CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

In 1895, a few years after invention of telephone, Marconi demonstrated the first radio based wireless transmission. The first radio based conversation was used in ships during 1915. The first public mobile telephone system known as Mobile Telephone System (MTS) was introduced in United States in 1946.

AT & T Bell laboratories devised the cellular concept which replaced high power high coverage base stations used by Mobile Telephone System (MTS) with a number of low power low coverage stations. The area of coverage of each such base station is called a cell. The operating area of the system was divided into a set of adjacent, non-over lapping cells. Each mobile uses a separate, temporary radio channel to talk to the cell site base station.

The cell site base transceiver station talks to many mobiles at once, using one channel per mobile. Channels use a pair of frequencies for communication—one frequency, the forward link, for transmitting from the cell site and one frequency, the reverse link, for the call site to receive calls from the users. Radio energy dissipates over distance, so mobiles must stay near the base station to maintain communication.
2.2 REVIEW ON CHANNEL ALLOCATION STRATEGIES

There has been significant amount of work on channel allocation in wireless networks, especially in cellular networks. Channel allocation schemes in cellular networks can be divided into three categories. They are Fixed Channel Allocation (FCA), Dynamic Channel Allocation (DCA) and Hybrid Channel Allocation (HCA) which combines the two former methods. In a fixed channel allocation scheme, the same number of channels is permanently allocated to the cells at the base transceiver stations. The FCA method performs very well under a high traffic load, but it cannot adapt to changing traffic conditions or user distributions.

To overcome the inflexibility of FCA, dynamic channel allocation methods are proposed. In contrast to FCA there is no constant relationship between the base transceiver stations in a cell and their respective channels. All channels are available for each base transceiver station and they are assigned dynamically as new users arrive. Typically, the available channels are evaluated according to a cost function and the one with the minimum cost is used. Due to its dynamic property, the DCA can adapt to changing traffic demand. Because adaptation implies some cost, it performs worse than FCA in the case of a heavy traffic load.

The channel assignment problem is the problem of allocating frequencies to mobile terminals and base transceiver stations such that the network’s capacity, in terms of number of mobile users, is maximal. The FCA scheme proposed by Ghosh et al (2006) allocates channels permanently to each cell based on predetermined estimated traffic. FCA scheme is simple but it does not adapt to the changes in traffic conditions. In a cell, a call can be assigned to a channel only if there is a free channel available in the predetermined set for this cell. Otherwise, the call might be rejected, even in some cases when many channels may be available in the network.
In DCA, there is no permanent allocation of channels to cells. Instead, the whole set of available channels is accessible to all the cells, and the channels are assigned on a call-by-call basis, in a dynamic manner (Lima et al 2007). Since a cell can use any of the channels in a dynamic way, it is possible that if a cell uses all channels at a given time, then there will be no channel available to its neighboring cells at that time due to the interferences. DCA makes wireless networks more efficient, especially if the traffic load distribution is not known beforehand, or varies with time. The advantage of DCA is the flexibility and the traffic adaptability, since channel assignment is based on the current network conditions. DCA methods have better performance than FCA methods for light to medium traffic load. Most of the DCA algorithms are based on heuristics, and do not guarantee an optimal solution. The cochannel constraints in DCA scheme is analyzed by Koutsopoulos and Tassiulas (2007). The main drawbacks of DCA are

- After a call request arrives, DCA requires some computation since allocation is done based on the “current state” of the network. In FCA the channel allocation is done offline, before the network starts operating, so when a call arrives at a cell ‘k’, any of the available channels assigned to the cell can be allocated to the new call immediately, without having to consider how the neighboring cells are being affected. Therefore, FCA is typically faster than DCA.

- In DCA, it is possible for a greedy cell to use up too many channels at a given time, so that there are no channels available for the neighboring cells.

HCA strategy proposed by Vidyarthi et al (2005) combines the features of both FCA and DCA techniques to overcome the drawbacks of FCA and DCA. In HCA, the set of channels is divided into two subsets, the
fixed channels set in which a set of channels permanently allocated to given
cells and the dynamic channels set in which a set of channels available to all
cells. The ratio of fixed to dynamic set is fixed by the cellular network
designer depending upon the traffic conditions. When a new call arrives in a
cell, the system first tries to serve it from the set of fixed channels. If no
channel is available in the set of fixed channels, then the DCA scheme
determines a suitable channel from the set of dynamic channels, satisfying the
interference constraints and the traffic demands in cells. A channel is selected
from the dynamic set, only if all channels in fixed set are busy. HCA does not
require a computation every time like DCA and is faster than DCA on
average but not as fast as FCA. In HCA, a greedy cell can use all the dynamic
channels in dynamic set, but it cannot use the fixed channels assigned to its
neighboring cells. So, the neighboring cells are not as affected as in the case
of DCA.

