(1) The Different Multislot Classes

Type	Multislot Class	Max No of Receive Timeslots	Max No of Transmit Timeslots	Sum Rx +Tx	T_{ta}	T_{tb}	T_{ra}	T_{rb}
1	**1**	1	1	2	3	2	4	2
1	**2**	2	1	3	3	2	3	1
1	**3**	2	2	3	3	2	3	1
1	**4**	3	1	4	3	1	3	1
1	**5**	2	2	4	3	1	3	1
1	**6**	3	2	4	3	1	3	1
1	**7**	3	3	4	3	1	3	1
1	**8**	4	1	5	3	1	2	1
1	**9**	3	2	5	3	1	2	1
1	**10**	4	2	5	3	1	2	1
1	**11**	4	3	5	3	1	2	1
1	**12**	4	4	5	2	1	2	1
2	**13**	3	3	N/A	N/A	1 / 0 *)	3	1 / 0 *)
2	**14**	4	4	N/A	N/A	1 / 0 *)	3	1 / 0 *)
2	**15**	5	5	N/A	N/A	1 / 0 *)	3	1 / 0 *)

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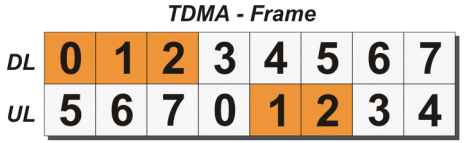
(1) The Different Multislot Classes

Multislot Class Type

Mobile phones with a multislot class of type 1 are not required to transmit and receive at the same time. Opposed to that, mobile phones with a multislot class of type 2 need to support simultaneous transmission and reception (full-duplex). Half-duplex mode of operation is possible (with fixed uplink resource allocation only) for multislot classes 19 – 29 only [2GTS 04.60]. Half-duplex refers to the capability to support either transmission in uplink direction or reception in downlink direction at any given time. Only in half-duplex mode of operation a mobile station with multislot classes 19 – 29 supports the maximum number of timeslots according to its multislot class. Therefore, in half-duplex mode of operation a mobile phone that is currently transmitting is not required to receive anything else than PACCH-information at scheduled times (⇔ MEASUREMENT_MAPPING) from the base station. Please note that the fixed uplink resource allocation is becoming an optional feature with GPRS Rel. 99 and GERAN Rel. 4. With GERAN Rel. 5, support for fixed allocation is withdrawn.

Max No of Receive Timeslots / Max No of Transmit Timeslots / Sum

These columns indicate on how many timeslots a mobile phone is capable to transmit and receive per TDMA-frame. Examples for multislot classes 8 and 12 are presented on the following pages. Note that the column „Sum“ presents the aggregated number of allocated transmit and receive timeslots per TDMA-frame that is supported by a mobile phone (see figure)



Example: **SumRx + Tx = 5**
(applicable for MS-Class 10, 11, 12)

Obviously this value is meaningful only for multislot classes 1 to 12.
Reasons:
⇒ Type 2: „Sum“ could be 3 – 6 for multislot class 13, 4 – 8 for multislot class 14 and so on (⇔ Ambiguity).
⇒ Type 1: For Multislot classes 19 – 29 there is an either / or relationship of transmit and receive timeslots. Hence the „Sum“ value doesn't make sense.

*) 1 TS with frequency hopping or 0 TS without frequency hopping.
**) 1 TS with frequency hopping or change from receive mode to transmit mode. 0 TS without frequency hopping and no change from receive mode to transmit mode.
***) 1 TS with frequency hopping or change from transmit mode to receive mode. 0 TS without frequency hopping and no change from transmit mode to receive mode.

[2GTS 05.02]

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(2) The Different Multislot Classes

Type	Multislot Class	Max No of Receive Timeslots	Max No of Transmit Timeslots	Sum Rx +Tx	T_{ta}	T_{tb}	T_{ra}	T_{rb}
2	**16**	6	6	N/A	N/A	1 / 0 *)	2	1 / 0 *)
2	**17**	7	7	N/A	N/A	1 / 0 *)	1	0
2	**18**	8	8	N/A	N/A	0	0	0
1	**19**	6	2	N/A	3	1 / 0 **)	2	1 / 0 ***)
1	**20**	6	3	N/A	3	1 / 0 **)	2	1 / 0 ***)
1	**21**	6	4	N/A	3	1 / 0 **)	2	1 / 0 ***)
1	**22**	6	4	N/A	2	1 / 0 **)	2	1 / 0 ***)
1	**23**	6	6	N/A	2	1 / 0 **)	2	1 / 0 ***)
1	**24**	8	2	N/A	3	1 / 0 **)	2	1 / 0 ***)
1	**25**	8	3	N/A	3	1 / 0 **)	2	1 / 0 ***)
1	**26**	8	4	N/A	3	1 / 0 **)	2	1 / 0 ***)
1	**27**	8	4	N/A	2	1 / 0 **)	2	1 / 0 ***)
1	**28**	8	6	N/A	2	1 / 0 **)	2	1 / 0 ***)
1	**29**	8	8	N/A	2	1 / 0 **)	2	1 / 0 ***)

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(2) The Different Multislot Classes

Measurements: Each mobile phone shall perform adjacent cell signal level measurements in 24 out of 26 TDMA-frames. Signal level measurements relate to measuring the BSIC plus the power level of adjacent cells. This rule applies unless the network has provided specific *Measurement Mapping* parameters to the mobile phone that would override this requirement. These *Measurement Mapping* parameters will provide information to the mobile phone at which times, in which timeslots it shall perform adjacent cell measurements [2GTS 04.60]. However, these specific rules only apply in half-duplex mode operation for multislot class 19 – 29 mobile phones. All other mobile phones and multislot classes have to obey the „24 out of 26 TDMA-frames rule".

Timing Constraints

Being involved in a multislot transmission and / or reception, a mobile phone has to have sufficient time gaps between the allocated timeslots:
⇒ to get ready to receive (⇔ T_{rb}) and (conditionally) to perform adjacent cell signal level measurements in between (⇔ $T_{ra} = T_{rb} + N$ timeslots)
⇒ to get ready to transmit (⇔ T_{tb}) and (conditionally) to perform adjacent cell signal level measurements in between (⇔ $T_{ta} = T_{tb} + K$ Timeslots)
The term „conditionally" in the previous sentences refers to the fact that a mobile phone will perform adjacent cell signal level measurements *either* while preparing for transmission *or* while preparing for reception. Accordingly, the more stringent time constraints T_{ra} and T_{ta} will never apply together during one flow. Rather T_{ra} & T_{tb} will apply together or T_{ta} & T_{rb} will apply together.
Note that in half-duplex mode (only multislot classes 19 – 29) only the less stringent time constraints T_{tb} & T_{rb} may apply together, if the PCU has provided *Measurement Mapping* parameters.

*) 1 TS with frequency hopping or 0 TS without frequency hopping.
**) 1 TS with frequency hopping or change from receive mode to transmit mode. 0 TS without frequency hopping and no change from receive mode to transmit mode.
***) 1 TS with frequency hopping or change from transmit mode to receive mode. 0 TS without frequency hopping and no change from transmit mode to receive mode.

Color Explanation:

⇒ MS's with these multislot classes and the according time constraints can be developed, using the dynamic / extended dynamic resource allocation.
⇒ MS's with these multislot classes can only be developed with either two antennas or two transceivers.
⇒ MS's with these multislot classes cannot operate using neither the dynamic nor the extended dynamic resource allocation method (⇔ Time constraints)

[2GTS 04.60 / 2GTS 05.02 / 2GTS 05.08]

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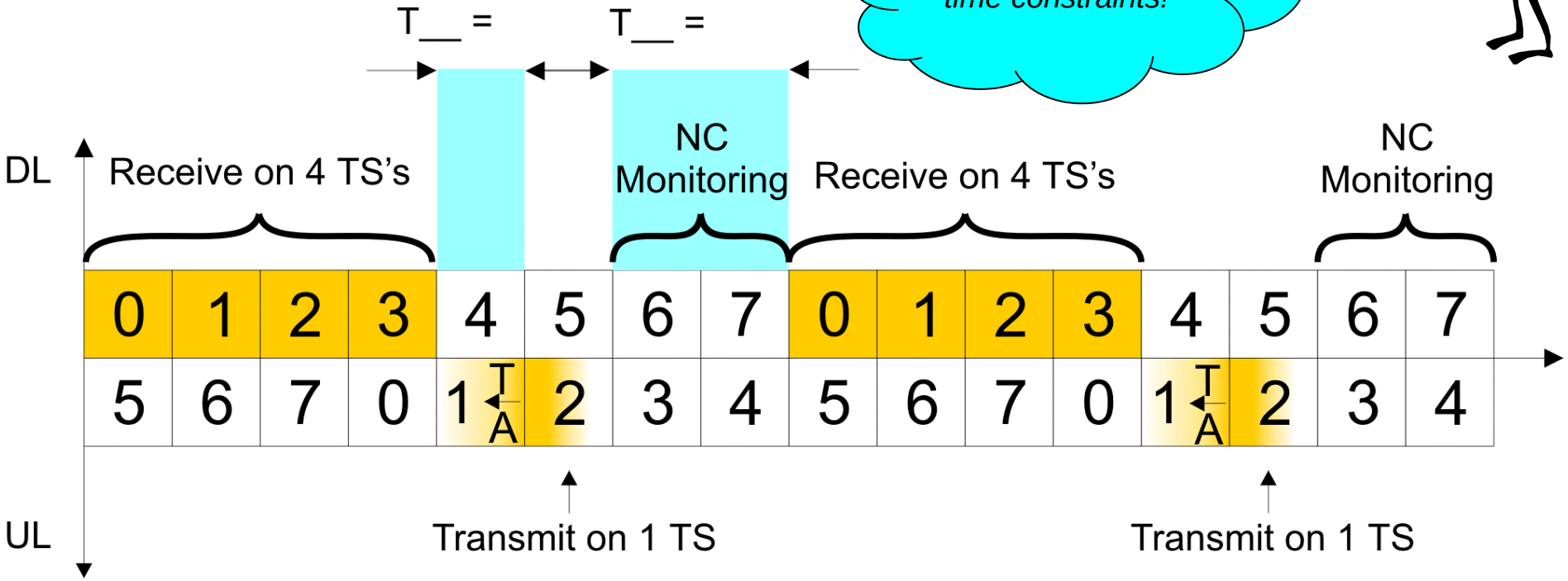
Example for Multislot Class 8 to 12

- **4 Receive : 1 Transmit - Configuration**



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Example for Multislot Class 8 to 12

4 Receive : 1 Transmit - Configuration

The example illustrates a mobile phone with either multislot class 8 or multislot class 12 being involved in a transaction where the mobile phone receives on four timeslots and transmits on one timeslot.

