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Release 2

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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 2 of a multi-part deliverable covering access profile using DECT-2020 New Radio (NR) technology, as identified below:

Part 1: "Overview";

Part 2: "Smart Metering, City and Buildings";

Part 3: "IPv6 Profile";

Part 4: "Over the Air Software Update Operation";

Part 5: "Generic Audio Applications".

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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document specifies the access profile requirements and recommendations of smart metering, city and buildings as well as any other similarly applicable use case for the DECT-2020 New Radio (NR).

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.

Referenced documents which are not found to be publicly available in the expected location might be found in the ETSI docbox.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

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

[1] ETSI TS 103 636-1 (V2.1.1): "DECT-2020 New Radio (NR); Part 1: Overview; Release 2".

[2] ETSI TS 103 636-2 (V2.1.1): "DECT-2020 New Radio (NR); Part 2: Radio Reception and transmission requirements; Release 2".

[3] ETSI TS 103 636-3 (V2.1.1): "DECT-2020 New Radio (NR); Part 3: Physical layer; Release 2".

[4] ETSI TS 103 636-4 (V2.1.1): "DECT-2020 New Radio (NR); Part 4: MAC layer; Release 2".

[5] ETSI TS 103 636-5 (V2.1.1): "DECT-2020 New Radio (NR); Part 5: DLC and Convergence layers; Release 2".

2.2 Informative 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 may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] ETSI TR 103 943: "System Reference document (SRdoc); DECT-2020 NR technology operating in frequency bands below 6 GHz".

3 Definition of terms, symbols, and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

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].

CVG	Convergence (layer)
DLC	Data Link Control (layer)
FO	Frame Offset
FT	Fixed Terminal (operational mode)
HARQ	Hybrid Automatic Repeat reQuest
IE	Information Element
IPv6	Internet Protocol version 6
LAN	Local Area Network
M	Mandatory (requirement)
MAC	Medium Access Control (layer)
MCS	Modulation and Coding Scheme
O	Optional (requirement)
PDU	Protocol Data Unit
PT	Portable Terminal (operational mode)
RACH	Random Access CHannel
RD	Radio Device
RSSI	Received Signal Strength Indicator
SFN	System Frame Number
SI	Segmentation Indication
SNR	Signal to Noise Ratio
TBS	Transport Block Size

4 Use Case Descriptions

4.1 General

The present document defines a generic access profile that can be used in multiple different use cases with a basic assumption of large number of devices and need for multi-hop mesh networking topology. The following clauses define a set of use cases recognized by TC DECT [i.1] but the use of this access profile is not necessarily limited to these.

4.2 Examples of use cases

4.2.1 Smart Electricity Metering

Electricity metering refers to electronic devices installed in buildings to record the consumption of electricity and report it to a backed system for monitoring and billing purposes.

4.2.2 Smart City Applications/Smart Street Lighting

Smart city applications are about collecting environmental sensor data and controlling some of the infrastructure devices, from which streetlights are considered.

Smart Street lighting is about controlling the use of the lights in efficient manner. The control may be autonomous and not only based on measuring how dark it is but also the movements of the people and/or vehicles. Streetlights may also provide information on the condition of the lights, e.g. the light bulbs/LEDs. Similarly, the streetlights may also be equipped to do various environmental sensing like air quality measurements and/or route the data of other devices for monitoring purposes.

4.2.3 Smart Building Applications

Smart building is a concept of various applications that consider energy efficiency, space optimization, environment quality and functionality.

4.2.4 Smart Emergency Lighting

Smart emergency lighting is about features for supporting the set up and maintenance of the emergency lighting. For example, the backup battery's (which is used in case mains power is cut) charging status and whether the light bulb/LED is broken is reported to a monitoring system, removing the need for site audits and manual checks. Further smart lighting can be used to provide additional guidance to the people in case of emergency.

4.3 Characteristics of the use cases

4.3.1 Physical location

The smart building and emergency lighting are mostly confined on premises of larger buildings, where the radio signals often face high path loss and strong fading caused by the concrete walls and floors. Further, buildings with modern selective glass windows and concrete and steel structure wall have very significant signal attenuation from outdoors, as well as many buildings' underground floors use vital support area for different functions operating in building, such as parking, warehouse, cleaning, personal locker rooms, etc.

However, some of the use cases like lighting and emergency lighting are associated with locally open spaces like rooms and corridors.

A typical intended use of electricity metering is the consumption at buildings in urban and suburban areas, wherein the physical distance between the electricity meters varies heavily. The metering devices may be grouped in the same space of a block house e.g. in basements and other technical rooms with concrete walls. On the other hand, the distance between the buildings may be hundreds of meters. In suburban areas, smart meters are typically per household.

The street lighting is mostly intended for outdoor conditions with less path fading. The distance between the lights mostly expected to be limited to some tens of meters.

4.3.2 Topology

The topology assumption of each use case supported by this profile is assumed to be based on mesh, as the number of devices for a network may be relatively high and the traffic characteristics allow multi-hop networking. Most of the use cases are at least partly confined to buildings causing strong fading conditions. Mesh topology with flexible number of multi-hops allows routing of data through the buildings. In addition, utilization of wireless technology with star network topology increases needs for extremely high link budget solutions, with limited data rate and network building and planning efforts for covering any coverage holes.

4.3.3 Roles

Each device within a use case can have similar role in terms of producing measurement results or e.g. switching the lights on/off and routing data. However, one or some of the devices need to be connected to a gateway which has further connection (e.g. cellular, LAN) to deliver the measurement results to the monitoring backend system or vice versa configuration or control from the backend to the devices. The reliability of the system and the overall system cost or average electricity meter cost can be balanced by adjusting the share of gateways in the network.

4.3.4 Power sources

Electricity meters, streetlights and emergency lights are typically mains powered devices.

Emergency lights need to deal with electricity cut-down situations, so despite of the normal use of the mains power, they are equipped with batteries. A typical regulation requires 90 minutes operation with batteries.

4.3.5 Traffic characteristics

This profile is agnostic on used application data formats. However, the applications may require support of up to 1 500 Bytes of length due to use of IPv6.

The traffic is mostly uplink, while configuration and some control may require downlink messaging. Local routing between RDs is seen lighting use case.

Examples of uplink traffic:

- Periodic or event-based measurement reporting (electricity consumption, environmental measurements in smart building and smart city).

Examples of downlink traffic:

- Configuration and software updates of devices (all use cases).
- Control of devices (lighting, smart building, and smart city applications).

Example of local routing between RDs:

- Local control (street lighting, smart building lighting).

4.3.6 Security

The integrity of the measurement data is highly important in each use case. The measurement, configuration and control data are generally considered private within the wireless communication, although e.g. some smart city data is likely published elsewhere.

5 Radio Reception and Transmission

5.1 Supported bands

Selection of frequency band, operating channel bandwidth and absolute channel numbers may differ between different regions. At least one band shall be chosen.

When operating at band 1 an RD shall follow the values presented in Table 5.1-1 and follow definitions given in ETSI TS 103 636-2 [2].

Table 5.1-1: Band, bandwidth, and absolute channel numbers

Clause in ETSI TS 103 636-2 [2]	Name	Value
5.2	Operating band	1
5.3	Operating channel bandwidth	1,728 MHz
5.4.2	Absolute channel numbers	1 657, 1 659, 1 661, 1 663, 1 665, 1 667, 1 669, 1 671, 1 673, 1 675, 1 677

Tables 5.1-2 and 5.1-3: For further Study

When operating at band 4 an RD shall follow the values presented in Table 5.1-4 and follow definitions given in ETSI TS 103 636-2 [2].

Table 5.1-4: Band, bandwidth, and absolute channel numbers

Clause in ETSI TS 103 636-2 [2]	Name	Value
5.2	Operating band	4
5.3	Operating channel bandwidth	1,728 MHz
5.4.2	Absolute channel numbers	525, 527, 529, 531, 533, 535, 536, 539, 541, 543, 545, 547, 549, 551

Tables 5.1-5 to 5.1-8: For further Study

When operating at band 9 an RD shall follow the values presented in Table 5.1-9 and follow definitions given in ETSI TS 103 636-2 [2].

Table 5.1-9: Band, bandwidth, and absolute channel numbers

Clause in ETSI TS 103 636-2 [2]	Name	Value
5.2	Operating band	9
5.3	Operating channel bandwidth	1,728 MHz
5.4.2	Absolute channel numbers	1 703, 1 705, 1 707, 1 709, 1 711

5.2 Maximum output power

RD may support any of the maximum transmitter outpower class I, class II, class III or class IV.

5.3 RX Gain value

As defined in ETSI TS 103 636-2 [2], clause B.2.2.

