# Journal of Internet Banking and Commerce

*An open access Internet journal (http://www.arraydev.com/commerce/jibc/)*

*Journal of Internet Banking and Commerce, April 2008, vol. 13, no.1*
*(http://www.arraydev.com/commerce/jibc/)*


## Wireless ATM: A Technological Framework to m-banking

---


**Susmi Routray, MCA**
**Assistant Professor, Institute of Management Technology, Ghaziabad, India**
*Postal Address:* **Raj Nagar, Hapur Road, Ghaziabad, U.P. – 201 010, India**
***http://www.imt.edu/page.asp?pageid=faculty_top.asp?option=Core%20Faculty***
*Email:* ***sroutray@imt.edu***
Susmi Routray received MCA degree from Barkatullah University Bhopal, India and currently pursuing a Ph.D. degree from University School of Information Technology, Indraprastha University, Delhi, India. She is currently holding the position of Assistant Professor at IMT Ghaziabad, India. She has been contributing papers in national and international journal/conferences. Her research interests include ATM, Wireless ATM, Mobile and Wireless Communication, Operating Systems and Computer Algorithm.

**A. M. Sherry, Ph.D**
**Professor, Institute of Management Technology, Ghaziabad, India**
*Postal Address:* **Raj Nagar, Hapur Road, Ghaziabad, U.P. – 201 010, India**
*Email:* ***sherry@imt.ac.in***
A. M. Sherry is a Ph.D., M.Sc.(Gold Medalist), M.Tech.-Computer Science from IIT Kharagpur, India. He is currently holding the position of Professor at IMT Ghaziabad, India. His Specialization is in the field of Computer Networks, inter-networking technologies and wireless communications. He has more than 15 years experience in teaching and research. He has published over 25 papers in international/national journals and conferences. He is an Information Technology Consultant of National Hydroelectric Power Corporation Ltd. (A Govt. of India Enterprise) and a Member of the Task Force for strengthening of Information Technology Application in Ministry of Power, Government of India.

**B. V. R. Reddy, Ph.D**
**Professor, USIT, Guru Gobind Singh Indraprastha University, Khasmere Gate, Delhi, India**

*Postal Address:* **Guru Gobind Singh Indraprastha University, Khasmere Gate, Delhi, 110006, India**
*Email:* ***bvrreddy@rediffmail.com***
B. V. R. Reddy received his B.E(E.C.E) from Andhara University, Waltair(A.P), M.E(E.C.E) from University of Roorkee, Roorkee(U.P) and Ph.D(E.C.E)from Kurukshetra University,Kurukshetra (Haryana),India He is currently holding the position of Professor in the University School of Information Technology, Indraprastha University, Delhi. He is a member of various professional bodies like ISTE, IE and IETE. He has many research publications to his credit. His teaching and research interests include semiconductor devices and circuits particularly using microwave and optical devices, microwave and optical communications, computer communication networks.

---

## Abstract

Mobile and Wireless communication devices are becoming enablers for organizations to conduct business more effectively and efficiently. One of the most effective applications is mobile banking (m-banking). For any application to gain recognition technological advancements play a vital role. To make m-banking application a success bandwidth management is an important issue. The increased flexibility and mobility feature of wireless ATM and its bandwidth on demand function is motivating a large number of carriers towards deployment of the WATM networks. But there are certain issues which are required to be addressed in WATM. The issues are cost effective planning of network, location management and handover management. In this paper we have suggested and evaluated a technological framework for the m-banking application using wireless ATM which optimizes the bandwidth usage and provides an effective handover management. Simulation results show that the resultant framework is very effective in handling the bandwidth and the handover issue in wireless ATM and provides an effective WATM framework model.

