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Technical Specification

Digital Enhanced Cordless Telecommunications (DECT); Ultra Low Energy (ULE); Machine to Machine Communications; Part 1: Test Framework and Profile Test Specification (PTS) for Home Automation Network (phase 1)

Reference

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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 1 of a multi-part deliverable covering the test specification of DECT Ultra Low Energy (ULE); as identified below:

Part 1: Test Framework and Profile Test Specification (PTS) for Home Automation Network (phase 1);

Part 2: Test Case Library (TCL) for Home Automation Network (phase 1);

Part 3: Protocol Implementation Conformance Statement (PICS) for Home Automation Network (phase 1).

The present document defines the Test Framework and the Profile Test Specification (PTS) for Home Automation Network (phase 1). Home Automation Network (phase 1) is defined as the functionality provided by TS 102 939-1 [10]. Further parts of this multi-part deliverable covering the Test Case Library or additional test specifications for ULE phase 1 or further phases will be defined in the future by other parts of this multi-part deliverable.

The present document is part of the testing specification of DECT Ultra Low Energy (ULE).

The present document is based on TS 102 939-1 [10] (DECT ULE; Home Automation Network - phase 1) and on EN 300 175, parts 1 to 8 [1] to [8] (DECT Common Interface).

The present document has been developed in accordance to the rules of documenting a profile specification as described in ISO/IEC 9646-6 [i.6].

The information in the present document is believed to be correct at the time of publication. However, DECT standardization is a rapidly changing area, and it is possible that some of the information contained in the present document may become outdated or incomplete within relatively short time-scales.

1 Scope

The present document contains the Test Framework and the Profile Test Specification (PTS) for "DECT Ultra Low Energy (ULE); Machine to Machine Communications; Part 1: Home Automation Network (phase 1) (TS 102 939-1 [10])". The present document covers both the Portable (PT) and the Fixed (FT) Radio terminations.

The objective of the present document is to provide a basis for approval tests of DECT Ultra Low Energy Part 1 equipment giving a high probability of air interface inter-operability between different manufacturer's DECT equipment.

The scope of the present document does not cover radio conformance test. The radio conformance is covered by the following documents:

- For devices operating in the DECT frequency band (1 880 MHz to 1 900 MHz): the radio test specification EN 300 176-1 [i.1] and EN 301 406 [i.2].
- For devices operating in the IMT-2000 frequency band (1 900 MHz to 1 920 MHz and other frequency bands): EN 301 908-10 [i.3].

The ISO standard for the methodology of conformance testing (ISO/IEC 9646-1 [i.4] and ISO/IEC 9646-2 [i.5]) as well as the ETSI rules for conformance testing (ETS 300 406 [i.8]) are used as a basis for the test methodology.

2 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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2.1 Normative references

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

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

[2] ETSI EN 300 175-2: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 2: Physical layer (PHL)".

[3] ETSI EN 300 175-3: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 3: Medium Access Control (MAC) layer".

[4] ETSI EN 300 175-4: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 4: Data Link Control (DLC) layer".

[5] ETSI EN 300 175-5: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 5: Network (NWK) layer".

[6] ETSI EN 300 175-6: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 6: Identities and addressing".

[7] ETSI EN 300 175-7: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 7: Security features".

[8] ETSI EN 300 175-8: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 8: Speech and audio coding and transmission".

[9] ETSI EN 300 444: "Digital Enhanced Cordless Telecommunications (DECT); Generic Access Profile (GAP)".

[10] ETSI TS 102 939-1: "Digital Enhanced Cordless Telecommunications (DECT); Ultra Low Energy (ULE); Machine to Machine Communications; Part 1: Home Automation Network (phase 1)".

[11] ETSI TS 102 527-3: "Digital Enhanced Cordless Telecommunications (DECT); New Generation DECT; Part 3: Extended Wideband Speech Services".

2.2 Informative references

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 300 176-1: "Digital Enhanced Cordless Telecommunications (DECT); Test specification; Part 1: Radio".

[i.2] ETSI EN 301 406: "Digital Enhanced Cordless Telecommunications (DECT); Harmonized EN for Digital Enhanced Cordless Telecommunications (DECT) covering the essential requirements under article 3.2 of the R&TTE Directive; Generic radio".

[i.3] ETSI EN 301 908-10: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 10: Harmonized EN for IMT-2000, FDMA/TDMA (DECT) covering essential requirements of article 3.2 of the R&TTE Directive".

[i.4] ISO/IEC 9646-1: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".

[i.5] ISO/IEC 9646-2: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 2: Abstract Test Suite specification".