6 Physical layer

6.1 Radio device capabilities

RD shall support following physical layer configuration:

- Maximum number of spatial streams: 1;
- Reception for transmit diversity: 1;
- Subcarrier width scaling - μ: 1;
- Fourier transform scaling - β: 1;
- Supported modulation and coding scheme: as defined clause 6.2;
- Number of HARQ processes: 1 per communication pair;

- When operating in FT mode, an RD shall have capability for at least 4 parallel HARQ processes;
- Soft-buffer size HARQ: 25 344 bytes;
- Codeblock segment size: 2 048 bits.

6.2 Supported MCS and Transport Block Sizes

The RD shall support MCS-0 for one subslot transmissions and MCS-1 for 1 to 8 subslot transmissions, with granularity of one subslot granularity. The transmission length and used modulation shall be selected so that used transport block size does not exceed 2 088 bits.

Table 6.2-1 presents an example transport block size with MCS and transmission lengths.

Table 6.2-1: Transport block sizes example in bits with MCS and transmission length

MCS	TBS/ 1 subslot (bits)	TBS/ 2 subslot (bits)	TBS/ 3 subslot (bits)	TBS/ 4 subslot (bits)	TBS/ 5 subslot (bits)	TBS/ 6 subslot (bits)	TBS/ 7 subslot (bits)	TBS/ 8 subslot (bits)
MCS0	0	-	-	-	-	-	-	-
MCS1	32	296	552	824	1 096	1 352	1 608	1 864

Full description of subslot properties can be read in ETSI TS 103 636-3 [3], clauses 4.4, 4.5 and 5.1.

7 MAC layer

7.1 MAC Configuration Overview

The RD shall support mesh network architecture and indicate its capabilities in the RD capability IE field as defined in clause 7.3.4.3.5.

The RD shall support MAC procedures and data units as depicted in Table 7.1-1 and as defined in clauses 7.2 to 7.4. Use of other MAC procedures and data units may be possible in the implementation but is out of the scope of this profile. The parameter values defined in clauses 7.2 to 7.4 are recommended as a minimum implementation and subject to be used in the testing. Use of other values may be possible but is outside of the scope of this profile. All the procedures and data units (protocol data units, messages, information elements and their fields, variables and timers) presented in clause 7 refer to those defined in ETSI TS 103 636-4 [4].

Table 7.1-1: MAC requirements by clause

Clause in ETSI TS 103 636-4 [4]	Name	Support
5	MAC Layer Procedures	
5.1	Spectrum Management Procedures	
5.1.1	General	M
5.1.2	Operating Channel(s) and Subslot(s) selection	M
5.1.3	Last Minute Scan	M
5.1.4	Selecting RD for association	M
5.1.5	Beaconing Transmissions	M
5.1.6	Power control	M
5.2	Broadcast Procedure	M
5.3	Random Access procedure	M
5.4	Scheduled access data transfer	
5.5	HARQ Operation	M
5.6	Multiplexing and assembly	M
5.7	Mobility Procedures	M
5.8	Association procedure	M
5.9	Security Procedures	M

Clause in ETSI TS 103 636-4 [4]	Name	Support
5.9.1	Mode 1	M
5.9.1.2	Integrity protection	M
5.9.1.3	Ciphering	M
5.10	Reconfiguration	
5.11	Group Assignment	
5.12	Paging	
5.13	Selective Source Routing	
6	Protocol Data Units, formats, and parameters	
6.2	Physical layer field	M
6.3	MAC PDU	
6.3.2	MAC Header type	M
6.3.3	MAC Common header	
6.3.3.1	DATA MAC PDU header	M
6.3.3.2	Beacon Header	M
6.3.3.3	Unicast Header	M
6.3.3.4	RD Broadcasting Header	M
6.3.4	MAC multiplexing header	M
6.4	MAC Messages and Information Elements (IEs)	
6.4.2	MAC messages	
6.4.2.2	Network Beacon message	M
6.4.2.3	Cluster Beacon message	M
6.4.2.4	Association Request message	M
6.4.2.5	Association Response message	M
6.4.2.6	Association Release message	M
6.4.2.7	Reconfiguration Request message	
6.4.2.8	Reconfiguration Response message	
6.4.2.9	Additional MAC message	
6.4.2.10	Joining Beacon message	O
6.4.3	MAC information elements	
6.4.3.1	MAC Security Info IE	M
6.4.3.2	Route Info IE	M
6.4.3.3	Resource allocation IE	M
6.4.3.4	Random Access Resource IE	M
6.4.3.5	RD Capability IE	M
6.4.3.6	Neighbouring IE	M
6.4.3.7	Broadcast Indication IE	
6.4.3.8	Padding IE	M
6.4.3.9	Group Assignment IE	
6.4.3.10	Load Info IE	M
6.4.3.11	Configuration Request IE	M
6.4.3.12	Measurement Report IE	M
6.4.3.13	Radio Device Status IE	M
6.4.3.14	Keep Alive IE	M
6.4.3.15	RD capability short IE	
6.4.2.16	Source Routing IE	
6.4.3.17	Joining Information IE	C see note
6.4.3.18	Association Control IE	
NOTE: Mandatory in case Secure Joining Procedure is supported.		

7.2 MAC Procedures Configuration

7.2.1 Spectrum Management Procedures

7.2.1.1 General

For Further Study.

7.2.1.2 Operating Channel(s) and Subslot(s) selection

Operating Channel(s) and Subslot(s) selection Procedure is supported as described in clause 5.1.2 in ETSI TS 103 636-4 [4].

7.2.1.3 Last Minute Scan

Last Minute Scan Procedure is supported as described in clause 5.1.3 in ETSI TS 103 636-4 [4].

7.2.1.4 Selecting RD for Association

Selecting RD for Association Procedure is supported as described in clause 5.1.4 in ETSI TS 103 636-4 [4], with the following addition:

- An RD shall calculate its own route cost for each association target candidate and select the RD with the lowest calculated route cost.

In case of selecting RD to start Secure Joining, see clause 10.3 in the present document, only RDs with supported authentication EndPoint(s) shall be selected.

7.2.1.5 Beacon Transmission

7.2.1.5.1 General

In addition to Operating Channel(s) and Subslot(s) selection and Beaconing Transmissions defined in clauses 5.1.2 and 5.1.5 in ETSI TS 103 636-4 [4], the following clauses 7.2.1.5.2 and 7.2.1.5.3 apply to Beacon transmission timings.

7.2.1.5.2 Network Beacon Transmissions

RD in FT mode shall send Network Beacons by applying the structure defined in clause 11.2.1 and the parameter values defined in clause 7.3. For Network Beacons sent for Secure Joining procedure, see clause 10.3. To improve Network Beacon detection probability by other RDs, the RD in FT mode may randomize the transmission timing of the Network Beacon messages so that the average Network Beacon transmission period is as indicated in Network Beacon period field.

7.2.1.5.3 Cluster Beacon Transmissions

When RD in FT mode detects other RD's Cluster Beacons and their transmission timings, the RD should:

- prioritize channels that have a lower number of Cluster Beacons;
- transmit its own Cluster Beacon equally spaced with other Cluster Beacons;
- synchronize its own Cluster Beacon transmission with other beacons being transmitted in neighbouring channels based on majority vote principle, i.e. aligning its Cluster Beacon transmit timing with RD(s) in the biggest detected synchronized group.

NOTE: RD receiving Cluster Beacons should consider sufficient margins in Cluster Beacon timings due to clock drifts and channel access rules.

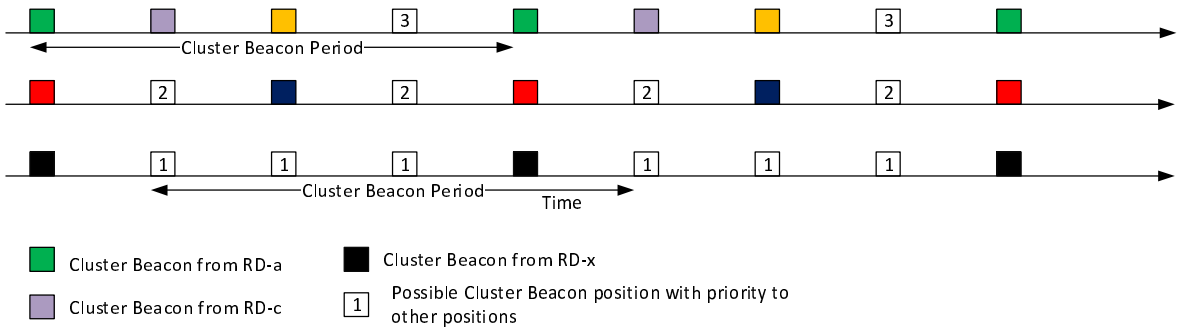

Figure 7.2.1.5.3-1: Example illustration of Cluster Beacon timings and priority of possible transmission locations

Furthermore, the RD should:

- transmit its own Cluster Beacon with different timing than the RD to which it is associated with;
- adjust its own Cluster Beacon transmission timing due to clock drifts during operations;
- prioritize its Cluster Beacon transmissions over Network Beacon transmissions.

