WCDMA Radio Access Network

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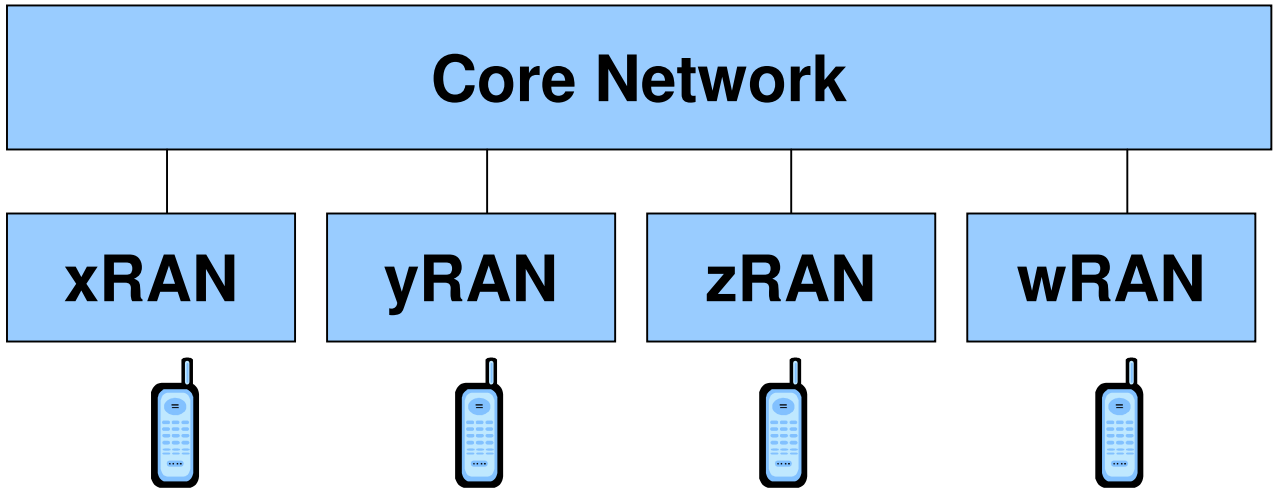
- WCDMA RAN
- What does UMTS mean to us?
- Further information

Radio Access Network

- The main purposes of separate RAN
  - Provide a connection between the handset and CN
  - Isolate all radio issues from CN
- The advantage is one CN supporting multiple access technologies



IMT-2000

- RECOMMENDATION ITU-R M.1457-3: Detailed specifications of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000) specifies following terrestrial radio interfaces for 3G:
  - IMT-2000 CDMA Direct Spread: WCDMA (UTRAN FDD)
  - IMT-2000 CDMA Multi-carrier: CDMA2000
  - IMT-2000 CDMA TDD: TD-SCDMA (UTRAN TDD)
  - IMT-2000 TDMA Single Carrier: UWC-136 (EDGE)
  - IMT-2000 FDMA/TDMA: DECT
  - All of these standards are incompatible
- 3GPP term for WCDMA RAN is Universal Terrestrial Radio Access Network (UTRAN)
- UMTS uses WCDMA as its RAN technology. As a result, the terms UMTS and WCDMA are often used interchangeably.

EDGE: Enhanced Data for GSM Evolution

CDMA 2000: Code Division Multiple Access as specified in IS-2000

TD-SCDMA: Time Division Synchronous CDMA

UMTS: Universal Mobile Telecommunications System

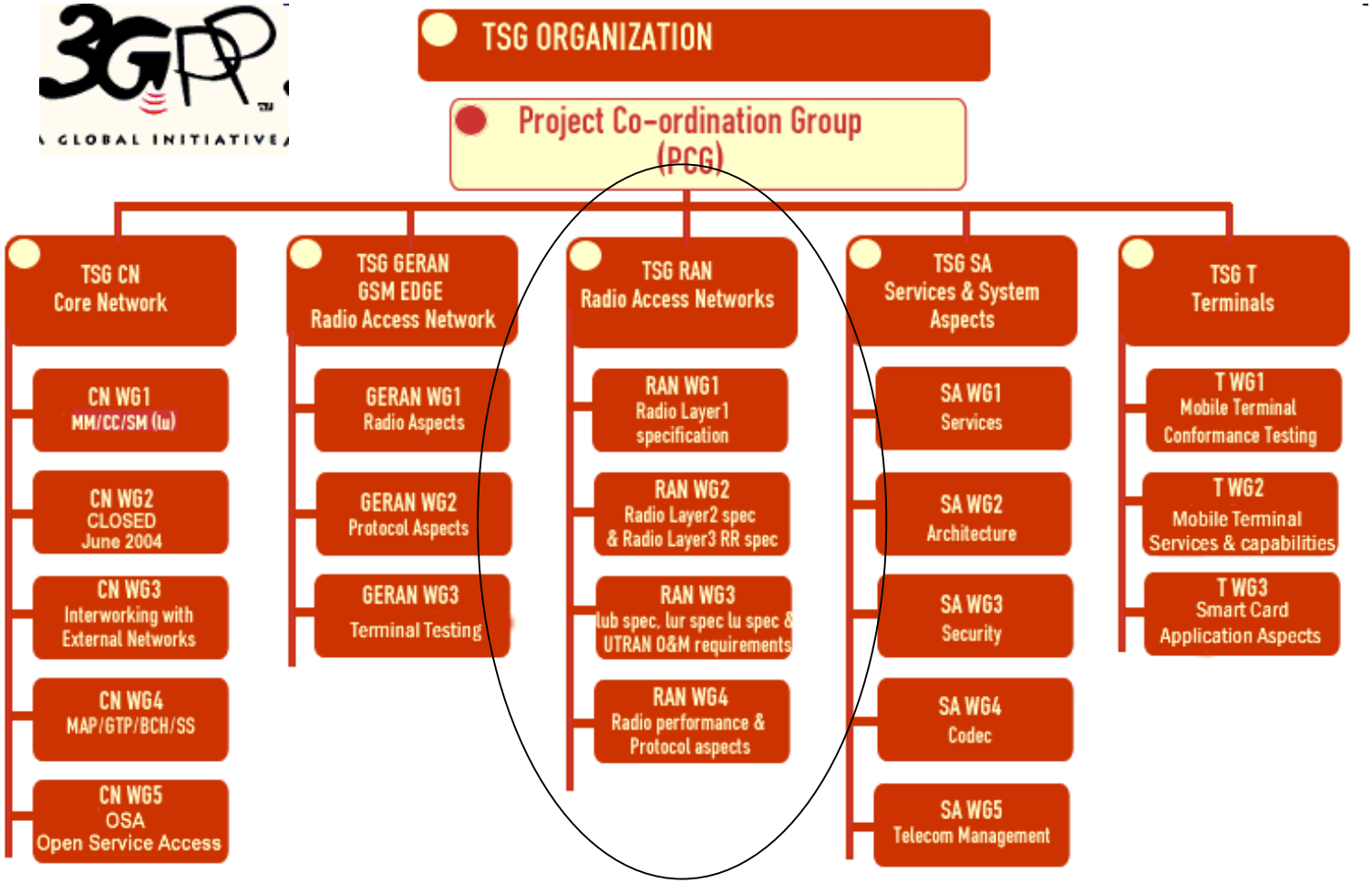
WCDMA: Wideband Code Division Multiple Access

