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OPNET-based WLAN Modeling and its Performance Testing

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With the rapid development of wireless communication and network technologies, people have higher demand for the network in its free access at any time or place, which prioritizes the convenience of the network. As a result, WLAN communication technologies will surely see a stronger momentum. This paper models a WLAN for its simulation and performance tests. Then the paper conducts the simulation analysis of the model, and systematically analyzes and compares statistics overall and between nodes as well as the simulation experiments with different parameters, leading to results that fully achieve WLAN modeling and its performance simulation based on the OPNET software.

1. Introduction

Wireless Local Area Network (WLAN) is one way to connect the data communication system by wireless communication, wireless connections and dots. WLAN sends and receives data through the electromagnetic wave instead of the fiber twisted pair cable or traditional LAN coaxial line. Also, WLAN enables website browsing, file transfer, traditional network communication, e-mailing, database visiting and peripheral sharing. Compared to traditional cable network, WLAN has its advantages in low operating and time cost, instant investment and rapid returns, steadiness, extension-friendliness and strong resistance from natural environment, landscape and disasters as the flexible and high-efficiency network (Kim et al, 2014; Lin and Chi, 2005). For recent years, as the IEEE802.11 protocol gets enriched and supplemented, Wi-Fi technology sees faster growth. Compared to cable network, wireless network equips with both the mobility of high nodes and the convenience of the network, which makes wireless network more suitable to the network scenarios newly built or of highly movable nodes, such as on-site investigation and on-spot emergency. In a sense, the wireless network extends and supplements the cable network.

On the other hand, it should be noted that there still exist some problems in WLAN technology compared to cable network as follows: the limited brand width and communication distance as well as high error rate and mobility (Manodham et al, 2008; Eckhardt and Steenkiste, 1999; Jansons et al, 2012; Vaidya et al, 2005; Bianchi, 2006; Cali et al, 2000). Besides, the wireless protocol only covers MAC and physical layer but not the amendment of the upper-layer protocol, so the protocol above IP layer still follows the traditional TCP/IP model. It is reasonable in terms of network hierarchy, but may exert some negative impact on the working performance of upper-layer service (Khan et al, 2013; Willig et al, 2002; Keong and Ming, 2010; Sabra et al, 2013; Maniotis et al, 2012; Tseng et al, 2003). Thus, further research is required in this respect.

OPNET is widely recognized and used in communication, national defense and computer network. Webmasters of operators manages the network with the help of network intelligence of OPNET.

And thanks to its sound openness and inter-connectivity, many popular software on network management and monitoring are formulated. As the network is a complicated system, OPNET Modeler classifies the complicated modeling system into different layers in line with hierarchy and modularity, with each layer having its specific function.

Also, each layer has more sub-layers with smaller tasks, and each module completes its inner modules. OPNET modeler consists of network domain, domain nodes and process domain. From the above-mentioned, OPNET can serve as the platform for modeling and test to optimize the network performance.

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2. WLAN network modeling

The latest version OPNET 14.5 is used in this paper for modeling. The first step to build a new network model is to set up a new project and a new scenario in this project. The Startup Wizard is done step by step in this paper as the following procedures: 1. Choosing the type of network topology; 2. Setting the coverage and size of the network; 3. Setting the background image of the network; 4. Choosing the target model family.

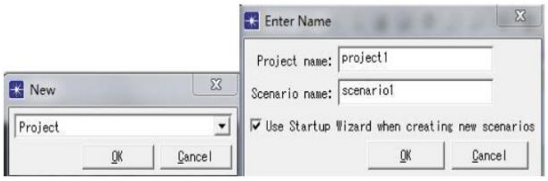

Figure 1: OPNET modeller 14.5-input of project and scenario name

Create an empty scenario, click “next” to choose the network type and scenario size that can be set as will. In the modeler menu, choose nodes of simulating network topology and the debugging module of network operating parameters in network service setting in the description of link features to run the simulation. The required family models are 3Com, Ethernet and wireless_lan. After all these steps, click “next” to verify the correctness of the parameters chosen, then click “finish” to complete the setting of parameters. Figure 2 below shows the whole process.

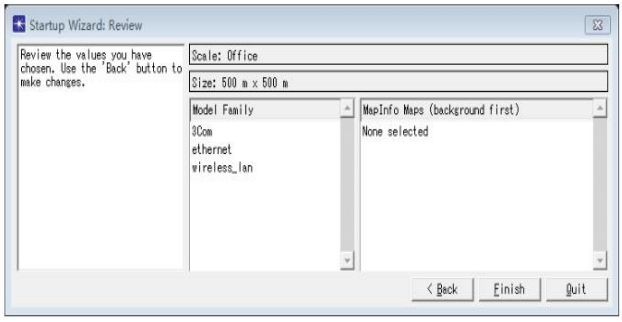

Figure 2: Setting of Network Type and Scenario Size

After the scenario setting, the network model is to be built. Choose needed network node models from the object panel, namely the switch, Ethernet server, wireless AP and wireless terminal, and then put them in the prepared setting. Connect the switch to Ethernet server and to the wireless AP by 10BaseT Link Model. Select 3C_CB2500_4s_e16_fe switch model, needed models of Ethernet server, wireless AP and wireless terminal to build the network. The number of wireless terminals can be set randomly. The terminal communication go across the AP, then enter Ethernet server through the router to get access to the internet, as the figure below demonstrates. By this step, the network model has been basically built. If there are no errors identified or steps missed, the following WLAN simulation can begin (Figure 3 and Figure 4).

