Maximizing Power Saving for VoIP over WiMAX Systems

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ABSTRACT

The voice-over-Internet protocol (VoIP) service is expected to be widely supported in wireless mobile networks. Mobile Broadband Wireless networks VoIP service to users with high mobility requirements, connecting via portable devices which rely on the use of batteries by necessity. Energy consumption significantly affects mobile subscriber stations in wireless broadband access networks. Efficient energy saving is an important and challenging issue because all mobile stations are powered by limited battery lifetimes. Therefore, the authors propose an adaptive mechanism suitable for VoIP service with silence suppression. The proposed mechanism was examined with a computer simulation. The simulation results demonstrate that the proposed mechanism reduces energy consumption.

KEYWORDS

Energy Consumption, IEEE 802.16, Power Saving, Sleep Mode, Voice over IP (VoIP), WiMax

INTRODUCTION

In recent times, Voice over IP (VoIP) has emerged as an important and dominant application in broadband mobile networks such as WiMAX. Using VoIP technology, Mobile-WiMAX users can utilize voice services more cheaply compared with current mobile systems. Therefore, supporting as many voice users as possible while using limited radio resources is a major issue, this could be a key to the success of the Mobile-WiMAX system (Fan et al., 2008; McBeath, Smith, Chen, Soong, & Bi, 2008).

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Mobile devices usually rely on portable power sources, such as batteries. Since batteries provide a limited amount of energy, it is important to design efficient power-saving mechanisms to prolong their lifetime. In wireless communications, for a significant amount of time, mobile stations are waiting for incoming or outgoing traffic. These periods of inactivity can be used for battery power conservation. In Mobile WiMAX, for significant amount of time a mobile station does not send or receive traffic in any of the active call sessions. Most wireless systems adopt a Power-Saving Mode (PSM) to reduce the energy consumption of Mobile Stations (MS). The common approach of PSM is discontinuous reception, that is, MS periodically power off their reception units (go into a sleep mode) instead of continuously listening to the radio channel. Since an MS in sleep mode wakes up only at predefined listening intervals, it can conserve much of its energy (Chen, Chen, & Chen, 2009; Park & Lee, 2008; Yang, Yoo, & Shin, 2007).

Mobile WiMAX provides flexible power-saving classes to facilitate mobile stations to conserve their energy during active and sleep mode (Ghosh, Wolter, Andrews, & Runhua, 2005; IEEE, 2006). According to IEEE 802.16e, the MS switches to sleep mode for a sleep period, and wakes up to send or receive packets in a listen period. During sleep periods, a base station (BS) must buffer incoming packets sent to the mobile station, and then after the mobile station switches to listen periods, the base station sends the queued packets to the mobile station. To accommodate different characteristics of applications and services, the IEEE 802.16e specifies three power-saving classes, in which each class implies a particular sleep and listen behavior for a mobile station. (i) The Power-Saving Class type I (PSC I) starts with initial sleep window, this sleep window is doubled if the BS does not tell MS about existence of data packets at its listen interval. This process repeated consistently until the sleep interval reaches to the final sleep window and then next sleep interval keeps unchanged. (ii) The Power-Saving Class type II (PSC II) uses sleep window with the same size repeated consistently. (iii) The Power-Saving Class type III (PSC III) has sleep cycle consists of only one predefined sleeping interval and it does not contain a listen window.

A mobile station can thus associate a power-saving class with a connection, beside negotiates the parameters of the power-saving class such as the time to sleep and listen, and the length of each sleep and listen period with the base station for the connection. Obviously, the parameters of a power-saving class associated with a network connection should be carefully specified to maximize the energy efficiency of a mobile station without violating the QoS requirements of that connection.

VoIP calls require packets to be sent continuously, and the small inter-packet intervals coupled with the real-time nature of voice, make it difficult for the radio to save energy by transitioning to the low power sleep state. It has been recognized that there is a tradeoff between the energy conservation of an MS and the QoS performance of transmitted packets (Nga, Kim, & Kang, 2007). In the PSM for VoIP, the same tradeoff happens according to the length of the sleep interval. If the sleep interval is equal to the packet generation interval of the VoIP codec with a short range of 10 to 30 ms (Cox & Kroon, 1996), it is sufficient to satisfy VoIP QoS, such as end-to-end
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