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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The present document defines for User Equipment (UE) those special functions and their activation/deactivation methods that are required in the UE for conformance testing purposes when the UE is connected to the 5G System (5GS) via its radio interface(s).

The document also describes the operation of these special functions when the 5GS capable UEs are connected via a non-5GS system e.g. E-UTRA FDD or TDD system.

Depending on the 5GS system's architecture some relevant for the UE for conformance testing special functions may be defined in TS 36.509 [6].

2 References

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

References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

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

[2] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment ".

[3] 3GPP TS 38.523-1: "5GS; User Equipment (UE) conformance specification; Part 1: Protocol ".

[4] 3GPP TS 38.523-3: "5GS; User Equipment (UE) conformance specification; Part 3: Protocol Test Suites "

[5] 3GPP TS 38.522: "NR; User Equipment (UE) conformance specification; Applicability of RF and RRM test cases".

[6] 3GPP TS 36.509: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Special conformance testing functions for User Equipment (UE)".

[7] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General Aspects".

[8] 3GPP TS 34.109: "Terminal logical test interface; Special conformance testing functions".

[9] 3GPP TS 44.014: "Individual equipment type requirements and interworking; Special conformance testing functions".

[10] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (EUTRA) Radio Resource Control (RRC) Protocol Specification".

[11] 3GPP TS 38.331: "NR Radio Resource Control (RRC) protocol specification".

[12] 3GPP TS 38.521-1: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone".

[13] 3GPP TS 38.521-2: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Range 2 Standalone".

[14] 3GPP TS 38.521-3: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[15] 3GPP TS 38.521-4: "NR; User Equipment conformance specification; Radio transmission and reception; Part 4: Performance".

[16] 3GPP TS 38.533: NR; "User Equipment (UE) conformance specification; Radio resource management".

[17] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[18] 3GPP TS 36.323: "Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification".

[19] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".

[20] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

[21] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[22] 3GPP TS 38.215: "NR; Physical Layer Measurements".

[23] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[24] 3GPP TS 37.355: "LTE Positioning Protocol (LPP)".

[25] 3GPP TS 38.211: "NR; Physical channels and modulation".

[26] 3GPP TS 24.587: " Vehicle-to-Everything (V2X) services in 5G System (5GS), Stage 3".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Frequency Range 2 (FR2): The frequency ranges in which NR can operate being in the range of 24250 MHz - 52600 MHz.

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 5G System simulator

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

NOTE: In other Special conformance testing functions for User Equipment (UE) 3GPP specifications e.g. 36.509 [6], the term Test Control (TC) is used for describing the same UE entity. The different names do not preclude the implementation of a single entity to handle all the functionality in a UE supporting different 3GPP technologies.

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

3.2 Symbols

No specific symbols apply for the purposes of the present document.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

EMMI	Electrical Man Machine Interface
FFS	For further Study
FR2	Frequency Range 2
LB	Loop Back
MTC	Main Test Component
NSSAI	Network Slice Selection Assistance Information
SS	System Simulator
TMC	Test Mode Control

4 UE special conformance test functions overview

4.1 Requirements for UE support of test functions

The UE special conformance test functions are required for the support of 5GS conformance testing. They form a part of the core requirements and thus have a direct impact on the design of the UE. The use of the word "mandatory" in the present specification shall be understood as a particular requirement being mandatory for performing UE conformance testing.

NOTE: While the importance of conformance testing should not be underestimated, and hence is highly recommended, the implementation of facilitation of it is left to the Device implementation.

4.2 UE special conformance test functions concept

The present specification defines the UE special conformance test functions including any relevant procedure and the Test Mode Control (TMC) message contents used for information exchange.

The conformance test methods applied in RF/RRM Conformance Test Specification TS 38.521-1 [12], TS 38.521-2 [13], TS 38.521-3 [14], TS 38.521-4 [15] and TS 38.533 [16], and, the conformance test models used in Protocol Conformance Test Specifications TS 38.523-1 [3] and TS 38.523-3 [4], as well as, common test environment definition and Generic procedures specified in TS 38.508-1 [2] utilise the UE special conformance test functions. Default TMC messages and information element contents utilised in all before mentioned test specifications are specified in TS 38.508-1 [2].

