International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 3, Issue 1 (Jan-Feb 2015), PP. 38-40

A LITERATURE SURVEY ON ENERGY SAVING SCHEME IN CELLULAR RADIO ACCESS NETWORKS BY TRANSFER ACTOR-CRITIC LEARNING FRAMEWORK

E. Priya[1], Dr. P. Rajkumar[2], M. Ananthi[3]

[1]PG Student, INFO Institute of Engineering, Coimbatore
[2,3]Assistant Professor, INFO Institute of Engineering, Coimbatore
priya0451991@gmail.com

Abstract: Recent many works have concentrated on dynamically turning on/off some base stations (BSs) in order to improve energy efficiency in radio access networks (RANs). In this survey, we broaden the research over BS switching operations, which should competition up with traffic load variations. The proposed method formulate the traffic variations as a Markov decision process which should differ from dynamic traffic loads which are still quite challenging to precisely forecast. A reinforcement learning framework based BS switching operation scheme was designed in order to minimize the energy consumption of RANs. Furthermore a transfer actor-critic algorithm (TACT) is used to speed up the ongoing learning process, which utilizes the transferred learning expertise in historical periods or neighboring regions. The proposed TACT algorithm performs jumpstart and validates the feasibility of significant energy efficiency increment.

Key Words:-Radio access networks, base stations, sleeping mode, green communications, energy saving, reinforcement learning, transfer learning, actor-critic algorithm.

I. INTRODUCTION

A. Radio Access Network

Most of the area in mobile telecommunication system covers radio access network (RAN) [11] which implements a radio access technology. Theoretically, this technology should be resides between a devices like a mobile phone and a computer or any remotely controlled system and provides connection with its core network (CN). Depending on the various techniques, mobile phones and other wireless devices used for connection are called known as user equipment (UE), terminal equipment, mobile station (MS), etc. RAN functionality is mostly given by a silicon chip that resides in both the core network as well as the user equipment.

B. Base Station

In mobile telephony network and computer network and other wireless communications and in land surveying the term base station is used. In surveying unit the base station is a GPS receiver placed at a known position. In wireless communication unit the base station is a transceiver which connects a multiple user with other user in a wider area. In mobile telephony Network the base station provides the link between mobile phones and the huge telephone network. In a computer network unit the base station is a transceiver which acts as a router for nodes in the network also connecting the nodes to a local area network and/or to the internet. In wireless communications network it will be a hub of a dispatch fleet such as a taxi or delivery fleet.

C. Reinforcement learning (RL)

It is an area of machine learning which should be used by behaviorist psychology. Reinforcement Learning should maximize some notion of cumulative incentive by software agents take actions in an environment. This type of learning create problem due to its generality and it is studied in many other disciplines like game theory, control theory, operations research, information theory, simulation-based optimization, statistics, and genetic algorithms. The reinforcement learning methods are known as approximate dynamic programming in the operations research and control literature, the field. The problem has been studied from theory of optimal control are concerned with existing optimal solutions and their characterization, and not by using the learning or approximation aspects. The reinforcement learning may be used to explain how equilibrium may arise under bounded rationality is used under economics and game theory.

D. Inductive transfer, or transfer learning,

This is a research problem in machine learning which focuses on knowledge gathering while finding solution to one problem and applying it to a different or related problem. For example, knowledge gained while learning to identify cars could apply when recognizing vehicles. This area of research has some relation to the long history of psychological literature on learning transfer. But the joining between the two methods is limited in formal application.

E. Power Consumption in Information and Communication Technology

The smart phones and tablets have ignited a surging traffic load demand in radio access network and it has been undergo massive energy consumption and huge greenhouse gas production. The information and communication technology (ICT) industry accounts the world's overall power consumption and it has been emerged as one of the major contribution in CO2 emission to the world-wide. Besides that, the existence of economical pressures in cellular network operators reduces the power consumption of their networks. The electricity bill will doubly increase in five years for China Mobile. Meanwhile the energy spending accounts for a

significant proportion of the overall cost. Therefore, it's big essential to improve the energy efficiency of ICT industry.

