



S-72.423 Exercise 4. Solutions

Asymmetrical Digital Subscriber Line ADSL

1. Why loaded loops are not suitable for DSL systems?

Solution.

The loaded loops are not suitable for DSL systems because its attenuation is much higher above the voice frequency band.

2. In rate adaptive DSL, the different sub-channels are allocated for their optimum rates during the channel activation phase, how?

Solution.

In channel activation phase different sub-channels are allocated for their optimum rates by changing number of levels in modulation.

3. What is the type of data paths in DMT and what are their characteristics and applications?

Solution

- Fast
 - low latency (2ms)
 - real-time traffic
- Interleaved
 - low error rate
 - Reed-Solomon encoding (concatenated convolutional codes) at the expense of increased latency
 - Video-on-demand

4. What is the function of the following in an ADSL system based on OFDM/DMT:
 - i. Pilot signal.
 - ii. Interleaving.
 - iii. Guard interval between OFDM symbols.
 - iv. FFT and IFFT.
 - v. Channel estimation.

Solution

- i. Pilot signal: Clock recovery, channel estimation.
 - ii. Interleaving: immunity to burst errors.
 - iii. Guard interval between OFDM symbols: Multipath effects.
 - iv. FFT and IFFT: DMT modulation and demodulation
 - v. Channel estimation: Rate adaptation, distortion adaptation, equalization.
5. List the initialization phases and the operations performed during each phase in ADSL T1.413.

Solution

The initialization process takes about 24000 symbols or six seconds of real time. The initialization process has four phases:

- *Activation and acknowledgment (384 symbols):*
 - ATU-C and ATU-R detect each other and exchange information about timing and pilot tone options.
- *Transceiver training (7808 symbols):*
 - Automatic gain adjustment, echo canceller, and channel equalizer training are performed.
- *Channel analysis (18186 symbols):*
 - Rate options are indicated, and subchannel SNR analysis is performed.
- *Exchange (about 200 symbols):*
 - Exchange of information about loop attenuation, performance margin, and number of bits supported takes place. Bit loading selections are confirmed.

6. True or False,

- a. Loading Coils enhance the performance of ADSL. (**FALSE**)
- b. ATM and STM can not be supported by ADSL. (**FALSE**)
- c. Downloading a file from the internet using ADSL is faster than using CDSL. (**TRUE**)
- d. NEXT is the crosstalk effect between a receiving path and a transmitting path of DSL transceivers at opposite ends of two different subscriber loops within the same twisted pair cable. (**FALSE**)

7. DECT:

- a) How many DECT digital channels need to be combined to get the ISDN's 144 kbit/s basic rate access?
- b) Describe (using a few sentences) the meaning of the following DECT acronyms:
 - GAP
 - GIP
 - IAP and IIP
 - RAP
 - CAP
- c) Explain the differences between closed-loop power control and open-loop power control. Why open-loop power control can be used in DECT?

SOLUTIONS:

- a) 5 DECT channels (rate 32 kbit/s).
- b) See <http://www.handytel.com/technology/dect07.htm>
 - GAP Generic Access Profile: defines a minimum mandatory set of technical requirements to ensure interoperability between any DECT GAP fixed part and portable part.



- GIP DECT/GSM Interworking Profile: providing mobility in DECT infrastructures distributed over multiple sites through GSM mobility functions.
- IAP and IIP ISDN interworking Profiles
- RAP Radio local loop Access Profile
- CAP Cordless Terminal Mobility (CTM) Access Profile

c) Explain the differences between closed-loop power control and open-loop power control. Why open-loop power control can be used in DECT?

- **Open-loop power control**
 - Depends solely on mobile unit
 - Uses the pilot signal
 - Not as accurate as closed-loop, but can react quicker to fluctuations in signal strength (important in CDMA)
- **Closed-loop power control**
 - Adjusts signal strength in reverse channel based on metric of performance
 - BS makes power adjustment decision and communicates to mobile on control channel
- **Example: GSM uses closed-loop with 8 power classes in BS (2.5-320 W) and 5 in mobile station (0.8-20 W)**

Open-loop power control and DECT:

The mobile estimates the path loss to the cell by measuring the received signal level and adjusts the uplink transmission power accordingly. Open-loop power control scheme can be used if we can assume that characteristics of channel are same in both directions (For example frequency). That is why open-loop power control can be used in TDD-systems like DECT. (Multipath fading is the same in uplink and downlink.)

