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Contents

Intellectual Property Rights	6
Foreword.....	6
Modal verbs terminology.....	6
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	7
3 Definition of terms, symbols and abbreviations.....	8
3.1 Terms.....	8
3.2 Symbols.....	8
3.3 Abbreviations	8
4 General	9
4.1 Introduction	9
4.2 MAC Architecture	9
4.2.1 General.....	9
4.2.2 MAC Structure.....	9
4.2.3 Identities	11
4.2.3.1 Network ID	11
4.2.3.2 Long Radio Device ID (Long RD ID).....	11
4.2.3.3 Short Radio Device ID (Short RD ID).....	12
4.3 Service.....	13
4.3.1 Services provided to upper layers.....	13
4.3.2 Services expected from physical layer.....	13
4.4 Functions	13
4.5 Channel Structure	14
4.5.1 Logical and Transport Channels	14
4.5.2 Mapping Physical layer packet	14
4.6 Order of transmission and figure numbering conventions.....	14
5 MAC Layer Procedures.....	15
5.1 Spectrum Management Procedures	15
5.1.1 General.....	15
5.1.2 Operating Channel(s) and Subslot(s) selection	15
5.1.3 Last Minute Scan	16
5.1.4 Selecting RD for association.....	16
5.1.5 Beacons Transmissions	17
5.1.6 Power control.....	18
5.2 Broadcast Procedure.....	18
5.2.1 General.....	18
5.2.2 Broadcast procedure initialization	18
5.2.3 Broadcast transmission	19
5.3 Random Access procedure	19
5.3.1 General.....	19
5.3.2 Announcing Random access resources	20
5.3.3 Random Access transmission	20
5.3.4 Random Access response.....	21
5.4 Scheduled access data transfer	22
5.5 HARQ Operation.....	23
5.5.1 General.....	23
5.5.2 Receiver Operation	23
5.6 Multiplexing and assembly.....	24
5.7 Mobility Procedures	25
5.8 Association procedure	25
5.8.1 General.....	25
5.8.2 Sending beacon for association.....	26

5.8.3	Association initiation	26
5.8.4	Sending association request	27
5.8.5	Association response.....	27
5.8.6	Association Release	28
5.9	Security Procedures	28
5.9.1	Mode 1	28
5.9.1.1	General	28
5.9.1.2	Integrity protection.....	28
5.9.1.3	Ciphering.....	29
5.10	Reconfiguration.....	31
6	Protocol Data Units, formats and parameters.....	31
6.1	General	31
6.2	Physical Header Field.....	31
6.2.1	General.....	31
6.2.2	Coding of Feedback info.....	33
6.3	MAC PDU	36
6.3.1	General.....	36
6.3.2	MAC Header type.....	36
6.3.3	MAC Common header.....	37
6.3.3.1	DATA MAC PDU header	37
6.3.3.2	Beacon Header	37
6.3.3.3	Unicast Header	38
6.3.3.4	RD Broadcasting Header.....	38
6.3.4	MAC multiplexing header	39
6.4	MAC Messages and Information Elements (IEs).....	42
6.4.1	General.....	42
6.4.2	MAC messages	42
6.4.2.1	General	42
6.4.2.2	Network Beacon message.....	42
6.4.2.3	Cluster Beacon message.....	43
6.4.2.4	Association Request message.....	44
6.4.2.5	Association Response message	46
6.4.2.6	Association Release message	47
6.4.2.7	Reconfiguration Request message	48
6.4.2.8	Reconfiguration Response message	48
6.4.2.9	Additional MAC message	49
6.4.3	MAC information elements	49
6.4.3.1	MAC Security Info IE.....	49
6.4.3.2	Route Info IE.....	50
6.4.3.3	Resource allocation IE	51
6.4.3.4	Random Access Resource IE	52
6.4.3.5	RD Capability IE.....	54
6.4.3.6	Neighbouring IE.....	54
6.4.3.7	Broadcast Indication IE.....	55
6.4.3.8	Padding IE.....	56
6.4.3.9	Group Assignment IE.....	57
7	Variables, and Timers.....	58
7.1	General	58
7.2	Variables.....	58
7.3	Timers	59
Annex A (normative):	MAC Layer Requirements for Radio Device Classes.....	60
A.1	Introduction	60
A.2	Radio Device Class (1.1.1.A).....	60
A.2.1	Modes	60
A.2.2	System Operation	60
A.2.3	Security	60
A.2.4	Feedback Info Formats	60

