

IMT-2000/UMTS delivering full BWA



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Agenda

- 3G and IMT 2000 Family
- UMTS phase 1 principles
- From GSM to GSM/UMTS
- Key Technical Characteristics of HSDPA
- HSDPA Terminals
- Key Technical Characteristics of HSUPA
- Benefits to roll out UMTS in frequency bands below 600 MHz
- Some Hints



3G and IMT 2000 family



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« IMT 2000 Family » concept

- ITU defined the criteria which shall be met by a standard in order it is seen as a 3G standard.
- The following frequency bands have been recommended for the IMT 2000 systems

1885 - 2025 MHz
2110- 2200 MHz

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IMT 2000 standards

- **UIT has defined five IMT-2000 Terrestrial Radio Interfaces :**

- FDD mode of UMTS

- TDD mode of UMTS

- cdma2000 (IS95 evolution)

- UWC136 : this is an evolution of IS136, it relies on EDGE and GPRS

- DECT

- **These Radio Interfaces are evolutions of 2G standards**

- UMTS is a migration from GSM. It is the result of an agreement between the GSM world (network principles, services) and Japan (radio access technology)

- > This alliance between Europe and Japan is a very important fact. As a matter of fact it yielded that the footprint of UMTS will contain the footprint of GSM and Japan.

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UMTS phase 1 principles



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UMTS Phase 1

General points

■ UMTS phase 1 :

The Core Network is an evolution of the GSM/GPRS Core Network : a MSC is used for the circuit services; SGSN and GGSN are used for the packet services

The radio system is entirely new; it includes two modes

- > WCDMA, Frequency Division Duplex (FDD) for the paired spectrum
- > TD-CDMA, Time Division Duplex (TDD) for the unpaired spectrum

MAP is common to GSM and UMTS, this allows the GSM/UMTS roaming

■ 3GPP defined one standard common to UMTS phase 1 Core Network and to GSM Release 99 Core Network

As a consequence the advantages of GSM (services, SIM card, interfaces ...) have been kept for UMTS

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UMTS Radio Access 1/2

- New throughputs at the radio interface : 8 kb/s, 64 kb/s, 128 kb/s, 384 kb/s

- WCDMA uses the following radio resources: 1920-1980 MHz and 2110-2170 MHz.

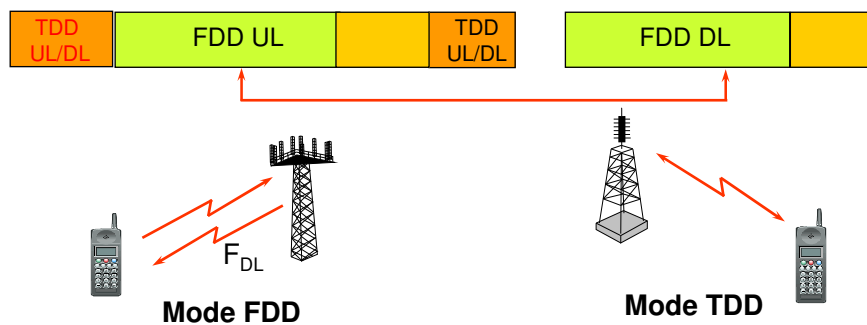
- A UMTS/WCDMA carrier utilizes 5 MHz duplex

This means that 12 carriers can be defined.

