



**UNIVERSITY  
OF OXFORD**  
CONTINUING EDUCATION

**CONTINUING  
PROFESSIONAL  
DEVELOPMENT**

*This is to certify that*

*Mr Roger Thijs*

*attended a course organised  
by this Department on*

*UMTS  
System Design and Operation*

*during the period*

*3-6 July 2007*



*Gregory Thomas*

Head of Department

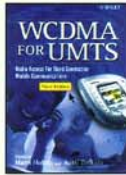
*Wilson*

Director of Studies

## UMTS: SYSTEM DESIGN & OPERATION

3 - 6 July 2007

Full four-day course available for  
**£1,250** early booking fee until  
1 month before start of course  
**£1,350** standard course fee



Price includes a copy of **WCDMA for UMTS** by the course presenters, **Harri Holma** and **Antti Toskala**

An update of the popular course, explaining the capabilities and operation of 3G WCDMA Mobile Networks, including presentations by world-renowned experts in the field. This course provides a detailed end-to-end description and explanation of the global WCDMA radio standard. Emphasis will be placed on real-world deployments and on optimising the data bearing capability of these networks.

### Course Outline

#### DAYS 1 AND 2

- UMTS network architecture: base site design, core network principles, packet data, mobility management, and states of mobile connectivity
- Introduction to cellular WCDMA and comparison to existing GSM networks
- WCDMA physical layer operation, including the operation of flexible transport channels, handovers and delivery of packet data
- Maximising data throughputs through radio and load control optimisation
- Capacity and throughput enhancements: transmit diversity, beam-forming and joint detection
- Factors affecting bit rate and latency, with impact on applications and end-user experience
- Comparison of WCDMA and TD-CDMA technologies and their future roles
- Description of UMTS transceiver architectures, power consumption and design constraints
- Evening seminar: the future of mobile data services and killer applications for 3G

**DAY 3** As per HSDPA/HSUPA course on 5 July.

**DAY 4** As per UMTS: Protocol Architecture on 6 July

### Who Should Attend?

The course is aimed at those wishing to gain a complete end-to-end overview of UMTS technology, RF and baseband engineers, radio planners, service developers, equipment designers and telecoms consultants. The course will also appeal to technical managers, analysts and strategists.

### PRESENTERS

**Dr Harri Holma**, Senior Manager, Standardization, Nokia

**Dr Antti Toskala**, HSDPA Chief Architect, Nokia

**Dr Jonathan Moss**, Principal Device Manager, i-mate™

**Laurent Noel**, 3G RF System Architect, NXP Semiconductors

**Tommi Ahonen**, Telecoms Consultant and Author

**Neil Wiffen**, Senior Technical Instructor, Red Banana

University of Oxford

## Technology

Electronics, Telecoms & Engineering

UMTS: System Design and Operation  
(including HSDPA / HSUPA)

3 - 6 July 2007

## UMTS Network Architecture

Jon Moss  
i-mate™

July 2007

## Contents

- UMTS Network Design & Architecture
  - Evolution from GSM/GPRS
- Packet Data and GPRS
  - Definition of bearers
- Mobility Management and Connectivity
  - Levels of mobility management
  - RRC states

## 2. Introduction to WCDMA

Jon Moss, i-mate™

Contact: jgom@hotmail.com

- Introduction to GSM and UMTS technologies
- Overview of Direct Sequence Code Division Multiple Access
- Correlation receivers, processing gain & code families
- Generic CDMA transceiver block diagram

## 3. CDMA Cellular Engineering

- Multipath Radio Propagation
- Power variability & power control – soft handover
- Synchronization of WCDMA
- Balancing SIR and 'pole capacity'

### References:

3GPP TR25.942 'RF System Scenarios'

3GPP TS25.101 'UE Radio Transmission and Reception (FDD)'

W.C.Y. Lee, 'Mobile Cellular Telecommunications Systems', McGraw-Hill International Editions, 1990

M. Hata, 'Empirical Formulae for Propagation Loss in Land Mobile Radio Services', IEEE Trans. On Vehicular Technology, Vol. 29, 1980

## 3b. DS-CDMA Synchronization

- Acquisition
  - Serial search & matched filter
  - WCDMA Cell Search
- Tracking
  - Analogue tracking loops and digital equivalent

Ref. A. Nielsen and S. Korpela, 'WCDMA Initial Cell Search', IEEE VTC2000

A. Polydoros, C. Weber, 'A Unified Approach to Serial Search Spread Spectrum Code Acquisition - Part I: General Theory', IEEE Trans. On Communications, Aug 77