The UE special conformance test functions vary depending on the conformance testing functionality they are designed to support. The following broader groups of UE special conformance test functions can be identified:

- **Test Loop Functions**: Functions which require a loop to be established between the UE and the System Simulator (SS) to allow e.g. DL data packets sent by the SS to be looped back UL by the UE

- **General Test Functions**: Commands send by the SS e.g. to trigger a certain UE behaviour which may be a behaviour determined by 3GPP core spec requirements or such needed to facilitate conformance testing and not being part of any 3GPP core spec requirements, or, to provide to the UE information needed for the conformance testing.

NOTE 1: An example for behaviour needed to facilitate conformance testing and not representing behaviour determined by 3GPP core spec requirements is counting and reporting the number of received data packets thereby providing means to the SS to verify 3GPP core spec requirements.

The utilisation of any UE special conformance test functions shall be considered as putting the UE in a test mode. The duration of the test mode depends on the UE special conformance test function and in most of the cases will be delimited by an activation and a deactivation command. However, in the case of general test functions used e.g. only to provide information relevant for the conformance testing the test mode can be considered as entered as soon as the information is received and exited as soon as the information has been acted upon.

As a common rule the UE special conformance test functions provide access to isolated functions of the UE via the radio interface without introducing new physical interfaces just for the reason of conformance testing. However, in certain cases the usage of AT Commands may be required which will require an external interface e.g. EMMI.

NOTE 2: It should be emphasised that the UE test functions only describe the functional behaviour of the UE with respect to its external interfaces; physical implementation of the UE test function is completely left open to the manufacturer.

Depending on the conformance testing functionality they are designed to support, the UE special conformance test functions may comprise:

- A single DL message (e.g. a test function intended to provide to the UE information needed for the conformance testing)

- A Request/Acknowledgement type of 2 messages exchange, an DL message followed by a UL message, (e.g. a test function intended to request the UE to execute an action which requires acknowledgment that request was received and acted upon)

Furthermore, depending on the conformance test scenarios

- An UE special conformance test function can be used in isolation.

NOTE 3: An example for this is the provision to the UE of location information which can then be used by the UE throughout its "normal" i.e. not test mode functions dependant behaviour.

- Two, or more, UE special conformance test functions may need to be executed in a particular sequence before the target UE behaviour can be assumed.

NOTE 4: An example for this are the Activate UE test mode and Close UE test loop functions. The former needs to be executed first, at a particular moment of time, in order a specific type of test bearer terminated in a particular UE protocol layer to be established. Followed by the latter, executed at different point of time, which will instruct the UE to start looping back the received packets.

- Two, or more, UE special conformance test functions may be executed simultaneously with no particular relation one to another allowing for different test mode functionality to take place at the same time.

NOTE 5: An example for this are the UE Beamlock test function and the test functions needed for test loop mode operation (see NOTE 4). The former may need to be active throughout the entire tests with the latter being active in parts of the test as appropriate. Both being active independently.

For the specification of UE special conformance test functions the present specification may refer to other specifications. In the case when text on the same matter exists in the present specification and in the referred specification, the text in the present specification takes precedence.

5 UE special conformance test functions operation

5.1 General

For consistency with legacy terminology, the present specification uses the terms 'Activate UE test mode' and 'Deactivate UE test mode' for denoting the activation and the deactivation of 5GS test mode bearers procedures respectively. Consequently, 'Activate UE test mode' should not be understood as setting the UE in test mode in general rather, as setting the UE in a mode (i.e. establishing a special type of test bearers) which other special UE conformance testing functions require for proper operation. As this has been mentioned elsewhere in the present specification, not all special UE conformance testing functions require such a setting.

Similarly, the present specification may use the term 'UE test loop mode X operation", where X is a chose letter, for denoting operation which does not represent true looping back of data being received rather, it represents what can be called as a "pseudo loop" i.e. providing back information about the received data e.g. the number of the received packets.

5.2 Activation and deactivation of 5GS test mode bearers (UE test mode procedures)

5.2.1 General

The SS performs, where applicable, activation and deactivation of the conformance test functions in the UE by sending Security Protected NAS Layer 3 messages.

The UE test mode procedures are intended for setting the UE into a test mode where the SS can set up test bearers terminated at a particular point in the 5GS protocol stack as specified in the functional block diagram of each UE test loop mode of operation. The following test bearers are defined in the present specification:

- data radio bearers (UE test loop mode A),
- EPS bearers or 5GS QoS flows (UE test loop mode B).
- NR PC5 QoS flows (UE test loop mode E).