RD in FT mode shall send Cluster Beacons by applying the structure defined in clause 11.2.2 and the parameter values defined in clause 7.3. For Cluster Beacons sent for Secure Joining procedure, see clause 10.3.

7.2.1.5.4 Joining Beacon Transmissions

If Joining Beacons within Secure Joining procedure, as defined in clause 10.3, are enabled the RD in FT mode shall send Joining Beacons by applying the structure defined in clause 11.2.3 and the parameter values defined in clause 7.3 in the present document.

The recommended interval to transmit Joining Beacons is 500 ms. To improve Joining Beacon detection probability by other RDs, the RD in FT mode may randomize the transmission timing of the Joining Beacon messages.

7.2.1.6 Power Control

Power Control Procedure is supported as described in clause 5.1.6 in ETSI TS 103 636-4 [4]. The transmitter should adjust the TX power for an initial transmission with its peer using MCS1 so that received power at the intended receiver is as follows:

$$RX\_Power \geq TX\_Power - PathlossEstimate$$

Where:

- RX_Power = -88 dBm.
- TX_Power is the lowest TX power value from Table 6.2.1-3a in ETSI TS103 636-4 [4] which satisfy the above formula.
- *PathlossEstimate* is the latest pathloss estimate obtained from a transmission received from the intended receiver on the given channel.

In case that initial transmission(s) are not successful, i.e. the RD does not receive any positive or negative acknowledgement the RD may increase the transmission power.

7.2.2 Broadcast Procedure

Broadcast Procedure is supported as described in ETSI TS 103 636-4 [4], clause 5.2.

7.2.3 Random Access Procedure

Random Access Procedure is supported as described in ETSI TS 103 636-4 [4], clause 5.3.

RD operating in FT mode shall provide RACH resources. The RACH resources may include time moments when RD is transmitting, scanning or short of resources.

7.2.4 Scheduled Access Data Procedure

Not applied in this version of the profile.

7.2.5 HARQ Operation

HARQ Operation is supported as described in ETSI TS 103 636-4 [4], clause 5.5.

7.2.6 Multiplexing and Assembly

Multiplexing and Assembly Procedure is supported as described in ETSI TS 103 636-4 [4], clause 5.6. Transmitter shall concatenate multiple Information Elements in a MAC PDU but should only include one DLC PDU per MAC PDU, as defined in clause 11 of the present document.

7.2.7 Mobility Procedures

Mobility Procedure is supported as described in ETSI TS 103 636-4 [4], clause 5.7, with following addition:

- An RD shall calculate its own route cost for each association target candidate for mobility, including the RD in FT mode it is currently associated, and select the RD with the lowest calculated route cost.

7.2.8 Association Procedure

Association Procedure is supported as described in ETSI TS 103 636-4 [4], clause 5.8, with the following additions:

- When associating, an RD shall use Association Request MAC PDU structure defined in clause 11.3.1 and the parameter values defined in clause 7.3.
- An RD shall respond to Association Request MAC PDU by applying the Association Response MAC PDU structure defined in clause 11.3.2 and the parameter values defined in clause 7.3. The RD should also include the following IEs:
  - Radio Devices Status IE, in case a memory full or scan, see clause 7.3.4.3.13;
  - Measurement Report IE, in case the MAC PDU transmission has failed, see clause 7.3.4.3.12.
- An RD shall use Association Release MAC PDU structure defined in clause 11.3.2 and the parameter values defined in clause 7.3 for releasing the association:
  - Association Release IE in case the RD is not associated with the data transmitting RD or not operating in the expected mode, see clause 7.3.4.3.6.
- When the ongoing Association Procedure is for initiating Secure Joining, the Association Request and Association Response MAC PDUs shall be sent without MAC security.

7.2.9 Security Procedures

Security Procedure of Security Mode 1 with Security IV type set to One-time HPC is supported as described in ETSI TS 103 636-4 [4], clause 5.9.

NOTE: To avoid compromising security, care should be taken to make sure the same initialization vector value is never repeated, e.g. in restarting situations.

7.2.10 Reconfiguration Procedure

Not applied in this version of the profile.

7.2.11 Group Assignment Procedure

Not applied in this version of the profile.

7.2.12 Paging Procedure

Not applied in this version of the profile.

7.2.13 Selective Source Routing Procedure

Not applied in this version of the profile.

7.3 MAC Protocol Data Units Configuration

7.3.1 General

For Further Study.

7.3.2 Physical Header Field

Physical Header Field configuration for header type 1 is depicted in Table 7.3.2-1.

Table 7.3.2-1: Physical Layer Control Field for header type 1

Field	Recommended values	Normative action/comment
Header Format	0b000	Header type 1 selected.
Packet length type	0b0	The length type is set in subslots.
Packet length	0b0000 - 0b1000	As defined in clause 6.2. The minimum length is selected to fit transmitted beacon message.
Short Network ID	Any	As defined in ETSI TS 103 636-4 [4].
Transmitter Identity	Any	As defined in ETSI TS 103 636-4 [4].
Transmit Power	Any	As defined in ETSI TS 103 636-4 [4].
Reserved	0b0	As defined in ETSI TS 103 636-4 [4].
DF MCS	0b001	MCS1 is selected.

Physical Header Field configuration for header type 2 is depicted in Table 7.3.2-2.

Table 7.3.2-2: Physical Layer Control Field for header type 2, Header Format: 000

Field	Recommended values	Normative action/comment
Header Format	0b000	Header type 2, Format 000 is selected.
Packet length type	0b0	The length type is set in subslot.
Packet length	0b0000 - 0b1000	As defined in clause 6.2.
Short Network ID	Any	As defined in ETSI TS 103 636-4 [4].
Transmitter Identity	Any	As defined in ETSI TS 103 636-4 [4].
Transmit Power	Any	As defined in ETSI TS 103 636-4 [4].
Reserved	0b0	As defined in ETSI TS 103 636-4 [4].
DF MCS	0b001	MCS1 is selected. If the receiver has indicated support of higher MCS, the transmitter may use MCS up to the highest supported MCS.
Receiver Identity	Any	As defined in ETSI TS 103 636-4 [4].
Number of Spatial Streams	0b00	Single spatial stream.
DF redundancy version	0b00	As defined in ETSI TS 103 636-4 [4].
DF New Data Indication	Either	As defined in ETSI TS 103 636-4 [4].
DF HARQ Process Number	0b000	One process in use.
Feedback format	0b0000	No feedback.
Feedback info	NA	Set to zero as defined in ETSI TS 103 636-4 [4]. The bit field is ignored by the receiver.

Table 7.3.2-3: Physical Layer Control Field for header type 2, Header Format: 001

Field	Recommended values	Normative action/comment
Header Format	0b001	Header type 2, Format 001 is selected.
Packet length type	0b0	The length type is set in subslot.
Packet length	0b0000 - 0b1000	As defined in clause 6.2.
Short Network ID	Any	As defined in ETSI TS 103 636-4 [4].
Transmitter Identity	Any	As defined in ETSI TS 103 636-4 [4].
Transmit Power	Any	As defined in ETSI TS 103 636-4 [4].
Reserved	0b0	As defined in ETSI TS 103 636-4 [4].
DF MCS	0b000 or 0b001	MCS-0 used if only HARQ feedback is transmitted without MAC PDU. MCS-1 is selected for transmitting MAC PDU. If the receiver has indicated support of higher MCS, the transmitter may use MCS up to the highest supported MCS.
Receiver Identity	Any	As defined in ETSI TS 103 636-4 [4].
Number of Spatial Streams	0b00	Single spatial stream.
Reserved	0b0	As defined in ETSI TS 103 636-4 [4].
Feedback format	0b0000, 0b0001, 0b0110	When no ACK/NACK feedback is included, the field is set to value: 0b0000: No feedback. When ACK/NACK feedback is included, the field is set to value: 0b0001: Format 1 or 0b0110: Format 6.
Feedback info	See the Normative action/comment	In case Feedback format field is set to value 0b0000 the Feedback info field is ignore by the receiver. In case Feedback format field is set to value 0b0001 (Format 1), see Table 7.3.2-4a and in case it is set to value 0b0110 (Format 6), see Table 7.3.2-4f.

Table 7.3.2-4a: Feedback info format 1

Field	Recommended values	Normative action/comment
HARQ Process number	0b000	One process in use, number fixed to value 0b000.
Transmission feedback	Either	As defined in ETSI TS 103 636-4 [4].
Buffer Status	0	Set to zero.
Channel Quality Indicator (CQI)	0b0010	MCS-1.

Tables 7.3.2-4b to 7.3.2-4e: For Further Study

Table 7.3.2-4f: Feedback info format 6

Field	Recommended values	Normative action/comment
HARQ Process number	0b000	Only one process in use, number fixed to value 0b000.
Reserved	0	As defined in ETSI TS 103 636-4 [4].
Buffer Status	0	Set to zero.
Channel Quality Indicator (CQI)	0b0010	MCS-1.

7.3.3 MAC PDU

7.3.3.1 General

For Further Study.