8. TETRA:

- a) List TETRA Teleservices
- b) List TETRA Bearer Services for data transfer.

Solutions

More about TETRA on www.tetramou.com

- a)

| TETRA Teleservices |
|----------------------------|
| Individual Call |
| Group Call |
| Acknowledged Group Call |
| Broadcast Call |

b)

| TETRA Bearer Services |
|--|
| Circuit mode data 7.2/14.4/21.6/28.8 kbits/s |
| Circuit mode protected data 4.8/9.6/14.4/19.2 kbits/s |
| Circuit mode heavily protected data 2.4/4.8/7.2/9.6 kbits/s |
| Connection oriented packet data |
| Connectionless packet data |

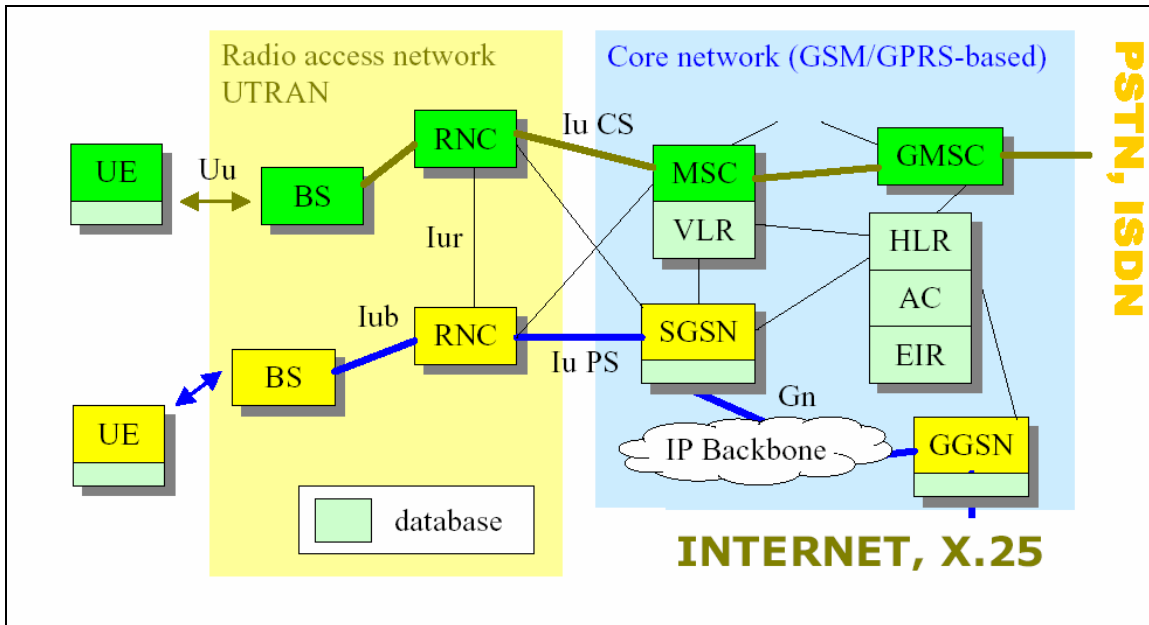
9. **UMTS:** Describe (using a few sentences) the meaning of the following UMTS features and acronyms:
- FDD / TDD
 - UTRAN
 - Spreading factor
 - Processing gain
 - Soft handover
 - RRC
 - Outer loop power control
 - AMR
 - Admission control

