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Foreword

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1 Scope

The present document specifies the MAC protocol.

The specification describes:

- MAC architecture;
- MAC entities;
- channel structure;
- services provided to upper layers;
- MAC functions;
- services expected from the physical layer;
- elements for layer-to-layer communication including primitives between MAC and RLC;
- elements for peer-to-peer communication;
- protocol data units, formats and parameters;
- elementary procedures.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[3] 3GPP TS 25.302: "Services provided by the Physical Layer".

[4] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode".

[5] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".

[6] 3GPP TS 25.322: "RLC Protocol Specification".

[7] 3GPP TS 25.331: "Radio Resource Control (RRC); protocol specification".

[8] 3GPP TR 25.921: "Guidelines and Principles for Protocol Description and Error Handling".

[9] 3GPP TR 25.990: "Vocabulary for the UTRAN".

[10] 3GPP TS 33.102: "Security architecture".

[11] 3GPP TS 25.425: "UTRAN Iur Interface User Plane Protocols for Common Transport Channel Data Streams".

[12] 3GPP TS 25.133: "Requirements for support of radio resource management (FDD)".

[13] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[14] 3GPP TS 25.123: "Requirements for support of radio resource management (TDD)".

[15] 3GPP TS 33.105: "Cryptographic Algorithm Requirements".

[16] 3GPP TS 25.212: "Multiplexing and Channel Coding (FDD)".

[17] 3GPP TS 25.215: "Physical layer - Measurements (FDD)".

[18] 3GPP TS 25.224: "Physical layer procedures (TDD)".

[19] 3GPP TS 25.222: "Multiplexing and Channel Coding (TDD)".

[20] 3GPP TS 25.225: "Physical layer – Measurements (TDD)".

[21] 3GPP TS 25.221 "Physical Channels and Mapping of Transport Channels onto Physical Channels (TDD)"

[22] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[23] 3GPP TS 25.306: "UE Radio Access Capabilities".

[24] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)"

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given below and in [9] and [1] apply.

3.1.1 HS-DSCH Specific Definitions

Multiflow (FDD): A mode of operation with two simultaneous HS-DSCH transport channels per carrier frequency, where the HS-DSCH transport channels may belong to the same or different Node Bs

Blind HARQ retransmissions for HSDPA (FDD): A HARQ operation where a UE in CELL_DCH state supports reception of MAC-hs/ehs PDU within 5 sub-frames from the reception of the previous MAC-hs/ehs PDU intended for the same HARQ process.

3.1.2 E-DCH Specific Definitions

3.1.2.1 General

E-DCH: The Enhanced Dedicated Channel (E-DCH) is an uplink transport channel.

HARQ profile: One HARQ profile consists of a power offset attribute and maximum number of transmissions. For 1.28 Mcps TDD, it also includes a retransmission timer attribute.

Power offset attribute (FDD): This represents the power offset between E-DPDCH(s) and reference E-DPDCH power level for a given E-TFC. This power offset attribute is set to achieve the required QoS in this MAC-d flow when carried alone in a MAC-e or MAC-i PDU and subsequently in the corresponding CCTrCh of E-DCH type. Details on the mapping on Beta factors can be found in [13]. The reference E-DPDCH power offset is signalled to the UE for one (or several) reference E-TFC(s) (see details in subclause 11.1).

Power offset attribute (TDD): The power offset attribute is set to achieve the required QoS in this MAC-d flow when carried alone in a MAC-e or MAC-i PDU and subsequently in the corresponding CCTrCh of E-DCH type. Details on the power offset can be found in [18].

Primary Absolute Grant: Absolute Grant received with the primary E-RNTI. Note that the primary E-RNTI is the only E-RNTI for TDD.

Serving E-DCH cell: Cell from which the UE receives Absolute Grants from the Node-B scheduler. A UE has one Serving E-DCH cell.

