CelPlan International, Inc.

2016 Training Catalog

Training Program

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Contents

INTRODUCTION

Wireless technologies have been evolving at a very fast pace and it became difficult for professionals to keep up-to-date with all the changes. At the same time, market newcomers do not have access to past technologies, which are often essential in understanding for building a solid base for learning new ones.

These professionals require different depths of training, but all of them need to have a thorough understanding of the technologies they are working on. Acknowledging this fact, CelPlan has developed a modular program that allows professionals to have a sequential and complete training at different depths by rearranging the modules as needed.

Besides offering classes on the CellDesigner Suite of tools, CelPlan, as a leader in wireless services and technologies, also offers a comprehensive array of training courses that follow market trends and focus on the newest technologies.

Our seasoned core of highly capable professionals with in-depth experience in international markets develops and teaches training courses covering major issues and technologies in the telecommunications arena. CelPlan courses reflect the most recent developments and standards in wireless telecommunications. Very complete and illustrated training material is provided for all technology training classes.

The "Wireless Communications Overview" module covers the common aspects of Cellular Wireless Networks and how they evolved over time from the original wired networks. Basic concepts applicable to all wireless technologies are explained.

The "Wireless Communications Fundamental Principles" module also covers basic principles applicable to all wireless systems but focuses more on the understanding of signal processing, RF propagation, and Radio Performance.

The "Technology" modules describe the different technologies, and the two previous modules, or equivalent knowledge, are pre-requisites.

The "Fifty Steps of a Wireless Design" module describes the steps that should be done to complete a proper wireless design, from GIS database, through market modeling and up to network performance. This module is illustrated using CellDesigner Suite tools along the design process. A CellDesigner trial license is provided as part of the class.

The "CellDesigner Suite modules" cover the usage of this advanced planning and design software.

Upon request, CelPlan can also develop new training modules to meet specific customer needs.

Besides an attendance certificate, CelPlan also offers a certification program for some of the Technology classes. In this process, students are evaluated based on a homework assignment that covers the different topics explained during training. The WiMAX class is also certified by the WiMAX Forum (see more details in the description of the course).

Because of all the research we do in-house to prepare the training classes and to write specifications for our CellDesigner Suite of tools, it was only natural for CelPlan to move towards publishing some of that research. In 2003 we published the book "*Designing cdma2000 systems*", which is now the training material used in our IS2000 classes. In 2011, the book "*LTE, WiMAX and WLAN – Network Design, Optimization and Performance Analysis*" was released, and is the training material used in both our WiMAX and LTE classes.

Scheduled for publication in 2016, the 2nd Edition of *LTE, WiMAX and WLAN Network Design, Optimization and Performance Analysis* will add over 1,000 pages of new content related to advanced 4G technologies, such as LTE-A and 802.16.
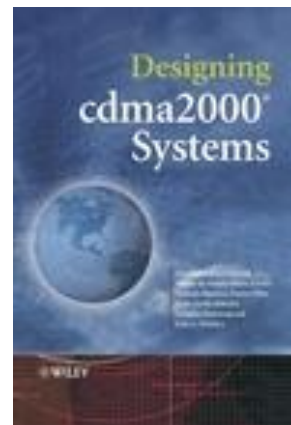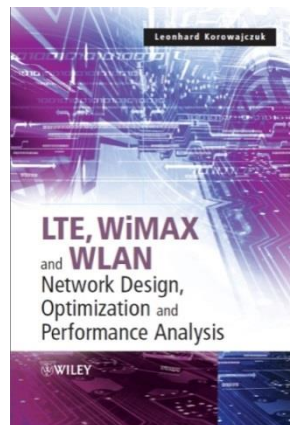
Also in the works and scheduled for publication in the 2nd half of 2016, *Network Video* will focus on Private and Public Safety Applications, while *Wireless Networks Radio Backhaul Design* will focus primarily on point-to-point, microwave backhaul technologies. Additionally, *The Design of Multi-Technology Voice and Data Networks* will focus on the use of different technologies (from GSM to HSPA and LTE-A) for the delivery of voice and data.
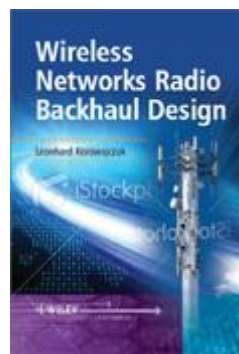
For more information about any of the training courses, please contact us at:

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CERTIFIED CLASS: 4G TECHNOLOGIES BOOT CAMP

The 4G Technologies Boot Camp is designed to give CEOs, CTOs, managers, engineers, and technical staff the practical knowledge on LTE and WiMAX 4G networks.

Course Description

Based on the current book and updates from the soon-to-be published 2nd edition of, "LTE, WiMAX, and WLAN: Network Design, Optimization and Performance Analysis," by Leonhard Korowajczuk, this five-day course presents students with comprehensive information on 4G technology, projects, and deployments.

Each module is taught by experienced 4G RF engineers that design and optimize networks around the globe.

The materials provided are based upon this experience and by the development of industry leading planning & optimization tools, such as the CellDesigner Software Suite, which is also provided as a 30-day demo to each student.

Course Overview

The 4G Technology Boot Camp is divided into two modules of two days each:

Module A: Wireless Communications Fundamentals

4G Broadband Wireless Systems use a whole new set of techniques and technological solutions that require the understanding of new concepts and terminologies. Students are presented with the basic principles of 4G technologies, from the mathematical basics to the specifics of each area. With this knowledge students will be able to understand the inner-workings of 4G technologies.

