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Universal Mobile Telecom System

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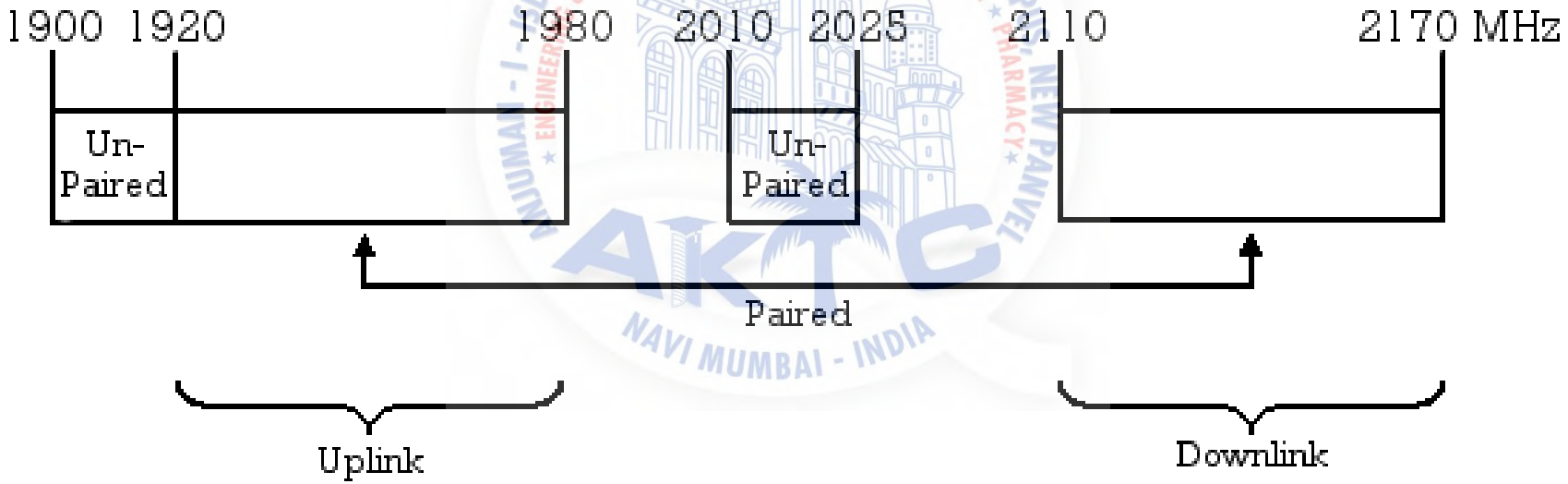
UMTS(UNIVERSAL MOBILE TELECOM SYSTEM)