[i.6] ISO/IEC 9646-6: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 6: Protocol profile test specification".

[i.7] ISO/IEC 9646-7: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 7: Implementation Conformance Statements".

[i.8] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TS 102 939-1 [10], EN 300 175-1 [1], ISO/IEC 9646-7 [i.7] and the following apply:

block of data: number of octets intended for transmission without interruptions in one or several bursts

NOTE: It may contain one or several SDUs.

certification program: test certification procedure organized by the industry on a voluntary basis with the aim to validate that a submitted implementation meets the required specifications in order to ensure full interoperability between implementations

DECT application layer: top-level C-plane layer that implements the DECT application features described in TS 102 939-1 [10], clause 5.1.5 and runs over ULE C-plane

Implementation Conformance Statement (ICS): statement made by the supplier of an implementation or system claimed to conform to a given specification, stating which capabilities have been implemented

test specific application logic: application layer specific for test and implemented in the test system that provides the required functionality to run the Test Cases described in the present document

ULE application logic (or layer): application layer that implements the ULE application functionality and runs over the ULE U-plane

ULE Phase 1 equipment: Portable Part or Fixed Part compliant with TS 102 939-1 [10].

U-plane test vector: stream of octets composed of one or several SDUs that should be transmitted consecutively over the ULE U-plane during the execution of the test procedures

3.2 Symbols and abbreviations

For the purposes of the present document, the symbols and abbreviations defined in TS 102 939-1 [10], EN 300 175-1 [1], ISO/IEC 9646-1 [i.4], ISO/IEC 9646-6 [i.6], ISO/IEC 9646-7 [i.7] and the following apply:

API	Application Programming Interface
ICS	Implementation Conformance Statement
IUT	Implementation Under Test
PICS	Protocol Implementation Conformance Statement
SAP	Service Access Point
SDK	Software Development Kit
SF1	Service access interface for FP level 1
SP1	Service access interface for PP level 1
TF0	Test interface for FP level 0
TF1	Test interface for FP level 1
TP	Test Purposes
TP0	Test interface for PP level 0
TP1	Test interface for PP level 1
TS	Test System

4 Overview and structure

4.1 Structure of the present document

The present document contains the following elements of the conformance test specifications of DECT Ultra Low Energy (ULE); Part 1: Home Automation Network (phase 1) (TS 102 939-1 [10]):

- Test framework and test architecture
- Test interface specification
- Test Specification conventions
- Profile Test Specification, Test Cases and Test Purposes
- ULE Services, features and procedures to Test Cases traceability table

Additionally it includes the following annexes:

- Description format of U-plane test vectors
- Parameters for static and negotiated capabilities

The present document will be complemented with the following test specifications to be created in the future by means of separate parts of this multi-part deliverable:

- PT and FT Test Case Library
- Run time view of the Test Specification
- Protocol Implementation Conformance Statement (PICS)

The purpose of each one of the different sections is described in the following clauses.

4.2 Overview of the different sections

4.2.1 Overview and Structure

"Overview and Structure" is the present clause of the present document. It explains the structure and content of the different parts of the present document and other parts of this multi-part deliverable.

4.2.2 Test framework and test architecture

Test architecture and Test method used to test the protocol conformance of DECT ULE equipment are described in clause 5.

Clause 5 starts with an overview on the global ULE protocol architecture and the foreseen DECT ULE standards ecosystem. Then, the specific test configurations for PT and FT conformance testing are introduced. As part of this architecture, the test interfaces TF1 and TP1 are created and their position in the overall schema is defined.

4.2.3 Test interface specification

Clause 6 defines the test interfaces TF1 and TP1 created by the test architecture and used in the rest of the present document.

In order to make possible some flexibility in the initial implementation of the interface, only a top level definition, named "functional definition" is provided. This allows flexibility for multiple implementations of the interface that may include Man-Machine-Interfaces (MMI) or not.

4.2.4 Profile Test Specification, Introduction and conventions

Clause 7.1 is an introductory section to the Profile Test Specification (PTS). It provides an overview and defines the conventions that will be used in the rest of the clause.

4.2.5 Profile Test Specification, Test Cases and Test Purposes (definition view)

The "Profile Test Specification, Test Cases and Test Purposes (definition view)" is the core part of the present document from test process specification point of view and is described in clause 7.2. Clause 7.2 creates and defines the different Test Groups, Test Purposes and Test Cases that will be part of the test specification suite. The clause also defines the status (mandatory, optional or conditional) of each Test Case.