- Wireless Network Mathematics Refresher
- Signal Processing Fundamentals
- The RF Communications Channel
- Advanced Antenna Systems (MIMO and AAS)
- Data and Internet Protocols

Module B: 4G Technologies in-depth Analysis (WLAN, WiMAX, LTE)

4G technologies are evolving at a fast pace. Many solutions exist in one technology but not in the others, so understanding all of them is essential to understand each one as its defined today, along with its possible evolution paths.

- 4G Wireless Communication Channel
- WLAN (Wi-Fi) Refresher
- WiMAX & WiMAX 2.0
- LTE and LTE Advanced
- Comparing 4G Technologies

4G Certification (Optional)

Participants who complete both modules will be eligible to take the CelPlan 4G Technologies Certification Exam to solidify their mastery of the topics covered.

This certification covers all topics explored within the 4G Technologies Boot Camp and is currently the only available professionally-backed certification for 4G Technology Expertise!

Prerequisite for CelPlan 4G Certification Exam: Completion of CelPlan's 4G Technologies Boot Camp in its entirety (Modules A and B).

CERTIFIED CLASS: 4G TECHNOLOGIES BOOT CAMP - ONLINE EDITION

The Online Edition of the 4G Technologies Boot Camp is designed to give CEOs, CTOs, managers, engineers, and technical staff the practical knowledge on LTE and WiMAX 4G networks.

Course Description

Based on the current book and updates from the soon-to-be published 2nd edition of, "LTE, WiMAX, and WLAN: Network Design, Optimization and Performance Analysis," by Leonhard Korowajczuk, this modular course presents students with comprehensive information on 4G technology, projects, and deployments.

Each module is broken into a two-day training session that presents students with comprehensive information on 4G technology, projects, and deployments. Classes are taught by experienced 4G RF engineers that design and optimize networks around the globe.

The materials provided are based upon this experience and by the development of industry leading planning & optimization tools, such as the CellDesigner Software Suite, which is also provided as a 30-day demo to each student.

Course Overview

The Online edition of the 4G Technologies Boot Camp is divided into two modules of 2-days each.

Each module is taught separately, but the course is designed so that later classes build upon the knowledge of earlier modules. It is highly recommended that participants take each class in order to ensure the greatest level of comprehension and overall understanding.

Module A: Wireless Communications Fundamentals

This 2-day, online module is designed to give students a solid foundation and understanding of the basic principles governing 4G technologies. Lessons cover new concepts and terminology specific to 4G broadband wireless systems and introduce students to the inner workings of 4G technologies.

- Wireless Network Mathematics Refresher
- Signal Processing Fundamentals
- The RF Communications Channel
- Advanced Antenna Systems (MIMO and AAS)
- Data and Internet Protocols

Module B: 4G Technologies in-depth Analysis (WLAN, WiMAX, LTE)

After establishing a firm understanding of the fundamentals, this 2-day, online module covers the leading technologies within 4G. Because there are multiple solutions within the realm of 4G, it's important for technical professionals to fully understand each one and how it is currently defined today.

Module B covers each technology in-depth, while also exploring the possible evolution paths and solutions that are specific to each separate 4G technology.

Topics covered in Module B include:

- 4G Wireless Communication Channel
- WLAN (Wi-Fi) Refresher
- WiMAX & WiMAX 2.0
- LTE and LTE Advanced
- Comparing 4G Technologies

Recommended Pre-Requisite: Module A.

4G Certification (Optional)

Participants who complete both modules will be eligible to take the CelPlan 4G Technologies Certification Exam to solidify their mastery of the topics covered.

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Prerequisite for CelPlan 4G Technologies Certification Exam: Completion of the Online Edition of CelPlan's 4G Technologies Boot Camp in its entirety (Modules A and B).

CERTIFIED CLASS: 4G NETWORK DESIGN & OPTIMIZATION BOOT CAMP

The 4G Network Design & Optimization Boot Camp is designed to give CEOs, CTOs, managers, engineers, and technical staff the practical knowledge to deploy and optimize LTE and WiMAX 4G networks.

Course Description

Based on the current book and updates from the soon-to-be published 2nd edition of, "LTE, WiMAX, and WLAN: Network Design, Optimization and Performance Analysis," by Leonhard Korowajczuk, this four-day course presents students with comprehensive information on 4G technology, projects, and deployments.

Each module is taught by experienced 4G RF engineers that design and optimize networks around the globe.

The materials provided are based upon this experience and by the development of industry leading planning & optimization tools, such as the CellDesigner Software Suite, which is also provided as a 30-day demo to each student.

Course Overview

The 4G Network Design & Optimization Boot Camp is divided into two modules of two days each:

Module A: 4G Network Design Fundamentals

Today's engineers have to be masters of multiple trades, as the different specialties converge. The design of a wireless network requires knowledge of business plans, networking, data applications, data protocols, data traffic, RF propagation, multiple wireless technologies, measurement techniques, optimization methodologies, among many other topics. CelPlan provides all the steps required to design a functional and profitable 4G network.

- Business Case
- Design Tasks
- Wireless Market Modeling
- Wireless Network Strategy
- Wireless Network Equipment Characterization

Module B: Design and Optimization of 4G Networks

- Wireless Site, Base Station & Cell Characterization
- Wireless Network Design
- Wireless Network Optimization
- Wireless Network Performance Assessment

4G Certification (Optional)

Participants who complete both modules will be eligible to take the CelPlan 4G Network Design & Optimization Certification Exam to solidify their mastery of the topics covered.

This certification covers all topics explored within the 4G Network Design & Optimization Boot Camp and is currently the only available professionally-backed certification for 4G Technology Expertise!

