A Soft Resource Reservation Scheme for Layered Video During Handoff on The 3G Wireless Networks

Ing-Chau Chang, Ching-Hsiang Wang

Department of Information Management
Chaoyang University of Technology, Taichung County, Taiwan, R.O.C.
TEL: 886-4-23323000 ; FAX: 886-4-24066635
icchang@cyut.edu.tw, shang@yles.tcc.edu.tw

Abstract

In this paper, the basic frame is 3G wireless network, however, concern with actual wireless network, the change of bandwidth caused by handoff in base station from mobile host (MH) is to maintain the service quality for multi-media video play. The method of this research is to make use of location of MH, direction of movement, and state of speed, and coordinates with neural network system to estimate on target cell. Meanwhile, in order to avoid processing early for target cell results in the idle waste of resource, in this system, we present a scheme for Soft Resource Reservation to let reserved resource become really active upon MH enter into the boundary of the cell.

Viewing from the point of application, in order to solve the negative influence of Handoff Delay for multi-media play, in this system, we adopt mechanism of multi-rate for transmission to separate multi-media stream into Base Layer and Enhancement Layer. Besides, in the resource allocation, Base Layer has the higher priority to sustain a normal reception of packet for Base Layer and let the process of playing not be interrupted.

Keywords: Mobile, Resource allocation, Handoff

1.Introduction

Mobile phone let's us can dial to talk while walking, and Internet network provides us versatile information services. Now, the features of these two technologies are integrated to form 3G wireless network for application. It brings a totally new communication to get information for trading, education, and entertainment so as to create a brand-new world of mobile information. Presently, it progresses toward the direction to integrate with multi-media network, thus installing multi-media information on mobile unit is no longer a dream only [1-4].

However, although the transmission mode of multi-media with quality guaranteed is widely discussed in many papers, data transmission rate is lower than wired network in the wireless network. Meanwhile, because of the transmission is exposed under atmosphere, the signal will be faded for the sake of distance and is very easily interfered by outside environment. Therefore, the problem of packet loss, connection jitter, etc. is more easily caused [5-7].

Besides, under environment of wireless network, MH isn't only fix at access point but roam among the cells. That result in inevitable handoff during the transmission. Special for the next generation of wireless network, in order to get

higher transmission capability, macro-cell adopts high frequency with low power rate. As to the smaller scope of Micro-cell or Pico-cell mode, the occurrence of handoff becomes more frequent.

Multi-media video has featured with continuance, so over long delay or interruption will be affected greatly to the quality of play for the user. In order to let multi-media video can be played continuously, many researchers raise the mechanism of reservation [8-11]. When MH user requests for multi-media, the process of reservation will function around cells. Thus, the better QoS can be provided at handoff and keeps lower connection dropping probability.

The Figure 1 indicates that when MH at Cell A, the advanced resource will be reserved for Cell 1,2,B,6,7,8. When MH at Cell A Handoff to Cell B, the process of reservation will be changed to Cell 2,3,4,5,6,A nearby Cell B. As to the Cell 1,7,8, for not nearby Cell of MH, the original reservation resource is released simultaneously at completion of Handoff.

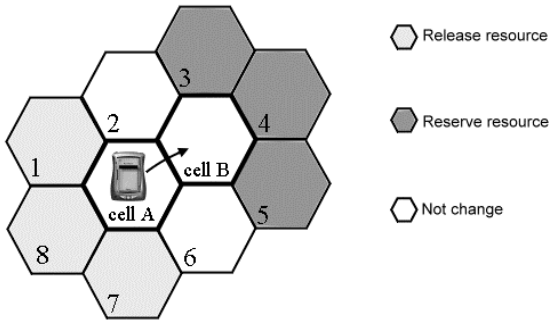


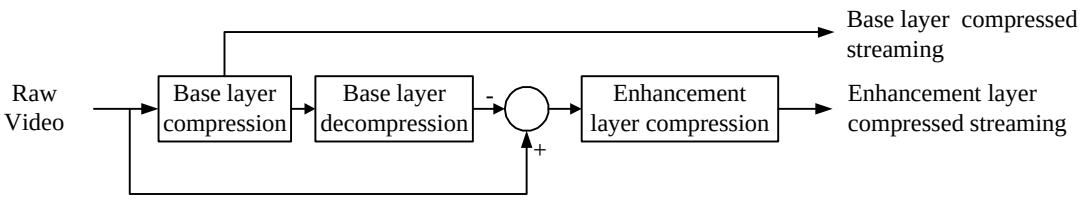
Fig.1 When MH moves, the change of reservation for resource

Volume of reservation and rate of use is a matter of tradeoff, and the resource of wireless network is limited. When MH stays continuously at the same location and no action for handoff, the resource for reservation becomes a waste. Therefore, we present Soft Resource Reservation Scheme in this study. In addition to meet the demand of multi-media play, we reduce greatly the problem of over low rate for the use of resource caused by surplus reservation.

