International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015
ISSN 2091-2730

Energy Saving Scheme In Cellular Networks Based On TACT Framework

Ani Pappachen[1], Nirosha R[2]

[1]PG Scholar, Department of ECE, CAARMEL Engineering College, Pathanamthitta, Kerala
[2]Assistant Professor, Department of ECE, CAARMEL Engineering College, Pathanamthitta, Kerala

Email:ani.p09@gmail.com

Abstract:The increasing popularity of tablets and smartphones has created a huge traffic load demand for radio access networks and has resulted in massive energy consumption and large emission of greenhouse gases. As the demand for energy in the information and communication technology is increasing abruptly, there is pressure in the cellular network operators to reduce the power consumption in the networks. In a typical cellular system, the base stations (BSs) contribute 60%-80% of the energy consumption of the whole network [1]. Recent studies shows the possibility of dynamically turning on/off some of the base stations can improve the energy consumption significantly. Therefore, to reduce the cost and the amount of energy conserved in cellular network, the reinforcement method is used. This project is mainly proposed for improving the energy conservation of base stations in cellular radio access networks by Markov decision process along with reinforcement learning approach. Here the traffic is calculated through the online processing by Markov decision process [2]. To speed up the ongoing learning process, a transfer actor-critic algorithm is used. We evaluate the proposed scheme and improve the energy consumption in micro cell regions as a further improvement to this project.

Keywords: Base stations, micro stations, macro stations, markov process, energy saving, transfer learning, reinforcement learning, actor critic learning, green communications.

INTRODUCTION

In information and communication technology (ICT) 80% of the power consumption takes place in the radio access networks (RANs), especially the base stations (BSs). The reason behind this is largely due to that the present BS deployment is on the basis of peak traffic loads and generally stays active irrespective of the heavily dynamic traffic load variations [3]. Recently, there has been a substantial body of works towards traffic load-aware BS adaptation and the authors have validated the possibility of improving energy efficiency from different perspectives. The possibility of energy saving achieved by actively adjust the working status of BS, contingent on the predicted traffic loads. Prediction is not sufficient for turn off/on base stations. Turning on/off some of the BSs will immediately affect the associated BS of a mobile terminal. At that time the base station consumes high power. On the other hand dynamic BS switching algorithms with the traffic loads a prior and preliminarily proved the effectiveness of energy saving. A Radio access network is part of a mobile communication system. It implements a radio access technology. It resides between a devices such as a mobile phone, a computer. Depending on the mobile phones and other wireless connected devices are known as user equipment (UE), terminal equipment (TE), mobile station.

In this paper, we try to solve this problem from a different perspective. Instead of predicting the volume of traffic loads, we apply a Markov decision process (MDP) to model the traffic load variations. Afterwards, the solution to the formulated MDP problem can be attained by making use of actor-critic algorithm,a reinforcement learning (RL) approach, one advantage of which is that there is no necessity to possess a prior knowledge about the traffic loads within the BSs. On the other hand, given the centralized structure of cellular networks, energy saving will significantly benefit from a literally existing centralized BS switching operation controller such as the base station controller (BSC) in second generation (2G) cellular networks or the radio network controller (RNC) in third generation (3G) cellular networks rather than a distributed one[4].

RELATED WORK

Existing works are based on a greedy algorithm, with the help of it we try to predict the total traffic under a region and based on it switching is made possible.The controller would firstly estimate the traffic load variations based on the on-line experience. Afterwards, it can select one of the possible BS switching operations under the estimated circumstance and then decreases or increases the probability of the same action to be later selected on the basis of the required cost. Here, the cost primarily focuses on the energy consumption due to such a BS switching operation and also takes the performance metric into account to ensure the user experience. After repeating the actions and knowing the corresponding costs, the controller would know how to switch the BSs for one specific traffic load profile. Moreover, with the MDP model, the resulting BS switching strategy is foresighted, which would improve energy

efficiency in the long run [5].However, it usually take some time for the RL approaches to be convergent to the optimal solution in terms of the whole cost. Hence, the direct application of the RL algorithms may sometimes get into trouble, especially for a scenario where a BS switching operation controller usually takes charge of tens or even hundreds of BSs [6]. Fortunately, the periodicity and mobility of human behaviour patterns make the traffic loads exhibit some temporal and spatial relevancies, thus making the traffic load-aware BS switching strategies at different moments or neighbouring regions relevant.