UMTS provides new radio resources allowing to accommodate higher traffic demands

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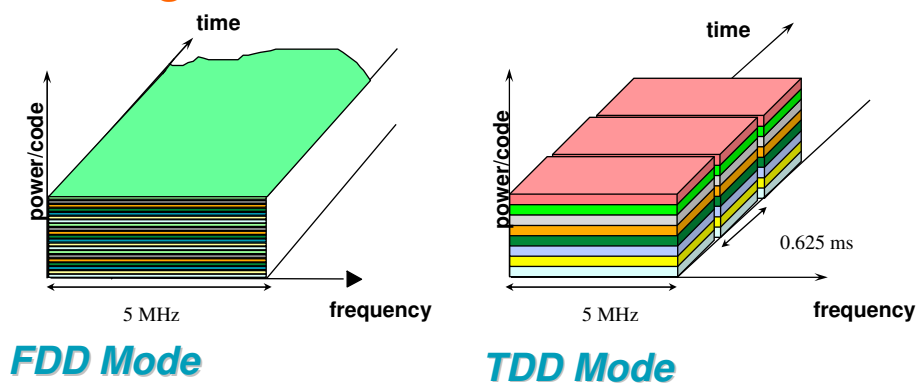
UMTS Radio Access 2/2 The two UMTS modes



- W-CDMA, FDD mode (Frequency Domain Duplex) in the paired bands (2x60 MHz)
- TD-CDMA TDD mode (Time Domain Duplex) in the unpaired bands (35MHz)

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W-CDMA and TD-CDMA Radio access technologies

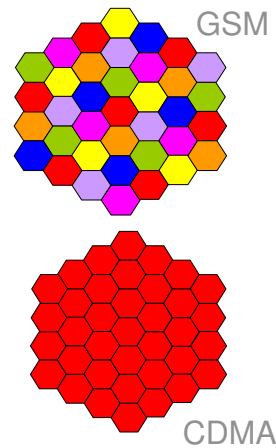


Both TDMA and CDMA principles are used

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Radio resources planning

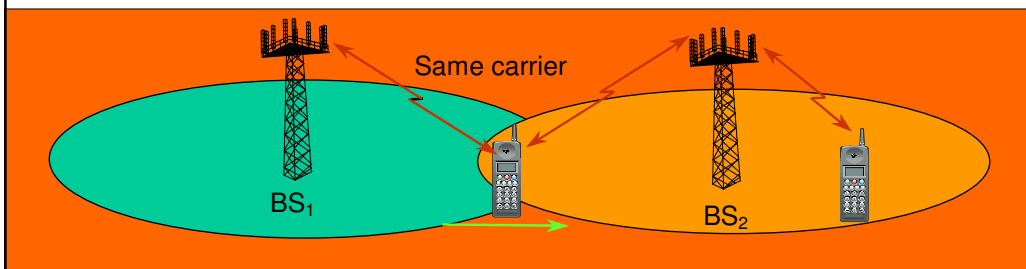
- With GSM it is necessary to use frequency reuse schemes in order to minimise the interferences
- With CDMA, all cells use the same frequency resources



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Soft Handover

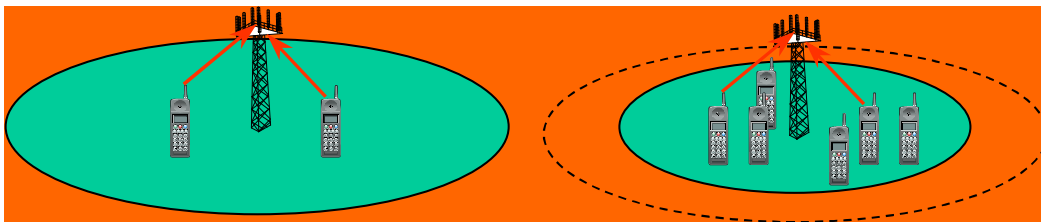
- On the cell border an MS establishes more than one radio link, this improves coverage and capacity



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Cell breathing effect

- The coverage may reduce when the traffic increases
 - > « Cell Breathing »
- Power Control
 - > Transmitted power shall vary in order to reach the desired radio quality
 - > It shall be minimum in order to minimise the global interference
- Load control



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Four facts about UMTS

- Core Network common to GSM and UMTS
- The radio system is completely new, therefore new equipments shall be rolled out
- UMTS provides a continuous coverage, this is a cellular coverage comparable to a GSM coverage
- UMTS allows new radio resources for the operators

