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Analysis of Received Signal Strength under Handoff Condition using Network Simulator 2

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***Abstract* —** Wireless communication involves a wide variety of technologies, services and applications, developed to satisfy the user's specific needs in variety of deployment scenarios. The cellular phones are one of the examples of wireless communication application. Globally, the cellular networks have progressed from a simple first generation to fourth generation and probably will be progressing to fifth generation by the end of 2019. Though there is an appreciable progress in the high speed data with the generation, the problem in the voice call still persists, particularly when in motion, due to the continuous changes in the receiving signal. This article aims at improving the QoS by implementing the tele-traffic pattern proposed in earlier 90's by Steele and Nofal to manage the hand-off mechanism in order to reduce the voice and data degradation during motion and simulating same using Network Simulator 2 for validation. The results of the experimental analysis show that the hand off degradation of voice and data is reduced by the implementation of the said tele-traffic pattern. Hence, proving the proposed energy detection technique on the Steele and Nofal traffic model to be best suited for the handoff situation.

***Keywords* —** Wireless communication, Handoff technique, Network Simulator 2, Analytical energy detection

I. INTRODUCTION

Wireless communication refers a method of transferring the information from one point to other in the absence of an electrical conductor. The said technique is applied to smart grid (SG) applications viz., SG – wide Area Network (WAN), SG – Neighborhood Area Network (NAN), SG – Home Area Network (HAN) etc., in addition to other applications like meter data collection, demand management, protection management, etc. The current 3rd and 4th generation (3G and 4G) cellular networks are used in SG-WAN, implies that these network uses existing infrastructure and provide a wider coverage along with high speed data [1]. The well-known advantages viz., excellent level of flexibility, simplicity in installation and ease of maintenance, is increasing the usage of such a system, right from its first time application in 20th century, particularly for complementing the traditional cellular networks [2]–[4]. The increase in the demand of high speed data and efficient network has led the development of 4G network from a simple 1G network [5].

In addition, the development of the internet of things (IoT) is making a pathway for the 5G network development, predicted to be launched globally [6] by the end of 2019. A major issue faced by most of the network providers, capable of providing high speed data, is the mobile management (reduce the degradation of voice call and data continuity) during motion [7]–[9]. The mobile management or the quality-of service (QoS) for a cellular communication is a function of handoff process. The said process could be defined as the mechanism by virtue of which the receiving signal changes from weaker one to comparably stronger one as the mobile station moves from one coverage area to other. Managing the handoff mechanism in order to improvise the QoS has been a research area of interest for several researchers [10]–[12].

This article aims at improving the QoS by implementing the tele-traffic pattern proposed in earlier 90's by Steele and Nofal [13] to manage the handoff mechanism in order to reduce the voice and data degradation during motion. The work focuses not only on the implementation of the said tele-traffic pattern but also analyzing and validating the same using the Network Simulator 2 (NS2).

Section I contains the introduction of wireless communication and the related issues, Section II contain the related work of implementing the NS 2 as a simulation tool and tele-traffic pattern, Section III explains the methodology involving the experimental analysis, Section IV describes results and discussion with reference to the conducted experiment and its relevance with the reviewed literature and Section V concludes research work with future directions.

II. Related Work

This section deals with the detailed description of Network Simulator 2 (NS2) and the tele-traffic patterns.

A. Network Simulator 2 (NS2)

The realistic simulation is a significant factor with reference to any appropriate evaluation of a newly developed model or algorithm. Network Simulator 2 (NS2), is a simple event driven simulation tool that facilitates the investigation of the dynamic nature of communication networks. The said tool is used to simulate the wired as well as the wireless network function and protocols [14].

Several researchers today are making use of NS2 tool to analyze or evaluate the generated algorithm and network functions [15]–[20]. Piorkowski et al. [21] in their research investigation used NS2 to evaluate the newly developed algorithms for Vehicular Ad-Hoc Networks in order to propose solutions fulfilling the requirements of same. Betancur et al. [22] delivered a novel proposal for the physical (PHY) layer and the propagation model which allows a quicker and detailed level of simulation execution. NS2 usage was implemented for the analysis of model. Kim et al. [23] worked on improving the programmable logic controller based network for MAC and the models generated were evaluated using NS2. Though the version 3 of Network Simulator is released (development phase), the version 2 is not obsolete as there are certain models in NS 2 at present, which are not yet accommodated in NS 3.