Annex B (normative):	Data Link Layer Operation	61
B.1	Segmentation.....	61
B.2	Routing PDU in Mesh operation.....	62
History		64

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Digital Enhanced Cordless Telecommunications (DECT).

The present document is part 4 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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1 Scope

The present document is one of the parts of the specification of the DECT-2020 New Radio (NR).

The present document specifies Medium Access Control (MAC) layer and interaction between MAC layer and physical layer and higher layers.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

- [1] ETSI TS 103 636-1: "DECT-2020 New Radio (NR); Part 1: Overview; Release 1".
- [2] ETSI TS 103 636-2: "DECT-2020 New Radio (NR); Part 2: Radio reception and transmission requirements; Release 1".
- [3] ETSI TS 103 636-3: "DECT-2020 New Radio (NR); Part 3: Physical layer; Release 1".
- [4] FIPS PUB 197: "Advanced Encryption Standard (AES)".
- [5] NIST Special Publication 800-38B: "Recommendation for Block Cipher Modes of Operation: The CMAC Mode for Authentication".

2.2 Informative references

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI EN 300 175 (All parts): "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

Fixed Termination point (FT): operational mode of RD where RD initiates coordinates local radio resources, provides information how other RDs may connect and communicate with it

operating channel: single continuous part of radio spectrum with a defined bandwidth where RDs transmits and/or receives as defined in ETSI TS 103 636-2 [2]

Portable Termination point (PT): operational mode of RD where RD selects another RD, which is in FT mode, for association

radio device: device with radio transmission and reception capability which can operate in FT and/or PT mode

resource: variable length time unit defined in subslot(s) or slot(s) in single operating channel that RD is using for transmission or reception of physical layer packet

NOTE: Resource can be contentious or contention free, i.e. scheduled.

subslot: unit of a radio frame as defined in ETSI TS 103 636-3 [3] in clause 4

NOTE: Subslots in the frame are numbered in increasing order and the first subslot of radio frame is number 0.

slot: unit of a radio frame as defined in ETSI TS 103 636-3 [3], clause 4

3.2 Symbols

For the purposes of the present document, the following symbols apply:

0x	Value in hexadecimals
β	Fourier transform scaling factor as defined in ETSI TS 103 636-3 [3]
μ	Subcarrier scaling factor as defined in ETSI TS 103 636-3 [3]
RSSI-1	RSSI-1 measurement as defined in ETSI TS 103 636-2 [2]
RSSI-2	RSSI-2 measurement as defined in ETSI TS 103 636-2 [2]

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 103 636-1 [1] and the following apply.

NOTE: An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in ETSI TS 103 636-1 [1].

ACK	Acknowledgement
BCC	Broadcast Control
BCCH	Broadcast Common Control Channel
BLER	Block Error Ratio
BS	Buffer Size
BSC	Beacon Scanning Control
CCC	Connection Configuration Control
CCCH	Common Control Channel
CQI	Channel Quality Indicator
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DF	Data Field

NOTE: As defined in ETSI TS 103 636-3 [3].

DTCH	Dedicated Traffic Channel
------	---------------------------

FT	Fixed Termination point
GI	Guard Interval

NOTE: As defined in ETSI TS 103 636-3 [3].

HARQ	Hybrid Automatic Repeat request
HPC	Hyper Packet Counter
IE	Information Element
ID	IDentity
LBT	Listen Before Talk
LRC	Local Radio Control
MCS	Modulation and Coding Scheme
MIC	Message Integrity Code

NOTE: Same as Message Authentication Code.

