

UMTS/HSPA+ Overview

Course Number: UMTS3000-01EN | Duration: 4 Days

Target Audience

- UE & UTRAN Development Staff
- Network Engineering & Optimisation Personnel
- System Design Engineering Staff, IOT & System Test Engineers
- Technical Sales and Marketing people

Prerequisites

- None

Learning Objectives

After completing this course, the students will be able to:

- Explain the differences between scrambling and spreading and what consequences of 1/1 re-use.
- Judge the performance improvements of HSDPA, HSUPA, MIMO and dual carrier vs. Rel. 99 DCH.
- Understand the relationship between SIR-Target, BLER and required power resp. Noise Rise.
- Describe the tasks and functions of RNC and NodeB for Rel. 99 and high speed evolution.
- Know the differences between SRB's and RAB's and the various services supported by UMTS.

Course Outline

1. Radio Frequency Fundamentals
 - 1.1 Frequency Bands for UMTS
 - 1.2 Coverage & Pathloss
 - 1.3 DS-CDMA ↔ WCDMA
 - 1.4 Modulations & Physical Bit Rates
2. WCDMA Basics
 - 2.1 Network Topology
 - 2.2 Chiprate & Processing Gain
 - 2.3 Forward & Backward Error Correction
 - 2.4 Noise Rise & Near Far Effect
 - 2.5 UL & DL Resources in (W)CDMA
3. Spreading Codes
 - 3.1 OVSF Tree
 - 3.2 Spreading & De-Spreading
 - 3.3 Auto-Correlation & Cross-Correlation
 - 3.4 Physical Channels and their SF
 - 3.5 Various Bit Rates (DL/UL)
4. Scrambling Codes
 - 4.1 Why Scrambling
 - 4.2 DL & UL Scrambling Codes
 - 4.3 Auto- & Cross-Correlation
 - 4.4 Multi-User Detection & IC
5. Channel Concept in UMTS
 - 5.1 Logical Channels & Bearers
 - 5.2 R99 TrCH's & PHY Channels
 - 5.3 Rel.5-Rel.9 TrCH's & PHY Channels
 - 5.4 DCH versus High Speed Evolution
 - 5.5 Compressed Mode Configuration
6. HSDPA+ Introduction
 - 6.1 HSDPA Setup and Reconfigurations
 - 6.2 UE Categories & max. Throughput
 - 6.3 HARQ and Link Adaptation
 - 6.4 CQI Reporting for QPSK, MIMO, QAM
 - 6.5 Dual Carrier HSDPA vs. MIMO
7. HSUPA+ Introduction
 - 7.1 E-DCH Scaling & Serving Grant
 - 7.2 UE Categories & max. Throughput
 - 7.3 E-DCH HARQ & Link Adaptation
 - 7.4 Dual Carrier HSUPA vs. 16QAM
8. RRC Procedures & Synchronisation
 - 8.1 Time- Synchronisation for SHO
 - 8.2 CFN and Activation Time
 - 8.3 RRC Procedures & Delays
9. SRB's & User Data Bearer Design
 - 9.1 RRC States & State Changes
 - 9.2 (WB-) AMR Voice Call Bearer Setup
 - 9.3 SMS Transfer
 - 9.4 CS Video Call
 - 9.5 R99 PS Bearer Setup & Reconfigurations
 - 9.6 Rel. 5 - R9 PS Bearer Setup & Reconfigurations
 - 9.7 Multi-RAB (CS&PS)
10. Idle & Connected Mode Mobility
 - 10.1 Cell Selection & Reselection
 - 10.2 Inter-RAT Reselections (3G ↔ 2G/4G)
 - 10.3 Soft HO versus Hard HO
 - 10.4 Inter-Frequency HO
 - 10.5 SRNC Changes and Iur Signaling
 - 10.6 IRAT Cell Changes & HO (3G ↔ 2G/4G)

UMTS/HSPA+ Air Interface

Course Number: UMTS3200-01EN | Duration: 4 Days

Target Audience

- UE & UTRAN Development Staff
- Network Engineering & Optimisation Personnel
- System Design Engineering Staff, IOT & System Test Engineers

Prerequisites

- UMTS & HSPA+ Overview (UMTS3000-01EN)

Learning Objectives

After completing this course, the students will be able to:

- Understand the differences between DCH and HS-DSCH/E-DCH Operation in Rel. 99 – Rel.9.
- Verify DC-HSDPA related procedures, MIMO operation as well DC-HSUPA operation.
- Plan and configure radio network parameters for UE and NodeB/RNC.
- Analyse UE-logs as well Iub- & Iu-network traces and determine faults.
- Know the differences between Ec/No and SIR as well RSCP and RSSI.