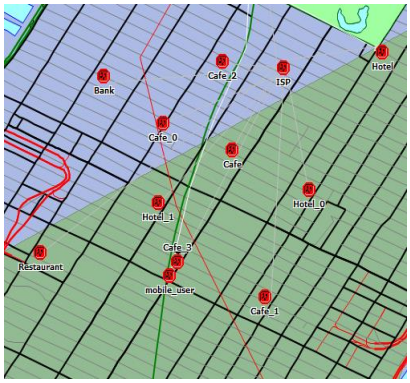

Figure 3: Picture of simulation scenario

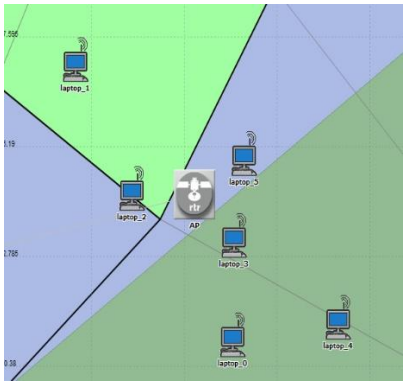

Figure 4: Picture of inner structure of nodes

3. The result and analysis of simulation experiments

Before simulation experiments, parameters of the model should be known. Figure 5 is the picture of attribute parameters of wireless AP, detailing the attributes of wireless interface. The figure shows MAC address of WLAN is distributed automatically. Click Wireless LAN Parameters, then attributes of wireless AP interface can be seen from the pull-down menu, such as data rate, RTs threshold, low and high retry limit.

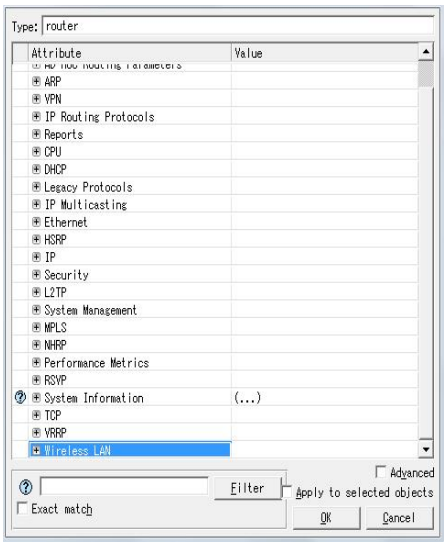

Figure 5: Parameters of wireless AP

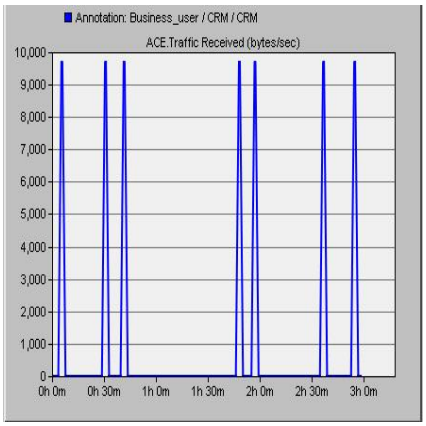

Figure 6: Graph of traffic received of bank node

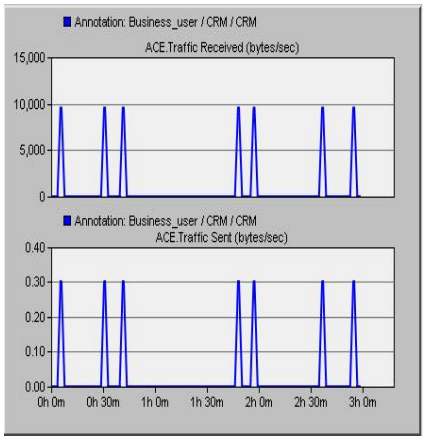

Figure 7: Graph of traffic received of bank node

Figure 6 is the graph of traffic received of Bank node. The abscissa means simulation time which is 3 hours totally, while the ordinate refers to the value of traffic received with the unit as bytes/sec.

