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Technical report on LTE OTA requirement derivation from MSG TFES ad hoc working group on LTE OTA

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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Mobile Standards Group (MSG).

Modal verbs terminology

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

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Executive summary

The present document is to capture the process, discussions and analyses for arriving at the final agreement on LTE UE OTA performance requirements to be included in ETSI EN 301 908-13 [i.22].

Introduction

Under the request of the European Commission, MSG TFES has been tasked to provide OTA TRP TRS requirements for LTE devices. As part of drafting work for ETSI EN 301 908-13 [i.22] in MSG TFES, an ad hoc OTA WG was established in October 2017 to address the OTA requirements because the nature of OTA requirement related work differs from 3GPP technical specification transposition in other part of ETSI EN 301 908-13 [i.22].

After 34 meetings, an agreement was reached in MSG TFES LTE ad hoc #34 on 7 July 2020 on LTE BHH UE OTA performance requirements.

The present document is to capture the process, discussions and analyses for arriving at the final agreement on LTE UE OTA performance requirements to be included in ETSI EN 301 908-13 [i.22].

1 Scope

The present document is to capture the process, discussions and analyses for arriving at the final agreement on LTE UE OTA performance requirements to be included in ETSI EN 301 908-13 [i.22].

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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.

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

[i.1] 3GPP RP-122030: "LTE UE TRP and TRS and UTRA Hand Phantom related UE TRP and TRS Requirements".

[i.2] 3GPP R4-1709053: "TRP TRS pass rate worksheet".

[i.3] 3GPP RP-172035: "LTE UE TRP and TRS and UTRA Hand Phantom related UE TRP and TRS Requirements".

[i.4] TFES(17)000016-NL-TCAM-input-document-about-antenna-perfomance.

[i.5] TFES(20)000046r1-Statistics-of-the-LTE-UE-OTA-Antenna-Parameters-Test-Campaig.

[i.6] TFES(20)000060-Modified-version-of-TFES-20-000049-OTA-statistics.

[i.7] TFES(20)000065: "Operator TRP-TRS limit for ETSI TFES".

[i.8] TFES(20)000078: "LTE OTA proposal".

[i.9] TFES(20)000070: "Revised proposal - TRP and TRS limits".

[i.10] TFES(20)000062: "Operator TRP - TRS limit for ETSI TFES".

[i.11] TFES(20)000077: "Proposed TRP TRS limit for Operators".

[i.12] TFES(20)000087-Draft-Meeting-Report.

[i.13] TFES(20)000095: "Apple input on OTA limits".

[i.14] TFES(20)000094: "Zebra proposal for TRP and TRS limits".

[i.15] ETSI TS 137 544 (V16.0.0): "Universal Mobile Telecommunications System (UMTS); LTE; Universal Terrestrial Radio Access (UTRA) and Evolved UTRA (E-UTRA); User Equipment (UE) Over The Air (OTA) performance; Conformance testing (3GPP TS 37.544 version 16.0.0 Release 16)".

[i.16] TFES(18)000036: "Way forward and Framework for LTE UE OTA parameters test campaign".

[i.17] TFES(19)000019r2: "LTE UE OTA Measurement Campaign Technical Guidance Document".

[i.18] TFES(20)065040: "LTE UE Round Robin Correlation Analysis".

[i.19] TFES(20)065003r1: "Draft Meeting report for MSGTFES#65".

[i.20] TFES(20)000052: "Draft Meeting report for OTA LE UE ad-hoc meeting#27".

[i.21] TFES(19)000021r3: "Questionnaire for OEM"s of the selected DUT"s for MSG-TFES OTA test campaign".

[i.22] ETSI EN 301 908-13 (V13.1.1): "IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 13: Evolved Universal Terrestrial Radio Access (E-UTRA) User Equipment (UE)".

[i.23] ISO/IEC 17025:2017: "General requirements for the competence of testing and calibration laboratories".

[i.24] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC (RED).

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 following abbreviations apply:

BHH	Beside Head and Hand
BHHL	Beside Head and Hand Left
BHHR	Beside Head and Hand Right
EC	European Commission
LTE	Long Term Evolution
OEM	Original Equipment Manufacturer
OTA	Over The Air
RED	Radio Equipment Directive
TAS	Transmit Antenna Selection
TRP	Total Radiated Power
TRS	Total Radiated Sensitivity
UE	User Equipment
WG	Working Group

4 Background

4.1 LTE UE OTA requirement in 3GPP

3GPP RAN WG 4 started to define LTE UE OTA requirement in 2012 [i.1]. More than 1 000 measured UE OTA values were submitted over 20 bands [i.2] from companies participating in 3GPP RAN WG 4. However, in 2017, 3GPP RAN decided to terminate the work item due to lack of agreement in RAN WG 4 with [i.3] being the last status report. Under the request of the European Commission, MSG TFES has been tasked to provide UE OTA TRP TRS requirements. To meet RED [i.24] requirements in ETSI EN 301 908-13 [i.22] as detailed in [i.4], MSG TFES established an ad hoc WG to define LTE UE OTA requirement in MSG TFES ad hoc #1 in October 2017.