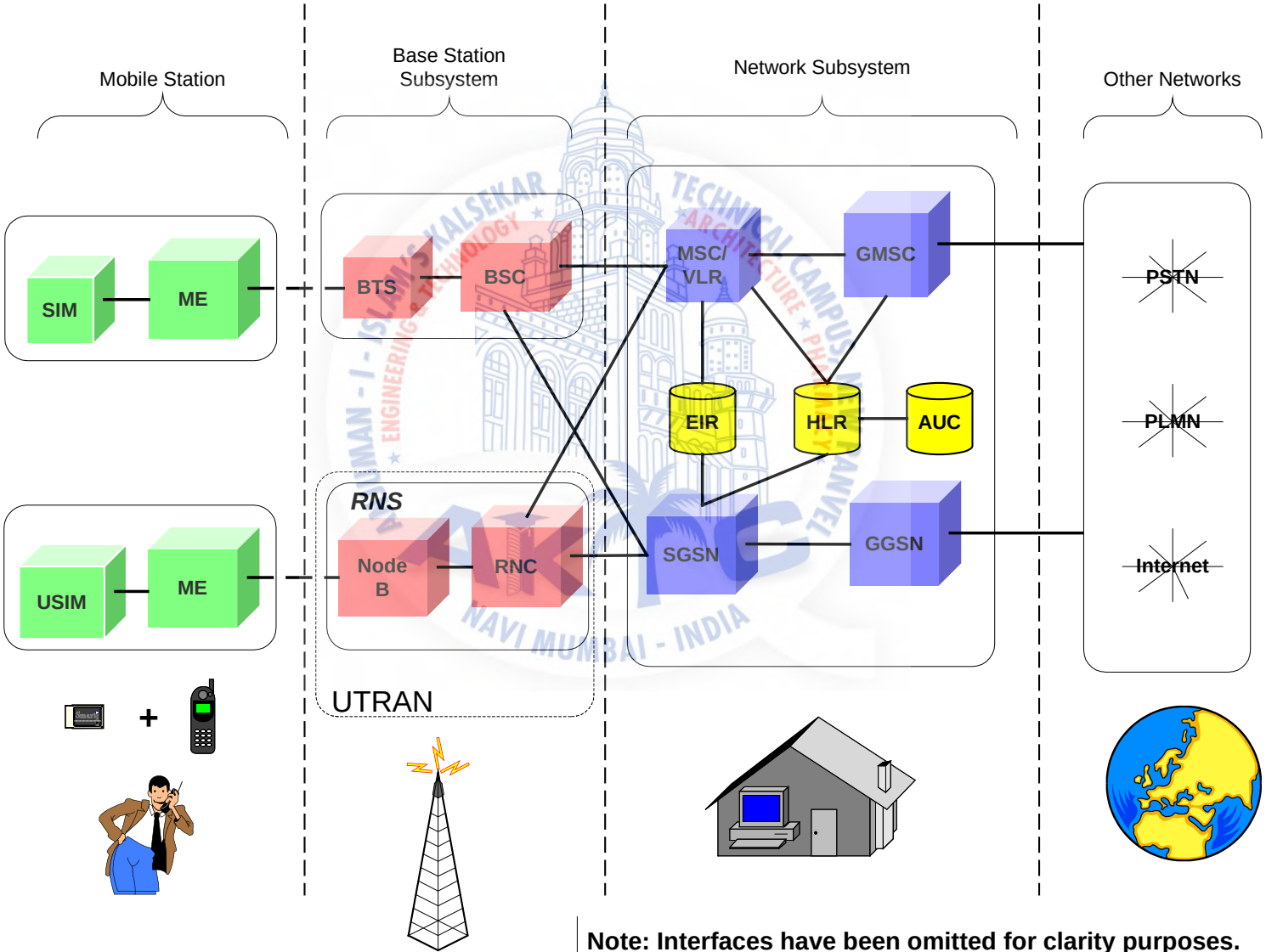
- UMTS is the European vision of 3G.
- UMTS is an upgrade from GSM via GPRS or EDGE.
- The standardization work for UMTS is carried out by Third Generation Partnership Project (3GPP).
- Data rates of UMTS are:
  - 144 kbps for rural
  - 384 kbps for urban outdoor
  - 2048 kbps for indoor and low range outdoor

UMTS Frequency Spectrum

- UMTS Band : 1900-2025 MHz and 2110-2200 MHz for 3G transmission.
- Terrestrial UMTS (UTRAN) : 1900-1980 MHz, 2010-2025 MHz, and 2110-2170 MHz bands

