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   REVIEW OF LITERATURE

   NEED/IMPORTANCE OF THE STUDY

   STATEMENT OF THE PROBLEM

   OBJECTIVES

   HYPOTHESES

   RESEARCH METHODOLOGY

   RESULTS & DISCUSSION

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   APPENDIX/ANNEXURE

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MOBILITY IN HETEROGENEOUS WIRELESS NETWORK USING HMAC

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ABSTRACT
These NG wireless terminals must provide seamless access while roaming between different wireless networks. For a seamless integration, the mobile terminal must be capable of accessing each network when needed. Each network structure performs resource allocation according to various techniques such as Time Division Multiple Allocation (TDMA) slots, Code Division Multiple Allocation (CDMA) codes, and random allocation in order to achieve high network utilization in accessing different networks. Therefore, to address the diverse Quality of Service (QoS) requirements, NG wireless terminals must be able to adapt to the heterogeneous access schemes. To achieve this Hexagon based Medium Access Control (HMAC) Layer is proposed to model heterogeneous access schemes. Based on this, HMAC provides architecture independent decision and guarantees QoS requirements. The six parameters are analyzed to evaluate the performance of the heterogeneous wireless network. The simulation result shows that HMAC provides a seamless access, achieves high network utilization and guarantees QoS requirement.

KEYWORDS
Heterogeneous Wireless Network, Medium Access Control, Resource Allocation, and Seamless Access.

INTRODUCTION
The next generation of wireless systems represents a heterogeneous environment with different access networks technologies that differ in bandwidth or data rate. In this kind of environment, seamless access is the challenging issue that supports the roaming of users from one system to another.

Wireless communication, despite the hype of the popular press, is a field that has been around for over a hundred years, starting around 1897 with Marconi's successful demonstrations of wireless telegraphy. By 1901, radio reception across the Atlantic Ocean had been established; thus, rapid progress in technology has also been around for quite a while. In the intervening hundred years, many types of wireless systems have flourished, and often later disappeared. For example, television transmission, in its early days, was broadcast by wireless radio transmitters, which are increasingly being replaced by cable transmission. Similarly, the point-to-point microwave circuits that formed the backbone of the telephone network are being replaced by optical fiber. In the first example, wireless technology became outdated when a wired distribution network was installed; in the second, a new wired technology (optical fiber) replaced the older technology. The opposite type of example is occurring today in telephony, where wireless (cellular) technology is partially replacing the use of the wired telephone network (particularly in parts of the world where the wired network is not well developed) [1].
Many types of wireless communication systems exist, but a distinguishing attribute of a wireless network is that communication takes place between computer devices. These devices include personal digital assistants (PDAs), laptops, personal computers (PCs), servers, and printers. As with networks based on wire, or optical fiber, wireless networks convey information between computer devices. The information can take the form of e-mail messages, web pages, database record, streaming video or voice. In most cases, wireless networks transfer data, such as e-mail messages and files, but advancements in the performance of wireless network is enabling support for video and voice communications as well.

TYPES OF WIRELESS NETWORKS
- WLANS: Wireless Local Area Networks

WLANS allow users in a local area, such as a university campus or library, to form a network or gain access to the internet. A temporary network can be formed by a small number of users without the need of an access point; given that they do not need access to network resources.
- WPANS: Wireless Personal Area Networks

The two current technologies for wireless personal area networks are Infra Red (IR) and Bluetooth (IEEE 802.15). These will allow the connectivity of personal devices within an area of about 30 feet. However, IR requires a direct line of site and the range is less.
- WMANS: Wireless Metropolitan Area Networks

This technology allows the connection of multiple networks in a metropolitan area such as different buildings in a city, which can be an alternative or backup to laying copper or fiber cabling.
- WWANS: Wireless Wide Area Networks

These types of networks can be maintained over large areas, such as cities or countries, via multiple satellite systems or antenna sites looked after by an ISP. These types of systems are referred to as 2G (2nd Generation) systems [3].
Today, growing consumer demand for access to communication services anywhere and anytime is accelerating the technological development towards the integration of various wireless access technologies, nowadays called as Fourth Generation (4G) wireless systems. 4G wireless systems will provide significantly higher data rates, offer a variety of services and applications previously not possible due to speed limitations, and allow global roaming among a diverse range of mobile access networks.

