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Contents

Foreword

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Introduction

User Equipment (UE) Test Loop functionality is a mandatory feature to support E-UTRA / EPC conformance testing. It forms part of the core requirements and thus has a direct impact on the design of the UE.

The test methods applied in RF Conformance Test Specification TS 36.521-1 [27] and the test models used in Protocol Conformance Test Specifications TS 36.523-1 [30] and TS 36.523-3 [32] define the corresponding UE Test Loop functionality. The present specification describes the location of the data loop in the protocol stack as well as the procedure and specific messages to activate/deactivate the Test Loop functionality in the UE.

1 Scope

The present document defines for User Equipment (UE) in E-UTRA FDD or TDD mode those special functions and their activation/deactivation methods that are required in UE for conformance testing purposes.

This document also describes the operation of these special functions for UEs supporting E-UTRA FDD or TDD mode, when operating in UTRA FDD and TDD mode, in GSM/GPRS mode, and in CDMA2000 mode.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

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

[2] 3GPP TS 23.003: "Numbering, Addressing and Identification".

[3] 3GPP TS 23.122: "Non-Access-Stratum functions related to Mobile Station (MS) in idle mode".

[4] 3GPP TS 23.401: "3GPP System Architecture Evolution; GPRS enhancements for E-UTRAN access".

[5] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".

[6] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3".

[7] 3GPP TR 24.801: "3GPP System Architecture Evolution; CT WG1 Aspects".

[8] 3GPP TS 27.007: "AT command set for User Equipment (UE)".

[9] 3GPP TS 31.101: "UICC-Terminal Interface; Physical and Logical Characteristics".

[10] 3GPP TS 34.108: "Common Test Environments for User Equipment (UE) Conformance Testing".

[11] 3GPP TS 34.109: "Terminal logical test interface; Special conformance testing functions".

[12] 3GPP TS 34.123-1: "User Equipment (UE) conformance specification; Part 1: Protocol conformance specification".

[13] 3GPP TS 34.123-2: "User Equipment (UE) conformance specification; Part 2: Implementation Conformance Statement (ICS) proforma specification".

[14] 3GPP TS 34.123-3: "User Equipment (UE) conformance specification; Part 3: Abstract Test Suites (ATS)".

[15] 3GPP TS 36.133: "Requirements for support of Radio Resource Management".

[16] 3GPP TS 36.211: "Physical Channels and Modulation".

[17] 3GPP TS 36.212: "Multiplexing and Channel Coding".

[18] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[19] 3GPP TS 36.302: "Services provided by the physical layer for E-UTRA".

[20] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (EUTRA) User Equipment (UE) Procedures in idle mode ".

[21] 3GPP TS 36.306: "Evolved Universal Terrestrial Radio Access (EUTRA) User Equipment (UE) Radio Access capabilities ".

[22] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (EUTRA) Medium Access Control (MAC) protocol specification".

[23] 3GPP TS 36.322: "Evolved Universal Terrestrial Radio Access (EUTRA) Radio Link Control (RLC) protocol specification".

[24] 3GPP TS 36.323: "Evolved Universal Terrestrial Radio Access (EUTRA) Packet Data Convergence Protocol (PDCP) specification".

[25] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (EUTRA) Radio Resource Control (RRC) Protocol Specification".

[26] 3GPP TS 36.508: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE); Conformance Testing".

[27] 3GPP TS 36.521-1: " Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification Radio transmission and reception; Part 1: Conformance Testing".

[28] 3GPP TS 36.521-2: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification Radio transmission and reception; Part 2: Implementation Conformance Statement (ICS)".

[29] 3GPP TS 36.521-3: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification Radio transmission and reception; Part 3: Radio Resource Management Conformance Testing".

[30] 3GPP TS 36.523-1: " Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification".

[31] 3GPP TS 36.523-2: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) conformance specification; Part 2: Implementation Conformance Statement (ICS) proforma specification".