In wireless mobile networks variety of work has been done in the
area of channel allocation strategies considering new calls and handoff calls.
Minimizing the handoff occurrence is one possible solution. Virtual tree
connection method analyzed by Acampora and Naghshineh (1994) is the
example solution. The model studied by Oliverira et al (1998) allocate the
bandwidth to a call in the cell where the call request originates and at the
same time reserves the same amount of bandwidth in all neighboring cells for
the call. A hierarchical cell model is proposed by Guerrero and Aghvami
(1998), in which macro cells and micro cells are taken, and it allocates the
bandwidth to appropriate cell according to the velocity of the Mobile Unit
(MU).

The model introduced by Ramanathan et al (1999) considers the
acceptance of new call is, according to an approximately calculated
probability of a mobile unit induces handoff. In order to meet “anywhere and
anytime” concept, the future wireless network is converge into heterogeneous cellular network to support multimedia calls. For this, the good and bad threshold state method is examined by Xushen and Mark (2005), to reduce the dropping probabilities. In real time traffic (example voice or video) with delay constraint, if a mobile station is in bad channel state for relatively long period, the multimedia call quality will be very much decreased and probably the call will be disconnected from the network. Since it only considers the threshold condition of a multimedia call. An analytical model of cellular mobile networks with instantaneous movement is investigated by Wei Li and Xiuli Chao (2004). This is very much useful to cost analysis for updating location information and paging in wireless networks.

Due to the emergence of alternative communication technologies, channel allocation schemes are becoming a focus area in wireless mobile networks. Mishra et al (2005) propose a channel allocation method for Wireless Local Area Networks (WLANs) based on weighted graph coloring. Zheng and Cao (2005) present a rule based spectrum management scheme for cognitive radios.


Most of the work on multi-radio channel allocation assumes that the radio devices cooperate to achieve a high system performance. But this assumption might not hold, as the users want to maximize their own
performance without necessarily respecting the system objectives. Game theory provides a straightforward tool to study medium access and channel assignment problems in competitive wireless networks. Cagalj et al (2005) has been applied the game theory to CSMA/CA protocol and MacKenzie and Wicker (2003) applied the same to Aloha protocol. Fixed channel allocation was presented by Halldorsson et al (2004) based on graph colouring. For cognitive radio networks, Nie and Comaniciu (2005) propose a dynamic channel allocation scheme based on machine learning with different utility functions.

In the channel allocation of wireless mobile networks, to reduce the handoff call dropping probability, the Non preemptive handoff scheme is proposed by Haitao et al (2006) and preemptive handoff scheme is proposed by Skalli et al (2007). In this the total numbers of channels in a reference cell ‘N’ have been divided into two groups of Real-time Service Channels (RC) group and Non Real-time Service Channels (NC) group. In the non preemptive borrowing scheme, real-time handoff requests are allowed to borrow channels from NC only if there are idle channels in NC. Other types of service calls do not borrow channels in any cases. The preemptive borrowing scheme is a two-way borrowing scheme in which a real-time service handoff request is allowed to borrow a channel from NC, and a non real-time service call is allowed to borrow an idle channel from RC. In both mentioned schemes video call is not included and the priority is analyzed with voice and data call as a multimedia call.

Towards the goal of reaching a balanced tradeoff, Luo et al (2004) presented a centralized and distributed scheduling algorithms in wireless ad hoc networks. These algorithms attempt to discuss the problem from both a theoretical and a practical point of view, making various degrees of trade-offs between the conflicting goals of maximizing bandwidth spatial reuse and
maintaining fairness among flows. While the contributions are original and noteworthy, their definition of a flow is limited to single-hop flows, with one direct wireless link between the source and the destination. In contrast, in actual multi-hop wireless ad hoc networks, flows with multiple hops are commonplace, while single-hop flows are only exceptions.

