ABSTRACT

Cellular Digital Packet Data is a technique, which is applicable over cellular network for quick transfer of data. It is applicable in providing a quick transfer of data over cellular networks. It transmits the packets over the cellular network in a reliable manner. Packet networks break a stream of data in to independent blocks of data called the packets. CDPD is wirelesses IP network that overlay on the existing AMPS cellular infrastructure. The CDPD raw channel modulation user rate is 19.2 kbps. It provides high speed, high capacity and cost effective data. It performs the important role in its network. It plays important role in credit card verification and ATM networks. With this technology both voice and data can be transmitted over existing cellular channels.

CHATER 1
INTRODUCTION

1. INTRODUCTION

CDPD – CELLULAR DIGITAL PCKET DATA

It is a technique used for transmitting small chunks of data, commonly referred to as packets over the cellular networks in a reliable manner. It allows users to send and receive data from anywhere in cellular coverage area at any time quickly and efficiently.

CDPD is a packet switched communication network that operates as an overlay on the cellular system. Packet networks including the Internet breaks a stream of data in to independent blocks of data, called packets. Each packet is transmitted independently carries its own destination and error correction information. Thus packet networks perform extremely well in systems with variable and channel quality both of which are found in wireless environment. CDPD provides an advantage over circuit switched (dial up) data, in that we have to connect to the network once, there is no need to dial in repeatedly.

CDPD technology provides extensive high speed (data can be sent over cellular air link at networks at rate 19.2kb/s), high capacity, cost effective data services to mobile users. With this technology, both voice and data can be transmitted over existing cellular channels. CDPD utilizes digital networks. Placing data conversations, photographs, and multimedia in to binary (0 & l) form and transmitting the information through a network with a large bandwidth permits more information to be sent more quickly with greater clarity. [BIB 1]

CHATER 2

CDPD NETWORK

2. CDPD NETWORK

CDPD is a data network designed to meet growing mobile data transmission needs. CDPD networks can stand-alone or overlay on the cellular system 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 continue 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 nonresistant Digital Sense Multiple Access with Collision Detection (DSMS/CD). In addition, it performs channel error detection and channel recovery. Several aspects of CDPD network are,

i. Effect of CDPD on cellular voice and
ii. Delay throughput performance due to DSMA/CD with error detection.

CDPD has been designed to provide connectionless network services to mobile end system. It is a relatively new data network. The radio resources for such a connectionless network are drawn from the pool of free or unused channels in existing analog cellular voice systems.

CDPD is a connectionless network that supports Internet Protocol (IP) and connectionless network protocol (CLNP). Now CDPD is available in over 40 states. Current usage of CDPD includes credit card verification, financial transactions, and remote telemetry. CDPD service is growing rapidly. Because, in many situations, it is most cost effective than other private packet radio network services such as ardis and ram. [BIB 2]

2.1 NETWORK BASED COMPNENTS

The CDPD overlay network is made up of a combination of key components that operate together to provision the overall service. These components are described below:

2.1.1 Mobile End System (M-ES)

It is defined as any mobile computing device, which is equipped with a CDPD modem (e.g. a PC). Unlike voice cellular phones, the decision to initiate a transfer, or hand-off from one cell to another cell is under the control of the CDPD M-ES itself, as it is the M-ES, which is responsible for monitoring the received signal strength of the cellular channels being used.

2.1.2 Fixed End System (F-ES)

It is defined as a stationary computing device, such as a host computer or an on-line information service.

2.1.3 Mobile Data Intermediate System (MD-IS)

It is a stationary network component with similar responsibilities to the cellular voice switch. It is responsible for keeping track of the M-ES's location and routing data packets to and from the CDPD network and M-ES appropriately. It has been referred to as the "brain" of the network, because of its functionality. Not only is it responsible for ensuring that an M-ES is valid to log on to the network, but it also stores information on the M-ES's last known location, traffic statistics and billing information.