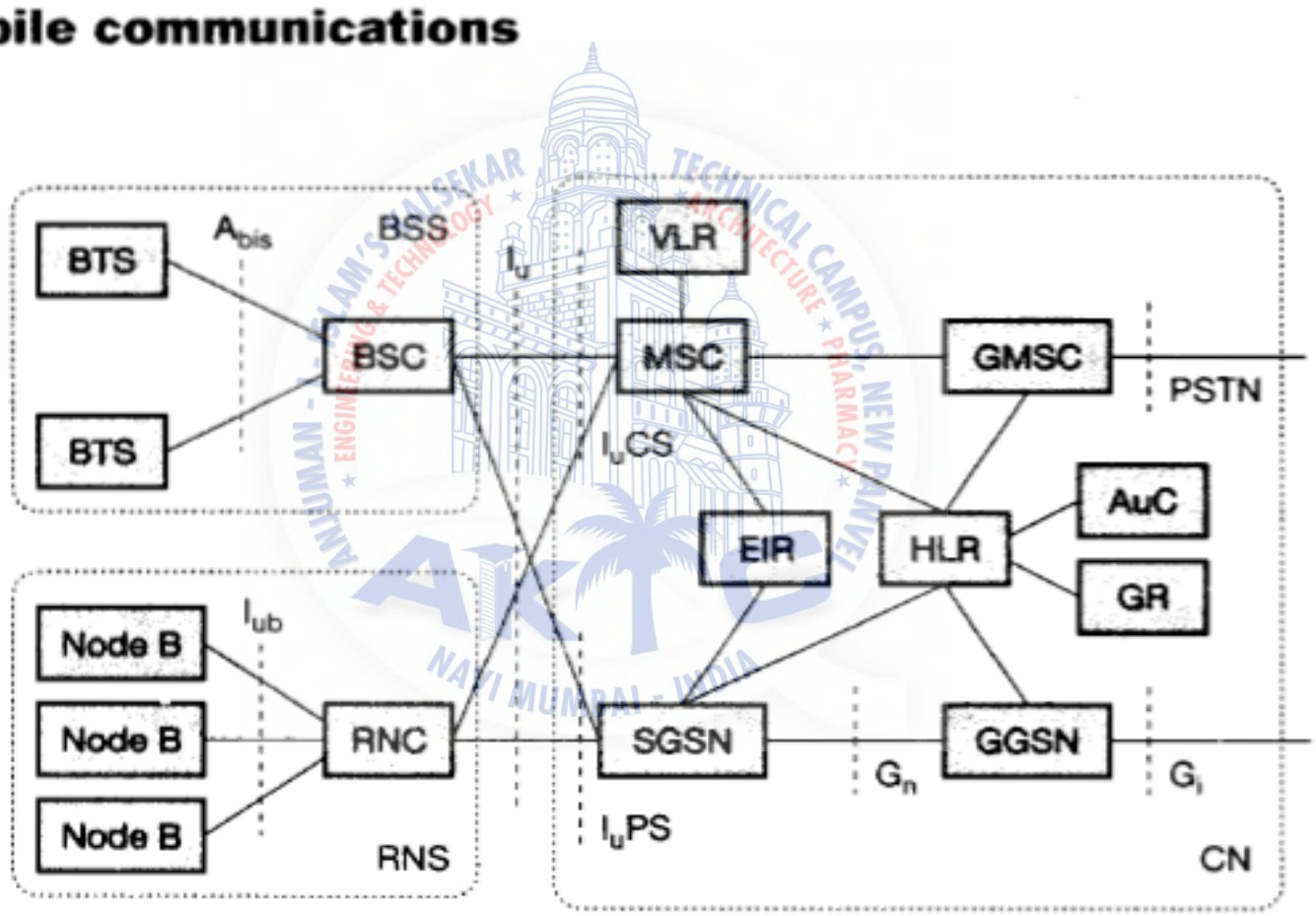


UMTS Network Architecture

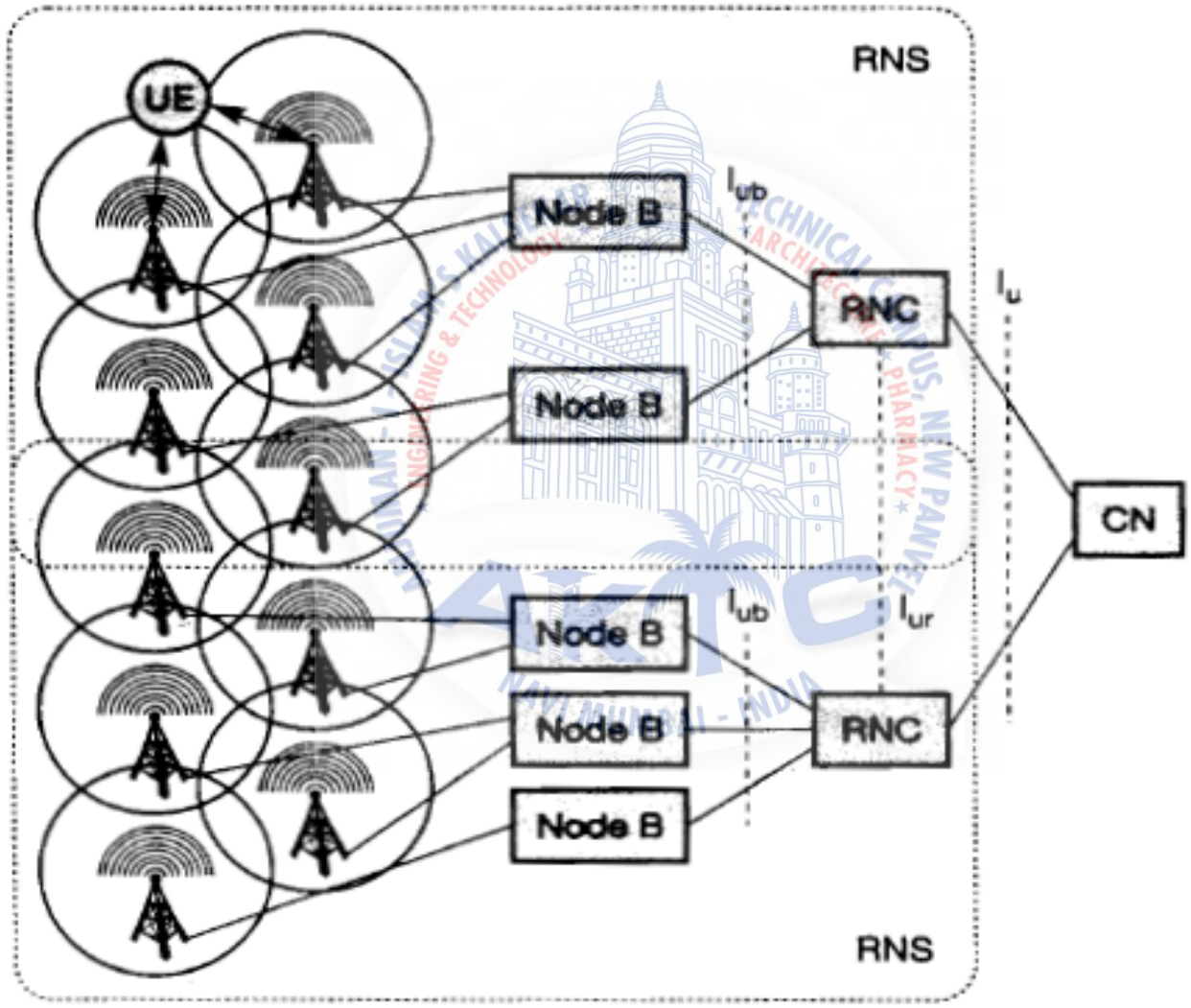


Note: Interfaces have been omitted for clarity purposes.

UMTS Network Architecture



UTRAN


RNS
UE
Node B
Node B
Node B
Node B
Node B
I_{ub}
I_{ub}
I_{ur}
I_u
RNC
RNC
CN
RNS

UTRAN

- Wide band CDMA technology is selected for UTRAN air interface.
- Base Station is referred to as Node-B and control equipment for Node-B's is called is called as Radio Network Controller (RNC).
  - Functions of RNC are:
    - CALL ADMISSION CONTROL
    - CONGESTION CONTROL
    - ENCRYPTION/DECRYPTION
    - ATM switching & multiplexing, protocol conversion
    - Radio resource control
    - Code allocation
    - Power control
    - Handover control & RNS relocation
    - management

User data

- Functions of Node –B are:
  - Air Interface Tx/Rx
  - Modulation / Demodulation.
  - Power control to mitigate near far effects.
  - Measures signal strength
  - Can even support a special type of hand over which takes place between different antennas of the same node.

-user equipment (UE)

- As a counter part of node B ,the UE performs:
  1. Signal quality measurements
  2. Inner loop power control
  3. Spreading and modulation

UMTS RADIO INTERFACE

- UMTS uses DS-CDMA.
- uses a constant chipping rate of -----.
- UMTS supports different user data rates using different spreading factors,(i:e no. of chips per bit)
- UMTS uses OVSF(Orthogonal Variable Spreading Factor) codes.

What are OVSF CODES?

