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Medium Access Control for ATM-to-CDMA Interface

AYKUT HOCANIN *
Department of Electrical and Electronics Engineering, Eastern Mediterranean University, Gazimağusa, TRNC

SHANUJ V. SARIN
Agilent Technologies, 24001 East Mission Avenue, Liberty Lake, Washington 99109, USA

HAKAN DELIÇ **
Signal and Image Processing Laboratory (BUSIM), Department of Electrical and Electronics Engineering, Boğaziçi University, Bebek 80815 Istanbul, Turkey

Abstract. An integrated medium access control framework for a direct sequence code-division multiple access (CDMA) radio access to an asynchronous transfer mode (ATM) network is considered. The system accommodates multimedia services such as voice and data. The inherently high error rate associated with the multipath fading channel is partly overcome by the introduction of a data link control layer employing one- and two-dimensional CRC codes for error detection/correction in voice and data packets, respectively. Analysis and simulations show promising average delay and error probability performance, as well as low coding redundancy. Two-dimensional CRC, particularly in conjunction with automatic repeat request (ARQ), outperforms convolutional coding with much less overhead and processing requirement at the ATM-CDMA interface.

Keywords: CDMA, ATM, CRC, multipath fading, ARQ

1. Introduction

The performance of personal computers and workstations has advanced dramatically in this decade and as a result, multimedia communication has become omnipresent. The asynchronous transfer mode (ATM) is characterized by its flexibility to accommodate a variety of services and its high-speed transport capability. It carries multimedia traffic, such as voice, video and data, at any specified speed by changing the transmission rate of the 53-byte ATM cells.

In mobile multimedia applications, a large amount of research is directed towards finding a suitable transmission medium for the ATM traffic. The ATM mechanisms are designed with the fundamental assumptions that channel-induced errors are rare and the allocated bandwidth is large. The former is valid for the fiber optic-based wireline systems, but the wireless medium is unreliable due to errors caused by the radio interface. Transmission speed of wireless channels is much lower than the fiber optic physical backbone of the broadband-integrated services digital network (B-ISDN). Moreover, for time-critical traffic such as real-time voice and video, we cannot take the liberty of issuing an automatic repeat request (ARQ) whenever an error occurs in transmission. Error control measures have to be used to ensure that the radio communications does not impair the ATM operation. Thus, the wireless transmission protocol that is to handle the ATM cells must be robust enough to limit the probability of error close to the ATM range. This encourages the adoption of code-division multiple access (CDMA).

CDMA and ATM have characteristics which separately and in combination can offer significant advantages in the cellular mobile radio environment [10]. Both allow a given transmission link to support simultaneous virtual connections which simplify routing and reduce overhead. CDMA allows many users to share the same radio frequency spectrum simultaneously through the utilization of spread spectrum. Some of its advantages include multipath fading resistance, soft handoff capability and capacity increase through voice activity detection. However, fast power control and precise timing are essential for its proper operation.

Wireless access to ATM networks requires the consideration of such issues as the unreliability of the radio interface, the user terminals' multiple access to the common radio resources and the user mobility [8]. Since a mobile terminal travels while a connection is active, frequent set-up and release of connections and associated resources take place. Handoff must be supported with low packet loss, delay and control overhead. This paper addresses the unreliability of the radio interface and multiple access to radio resources.

We consider a combined ATM-CDMA multimedia architecture and analyze its network related aspects. In particular, the CDMA air interface to the wired ATM network is designed to work with minimal processing and overhead. A 54-byte frame structure which allows efficient transformation of the packets at the wireless/wireline interface is proposed. Each frame has a header of 3 bytes containing the

* A. Hocanın was with the Department of Electrical and Electronics Engineering, Boğaziçi University, Bebek 80815 Istanbul, Turkey, during the course of this research.
** Corresponding author.