SYSTEM MODEL OF TACT

We presented a new scheme named as TACT (Transfer Actor Critic Algorithm) in Radio Access Network. Variation of Traffic Load and Reinforcement Learning in TACT easily we can take a decision while Turn off/on base stations in Radio access networks. Markov Decision Process in Traffic Load variations helps to forecasting the traffic load in future. Based on this techniques clearly we can take a decision while turn off/on base stations in radio access network. In this we have created mobile nodes based on macro and micro cell concepts. Macro cells are those which emit high energy signals, which cover a large geographical area, resulting in a large amount of greenhouse gas emission. Micro cells cover small geographical area and emits less greenhouse gases resulting in less pollution [7]. A switching between these two methods is made possible in this paper based on the ongoing traffic.

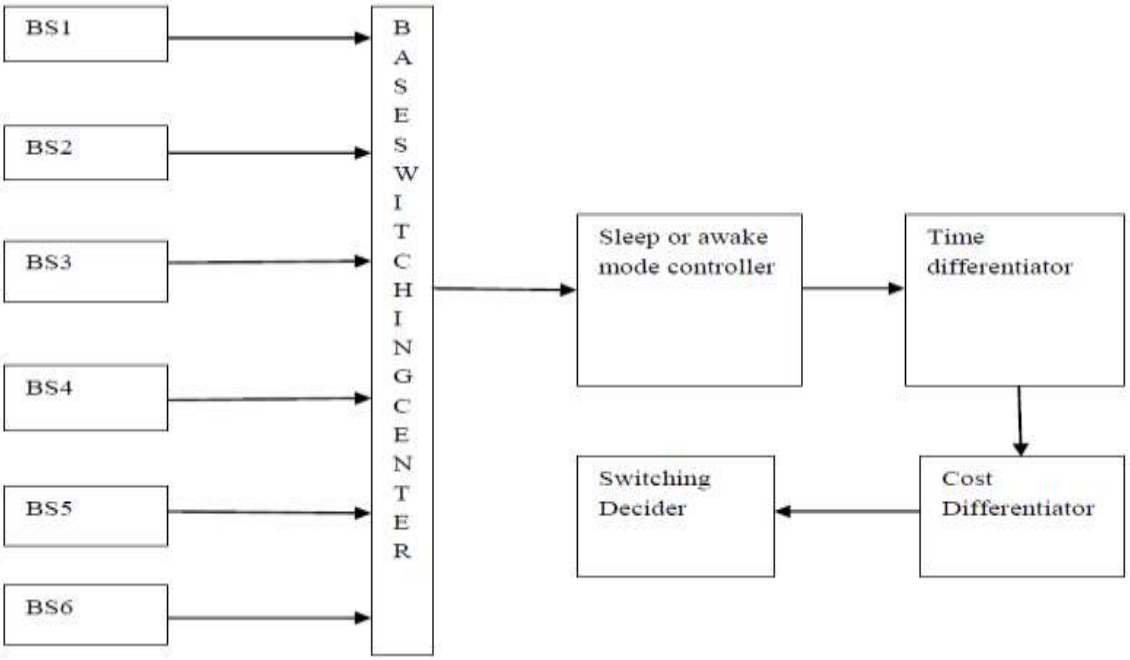
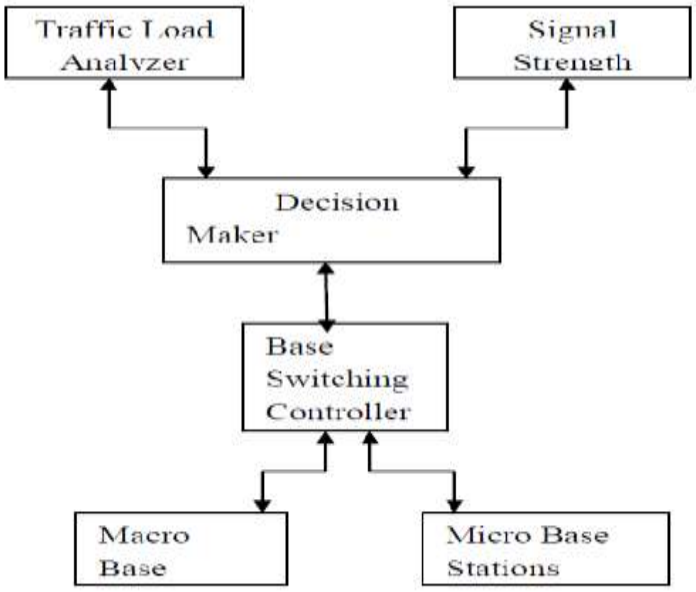


Fig 1: Base station switching operation

The figure shows how the switching operation takes place in the cellular system. Based on the cost and the time the controller decides whether its busy hour or not and based on these results the switching is made possible. The problem with the existing system is that we cannot accurately predict the number of customers associated with a base station accurately. In order to overcome these problems we introduced the concept of transfer actor critic learning framework to make the switching more accurately [8].



