International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.2, Issue.4, July-Aug. 2012 pp-2396-2403 ISSN: 2249-6645

A COMPARATIVE STUDY ON EFFECTIVE SCHEMES FOR NETWORK SELECTION IN 4G COMMUNICATION SYSTEMS

Jeeva Susan Jacob[1], Preetha K. G.[2]
[1]*Department of Computer Science, Rajagiri School of Engineering and Technology, Rajagiri Valley, Cochin, India.*
[2]*Department of Information Technology, Rajagiri School of Engineering and Technology, Rajagiri Valley, Cochin, India.*

Abstract: *Wireless technologies have been adopted into the field of communication in the recent past. The fast pace in the growth of advanced wireless hardware and technologies have caused the evolution and generation of five wireless communication standards within this short span of time. The fourth generation (4G) communication standard, which is the most recent of these five, is a promising area for research. 4G systems aim at implementing a global communication network by integrating all existing telecommunication standards. It modifies the main goal of wireless communication from "AlwaysConnected" to "Always Best Connected". Major issues which are delaying the commercial release of 4G devices include network selection, vertical handoff, billing issues, jamming and spoofing, location privacy and QoS support. The main expectation about 4G is the freedom for the users to choose and switch between services provided by various service providers integrated into the 4G network.. The main purpose of this paper is to explore the various network selection schemes which have been proposed by various researchers in the area. This paper discusses the method or technique of network selection, benefits and shortcomings of each of these selection schemes. And also the paper tries to accomplish a comparative study on their effectiveness in performance. A proposal is also made to improve the network selection scheme based on QoS technique to make it suitable for emergency situationsby adding a preplanner module.*

KEYWORDS: *4G SYSTEMS, NETWORK SELECTION, MOBILE COMPUTING, WIRELESS COMMUNICATION, COMPARATIVE STUDY.*

I. INTRODUCTION

Communication Techniques are evolving at the fastest pace ever known to mankind, with the worldwide development of new and efficient technologies in every split second. By instigating 4G, an integrated network of all networks, everything from laptops to smart phones and communication facilities from LANs to portable internet packages, grows to be a part of a common global standard. With a data rate of 100 Mbps to 1Gbps, 4G is the technology of the future. Techniques like OFDMA (Orthogonal Frequency Division Multiple Access), SDR (Software Defined Radio), MIMO (Multiple Input and Multiple Output) and so on adds to the boons of 4G wireless communication standard. This results in making computing and communication a much easily accessible and simple activity. The comparative study on various communication standards evolved in the course of the telecommunication era, shown in the figure 1, reveals further benefits of 4G standard.

	0G	1G	2G	3G	4G
TECHNOLOGY	ANALOG	DIGITAL	DIGITAL	DIGITAL	DIGITAL
PERIOD	1970s	1980s	1995+	2006+	2010+
DATA RATE	-	14.4Kbps	144-200Kbps	250Kbps-14.4 Mbps	100Mbps-1Gbps
SWITCHING	-	CIRCUIT	PACKET	PACKET	BROAD-BAND
PROTOCOLS	PSTN	NMT,AMPS ,TACS	GSM,GPRS, EDGE	DECT,HSPA ,WiMAX	OFDMA, MIMO

Figure 1. The figure shows comparative study on various communication standards.

A prominent aspect of 4G systems is the network selection scheme by which the users can choose the best connected network available for each of the services required. Suppose a user needs high security for a call, he can select the most secure call service from the available service providers. Similarly in the case where he requires a messaging service with the cheapest rate for messages he can choose the one which is cheaper among the available lot. Selection can also be made based on the values of multiple parameters as well. Thus the system always promises the best services provided by the best service providers.

To choose the suitable technology for each service at a particular place and time, assessing services provided by each of the service providers can be a tedious and complicated task. Researches on numerous schemes are going on in different parts of the world to simplify and improve the process.

Researchers around the world have accepted network selection as an NP-hard problem. The primary reason for this is the heterogeneous nature of the 4G system. In a normal mobile communication system the network utilized depends only on the signal strength from the base station. Network Selection in 4G depends on multiple criteria like bandwidth, security, cost of service, performance in heterogeneous network, user preference and so forth. Thus analysing each of these parameter values for all the networks available at each unit time for every single service turns out to be a herculean task.