FDD: Frequency Division Duplex

TDD: Time Division Duplex

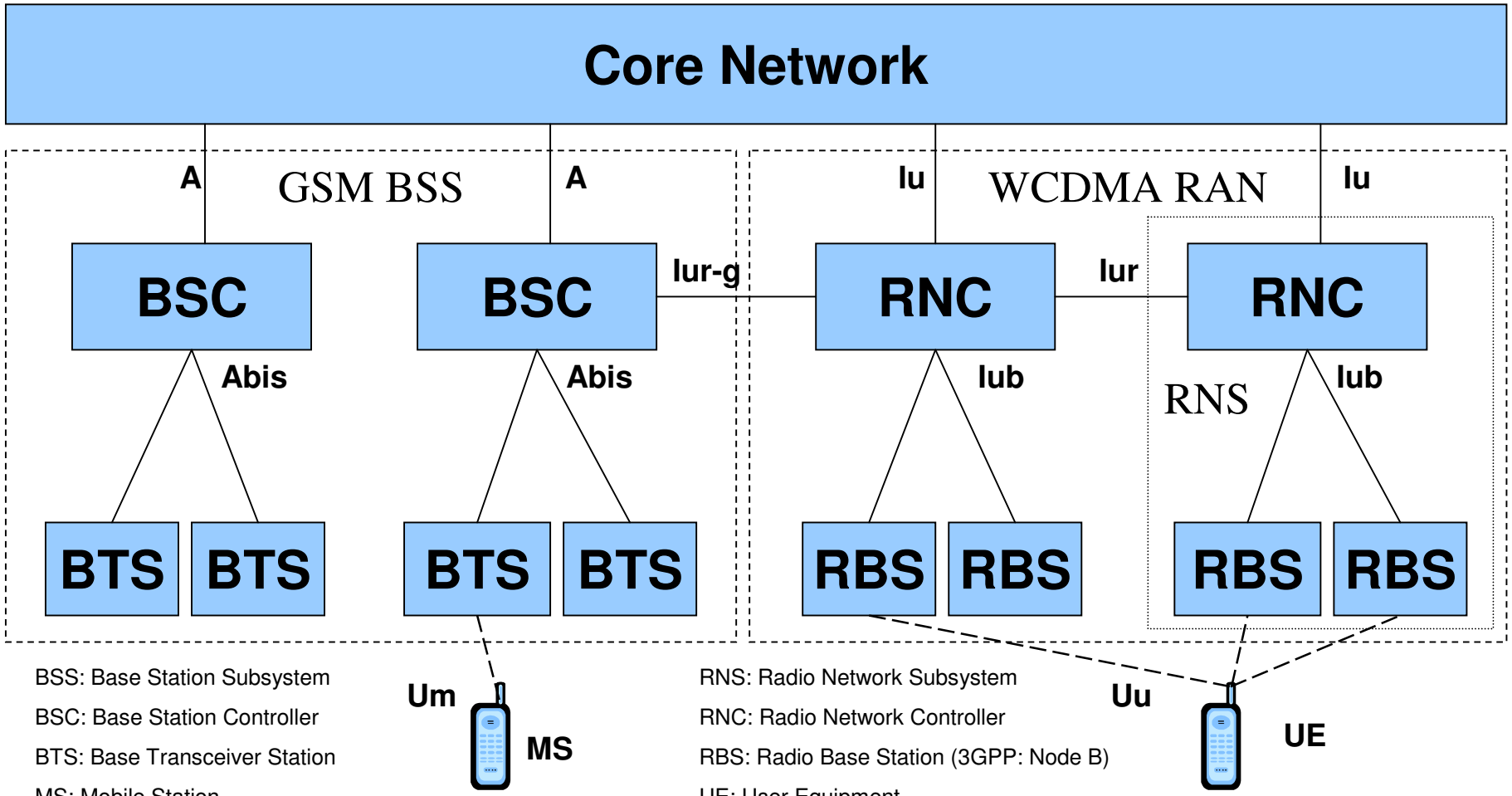
DECT: Digital Enhanced Cordless Telecommunications