Prerequisite for CelPlan 4G Network Design & Optimization Certification Exam: Completion of CelPlan's 4G Network Design & Optimization Boot Camp in its entirety (Modules A and B).

CERTIFIED CLASS: 4G NETWORK DESIGN & OPTIMIZATION BOOT CAMP – ONLINE EDITION

The Online Edition of the 4G Network Design & Optimization Boot Camp is designed to give CEOs, CTOs, managers, engineers, and technical staff the practical knowledge to deploy and optimize LTE and WiMAX 4G networks.

Course Description

Based on the current book and updates from the soon-to-be published 2nd edition of, "LTE, WiMAX, and WLAN: Network Design, Optimization and Performance Analysis," by Leonhard Korowajczuk, this four-day course presents students with comprehensive information on 4G technology, projects, and deployments.

Each module is taught by experienced 4G RF engineers that design and optimize networks around the globe.

The materials provided are based upon this experience and by the development of industry leading planning & optimization tools, such as the CellDesigner Software Suite, which is also provided as a 30-day demo to each student.

Course Overview

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Module A: 4G Network Design Fundamentals

Today's engineers have to be masters of multiple trades, as the different specialties converge. The design of a wireless network requires knowledge of business plans, networking, data applications, data protocols, data traffic, RF propagation, multiple wireless technologies, measurement techniques, optimization methodologies, among many other topics. CelPlan provides all the steps required to design a functional and profitable 4G network.

- Business Case
- Design Tasks
- Wireless Market Modeling
- Wireless Network Strategy
- Wireless Network Equipment Characterization

Module B: Design and Optimization of 4G Networks

- Wireless Site, Base Station & Cell Characterization
- Wireless Network Design
- Wireless Network Optimization
- Wireless Network Performance Assessment

Recommended Pre-Requisite: Module A.

4G Certification (Optional)

Participants who complete both modules will be eligible to take the CelPlan 4G Network Design & Optimization Certification Exam to solidify their mastery of the topics covered.

This certification covers all topics explored within the 4G Network Design & Optimization Boot Camp and is currently the only available professionally-backed certification for 4G Technology Expertise!

Prerequisite for CelPlan 4G Network Design & Optimization Certification Exam: Completion of CelPlan's 4G Network Design & Optimization Boot Camp in its entirety (Modules A and B).

WIRELESS COMMUNICATIONS OVERVIEW

Target Audience

This class is recommended for newcomers to the wireless arena, or as a refresher for engineers that already work with wireless networks.

Pre-requisite

None

Goals

This class covers the development of wireless technology starting from the traditional wired systems. The basic concepts applied to wireless communications are explained with in-class exercises to practice the different topics.

Course Syllabus
- ✓ Basic Mathematical Concepts Used in Wireless Networks
    - o Numbers and Vectors
    - o Circle Relationships
    - o Functions
    - o Sinusoids
    - o Fourier Analysis
    - o Logarithms
    - o Matrices
    - o Statistics;
- ✓ Telecommunication Basic Concepts
    - o Electrical Signals
    - o The Telephone Circuit
    - o Switching
    - o Telephony Traffic
    - o RF Spectrum;
- ✓ Signal Processing Fundamentals
    - o Digital Representation of Analog Signals
    - o Superposition of Delayed Waveforms
    - o Signal Orthogonality
    - o Digital Modulation;
- ✓ The RF Communications Channel
    - o The Transmitted Signal
    - o The RF Channel
    - o The Received Signal

- o   The Impairments (Noise, Interference, SNR, and Error Correction);
- ✓   Antenna Basics
  - o   Antenna Radiation
  - o   Antenna Types
  - o   Antenna Characteristics

Impedance and VSWR

Length
- ✓   1 day (6 hours)

FUNDAMENTALS OF WIRELESS COMMUNICATIONS

Target Audience

This class is recommended for newcomers to the wireless arena, or as a refresher for engineers that already work in wireless.

Pre-requisite

None

Goals

This class covers the development of wireless technology starting from the traditional wired systems. The basic concepts applied to wireless communications are explained, and exercises are done to fixate the topics.

Course Syllabus
- ✓ Basic Mathematical Concepts Used in Wireless Networks
    - o Circle Relationships
    - o Numbers and Vectors
    - o Functions Decomposition
    - o Sinusoids
    - o Fourier Analysis
    - o Logarithms
    - o Statistical Probability Distributions;
- ✓ Telecommunication Basic Concepts
    - o Electrical Signals
    - o The Telephone Circuit
    - o Switching
    - o Telephony Traffic
    - o RF Spectrum
    - o RF Signal
    - o RF Propagation;
- ✓ Signal Processing Fundamentals
    - o Digitizing Analog Signals
    - o Digital Data Representations
    - o Orthogonal Signals
    - o Combining Copies of a Sinewave
    - o Carrier Modulation;
- ✓ Antenna and Advanced Antenna Systems
    - o Antenna Basics
    - o Antenna Radiation
    - o Antenna Types

- o Antenna Characteristics
- o Impedance and VSWR
- ✓ RF Channel Analysis
  - o The Signal
  - o The RF Channel
  - o RF Signal Propagation
  - o The Fresnel Ellipsoid
  - o Diffraction
  - o Understanding Power (W x dB)
  - o RF Channel in Frequency Domain
  - o RF Channel in Time Domain
  - o Fading and Multipath
  - o RF Channel in Power Domain
  - o Standardized Channel Models
  - o RF Environment
  - o Fading;
- ✓ Radio Performance
  - o Input RF Noise
  - o Thermal Noise and Noise Figure
  - o Receiver Circuit Noise
  - o Signal-to-Noise Ratio;
- ✓ RF Channel Performance Prediction
  - o Advanced RF Propagation Models
  - o RF Measurements and Propagation Model Calibration
  - o RF Interference Issues
  - o RF Spectrum Usage and Resource Planning
  - o Network Footprint Enhancement;

Length
- ✓ 2 days (12 hours)

4G TECHNOLOGIES FUNDAMENTALS

Target Audience

Some fundamental principles apply to all technologies and their understanding is essential to understand the workings of each type of network. This class was conceived for engineers and management that need to understand technological aspects of the network.

