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From 2 to 2.5 and 3G, Agilent Technologies offers end-to-end wireless network solutions and services that span all major wireless technologies. We offer a comprehensive set of service offerings that can help isolate networking issues and fully exploit your network’s opportunities.

**Services include:**

- Turnkey Design Services
- Competitive Benchmarking Surveys
- Fixed Network Engineering
- Complete System Optimization
- System Performance Analyses
- Specialty RF Design Services
- Wireless Technology Training
- Network Improvement Program

Our globally dispersed service offices, staffed with experienced RF and network engineers, provide turnkey network design, complete network optimization and performance analysis, competitive benchmarking, fixed network engineering and a full curriculum of wireless technical training courses. Call 1-800-952-8301 for more information on classes offered at Agilent’s new regional wireless service offices:

**Florida**
600 Atlantis Road
Melbourne, FL 32904
Phone: (321) 952-8300
Fax: (321) 725-5062

**Oregon**
15115 SW Sequoia Parkway, Suite 100
Portland, OR 97224
Phone: (503) 670-6424
Fax: (503) 670-6476

**Texas**
1410 E. Renner Road, Suite 100
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Fax: (972) 669-6736

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For detailed information on Agilent’s end-to-end solutions and services for wireless service providers visit: [www.agilent.com/find/serviceproviders](http://www.agilent.com/find/serviceproviders)
Agilent delivers a complete curriculum of in-depth wireless technical training for RF engineers, technicians, and other industry professionals. Written and taught by experienced RF engineers our courses give your team the theoretical and practical insight needed to effectively engineer your wireless network.

**Course topics include:**
- Drive Testing and Propagation Model Optimization
- Statistics and Propagation Modeling
- Link Budgets and Coverage Reliability
- Frequency and Traffic Planning
- Antenna Systems for Cellular Communications
- Wireless Technologies (IS-95, cdma2000, IS-136 TDMA, GSM, GPRS, W-CDMA UMTS)
- RF Planning Criteria for Wireless System Design

Online Course descriptions and registration information is available at: [www.agilent.com/find/serviceproviders](http://www.agilent.com/find/serviceproviders)

**General Information**

All Agilent Wireless Technical Training classes are written and taught by Agilent’s experienced RF engineers. Standard classes are limited to 20 students and software classes are limited to 12 students per session.

**Registration Procedure**

To enroll in classes offered at Agilent’s regional engineering offices, please complete the registration form at the back of this catalog and fax it to (321) 725-5062 along with a purchase order or letter of authorization. You may register by calling the Training Coordinator at (321) 308-8175. The following information is required in order to register for a course or course series:

- Your Name
- Company name
- Address
- Telephone and fax numbers
- E-mail address
- Class titles
- Class dates
- Names of students enrolling
- Number of students enrolling
- Purchase order number

[www.agilent.com/find/serviceproviders](http://www.agilent.com/find/serviceproviders)

**Course Schedules**

Classes are scheduled quarterly. Check our website, [www.agilent.com/find/serviceproviders](http://www.agilent.com/find/serviceproviders), for a current course schedule. Classes generally begin at 9:00 AM and end by 5:30 PM. Students are given a 1-hour lunch break and session breaks as necessary throughout the day.

**Tuition**

Agilent Wireless Technical Training Services fees are based on a one student per class rate. Course rates are subject to change without notice. Discounted rates are available for qualified customers. Call the Agilent Wireless Technical Training Coordinator at (321) 308-8175 for current prices and ask how to qualify for discounted rates.

**Student Cancellation Policy**

Enrollment may be canceled up to 10 days prior to the class date. Class cancellations made less than 10 days before the start of the course are subject to all tuition fees. Substitutions may be made up to five days prior to the class date. Course fees may be applied to other classes held in the same calendar year.

You will be responsible for all tuition costs if you do not cancel or do not attend class. To cancel enrollment, call the Training Coordinator at (321) 308-8175, or fax a notice of cancellation to (321) 725-5062.
Software Product Training
In addition to general wireless technical training, Agilent offers training on all components of the WIZARD software product line. These classes teach WIZARD users how to utilize this powerful engineering tool to its fullest potential. Class descriptions for software product training classes are included in the course description section of this catalog. Class size for all software product classes is limited to 12 students per session. Students attending software product training must bring computers installed with the latest release version of WIZARD and WIZARD CDMA. A limited number of computers may be available for use at Agilent’s regional engineering office classrooms. Please call for more information on computer availability.

On-Site Training
On-site training is often a convenient and cost-effective option for some companies. Agilent Wireless Technical Training is available for on-site presentations at customer locations world-wide.

On-site class presentations are scheduled based on instructor availability. In order to maximize our ability to meet your requirements, Agilent Wireless Technical Training requires four weeks of lead-time in scheduling on-site presentations. Preparations for on-site training are finalized upon receipt of a purchase order or a letter of authorization. On-site delivery requires a classroom or a conference room sufficient for training activities. Audio/visual equipment such as a LCD projector and student computers are also required. For more information about on-site training, please call the Agilent Wireless Technical Logistics Coordinator at (321) 308-8175.

Customers who contract with Agilent Wireless Technical Training for on-site training services will be billed for classes at the quoted tuition rate plus instructor travel expenses. Travel expenses are estimated in all quotes to perform on-site training services. These expenses are billed at actual rates upon course completion.

Certificates
All students who attend classes delivered by Agilent Wireless Technical Training Services will receive certificates for each class attended. Students must attend the entire class to be eligible to receive a certificate.

Class Cancellations or Changes
Modifications to scheduled classes may occur due to factors like changes in class content, class length, or class enrollment. Agilent Wireless Technical Training reserves the right to alter class content as well as to cancel, reschedule, and add class dates according to student demand. Agilent will make every effort to notify the students affected by these changes. The Agilent Wireless Service Provider website at www.agilent.com/find/serviceproviders is updated regularly to reflect such changes. Agilent accepts no responsibility for student expenses such as airline or hotel charges resulting from these types of changes.