[32] 3GPP TS 36.523-3: " Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC)); User Equipment (UE) conformance specification; Part 3: Abstract Test Suites (ATS)".

[33] 3GPP TS 44.014: "Individual equipment type requirements and interworking; Special conformance testing functions".

[34] 3GPP TS 51.010-1: "Mobile Station (MS) conformance specification; Part 1: Conformance specification ".

[35] ISO/IEC 9646 (all parts): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework".

[36] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[37] 3GPP TS 36.355: “Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)”.

[38] 3GPP TS 24.334: "Proximity-services (ProSe) User Equipment (UE) to ProSe function protocol aspects; Stage 3".

[39] 3GPP TS 23.060: " General Packet Radio Service (GPRS); Service description; Stage 2".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] apply, unless specified below:

Uni-directional Data Radio Bearer: Data radio bearer identified by a data radio bearer identifier capable to deliver data only in downlink or uplink

Bi-directional Data Radio Bearer: Data radio bearer identified by a data radio bearer identifier capable to deliver data in both downlink and uplink

Logical Test Interface: interface which provides the logical service to interwork and to communicate between UE and System Simulator during the test of a UE

SS (System Simulator): test system (or equipment) that drives the test process with UE, like eNB (evolved Node B) simulator

TC (Test Control): UE protocol entity used by the SS to control the UE specific testing functions

UE (User Equipment): user equipment as defined in [1] that is under test

User: test user, who handles the test and measurement process via the logical test interface

UE uplink Rate control entity: The UE entity in a UE supporting Control Plane CIoT EPS optimization that is handling the UE uplink rate control of control plane messages carrying user data as specified in [36] TS 24.301 clause 6.3.8 (Serving PLMN rate control) and in [36] TS 24.301 clause 6.3.9 (APN rate control).

EMM SAP for control plane user data: The service access point to the EMM sublayer for control plane user data handling the UE uplink rate control entity for uplink transmissions of the User data container via ESM DATA TRANSPORT messages.

SMR SAP for control plane user data: The service access point to the SMR entity for uplink SMS user data handling for uplink transmissions of the RP User data element in Uplink NAS Transport messages. For details on SMR entity and SM-RP protocol see [39].

3.2 Abbreviations

For the purposes of the present document, the abbreviations specified in TR 21.905 [1] apply, with any additional abbreviations specified below:

DRB	Data Radio Bearer
EMM	EPS Mobility Management
E-MBMS	Evolved Multimedia Broadcast Multicast Service
ENB	Evolved Node B
EPS Bearer	Evolved Packet System Bearer
ESM	EPS Session Management
LB	Loop Back
MAC	Media Access Control
MBMS	Multimedia Broadcast Multicast Service
MBS	Metropolitan Beacon System
MTC	Main Test Component
ProSe	Proximity-based Services
RAB	Radio Access Bearer
RMC	Reference Measurement Channel
ROHC	Robust Header Compression
SDF	Service Data Flow
SMR	Short Message Relay (entity)
SS	System Simulator
TC	Test Control

SC	Single-cell
PTM	point-to-multipoint

4 UE special conformance test functions

4.1 General description

The SS performs activation and deactivation of the conformance test functions in the UE by sending Security Protected NAS Layer 3 messages. Apart from sending the appropriate deactivation command to the UE the functions shall be deactivated by:

switching off the UE; or

by removing the USIM.

The following special UE conformance testing functions can be activated (and deactivated):

- UE test loop function;
- Electrical Man Machine Interface (EMMI).

The following Test Control (TC) procedures are used to control the UE test loop function:

- Close UE test loop;
- Open UE test loop.

No specific TC procedures are associated with EMMI.

5 Test Control (TC) protocol procedures and test loop operation

5.1 General description

The UE test loop function provides access to isolated functions of the UE via the radio interface without introducing new physical interfaces just for the reason of conformance testing.

NOTE 1: It should be emphasised that the UE test loop function only describes the functional behaviour of the UE with respect to its external interfaces; physical implementation of the UE test loop function is completely left open to the manufacturer.

