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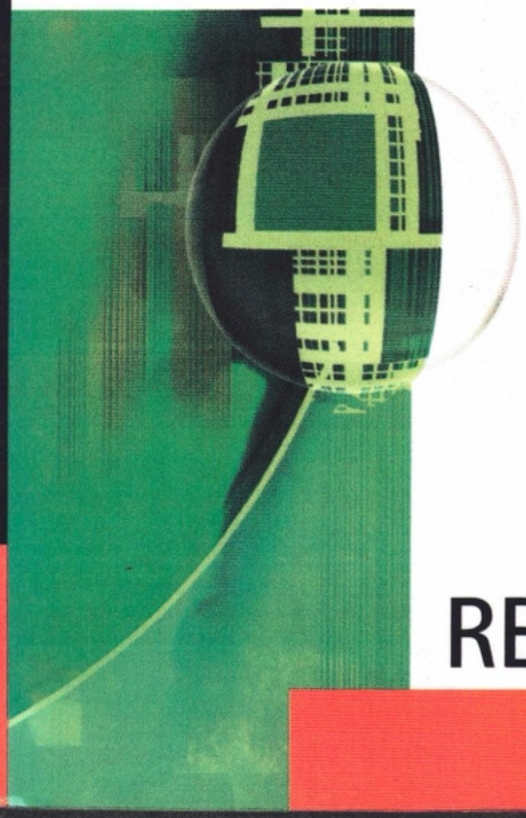
GPRS

General Packet Radio Service



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GPRS

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Dynamic Uplink (UL) Allocation

In dynamic UL allocation, shown in Figure 6-17, the bitmap is not transmitted for uplink access, but a number, called an USF and coded onto 3 bits, is attributed to each mobile station. The access is dynamically granted to each mobile station communicating on the same PDCH UL through the DL transmission of this USF in a traffic radio block (or in a dummy radio block if no DL traffic is present, where only relevant information consists in the USF). Note that one USF is assigned for each time slot allocated, so as many USF are present as time slots allocated (they may be equal because they concern different time slots). A TBF STARTING TIME may also be used (optional), and has the same role as for the static allocation case.

Temporary Block Flow (TBF) for Dynamic Allocation

Continuing with the case of dynamic allocation for UL network access, each mobile station decodes the USF transmitted on all blocks of the allocated

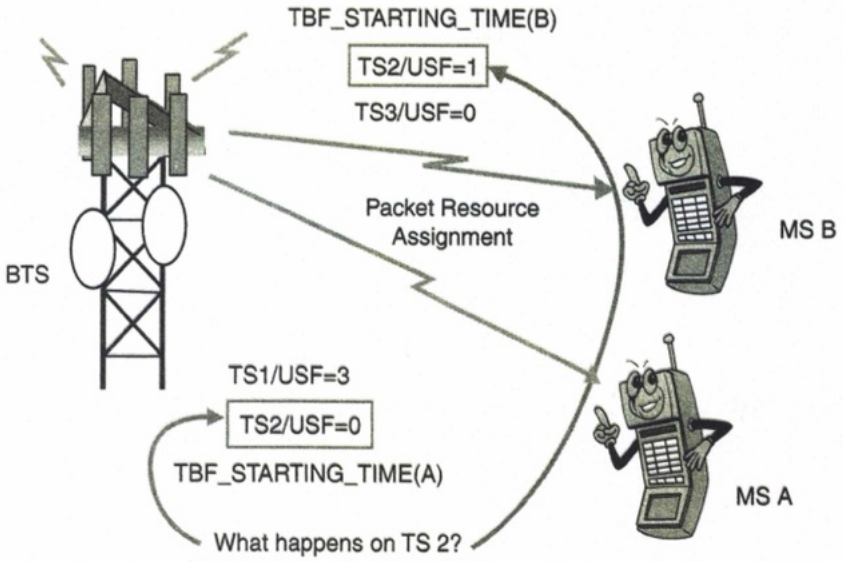

Figure 6-17 Dynamic uplink allocation.