Pre-requisite

Wireless Communications Overview or equivalent knowledge.

Goals

Cover basic principles applicable to all wireless systems focusing on the understanding of signal processing, RF propagation, and Radio Performance.

Course Syllabus

- ✓ Basic Mathematical Concepts Used in Wireless Networks
    - o Numbers and Vectors
    - o Circle Relationships
    - o Functions
    - o Sinusoids
    - o Fourier Analysis
    - o Logarithms
    - o Matrices
    - o Statistics;
- ✓ Telecommunication Basic Concepts
    - o Electrical Signals
    - o The Telephone Circuit
    - o Switching
    - o Telephony Traffic
    - o RF Spectrum;
- ✓ Signal Processing Fundamentals
    - o Digital Representation of Analog Signals
    - o Superposition of Delayed Waveforms
    - o Signal Orthogonality
    - o Digital Modulation;
- ✓ The RF Communications Channel
    - o The Transmitted Signal
    - o The RF Channel
    - o The Received Signal

- o The Impairments (Noise, Interference, SNR, and Error Correction);
- ✓ Establishing a 4G Wireless Network Communication Channel
    - o 4G Technologies
    - o 4G Wireless Data Communication Channel
    - o Capabilities and Requirements of 4G Technologies
    - o 4G Technologies Options Analysis
    - o OSI Protocol Layers
    - o 4G Physical Layer
    - o 4G MAX and Higher Layers
    - o Internet Protocol (IP)
    - o Duplexing
    - o FDD
    - o TDD
    - o Wireless Media Access
    - o Frameless
    - o Framed
    - o Network Synchronization
    - o RF Channel Equalization
    - o Scheduler
    - o Resource Allocation
    - o OFDM/OFDMA

- o Establishing a 4G Wireless Data Communication
- o 5G Technology;
- ✓ OFDM
  - o OFDM
  - o History
  - o Principle
  - o OFDM Implementation
  - o Symbol
  - o Cyclic Prefix
  - o Equalization
  - o OFDM Transmitter
  - o OFDM Receiver
  - o OFDM Peculiarities
  - o PAPR
- o SC-OFDMA;
- ✓ Advanced Antenna Systems
  - o Multiple Antenna Arrangements
  - o Receive Diversity
  - o Transmit Diversity
  - o Spatial Multiplexing
  - o Antenna Array Systems and Beamforming.
- ✓ Data Transmission
  - o Data Transmission Protocols
  - o Internet History
  - o Data Transmission Modeling;
- ✓ 4G Network Architecture
  - o Data Transmission Protocols

Length

- ✓ 3 days (18 hours)

MARKET MODELING

Target Audience

No market analysis can be done without a proper market modeling. This class is essential for managers and engineers alike. The class applies to all technologies but is especially useful for people working with networks that involve data transmission.

Pre-requisite

None

Goals

This class explains what should be considering when trying to plan a wireless network. Who will be the subscribers? Where are they located? What kind of services will the network offer and how to analyze their impact on the system's performance.

Course Syllabus
- ✓ Business Plan
    - o Market Plan
    - o Engineering Plan
    - o Financial Plan
    - o CAPEX, OPEX, ROI;
- ✓ Data Transmission
    - o Internet
    - o Network Modeling
    - o Internet Network Architecture
    - o Physical Layer
    - o Data Link Layer
    - o Transport Protocols
    - o Routing Protocols
    - o Application Protocols;
- ✓ Market Modeling
    - o Data Traffic Characterization
    - o Service Plan and Service Level Agreement (SLA)
    - o User Service Classes
    - o Applications
    - o Over-subscription Ratio
    - o Service Summary
    - o RF Environment
    - o Terminals
    - o Antenna Height
    - o Network Traffic Modeling
    - o KPI.

Length: 1 day (6 hours)

WIRELESS NETWORK DESIGN AND OPTIMIZATION

Target Audience

No market analysis can be done without a proper market modeling. This class is essential for managers and engineers alike. The class applies to all technologies but is especially useful for people working with networks that involve data transmission.

Pre-requisite

No pre-requisites but Wireless Fundamental and Technology classes are recommended.

Goals

Designing a wireless network is a complex task that requires a detailed methodology to cover all aspects. Such a methodology is described in this class. This class describes the steps that should be done to complete a proper wireless design, from GIS database, through market modeling and up to network performance. This class is lecture-style and illustrated using the ***CellDesigner Suite*** of tools. A 30-day training license of ***CellDesigner Suite*** is included.

