The Radio Channel and Antennas for Cellular Systems and PCS

A comprehensive, practical overview of the radiowave propagation channel characteristics in PCS presented by the author of the recently published course text book

Modern wireless system performance depends to a large degree on the air interface characteristics, and hence, on the optimal choice of antenna and the radio channel for any given application. In general, personal radio communications can be characterized by three distinct propagation issues: infrastructure site antennas interacting with local scatterers, urban radiowave propagation, and small antennas situated in proximity to the human body. These three diverse situations form the basis for the investigation of the personal communication path link in radio messaging systems. This course provides a comprehensive yet practical overview of the propagation channel segment for PCS application with special emphasis on non-voice systems. Selected examples of PCS radiolink characteristics will be presented throughout the course.

The course, presented by the author of the textbook, covers the historical perspective of personal communications systems, and includes a review of the underlying electromagnetics principles. Antennas employed at fixed sites in a terrestrial communications infrastructure, the mobile antennas, an overview of the radio communications channel, and a review of the applications specific to personal communications and the frequency spectrum are presented. The course also investigates specific problems associated with personal communications using an earth orbiting satellite infrastructure. Radiowave propagation along a plane earth, including methods to test site characteristics, is followed by investigations of urban and suburban radiowave propagation, and wave behavior in multipath environments. The specification and measurement of radio device performance, including human body effects and simulated body devices is detailed, along with the fundamental properties and limitations of small antennas proximate to the user. Design procedures for a communications system in re-use as well as a wide-area simulcasting environment are reviewed as well.

Applications and benefits:

You will benefit by enhancing your understanding of the :

- Fundamental antenna parameters and concepts.
- Fundamentals of radiowave behavior in urban areas.
- Basic propagation channel system design and calculations.
- Diversity reception.
- Radio/antenna performance parameters and their impact on path link margin.

Who should attend:

Systems Engineers and Technical Program Managers involved in personal communications system design and specification, and those who need an understanding of antenna performance in the environments where personal communications devices are used. Antenna Engineers who wish to broaden their understanding of antenna interaction in PCS environments. There is no prerequisite for this course; however, an engineering or science degree, or equivalent experience, is recommended.

Course Outline:

- **Introduction and Fundamentals**
- **The Radio Frequency Spectrum**

  ELF/VLF/HF/UHF/3 GHz and higher
  Picking an optimum frequency
  Multiple access techniques
- **Designing a Radio Communication System**

  Thermal noise, noise asymmetry
  Fixed-site antenna radiation patterns
  Link margins for specified performance
  Simulcast differential delay
  Proving coverage
- **Waves in Multipath Propagation**

  Statistical descriptions of signals
  Diversity transmission and reception techniques
- **Fixed Site Antennas**

  Array antennas
  Pattern shaping
  Multiple beam antennas
  Proximity effects in fixed-site antennas
- **Small Antennas**

  Quality factor, fundamental limitation
  Practical considerations in small antennas
- **Communications Device Performance**

  Measuring sensitivity of receivers
  Relating field strength to received power
  Compliance with RF exposure standards
- **Antennas near the Human Body**

  Simulated (SALTY) human body devices
  Body enhancement in body-worn receiver
- **The Radio Communication Channel**

  Guided waves
  Transmission lines
  The Friis transmission formula
  Wave polarization
- **Communications Using Earth-Orbiting Satellites**

  Satellite orbit fundamentals
  The satellite radio path
  Polarization effects
- **Two-Ray Path Propagation Model**

  Two-layer ground model
  An open field test range model
- **Radiowave Propagation in the Urban Paths**

  Theoretical and empirical propagation models
  Propagation within, near and into buildings
- **Selected Topics in Ultra-wideband Radio Technoloy**

Text: Kazimierz Siwiak and Yasaman Bahreini, ***Radiowave Propagation and Antennas for Personal Communications, Third Edition***, Norwood, MA: Artech House, 2007.

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