An Architecture of Integration Of 802.11 WLAN Network & UMTS

Mukhwinder Kaur, Bhawna, G. C. Lall

Abstract: - In Wireless network different technologies used for different purposes like Wireless LAN used for data services and UMTS are used for cellular networks such as provide various voice and data services, WLAN provides data services at high speed. Integration of UMTS and WLAN allows Operator to deploy used services at low cost and high speed. WLAN also allow covering hotspot areas Furthermore the architecture of WLAN and UMTS integration permits a mobile node to continue data connection (packet switch) through WLAN and voice connection (circuit switch) in parallel. In this paper the main features we are explaining WLAN and UMTS architecture along with its advantages and challenges facing during integration and handover scheme from WLAN to UMTS is being proposed.

Keywords- Circuit Switch, Packet Switch, Hotspot, Umts, Wlan

I. INTRODUCTION

In today scenario assimilating two technologies is becoming essential to have desirable services anytime anywhere. In present world a number of integrated technologies exist. Alliance of many radio based technologies provides good service quality and is cost effective. That's why new generation is likely to have various heterogeneous topologies to improve the performance results jointly for both network and users. Ieee802.11b is employed in authorization relieved to scientific, medical and industrial frequency band i.e. 2.4GHZ and it offers data rate of 11mb/s, [1] in comparison to 802.11a and 802.11g that offers data rate equal to 54mb/s exempting 2.4GHZ and 5GHZ bands correspondingly [2].

Ieee802.11 that is wireless local area network (wlan) has been implemented broadly in different areas of research in current years. Various technologies such as personal digital assistants and mobile phones are armed with wlan interface that allows users to have broadband mobile internet assistance.

Integrating technologies means we can connect or interface at the same time to have access of more than one technology. One case of integration is interfacing of wlan and umts. Wlan is efficient to provide extreme data rates at low prices. In spite of this its services are restricted to very less geographical areas. Similarly Umts coverage area network is extensive but Umts is expensive and it's provided data does not accomplish the constraint of high bandwidth demanding applications. In such case mechanism of integration is Beneficial as integration of two technologies improves user applications.

II. IEEE 802.11 WLAN

The IEEE standard 802.11 is generally carried out in the infrastructure and ad-hoc modes. In the infrastructure mode, the transmission between the nodes is coordinated by an Access Point (AP) within a

Particular radio coverage area called as service set. Infrastructure mode is related to its integration with the cellular network. One access point can be coupled with one mobile node (MN) in a given time.

The communication between all of the AP's connected to MN's is done by directly coordinating through an AP. Roaming around APs is carried out in layer-2 via an Inter-AP Protocol (IAPP).[9] Beacons contains cell-id known as the AP's MAC address and network-id known as Extended Service Set Identifier (ESSID) are periodically generated by the AP's along with other information.

When wlan is powered up the MN gets connected to the AP by transmitting an associate request frame to an AP. Once the MN shifts towards a new cell it get a beacon with the new cell-id but with same network-id, it then get connected to the new AP by transmitting the re-associate request frame including an old ap's MAC address. The old AP communicates with the new AP with the help of IAPP [3] for downloading the framework.

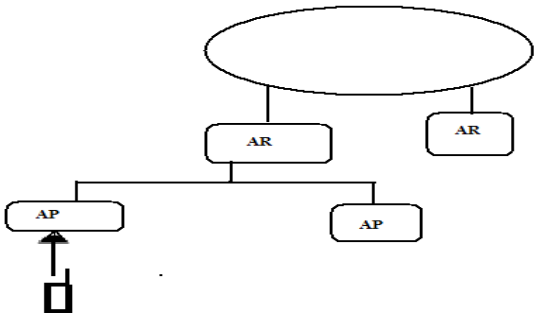

Fig.1 Wlan IP network

Mainly two MAC functions are demarcated for 802.11 that are point co-ordinate function (pcf) and distributed co-ordinate function (dcf). In dcf all of the sending nodes use CSMA/CA protocol [4] to strive for the radio channel.