Due to rapid evolution in Mobile Cellular Industry (MCI) there is an increase in complexity when using mobility management techniques during the design, commissioning and operations of mobile networks. 1 G methodology can no longer be adopted or applied for 2G and/or 3G mobile networks. Therefore, existing mobility management techniques need to evolve with the technological evolution in mobile networks which is offering different multimedia based services using internet and various other class based traffic as opposed to only conventional voice telephony with guaranteed Quality of Service (QoS) to the end user. Channel assignment schemes are the key to the mobility management. Atta-Ul Qudoos et al (2008) proposed a pre-emptive channel assignment model with fair queue scheduling. The model is evaluated with simulation and different complex scenarios are used to validate the results.

Brandt and Sulanke (2009) studied a communication system of ‘n’ stations with poisson arrival streams of messages enter the stations and require transmission to a destination station. The model is developed with each station is equipped with k channels and has a waiting room for messages. For transmission of a message, one channel is needed both at the arrival and at the destination station. The transmission time is exponentially distributed. Messages are lost (possibly after a waiting time) if, at the destination station, all channels are busy. The queuing network model is of the non-product type. To determine the losses at the ‘n’ stations, a heuristic approximation with nonlinear equations is developed. For this, an efficient iterative numerical
algorithm is developed. Author’s simulation studies show that the approximation is accurate enough for larger ‘n’ stations.

Multihop Cellular Networks (MCNs) allow faster and cheaper deployment of cellular networks. A fundamental issue in these networks is packet delay because multihop relaying of signals is involved. An effective channel assignment is the key to reducing delay. Hung Tam et al(2010) proposed an Optimal and a heuristic Channel Assignment scheme, called OCA and Minimum Slot Waiting First(MSWF) method to reduce packet delay.

In cellular networks, it is important to determine an optimal channel assignment scheme so that the available channels are used as efficiently as possible. The objective of the channel assignment scheme is to minimize the call-blocking and the call-dropping probabilities. Xin Wu et al (2010) presents two efficient Integer Linear Programming (ILP) formulations for optimally allocating a channel from a pool of available channels to an incoming call, such that, both hard and soft constraints are satisfied. Authors present the simulation results on a benchmark of 49 cell environment with 70 channels that validate the performance.

2.3 OVERVIEW ON BANDWIDTH ALLOCATION METHODS

It is widely recognized that future wireless networks will provide an increasing number of subscribers and more applications, which require high bandwidth and huge amount of data transmission such as high resolution of multimedia service. The limited radio spectrum used for mobile communication becomes the obstacle to provide these applications. Therefore, resource allocation is an important issue in wireless communications. During peak hours and in complex traffic situations, allocating a required bandwidth to a multimedia call is the critical issue and more complicated. Providing
quality of service for the mobile users in a multimedia environment is challenging one. Different methods have been used to model the multimedia traffic.

In order to meet the requirements of heterogeneous traffic with time-varying characteristics, priority-based scheme is introduced by Elalfy et al (2001), in which they give higher priority to handoff than to new calls to reduce handoff dropping probabilities. The method discussed by Guerrero and Aghvami (1996), concentrates on service classes of voice calls and not on the multimedia applications with video calls.

The Adaptive REsource Allocation Scheme (AREAS) proposed by Lee et al (2004) allocates connection resources to incoming calls depending on network conditions. In this the resources accumulated by bandwidth degradation for on-going calls are utilized to minimize dropping probability of handoff calls and blocking probability of new calls.

The main concern in wireless mobile communication is the optimum trade-off required between various parameters that determine the Quality of Service. The most important parameter concerned in mobile communication is the call dropping probability due to an incoming handoff call. Handoff scheme proposed and performances have been analyzed and simulated using different techniques by Wen-Hsing and Wanjun (2008) without considering video call, priority on voice call and data calls. The total number of channels allocated to a cell is dynamically assigned in three parts, namely, channels for voice traffic exclusively, channels for data traffic exclusively and channels shared for both handoff voice and handoff data. The performance measures such as new voice/data blocking probability, handoff voice/data dropping probability, channel utilization and busy time period in the cell are analyzed by Shensheng and Wei (2004).
An analytical model of wireless/mobile network supporting multilevel quality of service with bandwidth degradation ratio and upgrade/degrade frequency, is proposed by ChunTing and Chou Shin (2004). In this the resource allocation to the users can be adjusted dynamically according to the underlying network condition so as to increase resource utilization and service provider's revenue.