Course Outline

1. Spreading & Scrambling
 - 1.1 Design of OVSF and Code Tree
 - 1.2 Purpose of Scrambling Codes (DL/UL)
 - 1.3 Rake Receiver Architecture Types
 - 1.4 DL & UL Spreading Code Allocation
2. Channel Concept in UMTS/HSxPA
 - 2.1 LCH, TrCH and PHY Channels
 - 2.2 Channels per RRC State
 - 2.3 Rel. 99 TFS, TFC & CTFC
 - 2.4 HSPA+ Channel & eF-DPCH Operation (H-RNTI, Primary/Secondary E-RNTI)
 - 2.5 Multi-RAB with CS+PS Bearers
3. HARQ Operation in DL & UL
 - 3.1 HSxPA UE Category's (Rel.5 – Rel.9)
 - 3.2 Stop & Wait Machines
 - 3.3 CQI & Scheduling Info Reporting
 - 3.4 Retransmission Combining & LA
 - 3.5 Transfer of Higher Layer PDU's
4. RRC Idle Mode Procedures
 - 4.1 Cell Search Procedure
 - 4.2 System Info Decoding
 - 4.3 Paging Type 1 vs. Paging Type 2
 - 4.4 UMTS Cell Selection & Reselection
5. RRC Connected Mode Procedures
 - 5.1 RRC Establishment & DMCR
 - 5.2 SRB Setup & Reconfiguration
 - 5.3 RAB Setup & Reconfiguration
 - 5.3 RRC/RB Reestablishment & Release
6. HS/DCH Mobility Procedures
 - 6.1 Measurement Control & Events
 - 6.2 SHO Parameterisation
 - 6.3 HSxPA(+) Serving Cell Change
 - 6.4 Various Compressed Mode Settings
 - 6.5 Hard Handover & Inter-Frequency HO
 - 6.6 Inter-RAT HO (3G ⇔ 2G/4G)
 - 6.7 SRNS Relocation [UE (not)involved]
7. RRC & User Plane Operation in FACH & PCH
 - 7.1 Channel Type Switching & Cell Update
 - 7.2 User Data Reception & Transmission
 - 7.3 Call Setup in CELL_FACH or XXX_PCH
 - 7.4 Paging in CELL_FACH or XXX_PCH
8. HSDPA+ Procedure Details
 - 8.1 HS-SCCH Type 1, 2 & 3 Operation (64QAM, HS-SCCHless, MIMO)
 - 8.2 Dual Carrier HSDPA Operation (DC)
 - 8.3 HS-DPCCH Operation for DC / MIMO
9. E-DCH+ Procedure Details
 - 9.1 E-AGCH, E-HICH & E-RGCH Operation
 - 9.2 Dual Carrier E-DCH Operation
 - 9.3 Serving Grant Update
10. HSxPA Procedure Details & Functionalities
 - 10.1 HSPA Reconfigurations in DCH/FACH
 - 10.2 DTX/DRX Operation in DCH/FACH/PCH
 - 10.3 Flexible RLC-PDU with MAC-i/is MAC-ehs
 - 10.4 Summary of CPC Features

UMTS/HSPA+ Signaling & Protocols on Uu Interface

Course Number: UMTS3300-01EN | Duration: 4 Days

Target Audience

- System Design and IOT Engineers
- Network Planning/ Performance Engineering Staff
- Network Maintenance and Optimisation Personnel

Prerequisites

- UMTS & HSPA+ Air Interface (UMTS3200-01EN)

Learning Objectives

After completing this course, the students will be able to:

- Understand the various DCH and HSxPA related configuration & reconfiguration procedures.
- Analyse UMTS/HSxPA features and how they can be benchmarked.
- Identify faults in Iub & Iu traces, particular drops and the related root cause(s).
- Determine faulty procedures and erroneous protocol behaviours.
- Judge UE versus UTRAN mistakes and their impact on network performance.

