

## FUNDAMENTALS OF DIGITAL WIRELESS COMMUNICATIONS

**W**ireless services involve paging services, cordless telephone services and mobile cellular services. At the present time are dominated by voice services. It is expected that data and other services will enter wireless industry drastically in the near future. The course starts with the discussion of various wireless network architectures for paging, cordless phone and cellular services. It then reviews the landline networks. The wireless enabling technologies are described in detail: speech encoding, channel encoding, bit interleaving, encryption, multiplexing, modulation and radio transmission.

### *Audience:*

This course is important for managers, sales forces and technical persons in the telecommunications field to become familiar with the digital communication systems and networks. This course is basically designed for technical persons, however, it can be easily modified and tailored for managers and sales and marketing persons.

### *Prerequisites:*

There are no prerequisites for this course.

### *Objectives:*

At the conclusion of this course the student will be able to describe the:

- Wireless services and associated networks
- Landline network that is used for wireless connection
- Low data-rate speech encoding technologies
- Various channel encoding technologies for error control
- Various multiplexing technologies (FDMA, TDMA and CDMA)
- Modulation technologies for radio-frequency transmission
- Radio transmission issues: multipath, fading, Doppler, diversity and power

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### COURSE OUTLINE

#### Day 1

##### 1. Wireless Access

- Wireless services
- Various wireless service network architectures
- An end-to-end wireless connection
- Mobile station building blocks
- Various wireless standards
- Wireless spectrum allocation
- Section Review: Q&A

##### 2. Landline Network

- Voice digitization and Pulse Code Modulation (PCM)
- Bandwidth management: in TDM
- Network components
- Digital hierarchy
- Echo control

##### 3. Low Rate Speech Encoding

- Traditional (waveform) speech encoding (PCM, DPCM and DM)
- Speech properties
- Hybrid speech encoding
- Speech encoding implementation
- Performance comparison among various speech encoders
- Section Review: Q&A

##### 4. Channel Encoding, Bit-interleaving and Encryption

- Rationale for channel encoding
- Basic principle for channel encoding
- Classification of various channel encoding techniques
- Linear block code: CRC
- Convolutional code

- Examples of channel encoding for wireless services
- Section Review: Q&A

#### Day 2

##### 5. Multiple Access Radio Systems

- Various wireless multiple access methods
- Parameters used to compare various access methods
- Review of FDMA
- Frequency reuse: concept and applications
- Cellularization
- Sectorization
- Channel assignment
- Performance vs. channel capacity
- TDMA concept
- TDMA architecture
- E-TDMA
- CDMA principles
- Direct sequence generator
- Example of CDMA operations
- Capacity comparison among FDMA, TDMA and CDMA
- Section Review: Q&A

##### 6. Modulation and Demodulation

- Modulation for digital signals
- Amplitude shift keying
- Frequency shift keying
- Phase shift keying
- Quadrature amplitude
- Wireless modulation examples
- Channel filtering
- Demodulation
- Eye diagram

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- Inter-symbol interference (ISI)
- Equalization
- Section Review: Q&A

### **7. Radios, Antennas and Radio Propagation**

- Radio transmission
- Radio waves
- Polarization
- Radiation pattern
- Antenna
- Review of dB and dBm
- Power budgeting
- Multipath transmission
- Fading
- Doppler shift
- Diversity