Audio/Video Recording Policy
Agilent Technologies does not allow wireless technical training classes to be recorded through any electronic means without prior written consent. Please contact the Wireless Technical Training Coordinator at (321) 308-8175 for special requests.

Copyright Notice
Agilent Wireless Technical Training course materials are copyrighted ©2001 by Agilent Technologies. All rights reserved. No part of these course materials shall be reproduced, stored in a retrieval system, or transmitted by any means electronic or mechanical, including but not limited to photocopying, scanning, photographing, or otherwise recording without written permission from Agilent Technologies.

For More Information
For more information regarding Agilent Wireless Technical Training Services, call our Training Coordinator at (321) 308-8175 or fax your request to (321) 725-5062. Please also see our web site at www.agilent.com/find/serviceproviders

www.agilent.com/find/serviceproviders
Agilent Wireless Technical Training Packages

Agilent Technologies’ packaged set of wireless technical training provides a comprehensive set of course materials and instruction that address multiple areas of focus. Each curriculum explores the foundation of cellular networks and builds upon that base with the essential RF engineering procedures required for the deployment and maintenance of a mobile communications network.

Customized training packages are also available upon request. All training packages can be delivered anywhere in the world. Please call (321) 308-8175 for more information on customized wireless technical training from Agilent.

For detailed information on the courses listed below please turn to the Course Descriptions section of this catalog.

**RF Series I**

**Classes**

- **Day 1** Wireless Systems Overview
- **Day 2** Statistics and Macrocell Propagation Modeling
- **Day 3** Measurements in Wireless Mobile Communications
- **Day 4** Link Budgets
- **Day 5** Microwave Network Engineering

**Objectives**

This five-day package provides the student with a solid foundation in wireless communication networks for cellular applications. The series begins with the history of the cellular concept and its evolution into today’s personal mobile communications including network components, processes, and operations. Day 2 provides a clear mathematical and practical understanding of statistics and propagation modeling and its impact on the design of a network. Valuable wireless measurement processes are presented in a way that guarantees accurate and reliable data collection results. The series then covers link budget analysis, which allows the engineer to determine the nominal network coverage during the design stage and prepare for future growth during the network optimization stage. Next, students are introduced to microwave, LMDS, and MMDS networks by studying basic system architecture and design guidelines. By the end of this series, students will possess a general yet complete understanding of the past, present, and future of cellular communications.

**RF Series II**

**Classes**

- **Day 1** Traffic Planning
- **Day 2** Frequency Planning
- **Day 3** RF Planning for Cellular Networks
- **Day 4** Antenna Systems for Cellular Networks

**Objectives**

The RF Series II package thoroughly addresses the essential RF engineering procedures required for the deployment and maintenance of a mobile communications network. Next, the series explores processes, techniques, and tools available today to efficiently develop a frequency plan that yields maximum spectrum and resource utilization regardless of technology. The following step is to provide the student with sound engineering and statistical techniques that ensure efficient traffic resource planning for wireless networks under various operating conditions and growth scenarios. Once the specific processes have been explained in detail, the series presents the one process that ties all of the smaller steps into a comprehensive, reliable, repeatable, and effective RF design procedure. The series finishes with a session that covers theoretical concepts and practical applications of antenna systems and RF optimization in a cellular network. Upon completion of the series, the student will possess the skill set of a seasoned senior RF engineer who is ready to lead a team in any design and optimization effort.

[www.agilent.com/find/serviceproviders](http://www.agilent.com/find/serviceproviders)
CDMA Series

Classes

Day 1  Introduction to IS-95 CDMA Networks
Day 2  RF Planning of IS-95 CDMA Networks
Day 3  RF Optimization of IS-95 CDMA Networks
Day 4  Introduction to cdma2000 1xRTT Networks
Day 5  WIZARD IS-95 CDMA Training (optional)

Objectives

This five-day package provides the knowledge base required to design a network layout and optimize the air interface in IS-95 CDMA and cdma2000 1xRTT networks. The first course in the series covers the basic IS-95 CDMA terms and concepts required for a general understanding of the technology along with unique features such as CDMA call processing and soft handoffs. This is followed by Agilent’s detailed IS-95 CDMA design process which covers all the required action items necessary for the successful RF design and deployment of an IS-95 based CDMA network. The third course in the series provides the RF engineer with troubleshooting techniques that focus on processes that guarantee the optimization of an IS-95 CDMA network and include the use of planning tools, data analysis methods, and real-time optimization tips. The series then presents Agilent’s design and optimization procedures for 1xRTT cdma2000 networks, which highlights the factors that affect 1xRTT cdma2000 capacity and link quality, as well as traffic planning and integration issues of a cdma2000 carrier over an existing IS-95 network. Finally, for Agilent WIZARD customers, the optional WIZARD CDMA class trains engineers to use this powerful design tool to its maximum advantage in designing and optimizing an IS-95 or 1xRTT CDMA network.
Wireless Systems Overview

Target Audience
This introductory class is intended for entry-level engineers, sales personnel, support staff, and other industry professionals who need an introduction to or a refresher on the basics of wireless telecommunications engineering.

Course Description
This one-day class presents the historical facts of wireless communications and the subsequent evolution into today’s personal mobile communications. Emphasis is placed on the network components (switching systems, transmitters, mobile units), processes (i.e. handoffs, call origination, roaming), and operations (i.e. frequency planning, traffic planning, optimization) to ensure an overall understanding of today’s networks. Simple math is used to explain concepts such as propagation and traffic analyses, while block diagrams illustrate processes such as call flow and optimization techniques. Finally, the trainee is presented with an overview of the evolution of cellular communications from first generation analog to today’s digital and tomorrow’s third generation networks.

