Wireless Local Area Networks
- WiFi and related technologies -

A three day seminar

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Seminar Outline

1.- The OSI 7 layers model for communications networks

2.- Access systems profiles and standards

3.- WLAN Concepts

- *Architecture*
- *Typical Applications*
- *WLAN vs. Wired LAN*
- *Logical Services*
  - Traffic Services
  - Services that Support Distribution Services
  - Access and Confidentiality *(WEP; WPA)*

4.- Radio Technologies - Basics

- *Time domain / frequency domain*
  - Fourier Series
  - Fourier transforms
  - Useful Fourier series
- *Modulation Techniques*
  - Basic techniques
  - Symbols
  - Quadrature Amplitude Modulation (QAM)

- polar coordinates
    - symbol representation
    - symbol generation
    - symbol reception
- I/Q coordinates
    - a bit of trigonometry
    - symbol representation
    - examples
    - symbol generation
    - symbol reception
- QAM constellations (patterns)

- *Antennas Basics*
    - Definitions
    - Directivity / Gain
    - Radiation Patterns
    - Multi Beam Antennas (MBA)
- *Power Budget Calculations*

5.- Spread Spectrum Radio Technologies

- *Spread Spectrum Modulation Techniques*
    - Spread Spectrum vs. Narrow Band
    - Beneficial Effects of Spread Spectrum
    - The Role of the Spreading Code
    - Types of Spread Spectrum Modulation
    - Spread Spectrum Frequency Bands
- *Direct Sequence Spread Spectrum (DSSS)*
    - Transmission / Reception without Interference
    - Effect of Single Tone Interference in Narrow Band Systems
    - Effect of Single Tone Interference in DSSS Systems
    - Effect of Interference from other DSSS Systems (collocation)
        - case a: data of same polarity
        - case b: data of opposite polarity

- Properties Imposed to the Spreading Sequence
- DSSS Conclusions
- IEEE 802.11 DSSS basic parameters
  - operation at 1 Mbps
  - operation at 2 Mbps
  - operation at 11 Mbps
  - operation at 5.5 Mbps

- *Frequency Hopping Spread Spectrum (FHSS)*
  - Transmission / Reception without Interference
  - Effect of Single Tone Interference in FHSS Systems
  - Effect of Interference from other FHSS Systems (collocation)
  - FHSS Conclusions
  - IEEE 802.11 FHSS basic parameters
- *FHSS vs. DSSS*
  - Systems Collocation
  - Interference Rejection
  - Near / Far Problem
  - Multipath
  - Throughput
  - Bluetooth interference
  - Roaming
  - Conclusions

6.- OFDM Radio Technologies

- *The Basic Idea*
  - Inter-Symbols Interference (ISI)
  - Frequency Division Multiplexing (FDM)
  - Inter Channel Interference (ICI)
  - Orthogonal FDM (OFDM)
- *Original constraints*
- *The modulation process*
  - Definitions

- Graphic representation of transmitted symbols
    - per subcarrier
        - time domain
        - frequency domain
    - per whole channel
        - time domain
        - frequency domain
        - conclusions
- Numerical representation of transmitted symbols
- Applying Inverse Fourier Transform (IFT)
    - understanding IFT
    - examples
    - conclusions
- Generating the low frequency (LF) signal
- Generating the radio frequency (RF) signal
    - double sided modulation
    - single sided modulation
- Selecting the symbol duration
- Basic block diagram
- Main parameters values

- *Implementation limitations*
    - Actual symbol rate
    - Actual number of sub-carriers
    - Actual channel capacity
    - Actual amount of data bits
        - Forward Error Correction (FEC)
        - Convolutional coding
    - Actual data rates
- *Block diagram*

7.- IEEE 802.11 - The WLAN Standard

- *Media Access Control (MAC) Layer*

- Overview
    - CSMA/CA vs. CSMA/CD
    - Coordination Functions
    - Type of Frames
    - Fragmentation and Reassembly
    - Multirate Support
    - Basic Frames Format
- Distributed Coordination Function
    - The Backoff Procedure
    - Basic Access
    - Setting the NAV
    - Sending Multiple Fragments
    - Re-transmitting Unacknowledged Blocks
    - Conclusions
    - Specific Frames Format
- Point Coordination Function
    - Basic Access
    - Conclusions
    - Specific Frames Format
- QoS Enhancements - IEEE 802.11e
    - QoS provisioning concepts
    - QoS provisioning in IEEE 802.11 DCF and PCF
    - Enhanced Distributed Coordination Function (EDCF)
    - Hybrid Coordination Function (HCF)
- MAC Layer Management
    - Synchronization (beacons)
    - Scanning
    - Authentication
    - Association
    - Synchronization / Authentication / Association
    - Power Management

- *Physical (PHY) Layer*

- Frequency Hopping Spread Spectrum (FHSS)
    - PHY Frame Format
    - The Transmission Chain
    - 32/33 Whitener Operation
    - The Modulator
    - Regulatory Requirements
    - Operating Frequencies
    - Channel Center Frequency
    - Hopping Sequences
    - Transmit Power Level and Receive Sensitivity
- Direct Sequence Spread Spectrum (DSSS)
    - PHY Frame Format
    - Operation at 1 Mbps
    - Operation at 2 Mbps
    - Operation at 11 Mbps
    - Operation at 5.5 Mbps
    - Operating Frequencies
    - Channel Center Frequencies
- Infrared (IR)