## 3c. Cellular CDMA Capacity

- $E_b/N_0$  definitions and equations
- Downlink Orthogonality factor
- WCDMA power balancing examples & pole capacity



Oxford UMTS System Design and Operation

University of Oxford  
3<sup>rd</sup> / 4<sup>th</sup> July 2007

## Technical Challenges in designing for W-CDMA:

### Introduction from an RF perspective

All extracts reproduced with authorisation from the author(s)

Laurent Noël

## Agenda

- Introduction
- Transmitter chain design challenges  
*BREAK*
- Receiver chain design challenges
- Talk Time and power consumption  
*BREAK*
- Introduction to Multi Mode /Band Challenges
- Next generation RF-ICs chipsets
- Conclusion Q&A

# UMTS: System Design and Operation

July 4<sup>th</sup> 2007  
Oxford, UK

Harri Holma, Principal Engineer  
Antti Toskala, Senior Manager, Standardisation  
Nokia Siemens Networks, Finland



## Contents

- Standardisation
- Network Architecture
- Physical Layer
- Capacity & Coverage
- Radio Interface Protocols
- Radio Resource Management
- Packet data and TCP over WCDMA
- Multimedia Broadcast Multicast System (MBMS)
- AMR Wideband Voice Codec
- UMTS Frequency Variants

*"The mobile phone is the only device that 30% of the world's population carry"*  
says Tomi Ahonen **The Financial Times** 1 Sept 2005



## Killer Apps in '007 An Evening Seminar with New Mobile Services

**Tomi T Ahonen, M.B.A**  
3G Author & Consultant

3G UMTS Tech Course  
Oxford University, Oxford  
July 4, 2007

 WILEY

# WCDMA FOR UMTS

Radio Access For Third Generation  
Mobile Communications

Third Edition



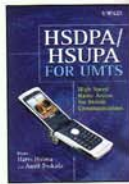
Edited by  
**Harri Holma and Antti Toskala**

## HSDPA/HSUPA for WCDMA

5 July 2007

£495 standard course fee

Price includes a copy of **HSDPA/ HSUPA for UMTS** by Harri Holma and Antti Toskala



This cutting-edge 1-day advanced course, explains the capabilities and operation of High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA) technologies, the key enhancements for 3G WCDMA Mobile.

This course provides a detailed description and explanation of the key enhancements, HSDPA and HSUPA, for the WCDMA radio standard. With presentations from Harri Holma and Antti Toskala, authors of the definitive work "WCDMA for UMTS", this course provides an excellent opportunity to refresh your knowledge of this emerging technology. The course focuses on HSDPA and HSUPA, as well as considering the differences to the current version of WCDMA deployed in networks today, and likely upgrade paths. The impacts to the equipment along with technology details are covered, along with the resulting system performance and cost benefits.

### Course Outline

- HSDPA principles, physical layer operation, protocol and architecture impacts.
- HSDPA performance and impact to network planning and transport dimensioning as well as network upgrade strategies
- HSUPA principles, physical layer operation, protocol and architecture impacts
- HSUPA performance and impact to network Planning

### Who Should Attend?

The course is aimed at those who have already basic understanding of WCDMA technology and wish to get themselves up-to-date with the latest technology development. The course is intended for engineers, radio planners, service developers and operators, equipment designers and telecoms consultants. In addition, the course will appeal to technical managers, analysts and strategists wishing to increase their technical understanding of the key subject area currently in the limelight of the telecoms world.

### PRESENTERS

**Dr Harri Holma**, Senior Manager, Standardization, Nokia

**Dr Antti Toskala**, HSDPA Chief Architect, Nokia

## High Speed Downlink/Uplink Packet Access HSDPA/HSUPA



July 5<sup>th</sup> 2007

Oxford, UK

Harri Holma, Principal Engineer  
Antti Toskala, Senior Manager, Standardisation  
Nokia Siemens Networks, Finland