Objectives
• Explain the origins of today’s wireless communications for mobile applications
• Describe the different types of networks in operation today while explaining the basics of multiple access technologies
• Identify the main components in a cellular and, PCS network and gain a general understanding of how they interact with each other
• Teach the call flow process from call origination to call termination
• Provide the basic engineering processes and procedures involving the design and optimization of a cellular network
• Introduce the trainee to the basic principles of RF propagation
• Familiarize the trainee with the basic principles of link budget analysis
• Present the basics of frequency and traffic planning engineering
• Explain the basics of antenna systems

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
The student should be familiar with college level algebra.

Length
8 Hours
Statistics and Macrocell Propagation Modeling

Target Audience
This class is intended for both intermediate and experienced RF engineers interested in exploring statistics and propagation modeling.

Course Description
This one-day class presents the mathematical principles and practical implementation associated with macroscopic and microscopic propagation modeling. The course presents a general overview of statistical tools that are useful and necessary to facilitate the understanding of the complex propagation phenomena. During the session, the instructor will cover today’s most widely used macroscopic propagation models: Lee and Hata-Okumura (COST 231 is also covered, but in less detail). The discussion is followed by an introduction to microscopic propagation models and their implementation in today’s dense urban environments. For students that are familiar with Agilent’s network planning tool, WIZARD, specific processes are covered to show functionality and accuracy of the propagation prediction processes when complemented with proper data collection techniques. The instructor then introduces digital elevation terrain models and the issues involving their use in propagation predictions. A description of how they are derived, as well as the various methods of interpolation used for creating terrain databases are presented. Upon course completion, the student will have the background knowledge to understand how to interpret the propagation phenomena using basic statistics. Students will also know how to properly setup and utilize a propagation prediction tool to aid in the design and optimization of a network.

Objectives
• Discuss the importance of statistical analysis and review the required background
• Describe the propagation decay phenomenon and its associated parameters
• Help students identify and understand the reasons for performing propagation modeling
• Explain the development of measurement based propagation models along with their advantages and limitations
• Define today’s most used macroscopic propagation models: Lee, Hata-Okumura, COST 231
• Optimize the Lee and Hata-Okumura propagation prediction models utilizing WIZARD
• Instruct how to model obstructions (knife edge diffraction) and local terrain variations (effective antenna height) using Lee’s approach
• Define bin size and associated terrain resolution and their effects on computation time
• Explain how the terrain grid and local area means affect the interpretation of the collected data
• Describe the various methods of interpolation used to create terrain databases
• Describe the relationship between processing speed and terrain resolution

Class Materials
A course handbook with student exercises is provided. The student will need a scientific calculator.

Prerequisites
The student should be familiar with college level algebra and basic statistics.

Length
8 Hours

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Measurements in Wireless Mobile Communications

Target Audience
This class is intended for entry level to experienced RF engineers who are interested in the various types of drive testing procedures and RF data collection techniques used for design, verification, optimization, and benchmarking of wireless networks.

Course Description
This one-day class presents both the theoretical and practical aspects of the various wireless measurement processes that can take place during the initial stages of network deployment all the way through the optimization of a mature network. Emphasis is placed on identifying detailed, accurate, and reliable data collection procedures that are independent of collection equipment and access technology. Test setups for various field applications (crane, tower, rooftop) are discussed in detail to ensure that processes are clearly understood, and to instill the importance of safety during testing. Some of the measurement processes discussed are site validation, propagation model optimization, spectrum clearance, interference studies, network optimization, and comparative analysis (benchmarking), among others. Propagation, antennas, coverage, mathematical conversions, and units of measure used in wireless systems engineering are also discussed. Upon course completion, the trainee will understand how to collect, process, evaluate, and validate RF data for cellular, PCS, and microwave applications. Furthermore, the trainee will have a clear understanding of the different types of drive testing techniques and the role of each technique in the design and optimization of a network.

Objectives
• Discuss the importance of wireless measurements
• Teach wireless measurement theoretical concepts and apply them in practical situations
• Provide an overview of various drive testing techniques
• Familiarize with the various test setups and procedures
• Emphasize the importance of safe operating procedures during the wireless measurement process
• Describe the propagation decay phenomenon and its associated parameters
• Teach techniques for analyzing collected data
• Familiarize with different measurement equipment and tools
• Examine real world examples

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
The student should be familiar with college level algebra.

Length
8 Hours
Link Budgets

Target Audience
This class is intended for both entry level and experienced RF engineers who are interested in learning more about link budget analysis.

Course Description
This one-day class presents an introduction to link budget analysis and its importance in the design and optimization of a mobile communications network. Agilent’s approach to link budgets extends beyond the calculation of gains and losses of the radio link. The process introduced in this course allows the RF designer to determine the nominal coverage area of a base station at the desired coverage reliability and signal quality targets. Furthermore, the course introduces ways of using link budget analysis as an aid in network optimization and future network growth. Some of the concepts introduced include path loss analysis, boundary reliability, area reliability, reliability fade margins, and balanced paths. This class reviews the basic statistical background necessary to guarantee a clear understanding of the aforementioned concepts. Multiple examples of link budgets for various technologies are evaluated, and the differences among them are highlighted.

Objectives
• Describe the basic statistical concepts required for link budget analysis
• Define the concepts of boundary reliability and area reliability
• Explain the need for a reliability fade margin when computing losses and gains for downlink (DL) and uplink (UL) transmission paths
• Teach what a link budget analysis is and how to apply it to wireless system engineering
• Identify important line items in the link budgets for base station (BS) and mobile station (MS) transmit and receive paths for GSM, North American TDMA, AMPS, and CDMA technologies
• Define the application of building penetration loss, vehicle penetration loss, and other environmental loss factors in the link budget
• Explain the need for a balanced path between the UL and DL transmission paths in a wireless system
• Calculate the coverage bands to be shown on propagation plots
• Describe the application of link budgets to nominal cell planning and network optimization

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
This class assumes that the student is familiar with probability density functions and their applications in RF engineering.