2.2 MOBILE DATA BASE STATION (MDBS)

It is primarily responsible for RF channel management. It is located at the voice cell sites and is responsible to instruct the M-ES to "hop" to new channels for continued communication in the event voice communication (which is the priority traffic) is detected. It also handles the legwork for the M-ES in locating new channels when a hand off is required between cell sites.

2.3 INTERMEDIATE SYSTEM (IS)

It is made up of (off the shelf) routers, which are CDPD compatible with the primary responsibility for relaying the data packets. The way these components interact with each other can be seen from the graphic depiction below: BIB [4]

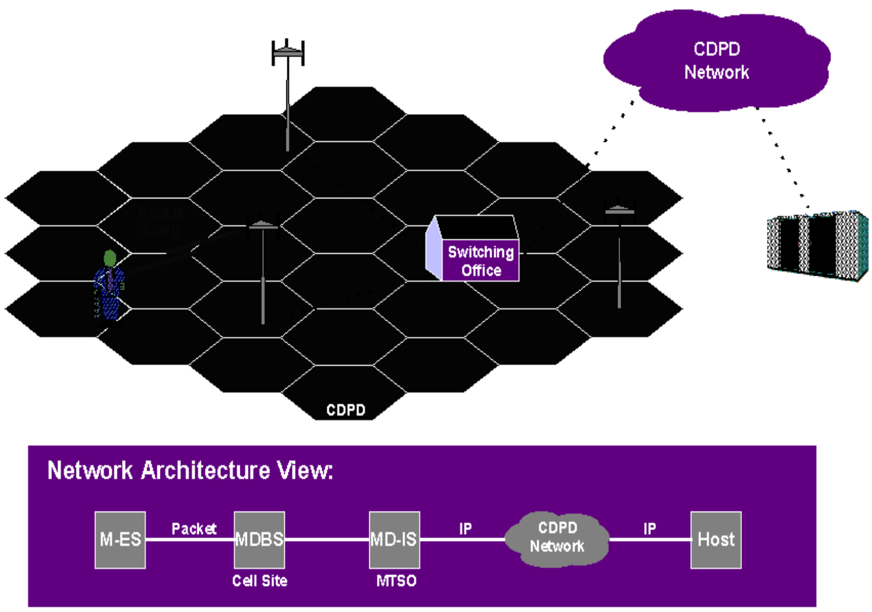

Fig 2.1 Network

CHATER 3

WORKING

3. WORKING

3.1 HOW DOES CDPD WORK?

To effectively integrate voice and data traffic on the cellular system without degrading the level of service provided to the voice customer, the CDPD network implements a technique called channel hopping. The way this works is that when a CDPD mobile data unit desires to initiate data transmission, it will check for availability of a cellular channel. Once an available channel is located, the data link is established. As long as the assigned cellular channel is not needed for voice communications, the mobile data unit can continue to transmit data packet bursts on it. However, if a cellular voice customer initiates voice communication, it will take priority over the data transmission. At such time, the mobile data unit will be advised by the Mobile Data Base Station (which is the CDPD serving entity in the cell and constantly checks for potential voice communication on the channel) to "hop" to another available channel. In the event that there are no other available channels, then data transmission will be temporarily discontinued. It is important to note that these channel hops are completely transparent to the mobile data user. As far as the user can see, there is only one data stream being used to complete the entire transmission. [BIB 1]

3.1.1 CDPD channel model

In a CDPD network, multiple Mobile end stations 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 same cell. The voice signals are transmitted via a mobile phone connected to RF modem unit. RF transfers data both in forward and reverse channel. The medium consists of forward channel from MDBS to MES and reverse channel from MES to MDBS. BIB [1]

