RESOURCE ALLOCATION SCHEMES FOR WIRELSS ASYNCHRONOUS TRANSFER MODE (ATM) NETWORK

MOHD FADEL BIN ALWI

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Faculty of Electrical Engineering
Universiti Teknologi Malaysia

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In the name of ALLAH, The Most Gracious, The Most Merciful…

For their love, support and advice, all the encouragement they gave and the understanding, and also patience they showed all this while, I would like to record my deepest appreciation to my beloved family and loves one…

They are always with me and my highest inspiration…

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ABSTRACT

With the ever increasing demand for easy portability and mobility of devices supporting diverse mobile multimedia applications, the need for the adaptation of broadband infrastructure to wireless scenario. However, the cost to set up broadband multimedia is very high but ATM network is cheaper. The mobile multimedia networks like the wireless ATM are faced with challenges relating to user mobility management and channel access. In WATM, traffic control is essential in order to protect the network from congestion and to achieve realistic network efficiency. The main objective is designed the resource allocation scheme that can give high (QoS) performance in terms of probability of call lost and handover call. It means performance in terms of probability of new call, handover call dropping for real time connections and the probability of overload for non-real time. All of these will be done in mathematical analysis using Matlab and simulations using COMNET III. The design started with scheme call With Reserved Channel (WRC), which has reserved channels for handover calls. The reserved channel will be getting the good performance in term of QoS. However, this scheme cannot be support for the new incoming calls. Hence, to improve it, the With Queuing and Reserved Channels (WQRC) will be design to handle that problem. This scheme allows queuing of new incoming calls and reserved channels for handover calls. Using WQRC, low probability of handover dropping was maintained and the new call blocking probability was eliminated. The network will be getting the higher link utilization and increase the performance and reliability of the network.

ABSTRAK

Permintaan yang tinggi terhadap penggunaan perkidmatan multimedia tanpa wayar menyokong kepada perkhidmatan tanpa wayar untuk beralih ubah kepada penggunaa infrastruktur jalur lebar tanpa wayar (Broadband Wireless). Walaubagaimanapun, kos untuk membangunkan infrastruktur jalur lebar amatlah tinggi jika hendak di bandingkan dengan mode penghantaran tidak segerak (ATM). Dalam WATM, pengawalan trafik adalah penting untuk mengelakkan kesesakan rangkaian bagi mencapai tahap kecekapan rangkaian yang cekap. Objektif projek ini adalah untuk mereka satu sistem peruntukan sumber yang boleh meningkatkan prestasi rangkaian (QoS) dalam kata kebarangkalian kehilangan panggilan, dan kebarangkalian kehilangan panggilan tukar, bagi perkhidmatan bukan masa sebenar adalah kebarangkalian lebihan beban. Kesemua ini dianalisa dengan menggunakan perisian Matlab dan COMNET III. Reka bentuk dimulakan dengan sistem yang dinamakan WRC, yang mana ia memperuntukan saluran khas untuk panggilan tukar. Sistem ini memberikan kecekapan yang tinggi dalam kata QoS. Walaubagaimanapun, sistem ini tidak menyokong panggilan baru. Untuk mengatasai masalah ini, sistem yang dikenali sebagai WQRC dibina. Sistem ini menyediakan ruang tunggu untuk panggilan baru dan tukar panggilan. Dengan menggunakan sistem ini, kebarangkalian terhadap tukar panggilan dapat dikekalkan pada tahap yang rendah dan dapat mengurangkan kebarangkalian panggilan baru. Dengan itu, rangkaian dengan menggunakan sistem ini dapat meningkatkan tahap penggunaan saluran pada kadar maksimum dan dapat meningkatkan kecekapan dan kebolehpercayaan terhadap rangkaian.