Length
8 Hours
Microwave Network Engineering

Target Audience
This class is intended for both entry level and experienced RF engineers interested in learning more about point-to-point terrestrial microwave communications.

Course Description
This one-day course familiarizes RF engineers with the nomenclature, basic operations and design procedures of point-to-point terrestrial microwave communications. Students will learn to design a microwave hop including path profiles, power budgets, and equipment selection. This is followed by an introduction to Local Multi-Point Distribution Systems (LMDS) and Multi-Channel Multi-Point Distribution Systems (MMDS). The course covers the basic system architecture for each type of network, as well as basic design guidelines, link analysis, parameters of interest, and spectrum requirements. Finally, the course briefly addresses topics on interfacing microwave and cellular networks.

Objectives
• Present the frequency bands for microwave, LMDS and MMDS communications
• Introduce microwave, LMDS and MMDS system architectures
• Describe microwave’s electrical interfaces with cellular systems
• Teach the role of antennas, microwave radios, and digital multiplexing
• Explain microwave propagation
• Compute link performance predictions
• Describe path profiling, link design, frequency planning, and interference considerations
• Discuss the similarities and differences among the various Point-to-Point and Point-to-Multi-Point communication networks

Class Materials
A course handbook including student exercises is provided. Practice topographic maps are also provided. The student will need a scientific calculator and an engineering ruler.

Prerequisites
The student should be familiar with college level algebra.

Length
8 Hours
traffic models
• Determine which traffic model is appropriate for certain traffic scenarios
• Use traffic model equations and the tables to determine the required number of voice or data channels for specified traffic projections and GOS objectives
• Identify the input parameters required to generate traffic projections
• Describe the various strategies that wireless engineers use to relieve traffic congestion in a system

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
The student should be familiar with college level algebra and basic cellular engineering concepts.

Length
8 Hours

Traffic Planning

Target Audience
This class is intended for both intermediate and experienced RF engineers looking for an introduction to traffic engineering for mobile communications.

Course Description
This one-day class introduces the importance of traffic analysis in the provisioning of optimum wireless networks. The course is divided into four general areas: terminology and background knowledge, traffic models for voice applications, traffic models for data applications, and engineering applications and techniques. The student will walk away with sound engineering and statistical techniques useful for the appropriate allocation of traffic resources for wireless networks under a variety of operating conditions and growth scenarios. Class topics include Erlang B, Erlang C, Poisson and data traffic models, traffic planning for a startup system vs. an established system, and strategies for relieving traffic congestion.

Objectives
• Define all units of measure in traffic engineering
• Describe the concept of Grade of Service (GOS) and its impact on the number of required voice channels
• Instruct how to interpret the most important traffic resource planning parameters
• Familiarize the impact of seasonal trends and special events on traffic projections
• Identify and understand the assumptions made for all traffic models and the assumptions that are specific to particular
Frequency Planning

Target Audience
This class is intended for both entry-level and experienced RF engineers interested in learning more about frequency planning.

Course Description
This one-day course introduces the RF engineer to the theoretical concepts of frequency reuse and their practical implementation in everyday design scenarios. The course begins with the historical evolution of frequency reuse and the cellular concept, followed by important theoretical information on reuse schemes, sectorization, interference, capacity and other key elements of frequency planning. The class will explore a detailed channelization process that guarantees (independent of technology or network size) a thorough but time efficient allocation of resources. This process includes steps such as traffic evaluation, propagation model optimization, permissions matrix generation, control channel dimensioning, and multi-technology interface management. The session then addresses evaluation issues including (but not limited to) penalty definitions, equipment implementation, neighbor list changes, retune costs, and frequency coordination. Following this discussion is a section on advanced techniques in frequency planning. Some of the techniques discussed are frequency hopping, HCS, ACA, DCA, super reuse, and overlay/underlay. Finally, the course addresses the popular concept of Automatic Frequency Planning (AFP) as implemented by Agilent Technologies' tool, CellOpt. At course completion, the student will be able to identify the processes to follow, techniques, and tools to efficiently plan for maximum spectrum utilization and optimal capacity.

Objectives
- Define the concept of frequency reuse
- Describe the benefits and drawbacks associated with various reuse plans
- Select the appropriate reuse plan for a given technology performance criteria
- Describe, develop, and apply a reuse matrix and channel plan templates
- Frequency plan for the different technologies available in wireless communication systems
- Describe and develop frequency plans at the set, group, subset, and channel level
- Define minimum serving signal, bias between adjacent cells/sectors, and channel spacing as they affect frequency planning
- Familiarize with advanced frequency planning techniques
- Teach the concepts and implementation of automatic frequency planning

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
The student should be familiar with college level algebra and basic cellular engineering concepts.

Length
8 Hours

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RF Planning of Cellular Networks

Target Audience
This class is intended for both intermediate and experienced RF engineers interested in new techniques to design and deploy a mobile communications network.

Course Description
This one-day class presents in detail the processes developed by Agilent Technologies to design and deploy a mobile communications network. Years of experience and numerous design and optimization contracts have established the foundation for this comprehensive set of RF design procedures. This course covers in depth all activities required at the initial, intermediate, and final stages of network dimensioning and deployment. Some of the more general processes include nominal design, market evaluation, propagation model optimization, preliminary design, and final design. Some of the more specific topics addressed during these stages include capacity evaluation, link budget analysis, drive testing configurations, morphology evaluation, population served, target areas, competing markets evaluation, site evaluation, document trails, and many more. The engineering processes and procedures presented are not technology specific. The procedures presented are comprehensive, reliable, repeatable, and effective in the design of any mobile communications network.