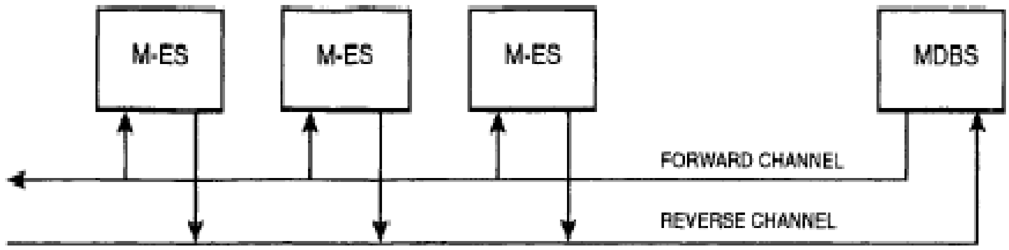

Fig. 3.1 CDPD channel model

The forward channel is a connectionless 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 resolution of contention is controlled by each MES assisted by reverse channel status returned by the MDBS on the forward channel.

CDPD extends only to the network layer, whose packets before transmission from an MES undergo several transformations, namely packet-header compression, packet encryption, segmentation and framing. For forward channel these packets undergo transmission before they are transmitted by MDBS on forward channel.

The basic unit of information transfer is a variable length ordered sequence of octets called frame. These frames are transmitted over the radio channels. Any frame that contains a block having uncorrectable errors is discarded and transmitted.

The reverse channel-signaling format is,

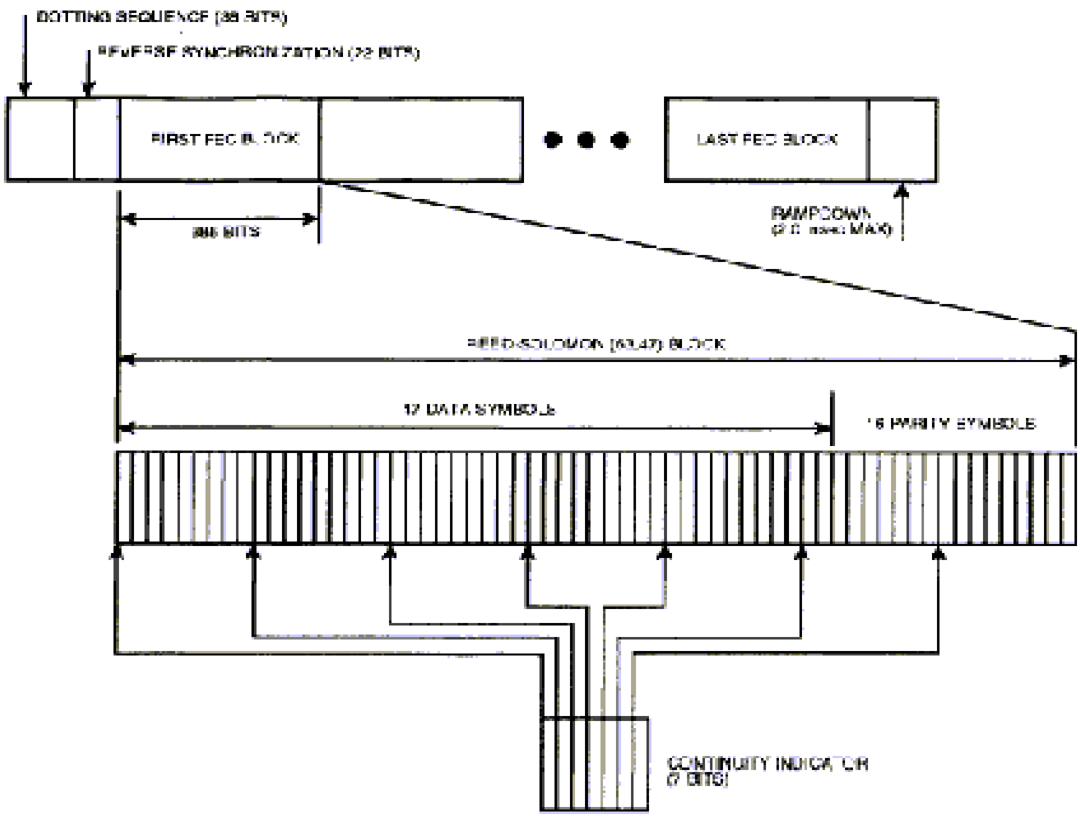

Fig. 3.2 Revere channel-signaling format

A reverse channel transmission burst consists of a dotting sequence during transmitted ramp up, a 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 reverse channels are shared between numbers of mobile units sharing a reverse link cannot communicate each other.

