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Multimedia Support for Wireless W-CDMA with Dynamic Spreading

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Abstract. The emerging multimedia communication needs more support in operating systems in order to be successful over a wireless environment. The system needs to support a seamless integration (i.e., transparent application switching) of voice, audio and conventional data (e.g., e-mails, and ftp). It should also support multiple users with a guaranteed quality. In this paper, we investigate effective protocol design with dynamic spreading factors such that various QoS based on different traffic types can be provided. Increasing spreading factors can benefit the system because it will increase the desired signal strength linearly. The measured bit error rate can be reduced 75 times with a long spreading factor. By taking advantage of this benefit, we propose some middle-ware solutions to monitor the network load and switch the spreading factors dynamically based on the current load with multimedia traffic. These middle-ware solutions are implemented in mobile and base stations and experiments are performed to measure the actual system performance. The preliminary results indicate that our proposed system can always maintain a desired quality for all the voice connections. We further extend our protocol to guarantee a balanced support among different traffic types. While the voice communication is still guaranteed to be non-interrupted, the data traffic is proved to be served with reasonable response time by our proposed system.

Keywords: wide-band CDMA, Quality-of-Service, integrated multimedia communication, admission control protocol, dynamic spreading factors

1. Introduction

Wireless networks make it possible for people to shop online anytime and anywhere. People will have instant access to information even when they are walking on the streets. In addition, customers will not only have access to plain information, but the information will be supported with multimedia components like images, animations, and audio. Recent technological advances are increasing multimedia capabilities in mobile devices. Cellular phones and notebooks are converging into a single mini-device which is capable of both computing and communicating. They are becoming more competitive to desktop PC in terms of computing power. In the near future, most of the multimedia applications will be able to run on mobile devices.

Therefore, a successful multimedia communication system needs to support a seamless integration of voice, audio and other conventional data (e.g., e-mails, and ftp). Table 1 lists the different traffic characteristics. We believe that ftp and e-mails require the highest support on the bit error rate (BER) since the accuracy of the content needs to be guaranteed. However, there is no data rate requirement for these two traffic types (though short turn-around time is still preferred). Similarly, compressed image data (e.g., JPEG) do not require a specific data rate, and can tolerate a higher degree of bit error.

Table 1
BER requirement of different traffic types.

FTP	BER $< 10^{-6}$, no data rate requirement
Email	BER $< 7 \cdot 10^{-5}$, no data rate requirement
Image	BER $< 2 \cdot 10^{-4}$, no data rate requirement
Audio	BER $< 10^{-3}$, minimum data rate 10 Kbps
Voice	BER $< 10^{-2}$, data rate 8–64 Kbps

However, the bottom-line is that the minimum BER and data rate requirements for audio and voice types must be satisfied at any time. Otherwise the system will not guarantee the performance. Voice connections should be synchronized, and maintained at a certain range of data rate (typically 16 Kbps), any interruption will degrade the quality of voice. Audio traffic (e.g., streaming MP3) also requires a constant data rate (with an even smaller BER). We believe that the integrated solutions need to support all of the above traffic types with guaranteed quality.

The ideal solutions should also support multiple users with a guaranteed quality. These solutions should also transmit e-mails and ftp without connection re-establishment even in the middle of voice conversation. It is our belief that this application switching should be transparent. For example, during a conversation, if a user wants to send an email, he/she will be able to do so without disconnecting current voice application and re-establishing connection for the email application. To avoid "connection" setup overhead, the user should stay connected no matter what application is running. We target our system and solutions to make these functionalities feasible[1]. In this paper, we present our on-going study for the design issues to accomplish the above goals. We focus on the discussions on a single cell environment in this paper and

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[1] The current cellular phones/PDA devices start offering e-mail and browsing functions. But these two functions cannot be run with an active voice conversation.