7.3.3.2 MAC Header Type

MAC header type for Beacon header is depicted in Table 7.3.3.2-1.

Table 7.3.3.2-1: MAC header type for Beacon header

Field	Recommended values	Normative action/comment
Version	0b00	PDUs with higher Version number are not applied in this version of the profile.
MAC security	0b00, 0b10	Value 0b00 (no MAC security) is used for Joining Beacon, Network Beacon, and Cluster Beacon messages in Secure Joining procedure, see clause 10.3 in the present document. Value 0b01 (MAC security in use) is used for other Network Beacon and Cluster Beacon messages; MAC Security Info IE is included in the MAC PDU. The ciphered part starts immediately after the MAC Security info.
MAC header type	0b0001	Beacon header.

MAC header type for Unicast header is depicted in Table 7.3.3.2-2.

Table 7.3.3.2-2: MAC header type for Unicast header

Field	Recommended values	Normative action/comment
Version	0b00	PDUs with higher Version number are not applied in this version of the profile.
MAC security	0b00, 0b10	Value 0b00 (no MAC security) is used in the ACK with MAC Payload, see clause 11.4.3. Value 0b00 is also used for Association Request and Association Response messages, and Application Data MAC PDUs, while lacking network credentials in the Secure Joining procedure. Value 0b10 is for any other unicast message.
MAC header type	0b0000, 0b0010	Value 0b0000 (DATA MAC PDU header) is used in the ACK with MAC Payload, see clause 11.4.3. Value 0b0010 (unicast header) is used for any other unicast message.

7.3.3.3 MAC Common header

7.3.3.3.1 Data MAC PDU header

Data MAC PDU header is depicted in Table 7.3.3.3-1.

Table 7.3.3.3-1: Data MAC PDU header

Field	Recommended values	Normative action/comment
Reserved	0b000	As defined in ETSI TS 103 636-4 [4].
Reset	0b1	Reset for every PDU, i.e. no re-ordering function is in use.
Sequence number	Any	As defined in ETSI TS 103 636-4 [4].

7.3.3.3.2 Beacon Header

Beacon Header configuration for Beacon messages is depicted in Table 7.3.3.3.2-1.

Table 7.3.3.3.2-1: Beacon header for Beacon messages

Field	Recommended values	Normative action/comment
Network ID	Any	As defined in ETSI TS 103 636-4 [4].
Transmitter address	Any	As defined in ETSI TS 103 636-4 [4].

7.3.3.3.3 Unicast Header

Unicast Header configuration is depicted in Table 7.3.3.3.3-1.

Table 7.3.3.3.3-1: Unicast header

Field	Recommended values	Normative action/comment
Reset	0b0	No MAC re-ordering function expected.
Sequence number	Any	As defined in ETSI TS 103 636-4 [4].
Receiver Address	Any	As defined in ETSI TS 103 636-4 [4].
Transmitter Address	Any	As defined in ETSI TS 103 636-4 [4].

7.3.3.3.4 RD Broadcasting Header

Not applied in this version of the profile.

7.3.3.4 MAC Multiplexing headers

MAC Mux header options A, B, C and D shall be supported in this version of the profile.

7.3.4 MAC Messages and Information Elements

7.3.4.1 General

For Further Study.

7.3.4.2 MAC Messages

7.3.4.2.1 General

For Further Study.

7.3.4.2.2 Network Beacon Message IE

The recommended field values for this profile are defined in Table 7.3.4.2.2-1.

Table 7.3.4.2.2-1: Network Beacon Message IE

Field	Recommended values	Normative action/comment
Tx Power	0b0	Clusters Max TX power field is not included.
Power const	0b0	The RD operating in FT mode does not have power constrains.
Current	Either	As defined in ETSI TS 103 636-4 [4].
Network Beacon Channels	0b0	No additional Network beacon channels is included.
Network Beacon Period	0b0011	1 000 ms.
Cluster Beacon Period	0b1000	8 000 ms.
Next Cluster Channel	Any	As defined in clause 5.1.
Time to Next	Any	As defined in ETSI TS 103 636-4 [4].
Cluster Max TX Power	NA	Parameter is not present.
Current Cluster channel	NA/Any	As defined in clause 5.1. Present when Current field is set to value 1.
Additional Network Beacon Channels	NA	Parameter is not present.

7.3.4.2.3 Cluster Beacon Message IE

The recommended field values for this profile are defined in Table 7.3.4.2.3-1.

Table 7.3.4.2.3-1: Cluster Beacon Message IE

Field	Recommended values	Normative action/comment
SFN	0x00	Set to zero at every Cluster Beacon sent at 8 second interval.
TX Power	0b0	Cluster's Max TX power field is not included.
Power const	0b0	The RD operating in FT mode does not have power constrains.
FO	0b0	Frame Offset field is not present.
Next Channel	Either	As defined in ETSI TS 103 636-4 [4].
Time to Next	Either	As defined in ETSI TS 103 636-4 [4].
Network Beacon Period	0b0100	1 000 ms.
Cluster Beacon Period	0b1001	8 000 ms.
Count To Trigger	0b1000	8 times.
RelQuality	0b0011	6 dB.
MinQuality	0b0011	6 dB.
Cluster Max TX Power	NA	Parameter is not present.
Frame Offset	NA	Parameter is not present.
Next Cluster Channel	NA/Any	As defined in clause 5.1. Present when Next Channel field is set to value 1.
Time to Next	NA/Any	As defined in clause 5.1. Present when Next Channel field is set to value 1.

7.3.4.2.4 Association Request Message IE

The recommended field values for this profile are defined in Table 7.3.4.2.4-1.

Table 7.3.4.2.4-1: Association Request Message IE

Field	Recommended values	Normative action/comment
Setup cause	0b000	Initial association.
Number of flows	0b001	One flow.
Power const	0b0	RD has no power constraints.
FT mode	Either	As defined in ETSI TS 103 636-4 [4].
Current	Either	As defined in ETSI TS 103 636-4 [4].
HARQ Process Tx	0b001	One HARQ process.
MAX HARQ RE-TX	0b01010	20 ms.
HARQ Process Rx	0b001	One HARQ process.
MAX HARQ RE-RX	0b01010	20 ms.
Flow ID	0b000011	User plane data - flow 1.
Network Beacon period	0b0011	1 000 ms.
Cluster Beacon period	0b1000	8 000 ms.
Next Cluster Channel	NA/Any	Present, if FT mode field was set in 0b1. For values, see clause 5.1.
Time To Next	NA/Any	Present, if FT mode field was set in 0b1. Values as defined in ETSI TS 103 636-4 [4].
Current Cluster Channel	NA/Any	Present, if Current Cluster Channel field was set in 0b1. For values, see clause 5.1.

7.3.4.2.5 Association Response Message IE

The recommended field values for this profile are defined in Table 7.3.4.2.5-1.

Table 7.3.4.2.5-1: Association Response Message IE

Field	Recommended values	Normative action/comment
ACK/NACK	Either	As defined in ETSI TS 103 636-4 [4].
HARQ-mod	Either	As defined in ETSI TS 103 636-4 [4].
Number of flows	0b001	One flow.
Group	0b0	Group ID and Resource Tag are not included.
Reject Cause	0b0	No sufficient radio capacity.
Reject Timer	0b0101	120 seconds.
HARQ Process RX	NA/0b001	Parameter is not present/1 HARQ process.
MAX HARQ RE-RX	NA/Any	Parameter is not present/decided value.
HARQ Process Tx	NA/0b001	Parameter is not present/1 HARQ process.
MAX HARQ RE-TX	NA/Any	Parameter is not present/decided value.
Flow ID	0b000011	User plane data - flow 1.
Group ID	NA	Parameter is not present.
Resource Tag	NA	Parameter is not present.

7.3.4.2.6 Association Release Message IE

The recommended field values for this profile are defined in Table 7.3.4.2.6-1.

Table 7.3.4.2.6-1: Association Release Message IE

Field	Recommended values	Normative action/comment
Release cause	0b000, 0b1010, 0b1100	Connection termination, not associated, not operating in FT mode.

7.3.4.2.7 Reconfiguration Request Message IE

Not applied in this version of the profile.

7.3.4.2.8 Reconfiguration Response Message IE

Not applied in this version of the profile.

7.3.4.2.9 Additional MAC Message

Not applied in this version of the profile.

7.3.4.2.10 Joining Beacon Message

When used to signal Joining Information, the recommended field values for this profile are defined in Table 7.3.4.2.10-1.

Table 7.3.4.2.10-1: Joining Beacon Message IE

Field	Recommended values	Normative action/comment
Network Beacon Channels	0b00	One network beacon channel.
Network Beacon Period	0b0011	See Table 7.3.4.2.2-1 in the present document.
Network Channel	Any	The Network Beacon channel used for sending the related Network Beacons, available values are as defined in clause 5.1 of the present document.

