GSM Network Planning and Optimization

Course Outline

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Course Learning Objectives:

1) Cellular Network overview and RF Fundamentals
2) GSM Technology Fundamentals, Different concepts, Events
3) Coverage, Capacity and Frequency planning fundamentals of GSM Network
4) Handover and Power Control in GSM Network
5) Key Performance Indicators and Quality of Service
6) Fundamentals of Network Optimization
7) Monitoring and Analysis of Radio Network performance
   a. Daily Reports for Network operation Centre
   b. Drive Test – Data Collection, Observations, Trouble Shooting, Data analysis
   c. Customer Complaints
8) Radio Network parameters for Handover, Power Control and network optimization

Target Audience:

The target audience for this course includes:

- Anyone who needs understanding
  - GSM-based networks, details on Radio Network & Core Network, Network deployment, network engineering, RF and BSS Engineers, Transmission and switching engineers

Delivery Method:

The delivery will be instructor-led classroom training with extensive practical case studies, interactive discussions and Q&A / quiz sessions

Course Material:

The course material will be in the form of hardcopy notes

Pre-requisites:

The participants are expected to have prior knowledge of:

- Knowledge of wireless communication fundamentals and GSM Basics

Duration:

3 Days

Revision:

1.0

Course Outline

Day 1:

Cellular Communication Fundamentals and RF Fundamentals

- Cellular Network overview and different Nodes
- Radio Network Access Methodologies
- Frequency Bands for Mobile Communication, Frequency reuse in Cellular Network
- Events in Cellular Network (Calls, Handover, Paging)
- RF Signals and its fundamentals
- Line of sight communication and non line of sight communication
- Types of Propagation losses in Air Medium and factors affecting losses
- Antenna Theories and types of antennas

GSM Network Fundamentals, Concepts, Events

- GSM Network Architecture and Functions of Nodes
- GSM Network Entities
- Logical Channels in Air Interface and their usage for calls
- Frame Structure in Air Interface (Signaling and Traffic)
- Different Concepts like Cell Selection, Reselection, Timing Advance, Time Offset and Radio Link Time out etc
- Mobile Originating and Terminating Call
- Paging, Location Update in GSM

Fundamentals of Coverage and Capacity planning

- What and why Network Planning?
- Scope of Network Planning
- Inputs required for Network planning

Day 2:

Coverage Planning

- Factors affecting coverage of a Cell site, Coverage boundary and overlap
- Different Propagation Models and Model tuning
- Site Selection criteria
- City Planning
- Highway Planning
- Rural Planning

- Indoor Coverage Planning (IBS, Repeater, Leaky Feeder)
- Selection of different Antenna Systems
- Radio Link Budget
- Various techniques for coverage enhancement
- Various activities like Nominal Cell Plan, CW Test, RF Survey

Capacity Planning

- Factors that governs call handling capacity of the network

- Air interface dimensioning for logical channels
  - Combined Signaling
  - Non Combined Signaling
- Traffic Theory and Erlang concept
- Traffic pattern in the network
- Traffic calculation with example for signaling and voice/data
- Grade of Service (GoS), SDCCH GoS, TCH GoS
- Erlang Table
- Various techniques for capacity enhancement

Frequency Planning

- Factors affecting frequency planning
- BCCH Frequency Planning
- Traffic Frequency planning
- Hopping Fundamentals and explanation
- Case study

Handover and Power Control

- Criteria for Handover and handover decision making
- Different Types of Handover in GSM
- Measurement report and Averaging
- Handover Parameters and handover signalling
- Power Control in GSM
- Power Control Parameters and Criteria
- Thresholds for Handover and Power Control
- Handover Priority
- Typical problems in Field and Analysis – Case Studies

Key Performance Indicators and Quality of Service

- Channel Success Rates (SDCCH, TCH, RACH, etc)
- SDCCH Drop, TCH Drop
- QoS Indicators
- Call Success Rate
- Dropped Calls
- Call Set-up Success Rate
- Radio Link quality
- Network Coverage Map (Indoor, In-Car, Outdoor)
- Handover Success Rate
- Paging Success Rate
- TCH Allocation Success Rate

Day 3:

Fundamentals of Optimization

- What is optimization and why optimize
- Optimization Philosophy
- Triggers for optimization
- Issues in Optimization
    - Examples of Optimization – Different Scenarios

Monitoring and Analysis of Radio Network Performance

- Daily report Monitoring and Analysis

- Identifying issues from daily reports
- System Information messages and Layer 3 messages
- Data Collection in drive Test
- Long Calls, Short Calls, Data Calls
- Primary/Secondary/Tertiary Routes
- Observations and trouble shooting of issues
- Typical problems of Drive Test Set-up
- Typical Network Problems (Cell Dragging, Missing Neighbors, Parameter Settings, Interference etc)
- Bench Marking Exercise

Critical Radio Network Parameters

- Critical BSS Parameters for GSM events and procedures
    - Capacity enhancement Parameters
    - Coverage Enhancement Parameters

- o GSM Technology Parameters
- Handover Related Parameters
- Power Control Related Parameters

Green Filed Project and Network Expansion (Case Study)

- Planning activities for Greenfield project
  - o Coverage Planning
  - o Capacity Planning
  - o Frequency Planning
  - o Nominal Cell Planning
  - o Model Tuning
  - o RF Survey
  - o Network Implementation
- Decide Parameters for the network
- Network Expansion by adding carriers and adding BTS