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Heterogeneous Network Routing Analysis

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***Abstract*— The two main driving technologies in the mobile telecommunication market of third generation mobile systems were identified as UMTS (Universal Mobile Telecommunication Systems) and Internet on mobile systems. The UMTS evolved the mobile systems with the concept of portability. The portability rendered the service of a personalized service set across the network/terminal boundaries. The other services like Voice Over IP (VOIP) is another important evolution of the third generation which helps to acquire data communication on mobile systems. In this paper we have simulated UMTS application using a network simulator called Qualnet. The simulation results are taken for different applications and routing protocol.**

***Keywords*- UMTS, IERP and Fisheye.**

I. INTRODUCTION

The Universal Mobile Telecommunication System (UMTS) is a third generation (3G) mobile communication system that provides a range of broadband wireless and mobile communication services. UMTS maintains the global roaming capability of the second generation (2G) GSM system and its packet-switch mode enhancement (GPRS system) and provides enhanced capabilities. Compared with 2G telecommunication systems, UMTS is able to support multimedia services including graphics, pictures, and video communications, as well as voice and data at a higher data rate and with better quality of service.

UMTS targets to build an all-IP network by extending the second generation GSM/GPRS system and using complex technologies including Code Division Multiple Access (CDMA), Asynchronous Transfer Mode (ATM), and Internet Protocol (IP). GPRS is the convergence point between the 2G technologies and the packet-switch domain of UMTS. The UMTS architecture for a typical third generation telecommunication system is illustrated in Figure1.

There are three major categories of network elements as listed below:

1.GSM Core Network Elements: It mainly consists of Mobile Service Center (MSC), Visitor Location Register (VLR), Home Location Register (HLR), Authentication Center (AuC), and Equipment Identity Register (EIR).

2. GPRS Network Elements: It mainly consists of Serving GPRS Support Node (SGSN), and Gateway GPRS Support Node (GGSN).

3. UMTS-specific Network Elements: It mainly consists of User equipment (UE), and UMTS Terrestrial Radio Access Network (UTRAN) elements.

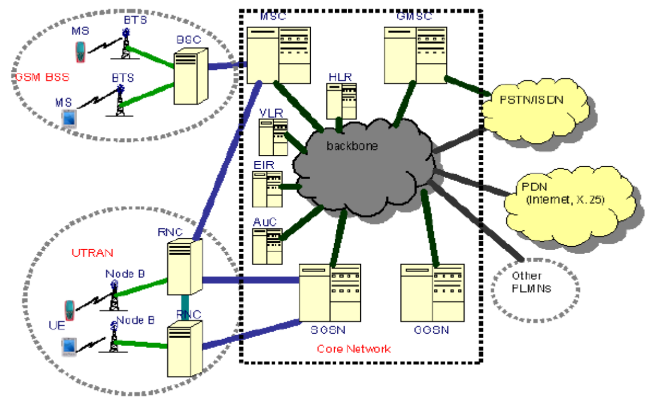

Figure 1: UMTS architecture

The core network is based on GSM/GPRS, but uses ATM or IP as the transport network. The ATM-based UMTS network is more popular since it ensures various QoS and classes-of-service to the end users. The functions of core networks include switching, routing, transporting, and maintaining a database for user traffic. It contain the circuit-switch domain that includes MSCs, VLRs, and GMSCs, and the packet-switch domain that includes SGSNs and GGSNs. The EIR, HLR, and AuC are part of both domains. In an ATM-based UMTS network, ATM adaptation layer type 2 (ALL2) can handle circuit-switch connections, while ALL5 can handle packet-switched connections.