7.3.4.3 MAC Information Elements

7.3.4.3.1 MAC Security Info IE

MAC Security Info IE configuration for the profile is depicted in Table 7.3.4.3.1-1.

Table 7.3.4.3.1-1: MAC Security info IE

Field	Recommended values	Normative action/comment
Version	0b00	Mode 1.
Key Index	0b00	First key index.
Security IV type	0b0000	Value 0b0000 (One-time HPC) is used when sending any message.
HPC	Any	As defined in ETSI TS 103 636-4 [4].

7.3.4.3.2 Route Info IE

The recommended field values for this profile are defined in Table 7.3.4.3.2-1.

Table 7.3.4.3.2-1: Route Info IE

Field	Recommended values	Normative action/comment
Sink_Address	Any	As defined in ETSI TS 103 636-4 [4].
Route_cost	Any	As defined in ETSI TS 103 636-4 [4].
Application_Sequence_Number	Any	As defined in ETSI TS 103 636-4 [4].

7.3.4.3.3 Resource Allocation IE

Not applied in this version of the profile.

7.3.4.3.4 Random Access Resource IE

The recommended field values for this profile are defined in Table 7.3.4.3.4-1.

Table 7.3.4.3.4-1: Random Access Resource IE

Field	Recommended values	Normative action/comment
Reserved	0b000	As defined in ETSI TS 103 636-4 [4].
Repeat	0b01	Resource allocation is repeated in coming frames.
SFN	0b0	The SFN offset field is not present.
Channel	Either	As defined in ETSI TS 103 636-4 [4].
Chan_2	0b0	Random access response is received on the same channel.
Start_subslot	0b0	Random access resource is started at subslot 0 of the frame.
Length_type	0b0	Random access resource length is given in subslots.
Length	0x30	8-bit binary field, value 48 indicates that Random access resource is valid for complete frame.
Length_type	0b0	Maximum Random access transmission length is given in subslots.
Max_RACH_Length	0x08	8-bit binary value, indicating maximum TX length of 8 subslots.
CWmin_sig	0b111	4,7 ms.
DECT_Delay	0b0	As defined in ETSI TS 103 636-4 [4].
Response_window	0b0011	4 (3+1) subslots.
CWmax_sig	0b111	149,3 ms.
Repetition	0x01	As defined in ETSI TS 103 636-4 [4].
Validity	0xFF	Resource is valid until next Random Access Resource allocation is received.
SFN	NA	Parameter is not present.
Channel	NA/Any	Parameter is not present, when RACH IE is included in beacon. Parameter is present and set as defined in clause 5.1 when included in Association Request message.

7.3.4.3.5 RD Capability IE

The recommended field values for this profile are defined in Table 7.3.4.3.5-1.

Table 7.3.4.3.5-1: RD Capability IE

Field	Recommended values	Normative action/comment
Number of Phy capabilities	0b000	The device supports single numerology used in an existing connection.
Release	0b00001	Release 1
GroupAs.	0b0	Group assignment operation is not supported.
Paging	0b0	Paging is not supported.
Operating modes	0b01, 0b10	The field is set to value 0b01 for Sinks, otherwise it is set to value 0b10 for both FT mode and PT mode.
Mesh	0b1	Mesh system operation shall be supported.
Schedul.	0b0	Scheduled data transfer service is not supported.
MAC security	0b01	MAC security Mode 1 is supported.
DLC service type	0b010	DLC service type 2 is supported.
RD Power Class	0b010	Power class III (19 dBm).
MAX NSS for RX	0b000	One stream.
RX for TX diversity	0b000	1.
RX Gain	0b0110	2 dB.
MAX MCS	0b0001	MCS-1.
Soft-buffer size	0b0001	25 344 Bytes.
Num. of HARQ proce	0b00	1 HARQ process.
HARQ feedback delay	0b0010	2 subslots.
D_Delay	0b0	DECT_Delay and reception of Broadcast Indication IE in Random Access operation not supported.
HalfDup	0b0	Half-duplex operation not supported.
μ	NA	Parameter is not present.
β	NA	Parameter is not present.

7.3.4.3.6 Neighbouring IE

The recommended field values for this profile are defined in Table 7.3.4.3.6-1.

Table 7.3.4.3.6-1: Neighbouring IE

Field	Recommended values	Normative action/comment
ID	0b0	The Long RD ID is not present.
μ	0b0	Radio device class signalling is not present. The indicated RD operates with same μ and β factor as the RD sending this IE.
SNR	0b0	SNR measurement is not included.
RSSI-2	0b0	RSSI-2 measurement is not included.
Power_Const	0b0	The RD operating in FT mode does not have power constrains.
Next_Channel	0b1	Next cluster channel field of the neighbour is included.
Time_to_Next	0b1	Time to next field is present.
Network Beacon period	0b0011	1 000 ms.
Cluster Beacon period	0b1000	8 000 ms.
Long RD ID	NA	Parameter is not present.
Next_Cluster_Channel	Any	Absolute channel number as defined in clause 5.1.
Time_to_Next	Any	As defined in ETSI TS 103 636-4 [4].
RSSI-2	NA	Parameter is not present.
SNR	NA	Parameter is not present.
Radio Device Class: μ	NA	Parameter is not present.
Radio Device Class: β	NA	Parameter is not present.
Reserved	NA	Parameter is not present.

7.3.4.3.7 Broadcast Indication IE

Not applied in this version of the profile.

7.3.4.3.8 Padding IE

Padding IE is configured as described in ETSI TS 103 636-4 [4].

7.3.4.3.9 Group Assignment IE

Not applied in this version of the profile.

7.3.4.3.10 Load Info IE

The recommended field values for this profile are defined in Table 7.3.4.3.10-1.

Table 7.3.4.3.10-1: Load Info IE

Field	Recommended values	Normative action/comment
Max_Assoc	0b0	MAX number of associated RDs is 8-bit field.
RD_PT_load	0b1	Currently associated RDs in PT mode percentage field is present.
RACH_load	0b0	RACH Load percentage field is not present.
Channel_Load	0b0	Percentage of slots detected "free" and Percentage of slots detected "busy" fields are not present.
Traffic_Load_Percentage	Any	As defined in ETSI TS 103 636-4 [4].
Max_number_of_associated_RDs	0x0A - 0xFF	The number can be chosen by the implementation but should be at least 10 to avoid long hop-chains.
Currently associated RDs in FT mode	Any	As defined in ETSI TS 103 636-4 [4].
Currently associated RDs in PT mode	Any	As defined in ETSI TS 103 636-4 [4].
RACH_load_in_percentage	NA	Parameter is not present.
Percentage of subslots detected "free"	NA	Parameter is not present.
Percentage of subslots detected "busy"	NA	Parameter is not present.

7.3.4.3.11 Configuration Request IE

Configuration Request IE is as described in ETSI TS 103 636-4 [4], clause 6.4.3.11.

7.3.4.3.12 Measurement Report IE

The recommended field values for this profile are defined in Table 7.3.4.3.12-1.

Table 7.3.4.3.12-1: Measurement Report IE

Field	Recommended values	Normative action/comment
SNR	0b0	SNR is not present.
RSSI-2	0b0	RSSI-2 is not present.
RSSI-1	0b0	RSSI-1 is not present.
Tx count	0b1	Tx count is present.
RACH	0b1	Measurement result obtained from DL reception of Random access response.
SNR result	NA	Parameter is not present.
RSSI-2 result	NA	Parameter is not present.
RSSI-1 result	NA	Parameter is not present.
TX count result	0xFF	Value 0xFF indicates that transmission of a MAC PDU has completely failed.

7.3.4.3.13 Radio Device Status IE

When used to signal memory full situation in acknowledgement or response message, the recommended field values for this profile are as defined in Table 7.3.4.3.13-1.

Table 7.3.4.3.13-1: Radio Device Status IE for memory full situation

Field	Recommended values	Normative action/comment
Status flag	0b01	Memory full.
Duration	0b1011	Unknown duration.

When used to indicate that device was doing a network scan in acknowledgement or response message, the recommended field values for this profile are as defined in Table 7.3.4.3.13-2.

Table 7.3.4.3.13-2: Radio Device Status IE for scan indication

Field	Recommended values	Normative action/comment
Status flag	0b10	Shall set to value 0b10, when RD in FT mode has returned to normal operation.
Duration	0b0111	1 500 ms (network beacon interval + margin).

7.3.4.3.14 Keep Alive IE

Keep Alive IE is as described in ETSI TS 103 636-4 [4], clause 6.4.3.14.

7.3.4.3.15 RD capability short IE

Not applied in this version of the profile.

7.3.4.3.16 Source Routing IE

Not applied in this version of the profile.

7.3.4.3.17 Joining Information IE

When used to signal Joining Information, the recommended field values for this profile are as defined in Table 7.3.4.3.17-1.

Table 7.3.4.3.17-1: Joining Information IE

Field	Recommended values	Normative action/comment
Number of EPs	Any	As defined in ETSI TS 103 636-4 [4].
EP	Any	The supported authentication protocol EndPoint value(s), as defined in ETSI TS 103 636-5 [5], Annex A.