The rapid increase in the use of mobile devices demands the need, to meet different multimedia application requirements of the users. However, the application demand and allocation could lead to congestion if the network has to maintain high resources for the quality of service requirements of the applications. Ojesanmi et al (2009) proposed a new admission control policy for wireless mobile multimedia networks. In this two kinds of traffic categorized as new real time and non-real-time calls or real-time and non-real time handoff calls are considered. Blocked new real-time and non-real-time calls are lost, while blocked real-time and non-real-time handoff calls can wait in the handoff buffer for channel to be available.

Dusit Niyato and Ekram Hossain (2010) examine the problem of hierarchical bandwidth sharing in dynamic spectrum access (or cognitive radio) environment. In this model licensed service can share its available bandwidth to an unlicensed service and again, the unlicensed service can share its allocated bandwidth to other services. Authors formulate the problem of hierarchical bandwidth sharing and use the concept of demand and supply functions to obtain the equilibrium at which all the services are satisfied with the amount of allocated bandwidth and the price. They also demonstrate the application of the proposed model to achieve dynamic bandwidth sharing in an integrated WiFi-WiMAX network.

Collaborations between the IEEE 802.11 and the IEEE 802.16 networks operating in a common spectrum with dynamic bandwidth
allocation produce an improved performance for network applications. Deyun Gao et al (2010) studied the bandwidth allocation in collaborative IEEE 802.11 and IEEE 802.16 networks. Authors analyzed the Medium Access Control (MAC) protocols, frame structures, and design a cooperation mechanism for the IEEE 802.11 and the IEEE 802.16 networks to share the same medium with adaptive and optimized resource allocation scheme.

Data broadcast is an advanced technique to realize bandwidth utilization in a mobile computing environment. In this, the channel bandwidth of each channel is variant with time in real case. Chung HuaChu et al (2010) proposed an algorithm using adaptive allocation on time-variant bandwidth to generate the broadcast program to minimize average waiting time.

Anh Tuan Hoang et al (2010) introduced a point-to-multipoint cognitive radio network that shares a set of channels with a primary network. Within the cognitive radio network, a base station controls and supports a set of fixed-location wireless subscribers. The objective is to maximize the throughput of the cognitive network while not affecting the performance of primary users. In this the centralized channel assignment is carried out within the cognitive network to maximize the throughput.

2.4 SURVEY ON RESOURCE PREDICTION AND RESERVATION TECHNIQUES

In mobile cellular networks, handoff call resource management has been most important and challenging issue. It becomes most significant and critical because reducing the cell size to accommodate maximum mobile users will cause more frequent handoffs. To support multimedia traffic such as data, voice and video, managing handoffs becomes more critical. In practical it is difficult to avoid handoff call droppings due to unpredictable fluctuations in the handoff traffic load. To avoid handoff call droppings up to some extend,
each cell can reserve some amount of bandwidth from its maximum capacity and it is fully utilized for handoff calls.

The concept of reserving resources for handoff was introduced in the mid of 1990. Del Re et al (1995) proposed a scheme in which, from the total available bandwidth a portion of bandwidth is permanently reserved in advance for handoffs to reduce handoff call droppings.

Reserving resources for future handoff calls and new calls is an effective way to reduce the new call blocking and handoff call dropping probability. Predicting and reserving resources for future calls can be classified into two types. They are local and collaborative methods. Yu and Leung (1997) and Epstein and Schwartz (2000) proposed a collaborative method. Collaborative method requires a base transceiver station to collaborate with other base transceiver stations to make resource reservation decisions. They specifically require each base transceiver station to gather real-time information on the behaviors of mobile stations in neighboring cells. Such information may include how many users are expected to be handoff and service class of multimedia call in the neighboring cells at a given time. Service class of a multimedia call mainly deals with how much amount of resource required for each call request. In the real time environments gathering the above information in a very short duration is very difficult one.

Ortigoza Guerrero and Aghavami (1999), proposed a local method in which a base transceiver station uses local information only to make resource reservation decisions. Local methods examined by Luo et al (1999) and Kim and Znati (1999) assumes that every call requires the same bandwidth, the call arrival process is poisson, and the call holding time and a particular call channel holding time in each cell is exponentially distributed.
Bajaj et al (1999) proposed a resource reservation scheme, which compares the model by assuming utilization and loss separately. The solution is to avoid the bandwidth shortage of the cell by reserving the resource, in which direction the mobile user moves. Bo Li et al (2001) proposed a novel adaptive resource allocation scheme to estimate dynamically the changing traffic parameters through local on-line estimation. They also examined the probabilistic control policy, to achieve high channel utilization.