MIMO	Multiple Input Multiple Output
MSB	Most Significant Bit
MTCH	Multicast (Broadcast) Traffic Channel
MUX	Multiplexing
NACK	Negative Acknowledgement
OFDM	Orthogonal Frequency Division Multiplexing
PCC	Physical Control Channel
PCCH	Paging Common Channel
PCH/BCH	Paging and Broadcast Channel
PDC	Physical Data Channel
PDU	Protocol Data Unit
PT	Portable Termination point
PTC	Paging Transmission Control
RAC	Random Access Control
RACH	Random Access Channel
RD	Radio Device
RSSI	Received Signal Strength Indicator
SDU	Service Data Unit
SFN	System Frame Number
STF	Synchronization Training Field

NOTE: As defined in ETSI TS 103 636-3 [3].

4 General

4.1 Introduction

The objective of this clause is to describe the MAC protocol layer architecture, used identities, used transport channels and mapping MAC PDU into physical layer packet.

4.2 MAC Architecture

4.2.1 General

This clause describes a model of the MAC i.e. it does not specify or restrict implementations.

4.2.2 MAC Structure

The overall MAC structure is depicted in Figure 4.2.2-1. MAC provides DTCH and MTCH logical channels for transferring higher layer data. The flow of the higher layer data and MAC internal message to physical channels is depicted with black solid lines. The grey dashed line corresponds MAC internal control interfaces between MAC function and MAC control entity.