Serving_Grant (FDD): The state variable Serving_Grant indicates the maximum E-DPDCH to DPCCH power ratio that the UE is allowed to use for scheduled data in the following transmission. The value in the appropriate state variable will be provided to the E-TFC selection function to help in selecting the best format for the upcoming transmission. Possible values are: "Zero_Grant" and numerical values. The DPCCH power assumed for the Serving_Grant in a compressed frame is the actual DPCCH power in the compressed frame minus $10\text{Log}_{10}(N_{pilot,N}/N_{pilot,C})$ as defined in [13].

Serving_Grant (TDD): The state variable Serving_Grant indicates the power ratio of maximum E-PUCH power level per TDD resource unit relative to a reference E-PUCH power level $P_{e\text{-}ref}$ that the UE is allowed to use for scheduled data on the physical resources associated with the E-AGCH grant. $P_{e\text{-}ref}$ is defined as the calculated E-PUCH transmit power ($P_{E\text{-}PUCH}$) in [18] with β_e=0. The value in the appropriate state variable will be provided to the E-TFC selection function to help in selecting the best format for the upcoming transmission. Possible values are: "Zero_Grant" and numerical values.

UL Common MAC Flow(1.28 Mcps TDD): an UL Common MAC Flow is a flow of MAC-c PDU mapped to E-DCH configured for UEs in Cell_FACH state and IDLE mode.

3.1.2.2 FDD

Active Process: HARQ process for which Scheduling Grant are applicable, i.e. scheduled data can be sent.

AG_Timer: This timer is set to one HARQ RTT (40ms in the case of 10ms TTI, 16ms in the case of 2ms TTI).

Common E-DCH resource: Common E-DCH resources are under direct control of the Node B and are shared by UEs in CELL_FACH state and IDLE mode.

Common E-RGCH RL: Cell which is not the serving E-DCH radio link and from which the UE can receive one Relative Grant in CELL_FACH state. The UE can have zero, one or up to 3 Common E-RGCH RL(s).

E-DCH active set: The set of cells which carry the E-DCH for one UE. For FDD, in CELL_FACH state and Idle mode, the E-DCH active set consists of the Serving E-DCH cell only.

Implicit Grant handling: A scheduling scheme where a UE's Scheduling Grant on the Secondary Serving E-DCH cell may be revoked by means of an Absolute Grant addressed to another UE.

Implicit_Zero_Grant: A boolean variable used to indicate if the Serving Grant can be implicitly set to zero by the reception of an Absolute Grant that is addressed to another UE.

Inactive Process: HARQ process for which Scheduling Grants are not applicable, i.e. scheduled data cannot be sent.

INACTIVE: Absolute Grant value that can be sent by the serving cell's scheduler on the E-AGCH to deactivate a process or to switch the UE to its secondary E-RNTI. In CELL_FACH state, this absolute grant value is used to release a common E-DCH resource when the Absolute Grant Scope is set to "All HARQ processes".

Lowest Configured Serving Grant Value: The serving grant value indicated by index 0 of the SG table in use.

Maximum_Serving_Grant: The variable Maximum_Serving_Grant indicates the maximum E-DPDCH to DPCCH power ratio that the UE is allowed to use for scheduled data while the timer Non_Serving_RG_Timer has not expired.

Maximum number of re-transmissions, Maximum number of transmissions: Maximum number of re-transmissions = maximum number of transmissions - 1. Both these notations are used.

Minimum_Grant: The value Minimum_Grant corresponds to the minimum E-DPDCH to DPCCH power ratio that the UE considers. This value is in index 0 of the configured scheduling grant table described in subclause 9.2.5.2.1.

NodeB triggered HS-DPCCH transmission: Transmission on a common E-DCH resource to provide HS-DPCCH feedback in CELL_FACH state, which is triggered by the reception of an HS-SCCH order as defined in [16].

Non-serving E-DCH RL or Non-serving RL: Cell which belongs to the E-DCH active set but does not belong to the Serving E-DCH RLS and from which the UE can receive one Relative Grant. The UE can have zero, one or several Non-serving E-DCH RL(s).

Non_Serving_RG_Timer: This timer is set to one HARQ RTT (40ms in the case of 10ms TTI, 16ms in the case of 2ms TTI).