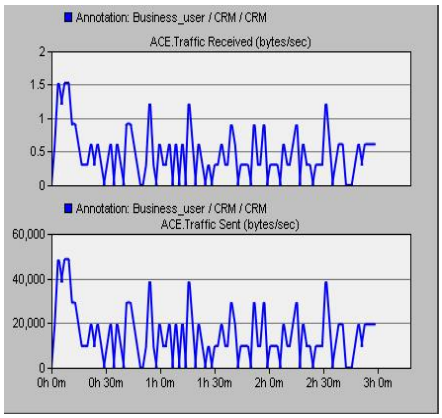

Figure 8: Graph of traffic sent of bank node

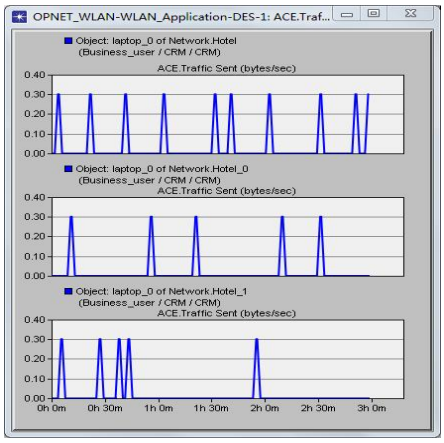

Figure 9: Graph of traffic sent of laptop_0 under hotel, hotel_0 and hotel_1 nodes

Figure 7 and Figure 8 refers to traffic received and sent of Bank node. The abscissa means simulation time totaling 3 hours, while the ordinate refers to the value of traffic received with the unit as bytes/sec. From the figures, it can be seen that the curves of traffic received and sent at the same time are consistent with each other.

Figure 9 is the graph of traffic sent of laptop_0 under Hotel, Hotel_0 and Hotel_1 nodes. The abscissa means simulation time totaling 3 hours, while the ordinate refers to the value of traffic sent with the unit as bytes/sec. The figure shows the traffic sent of laptop_0 under Hotel is more than that under Hotel_1 and Hotel_0.

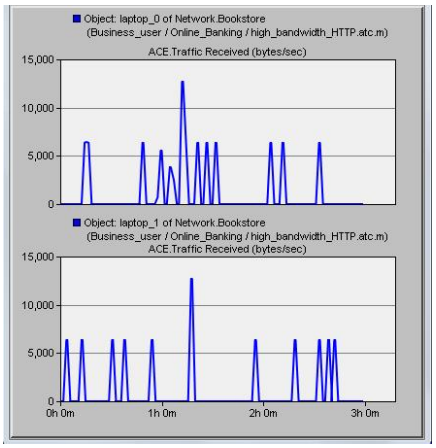

Figure 10: Graph of traffic received and sent of bookstore nodes

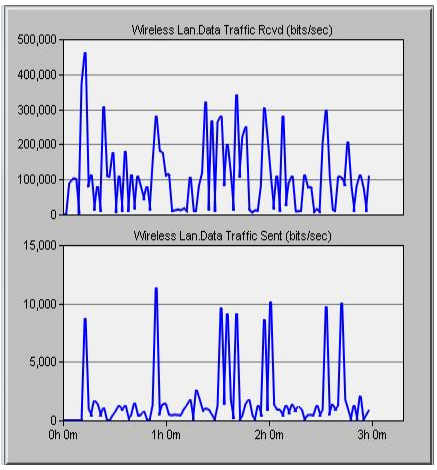

Figure 11: Graph of data received and sent

Figure 10 is the graph of traffic received and sent of laptop_0 and laptop_1 under Bookstore nodes. The abscissa means simulation time totaling 3 hours, while the ordinate refers to the value of traffic received with the unit as bytes/sec. The figure shows, if simulation time is at the range of 0h-1h, laptop_0 receives less traffic than laptop_1. But if the time ranges from 1h to 2h, laptop_0 receives more traffic than laptop_1. The traffic received is different in different time ranges.
Figure 11 is the graph of data received and sent. The abscissa means simulation time totaling 3 hours, while the ordinate refers to the value of traffic received and sent at the same time with the unit as bytes/sec. The figure shows, this WLAN receives much more traffic than it sends.

4. Conclusion and discussion

To summarize, this paper builds a WLAN model for simulation and performance test, and conducts the simulation analysis of the model. Then the author systematically analyzes and compares statistics overall and between nodes as well as the simulation experiments with different parameters. The satisfying results fully achieve WLAN modeling and its performance simulation based on OPNET and provide a new and efficient way for WLAN network modeling and its performance simulation.
In nature, WLAN has no big difference from the traditional computer network in many aspects except in the transmission media. WLAN can connect networks in places that traditional Ethernet cannot reach, expand the network transmission distance, achieve resource sharing by its connect to the existing Ethernet and build an

independent network through wireless terminals. However, regarding current situation, WLAN cannot dominate the network, because WLAN or traditional Ethernet is a supplement to each other rather than a replacement.

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