COMPUTER NETWORKS

- Chapter 2. The Physical Layer 3

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Second Generation Mobile Phones: Digital Voice

CDMA: Code Division Multiple Access

In an airport lounge with many pairs of people conversing:
TDMA: take turns speaking
FDMA: people in widely separated clumps, each clump holding its own conversation
CDMA: all talking at once, but with each pair in a different language

The key to the CDMA is to be able to extract the desired signal while rejecting everything else as random noise.

Second Generation Mobile Phones: Digital Voice

CDMA: Code Division Multiple Access

In CDMA, each bit time is subdivided into m short intervals called **chips**. Typically, there are 64 or 128 chips per bit.

Each station is assigned a unique m-bit code called a chip sequence. To transmit a **1 bit, it sends its chip sequence**. To transmit a **0 bit, it sends the 1's complement** of its chip sequence.

Second Generation Mobile Phones: Digital Voice

CDMA: Code Division Multiple Access

A: 0 0 0 1 1 0 1 1
B: 0 0 1 0 1 1 1 0
C: 0 1 0 1 1 1 0 0
D: 0 1 0 0 0 0 1 0

(a)

A: (–1 –1 –1 +1 +1 –1 +1 +1)
B: (–1 –1 +1 –1 +1 +1 +1 –1)
C: (–1 +1 –1 +1 +1 +1 –1 –1)
D: (–1 +1 –1 –1 –1 –1 +1 –1)

(b)

Six examples:

– – 1 –	**C**	S_1 = (–1 +1 –1 +1 +1 +1 –1 –1)
– 1 1 –	**B** + $\overline{\mathbf{C}}$	S_2 = (–2 0 0 0 +2 +2 0 –2)
1 0 – –	**A** + $\overline{\mathbf{B}}$	S_3 = (0 0 –2 +2 0 –2 0 +2)
1 0 1 –	**A** + **B** + **C**	S_4 = (–1 +1 –3 +3 +1 –1 –1 +1)
1 1 1 1	**A** + **B** + **C** + **D**	S_5 = (–4 0 –2 0 +2 0 +2 –2)
1 1 0 1	**A** + **B** + $\overline{\mathbf{C}}$ + **D**	S_6 = (–2 –2 0 –2 0 –2 +4 0)

(c)

$S_1 \bullet C = (1 +1 +1 +1 +1 +1 +1 +1)/8 = 1$
$S_2 \bullet C = (2 +0 +0 +0 +2 +2 +0 +2)/8 = 1$
$S_3 \bullet C = (0 +0 +2 +2 +0 –2 +0 –2)/8 = 0$
$S_4 \bullet C = (1 +1 +3 +3 +1 –1 +1 –1)/8 = 1$
$S_5 \bullet C = (4 +0 +2 +0 +2 +0 –2 +2)/8 = 1$
$S_6 \bullet C = (2 –2 +0 –2 +0 –2 –4 +0)/8 = –1$

(d)

(a) Binary chip sequences for four stations
(b) Bipolar chip sequences
(c) Six examples of transmissions
(d) Recovery of station C's signal