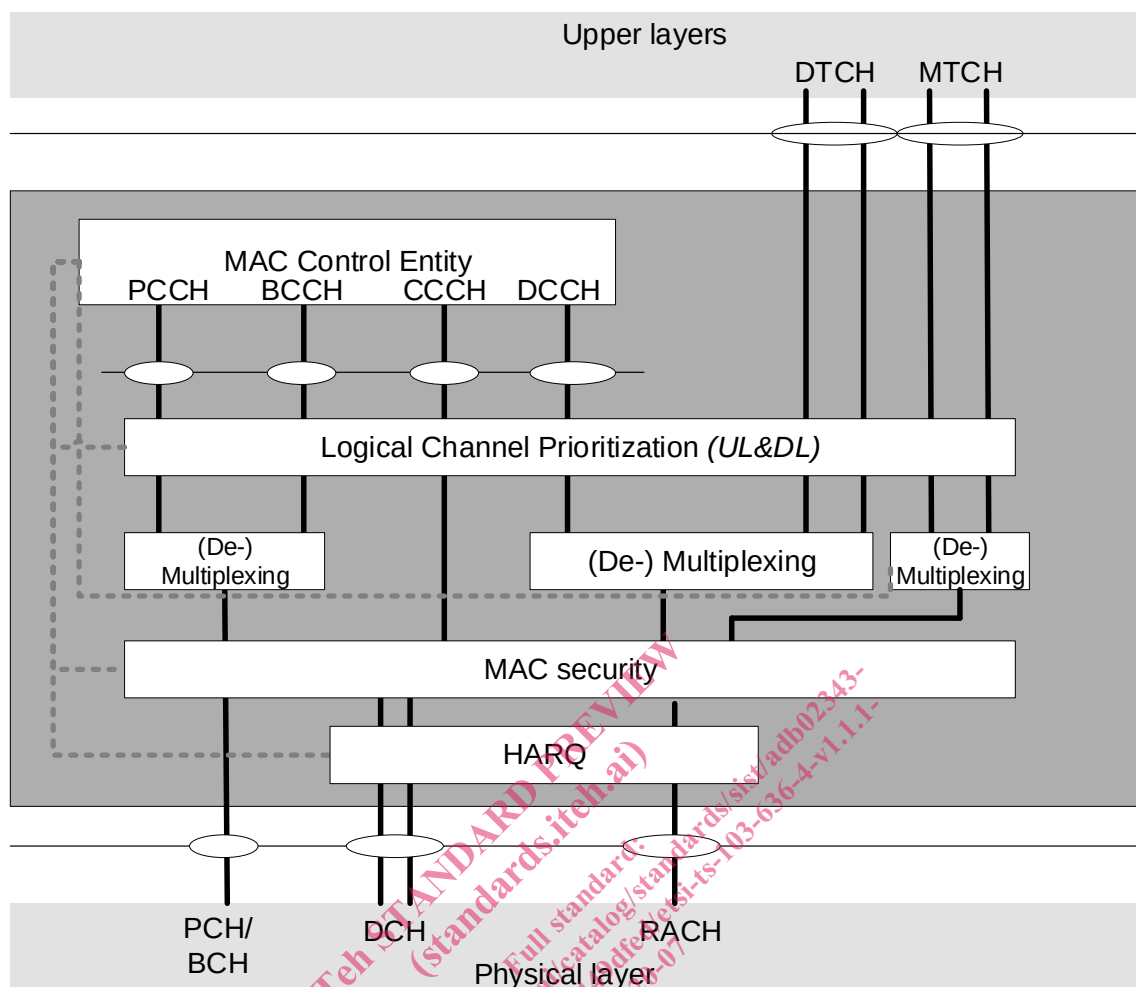


Figure 4.2.2-1: MAC structure overview

The MAC layer of the Radio Device (RD) handles transmission and reception of the following transport channels:

- Paging and Broadcast Channel (PCH/BCH);
- Dedicated Channel (DCH);
- Random Access Channel (RACH)

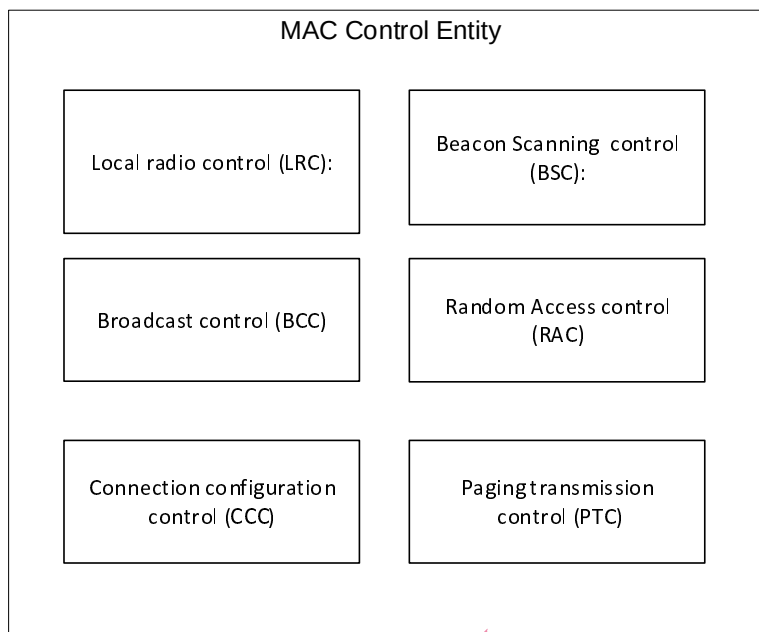


Figure 4.2.2-2: MAC control Entity

The MAC control entity is depicted in Figure 4.2.2-2 and described in clause 4.4.

4.2.3 Identities

4.2.3.1 Network ID

Network ID has length of 32 bits, and first 24 MSB bits are used to identify a DECT-2020 network uniquely from other DECT-2020 networks. The 8 LSB bits of the network are selected locally to minimize collision with other networks.

The network ID is transmitted periodically in a beacon frame as plain text enabling other RDs to detect which network the transmitted beacon belongs to.

The last 8 LSB bits of the network ID are transmitted in PHY control field of the packet as defined in clause 6.2.

The 24 MSB bits of the network ID are provided to PHY layer to initialize the PDC scrambling sequence in clause 7.6.6, ETSI TS 103 636-3 [3].

The network ID can be set to any other value than 0x00000000.

NOTE: Network ID should be set in such a manner that maximum likelihood for a unique identity for a network is obtained due to randomness of 2 power of 32.