Objectives
- Define the various stages of network design
- Describe how to organize each stage of network design
- Show the impact that various link budget assumptions can have on the network layout
- Familiarize with the tradeoffs between cost and all pertinent engineering requirements
- Define the deliverables required at the completion of each stage
- Identify the objectives for market evaluations conducted at various times during the design
- Explain how a final design is a continuation of the design process based on system growth and changing requirements
- Describe how topographic maps are used in RF engineering applications
- Familiarize with pertinent FCC/FAA engineering requirements and forms

Class Materials
A course handbook including student exercises is provided.

Prerequisites
The student should be familiar with college level algebra and basic cellular engineering concepts.

Length
8 Hours
Antenna Systems for Cellular Communications

Target Audience
This class is intended for engineers with some wireless system planning experience, field engineers, field technicians, and experienced RF engineers.

Course Description
This one-day course provides theoretical fundamentals and practical applications of antennas in the mobile communications world. The course starts by familiarizing the student with antenna theory and fundamental antenna parameters as they apply to cellular communications. Special topics of interest such as space diversity, polarization diversity, smart antennas, interference avoidance techniques, downtilting techniques, and antenna selection are covered in detail. Students will learn how to combine the previously mentioned topics into a practical and effective process that has proven to aid engineers in the optimization of RF coverage in a cellular network.

Objectives
- Describe the role of antennas in cellular communications
- Identify and explain essential antenna parameters
- Familiarize with different types of antennas for different applications within cellular communications
- Discuss and understand the application of space diversity vs. polarization diversity
- Instruct how to select antennas to maximize reliable coverage and signal quality
- Implement effective downtilts for different types of propagation environments
- Convey the importance of RF control and how antenna selection helps
- Familiarize with the joint role of propagation prediction tools and antennas in optimization of RF signal throughout a geographical region

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
The student should be familiar with college level algebra, basic cellular engineering concepts, and basic propagation theory.

Length
8 Hours
Introduction to GSM Networks

Target Audience
This class is intended for both entry-level and experienced RF engineers.

Course Description
This one-day class introduces trainees to GSM, the world’s most widely used cellular standard. The course presents the historical events that led to the development of the standard and its eventual proliferation throughout the world. System architecture, network features, air interface parameters, capacity calculations, frequency management, and engineering parameters are just some of the topics covered. Also covered are design processes that allow for a systematic and repeatable design and evaluation of any GSM network. In the end, students are presented with GSM’s migration path toward 2.5G (GPRS) and 3G (UMTS). Students who attend this course will gain a thorough understanding of GSM technology, its derivatives, and its future.

Objectives
- Review the historical evolution of GSM-based cellular systems
- Describe the physical characteristics of the air interface
- Review the GSM system organization
- Familiarize with GSM features such as authentication, privacy, encryption, time advancing, and network services
- Teach how to perform RF planning for GSM
- Explain the differences between frequency planning for GSM and other non-GSM FDMA/TDMA based networks
- Review equipment specifications for GSM and their impact on link budget analysis
- Present basic GSM system optimization processes

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
This class assumes a basic understanding of RF cellular systems and propagation.

Length
8 Hours
GPRS Network Design and Optimization

Target Audience
This class is intended for both intermediate and experienced RF engineers.

Course Description
This one day class presents techniques developed by Agilent Technologies to design, evaluate and optimize GSM/GPRS networks. The course begins by evaluating the evolution from GSM to GPRS and identifying the areas where this impacts the network dimensioning processes. Areas in the design process that are technology independent are reviewed, while areas with distinct technological differences are studied in detail. This is followed by an in depth analysis of the major challenges associated with migrating to GPRS and the inevitable engineering and business tradeoffs that accompany these challenges. For instance, emphasis is placed on the major challenge of modeling for data traffic with a network configuration that was designed to support voice traffic.

Objectives
• Describe the physical characteristics of the GPRS architecture
• Identify GPRS parameters that are relevant in the RF planning process
• Present GSM/GPRS interoperability and overlay
• Familiarize with GPRS features and how they work within the existing GSM infrastructure
• Identify RF planning similarities between GSM and GPRS
• Identify RF planning differences between GSM and GPRS
• Introduce the data traffic modeling scheme that allows for adequate resource allocation in a GPRS network
• Teach how to model for multiple services within the same network
• Explain the frequency planning considerations that come along with GPRS deployment
• Familiarize with how RF planning tools can help with GPRS planning
• Teach how to modify a GSM link budget to include GPRS infrastructure
• Present basic GPRS system optimization processes

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
This class assumes a basic understanding of RF cellular systems and propagation. Additionally, the student should be familiar with GSM networks or previously attended Introduction to GSM Networks.

Length
8 Hours
Introduction to TDMA IS-136 Networks

Target Audience
This class is intended for both entry-level and experienced RF engineers.

Course Description
This one-day class presents the United States PCS digital standard, IS-136, also known as North American TDMA. The session addresses the chronological events that led to the development and deployment of this technology in the United States and later in other parts of the world. Topics for discussion include TDMA development, system architecture and network features. Moreover, the course presents TDMA RF planning issues such as link budget analysis, interference avoidance, frequency planning, capacity calculation, power control, and call processing. Emphasis is placed on those engineering parameters that most affect network dimensioning, thus affecting the bottom line network deployment cost the most. Finally, students are introduced to the NA TDMA IS-136 migration path toward 3G (EDGE and UMTS). By attending this course, the student will gain a thorough understanding of the current status of this technology as well as its future.

Objectives
- Review TDMA IS-136 history and development
- Describe the physical characteristics of the air interface
- Present the IS-136 system architecture
- Familiarize with IS-136 features such as non-public operation, time advancing, sleep mode, authentication, hierarchical cell structures, and network services
- Identify parameters of importance for RF planning such as handoff thresholds, DCCH selection process, and others
- Teach the essential ingredients for IS-136 network dimensioning. (To include link budget analysis, frequency planning, capacity allocation, among others.)
- Explain the differences between frequency planning and network dimensioning for IS-136 and other FDMA/TDMA based networks
- Review equipment specifications for IS-136 and their impact on link budget analysis
- Familiarize with the IS-136 call process
- Present methods for IS-136 system optimization

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
This class assumes a basic understanding of RF cellular systems and propagation.