B. Tele-traffic Pattern

Rappaport and Hong [24] presented the traffic network model for a hexagonal cell with certain assumptions leading to uniformly distributed call initiation in the cell. The mathematical model for arrival rate of handoff call and handoff in wireless mobile network as per the researcher is represented in (1) and (2)

$$\boldsymbol{\lambda}_H = \frac{P_h(1-B_0)}{1-P_{hh}(1-P_f')}\boldsymbol{\lambda}_0 \quad (1)$$

Considering $1/\mu_C$= the average call duration

$$\gamma_c = p_h(1-B_0)/\left[1-P_{hh}(1-P_f')\right] \quad (2)$$

Where,

P_h= the probability that a new call that is not blocked would require at least one hand-off

P_{hh}= the probability that a call that has already been handed off successfully would require another handoff

B_0= Probability of Blocking to calls (originating)

P_f'= Handoff failure Probability

$\boldsymbol{\lambda}_0$= Arrival rate of originating Calls

The tele-traffic performances of a personal communication network hinge on the city street microcells provided for moving individual cell-phone users. The tele-traffic evaluation is conducted to investigate the new and handover call rates, in addition to the channel holding time of the personal communication network. Steele and Nofal [13] in their work presented several results which is effectively used by network planners to analyze the tele-traffic performance [25]–[28]. The mathematical model of this pattern is discussed further in next section.

III. Methodology

This section of article deals with the details of the experimental analysis. Initially the discussion is about the section details about the mathematical model used, as proposed by Steele and Nofal [13]. The section ends with the details regarding the employment of NS2 for simulation.

The flexible model proposed by Steele and Nofal is used to evaluate the call access rates to facilitate a continuous reduction in the probability of a voice call degradation viz., low call and call blocking. Equation 3 represents the said model in its mathematical form [29], [30].

$$\lambda_H = \sum_{m=1}^{n} \lambda o(1-Bo)[P_h\beta + 3P_1\beta(1-p_f)P_{hh}\beta] \quad (3)$$

Where,

λo: rate of incoming calls,

Bo: probability of blocking outgoing calls,

p_f: probability of handover,

P_h: at least,

P_{hh}: need to successfully deliver the call the probability of another transfer operation,

P_1: A new connection may require at least one connection to be disabled. In a mathematical model, the resident access call rate is directly dependent on a wide range of parameters.

The next step is to perform the simulation using NS2. The proposed work is designed in NS2 to facilitate mobile network set up where handoff mechanisms is performed and deliveries are focused. Results are displayed in graphical mode and represent the underlying technique of distribution.

An analytical energy detection (ED) model for the transmission process that calculates the energy consumption of each call transfer in the mobile network area is implemented. Time delays, packet drops, and packet transfer rates are evaluated using the proposed analysis model. Figure 1 represents the start-up codes, written for the implementation of mobile nodes and base station in NS2.

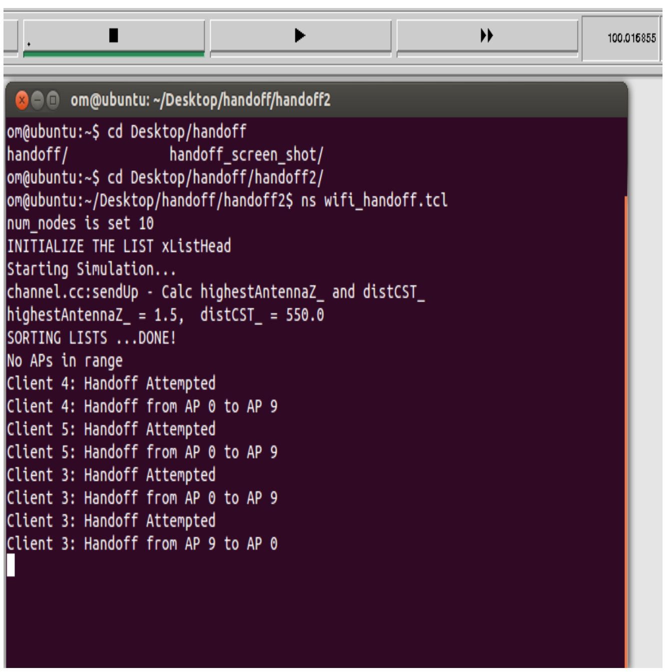

Figure 1. Basic processing in NS2

IV. RESULTS AND DISCUSSION

This section of the article showcases the obtained results and briefs about the inferences obtained on the basis of result.