Vertical handoffs, billing frauds, service theft, privacy attacks and the like may also create nuisance in efficient selection of network and its utilization. We found scores of indispensable proposals for solutions on network selection from many researchers related to the area. In this paper we discuss a few of the renowned schemes for network selection in 4G communication systems. We also try to analyze the benefits and detriments of each in performing network selection.

The rest of this paper is organized as follows. Section II provides an overview on the basic architecture of 4G. Section III to X discusses the significant schemes as analyzed by us for network selection. The comparative study on the analysis of their performance based on certain parameters is described in section XI. Section XII explains the new proposal with the preplanner module. Section XIII expounds future enhancements and section XIV the conclusion.

II. 4G : BASIC ARCHITECTURE AND FUNCTIONING

Advanced devices with imminent technologies are required for implementing 4G with its entire functional package. Various appliances developed with the aim of accomplishing this failed in executing one fragment or the other of the 4G functional plan. Although fundamental properties and functionalities were devised much earlier, the lack of suitable equipments with adaptable architecture has delayed the introduction of 4G in the communication zone. However, numerous proposals have been made by inquisitive brains around the world for developing a basic architecture for 4G systems which promise a revolution in this field.

Long Term Evolution (LTE) developed by the Third Generation Partnership Project (3GPP) is a great improvement in the Telecommunications Systems. With the use of advanced techniques like OFDM and MIMo, LTE paves the way for the integration of ubiquity into the field of wireless communication and mobile computing. Here, users are assured with Quality of Service (QoS) with the help of Evolved Packet System (EPS). It supports both Frequency Division Duplexing (FDD) and Time Division Duplexing (TDD). It gives much better performance than Code Division Multiple Access (CDMA) with bandwidths ranging from 1.4MHz to 20MHz. The actual practical implementation process of 4G is proved to be accelerated by the development of LTE. The basic LTE system architecture configuration consists of logical components like :

- User Equipment (UE) such as a smartphone for individual users
- Evolved Universal Terrestrial Radio Access Node-Bs (e-UTRAN) which act like the Base stations
- Mobility Management Entity (MME) which manages the user's mobility
- Serving Gateway(S-GW) for tunnel management and switching of UE
- Packet Data Network Gateway (PDN-GW) which is the IP point of attachment for the UE
- Policy and Charging Resource Function (PCRF) which is responsible for Policy and Charging Control (PCC) for various service providers
- IP Multimedia Subsystem (IMS) to provide services using Session Initiation Protocol (SIP)
- Home Subscription Server (HSS) which is the data repository of the subscriber's profile

By implementing the perfect architecture 4G is expected to have high performance, good interoperability, perfect networking, high bandwidth, advanced technological functions, ubiquitous coverage, convergent connectivity, better device interfaces, good scalability, high quality service and a cheaper globally connected communication system. The potential applications which are expected to be developed or improved by the effective implementation of 4G systems include virtual presence, virtual navigation, tele-medicine, tele-geoprocessing, crisis management, education, mobile banking and other emergency services. The basic functioning of 4G is based on the provision of users to select the required network for performing particular services. The following sessions describe various solutions proposed by researchers around the world for effective network selection in 4G.

III. QOS BASED NETWORK SELECTION SCHEME

Quality of Service (QoS) is the key constraint for most of the technologies in all major fields of societal life. QoS based scheme ensures the best service for maximum user satisfaction and the best approach for resource utilization.

In this scheme [21], QoS is ensured by creating the ranklist based on certain parameters evaluated during performance. Miscellaneous performance parameters to ensure QoS for the users are taken into account. Cost of the service, available bandwidth, connectivity during handover and the like are encompassed in this set of parameters. The algorithm used includes calculating the distance function based on these parameters and creating ranklists for each network as the initial step. Weighted distance function is performed on the results thus obtained and network with the highest score is selected for providing the required service.

The greatest advantage is the user has a choice in the parameters to be considered for each service selection. Also, the number of parameters considered can vary according to the required service. When considering only a single parameter, weighted distance function calculation can be skipped and network can be chosen from the rank list for that particular parameter. There is still the drawback of overhead because of repeated calculations for each and every service. In spite of this slight shortcoming, this is so far the best method for network selection as per our analysis.

IV. QoE Based Network Selection Scheme

V.

Since 4G is a network of numerous existing networks and service providers, the selection based on the parameter values of individual networks may not be accurate for its proper functioning. Thus, a new scheme was anticipated where the performance of each network, in the presence of other networks, is evaluated.