REVIEW OF LITERATURE
There exist several studies in the literature to address the integration of existing wireless system. In [12], Ad-hoc CEllular NETwork (ACENET) architecture for 3.5G and 4G mobile system is proposed. In which a heterogeneous MAC protocol is used to integrate IEEE 802.11, Bluetooth and HiperLAN/2 with cellular architectures. The coordination between transmissions of different access protocols is provided using beacons from the base stations. ACENET consists of a cellular network and ad hoc network. Even though ACENET improves the throughput performance, it needs many modifications in the base stations in order to achieve this.

In [6], a dynamic access probability protocol has been proposed for cellular Internet and satellite-based networks. The network computes an access probability, which depends on the load, and announces it, as a broadcast message, to the user. However, the QoS requirements of the application are not addressed.

A unified framework for the channel assignment problem in time, frequency, and code domains is proposed in [9]. The unified (T/F/C) DMA algorithm consists of labelling and colouring phases. Using the graph theory solutions, channel assignment problems in heterogeneous network structures have been addressed.

A MAC protocol with Fair Packet Loss Sharing (FPLS) scheduling is proposed for fourth generation wireless multimedia communications in [4]. The MAC protocol exploits both time-division and code division multiplexing. FPLS is a QoS requirement based packet scheduling algorithm. The main aim is to provide QoS guarantees in terms of transmission delay, accuracy, and to maximize system resource utilization. The proposed MAC protocol is shown to provide QoS guarantees in hybrid TD/CDMA systems. However, the proposed protocol necessitates a new wireless network infrastructure with new base stations for fourth generation communications.

In [8], an integrated approach for the management of power and performance of mobile devices in heterogeneous wireless environments is developed. It decides what wireless network interface (WNIC) to employ for a given application and how to optimize the WNIC usage. And it enhances the QoS by maximizing the power savings in heterogeneous wireless systems. In [5], an Adaptive Medium Access Control (A-MAC) layer to address the heterogeneities posed by the NG wireless networks is proposed.

A joint session admission control scheme for multimedia traffic is introduced in [13]. In which it maximizes the overall network revenue with good Quality of Service (QoS). They integrate two different networks, a Wireless Local Area Network (WLAN) and a wideband Code Division Multiple Access Network (CDMA). A novel concept of effective bandwidth is used in the CDMA network to derive the unified radio resource usage, taking into account both physical layer linear minimum mean square errors (LMMSE) receivers and characteristics of the packet traffic. However, the integration requires modifications in the existing base stations.

In [2], a new adaptive MAC based on OFDMA technology has been designed. In Wireless Local Area Network (WLAN), the existing Medium Access Control (MAC) scheme lack scalability when the network is crowded. It is due to the use of random multiple access techniques in the MAC layer. It provides a new opportunity for devising more efficient MAC protocols. Data transmission opportunities are assigned through an access point that can schedule traffic streams in both time and frequency domains.

A radio resource allocation is proposed for a heterogeneous wireless access medium in [11]. A novel algorithm is developed for the resource allocation. The coordination among different available wireless access networks base stations is established via the MT multiple radio interfaces in order to provide the required bandwidth to each MT. A priority mechanism is employed, so that each network gives a higher priority on its resources to its own subscribers as compared to other user. Numerical results demonstrate the validity of the proposed algorithm. The application of this framework requires major modifications in the NG wireless network components.

Based on the above works, the existing proposals need a significant modification in the existing infrastructure and base stations or a completely new architecture. The result is the integration problem, in terms of implementation costs, scalability and backward compatibility. The NG wireless networks are also expected to provide diverse range of services. This diversity in the MAC layer guarantees Quality of Service requirements in wireless environments.