For the determination of T_{ta}, T_{tb}, T_{ra} and T_{rb} the respective timing advance values shall remain unconsidered.

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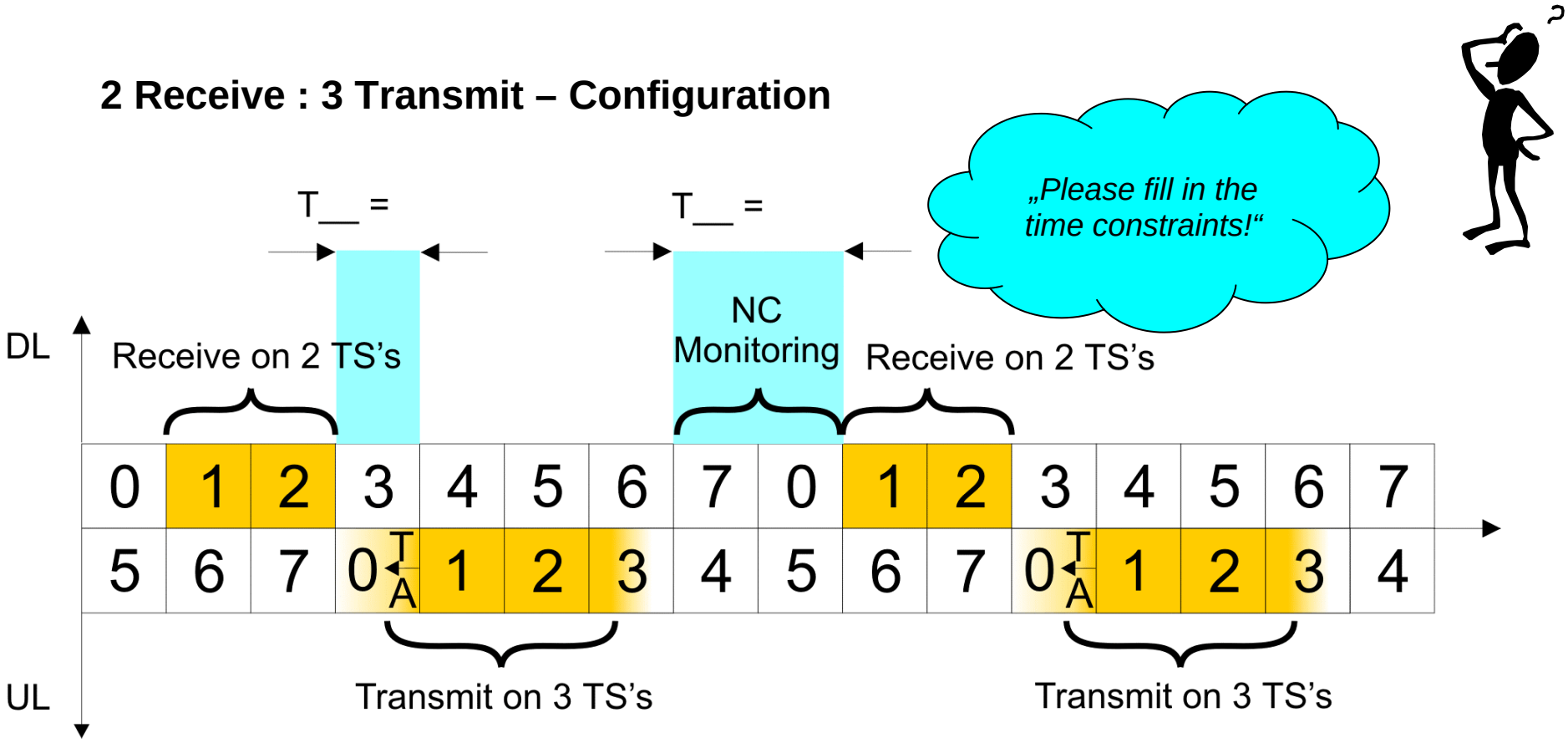
Example for Multislot Class 11 and 12

- **2 Receive : 3 Transmit – Configuration**



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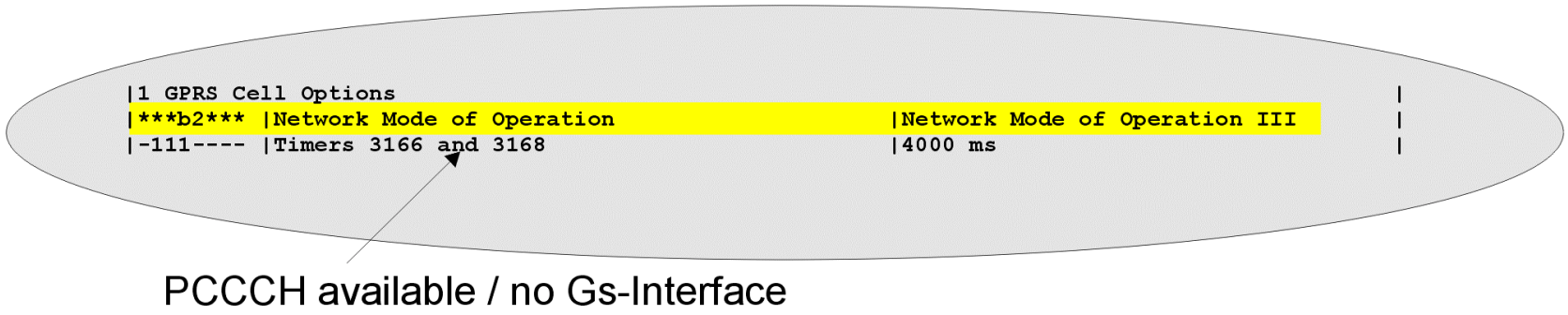
(1) The Different Network Operation Modes

- **The Network Operation Mode is broadcast to the mobile stations in SYS_INFO13, PACK_SYS_INFO1 and 13**



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(1) The Different Network Operation Modes

- **The Network Operation Mode is broadcast to the mobile stations in SYS_INFO13, PACK_SYS_INFO1 and 13**
  Three different network operation modes (NOM I, NOM II and NOM III) are defined dependent on whether or not the Gs-interface between SGSN and VLR is available and dependent on whether or not a BTS is equipped with PCCCH.

[2GTS 03.60]

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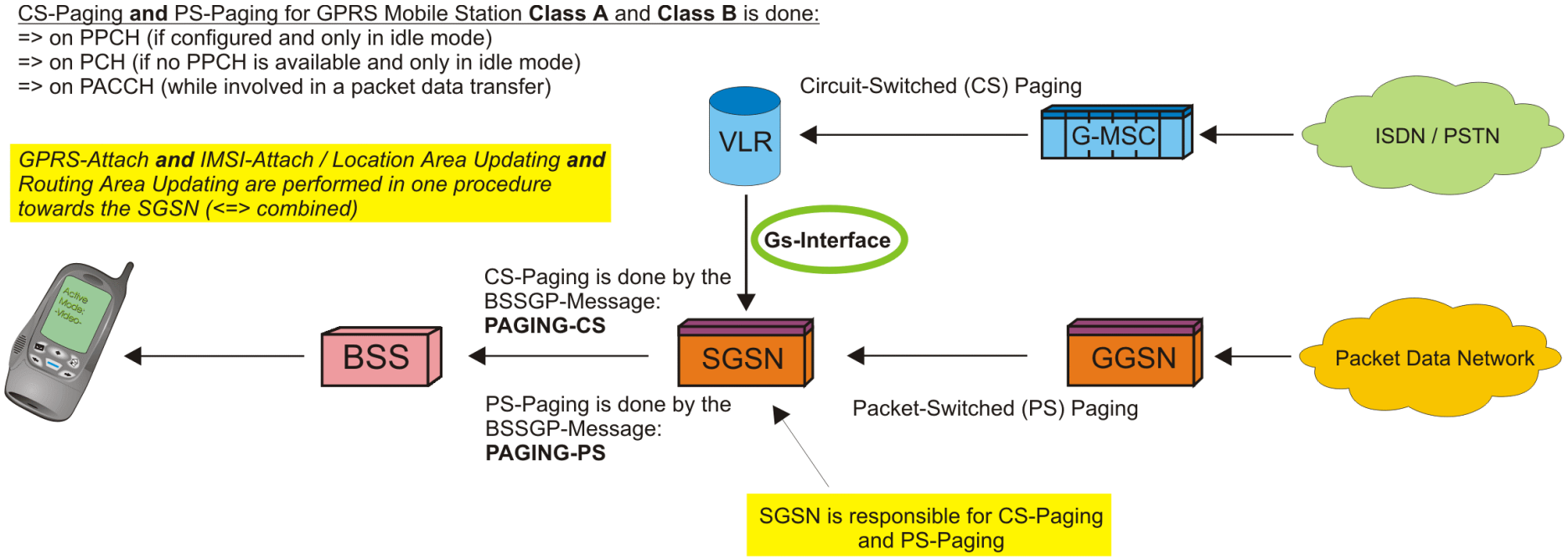
(2) The Different Network Operation Modes