Functions of the UMTS Domains

Infrastructure domain

- Access network (AN) domain: functions specific to access technique
- Core network (CN) domain: functions independent of access technique

Access network domain

- physical entities managing the resources of the access network
- provides the user with a mechanism to access the core network domain

Serving network (SN) domain

- part of the CN domain to which the AN domain that provides the user's
- access is currently connected
- responsible for routing calls and transport user data/information from source to destination
- provides CN functions that are local to the user's access point (i.e. SN changes when the user moves)

Home network (HN) domain

- contains user-specific data and is responsible for management of subscription information
- handle home-specific services, not offered by the serving network domain
  User Services Identity Module domain (USIM)
- related to the home network domain by subscription

II. Related Work

Paper [1] presents an end-to-end Quality of Service (QoS) architecture suitable for IP communications scenarios that include UMTS access networks. The rationale for the architecture is justified and its main features are described, notably the QoS management functions on the terminal equipment, the mapping between IP and UMTS QoS parameters and the negotiation of these parameters.

Paper [2] investigates the impact of the evolution toward an all-IP UMTS network architecture on the UMTS service architecture, which is based on the VHE concept. The article discusses two possible scenarios for supporting VoIP services in the UMTS service architecture and analyzes their applicability in an all-IP-based UMTS network.

The first is based on the traditional centralized IN service architecture. The second proposes a new decentralized architecture based on direct control of VoIP call control equipment by open service architecture interfaces.

Paper [3] discusses High tier wireless systems such as GPRS and UMTS provide users high mobility but less bandwidth. On the other hand, low tier wireless systems such as Wireless LAN offer high bandwidth with less mobility. To support seamless roaming between heterogeneous wireless networks is regarded as one of the key issues in the future mobile communication system. The paper presents the design and evaluation of three possible UMTS-WLAN interworking strategies, i.e. mobile IP approach, gateway approach, and emulator approach based on the current UMTS, WLAN and Mobile IP specifications. Recommendations to UMTS-WLAN interworking strategies according to different deployment scenarios are also discussed in this paper.

In paper [4], a novel architecture for interworking of the Wireless Local Area Network (WLAN) and the Third Generation (3G) mobile cellular network is presented. This architecture is a hybrid model with additional controls compared with the existing architectures and the use of IP Multimedia Subsystem (IMS), as an arbitrator for coupling and real-time session management. Furthermore, a new networking entity called a mobility manager has been introduced within the IMS for seamless management of vertical handoffs. Efficient strategies for IP address distribution and bypassing high traffic loads form the cellular core network are other benefits of this architecture.

Paper[5],In this context the EURESCOM Project P507 "Mobility Applications Integration in Intelligent Networks" has investigated in particular a set of scenarios for the evolution from different initial network situations towards the target UMTS, including the fixed network, Cordless Terminal Mobility, GSM, cable networks / Wireless Local Loop, mobile satellite networks and a stand alone UMTS scenario. The objective of this project part was an assessment of the technical feasibility as well as an evaluation of the suitability of the identified scenarios. The paper presents the basic results **of** this project.

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III. PROPOSED MODEL

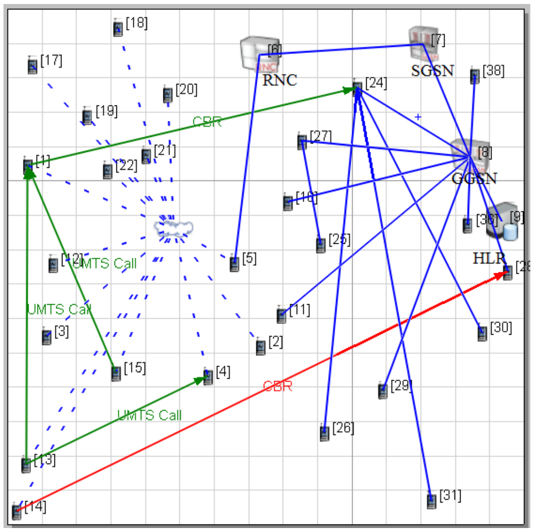

Figure 2: Scenario depicting the interworking between an IP network and UMTS network.