WCDMA RAN specifications



http://www.3gpp.org/TB/RAN/RAN.htm

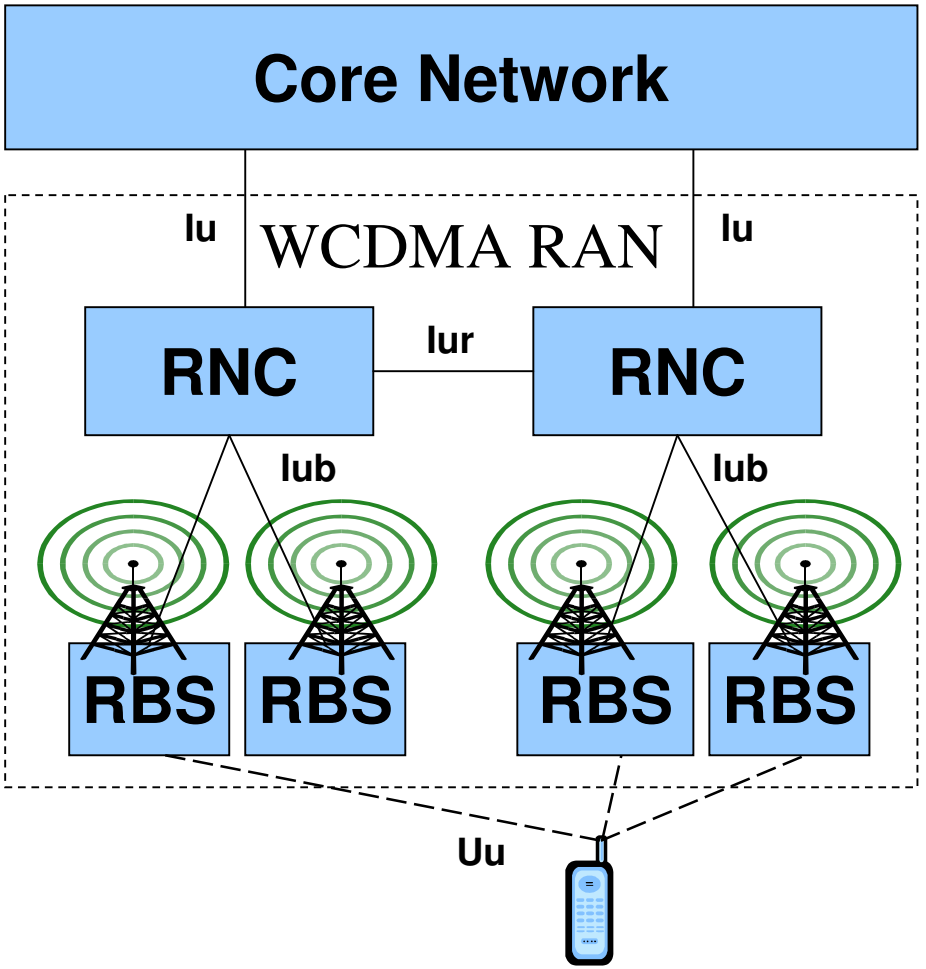
WCDMA RAN nodes



3GPP TS 25.401 UTRAN overall description (Release 6)

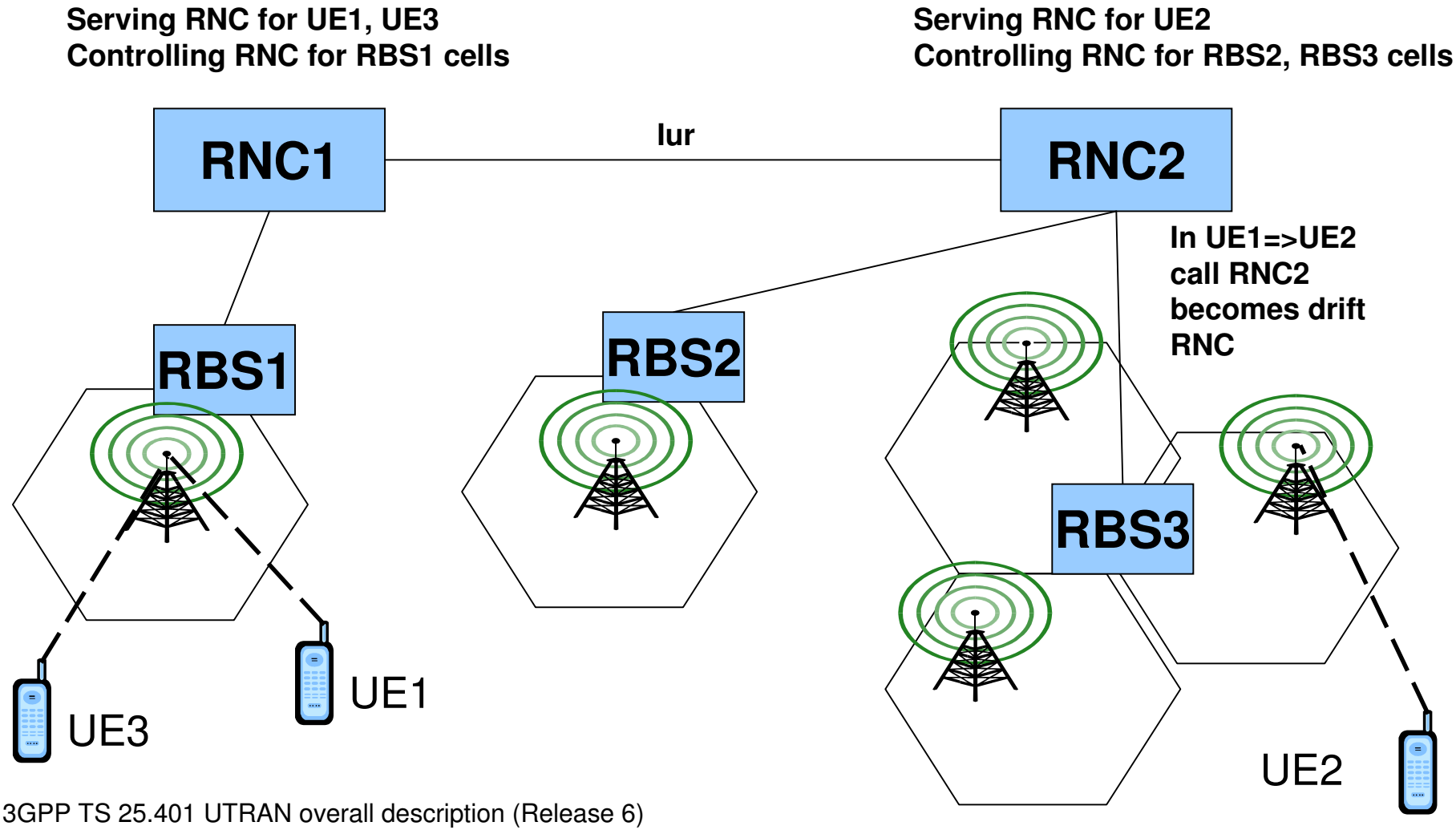
Radio Network Controller (RNC)