- **Network Operation Mode I (NOM I)**



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(2) The Different Network Operation Modes

Network Operation Mode I (NOM I)

In NOM I the Gs-interface [2GTS 09.18] is present and PCCCH may but doesn't need to be equipped. Accordingly the SGSN is in charge not only for the packet-switched paging but also for the circuit-switched paging. The VLR will forward the circuit-switched paging to the SGSN that will relay them on either on PPCH or PCH to the mobile station. Note that the SGSN will use the PPCH also for circuit-switched paging if the PPCH is equipped. It will use the PCH for both types of paging, if there is no PPCH [2GTS 03.60]. In either case the mobile station class A and B is relieved from listening to both, the SGSN and the MSC/VLR for paging. Also, in NOM I only the packet-switched DRX-parameters apply for mobile stations class A and B (and class C in GPRS-attached mode) which is another relieve compared to NOM II.

The NOM I has the major advantage that even a class B mobile station can be alerted of an incoming circuit-switched transaction while involved in a packet-switched transaction. In that case, the circuit-switched paging is forwarded to the mobile station by means of the PACCH [2GTS 03.60]. Note that this advantage does not apply vice versa because paging coordination is possible only *from* the VLR *to* the SGSN: Being involved in a circuit-switched transaction, there is no requirement that a mobile station class B still receives the packet-switched paging channel.

Another major advantage of NOM I or rather of an equipped Gs-interface is the possibility to perform attachments and registrations in combined format towards the SGSN. Hence, IMSI- and GPRS-Attach as well as Location Area- and Routing Area-Updating and IMSI- and GPRS-Detachments are done combined [2GTS 03.60 / 2GTS 04.08 / 2GTS 09.18]. It is the responsibility of the SGSN to inform the VLR of any of these procedures.

Note that in NOM I a mobile station will only perform Periodic Routing Area Updating but no Periodic Location Area Updating. It is the responsibility of the SGSN to update the VLR.

Note: Whether or not a mobile station class A/B performs a combined IMSI/GPRS-attachment upon power on also depends on the setup of the mobile station: Some manufacturers prevent automatic GPRS attachment, since there is the possibility that an operator already charges for GPRS attachments.

[2GTS 03.60 / 2GTS 04.08 / 2GTS 09.18]

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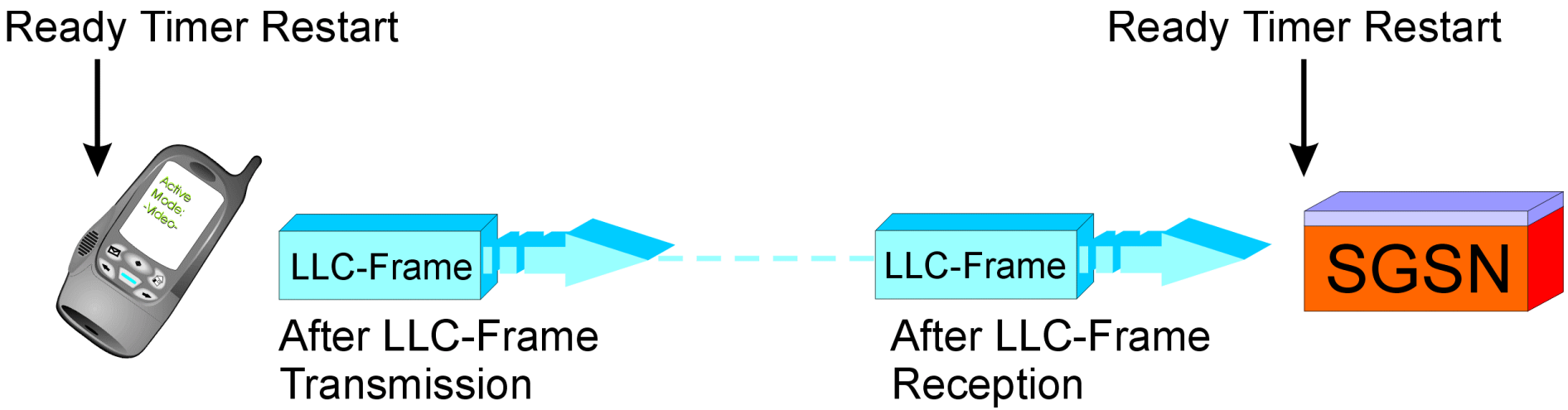
(6) New Identifiers and Parameters with GMM

- **The Ready Timer (T3314)**



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(6) New Identifiers and Parameters with GMM

The Ready Timer (T3314)

The Ready Timer T3314 is a new timer with GPRS. It is restarted by the mobile station whenever the mobile station has successfully transmitted an LLC-frame. The Ready Timer is restarted by the SGSN for a particular mobile station whenever the SGSN has successfully received an LLC-frame from that mobile station.

- **Default Value of T3314**
  The default value of T3314 is 44 s but different values can be negotiated upon GPRS Attachment and Routing Area Updating.
- **T3314 is shorter in the SGSN**
  To provide for a synchronous duration of the Ready State in the mobile station and the SGSN the Ready Timer should be configured a little bit shorter (≈ 2 s) in the SGSN to leverage the transfer time of an LLC frame from the mobile station to the SGSN.

[2GTS 04.08 / 2GTS 03.60]

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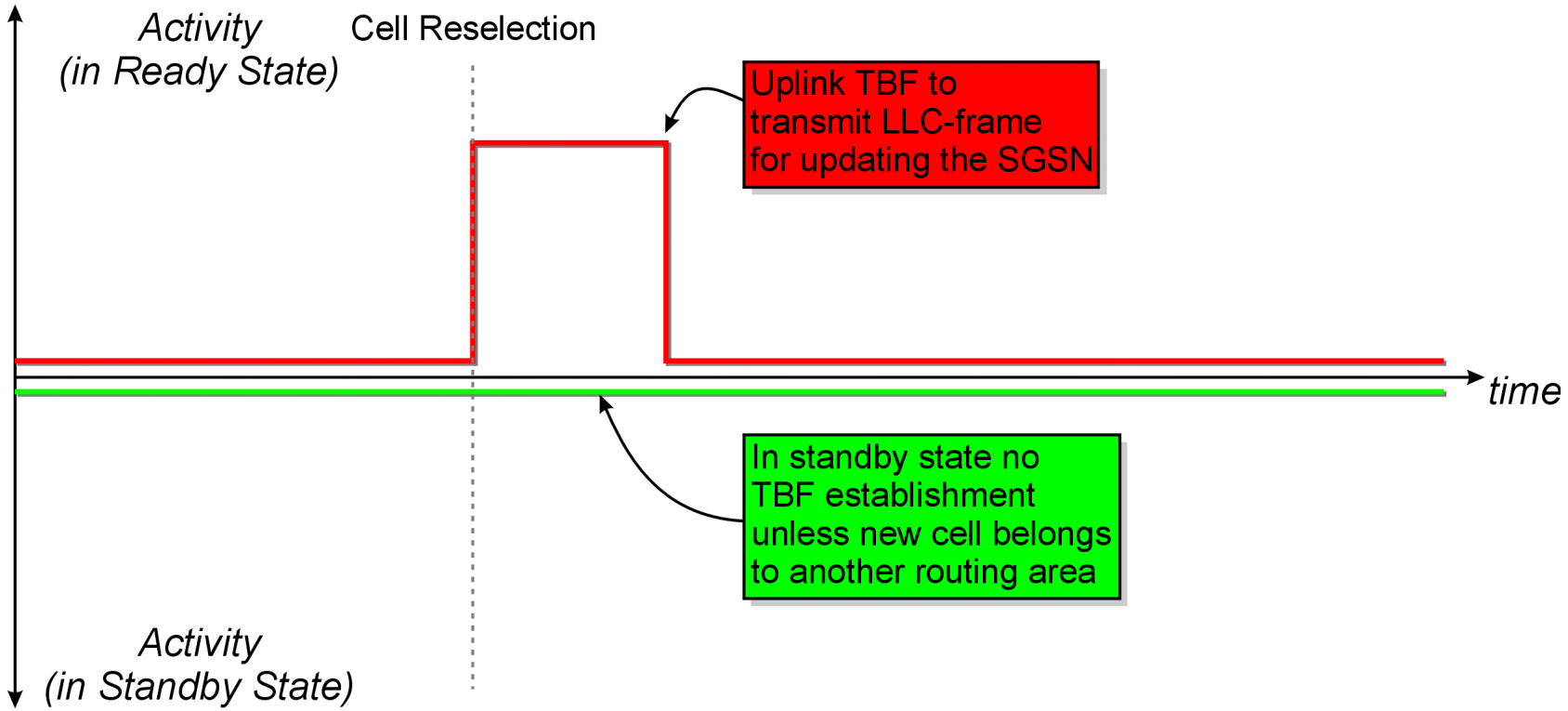
(7) New Identifiers and Parameters with GMM

- **Operation of the Ready Timer (T3314)**



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(7) New Identifiers and Parameters with GMM

Operation of the Ready Timer (T3314)

- **Cell Update Scenario in Ready State**
  In Ready State the mobile station will inform the SGSN upon every cell reselection by means of the Cell Update scenario. During the cell update scenario the mobile station will convey a possibly empty LLC-frame to the SGSN which tells the SGSN the Cell ID of the new serving cell of the mobile station. If the cell reselection means also a change of the routing area the mobile station will rather perform a routing area update scenario.
- **No Cell Update Scenario in Standby State**
  In Standby State the mobile station will not perform Cell Update scenarios when reselecting the serving cell. However, upon change of the routing area the mobile station in Standby State will still perform Routing Area Updates.
- **Initial Cell Update after GPRS Attach / Routing Area Updating**
  If mobile station and SGSN negotiate a specific Ready Timer value either in the GPRS Attach- or the Routing Area Update-procedure the mobile station will immediately perform a cell update scenario by responding to the ATT_ACC- / RA_UPD_ACC-message with a ATT_COM- / RA_UPD_COM-message. The only exceptions to this rule apply if the SGSN has set T3314 = 0 or if the SGSN has indicated *Force to Standby* (⇔ information element).

