

# Wireless Access Techniques

TDMA/FDMA/CDMA

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CDMA lectures of Sir  
Jahanzeb of C.A.S.E  
Islamabad

## Wireless Access Techniques

- Frequency Division Multiple Access (FDMA)
- Time Division Multiple Access (TDMA)
- Code Division Multiple Access (CDMA)

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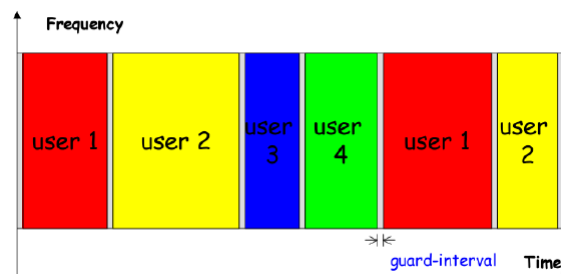
## TDMA (Time Division Multiple Access)

- TDMA technology, which stands for *Time Division Multiple Access*, is a cell phone standard that has been incorporated into the GSM Standards.
- Multiple users, therefore, can share the same frequency channel without causing interference because the signal is divided into multiple time slots.

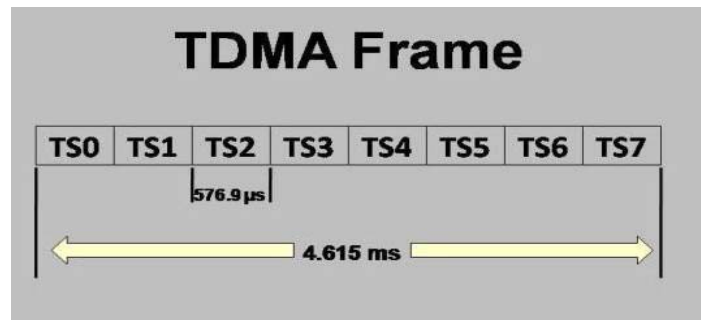
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## Cont'd

- Divide the radio spectrum into Time slots
- Only one user is either allowed to transmit or receive in each slot



## TDMA FRAME



## FDMA (Frequency Division Multiple Access)

- A fixed carrier frequency is assigned to a user terminal and is retained until released by the user
- Radio Networks operate in a defined frequency spectrum
- Spectrum is sub-divided into a number of smaller carrier bands
- Each user is assigned a frequency carrier after “requesting access”

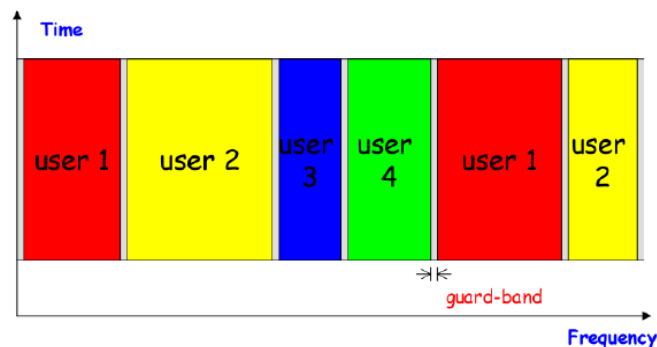
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## Cont'd

- Frequency Division Multiple Access (FDMA) is an analogue transmission technique used for mobile phone communications
- The frequency band allocated to a network is divided into sub-bands or channels.
- Each frequency channel can carry either a voice conversation or digital data, and one channel will be assigned to each subscriber for the duration of a call.
- Using FDMA in this way, multiple users can share the available band without the risk of interference between the simultaneous calls.

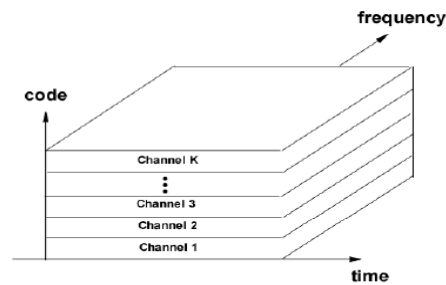
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## FDMA (Cont'd)



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## CDMA (Code Division Multiple Access)



**Anyone can transmit using all the frequency resources at all times using separate assigned codes**

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## Walsh Codes

- Walsh codes provide a means to uniquely identify each user on the forward link
- Currently used CDMA2000 systems use 64 bit Walsh Codes

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## XOR (Xclusive OR)



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

**XOR**

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## Generation of Walsh Codes

- The set of Walsh codes of  $n$  bits length consists of  $n \times n$  Walsh matrix:

$$W_1 = (0) \text{ or } (1) \quad W = \begin{pmatrix} W & W \\ W & \overline{W} \end{pmatrix}$$

0 Seed  $\rightarrow$   $\begin{array}{c|c} 0 & 0 \\ \hline 0 & 1 \end{array}$   $\rightarrow\rightarrow$   $\begin{array}{c|c} 00 & 00 \\ \hline 01 & 01 \\ \hline 00 & 11 \\ \hline 01 & 10 \end{array}$   $\rightarrow\rightarrow\rightarrow$   $\begin{array}{c|c|c|c} 00 & 00 & 00 & 00 \\ \hline 01 & 01 & 01 & 01 \\ \hline 00 & 11 & 00 & 11 \\ \hline 01 & 10 & 01 & 10 \\ \hline 00 & 00 & 11 & 11 \\ \hline 01 & 01 & 10 & 10 \\ \hline 00 & 11 & 11 & 00 \\ \hline 01 & 10 & 10 & 01 \end{array}$

Repeat

Right & Below

Invert

Diagonally

## Cont'd

- At Transmitter Side: User information XOR with Walsh code
  - The resulting information T is transmitted
- At Receiver Side : T information received is again XOR with the same Walsh code used at the Transmitter side
  - The required user information is recovered.

## Example

Example: User input 10011

1	0	0	1	1
$\oplus$	$\oplus$	$\oplus$	$\oplus$	$\oplus$
0011	0011	1100	1100	0011
<b>Walsh Code</b>				
1100	0011	1100	0011	1100
<b>DATA to be transmitted</b>				

The above data sequence is transmitted over the Physical channel along with other spread inputs.

In the above example, the 4-Digit Code used.

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## Recovery of Data

Data Received	1100	0011	1100	0011	1100
	$\oplus$	$\oplus$	$\oplus$	$\oplus$	$\oplus$
Walsh Code	<u>0011</u>	<u>0011</u>	<u>1100</u>	<u>1100</u>	<u>0011</u>
	1111	0000	0000	1111	1111
	↓	↓	↓	↓	↓
Data bits recovered	1	0	0	1	1

The encoded input when XORed twice using the same Walsh code undergoes no change.