The UE test loop function is activated by transmitting the appropriate TC message to the UE, see clause 6.

The UE test loop function can be operated in different loopback modes:

- UE test loop mode A;
- UE test loop mode B;
- UE test loop mode C;
- UE test loop mode D;
- UE test loop mode E;
- UE test loop mode F;
- UE test loop mode G;
- UE test loop mode H;

- UE test loop mode I.

UE test loop mode A provides loopback of PDCP SDUs for bi-directional data radio bearers while UE is operating in E-UTRA or NB-IoT mode. The downlink PDCP SDUs received by the UE on each bi-directional data radio bearer are returned on the same radio bearer regardless of the PDCP SDU contents and of the TFT of the associated EPS bearer context [36].

UE test loop mode B provides loopback of PDCP SDUs (E-UTRA and UTRA), SNDCP PDUs (GSM/GPRS) and RLP PDUs (CDMA2000) for bi-directional EPS bearers while UE is operated in E-UTRA, NB-IoT, UTRA, GSM/GPRS or CDMA2000 modes. When operating in E-UTRA, NB-IoT, UTRA or GSM/GPRS then the downlink PDCP SDUs or SNDCP PDUs received by the UE on all bi-directional data radio bearers are returned by the UE on the data radio bearer associated with an EPS bearer context with a TFT matching the TCP/UDP/IP protocol information within the PDCP SDU or SNDCP SDU [36]. When operating in CDMA2000 modes, the downlink RLP PDUs received by the UE on all bi-directional data radio bearers are returned by the UE on the data radio bearer with the smallest identity, regardless of the RLP PDU content and of the TFT of the associated EPS bearer context.

NOTE 2: When multiple PDN connections are established (or multiple Primary PDP Contexts are active), it is assumed that different IP addresses are allocated to the UE by the SS on each PDN.

UE test loop mode C provides counting of successfully received MBMS Packets on a given MTCH while UE is operating in E-MBMS/E-UTRA mode. For E-MBMS then one or more MTCHs are multiplexed on a MCH. MBMS packets for a MTCH are delivered as one RLC SDU per MBMS packet segmented into one or more RLC UMD PDUs.

UE test loop mode D provides means for announcing or monitoring of ProSe Direct Discovery messages on SL-DCH, as specified by the test loop mode D setup IE in the CLOSE UE TEST LOOP message. In particular, for discovery monitor operation, UE test loop mode D provides counting of successfully received SL-DCH MAC SDUs while the UE is operating in ProSe Direct Discovery/E-UTRA mode. For discovery announce operation, UE test loop mode D provides trigger for transmission of ProSe Direct Discovery message on SL-DCH.

NOTE 3: UE test loop mode D is intended for RF/RRM testing purposes.

NOTE 4: ProSe Direct Discovery messages on the PC5 interface are delivered as one MAC SDU per ProSe Direct Discovery message.

UE test loop mode E provides means for either transmit or receive of ProSe Direct Communication packets, as specified by the test loop mode E setup IE in the CLOSE UE TEST LOOP message. In particular, for communication receive operation, UE test loop mode E provides counting of successfully received STCH PDCP SDUs and PSCCH transport blocks while the UE is operating in ProSe Direct Communication/E-UTRA mode. For communication transmit operation, UE test loop mode E provides trigger for transmission of IP packets for ProSe Direct Communication message on STCH.

NOTE 5: UE test loop mode E is intended for RF/RRM testing and partially for Protocol testing - for Protocol testing it is used only in the case of Reception of communication data.

NOTE 6: The Application trigger required to force the UE to start or stop a particular ProSe Service is out of the scope of the test loop modes D and E.

UE test loop mode F provides counting of successfully received MBMS Packets on a given SC-MTCH while UE is operating in SC-PTM/E-UTRA mode. For SC-PTM one SC-MTCH is transmitted on a DL-SCH. MBMS packets for a SC-MTCH are delivered as one RLC SDU per MBMS packet segmented into one or more RLC UMD PDUs.