- Controls all WCDMA RAN functions.
- Connects the WCDMA RAN to the core network via the Iu interface.
- Roles of RNC
  - Serving RNC
  - Controlling RNC
  - Drift RNC



3GPP TS 25.401 UTRAN overall description (Release 6)

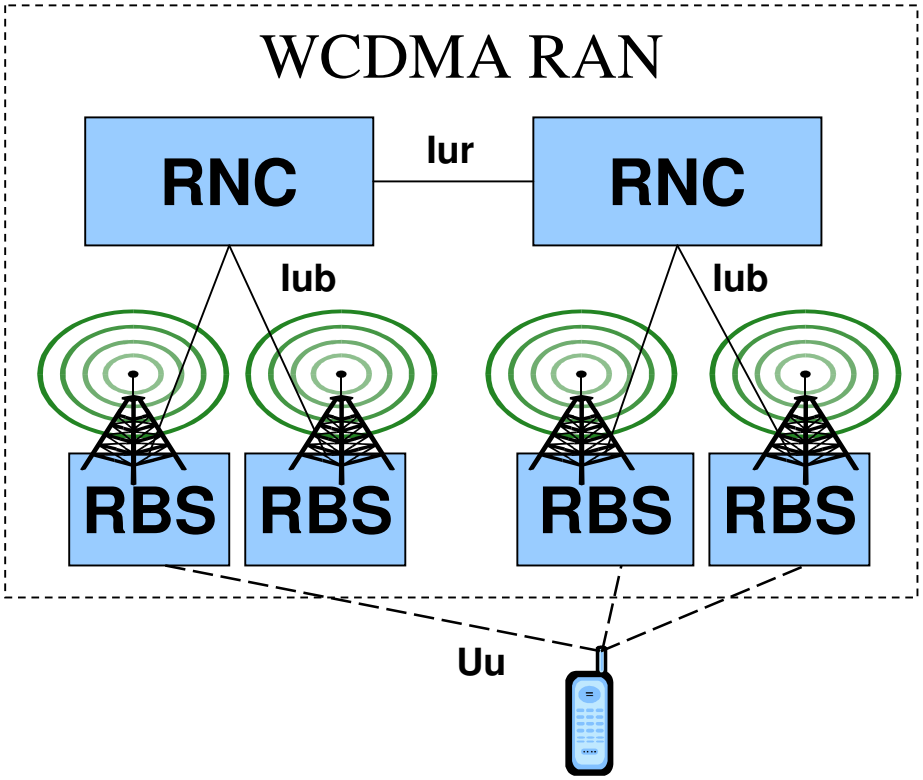
Roles of RNC



3GPP TS 25.401 UTRAN overall description (Release 6)

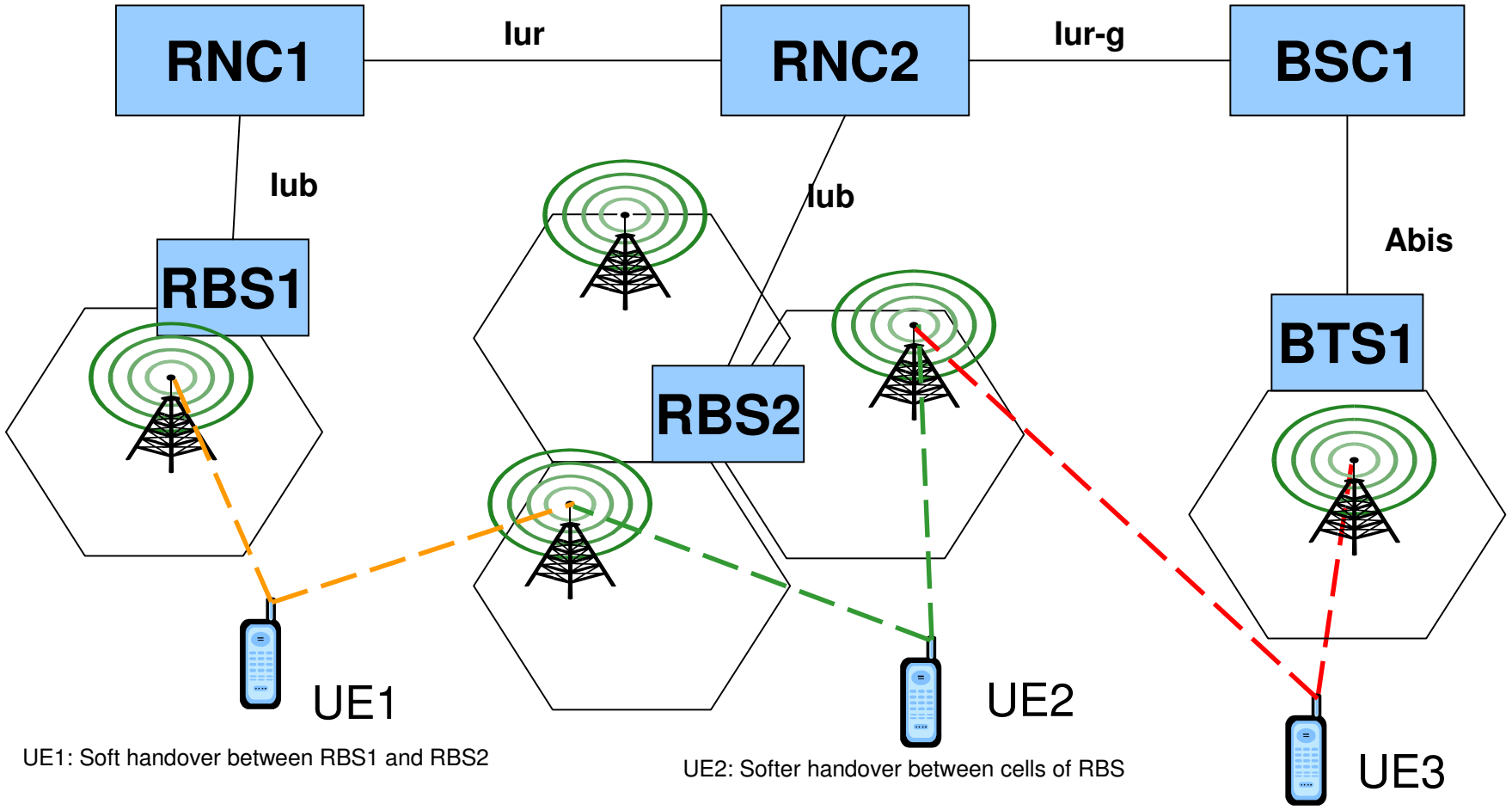
Radio Base Station (Node B)