Keywords: **m-banking, ATM, WATM**



---

## INTRODUCTION

The use of wireless communications is now gathering pace. The two applications gaining momentum are the mobile commerce and mobile finance. These applications are now moving toward mainstream consumer use. One of the first commercial applications of the mobile commerce was mobile banking (m-banking) [Barnes et. al.(2003), Laukkanen et. al. (2005)]. Mobile banking is an extension to application such as phone banking and online banking [Pousttchi, K., & Schurig, M. (2004)]. It can be defined as a channel whereby customers interact with a bank through a mobile device e.g. cell phone or PDA [Scornavacca, E., & Barnes, S.J. (2004)]. Today, much of the banking industry's business depends on customer service and building relationships with a broad client base. New and better ways of providing customer service are essential to growth. As people are constantly on the move wireless technology holds huge potential for developing new business such as m-banking where customers can use time spent away from the office to carry out banking transactions. As a result mobile banking or m-banking application is becoming popular worldwide. m-banking can be used for variety of banking related activities like performing balance checks, account transactions, payments etc using mobile devices. M-banking is also performed via SMS or the mobile internet. The m-banking services can be broadly categorized as [en.wikipedia.org/wiki/Mobile_Banking]: *Account Information* - Mini-statements and checking of account history, Alerts on account activity or passing of set thresholds etc. *Payments & Transfers* - Domestic and international fund transfers, Micro-payment handling,etc. *Investments* - Portfolio management services, Real-time stock quotes etc. *Support* - Status of requests for credit, including mortgage approval, and insurance coverage, cheque book and card requests etc. *Content Services* - General information such as weather updates, news, Loyalty-related offers etc. But there are certain technical challenges in implementing the m-banking scenario. Wireless technology is an enabler for the m-banking application.

Over the last few years the mobile and the wireless market has been one of the fastest growing markets in the world and is still growing at a rapid pace. According to the marketresearch.com study on ICT front India has total 129.3 Million Telecom Subscribers with Tele-density of 11.8. Out of total 129.3 Million Telephone main lines in use fixed lines are around 67.29 Million while rest of the subscribers being mobile users (approx 62.02 Million lines). The number of Internet users has reached 39200 thousand users with Internet penetration of 3.6 [marketresearch.com]. Faster wireless networks, improvements in handset designs and new business models for mobile applications are all being developed worldwide. As wireless telecommunications will be the key method of network access in m-banking, carriers need to develop and implement clear strategies so that they are not providing just one service but are able to provide multiple services at low costs. There is a great deal of decision making within companies to decide if they should spend the money to upgrade their existing wireless networks or deploy new ones which will be more modular and easily upgradeable to support new services. There are numerous technological products that are being developed in the wireless field. In this paper we are suggesting a technological framework using wireless ATM for m-banking solution.

## WIRELESS ATM

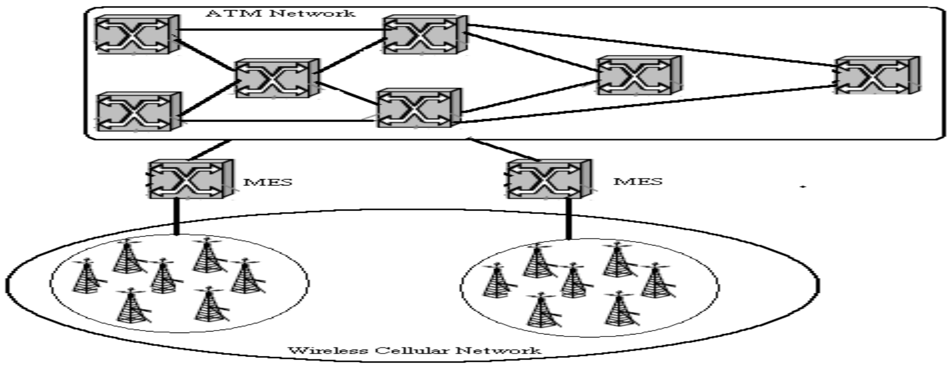
The Asynchronous Transfer Mode (ATM) Network Model has been evolving as the standard for future networking that is expected to carry voice, real time video and a large volume of still images in addition to the growing volume of computer data. ATM has made the broadband integrated service of digital network a reality. It is a technology that allows total flexibility and efficiency required for high speed multi-service and multi-media networks by providing bandwidth on demand. Another advantage of ATM networks is its extension to wireless scenario namely, wireless ATM. WATM can be viewed as a solution for next-generation personal communication networks, or a wireless extension of the B-ISDN networks, which will support integrated data transmission - data, voice, and video, with guaranteed Quality of Service (QoS). The strength of the wireless ATM technology will be its ability to support different protocols like ISDN (Integrated Services Digital Network) and Internet protocols.