UE test loop mode G provides loopback of the User data container content of any received downlink ESM DATA TRANSPORT message in uplink. The received data can be configured to be either returned via the UE EMM entity (before the UE uplink rate control entity) or as a RLC SDU to the SRB RLC entity (SRB1bis for NB-IoT UE or to SRB2 for E-UTRA UE). UE test loop mode G may be configured to delay the uplink loopback of user data. UE test loop mode G may also be configured to repeat the received user data of the User data container in uplink to generate higher data rates in uplink.

UE test loop mode H provides loopback of the TP-User-Data field (including the SMS user data) of any received downlink TPDU (SMS-DELIVER) in uplink. The received data can be configured to be either returned via the UE SM-TL entity or as a RLC SDU to the SRB RLC entity (SRB1bis for NB-IoT UE or to SRB2 for E-UTRA UE). UE test loop mode H may be configured to delay the uplink loopback of SMS user data. UE test loop mode H may also be configured to repeat the received SMS user data in uplink to generate higher data rates in uplink.

NOTE 7: UE test loop mode G and H are intended for control plane data testing for UEs supporting EPS services with Control Plane CIoT EPS optimization.

NOTE 8: The delay timer for UE test loop mode G and H is triggered by the first reception of user data after the reception of a CLOSE UE TEST LOOP TC message. While the delay timer is running only the user data received in the latest ESM DATA TRANSPORT or SMS message is buffered.

NOTE 9: The repetition of uplink transmission of uplink messages carrying data can be configured as 0 (no data returned), 1 (the same content and size of user date as received in downlink is returned) or value N > 1 (user data corresponding to N times repetition of the received user data is returned in uplink).

UE test loop mode I provides loopback of the IP PDUs received in User data container content of downlink ESM DATA TRANSPORT message in uplink via the UE uplink TFT hander and the UE EMM entity (before the UE uplink rate control entity).

NOTE 10: UE test loop mode I is intended for control plane data testing for UEs supporting EPS services with Control Plane CIoT EPS optimization.

UE test loop mode A is mandatory to all E-UTRA UEs and all NB-IoT UEs supporting user plane data transfer.

UE test loop mode B for operation in E-UTRA mode is mandatory to all E-UTRA UEs and all NB-IoT UEs supporting user plane data transfer.

UE test loop mode B for operation in UTRA mode is mandatory to all E-UTRA UEs supporting UTRA radio access.

UE test loop mode B for operation in GSM/GPRS mode is mandatory to all E-UTRA UEs supporting GSM/GPRS radio access.

UE test loop mode B for operation in CDMA2000 mode is mandatory to all E-UTRA UEs supporting CDMA2000 radio access.

UE test loop mode C is mandatory for E-UTRA UEs supporting E-MBMS.

UE test loop mode D is mandatory for E-UTRA UEs supporting ProSe Direct Discovery.

UE test loop mode E is mandatory for E-UTRA UEs supporting ProSe Direct Communication.

UE test loop mode F is mandatory for E-UTRA UEs supporting SC-PTM.

UE test loop mode G is mandatory for UEs supporting Control Plane CIoT EPS optimization and control plane data transfer using the ESM DATA TRANSFER procedure.

UE test loop mode H is mandatory for UEs supporting Control Plane CIoT EPS optimization and control plane data transfer using SMS.

UE test loop mode I is mandatory for UEs supporting Control Plane CIoT EPS optimization and control plane data transfer using the ESM DATA TRANSFER procedure.

Support of UPDATE UE LOCATION INFORMATION is optional for all E-UTRA UEs with the exception of E-UTRA UEs supporting ProSe Direct Communication for which it is mandatory.

For E-UTRA UE supporting multiple radio access technologies then UE reception of Test Control messages is limited to UE operating in E-UTRA mode, while continuation of loopback of user data is provided over the change to other UE supported radio access technologies.

UE test loop mode B for operation in UTRA, GSM/GPRS and CDMA2000 mode is only applicable for loopback of user data in PS domain.