- Handles the radio transmission and reception to/from the handset over the radio interface (Uu).
- Controlled from the Radio Network Controller via the Iub interface.
- One Radio Base Station can handle one or more cells.
- Connected to only one RNC



3GPP TS 25.401 UTRAN overall description (Release 6)

Mobility - Handovers



UE1: Soft handover between RBS1 and RBS2

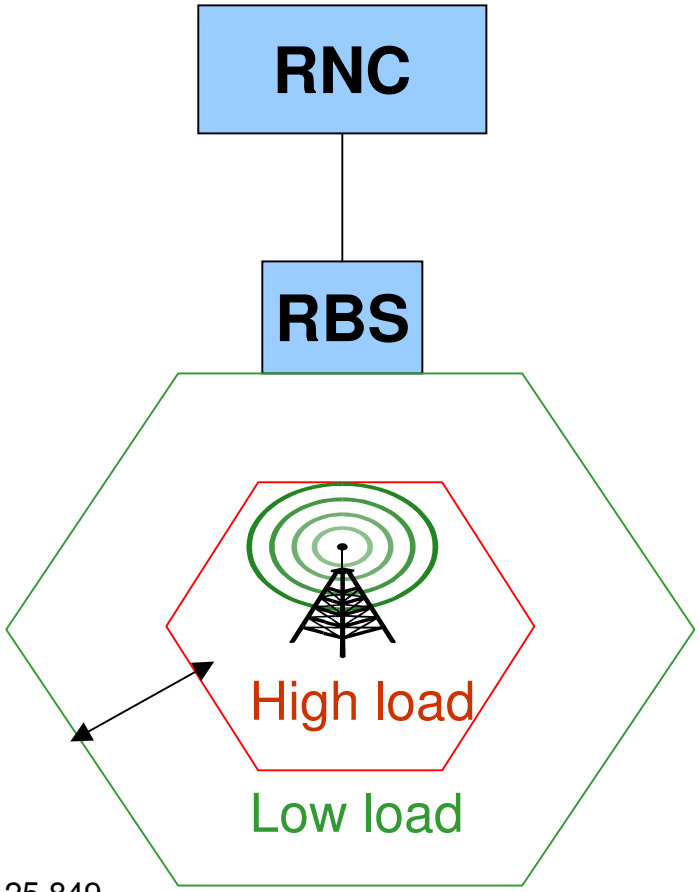
UE2: Softer handover between cells of RBS

UE3: Hard handover between UMTS and GSM (DBSS = Drift BSS, BSC+BTS)

TS 25.331 Radio Resource Control (RRC) protocol specification

Radio resources

- Power control
  - Cell breathing: traffic load change causes cells to grow and shrink
  - Regulates the transmit power of the terminal and base station
  - Less interference and more users on the same carrier
- Congestion control
  - Reduce the bit rate of non real-time applications
  - Triggers the inter- or intra-frequency handover to moves some subscribers to less loaded frequencies.
  - Handover of some subscribers to GSM
  - Discontinue connections and protect the remaining connections
- Admission control
  - Decide if new connections are allowed based on network load