Quality of Experience (QoE) in this scenario means the performance of a particular service provider or network in a heterogeneous network of networks in providing proffered services. In this scheme [14] a number of packet-switched networks are compared based on certain parameters evaluated for each network in the presence of other heterogeneous networks and the one providing highest QoE standard is chosen. The techniques of Analytical Hierarchy Process (AHP) and Grey Relational Analysis (GRA) are combined in this method. Then the available networks are ranked to discover the apt one.

This method guarantees the best performing network in a miscellaneous set of networks. But it does not consider the performance of the networks individually, which deteriorates the performance by a fraction since the number available networks can diverge in the milieu.

VI. Open Resources Based Network Selection Scheme

Resources of a network comprises of aspects like area covered, services provided, expandability, files, memory, power, external devices and so forth. For each service requested by the user, the networks with the appropriate resources to perform it need only be considered. Thus the selection process thus prunes the list of available networks and confines the list of networks to the best suited ones with the required set of resources only. So this is basically a selection process based on elimination.

In this scheme request sent by user is processed and the resources required are gathered together. Then each of the networks available is explored to confirm whether any of them comply with the request. Thus the network with maximum suitability with the request is selected and designated to provide the service to the user. If more than one network qualifies for the actual selection process, additional weights are added as per user preference before selection. If none qualifies in its entirety, the one that has the maximum match score with the resources required is selected.

Better resource utilization for the users is the foremost benefit of this method. Since no complex calculations are involved, this scheme does not generate much overhead. On the contrary, efficiency in functioning is low in comparison with the other schemes discussed earlier.

VII. User Requisites Based Network Selection Scheme

This is the scheme [8] which assigns utmost importance to the choice and demands of users of the system. Network selection is done based on dynamic adaptation with respect to the user's preference. Here a user agent and a network agent, its client side image, are used.

The selection algorithm is integrated into a middleware layer which hides the complexity of the system from the users. Cost functions are executed to determine service cost, power conception, network availability, bandwidth degradation and network unreliability. Each cost parameter is dynamically mapped to a weight which is dynamically calculated as per user preferences.

The scheme provides a higher dynamicity to the whole selection process. Thus it achieves a more effective criterion for selecting the access network selection. Although it has much calculation overhead and complexity in the lower layers, this is the best and user affable scheme which suits the user's preference factors.

VIII. COMPETITION BASED NETWORK SELECTION SCHEME

Game theory can be used for effective modeling and resource allocation for networks. This scheme [3] models network selection problem as a game in the 4G global network. The major components included in game theory are players, strategies, payoffs and resources.

All available networks become the players of the game. These networks compete with each other in a non-cooperating manner for several rounds. Thus their pay-off values are maximized, which means the performance parameters of the services received by users have high values. Strategies are the adaptations done by the networks to provide the best service for users. Resources are the features of each network like bandwidth, power usage, coverage, security and so on.

Since this is held between access networks, users do not get tangled in the complexities of the selection process. But user participation can be ensured by collecting their preference values for the participating networks. As in every other discipline, competition improves Quality of Service among the various service provider networks involved in the 4G communication systems. Conflicts tend to occur in this scheme due to the preference factors. Also, the initial stage tends to be much tedious.

IX. RANKING BASED NETWORK SELECTION SCHEME

This scheme [5] is a collaboration technique of methods of network selection based on user preferences and open resources. It removes abnormalities due to other selection schemes and also scores high on efficiency. The critical attributes used for selection are cost per byte, total bandwidth, available bandwidth, delay, jitter, packet loss, signal strength and utilization. Terminal power consumption is also considered at times.

Initially, a list of available networks which can provide the requested service is created. Then weight matrix along with user preferences is obtained by classifying the attributes into speed, cost and quality categories. Then a ranking algorithm is executed and rounding off is done on the ranks. The network with the best rank is chosen from the results obtained.

This is a much easier method when compared to earlier techniques. Although much hectic calculations are to be performed till the rank list is obtained, choices can be made easily based on the ranks. The consistency of the algorithm paves the way for a stable ranking system.

X. UTILITY THEORY BASED NETWORK SELECTION SCHEME

Utility, in this context, implies the efficacy of a network in gratifying the user's demands. Fundamental utility theory of Von Neumann mathematically defines a set U(w,x), where x is the set of user's observation on product criteria and w is the set of user preferences, both rounded off to real numbers.