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P_{HO}	-	Probability Of Handover
B	-	The Number Of Base Station In A Cell Cluster
Pv	-	The Probability That The Mobile User Visit K Cell Sites
λ	-	Arrival Rate
μ	-	Departure Rate
P_{nrt}	-	The Probability Of S Connection At Base Station
P_{ov}	-	The Overload Probability
$\Im$	-	State Space In Reversible Markov Process
P_{NCH}	-	The Probability Of New Call Block
P_{HDH}	-	The Probability Of Handover Dropping
γ_{rt}	-	The Departure Rate Of Handover Calls From The Source Cell To The Target Cell Cite
γ_{a}	-	The Arrival Of Handover Calls In Source Cell Site
λ_{rt}	-	The New Call Arrival Rate For WRC
μ_{ert}	-	The New Call Departure Rate For WRC
μ_{rt}	-	The Completion Of Calls In The Source Cell Site
λ_{rt}	-	The New Incoming Calls In The Source Cell Site
$P_{HDH_{II}}$	-	The Probability Of Handover Blocking
P_{D}	-	The Probability Of Delay

AAL	-	ATM Adaptation Layer
ABR	-	Available Bit Rate
ATDM	-	Asynchronous Time Division Multiplexing
ATM	-	Asynchronous Transfer Mode
BER	-	Bit Error Rate
B_{II}	-	The Number Of Base Station In WQRC
B-ISUP	-	Broadband ISDN User Part
BS	-	Base Station
CAC	-	Connection admission control
CBR	-	Constant Bit Rate
CDMA	-	Code Division Multiple Access
CLP	-	Cell Loss Priority
COS	-	Crossover Switch
CPE	-	Customer Premises Equipment
CSMA	-	Carrier Sense Multiple Access
DSS2	-	Digital Subscriber Signalling System No.2
EFCI	-	Explicit Forward Congestion Indication
FIFO	-	First In First Out
g	-	The Percentage Of Reserve Channels
GFC	-	Generic Flow Control
HEC	-	Header Error Control
HLM	-	Home Location Register
ISDN	-	Integrated Services Digital Network
ITU-T	-	International Telecommunication Union – Telecommunication Sector

k	-	Mobile User Visit In Cell
LAN	-	Local Area Network
m	-	The Number Of Call A Base Station
MAC	-	Medium Access Control
MDR-TDMA	-	Multiservices Dynamic Reservation TDMA
m_{II}	-	The Number Of Connection A Base Station Can Handle In WQRC
M-QoS	-	Mobile Quality of Service
MRAP	-	Multiservice Resource Allocation Policies
MSC	-	Mobile Switch Control
MT	-	Mobile Terminal
MU	-	Mobile Unit
NCP	-	Network Control Processors
N_{II}	-	The Pre Determined Threshold for WQRC
NNI	-	Network Node Interface
N_{rt}	-	The Number Of Connections In The Network Exceeded The Pre-Determined Threshold
nrt-VBR	-	Non Real Time Variable Bit Rate
OAM	-	Operations, Administration, And Management
OSI	-	Open System Interconnection
PCS	-	Personal Communications Services
p_k	-	The Probability That The System Has K Members.
PLMN	-	Public Land And Mobile Network
PT	-	Payload Type
QoS	-	Quality Of Service
RS	-	Root Switch

RSS	-	Radio Signal Strength
SMS	-	Short Massage Service
TDM	-	Time Division Multiplexed
TDMA	-	Time Division Multiple Access
TE	-	Terminal Equipment
UBR	-	unspecified bit rate
UNI	-	User Network Interface
UPC	-	Usage parameter control
VBR	-	Variable Bit Rate
VC	-	Virtual Circuits
VCI	-	Virtual Channel Identifier
VCN	-	virtual circuit numbers
VCT	-	virtual connection tree
VLR	-	Visitor Location Register
VP	-	Virtual Paths
VPI	-	Virtual Path Identifier
WAN	-	Wide Area Network
WATM	-	Wireless Asynchronous Transfer Mode
WORC	-	Without reserved channels
WQRC	-	Call Admission Control With Queuing
WRC	-	With reserved channels
μ_{II}	-	The Call Departure Rate Of WQRC

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CHAPTER 1

INTRODUCTION

1.1 Overview

The service area of wireless network is divided into cell as shown in Figure 1.1a and 1.1b. Each cell has an assigned group of discrete channels from the available bandwidth. The base station (BS) is established in each cell. Subscribers in each cell use channels assigned to each cell. Every mobile unit (MU) in the cell communicates through the BS via a channel. A region initially served by a BS in a conventional mobile system is split into several cells, each of which has its own BS; it serves by a certain number of channels.