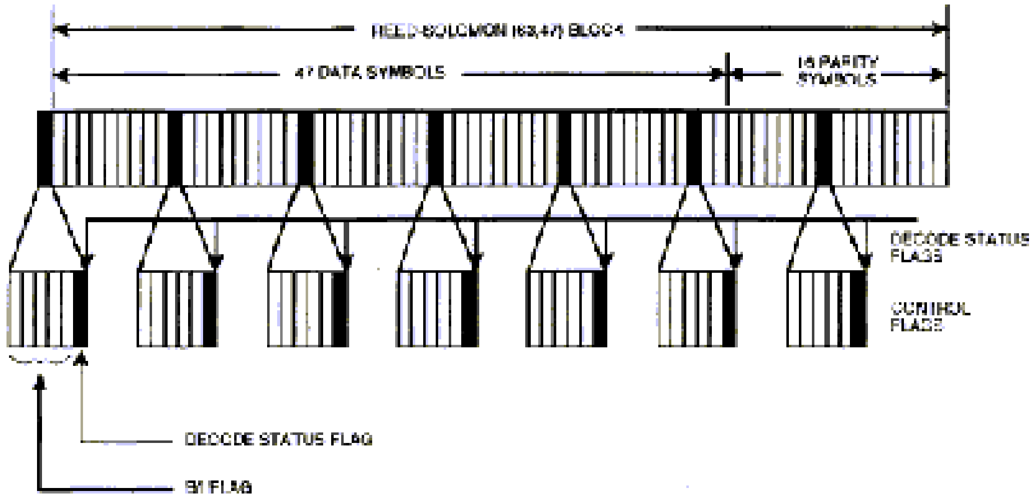

Fig 3.3 Forward-channel signaling format

The channel for forward communication is from MDBS to the mobile units. This channel is unique to each mobile unit and hence connectionless. Forward channel data consists of a continuous stream of RS blocks interleaved with control flags. Communication between MDBS and MES take place over a pair of RF channel, each channel having a bandwidth of
30 kHz and transmission rate of 19.2 kbps.

The MAC function used over the air interface is unique to CDPD. It creates a bit stream by taking the its within the MDLP frames and "blocking" them in to a format that incorporates a forward error correction scheme known as Reed Soloman (RS) block. Within the forward channel, there is channel Busy/Idle status and Block-Decode status.

3.1.2 Channel Busy/Idle status

The Busy/Idle status indicates whether the reverse channel is busy or idle. An n MES wishing to transmit defers until the channel is signaled idle.

3.1.3 Block-Decode status

The decode status indicates whether the previous RS block was decoded successfully or unsuccessfully by MDBS. Since, the MDBS cannot distinguish between errors due to collision and channel impairment. The decode status flag effectively acts as a collision detection signal. Decode status timing relationship is as, BIB [1]

