

Basic concepts and planning of 3G networks

Course Description

The training starts with a review of the main UMTS concepts, such as CDMA, coding process, network load and most important physical channels. This part will ensure the participant a proper understanding of the important 3G concepts, and no time will be lost on useless theoretical details. Also more advanced topics like handover operation, power control and load control will be explained.

The next part describes in detail the complete planning process of a 3G network. This will start of course with the link budget and most popular 3G radio propagation models, as this information is needed in the Radio Access Network dimensioning phase. Multiple guided exercises will enable the participant to review and adapt the link budget, and the impact of important phenomena

like cell breathing will be calculated in detail. Next, the focus will be on the differences in network planning between GSM and UMTS, particularly important for those with limited practical 3G experience. Both nominal planning and detailed planning will be discussed, and typical 3G planning problems will be reviewed in detail. The extensive and practical experience of the trainer will allow an open discussion on all 3G planning aspects.

Finally, to encourage a good understanding of what needs to be achieved with 3G network planning, the initial tuning procedure for 3G clusters will be discussed.

At least 50% of the time will be spent to guided exercises to maximise the participant's learning experience.

Course Outline

- ✦ Basic concepts and operation of 3G
- + UMTS link budget and 3G radio propagation models
- + Radio resource management
- + Planning 3G networks
- + Initial tuning for 3G clusters



Training from P3 communications: 10 Good Reasons

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| + Flexible approach | + Vendor-independent |
| + Delivered by experts with practical experience | + Detailed training requirement analysis available |
| + Trainers with excellent and proven teaching skills | + Further follow-up/on-the-job coaching available |
| + More than 50% of the time is spent on exercises | + Up-to-date-content |
| + Using your own software and tools | + Competitive pricing structure |

Detailed Course Outline

Basic concepts and operation of 3G

History, multiple access schemes, concept of spread spectrum, codes in CDMA, two stage coding process including spreading and scrambling, signal to noise ratio, processing gain, load, network and protocol architecture, QoS, channels and channel mapping, Rake receiver.

UMTS link budget and 3G radio propagation models

Basics of radio propagation, link budget methodology, assumptions for both UE and node B, calculation of receiver sensitivity, maximum path loss, impact of TMA on link budget, coverage thresholds, calculation of inter-site distance, concept of soft capacity, propagation models for 3G planning, multiple guided exercises on link budget calculation (including calculation of cell breathing, impact of service on cell range).

Radio resource management

Description of 3G handover scenarios, power control, load/admission control.

Planning 3G networks

RF planning procedure including 2G and 3G approach, differences between radio planning for GSM and UMTS, impact of high sites on the network (including case study), concept of soft handover overhead, providing coverage/capacity for hot spots, power planning for common control channels and traffic Channels.

Initial tuning for 3G clusters

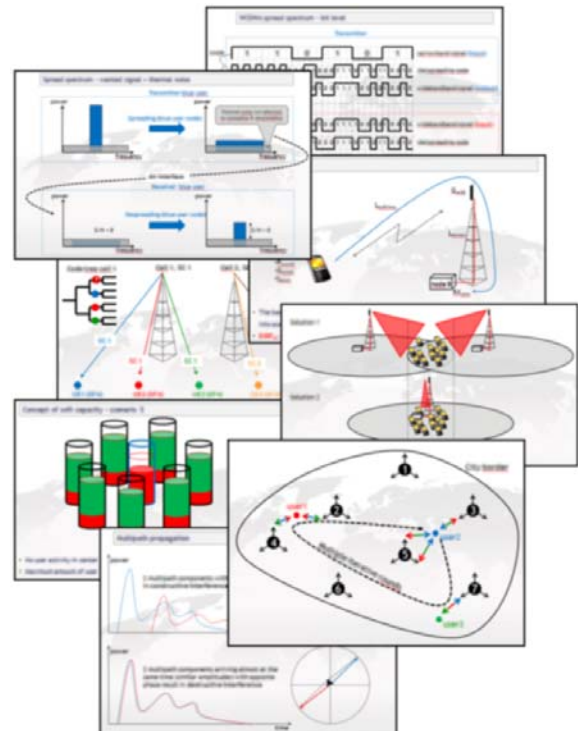
Analysis of 3G scanner data including verification of KPIs (coverage, quality, pilot pollution), initial tuning procedure, optimisation actions.

Target Audience

This course is aimed at operators in the pre- or early 3G network planning/deployment phase who want to make sure the network is designed the right way from the first time. This allows huge cost savings on future re-engineering and optimisation, resulting in the best network performance at minimal cost. The extensive practical 3G planning experience of the trainer will be shared with the participants during numerous interactive discussions.