The proposed work depicts on interconnection between the two networks. The networks considered are IP and UMTS. Basically aim of the simulation is to set up the connection between heterogeneous networks that runs for the single application. The model is constructed using the basic architecture of UMTS as shown in Fig 1. According to the architecture the default nodes are to be connected to the Radio Node Controller that acts as the base station to the nodes which communicate through the wireless subnet. The node controller is in turn connected to the Serving GPRS Support Node that provides the encryption parameters to the node controller for the encryption for the calls to and from the nodes. This node is connected to the Gateway GPRS Support Node that functions as the gateway between UMTS and other networks like PSTN, PLMN or Internet. In our scenario we have interfaced an IP network with the UMTS network through GGSN. GGSN is finally connected to the Home Location Register which maintains the database of the connected nodes. The information might be about subscriber profiles. Specifically the HLR is the location register to which an MS identity is assigned for record purposes, such as directory number, profile information, current location, and validation period.

IV. SIMULATION RESULTS

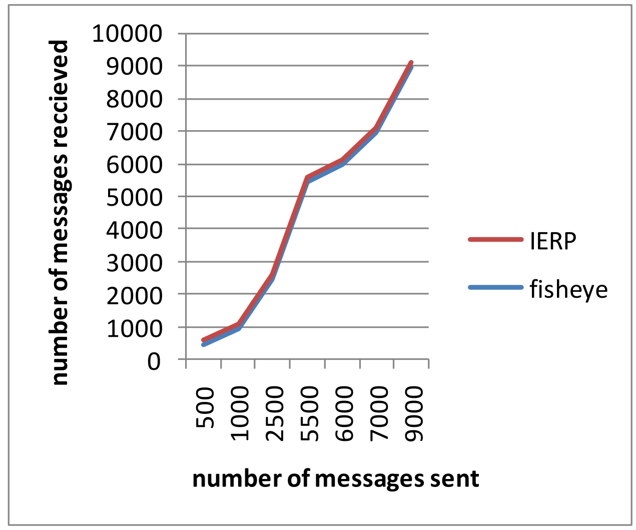

Figure 3: Observations made on different messages sent and received using two routing protocols on CBR1

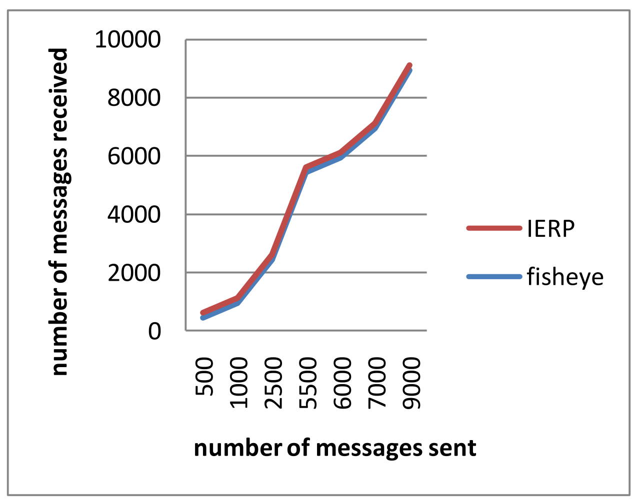

Figure 4: Observations made on different messages sent and received using two different protocols on CBR2

Simulations are carried out for both CBR applications using two different routing protocols IERP and FISHEYE. Figure 3 and 4 shows the number of packets received for the total number of packet sent for two different applications using two different routing algorithms.

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The loss of 5 packets is found on CBR1 using fisheye routing protocol and a loss of 8 packets is observed with the same routing protocol on CBR2. The simulations carried out using IERP routing protocol is observed with no packet loss on CBR1 and a loss of 3 packets on CBR2. Hence comparatively it can be observed that IERP routing protocol to be more efficient than Fisheye routing protocol of more packet loss.

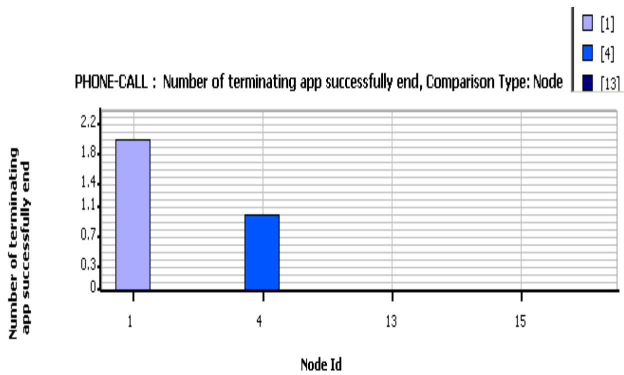

Figure 5: Number of terminating applications successfully end at nodes 1 and 14.