II. EXISTING SYSTEM

[4] Due to the increasing energy consumption of telecommunication networks the driving operators to manage their equipments to optimize energy utilization without sacrificing the user experience. This paper focus on UMTS access networks. Access devices are the major energy consumers in UMTS networks.

A novel approach for the energy-aware management of UMTS access networks consists a dynamic network planning that is based on the instantaneous traffic intensity which reduces the number of active access devices when they are utilized at night. If some access devices are switched off the active devices taken care of radio coverage and service provisioning.

Advantages:-

- The service available over the whole network with the desired quality is guaranteed.

[7] This paper addresses the next-generation cellular networks from the energy efficiency viewpoint. In particular, it retrieves the networks planning and operation which should be more energy efficiency oriented and in the meantime the radio resources speeded over different cellular networks.

The base stations should be optimized in a global way to resource-optimization and energy-efficient networks.

Advantages:-

- While keeping QoS at a satisfactory level the energy efficiency of cellular networks gets improved.

[8] Currently more than 80% of the power consumption takes place in the radio access networks (RANs) especially in the base stations. The reason behind this is largely due to the present BS deployment is peak traffic loads which stays active irrespective of the heavily dynamic traffic load variations.

Advantages:-

- Handle heavy traffic load variation

[6][5]This paper propose a Dynamic BS switching algorithms with the traffic loads to prove the effectiveness of energy saving. Besides, it is also found that turning on/off some of the BSs will immediately affect the associated Base Station of a mobile terminal (MT). Moreover, If any two consecutive BS switching operations are correlated with each other Subsequent choices of user associations in turn lead to the traffic load differences of BSs.

Advantages:-

- BS switching operation will also further influence the overall energy consumption in the long run.
- While minimizing the energy consumption energy saving scheme must be utilized.
- Deliver a creative BS switching operation solution.[

[2][3][1]These Paper address the MDP approach .This method can be use actor-critic algorithm [2][3]a reinforcement learning (RL) approach [1]. The controller will first calculate the traffic load variations based on the experience gained from on-line then it will select one of the possible BS switching operations under the estimated environment.

The probability of the same action will be decreased or increased later based on the required cost. After repeating the actions then find the corresponding costs the controller would identify how to switch the BSs from one specific traffic load profile.

Algorithms for learning the optimal policy of a Markov decision process (MDP) based on simulated transitions are formulated and analyzed. These are variants of the well-known "actor-critic" (or "adaptive critic") algorithm in the artificial intelligence literature. Distributed asynchronous implementations are considered. The analysis involves two time scale stochastic approximations.

Advantages:-

- No need to possess a prior knowledge about the traffic loads within the BSs.
- Energy saving increased.

[9]In this paper propose energy saving scheme over predicted traffic loads based on grid. First it takes advantage of the spatial-temporal pattern of traffic loads and use the compressed sensing method to predict the future traffic loads. A grid-based energy saving scheme is used to improve the energy efficiency through changing some base stations into sleeping mode while ensuring the quality of service.

Advantages:-

- The accuracy of the traffic load prediction improved.

A. Problem Statement

- [2][3][9]Take more time for the RL approaches to the optimal solution in terms of the whole cost.
- [6][5]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.
- [1]Reliably predict the traffic loads is still quite challenging makes these works suffering in practical applications.

III. PROPOSED SYSTEM

Transferring the learned Base Station switching operation strategy [10] at historical moments or neighboring regions called source tasks. Transfer Learning could make use of the temporal and spatial correlation in the traffic loads and speed up the on-going learning process in regions of interest called target tasks.

The learning framework of BS switching operation is further enhanced by combining the idea of TL into the classical actor-critic algorithm (AC) namely the Transfer Actor-Critic algorithm (TACT)[10] in this survey.