Primary Absolute Grant: Absolute Grant received with the primary E-RNTI.

Primary_Grant_Available: This state variable is a Boolean, indicating whether the UE's serving grant is only affected by Primary Absolute Grants and Relative Grants (i.e. not by Secondary Absolute Grants).

Primary Uplink Frequency: If a single uplink frequency is configured for the UE, then it is the primary uplink frequency. In case more than one uplink frequencies are configured for the UE, then the primary uplink frequency is the frequency on which the E-DCH corresponding to the serving E-DCH cell associated with the serving HS-DSCH cell is transmitted. The association between a pair of uplink and downlink frequencies is indicated by higher layers.

reference_ETPR: The state variable reference_ETPR holds the E-DPDCH to DPCCH power ratio used as reference for relative grant commands. This variable is set to the E-DPDCH to DPCCH power ratio used for the E-TFC selected for the previous TTI on this HARQ process, calculated using the amplitude ratios prior to the quantization according to subclause 5.1.2.5B.2.3 or 5.1.2.5B.2.4 of [13], excluding non-scheduled transmissions, excluding any scaling applied according to subclause 5.1.2.6 of [13] and is obtained from the physical layer. In case no scheduled transmission took place on a HARQ process in the previous TTI, reference_ETPR shall be set to Minimum_Grant for this HARQ process.

reference_ETPR2: The state variable reference_ETPR2 holds the E-DPDCH to DPCCH power ratio used as reference for non serving relative grant commands. This variable is set to the previously stored **reference_ETPR** on this HARQ process when the reference_ETPR is updated with a new value.

Secondary Absolute Grant: Absolute Grant received with the secondary E-RNTI.

Serving E-DCH RLS or Serving RLS: Set of cells which contains at least the Serving E-DCH cell and from which the UE can receive and combine one Relative Grant. The UE has only one Serving E-DCH RLS. For FDD, in CELL_FACH state and Idle mode, the Serving E-DCH RLS or Serving RLS contains the Serving E-DCH cell only, from which the UE can receive one Relative Grant.

Stored_Secondary_Grant: This state variable is used to store the value derived from the last received Secondary Absolute Grant Value. Possible values are: "Zero_Grant" and numerical values.

UL Common MAC Flow: an UL Common MAC Flow is a flow of MAC-c PDU mapped to E-DCH configured for UEs in Cell_FACH state and IDLE mode.

3.1.3 DTX-DRX and HS-SCCH less Specific definitions (FDD only)

MAC DTX cycle: Defines the pattern of time instances where the start the uplink E-DCH transmission after inactivity is allowed.

MAC Inactivity Threshold: E-DCH inactivity time after which the UE can start E-DCH transmission only at given times.

UE DTX DRX Offset: Uplink DPCCH burst pattern and HS-SCCH reception pattern offset in subframes.

HS-SCCH less mode of operation: HS-SCCH less mode of operation is enabled when the variable HS_SCCH_LESS_STATUS defined in [7] is set to TRUE.

Inactivity Threshold for UE Grant Monitoring: Determines the number of E-DCH TTIs after an E-DCH scheduled transmission during which the UE is required to monitor the full E-AGCH transmissions from the serving radio link and the full E-RGCH(s) from all the cells in the E-DCH active set.

Inactivity Threshold for UE DTX cycle 2: Defines a number of consecutive E-DCH TTIs without an E-DCH transmission, after which the UE shall immediately move from UE_DTX_cycle_1 to using UE_DTX_cycle_2.

Default-SG-in-DTX-Cycle-2: Defines the default E-DCH Serving Grant used in the case when the UE moves from UE DTX cycle 1 to UE DTX cycle 2 after Inactivity Threshold for UE DTX cycle 2 triggers.

3.1.4 HS-DSCH/E-DCH SPS Specific definitions (1.28 Mcps TDD only)

HS-DSCH SPS operation: HS-DSCH SPS operation is enabled when the variable HS_DSCH_SPS_STATUS defined in [7] is set to TRUE.