Course Syllabus

- ✓ Business Plan
    - o Market Plan
    - o Engineering Plan
    - o Financial Plan
    - o CAPEX, OPEX, ROI;
- ✓ Design Tasks
- ✓ Modeling a Wireless Market
    - o Findings Phase
    - o Area of Interest
    - o Terrain Data Bases
    - o Demographic Data Bases
    - o Service Modeling
    - o User Terminal Modeling
    - o Traffic Distribution Modeling
- ✓ Wireless Network Strategy
    - o Spectrum Usage
    - o Deployment Strategy
    - o Core Equipment
    - o Base Station Equipment
    - o Customer Premises Equipment

- o Link Budget
- o Backhaul Equipment
- o Land Line Access Point (PoP)
- ✓ Wireless Network Design
    - o Field Measurement Campaign
    - o Measurement Processing
    - o Propagation Models and Parameters
    - o Site Location
    - o Site Predictions
    - o Static Traffic Simulation
    - o Backhaul Design
- ✓ Wireless Network Optimization
    - o Cell Enhancement and Footprint Optimization
    - o Resource Optimization
- ✓ Wireless Network Performance
    - o Perform Dynamic Traffic Simulation
    - o KPI Performance
  Performance Prediction Plot

Length: 2 days (12 hours)

WIRELESS NETWORK DESIGN AND OPTIMIZATION HANDS-ON

Target Audience

No market analysis can be done without a proper market modeling. This class is essential for managers and engineers alike. The class applies to all technologies but is especially useful for people working with networks that involve data transmission.

Pre-requisite

No pre-requisites but Wireless Fundamental and Technology classes are recommended.

Goals

Designing a wireless network is a complex task that requires a detailed methodology to cover all aspects. Such a methodology is described in this class. This class describes the steps that should be done to complete a proper wireless design, from GIS database, through market modeling and up to network performance. This class is lecture-style with hands on exercises using *CellDesigner Suite* of tools. A 30-day training license of *CellDesigner Suite* is included.

Course Syllabus

✓ Same Syllabus as "Wireless Network Design and Optimization" class but with time between topics for hands on exercises using *CellDesigner Suite* of tools.

Length

✓ 3 days (18 hours)

HANDS-ON WIRELESS DESIGN

Target Audience

This class is ideal for the professionals involved on the design of wireless networks using planning tools. Different technologies may be used in this class (check calendar of offerings). Private classes can be customized to the customer's specific technology.

Pre-requisite

Wireless Communications Overview, Fundamentals, Market Modeling, Specific Technology, Fifty Steps of Wireless Design or equivalent knowledge.

Goals

Students will have a chance of using *CellDesigner Suite* tools to perform a design on a virtual market. Optionally the design can be made on customer's market (private classes only). This class includes 30 days training license of *CellDesigner Suite*.

Course Syllabus

This syllabus covers the main topics discussed in class, due to the differences in technologies, additional topics may be included.

- ✓ GIS Data base configuration and visualization
- ✓ Antenna Data base
- ✓ Site Data base
- ✓ Area Visualization (maps, images, Google)
- ✓ Determining the AoI (Area of Interest)
- ✓ Defining Service Classes
- ✓ Defining Services
- ✓ Defining Radio
- ✓ Defining Environment
- ✓ Defining Traffic
- ✓ Site Location
- ✓ Performing Individual Predictions
- ✓ Static Traffic Simulation
- ✓ Performing Composite Predictions
- ✓ Dynamic Traffic Simulation

Performance Analysis

Length

- ✓ 2 days (12 hours)

TECHNOLOGY: GSM & GPRS SYSTEMS

Target Audience

GSM is still the most pervasive wireless technology in the world. A detailed description of the technology is presented explaining its different aspects. This class is essential for managers and engineers that work with this technology.

Pre-requisite

Wireless Communications Overview and Fundamentals or equivalent knowledge.

Goals

Present the most relevant aspects related to GSM and GPRS systems.

Course Syllabus

- ✓ Global System for Mobile Communications (GSM)
    - o History
    - o GSM Evolution
    - o GSM Specifications;
- ✓ GSM Architecture
    - o Cell
    - o Mobile Station
    - o Base Station Subsystem
    - o Network Switching Subsystem
    - o Network Management Subsystem
    - o GSM Interfaces
    - o User Features;
- ✓ Speech Digitization
    - o Digital Speech
    - o Vocoders
    - o Voice Activity
    - o Transcoder and Rate Adaptation Unit;
- ✓ Channel Processing
    - o Voice Coding
    - o Channel Coding
    - o Voice Channel Encoders
    - o Full Rate Voice Channel Encoding
    - o Half Rate Voice Channel Encoding
    - o Signaling Channels Encoding
    - o Interleaving
    - o Control Channel Encoding
    - o MS Authentication
    - o Ciphering

- o Burst Formatting and Multiplexing
- o Modulation;
- ✓ GSM Radio Interface
    - o Operational Bands
    - o Multiple Access
    - o TDMA Channels Structure
    - o Logical Channels
    - o Logical Channel Organization
    - o ARFC Mapping
    - o Frequency Hopping;
- ✓ Call Processing
    - o Call Establishment from MS
    - o Call Establishment to MS
    - o MS Connection to a GSM network
    - o MS Registration
    - o MS Call to Other MS
    - o MS Call to PSTN
    - o PSTN Call to MS
    - o PSTN Originated Call Paging on BTS
    - o Handover Between BTSs of the Same MSC
    - o Handover Between BTSs of Different MSCs;
- ✓ Data in GSM
    - o High Speed Circuit Switched Data (HSCSD)
    - o General Packet Radio Services (GPRS)
    - o Enhanced Data Rates for Global Evolution (EDGE)