Please compare the Ready Timer to the screen saver timer on your computer.

Note: The Ready Timer has no impact on the DRX behavior of the mobile station [2GTS 03.64]. When the mobile station is not transmitting or receiving (no TBF is activated) it will change into the negotiated DRX mode of operation. If DRX is applied, the mobile station will listen only to its paging channel(s) even while the Ready Timer is running.

[2GTS 04.08 / 2GTS 03.60]

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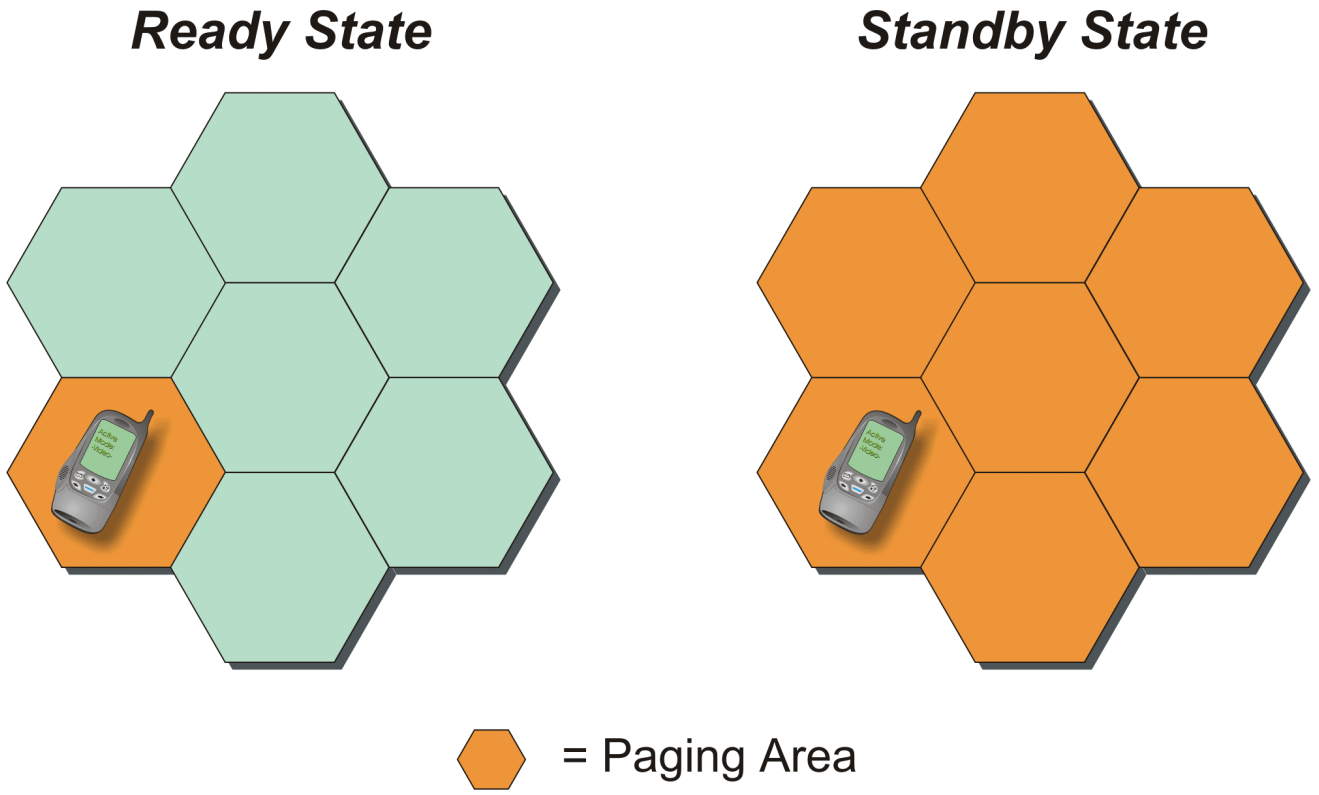
(8) New Identifiers and Parameters with GMM

- **Implications of the Ready Timer: Reduction of the Paging Load**



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(8) New Identifiers and Parameters with GMM

Implications of the Ready Timer:

Reduction of the Paging Load

If a mobile station is in Ready State, the SGSN is not only aware of the routing area in which the mobile station is currently located but it even knows the very cell that is currently serving the mobile station.
Consequently, while a mobile station is in Ready State, the size of the necessary paging area shrinks down to just the serving cell. As a matter of fact, there won't even be a packet-switched paging procedure required while a mobile station is in Ready State as will be explained on the following page.
However, in case of NOM I and for a mobile station class A or B in Ready State, circuit-switched paging will be performed only in the cell. Therefore, the paging load is reduced.

Reduction of the paging load is particularly important for any kind of bursty traffic in downlink direction.

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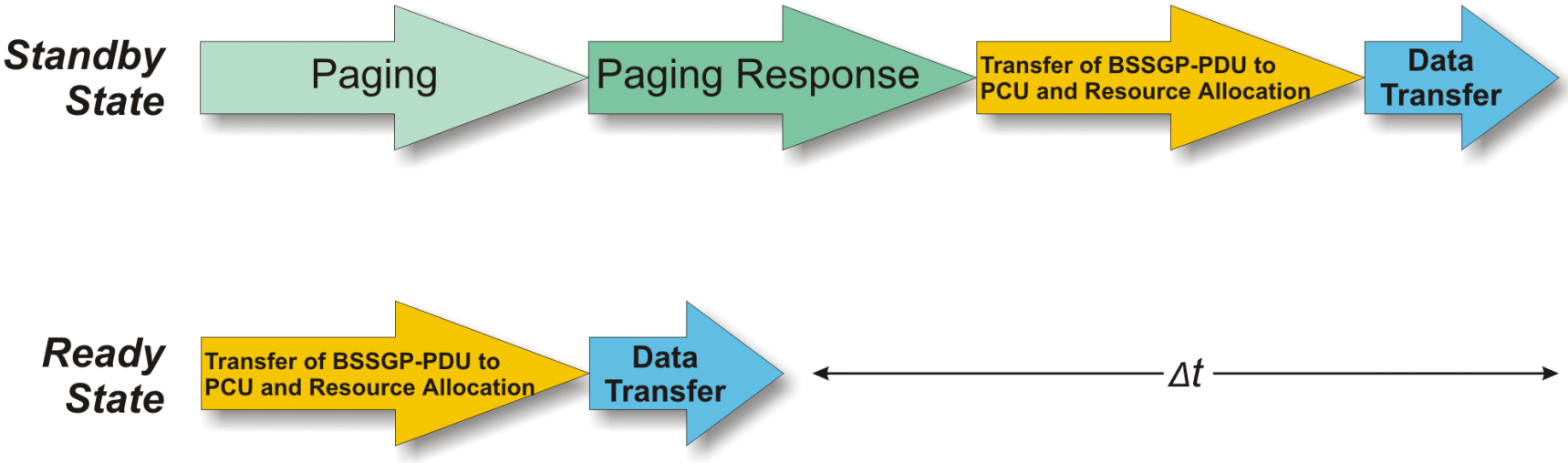
(9) New Identifiers and Parameters with GMM

- **Implications of the Ready Timer: Reduction of the Paging Time**



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(9) New Identifiers and Parameters with GMM

Implications of the Ready Timer

Reduction of the Paging Time

For any kind of packet-switched traffic, the latency shall be as small as possible. Consider a bursty application transmitting data in downlink direction to a mobile station. It would be annoying, if the network (⇔ the SGSN) would need to page the mobile station each time to resume transmission. This was the primary reason for the introduction of the Ready Timer:

⇒ As long as the Ready Timer is running, packet-switched paging is not necessary, Instead, the SGSN will just forward the respective LLC-PDU's to the PCU (embedded in BSSGP DL-UNITDATA PDU's) and implicitly request the PCU to establish a downlink TBF (resource allocation) to the mobile station. The time delay between a downlink data packet arriving at the SGSN and being forwarded to the mobile station is minimized.

⇒ If the mobile station is in Standby State, the SGSN only knows the routing area in which the mobile station is currently registered. Accordingly, the SGSN first needs to send BSSGP PAGING-PS-PDU's to all PCU's which serve cells of this routing area. If the mobile station receives the paging message in one of these cells it needs to establish an uplink TBF to transmit an empty LLC-frame to the SGSN to consequentially move into Ready State. This procedure, paging and paging response will cause an additional delay time.