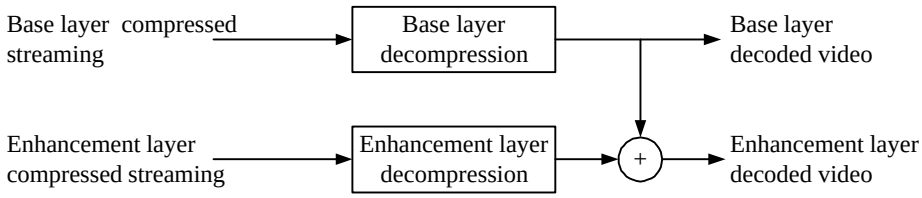
To cope with the influence resulting from the change of network transmission rate, a mechanism of scalable video coding for solution has been raised. Refer to Figure. 2, original video data can be encoded into multi-stream. Among it, a basic -stream can be decoded into rough image. While, other sub-streams can be applied for enhancement. Although Enhancement layer streaming is unable to play from encoding alone, the quality of image can be upgraded after combination with base layer streaming [7,12]. Through encoding of multi-media video streaming, the traffic type can be set according to the requirement of the users and the present condition of network.

In this paper, the proposed scheme includes call admission and specific reservation to guarantee QoS requirements. When MH has reached the overlap scope between two cells, neural network will estimate the possibility to enter into target cell to active for reserved resource. Through this initial action, the improper reservation resource resulting in low rate of use nearby cell can be avoided, and MH unable to get resource required resulting in interruption of multi-media play at handoff could be reduced.

The important points of this paper are specified below. In the second section is to introduce the various methods to process for resource reservation in the wireless network. In the third section is to describe the frame of system for proceeding, including introduction of environment, operation flow, and solution points. In the fourth section is the result of this simulate laboratory, and the conclusion of this study is listed in the fifth section.



(a) Sender



(b) Receiver

Fig. 2 Layered encoding and decoding video

2. Resource reservation

In the transitional period of handoff, using the resource reservation and high-speed state of resource allocation can reduce the dropping probability of handoff call. On 3G wireless multi-media network, in order to increase the capacity, cell is changed for a smaller frame to increase greatly the channel reuse and data transmission rate. However, this causes the handoff frequency increased greatly at different cells for wireless user.

Carlos Oliverira et al. [8] raised Adaptive Bandwidth Reservation Scheme. When MH user requests for multi-media, the reservation of bandwidth nearby cell is proceeded. Meantime, through continuous monitor dropping probability, the size of reserved bandwidth pool can be changed. Although the better QoS is provided at handoff and keeps lower connection dropping probability, the required bandwidth for multi-media video is quite large. If resource reserved simultaneously for nearby cell, then idle reservation will be created easily resulting in over large probability for new call blocking and low rate of use for bandwidth.

D. A. Levine et al. raised the concept of Shadow Cluster [9]. Cell will exchange MH location and movement pattern, etc. information for nearby cells after every period of time to predict handoff probability for MH and reduce unnecessary reserved waste. But, this scheme shall be resulted in large overhead of BS for huge information exchange volume between cells.

G.S. Kuo et al. raised one Semi-Reservation Scheme [10] to set 100% for total rate of nearby cells moved from MH. In other words, when a certain cell of MH has higher handoff probability and simultaneously low down handoff probability for other cells, the total value is still fixed at 100%. Basically, this assumption is no problem. But, when MH still stays at fixed location without Handoff, then reserved resource is unavoidable to be a waste.

If the reserved resource in the cell can expert the effectiveness, it depends on whether MH will enter into that cell. Therefore, if the movement pattern of MH can be held, then it helps to upgrade the effect for resource reserved and also increase the use rate of resource. Many researchers who use MH historical movement pattern predict entering into the cell and the occurrence of handoff.

However, the models from data analysis and statistical record, they are most suitable for big cell. Because in the small cell with shorter scope of function for wireless signal, the occurrence frequency of handoff become higher resulting in a similar random situation for the wireless user. Therefore, the profiles of any user will become ineffectiveness.

However, ordinary MH will not change greatly the direction or speed of movement, so the current location, movement speed, and movement direction of MH still can provide some useful information as reference to predict target cell. Under this assumption, Yu et al. [11] constructed a model to describe random situation of movement in the small cell for wireless user. After having obtained the location of coordinates, movement speed and direction of MH, then through Back Propagation Neural Networks, the classification can be proceeded to figure out the possibility for MH to leave current cell and enter into a specific cell. This kind of method is used for initial stage of MH to reserve an estimated resource at nearby cell without exchanging the MH current location for each individual cell so as to reduce greatly the overhead consumed for network monitor and exchange information. However, this causes another problem, refer to Fig. 3. From initial call of MH to entering into cell will spend a certain time, and during this period, movement direction and state of speed might be changed. Therefore, it is difficulty to infer target cell correctly for appropriate resource reservation only basing on preliminary information. Meanwhile, the speed could affect the time of MH into specific cell, but inappropriate use to predict target cell.

Bandwidth reservation and use rate of bandwidth is a problem of tradeoff. Under wireless network environment, the useable resource is prohibited. Specially, under the circumstance of increasing requirement on multi-media day by day, improper system reservation results in less system capacity and creates more negative influence to QoS. While, Back Propagation Neural Networks can go through supervision-type of learning to proceed the training with current existing value of MH and information of target cell. Therefore, when system proceeds for a new set of information, the probability for entering into a specific cell can be assessed.