The primary rule of a BS is to terminate the radio link in the network side of the user to network interface. In a small micro cell system, a distributed channel assignment function can be implemented in BS. BSs are connected to the switching network through the wired lines. The major requirement for the future mobile communication systems is high network capacity and flexibility to accommodate time varying communication network. The limited availability of the radio frequency spectrum or bandwidth is the main reason that the future cellular mobile systems must be efficiently employed channel assignment methods to increase network capacity and adapt to time varying traffic.

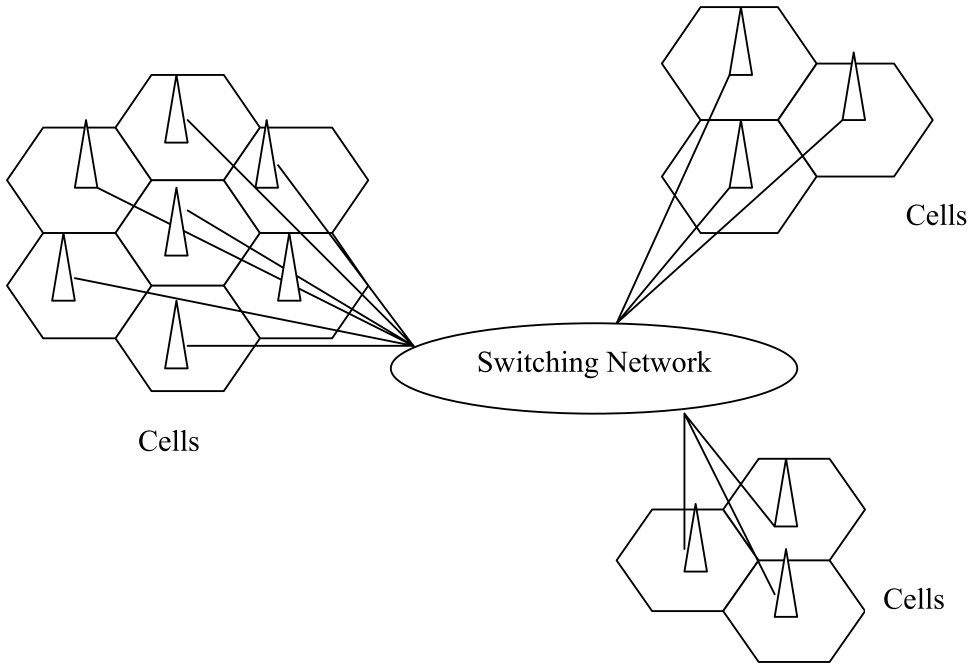


Figure 1.1a: Wireless Network Architecture

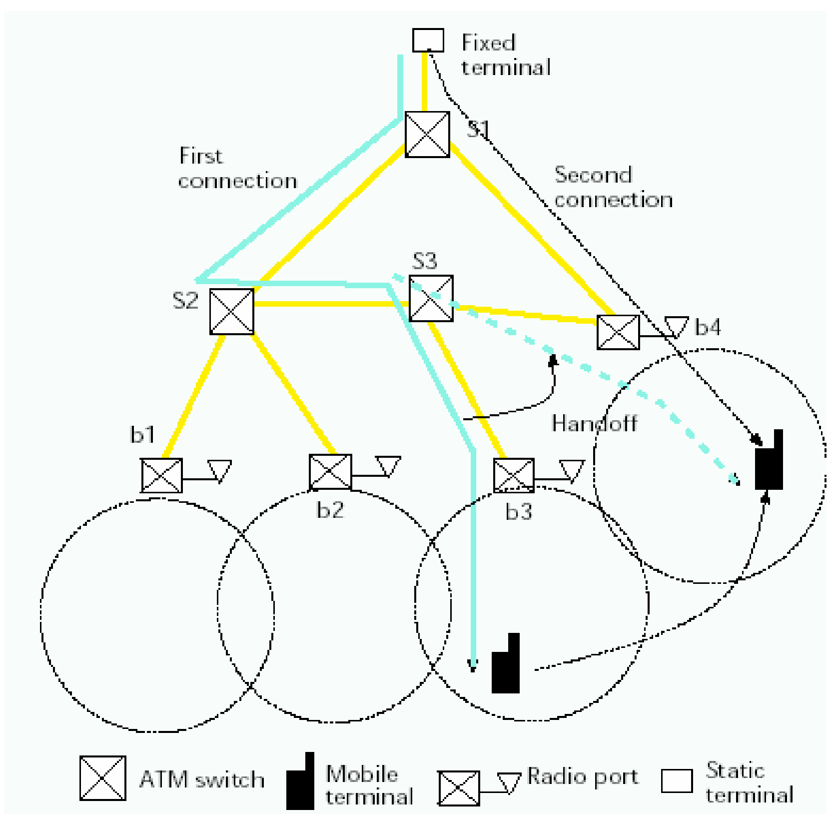


Figure 1.1b: Network Architecture of Mobile ATM

The wireless cellular has designed to maximize the number of channel in the space and spectrum under the constraint due to interference is lower than the prescribed limit. The capacity of wireless cellular system is directly related to the number of channels available. The area in which channel can be reused, and the minimum cell size that can be implement in a given by environment. For the rural area, micro cell can be used, and for urban and suburban areas micro cell is introduced. The radius of macro cell about 10 KM and micro cell between 500 meter and 1000 meter.

The large subscriber capability requirement demands on the system are capable of serving many thousands of mobile unit within a local requirement area with fixed number of hundred channels. The same frequency channel is reused in several cells simultaneously if they are separated by a distance that is long enough to avoid co channel interference. When we use the frequency reuses, big problem become like a channel assignment. To find a channel assignment within each cell that avoids co channel interference. When a call is requested, the wireless network goes through the channel assignment process. If a channel is available, the process allocates the channel to the user.

When the MU moves from source cell to destination cell, handover will occurs. Based on that, the destination cell should provide sufficient resources to the call have handed in. This is because if the resources are not sufficient to meet the pertinent QoS needs, premature termination of the calls can occur. In resource allocation at BS should be priority to the handover request over new connection request as premature termination of a call is more detrimental to the network performance than the rejection of new call.

At this time, the non-real time connection such as Short Massage Service (SMS) arrival at the BS, but the system put it in the buffer if the systems have a buffer. The strategy to solve this problem is allocated an effective bandwidth for a channel assignment and reservation channel. It is the objective of this project. Future mobile connections will include the requiring Quality of Service (QoS) guarantee with fairly high bandwidth requirement.