As after the initial condition as shown in Figure 2, the communication started as per the defined set of protocols. Figure 3 represents a large circle which has been created at different times. This phenomenon is random in nature because the real situation can be achieved through the proposed set of nodes. The Mobile Network (MN) and Access Point (AP) - Static Node, acts as a base station.

The 7 numbers of MN and 2 numbers of AP are implemented in the proposed area to perform the handoff mechanism. Figure 3 also clearly depicts that range of AP cover the MN1, MN3, MN1 and MN2 whereas AP cover the MN1, MN5, MN7 and MN6.

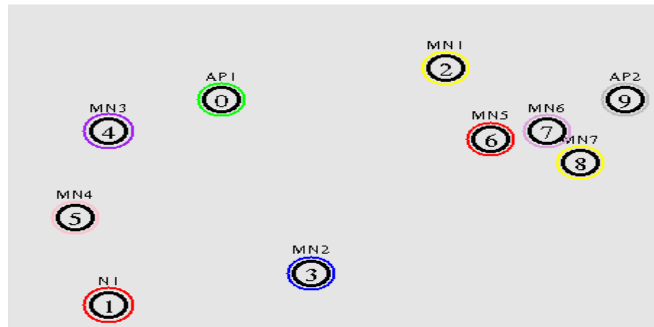

Figure 2. Node creation in proposed area

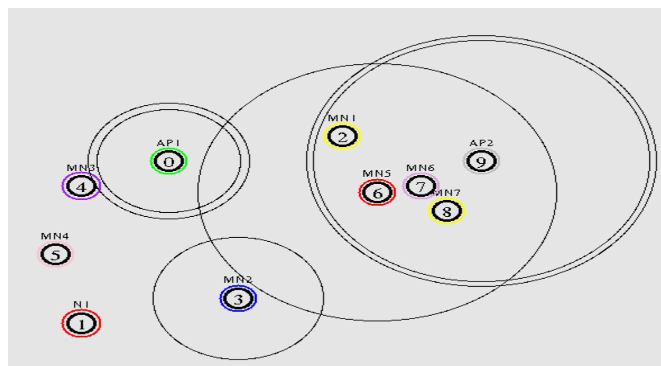

Figure 3. Nodes communicate with each other via base station

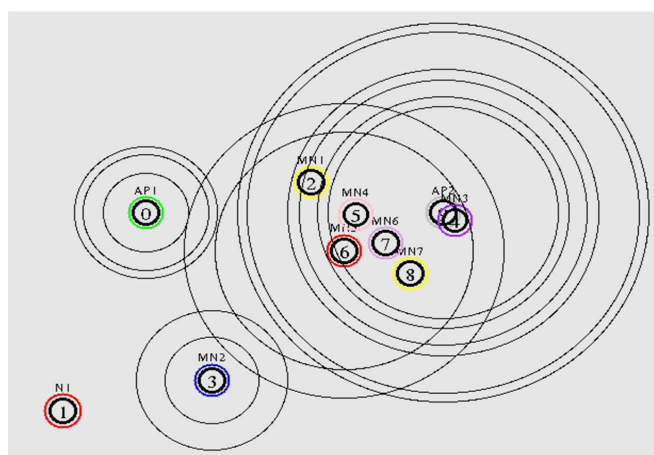

Figure 4. Execution of handoff done and movable node come into the area of proposed regions.

It is observed through Figure4that the mobile node MN4 move from the region of AP1 to AP2. The mobile node MN4 communicating to AP1 hand over their signal to AP2.

The service of wireless communication depends on the handoff strategy. The proposed handoff requires suitable parameters to minimize the handoff. Thus, It has been cleared that handoff technique could be implemented in NS2.

From the results obtained, the handoff process constituting three main phases i.e. initiation, decision and execution are observed. The handoff mechanism initiation is observed when the stronger link signal detected as compared to the present base station. The mobile station received the strong link and then the decision phase came into action to handoff the call data from the present to the new base station. If any obstacle come across in receiving the signal, then the MS continues to be connected with the present base station. Finally, when the mobile station registered themselves to the new base station, then the execution of the call with the new base station is the final stage for handoff process and handoff is considered successful once this transmission is concluded.