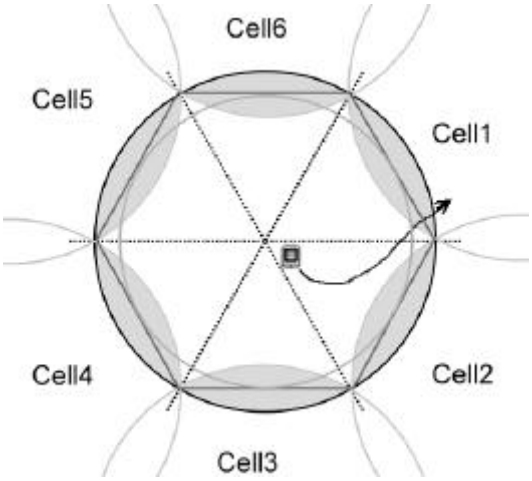


Fig. 3. Movement pattern illustration of MH

The important point of this study is to base on current technology and modern research, and subject to the mechanism of multi-media video stream layered encoding to raise dynamic resource allocation, and when MH for movement or facing handoff, basic play quality can be sustained without interruption. The raised mechanism goes through active establishment for resource reservation to judge if MH faced to handoff. Meanwhile, making use of Back Propagation Neural Networks to estimate the correlation on possibility for current state of MH and entering into a specific cell to consider about resource reservation. When the possibility of neural network reaches a certain degree to reserve resource formally, the influence to system caused by idle resource reservation can be eliminated.

3. System frame design

The requirement on multi-media application program is able to satisfy at playing time executed smoothly for the object of multi-media. Because of data capacity of multi-media is usually larger than ordinary file, if loading to Client for temporary save and through player to play, then the user will waste a longer time for waiting and consume big save cost. This problem becomes more seriously for smaller save space on MH. Therefore, using media streaming lets users save temporarily some part of information for multi-media at initial stage, and the rest part will be continuously loaded with network at the time of playing. This is the future trend for development.

3.1 BPN-based resource reservation

Artificial neural networks can be used to compute solutions for complex problems. They possess an adaptive feature that allows each cell within the network to modify its state in response to experience. The neural network can then learn or self-modify. Often, they have been used to mimic expert systems [13]. The Back Propagation Network(BPN)[14] model is a layered feed forward supervised learning network model, first found in P. Werboss dissertation at 1974. BPN provides an effective means of allowing a computer to examine data patterns that are incomplete or noisy.

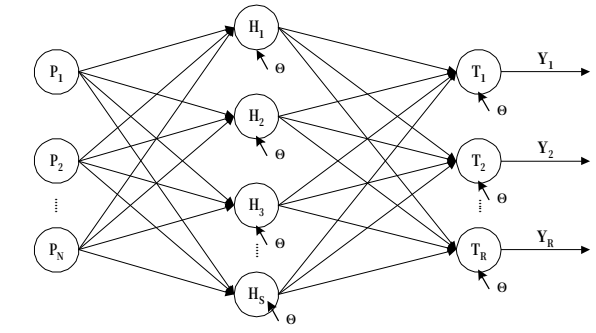


Fig. 4. Neural networks system

3.2 Environment of system

Under wireless network, the useable bandwidth will be descended according to the distance between MH and BS, and increment of interference power rate. Therefore, one method of QoS Guarantee is to have the capability for transmission priority adjustment on lined units (Mobile Host, Base Station, Base Station Controller, Media Sender, and Router, etc.) [15-17]

In this study, the wireless network is to expand the current network service with sender to MH. There are two sections in the environment of wireless network. The Sender to BS adopts current wired line, service quality is guaranteed with higher speed of Data Transmission Rate. However, from BS to MH, the wireless is the actual transmission media to transfer data with lower transmission rate. Refer to Figure 5 for the environment of this system:

MH has the capability to receive and play multi-media data stream. In addition to being a transmitter and receiver, BS also has the capability to know about power rate of MH wireless signal and the hardware condition of MH. Base Station Controller (BSC) is able to manage for wireless resource, calculate different request according to MH movement mode, handoff, and proceeding on the arrangement for wireless network packet priority. While, Media Streaming Server has the capability for layered encoding and can provide relative multi-media data streaming according to the requirement of the user [11-12].

The transmission step of multi-media video streaming is below:

1. When MH requests service from Media Streaming Server, the packet will be transferred by wireless network to BS.

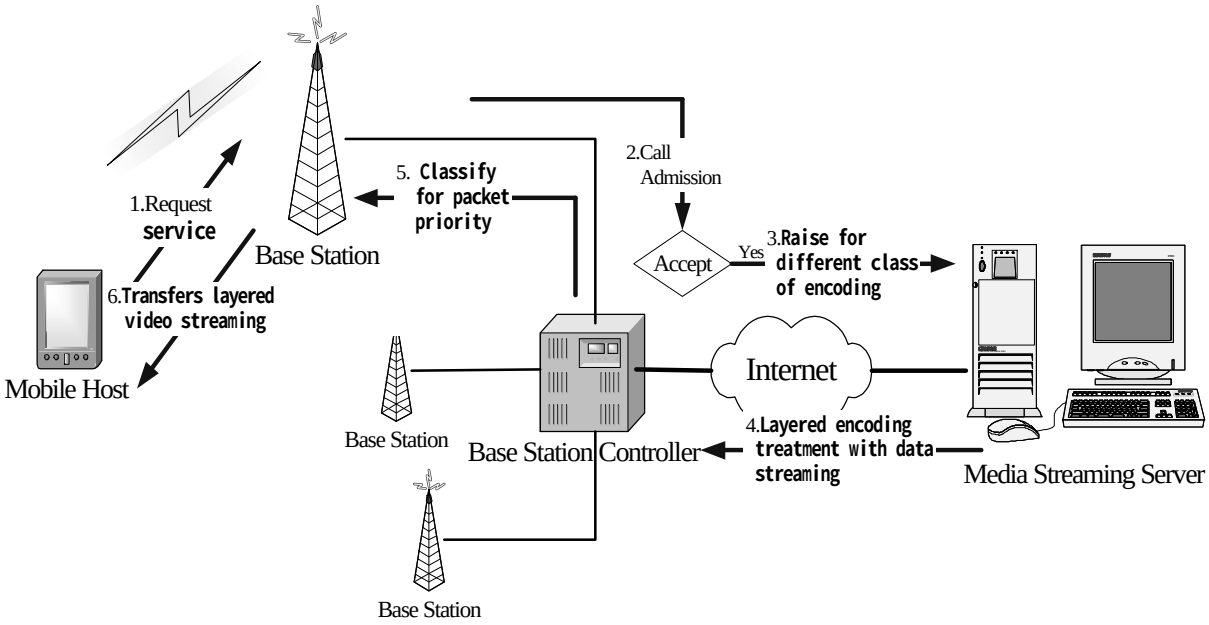


Fig. 5. The transmission step of multimedia streaming

2. Subject to the mechanism of Call Admission Control under MH bandwidth, etc. QoS requirement, hardware platform delivered to BSC, BS judges if needed to setup QoS contract under wireless network and proceed soft reservation register at nearby cell.

3. BSC supervises continuously the movement information feedback from MH to raise the request to Media Streaming Server for different class of encoding.

4. Media Streaming Server sends the object of multi-media for layered encoding treatment with data streaming, and through wired network, the text of qualified class under request is sent to BSC.

5. Subject to QoS Contract for Base Layer and Enhancement Layer media data streaming, BSC adopts the mechanism of QoS to classify for packet priority and simultaneously proceeds for arrangement.

6. Through wireless transmission signal, BS transfers Multi-rate layered video streaming to MH.

A contract to guarantee for service quality from the change of bandwidth during playtime shall be assured no destroy of QoS contract. Therefore, the connection with handoff from other cell at connection stage, a new call from initial setup needs to have resource priority to avoid interruption of communication.

3.3 Dynamic resource allocation

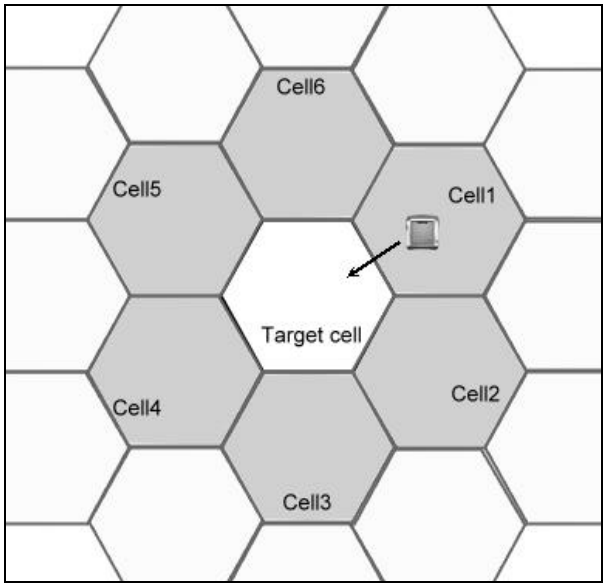


Fig. 6. Target cell and resource reservation.

Because of in wireless network, the resource of bandwidth is quite precious. Surplus resource reservation will cause for much unnecessary waste and result in problem on expansion. Hence, the standard in this study aims at reservation for minimum capacity under application. The calculation mechanism of resource reservation raised by this study uses the distance from MH to BC and movement state to coordinate with neural network to predict the target cell. When the predicted value of target cell reaches the preset threshold, the resource reservation required requests to be proceeded by the cell. As this adopts the mechanism of case initial, overhead caused by MH current state from the exchange between cells will be greatly lowered down.

The system of resource allocation is refer from RSVP extensions[18-19], that shown as Figure.7:

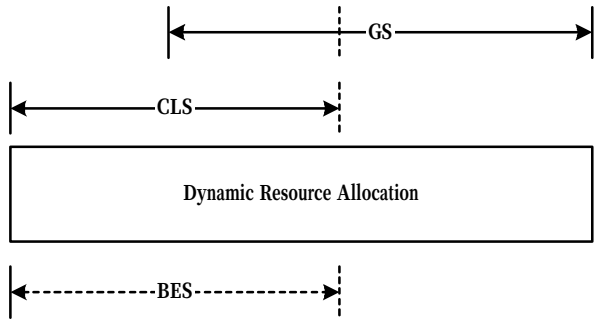


Fig. 7. Resource Allocation for Soft Reservation

- Guaranteed service(GS): This allocation part mainly is the Base Layer Streaming Reservation Pool for MH. When the application rate does not reach to the up limit, some part of resource is allocated temporarily for CLS communication. If the use rate of the resource of this part does not reach to the up limit, then it is unable to accept the request from new MH to proceed for multi-media video streaming.
- Controlled-load service(CLS): This part belongs to the scope of resource allocation used by enhanced layer streaming for current cell of MH. When the resource of this part is used up and unable to get resource from GS, MH is unable to upgrade the play quality of multi-media with enhanced layer streaming.
- Best-effort service(BES): for streaming or data packet that unable to control, transmission is proceeded with best-effort mode, and the priority of resource allocation is the lowest one. When the use rate of CLS does not reach to the up limit, the transmission of resource in that part will be used with dynamic state. If no resource could be used, then it will be sent to infinite queue for temporarily saved.

When new connection requests service, the sender of multi-media must be confirmed to realize if media source could adopt multi-layer encoding for layered transmission. If the sender of multi-media is unable to provide the service, then this kind of package will be transmission with the best-effort mode.