These connections will also require being of different bandwidths according to the specific application. In wireless Asynchronous Transfer Mode (WATM), traffic control is an important issue to protect the network from congestion and to achieve network efficiency compliance with the QoS [1].

1.2 Standard ATM

Broadband telecommunication networks, according to the I-300 series of the International Telecommunication Union – Telecommunication Sector (ITU-T) recommendations, are based on packet switching technique, established in 1990/91 the so called asynchronous transfer mode (ATM). ATM is a member of the fast packet switching family called cell delay. As part of its heritage, it is an evolution from many other sets of protocols. In fact, ATM is a statistical time division multiplexed (TDM) from the traffic that is designed to carry any form of traffic and enables the traffic to be delivered asynchronously to the network. In another word, ATM is a data transport technology that supports a single high speed infrastructure that integrates broadband communications which involve voice, video and data. It achieves bandwidth efficiency through statistical multiplexing of transmission bandwidth.

The data are usually transmitters over a coaxial or optic fiber cable of high transfer rate (155,600,1200Mb/s), low bit error rate (10^{-9}). In the end of the equipment, an ATM adaptation layer (AAL) maps the service offered by the ATM network to the services required by the application. This enables ATM to handle a wide range of information bit rate together with various types of real time and non real time service classes with different traffic attributes and Quality of Service (QoS) guarantees at cell and call levels.

ATM technology is an integration of the existing circuit mode digital communication technique with the packet mode communication technique. In the sense that ATM uses ATM cells as its basic unit of transmissions, it has a close connection with packet mode communication. However, there is significant different that ATM is designed from beginning to manage real time CBR/VBR traffic, whereas traditional packet networks were designed primary for non real time data traffic ABR/UBR/nrt-VBR. This topic will be discussed in chapter 2.1.2.

ATM is based on sort of packet technology, it yields an efficient use of network resource through dynamic allocation of resource and statistical multiplexing. In addition, the concept of virtual circuits (VC) results in clear and simple basis for QoS guarantees. ATM technology has four main characteristic that differentiate it from other network technology. First; ATM networks transport traffic in the form of cells; secondly ATM network form virtual circuits using these cells; third, ATM technology uses a multiplexing technique call asynchronous time division multiplexing (ATDM); and fourth, it is designed to support the concept of QoS [2].

