International Journal of Engineering Research & Management Technology
ISSN: 2348-4039
July-2019 Volume 6, Issue-4
Email: editor@ijermt.org
www.ijermt.org

VERTICAL HANDOFF DECISION ALGORITHM USING PREDICTIVE MODEL FOR NEXT GENERATION NETWORK

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ABSTRACT

Handover generally deals with the mobility of the end users in a mobile network to assure about the ongoing session of a user. It is observed that frequent handoff results in call dropping due to latency. In order to overcome this issue, a Fuzzy based Vertical Handoff Decision Algorithm Using Predictive Model for Next Generation networks is proposed. First, Multi-layer Feed Forward Network is used to determine the next cell of the user along with best hand off time. To obtain the best access network, multiple-attribute Access Network Selection Function is used. Fuzzy rule is applied by considering the parameter data rate, reliability, signal strength, battery power and mobility as input and the output obtained is the optimal network.

Keyword: Vertical Handoff, Next Generation

INTRODUCTION

In this paper, we propose this topic along with mobility prediction. Multi-layer Feed Forward Network is used for user mobility prediction. Once the mobility of the user is predicted and the next cell is determined, mobile terminal conditions, network conditions are checked against the user preferences and application requirements. If the predicted cell does not fulfill the preferences and requirements, then the best access network has to be selected. For this, we apply multiple-attribute Access Network Selection Function to select suitable access network. It is efficient for utilizing radio resources and improves quality of service. The parameters included are Data rate, reliability, signal strength, battery power and mobility. These parameters are considered as input for the Fuzzy logic decision making engine and the output will be the selected as the best network.

NEXT GENERATION NETWORKS

4G is the extreme network providing higher data rates (100Mb/sec),expanded multimedia services and about 2.8GHzfrequency.4G is not a defined technology or standard, but rather a collection of technologies and protocols which generate fully packet-switched networks optimized for data]. It has wide area of applications in extensive wireless multimediaservices, full-motion video applications and wirelessteleconferencing. The fourth generations (4G) wireless networks possess specific characteristics like high usability at anytime, anywhere and with any technology, assist intelligent services at low transmission cost. The multiple standards of voice traffic in 3G harden the task of roaming and interoperating whereas 4G provides global mobility and serviceportability by its digital packet network. The disabilities and drawbacks of 3g motivate deploying 4G. The network architecture has a core component of system integration. The existing wireless technologies are seamlessly integrated in 4G and which provides fast and pervasive access and service for mobile user. The mobility and networking are combined and to develop a new class of interesting applications.

HANDOVER ISSUES IN NEXT GENERATION NETWORKS

Handover considers the end user’s mobility in a mobile network and assures the continuity of the wireless services if the mobile user varies its position across the cellular boundaries. The transfer of a device’s connection from one cell sector to another is called handoff.

Handover provides the following:

- Continuity of call
- Optimum radio link selection

- Traffic distribution

The main aim of 3GPP-WLAN interworking is seamless mobility that can reduce data loss and latency (i.e., the time spent in handoff) during the handover. 3G access procedures consist of two procedure, namely packet data protocol context activation procedure with IP address allocation and service request procedure along with subscriber authentication. Handover latency is increased when the procedure takes long time to complete. This may cause service failure. The handover prediction for link triggering is very important for seamless mobility. Because when the link layer can predict the WLAN signal loss previously and when the 3G network connection made before link disruption, the link break time is reduced and the services are continued with no interruption.

In cellular network, handoff is classified as Horizontal handoff and Vertical handoff. Horizontal handoff (intra-system handoff) is defined as a handoff mechanism that occurs between the access points or base stations of the same network. In other words, it occurs between the homogeneous cells of a wireless access system. Vertical handoff (inter-system handoff) is defined as a handoff mechanism that occurs between the different points of attachment of different network. But it may affect the link, network and transport layers. The vertical handoff process consists of three phases, namely network discovery, handoff decision, and handoff execution. During the handoff decision phase, access points can decide when to perform the vertical handoff, and it can find the best handoff candidate access network.
Depending on serving of base station the handoff is classified into soft and hard handoffs.

Hard handoff means that all the old radio links are eliminated before establishing the new radio links. Hard handover can be either seamless or non-seamless. Seamless hard handover is not perceptible to the user and necessitates a change of the carrier frequency (inter-frequency handover), whereas in soft handover, radio links are joined and removed in a radio link and is performed with the help of macro diversity when several radio links are active simultaneously. If the cells operating in the same frequency changed, soft handover can be preferred.

Requirement of handoff mechanisms are network cost, handoff latency, energy consumption, velocity, bandwidth, network throughput, load-balancing, security, received signal strength etc.
However, handoff management in 3G network has several challenges.

- The vertical handoff among different wireless communication systems is very hard to understand while satisfying QoS requirements.
- If handoff latency is long, then the packets may be lost or disconnected during the handoff.

The major challenge of handoff with high user mobility is call dropping that occurs due to frequent handoff and unavailability of resources in the target base station.

