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Evolved EDGE & GERAN Evolution

Course Duration:

- 2 days

Course Description:

- This course addresses the needs of design and test engineers both at vendors and operators to understand in detail the contents and implications of the next phases of GERAN, usually referred to as "Evolved EDGE" or GERAN-evolution.

- In that respect, the course starts with an assessment as to where GSM and GERAN stand today compared to 1991.

- The course continues with the detailed description and analysis of the various proposed changes which are commonly referred to as EDGE phase 2, evolved EDGE or as GERAN-evolution.

- This chapter includes but is not limited to the description of techniques like downlink and uplink multicarrier, HOMTC, MORE, HUGE, RED HOT and LATRED. Each description is accompanied by a detailed analysis of the related pros and cons and implementation implications.

- The focus of the following chapters is the detailed description as to how features like downlink multicarrier, flexible timeslot assignment, HUGE, RED HOT (EGPRS2) and RL-TBF have been integrated into the release 7 series of specifications.

Prerequisites:

- The student must possess detailed understanding of GSM- and EGPRS-technology, obtained during the design or test of the related equipment.

Course Target:

- The student is enabled to implement or test the related technology updates within handsets or base stations.

- The student will be aware of the current state of Evolved EDGE and the integration of the related techniques into the specifications.

- In addition the student will understand the implications of each technique in detail.

Some of your Questions that will be answered:

- What is the motivation of GERAN-evolution and who steers it?

- How does GERAN differ from the envisaged 4G-mobile networks and can it be evolved to offer similar services?

- How do technology improvements like HOMTC, multi carrier, higher symbol rates, RTTI or VSRB operate?

- What are the differences between 16-QAM- and 16-APK-modulation?

- Which new slot and burst formats have been investigated?

- How many RF-carriers are supported in uplink and downlink direction with GERAN-Evolution?

- What is "Flexible Timeslot Assignment"?

- Which performance improvements are achieved through multicarrier operation?

- Which performance improvements do HUGE and RED HOT offer?

- How do HUGE and RED HOT cope with the presented liabilities of higher order modulation schemes?

- What is bit swapping and how is it used in HUGE and RED HOT?

- Which new burst formats and which new coding schemes (DAS, UAS, DBS and UBS) have been defined for HUGE and RED HOT?

- Which options for latency reduction have been incorporated into Release 7 for the so called RL-TBF operation?

- How can mobile stations operating in BTTI-mode be multiplexed with mobile stations operating in RTTI-mode?

- How does a mobile station receive USF-allocations during RL-TBF operation?

- How is a PAN-Field transmitted?

- What is MCS-0 and why was it introduced?

- What is RLC non-persistent-mode of operation and how does it operate?

Who should attend this Course:

- Design and test engineers who shall be on track with the current state of technology.

- Managers who needs to understand the details and implications of GERAN evolution.

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Table of Content:

Angles

=Turbo Coding

Performance Considerations, Principles of Turbo Encoding, Principles of Turbo Decoding, Reliability Information and Extrinsic Information

● **Increased Symbol Rates**

=Normal Symbol Rate and Dual Symbol Rate

=Modified Dual Symbol Rate and Higher Symbol Rate

Pulse Shaping at Higher Symbol Rate

=Important Characteristics

Dual Symbol Rate, Modified Dual Symbol Rate, Higher Symbol Rate

=Performance Considerations

● **Latency Enhancements**

=Latency Contributing Factors

Network Node related Latency Contributors, Related to Block Building, Related to Processing, Related to Queuing, Link related Latency Contributors, Related to Throughput Rate, Related to Distance, BEC related Latency Contributors

=The Impact of Latency on the Performance

Download Time with Static Latency / var. Throughput Rate, Download Time with var. Latency / static Throughput Rate

=Practical Exercise: Determine the One-Way Latency within GERAN between MS and BSC/PCU

=Suggested Improvements of LATRED

Improved Ack/NACK-Reporting, Reduced Transmission Time Interval (RTTI), Variable Sized Radio Blocks (VSRB), High Speed HARQ (HS-HARQ)

=Implementation Options of RTTI

Timeslot Combination, Frequency Combination

=Description of VSRB

Operation, Burst Mapping (2 Burst Solution), Constraints & Conditions, Restricted to short data packets, Requires different interleaving and burst mapping, Indication of VSRB-operation e.g. through stealing flags, Can be extended to 1 or 3 burst solutions