The aim is this scheme [16] is to provide "Always Best Connected" (ABC) service, replacing the existing intent of providing "Always Connected" (AC) service. A new multi-criteria utility theory function has been developed in the scheme to suit the network selection process in 4G, which is expected to be consisting of dissimilar networks with contradicting attribute values. It has been created after numerical analysis on existing utility theory functions and to overcome the shortcomings of them.

Strict and effective selection is possible through this method. Also the user's preferences limits the whole lot of available networks to a few which makes the selection process much easier. However, for simple services such amount of complex mathematics ruins the objective.

XI. AGENT ACUITY BASED NETWORK SELECTION SCHEME

Agent based learning systems dynamically adapts to the environment in which they function through continuous perception. An agent is required to be adaptable to the environment its acting on for any minute changes which may happen. Cognitive networks are a group of such networks which functions on constant perception and actions based on thus acquired data. This scheme [7] provides an improved technique for the network selection by individual cognitive terminals. It also aims at improving the adaptability of the system by enhancing the resource utilization of the system.

A Q-learning algorithm is a sort of classic reinforcement learning algorithm. Constant perception is performed and actions are taken from the knowledge acquired to adapt to the system. For each state the environment is in, a particular action is adopted. Trend of performing a particular action depends on the rewards obtained on previous adaptation of the action. To determine the optimum action to be adopted an objective function is executed.

Since the system is dynamically adaptable, continuous connectivity is guaranteed throughout the service performed. Constant perception may require high memory and much complex lower level functions. Also vertical handover issues may affect the adaptation process adversely.

XII. COMPARATIVE STUDY ON THE SCHEMES

The sections above discussed the renowned schemes in performing network selection in 4G communication systems. The method adopted for network selection, benefits and shortcomings were discussed earlier. Here we make a comparative analysis on each of these methods with each other. A comparative study on these schemes based on attributes like bandwidth, user preference, dynamic adaptability, security and the like is shown in figure 2.

Network Selection Schemes Based on	Bandwidth	User preference	Dynamic Adaptability	Connectivity Maintenance	Overhead	Security	Power Requirement	Cost of Service	Heterogeneity Adaptation	Memory Requirement	Best Service
QoS	√	√	x	√	√	√	√	√	√	x	√
QoE	√	x	x	√	x	√	√	√	√	x	√
Open Resources	√	√	x	x	x	√	√	√	x	√	x
User Requisites	√	√	√	√	√	x	√	√	√	x	x
Network Competition	√	√	x	x	√	√	√	√	x	x	√
Ranking Algorithm	√	√	x	√	√	√	√	√	x	√	√
Utility Theory	√	√	x	x	√	x	x	√	√	x	√
Cognitive networks	√	x	√	√	√	√	x	√	√	√	√

Fig. 2. The figure shows comparative study on various network selection schemes.

As per the comparative study, all the schemes provide the necessary bandwidth and consider the cost of service on network selection. Dynamic adaptation to the environment's functional situation is possible in user requisites based method and Cognitive networks utilizing Agent Acuity. However vertical handoff issues destroy this scope on practical implementation.

The best method for network selection as per the study is the QoS based method. Overhead due to calculations, which affects its performance a bit, when compared to other techniques, is much lower. Since it takes into account almost all parameters to be considered it would be easy to implement and enhance.

XIII. A NEW PROPOSAL FOR EMERGENCY SERVICES

Selection of application as per the user preference based on QoS (Quality of Service) is one of the best solution for the issue. This user-centric system works on the basis to provide best services of the network to the users. Here, a selection algorithm has been proposed which provides a better way to implement user preferences as per the features of 4G by adding a memory portion to the QoS based scheme. The steps involved in this new proposal are described in figure 3 and 4.