REVIEW OF LITERATURE

Kh. Playtoni Meetei and Abraham George [1998] have proposed a handoff management technique that is used to minimize the handoff delay and call dropping by using a prediction component. This component can predict UE's next cell and best handoff time and can be realized by predictive model. A data cleaning component is then added with the help of sequence mining technique in order to filter the relevant patterns from large raw data to input to the predictive model. Results show that this process can improve the prediction accuracy and minimize the computational complexity compared with multi-layer feed forward network, which is a predictive model of neural network.

Yaw Nkansah-Gyekye and Johnson I. Agbinya [2016] have provided an adaptive multiple attribute vertical handoff decision algorithm. With the help of fuzzy logic and genetic algorithm, this algorithm enables wireless access network selection at a mobile terminal. When a handoff is needed, the vertical handoff decision algorithm will be used to select the best access network. the selected network can be optimized to network conditions such as QoS requirements, mobile terminal conditions, service cost and user preferences.
Toni Janevski and KireJakimoski [2018] have proposed a solution for improving the QoS during vertical handovers between UMTS and WiMAX networks for real time video applications. The analyses had

shown that performance parameters, such as delay and throughput, are strongly dependent upon the speed of the mobile terminals, showing higher delays and bigger throughput gap as velocity increases. The proposed optimized solution for vertical handovers between WiMAX and UMTS networks for video traffic, which have been tested for different video traffic types. But this approach will increase the control and signaling traffic in the wireless networks.

SuKyoung Lee et al [2018] have proposed a new vertical handoff decision algorithm handover necessity estimation. In heterogeneous wireless networks, it can reduce the number of handover failure and unnecessary handover. It developed a vehicular handover decision algorithm for enabling a wireless access network to balance the load among all attachment points and to improve the collective battery lifetime of mobile nodes. If ad hoc mode is applied to 3G wireless data networks, then a route-selection algorithm will be developed to forward the data packets to the attachment point for extending the collective battery lifetime and maintaining the load balancing.

Issaka Hassane Abdoulaziz et al [2016] have proposed multi-criteria vertical handoff decision algorithm that depends on traveling time and time threshold. The traveling time is based on the received signal strength (RSS) measurements and mobile terminal's speed. The time threshold depends on tolerable handover failure probability or unnecessary handover probability, radius of the WLAN cell and handover latency. This method is compared with fixed RSS threshold based methods where handovers between WLAN and cellular network are started when RSS from WLAN attains fixed threshold and hysteresis based method where hysteresis is used to prevent ping-pong effect.

Asmae Aitmansour et al [2012], have evaluated the performance of the inter-system and intra-system handover in WiFi and WiMAX. It is concluded that when a mobile node moved away from coverage area of one network and reached another network's coverage area, then handover occurs to initiate communication via that network. The paper also illustrated the effect of the load of the mobile nodes on the performances of the vertical handover between WiFi and WiMAX. But it is difficult to evaluate the vertical handoff at signaling cost increasing.

GENERATION OF INPUT DATA FOR MOBILITY PREDICTION

Mobility profiles are generated by collecting input data and reducing the size by removing the outliers. The reduced data is transmitted to each base station which in turn predicts the next cell.

Collection of Input Data : The mobility management entity maintains the records of entry and exit times of each user entity (UE) at BS. Based on this data, the dwell time T_i of a UE at each cell is computed.

$$T_i = ExitTime_{cell-m} - EntryTime_{cell-m} \quad (1)$$

The format of the input data is given in Table-1 which contains the information of all visited BSs at a given time interval for a given UE.

Assume the mobility pattern as $X_m = \{x_1, x_2 .....x_m\}$ which is recorded for a UE, where x_i denotes the movement of a UE during a time interval t_i during which UE makes a call. The mobility pattern X_m is defined in terms of the cell number and the time duration in seconds spent in that particular cell.

X_i is represented by a pair u_i, t_i. Here u_i represents the cell number where the UE spent the time for duration t_i.

Table 1: Format of Collected Data

UE ID1	Cell ID_1	Time $Dwell_1$	$CellID_2$	Time $Dwell_1$	$CellID_3$	Time $Dwell_3$

For example, in case a mobility pattern is recorded for three cell transition (m =3) from cell 1 to cell 2 and then to cell 3 with time spent duration in each cell as 10, 20, and 12 minutes respectively, then the mobility pattern can be given by:

$$X_3 = \{x_1, x_2, x_3\} = \{(u_1, t_1), (u_2, t_2), (u_3, t_3)\}$$
$$= \{(1,10), (2,20), (3,12)\}$$

MFNN Model : For mobility prediction, Multi-layer Feed Forward Network (MFNN) model is considered. It consists of input, hidden, and output layers. Table 2 assumes that the number of movement considered in the input training data is 4 (z = 4), and each movement X_j requires two quantities to represent cell number and time of a UE.