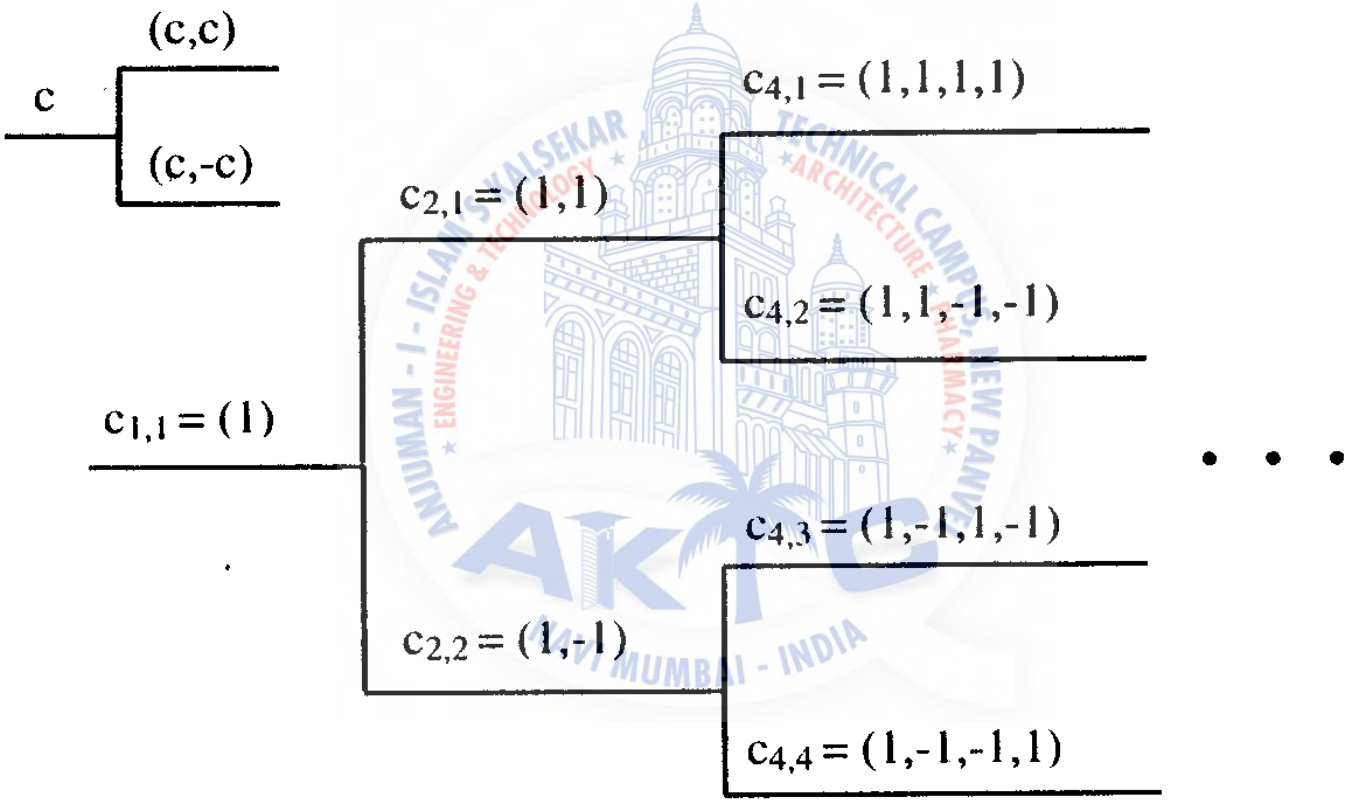


Figure 6.4. Beginning of the channelisation code tree

- If the chipping sequence is doubled, how much does the spreading factor change?

- If the chipping sequence is doubled, how much does the data rate change?

- Spreading is used in combination with scrambling
- • *Scrambling: used on top of spreading; needed to separate terminals*
- or base stations from each other
- • *Scrambling does not change the chip rate nor the bandwidth*