3GPP TS 25.101, 25.133, 25.214, 25.215, 25.331, 25.433, 25.435, 25.841, 25.849

UTRA FDD protocol architecture

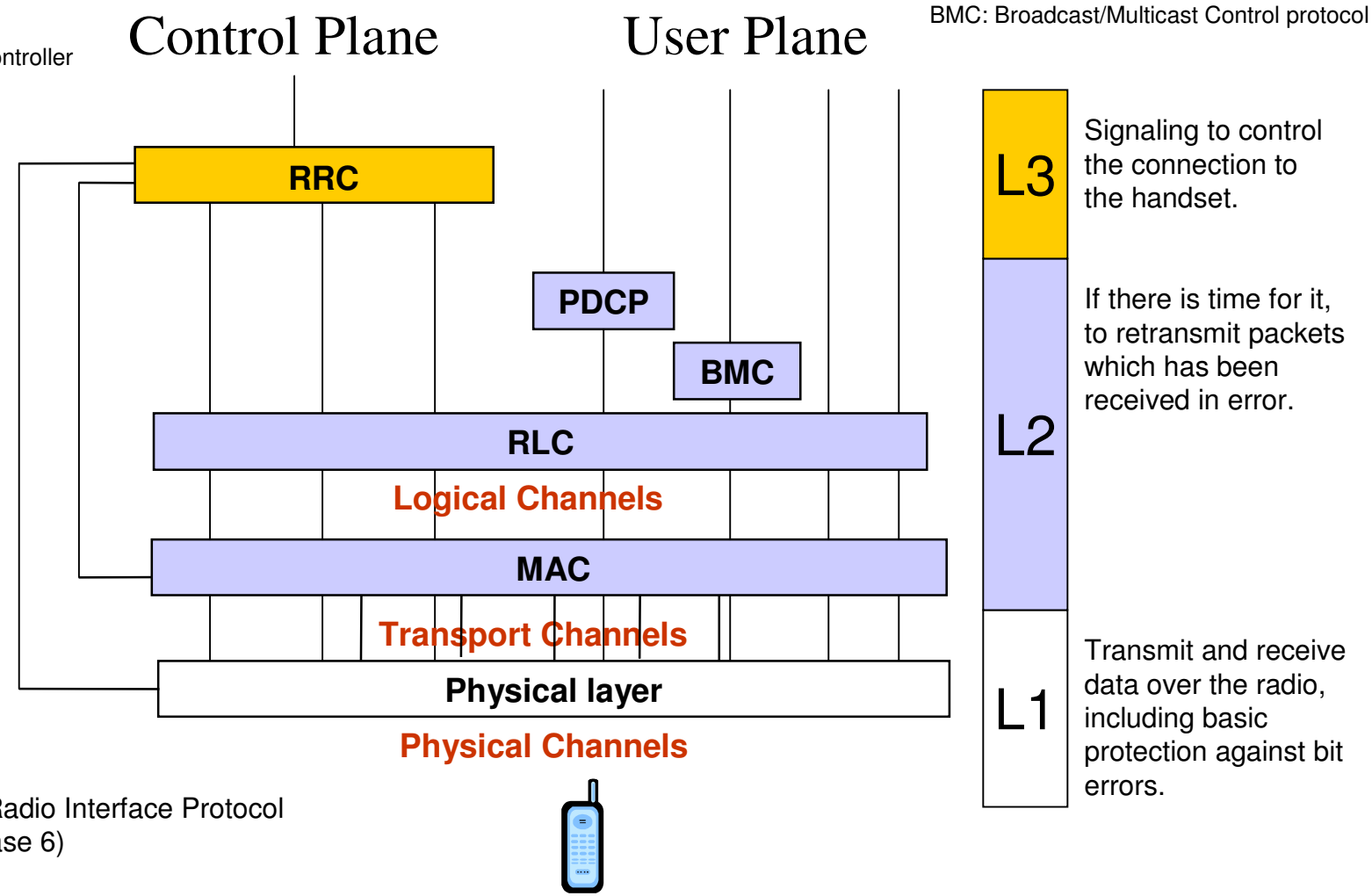
MAC: Medium Access Control

RLC: Radio Link Control

RRC: Radio Resource Controller

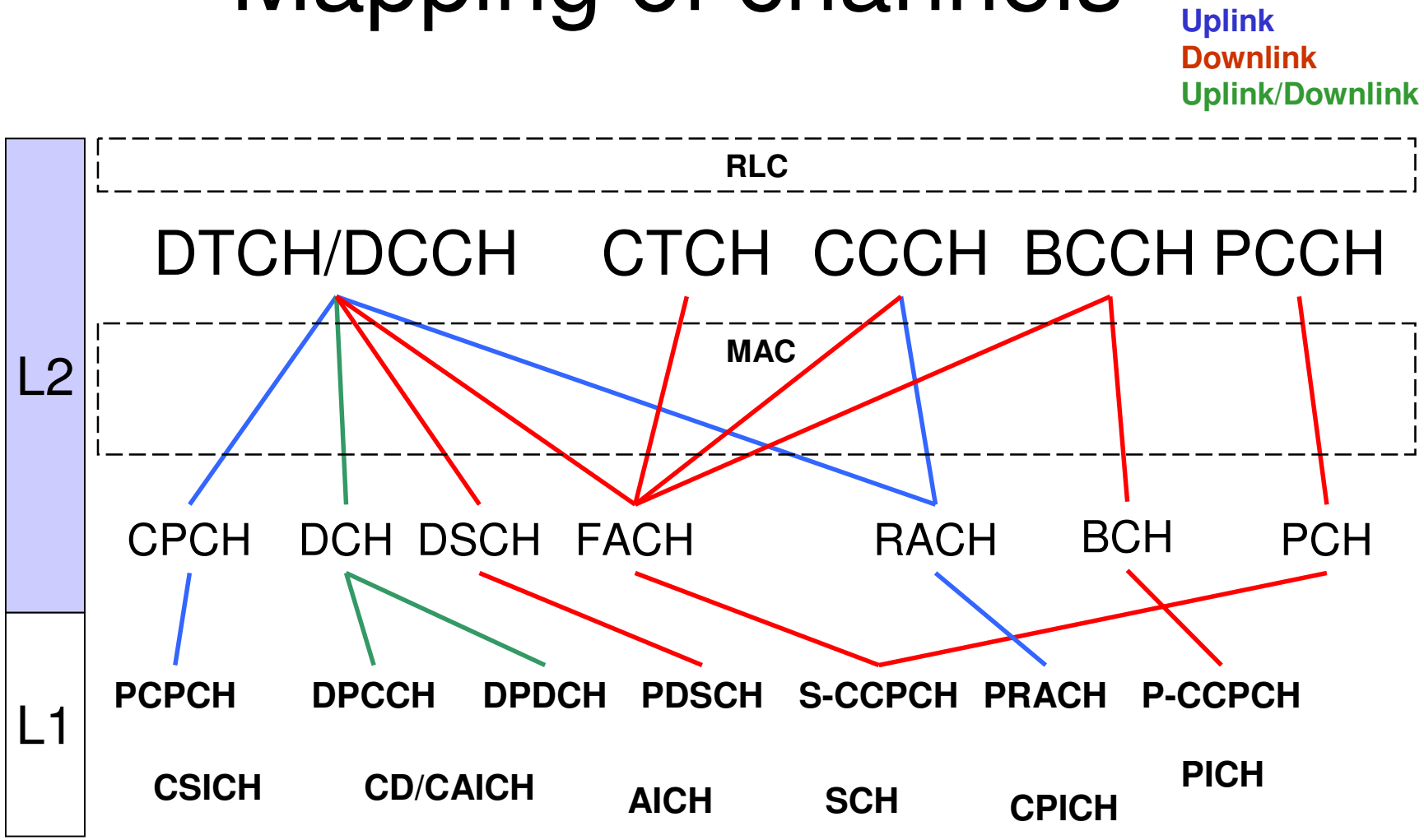
PDCP: Packet Data Convergence Protocol

BMC: Broadcast/Multicast Control protocol



3GPP TS 25.301 Radio Interface Protocol Architecture (Release 6)