Note: There is no explicit page response message defined in GPRS neither for GMM nor for RLC/MAC. Paging response is achieved similarly to cell updating through the transfer of an empty LLC-frame (SAPI = '1') to the SGSN which moves the mobile station back into Ready State.

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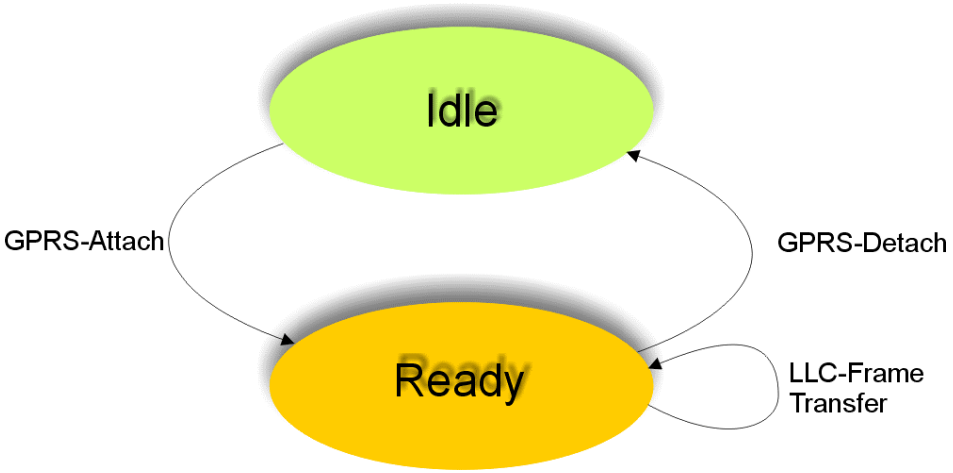
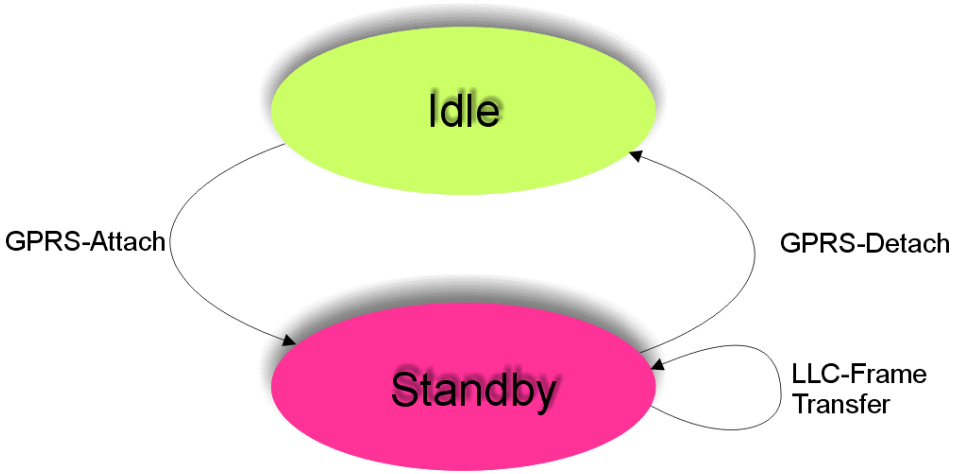
(10) New Identifiers and Parameters with GMM

- **(c) Specific Settings of the Ready Timer (T3314)**

T3314 = ‚111X XXXX'$_{bin}$



T3314 = ‚XXX0 0000'$_{bin}$



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(10) New Identifiers and Parameters with GMM

(c) Specific Settings of the Ready Timer (T3314)

Bit 7, 6 and 5 of the 8 bit long generic GMM Timer information element encoding indicate the unit type of the respective timer (e.g. Ready Timer) [2GTS 04.08]:

Bit Coding (bin)	Unit Type
000	2 seconds
001	1 minute
010	1/10 hour
111	Deactivated
All others	To be interpreted as '001'

Bit 4 to 0 contain the requested value of T3314 (⇔ if sent by the mobile station) or the value of T3314 to be applied (⇔ if sent by the SGSN).

- **T3314 = ‚111 XXXX'$_{bin}$ (deactivated ⇒ No Standby State)**
  In the deactivated state the Ready Timer is neither started nor stopped. The Ready State never ends which means that mobile station and SGSN will never move into Standby State.
- **T3314 = ‚XXX 00000'$_{bin}$ (Ready Timer to be stopped immediately ⇒ No Ready State)**
  If the Ready Timer value is set to ‚00000'$_{bin}$ then T3314 is to be stopped immediately. Mobile station and SGSN remain in Standby State even after an LLC-frame transmission by the mobile station. Both, mobile station and SGSN will never move into Ready State.

Note: Even in packet idle mode the mobile station will remain in Non-DRX mode after data transmission or data reception for a time period defined by the parameter NON-DRX-TIMER (0 ... 64 s) which is part of the DRX parameter information element. This information element is sent by the mobile station to the SGSN as part of the ATT_REQ-message (⇔ mandatory) and / or the RA_UPD_REQ-message (⇔ optional).

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Practical Exercise:

SGSN

ATT_REQ
Ready Timer=01011111$_{bin}$

→ Value Requested=_____

ATT_ACC
Ready Timer=00000001$_{bin}$

→ Value Negotiated=_____

RA_UPD_REQ
Ready Timer=00100110$_{bin}$

→ Value Requested=_____

RAC_UPD_ACC
Ready Timer=11111111$_{bin}$

→ Value Negotiated=_____

"Please interpret these Ready Timer Values"

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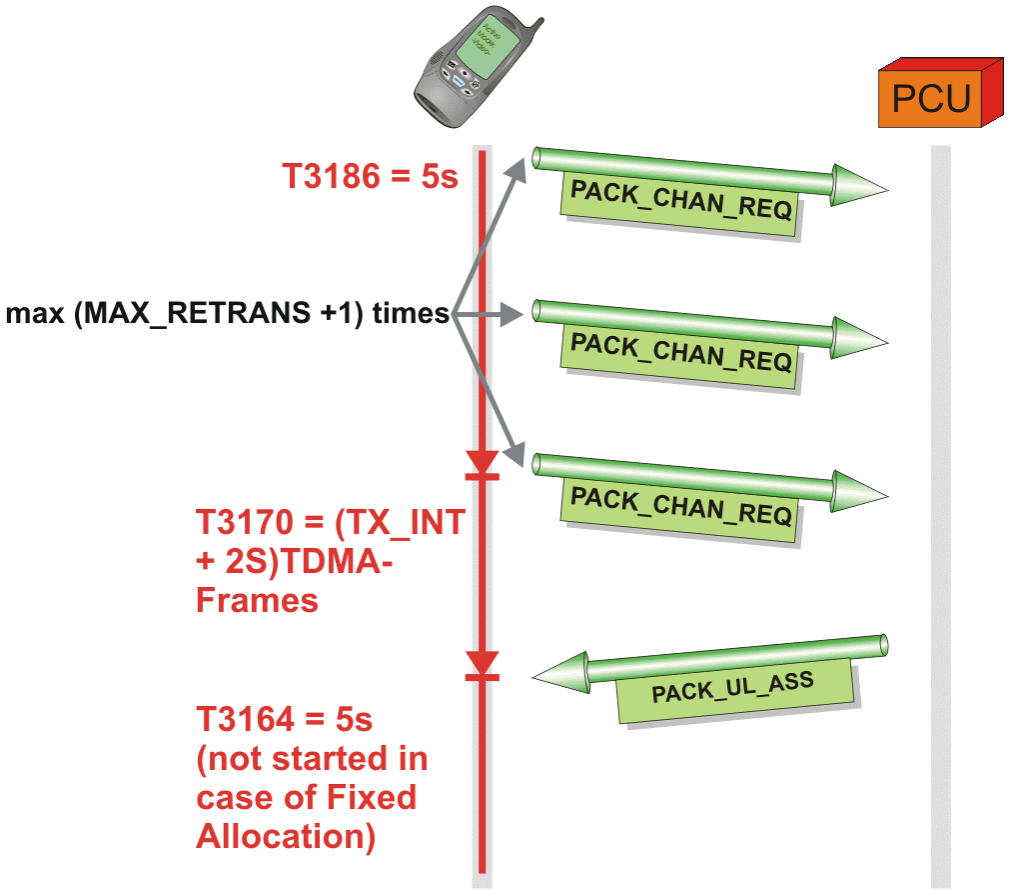
(1) One-Phase Packet Access on PCCCH in Detail



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(1) One-Phase Packet Access on PCCCH in Detail

Initial Conditions

The network operates in NOM I or III, the Mobile Station is Class A, B or C and may or may not be already attached to circuit-switched *and* packet-switched services. The RLC/MAC-layer receives the request from LLC or GMM to transmit one or more PDU's to the network.

Applicability of this Procedure

⇒ One-Phase Packet Access on PCCCH is applicable only in case of acknowledged RLC/MAC operation mode. However, the Short Access, the Access for GMM/SM and the Access for Cell Update will deploy the same procedure as One-Phase Packet Access.