Solution

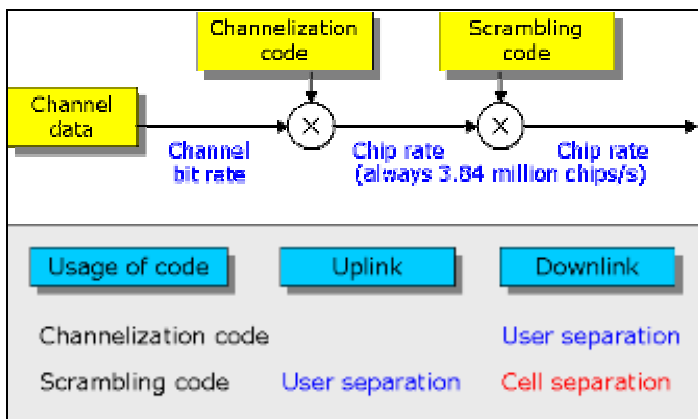
FDD / TDD

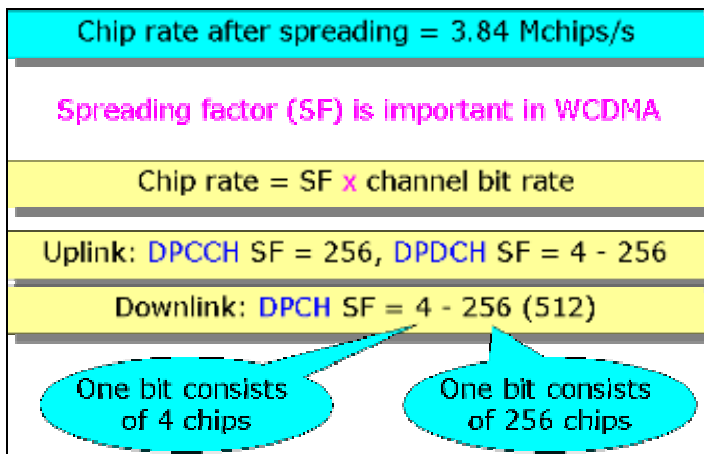
WCDMA has two basic modes of operation: FDD (Frequency Division Duplex) and TDD (Time Division Duplex). FDD allows continuous transmission in both directions requires a paired frequency band and is suited for symmetric bandwidth needs. In TDD Option same carrier frequency is utilized for uplink/downlink transmission using time division.

UTRAN
UMTS Terrestrial Radio Access Network



Spreading factor





Processing gain

Ojanperä, Prasad, Wideband CDMA for Third Generation Mobile Communications, Artech House Publishers, 1998 (page 34): "The ratio of transmitted bandwidth to information bandwidth is called the processing gain G_p of the spread-spectrum system..."

Soft handover

during soft handover, a mobile station is in the overlapping cell coverage area of different base stations. It is possible to make the connection to the new cell before leaving the current cell. Soft handover is used in CDMA to reduce the interference into other cells and improve performance through macro diversity.