Length
8 Hours
Introduction to IS-95 CDMA Networks

Target Audience
This class is intended for both intermediate and experienced RF engineers, technicians, and managers.

Course Description
This one-day class introduces RF engineers to the basic properties of the Code Division Multiple Access (CDMA) standard, IS-95. Initially, the course covers the basic differences among the most popular and traditional multiple access techniques (FDMA and TDMA) employed in mobile communications today as they relate to CDMA. Essential CDMA terminology such as correlation, coherent combination, soft handoff, power allocations, pilot Ec/Io, and traffic Eb/Nt are examined, along with an overview of the call flow process implemented in IS-95 CDMA. Factors affecting the theoretical and practical capacity of CDMA systems are discussed in an effort to allow the trainee to make a realistic assessment of potential capacity advantages offered by CDMA. The unique aspects of CDMA call processing and handoffs are presented along with a synopsis of IS-95 CDMA engineering design issues. The end goal of the course is to provide the trainee with the IS-95 CDMA terms and concepts required for a general understanding of the technology.

Objectives
• Introduce the historical development of CDMA technology as implemented by IS-95
• Describe the physical characteristics of the air interface
• Explain the physical and logical channels within IS-95 CDMA
• Familiarize with IS-95 CDMA network architecture
• Identify parameters of importance for RF engineering such as handoff thresholds, pilot channel coverage, capacity calculations, soft handoff management, and many others
• Define call quality, how it is measured, and how it influences system capacity and coverage
• Learn the primary components required for IS-95 CDMA network planning
• Explain the main differences between RF planning for IS-95 CDMA and planning for any other type of network
• Familiarize with the IS-95 call flow process
• Describe some basic concerns associated with engineering a CDMA system

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
This class assumes a basic understanding of wireless digital and analog communications systems.

Length
8 Hours
RF Design of IS-95 CDMA Networks

Target Audience
This class is intended for both intermediate and experienced RF engineers and system engineers involved with the design and operation of CDMA systems.

Course Description
This one-day class presents Agilent Technologies’ system design and dimensioning process for IS-95 CDMA networks. This course provides a detailed step-by-step process that encompasses all tactics necessary for the successful RF design and deployment of an IS-95 based CDMA network. Some of the stages included in the process are morphology evaluation, nominal cell planning, propagation model optimization, and candidate analysis, among others. The course places emphasis on the multiple steps taken within these stages. Some of these steps are spectrum clearing, terrain verification, site visits, propagation parameter validation, data collection, link budget generation, capacity calculations, and many others. Furthermore, the instructor will identify and evaluate the factors that influence CDMA system capacity and link quality to clarify the relationship between capacity and coverage. CDMA traffic planning is addressed in detail, as well as the issues that arise when integrating a CDMA carrier into an existing cellular system.

Objectives
• Define the various stages of IS-95 CDMA RF planning and design
• Describe all of the IS-95 relevant steps within each stage of the design process
• Show the impact that various link budget assumptions can have on the network layout
• Identify the parameters that affect system loading and understand the role of each in network dimensioning
• Describe forward and reverse link limitations due to operational and environmental factors
• Familiarize with the tradeoffs between cost and all IS-95 engineering requirements
• Describe the basic process associated with resource allocations to meet anticipated system Erlang demand
• Develop the spectrum clearing requirements and implementation processes as a function of CDMA system capacity, frequency of application, and existing infrastructure
• Define the deliverables required at the completion of each stage
• Identify the objectives for market evaluations conducted at various times during the design
• Explain how the final design is a continuation of the design process based on system growth and changing requirements

Class Materials
A course handbook with student exercises is provided. The student will need a scientific calculator.

Prerequisites
This course assumes a basic understanding of CDMA technology and various modeling techniques associated with coverage predictions.

Length
8 Hours
RF Optimization of IS-95 CDMA Networks

Target Audience
This class is intended for RF and senior RF engineers involved with the system design, implementation, and optimization of IS-95 CDMA networks.

Course Description
This one-day class provides the RF engineer with the necessary troubleshooting techniques to optimize IS-95 systems. This third class in the CDMA series builds on the concepts presented in Introduction to IS-95 CDMA and RF Design of IS-95 CDMA Networks. The course will focus on Agilent Technologies’ proven IS-95 CDMA optimization process. The course describes the processes that guarantee the optimization of a network by first tackling those parameters that most influence the bottom line (coverage, capacity, quality, and cost). Some of the parameters that are optimized are pilot channel coverage (Ec/Io and power boundary), Frame Erasure Rate (FER), mobile transmit power, total received power, handoff percentages, neighbor lists, and others.

Although the IS-95 CDMA standard offers a myriad of tunable parameters, the course emphasizes on the optimization of those dealing with the quality and quantity of CDMA signal in the environment. Nevertheless, important technology parameters (such as pilot thresholds, RAKE window sizing, channel gains, power control parameters) are evaluated along with their corresponding troubleshooting tips. Valuable information regarding the role of planning tools, collection equipment and techniques, data analysis methods, and real-time optimization tips are presented in detail.

Objectives
- Identify IS-95 parameters that are relevant in the RF optimization process
- Teach optimization processes that take into account issues such as coverage, resource allocation, build-out plans, capacity requirements, and land classification
- Familiarize with data analysis techniques at layers 1, 2 and 3
- Teach the value of modeling tools in the optimization process of an IS-95 network
- Define potential acceptance optimization thresholds for IS-95 parameters
- Explain the importance of RF control in IS-95 CDMA systems
- Introduce switch information that is relevant and essential in the optimization process
- Familiarize with neighbor list optimization and PN offset planning
- Describe the mechanisms and impact of cross technology interference and methods to reduce its effect on system performance

Class Materials
A course handbook including student exercises is provided. The student will need a scientific calculator.