WATM was first proposed in 1992 and now it is being actively considered as a potential framework for next-generation wireless communication networks capable of supporting integrated, quality-of-service (QoS) based multimedia services [Raychaudhuri, D. (1999)]. The various application scenarios for WATM can be cellular wireless ATM, wireless ATM LAN, and radio local loop system[2]. The integration of ATM in the wireless network scenario creates many issues such as, maintaining the user connection as the user moves from one location to another – also known as handover, tracking of mobile location and providing quality of service. In this paper we have focussed on the bandwidth and handover management issue. As a mobile terminal moves from one place to another, it becomes necessary to hand over its ongoing connections from the old radio port to the new one. The decision to change the radio port is made either by the mobile terminal or the base station based on signal strength measurements [Seydim, Ayse Yasemin (2000)]. Several rerouting schemes have been analysed in the literature [U. Varshney (1996), J. Porter et. al.(1997), Anthony S. Acampora et. al. (1994)]. Anna Hac et al. have proposed a new handoff call management scheme which reduces signalling traffic in wireless ATM networks and improves the efficiency of the virtual channel. Marsan et al present [M. Ajmone Marsan, A. Fumagalli, et al. (2001)] a handover protocol for wireless ATM networks, which makes use of inband signaling, ie., of ATM resource management cells, to process network handovers and guarantee the in-sequence and loss-free delivery of the ATM cells containing user data. Changes in the structure of the telecommunications industry and market conditions have brought new opportunities and challenges for network operators and public service providers.In this paper we have suggested and evaluated a technological framework model for wireless ATM.

## PROPOSED WATM FRAMEWORK

There are many scenarios possible with regards to the mobility support in the ATM switches. The feasible scenarios are either all ATM switches provide mobility support or some of the switches namely the edge switches provide the mobility support. In this paper we have assumed the architecture specification given in the literature [J. Jiang, T. Lai, and M. Sun (1999)]. The wired network is the ATM network and the edge switches of this wired network are mobility enhanced ATM switches MES [Jamal Elbergali, Neco Ventura(2002)]. The wireless network is the cellular structure network wherein each cell is connected to a base station and the base station in return is connected to the wired ATM network through the MES. Each base station is connected to one MES (Figure 1). From the ATM network the MES receives ATM cells and converts the cells into suitable format as required by the wireless network and passes it to the base station in the wireless network. All those base station which are connected to the same MES form a cluster. The adjacent MESs are connected by Permanent Virtual Paths [U. Varshney (1997)].

Figure 1. Wireless ATM architecture




## PROPOSED HANDOFF FRAMEWORK

The proposed handoff framework has been divided into two phases. During call set-up, SVC is established between the base station to which the MT is connected and the MES [Jamal Elbergali, Neco Ventura(2002)]. When a MT moves from one base station to another base station which are connected to the same MES, one new SVC has to be established between the MES and the new base station, as a result no optimization is required as the resultant route is optimal [J. Jiang, T. Lai, and M. Sun (1999)]. So for Handoffs within the same cluster no optimization is required. When a MT moves from one cluster to another then the MES needs to be changed, as the old base station is connected to one MES and the new base station is connected to another MES. In such type of handoffs the resultant route may not be optimal and as a result optimum network utilization is not possible. For all Inter-cluster handoffs two phase scheme has been proposed.

***Phase-I – Path Extension using PVPs***

As given in the WATM architecture [Figure 1] adjacent MESs are connected with the PVPs[U. Varshney (1997)]. For Inter-cluster handoff a fast handoff is initiated by extending the connection between the old-MES and the new-MES through the connection PVPs. But the resultant route may not be the optimal. In the proposed handoff framework, an assumption has been taken - for all inter-cluster handoffs route optimization is required. So phase-I is followed by phase-II for all inter-cluster handoffs.