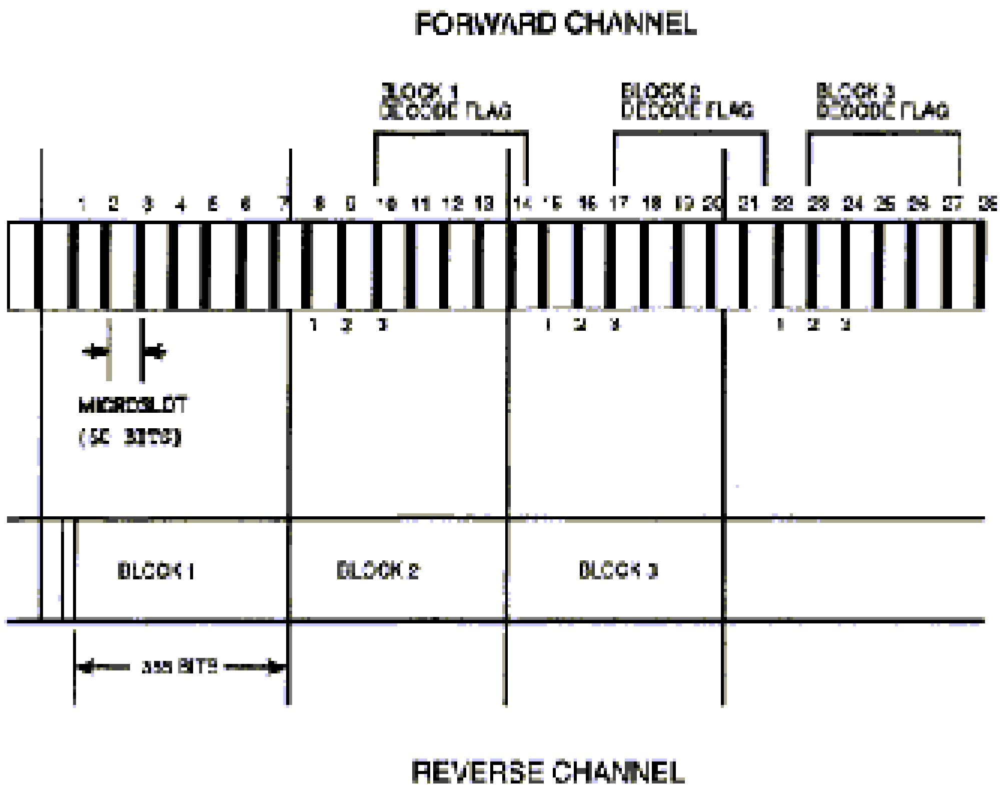

Fig 3.4 Decode-status timing relationship

Busy/Idle and decode status flags together constitute the control flag. The control flags allow the ensemble of MES's to "Digitally Sense" the state of the reverse channel, providing a multiple access capability. Hence, the access mechanism is named Digital Sense Multiple Access (DSMA).

3.1.4 DSMA/CD

Reverse channels are accessed using a Digital Sense Multiple Access with Collision Detection (DSMA/CD) protocol, which utilizes carrier sense multiple accesses with collision detection. This protocol allows the collision of two data packets on a common channel to be detected so that the mobile unit can be alerted by the MDBS to retry transmission at a later time.

When the channel is available for CDPD, the MDBS has permanent receive access to the reverse channel. When the MDBS detects the presence of a reverse channel transmission, it sets the Busy/Idle flag to busy state. Otherwise this flag continues to indicate the idle state.

A terminal with a message ready for transmission senses the forward channel. If the channel is idle, MES initiates transmission. If the channel is sensed busy, the MES goes in to defer mode and waits for a random interval before sensing the channel again. Once an MES is successful in gaining access to the channel, it continues to transmit until there is a decoding failure indicated in the control flags on the forward channel. Upon detection of decoding failure, MES ceases transmission and goes in to back off mode. In the back off mode, MES waits for a random interval before it senses the channel again. Upon sensing the channel idle, if two or more MES transmit in the slot, a collision results, which in turn causes decoding failure. The decode status flag thus effectively acts as a collision detection signal. Thus, MES goes in to differ mode when the channel is sensed busy, and it goes in to back off mode when there is a decoding failure.

3.1.5 Effect on Cellular Voice

CDPD network is overlaid on a cellular voice network and draws the channel resources from the pool of free voice channels.

There are two ways one can overlay CDPD on cellular voice.

1. Channel hopping
2. Dedicating voice channels to CDPD

In first, channel snuffers are deployed to detect whether the channel is free or occupied. From the free voice channels, may allocate some channels to CDPD use. Once an MES gets access to an allocated CDPD channel, it continues to use it until the channel is assigned to a voice customer. And if quits the channel within 40 ms of initiation of any voice activity on the channel and then hops to another free channel. An alternative to sniffing is dedicating some voice channels to CDPD use, but such dedication will reduce the number of channels available for regular voice use and will result in increased blocking probability and hence poorer service quality.

