UMTS SIGNALING

UMTS Interfaces, Protocols, Message Flows and Procedures Analyzed and Explained

SECOND EDITION

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Second Edition

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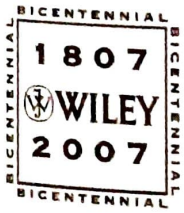

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ted July 2007

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ey & Sons Inc., 111 River Street, Hoboken, NJ 07030, USA

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CH Verlag GmbH, Boschstr. 12, D-69469 Weinheim, Germany

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ay not be available in electronic books.

ry Logo Design : Richard J. Pacifico

brary Cataloguing in Publication Data

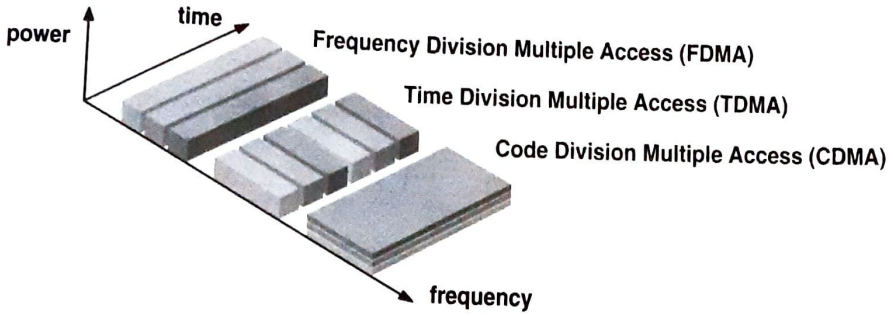

Figure 1.55 Multiple access methods.

For network operators, the difference in planning is that for FDMA and TDMA, frequency planning is the major task, whereas for CDMA, code planning is the major task.

1.7.3 UMTS CDMA

The tasks that result from the CDMA technique are mainly implemented in Node B and in the UE (Figure 1.56).

The following work steps must be performed before the signal can be transmitted via the antenna:

- Spreading of the data with Orthogonal Codes with Variable Spreading Factor (OVSF) codes.
- Scrambling of the spread stream with scrambling codes.
- Modulation of the digital signal onto the air interface.

The receiver will have to perform these steps in reverse order.

Since spreading codes and scrambling codes are important to identify UTRAN signaling messages belonging to a defined user, a short introduction to these techniques is given, while modulation is outside the scope of this book. However, the following section will demonstrate the process for CDMA-FDD only, because TDD is close to implementation, but typically not introduced into the networks yet.

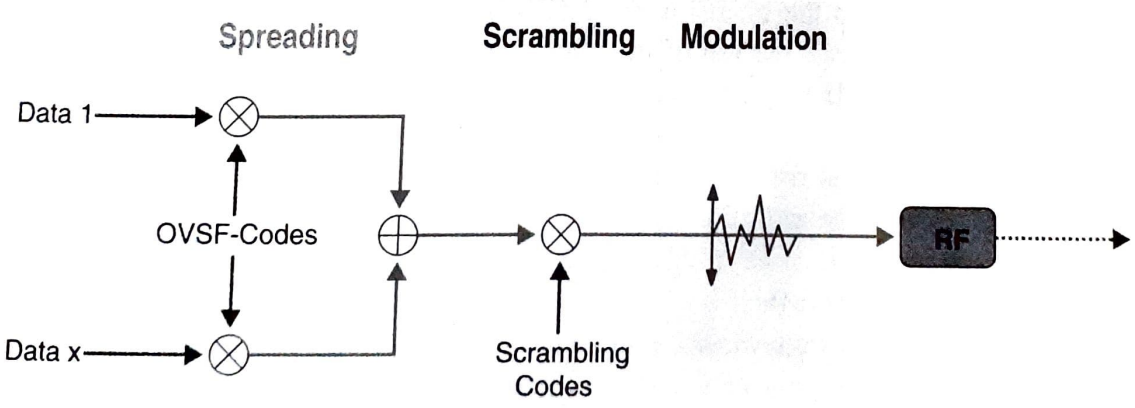

Figure 1.56 UMTS CDMA.

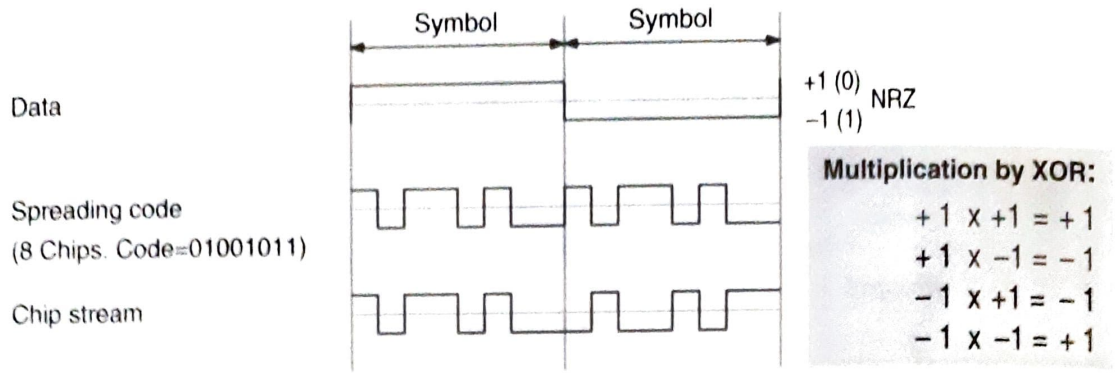

Figure 1.57 Spreading using Direct Sequence CDMA.

1.7.4 CDMA Spreading/Channelization

CDMA can use different methods of spreading channelization:

- Direct Sequence CDMA (DS-CDMA).
- Frequency Hopping CDMA (FH-CDMA).
- Time Hopping CDMA (TH-CDMA).
- Hybrid Modulation CDMA (HM-CDMA).
- Multi-Carrier CDMA (MC-CDMA).

UMTS will use, in the first stage, the DS-CDMA technique (Figure 1.57).

Every bit of the data (symbol) stream will be spread (coded) by a number of code bits (chips). By this, the data stream becomes a chip stream with the length:

data bits × code chips

The input data rate is also called symbol rate.

For the spreading, the data bit values have to be turned to nonreturn to zero (NRZ) codes: for example, +1 or −1. Binary zero is presented as +1 and binary one is presented as −1.

Multiplying the code to the bit using the XOR function performs the spreading. As can be seen, the chip stream is a picture of the code; i.e., if a binary zero has to be spread, the chip stream is the code. If a binary one has to be spread, the chip stream is the inverted code.

One of the main reasons for spreading is to convert a narrowband signal to a wideband signal, nearly as wide as the radio interface frequency band.

In UMTS, the chip stream always has the size of 3,840,000 chips/s, for example 3.84 Mcps, equal to a frequency of 3.84 MHz.

Depending on the data stream variable, spreading codes have to be used. First of all, the value of the code is not important, but its length is. Secondly, the used codes should be orthogonal; they differ completely from each other. In the uplink direction, the UE separates different data