**Phase II – Dynamic Route optimization using GA**

Figure 2. Network Model with Physical Link Capacity

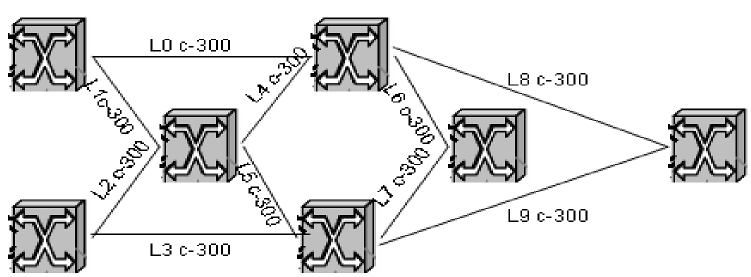
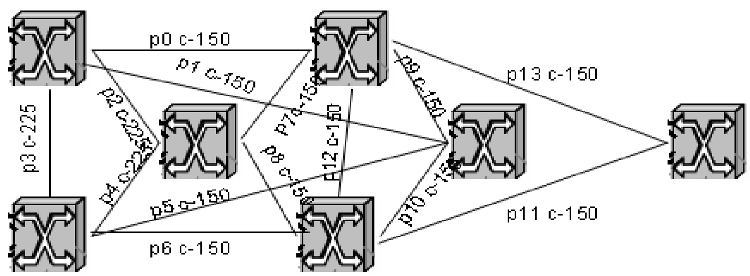


Figure 3. Network Model with Virtual Paths




The second phase is initiated by the new MES immediately after the first phase. In this phase we are optimizing the route of the ATM network. The purpose is to find an optimal route from new MES to the destination MES. The ATM network model that we have considered in the paper is taken as a graph [S. Tanterdtid *et al*. (1998)] G(N,L) . N represents switching nodes and L represents physical link, connecting each node [N. Shimamoto et. al. (1993)]. Lij is the link between node i and j. The second order graph $G_L(N,P)$ where P represents the logical path connection. In this paper we have experimented second phase on a sample network with seven switching nodes and ten physical links is considered in (Figure 2). A pair of node is connected by one logical link by sharing the capacities of physical links connecting the nodes. The path created by connecting two nodes is bidirectional therefore the capacity requirement is the sum of the traffic demand in both directions and total paths will be N (N-1)/2. In this paper we have considered one VP sub-network (Figure 3) carrying the same type of traffic with the same QoS requirement and also the VP sub-network is considered to be fixed. We have considered fourteen logical links in this paper. Bandwidth allocation to each VP is based on the deterministic bandwidth allocation [Y. Sato and K. Sato (1991)]. The capacity allocation to each VP is done on the basis of equal distribution of physical capacity. The capacity is measured in Mbps. The network model that has been considered is a dynamically reconfigurable network model [M. Gerla et. al. (1989)] that can be embedded into the backbone network to meet the traffic demand. In ATM networks to measure the network quality, buffer overflow probability is an important consideration. Buffer overflow probability is related to the average queue length and it is in turn related to the average cell delay [H. Pan and I. Y. Wang, (1991)]. Hence cell delay is an indirect measure of cell loss probability. Therefore average cell delay has been considered to be optimized in the objective function [H. Pan and I. Y. Wang, (1991)].