- o Evolved Edge (EDGE + or E-EDGE);
- ✓ Measurements in GSM
  - o RxLev
  - o RxQual
  - o BER Calculation
  - o FER Calculation;
- ✓ Cellular Network Design
  - o Cell Categories
  - o Hierarchical Cell Structure (HCS)
  - o Underlay/Overlay
  - o Tight BCCH Frequency Reuse
  - o Extended Range
  - o Cell Load Sharing
  - o Multi-band Cells
  - o Intra Cell Handover
  - o Assignment to Another Cell
  - o Dynamic BTS Power Control
  - o Dynamic MS Power Control
  - o Double BCCH Allocation List
  - o Speech Quality
  - o Objective Speech Quality;
- ✓ Radio Link Control
  - o Measurements in GSM
  - o RF Power Control
  - o System Information
  - o Handover
  - o Radio Link Failure Criteria
  - o Idle Mode and MS Paging
  - o Ancillary Functionalities;
- ✓ Typical Equipment Description
  - o AXE
  - o GSM Switching System
  - o Base Station System
  - o Radio Base Station (RBS)
  - o Mobile Stations;
- ✓ Cell RF Configuration
  - o RF Equipment Main Parts
  - o Typical Configurations
  - o Design Values;
- ✓ Typical Equipment Parameters
  - o Site Data
  - o Cell Common Data
  - o Neighboring Cell Relation Data
  - o Idle Mode Behavior
  - o Locating

- o GPRS/EGPRS Idle Mode Behavior
- o GPRS/EGPRS Cell Reselection
- o Channel Administration/ Immediate Assignment on TCH
- o GPRS/EDGE Channel Administration
- o Dynamic MS Power Control
- o GPRS/EDGE Dynamic MS Power Control
- o Dynamic BTS Power Control
- o Discontinuous Transmission
- o Frequency Hopping
- o Intra Cell Handover
- o Assignment to Other Cell
- o Overlaid/Underlaid Subcells/ Subcell Load Distribution
- o Hierarchical Cell Structures
- o Extended Range
- o Double BA Lists
- o Idle Channel Measurements
- o Cell Load Sharing
- o Multi-Band Operation
- o Differential Channel Allocation
- o Enhanced Multilevel Precedence
- o Adaptive Configuration of Logical Channels
- o GSM-UMTS Cell Reselection and Handover
- o Adaptive Multi-rate (AMR)
- o Link Quality Control and Enhanced GPRS
- o GPRS Link Adaptation
- o GPRS/EDGE Quality of Service
- o Interference Rejection Combining
- o Multi Band Cell
- o GPRS/EDGE Connection Control and Transfer
- o Antenna Hopping
- o Synchronized Radio Networks
- o Channel Allocation Optimization
- o Dual Transfer Mode (DTM)
- o Flexible Abis (FLAB)
- o Voice Group Call Service
- o Tandem Free Operation (TFO)
- o Handover and Signaling Robustness
- o Fund Faulty Antenna Features
- o Abis over IP

- o Abis Optimization
- o PGW Load Distribution
- o Reduced Power Consumption in GSM RAN
- o Adaptive Multi Rate Wide Band
- o Abis Local Connectivity
- o Hardware Characteristics;
- ✓ Typical Commands;
- ✓ *CellDesigner Suite* Planning Tool Parameters

- o *CelSelect*
- o *CelTools*
- o Project File
- o *CellDesigner*
- o Site/Cell Data
- o *CelOptima*
- o *CelEnhancer*;
- ✓ Vocoder Algorithms.

Length

- ✓ 3 days (18 hours)

TECHNOLOGY: CDMA2000 & EVDO SYSTEMS

Target Audience

This class is essential for managers and engineers that work with this technology.

Pre-requisite

Wireless Communications Overview and Fundamentals or equivalent knowledge.

Goals

CDMA presented to the industry a new way of multiplexing channels that presented advantages when working with variable rate channels. A detailed description of the technology is presented explaining its main aspects.

Course Syllabus

- ✓ Introduction to Spread Spectrum;
- ✓ CDMA Evolution;
- ✓ Spread Spectrum
  - o Codes and Sequences;
- ✓ Forward Link Channel
  - o IS-95
  - o cdma2000;
- ✓ Reverse Link Channel
  - o IS-95
  - o cdma2000;
  - ✓ Call Processing in CDMA Systems
    - o Call Processing
    - o Message Exchange
    - o Registration
    - o Roaming
    - o Authentication;
  - ✓ Power Control, Handoff and Radio Resource Management;

- ✓ EVDO
  - o Requirements (IS-856/R.S0026)
  - o Reference Model
  - o Channel Structure
  - o Air Interface Encoding
  - o Modulation/Encoding
  - o Power Control
  - o Scheduling;
- ✓ Radio Network Engineering Fundamentals
  - o Design Principles
  - o CDMA Equipment Block Diagram
  - o Transmit Stage
  - o Channel
  - o Link Management
  - o Receive Stage;

Length

- ✓ 2 days (12 hours)

TECHNOLOGY: UMTS &HSPA SYSTEMS

Target Audience

This class is essential for managers and engineers that work with this technology.

Pre-requisite

Wireless Communications Overview and Fundamentals or equivalent knowledge.

Goals

UMTS/HSPA is an evolution of the GSM technology toward data like applications. A detailed description of the technology is presented explaining its different aspects.

Course Syllabus

- ✓ Spread Spectrum / Code Division Multiple Access
- ✓ Architecture Interfaces and Functionality
- ✓ WCDMA Structure
- ✓ WCDMA Logical Transport and PHY Channels
- ✓ Timing, Synch and Signaling
- ✓ QOS
- ✓ HSPA
- ✓ Basics of Radio Functionality
- ✓ Ericsson RBS 3000
- ✓ RNC
- ✓ Radio Network Planning
- ✓ Radio Network Configuration
- ✓ Cell Network Configuration

Length

- ✓ 3 days (18 hours)
- ✓ This class can be combined with the UMTS & HSPA Radio Functionalities class for a total length of 5 days

TECHNOLOGY: UMTS & HSPA RADIO FUNCTIONALITIES

Target Audience

This class is essential for managers and engineers that work with this technology.