The node retransmits the frame when collision occurs then frames are retransmitted by the node that is identified by the lack of acknowledgement of the receiver.

Manuscript received on April 14, 2012.

Mukhwinder Kaur, ECE Dept Haryana College of Tech. & Management (Kaithal) (E-mail:Mukhvinderkaur24@indiatimes.com).

Bhawna ECE Dept Haryana College of Tech. & Management (Kaithal) (E-mail:bhawna.sept@gmail.com).

G. C. Lall ECE Dept Haryana College of Tech. & Management (Kaithal) (E-mail:dr.gclall_mr@yahoo.com).

In pcf the Collision Free Period (CFP) is announced by an AP when all the MNs are back off. The AP polls assure MNs in the CFP, which in return transfer the frames The PCF is defined for an isochronous traffic, pcf is mainly defined.

In spite of this the PCF is not broadly used for commercial APs.

III. DIFFERENT METHODS OF INTEGRATION

Basically Integration is done in three different mechanisms. Loose coupling, Tight coupling, Open coupling are the three different mechanisms of integrating the technologies.

1) Loop coupling: In this wlan is basically connected to an internet back bone with the help of gateway router. [5] So it maintains an indirect connection. Jointly the networks are indecently operated. Little alteration is required for the maintenance purpose.

2) Open coupling: In open coupling both wireless networks are not integrated in real. For example in case of wlan and umts both function independently and it uses distinct authentication mechanism. It is basically employed for billing scheme.

3) Tight coupling: In this mechanism wlan is directly connected either by ggsn or by sgsn to the umts network. [5] Mobility management and to reduce handoff are its main advantages. But it is more complex than loose coupling.

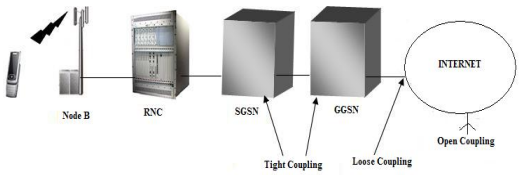

Fig.2 Integration of coupling schemes

V Wlan protocol

Wlan basically deploys assertion centered medium access protocol (Mac) known as carrier sense multiple access protocol accomplished with collision averting (csma/cs) which is also known as energy consuming protocol. The problem is Wlan interfacing consumes lots of energy. Therefore by reducing consumption of energy wlan interfacing can be easily done. [6]

IV. HOW MAC WLAN CONSUMES ENERGY?

Ieee802.11 standard specifies that Mac wlan operates either in power saving mode or active mode. [7] In the active mode, a station has been required to rouse to listen to the wlan channel and to transmit and receive packets. There is an access point (AP) that proclaims the contention free protocol (CFP). The contention free mechanism is basically known as point coordination function (PCF). But when the stations do not transmit and receive then it is called a doze state.

V. ARCHITECTURE OF UMTS

UMTS network is mainly divided in two main parts i.e. UMTS terrestrial radio access network (UTRAN) and Core network (CN).[8] Chas two domains i.e. packet switch (PS) domain and circuit switch (CS).The diagram depicts that PS-domain has gateway GPRS support node (GGSN) along with HLR and serving GPRS support node (SGSN). But UTRAN has radio network controller (RNC) performing, mobility management, encryption and radio resource management. It also manages node-B providing wireless access to mobile user [9].

