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Hopfield Neural Network based Dynamic Call Admission Control for Quality of Service Provisioning in Mobile Multimedia Networks

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In mobile multimedia communication systems, the channel allocation schemes and computational model are becoming the topic of research interest. The computational model gives the faster processing time based on learning algorithm and neural network models. In wireless network the limited bandwidth is an issue of serious concern. However for the better utilization of available resources in a network, channel allocation scheme plays an important role to manage the available resources in each cell of cellular network. Therefore this issue should be managed to reduce the call blocking or dropping probabilities. This paper gives the new dynamic channel allocation scheme and extends the previous work, which is based on traffic mobility using Hopfield neural network.This neural network method develops the new energy function that allocates channel not only for new call but also for handoff calls on the basis of traffic mobility information. Moreover, we have also examined the performance of traffic mobility to enhance the overall Quality of Services (QoS) in terms of continuous service availability, inter-cell handoff calls and increasing traffic load.The prime objective of this paper is to decrease the handoff call dropping and blocking probability as compared to the other existing systems of static and dynamic channel allocation schemes.

Keywords : Call Blocking Probability, Call Dropping Probability, Dynamic Channel Allocation, Hopfield Neural Networks, Mobile Multimedia Networks.

1. INTRODUCTION

Recently, the demands of mobile users are varying everyday due to the portability and the availability of mobile system. But the radio spectrum is limited for this purpose as compare to mobile users. Therefore the most efficient utilization of the radio spectrum is the dynamic channel allocation schemes which improve the overall quality, capacity and performance of the wireless networks. The prime objective of the Dynamic Channel Allocation (DCA) is to improve the capacity of mobile multimedia communication networks where the traffic load is unpredictable *i.e.*, randomly distributed, has been proposed and explain very well in [1–4]. So far several DCA schemes have been developed and proposed to use various techniques. In recent years, Hopfield neural network or HNN based dynamic channel allocation or DCA schemes have been discussed frequently [2],[5],[6]. HNN is fast and parallel optimizer which is very efficient neural network model for channel allocations. The optimization of the HNN can be seen in its energy function which minimizes the cost and channel allocation problem in mobile networks.

This paper uses the HNN model, which plays a very important role for the prediction of traffic mobility as part of DCA schemes. The literature survey shows that neural network based DCA schemes are normally focused only on the channel allocation of new call and to compute the time of convergence or blocking probability of new calls. But it doesn't give more attention about the influence of traffic mobility on performance in mobile networks. From the above

Figure 4 shows the percentage result of handoff dropping probability based on the number of channels available in random traffic. It is not possible to completely eliminate the handoff dropping percentage but it can be controlled up to a certain threshold value. According to Figure 3 the percentage of handoff dropping call decreases when the numbers of channels are increased. Consequently our proposed model HNN-DCA keeps the percentage of handoff dropping calls between 3 to 5 percent.

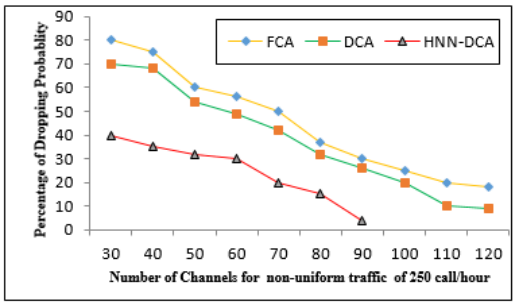

Figure 4. Channels Vs. Handoff Call Dropping Probability

6. CONCLUSIONS

This paper focuses on mobility in dynamic channel allocation scheme using Hopfield neural network at different levels. It is carried out in two phases. First phase, gives the mobility prediction and performance estimation of the traffic load. In the second phase, dynamic channel allocation scheme has been implemented using neural network to improve the capacity of existing dynamic channel allocation schemes.This scheme predicts the uniform or non-uniform mobile users who usually move in the cellular networks. Further, a dynamic resource allocation model, based on traffic mobility, has been developed. The model not only enhances the resource utilization capability but also reduces the blocking and dropping probabilities significantly. Moreover, our approach is unbiased in resource sharing while considering acceptable QoS levels to the new and handoff calls. Our results show the significant effect in terms of reduction of blocking and dropping probabilities and ultimately increasing efficient channel utilization. Furthermore, In future our model might be implemented for other soft computing techniques or combination of these soft computing approaches like genetic-neuro, fuzzy-neuro, or fuzzy-genetic-neuro.

REFERENCES

1. I Katzela and M Nagnshinen. Channel Assignment Schemes for Cellular Mobile Telecommunication Systems: A Comprehensive Survey, *IEEE Personal Communications*, 1996.
2. Oscar Lzaro and Demessie Girma. Hopfield Neural-Network-Based Dynamic Channel Allocation with Handoff Channel Reservation Control, *IEEE Transaction on Vehicular Technology*, 49(5), 2000.
3. N Garcia, R Agusti and J Perez-Romero. A User-Centric Approach for Dynamic Resource Allocation in CDMA systems based on Hopfield Neural Networks.
4. Chang Wook Ahn and R SRamakrishna. QoS Provisioning Dynamic Connection-Admission Control for Multimedia Wireless Networks Using a Hopfield Neural Network, *IEEE Transaction on Vehicular Technology*, 53(1), 2004.
5. Omid Moradi. A Hopfield Neural Network for Channel Assignment Problem in Cellular Radio Networks, *Computer and Information Science*, ISSN 1913-8989, 4(1), January 2011.
6. E Del Re, R Fantacci and L Ronga. A Dynamic Channel Allocation Technique based on Hopfield Neural Networks, *IEEE Transactions on Vehicular Technology*, 45:26–32, Feb. 1996.
7. Suresh Venkatachalaiah. Mobility Prediction and Multicasting in Wireless Networks: Performance and Analysis, 2006.
8. Fei Yu, Victor Leung. Mobility based Predictive Call Admission Control and Bandwidth Reservation in Wireless Cellular Networks, *Elsevier*, 2001.
9. S Tekinay and B Jabbari. Handover and Channel Assignment in Mobile Cellular Networks. *IEEE communication magazine*, 1991.
10. M Zhang and T S P Yum. Comparisons of Channel-Assignment Strategies in Cellular Mobile Telephone Systems, *IEEE Transaction Vehicular Technology.*, 8:211–215, 1989.