BS switching process needs reinforcement learning, especially for energy saving in RAN'S (Radio Access Networks). MDP can solve current Traffic Loads. Reinforcement learning approaches to solve the MDP problem without requiring the knowledge of traffic loads a prior and specifically adopt the actor-critic algorithm.BS Switching control, this is the system to take the decisions such as which base stations are necessary and which base stations are unnecessary based on MDP process and transfer actor critic algorithm[9]. Operation of base station switching control is shown in fig.2. From this controller we can improve the energy awareness and reduce the radiations [10]. In the TACT algorithm, the overall policy to select an action and it is divided as a native one and an exotic one. Without loss let's assume that the traffic load state is chosen action. Exotic policy is obtained from learned knowledge transfer [11].

Transfer Learning Framework for Energy Saving

The following steps are done to choose whether switching is needed or not[12]. Based on the results the switching is done between the micro and macro stations

1. Base station controller checks the traffic level in eachbase station.
2. If the traffic level is lower than the particular threshold it will turn off the base stationotherwise it turns on the base station.
3. It makes use of markov decision process to discoverthe traffic level in every base station.
4. In markov decision process the dynamic programmingproblem can be occurs. So that the reinforcementlearning and transfer actor critic algorithm is used t overcome the problem.
5. Transfer actor critic algorithm is used to maximize theenergy saving in current active base station by transferactor critic algorithm is used to overcome the problem.

Simulation Results

Energy saving in cellular radio access network is achieved by network simulator 2. Here the tool command language (TCL) is used.

Number of nodes - 35

Mac type - 802.11

Antenna type - Omni directional antenna

Routing protocol - AODV protocol

Energy saving - 70%

In Busy Hours

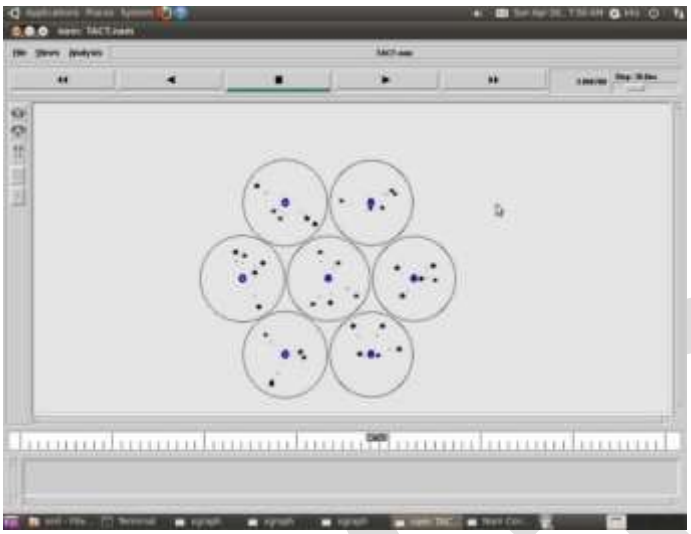


Fig 3: Base stations working under busy hours

Other Than Busy Hours

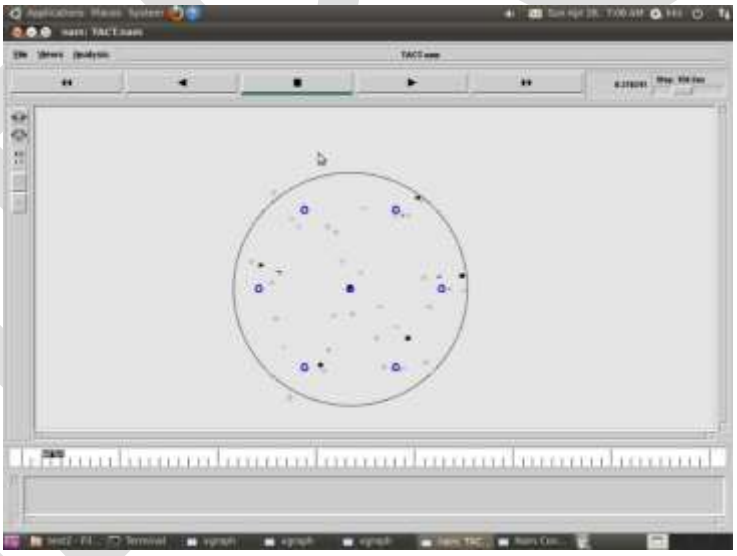


Fig 4: Macro station working during less traffic hours

In this scenario (Fig 3. Energy consumption in peak hours) shows all the base stations are in active mode due to the heavy traffic loads.