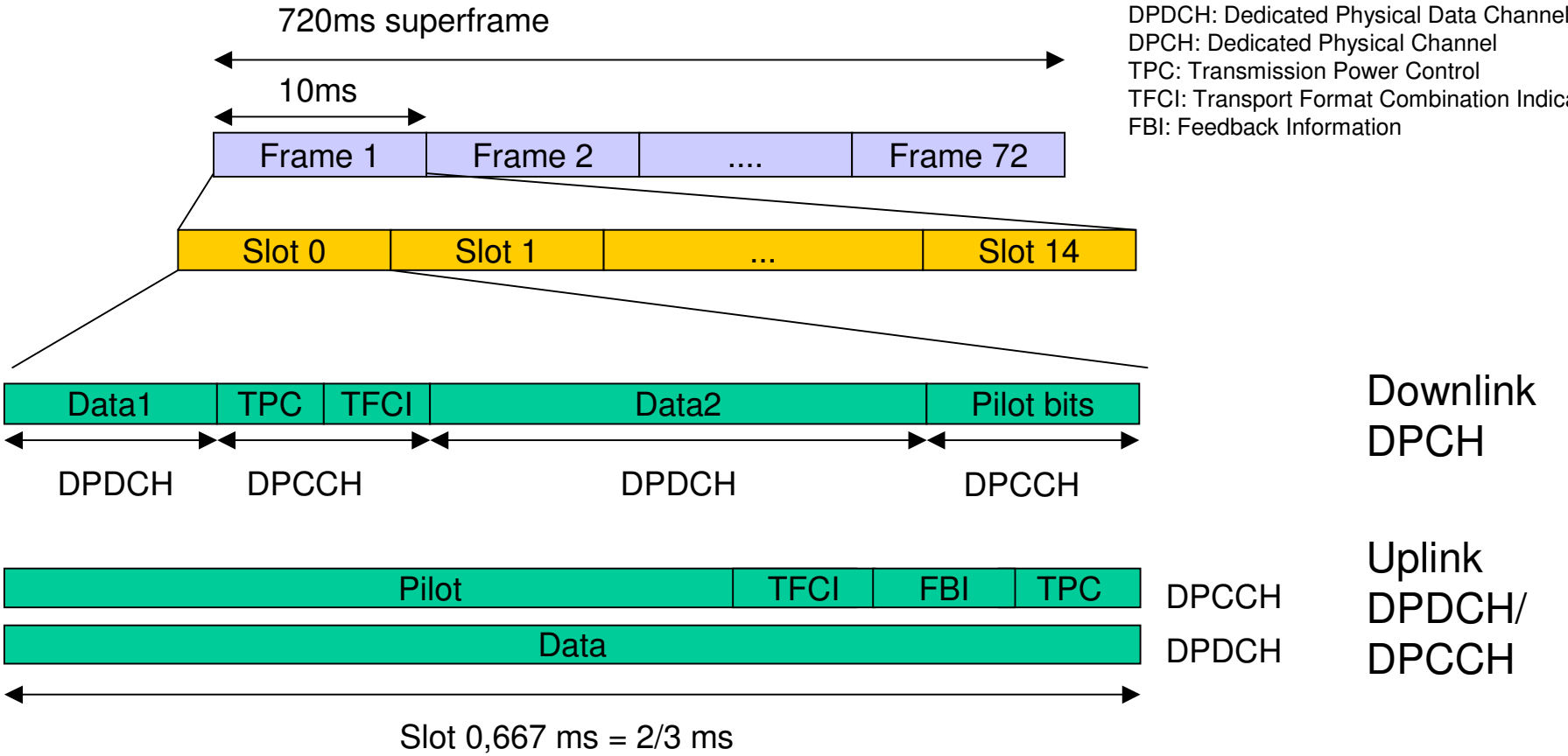
Mapping of channels



3GPP TS 25.301 Radio Interface Protocol Architecture (Release 6)

Time slot configuration example

DPCCH: Dedicated Physical Control Channel
DPDCH: Dedicated Physical Data Channel
DPCH: Dedicated Physical Channel
TPC: Transmission Power Control
TFCI: Transport Format Combination Indication
FBI: Feedback Information



3GPP TS 25.211 Physical channels and mapping of transport channels onto physical channels (FDD) (Release 6)

Who needs UMTS?

- The Harris Interactive survey conducted an online survey on over 10,000 adults in Europe (UK, France, Germany, Spain, Italy and Belgium) regarding 3G in early 2004.
- Some findings from the survey:
  - 49% of the mobile phone users in Europe are not interested in 3G services
  - 44% would not use their phones more than to make regular calls
  - 55% believes 3G will be expensive to use
  - 52% claims not knowing what 3G is and why is it worth having

What does UMTS mean to us?

- You need a UMTS phone
  - GSM phones do not work in UMTS
  - CDMA2000 phones are backward compatible and work in cdmaOne networks.
  - Intelligent terminals
- Efficient power control in UMTS
  - Increased capacity, increased battery lifetime
- High data rate transmission
- WCDMA-GSM handover
  - UMTS/GSM dualband phone for more coverage
- New services
  - Live video conversation, Wireless Internet or VPN, Mobile Media
- New applications
  - Nobody knows what the 3G Killer Application(s) will be
- All basic services like voice and messaging will flow between all systems