Description

⇒ The mobile station will start T3186 (⇔ 5 s) when it sends the first PACK_CHAN_REQ-message [*Access Reason (m), Random Reference (m)*] on its PCCCH timeslot (as given by the parameter PCCCH_GROUP) to the BTS. The mobile station may send max. (MAX_RETRANS + 1) PACK_CHAN_REQ- to the BTS. The number of TDMA-frames between the single PACK_CHAN_REQ-messages depends on the number of PRACH-blocks on this timeslot, on the parameters TX_INT and S which are like MAX_RETRANS broadcast in the PRACH_CONTROL_PARAMETERS in PACK_SYS_INFO1 and on the Persistence Level (0 ... 15) (⇔ also part of the PRACH_CONTROL_PARAMETERS) which depends on the Radio Priority that the mobile station may apply. If T3186 expires before the mobile station could transmit (MAX_RETRANS + 1) PACK_CHAN_REQ-messages then a packet access failure needs to be reported and the mobile station returns to packet idle mode.

⇒ Having send the last PACK_CHAN_REQ-message the mobile station will start T3170 (⇔ (TX_INT + 2S) TDMA-frames [in seconds]).

⇒ Mobile stations class A or B shall continue to listen for their PPCH (⇔ NOM I) or PCH (⇔ NOM II / NOM III) to be able to respond to a circuit-switched paging command message. Class B mobile stations *may* abort the One-Phase Packet Access procedure when receiving a circuit-switched paging.

⇒ Having received the PACK_CHAN_REQ-message from the mobile station the BTS will forward it to the PCU within a normal PCU-frame. The PCU will build a PACK_UL_ASS-message [*Page_Mode (m), {Global TFI / TLLI / TQI / Random Reference}(m), Coding Scheme (m), Coding Scheme for TLLI (m), Packet Timing Advance (m), Frequency Parameters (o), {Dynamic / Fixed / Single Block Allocation}(m)*] and send it to the mobile station on PAGCH.

⇒ Having received the PACK_UL_ASS-message the mobile station will stop T3170, react upon the allocation and start T3164 (⇔ 5 s) if the dynamic resource allocation method is used.

[2GTS 04.60]

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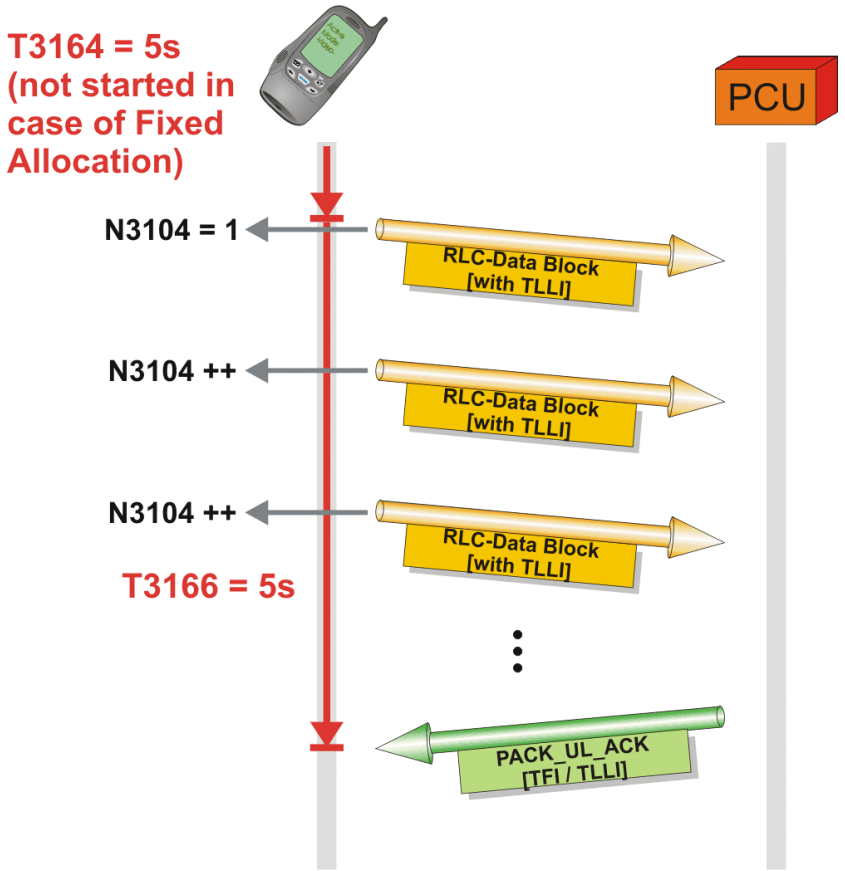
(2) One-Phase Packet Access on PCCCH in Detail



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(2) One-Phase Packet Access on PCCCH in Detail

Description

⇒ With T3164 (⇔ 5 s) running the mobile station waits for the allocation to begin.

⇒ Upon sending of the first RLC-Data Block [⇔ *including the TLLI of the mobile station for contention resolution*] the mobile station will set N3104 = 1 stop T3164 and start T3166 (⇔ 5 s).

⇒ With every new RLC-Data Block [⇔ *including the TLLI of the mobile station for contention resolution*] that the mobile station sends N3104 is incremented.

⇒ When the PCU receives the first RLC/MAC-Data Block [⇔ *including the TLLI of the mobile station for contention resolution*] it will issue a PACK_UL_ACK-message [*Page_Mode (m), Uplink TFI (m), Coding Scheme (m), Ack/Nack-Description (m), Cont. Resolution TLLI (o), Packet Timing Advance (o), Power Control Parameters (o), Fixed Allocation Parameters (o)*] to the mobile station.

⇒ If the PACK_UL_ACK-message contains the related Uplink TFI and the TLLI of the mobile station the contention resolution procedure was successful and the mobile station may continue to send RLC-Data Blocks without including the TLLI. The mobile station shall stop T3166 and reset counter N3104.

⇒ If the PACK_UL_ACK-message contains the related Uplink TFI but not the TLLI of the mobile station the contention resolution procedure was not successful. Consequently, the mobile station *shall immediately stop* to use the allocated resources and may retry the packet access procedure.

On PCCCH the chances to send PACK_CHAN_REQ-messages to the PCU depend on the Radio Priority (⇔ QoS-profile) of the TBF to be established. Besides, on PRACH with 11 bit format the mobile station can convey its radio priority already in the access burst, if important (⇔ signaling procedures for GMM, SM and Cell Update or RLC/MAC-control anyway shall use the highest radio priority).

[2GTS 04.60]

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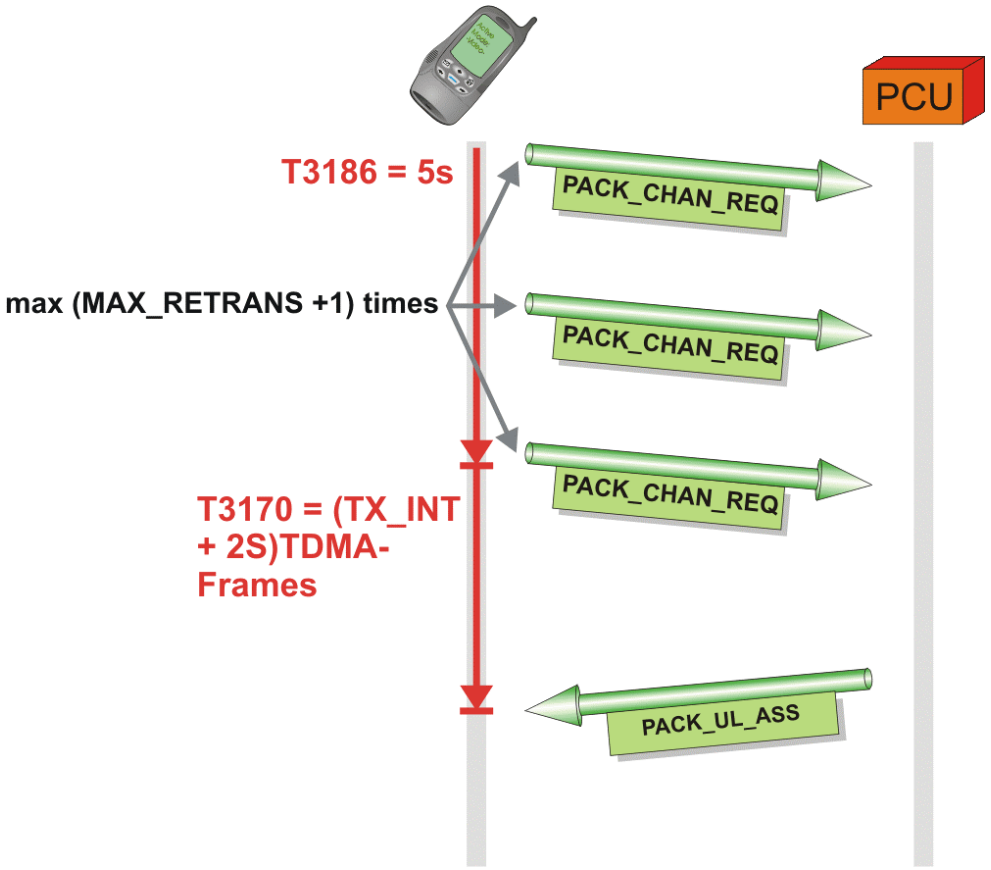
(1) Two-Phase Packet Access on PCCCH in Detail



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(1) Two-Phase Packet Access on PCCCH in Detail

Initial Conditions

The network operates in NOM I or III, the Mobile Station is Class A, B or C and may or may not be already attached to circuit-switched *and* packet-switched services. The MAC-layer receives the request from RLC to transmit an RLC/MAC-control message (e.g PACK_MEAS_REP) or to transmit one or more LLC-PDU's in acknowledged or unacknowledged RLC/MAC operation mode.