If the sender could support multi-layer encoding, then different treatment could be used according to Base Layer and Enhancement Layer. Among them, the packet of Base Layer is the essential content for the play of multi-media streaming, so it adopts higher class of priority.

Moreover, because MH has the mobile ability, after instant transmission connection is set-up, signal will be fading for far away access point resulting in elimination of available bandwidth [20]. If use Diffserv[21-22] to simply considering about service category for different packet transmission priority, it is unable to provide correctly the guarantee of QoS. Therefore, combining the requirement on multi-media application program and considering current state of MH location, the mechanism to service with different treatment on packet by different layered streaming.

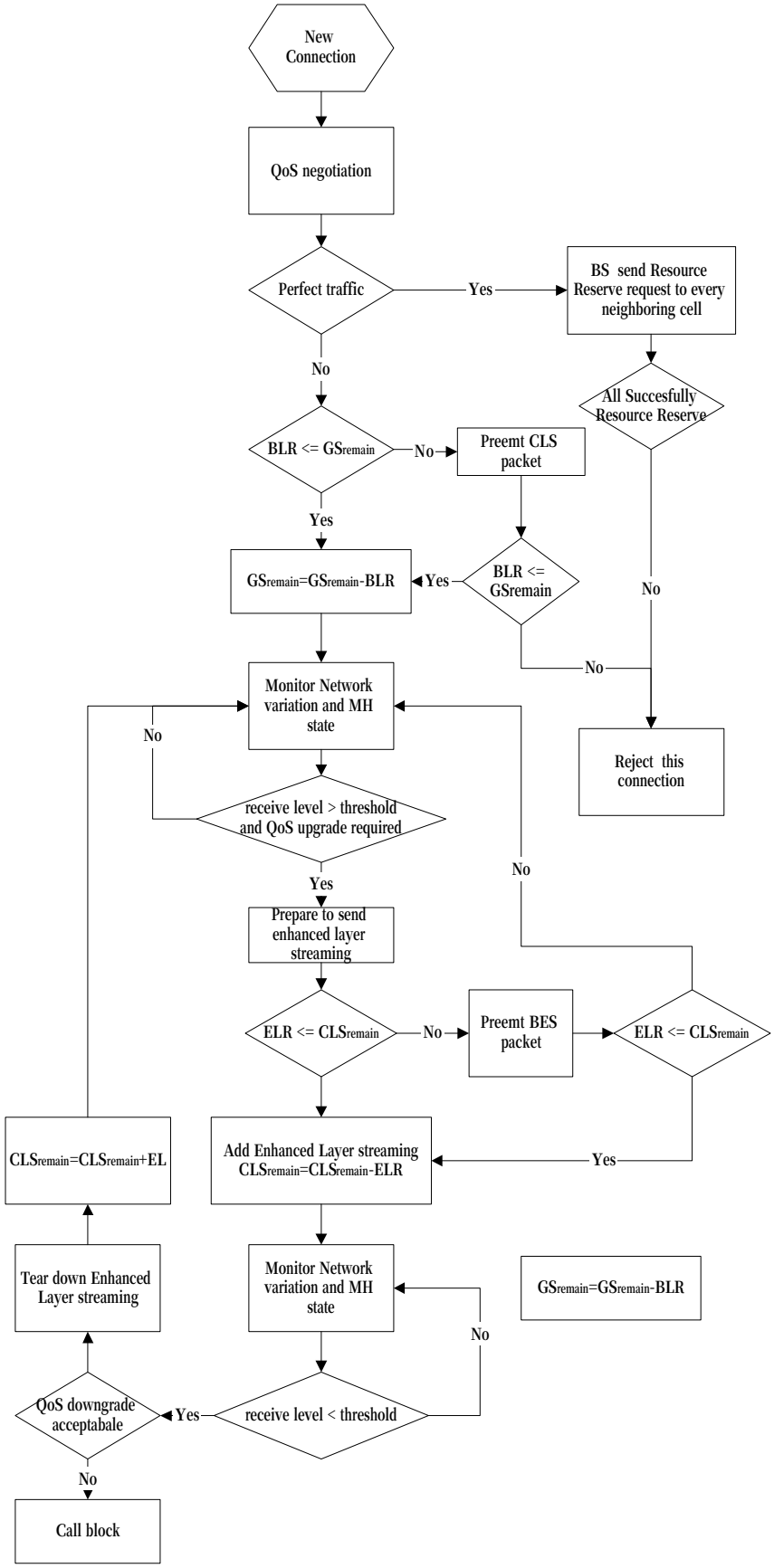


Fig 8. A flow diagram of Dynamic Resource Allocation

In Fig. 8 indicates the calculation flow with dynamic resource allocation for BSC, and the system can supervise continuously to provide network resource for new call and handoff call that is used as reference for resource allocation adjustment.

Because the cell is in different geographical location, it causes MH have different movement state, for example, in the high population urban area or less population of outskirts area. In addition to passengers, automobile, etc. movement, MH influences to a specific system. A preset value can be stipulated according to the mode of network, among which, ***m*** represents the proportion of sensitive range for neighboring connection, and ***r*** represents the resource required for Base Layer under calculation from neural system.

4. Simulation

The cell in a smaller wireless network, the movement state of MH is more randomly. Meanwhile, the handoff is produced more frequently. Therefore, it is more difficult to predict the target cell with the user's movement state. However, some current locations, movement direction of MH still provide some useful information. In order to comparison between features and target cell, Back Propagation Neural Network is adopted to classify as Model.

