Hands-On

RF System Design

Course Description

This course teaches design engineers and technicians the key elements needed for designing Radio Frequency communications systems. The aim is to take experienced fixed wire telecommunications and data professionals from digital fixed line voice and data services and give them an understanding of the principles of radio link and coverage engineering so that they can successfully design and implement microwave, WiFi, WiMAX and simple private cellular mobile services.

The course introduces the elementary principles of radio frequency propagation in free space and over cable systems. Students will learn how to design links to match power budgets, calculate impairments, engineer correct polarization systems, determine antenna parameters and read coverage charts. Using spreadsheets students will design links in class case studies for point-to-point links, multi-link loops and areas cellular coverage.

This course teaches the key system parameters needed to specify and select the correct equipment such as Effective Radiated Power (ERP) Signal to Noise Ration (SNR), Received Signal Strength Indication (RSSI), Noise Figure (NF) and sensitivity. It includes a survey different kinds of test equipment classes and allows students to practice measurement of key system parameters. It teaches how to survey the location in order to position plant in the appropriate location and how to avoid interference with other services, and how to use the results in engineering a full system design.

Students Will Learn

- Describe The Basic Radio Principles Used In Modern RF Communications Systems
- Calculate Path Loss, Evaluate Fading Effects And Engineer Link Budgets
- Produce Block Level Designs Of RF Systems

- Analyze Antenna Polarization Options And Calculate Mismatch Effects
- Identify Interference Sources And Calculate The Effects Caused By Obstructions
- Plan Area Coverage Of RF Services For Single And Multi-Cell Applications
- Specify Test Equipment And System Test Procedures
- And More...

Target Audience

This course is geared for design engineers and technicians.

Prerequisites

This course assumes attendees already have basic knowledge of data communications, PCs and IP systems. No prior knowledge of radio or Wireless systems will be assumed.

Course Outline

Module I: Radio Principles

Designing to Service availability targets

Radio Transmission Principles

Radio Propagation

Frequency, Wave Length, Phase and polarization

Signal Power and Free Space Loss

Effective Radiated Power (ERP)

Polarization

Absorption

Diffraction

Reflection

Signal to Noise Ratio

Interference effects and Fading

MiMo and SiSo

Channel Allocation

Modulation

Amplitude, Frequency and Phase Modulation

QAM

Multi-Access Systems

FDM, TDM, TDMA, FHSS, DSSS, OFDM, CDMA

Frequency use

Overlapping channels

Noise and signal strength

Sensitivity, Feedback and Drift

Noise: sources and temperature

Module II: Antenna Systems

Classes of Antennas

Selecting the appropriate types

Antenna Loss and Gain

Point-to-point services

Area Coverage

Cellular coverage

Towers and Mountings

Static Mounts

Calculating Wind Effects

Loading and support

Antenna Tower Engineering

Static Self Supporting Systems

Guyed Systems

Hiding Antennas

Case Study Engineering Antenna System

Module III: Transmitters and Receiver

Transmitter and Receiver Characteristics

Classes of Transmitter

Transmitter Feeds

Classes of Receiver

Interfaces

Safety and Regulation Issues

Case Study Selecting Transmitters and Receivers for a Link

Module IV: Cable Plant

Digital Interfaces

Cable transmission fundamentals

Twisted pair Cables

Coaxial Cables Characteristics

Characteristic Impedance

RF Cable Signal Loss and Noise

Reflections and termination

Cable loss and noise

Splitters, Taps, Line Amplifiers, Attenuators and Connections

Optical Cables

Engineering Antenna Cable Feeds

Case Study Engineering Cable Plant

Module V: Area Coverage Systems

Single Cell Systems

Multi-Cell Systems

Frequency Selection and Allocation

Carrier Interference Effects

WiFi Coverage and Hot-Spots

Module VI: RF Link and System Engineering

Key Specification Parameters

Typical Link Applications

Identifying the Link Budgets

Frequency Selection

Transmission Path Loss calculation

Calculating the Antenna Height Required

Allowing for obstructions

Allowing for Interference

Feeder Loss

Allocating the Link Budget

Matching the receiver sensitivity

Matching design to service availability targets

Case Study Designing an RF System

Module VII: Radio Test Equipment

Element Testing

System Testing

Noise testing: Static, Noise temperature, SNR

Digital Interface testing: Network Analyzers

Radio Interface testing: Spectrum Analyzers

Cable Plant Testing: Time Domain Reflectometers

Hands-on Exercise Building and Testing a Simple Systems

Module VIII: Conformance and Delivery

System Testing and Performance Measurements

Reasons for System Testing

Types of Validation Test Measurements

Error Ratios

Spectrum and interference testing

Specifying Test & Troubleshooting Procedures

Verifying the Design

Validating the Service

Proving the Delivered Network matches the Specification

Case Study defining specification provability tests procedures

Evaluation and Review

Delivery Method

Instructor-Led with numerous case-studies and Hands-On exercises.

Equipment Requirements

(This apply's to our hands-on courses only)

BTS always provides equipment to have a very successful Hands-On course. BTS also encourages all attendees to bring their own equipment to the course. This will provide attendees the opportunity to incorporate their own gear into the labs and gain valuable training using their specific equipment.

Course Length

4 Days