7.3.4.3.18 Association Control IE

Not applied in this version of the profile.

7.4 MAC Variables and Timers Configuration

7.4.1 General

For Further Study.

7.4.2 MAC Variables Configuration

Table 7.4.2-1: Channel Selection and Mobility variables

Variable	Default value on Operating Band 1, 2, 9 or 22 in ETSI TS 103 636-2 [2]	Default value on other Operating Bands in ETSI TS 103 636-2 [2]	Definition
DECT_PROTECTED	TRUE	NA	As defined in ETSI TS 103 636-4 [4].
SCAN_MEAS_DURATION	24 slots	NA	As defined in ETSI TS 103 636-4 [4].
RSSI_THRESHOLD_MIN	-85 dBm	NA	As defined in ETSI TS 103 636-4 [4].
RSSI_THRESHOLD_MAX	-52 dBm - MAX TX power of the RD	-40 dBm - MAX TX power of the RD	As defined in ETSI TS 103 636-4 [4].
SCAN_SUITABLE	75 %	NA	As defined in ETSI TS 103 636-4 [4].
CHANNEL_LOADED	80 %	NA	As defined in ETSI TS 103 636-4 [4].
SCAN_MEAS_START	8 s	NA	As defined in ETSI TS 103 636-4 [4].
NETWORK_BEACON_PRERIOD	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].
CLUSTER_BEACON_PERIOD	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].
COUNT_TO_TRIGGER	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].
REL_QUALITY	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].
MIN_QUALITY	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].
NEXT_CLUSTER_CHANNEL	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].

Table 7.4.2-2: Random Access variables

Variable	Default value on Operating Band 1, 2, 9 or 22 in ETSI TS 103 636-2 [2]	Default value on Operating Band in ETSI TS 103 636-2 [2]	Normative action/comment
CW_CURRENT	Dynamic	Dynamic	As defined in ETSI TS 103 636-4 [4].
CW_MAX	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].
CW_MIN	Always signalled	Always signalled	As defined in ETSI TS 103 636-4 [4].
MINIMUM_LBT_ PERIOD	1 slot	1 slot	RD may adjust the LBT length according to radio environment.

7.4.3 MAC Timers Configuration

Table 7.4.3-1: Channel Selection and Mobility variables

Timer	Value on Operating Band 1, 2, 9 or 22 in ETSI TS 103 636-2 [2]	Value on Operating Band in ETSI TS 103 636-2 [2]
dectProTime	Beacon transmissions and Resources announced for random access transmission: Cluster beacon period. Resources to be allocated for scheduled access transmissions: 800 ms	As defined in ETSI TS 103 636-4 [4].
scanStatusValid	300 s	As defined in ETSI TS 103 636-4 [4].
rachBackOff	Dynamic	As defined in ETSI TS 103 636-4 [4].
countToTrigger	Always signalled	As defined in ETSI TS 103 636-4 [4].
timeToNext	Always signalled	As defined in ETSI TS 103 636-4 [4].
dectScheduledResourceFailure	Default value 2 seconds Other values signalled	As defined in ETSI TS 103 636-4 [4].
dectRachResourceFailure	10 s	As defined in ETSI TS 103 636-4 [4].

8 DLC layer

8.1 DLC Configuration Overview

DLC procedures and data units support overview is depicted in Table 8.1-1 and as defined in clauses 8.2 to 8.3. Use of other DLC procedures and data units may be possible in the implementation but is out of the scope of this profile. The parameter values defined in clauses 8.2 to 8.3 are recommended as a minimum implementation and subject to be used in the testing. Use of other values may be possible but is outside of the scope of this profile. All the procedures and data units (protocol data units, messages, information elements and their fields) presented in clause 8 refer to those defined in ETSI TS 103 636-5 [5].

Table 8.1-1: DLC requirements by chapters

Clause in ETSI TS 103 636-5 [5]	Name	Support
5.2.	DLC Procedures	
5.2.1	DLC Service type 0 procedures	
5.2.2	DLC Service type 1 procedures	
5.2.3	DLC Service type 2 and service type 3 procedures.	M See note
5.2.4	Segmentation	
5.2.5	Reassembly	
5.2.6	DLC Retransmissions (ARQ) using implicit ACK/NACK	M
5.2.7	DLC SDU lifetime control	M
5.2.8	Routing Service	
5.2.8.2	Packet Routing to backend (uplink)	M
5.2.8.3	Packet Routing from backend (downlink)	M
5.2.8.4	Packet Routing between RDs	
5.3	DLC Data units	
5.3.2	DLC Service Type 0	
5.3.3	DLC Service Types 1, 2 and 3	
5.3.3.1	Data PDU	M
5.3.3.2	DLC Timers configuration Control IE	
5.3.4	Routing header	M
NOTE: DLC Service type 2 only.		

8.2 DLC Procedures Configuration

8.2.1 DLC Service Type 0: Transparent Mode

Not applied in this version of the profile.

8.2.2 DLC Service Type 1: Segmentation Mode

Not applied in this version of the profile.

8.2.3 DLC Service Type 2: ARQ Mode

DLC Service Type 2 shall be supported.

8.2.4 DLC Service Type 3: Segmentation and ARQ Mode

Not applied in this version of the profile.

8.2.5 DLC Routing Service

DLC Routing Services shall be supported.

8.3 DLC Data Units Configuration

8.3.1 DLC Data PDU configuration

The recommended field values for this profile are defined in Table 8.3.1-1.

Table 8.3.1-1: DLC Data PDU configuration

Field	Recommended values	Normative action/comment
IE type	0b0010	Data: DLC Service Types 1, 2 or 3 with routing header.
SI	0b00	Data field contains complete higher layer SDU.
Sequence number	Any	As defined in ETSI TS 103 636-5 [5].

8.3.2 DLC Data PDU configuration

For Further Study.

8.3.3 Routing Header configuration

The recommended field values for this profile are defined in Table 8.3.3-1.

Table 8.3.3-1: Routing Header configuration

Field	Recommended values	Normative action/comment
QoS	Any	As defined in ETSI TS 103 636-5 [5].
Delay	0b1	Delay field is present.
Hop count/limit	0b01, 0b10	If hop limit is requested by application, value 0b01 (both present) is used, else value 0b10 (Hop-count is present, Hop-limit is not present).
Dest_Addr	0b000, 0b001, 0b010, 0b011	Dest_Addr shall be set to value 0b000 (Destination and source addresses are present), if packet is sent using Routing Type 0b011 (downlink from sink) and higher layer request unicast transmission. Dest_Addr shall be set to value 0b001 (Destination address is broadcast), if packet is sent using routing type 0b011 (downlink from sink) and higher layer requests broadcast transmission. Dest_Addr shall be set to value 0b010 (Destination address is backend address), if packet is sent using routing type 0b000 (uplink to anySink). Dest_Addr shall be set to value 0b000 (Destination and source addresses are present), if packet is sent using routing type 0b101 (local RD to RD).
Routing Type	0b000, 0b011, 0b101	As defined in ETSI TS 103 636-5 [5].
Source Address	Any	As defined in ETSI TS 103 636-5 [5].
Destination Address	Any	As defined in ETSI TS 103 636-5 [5].
Hop-count	Any	As defined in ETSI TS 103 636-5 [5].
Hop-limit	Any	As defined in ETSI TS 103 636-5 [5].
Delay	Any	As defined in ETSI TS 103 636-5 [5].
Sequence number	Any	As defined in ETSI TS 103 636-5 [5].

9 CVG layer

9.1 CVG Configuration Overview

CVG procedure and data unit support overview is depicted in Table 9.1-1 and as defined in clauses 9.2 to 9.3. Use of other CVG procedures and data units may be possible in the implementation but is out of the scope of this profile. The parameter values defined in clauses 9.2 to 9.3 are recommended as a minimum implementation and subject to be used in the testing. Use of other values may be possible but is outside of the scope of this profile. All the procedures and data units (protocol data units, messages, information elements and their fields, variables and timers) presented in clause 9 refer to those defined in ETSI TS 103 636-5 [5].