The first characteristic of ATM technology is that cells are the basis for multiplexing, switching, and transport. Cells are small fixed sized packets, so ATM can be regarded as a sort of packet based network technology. Fixed sized packets are chosen, as they would enable simple and cheap equipment design, including large and fast switches. The reason for choosing a small packet cell size of only 53 byte was to accommodate voice traffic. If the packet size is large, due to the small size of compressed voice sample, unacceptably large packet utilization delay would occur while filling its payload with voice. This topic will be discussed in chapter II.

The second main characteristic is the use of virtual circuit (VC). ATM is a connection oriented method that transfer service information through the establishment of VCs. A connection identifier is assigned whenever a VC is established and removed when the connection released. This identifier, located at the header of each cell, contains information on the virtual connection a utilized for the multiplexing and switching of the cell. One additional characteristic is that the two tier virtual circuit architecture is used, with the lower layer comprised of VCs, and the upper layer being comprised of virtual paths (VPs). These two tier architecture are seen as a way of aggregation. By aggregating many VCs and VP connection, the switches in the core network could be built in a simpler manner, yet enable faster operation.

The main reason for adopting virtual circuits is that it is the easiest way to enable easy implementation of QoS guarantee. Since the virtual circuit architecture would set up connections along the path before data transport, it would be easy negotiate and allocate resource along the network path. This contrast to the connectionless packet network architecture that has no obvious means of guaranteeing such resource allocation.

The third characteristic of ATM is that it makes use of ATDM. ATDM is a TDM technique that is based on fixed sized time slots, but the time slots are allocated to users not on a periodical basis but on an occasional basis. The ATM cells of various users are chosen, one at one time, to be transported over the time slots, but no user is guaranteed a fixed time slots on irregular basis. The main advantage of ATDM is that it enables an efficient use of transport and switching resources by allowing intelligent multiplexing of user traffic. A fourth characteristic, ATM has been designed to support QoS. This is basically enabled by the combination of therefore mentioned characteristics; virtual circuits result in fixed routes through the network, allowing easy network resource allocation. The use of fixed sized cells enables easy network resource allocation. Additionally, designing hardware with sophisticated resource management schemes is simpler due to the fixed size. The use of ATDM enables flexible allocation of network resource, allowing the support of a much more varied and flexible QoS infrastructure.

1.3 ATM Architecture

This approach permits each layer to evolve while maintaining consistent interface layer. Several configurations are possible. The use of the ATM technologies improves routing and quality aspects. If such technologies are adopted, the layers are configured as shown in figure 1.2 Peer-to-peer communications refer to layer in one entity exchanging information with a corresponding layer in another entity.

The AAL user is the higher layer signaling for broadband. The AAL user can be the Digital Subscriber Signaling System No.2 (DSS2) for access signaling or the Broadband ISDN User Part (B-ISUP) for inter-nodal signaling.

The ATM Adaptation Layer (AAL) bridges the function of the ATM layer and the higher layers. The functions performed by the AAL depend upon the type of user and application. The functions are grouped into services that are offered to the higher layers.

The ATM layer provides a service independent transport function. Any requirement that are specific to a particular application is covered by the higher layer functions. The ATM layer transports imformation supplied by the higher layer in packets of data called cells. ATM standard define a fixed size cell with a length of 53 byte comprised of 5-byte header and a 48-byte payload as shown in figure 1.3. This information is transported transparently by the ATM layer, without any processing of the information field.

The Physical Layer defined the physical characteristics of the tranmission links and corresponds to the Physical Layer in the Open System Interconnection (OSI) model. The architecture for the Network Node Interface (NNI) and User Network Interface (UNI) are based on the same model, but they differ to take account of the varying nature of access and inter-nodal signalling.

Each cell consists of a Header and Information Field. The Header identifies cells belonging to the same Virtual Channel. The information Field contains the data to be transferred. Cell sequence integrity is maintained over the Virtual Channel.

The signaling for ATM is carried on the ATM layer connection that is separate from the user information.