Course Duration

The normal duration of this training is 3 days. A reduced version of this training could also be delivered as an introduction to more advanced optimisation courses.



UMTS CS performance analysis and optimisation

Course Description

This course describes the next step in the life cycle of a 3G network, the initial tuning and optimisation phase. This takes place after the network planning phase, once the first sites come on air. Only when the appropriate optimisation actions are taken during this phase, the network will reach the performance level expected by the customer. Initially, most of the operators focus on CS services like voice.

The participant will be guided through the initial tuning procedure, where scanner data is used to optimise coverage, quality and pilot pollution. The proper implementation of this procedure is of crucial importance to reach a high quality network. The participant will get familiar with 3G signalling captured during drive tests,

and the main RRC and NAS signalling procedures will be discussed. This leads to the analysis of a complete voice call, both normal cases and dropped calls. Also, idle mode behaviour and PS services over R99 will be studied.

Recommended values will be given for all different parameters discussed during this training, and the operator settings will be compared against these values. Vendor specific problems will be highlighted and solutions will be discussed. At least 50% of the time will be spent on guided exercises to maximise the participant's learning experience.

Course Outline

- + Initial tuning for 3G clusters
- + Air interface signalling for CS services
- + Soft handover operation
- + 3G-2G inter-RAT handover for CS services
- + Idle mode behaviour
- + Introduction to R99 PS services



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Detailed Course Outline

Initial tuning for 3G clusters

Analysis of 3G scanner data including verification of KPIs (coverage, quality, pilot pollution), initial tuning procedure, optimisation actions, definition of polygons for cluster statistics, guided exercises with scanner data.

Air interface signalling for CS services

UMTS control plane and user plane, overview of application protocols, service related signalling, description of basic concepts (RRC connection, Radio Bearer, RAB), detailed description of RRC application protocol, signalling for MOC and MTC, abnormal signalling, introduction to counters and statistics, multiple guided exercises with log files.

Soft handover operation

Handover types, description and parameters of handover related events (radio link addition, deletion and replacement), neighbour list definition, overview of UE measurement reporting, detailed analysis of active set update procedure, measurement filtering, analysis of hysteresis for handover related events, multiple guided

exercises with log files including dropped call analysis.

3G-2G inter-RAT handover for CS services

Principles and algorithms, compressed mode, overview of available handover triggers, analysis of different vendor implementations and related events, performance comparison between vendors, parameter tuning for tunnels, guided exercises with log files.

Idle mode behaviour

Initial 3G cell selection, parameters for 2G->3G cell reselection, description of procedures for 3G cell reselection, possible cell reselection problems, guided exercises with log files.

Introduction to R99 PS services

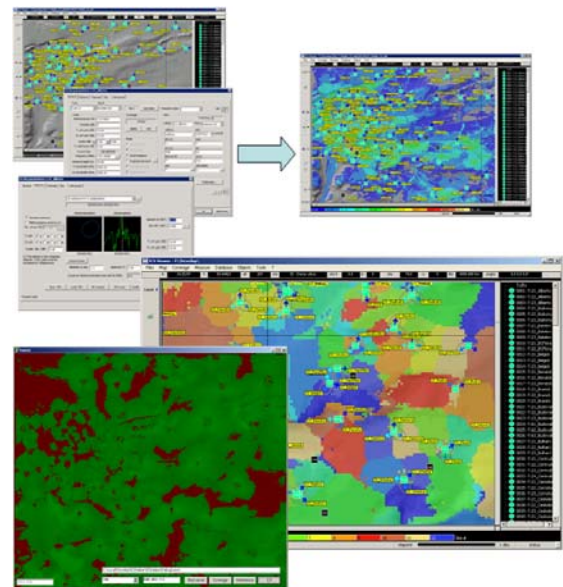
Description of main PS procedures, RRC state model and practical operator implementations, RRC state transitions, inactivity timers, traffic-related events, bearer upgrades and downgrades, relation between spreading factor and data rate, RRC state transition times, guided exercises with log files.

Target Audience

This training is aimed at operators with an operational 3G network who want to get the most out of their network by parameter tuning and optimisation. Ideally, participants already have first 3G optimisation experience, but this is not a must. Also suitable for operators without operational 3G network who want to be prepared for the next step.

Course Duration

The normal duration of this training is 4 days. On request, one additional day can be added, refreshing the basic UMTS concepts.



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Advanced optimisation for 3G data services

Course Description

Most operators on the market currently offer flat rate data services over their HSPA network, leading to a substantial increase in air interface load and interference. In addition, a different approach is needed for the optimisation of data services to ensure the best possible user experience. The aim of this training is to prepare the optimisation engineers for the challenges encountered in this next phase of the network life cycle.

