Chapter 5: Introduction to GPRS

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Data services in GSM I

Data transmission standardized with only 9.6 kbit/s

- advanced coding allows 14,4 kbit/s
- not enough for Internet and multimedia applications

HSCSD (High-Speed Circuit Switched Data)

- mainly software update
- bundling of several time-slots to get higher AIUR (Air Interface User Rate) (e.g., 57.6 kbit/s using 4 slots, 14.4 each)
- advantage: ready to use, constant quality, simple
- disadvantage: channels blocked for voice transmission

AIUR [kbit/s]	TCH/F4.8	TCH/F9.6	TCH/F14.4
4.8	1		
9.6	2	1	
14.4	3		1
19.2	4	2	
28.8		3	2
38.4		4	
43.2			3
57.6			4

Data services in GSM II

GPRS (General Packet Radio Service)

- packet switching
- using free slots only if data packets ready to send (e.g., 50 kbit/s using 4 slots temporarily)
- standardization 1998, introduction 2001
- advantage: one step towards UMTS, more flexible
- disadvantage: more investment needed (new hardware)

GPRS network elements

- GSN (GPRS Support Nodes): GGSN and SGSN
- GGSN (Gateway GSN)
  - interworking unit between GPRS and PDN (Packet Data Network)
- SGSN (Serving GSN)
  - supports the MS (location, billing, security)
- GR (GPRS Register)
  - user addresses

GPRS quality of service

Reliability class	Lost SDU probability	Duplicate SDU probability	Out of sequence SDU probability	Corrupt SDU probability
1	10^{-9}	10^{-9}	10^{-9}	10^{-9}
2	10^{-4}	10^{-5}	10^{-5}	10^{-6}
3	10^{-2}	10^{-5}	10^{-5}	10^{-2}

Delay class	SDU size 128 byte		SDU size 1024 byte	
	mean	95 percentile	mean	95 percentile
1	< 0.5 s	< 1.5 s	< 2 s	< 7 s
2	< 5 s	< 25 s	< 15 s	< 75 s
3	< 50 s	< 250 s	< 75 s	< 375 s
4	unspecified			

