

Cellular Digital Packet Data Network

Debabrata Saha, *Senior Member, IEEE*, and Stanley E. Kay, *Member, IEEE*

Abstract—Cellular digital packet data (CDPD) is a data network designed to meet growing mobile data transmission needs. CDPD networks can stand alone or overlay on the cellular voice systems by drawing radio resources from the pool of unused or free cellular analog voice channels. Detection as to whether a channel is free or occupied is mechanized through channel sniffers. Once the CDPD network seizes a channel, it continues to use the channel as long as it is free and leaves the channel within 40 ms of initiation of any voice activity on the channel—the CDPD network then hops to another free channel, if available. CDPD follows slotted nonpersistent digital-sense multiple access with collision detection (DSMA/CD). In addition, it performs channel-error detection and channel-error recovery. In this paper, we investigate several aspects of CDPD network, namely, the: 1) effect of CDPD on cellular voice and 2) delay-throughput performance due to DSMA/CD with error detection.

Index Terms—Cellular communications, CDPD, data network, DSMA, mobile communications.

I. INTRODUCTION

CELLULAR digital packet data (CDPD) has been designed to provide connectionless network services to mobile end systems (MES's). It is a relatively new data network, detailed descriptions of which are available in [1]. The radio resources for such a connectionless network is drawn from the pool of free or unused channels in existing analog cellular voice systems. As an example, consider a typical sector having 19 voice channels. Suppose the network is operating at a blocking probability of 0.02. Then, the sector will support a load of 12.3 Erlang. In this situation, the average number of channels that remain free is a little less than seven. CDPD evolved from an attempt to utilize these free channels for data communication.

CDPD is a connectionless network that supports Internet Protocol (IP) and Connectionless Network Protocol (CLNP). Initially, a group of eight industry leaders in the United States contributed towards the development of CDPD. Now, CDPD service is available in over 40 states. Early acceptance of CDPD came from law enforcement officials. In many cities, law enforcement officials are using CDPD services from their car to have cost-effective instant access to large data bases related to public safety. Other current usage of CDPD includes credit card verification, financial transactions, and remote telemetry. Deployment of CDPD service is growing rapidly because, in many situations, it is more cost effective than other private packet radio network services such as Ardis and Ram.

Section II gives a brief description of CDPD network with special attention to its protocol mechanisms. The effect of CDPD on cellular voice is addressed in Section III. Section IV presents a detailed analysis of the protocol performance, and the results are presented in Section V. Section VI presents some concluding remarks.

II. CDPD NETWORK

In a CDPD network, multiple MES's share the channel medium with a single mobile data base station (MDBS). Direct communication is possible only between an MES and MDBS, but not between two MES's in the same cell. The medium consists of a forward channel from MDBS to MES and a reverse channel from MES to MDBS (as shown in Fig. 1). The forward channel is a contentionless broadcast channel carrying transmission from only MDBS. Information is received and decoded by all MES's on the channel simultaneously. The reverse channel is shared among all MES's. Access to the channel and resolution of contention is controlled by each MES assisted by reverse-channel status information returned by the MDBS on the forward channel.

CDPD extends only to the network layer (Layer 3). Network layer packets before transmission from an MES undergo several transformations, namely, packet-header compression, packet encryption, segmentation, and framing. Packets destined for forward channel also undergo similar transformations before they are transmitted by MDBS on the forward channel.

The basic unit of information transfer is a variable-length ordered sequence of octets called a frame, and the length of a frame may vary from 2 to 136 octets [1]. Frames are delimited by frame flag sequences, which are prohibited from occurring naturally within the frame (by proper zero padding). These frames are transmitted over the radio channel as a burst of an integral number of blocks interleaved with control flags and synchronization words. Each block is encoded with (63, 47) Reed-Solomon error-correcting code using 6-b symbols as code letters. Each block thus contains a total of 378 bits. Any frame that contains a block having uncorrectable errors is discarded and retransmitted.

The reverse-channel signaling format is illustrated in Fig. 2. A reverse-channel transmission burst consists of a 38-b dotting sequence during transmitter ramp up, a 22-b reverse-channel synchronization word, followed by one or more blocks. Each block is interleaved with a continuity indicator, which signals termination or continuation of the burst. The termination of a burst is followed by the transmitter ramp down. The forward-channel signaling format is illustrated in Fig. 3. Forward-channel data consists of a continuous stream of Reed-Solomon (R-S) blocks interleaved with control flags.

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D. Saha is with the Department of Electrical Engineering and Computer Science, George Washington University, Washington, DC 20052 USA.
S. E. Kay is with Hughes Network Systems, Germantown, MD 20878 USA.
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