4.2.3.2 Long Radio Device ID (Long RD ID)

Long radio device ID has length of 32 bits, and it identifies radio device uniquely in single DECT-2020 network. The coding of the long RD ID is defined in Table 4.2.3.2-1. An RD obtains the long RD ID as part of authentication process over DECT-2020 system or via manually provision or by using other communication channel.

The long RD ID is used:

- in association procedure to recognize associating RDs uniquely;
- in MAC layer security procedures;
- in packet routing in mesh system operation to identify original source and final target receiver of the routed data packet.

Table 4.2.3.2-1: Use of long RD ID address space

Address type	Address field	Comment
Reserved address	0x00000000	Shall not be used as it is considered as not defined.
Backend address	0xFFFFFFFFE	Indicates that packet is to be delivered out from DECT-2020 system, i.e. to backend system.
Broadcast address	0xFFFFFFFF	This address can be used to indicate that packet needs to be received by all RDs in the system when performing packet routing.
Long RD ID	0x00000001-0xFFFFFFFFD	This address space is used to identify radio device uniquely in DECT-2020 systems.
Multicast address	0x00000001-0xFFFFFFFFD	The system configuration defines range of address that are used as multicast address in the given system. A multicast group can use any of those addresses. When receiver address of the packet is multicast group the packet is intended to all members of that group. An RD can be part of one or multiple multicast group.

The long RD ID is transmitted in MAC PDU to:

- identify the receiver and the transmitter of the packet in association procedure for exchanging short RD IDs, or
- when transmitter of the frame considers that there is potential confusion on short RD IDs.

When RD is initiating authentication over DECT-2020 network the RD can use random value or application defined value as Long RD ID from Long RD ID space defined in Table 4.2.3.2-1, if no valid long RD ID value is available from previous authentication procedures.

4.2.3.3 Short Radio Device ID (Short RD ID)

Short radio device ID has length of 16 bits, and it identifies radio device locally in DECT-2020 network. The coding of the short RD ID is defined in Table 4.2.3.3-1.

The short RD ID is used in PHY control field as in transmitter or receiver fields to identify transmitter and receiver of the packet.

The short RD ID is exchanged during association procedure between RDs performing association so that linkage between short RD ID and long RD ID is obtained by both associating RD. Each radio device randomly selects Short RD ID value that it uses in association.

Table 4.2.3.3-1: Use of short RD ID address space

Address type	Address field	Comment
Reserved address	0x0000	Shall not be used as it is considered as not defined
Short RD ID	0x0001-0xFFFFE	This address space is used to identify RD in PHY control field
Broadcast address	0xFFFF	This address can be used to indicate that transmission is broadcast frame

4.3 Service

4.3.1 Services provided to upper layers

The MAC layer provides the following services to upper layers:

- data transfer;
- radio resource allocation.

4.3.2 Services expected from physical layer

The MAC layer expects the following services from the physical layer:

- data transfer services in physical layer packets;
- measurements.

4.4 Functions

The MAC layer supports the following control functions in MAC control entity:

- Local Radio Control (LRC): This function is overall in charge of radio resource in local coordination area, when RD coordinates local radio resources, i.e. operates as FT.
- Paging Transmission Control (PTC): This function controls paging message transmission when RD coordinates local radio resources, i.e. operates as FT.
- Broadcast Control (BCC): This functionality controls Beacon and other broadcast/multicast transmission.
- Random Access Control (RAC): This functionality is in charge of random access transmission.
- Beacon Scanning Control (BSC): This function controls scanning operation.
- Connection configuration control (CCC): This functionality controls multiplexing, mapping data to transport channel, MCS, HARQ configuration, MAC security and handovers with LRC.

The MAC layer supports the following transmission functions:

- paging and broadcast signalling;
- control signalling;
- radio resource management by channel selection and channel access procedures;
- logical channel prioritization;
- mapping between logical channels and transport channels;
- multiplexing of MAC SDUs from one or different logical channels onto MAC PDU to be delivered to the physical layer on transport channels;
- demultiplexing of MAC SDUs to one or different logical channels from transport blocks MAC PDU delivered from the physical layer via transport channels;
- error correction through HARQ;
- MAC layer security by providing integrity protection and ciphering.