PROBLEM IDENTIFICATION

The literature reviews presented above discussed listed several proposals which address the integration of existing wireless systems. However, the integration requires modifications in the existing base stations or a new wireless network infrastructure with new base stations. Although it improves the throughput performance over the existing networks, many modifications in the base stations are required to achieve this. These approaches lead to integration problems in terms of implementation costs, scalability and backward compatibility. Few proposals concentrate only on integrating the existing wireless network but not on the Quality of Service. Some proposals discuss the Quality of Service requirement in heterogeneous wireless network. Therefore, the problem is identified as integration of existing wireless network, high network utilization and guarantees Quality of Service requirements.

METHODOLOGY

The proposed work is a solution to the problems identified above. The solution is a new Hexagon based Adaptive Medium Access Control (HMAC) layer. The proposed HMAC framework has three sub-layers for seamless access, resource utilization and QoS scheduling. This HMAC framework is deployed in the NG wireless terminals of heterogeneous wireless network.

A. *Hexagon based Medium Access Control*

HMAC has three sub-layers. The Access sub-layer detects the available networks that the NG wireless terminal can access. The Decision sub-layer is responsible for selecting a suitable resource from the available network. The Scheduling sub-layer provides a QoS-based scheduling.

B. Access sub-layer

The NG wireless terminal is equipped with multiple-mode radio capabilities. Recent developments in radio receiver and transmitter development have led the way to mobile hand-held devices that are capable of functioning in multiple access technologies. The NG wireless terminals are capable of receiving signals from multiple network access points and transmitting signals to different access schemes simultaneously.

The HMAC consists of Adaptive Network Interfaces (ANIs) which is responsible for accessing different resource schemes in the underlying heterogeneous wireless networks. The MT communicates with different networks through ANIs. It monitors and records the parameters of various networks based on bandwidth, usage charges and power consumption as in [7]. These parameters are expressed in terms of weight factors to calculate the access function as follows:

$$N^{i}_{access} = \sum_{j=1}^{n} w_j f_{i,j} \quad 0 < N^{i}_{access} < 1 \qquad (1)$$

$$\sum_{j=1}^{n} w_j = 1 \qquad (2)$$

In the equation (1) and (2), *n* represent the numbers of parameters consider for calculating the N^{i}_{access} access function of network interface *i*. w_j represent the weight of j^{th} parameters. $f_{i,j}$ stands for the normalized score of interface *i* for j^{th} parameter.

C. Decision Sub-layer

The Decision sub-layer performs decision to choose a suitable interface to forward a specific traffic. The ANIs associated with each network discovers the possible network from the available networks. The Received Signal Strength of the base station and velocity of the NG wireless terminals are used to select the possible network. The decision algorithm is shown below:

Step 1: If the rss_i is less than $rsst_i$ then for all n_j where *j* not equal to *i*

Step 2: Check whether rss_i is greater than $rsst_i$ and v_i is less than vt_j then

Step 3: Add the network n_j to the possible network

Step 4: Calculate the difference $rssd_i$ between rss_i and $rsst_i$

After selecting the possible network, a priority value is assigned to each possible network. Based on the decision function the ANIs selects a suitable network interface. The decision function is calculated as follows:

$$N^{i}_{decision} = N^{i}_{acces} * P^{i}_{value} \qquad (3)$$

In the equation (3), N^i_{access} is the access function calculated by access sub-layer using (1) and (2). P^i_{value} is the priority value assigned to each possible network.

D. Scheduling Sub-layer

After the decision process calculation using (3), a QoS-based scheduler is used for each ANI in order to guarantee the QoS requirements of each flow. Accordingly the scheduling is performed in the ANIs where multiple flows are directed.

To address the requirements of the scheduler in NG wireless terminals, we propose a Dynamic Time Slot scheduling algorithm based on the idea presented in [10]. The scheduling algorithm is presented as follows.

