

## Course Description

Mobile cellular telephone systems are today universally used throughout the developed world. The key issue in many locations however is the lack of good coverage. In some cases this is caused by topographical features of the geography of the area or the lack of cellular telephone masts near by. However in other cases coverage may be good for some users of one operator but very bad for another. It may also happen that black spots exist even when no topographical feature would seem to be present to cause it or that strong signals are indicated but calls drop for no apparent reason. These situations are a strong indication of radio interference sources cause problems.



To resolve such problems is a challenge for Radio Frequency Engineers. First it is necessary to fully understand the radio technology in use and how signals are encoded, decoded and engineered in fully working systems. Coverage will be affected by antennas and the coverage expected for different types of antenna systems must be understood. With this knowledge and good spectrum analyzers it is possible to examine radio signals in locations where interference is expected and identify the type of interference. Different types of interference exhibit different signal patters and from this experienced technicians can start to locate suspected interference sources.

This course provides an understanding of radio systems in the 850, 900, 1800 (PCS) and 2100 MHz bands used for cellular and mobile telephony and in the 2400 MHz used for WiFi systems. Students will use simple laptop computers, regular cell phones and Spectrum Analyzers to understand RF interference, expected antenna propagation and the patterns generated by interference sources on tester displays. They will use directional antennas to track interference and learn how to locate individual interference sources.

## Students Will Learn

- Describe the Radio Principles used in Modern RF Cellular Systems
- Calculate Path Loss, Evaluate Fading Effects on Signals and Interference Sources
- Analyze Antenna types and Identify their likely Coverage
- Identify Interference Sources and Calculate the Effects Caused by Obstructions
- Recognize the Effects of Different Types of Interference
- Use Test Equipment to Identify and Locate Interference Sources
- And More...

## Target Audience

This course is aimed at field technicians who require to learn how to detect, measures and locate interference sources on cellular phone, WiFi and wireless data networks.

## Course Outline

### Module I: Radio Principles

- Radio Transmission Principles
- Radio Propagation
- Frequency, Wave Length, Phase and polarization
- Signal Power and Free Space Loss
- Effective Radiated Power (ERP)
- Polarization, Absorption, Diffraction and Reflection effects
- Signal to Noise Ratio
- Interference effects and Fading
- Channel Allocation
- Modulation: Amplitude, Frequency and Phase Modulation
- QAM
- Multi-Access Systems: FDM, TDM, TDMA, FHSS, DSSS, OFDM, CDMA
- PCS and GSM system timing needs
- Frequency use
- Overlapping channels
- Coverage and what affects it
- Causes of drop-outs of calls

### Module II: Antenna Systems

- Classes of Antennas
- Antenna types used
- Antenna Loss and Gain
- Point-to-point services
- Area Coverage
- Cellular coverage
- Towers and Mountings
- Antenna Tower Engineering
- Hidden Antennas

### Module III: Noise and Interference

- Noise and signal strength
- Noise: sources and temperature
- Co-channel Interference
- Noise Types: Narrow band, Wide band, Impulse noise
- Effects of reflection
- Locating noise sources

#### **Module IV: Interference Testing**

Types of test equipment and the tests that it can perform  
Using Spectrum Analyzers to test and analyze normal signals  
Recognizing different kinds of interference  
Using directional antennas to locate interference sources  
Handing off descriptions of interference faults found

#### **Module V: Evaluation and Review**

### **Notes**

This course is gear toward Antenna / Test Equipment that is used by the attending company and/or technicians.

### **Delivery Method**

Instructor-Led with numerous Hands-On Labs and 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**

3 Days