In plan coordinates (x,y) for cell of MH, movement direction, the three values are applied as inputs, and the possible entering rate nearby 6 cells will be regarded as outputs. There are included two layers that each layer has hidden layers of 20 nodes. To set the transfer function, except hidden layer and output layer using Log-sigmoid transfer function, another layer is to use Tangent-sigmoid as transfer function.

The training of the BPN was continued until the sum of the squares of the training error was less than 0.001. If the error does not fall below 0.001, the BPN is allowed to train until 1000 epochs. The large number of epochs was chosen to give the BPN sufficient time to converge if possible. The training time on the RS/6000 H80-450MHz (CPU 4,Memory 5GB, OS AIX4.3.3) was 1.5 h of CPU cycle time on the average.

Table 1. Laboratory data direction

	Assumptions
Cell radius	1000m
Link capacity	2Mbps
Base Layer	24Kbps
Enhanced Layer	32Kbps
Velocity initial value	Normal distribution, mean 6km/h, variance 4 $(km/h)^2$
Direction initial value	uniform distribution $Q=[-\pi, \pi]$
Time interval	τ =[1sec-5sec]
Velocity variation	Uniform distribution dV = [0,2km/h]
Directory variation	Uniform distribution dQ = $[-\pi, \pi]$
Call arrival model	Poisson distribution(λ =5)
Proportion of sensitive range	***m*** (default 20% ,800m)
Resource allocation for GS	***r*** (default 30%)
Max Inter-packet delay	200 ms

In the beginning of simulation, a random location of coordinates, coordinates and speed are provided to MH, in the preset time cycle, MH will be moved to next location subject to the coordinates and speed. Besides, a variance for new speed and direction can be obtained according to formula. This step is continuously repeated until MH leaves current cell and enters into nearby cells.

$$x = x_{current} + t * v_{current} * \cos Q_{current} \quad (1)$$

$$y = y_{current} + t * v_{current} * \sin Q_{current} \quad (2)$$

$$v = \sqrt{(dv + v_{current} * \cos(dQ * p))^2 + (v_{current} * \sin(dQ * p))^2}\ , -1 \le dQ \le 1 \quad (3)$$

$$\left.\begin{aligned} Q &= Q_{current} + (dQ - (\arccos \frac{dv + v_{current} * \cos(dQ * p)}{v}) / p \quad , dQ > 0 \\ Q &= Q_{current} + (dQ + (\arccos \frac{dv + v_{current} * \cos(dQ * p)}{v}) / p \quad , dQ < 0 \end{aligned}\right\} \quad (4)$$

Fig. 9. The relationship between the user's state and time variance.

At time $T_k = k\,\tau$, the MH is at the position $P(x_k,y_k)$. After a time interval τ,it moves to the new position $P(x_{k+1},y_{k+1})$. The speed is changed from (n_k, Q_k) to (n_{k+1}, Q_{k+1}) based on a randomly generated difference (dv, dQ). After another time interval τ ,it will move to another position $P(x_{k+1},y_{k+1})$. and repeat the same process.

By making use of aforesaid formula to produce 1000 samples, among them, the preset current boundary, coordinates, direction and speed entering into MH, and final stay time entering into target cell and cell will be recorded. Further, among them, 200 samples will be used to train for neural network, and the remaining 800 samples will be used to test and distinguish the neural network, where each pattern contains three inputs and six desired outputs.

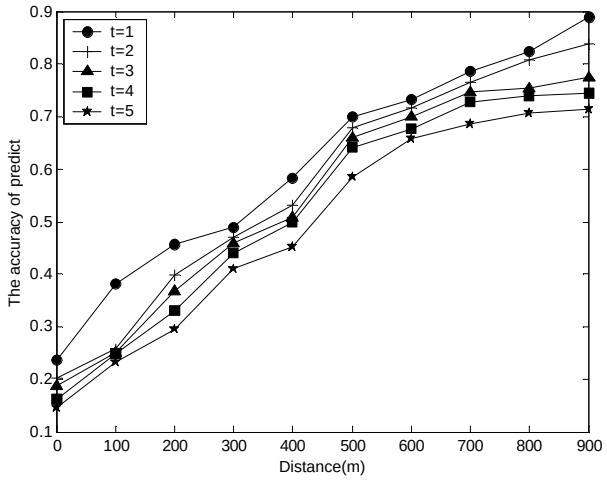


Fig. 10 Reserved initial location and accurate estimation.

According to Fig. 10, in the beginning to proceed the estimation of target cell, and the accuracy is lower. That is to say, it is unable to provide the resource reservation accurately resulting in idle waste of resource by a mistaken estimation on system.

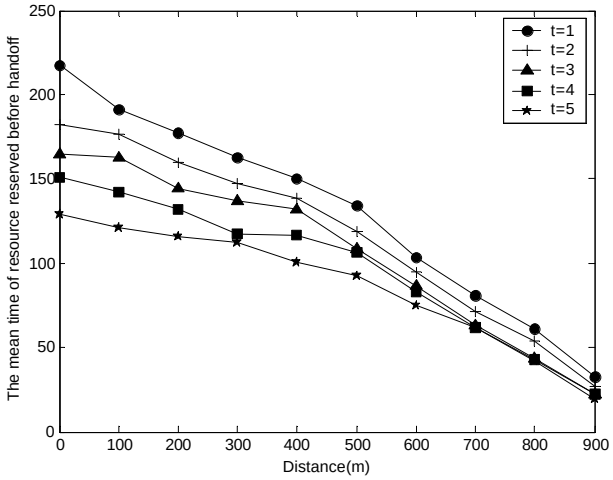


Fig. 11. Time relation between reservation initial location and cell in MH.