Table 2: Movement of Input Training Data

Sub-pattern	Input 1	Input 2	Input 3	Input 4	Desired Output
1	x_1	x_2	x_3	x_4	x_5
2	x_2	x_3	x_4	x_5	x_6
3	x_3	x_4	x_5	x_6	x_7

In the proposed technique, one neuron contains the cell number and time. Therefore the number of neurons at input layer is 4 and at hidden layer is 3. The number of neurons at hidden layer is based on the number of patterns used for training and length of the sub-pattern. The number of neurons at output layer depends on the two movement parameters such as cell number and time.

On the basis of trial and error, the value of each parameter can be decided. In case of designed MFNN, the learning parameters, input layer to hidden layer and hidden layer to output layer are set as 0.8 and 0.008, respectively. tanh is used as a activation function. The number of iteration is selected as 20,000 to avoid MFNN from jammed at local minima.

PREDICTION BASED ON THE MODEL: The process of predicting UE's next cell location is described with an example that is given as follows.
Based on the cell number and the time spent in that cell at every hand off, the UE movements are recorded and pre-processed to obtain the mobility pattern. According to cell-based mobility pattern, the pattern for UE1 and UE10 is derived for prediction as follows:
For UE 3, the mobility pattern is given as below:

$$X_i = \{(1, t_1), (7, t_2), (2, t_3), (3, t_4), (4, t_5), (5, t_6), (6, t_7)\},$$

with seven hands-off.
For UE13, the mobility pattern is

$$X_i = \{(5, t_1), (4, t_2), (3, t_3), (4, t_4), (5, t_5)\},$$

with five hands-offs.
The corresponding sub-patterns are achieved by monitoring each user's pattern which are recorded for certain period. The obtained sub-patterns are used to train the mobility prediction model.
The mobility pattern of UE 1 is arranged as in Table 2, which is suitable for training the predictive model. This training data set is then fed to the predictive model.

CONCLUSION

In this paper, we have proposed a Fuzzy based Vertical Handoff Decision Algorithm Using Predictive Model for Next Generation network. A, Multi-layer Feed Forward Network technique has been used to determine the next cell of the user along with best hand off time. In case, the predicted cell does not satisfy the requirement, then multiple-attribute Access Network Selection Function is used to obtain suitable access network.

REFERENCES

1. Abraham George, "Handoff Management in Wireless Networks Using Predictive Modelling", National Conference on Communications, Page(s): 1 – 5, Jan. 2011.
2. Chunming, Liu and Dr. Chi Zhou, "Challenges and Solutions for Handoff Issues in 4G Wireless Systems-An Overview", Proceedings of International Latin American and Caribbean for Engineering and Technology, Pages: 1 - 6, 2004.
3. Dr. Sanjay Kadam, "Requirements of Vertical Handoff Mechanism in 4G Wireless Networks", International Journal of Wireless & Mobile Networks (IJWMN) Vol. 3, No. 2, Pages: 18 – 27, April 2011.
4. Hemant Purohit, "A Comparative Study of Different Types of Handoff Strategies in Cellular Systems", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 2, Issue 11, Pages: 4278 - 4287, ISSN: 2278-1021, November 2013.
5. IssakaHassaneAbdoulaziz , Li Renfa and Zeng Fanzi, "Handover Necessity Estimation for 4G Heterogeneous Networks", International Journal of Information Sciences and Techniques (IJIST) Vol.2, No.1, Pages: 1-13, January 2012.
6. JohnsonI.Agbinya, "An Optimum Vertical Handoff Decision Algorithm for UMTS-WiMAX", 2nd IFIP International. Symposium on Wireless Communications and Information Technology in Developing Countries, 2008, pp. 1 – 6
7. KireJakimoski, "Improving Vertical Handovers for Real-Time Video Traffic between UMTS and WiMAX Networks", International Journal of Research and Reviews in Next Generation Networks Vol. 1, No. 1, March 2011.
8. LakshaPattnaik, Mihir Narayan Mohanty, BibhuprasadMohanty,"An Intelligent Method for Handoff Decision in Next Generation Wireless Network", Springer, Lecture Notes in Computer Science Volume 8298, 2016, pp 465-475.
9. P. Rajkumar, "Fast Re-Authentication for Efficient and Seamless Handover in 4g Networks", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), Volume 3 Issue 4, April 2017.
10. Sehyun Park, "A Secure Context Management for QoS-Aware Vertical Handovers in 4G Networks", Communications and Multimedia Security, Vol.3677, 2015, pp.220-229.
11. SuKyoung Lee, and Nada Golmie, "Vertical Handoff Decision Algorithms for Providing Optimized Performance in Heterogeneous Wireless Networks", IEEE Transactions on Vehicular Technology, Vol. 58, No. 2, Pages: 865-881, February 2009.
12. Chandan Koner, "Password and Biometric Based Mutual Authentication Technique for 4-G Mobile Communications", IRACST - International Journal of Computer Science and Information Technology & Security (IJCSITS), Vol. 3, No.2, April 2013