Pre-requisite

Technology class: UMTS & HSPA Systems

Goals

This class describes in details the Radio Functionalities in UMTS/HSPA Systems.

Course Syllabus

- ✓ Radio Functionality
  - o Idle Mode Behavior
  - o Radio Connection Supervision
  - o Power Control
  - o Capacity management
  - o Handover and Load Sharing
  - o Channel Switching

Length

- ✓ 3 days (18 hours)
- ✓ This class can be combined with the UMTS & HSPA Systems class for a total length of 5 days

TECHNOLOGY: WIRELESS LAN SYSTEMS

Target Audience

This class is essential for managers and engineers that work with this technology.

Pre-requisite

Wireless Communications Overview and Fundamentals or equivalent knowledge.

Goals

Wireless LAN was the first OFDM commercial technology to be developed, and achieved an unprecedented penetration level. It is a last leg technology, complementing either cable or broadband wireless connections.

Course Syllabus

- ✓ Standardization
- ✓ Network Architecture
- ✓ IEEE Std 802.11-2007
- ✓ Physical Layer
- ✓ MAC Layer
- ✓ RF Channel Access
- ✓ Power Management
- ✓ IEEE Std 802.11-2009 (802.11n)
- ✓ Physical Layer
- ✓ MAC Layer
- ✓ WLAN Spectral Efficiency

Length

- ✓ 1 days (6 hours)

TECHNOLOGY: WIMAX SYSTEMS

Target Audience

This class is essential for managers and engineers that work with this technology.

Pre-requisite

Wireless Communications Overview and Fundamentals or equivalent knowledge.

Goals

WiMAX was the first outdoor broadband technology to be specified and has been deployed successfully over the world. It is a mature technology that addresses data transmission issues. This technology is data-centric and requires many new concepts to support it. Traditional concepts were replaced or extended to cope with issues such as SLA (Service Level Agreement), data rate, tonnage, QoS, latency and many others. Network design is much more complex as a result of multiple service classes, adaptive modulation and coding (AMC), MIMO antenna techniques and OFDM-based carriers. This class covers the fundamentals of this technology.

Course Syllabus
- ✓ Standardization
- ✓ Network Architecture
- ✓ Physical Layer
- ✓ Physical Layer in the Frequency Domain
- ✓ Physical Layer in the Time Domain
- ✓ Physical Layer in the Power Domain
- ✓ WiMAX Network Layers
- ✓ Frame Description
- ✓ WiMAX Interference Reduction techniques
- ✓ WiMAX Resource Planning

Length
- ✓ 1 day (6 hours)

TECHNOLOGY: LTE SYSTEMS

Target Audience

This class is a must for everyone involved with the new generation of wireless communications.

Pre-requisite

Wireless Communications Overview and Fundamentals or equivalent knowledge.

Goals

LTE is based in advanced technological break-through not present in traditional technologies. Even the basic telecommunication theory had to be revised, as a much more in-depth understanding of the concepts involved is required. Many new concepts, such as OFDMA, MIMO and SON were developed as part of the technological evolution. LTE is a data-centric technology which requires many new parameters for defining the market, user traffic and demand. This class aims to introduce these new concepts and provide students with a thorough understanding of the technology.

Course Syllabus
- ✓ Standardization
- ✓ Subscriber Service Level Agreement
- ✓ Architecture
- ✓ Wireless Message Flow and Protocol Stack
- ✓ Physical Layer Architecture
- ✓ Downlink Signals
- ✓ Downlink Channels
- ✓ Downlink Control Information
- ✓ Downlink Operational Summary
- ✓ Uplink Physical Channels
- ✓ Uplink Signals
- ✓ Uplink Channels
- ✓ Uplink Control Information

Length
- ✓ 2 days (12 hours)

CELLDESIGNER SUITE: RELEASE TRAINING

Features

Because CelPlan wants its customers to take advantage of all the new features implemented in the tools, a free release training course is offered with each new release.

Upon receiving an email notice about a new release, clients are encouraged to look for the dates and instructions for registering to the Free Release Training. This class, which is usually offered online over a 1 to 2 hour period, covers the main topics of the release notes.

CELLDESIGNER SUITE: BASIC COURSE

Target Audience

First time users of the tool(s) selected for the class. This class is required for users to be eligible for customer support.

Pre-requisite

Wireless Communications Overview or equivalent knowledge.

Goals

This class covers one technology in one or more **CellDesigner Suite** tools. Designed for first-time users, the class introduces students to the concepts behind the selected tools and helps in understanding all the inputs and outputs for each tool. Students are presented to the several parameters that should be configured in the selected tool to be able to create their own projects later. The selected demo project and technology may vary. Check the website listing for the next public classes offerings. Closed courses can be customized to use the customer's own data in the class.

Course Syllabus

The syllabus and length of this class varies depending on the tools selected. The following is a brief syllabus for each of the tools along with the duration of the class.