1.3.1 Cell Structure

Follow the figure 1.3, each ATM cell comprises header of five octets and information field (payload) of 48 octets. The format of the header is different for the UNI and NNI. The combination of Virtual Path Identifier (VPI) and Virtual Channel Identifier (VCI) forms the Routing Field and is used to route cells through the network. There are 24 bits available at the UNI and 28 bits available at the NNI for Routing Field.

The Generic Flow Control (GFC) Field consists of four bits and is used to assist in the control of information flow and ATM connection queues. The Payload Type (PT) Field consists of three bits and indicates the form of data being carried.

The Cell Loss Priority (CLP) Field is a bit that indicates the priority of the cell. In abnormal network conditions, lower priority cells are discarded before higher priority cells. The Header Error Control (HEC) Field is a means of checking the validity of the header. The receiving node or user can perform several modes of error detection and correction under fault conditions.

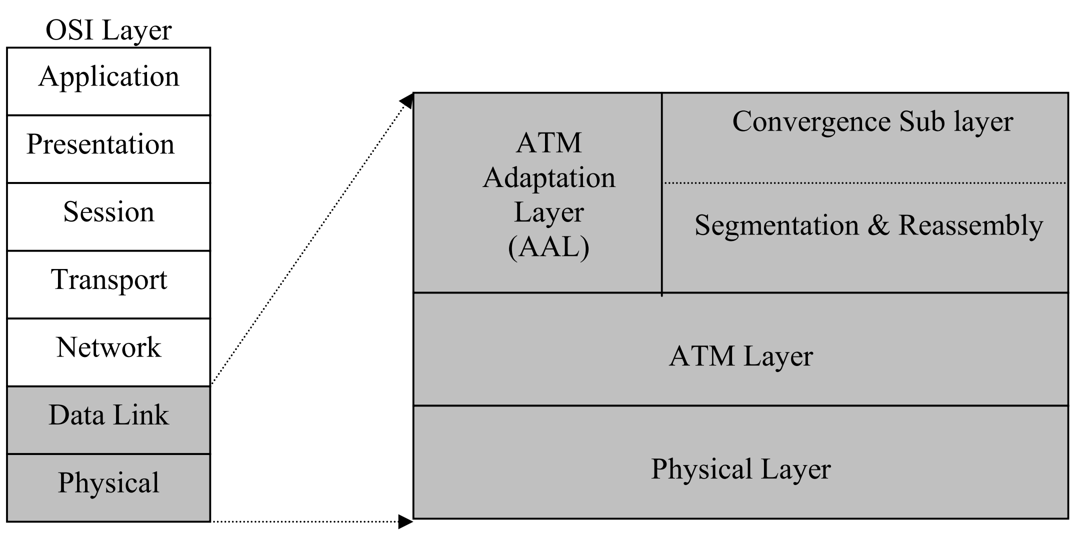
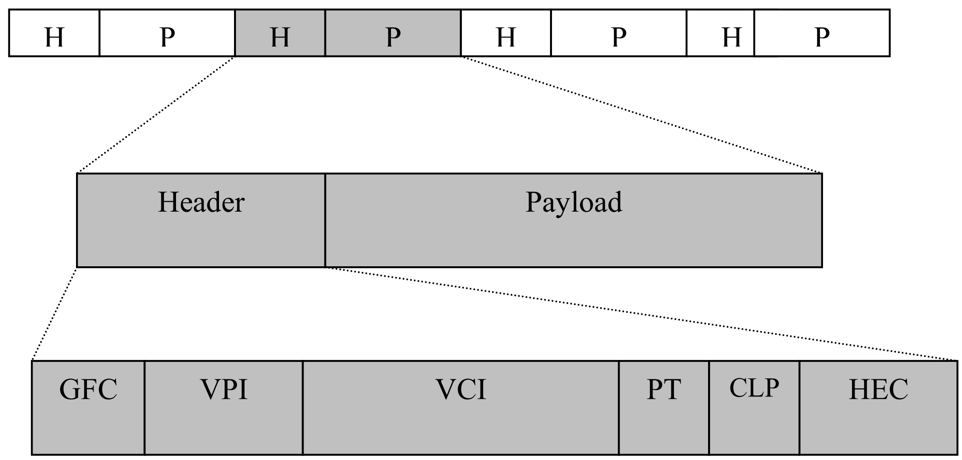


