

## 2G1723 GSM Network and Services

The exam will consist of two sections: section A (20p) and section B (8p). Section A consist of 20 multiple-choice questions (1p each), where exactly one answer is correct. A correct answer is rewarded one point and a wrong answer zero points. If you haven't scored at least 16 points in section A then section B will not be corrected.

Section B consist of 2 to 4 questions where answers are handed in on a separate sheet, one answer per sheet, keep answers to the point. The questions will be awarded zero to four points. No extra material is allowed.

The limits for grading are as follows:

- grade 3, at least 12 on section A
- grade 4, at least 16 on section A
- grade 5, at least 16 on section A, and at least 6 on section B

Note that point from section A does not carry over to section B.

### Section A : example questions

A:1 1p. How large is the GSM spectrum allocation in the 900 band?

A:2 1p. What is the GSM spectrum allocation in the 1800 band?

A:3 1p. How is the spectrum divided for duplex communication in GSM?

A:4 1p. How is the spectrum divided for cellular coverage in GSM?

A:5 1p. How is the spectrum divided for multiple access in GSM?

A:6 1p. How is the GSM spectrum divided between national operators in a country?

A:7 1p. Which organization is now responsible for GSM network standards?

A:8 1p. What is a good rule of thumb when it comes to wireless networks, bandwidth and modulation bit rate?

A:9 1p. What is the most important factor that determines the capacity of a carrier in a cellular network?

A:10 1p. What is fast fading?

A:11 1p. What is slow fading?

A:12 1p. What is symbol interference?

A:13 1p. What is roughly the cell size in a dense city environment?

A:14 1p. What is the maximum radius of a cell GSM (if we're not cheating)?

A:15 1p. What determines the maximum cell size in GSM?

A:16 1p. What is the idea behind the concept of location area?

A:17 1p. Which address identifies a subscriber?

A:18 1p. Which address identifies a mobile terminal?

A:19 1p. Which address is the "phone number"?

A:20 1p. What is a GSM cell?

A:21 1p. What is the BSIC?

A:22 1p. What is the A-bis interface?

A:23 1p. What is the A interface?

- A:24 1p. What is the Um interface?
- A:25 1p. What is the purpose of the VLR?
- A:26 1p. What is the purpose of the HLR?
- A:27 1p. What is LAPDm and where is it used?
- A:28 1p. What is the purpose of the RR protocol?
- A:29 1p. What is the purpose of the MM protocol?
- A:30 1p. What is the purpose of the CC protocol?
- A:31 1p. What is the purpose of the BTSM protocol?
- A:32 1p. What is the purpose of the BSSMAP protocol?
- A:33 1p. What is the purpose of the MAP protocol?
- A:34 1p. What is the purpose of the FCCH?
- A:35 1p. What is the purpose of the SCH?
- A:36 1p. What is the purpose of the BCCH?
- A:37 1p. What is the purpose of the RACH?
- A:38 1p. What is the purpose of the AGCH?
- A:39 1p. What is the purpose of the PCH?

- A:40 1p. What is the purpose of the SDCCH?
- A:41 1p. What is the purpose of the FACCH?
- A:42 1p. What is the purpose of the SACCH?
- A:43 1p. Which logical channels are combined in timeslot 0 of the broadcast carrier?
- A:44 1p. What is sent in idle timeslots of the broadcast carrier?
- A:45 1p. How is the FCCH implemented?
- A:46 1p. Why is the access burst shorter than the other bursts?
- A:47 1p. How is the FACCH implemented?
- A:48 1p. What is the length of a traffic multiframe and why does it have this length?
- A:49 1p. What is the length of a broadcast/common control multiframe and why does it have this length?
- A:50 1p. What is the length of a dedicated control multiframe and why does it have this length?
- A:51 1p. Why is the length different between a traffic multiframe and broadcast/common control multiframe?
- A:52 1p. How is handover controlled?
- A:53 1p. What are the steps in channel coding and in what order are they done?

- A:54 1p. What is the purpose of the block coding?
- A:55 1p. What is the purpose of interleaving coding?
- A:56 1p. What is the purpose of convolutional coding?
- A:57 1p. What does it mean that a convolutional coder is of rate  $1/2$ ?
- A:58 1p. What is the purpose of puncturing after convolutional coding?
- A:59 1p. How is interleaving performed for voice channels?
- A:60 1p. Which kind of interleaving is done for signaling channels?
- A:61 1p. What is the exact length, in time, of a TDMA frame?
- A:62 1p. How are stealing flags used to code FACCH?
- A:63 1p. What is the sample rate and sample size of the GSM full rate voice coder?
- A:64 1p. What is the size of a 20 ms voice sample after GSM full rate voice coding?
- A:65 1p. What is the purpose of the DTX coder/decoder?
- A:66 1p. What is the difference between vocoders and waveform coders?
- A:67 1p. Is the GSM voice coder a vocoders or waveform coders?
- A:68 1p. What is the advantage of the AMR coder?