The results obtained is an addition to the existing literature on wireless communication. The experimental work shows that the voice degradation is a resultant of hand-off mechanism and could be improved by making use of Steele and Nofal tele-traffic pattern.

V. CONCLUSION AND FUTURE SCOPE

This research work focus on implementing the Steele and Nofal tele-traffic pattern to manage the hand-off mechanism and simulating the same using Network Security 2 (NS2) for validation. The handoff situation created under the NS2 environment is executed through basic set of parameters.

The implementation of hand-off shows the received signal strength level in form of the respective through-put, time delay and transmission rate. The hand off degradation of voice and data in this situation is observed to be reduced. Hence, it is inferred that the proposed energy detection technique on the Steele and Nofal traffic model find best suited with proposed handoff situation. Hence the investigation has added a literature to the existing techniques of reducing the voice degradation caused due to handoff mechanism, particularly during motion.

Though the implementation of the said model delivered an excellent result, the experimental work done does not consider the simultaneous occurrence of the vertical and horizontal handoff. The complex scenario thus caused, nevertheless is beyond the scope of this article and can be considered as a future scope of work. Yet another scope of work is to use the Network Simulator Version 3, released first in 2008 and still under its development phase, for the purpose of investigation. The NS 3 is said to accommodate new capabilities like handling multiple interfaces on nodes, which could yield better simulation results.

REFERENCES

[1] H. A. Gabbar, A. Zidan, and M. Xiaoli, "Data centers for smart energy grids", in Smart Energy Grid Engineering, Elsevier, pp. 433–452, 2017.

[2] S. Ahmadi, "Wireless broadband standards and technologies", Academic Press Library in Mobile and Wireless Communications, Elsevier, pp. 559–619, 2016.

[3] E. Sisinni and F. Tramarin, "Isochronous wireless communication system for industrial automation", Industrial Wireless Sensor Networks, Elsevier, pp. 167–188, 2016.

[4] P. Ganeshkumar, K. P. Vijayakumar, and M. Anandaraj, "A novel jammer detection framework for cluster-based wireless sensor networks", EURASIP Journal on Wireless Communications and Networking, Vol. 2016, Issue. 1, pp. 35, 2016.

[5] B. R. Chandavarkar and G. R. M. Reddy, "Survey Paper: Mobility Management in Heterogeneous Wireless Networks", Procedia Engineering, Vol. 30, pp. 113–123, 2012.

[6] S. S. Soliman and B. Song, "Fifth generation (5G)cellular and the network for tomorrow: cognitive and cooperative approach for energy savings", Journal of Network and Computer Applications, Vol. 85, pp. 84–93, 2017.

[7] H. Cui, H. Tain, H. Xu, and P. Zhang, "The Research on Handoff Strategy in Beyond 3G Wireless Networks", The Journal of China Universities of Posts and Telecommunications, Vol. 13, Issue 2, pp. 26–30, 2006.

[8] G. A. F. Mohamed Khalaf and H. Z. Badr, "A comprehensive approach to vertical handoff in heterogeneous wireless networks", Journal of King Saud University - Computer and Information Sciences, Vol. 25, Issue. 2, pp. 197–205, 2013.

[9] T. Padmapriya and V. Saminadan, "Handoff Decision for Multi-user Multi-class Traffic in MIMO-LTE-A Networks", Procedia Computer Science, Vol. 92, pp. 410–417, 2016.

[10] A. Hamad, E. Morsy, and S. Adel, "Performance analysis of a handoff scheme for two-tier cellular CDMA networks", Egyptian Informatics Journal, Vol. 12, Issue. 2, pp. 139–149, 2011.

[11] A. Sleem and A. Kumar, "Handoff management in wireless data networks using topography-aware mobility prediction", Journal of Parallel and Distributed Computing, Vol. 65, Issue. 8, pp. 963–982, 2005.

[12] T. Velmurugan, S. Khara, S. Nandakumar, and B. Saravanan, "Seamless Vertical Handoff using Invasive Weed Optimization (IWO) algorithm for heterogeneous wireless networks", Ain Shams Engineering Journal, Vol. 7, Issue. 1, pp. 101–111, 2016.

[13] R. Steele and M. Nofal, "Teletraffic performance of microcellular personal communication networks", IEE Proceedings I Communications, Speech and Vision, Vol. 139, Issue. 4, p. 448, 1992.