11. Tuna Tugcu and Cem Ersoy. Application of Realistic Mobility Model in Metropolitan Cellular Systems, *Vehicular Technology Conference VTC*, 2001.
12. E Del Re, R Fantacci and L Ronga. A Dynamic Channel Allocation Technique Based on Hopfield Neural Networks, *IEEE Transactions on Vehicular Technology*, February 1996.
13. D A Levine, I F Akyildiz and M Naghshineh. A Resource Estimation and Call Admission Algorithm for Wireless Multimedia Networks using the Shadow Cluster Concept, *IEEE/ACM Transaction on Networking*, 5:1–12, 1997.
14. M Zhang and T S P Yum. The Nonuniform Compact Pattern Allocation Algorithm for Cellular Mobile Systems, *IEEE Transaction Vehicular Technology*, 40:387–391, Nov. 1991.
15. Kumar S, Kumar K and Kumar P. Mobility based All Admission Control and Resource Estimation in Mobile Multimedia Networks using Artificial Neural Network, *In Proceedings of Ist International Conference on Next Generation Computing Technologies(NGCT)*, pages 852–857, 2015.
16. Kumar Sanjeev, Krishan Kumar and Anand Kumar Pandey. Dynamic Channel Allocation in Mobile Multimedia Networks using Error Back Propagation and Hopfield Neural Network (EBP-HOP), *Proceedia Computer Science*, 89:107–116, 2016.
17. H Si, Y Wang, J Yuan and X Shan. Mobility Prediction in Cellular Network Using Hidden Markov Model, *7th IEEE CCNC*, pages 9–12, 2010.
18. Peppino Fazio, Mauro Tropea, Cesare Sottile, Salvatore Marano, Miroslav Voznak and Francesco Strangis. Mobility Prediction in Wireless Cellular Networks for the Optimization of Call Admission Control Schemes. *in Proceedings of CCECE*, 2014.
19. M Chiu and M Bassiouni. Predictive Schemes for Handoff Prioritization in Cellular Networks based on Mobile Positioning, *IEEE Journal on Selected Areas in Communications*, 18:510–522, 2000.
20. Fazio, P Tropea and M Marano. A Distributed Hand-Over Management and Pattern Prediction Algorithm for Wireless Networks With Mobile Hosts, *9th International Wireless Communications and Mobile Computing Conference*, pages 294–298, 2013.
21. D Hong and S S Rappaport. Traffic Model and Performance Analysis for Cellular Mobile Radio Telephone Systems with Prioritized and Non-Prioritization Handoff Procedures, *IEEE Transaction Vehicular Technology*, 35:77–92, 1986.
22. M J Yazdanpanah, E Madanian and A M Farahmand. Channel Assignment in Cellular Communication using a New Modification on Hopfield Networks *Iranian Journal of Science and Technology, Transaction B, Engineering*, 29(B4), Printed in the Islamic Republic of Iran, 2005
23. Sanjeev Kumar, Krishan Kumar and Anand Pandey.A Comparative Study of Call Admission Control in Mobile Multimedia Networks Using Soft Computing, *International Journal of Computer Applications*, 107(16), 2014.
24. U Gotzner, A Gamst and R Rathgeber. Spatial Traffic Distribution in Cellular Networks, *in Proceedings IEEE Vehicular Technology Conference*, pages 1994–1998, 1998.
25. K Shimada, T Watanabe, M Sengoku and T Abe. Dynamic Channel Assignment Approach to Reuse Partitioning Systems using Rearrangement Method, *IEICE Transaction Fundamentals*, 831–837, 1995.
26. C Mihailescu, X Lagrange and D Zeqhlache. Analysis of a Two Layer Cellular Mobile Communication System, *in Procedings of 47th IEEE Vehicular Technology Conference*, pages 954–958, 1997.
27. Joe Capka and Raouf Boutaba. Mobility Prediction in Wireless Networks Using Neural Networks, *International Federation for Information Processing*, 2004.
28. R Thomas, H Gilbert and G Maziotto. Influence of the Moving of the Mobile Stations on the Performance of a Radio Mobile Cellular Network, *Proceedings 3rd Seminar Digital Land Mobile Communications*, 1988.
29. S N Sivanandam and S N Deepa. Principle of Soft Computing, Second Edition, *Wiley India publication*, 2011.
30. M Zhang and T S P Yum. Comparisons of Channel-Assignment Strategies in Cellular Mobile Telephone Systems, *IEEE Vehicular Technology Conference*, 38:211–215, Nov. 1989.
31. J J Hopfield. Neural Networks and Physical Systems with Emergent Computational Abilities, *Proceedings of National Academy Science, USA*, 79:2554–2558, 1982.
32. J J Hopfield and D W Tank. Neural Computation of Decision in Optimization Problems,

Biological Cybernatics., 52:141–152, 1982.
33. J J Hopfield. Neurons with Graded Response have Collective Computational Properties like those of Two-state Neurons, *Proceedings of National Academy Science, USA*, 81:3088–3092, 1984.
34. S Haykin. Neural Networks:A Comprehensive Foundation, *New York: MacMillan*, 1994.

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