Applicability of this Procedure

⇒ Two-Phase Packet Access is mandatory in case of unacknowledged RLC/MAC operation mode and if an RLC/MAC-control message shall be transmitted. Two-Phase Packet Access *may* be used in case of acknowledged RLC/MAC operation mode.

Description

⇒ The mobile station will start T3186 (⇔ 5 s) when it sends the first PACK_CHAN_REQ-message [*Access Reason (m), Random Reference (m)*] on its PCCCH timeslot (as given by the parameter PCCCH_GROUP) to the BTS. The mobile station may send max. (MAX_RETRANS + 1) PACK_CHAN_REQ- to the BTS. The number of TDMA-frames between the single PACK_CHAN_REQ-messages depends on the number of PRACH-blocks on this timeslot, on the parameters TX_INT and S which are like MAX_RETRANS broadcast in the PRACH_CONTROL_PARAMETERS in PACK_SYS_INFO1 and on the Persistence Level (0 ... 15) (⇔ also part of the PRACH_CONTROL_PARAMETERS) which depends on the Radio Priority that the mobile station may apply. If T3186 expires before the mobile station could transmit (MAX_RETRANS + 1) PACK_CHAN_REQ-messages then a packet access failure needs to be reported and the mobile station returns to packet idle mode.

⇒ Having send the last PACK_CHAN_REQ-message the mobile station will start T3170 (⇔ (TX_INT + 2S) TDMA-frames [in seconds]).

⇒ Mobile stations class A or B shall continue to listen for their PPCH (⇔ NOM I) or PCH (⇔ NOM II / NOM III) to be able to respond to a circuit-switched paging command message. Class B mobile stations *may* abort the One-Phase Packet Access procedure when receiving a circuit-switched paging.

⇒ Having received the PACK_CHAN_REQ-message from the mobile station the BTS will forward it to the PCU within a normal PCU-frame. The PCU will build a PACK_UL_ASS-message [*Page_Mode (m), {Global TFI / TLLI / TQI / Random Reference}(m), Coding Scheme (m), Coding Scheme for TLLI (m), Packet Timing Advance (m), Frequency Parameters (o), {Dynamic / Fixed / Single Block Allocation}(m)*] and send it to the mobile station on PAGCH.

⇒ Having received the PACK_UL_ASS-message the mobile station will stop T3170 and react upon the allocation.

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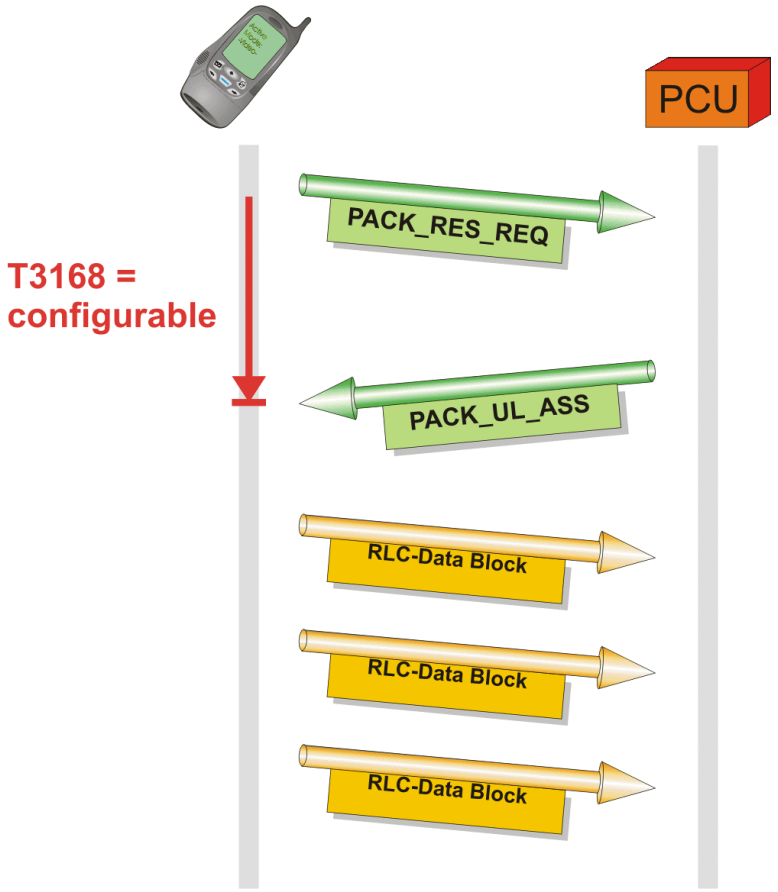
(2) Two-Phase Packet Access on PCCCH in Detail



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(2) Two-Phase Packet Access on PCCCH in Detail

Description

⇒ The mobile station will wait until the indicated uplink radio block occurs (⇔ Starting Time) and use this uplink radio block to transmit an RLC/MAC-control message (e.g. PACK_RES_REQ [*Access Type (o), {Global TFI / TLLI}(m), MS Radio Access Capability (o), PEAK_THROUGHPUT_RATE (m), RADIO_PRIORITY (m), RLC_MODE (m), LLC_ PDU_TYPE (m), RLC_OCTET_COUNT (m), Change_Mark (o), C_Value (m), Sign_Var (o), I_Level_TS 0 – 7 (o)]* to the network. If the message sent is PACK_RES_REQ, the mobile station will start T3168 (⇔ as broadcast in SYS_INFO13, PACK_SYS_INFO1 and PACK_SYS_INFO13 / GPRS Cell Options Information Element).

⇒ Having received the PACK_RES_REQ-message the PCU will (if possible) allocate appropriate resources and convey a PACK_UL_ASS-message [*Page_Mode (m), {Global TFI / TLLI / TQI / Random Reference}(m), Coding Scheme (m), Coding Scheme for TLLI (m), Packet Timing Advance (m), Frequency Parameters (o), {Dynamic / Fixed / Single Block Allocation}(m)*] to the mobile station. Upon reception of PACK_UL_ASS the mobile station will stop T3186 and react upon the allocation.

⇒ If the PACK_UL_ASS-message contains the related Uplink TFI and the TLLI of the mobile station the contention resolution procedure was successful.

⇒ Note that in case of Two-Phase Packet Access the mobile station will not include its TLLI in the RLC-Data Blocks that are sent.

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Practical Exercise:

"Was it One-Phase Access or Two-Phase Access ?"

BITMASK	ID Name	Comment or Value
00------	Payload Type	RLC Data Block
--0010--	Countdown Value	2
------0-	Stall Indicator	MS RLC Tx Window is not stalled
-------0	Retry	MS sent CHN_REQ msg once
00------	Spare	0
--00000-	Temporary Flow Identifier	0
-------1	TLLI Indicator	TLLI Field is present
0000000-	Block Sequence Number	0
-------1	Extention bit	No ext. octets follows
B4	TLLI	c1c55555
B20*	RLC Data Block #1	0b c1 f1 65 00 00 7c 45 00 00 3c ...

HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	01	00	39	02	08	01	01	c1	c5	55	55	0b	c1	f1	65	00
10	00	7c	45	00	00	3c	c9	35	00	00	20	01	99	12	0a	64
20	00	02	0a	00	24	25	25	cf								

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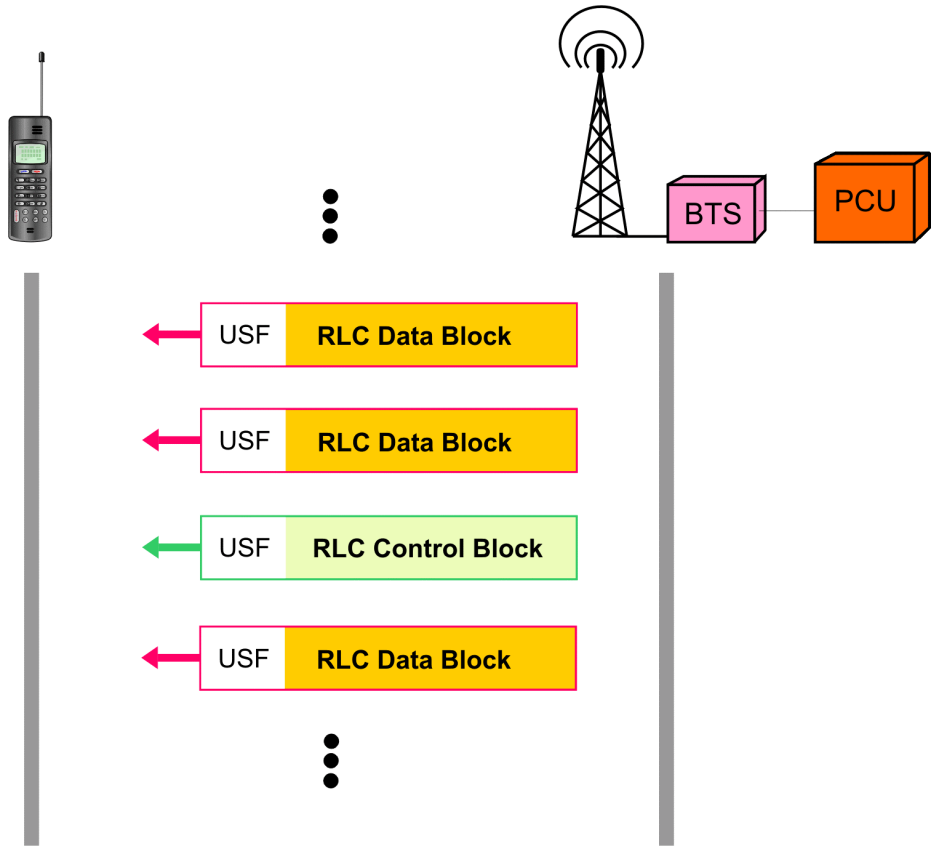
(1) The Dynamic Resource Allocation Method



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(1) The Dynamic Resource Allocation Method

The dynamic resource allocation method is based on the 3 bits long USF (Uplink State Flag) which is part of every downlink RLC-data and control block. On an assigned timeslot N, the USF of downlink block K allocates uplink block (k+1) to the mobile station that has been allocated this USF for this timeslot.