Figure 1.2: Architecture for broadband signaling [3]



GFC = Generic Flow Control	VPI = Virtual Path Identifier
CLP = Cell Loss Priority	HEC = Header Error Control
VCI = Virtual Channel Identifier	PT = Payload Type

Figure 1.3: ATM cell format

1.4 Wireless ATM (WATM)

A significant development emerged in the 1900's, which is the area of wireless personal communication. Wireless communication networks have been growing rapidly in recent years and will extend the service from conventional voice and data to wider range of multimedia service include the voice, data, text, video, graphic, and so on. The number of mobile phone subscribers reaches one million by the year 2010 and surpass fixed phone lines. No bounded offered and freedom, who is using mobile devices such as phones, television and wireless computer.

The capability of ATM network to provide a large bandwidth and to handle multiple QoS guarantee can be realized by preparing effective traffic and effective bandwidth management mechanism. Traffic management includes congestion control, call admission control, and virtual circuit routing. In this project, we concentrate at the call level at the call admission control.

An important issue in the selection of congestion control scheme is the traffic pattern. In Constant Bit Rate (CBR) and Variable Bit Rate (VBR) services the traffic parameters are described in term of peak cell rate, cell delay variation and burst length. The congestion control for CBR and VBR services is administrated through admission control and bandwidth allocation.

If the WATM cannot deliver the resource demand by the connection request, the request will be rejected at call setup time. Voice and video or real time service are examples of source that requires guaranteed traffic service. The remaining bandwidth not used by guaranteed bandwidth services must be shared fairly among all active users by using non real time service as Available Bit Rate (ABR) service such as data, or best effort service.

Designing a high speed wireless network architecture requires careful consideration of the type of services to be supported, the mobility profiles of users, the communication and computation ability of mobile host, the needs for internetworking, the availability and limitations of wires technologies.

1.4.1 Why WATM

The growth of wireless communications paired with the rapid developments in asynchronous transfer mode (ATM) networking technology signals the start of a new era in telecommunications. The growth of cellular radio communications in the past decade has been remarkable. The number of cellular users has exceeded all predictions on cellular use. Demand for cellular communications has placed a heavy demand on the capacity of wireless/air interfaces and the network resources available.

The success of cellular mobile communications has spurned the telecommunications industry to push the implementation Personal Communications Services (PCS). PCS will provide voice, text, video and data. As a result, the demand for higher transmission speed and mobility is even greater. Since the beginning the concept of ATM is for end-to-end communications (i.e. in a WAN environment).

The communication protocol will be the same (i.e. ATM), and companies will no longer have to buy extra equipment (like routers or gateways) to interconnect their networks. Also, ATM is considered to reduce the complexity of the network and improve the flexibility while providing end-to-end consideration of traffic performance. That is why researchers have been pushing for an ATM cell-relay paradigm to be adopted as the basis for next generation wireless transport architectures.

There are several factors that tend to favor the use of ATM cell transport for a personal communication network. These are:

- Flexible bandwidth allocation and service type selection for a range of applications.
- Efficient multiplexing of traffic from bursty data/multimedia sources
- End-to-end provisioning of broadband services over wireless and wired networks.
- Suitability of available ATM switching equipment for inter-cell switching.
- Improved service reliability with packet switching techniques
- Ease of interfacing with wired B-ISDN systems that will form the telecommunications backbone.

In general, internetworking may always be seen as a solution to achieve wireless access to any popular backbone network but the consequence, in this case, is a loss of the ATM quality of service characteristics and original bearer connections. The more internetworking there is in a network, the less harmonized the services provided will be. Therefore, it is important to be able to offer appropriate wireless extension to the ATM network infrastructure.

One of the fundamental ideas of ATM is to provide bandwidth on demand. Bandwidth has traditionally been an expensive and scarce resource. This has affected the application development and even the user expectations. So far, application development has been constrained because data transmission pipes cannot support various qualities of service parameters, and the maximum data transmission bandwidth that the applications have to interface with is relatively small. Finally, ATM has removed these constraints. Bandwidth has become truly cheap and there is good support for various traffic classes. A new way of thinking may evolve in application development.