In low traffic load variations, the minimum number of users in each base station. Due to the low traffic load thebase stations are in sleep mode only the centralized base station in active mode. It controls all of the base station by using transfer learned frame work approach. Hence, the base station energy consumption is minimized.

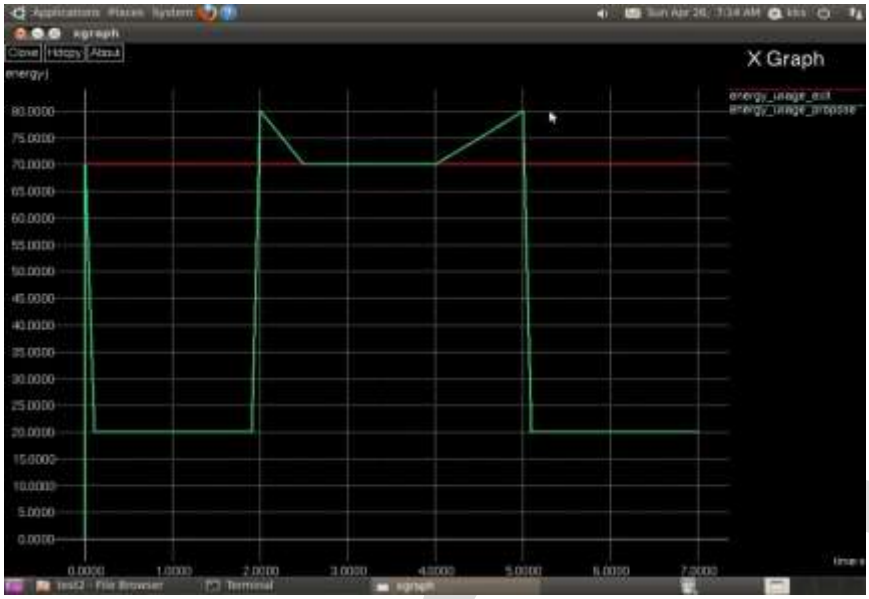


Fig 5: Energy usage graph

Conclusion

In this paper base station energy is limited by reinforcement learning framework. Here markov decision process is used to find the traffic load level of each base station and also transfer actor critic method is used to reduce the overall energy consumption of base station. Efficiency of TACT algorithm is improved by reinforcement learning algorithm. Saving energy consumption of the base stations in cellular radio access networks elaborately explained in this paper. We planned to improve the tact based switching scheme by a traffic aware sensitive system which covers the traffic details associated with the each cell, and thus implementing macro and micro systems in a single coverage area if necessary as our future work.

REFERENCES:

[1] G. P. Fettweis, E. Zimmermann, ICT energy consumption-trends and challenges, 2008 WPMC, 4.

[2] S. Zhou, J. Gong, Z. Yang, Z. Niu, P. Yang, Green mobile access network with dynamic base station energy saving, 2009 ACM Mobicom.

[3] V. Konda, J. Tsitsiklis, Actor-critic algorithms, SIAM J. Contr. Optim., 42(4), 2000, 1143–1166.

[4] K. Son, H. Kim, Y. Yi, B. Krishnamachari, Base station operation and user association mechanisms for energy-delay tradeoffs in green cellular networks, IEEE J. Sel. Areas Commun., 29(8), 2011, 1525–1536.

[5] Ivo Grondman, Lucian Bus¸ oniu, Gabriel A.D. Lopes, Robert Babuska, A Survey of Actor-Critic Reinforcement Learning: Standard and Natural Policy Gradients.

[6] Hao Zhu, Guohong Cao, A Power-aware and QoS-aware service model on wireless networks.

[7] Michimune Kohno, Yuji Ayatsuka, Jun Rekimoto, TACT: Mobile Wireless Terminal for Digitally- Enabled Environments.

[8] M. Marsan, L. Chiaraviglio, D. Ciullo, and M.Meo, "Optimal energy savings in cellular networks", in Proc. 2009 IEEE ICC Workshops.

[9] C. Peng, S.-B. Lee, S. Lu, H. Luo, and H. Li, "Traffic-driven power savings in operational 3G cellular networks", in Proc. 2011 ACM Mobicom.

[10] Z.Niu, TANGO: traffic-aware network planning and green operation" IEEE Wireless Commun., vol. 18, no. 5, pp. 25–29, Oct. 2011.

[11] L.Chiaraviglio, D.Ciullo, M. Meo, M. Marsan, and I.Torino, "Energy aware UMTS access networks," in Proc. 2008 WPMC.

[12] Z.Niu, Y.Wu, J.Gong, and Z.Yang, "Cell zooming for cost-efficient green cellular networks," IEEE Commun. Mag., vol. 48, no. 11, pp. 74–79,Nov. 2010