router (oAR) to the new access router MOBILE NODE sends a Search message.
2. Now the new message moves from old Access Router to the new access router, and it passes through the nodes and from this node it will get a new RSVP connection.
3. As this search message is received by each router, each router records the IP address of the PHOP router as PHOPSEARCH and NHOP router as NHOPSEARCH.
4. Then the router is updated regularly with the changed nodes with the new messages PHOPSEARCH and NHOPSEARCH .This is compared against the original RSVP session's PHOP and NHOP stored in each RSVP router.
5. After the completion of handoff, MOBILE NODE gets Search message from the nAR, and send the Resv message to the sender.

According to the IP addresses and port numbers of the sender and receiver the Classifier, classifies RSVP packets.

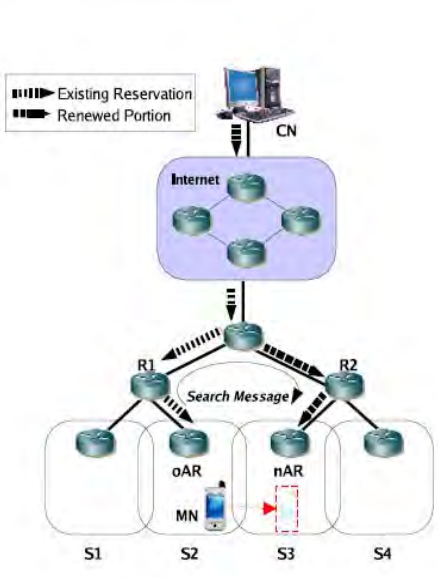

Figure 6. Message movement

D.5. RSVP Mobility Proxy–

This is hierarchical mobility architecture such as HMIPv6 (HMIPv6 allows a MOBILE NODE to have two IP addresses: the RCoA for communication with external nodes, and the LCoA for internal communication within the access network) .The main idea for this RSVP Mobility Proxy (RSVP-MP) is with minimum modification increase Quality of Service and mobility functions. This hierarchical mobility architecture takes responsibility for RSVP message handling. The content of inbound and outbound RSVP messages is modified by the RSVP-MP. Using Dynamic Address Translation (DAT), RSVP-MP avoids the IP-in-IP encapsulation of RSVP messages.

In IP tunnels at the tunnel entry point, RSVP sends a Path message and creates a separate RSVP session over the tunnel. So HMIPv6 establishes two independent RSVP sessions, one is external and another one is local one. This creates chance to the MOBILE NODE to re-establish the local session during the hand off. The Features of RSVP are stated below

1. RSVP-MP modifies the content of inbound and outbound RSVP messages
2. RSVP signaling is exchanged between the MOBILE NODE and RSVP-MP rather than the CN.
3. RSVP-MP modifies the content of inbound and outbound RSVP messages.
4. RSVP-MP avoids the IP-in-IP encapsulation of RSVP messages at the MAP.
5. It significantly reduces the RSVP reestablishment time after a handoff.
6. The RSVP-MP intercepts this message and replies with a Resv message to the MOBILE NODE.
7. RSVP Operation over IP tunnels, recursively sends a Path message at the tunnel entry point and creates a separate RSVP session over the tunnel.
8. Allows MOBILE NODE to re-establish the local session in the event of a local handoff without modifying the external session.
9. Using the CN's address the RSVP-MP intercepts this message and replies with a Resv message to the MOBILE NODE.
10. RSVP Operation over IP Tunnels seems to achieve the same goal with less complexity.

This RSVP-MP is responsible for RSVP message handling and within the access networks this RSVP-MP always it isolates signaling and relies on hierarchical mobility architecture. HMIPv6 supports MOBILE NODE to have two IP addresses:

They are RCoA for communication with external nodes, LCoA for internal communication within the access network. This research initiated to study the exiting routing protocol algorithms for the 4G devices in the ado-hoc network and optimize the same. Through the optimization of Routing algorithm for 4G devices, the accessibility and its performance will strengthen the Quality of Service for the 4G device users in the Ad-hoc Network.

E. Research Methodology–

In their research we are highlighting the network size growth, multi hopping over several intermediate devices to reach final destination becomes prevalent because of obstacles, spatial spectrum reuse and power saving consideration. Mobility also common in ad-hoc network because of the nature of applications they are designed of support. Multi hopping, mobility, large network size combined with device heterogeneity and bandwidth make the design of adequate routing protocols major challenges. So this research proposal also helps to determine the routing techniques for ad-hoc network.

IV. RESULTS & DISCUSSION

An inter-domain end-to-end mechanism used for best path selection in a hybrid access WLAN-UMTS scenario, based on one-way delay estimation as the network parameter requested by the application and managed by mobile agents. Further, based on the obtained results, the project proposed an extended mechanism using profiles, a set of aggregate parameters like bandwidth, delay, jitter, etc. The mechanism is called I-NAME (In-Network Autonomic Management Mechanism) and it is used for network resource reservation and management functions. Determination of aggregate parameter we will use the data mining techniques to strengthen the QoS. Mobility also common in ad-hoc network because of the nature of applications they are designed of support. Multi hopping, mobility, large network size combined with device heterogeneity and bandwidth make the design of adequate routing protocols major challenges. So this research proposal also inline to determine the routing techniques for ad-hoc network. As networks modernize and expand with the increasing deployment of high-speed technology, routing protocols that use shortest-path algorithms for single-metric path computation are inadequate for real-time huge-volume data transfer applications which often require guaranteed quality of service (QoS). To support QoS requirements, a routing protocol must supply explicit information on resources available in the network so that applications can make proper resource reservation.

V. CONCLUSION

This research will identify the complexity structure of different metrics since multiple routing metrics have important implications on the complexity of path computation while the problem of finding a path subject to multiple constraints is usually difficult. In this research, researcher will also design new efficient algorithms that are able to compute paths that satisfy multiple constraints for Routing Optimization for 4G-device performance (RO4P) on Ad-hoc Network. 4G devices in ad hoc mode offer minimal security against unwanted incoming connections. For example, ad-hoc 4G devices cannot disable SSID broadcast like infrastructure mode devices can. Attackers generally will have little difficulty connecting to your ad-hoc device if they get within signal range. Signal strength indications accessible when connected in infrastructure mode will be unavailable to you in ad-hoc mode. Therefore, you will face some difficulty whenever re-positioning an ad-hoc device to achieve a better signal. The WiFi networking standards (including 802.11g) require only that ad-hoc mode communication supports 11 Mbps bandwidth. You should expect that WiFi devices supporting 54 Mbps or higher in infrastructure mode, will drop back to a maximum of 11 Mbps when changed to ad-hoc mode. Ad-hoc mode should generally be viewed as "slower" than infrastructure mode for this reason.

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