Table 9.1-1: CVG requirements by chapters

Clause in ETSI TS 103 636-5 [5]	Name	Support
6.2	CVG Procedures	
6.2.2	CVG Service types	
6.2.2.1	CVG Service type 0 procedures (Transparent)	
6.2.2.2	CVG Service type 1 procedures (Sequence numbering)	
6.2.2.3	CVG Service type 2 procedures (Segmentation & reassembly)	M
6.2.2.4	CVG Service type 3 procedures (FC)	
6.2.2.5	CVG Service type 4 procedures (FC and ARQ)	
6.2.3	Transparent procedure	
6.2.4	Endpoint multiplexing procedure	M
6.2.5	Duplicate Removal procedure	
6.2.6	Delivery Order procedures	
6.2.7	Transmission and Segmentation procedure	M
6.2.8	Reception and Reassembly procedure	
6.2.9	Flow control procedures	
6.2.10	Retransmission (ARQ) procedure	
6.2.11	Lifetime control procedure	
6.2.12	Tx Services configuration procedure	
6.2.13	Security Procedures	
6.2.13.2	Security Mode 1 procedures	
6.2.14	Flow Status procedures	
6.3	CVG Protocol Data Units	
6.3.2	CVG Header	M
6.3.3	EP Mux IE	
6.3.4	Data IE	
6.3.5	Data EP IE	M
6.3.6	Data Transparent IE	
6.3.7	Security IE	
6.3.8	Tx Services Config IE	
6.3.9	ARQ Feedback IE	
6.3.10	ARQ Poll IE	
6.3.11	Flow Termination IE	

9.2 CVG Procedure Configuration

9.2.1 CVG Service Types

Service type 2 (segmentation and reassembly) shall be supported.

9.2.2 Transparent Procedure

Not applied in this version of the profile.

9.2.3 Multiplexing Procedure

Endpoint Multiplexing procedure shall be supported.

9.2.4 Duplicate Removal Procedure

Duplicate removal procedure is recommended to be used.

9.2.5 Delivery Order Procedure

Not applied in this version of the profile.

9.2.6 Transmission and Segmentation Procedure

Transmission and Segmentation Procedure shall be supported as defined in ETSI TS 103 636-5 [5], clause 6.2.7.

RD shall support segmentation of CVG SDU sizes up to 1 500 octets.

NOTE 1: TBS limitation is defined in clause 6.2.

NOTE 2: CVG security and concatenation of SDUs are not applied in this version of the profile.

9.2.7 Reception and Reassembly Procedure

Reception and Reassembly Procedure shall be supported as defined in ETSI TS 103 636-5 [5], clause 6.2.8.

RD shall support reassembly of CVG SDU sizes up to 1 500 octets.

NOTE: CVG security and concatenation of SDUs are not applied in this version of the profile.

9.2.8 Flow Control Procedure

Not applied in this version of the profile.

9.2.9 Retransmission (ARQ) Procedure

Not applied in this version of the profile.

9.2.10 Lifetime Control Procedure

Not applied in this version of the profile.

9.2.11 Tx Services Configuration Procedure

Not applied in this version of the profile.

9.2.12 Security Procedures

Not applied in this version of the profile.

9.2.13 Flow Status Procedures

Not applied in this version of the profile.

9.3 CVG Protocol Data Unit configuration

9.3.1 CVG Header

CVG header format 1 shall be supported.

9.3.2 EP Mux IE

Not applied in this version of the profile.

9.3.3 Data IE

Not applied in this version of the profile.

9.3.4 Data EP IE

Data EP IE shall be supported.

The recommended field values for this profile are defined in Table 9.3.4-1.

Table 9.3.4-1: Data EP IE configuration

Field	Recommended values	Normative action/comment
CVG Ext	0b01, 0b10	The field is set depending on the length of the current SDU.
MT	0b0	The field is set to indicate header format 1.
CVG IE Type	0b00010	Type is set to Data EP IE.
Length	Any	As defined in ETSI TS 103 636-5 [5].
Endpoint mux	Any	The field is set to a system specific value or a standard value, see ETSI TS 103 636-5 [5], Annex A.
SI	Any	As defined in ETSI TS 103 636-5 [5].
SLI	0b0	SDU length is not included.
Sequence number	Any	As defined in ETSI TS 103 636-5 [5].
SDU length	NA	Parameter is not included.
Segmentation offset	Any	As defined in ETSI TS 103 636-5 [5].

9.3.5 Data Transparent IE

Not applied in this version of the profile.

9.3.6 Security IE

Not applied in this version of the profile.

9.3.7 Tx Services Config IE

Not applied in this version of the profile.

9.3.8 ARQ Feedback IE

Not applied in this version of the profile.

9.3.9 ARQ Poll IE

Not applied in this version of the profile.

9.3.10 Flow Status IE

Not applied in this version of the profile.

10 Profile Procedures

10.1 Association maintenance

10.1.1 Uplink Connection

If there is no other messaging with the association target, the RD should renew its association within 48 seconds by sending the Association Request MAC PDU as defined in clause 11.3.1. Also, if an RD changes its mode from FT to PT or from PT to FT, it shall update this information by sending the Association Request MAC PDU to its association target RD.

10.1.2 Downlink Keep Alive procedure

Downlink Keep Alive messaging is used for verifying downlink connectivity when uplink and downlink communication between two RDs is arranged on different frequency channels and there is no downlink traffic for a long period. The length of the silent period to trigger the messaging is decided by the RD in FT mode.

The RD in FT mode transmits Keep Alive MAC PDU, as defined in clause 11.3.6 to an associated member RD. The member RD shall respond with Keep Alive Response MAC PDU as defined in clause 11.3.7. and should include in the response the Radio Devices Status IE, in case a memory full or scan, see clause 7.3.4.3.13.

10.1.3 Configuration procedure

Configuration procedure is used to acquire lost Cluster Beacons, including number of Information Elements, see clause 6.4.3.11 in ETSI TS 103 636-4 [4].

When sending Configuration Request, the RD shall apply the Configuration Request MAC PDU structure defined in clause 11.3.4 and the parameter values defined in clause 7.3. When an RD receives Configuration Request MAC PDU it shall respond using the Configuration Response MAC PDU structure defined in clause 11.3.5 and the parameter values defined in clause 7.3. The RD should include the Radio Devices Status IE in the response, in case a memory full or scan, see clause 7.3.4.3.13.

10.2 Data Transmission and Acknowledgement

10.2.1 Data Transmission

When an RD sends application data to another RD, the RD shall apply the Application Data MAC PDU structure defined in clause 11.4.1 and the parameter values defined in clauses 7.3, 8.3 and 9.3.

The transmissions shall be directed to the RACH resource indicated by the receiver.

NOTE: The RACH resource of RD in PT mode is indicated in the Association Request sent by the RD in PT as defined in clause 11.3.1.

10.2.2 Acknowledgement

When an RD receives an Application Data MAC PDU:

- if there is no MAC level feedback needed, the RD shall respond with the ACK Without MAC Payload as defined in clause 11.4.2, using MCS-0;
- else if there is MAC level feedback needed, the RD shall respond with the ACK With MAC Payload as defined in clause 11.4.3, using MCS-1, and include the related information elements corresponding with the situation:
  - Radio Devices Status IE, in case a memory full or scan, see clause 7.3.4.3.13;

- Association Release IE in case the RD is not associated with the data transmitting RD or not operating in expected mode, see clause 7.3.4.3.6;
- Measurement Report IE, in case the MAC PDU transmission has failed, see clause 7.3.4.3.12.

10.3 Secure Joining Procedure

10.3.1 General

Secure Joining Procedure follows the approach of having Provisioning Client, Proxy and Server as defined in ETSI TS 103 636-1 [1], clause 7.2. Beaconing, Association and Data exchange protocols involve Provisioning Client and Proxy to communicate in unsecured (MAC security disabled) manner, while the communication between Provisioning Proxy and Server are considered as normal data communication from the DECT-2020 NR radio stack perspective. Secure Joining Procedure is optional to implement in this version of the profile.

10.3.2 Beaconing procedure for Secure Joining

When an RD in FT mode operates as Provisioning Proxy, it shall:

- send Joining Information IE as defined in clause 7.3.4.3.17 in using unsecured Joining Beacons, Network Beacons, and/or Cluster Beacons and announce RACH using unsecured Cluster Beacons:
  - when using Network Beacons, the structure defined in clause 11.2.1 is recommended;
  - when using Cluster Beacons, the structure defined in clause 11.2.2 is recommended.

10.3.3 Association procedure for Secure Joining

When an RD in PT mode operates as Provisioning Client, it shall:

- select the network as defined in ETSI TS 103 636-4 [4], clause 5.1.4;
- initiate Association Procedure, as defined in clause 7.2.8, using unsecured Association Request message as defined in clause 11.3.1 in the present document.

When an RD in FT mode operates as Provisioning Proxy, it shall:

- respond the Association Request with Association Response as defined in clause 11.3.2 in the present document.

10.3.4 Data exchange procedures for Secure Joining

When an RD in FT mode operates as Provisioning Proxy and the RD in PT mode operates as Provisioning Client, and they have successfully finished the mutual Association Procedure as defined in clause 10.3.3, they shall:

- use the Application Data MAC PDU and ACK PDUs without MAC security as defined in clause 11.4 in the present document, exploiting the RACH resource announced by the RD in FT mode, for their mutual communication, until the RD in PT mode has acquired the network credentials.

When an RD in PT mode operates as Provisioning Client the RD shall set the routing type as uplink routing and set the target address in route PDU as the RD ID of RD in FT Mode operating as the Provisioning Proxy.

