Research on Multimedia Transmission of Mobile Learning Based on Wireless Network*

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Abstract. Wireless Local Area Network(WLAN) technology has been developed rapidly and impacted education greatly. Mobile learning(M-learning) is the trend of the modern education. The Mobile learning has a high requirement of multimedia applications on limited bandwidth network, but the transmission of voice and video becomes a bottleneck. Based on the polling scheme used in medium access control(MAC) protocols in IEEE 802.11 for WLAN, especially for delay sensitive multimedia information packet delivery, this paper focuses on improving the efficiency of polling scheme to satisfy the quality of service requirements. A new scheme model of polling system is analyzed and the information packet waiting time of voice and video is obtained. Through theoretic calculations and experiments based on voice and video traffic models it proves to be an efficient way of serving the M-learning.

1 Introduction

With the population of wireless device and the maturity of wireless network technology, Mobile learning becomes a new research area of E-learning. However there are many problems need to be resolved with the emergence of Mobile learning such as whether the wireless network can provide enough bandwidth for learner to receive online voice and video as the wired network does. Therefore[1] wireless networks are expected to support multimedia services with guaranteed Quality of Service (QoS) for diverse traffic types (video, voice, and data).The efficiency of bandwidth in Mobile learning becomes crucial.

WLAN has developed into a viable technology to support multimedia traffic. The IEEE 802.11 standard is being adopted by manufacturers and accepted by users as a mature WLAN technology. The MAC protocol defined in the 802.11 standard uses a polling scheme to distribute the channel access permission among contending stations wishing to transmit delay sensitive data carrying a heterogeneous mix of Voice/Data/Video packets[1]. However the standard does not define the method of carrying out the polling scheme[2].

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Polling systems have been studied by many authors. The case of symmetric stations was studied by Hashida [3], and Rubin and De Moraes [4], and Takagi [5]. The case when the stations are not symmetric was studied by Ferguson and Aminetzah [6]. Above mentioned results in [3], [6] are for continuous-time systems. The results in [7], [8], [9], [10] are for discrete-time systems where the time is slotted.

In this paper we propose a new polling scheme for improving efficiency to satisfy the QoS requirements in M-learning based on WLAN. This polling scheme synchronize polling and transmissions of information packets. Based on the imbedded Markov chain theory and the generation function method the model is given and explicitly analyzed to obtain the mean information packet waiting time. Through theoretic calculations and experiments of voice and video transmission in M-learning the better efficiency of new polling scheme can be proved.

2 A New Model of Polling Scheme

We assume that there are N terminals and these terminals are polled in order by a logic sever. When the central server polls terminal i ($i = 1, 2, \cdots, N$) at t_n time if it has information packets in its storage to transmit the central server will proceed the transmission service, but simultaneously the server will switch to poll terminal i+1, unlike the original model in which the server switches to poll terminal i+1 after proceeding the transmission service of terminal i. Once terminal i finishes the transmission of limited information packets according to limited service (K=1) protocol, the central server begins to serve terminal i+1 at t_{n+1} time.

2.1 Working Conditions of System

(i) The arriving process of information packets waiting for transmission meets the independent $Poisson$ distribution with arrival rate λ;

(ii) The time variables which any terminal takes to transmit information packets are independent to each other, and their Laplace transformation is $\tilde{B}(s)$. Mean value is $\beta = -\tilde{B}'(0)$ and double origin quadrature is $\nu_\beta = \tilde{B}''(0)$;

(iii) The variables walking and polling time between any two neighbor terminals are independent to each other, and their Laplace transformation is $\tilde{R}(s)$. Mean value is $\gamma = -\tilde{R}'(0)$ and double origin quadrature is $\nu_\gamma = \tilde{R}''(0)$.

In the queuing system we assume every terminal has enough storage with no loss of information packets under the First in First out rule.

2.2 Generation Function $\tilde{G}_i(z_1, z_2, \cdots, z_i, \cdots, z_N)$

Random variable $\tilde{\xi}_i(n)$ is defined as value of information packets in storage of terminal i at t_n time. Then the status of whole queuing system at t_n time can be