Course ID
RFOPT
Course Duration
3-5 days

Course Title
RF Systems Optimization Workshop: GSM, GPRS, EDGE, UMTS, cdmaOne, 1xRTT, EVDO

Related Courses

- Traffic Engineering Models for Network Design (TRAFFIC, 3 days)
- Traffic Engineering Models for 3G Network Design (TRAFFIC3G, 2 days)
- EGPRS Engineering: Designing and Optimizing a GPRS/EDGE Network (EGPRS, 3 days)
- UMTS-TDD: Network Architecture, Operation, and Design (UMTSTDD, 2 days)
- Wireless Technologies: A Comparative Study (COMPARISON, 2-4 days)
- iDEN™: A Technology Overview (IDENO, 1 day)
- Microwave and Fixed Line-of-Sight Link Design Principles (MICROWAVE2, 2 days)
- TETRA: Network Architecture, Operation, and Design (TETRA, 3 days)
- HF/VHF: An Overview (HF-VHF, 1 day)
- Satellite Communications Principles and Design: A-to-Z of Modern Commercial and Military Satellite Systems (SATCOM, 2 days)
- WiMAX: The Technology (WIMAX-TECH, 2 days)

Aimed At

RF Engineers, drive testers and post-processing technicians, managers, and others responsible for wireless systems, whether cellular/mobile or other RF, who will benefit from a comprehensive understanding of RF optimization, spectrum utilization, spectrum planning, and capacity and quality of service management issues. An electrical engineering degree or equivalent background is desired, but not required.

Group Size

5-25

Prerequisites

- GSM: Network Architecture, Operation, and Design (GSM-I, 5 days)
- GSM: A Technology Overview (GSM-B, 1 day)
- GPRS: Network Architecture, Operation, and Design (GPRS, 3 days)
- EDGE: Network Architecture, Operation, and Design (EDGE, 2 days)
- UMTS-FDD: Network Architecture, Operation, and Design (UMTSFDD, 3 days)
- cdmaOne/IS95: Network Architecture, Operation, and Design (IS95, 2 days)
- Direct Sequence Spread Spectrum Techniques and CDMA-Based Technologies (CDMA, 2 days)
- 1xRTT: Network Architecture, Operation, and Design (1XRTT, 2 days)
- 1xEVDO: Network Architecture, Operation, and Design (EVDO, 2 days)

- Cell Planning and Site Development (CELLPLAN, 3 days)
- RF Propagation Models, Fading Characteristics, and Link Budget Analysis (RFPROP, 3 days)
- Antennas: Characteristics, Deployment, and the Future (ANTENNA, 1 day)
- RF Systems: Principles, Design, and Deployment (RFSYS, 3 days)
- Wireless Network Structure, Operation, and Technologies (WIRELESSNET, 3 days)

You should have at least two years of experience in the field of wireless communications and a good working knowledge of at least one major (GSM- or CDMA-based) wireless technology which can be acquired by taking one or more of the courses listed above.

Course In a Nutshell

In this comprehensive, three-to-five-day workshop (the exact duration depending on the desired technology coverage and depth), you will learn how to diagnose performance problems, perform root cause analysis, evaluate system tradeoffs, and make optimization decisions that will help you maintain and enhance the quality of service received by the subscribers of your network.

Covered in depth are the RF performance degradation issues, testing and measurement techniques, data collection methods, post processing techniques and tools, drive testing, model tuning, spectrum planning, hand off considerations, morphology analysis, cell splitting, antenna tilt azimuth, noise, SNR, BER, SIR, frequency planning, interference, and more. Whether your system employs a GSM- (such as GSM, GPRS, EDGE, EGPRS, UMTS) or CDMA-family (cdmaOne, cdma2000, 1xRTT, EVDO) technology, you will perform exercises that will help you make the bridge from the optimization theory to its real-world application.

Customize It!

We can customize this course, usually at little to no added cost, to adapt it to the needs of the RF system you're responsible for. We can also tailor the course to the special needs of a given audience, including:

- System designers and planners
- Network optimization and traffic engineers
- Drive test or post-processing technicians
- Equipment or application developers
- Information Technology (IT) professionals
- Less technical audiences such as managers, business planners, sales and marketing specialists, and operations and support personnel.

Course Outline

- Defining, Measuring, Troubleshooting, and Optimizing RF System Performance
  - RF engineering principles
  - Performance characteristics
  - Testing and measurement
  - Drive testing
  - Performance counters and Key Performance Indicators (KPIs)
  - Collection and post-processing of data
  - Root Cause Analysis (RCA)
  - Spectrum utilization
  - Dropped calls
  - Poor coverage
  - Hard handover failures
  - Soft handover failures
  - Overview of optimization process for FFR modulation technologies
  - Overview of optimization process for CDMA modulation technologies
- RF Operating Environment
  - RF propagation models
  - Link budget analysis
  - Path loss
  - Reflection
  - Okamura/HATA
  - Noise and interference
  - Polarization distortion
  - Diversity
  - Rayleigh effect
  - Detection of co-channel interference
  - Coverage maps
  - RF site acquisition process
  - Cell splitting process
- Antennas in the Context of RF Systems Optimization
  - Antenna properties, elements and performance characteristics
    - Impedance
    - Radiation
    - Polarization
    - Gain
    - Diversity
    - Antenna noise temperature
    - Dipole definition
    - Bandwidth
    - Radiation patterns
    - Antenna materials
    - Isotropic radiation theory
    - Effect of ground
    - Mutual impedance
    - Angle of incidence

