GPRS PROTOCOL
The *Subnetwork Dependent Convergence Protocol (SNDCP)* runs between the MS and the SGSN.

SNDCP basically provides:

1. acknowledged and unacknowledged transport services
2. compression of TCP/IP headers
3. compression of user data
4. datagram segmentation/reassembly
5. PDP context multiplexing
- **Packet Data Protocol (PDP) Context** essentially represents a virtual connection between an MS and an external PDN.
- The PDP Context multiplexing is a function that
  1. routes each data unit received on a particular PDP Context to the appropriate upper layer
  2. routes each data unit arrived from an upper layer to the appropriate PDP Context.
• **Logical Link Control protocol** provides one or more separate **logical links (LLs)** between the MS and the SGSN, which are distinguished into

  - **user-LLs** *(used to carry user data)* - four user-LLs
  - **control-LLs** *(used to carry signaling)* - three control-LLs:
    - *exchanging GPRS mobility management and session management signaling*
    - *to support SMS*
    - *to support location services (LCS)*
The user-LLs are established dynamically, in the context of the PDP Context Activation procedure and their properties are negotiated between the MS and the SGSN during the establishment phase.

Negotiated properties typically include:

1. The data transfer mode (acknowledged Vs unacknowledged)
2. The maximum length of transmission units
3. Timer values
4. Flow control parameters.
• Control-LLs operate only in unacknowledged mode, which basically provides an unreliable transport service.

• User-LLs operate either in unacknowledged mode or in acknowledged mode, depending on the reliability requirements.

• It provides reliable data transport by
  (1) detecting and retransmitting erroneous data units
  (2) maintaining the sequential order of data units
  (3) providing flow control.

• Another service provided by the LLC layer is ciphering – provided in both acknowledged and unacknowledged mode of operation, and therefore, all LLs can be secured and protected from eavesdropping.
• The RLC and MAC protocols run between the MS and the PCU.

• It provides the procedures for unacknowledged or acknowledged operation over the radio interface.

• It also provides segmentation and reassembly of LLC data units into fixed-size RLC/MAC blocks.

• In RLC acknowledged mode of operation, RLC also provides the error correction procedures that enable the selective retransmission of unsuccessfully delivered RLC/MAC blocks. Additionally, in this mode of operation, the RLC layer preserves the order of higher layer data units provided to it.

• LLC provides transport services between the MS and the SGSN, the RLC provides similar transport services between the MS and the PCU.
• The MAC layer implements the procedures that enable multiple mobile stations to share a common radio resource, which may consist of several physical channels.
  
In the uplink direction (MS to network) in particular, the MAC layer provides the procedures for the arbitration between multiple mobile stations, which simultaneously attempt to access the shared transmission medium.

• In the downlink direction (network to MS), the MAC layer provides the procedures for queuing and scheduling of access attempts.

• The MAC function in the network maintains a list of active MSs, which are mobile stations with pending uplink transmissions. These MSs have previously requested permission to content for uplink resources and the network has responded positively to their requests.

• Each active MS is associated with a set of committed QoS attributes, such as delay and throughput.
• The main function of the MAC layer in the network is to implement a **scheduling function** (in the uplink direction), which successively assigns the common uplink resource to active MSs in a way that guarantees that each MS receives its committed QoS.

• A similar scheduling function is also implemented in the downlink direction.

• From the above, it is obvious that every GPRS cell features a central authority, which

  (1) arbitrates the access to common uplink resources (by providing an uplink scheduling function)

  (2) controls the transmission on the downlink resources (by providing a downlink scheduling function).
• The **Base Station Subsystem GPRS Protocol (BSSGP)** runs across the Gb interface.

BSSGP basically provides

1. **unreliable transport of LLC data units between the PCU and the SGSN**
2. **flow control in the downlink direction.**

   The flow control aims to prevent the flooding of buffers in the PCU and to match the transmission rate on Gb (from SGSN to PCU) to the transmission rate on the radio interface (from PCU to MS).
• BSSGP also provides **addressing services**, which are used to identify a given MS in uplink and downlink directions, and a particular cell.

• In the downlink direction, each BSSGP data unit typically carries an LLC data unit, the identity of the target MS, a set of radio-related parameters (identifying the radio capabilities of the target MS), and a set of QoS attributes needed by the MAC downlink scheduling function.
• In the uplink direction, each BSSGP data unit typically carries an LLC data unit, the identity of the source MS, the identity of the source cell, and a corresponding set of QoS attributes.

• The **GPRS Tunneling Protocol GTP** between the SGSN and the GGSN. GTP also runs between two SGSNs.

• GTP provides an unreliable transport function (usually runs on top of UDP) and a set of signaling functions primarily used for tunnel management and mobility management.
• The transport service of GTP is used to carry user originated IP datagrams (or any other supported packet unit) into GTP tunnels.

• GTP tunnels are necessary between the SGSN and the GGSN for routing purposes.

• They are also necessary for correlating user-originated IP datagrams to PDP Contexts.
By means of correlation, a GGSN knows how to treat an IP datagram received from an SGSN (e.g., to which external PDN to forward this datagram), and an SGSN knows how to treat an IP datagram received from another SGSN (or another SGSN) (e.g., what QoS mechanisms to apply to this datagram and to which cell to forward this datagram).