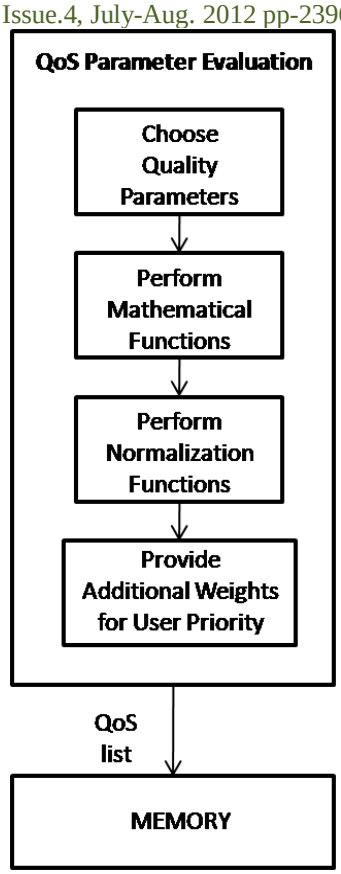

Fig. 3. The figure shows the creation of the QoS list to be stored in the memory

As in the Qos based scheme [21] for network selection, we first fix the parameters to be considered. It can be done based on the quality parameters usually considered and also with the user's demand for certain parameters if any. For example, for the deals between business empires the primary quality they prefer during communication will be secured connectivity rather than cost of communication.

Next, the values of these parameters are calculated using mathematical functions. Round off functions can be performed on the results to normalize and confine them to a scale from 0 to 10. Additional weights can be allotted to include user priorities. This list is stored in memory and is updated periodically as per the changes in each network's functionalities or policies.

The usual method based on QoS is repeated for each new service accessed by user since parameter values considered may vary in every fraction of time. This creates much overhead for emergency communication requirements. So, with the list stored in memory, a preplanner module is added to the method which enables user to plan in advance and select the networks suitable for different services so as to avoid overhead of calculations during emergencies. Plans are updated periodically to suit major changes in parameter values under consideration.

So the actual network selection process in this proposal is done as follows. Initially, the global 4G network is analyzed for available service providers in that particular area at that particular time. Then we determine the QoS score for each of the network from the QoS value list previously stored in memory.

User's requests for additional parameters are also taken care of and their values are also considered. Additional weights are added for user priorities. Again normalization is applied to obtain uniformly standardized values. Finally, the rank list is made from these scores. The best scoring network is selected for accomplishing the service.

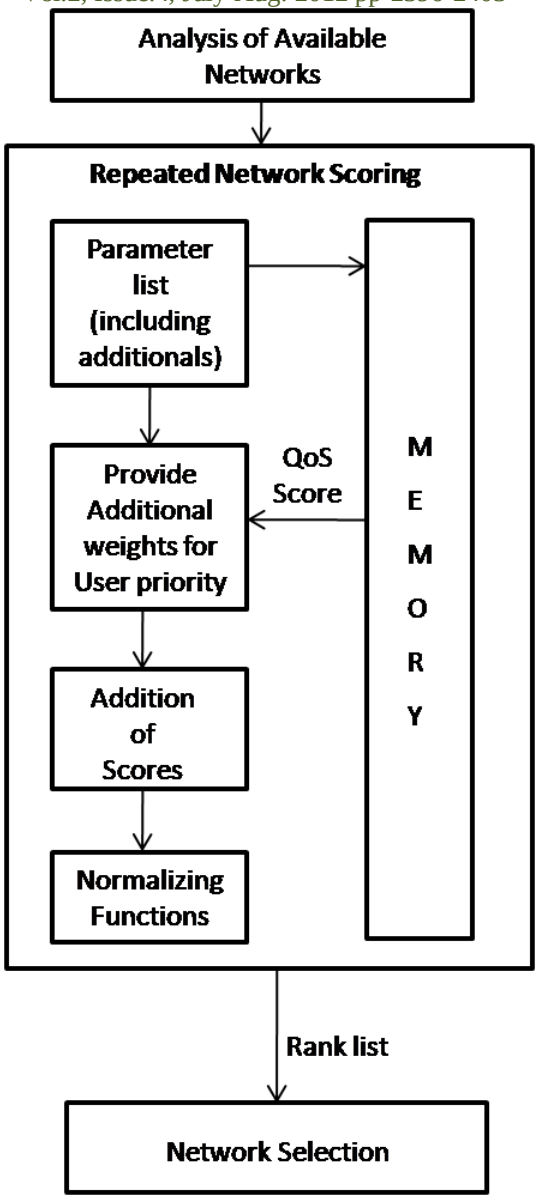

Fig. 3. The figure shows the creation of the QoS list to be stored in the memory

For emergency services, instead of repeating the whole process of calculations and selection, the network which is best from the preplanned list can be selected as suited for the required service. Thus the use of memory for storage of scores can reduce the overhead in selection in almost all normal scenarios.