$$\text{Minimize } T = 1/\lambda \sum_{m=1}^{M} f_m/(c_m - f_m)$$

Subject to, $f_m <= c_m$ for all $VP_m$ in N

Where, M = total number of VPs

$\lambda$ = total external load on the network

$f_m$ = total flow going through VPs in bps

$c_m$ = Transmission capacity of VPm in bps

N = total number of nodes in the network

### *Genetic Algorithm Approach*

*Encoding Mechanism* - Network configuration has been encoded based on the multi-parameter encoding mechanism [N. Shimamoto et. al. (1993)]. Route table are created for all pairs of node combination. Steps involved in Genetic algorithm: *Initialization* - The very first step in GA is initialization. The routes are selected randomly from the route table. Between each pair of nodes a route is selected from the route table and that forms the configuration string (CS). *Evaluation* - Based on the objective function the fitness of the CS are calculated. In this paper we are minimizing the average cell delay. *Selection* - Based on the fitness function parents are selected and children are produced. In this paper we have taken into consideration the roulette wheel selection, Truncation selection and Tournament selection mechanisms. *Crossover* - We have considered single point crossover in this paper. Two strings are selected from the parent string and a point is selected randomly. From that point onwards the strings are interchanged. *Mutation* - We have considered mutation rate of 0.5% in this algorithm. The steps are repeated *till the terminating condition is reached.* Terminating condition can be taken when average fitness is almost equal to the maximum fitness or the algorithm can be repeated for a fixed number of generations. Out of the two conditions whichever is reached first has been taken as the terminating condition.

## RESULTS AND DISCUSSIONS

Phase-I based on path extension mechanism using PVPs results in a very fast handoff. Path extension scheme compared to other re-routing schemes results in faster handoff thereby minimizing the call dropping probability. But the drawback of the scheme is non-optimal route which in our scheme has been handled by phase-II. By applying dynamic routing based on GA a new optimal path is returned which is then extended to the MESs. This scheme is faster than the traditional path re-establishment schemes as here we are not completely setting up a new path between wireless and the wired network but only partially for the wired network. So only the ATM network is rerouted and extended to the MESs. Phase-II of the scheme was applied on the ATM network shown in the WATM architecture (Figure 1) .The Dynamic routing algorithms were applied to the network model (Figure 2). The traffic matrix for the nodes is given in Table1 has been considered for the evaluation of the algorithms and the flow capacities have also been listed in the network model. The algorithm was programmed in the C language. The average cell delay is coming to be 6.16 µsec. On the basis of VP flow and utilization factors, (Table 2), it can be inferred that GA is utilizing the VP’s efficiently. Applying phase-II results in an optimal utilization of network resources.

Table 1 Traffic specification

| ATM Nodes | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 20 | 10 | 20 | 10 | 20 | 10 |
| 1 | 12 | 0 | 13 | 40 | 12 | 16 | 14 |
| 2 | 13 | 16 | 0 | 15 | 11 | 20 | 12 |
| 3 | 10 | 15 | 14 | 0 | 18 | 8 | 16 |
| 4 | 15 | 18 | 12 | 10 | 0 | 16 | 10 |
| 5 | 10 | 20 | 10 | 20 | 10 | 0 | 15 |
| 6 | 12 | 18 | 15 | 18 | 15 | 18 | 18 |

Table 2 Capacity - Flow utilization

| VP No. | Capacity | GA-Flow | GA-U |
|---|---|---|---|
| 0 | 150 | 97 | 0.64 |
| 1 | 150 | 84 | 0.56 |
| 2 | 225 | 129 | 0.57 |
| 3 | 225 | 124 | 0.55 |
| 4 | 225 | 109 | 0.48 |
| 5 | 150 | 63 | 0.42 |
| 6 | 150 | 110 | 0.73 |
| 7 | 150 | 98 | 0.65 |
| 8 | 150 | 96 | 0.64 |
| 9 | 150 | 51 | 0.34 |
| 10 | 150 | 42 | 0.28 |
| 11 | 150 | 30 | 0.2 |
| 12 | 150 | 60 | 0.4 |
| 13 | 150 | 30 | 0.2 |
| | | | Avg. 0.47 |

## CONCLUSIONS

For the m-banking application to be successful the underlying wireless technology needs to be fast, secure and easy to use. In this paper we have suggested and evaluated a technological framework using wireless ATM. The framework suggested handles the issue of bandwidth and handover management in an efficient way which is one of the major concerns in the WATM scenario. As third-generation style networks move toward permanent connections to public wireless networks, there is increased need of providing a solution for handed off connections. They will also need to be capable of processing data that has been streamed in a small, compressed format in order to reduce bandwidth congestion. Wireless banking must offer customers a way to perform banking transactions without interruption and at any time and place. A high-performance, mobile banking solution is needed with well-developed security, and a flexible, fast and user-friendly banking application. Thus the framework suggested in the paper provides a solution for handed-off connections by optimizing the available bandwidth in the wireless ATM scenario.