From Fig. 11, we can clearly see that MH stays a certain time at current cell. Therefore, too early initial reservation will result in idle waste nearby cells. On the contrary, when MH entering into boundary area to proceed the resource reservation can provide better rate of use.

While in this system, we also discover that when decrease the sensitive range, the quantity of package required for instant treatment is increased. Thus, the system loading capacity becomes larger resulting in bigger dropping probability.

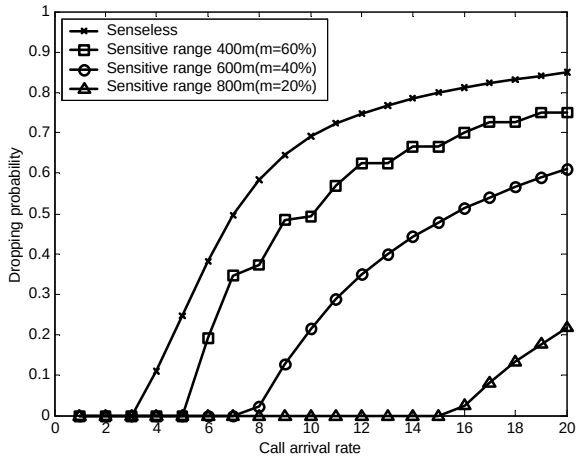


Fig. 12. The increment of sensitive range affects to the dropping probability

Base Layer can provide the basic quality required for multi-media play. Therefore, it shall avoid too much delaying. In this study, the programmed proportion for reservation is to prohibit the quantity of high priority package so as to keep Base Layer have much time delaying. In Fig. 13, different value r represents system to reserve Base Layer to proceed resource proportion for high priority transmission. When the proportion value for reservation is smaller, it indicates that the resource quantity for Base Layer is less. Therefore, when MH proceeds handoff call, the bigger dropping probability can be created.

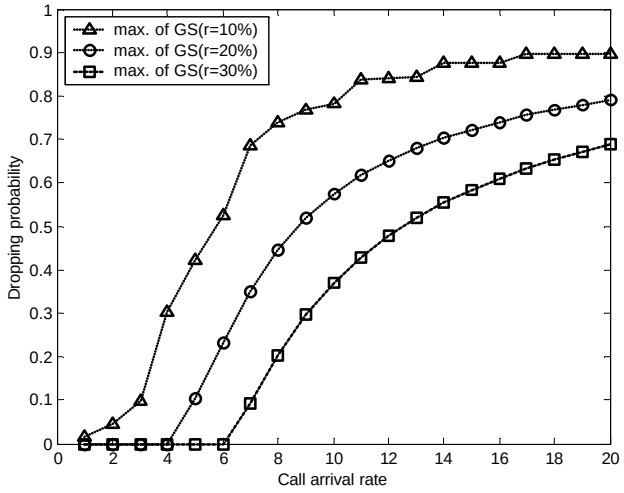


Fig. 13 Different reservation of Base Layer affect to the dropping probability

Multi-media video with application layer is proceeded with multi-layer encoding. Meantime, the transmission is implemented through the package of Base Layer and Enhanced Layer. As the former is basic requirement of instant multi-media video, the transmission adopts high priority. While, when MH transmission rate is lowering down for wireless signal fading and interference, the package of Enhanced Layer can be eliminated without causing for play interruption. In Fig. 14, we discover that if unable to proceed different encoding for multi-media video streaming and adjust value of package according to the layer, then packet loss possibility will be lifted when over quantity of instant package occurs. The quality of play will be affected.

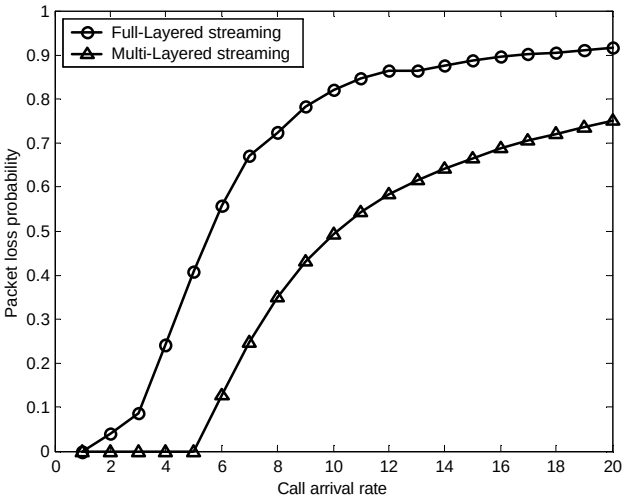


Fig. 14. Comparison between different priority for multi-media video streaming layer and influence on packet loss probability

5. Conclusion

The bandwidth resource of wireless network for use is quite limited. As the demand of mobile user on multi-media is very urgently, we need to consider about resource allocation in the wireless network. Different from other researchers to raise resource reservation mode, this study is to estimate the possibility on making use of neural network for MH entering into target cell. When this value reaches to the threshold, the reservation will be initialized to eliminate the problem of resource idle waste and low rate of use.