=More Details about HS-HARQ

Introduction, Stop & Wait Operation, Practical Exercise: Implementation Implications of HS-HARQ

● **New Slot and Burst Formats**

=Overview and Introduction

=Details and Performance of the different Combinations

The 2-Burst Combination, Performance Gain, The 3-Burst Combination, Performance Gain, The 4-Burst Combination, Performance Gain

=Liabilities

Integration of MSRD, Downlink Dual Carrier and Flexible Timeslot Assignment

- **Overview and Applicability**
- **Indication of Support for DARP II and MSRD**
- **Understanding Multislot Capabilities for Dual Carrier Mobile Stations**

  =Introduction and Defined Multislot Classes

  =Interpretation of the "Multislot Capability Reduction" IE
  Comprehension Questions

  =Practical Exercise: Translate "MS Capability Reduction IE" into actual Performance Values and Timing Requirements

- **Flexible Timeslot Assignment**

  =Detailed Description
  Difference Allocation / Assignment, Allocation Example 1, Allocation Example 2, Advantage of Flexible Timeslot Assignment

Integration of RED HOT and HUGE

- **Overview & Introduction**

  =From 3GTR 45.912 to RED HOT and HUGE
  HUGE, RED HOT

- **Introducing Enhanced GPRS phase 2 (EGPRS2)**
  EGPRS2 - Important Characteristics, EGPRS2-A Downlink, EGPRS2-A Uplink, EGPRS2-B Downlink, EGPRS2-B Uplink

  =Indicate Support for EGPRS2 (MS-Radio Access Capability)

- **Burst Formats of EGPRS2**

  =Normal Symbol Rate
  GMSK, Stealing Flag Setting, 8-PSK, Stealing Flag Setting, 16-QAM and 32-QAM, Stealing Flag Setting 16-QAM, Stealing Flag Setting 32-QAM

  =Higher Symbol Rate (HSR)
  QPSK, Stealing Flag Setting, 16-QAM, Stealing Flag Setting, 32-QAM, Stealing Flag Setting

  =EGPRS2 Gross Throughput Rates (per Timeslot)
  Normal Symbol Rate, Higher Symbol Rate

- **Bit Swapping**

  =Operation Principles

  =Practical Exercise: Does it also work with 8-PSK?

- **Channel Coding in EGPRS2**

  =Overview

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=EGPRS2-A (Normal Symbol Rate)
Downlink: DAS-5 - DAS-12, Uplink: UAS-7 - UAS-11

=EGPRS2-B (Higher Symbol Rate)
Downlink: DBS-5 - DBS-12, Uplink: UBS-5 - UBS-12

Integration of Reduced Latency- and RLC-Non Persistent Mode-Operation

- **Overview and general Characteristics of RL-TBF**
  Description of FANR, Description of RTTI and BTTI

  =Indicating Support for RL-TBF-Operation and RLC Non-Persistent Mode

- **More Details about FANR**

  =Fast Polling while in BTTI

  =Fast Polling while in RTTI

  =PAN-and PANI-Fields
  SSN-based PAN-Field, Time-based PAN-Field

  =Channel Coding of the PAN-Field

- **USF-Allocation Issues related to RL-TBF-Operation**

  =Overview & Identification of potential Problems
  BTTI USF-Mode and RTTI USF-Mode, Problem: Cutting out the USF, Operation of the DL-PACCH

  =UL-TBF = RTTI / DL-Block = RTTI and RTTI USF-Mode
  Differences between Dynamic and Extended Dynamic Allocation, Corresponding DL PDCH-Pairs

  =UL-TBF = RTTI / DL-Block = BTTI and BTTI USF-Mode
  Differences between Dynamic and Extended Dynamic Allocation

  =UL-TBF = RTTI / DL-Block = RTTI and BTTI USF-Mode
  Necessity to introduce MCS-0

  =MCS-0 encoded RLC/MAC-Control Blocks
  RLC/MAC-Format, RLC/MAC-Header, RLC-Header, RLC/MAC-Control Message, Channel Coding Process, USF-Precoding, 18-bit CRC Check, RLC/MAC-Header Encoding Process, RLC/MAC-Control Message Encoding Process, Interleaving and Burst Mapping, Use of MCS-0

- **RLC Non-Persistent Mode**

  =Overview & Introduction

  =Procedure Description
  NPM-Timer, Behavior of NPM in case of Retransmissions