## REFERENCES

Anna Hac, Yongcan Zhang(August 2002) “Reducing signalling traffic in wireless ATM networks through handoff scheme improvement”, International journal of network management, Volume 12 Issue 5

Anthony S. Acampora, Mahmoud Naghshineh (1994), “ An Architecture and Methodology for Mobile-Executed Cell Hand-off in Wireless ATM Networks”, IEEE Journal on Selected Areas in Communications 12(8), October 1994, pp. 1365-1375.

Barnes, S. J., & Corbitt, B. (2003), “Mobile banking: Concept and potential”, International Journal of Mobile Communications, 1(3), 273-288.
H. Pan and I. Y. Wang, (1991)The bandwidth allocation of ATM through Genetic Algorithm, Proc. IEEE GLOBECOM’91, Phoenix, AZ, USA, 125–129,1991.

Jamal Elbergali, Neco Ventura(2002), “Performance evaluation of a new fast path re-routing for inter-cluster handoff scheme in wireless ATM Networks,” International conference on communication systems, Vol 2, pp 1042-1047, 25 -28 Nov, 2002.

J. Jiang, T. Lai, and M. Sun (1999), “ Consideration on preestablished tree rerouting handoff protocols for wireless ATM PCN,” Computer Networks Journal, vol. 31, pp. 999-1009, May 1999.

J. Porter, D. Gilmurray, A. Massarella, J. Naylon (1997), “Wireless ATM Handover Requirements and Issues”, ATM Forum/97-0153, 1997.

Laukkanen, T., & Lauronen, J. (2005), “Consumer value creation in mobile banking services”, International Journal of Mobile Communications, 3(4), 325 - 338.

M. Ajmone Marsan, A. Fumagalli, et al. (2001), “Local and Global Handovers Based on In-Band Signalling in Wireless ATM networks”, Wireless Networks, Volume 7 Issue 4 (September 2001)

M. Gerla et. al. (1989),” Topology design and bandwidth allocation in ATM nets,”, IEEE journal on selected areas of communications, Vol. 7, No. 8, pp. 1253 – 1262, October 1989.

N. Shimamoto, A. Hiramatsu and K. Yamasaki (1993), "A dynamic routing control based on a Genetic Algorithm",*Proc.* IEEE ICNN'93, San Francisco, CA, USA,1123–1128, 28 March–1 April 1993.

Pousttchi, K., & Schurig, M. (2004), "Assessment of today's mobile banking applications from the view of customer requirements", Paper presented at the 37th Hawaii International Conference on System Sciences, Big Island, Hawaii.

Raychaudhuri, D. (1999), "Wireless ATM Networks: Technology Status and Future Directions", Proceedings of the IEEE, vol. 87, no.10, pp 1790-1806, (October 1999)

Scornavacca, E., & Barnes, S.J. (2004), "M-banking services in Japan: A strategic perspective", International Journal of Mobile Communications, 2(1), 51-66.

Seydim, Ayse Yasemin (2000), WIRELESS ATM (WATM), AN OVERVIEW. Southern Methodist University EE 8304 Section 799(2000)

S. Tanterdtid *et al*. (1998), "An optimum virtual paths network-based ATM network using the Genetic Algorithm", Proc. International Journal of Network Management, 8,158-169 , 1998.

U. Varshney (1996), "A Scheme for Connection Management in Wireless ATM Networks", in Proc. First NDSU Workshop on ATM Networking, Fargo, ND, Aug. 1996.

U. Varshney (1997), "Two Connection Re-Routing Schemes for Wireless ATM Environment", in Proc. IEEE ICUPC, 1997.

Y. Sato and K. Sato (1991), "Virtual path and link capacity design of ATM networks", IEEE journal on selected areas of communications, Vol. 9, No. 1, pp. 104 – 111, Jan 1991.

http://en.wikipedia.org/wiki/Mobile_Banking.
http://www.marketresearch.com/
http://www.ikr.uni-stuttgart.de/Content/Projects/BroadbandNet/WirelessATM/WATMTM.html
Institute of Communication Networks and Computer Engineering