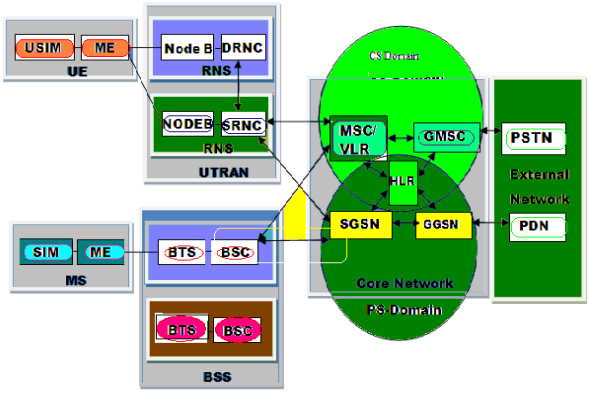

Fig.3 Architecture of UMTS

VI. ARCHITECTURE OF WLAN

The architecture of integration of wlan 802.11 and umts permits a mobile node to sustain voice connection across umts and data connection across wlan equivalently. It becomes possible only because wlan is mainly known for its high speed and is used for high speed data services.

Wlan is predominantly known for the asymmetric bandwidth usage in which downloading bandwidth is mainly two or three magnitude greater e.g. in internet

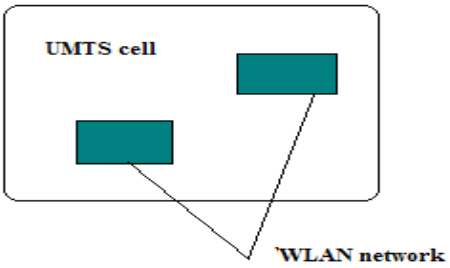

Fig.4 maximum range (Hot Spot)

cafe, apartment buildings, office buildings. The cluster of high speed is known as usage area primarily recognized as hot spot. [10]

In wlan and umts there is more than one point of integration.

VII. ARCHITECTURE OF WLAN AND UMTS INTERRATION

The elementary objective behind the architecture of integration is to support the hot spot scenario. It says that when a MN steps towards the 802.11 micro cells,

the PS connection (connection for the packet data service) by the means of UMTS RNS (or effectually with the help of GPRS) is disassembled and it is restored by the means of WLAN network. [11] The MN uses UMTS RNS to build up the CS connection which is connection for voice service within the 802.11 cells.

Therefore it is presume that MN is basically a dual-mode terminal having two interfaces – one is 802.11 interfaces and another is UMTS interface. Both of the interfaces can be activated uniformly. The projected architecture is shown in fig.5 in which SGSN represents the point of integration. UTRAN and WLAN are mainly two distinct types of radio access networks for the SGSN.Other two possibilities are evaluated before describing the integration at the SGSN.

The RNC carry out the radio specific tasks, like it converts radio frames into packets and vice versa, regulates handover and control the radio resources etc.Complex radio procedures are implemented at RNC while establishing the wlan connection because both the radio interfaces are completely different.

On the other hand, the WLAN can also be attached at GGSN which makes the handover from UMTS to WLAN simpler because the GGSN simply sustains session contexts for the PS connections. On the other hand during handover to UMTS the SGSN reconstructs the mobility state while having handover with umts, and re-establish or acquire the pdp session and RAB framework. [12] This is the information which is not possessed by the GGSN thereby the handover becomes slow.

The architecture of integration is presented in Figure 5 revealing that WLAN network is linked by the means of border routers (BRs) to the SGSN.Specific signaling between the MN and the network is required for having a connection through umts network for establishing and managing bearer path. WLAN network and UMTS connectivity through various interfaces is maintained by the MN in 802.11. UMTS connection is mainly depleted for the voice services. In addition UMTS connection is use for the PS signaling primarily for establishing and managing the PS connection. Thus, the PDP context which is the surviving gprs signaling protocol is used to establish the bearer data path by the means of WLAN network.

Besides it also acquires prominent changes in majority of the GPRS procedures realized at the SGSN to differentiate both of the cases comprising of the PS bearer paths that are establish either through wlan or umts rns. In other methodology, implemented for the same architecture is for both of the signaling or bearer paths for the PS connections.

They are created by the means of WLAN to SGSN. The complete connection acquires very little changes in few of the prevailing GPRS procedures. Independent signaling is possessed by the voice connection and bearer path without any bearing on data connection.