4.2.6 ULE Services, features and procedures to Test Cases traceability table

Clause 7.3 provides a set of tables that define the traceability between the Test Cases defined in the present document and the services, features and procedures defined in TS 102 939-1 [10]. In other words, the tables included in clause 7.3 provide information about which Test Cases are testing the different services, features and procedures defined in the main specification.

4.2.7 Description format of U-plane test vectors

The description format of the U-plane vectors is described in annex A. The bit content of the vectors themselves will be given in the Test Case Library. The annex may be seen as an extension of clause 6 defining the interfaces TP1 and TF1.

4.2.8 Parameters for static and negotiated capabilities

Annex B introduces the list of parameters describing capabilities that are either inherent of the IUT or that are negotiated using an application protocol and that need to be exchanged through the interfaces TP1 or TF1 during the test preparation process. The test commands "Retrieve Static capabilities" and "Store Negotiated capabilities" (see clause 6.3.1, table 1) allows to emulate the negotiation process during the Test setup stage.

The test specification will be complemented with the following parts to be created in the future by means of separate parts of this multi-part deliverable:

4.2.9 PT and FT Test Case Library

The Test Case Library defines the detailed content of the Test Cases, including sequence diagrams, states, stimulus and pass criteria. The Test Cases and Test Purpose are defined in clause 7.2 of the present document.

The Test Case Library will be implemented as a separate part (part 2) of this multi-part deliverable.

4.2.10 Run time view of the Test Specification

The Run time view of the Test Specification defines the execution view of the test certification program. In order to do that, the Test Cases are grouped in execution sequences that will be a functional execution unit in the test systems. Sequences are chosen according to technical convenience for the design and implementation of the test equipment and may include multiple Test Cases testing multiple layers.

The Run time view of the Test Specification will be included in part 2 of this multi-part deliverable

4.2.11 Protocol Implementation Conformance Statement (PICS)

The Protocol Implementation Conformance Statement (PICS) proforma is the document that shall be filled by the supplier of any implementation subject to test under the scope of the present document stating which capabilities have been implemented.

5 Test Framework and test architecture

This clause describes the Test architecture and Test method used to test the protocol conformance of DECT ULE equipment. The device under test can be either a FT part or a PT part depending on the test and on what feature is tested.

5.1 Overall ULE protocol architecture

The general ULE phase 1 architecture is depicted in figure 1.

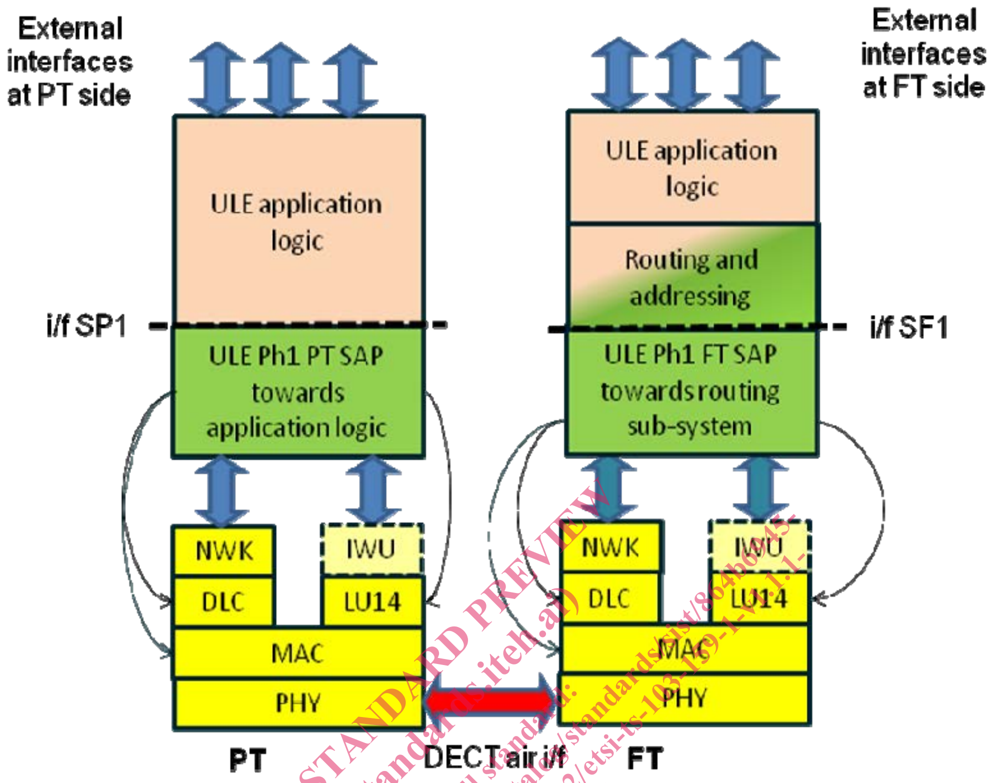

Figure 1: General ULE phase 1 architecture showing interfaces to application layers