Reserving some amount of bandwidth for new calls and handoff calls in advance is proposed by Tao Zhang and Prathima Agarwal (2001), so that, the blocking and dropping probabilities can be reduced. To utilize the available spectrum effectively the ‘Spectrum holes’ i.e., prediction of resource availability in advance is discussed by Syrotuik (2004). Resource prediction is also a method to reduce handoff call droppings.

Most of the bandwidth reservation schemes assume that handoff call arrivals are poisson and each call requires the identical amount of bandwidth. But this is not true in multimedia applications.

Hong Bong kim (2005) discussed about distributed adaptive bandwidth reservation scheme and connection admission test for multimedia mobile networks to limit the handoff call dropping probability. In this each base station counts the number of handoff success and failures to adoptively change the reserved bandwidth for handoff.

The Mobility-Dependent Predictive Resource Reservation (MDPRR) scheme and an admission control scheme are proposed by Li Liann Lu et al (2004) based on common handoff procedure to provide flexible usage of scarce resource in mobile multimedia wireless networks. NPS (Neural-Network Prediction Scheme) is proposed by Shiang Chun Liou et al (2003), to provide high accurate location prediction of a mobile host in wireless
networks. In order to avoid too early or over reservation resulting in a waste of resources, a Three Times Resource Reservation scheme (TTRR) is also proposed.

The method investigated by Rozic Nikola and Kandus Gorazd (2004) is based on application of Multi-Input-Multi-Output (MIMO) multiplicative Autoregressive-Integrated-Moving Average (ARIMA) \((p,d,q)\times(P,D,Q)s\) models fitted to the traffic data measured in the considered cell itself and on the new Call Admission Control (CAC) algorithm that simultaneously maximizes the system throughput while keeping the handoff call dropping probability below the targeted value. The Mobility-aided Adaptive Resource Reservation (MARR) with Admission Control (AC) based on cell division, to provide better usage of scarce resource in wireless multimedia networks is proposed by Li-Liann Lu et al.(2006).

Convergence of heterogeneous wireless networks is paving the way to scenarios in which end users will be capable of using simultaneously services through different Radio Access Technologies (RATs), by means of reconfigurable mobile terminals and different network elements. In order to exploit the potential of these heterogeneous network scenarios, optimal RAT selection and resource utilization mechanisms are required. As a result, the heterogeneous networks are introducing a new mechanism to Radio Resource Management (RRM) problem, so that a joint perspective has to be considered. In this sense, Lorenza Giupponi et al(2006) proposed a Joint Radio Resource Management (JRRM) strategy in a multi-RAT, multi-cellular and multi-service scenario based on Fuzzy Neural methodology.

The effect of pre-reservation area size on handoff performance in wireless cellular networks is discussed by Zhenqiang Ye et al (2007). It shows that if the reserved channels are strictly mapped to the mobile units that made the corresponding reservations, by increasing the pre-reservation area size, the
system performance (in terms of the probability that the handoff calls are dropped) improves initially. The optimal pre-reservation area size is closely related to the traffic load of the network and the mobile unit’s mobility pattern i.e. moving speed.

Nagla et al (2008) proposed two resource reservation methods for wireless mobile networks, in which, a single wireless cell which is accessed by voice and non-voice traffic types producing, respectively of narrowband and wideband calls. Here channels are reserved in a fixed or dynamic fashion for the use of originating wideband calls in addition to the guard channels allocated for the handoff calls. The dynamic reservation based strategy makes the system fairer for the originating wideband calls while maintaining low handoff dropping probability and acceptable channel utilization levels. On the other hand, the fixed reservation strategy provides a lower handoff call dropping at comparable channel utilization levels. Both strategies provide better performance for the originating wideband calls compared guard channels strategy.