Upcoming mobile networks seem to be developed using packet-switched architecture having a number of access technologies.

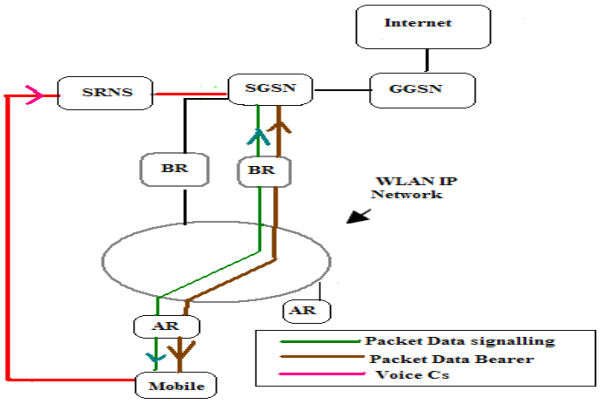

Fig.5 Integration of Umts & Wlan

This architecture allows 3G mobile networks to get extend with different wireless access technologies based on IP like Worldwide interoperability for Microwave Access called WiMAX or Wireless Local Area Network named as wlan. Many wireless networks have different designs.

In spite of this the wide range of characteristics counterpart each other making integration process attractive. On one side there is UMTS for 3G cellular networks providing high mobility, wide coverage area with narrow bandwidth. While on other side there are many technologies for example wlan providing less area of coverage with broad bandwidth. When both of the technologies are combined they result in pervasive wireless network having hotspots providing services at high speed.

Different ways have been studied [11] [12] [13] illustrating about way to combine umts and wlan and explain how handover is done among the technologies. More or less all approaches are based on Mobile IP. Different simulations depict [11] that performance of handover with IP [12] is quite low specifically when handover is performed with a particular technology. This poor performance is mainly observed when handover is performed on the network layer. Messages have been sent periodically by mobile IP for changing the connection.

Simultaneously if three messages are mislaid then only handover is done. This results in handover delays for few seconds. A handover protocol having tight coupled architecture is used for reducing the handover delays allowing the integration of the wlan access points into the architecture of umts network.

VIII. HANDOVER FROM WIRELESS LAN TO UMTS

In this part of paper, handover protocols from wlan to umts are described. The network architecture is shown in figure 6. .The integral part of umts network is wlan access points are connected directly with serving gprs

Support node called SGSN providing another radio access network for the prevailing cellular network. [14] There are two interfaces for mobile equipment named as wlan interface and umts interface.

Both Interfaces are connected with each other and with network layer by handover module. Measurement reports indicate SGSN when ME goes out of the coverage area of wlan cell and the vertical handover get initiate.

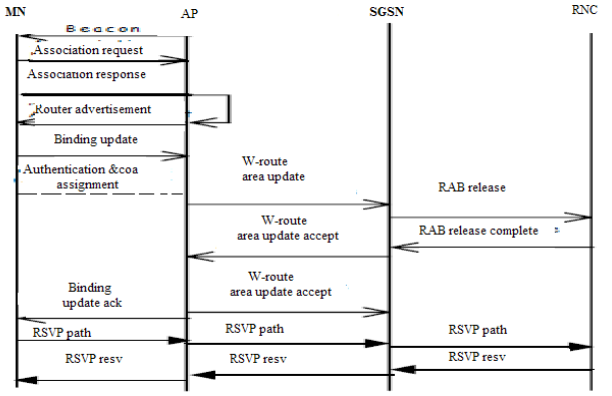

Fig.6 UMTS_WLAN handover procedure

The diagram tells about important aspects related to vertical handover such as tunnel