Course Outline

1. Fundamentals of UMTS & HSPA+
 - 1.1 Network Architecture – RAN & CN
 - 1.2 Rel. 99 – Rel. 9 Feature Overview
 - 1.3 RRC States & supported Bearers
 - 1.4 Protocol Architecture Rel. 99 – Rel. 9
2. General Signaling Procedures
 - 2.1 UE & RAN/CN Identifiers
 - 2.2 SIM/USIM Functionality
 - 2.3 System Information Broadcasting
 - 2.4 Service Area Broadcasting - CBS
 - 2.5 CS/PS Paging – Paging Coordination
3. Registration (MM/GMM)
 - 3.1 PLMN & Cell Search
 - 3.2 Location Update & Attach Procedure
 - 3.3 Combined Attach for PS & CS
 - 3.4 Location & Routing Area Update
 - 3.5 CS/PS Detach Scenarios
4. RRC Establishment & Re-Establishment
 - 4.1 Random Access using RACH/FACH
 - 4.2 Random Access via E-DCH/HS-DSCH
 - 4.3 Synchronisation on DCH & F-DPCH
 - 4.5 Drop & Re-establishment
5. MAC Protocol Functionality R99 – Rel.9
 - 5.1 MAC-Header for LCH to TrCH Mapping
 - 5.2 (E-)TFC Selection & BSR/SI
 - 5.3 Reordering & Stalling Prevention
 - 5.3 Ciphering/De-Ciphering for RLC-TM
 - 5.4 Cell Update & Cell Update Confirm
 - 5.5 HARQ Signaling for HS-DSCH & E-DCH
 - 5.6 CQI Reporting per Category Table
6. RLC Protocol Functionality Rel. 99 – Rel. 9
 - 6.1 RLC Modes for CS & PS Bearers
 - 6.2 SDU Segmentation & Reassembly
 - 6.3 Flow Control & In-Sequence Delivery
 - 6.4 Error Correction & Status PDU's
 - 6.5 Ciphering / Deciphering
7. PDCP Protocol Functionality Rel. 99 – Rel. 9
 - 7.1 ROHC
 - 7.2 Lossless SRNS Relocation
 - 7.3 CS Voice over High Speed
8. RRC Protocol Procedures Rel. 99 – Rel. 9
 - 8.1 (Re-) Configuration of SRB's
 - 8.2 RRC Connection Management
 - 8.3 Radio Bearer Control
 - 8.4 Measurement & Control
 - 8.5 RRC Connection Mobility
9. Selected CS Scenarios
 - 9.1 Voice Call Setup
 - 9.2 TF Combination Control
 - 9.2 SMS & USSD Transfer
 - 9.3 64 kbps Video Call
10. Selected PS Scenarios
 - 10.1 PDP Context Activation & Modification
 - 10.2 Use Cases for XXX Reconfigurations
 - 10.3 HSxPA Serving Cell Change
 - 10.4 Fast Dormancy
11. Selected Multi-RAB Scenarios
 - 11.1 CS Voice & HSxPA PS Bearer
 - 11.2 Call Setup in CELL_FACH/XXX_PCH
 - 11.3 Compressed Mode & IRAT Mobility

HSPA+ Parameter Optimisation & Troubleshooting on Uu Interface

Course Number: UMTS3500-01EN | Duration: 5 Days

Target Audience

- Network Planning/ Performance Engineering Staff
- Network Engineering and Optimisation Personnel

Prerequisites

- UMTS & HSPA+ Air Interface (UMTS3200-01EN)

Learning Objectives

After completing this course, the students will be able to:

- Evaluate drive-tests logs and critical signaling faults as well as procedure mistakes.
- Analyse RRC parameter settings and their performance impact on Uu.
- Optimise procedures and their related parameters to reach better network performance.
- Debug critical system problems in UE & UTRAN as well as interworking with core and IRAT.
- Improve E2E network KPI and quality of experience (QoE) .

Course Outline

1. Major HSxPA Uu Features in Rel. 5/6
 - 1.1 Hybrid ARQ & Link Adaptation
 - 1.2 E-DCH Scaling and Serving Grant
2. Important Features in Rel. 7/8
 - 2.1 Enhanced Fractional DPCH
 - 2.2 Flexible RLC with MAC-ehs/MAC-i/is
 - 2.3 MIMO & Dual Cell HSDPA
 - 2.4 DTX/DRX in CELL_DCH
 - 2.5 Enhanced FACH/PCH
3. RRC Setup & Radio Bearer Reconfiguration
 - 3.1 RRC Connection Setup with eFDPCH
 - 3.2 Radio Bearer Setup for HSxPA
 - 3.3 Radio Bearer Reconfigurations for TrCH Type Switching
 - 3.4 Physical Channel Reconfiguration
4. Idle Mode Mobility
 - 4.1 Cell Selection & (Priority) Reselection
 - 4.2 Measurement Types
 - 4.3 Paging in Idle and XXX_PCH
 - 4.4 EPLMN and MOCN
5. Connected Mode Mobility
 - 5.1 (S)HO Events and Trigger Parameters
 - 5.2 HSxPA Serving Cell Change Performance (Target Cell Pre-Config)
 - 5.3 Inter-Frequency HO Optimisation
 - 5.4 Inter-RAT HO Parameter Analysis
6. Power Control and Power Setting
 - 6.1 UL Power Control Parameters (Open Loop/Closed Loop)
 - 6.2 DL Power Setting (Open Loop/Closed Loop)
7. E-DCH Scheduling in Uplink
 - 7.1 Reference E-TFCI's & Max Throughput
 - 7.2 BLER-Target and RoT
 - 7.3 High RTWP & Overload Handling
 - 7.4 Non Serving Grant Down
8. TCP/IP and E2E Performance
 - 8.1 Why Duplicate ACK's?
 - 8.2 Why TCP Retransmissions?
 - 8.3 Low Frame Utilization for HSDSCH (high DTX and high Window Size)
 - 8.4 Concurrent Up- & Down-Loads
 - 8.5 Max possible UL/DL Throughput considering Protocol Overhead
9. Enhanced Battery Saving
 - 9.1 Fast Dormancy & SCRI
 - 9.2 Enhanced UE DRX in Rel. 8
 - 9.3 LTE vs. HSPA Energy Consumption
10. Radio Performance Optimisation
 - 10.1 CQI Improvement
 - 10.2 Ideal Iub Flow Control for HSxPA
 - 10.3 Drop Call Reduction & Multi-RAB