The RD in FT mode operating as a Provisioning Proxy shall forward data received from Provisioning Client in EndPoint used for authentication to the backend using uplink routing and backend address in a route PDU. The RD in FT mode operating as a Provisioning Proxy shall discard any other data received from the RD in PT mode operating as a Provisioning Client.

When the RD in FT mode operating as a Provisioning Proxy receives downlink data to the authentication EndPoint from the backend it shall forward data to the RD in PT mode operating as a Provisioning Client using downlink routing and set the target address in route PDU as the RD ID of RD in PT Mode.

11 Complete MAC PDU contents

11.1 General

When an RD transmits a MAC PDU, the MAC PDU is composed of the MAC, DLC and CVG headers, information elements, and payload fields as defined in clauses 7, 8 and 9. This clause defines the physical layer header and the content of the MAC PDU in different scenarios mandatory in this profile.

11.2 Control Plane: Beacon MAC PDUs

11.2.1 Network Beacon MAC PDU

When an RD transmits Network Beacon MAC PDU the transmission is composed of:

- Physical layer control field:
  - Type 1
- MAC PDU:
  - MAC header type
  - Beacon header
  - MAC Mux header C: (if MAC security is used):
    - MAC Security info IE (if MAC security is used)
  - MAC Mux header C:
    - Network Beacon Message IE
  - MAC Mux header C:
    - Random Access Resource IE
  - MAC Mux header C:
    - Route Info IE
  - MAC Mux header C:
    - Load Info IE
  - MAC Mux header C:
    - Neighbouring IE (0-2 per MAC PDU)
  - MAC Mux header C (if Joining Information IE is present):
    - Joining Information IE (optional)
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if padding needed)
  - MIC (if MAC security is used)

11.2.2 Cluster Beacon MAC PDU

When an RD transmits Cluster Beacon MAC PDU the transmission is composed of:

- Physical layer control field:
  - Type 1
- MAC PDU:
  - MAC header type (for Beacon header)
  - Beacon header
  - MAC Mux header C: (if MAC security is used):
    - Security info IE (if MAC security is used)
  - MAC Mux header C:
    - Cluster Beacon Message IE
  - MAC Mux header C:
    - Random Access Resource IE
  - MAC Mux header C:
    - Route Info IE
  - MAC Mux header C:
    - Load Info IE
  - MAC Mux header C:
    - Neighbouring IE (0-2 per MAC PDU)
  - MAC Mux header C (if Joining Information IE is present):
    - Joining Information IE (optional)
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if padding needed)
  - MIC (if MAC security is used)

11.2.3 Joining Beacon MAC PDU

When an RD transmits Joining Beacon MAC PDU the transmission is composed of:

- Physical layer control field:
  - Type 1
- MAC PDU:
  - MAC header type (for Beacon header)
  - Beacon header
  - MAC Mux header C:
    - Joining Beacon Message

- MAC Mux header C:
  - Joining Information IE
- MAC Mux header A, B or D (if Padding IE present):
  - Padding IE (if padding needed)

11.3 Control Plane: Unicast Control MAC PDUs

11.3.1 Association Request MAC PDU

Association Request MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type (for unicast header)
  - Unicast header
  - MAC Mux header C (if MAC security is used):
    - Security info IE (if MAC security is used)
  - MAC Mux header C:
    - Association Request Message IE
  - MAC Mux header C:
    - RD Capability IE
  - MAC Mux header C:
    - Random Access Resource IE
  - MAC Mux header C:
    - Measurement Report IE
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if needed)
  - MIC (if MAC security is used)

11.3.2 Association Response MAC PDU

Association Response MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type (for unicast header)
  - Unicast header

- MAC Mux header C:
  - Security info IE
- MAC Mux header C (if MAC security is used):
  - Association Response Message IE (if MAC security is used)
- MAC Mux header C (if Radio Device Status IE is present):
  - Radio Device Status IE (optional)
- MAC Mux header C (if Measurement Report IE is present):
  - Measurement Report IE (optional)
- MAC Mux header A, B or D (if Padding IE present):
  - Padding IE (if needed)
- MIC (if MAC security is used)

11.3.3 Association Release MAC PDU

Association Release MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type (for unicast header)
  - Unicast header
  - MAC Mux header C (if MAC security is used):
    - Security info IE (if MAC security is used)
  - MAC Mux header C:
    - Association Release Message IE
  - MAC Mux header C:
    - Measurement Report IE
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if needed)
  - MIC (if MAC security is used)

11.3.4 Configuration Request MAC PDU

Configuration Request MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type (for unicast header)

- Unicast header
- MAC Mux header C (if MAC security is used):
  - Security info IE (if MAC security is used)
- MAC Mux header A (Configuration Request IE)
- MAC Mux header C:
  - Measurement Report IE
- MAC Mux header A, B or D (if Padding IE present):
  - Padding IE (if needed)
- MIC (if MAC security is used)

11.3.5 Configuration Response MAC PDU

Configuration Response MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type (for unicast header)
  - Unicast header
  - MAC Mux header C (if MAC security is used):
    - Security info IE (if MAC security is used)
  - MAC Mux header C:
    - Cluster Beacon message IE
  - MAC Mux header C:
    - Random Access Resource IE
  - MAC Mux header C:
    - Route Info IE
  - MAC Mux header C:
    - Load Info IE
  - MAC Mux header C (if Radio Device Status IE is present):
    - Radio Device Status IE (optional)
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if needed)
  - MIC (if MAC security is used)

11.3.6 Keep Alive MAC PDU

Keep Alive MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type (for unicast header)
  - Unicast header
  - MAC Mux header C (if MAC security is used):
    - Security info IE (if MAC security is used)
  - MAC Mux header A (Keep Alive IE)
  - MAC Mux header C:
    - Measurement Report IE
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if needed)
  - MIC (if MAC security is used)

11.3.7 Keep Alive Response MAC PDU

Keep Alive Response MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type (for unicast header)
  - Unicast header
  - MAC Mux header C (if MAC security is used):
    - Security info IE (if MAC security is used)
  - MAC Mux header A (Keep Alive IE)
  - MAC Mux header C:
    - Measurement Report IE
  - MAC Mux header C (if Radio Device Status IE present):
    - Radio Device Status IE (optional)
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if needed)
  - MIC (if MAC security is used)

11.4 Data Plane: MAC PDUs

11.4.1 Application Data MAC PDU

Application Data MAC PDU transmission is composed of:

- Physical layer control field:
  - Type 2, Format 000
- MAC PDU:
  - MAC header type (for unicast header)
  - Unicast header
  - MAC Mux header C (if MAC security is used):
    - Security info IE (if MAC security is used)
  - MAC Mux header D (MAC user plane data - Flow 1):
    - DLC PDU header
    - Routing header
    - CVG header
    - Data EP IE (with application data payload)
  - MAC Mux header C:
    - Measurement Report IE
  - MAC Mux header A, B or D (if Padding IE present):
    - Padding IE (if needed)
  - MIC (if MAC security is used)

11.4.2 ACK without MAC Payload

ACK without MAC Payload transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001

ACK without MAC Payload shall be sent using MCS-0.

11.4.3 ACK with MAC Payload

ACK with MAC Payload transmission is composed of:

- Physical layer control field:
  - Type 2, Format 001
- MAC PDU:
  - MAC header type
  - DATA MAC PDU Header

- MAC Mux header C (if Radio Device Status IE is present):
  - Radio Device Status IE (optional)
- MAC Mux header C (if Association Release IE is present):
  - Association Release IE (optional)
- MAC Mux header C (if Measurement Report IE is present):
  - Measurement Report IE (optional)
- MAC Mux header A, B or D (if Padding IE present):
  - Padding IE (if needed)

12 Configuration Data Distribution

12.1 General

This version of the profile shall support Configuration Data Distribution as defined in ETSI TS 103 636-5 [5], Annex C.

12.2 Procedures

Configuration Data Distribution procedure shall be used as defined in ETSI TS 103 636-5 [5], Annex C.

12.3 PDUs

Configuration Data Distribution PDUs, as defined in ETSI TS 103 636-5 [5], Annex C, shall be encapsulated within Application Data MAC PDU as defined in clause 11.4.1 in the present document.

Annex A (informative): Change history

Date	Version	Information about the changes
September 2024	1.1.1	First publication of the TS
January 2025	1.1.2	Implemented Change Requests: DECT(24)000278 Correcting channel_numbering_Band4 DECT(24)000297 DECT-2020 Profile part 2 Configuration Data Distribution
May 2025	2.0.1	Version branching of the document, compare with RTS/DECT00425 Implementing Change Requests: DECT(25)000017 CR for corrections in profile part 2 DECT(24)000296r2 DECT-2020 Profile part 2 CR for Secure Joining
November 2025	2.0.2	Implementing Change Request: DECT(25)000277 Smart metering profile CVG SDU length
January 2026	2.0.3	Implementing Change Request: DECT(26)000011 Corrections to Smart metering profile

History

Version	Date	Status
V2.1.1	March 2026	Publication