3.1.6 Voice Call Activity

Activity on voice channels in any sector is best illustrated by the arrival departure process of the voice calls, which is often modeled as a state independent birth death process

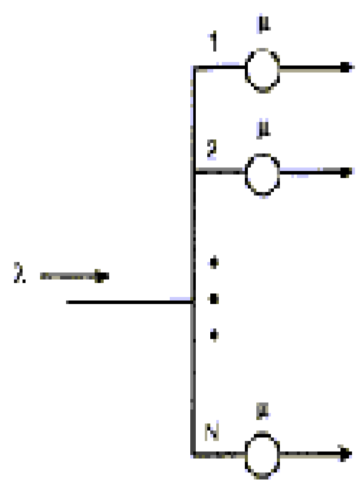

Fig 3.5 Arrival-Departure process of voice customer's birth-death process

3.1.7 Propagation

Generally, the cellular propagation model is assumed to comprise of a combination of small and large-scale effects. The small-scale effects are noticeable on the scale of a few inches. In our propagation model, we consider only large-scale effects. Which are due to propagation path loss and shadowing, when the area is very open and line of sight condition exist, propagation loss. In addition to the negative exponential power loss, the no uniform nature of the medium causes some local variations.

3.1.8 Voice Quality

CDPD be overlaid on cellular voice through sniffing and hopping. There is enough CDPD demand in each cell such that whenever a channel becomes free from cellular voice activity, the channel is taken over by CDPD transmission.

3.2 ANALYSIS OF PROTOCOL

In a cell there are number of mobile end stations which share a reverse channel through DSMA. MES can be in two states active or idle. In active state it may either be transmitting or in differ or back off mode. [BIB 2]

CHATER 4
DELAY ANALYSYS

4. DELAY ANALYSIS

In circuit switching network, the data from one user (sender) to another (receiver) has to follow a prespecified path, if a link to be used is busy, the message can not be redirected, which causes many delays.

While, in packet switching network, it make better utilization of existing network by splitting the message to be sent in to packets. Each packet contains the information about the sender, the receiver, and the position of the packet in the message as well as part of actual message. Packet switching requires more equipment at the receiver, where reconstruction of the message will have to be done. PCSI has come up with an idea called CDPD (cellular digital packet data) technology, which uses the existing mobile networks. CDPD is a connectionless. It sends each packet intermittently, when there is 'space' available there is also packet delay analysis for cellular digital packet data.

To analyze the packet delay, here formulate and analyze a model of voice and data burst traffic for cellular digital packet data.

4.1 CDPD SYSTEM

CDPD is a wireless data system that operates on a no interfacing basis with the existing analog cellular voice systems. CDPD uses the idle cellular voice channels for data transmission. The CDPD system exploits the fact that there is significant number of idle AMPS (advanced mobile phone standard) channels on the average that can be used effectively for short data traffic bursts. The CDPD system is intended to provide all data services such as message delivery and paging.

4.2 FUNCTION OF CDPD SYSTEM

To avoid interference with the voice traffic, the CDPD traffic hops from a CDPD channel about to be preempted by voice to a free AMPS channel.

Mobile units or terminals on power up will scan the cellular channels to identify the CDPD channels; it goes through a registration process. Upon successful registration, the terminal is ready to transmit and receive data over the channel. Typically, for short message applications a single burst is sent. After a predetermined amount or time or when a voice call is assigned to a CDPD channel, the MDBS instructs the terminals to switch channels or to hop to a new channel. They do not register if the channel is served by same MDBS. The MDBS periodically broadcasts a list of available CDPD channels. When a CDPD channel is preempted by a voice call, it is called force hopping. When a CDPD channel is moved to a different channel to avoid preemption by a voice call, it is called planned hopping.