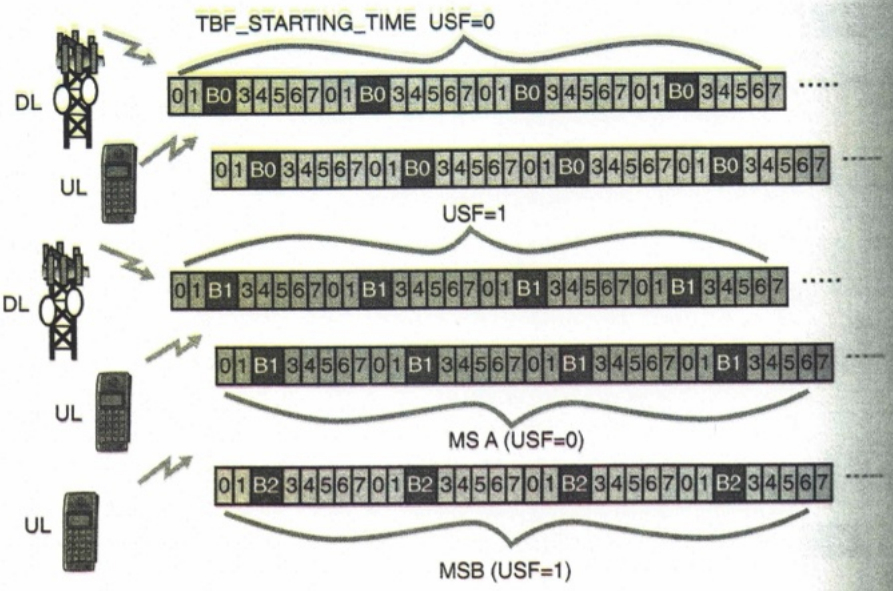

Figure 6-18
TBF for dynamic allocation.

time slot DL, as shown in Figure 6-18. The focus is still on time slot 2, which has been allocated for both mobile station A and mobile station B.

When a mobile station decodes its USF on one radio block DL, it is allowed to transmit on the next radio block UL. This way, the PCU enables or disables the access on the successive blocks of the same PDCH, for mobile stations that have been allocated a common PDCH. (This way, the PCU also manages the transmission on polling answer by mobile station UL, by coordinating the *Relative Reserved Block Period* [RRBP] field, indicating for a polled mobile station the block position where the answer is expected on the network side and the USF transmission on the previous DL radio block for this mobile station.)

RLC/MAC Block Structure

A radio block (also called an RLC/MAC block) consists of one MAC header, one RLC data block or one RLC/MAC control block, and one *Block Check Sequence* (BCS). Some fields are specific to the uplink or to the downlink way. Figure 6-19 shows the data blocks side by side.

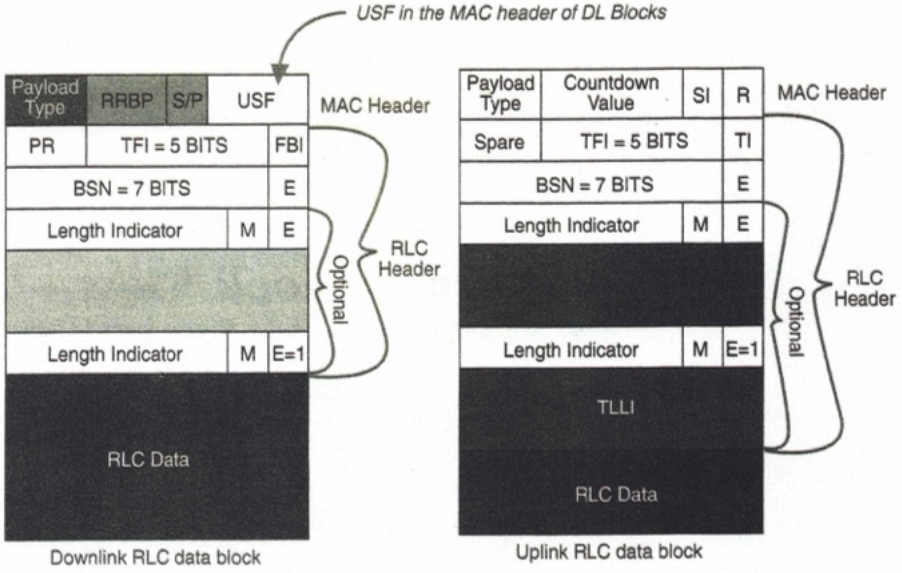

Figure 6-19 The RLC/MAC data blocks.

MAC header contains the following:

- **Uplink state flag (USF—3 bits)** This is used to identify users for UL transmission, or to characterize a PRACH.
- **Type (2 bits)** The payload type that identifies the type of block that follows (RLC data block or RLC/MAC control block).
- **Polling control (3 bits)** One *Supplementary / Polling* (S/P) bit to poll the mobile station (so that it sends an acknowledgment message) and two RRBP bits to tell the mobile station where to send the acknowledgment message.

The RLC data block's header contains the following:

- ***Block Sequence Number* (BSN—7 bits)** This carries the absolute BSN modulo 128 of each RLC data block within the TBF.
- **Temporary Flow Identifier (TFI—5 bits)** The TFI identifies the TBF to which the RLC block belongs.
- ***Power Reduction* (PR—2 bits)** This indicates the power level reduction of the next RLC blocks, which is based on GSM power control.
- ***Final Block Identifier* (FBI—1 bit)** The FBI indicates that the RLC data block is the last one of the downlink TBF (DL).