- Dynamic Time Slot Scheduling Algorithm

The dynamic time slot scheduling is a frame based packet scheduler. Here, the time is slotted into frames of variable length. Each session makes a reservation in terms of maximum traffic when it is allowed to transmit during a frame period. The reservation is made according to a session's allocated rate. Each session is assigned a weight in terms of number of bits or bytes. The algorithm is defined as follows:

Enqueue

Step 1: Assign arrived packet *p* to a flow index $flow_i$

Step 2: Check whether the active list $alist_i$ is empty then

Step 3: Add the flow index $flow_i$ in the active list $alist_i$

Step 4: Assign zero to the deficit counter dc_i

Step 5: Check for free buffers if not available then

Step 6: Free the buffer

Step 7: Enqueue the packet *p* to the queue q_i

The Enqueue algorithm adds arrived packet in the queue. When the packet *p* arrives, a flow index $flow_i$ is assigned to the packet. Then the flow index $flow_i$ is added in the active list $alist_i$ queue. If the active list $alist_i$ is full, then find a free buffer and add the flow index $flow_i$ with packet *p* in the queue.

Dequeue

Step 1: Check whether the active list $alist_i$ is not empty then

Step 2: Remove the flow index $flow_i$ from the active list $alist_i$

Step 3: Add quantum value qtv_i to the deficit counter dc_i

Step 4: Calculate the packet size $pktsize_i$ of the packet p in the queue qi

Step 5: If the packet size $pktsize_i$ is less than or equal to deficit counter dc_i

Step 6: Delete the flow index $flow_i$ from the queue q_i

Step 7: Subtract the packet size $pktsize_i$ from the deficit counter dc_i

The Dequeue algorithm removes the flow index $flow_i$ from the queue q_i. Then the quantum value qtv_i is added to the deficit counter dc_i. The packet size $pktsize_i$ is calculated from the queue q_i. Then subtract the packet size $pktsize_i$ from the deficit counter dc_i and delete the head of the active list $alist_i$.

PERFORMANCE EVALUATION

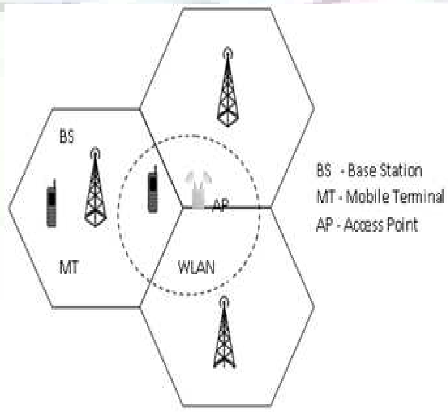
In this section, the experimental work evaluates the performance of the existing and proposed systems. A simulation model is developed using Network Simulator (NS2) for heterogeneous wireless network. Figure 1 shows the heterogeneous wireless network. It has different access schemes namely TDMA, CDMA, and CSMA. There are 100 nodes. The simulation parameters are listed in the below in Table I.

TABLE I: SIMULATION PARAMETERS

Parameters	Values
Simulator	NS2
Protocol	DSDV
No. of Nodes	100
Simulation Time	230seconds
Simulation Area	1000x1000m
Transmission Range	230m
Traffic Model	CBR, VBR
Transfer per Packet	512 bytes
Data Processing Delay	0.5,0.10,0.15ms
Energy Model	0.3,0.6

These nodes are distributed randomly in a 1000 x 1000m grid. The simulation time is 230 seconds. Each node is connected to only one network. And one node is equipped with the proposed model HMAC. This node is named as an Adaptive Node which is capable of accessing different networks.

FIG. 1: THE HETEROGENEOUS WIRELESS NETWORK



Two traffic models CBR and VBR are used. In this model six parameters throughput, power consumption, data rate, end-end delay, routing overhead, and network density are calculated.

RESULTS AND DISCUSSIONS

The results are carried out for the throughput, power consumption, data rate, end-end delay, routing overhead, and network density. The proposed system performance is compared with the existing systems. In Figure 2 the throughput for CBR and VBR traffic are presented. The throughput ratio of three nodes is considered. It is shown that, the proposed model achieves high throughput. In Figure 3 the power consumption of the proposed model is shown.