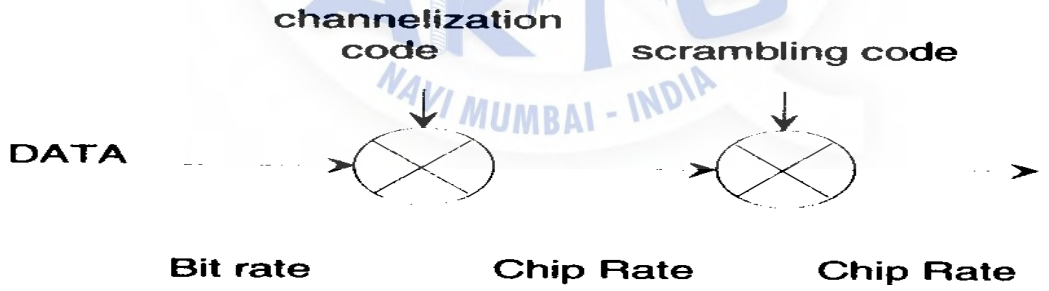
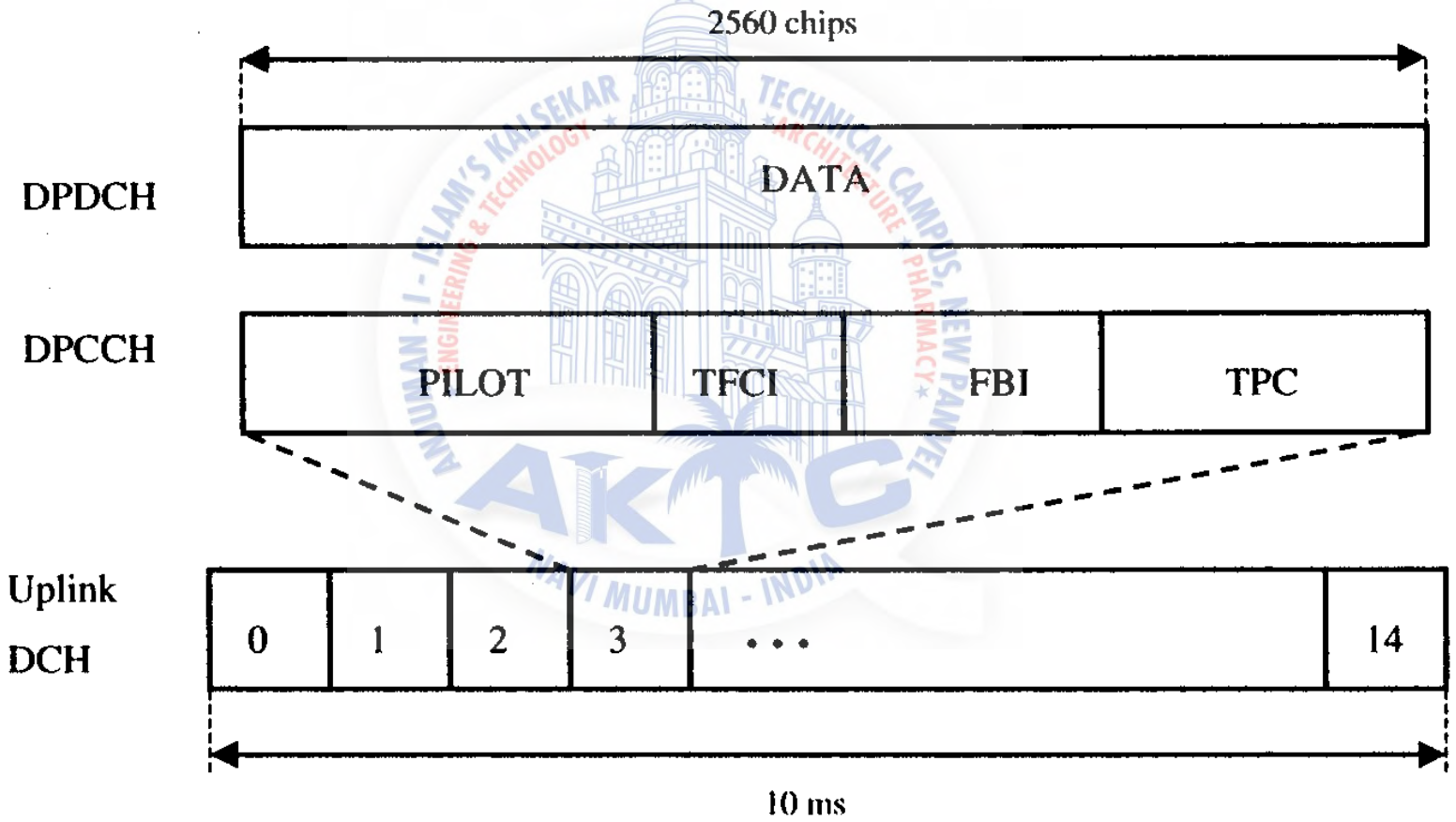