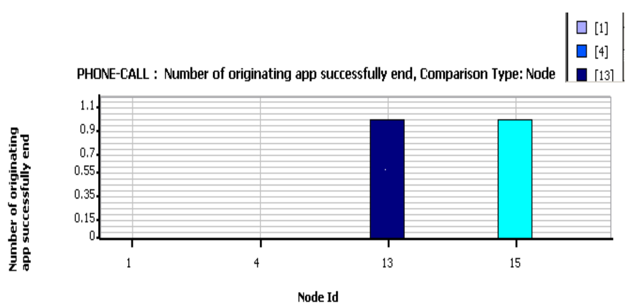

Figure 6: Number of originating applications successfully end at node 13 and 15.

As shown in the proposed model The scenario is simulated for the two UMTS calls originate from node 13 terminated at nodes 1 and 4. And one UMTS call originating from node 15 terminated at node 1.By simulating the scenario the applications ended successfully at the originating and terminating nodes is observed as shown above. Two applications successfully end at the terminating nodes 1 and 4, which are respectively sent by nodes 13 and 15.

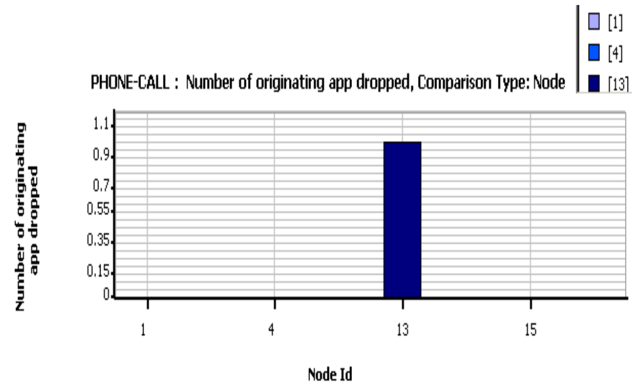

Figure 7: Number of originating applications dropped at node 13

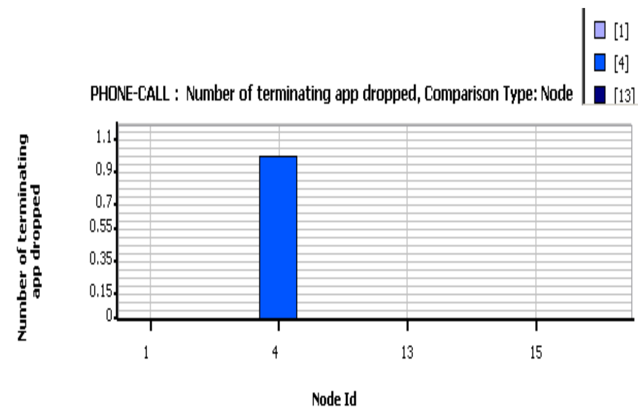

Figure 8: Number of terminating applications dropped at node 4.

Simulations are carried out for the scenario and the observations are made. The number of packets dropped is observed at the nodes 13 and 4. One application drop is observed at each node. The packet losses observed which are successfully end and the dropped packets are as depicted in the figures above.

V. CONCLUSIONS

We have simulated a scenario to interoperate between an UMTS and an IP network. Simulations are run and observations are noted varying the network routing protocol. The numbers of packets are successfully sent on the both applications CBR1 and CBR2. The loss in packets is found to be increased with the distance and it is also dependent on the routing protocol used.

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The comparative study illustrates the IERP routing protocol to be more efficient than the fisheye routing protocol. Hence we can conclude that packet transfer can be successfully done in an interdomain routing network of IP based and UMTS. And also the applications dropped in anUMTS call establishment are studied.

Future research directions will be essentially aimed towards improving the mobility manager for handling seamless data routing and QoS provisioning with specific emphasis on high data volumes originating from the WLAN.

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