        - Refractive index
        - Azimuth & downtilt
    - Types of antennas
        - Yagi
        - Slot
        - Omnidirectoinal
        - Monopoles and dipoles
        - Microstrip
        - Periodic/resonant
        - Reflector
        - Loop, slot, spiral, and horn
        - Microstrip patch, or patch antenna
        - Half-wave dipole
        - Folded dipole
        - Crossed dipole
        - Quadrifilar helix
    - Antenna arrays
        - What is an array?
        - How can arrays help in capacity and performance?
        - What are the tradeoffs of using antenna arrays?
        - Antenna array types: Log periodic dipole array, phased array coliner, Yagi-Uda, Broadside
    - Smart antennas
        - Operation
        - Basic components
        - Smart antennas tradeoffs
        - Beamforming
        - MIMO
        - Direction of arrival (DOA)
        - Switched beam
        - Adaptive array

- FFR Modulation Technologies
    - Frequency planning
    - Interference matrices
    - Neighbor planning
    - GSM logical channels (BCCH, FCH, SCH, SACCH, TCH, RACH)
    - Cell tiering
    - Frequency hopping
    - Congestion
    - RF parameter datafills
    - Picocells
    - Femtocells
    - Cell on wheels (COW)
    - In-building coverage
    - Towertop Mounted Amplifiers (TMA)
    - GPRS/EGRS overview and interfaces
    - GPRS attach process

- PDP context activation process
- Throughput measurements
- Impact of retransmissions on throughput
- LAC/RAC boundaries

- CDMA Modulation Technologies
  - PN planning
  - Soft handover border planning
  - FER
  - Mobile assisted power control
  - Ec/Io
  - SIR
  - Self generated system interference
  - System parameter optimization
  - Neighbor analysis and search window
  - ERP changes
  - Multicarrier optimization
  - Multiband optimization
  - Reverse link interference
  - Orientation changes
  - 1xRTT/1xEV-DO overview and interfaces
  - Measurement of data throughput
  - Towertop Mounted Amplifiers (TMA)
  - Picocells
  - Femtocells
  - In-building coverage
  - RF parameter datafills

- RF Optimization Process
  - Setting the optimization criteria
  - Optimization in CDMA networks (including W-CDMA)
    - Sources of information
    - Parameter investigation
    - Analysis of the existing RF plan
    - Performance of cell site audit
    - Multicarrier and multimode optimization
    - Post-processing and analysis of data
    - Corrective actions
  - Optimization in fractional frequency reuse networks
    - Sources of information
    - Interference matrices
    - Frequency reuse plan
    - Parameter investigation
    - Analysis of the existing RF plan
    - Cell tiering
    - Performance of cell site audit
    - Post-processing and analysis of data
    - Corrective actions

- Correlation of customer complaints to possible root cause (RCA)
  - Capacity and loading examples
  - Dropped call, poor coverage
  - Dropped call, system resources
  - Dropped call, other
- Mobile drive testing and data collection
  - Tools available
  - Post processing, what does it mean
  - Root cause analysis
  - Tracking and benchmarking
  - PN scanners and their capabilities

- Exercises: GSM/GPRS Optimization
  - Performance analysis
  - Optimization process
  - BCCH parameter optimization
  - Cell selection & reselection
  - Interference analysis
  - GPRS Attach
  - Routing area updates
  - Measuring throughput
  - Root cause analysis (RCA)
  - Final recommendations

- Exercises: CDMA2000 and 1xEV-DO Optimization
  - Performance analysis
  - Dropped calls
    - Poor coverage
    - Forward/reverse link interference
  - Specific neighbor list, search window and congestion
  - Managing excessive soft handoff
  - Multicarrier optimization
  - Intercarrier and intersystem troubleshooting
  - 1xRTT and 1xEV-DO throughput measurement
  - Overview of 1xRTT and 1xEV-DO
  - Optimization principles of 1xRTT data and 1xEV-DO

- Conclusion
  - Directions for advanced study
  - Course recap, Q/A, and Evaluations

How You Will Learn

- An experience RF engineer, who is also a good teacher, will teach this course in an interactive lecture/workshop format.
- Along with lecture, we will use activities, exercises, and case studies to make the content more practical and relevant to your own RF system.
- If you already know something about RF optimization, we will build on that to make it easier to learn new concepts and techniques.

- If your background is less technical, we will use pertinent examples and analogies to simplify this complex topic and make it more readily understandable.
- You will receive a copy of the instructor presentation to which you can add the information and insight provided in real-time, turning it into a useful reference resource.

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