FIG. 2: THROUGHPUT OF PROPOSED MODEL

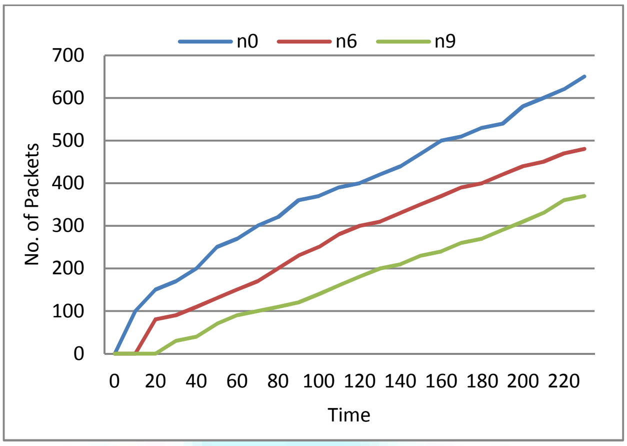
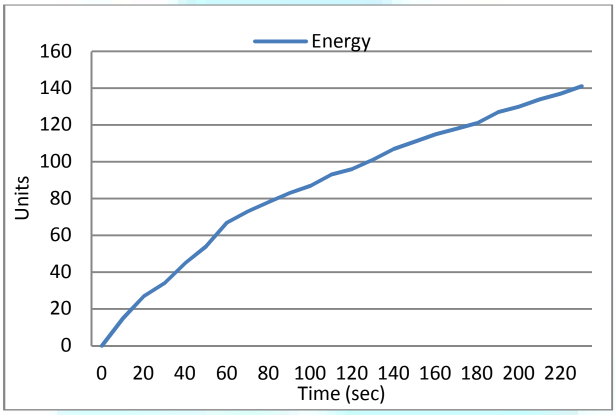
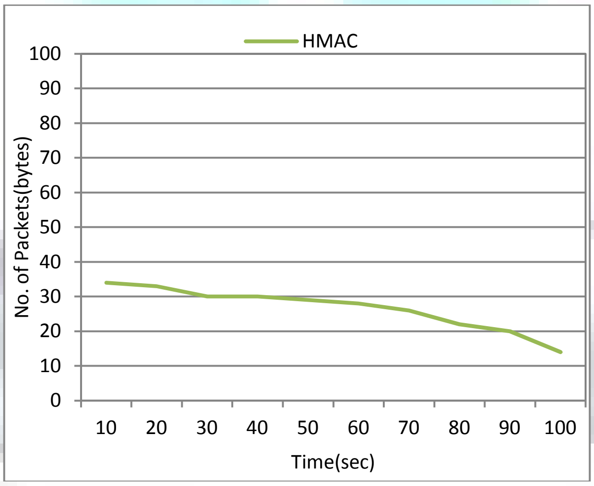


FIG. 3: POWER CONSUMPTION OF PROPOSED MODEL



The routing overhead graph is shown in Figure 4. The routing overhead of existing model is 1.45 where as the proposed model has 0.87. The routing overhead has been reduced by HMAC.

FIG. 4: ROUTING OVERHEAD OF PROPOSED MODEL



It is observed that the proposed scheme is more effective than the existing model. The packets arrival rate is higher, and the overall system throughput is higher in the proposed model. This is because our model uses QoS scheduling. Based on this, the routing overhead of the proposed model is reduced.

CONCLUSION

The proposed a Hexagon based Adaptive Medium Access Control Layer integrates different wireless networks. The HMAC is incorporated in the next generation wireless terminal. This HMAC has three-layered architecture. It provides seamless access through the access sub-layer. It achieves high network utilization by selecting a suitable resources using decision sub-layer. And also guarantees QoS requirement through scheduling sub-layer. The system performance is analyzed by the simulation software. Thus, HMAC addresses these challenges without any modification in the existing structure.

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Sd/-

Co-ordinator

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