The part of the overall architecture that is described by TS 102 939-1 [10] comprises the complete DECT stack from physical (PHY) to the Network (NWK) layer at C-plane and to the Interworking (IWU) layer at the U-plane. This part will be the named "DECT ULE sub-system" and is the test scope of the present document.

NOTE: For the sake of simplicity, in this description the C-plane part of the Interworking layer (NWK control messages related to the interworking) is considered as included in the C-plane NWK layer box. In addition, the DECT Application features (see TS 102 939-1 [10], clause 5.1.5) are considered as included in the C-plane NWK layer box. These DECT Application features should not be confused with the ULE application logic shown in the diagrams and described below.

On top of the "DECT ULE sub-system" there should be primitives (shown as blue arrows), not yet described in TS 102 939-1 [10] towards an interface logic that is in charge of implementing well-defined Software interfaces, the interfaces SP1 and SF1 towards the application logic.

In the Fixed Part, the interface SF1 defines the boundary between the DECT sub-system and an intermediate sub-system named "routing and addressing" that should be in charge of resolving addressing and providing internal and external routing based on such addressing. The "routing and addressing" sub-system is not defined at the time of writing the present document.

On top of such "routing and addressing" sub-system there is the true application logic (layer 7) with the ULE application functionality implemented at FP side.

In the Portable part, such "routing and addressing" sub-system is not needed, and the ULE application logic is placed on top of the DECT sub-system. The interface SP1 is defined as the interface between DECT sub-system and ULE application logic at PP side.

The ULE application logic may be standardized or proprietary. In the case of standardized protocols, the standard may be in the scope of ETSI TC DECT, other ETSI TBs or other organizations.

5.2 ULE standards ecosystem

The foreseen standards ecosystem for the whole ULE technology is depicted in figure 2.

The different parts of the diagram are described below.

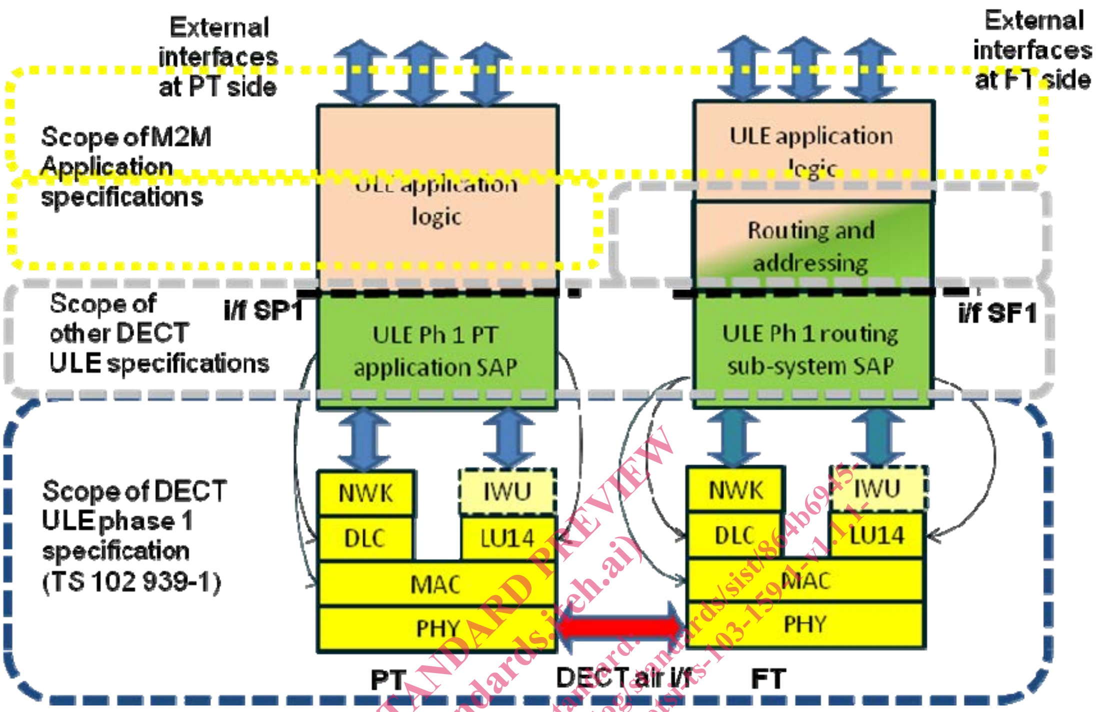

Figure 2: DECT ULE standards ecosystem.