- A:69 1p. Where is encryption applied in a voice or signaling connection?
- A:70 1p. How is the encryption session key generated?
- A:71 1p. How is authentication performed?
- A:72 1p. Who and why allocates a TMSI?
- A:73 1p. How is can a subscriber be authenticated in a roaming network?
- A:74 1p. Which parameters are used as input to A5?
- A:75 1p. What type of cipher technique is used in A5?
- A:76 1p. What cipher is used as A3?
- A:77 1p. How does the SMSC determine for how long a SMS message is valid?
- A:78 1p. How large is the user data part of a SMS submission?
- A:79 1p. How is the SMSC address determined?
- A:80 1p. How is the recipient address of a SMS determined?
- A:81 1p. Which logical channels are used for SMS signaling messages?
- A:82 1p. What is the purpose of the MSRN?
- A:83 1p. Who allocates the MSRN and what does it identify?

- A:84 1p. Which node holds the mapping of MSISDN to IMSI?
- A:85 1p. How does the HLR find the MSRN?
- A:86 1p. Which node holds the mapping from MSRN to TMSI?
- A:87 1p. Why is the TMSI needed to handle an incoming call?
- A:88 1p. Which modulation technique is used in regular GSM?
- A:89 1p. How are symbols coded using regular GSM modulation?
- A:90 1p. How many bits are coded per symbol using regular GSM modulation?
- A:91 1p. Why is differential coding used before symbol coding?
- A:92 1p. What is the purpose of the training sequence?
- A:93 1p. Given a downlink broadcast carrier, how is the corresponding uplink carrier found?
- A:94 1p. Why is timing advance information needed?
- A:95 1p. Why is timing advance information needed?
- A:96 1p. What is the resolution and format of timing advance information?
- A:97 1p. What logical channel is used for measurement reports?
- A:98 1p. Why does a mobile need to know the frame number?

- A:99 1p. What is reported in measurement reports?
- A:100 1p. How long is the frame number cycle?
- A:101 1p. What is the main argument for introducing GPRS?
- A:102 1p. What is the purpose of the GGSN?
- A:103 1p. Name one thing that is managed by the SGSN?
- A:104 1p. Why introduce two nodes SGSN and GGSN, why not just one?
- A:105 1p. What does GPRS mobile station class A, B and C define?
- A:106 1p. What does GPRS mobile station multislot classes define?
- A:107 1p. What are the states of a GPRS MS?
- A:108 1p. In which GPRS states will a MS do routing area updates?
- A:109 1p. How is handover handled during a GPRS session?
- A:110 1p. What modulation technique is used for GPRS?
- A:111 1p. What is the purpose of the GPRS SNDCP layer?
- A:112 1p. What is the purpose of the GPRS LLC layer?
- A:113 1p. what is the purpose of the RLC layer?
- A:114 1p. What is the purpose of the GPRS MAC layer?



A:115 1p. Why can we not do encryption in GPRS immediately before radio modulation?

A:116 1p. Why introduce a packet random access channel?

A:117 1p. What is the structure of the PDTCH multiframe?

A:118 1p. How can a mobile identify its own TBF?

A:119 1p. How can a mobile know which uplink TBF to use?

A:120 1p. Which header contains the USF?

A:121 1p. Which modulation technique is used in E-GPRS?

A:122 1p. How are different layer one rates achieved in E-GPRS?

## **Section B : example questions**

B:1 4p. Describe in brief the actions performed by a mobile station when powered up.

B:2 2p. Describe a handover between two BSCs under the same MSC. Draw a signaling diagram containing the BSSMAP signals and indicating the RR signals that are directly involved in the handover.

B:3 2p. Describe in brief the use of System Information messages type 1-4, 5-6 and 13; which logical channels are they delivered over and in general what do they contain.

B:4 2p. Explain how authentication, session key generation and encryption is performed. What implications would it have if a mobile operator would change the A3, A5 or A8 algorithms?

B:5 2p. Draw a message diagram and explain the steps performed for a PSTN originating mobile terminating call. Explain the purpose of the MSISDN, MSRN, TMSI and when they are used.

B:6 2p. Draw a message diagram and explain the steps performed for a

location update in a LA controlled by a new VLR. How is the MS identified, how is the old VLR found?

B:7 2p. Explain how a mobile, starting from scratch, can find a suitable broadcasting carrier to camp on.

B:8 2p. Explain how E-GPRS can improve throughput compared to regular GPRS even if only the lower, MCS-1 through MCS-4, coding schemes are used.

B:9 4p. What options are available for a GSM operator that needs to increase its capacity in a city environment? List the options and briefly present their pros and cons.

B:10 4p. What are the reasons for selecting the bandwidth of a GSM carrier. What would be the pros and cons of having a more narrow or wider carrier while still using TDMA.

B:11 4p. Why was GPRS introduced? Describe the main advantages over circuit-switched data connections. What are the key benefits, who benefit most, when is circuit-switched data better?