Management among the SGSN and the Gateway GPRS Support Node called GGSN and intercommunication. All the features are carried out in simulation. The vertical handover is fragmented mainly in three parts that is connection establishment, handover procedure and connection release. To initialize the procedure an UMTS device activation request is being transmitted from SGSN to mobile equipment via existing wlan connection. A Packet Data Protocol (PDP) context request is send in return by mobile equipment for quality of service class being used in wlan around the UMTS channel back to the SGSN. After the completion of transmission radio Access Bearer (RAB) is installed and tunnel is created between RNC and SGSN. [15]The mobile equipment gets connected with both of the networks after achieving good quality of service and activation response is transmitted to the SGSN by the

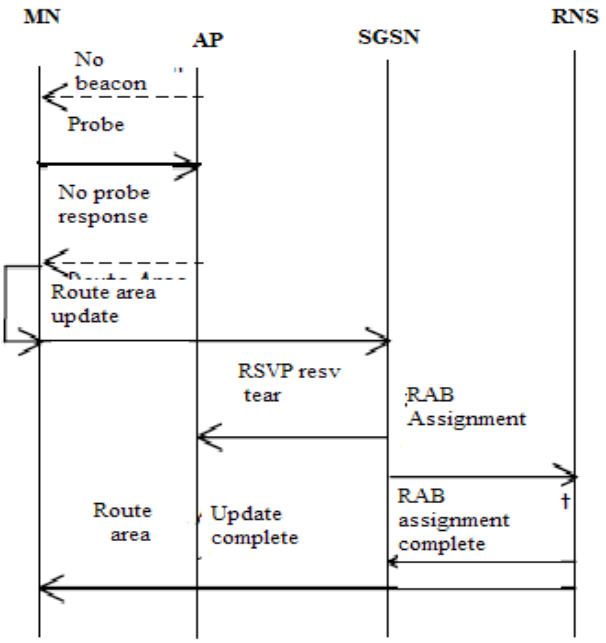

Fig.7 WLAN-UMTS handover procedure

UMTS network when the connection gets established successfully the vertical handover gets initiate it by SGSN. After this ME get switched over to UMTS indicating device exchange to SGSN along with message of handover. After that, SGSN initiates IP-over-IP tunnel to RNC. Simultaneously SGSN updates ME address to forward traffic to RNC. Finally wlan's old connection is de-allocated to save resources. Thus the tunnel between the access point and SGSN is released and ME is disassociated to the access point.

IX. CHALLENGES DURING INTERGATION OF WLAN AND UMTS

The major challenges that are encountered in integrating wlan are as follows [16][17]

1) The impact of difference in the qos model for the two radio access network types of applications

2) How to deal with variant connection paradigms that are used in every network like wlan is connection less whereas gprs is connection oriented.

3) How to certify the packet routing access.

4) How to choice the best integration point when multi network is being used.

X. ADVANTAGES OF WLAN AND UMTS INTERGATION

1) 4G networks endow many benefits to service providers and users [18] [19]. They can choose a particular network according to user's requirement from available integrated networks which avoids several issues of limited capacity and out of coverage.

2) 4G networks can be easily connected with networks having abundant resources. Therefore, users can be connected anytime, anywhere with the network

3) Available resources of wireless network can be utilized economically by integrated heterogeneous network each wireless network. It helps in reusing deployed networks to provide services anytime, anywhere.

4) The WLAN-UMTS integration networks provide [20] load balancing and avoid congestion. For example in a network at the time of congestion, user's data is transfer to a number of integrated wireless networks. By doing this congestion can be avoided.

5) WLAN and cellular network area of coverage gets increase with integration of WLAN-UMTS network. For example, in the hotspot region UMTS user can be aided by WLAN in hotspot regions. Similarly WLAN user can also be aided by UMTS network when he goes away from coverage area of WLAN.

6) The integration helps in improving security features because WLAN security features do not provide security to network from various network attacks. Thus in case of integrated WLAN-UMTS network, security features of UMTS is reused for WLAN.