CellDesigner – 3 days

(A subset of this syllabus might be used for the 1-day **CellDesigner** classes required by other courses)

Pre-requisite: none

- ✓ Directory structure and file types
- ✓ Menus structure
- ✓ GIS database used by the tool
- ✓ Presentation Resources
- ✓ Vectors/Regions
- ✓ System Parameters
- ✓ Service Classes
- ✓ Service Configuration
- ✓ Terminal Configuration
- ✓ Environment Configuration
- ✓ Moving/creating cell sites
- ✓ Configuring cell sites

- ✓ Phase, Areas and Flags
- ✓ Propagation Models
- ✓ Measurement menu
- ✓ Executing Measurements
- ✓ Prediction Thresholds
- ✓ Interference Predictions
- ✓ Prediction Detail
- ✓ Printing Predictions
- ✓ Profile
- ✓ Creating Traffic
- ✓ Simulating Traffic
- ✓ Fixed Subscribers

Backhaul Networks – 1 day

Pre-requisite: 1 day CellDesigner class
- ✓ Creating Links
- ✓ Configuring Radios
- ✓ Understanding ITU Recommendations
- ✓ Configuring Tx/Rx Data
- ✓ Link Profiles
- ✓ Link Performance Report
- ✓ Link Interference Analysis
- ✓ Multi-Hop Analysis

Implementing Field Data – 1 day

Pre-requisite: 1 day CellDesigner class
- ✓ *CelView* Visualization Features
  - o Working with Multiple Views
  - o Displaying Vectors
  - o Displaying Regions
  - o Displaying Drive-test data
  - o Displaying Predictions
  - o GIS Database Information
- ✓ Best Practice Rules to Collect Statistically Valid Samples
- ✓ Analyzing Drive Test Samples
- ✓ Filtering Measurement Files
- ✓ Calibrating Propagation Model

Automatic Frequency Planning (AFP) – 2 days

Pre-requisite: 3 days CellDesigner class
- ✓ *CelView* Visualization Features
  - o Working with Multiple Views
  - o Displaying Vectors
  - o Displaying Regions
  - o Displaying Drive-test data
  - o Displaying Predictions
  - o GIS Database Information
- ✓ Optimization parameters - AFP
  - o Signal thresholds
  - o Quality criteria
  - o Definition of Outage
  - o Power control
  - o Analysis direction
- ✓ Neighbor list
  - o Creation
  - o Filtering
  - o Handoff parameters
  - o Editing the list
- ✓ Interference matrix
  - o Connectivity
  - o Priority regions
  - o Outage table
  - o Editing the matrix
- ✓ Frequency plan
  - o AFP constraints
  - o Definition of penalties
  - o Channel planning
  - o Plan refinement
- ✓ Code plan
  - o IDCell, PermBase, etc.

Automatic Cell Planning (ACP) – 1 day

Pre-requisite: 3 days CellDesigner class
- ✓ *CelView* Visualization Features
  - o Working with Multiple Views
  - o Displaying Vectors
  - o Displaying Regions
  - o Displaying Drive-test data
  - o Displaying Predictions
  - o GIS Database Information
- ✓ Directories structure
  - o Root directory
  - o Traffic folders
  - o Other input folders
- ✓ Using *CelSelect* to Choose Best Sites
- ✓ Enhancement parameters - ACP
  - o Types of enhancement: tilt, height, type, azimuth, power
  - o Signal thresholds
  - o Traffic constraints
  - o Improvement/deterioration table
  - o ACP criteria table
- ✓ Enhancement Process
  - o Grades x improvement analysis
  - o Selection of improvement parameters
  - o Exporting ACP improvements to CellDesigner

GIS Database Manipulation – 0.5 day

Pre-requisite: none
- ✓ Understanding GIS in CellDesigner
- ✓ Understanding GIS Resolution
- ✓ Converting GIS from other Formats
- ✓ Decimating GIS files
- ✓ Carving GIS files Using Vectors
- ✓ Carving GIS files Using Regions
- ✓ Modifying Clutter Heights and Types
- ✓ Other Tools Within CelData

CELLTRACE: BASIC COURSE

Target Audience

First time users of the tool(s) selected for the class. This class is required for users to be eligible for customer support.

Pre-requisite

Wireless Communications Overview or equivalent knowledge.

Goals

This class covers one technology in one or more *CellTrace* tools. Designed for first-time users, the class introduces students to the concepts behind the selected tools and helps in understanding all the inputs and outputs for each tool. Students are presented to the several parameters that should be configured in the selected tool to be able to create their own projects later. The selected demo project and technology may vary. Check the website listing for the next public classes offerings. Closed courses can be customized to use the customer's own data in the class.

Course Syllabus

The syllabus and length of this class varies depending on the tools selected. The following is a brief syllabus for each of the tools along with the duration of the class.

CellTrace – 1 Day

- ✓ Building Data – Theory
    - o Indoor Building Data
    - o Material Properties Definition
- ✓ CellWall – Practice
    - o Generation of Indoor Building Data
    - o Conversion of Indoor Building Database
    - o Material Properties Assignment
- ✓ CellAntenna – Practice
    - o Generation, Conversion & Modification of Antenna Patterns
    - o Interpolation of antenna patterns (2x2D => 3D)
- ✓ CellProp – Practice Wave Propagation
    - o Handling of propagation projects
- ✓

- o Definition of transmitter sites (power, frequency, antenna)
- o Indoor propagation: project settings & parameters
- ✓ Network Planning – Theory
    - o Air Interfaces
    - o Cell Assignment & Co-Channel Interference
- ✓ CellProp– Practice Network Planning
    - o Definition of RF and network parameters (air interface)
    - o Possible outputs
    - o Import of measurement data
    - o Comparison of simulation results with measurements
- ✓ Discussion
- ✓ Open questions

MENTORING

Target Audience

CelPlan customers that require one-on-one assistance or team supervision in learning certain tasks or methodologies related to network design, optimization, and performance analysis.

Pre-requisite

None

Goals

Assist the student(s) in acquiring new knowledge, improving his skills, and building up confidence when performing certain tasks.

Length

✓ as required by the customer

CONTACT CELPLAN

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