In CDPD system, there is random delay in the processing time for arriving data bursts, is sufficiently minimized. The amount of data burst traffic redirected toward the logic CDPD channels not preempted by voice, which increases the data burst transmission delay times for these channels.

For typical CDPD systems, it is reasonable for this data burst processing rate to be considerably larger than all of the other rates.

4.3 THE MODEL DUE TO DELAY ANALYSIS

Due to stochastic nature of voice calls, the number of CDPD channels available for data burst traffic fluctuates. In order to understand the quality of service that the data burst traffic receives in the presence of the voice traffic, we construct an approximate model of a CDPD system that captures the following capture key features.

- Service times for voice calls are exponentially distributed.
- Voice traffic has access to all of the channels.
- Voice traffic that finds all of the channels occupied by voice are assumed to be lost.
- Voice traffic has priority over data traffic, and voice calls preempt the data traffic occupying a CDPD channel.

Our model for the CDPD system differs from existing models in the way we model the data burst traffic.

We assume following

- Arriving data bursts are evenly distributed among the free CDPD channels, and each CDPD channel transmits data bursts at an exponential rate.
- If no CDPD channels are available, data bursts are assumed to be lost. Since, lost packets are really retransmitted.
- When a voice call takes over a CDPD channel, the data arrival mechanism for this preempted channel is shut off, and newly arriving data bursts are distributed evenly among the remaining free CDPD channels.

E.g. when CDPD channels are free, the total traffic is uniformly distributed among the channels, i.e. the arrival rate of data bursts for one of the CDPD channels. No new arrivals of data bursts are allowed of these channels. Arrivals resume when the preempted channels become free again. [BIB 3]

CHATER 5

APLICATION

5. APPLICATIONS

5.1 COMPARING WITH CIRCUIT SWITCHED NETWORK

Today, the mobile data communications market is becoming dominated by a technology called CDPD. It is more advantageous as compared to circuit switched cellular network.

	CDPD	CIRCUIT SWITCHED CELLULAR NETWORK
SPEED	Best	Best
SECURUTY	Best	Better
UBUQUITY	Best	Best
COST OF SERVICE	Best	Better
MOBILITY	Best	Good
INTEROPERABILITY	Best	Good

5.2 APPLICATIONS OF CDPD

Since, CDPD is an integrated technology, it can be used in variety of applications.

5.2.1 Credit Card Verification

A credit card number is entered at the point of sale and an enquiry is sent to authorize the purchase.

E.g. Yellow cab, located in San Francisco, California, is a customer who has started outfitting cabs with small terminals, which allow the customers to automatically pay by credit card. The terminals use the CDPD technology to validate credit card information and receive payment verification. It takes less than five seconds, which is a significant savings than the traditional approach they had previously employed of validating customer credit card information through radio dispatch.

5.2.2 ATM Network

The benefits of CDPD in ATM's are,

5.2.2.1 Fast Transaction

- Customers won't have to wait for their money.
- More people can use the ATM during busy times.
- Less time in front of the ATM means more security of customers.

5.2.2.2 Secure Data Transfer

- Data is transmitted in digital form (unlike most cellular phones, which send information in analog form) and is encrypted automatically by the CDPD modem.
- It uses private data networks to route the transactions to the host.

5.2.2.3 Cost Effective

- CDPD is priced by the amount of data sent through the system , not by the time it takes to send it .

5.2.2.4 Easy To Install

- Since CDPD is wireless, it works almost anywhere there is cellular coverage.
- No installation is required just turn it on. On power up, the CDPD modem automatically registers itself.

5.2.3 Emergency Services

Ability to receive information on the move is vital, where the emergency services are involved. Information regarding the address, type and other details of an incident can be dispatched quickly via a CDPD system using mobile computers. It is also used in wide area wireless network data systems. E.g. package pick up delivery and electronic mail notifications

5.2.4 Fleet Management

Messages could be sent to specific mobile computing devices in to a vehicle to direct it toward destination for a pick up or next job. The technology allows the officers to communicate car to dispatch through e-mail messages. It is more secure than the traditional voice communication.