XI. CONCLUSION

During the course of this paper we discussed briefly about integration architecture meant for umts and wlan; we also talked about wlan being used in hotspot area from microcell within umts microcells along with the UMTS. We threw some light on some of the advantages and challenges of this integration and also on various vertical handover techniques which support and work with a lot of micro mobility solutions which are used in WLAN network.

REFERENCES

1. W. Song , H. Jiang, W. Zhuang, and Xuemin Shen , "Resource management for Qos support in cellular/WLAN interworking," Network, IEEE , vol.19, no.5, pp. 12- 18, Sept.-Oct. 2005.
2. W.Song,W.Zhuang,A.Saleh," Interworking of 3G cellular networks and Wireless LAN" ,International Journal of Wireless and Mobile Computing, vol.2, no. 4, pp. 237-247, 2007.
3. Matthew Gast, 802.11 Wireless Networks – The Definitive Guide, O'Reilly, 2002.
4. IEEE Std. 802.11b, Supplement to ANSI/IEEE Std. 802.11,1999 Edition, IEEE Standard for Wireless LAN MAC and PHYSpecifications, PDF: ISBN 0-7381-1812-5, January 2000.
5. Aziz, A.; Saad, N.M.; Samir, B.B.; Dept. of Elect. & Electro Eng, Univ. Teknol. Petronas, Tronoh, Malaysia "A comparative analysis of integration schemes for UMTS and WLAN networks ",Circuits and Systems (APCCAS), 2010 IEEE Asia Pacific Conference on 6-9 Dec. 2010.
6. Christine E. Jones, Krishna M. Siva lingam, Prathima Agrawal, Jyh Cheng Chen, A survey of energy efficient network protocols for wireless networks, Wireless Networks 7 (4) (2001) 343–358.
7. A. Helmy, and M. Jaseemuddin, Efficient Micro-Mobility using Intra-domain Multicast-based Mechanisms (M&M), USCCS-TR-01-747, August 2001.
8. A Comparative Analysis of Integration Schemes for UMTS and WLAN Networks Safdar Rizvi, Asif Aziz, N.M. Saad, Brahim Belhaouari Samir, Department of Electrical and Electronic Engineering, University Technology Petrona 31750 Tronoh, Perak, Malaysia, 978-1-4244-7456-1/10, 2010 IEEE.
9. M.A. Amara,"Performance of WLAN and UMTS integration at the hot spot location using opnet", 2003-2006
10. 'An Architecture for Integrating UMTS and 802.11 WLAN Networks", Muhammad Jaseemuddin Dept. of Electrical & Computer Engineering, Ryerson University, 2009
11. J. Alba-Laurila, J. Mikkonen, and J. Rinnemaa, Wireless LANAccess Network Architecture for Mobile Operators, IEEE Communications, pp. 82-89, Vol. 39, No. 11, November 2001
12. M. Bauer et al, Comparison of Different Strategies for UMTS and WLAN integration, IPCN 2002.
13. A.K. Salkintzis, "Interworking techniques and architectures forWLAN/3G integration toward 4G mobile data networks," Wireless Communications, IEEE, vol.11, no.3, pp. 50- 61, June 2004
14. Rastin Pries, Andreas M¨ader, Dirk Staehle, and Matthias Wiesen "On the Performance of Mobile IP in Wireless LAN Environments, In Wireless Systems and Mobility in Next Generation Internet", LNCS vol. 4369, Sitges, Spain, June 2006.
15. G. Dommety, "Fast Handovers for Mobile IPv6", Internet Draft, July 2001.
16. A. Campbell, J. Gomez, S. Kim, A. Valko, C. Wan, Z.Turanyi, Design, Implementation, and Evaluation of Cellular IP,IEEE Personal Communications, Vol. 7, No. 4, pp. 42-49,August 2000.
17. Vahid Solouk, Borhanuddin Mohd Ali, Daniel Wong "Vertical Fast Handoff in Integrated WLAN and UMTS Networks ", ICWMC 2011, the Seventh International Conference on Wireless and Mobile Communications, 2011