Under environment of smaller cell size, the movement route is similar to the random mode. Making use of historical movement data for estimation is not a practical way, on the other hand, making use of current state of MH can provide the useful information. In this study, through the training on neural network, the correlation between input data and target cell could be obtained as the estimation value for volume of reservation. Moreover, in order to avoid early reservation resulting in waste of resource, boundary respond area is applied. When MH moves to a specific area, the resource reservation is proceeded. Under experiment, the method adopted by this study has better effectiveness and decreases the packet loss probability.

Moreover, instant multi-media video streaming of layered encoding can have high priority for base layer streaming with dynamic resource allocation model recommended by this study. This is to assure that MH in different cell at handoff or facing to network congestion keeps the multi-media play continuous without interruption.

6.Reference

1. H.H. Chen, C.X. Fan; W.W. Lu, “China's perspectives on 3G mobile commuunications and beyond: TD-SCDMA technology,” IEEE Wireless Communications, vol.9, April 2002, pp.48-59.
2. R.Pandya, D.Grillo, E.Lycksell, P.Mieybegue; H.Okinaka and M.Yabusaki, “IMT-2000 Standards: Network Aspects,” IEEE Personal Communications , vol.4, no. 4 , Aug. 1997, pp. 20 –29.
3. B.Sarikaya, “Packet mode in wireless networks: overview of transition to third generation,” IEEE Communications Magazine, vol.38, Sep. 2000, pp.164-172.
4. S.Nanda, K.Balachandran, S.Kumar, “Adaptation techniques in wireless packet data services,” IEEE Communications Magazine , vol.38, Jan. 2000, pp.54-64.
5. S. Hadjiefthymides and L. Merakos, “Using Proxy Cache Relocation to Accelerate Web Browsing in Wireless/Mobile Communications,” 10th International World Wide Web Conference, Hong Kong, May 2001, pp.26-35.
6. K. Kim, Y. Han, C.H. Yim and K.S. Jeong ,”A Call Admission Algorithm with Optimal Power Allocation for Multiple Class Traffic in CDMA Systems,” 52nd Vehicular Technology Conference, vol.6 , 2000, pp.2666 –2671.
7. Y. Xiao, C.L.P and Y.Wang, “Quality of Service and Call Admission Control for Adaptive Multimedia Services in Wireless/Mobile Networks,” National Aerospace and Electronics Conference, 2000, pp. 214 –220.
8. C. Oliviera, J.B. Kim, T. Suda, “Quality of service quarantee in high speed multimedia wireless networks,” IEEE infocom, Mar. 1996, pp.728-734
9. D. A. Levine, I.F. Akyildiz, and M.Naghshineh, “The shadow cluster concept for resource allocation and call admission in ATM-based wireless networks,” IEEE/ACM Trans. Networking, vol.6, Feb. 1997, pp.1-10
10. G.S. Kuo, P.C. Ko and M.L. Kuo,“A probabilistic resource estimation and semi-reservation scheme for flow-oriented multimedia wireless networks,” IEEE, 2000, pp.1046-1051
11. W.W.H. Yu, Changhua He, “Resource Reservation in Wireless Networks based on Pattern Recognition,” IEEE pp.2264-2269.

12. W. Li, “Overview of Fine Granularity Scalability in MPEG-4 Video Standard,” IEEE Transactions on Circuits and Systems for Video Technology, vol. 11, no. 3, MAR. 2001, pp. 301-317.

13. M.Patel, N.Ranganathan, “IDUTC: An Intelligent Decision-Making System for Urban Traffic-Control Applications,” IEEE Transactions Vehicular Technology, vol. 50, May 2001, pp. 816 –829.

14. R. Hecht-Nielsen, “Theory of Backpropagation Neural Networks,” IJCNN-89, pp 593.

15. L. Hsu, R.Purnadi and S.S.P, “Maintaining Quality of Service (QoS) During Handoff in Cellular System With Movement Prediction Schemes,” 50th Vehicular Technology Conference. (IEEE VTS 1999), vol.4, Fall. 1999, pp. 2153 –2157.

16. S.Sen, A.Arunachalam, K.Basu and M.Wernik “A QoS Management Framework for 3G Wireless Networks,” Wireless Communications and Networking Conference. (WCNC 1999), vol.3, 1999, pp. 1273 –1277.

17. J. Kim, A. Jamalipour, “Traffic Management and QoS Provisioning in Future Wireless IP Network,” IEEE Personal Communications , vol .8 , Oct. 2001, pp. 46 –55.

18. J.H. Lee, T.H. Jung, S.U. Yoon, S.K. Youm and C.H. Kang, “An Adaptive Resource Allocation Mechanism Including Fast and Reliable Handoff in IP-Based 3G wireless Networks,” IEEE Personal Communications, Dec. 2000, pp.42-47.

19. M.B.and A. H., “RSVP Extensions for Real-Time Service in Wireless mobile networks,” IEEE Communications magazine, Dec 2001, pp 52-59

20. K.M. Rege, S. Nanda, C. F. Weaver and W. C. Peng, “Fade Margins for Soft and Hard Handoffs,” Wireless Networks2, 1996, pp.277-288.

21. J.Tanaka, S.Oda, M.Goto and T.Ishihara, “QoS Interworking for Diffserv over ATM Access Networks,” IEEE Global Telecommunications Conference (GLOBECOM 2000), vol.3, 2000,pp. 1560 –1564.

22. W.C. Feng, D.D.Kandlur, D.Saha, and K.G.Shin, “Adaptive Packet Marking for Providing Differentiated Services in the Internet,” the 6th International Conference on Network Protocols, 1998, pp. 108 –117.