IV. ARCHITECTURE

The controller would firstly estimate the traffic load variations based on the on-line experience as illustrated in Fig1. 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.

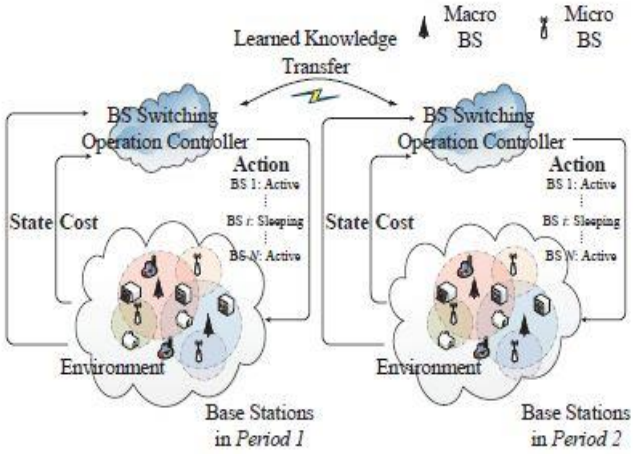

Fig1: BS Switching Operation

Advantages

- The learning framework is feasible to save the energy consumption in Radio Access Networks without the knowledge of traffic loads at prior.
- The performance of the learning framework approaches and State-Of-
  The-Art scheme (SOTA), which is assumed to have full knowledge of traffic loads.
- TACT algorithm better performed than a classical AC algorithm by a jumpstart technique.

Table 1:-Comparative Study on Existing vs. Proposed System

Method	**Existing**	**Proposed**
Algorithm	Actor-Critic Method, A Reinforcement Learning Algorithm[2008]	Transfer Actor-Critic Algorithm
Approach	Reinforcement Learning (RL) Approach[2014]	Transfer Learning (TL)

V. CONCLUSION

This survey propose learning framework for BS energy saving also specially formulated the BS switching operations under varying traffic loads as a Markov decision process. Both the actor-critic method and a reinforcement learning algorithm are adopted to give the BS switching solution to decrease the overall energy consumption. In order to fully use the temporal relevancy in traffic loads a transfer actor-critic algorithm is used which improve the scheme by taking advantage of learned knowledge from historical periods. The proposed algorithm provably finds certain restrictions that arise during the learning process and produce effectiveness and robustness of our energy saving schemes under various practical.

REFERENCES

[1] R. Sutton and A. Barto, Reinforcement Learning: An Introduction. Cambridge University Press, 1998. vailable:http://webdocs.cs.ualberta.ca/sutton/book/ebook/

[2] V. Konda and V. Borkar, "Actor-critic-type learning algorithms for Markov decision processes," SIAM J. Contr. Optim., vol. 38, no. 1, pp94–123, 1999.

[3] V. Konda and J. Tsitsiklis, "Actor-critic algorithms," SIAM J. Contr. Optim., vol. 42, no. 4, pp. 1143–1166, 2000.

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

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

[6] E. Oh and B.Krishnamachari, "Energy savings through dynamic base station switching in cellular wireless access networks," in Proc. 2010IEEE Globecom.

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

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

[9] R. Li, Z. Zhao, Y. Wei, X. Zhou, and H. Zhang, "GM-PAB: a grid-based energy saving scheme with predicted traffic load guidance for cellularnetworks," in Proc. 2012 IEEE ICC.

[10] Rongpeng Li, Zhifeng Zhao, Xianfu Chen, Jacques Palicot, And Honggang Zhang" TACT: A Transfer Actor-Critic Learning Framework For Energy Saving In Cellular Radio Access Networks" IEEE transactions on wireless communications, vol. 13, no. 4, April 2014.

[11] China Mobile Research Institute, "C-RAN: road towards green radio access network," Tech. Rep., 2010.