The important HSPA concepts will be reviewed in detail, and multiple guided exercises will ensure a swift processing of the acquired knowledge by all participants.

To assess the user plane performance for mobile data services, the capture and analysis of TCP/IP traces is considered of crucial importance. However, most opti-

misation engineers have a lack of knowledge in this terrain. In this training, participants will become familiar with the required TCP/IP concepts, and multiple guided exercises with Wireshark logfiles will ensure an active working knowledge on TCP/IP trace analysis.

In addition, more advanced topics such as PS inter-RAT mobility, HSPA+ (R7/R8) concepts and operation, and multiple carrier implementation and related mobility will be reviewed in detail. To illustrate these concepts, a demo on HSPA+ trouble shooting and tuning is included.

The training is concluded with a HSPA+ performance analysis workshop, investigating in detail the user experience (throughput, latency, mobility) in your own 3G network.

Course Outline

- + HSDPA/HSUPA concepts and operation
- + TCP/IP concepts and interaction with mobile networks
- + PS inter-RAT mobility and impact on user experience
- + HSPA multicarrier implementation
- + HSPA+ concepts and operation
- + HSPA(+) performance analysis workshop



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Detailed Course Outline

HSDPA/HSUPA concepts and operation

Data rate evolution, targets and characteristics, changes compared to R99, description of new physical channels, HSPA setup signalling, cell capability indication, terminal capability, packet scheduler, CQI, AMC (Adaptive Modulation and Coding), MPO (Measurement Power Offset), serving/absolute/relative grant, absolute grant value table, scheduling grant table, happy bit, advanced receivers, HARQ, HSPA mobility and serving cell, HSPA handover (including inter-RNC handover), impact of mobility on throughput, multiple guided exercises with log files.

TCP/IP concepts and interaction with mobile networks

5-layer model, Description of IP, ICMP (ping), UDP, TCP (characteristics, TCP port, TCP connection setup and release, TCP slow start, acknowledgement strategy, RWIN, SACK, window scaling), FTP, guided exercises to illustrate concepts and to improve Wireshark working knowledge.

PS inter-RAT mobility and impact on user experience

Handover algorithms, handover signature, im-

pact on user experience, guided exercises with log files.

HSPA multicarrier implementation

Drivers for 2nd carrier, advantages and disadvantages, different implementations, impact on network planning, description of interfrequency handover algorithms, inter-layer mobility scenarios, guided exercises with log files.

HSPA+ concepts and operation

MIMO, PCI (Precoding Control Information), HS-SCCH type 3, dual stream HARQ implementation, type A/B CQI reports, 64-QAM downlink, 16-QAM uplink, new UE categories & CQI mapping tables, CPC (Continuous Packet Connectivity), uplink DTX, downlink DRX, E-DCH TX start time restrictions, HS-SCCH less operation, HS-SCCH orders, enhanced F-DPCH, flexible RLC PDU size, enhanced cell-FACH state, Dual-Cell HSDPA, Serving Cell Change Enhancements.

HSPA(+) performance analysis workshop

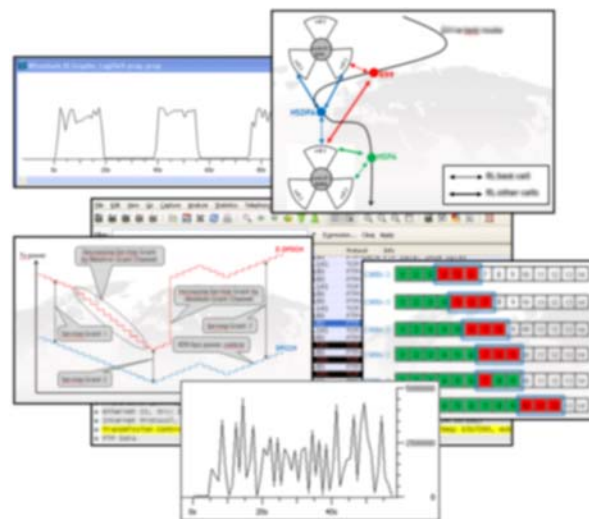
Calculation of theoretical maximum application throughput, ping performance analysis, analysis of static upload and download, analysis of drive test upload and download, inter-RNC mobility.

Target Audience

This training is targeting experienced 3G optimisation engineers who want to take the next step. After completion of the course they will have acquired the knowledge and working skills to start advanced performance analysis and optimisation for PS data services in their network. Ideally, participants have several years of 3G optimisation experience and have been working on HSPA before.

Course Duration

The normal duration of this training is 4 days. On request, this training can be tailored to meet the operator's specific needs.



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