## TD-CDMA, TD – SCDMA

W-CDMA (WCDMA; Wideband Code-Division Multiple Access), along with UMTS-FDD, UTRA-FDD, or IMT-2000 CDMA Direct Spread is an air interface standard found in 3G mobile telecommunications networks. It supports conventional cellular voice, text and MMS services, but can also carry data at high speeds, allowing mobile operators to deliver higher bandwidth applications including streaming and broadband Internet access

W-CDMA uses the DS-CDMA channel access method with a pair of 5 MHz wide channels. In contrast, the competing CDMA2000 system uses one or more available 1.25 MHz channels for each direction of communication. W-CDMA systems are widely criticized for their large spectrum usage, which delayed deployment in countries that acted relatively slowly in allocating new frequencies specifically for 3G services (such as the United States).

The specific frequency bands originally defined by the UMTS standard are 1885–2025 MHz for the mobile-to-base (uplink) and 2110–2200 MHz for the base-to-mobile (downlink). In the US, 1710–1755 MHz and 2110–2155 MHz are used instead, as the 1900 MHz band was already used While UMTS2100 is the most widely deployed UMTS band, some countries' UMTS operators use the 850 MHz (900 MHz in Europe) and/or 1900 MHz bands (independently, meaning uplink and downlink are within the same band), notably in the US by AT&T Mobility, New Zealand by Telecom New Zealand on the XT Mobile Network and in Australia by Telstra on the Next G network. Some carriers such as T-Mobile use band numbers to identify the UMTS frequencies. For example, Band I (2100 MHz), Band IV (1700/2100 MHz), and Band V (850 MHz).

UMTS-FDD is an acronym for Universal Mobile Telecommunications System (UMTS) – frequency-division duplexing (FDD) and a 3GPP standardized version of UMTS networks that makes use of frequency-division duplexing for duplexing over an UMTS Terrestrial Radio Access (UTRA) air interface

W-CDMA is the basis of Japan's NTT DoCoMo's FOMA service and the most-commonly used member of the Universal Mobile Telecommunications System (UMTS) family and sometimes used as a synonym for UMTS It uses the DS-CDMA channel access method and the FDD duplexing method to achieve higher speeds and support more users compared to most previously used time-division multiple access (TDMA) and time-division duplex (TDD) schemes.

**TD-CDMA (UTRA-TDD 3.84 Mcps High Chip Rate (HCR))**

TD-CDMA, an acronym for Time-Division-Code-Division Multiple Access, is a channel-access method based on using spread-spectrum multiple-access (CDMA) across multiple time slots (TDMA). TD-CDMA is the channel access method for UTRA-TDD HCR, which is an acronym for UMTS Terrestrial Radio Access-Time Division Duplex High Chip Rate

UMTS-TDD's air interfaces that use the TD-CDMA channel access technique are standardized as UTRA-TDD HCR, which uses increments of 5 MHz of spectrum, each slice divided into 10 ms frames containing fifteen time slots (1500 per second). The time slots (TS) are allocated in fixed percentage for downlink and uplink. TD-CDMA is used to multiplex streams from or to multiple transceivers. Unlike W-CDMA, it does not need separate frequency bands for up- and downstream, allowing deployment in tight frequency bands

TD-CDMA is a part of IMT-2000, defined as IMT-TD Time-Division (IMT CDMA TDD), and is one of the three UMTS air interfaces (UTRAs), as standardized by the 3GPP in UTRA-TDD HCR. UTRA-TDD HCR is closely related to W-CDMA, and provides the same types of channels where possible. UMTS's HSDPA/HSUPA enhancements are also implemented under TD-CDMA

TD-SCDMA is a time division duplex, TDD version of UMTS that was developed in China and offered some key advantages as a TDD version. TD-SCDMA standards for Time Division - Synchronous CDMA.

Although different to the more standard TDD version of UMTS, TD-SCDMA was adopted by 3GPP and was included in the 3GPP standards as an accepted version of UMTS.