5.2.1 ULE DECT subsystem

The ULE DECT sub-system for both parts is defined in a TS 102 939-1 [10] and further parts of the same multi-part deliverable which are application profiles based on the DECT Common Interface (DECT CI) EN 300 175 parts 1 to 8 [1] to [8].

At the time of writing the present document, only TS 102 939-1 [10] (DECT Ultra Low Energy (ULE); Machine to Machine Communications; Part 1: Home Automation Network (phase 1) is published. Further phases that may be evolutions or extensions of HAN phase 1, or separate scenarios may be defined by further parts of the TS 102 939 series.

5.2.2 Interfaces (Service Access Points) of the DECT subsystem

According to DECT standardization methodology, a series of primitives (see EN 300 175 parts 1 to 8, [1] to [8]) are used for accessing the different DECT layers. However, this primitive model is not considered suitable for practical implementation and has not been standardized beyond what is defined in EN 300 175 specifications. In any case these primitives are only aids for implementation and each particular vendor may use its own solution. Therefore, the use of a specific primitive model would not be the basis for standardization.

In order to provide a standardized interface towards application logic, or towards the "routing and addressing" subsystem described in clause 5.1, it is foreseen that a pair of standardized software interfaces (or Service Access Points, in DECT terminology) named SP1 and SF1 will be defined and fully standardized. Such interfaces would provide an encapsulated view of the DECT system and would be available to the application developers.

Due to the inherent complexity of the technology, platform issues and other practical reasons, the external functional interfaces SP1 and SF1 are not defined at the time of writing the present document. However they are identified as elements for future DECT standardization.

5.2.3 Routing and addressing sub-system

The "Routing and addressing" sub-system is located at the FP side and is in charge of resolving addressing and providing internal and external routing based on such addressing.

The "Routing and addressing" sub-system is not defined at the time of writing the present document. It is identified as a potential element for future standardization; however it is not decided yet if it should be in the scope of the DECT standards, or be in the scope of application specifications.

5.2.4 Application logic

On top of the "routing and addressing" sub-system (FP) and on top of the interface SP1 (PP), there is the true application logic (layer 7). The application logic may be standardized or proprietary.

NOTE: In the case of standardized application logic functionality, dedicated specific application standards will be developed by either ETSI TC DECT, other ETSI TBs or other organizations.

The interfaces SP1 and SF1 will provide the encapsulation of the DECT system from the point of view of the application logic. Such interfaces may be further encapsulated as a Software Development Kit (SDK) making easier the creation of application protocols and application logic.

5.3 Problem and solution to the testing of ULE phase 1

With the current state of standardization the main problem for conformance testing is the lack of clearly defined interfaces SF1 and SP1.

The radio air interface is not an issue since it is clearly defined by TS 102 939-1 [10] up to NWK and IWU layers. Application protocol is, however, not standardized, but it can be replaced at the time of testing by test vectors with proper sizes and standardized content.

An additional problem for ULE testing is the potentially wide range of PP device types, many of them of small size, with limited external interfaces and with significant cost constraints. Because of it, the standardization of a physical test interface (such as a connector, bus, or serial i/f) is seen as not a realistic approach.

The solution that has been found for approaching the test problem is depicted in figures 3 and 4.

It is based on the creation of a specific test interface, which is only defined at functional level. Such interface may be provided by a software module (driver) provided by the vendor of the IUT, or with some limitations, by a Man-Machine Interface. On the other hand, the real physical interface between the device itself and such standardized interface may be proprietary and multiple solutions may be tried by the implementers.

The new standardized test interfaces operate at the level of the planned interfaces SP1 and SF1. It means that at the FT, it is defined *under* the planned addressing and routing sub-system described in figure 1.

5.4 Test configurations: general approach

The present clause presents the general test configurations for testing PT and FT. This general approach is applicable to all Test scenarios and allows both fully automated and manual test configurations.

5.4.1 Test configuration for PT conformance testing

The test configuration for PT conformance testing is shown in figure 3. The key elements of the configuration are the following:

- The Implementation Under Test (IUT):
  - The implementation under test shall provide the DECT ULE radio interface linking it via radio with the test system.