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Performance analysis of double buffer technique (DBT) model for mobility support in wireless IP networks

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Abstract

Existing mobility support models in cellular communications misinterpret mobility loss in cellular networks as congestion loss, thus it degrades the performance by invoking unnecessary congestion control action. In this paper, we investigated the performance of Double Buffer Technique (DBT) model for mobility support in wireless IP networks. The DBT model uses the END message and the TQRS timer to maintain the packet sequence and decrease the load on the new foreign agent when the timer expires, respectively. Also, the protocol showed improved performance degradation caused by the handover of the mobile terminal. In order to demonstrate the superiority of our scheme over the existing ones, we used the following performance metrics: packet out-of-sequence, cell loss ratio, bandwidth overhead, and suitability for real-time services. The numerical results obtained revealed that the buffer size, the waiting time, and the packet loss probabilities in the model were suitable to the wireless IP environment.

Keywords: Cellular; Mobility; Wireless; Handover; Double buffer technique; Internet protocol; Routing; Seamless; QoS

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1. Introduction

Future internetworks will include networks of small wireless cells populated by large numbers of portable devices. Laptop computers and cellular telephones have proven their utility, while continuing advances in miniaturization promise increasingly functional portable devices. Networks of small wireless cells offer high aggregate bandwidth, support low-powered mobile transceivers, and provide accurate location information (Caceres and Padmanabhan, 1998). The changing needs of the business world and the availability of new technologies have led to the emergence of mobile Internet Protocol (IP) for mobility support in wireless IP networks. Mobile communications and the Internet are expected to be the main drivers for today's and tomorrow's business. This is more so as new and novel kinds of value-added services over wireless broadband connections are emerging. According to Castellucia (1998) and Gustafssor et al. (2000), today's Internet does not fully support mobility. In fact, the Internet's routing and address structure prohibits packets addressed to a roaming mobile node from reaching it without specific support for mobility.

The increasing importance of portable computing and telecommunication applications motivate the fast development of high-speed wireless networking technologies. Especially with the increasingly mainstream role of multimedia laptops, PCs, Personal Digital Assistants (PDAs) and Personal Information Assistants (PIAs) require communication techniques with higher and more flexible bandwidth (Liu, 1997). The growth of cellular radio communications in the past decade has been remarkable. Demand for cellular communications has placed heavy demand on the capacity of wireless interfaces and the network resources available. As a result, the demand for higher transmission speed and mobility is even greater.

There has been an increasing need for supporting users' mobility in today's computing environment through the Internet. One of the most important things to support terminal's mobility is the location management in the Internet. The Internet Engineering Task Force (IETF) defines Mobile Internet Protocols (IP) based on forwarding pointer concepts, which has as an extension the Route Optimization Protocol (ROP). There are some problems associated with the mobile terminal's itinery as it crosses cell boundaries especially in the midst of data transfer. One of them is the packet out-of-sequences caused by the frequent handovers of the mobile terminal. In this paper, the authors examine the mobility issues in wireless IP networks and proposed a Double Buffer Technique (DBT) model for guaranteeing the packet sequence.

2. Cellular communication

Cellular technology is based on geographical areas called cells. Each cell includes a base station that subscribers within the cell communicate with using two Radio Frequency (RF) links. All transmissions are full duplex, and one RF link is used for transmitting information, while the other is used for receiving (Adewale and Falaki, 1999). Cell (i.e. Pico) are typically represented as hexagons and placed close to each other as to resemble a honey comb. The structure of a typical cellular network is as shown in Fig. 1. The mobile