[14] T. Issariyakul and E. Hossain, "Introduction to Network Simulator 2 (NS2)", Introduction to Network Simulator NS2, Boston, MA: Springer USA, 2012, pp. 21–40.

[15] D. Pediaditakis, Y. Tselishchev, and A. Boulis, "Performance and scalability evaluation of the Castalia wireless sensor network simulator", Proceedings of the 3rd International ICST Conference on Simulation Tools and Techniques, 2010.

[16] C. Lochert, A. Barthels, A. Cervantes, M. Mauve, and M. Caliskan, "Multiple simulator interlinking environment for IVC", Proceedings of the 2nd ACM international workshop on Vehicular ad hoc networks - VANET '05, p. 87, 2005.

[17] P. Xie, Z. Zhou, Z. Peng, and H. Yan, "Aqua-Sim: an NS-2 based simulator for underwater sensor networks", Oceans pp. 1–7, 2009.

[18] M. Al-Shurman, S.-M. Yoo, and S. Park, "Black hole attack in mobile Ad Hoc networks", Proceedings of the 42nd annual Southeast regional conference on - ACM-SE 42, p. 96, 2004.
[19] M. Ali, M. Welzl, A. Adnan, and F. Nadeem, "Using the NS-2 network simulator for evaluating network on chips (NoC)", Proceedings - 2nd International Conference on Emerging Technologies 2006, ICET 2006, pp. 506–512, 2006.
[20] V. Rajeshkumar and P. Sivakumar, "Comparative Study of AODV , DSDV and DSR Routing Protocols in MANET Using Network Simulator-2", Scinzer Journal of Engineering, Vol. 1, Issue. 1, pp. 1–5, 2016.
[21] M. Piórkowski, M. Raya, A. L. Lugo, P. Papadimitratos, M. Grossglauser, and J.-P. Hubaux, "TraNS", ACM SIGMOBILE Mobile Computing and Communications Review, Vol. 12, Issue. 1, pp. 31, 2008.
[22] L. Betancur, R. C. Hincapié, and R. Bustamante, "WiMAX channel", Proceeding from the 2006 workshop on ns-2: the IP network simulator - WNS2 '06, pp. 6, 2006.
[23] Min-Soo Kim, Dong-Min Son, Young-Bae Ko, and Young-Hyun Kim, "A simulation study of the PLC-MAC performance using network simulator-2", 2008 IEEE International Symposium on Power Line Communications and Its Applications, pp. 99–104, 2008.
[24] Daehyoung Hong and S. S. Rappaport, "Traffic model and performance analysis for cellular mobile radio telephone systems with prioritized and nonprioritized handoff procedures", IEEE Transactions on Vehicular Technology, Vol. 35, Issue. 3, pp. 77–92, 1986.
[25] M. Au and R. Steele, "Teletraffic performance of a city street microcellular system using equalised base station loading for TDMA/FCA", Electronics Letters, Vol. 30, Issue. 20, pp. 1649–1650, Sep. 1994.
[26] F. Barceló and J. Jordán, "Channel holding time distribution in cellular telephony", Electronics Letters, Vol. 34, Issue. 2, pp. 146, 1998.
[27] Cooper Chang, Chung-Ju Chang, and Kuen-Rong Lo, "A hierarchical cellular system with reneging and dropping for waiting new and handoff calls", Proceedings of 8th International Symposium on Personal, Indoor and Mobile Radio Communications - PIMRC '97, Vol. 3, pp. 766–770, 1997.
[28] C. Chang, Chung-Ju Chang, and Kuen-Rong Lo, "Analysis of a hierarchical cellular system with reneging and dropping for waiting new and handoff calls", IEEE Transactions on Vehicular Technology, Vol. 48, Issue. 4, pp. 1080–1091, 1999.
[29] J. Labovský, Z. Švandová, J. Markoš, and L. Jelemenský, "Mathematical model of a chemical reactor—useful tool for its safety analysis and design", Chemical Engineering Science, Vol. 62, Issue. 18–20, pp. 4915–4919, 2007.
[30] K. Knobe, J. D. Lukas, and G. L. Steele, "Data optimization: Allocation of arrays to reduce communication on SIMD machines", Journal of Parallel and Distributed Computing, Vol. 8, Issue 2, pp. 102–118, 1990.

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