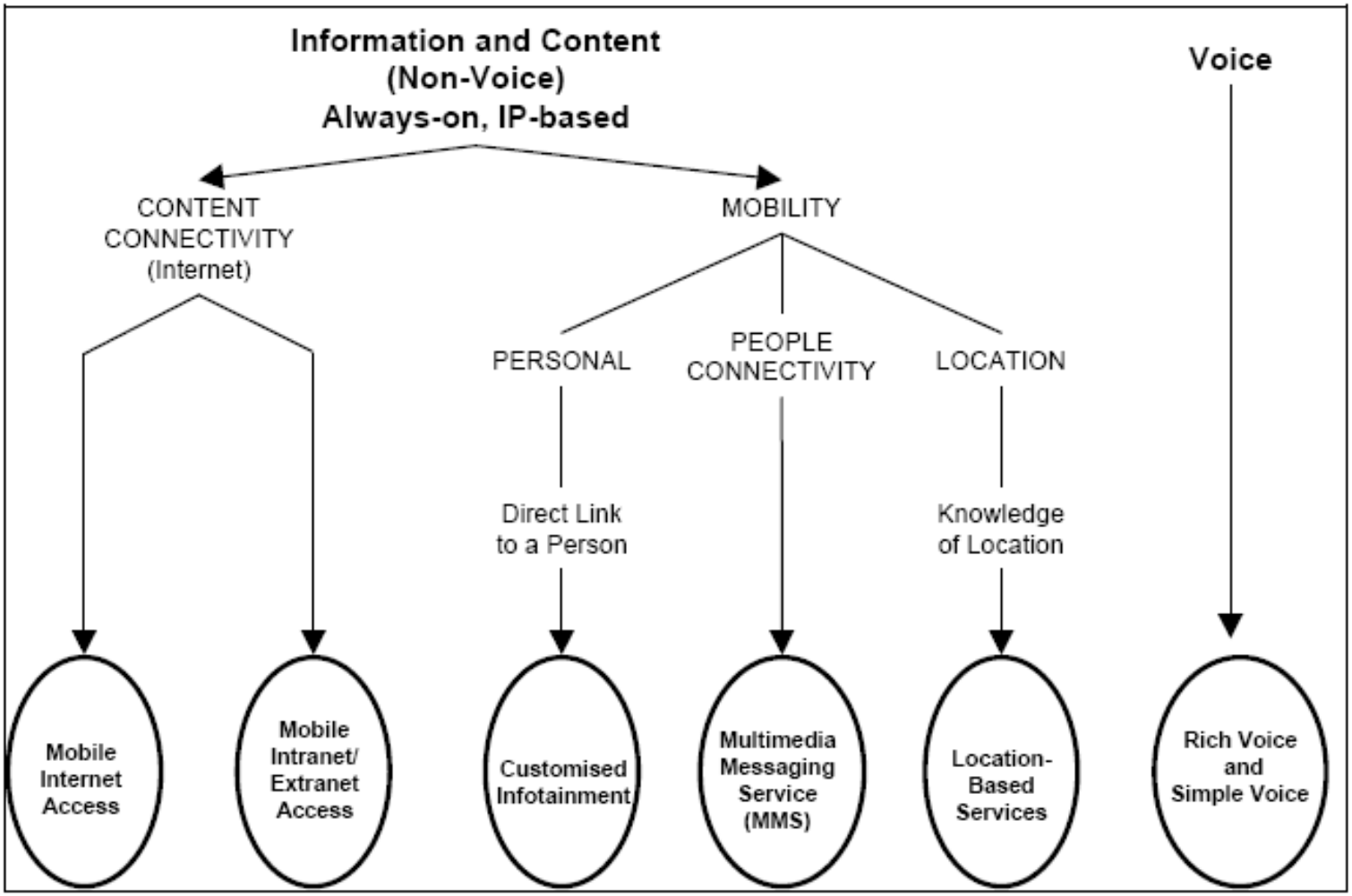
Cellular data rates

Typical data rates from the different cellular standards					
Cellular Family	**Standard**	**Peak Data Rate (kbits/s)**	**Typical real life data rate (kbits/s)**	**Connection type**	**Modulation**
GSM	GSM-CSD (normal)	9.6 / 14.4	9.6	Circuit	GMSK
	HSCSD	28.8 / 43.2	28.8	Circuit	GMSK
	GPRS	115 / 171	50	Packet	GMSK
	EDGE	384 / 513	115	Packet	8-PSK
UMTS	FDD	384 / 2000	144	Packet	QPSK
	TDD	384 / 2000	144	Packet	QPSK
CDMAone	IS-95A	14.4	14.4	Circuit	QPSK
	IS-95B	64 / 115	56	Packet	QPSK
CDMA 2000	1X	144 / 307	130	Packet	QPSK
	1X-EV	2000	tba	Packet	QPSK
	1X-EVDO	2400	tba	Packet	QPSK
TDMA	CSD	9.6	9.6	Circuit	DQpi/4PSK

http://www.cellular-news.com/

GMSK: Gaussian Minimum Shift Keying
8-Phase: Phase Shift Keying modulation scheme
QPSK: Quadrative Phase-Shift Keying
4PSK: Four-Level Phase Shift Keying

3G Service Examples



The market push

- Application providers and operators are unlikely to implement new features to GSM, money is going to UMTS services.
- Operators must gain revenue from UMTS investments
- As of January 2005 there were 123 UMTS licenses granted totally in Europe, Middle East, Africa and Asia Pacific and 61 UMTS networks were launched commercially.
- At the same time there were 107 commercially launched CDMA2000 networks.
- The launch of first TD-SCDMA network is planned for mid-2005.

Would you like to know more?

- 3GPP TS 25.xxx series of specifications
  - TS 25.401 UTRAN overall description
  - TS 25.200 series describes the Layer-1 specification
    - TS 25.201: Physical layer – General description
    - TS 25.211: Physical channels and mapping of transport channels onto physical channels (FDD)
    - TS 25.223: Spreading and modulation (TDD)
    - ...
  - Layers 2 and 3 of the radio interface are described in the TS 25.300 series
    - TS 25.301 Radio interface protocol architecture
    - ...
- ITU Activities on IMT-2000
  - http://www.itu.int/home/imt.html
  - RECOMMENDATION ITU-R M.1457-3: Detailed specifications of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)

Would you like to know more?

- T-110.498 Special Course in data communications and networks, slides of spring 2003
  - http://www.tml.hut.fi/Opinnot/T-110.498/2003/
- Websites
  - Vodafone Live, http://www.vodafone-i.co.uk/live/
  - Hutchison 3G, http://www.hutchison3g.com/
  - UMTS Forum, http://www.umts-forum.org/
  - 3GPP, http://www.3gpp.org/
  - CDMA development group, http://www.cdg.org/
- Harri Holma and Antti Toskala: WCDMA for UMTS : Radio Access for Third Generation Mobile Communications (3rd edition published in September 2004)

Would you like to know more?

- WCDMA network vendors
  - Alcatel
  - Ericsson
  - Lucent
  - Motorola
  - Nokia
  - Nortel
  - Siemens/NEC
- CDMA2000 network vendors
  - Ericsson
  - LG Electronics
  - Lucent
  - Motorola
  - Nortel
  - Samsung

Check their websites for 3G information

Thank you!