In wireless and mobile networks, reservation of resources is more challenging than in wired networks due the scarcity of bandwidth in wireless links. Jie Li et al (2009) focuses on quality of service provision schemes in wireless access networks. In allusion to the limitations of mobile IP in fast and efficient handoff, a QoS solution of micro-mobile IP and RSVP Loosely Coupled-Advanced Weak Dynamic Resource Reservation Protocol (AWDRSVP) is proposed. This mechanism can minimize resource reservation delays and signaling overheads, which combines Signal Prediction Priority Queuing (SPPQ) algorithm to perform basic resource reservation in advance. It enhances the efficiency and auto-adaptability of resource reservation in micro-mobility areas.
End-to-end QoS can be achieved through resource reservations along the communication path between end points. Per flow or per aggregate signaling can be used to set up reservation states in routers or domains on the path. In a mobile environment this reservation process can be very cumbersome, given that (i) the time to set up the resources in the new path is not neglectable and (ii) the resources may not be available during the handover process. An advance reservation is a possible solution for this problem. EraldoSilveira et al (2009) describes a procedure to compute a set of considered paths in a resource reservation, during a communication session when both hosts are mobile. The model combines user models to generate a time evolution equation that allows computing the probability to be in a future path from a current path in a given time.

With the continuous deepening of the network technology and application, there is a strict requirements in quality of service to the grid, how to reasonable allocation resources so that the maximum utilization of the resources becomes a press for solution based on users in meeting the requirements of QoS. ZhangJingmiao and GaoShuangxi (2009) introduced a dynamic, distributing and isomerism of QoS-based dynamic grid resource allocation strategy which brings a grid-based resource reservation mechanism to improve the reliability and accuracy of resource management.

Bandwidth is reserved for multimedia application to ensure the QoS. For Variable Bit Rate (VBR) applications, it is difficult for the Subscriber Stations (SSs) to predict the amount of incoming data. To ensure the QoS guaranteed services, the SS may reserve bandwidth more than the amount of its transmitting data. As a result, the reserved bandwidth may not be fully utilized all the time. David Chuck and Morris Chang (2010) proposed a scheme, named Bandwidth Recycling(BR), to recycle the unused bandwidth without changing the existing bandwidth reservation. The idea is to allow other SSs to utilize the unused bandwidth when it is available. Thus, not only the same QoS guaranteed services can be provided but also the system
throughput can be improved. Simulation results show that the algorithm can improve the overall throughput by 40 percent when the network is in the steady state.

Kelvin Dias et al (2010) presents a novel framework for session admission control and resource reservation in next generation mobile and cellular networks. In this the local Call Admission Control and Time Series-based Resource Reservation are considered and uses local information for resource reservations. Authors suggest the time series-based models for predicting handoff load, because it is an adaptive exponential smoothing technique, and Autoregressive Integrated Moving Average (ARIMA) that uses the Box and Jenkins methodology. It is a simple method produces similar level of handoff call dropping probability as compared with complex distributed approaches.

2.5 INTRODUCTION AND RESOURCE ALLOCATION IN UNIVERSAL MOBILE TELECOMMUNICATIONS SYSTEM NETWORKS

Universal Mobile Telecommunications System (UMTS) is a third-generation (3G) broadband, packet-based transmission of text, digitized voice, video, and multimedia at data rates up to 2 megabits per second (Mbps). UMTS offers a consistent set of services to mobile computer and phone users, no matter where they are located in the world. UMTS is based on the Global System for Mobile (GSM) communication standard. It is also endorsed by major standards bodies and manufacturers as the planned standard for mobile users around the world.

One of the main benefits of UMTS is its speed. Current rates of transfer for broadband information are 2 Mbps. This speed makes possible the
kind of streaming video that can support movie downloads and video conferencing.

Universal Mobile Telecommunication System (Faris Muhammad 2008) network shown in Figure 2.1 consist of three interacting domains; Core Network (CN), UMTS Terrestrial Radio Access Network (UTRAN) and User Equipment (UE). The main function of the core network is to provide switching, routing and transit for user traffic. Core network also contains the databases and network management functions.

Figure 2.1 UMTS Network High Level Architecture

The basic Core Network architecture for UMTS is based on GSM network with GPRS. All equipment has to be modified for UMTS operation and services. The UTRAN provides the air interface access method for User Equipment. Base Station is referred as Node-B and control equipment for Node-B's is called Radio Network Controller (RNC).

The Core Network is divided in circuit switched and packet switched domains. Some of the circuit switched elements are Mobile services Switching Centre (MSC), Visitor location register (VLR) and Gateway MSC.
Packet switched elements are Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN). Some network elements, like EIR, HLR, VLR and AUC are shared by both domains.