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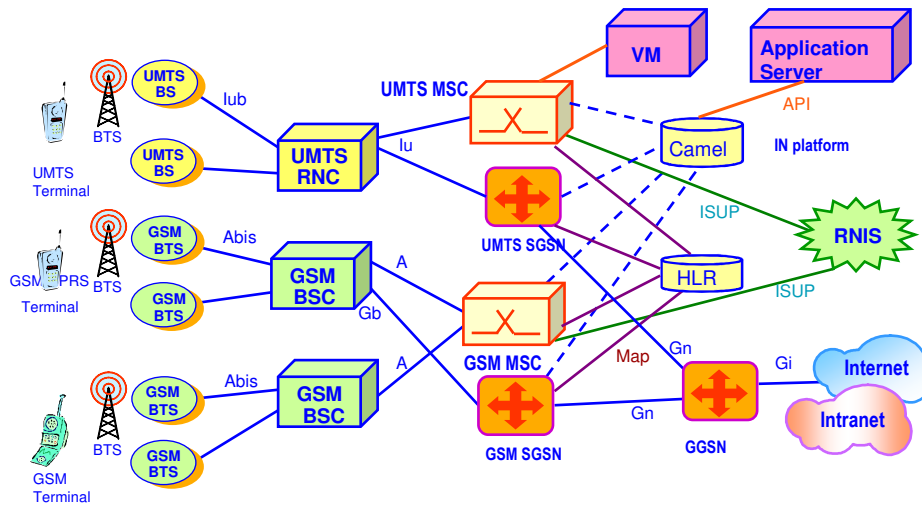


From GSM to GSM/UMTS



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GSM/UMTS network architecture



In a first phase the two Core Network are separated. Then we will migrate towards an architecture where the Core Network is common to GSM and UMTS radio accesses. Most of our value added services are already common to GSM and UMTS

Features/Services

- **GSM and GPRS services/features presently can be delivered by a UMTS network with higher bitrates**
voice services, SMS, Voice mail, GSM supplementary services, CAMEL features, SIM toolkit, MMS, WAP services, WEB browsing, data transfer on both circuit bearers and packets bearers.
- **Some of these services are improved by the higher bit rates provided by the UMTS radio interface**
 - up to 64 kb/s for the circuit switched services
 - up to 128 kb/s uplink and 384 kb/s downlink for the packet switched services
- **Innovative services based on picture will be provided as well :**
 - videophone
 - video streaming
 - downloading of videoclips

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UMTS Coverage, GSM coverage, roaming

- **GSM/UMTS dual mode features (selection/reselection and handover) are implemented in both the infrastructures and the terminals. Services fallbacks are implemented in order that the UMTS subscribers can benefit from the GSM coverage**
- **When using a GSM/UMTS terminal, the UMTS subscribers of OrangeFrance are offered a world coverage**
 - They will benefit from the present GSM roaming agreements concluded between OrangeFrance and the GSM operators
 - This is possible because the MAP is common to GSM and UMTS
- **Roaming agreements have been concluded with other UMTS networks**

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From GSM to GSM/UMTS

The efficient path to 3G

- For the GSM operators UMTS allows a smooth migration from 2G to 2G and 3G
 - Dual mode mobile stations
 - Core Network common to GSM and UMTS
 - Reuse of 2G services
- As MAP is common to GSM and UMTS, the success of GSM roaming can be kept and extended
 - UMTS subscribers will benefit from the GSM foot print + Japan

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Key Technical Characteristics of HSDPA



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General Description of HSDPA 1/3