For example, a user makes a call after selecting a network from the available networks.. After the call is ended he/she realizes he/she forgot to say something to the callee. When the user attempts to call again, in the normal QoS method the whole process needs to be repeated again. But with the new method, a suitable network can be selected from the preplanner module to perform the call. Of course, this is possible only if the second call is done within a particular period of time, say maximum one minute, from the first call.

XIV. FUTURE ENHANCEMENTS

Future work includes the comparison of these techniques on practical implementation factors. Of course that would take time as 4G system implementation has not yet been perfectly accomplished. Enhancing the QoS based method to reduce the overhead can make it the best method for network selection. In the case of the new solution proposed, overhead during the initial stages of the method, even though does not affect the network selection process directly, need to be reduced for effective implementation of network selection.

Emergency services require fast selection and handover processes even when services are going on. Also techniques for effectively resolving vertical handoff issues are yet to be researched on. There exists much scope on using genetic algorithmic methods for solving network selection problem in 4G.

XV. CONCLUSION

In this paper we discuss the network selection issue in 4G communication systems. A comparative study on the various technical schemes for resolving network selection issue is discussed here. Even though a bit of overhead exists in the scoring phases, the main process of network selection gets easier with lists to support the calculations involved. Numerous new proposals from many researchers are emerging day by day. 4G systems on implementation can pave the way for the ubiquitous standard of communication. This would enable "anytime anywhere" computing which is a huge leap forward in the field of global telecommunication system.

REFERENCES

[1] Afaq H. Khan, Mohammed A. Qadeer, Juned A. Ansari, Sariya Waheed, "4G as a Next Gene-ration Wireless Network", pp: 334, International conference on Future Computer and Communication, ICFCC 2009.
[2] Akan, A.; Edemen C., "Path to 4G wireless networks", pp: 405, Personal, Indoor and Mobile Radio Communications Workshops, 2010 IEEE 21st International Symposium on 2010.
[3] Antoniou, J.; Pistllides, A.; "4G Converged Environment: Modeling Network Selection as a Game", pp: 1, obile and Wireless Communications Summit, 2007. 16th IST, 2007.
[4] Bill Krenik, "4G Wireless Technology: When will it happen? What does it offer?", pp: 141, Solid-State Circuits Conference, 2008. A-SSCC '08. IEEE Asian, 2008.
[5] Dhar, J.; Kiran S, R.; Reddy K, Y.; "Network Selection in Heterogeneous Wireless Environment: A Ranking Algorithm", pp:41, Wireless Communication and Sensor Networks, 2007. WCSN '07. Third International Conference on, 2008.
[6] Govil, J., "4G: Functionalities Development and an Analysis of Mobile Wireless Grid", pp: 270, Emerging Trends in Engineering and Technology, 2008. ICETET '08. First International Conference on, 2008.
[7] Haifeng Tan; Yizhe Li; Yami Chen; Li Tan; Qian Li; "A novel access network selection scheme using Q-learning algorithm for cognitive terminal", pp : 1, Communications and Networking in China (CHINACOM), 2010, 5th International ICST Conference on, 2011.
[8] Iera, A.; Molinaro, A.; Campolo, C.; Amadeo, M., "An Access Network Selection Algorithm Dynamically Adapted to User Needs and Preferences", pp: 1, Personal, Indoor and Mobile Radio Communications, 2006 IEEE 17th International Symposium on, 2006.
[9] Jamil, M.; Shaikh, S.P.; Shahzad, M.; Awaais, Q., "4G: The Future Mobile Technology", pp: 1, 2008-2008 IEEE Region 10 Conference, 2009.
[10] Jivesh Govil, Jivika Govil, "4G Mobile Communication Systems: Turns, Trends and Transition", pp: 13, International Conference on Convergence Information Technology, 2007.
[11] Kyung-Ho Kim; "Key technologies for the next generation wireless communications", pp: 266, Hardware/Software Codesign and System Synthesis, 2006. CODES+ISSS '06. Proceedings of the 4th International Conference, 2007.
[12] Li Zhen, Zhou Wenan, Song Junde, Hou Chunping, "Consideration and research issues for the future generation of mobile communication", pp:1276, Electrical and Computer Engineering, 2002. IEEE CCECE 2002.
[13] Makhecha, K.P.; Wandra, K.H.; "4G Wireless Networks: Opportunities and Challenges", pp:1, Conference (INDICON), 2009 Annual IEEE, 2010.
[14] Markaki, O.; Charilas, D.; Nikitopoulos, D.; "Enhancing Quality of Experience in Next Generation Networks Through Network Selection Mechanisms", pp: 1, Personal, Indoor and Mobile Radio Communications, PIMRC 2007. IEEE 18th International Symposium on, 2007.
[15] Nossenson, R., "Long-term evolution network architecture", pp: 1, Microwaves, Communications, Antennas and Electronics Systems, 2009. IEEE International Conference on, 2010.
[16] Quoc-Thinh Nguyen-Vuong; Ghamri-Doudane, Y.; Agoulmine, N., "On utility models for access network selection in wireless heterogeneous networks", pp: 144, Network Operations and Management Symposium, 2008. NOMS 2008.
[17] Rahman, M.; Mir, F.A.M.;, "Fourth Generation (4G) Mobile Networks – Features, Technologies Issues", 3G and Beyond, 2005 6th IEEE International Conference on 2007.
[18] Rouffet, Denis; Sehier, Philippe; "Convergence and Competition on the Way Towards 4G", pp: 277, Radio and Wireless Symposium, 2007 IEEE, 2007.
[19] Santhi, K.R; Kumaran, G.S.;, "Migration to 4G: Mobile IP based Solutions", pp: 76, Telecommunications, 2006. AICT-ICIW '06. International Conference on Internet and Web Applications and Services, 2006.
[20] Santhi, K.R; Srivastava, V.K.; senthilKumaran, G.; Butare, A., "Goals of true broadband's wireless next wave (4G-5G)", pp: 2317, Vehicular Technology Conference, 2003. VTC 2003-Fall. 2003 IEEE 58th,2004.
[21] Sehgal, A.; Agrawal, R.; "QoS based network selection scheme for 4G systems", pp:560, Consumer Electronics, IEEE Transactions on, 2010.
[22] Suk Yu Hui ; Kai Hau Yeung;, "Challenges in the migration to 4G mobile systems", pp: 54, Communications Magazine, IEEE 2003.
[23] J. Govil, "An Empirical Feasibility Study of 4G's Key Technology", Electro Information Technologies, pages 267 – 270, 2008.