Figure 6.3. Relation between spreading and scrambling

WCDMA-UTRA FDD

- UPLINK FREQ:1920-1980 MHz
- DOWNLINK FREQ:2110-2170 MHz
- THE OCCUPIED BANDWITH PER CHANNEL IS ----
- 1 FRAME CONSISTS OF 38400 CHIPS & HAS A DURATION OF 10 ms.
- 15 TS IN A FRAME.
- EACH TS CONSISTS OF ----- CHIPS

FRAME STRUCTURE



- DPDCH:
- Conveys user data
- Spreading factor can vary from 4 to 256.
- If spreading factor is 4:

  data rate=-----.

  bits per slot=-----

Table 6.2. Uplink DPDCH data rates

DPDCH spreading factor	DPDCH channel bit rate (kbps)	Maximum user data rate with ½-rate coding (approx.)
256	15	7.5 kbps
128	30	15 kbps
64	60	30 kbps
32	120	60 kbps
16	240	120 kbps
8	480	240 kbps
4	960	480 kbps

DPDCH

- Uses a constant spreading factor of 256 (15 kbps).
- Pilot is used for channel estimation.
- TFCI(transport format combination identifier) specifies the channels transported within the DPDCH.
- Signalling for a soft hand off is supported by FBI (feedback information field)
- Transmit power control is used for controlling the transmit power of the sender.

UTRA TDD CDMA-TD

- 15 SLOTS/FRAME with 2560 chips/slot.
- Radio frame with duration 10 ms.
- Chipping rate 3.84 Mchips/sec.
- TDD frame can be symmetrical or asymmetrical.
- Can have 1 switching point or more.
- System can change S.F as a function of desired data rate.
- Data rates of 6624,3312,1656,828,414 kbps is possible