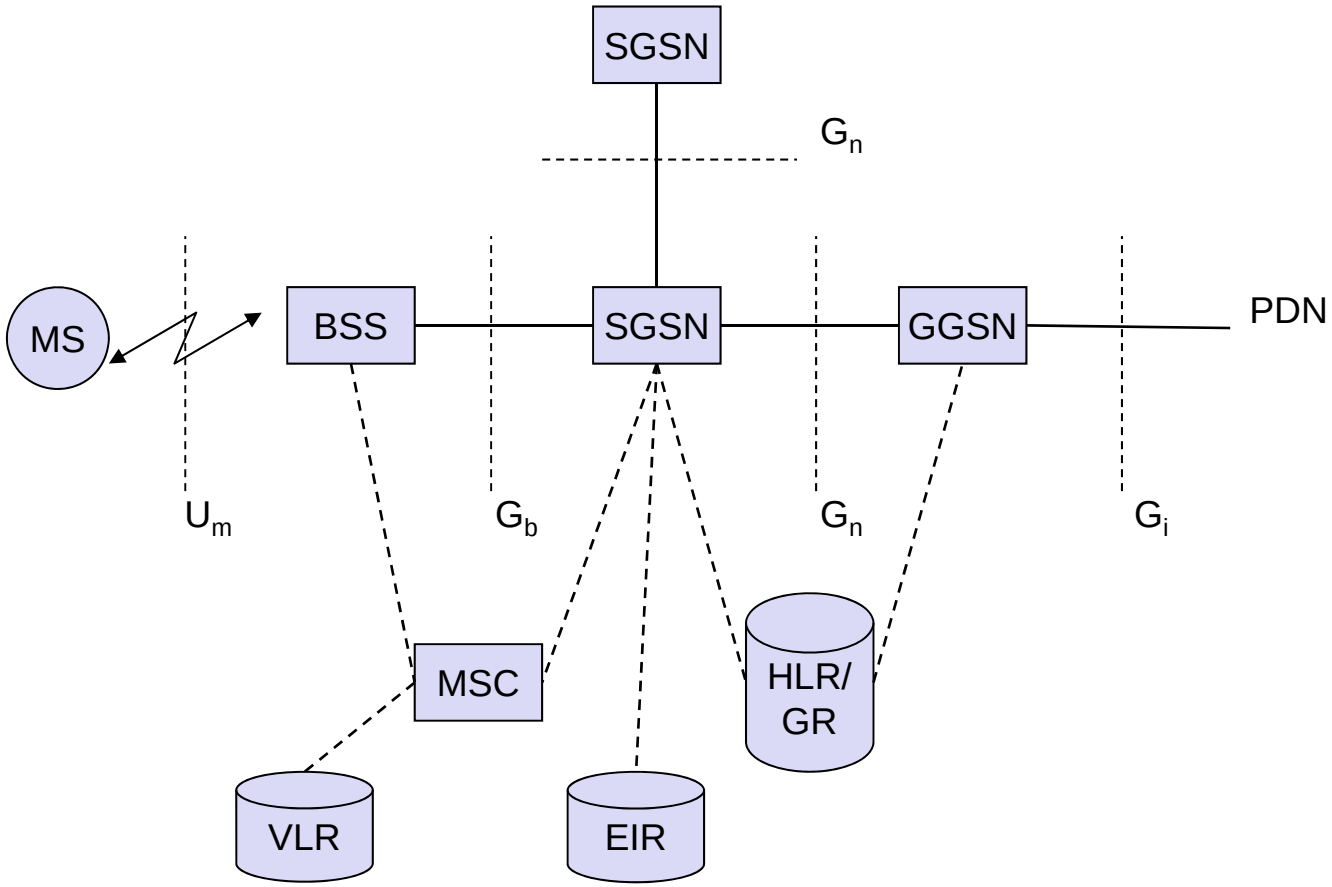
Examples for GPRS device classes

Class	Receiving slots	Sending slots	Maximum number of slots
1	1	1	2
2	2	1	3
3	2	2	3
5	2	2	4
8	4	1	5
10	4	2	5
12	4	4	5

GPRS user data rates in kbit/s

Coding scheme	1 slot	2 slots	3 slots	4 slots	5 slots	6 slots	7 slots	8 slots
CS-1	9.05	18.2	27.15	36.2	45.25	54.3	63.35	72.4
CS-2	13.4	26.8	40.2	53.6	67	80.4	93.8	107.2
CS-3	15.6	31.2	46.8	62.4	78	93.6	109.2	124.8
CS-4	21.4	42.8	64.2	85.6	107	128.4	149.8	171.2

GPRS architecture and interfaces



GPRS architecture

The GPRS architecture introduces two new network elements, **GPRS support nodes (GSN)**

- The **gateway GPRS support node (GGSN)** is the interworking unit between the GRPS network and external **packet data networks (PDN).**
- **The serving GPRS support node (SGSN)** which supports the MS via Gb interface.

- The GGSN contains routing information for GPRS users, performs address conversion, and tunnel data to a user via encapsulation.
- The GGSN is connected to external networks (e.g. IP or X.25) via the Gi interface and transfers packets to the SGSN via an IP-based GPRS backbone network (Gn interface).

Cont.

As shown in Fig. (page 5.7), packet data is transmitted from a PDN, via the GGSN and SGSN directly to the BSS and finally to the MS.

The MSC, which is responsible for data transfer in the traditional circuit-switched GSM, is only used for signaling in the GPRS scenario.

Before sending any data over GRPS network, an MS must attach to it, following the procedures of the **mobility management**.

GPRS protocol architecture

All data within the GPRS backbone, i.e., between the GSNs, is transferred using the GPRS tunnelling protocol (GTP).