Much of the work to develop TD-SCDMA was undertaken by China Academy of Telecommunications Technology (CATT).

TD-SCDMA offers the advantages of the of any TDD system, but also was designed to incorporate many new technologies including joint detection, adaptive antennas, and dynamic channel allocation.

Although TD-SCDMA was never deployed outside China, it promoted the advantages of TDD systems and enabled 4G LTE push forwards the TDD versions of 4G LTE.

**TD-SCDMA basics**

One of the key elements of TD-SCDMA is the fact that it uses a TDD, Time Division Duplex approach. As seen with UMTS TDD this has advantages in a number of areas, enabling the balance to be changed between uplink and downlink to accommodate the different levels of data transfer. It also has advantages in terms of using unpaired spectrum, spectrum efficiency for certain loads and it does not require expensive diplexers in the handsets to enable simultaneous transmission on the uplink and downlink, although transmit / receive switching times must be accommodated and can reduce the efficiency of the system.

As a further advantage, TD-SCDMA uses the same RAN as that used for UMTS. In this way it is possible to run TD-SCDMA alongside UMTS, and thereby simplifying multi-system designs.

Although UMTS (W-CDMA) and cdma2000 are widely recognized as 3G cellular standards, TD-SCDMA is equally valid. In fact it has been adopted as the low chip rate (LCR) version of the 3GPP TDD standard.

## TD-SDCMA specification overview

The TD-SCDMA standard provides many advantages. As already mentioned it has many similarities to W-CDMA, although a summary of the basic features and specification is given below:

**TD-SCDMA SPECIFICATION SUMMARY**

| TD-SCDMA CHARACTERISTIC | FIGURE |
|---|---|
| Bandwidth | 1.6 MHz |
| Chip rate per carrier | 1.28 Mcps |
| Frame Rate | 10ms |
| Spectrum spreading mode | DS SF=1/2/4/8/16 |
| Modulation | QPSK / 8PSK / 16QAM |
| Channel coding | Convolutional codes: R=1/2,1/3<br>Turbo implemented |
| Interleaving | 10/20/40/80 ms |
| Frame structure | Super frame 720ms,Radio frame 10ms<br>Subframe 5 ms |
| Uplink synchronisation | 1/2 chip |
| Number of voice channels per carrier | 48 |
| Spectrum Efficiency | 25Erl./MHz |
| Total transmission rate provided by each carrier | 1.971Mbps |

## TD-SCDMA operation

The UMTS TD-SCDMA system has adopted a number of advanced techniques and technologies to optimise the operation. These are often above and beyond those that have been catered for in the more widely used standard forms of FDD and TDD UMTS. Some

of these result from the fact that TD-SCDMA uses the same frequency for both uplink and downlink, and as a result of the higher processing levels now available.

These include:

- ***Smart antennas:*** Smart antenna technology is incorporated into the base station. This enables beams to be formed and this is able to reduce interference between terminals and concentrate transmitted power at active terminals. This technique is implemented using smart antenna arrays that incorporate advanced DSP algorithms. The base station is able to locate the mobile terminals and to steer transmit beams to specific terminals. In this way spatial beamforming is able to reduce interference within a given channel with a resulting improvement in the downlink capacity.
- ***Joint detection technology:*** Within CDMA, multiple users all occupy the same frequency band, accessing he base station using different codes. In this way, multiple-access interference results and this is a major problem in CDMA-based systems. A technique referred to as joint detection technology treats signals from all users as useful and processes them in parallel. As the maximum number of users in any time slot is 16, the processing complexity to separate users is kept within manageable limits.
- ***User terminals and base station synchronization:*** The synchronization of the network enables precise adjustment of the timing advances for transmission from terminals so that signals from different users arrive at the base station together, and not overlapping in time into the transmit time frames making detection much simpler. This synchronization enables faster search for neighboring cells during handover and it also removes the need for soft handover