RRC

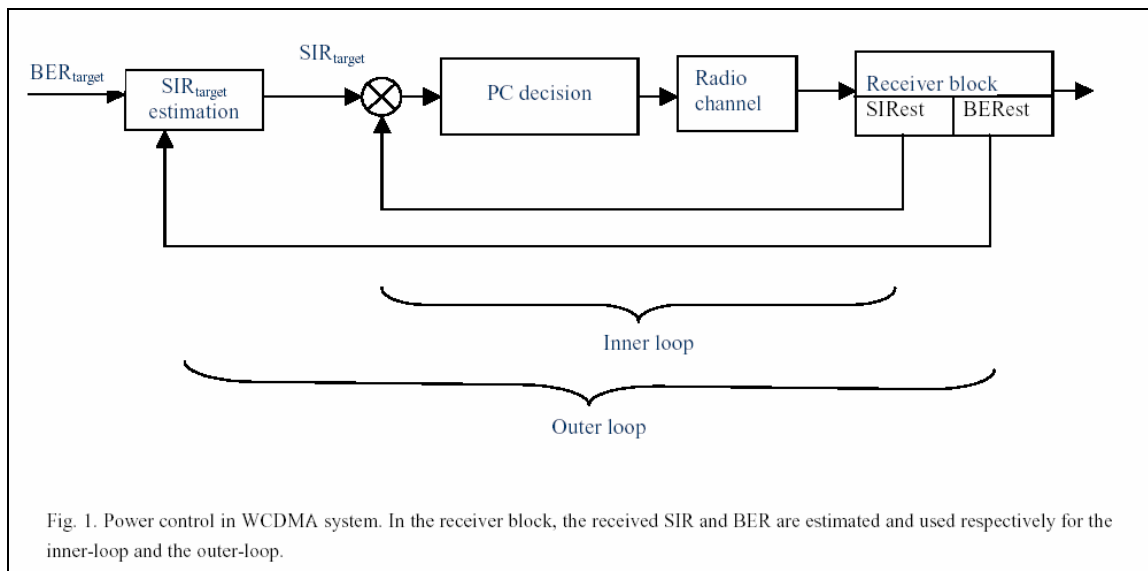
Radio Resource Control

RRC protocol

Over the Uu (air) interface, Radio Resource Control (RRC) messages carry all the relevant information required for setting up, modifying, and releasing **Radio Bearers** between UE and UTRAN. RRC also participates in the coordination of other Radio Resource Management (RRM) operations, such as measurements and handovers.

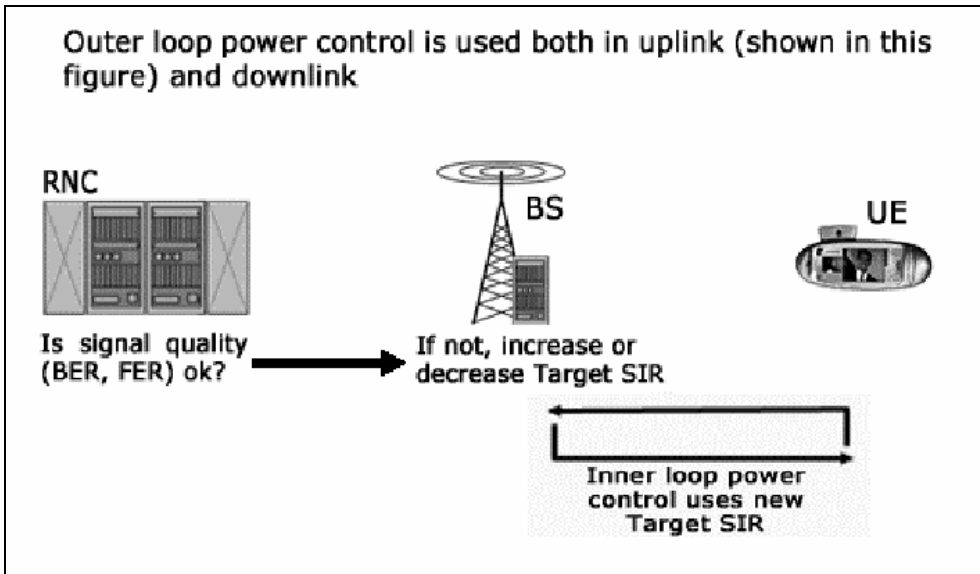
In addition, RRC messages may carry in their payload higher layer signalling information (MM = Mobility Management, CM = Connection Management, SM = Session Management) that is not related to the air interface or UTRAN.

Outer loop power control



[<http://www.ing.unipi.it/ew2002/proceedings/177.pdf>]

BER = Bit Error Rate
SIR = Signal-to-Interference Ratio



[Fig: Hongying Yin, *Power Control in Cellular System*, 2002, S-72.333]

AMR

Adaptive Multi-rate. The speech codec in UMTS will employ the adaptive Multi-rate technique.

Admission control

Ojanperä, Prasad, *Wideband CDMA for Third Generation Mobile Communications*, Artech House Publishers, 1998 (page 156): "The purpose of admission control is to ensure that there are free radio resources for the intended call with required SIR and bit rate... .. Admission control is always performed when a mobile station initiates communications in a new cell; either through a new call or handover... .. admission control procedure ensures that the interference created after adding a new call does not exceed a pre-specified threshold."