5.2.2 Activate UE test mode

Same as TS 36.509 [6], subclause 5.3.2 with the following exceptions:

- where E-UTRA is mentioned the same applies for NR;
- where V2X is mentioned the same applies for NR sidelink;

  the NB-IoT mode is out of the scope of the present specification;

  where different UE test loop modes are mentioned only those applicable to 5GS should be taken into account (see subclause 5.3.4 for the applicable 5GS UE test loop modes).

5.2.3 Deactivate UE test mode

Same as TS 36.509 [6], subclause 5.3.3 with the following exceptions

- where E-UTRA is mentioned the same applies for NR;
- where V2X is mentioned the same applies for NR sidelink;
- the NB-IoT mode is out of the scope of the present specification;
- where different UE test loop modes are mentioned only those applicable to 5GS should be taken into account (see subclause 5.3.4 for the applicable 5GS UE test loop modes).

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.

5.3 Test loop functions

5.3.1 General

Before a loop functionality can be exercised, the test loop needs to be closed; this is to be understood as the UE being instructed to start looping back received data packets. When looping back received data packets is not any longer required the loop should be re-opened; opening of a loop does not change the type of bearer being established by the UE test mode activation function (subclause 5.2.2).

To limit the number of special test functions, the concept of closing and opening a loop is also used as instruction to the UE to initiate/terminate other actions. An example of this is counting the received packets and reporting the number of received packets back to the SS; in the context of this utilisation closing a loop is to be understood as the UE being instructed to start counting the packets, whereas opening a loop should be understood as stop counting the packets. Other utilisation of the closing/opening a "test loop" test functionality can be specified if appropriate.

The UE test loop functions for 5GS are intended for:

- NR receiver and transmitter testing to disable application data transfer in downlink and uplink during SS UE measurements.
- NR layer 2 (MAC, RLC, PDCP, SDAP) and data radio bearer testing to generate data transfer in downlink and uplink.
- NR layer 2 (MAC, RLC, PDCP, SDAP) and sidelink data radio bearer testing to generate data transfer in sidelink.
- 5GC and NR layer 3 testing to verify data transfer continuation over RRC and 5GC procedures.
- 5GC and NR layer 3 testing to verify data transfer over PC5 interface.
- 5GC NAS user-plane testing to verify uplink QoS flow descriptions handling.
- PC5-U testing to verify sidelink PC5 QoS flow descriptions handling.

5.3.2 Close UE test loop

5.3.2.0 General

Same as TS 36.509 [6], subclause 5.4.2 with the following exceptions:

- where E-UTRA is mentioned the same applies for NR;
- where V2X is mentioned the same applies for NR sidelink;
- the NB-IoT mode is out of the scope of the present specification
- where different UE test loop modes are mentioned only those applicable to 5GS should be taken into account (see subclause 5.3.4 for the applicable 5GS UE test loop modes).
- where EPS bearers are mentioned the same applies for 5GS QoS flows; and
- UE supported minimum buffer size for MR-DC and NR shall match the required total layer 2 buffer size as specified in TS 38.306 [20], clause 4.1.4.
- Subclause 5.4.2.3 in TS 36.509 [6] is replaced by 5.3.2.1 in current specification.
- Subclause 5.4.2.4in TS 36.509 [6] is replaced by 5.3.2.2 in current specification.

5.3.2.1 Reception of CLOSE UE TEST LOOP message by the UE

Same as TS 36.509 [6], subclause 5.4.2.3 with the following exceptions:

…

1> else if UE test loop mode E has been selected;

2> if UE test loop mode A or UE test loop mode B operation is already closed on one or more data radio bearers; or

2> if TEST_LOOP_MODE_C_ACTIVE = TRUE or TEST_LOOP_MODE_D_ACTIVE = TRUE or TEST_LOOP_MODE_E_ACTIVE = TRUE or TEST_LOOP_MODE_F_ACTIVE = TRUE or TEST_LOOP_MODE_G_ACTIVE = TRUE or TEST_LOOP_MODE_H_ACTIVE = TRUE or TEST_LOOP_MODE_I_ACTIVE = TRUE; or

2> if the UE is unable to read the pre-configured parameters for NR sidelink Communication from the USIM; or

2> when test loop mode E is utilised in NR sidelink out-of-coverage scenarios:

3> the UE behaviour is unspecified.