Protocol layer

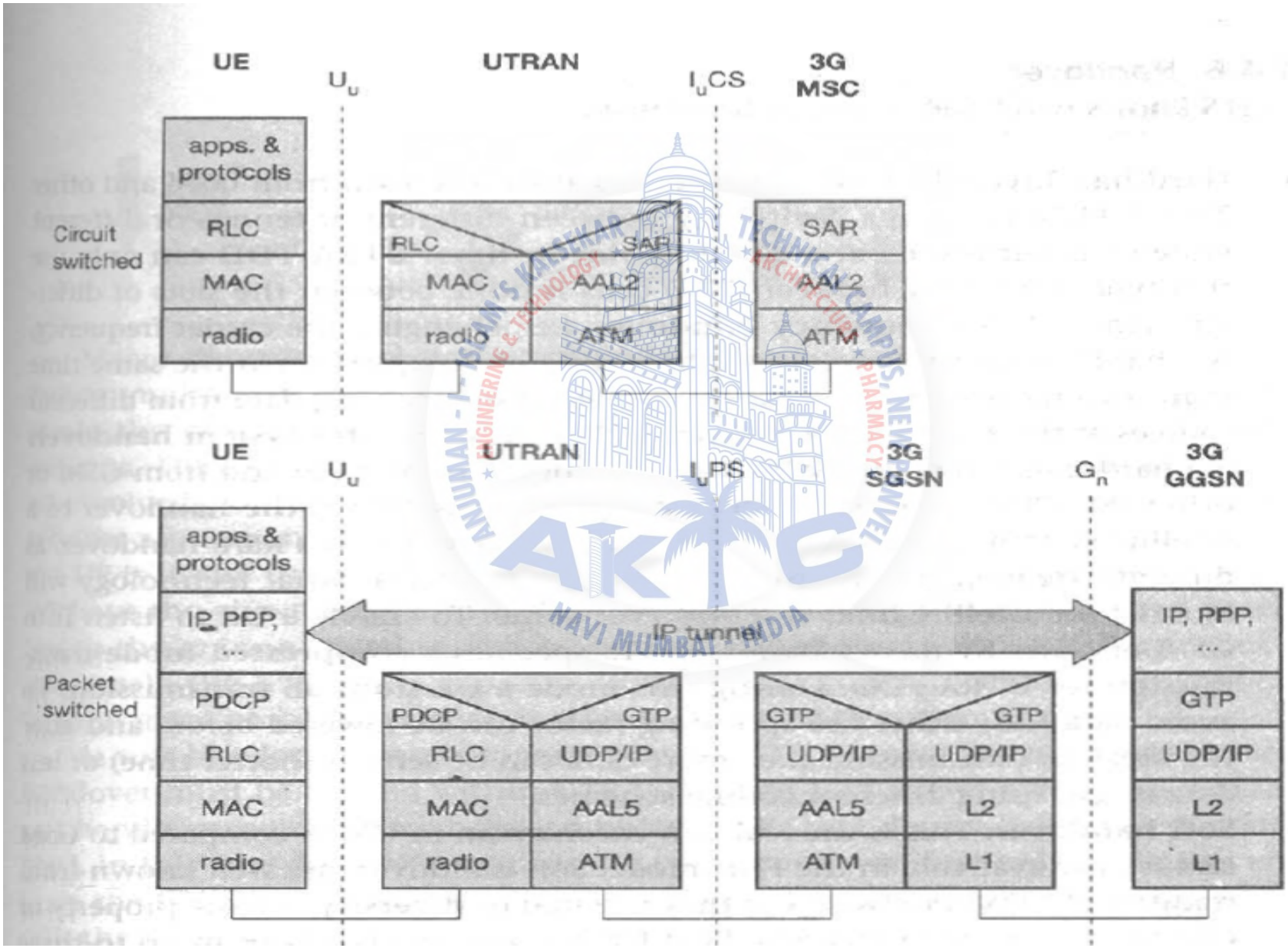


Table 1.1. Main differences between WCDMA and GSM air interfaces

	WCDMA	GSM
Carrier spacing	5 MHz	200 kHz
Frequency reuse factor	1	1–18
Power control frequency	1500 Hz	2 Hz or lower
Quality control	Radio resource management algorithms	Network planning (frequency planning)
Frequency diversity	5 MHz bandwidth gives multipath diversity with Rake receiver	Frequency hopping

Table 1.2. Main differences between WCDMA and IS-95 air interfaces

	WCDMA	IS-95
Carrier spacing	5 MHz	1.25 MHz
Chip rate	3.84 Mcps	1.2288 Mcps
Power control frequency	1500 Hz, both uplink and downlink	Uplink: 800 Hz, downlink: slow power control
Base station synchronisation	Not needed	Yes, typically obtained via GPS
Inter-frequency handovers	Yes, measurements with slotted mode	Possible, but measurement method not specified
Efficient radio resource management algorithms	Yes, provides required quality of service	Not needed for speech only networks

IMPACT ON EXISTING NETWORK

Wireless Data Tech	Channel BW	Duplex	Infrastructure Change	Requires New Spectrum	Requires New Handsets
HSCSD	200KHz	FDD	Requires Software Upgrade at base station	No	Yes, New HSCSD handsets provide 57.6Kbps on HSCSD n/w and 9.6 Kbps on GSM n/w with dual mode phones. GSM only phones will not work in HSCSD N/w.
GPRS	200KHz	FDD	Requires new packet overlay including routers and gateways	No	Yes, New GPRS handsets work on GPRS n/w at 171.2Kbps, 9.6 Kbps on GSM n/w with dual mode phones. GSM only phones will not work in GPRS n/w.
EDGE	200KHz	FDD	Requires new transceivers at base station. Also, software upgrade to the BSC & BTS	No	Yes, New handsets work on EDGE n/w at 384Kbps, GPRS n/w at 144Kbps, and GSM n/w at 9.6 Kbps with tri-mode phones. GSM and GPRS-only phones will not work in EDGE n/w.
W-CDMA	5MHz	FDD	Requires completely new base stations	Yes	Yes, New W-CDMA handsets will work on W-CDMA at 2Mbps, EDGE n/w at 384 Kbps, GPRS n/w at 144 Kbps. GSM n/w at 9.9 Kbps. Older handsets will not work in W-CDMA.