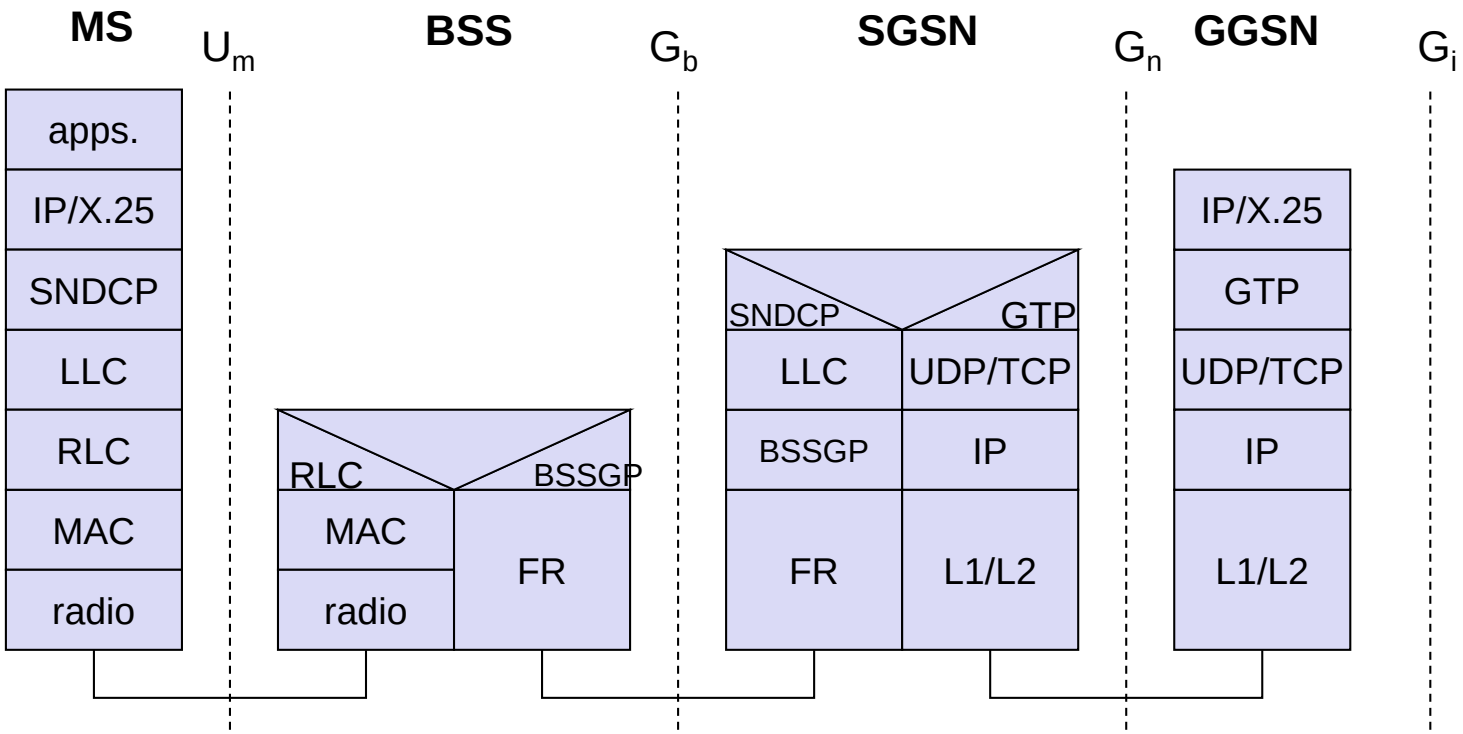
GTP can use two different transport protocols, either reliable TPC (needed for reliable transfer of X.25 packets) or non-reliable UDP (needed for IP packet).

The subnetwork dependent convergence protocol (SNDCP) is used between SGSN and MS.

On the top of SNDCP and GTP, user packet data is tunneled from the MS to the GGSN and vice versa.

To achieve a high reliability of packet transfer between SGSN and MS, a special LLC is used.

GPRS protocol architecture



Homework #5:

1. What's the GPRS architecture ?
2. What's the detailed function of GGSN and SGSN ?
3. What's the GPRS protocol stack ?