Frequently, there is the question about the differences between USF and TFI. As a matter of fact, there is several differences between these two identifiers:

⇒ Most importantly, the TFI serves as identifier for all data packets in either direction which belong to one data flow while the USF is just denoting the user of the next uplink radio block.

⇒ The TFI is applicable to all timeslots which are used for a given data transfer while the USF is applicable to a single timeslot only.

⇒ The TFI is a mandatory parameter while the USF is only required for dynamic allocation.

Note: If the PCU has no downlink blocks to transmit it will use PACK_DL_DUMMY_CTRL_BLK-messages as bearers of the USF.

Note: On every timeslot the PCU shall reserve a USF-Unused-Value for identifying radio blocks for uplink PACCH or radio blocks that are used for fixed allocations. There is no fix value defined for the USF-Unused-Value. On timeslots with PCCCH the USF-Free-Value = '111'bin shall be reserved in addition for denoting of PRACH blocks. Consequently, there are 7 USF-values available for dynamic and extended dynamic resource allocations on timeslots without PRACH while on timeslots that deploy PRACH, there is only 6 USF-values available for this task.

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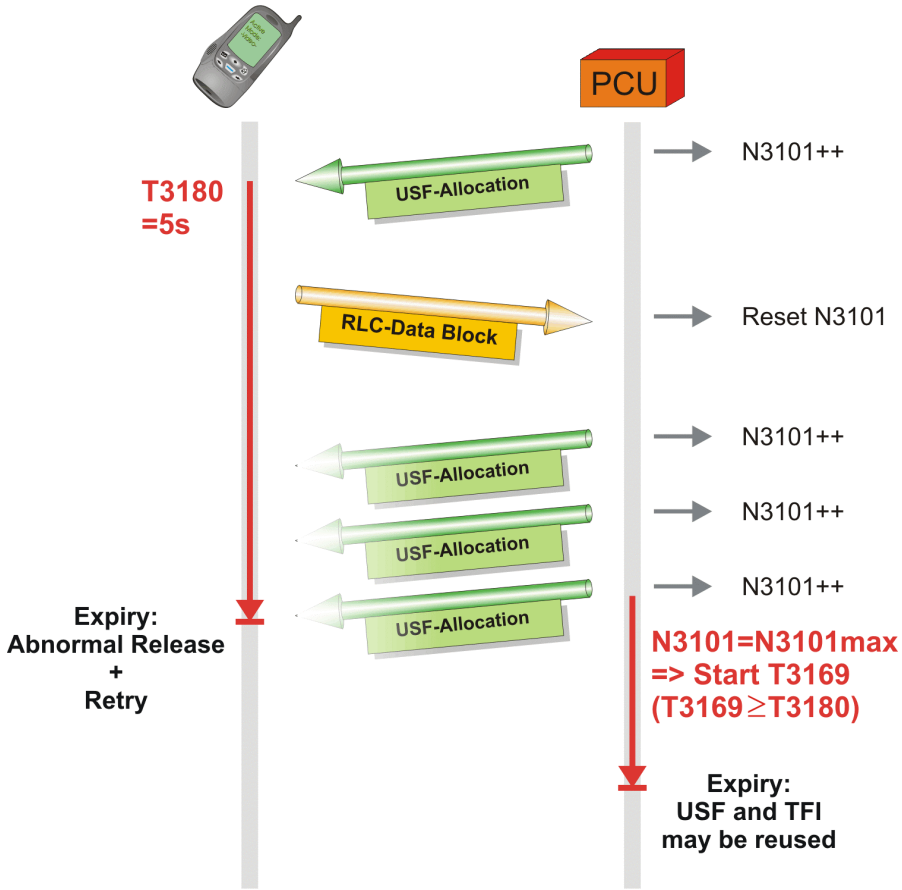
(2) The Dynamic Resource Allocation Method



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(2) The Dynamic Resource Allocation Method

For the operation of dynamic resource allocations different timers and counters are in operation on the mobile station side and in the PCU.

- ⇒ The PCU will increment N3101 with every USF-allocation to a certain mobile station. If the respective uplink RLC-data block is received from that mobile station the PCU will reset N3101.
- ⇒ If multiple USF-allocations result in no RLC-data block being received from that mobile station and N3101 = N3101max (> 8), then the PCU will stop scheduling uplink resources for that mobile station and start timer T3169 (⇔ ≥ 5 s). If T3169 expires and the mobile station has not resumed the uplink TBF the PCU may reuse the TFI and USF.
- ⇒ On the other hand, the mobile station will start T3180 (⇔ 5 s) with every “own” USF-value that is received on one of the allocated timeslots. If T3180 expires which means that the mobile station didn’t receive a block allocation, the mobile station shall perform an abnormal release and perform another packet access procedure.

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PACK_UL_ASS-Message with Dynamic Allocation

Packet Uplink Assignment		
01------	Payload Type	RLC/MAC Control Block, no opt.octets
--00----	Relative Reserved Block Period	TDMA frame N+13
----0---	Supplementary/Polling	RRBP field is not valid
-----000	Uplink State Flag	0
001010--	Message Type	10

3 Dynamic Alloc Struct		
0-------	Extended Dynamic Allocation	Dynamic Allocation
-0------	Bit	0
--0-----	USF Granularity	Transmit 1 RLC/MAC block
---1----	Bit	1
b5	Uplink TFI assignment	0
-0------	Bit	0
--0-----	Bit	0
---1----	Bit	1
----0011	Alpha	alpha = 0.3
0-------	Bit	0
-0------	Bit	0
--1-----	Bit	1
---100--	USF TN2	4
b5	GAMMA TN2	3
---1----	Bit	1
---000--	USF TN3	0
b5	GAMMA TN3	3
----1---	Bit	1
---111--	USF TN4	7
b5	GAMMA TN4	3
-----0--	Bit	0
------0-	Bit	0
-------0	Bit	0
3 (end of) Dynamic Alloc Struct		

No extended dynamic allocation

USF-Granularity Flag = 0. Therefore USF is valid for only one radio block.

Different USF-values per timeslot

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PACK_UL_ASS-Message with Dynamic Allocation

In case of dynamic allocation the PACK_UL_ASS- or PACK_TS_RECONF-message will contain:

- ⇒ The information whether EXTENDED_DYNAMIC_ALLOCATION (m) shall be applied.
- ⇒ The information whether or not downlink power control is used and what the offset downlink power level (P0 (o)) relative to BCCH is.
- ⇒ The information which power reduction mode shall be used for this TBF (PR_MODE (o)) (⇔ only if downlink power control is used).
- ⇒ The information whether USF-detection authorizes the mobile station to transmit only in the next or in the next four uplink radio blocks on this timeslot (USF_GRANULARITY) (m).
- ⇒ The assignment of the uplink TFI (o)
- ⇒ The possible limitation of a TBF. By means of RLC_DATA_BLOCKS_GRANTED (o) the mobile station can be limited to transfer only the indicated number of uplink radio blocks.
- ⇒ The delay between the assignment message and the allocation (TBF_STARTING_TIME (o))
- ⇒ The USF (m) per timeslot number plus the information of the uplink power control parameters (ALPHA (o) and GAMMA (o). Note that GAMMA is included per timeslot.

(m) ⇒ mandatory parameter
(o) ⇒ optional parameter
(c) ⇒ parameter is present under certain conditions

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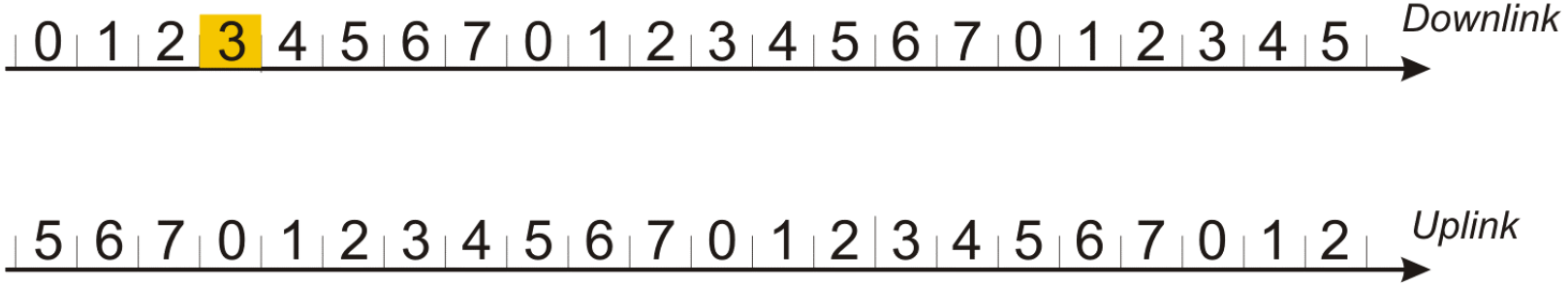
Practical Exercise:

"How much time does a mobile station have after USF-detection on TS 3 to prepare for transmission ?"

Timeslots

Last Segment of
Downlink Block K



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