1 Oxford HSDPA/PPF/0507/2007/ATA001

## Agenda

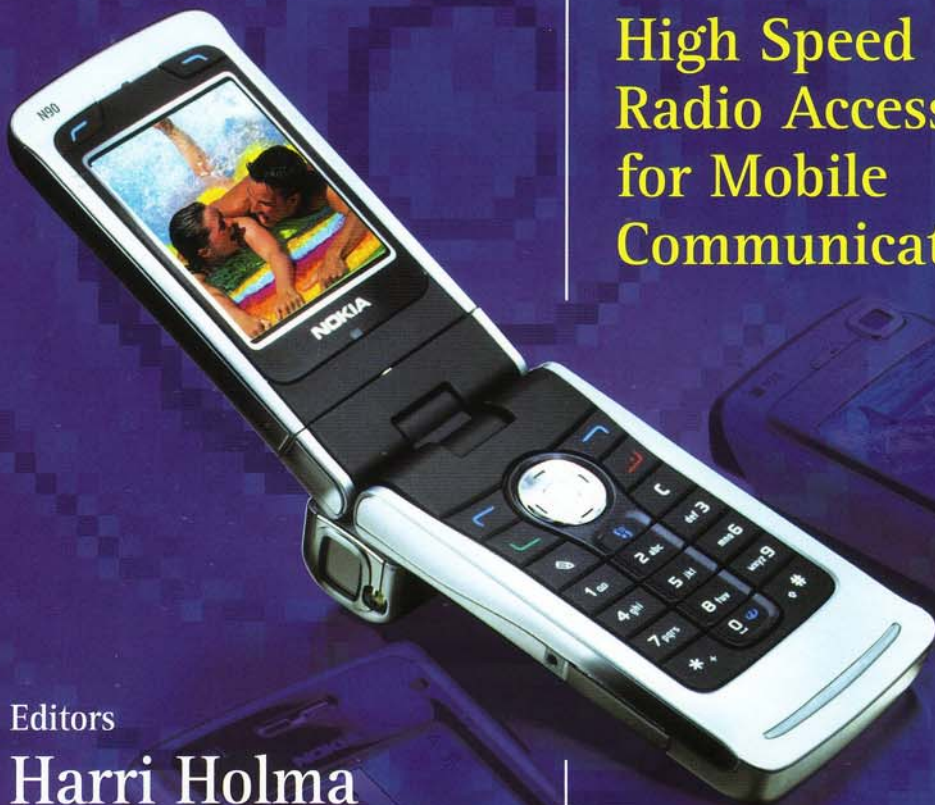
- HSDPA in Release 5
- HSUPA in Release 6
- HSPA evolution in Release 7
- LTE, WiMAX
- Benchmarking

2 Oxford HSDPA/PPF/0507/2007/ATA001

 WILEY

# HSDPA/ HSUPA FOR UMTS

High Speed  
Radio Access  
for Mobile  
Communications



Editors

Harri Holma  
and Antti Toskala

## UMTS - PROTOCOL ARCHITECTURE

6 July 2007

£895 early booking fee until 1 month before start of course  
£995 standard course fee

This course presents a technical description of UMTS Protocol Architecture and signalling procedures, including the enhancements introduced in Releases 5 and 6 of the 3GPP specifications to support HSDPA and the Enhanced Uplink Dedicated Channel (HSUPA).

UMTS protocol analysis software is utilized during the course the output of which will be made available to delegates as required enabling them to analyse detailed logs taken from data-call and IP packet transfer sequences. The output from the analyser software will be made available in HTML format following the course so that delegates can also analyse the call sessions for themselves following the presentation.

### Course Outline

#### Air Interface Protocol Architecture

- Functions and responsibilities
- Channels and their usage
- Layer 3 functionality and structure (UE/Network)

#### UTRAN Protocol Architecture

- Generic Protocol Structure
- Interfaces
- RRC in the UTRAN

#### Example Procedures

- Mobile Originated Voice Call
- Packet Switched Data Transfer HSPA
- Protocols Architecture and principles
- RLC Functions and Procedures
- MAC Functions and Procedures
- Layer 1 Functions and Procedures

### Who Should Attend?

Hardware / software engineers, system designers and implementation engineers who require an understanding of the UMTS protocol architecture including the changes that will occur with the introduction of HSPA and an insight into the consequences of these changes. Delegates should already have a general understanding of UMTS principles and basic mobile call / network procedures, or have attended the UMTS System Design and Operation course

### PRESENTER

Neil Wiffen, Senior Technical Instructor, Red Banana

## UMTS Protocol Architecture

Neil Wiffen

[info@red-banana.org](mailto:info@red-banana.org)

## Agenda

- UMTS Protocols
  - Air Interface
    - Protocol Architecture
    - Channels
  - UTRAN
    - Interfaces
    - Protocols
    - RRC in the UTRAN
  - Procedures
    - Security
    - General
  - HSPA
    - Outline
    - Protocols
    - Channels