The TC entity may be seen as a L3 or a NAS entity.

Figure 5.1-1 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode A. The loopback of PDCP SDUs for UE test loop mode A is specified in sub clause 5.4.3.

Figure 5.1-2 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode B. The loopback of IP PDUs/PDCP SDUs for UE test loop mode B and UE in E-UTRA mode is specified in subclauses 5.4.4.2 and 5.4.4.3.

Figure 5.1-3 shows a functional block diagram of UE test loop function for UE test loop mode B and UE operating in UTRA mode. The loopback of IP PDUs/PDCP SDUs for UE test loop mode B and UE in UTRA mode is specified in subclauses 5.4.4.4 and 5.4.4.5.

Figure 5.1-4 shows a functional block diagram of UE test loop function for UE test loop mode B for UE operating in GSM/GPRS mode. The loopback of IP PDUs/SNDCP SDUs for UE test loop mode B and UE in GSM/GPRS mode is specified in subclauses 5.4.4.6 and 5.4.4.7.

Figure 5.1-5 shows a functional block diagram of UE test loop function for UE test loop mode B for UE operating in CDMA2000 mode. The loopback of IP PDUs/RLP SDUs for UE test loop mode B and UE in CDMA2000 mode is specified in subclauses 5.4.4.8 and 5.4.4.9.

Figure 5.1-6 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode C. The MBMS Packet Counter function for UE test loop mode C is specified in sub clause 5.4.4.a. The MBMS Packet Counter function is limited to count successfully received MBMS packets on one MTCH configured by the SS when UE test loop mode C is activated.

Figure 5.1-7 and Figure 5.1-8 show a functional block diagram of the UE test loop mode for TC entity and UE test loop mode D. The ProSe Direct Discovery Packet Counter function for UE test loop mode D is specified in clause 5.4.4b. The ProSe Direct Discovery packet counter function is limited to count successfully received SL-DCH MAC SDUs when UE test loop mode D is activated.

Figure 5.1-9 and Figure 5.1-10 show a functional block diagram of the UE test loop mode for TC entity and UE test loop mode E. The ProSe Direct Communication Packet Counter function for UE test loop mode E is specified in clause 5.4.4c. The ProSe Direct Communication packet counter function is limited to count successfully received STCH PDCP SDUs and PSCCH PHY Transport blocks when the UE test loop mode E is activated.

Figure 5.1-11 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode F. The SC-PTM Packet Counter function for UE test loop mode F is specified in sub clause 5.4.4.d. The SC-PTM Packet Counter function is limited to count successfully received MBMS packets on one SC-MTCH configured by the SS when UE test loop mode F is activated.

Figure 5.1-12 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode G when User data container content received in a downlink ESM DATA TRANSFER message is configured to be returned in uplink via the EMM entity. Figure 5.1-13 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode G when User data container content received in a downlink ESM DATA TRANSFER message is configured to be returned in uplink in a RLC SDU via the SRB1bis/SRB2 RLC AM entity. The UE test loop mode G mode of operation is specified in sub clause 5.4.4e.

Figure 5.1-14 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode H when TP-User-Data (SMS user data) received in a downlink TPDU (SMS-DELIVER) is configured to be returned in uplink via the SM-TL entity (in a TPDU (SMS-SUBMIT)).

Figure 5.1-15 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode H when TP-User-Data (SMS user data) received in a downlink TPDU (SMS-DELIVER) is configured to be returned in uplink in a RLC SDU via the SRB1bis/SRB2 RLC AM entity. The UE test loop mode H mode of operation is specified in sub clause 5.4.4f.

Figure 5.1-16 shows a functional block diagram of UE test loop function for TC entity and UE test loop mode I when IP PDU received in User data container content in a downlink ESM DATA TRANSFER message is returned in uplink via the EMM entity. The UE test loop mode I mode of operation is specified in sub clause 5.4.4g.

NOTE 7: ROHC functionality in PDCP Layer 2 is optional for UE implementations.