- **HSDPA is an evolution of the 3GPP radio interface**
It is specified in 3GPP R5
Several commercial launch of HSDPA services are scheduled in 2006
- **A new DL Channel shared by the UEs; it utilises several new techniques :**
 - Adaptative modulation and coding scheme (AMC)
 - > Selection of transport format in the Node B depending on channel quality reported by the UE (instead of R99 PC)
 - > High order modulation: QPSK (R99) and 16 QAM (New) modulation
 - Improved Packet scheduling
 - > Scheduling moved from RNC to Node B
 - Improved retransmission strategy: Hybrid ARQ in the NodeB
- **The UL Channel is a dedicated channel compliant to UMTS R99**
128 UL and 384 UL will be provided
- **HSDPA is compatible with UMTS R99.**
HSDPA and R99 can be provided in the same cell, terminals can coexist and access simultaneously to the network

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General Description of HSDPA 2/3

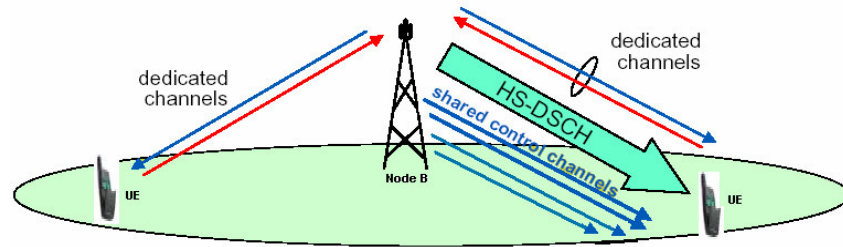
- **These new radio techniques provide higher throughputs on the radio interface**
 - > 1.8Mb/s in 2005, then 3.6 Mb/s and even 7.2 Mb/s
 - > Benefits expected from these high throughputs

For the consumer market
The following services are being considered: High speed download (video and mp3), Video streaming and TV live with higher quality, High speed browsing

For the business market
HSDPA is expected to leverage the PC card market for business nomads
- **Latency time is reduced**
- **The new Shared Channel**
provides a better utilisation of the radio resources
allows to accommodate more simultaneous users in a given cell
is particularly well suited to the bursty traffic

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General Description of HSDPA 3/3



- DL channel shared between the UEs : HS-DSCH (High speed downlink shared channel)
Several UEs can simultaneously use this channel
- Modulation and coding scheme can be adapted for each TTI (2ms) according to the radio conditions
Radio quality is measured by the UE and sent to the network via the UL HS-PDCCH
- H-ARQ retransmission schemes are implemented in the Node B (10 to 20 ms)
This complements the retransmission mechanisms implemented in the RNC (RRC layer) according to UMTS R99 (200ms)

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Some figures with Category 12 Handsets

■ Choice of UE ,data stream and amount of data allocation @ node B level

■ Dynamic adaptation of throughput (modulation and coding- AMC)

■ Shared channel between users



■ High throughput peak (closely related to UE position in the cell)

Mobile Cat 12	Close to NB	Cell Center	Cell Edge
	1,3 Mbps	900 kbps	400 kbps

■ Higher number of data users (15 users per cell)

■ Reduction of latency time (around 120 ms)

■ Radio resources optimized

> Spectrum efficiency improved, i.e. doubled compared to an average of 1,5 Mb/s per cell. Less gain for shared frequency case (R99 + HSDPA)

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Some theoretical figures with Handsets from other Categories

- The standard defined 12 terminals categories
- Today category 12 HSDPA handsets are available
QPSK Modulation only
- Category 6 HSDPA handsets will be available in 2006
QPSK and 16QAM Modulations

Category	Data Rate	Codes	Modulation
1	1,2 Mbps	5	QPSK / 16QAM
2	1,2 Mbps	5	QPSK / 16QAM
3	1,8 Mbps	5	QPSK / 16QAM
4	1,8 Mbps	5	QPSK / 16QAM
5	3,6 Mbps	5	QPSK / 16QAM
6	3,6 Mbps	5	QPSK / 16QAM
7	7,2 Mbps	10	QPSK / 16QAM
8	7,2 Mbps	10	QPSK / 16QAM
9	10,2 Mbps	15	QPSK / 16QAM
10	14,4 Mbps	15	QPSK / 16QAM
11	0,9 Mbps	5	QPSK only
12	1,8 Mbps	5	QPSK only

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HSDPA Terminals



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First HSDPA Handsets announced...