18. F. Zarai, N. Boudriga, M.S. Obaidat. "WLAN-UMTS Integration: Architecture, Seamless Handoff, and Simulation Analysis". SIMULATION, 82(6): 413-424, 2006
19. A. H. Zahran, B. Liang, A. Saleh, "Signal Threshold Adaptation for Vertical Handoff in Heterogeneous Wireless Networks". Mobile Networks and Applications, 11: 625-640, 2006
20. A. Hacker, H. Labiod, G. Pujolle, H. Afifi, A. Serhrouchni, P. Urien. "A New Access Control Solution for a Multi-Provider Wireless Environment", Telecommunication Systems, 29(2): 131-152, 2005
21. Zhi Ren, Guangyu Wang, Qianbin Chen, Hongbin Li" Modeling and simulation of Rayleigh fading, path loss, and shadowing fading for wireless mobile networks", Simulation Modeling Practice and Theory 19 (2011)
22. V. Dasarathan, M. Muthukuma, K.N. Elankumaran, Outdoor channel measurement, path loss modeling and system simulation of 2.4 GHz WLAN IEEE802.11g in Indian rural environments, in: Asia-Pacific Microwave Conference, 2007.
23. N. Alsindi, B. Alavi, K. Pahlavan, "Empirical path loss model for indoor relocation using UWB measurements", IET Electronics Letters 43 (7) (2007)
24. Celal Ceken, Serhan Yarkan ,Huseyin Arslan," Interference aware vertical handoff decision algorithm for quality of service support in wireless heterogeneous networks", Computer Networks 54 (2010)
25. S. Yarkan, A. Maaref, K.H. Teo, H. Arslan, "Impact of Mobility on the Behavior of Interference in the field of Cellular Wireless Networks", Global Telecommunications Conference, 2008.
26. Upendra Rathnayake, Maximilian Ott, Aruna Seneviratne, "Network availability prediction with hidden context", Performance Evaluation 68 (2011)
27. C. Zhu, H. Yu, Xining Wang, and H. Chen, Improvement of Capacity and Energy Saving of VoIP over IEEE 802.11 WLANs by A Dynamic Sleep Strategy, IEEE GLOBECOM09 (2009)
28. Qixiang Pang, S.C. Liew, V.C.M. Leung, Performance improvement of 802.11Wireless network with TCP ACK agent and auto-zoom backoff algorithm, in: IEEE Vehicular Technology Conference, 2005
29. M. van Der Schaar, N. Sai Shankar, Cross-layer wireless multimedia transmission: challenges, principles, and new paradigms, IEEE Wireless Communications 12 (4) (2005) 50–58.

AUTHORS PROFILE

Mr G.C Lall work as prof and chairman of ece dept of hctm engg.college.he has 47yr work experience in teaching deptt.

Mukhwinder I am mukhwinder kaur did my b.tch from gju hisar and having work experience with various companies,specialy in hcl being tso(technical support officer).right now I am doing mtech from hctm kaithal(Haryana college of technology and management).which is allified by kurukshtera university.i am passed my diploma degree in 2002 from bps university.and also qualify gate exam in 2004.in mtech.i am working on papers of various fields and on various networks and specialy on next generation networks.

Bhawna I am Bhawna from Chandigarh (India). I am pursuing M.E. in electronics and communication from Haryana College of Technology and management which is affiliated by kurukshtera university. I am doing dissertation on " Automatic Modulation recognition of digitally modulated signals". I have presented dis paper on my dissertation work. I did B.Tech from Indo Global College of Engineering in 2010. I did work on project " Automatic Life Saving dialler " based on GPS and GSM modem. I have passed senior secondary in 2006 from Shishu Niketan Senior Secondary School and metric in 2004 from Manav Mangal High School.