Prerequisites
The student should have a good working knowledge of cellular system concepts and CDMA technology.

Length
8 Hours
Introduction to CDMA2000 1XRTT Networks

Target Audience
This class is intended for both intermediate and experienced RF engineers and system engineers involved with the design and operation of CDMA systems.

Course Description
This one-day class introduces the third generation digital cellular standard cdma2000 1xRTT. This course builds on the concepts presented in Agilent’s IS-95 CDMA series. It introduces new terminology and unfolds the evolution process of such networks into third generation compliant 1xRTT systems. The initial focus of the course is to identify and study the new air interface parameters, network components, and performance indicators that are relevant to RF planning, while reviewing those that remain unchanged in the evolution from IS-95 to 1xRTT. The course materials also focus on adjusting Agilent’s IS-95 CDMA design and optimization procedures to meet the requirements of a 1xRTT cdma2000 network. In doing so, students will learn to identify and evaluate the factors that affect 1xRTT cdma2000 capacity and link quality. Students will also become familiar with the inherent issues regarding cdma2000 traffic planning and integration of a cdma2000 carrier over an existing IS-95 network.

Objectives
- Describe requirements placed before 3G communication services
- Specify the general layout of the cdma2000 1xRTT network
- Identify new cdma2000 parameters and their relevance in the RF planning process
- Explain IS-95/cdma2000 interoperability and overlay issues
- Familiarize with cdma2000 features
- Identify RF planning similarities between IS-95 and cdma2000
- Identify RF planning differences between IS-95 and cdma2000
- Describe packet data implementation for cdma2000
- Teach how to model for multiple services within the same network
- Familiarize with how RF planning tools can help with cdma2000 planning
- Teach how to modify an IS-95 link budget to account for cdma2000 infrastructure
- Estimate coverage and capacity of the cdma2000 system

Class Materials
A course handbook with student exercises is provided. The student will need a scientific calculator.

Prerequisites
This course assumes a basic understanding of CDMA technology and various modeling techniques associated with coverage predictions.

Length
8 Hours
Introduction to W-CDMA UMTS-FDD Networks

Target Audience
The course is intended for RF and senior RF level engineers who are interested in becoming versed in UMTS-FDD W-CDMA third generation technology.

Course Description
This two-day course presents an introduction to the third generation digital cellular standard, UMTS-FDD. The course presents a historical review of the development of the UMTS-FDD standard as a solution for third generation wireless communication. The course then reviews the GPRS infrastructure and its role as an essential component of the UMTS network architecture. Although the course identifies and explains essential terminology within the standard, emphasis is placed on the information the RF engineer can use for the purpose of RF planning and optimization of a UMTS-FDD network. Moreover, the material addresses the vital issue of modeling voice and data traffic and maintaining the desired Quality of Service (QoS). Through this course, students will gain practical knowledge of the UMTS-FDD features and system operation. Factors affecting UMTS capacity are discussed along with call processing, handoffs and other essential engineering issues relevant in the design and optimization process.

Objectives
- Describe requirements placed before 3G communication services
- Specify the general layout of the UMTS communication network
- Identify the most prominent characteristics of the W-CDMA air interface
- Specify the steps of the UMTS network design process
- Explain the role and the use of network planning tools
- Estimate coverage and capacity of the UMTS system
- Describe packet data implementation for UMTS-FDD
- Specify major RF optimization tools and procedures

Class Materials
A course handbook with student exercises is provided. The student will need a scientific calculator.

Prerequisites
This course assumes a basic understanding of CDMA technology and various modeling techniques associated with coverage predictions.

Length
16 Hours
Agilent Software Products for Service Providers Course Descriptions

Essentials of WIZARD

Target Audience
This class is intended for RF engineers who use the WIZARD wireless network planning tool to design and optimize wireless telecommunication systems. Class size is limited to 12 students per session.

Course Description
This three-day class provides students with the knowledge and skills needed to operate WIZARD and details the efficient use of this software to manage project data and perform analyses. Upon completion of the class, students will know how to utilize WIZARD to manage project data, perform engineering analyses, and export data from WIZARD to aid in the creation of presentation material including plots and tabular data.

Objectives
- Describe how WIZARD works and why planning tools are used
- Instruct students how to understand, access and edit projects
- Explain terrain and the bin grid resolution
- Define the entity hierarchy and its use
- Run and interpret coverage and interference analyses
- Explain cell colors
- Load and import data.
- Predict microwave paths using the WIZARD microwave path profile tool
- Compare and merge project data
- Display existing tower and airport locations
- Create channel plans manually and interactively with the permission matrix
- Optimize and integrate WIZARD with measured data
- Describe the permission matrix and its uses
- Create FCC contours and forms (for required users)
- Use clutter and land use data
- Export and delete data

Class Materials
A course handbook including student exercises is included. The student is responsible for providing a computer with the latest release of WIZARD installed for use in this class. Having MapInfo and Microsoft® Excel installed is also helpful but not required.

Prerequisites
This class assumes a basic understanding of RF cellular systems and propagation. It is suggested that the student attend the course Wireless Systems Overview before taking this class. The student should also have completed the tutorial included in the WIZARD User’s Guide.

Length
3 Days
WIZARD IS-95 CDMA Training

Target Audience
This class is intended for intermediate to experienced RF engineers who are involved with the design and operation of CDMA systems. Class size is limited to 12 students per session.

Course Description
This one-day class teaches students how to use the WIZARD CDMA module to design a CDMA system and demonstrates the performance and behavior of a CDMA system. Basic IS-95 features and some advanced CDMA planning techniques are covered. This class introduces the algorithms used in WIZARD to compute CDMA forward and reverse link coverage. Classroom exercises illustrate the relationship of forward and reverse link coverage to assumed system loading and other design parameters.