- BenQ-Siemens EF91 features 3.2 mega pixel camera and multimedia player
- Available Summer 2006







- Samsung SGH-Z560 targeted at European markets



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Two HSDPA PC cards

 PC Card Sierra Wireless AirCard® 850	 USIM	 PC Card Novatel Merlin U740	 USIM
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Technical specifications for both cards are listed in yellow starburst shapes above them: HSDPA, 3G, EDGE, GPRS.

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Key Technical Characteristics of HSUPA



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HSUPA

- HSUPA (High Speed Uplink Packet Access) specified in 3GPP R6
 - > It will not be commercially launched before 2007
- A new Uplink Channel (E-DCH) is defined
- Mobility & architecture:
 - Soft/softer handover is allowed
 - Power control is used
- Reuse of some HSDPA concepts:
 - Hybrid ARQ for better and faster link adaptation
 - 2ms TTI to reduce delay (but 10 ms TTI also standardized)
 - Scheduler at the NodeB side to allocate resource to the UE and control uplink load.
- Foreseen performance : 1-2 Mbps

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Benefits to roll out UMTS in frequency bands below 600 MHz



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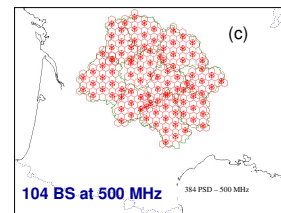
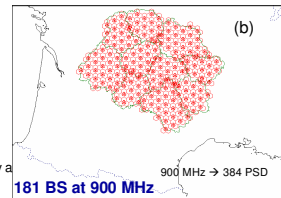
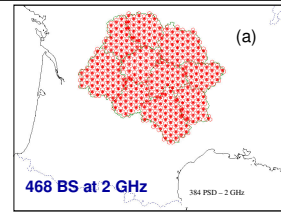
Extending UMTS/IMT-2000 Mobile Coverage in developing countries to bridge the digital divide

- ITU World Radiocommunication Conference (WRC-07) will be held in Geneva from 15 October to 9 November 2007
- The additional spectrum bands for the future development of IMT-2000 and systems beyond IMT-2000 (IMT-Advanced) will be decided by WRC-07
- WRC-07 Agenda Item 1.4 is of major importance for the mobile industry and offers a unique opportunity to identify spectrum to extend coverage in a cost efficient manner in the 470-600 MHz band

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Coverage in 500 MHz: more economic & more efficient

- Detailed studies by UMTS Forum confirm clear advantages for UMTS500/IMT-2000 providing extended propagation range
- Larger cell sizes and lower number of base stations to cover low density populated areas (Report 38)
 - > 5 times more Base stations at 2GHz compared to 500MHz
 - > 3 times more Base stations at 2GHz compared to 900MHz
- Cost Cost savings of 80% for BSs at 500 MHz compared to 2GHz
 - > Remarkable cost savings in network investments, since base stations subsystems and transmission costs play a vital role in determining up-front and downstream capital costs as well as ongoing operating costs



UMTS500/IMT-2000 would allow cost-efficient extension of coverage

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Some Hints

- We firmly believe that UMTS and its evolutions (HSDPA, HSUPA, LTE ...) is the optimal solution to provide Broadband Wireless Access
- GSM, UMTS, UMTS evolutions are built in a compatible and evolutionary manner which allows to protect the investments and to migrate smoothly customers and networks according to the markets requirements while keeping the benefits of GSM (security, worldwide coverage)
- GSM/UMTS/UMTS evolutions networks provide both basic services (voice, SMS ...) and broadband networks : up to 14 Mb/s with HSDPA
- Rolling out GSM and UMTS in bands lower than 600 MHz will allow to provide these advantages in a cost effective manner.

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