The progress towards ATM transport in fixed networks has already started and the market push is strong. It can be expected that new applications will evolve that fully exploit all the capabilities of the ATM transport technology. The users will get used to this new service level and require that the same applications be able to run over wireless links. To make this possible the wireless access interface has to be developed to support ATM quality of service parameters.

The benefits of a wireless ATM access technology should be observed by a user as improved service and improved accessibility. By preserving the essential characteristics of ATM transmission, wireless ATM offers the promise of improved performance and quality of service, not attainable by other wireless communications systems like cellular systems, cordless networks or wireless LANs. In addition, wireless ATM access provides location independence that removes a major limiting factor in the use of computers and powerful telecom equipment over wired networks.

1.4.2 Challenges in WATM

A typical reaction to the concept of wireless ATM is to question the compatibility of several aspects of the ATM protocol and the wireless channel. First, considering the fact that ATM was designed for the media whose bit error rates are very low (about 10_{10}), it is questioned whether ATM will work at all in the highly noisy wireless environment. The environment in question is a multi-access channel that may also be time varying. Second, the wireless channel is an expensive resource in terms of bandwidth, whereas ATM was designed for bandwidth-rich environments. Every ATM cell carries an overhead of about 10%. This is considered too high in a wireless environment where bandwidth is precious. In addition, the potential need to transmit single ATM cell means the system should be capable of transmitting individual cells.

However, the physical layer overhead associated with the transmission of individual cells, due to channel equalization and timing can exceed leading to inefficiency which may outweigh the advantages of the wireless access. Supporting wireless users in an ATM network presents two sets of challenges to the existing ATM protocols. The First set includes problems that arise due to the mobility of the wireless of the users. The second set is related to providing access to the wireless ATM network.

1.4.2.1 Challenges Related to the Mobility of Wireless Users

The ATM standards proposed by the International Telecommunication Union (ITU) are designed to support the wire line users at fixed locations; on the other hand, wireless users are mobile. Current ATM standards do not provide for any provisions of support of location lookup and registration transactions that are required by the mobile users. They do not support hand-offs and rerouting functions that are required to maintain connectivity to the backbone ATM network during a move. If a wireless user moves while he is communicating with another user or a server in a network, the network may need to transfer the radio link of the user between radio access points in order to provide seamless connectivity to the user.

The transfer of a user’s radio link is referred to as hand-off. During a hand-off event, the user’s existing connection may need to be rerouted in order to meet delay, quality of service or cost criteria or simply to maintain the connectivity between two users or between a server and a user. Since the existing ATM protocols are designed for wire line networks with fixed users, support for rerouting of existing user is not included in ATM standards. Rerouting is critical to wireless networks which need to maintain connectivity to a wireless user through multiple, geographically dispersed radio access points. In mobile networks, as end points move, segments of connections have to be turndown and re-establishes. Maintaining cell sequence and connection QoS while performing hand-offs are important requirements in Wireless ATM networks.

1.4.2.2 Challenges Related to Providing Access

ATM key benefit of a wireless network is providing tether less access to the subscribers. The most common method for providing tether less access to a network is through the use of radio frequencies. There are two problems that need to be addressed while providing access to an ATM network by means of radio frequencies:

A. Error Performance of the Radio Link:

ATM networks are designed to utilize highly reliable fiber optical or very reliable copper based physical media. These physical media have very low probability of bit error and hence ATM does not include error-correcting mechanism. In order to support ATM traffic in a wireless ATM network, the quality of radio links needs to be improved by error correction and detection.

B. Multiple Access for Wireless ATM Networks:

A wireless ATM network needs to support multiple traffic types with different priorities and quality of service guarantees. A Medium Access control protocol that supports multiple users, multiple connections per user and service priorities with quality of service requirements must be developed in order to maintain full compatibility with existing ATM protocols. This medium access protocol needs to make the maximum use of shared radio resource and needs to achieve full utilization of radio frequencies in a variety of environments.

1.5 Objective

The main objective is designed the resource allocation scheme that can give high (QoS) performance in terms of probability of call lost and handover call. It means performance in term of probability of new call, handover call dropping for real time connections and the probability of overload for non-real time.

1.6 Scope

1.1 Concentrate on the performance of WATM at call level probability of new call, probability of handover call, call delay and non real time service.

1.2 Improves the schemes allowing without reserve channel and with reserved channels for handover call and allowing queuing for new calls include non real time request.

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