2> otherwise:

3> set TEST_LOOP_MODE_E_ACTIVE to TRUE

3> if the E0 bit in Communication Transmit or Receive parameter in UE test loop mode E setup IE is set as zero;

4> set TEST_LOOP_MODE_E_TRIGGER to RECEIVE

4> set state variable PROSE_COMMUNICATION_MONITOR_N to the number of entities in the list of Group Destination IDs to individually monitor included in the UE test loop mode E setup IE;

4> if PROSE_COMMUNICATION_MONITOR_N is greater than MAX_ModeE_Monitor_Entities:

5> the UE behaviour is unspecified.

4> for SL_ID = 0…(PROSE_COMMUNICATION_MONITOR_N-1):

5> set state variable PROSE_COMMUNICATION_DEST_ID(SL_ID) to the parameter Group Destination ID #(SL_ID) to monitor of the UE test loop mode E setup IE;

5> set state variable STCH_PACKET_COUNTER(SL_ID) to zero;

5> set state variable PSCCH_PACKET_COUNTER(SL_ID) to zero;

5> set state variable PSSCH_PACKET_COUNTER(SL_ID) to zero;

4> set state variable STCH_PACKET_COUNTER(PROSE_COMMUNICATION_MONITOR_N) to zero;

4> set state variable PSCCH_PACKET_COUNTER(PROSE_COMMUNICATION_MONITOR_N) to zero;

4> set state variable PSSCH_PACKET_COUNTER(PROSE_COMMUNICATION_MONITOR_N) to zero;

4> perform the UE actions for UE Test Loop Mode E operation as specified in subclause 5.3.4.3.1;

3> if the E0 bit in Communication Transmit or Receive parameter in UE test loop mode E setup IE is set as one;

4> if the E1 bit in Communication Transmit or Receive parameter in UE test loop mode E setup IE is set as zero;

5> set TEST_LOOP_MODE_E_TRIGGER to TRANSMIT;

4> else

5> set TEST_LOOP_MODE_E_TRIGGER to TRANSMIT_SL_MIMO;

4> perform the UE actions for UE Test Loop Mode E operation as specified in subclause 5.3.4.3.1;

3> send CLOSE UE TEST LOOP COMPLETE message (the loopback shall be operational prior to the sending of the acknowledgement).

5.3.2.2 Reception of AT Command +CCUTLE by the UE

Upon receiving the AT Command
+CCUTLE=<status=0>[,<direction>[,<format>,<length>,<monitor_list>,<sl_mimo>]] the UE shall:

1> if UE test loop mode E has been selected;

2> if TEST_LOOP_MODE_E_ACTIVE = TRUE; or

2> if the UE is unable to read the pre-configured parameters for NR sidelink Communication from the USIM:

3> the UE behaviour is unspecified.

2> otherwise:

3> set TEST_LOOP_MODE_E_ACTIVE to TRUE

3> if the <direction> parameter in +CCUTLE set command is set as zero;

4> set TEST_LOOP_MODE_E_TRIGGER to RECEIVE

4> if the <format> parameter in +CCUTLE set command is set as 1

5> set state variable PROSE_COMMUNICATION_MONITOR_N to the number of entities in the list of Destination Layer-2 IDs to individually monitor included in the <monitor_list> parameter of +CCUTLE set command;

5> if PROSE_COMMUNICATION_MONITOR_N is greater than MAX_ModeE_Monitor_Entities:

6> the UE behaviour is unspecified.

5> for SL_ID = 0…(PROSE_COMMUNICATION_MONITOR_N-1):

6> set state variable PROSE_COMMUNICATION_DEST_ID(SL_ID) to the parameter Destination Layer-2 ID #(SL_ID) to monitor in the +CCUTLE set command;

6> set state variable STCH_PACKET_COUNTER(SL_ID) to zero;

6> set state variable PSCCH_PACKET_COUNTER(SL_ID) to zero;

6> set state variable PSSCH_PACKET_COUNTER(SL_ID) to zero;

5> set state variable STCH_PACKET_COUNTER(PROSE_COMMUNICATION_MONITOR_N) to zero;

5> set state variable PSCCH_PACKET_COUNTER(PROSE_COMMUNICATION_MONITOR_N) to zero;

5> set state variable PSSCH_PACKET_COUNTER(PROSE_COMMUNICATION_MONITOR_N) to zero;

5> perform the UE actions for UE Test Loop Mode E operation as specified in subclause 5.3.4.3.1;

4> else

5> the UE behaviour is unspecified.

3> if the <direction> parameter in +CCUTLE set command is set as one;

4> if the <sl_mimo> parameter in UE test loop mode E setup IE is set as zero

5> set TEST_LOOP_MODE_E_TRIGGER to TRANSMIT

4> else