[24] D. Charilas, O. Markaki, D. Nikitopoulos, M. Theologou, "Packet Switched Network Selection with Highest QoS in 4G Networks", Computer Networks: The International Journal of Computer and Telecommunications Networking, vol 52, issue 1, pages 248 – 258, 2008.
[25] V. Gazis, N. Alonistioti, L. Merakos, Toward a Generic "Always Best Connected" Capability in Integrated WLAN/UMTS Cellular Mobile Networks (and Beyond), IEEE Wireless Communications, June 2005
[26] Bellavista, M. Cinque, D. Cotroneo, and L. Foschini, "Integrated support for handoff management and context awareness in heterogeneous wireless networks", ACM International Conference Proceeding Series, vol. 115, pp. 1 - 8, 2005.
[27] S. Ryu, S. Park, and D. Oh et al, "Research Activities on the Next Generation Mobile Communications and Services in Korea," IEEE Communications Magazine, Vol. 43, Issue 9, Sept. 2005, pp. 122-131

Authors

Ms. Jeeva Susan Jacob
Ms. Jeeva Susan Jacob completed her B.Tech Degree in Computer Science and Engineering from Mahatma Gandhi University, Kerala India in 2010. Currently she is pursuing her M.Tech degree in Computer Science and Engineering with specialization in Information Systems at Rajagiri School of Engineering and Technology, Cochin, India. Her research areas of interest include Mobile Computing, Pervasive Computing, Green Computing, Computer Networks and Wireless Communication.

Ms. Preetha K.G.
Ms. Preetha K G completed her B Tech and M Tech in Computer Science and Engineering from Calicut University and Dr. MGR University in the year 1999 and 2007 respectively. She is associated with Rajagiri School of Engineering & Technology, Cochin, India as an Assistant professor in Department of Information Technology. She has around 10 years of academic experience. Currently she is pursuing PhD at Cochin University of Science & Technology. Her research interest includes mobile computing, ad hoc networks, and Wireless Networks.