Objectives
- Describe how propagation modeling tools may be applied to the design and optimization of a CDMA system
- Define the basic algorithms that may be applied in predicting CDMA coverage and call quality
- Build a CDMA system in WIZARD and assign basic operation parameters
- Interpret WIZARD CDMA static analyses including:
  - Pilot channel Ec/Io
  - Pilot delta
  - Pilot power boundaries
  - Forward and reverse link performance
  - User-specified mobile distributions
  - Total receive power
  - PN offset interference
- Familiarize with Monte Carlo techniques implemented in the module
- Teach students how to interpret Monte Carlo statistics and reports
- Describe the effects on system performance of adjustments in T_ADD, T_DROP, building attenuation values, system loading, and other system parameters

Class Materials
A course handbook including student exercises and a CDMA project on floppy disk are provided. The student is responsible for providing a computer with the latest release of WIZARD and WIZARD CDMA installed for use in this class.

Prerequisites
This class assumes a basic understanding of and experience with cellular engineering, propagation modeling and CDMA technology. Previous WIZARD experience is an advantage but is not required.

Length
8 Hours
WIZARD GSM/GPRS Training

Target Audience
This class is intended for both intermediate and experienced RF engineers who are involved with the design and optimization of GSM and GPRS networks. Class size is limited to 12 students per session.

Course Description
This one-day class teaches students how to use the WIZARD GSM module to design a GSM network. The GSM module contains analyses that allow the evaluation of the overall performance and behavior of a GSM system. This class introduces an approach to calculate GSM coverage, interference and other important parameters. Additionally, the module includes a GPRS throughput analysis that accounts for message length, overhead, and data rate to calculate effective throughput, probability of packet failure, and message delay. Classroom exercises illustrate the relationship between interference and effective throughput among many other scenarios.

Objectives
- Describe how propagation modeling tools may be applied to the design and optimization of a GSM/GPRS network
- Define the basic algorithms that are used in the calculation of GSM and GPRS coverage
- Build a GSM system in WIZARD and assign basic operation parameters
- Interpret WIZARD GSM analyses:
  - Coverage
  - Interference
  - Reverse link
  - GPRS throughput
  - Neighbor list generation
- Familiarize with radio characteristics of a GPRS transmitter in WIZARD

Class Materials
A course handbook including student exercises and a GSM project on floppy disk are provided. The student is responsible for providing a computer with the latest release of WIZARD and WIZARD GSM installed for use in this class.

Prerequisites
This class assumes a basic understanding of and experience with cellular engineering, propagation modeling and GSM technology. Previous WIZARD experience is an advantage but is not required.

Length
8 Hours
WIZARD UMTS W-CDMA Training

Target Audience
This class is intended for both intermediate and experienced RF engineers who are involved with the design and operation of W-CDMA UMTS networks. Class size is limited to 12 students per session.

Course Description
This one-day class introduces WIZARD’s W-CDMA UMTS-FDD module. The student will learn how to design UMTS-FDD networks and obtain an idea of the overall performance and behavior of these types of networks. Basic UMTS-FDD features and some planning techniques are covered in order to facilitate the effective use of the tool. This class focuses on the explanation of the algorithms responsible for the calculation of coverage. It also focuses on clearly defining the assumptions taken in the development of these algorithms. Classroom exercises illustrate the relationship of forward and reverse link coverage to system loading and other design parameters.

Objectives
• Describe how propagation modeling tools may be applied to the design and optimization of a UMTS-FDD system
• Define the basic algorithms used to predict UMTS-FDD coverage and call quality
• Build a UMTS-FDD system in WIZARD and assign basic operation parameters
• Interpret the available UMTS-FDD static analyses:
  • Pilot channel Ec/Io
  • Pilot delta
  • Pilot power boundaries
  • Forward link performance
  • Reverse link performance
• Familiarize with Monte Carlo techniques implemented in the module
• Teach students how to interpret Monte Carlo statistics and reports
• Describe how building attenuation values, system loading, and other system parameters can impact UMTS-FDD coverage

Class Materials
A course handbook including student exercises and a UMTS-FDD project on floppy disk are provided. The student is responsible for providing a computer with the latest release of WIZARD and WIZARD UMTS-FDD installed for use in this class.

Prerequisites
This class assumes a basic understanding of and experience with cellular engineering, propagation modeling and UMTS-FDD technology. Previous WIZARD experience is helpful but not required.

Length
8 Hours
Essentials of CELLOPT

Target Audience
This class is intended for RF engineers who use the CellOpt Automatic Frequency Planning tool. Class size is limited to 12 students per session.

Course Description
This two-day class provides students with the knowledge and skills needed to operate CellOpt for the purpose of frequency planning for an FDMA/TDMA network. Upon completion of the class, students will be able to utilize CellOpt to meet the following objectives:

Objectives
• Identify and extract input data from predictions and measurements
• Explain the CellOpt ASCII file formats
• Import and export data to and from WIZARD
• Define available, reserved and illegal spectrum
• Model network equipment, design methodologies, and advanced network features using categories and layers
• Explain the difference between frequency and separation constraints
• Review the concepts of a penalty-based system and the optimization algorithm
• Optimize frequency (as well as MAL, HSN and MAIO) and color code assignments
• Analyze a frequency plan using CellOpt’s powerful reporting tools
• Uncover design problems and evaluate the impact of different band splits or new feature implementation using the report

Class Materials
The student is responsible for providing a computer with the latest release of CellOpt installed for use in this class.

Prerequisites
This class assumes an advanced understanding of RF cellular systems including RF design, frequency planning and traffic planning.

Length
2 Days
### Agilent Wireless Technical Training Services Registration Form

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- Classes begin at 9:00 AM and finish by 5:30 PM.
- Maps, travel, and hotel information will be provided following receipt of registration.
- Class size may be limited, so please register early.
- Call Agilent Technologies for current tuition rates.

### Attendees: (Please use additional sheets as necessary)

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Payment: □ Check Enclosed □ Purchase Order Enclosed

*Authorized Signature Required

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