- **Length indicators (optional bytes)** Length delimits the LLC frames when an RLC block contains more than one LLC frame.
- **Temporary Logical Link Identifier (TLLI—several bytes)** This identifier identifies the logical link established between the user and the *Serving GPRS Support Node* (SGSN) (UL only).

Temporary Block Flow—Uplink (UL) Data Transfer

This procedure, shown in Figure 6-20, is an example of message sequence for the uplink data transfer with one resource reallocation and possible RLC data blocks retransmissions (we assume that the transfer mode is ACK). A contention resolution mechanism is adopted in order to avoid two mobile stations perceiving the same UL channel as their own. If static allocation is used, this mechanism is the UL bitmap transmission for the allocated UL PDCH, and if dynamic allocation is used, the USF field transmitted on the DL radio blocks dynamically indicates the attribution of the next UL radio block.

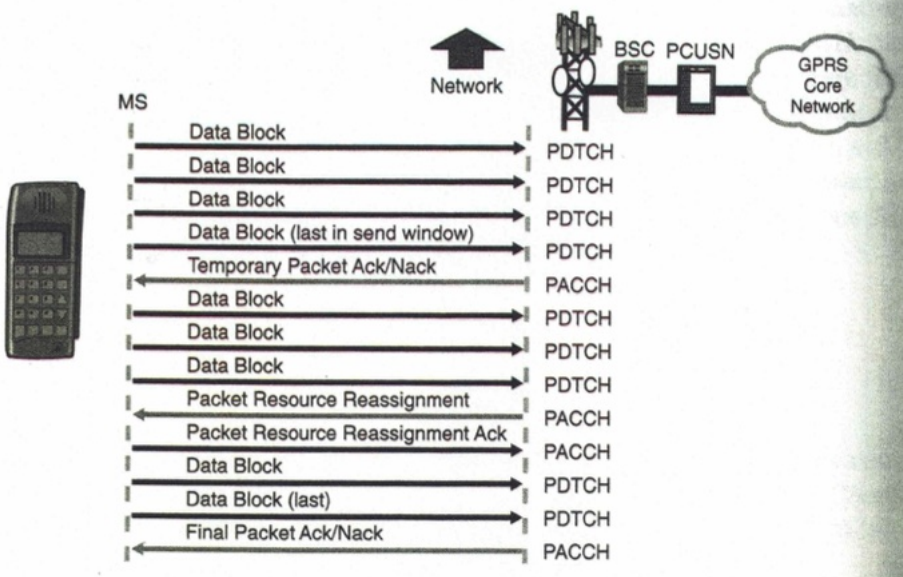

Figure 6-20
The uplink data transfer.

Two modes of transmission are available: acknowledged and unacknowledged. The mode of transmission is indicated in the PDP context activation (*quality of service* [QoS] field).

In the acknowledged mode of DL transmission, the mobile station is regularly polled through the S/P bit in the MAC header, and it should transmit an acknowledgment bitmap in the correct block indicated in the RRBP field of the MAC header (2 bits). This bitmap enables the network to selectively retransmit received blocks with errors.

In the acknowledged mode of UL transmission, the network regularly sends temporary acknowledgments to the mobile station.

In any case, the sending window is 64 blocks (UL and DL). This window is shifted after each temporary or final acknowledgment message. All acknowledgment messages are transmitted on a PACCH (RLC/MAC control block).

Downlink (DL) Resource Allocation

Downlink resources are allocated to the mobile station via the Packet Downlink Assignment message. This message will detail all the time slots that the mobile station may receive data on for a particular transaction. Each complete data transfer is allocated a TBF known by the identifier as already discussed (the TFI). The TFI is part of each uplink/downlink RLC data block and consists of 7 bits in the uplink and 5 bits on the downlink. The TFI for a specific mobile station is also specified in the Packet Downlink Assignment message. The mobile station has to receive and decode all the RLC/MAC blocks on its allocated time slots to ascertain if the TFI contained in the block is the appropriately assigned TFI. When the mobile station identifies a block with its allocated TFI, it will decode and process the data block. This is shown in Figure 6-21.

The network initiates packet transfer to a mobile station in standby state by sending a Packet Paging Request message in the downlink PCCH (or PCH).

- The mobile station responds by requesting a channel.
- The Packet Paging Response message contains the TLLI as well as a complete LLC frame, including the TLLI.
- The mobility management state of the mobile station then becomes ready state.