The Asynchronous Transfer Mode (ATM) is defined for UMTS core transmission. ATM Adaptation Layer type 2 (AAL2) handles circuit switched connection and packet connection protocol AAL5 is designed for data delivery.

Wide band CDMA technology was selected to for UTRAN air interface. UMTS- WCDMA is a Direct Sequence CDMA system where user data is multiplied with quasi-random bits derived from WCDMA Spreading codes. In UMTS, in addition to canalization, Codes are used for synchronization and scrambling. WCDMA has two basic modes of operation: Frequency Division Duplex (FDD) and Time Division Duplex (TDD).

The UMTS standard does not restrict the functionality of the User Equipment in any way. Terminals work as an air interface counter part for Node-B and have many different types of identities.

2.5.1 Spectrum Allocated For UMTS Networks

The process of reserving and allocating frequency spectrum for the deployment of new radio systems takes many years. The World Administrative Radio Conference (WARC) allocated 230 MHz of spectrum (Richardson 2000) for the implementation of a single world-wide 3G mobile system from the year 2000 (Richardson 2000). The allocation was split into the frequency bands 1885–2025 MHz and 2110–2200 MHz, within which the subbands 1980–2010 MHz and 2170–2200 MHz are for the satellite component and the remainder for the terrestrial component.
Within Europe, the European Radio communications Committee (ERC) of the European Conference of Postal and Telecommunication Administrations (CEPT) is responsible for the actual allocation of radio frequencies. CEPT Decision ERC/DEC/(97)07 specifies that 155 MHz of spectrum shall be reserved for the terrestrial component of 3G systems. The 155 MHz is split into the ‘paired band’ (2×60 MHz) for frequency division duplex (FDD) operation and ‘unpaired bands’ (separate 20 MHz and 15 MHz allocations) for time division duplex (TDD) operation where one carrier is switched in time between uplink and downlink transmissions.

### 2.5.2 Review on Channel Assignment Schemes in UMTS

The Universal Mobile Telecommunications System (UMTS) adopts WCDMA as the air interface to provide variable transmission rate services. Four traffic classes are identified in UMTS, which are conversational, streaming, interactive, and background classes. To efficiently utilize the radio bandwidth, the shared channel technology is proposed by Phone Lin et al. 2004 to deliver interactive and background traffics. They proposed a “Shared-Channel Assignment and Scheduling” (SCAS) algorithm to allocate shared channels to interactive and background connections. The SCAS algorithm can satisfy the transmission rate requirement of each interactive connection and can efficiently utilize the radio bandwidth.

Third Generation Partnership Project (3GPP) 23.246 proposed the Multimedia Broadcast Multicast Service (MBMS) to deliver multicasting content in the Universal Mobile Telecommunications System (UMTS). In MBMS, the common logical channel is enabled to serve multiple MBMS calls at the same time. Use of the common logical channel may cause interference to the dedicated logical channels serving the traditional calls. To more efficiently utilize the radio resource to serve both traditional and MBMS calls, Phone Lin et al. 2008 proposed two channel allocation algorithms namely
Reserved Resource for Multicasting (RRM) and Unreserved Resource for Multicasting (URM). They proposed analytic models and conduct simulation experiments to investigate customer Satisfaction Indication (SI) for the two algorithms. This study indicates that URM outperforms RRM in terms of customer SI.

2.6 SUMMARY

A wireless mobile network has to provide the quality-of-service for a variety of applications. One of the key generic QoS parameter is the call dropping probability, which has to be maintained at a predefined level independent of the traffic condition. In the presence of multimedia traffic, an adaptive and dynamic bandwidth allocation is essential in ensuring QoS. The fixed, dynamic and hybrid channel allocation strategies with traffic parameters are first examined. Secondly, through various work, the bandwidth allocation method for different type of calls and bandwidth degradation of an ongoing call are studied. In most of the cases, voice and data calls are considered for bandwidth allocation. To reduce the handoff call dropping probability and effective resource utilization, the resource prediction and reservation schemes are surveyed. Finally an introduction to UMTS networks and a review on channel allocation schemes in UMTS networks are discussed. In the present work, the proposed models are developed with the examination of different channel allocation strategies, preemptive and non preemptive handoff schemes, multimedia call bandwidth requirements and on-line bandwidth estimation methods.