4.2 Working Approach in TFES ad hoc UE OTA WG

The TFES ad hoc OTA WG agreed to take a different approach from those used in 3GPP RAN WG 4 by deriving OTA requirements from commercial device measurement. Based on the distribution of OTA measurement from a selected pool of devices according to [i.15], measured LTE UE OTA values are used to agree on OTA requirements for the following European LTE bands, B1, B3, B7, B8, B20, B28, B32, B38 and B40.

5 Measurement of commercial devices to establish a baseline

5.1 Device selection for measurement

It was agreed to select the devices listed in Table 1 based on the following criteria. The consensus was that the 21 selected device models provide a good representation of devices available on European market:

a) When the devices came to European market (i.e. 2017, 2018)

b) Brand variety

c) Price range (to capture different price segment)

d) Popularity

e) Number of bands supported

f) Device width

NOTE Devices within 1 mm of 56 or 72 mm are also accepted in the measurement campaign.

Table 1: Devices selected for OTA measurement

	OEM	EU Model	Year	W≤72	B1	B3	B7	B8	B20	B28	B32	B38	B40
1	Samsung	Galaxy S8 (SM-G950F)	2017	Y	1	1	1	1	1	1	0	1	1
2	Huawei	P10 Lite	2017	Y	1	1	1	1	1	0	0	0	0
3	Asus	Zenfone Live (ZB501KL)	2017	Y	1	1	1	1	1	0	0	0	0
4	Alcatel	A3	2017	Y	1	1	1	1	1	0	0	0	0
5	Apple	Iphone X	2017	Y	1	1	1	1	1	1	0	1	1
6	Sony	Xperia XA2 SM12 (H3113)	2017	Y	1	1	1	1	1	0	0	1	0
7	Samsung	Galaxy S9 (SM-G960F)	2017	Y	1	1	1	1	1	1	1	1	1
8	Samsung	Galaxy J3 2017 (SM-J330FN)	2017	Y	1	1	1	1	1	0	0	1	1
9	Samsung	Galaxy A5 2017 (SM-A520F)	2017	Y	1	1	1	1	1	1	0	1	1
10	Honor	6A	2017	Y	1	1	1	1	1	0	0	1	1
11	LG	G6 (H870)	2017	Y	1	1	1	1	1	1	0	1	1
12	LG	K8 2017	2017	Y*	1	1	1	1	1	0	0	0	0
13	Nokia	3	2017	Y	1	1	1	1	1	1	0	1	1
14	Zebra	TC25BJ (EU version)	2017	Y	1	1	1	1	1	1	0	0	0
15	Motorola	Moto G6 Play	2018	Y*	1	1	1	1	1	0	0	1	0
16	Huawei	P20 (Emily-L09)	2018	Y	1	1	1	1	1	1	1	1	1
17	LG	Q7 LMQ610EM	2018	Y	1	1	1	1	1	1	1	1	1
18	Huawei	Y6 Prime 2018 (ATU-L11)	2018	Y*	1	1	1	1	1	0	0	0	0
19	Blackberry	Key Two	2018	Y	1	1	1	1	1	1	1	1	1
20	Samsung	Galaxxy J2 (SM-J250Y)	2018	Y	1	1	1	1	1	0	0	0	0
21	Wiko	Tommy 3 (C200)	2018	Y	1	1	1	1	1	0	0	0	0

NOTE: An entry of 1 indicates the corresponding band is supported, 0 otherwise. "*" indicates the device width is within 1 mm of 72 mm.

Five ISO/IEC 17025 [i.23] certified test laboratories volunteered to participate in the measurement activity, which was managed by ETSI secretariat to ensure device and laboratory anonymity. The test labs are selected according to [i.16] and [i.17].

The OEM questionnaire [i.21] also identifies if a device is TAS (Transmit Antenna Selection) capable or not with explanations on how to test such devices.

At the first stage, two devices were selected at random out of 21 by the ETSI secretariat for a round robin test among the test laboratories. Then four devices were chosen for each laboratory except five devices were allocated to a randomly and anonymously selected laboratory to evenly distribute the 21 devices.

The measurement took several months to complete due to the nature of UE OTA tests and the time needed to transport the devices across various continents and the results became available at the beginning of 2020.

5.2 Measurement result analyses

The round robin test revealed a large discrepancy in the test results from one laboratory with a deviation of 4 dB across the TRP of devices 1 and 2, which this WG has decided to remove from the test campaign [i.18] . As a result, four devices tested by this laboratory were re-tested by the remaining four laboratories.

The group decided to analyse the TRP and TRS results separately [i.19].

The measurement results were analysed and the results in the form of TRP and TRS distributions and passing rates are given in [i.5]. Other analyses based on [i.5] followed to address statistics on a per band basis [i.6] or to show the margins of failure on a per device and per band basis [i.7].

The group did not agree on any threshold across the distributions of the measurement results or define any failing rate criteria to derive the final UE OTA values.

6 Discussions to reach an agreement

6.1 Discussion phase

Based on the measurement results, network coverage needs from operators and product performance from manufacturers, various proposals on OTA requirements were submitted [i.8], [i.9], [i.10] and [i.11]. Discussion and negotiation ensued over a number of meetings. The outcome in the penultimate round is summarized in [i.12] and reproduced in Tables 2 and 3. The figures in Tables 2 and 3 are averaged over 6 values, 3 channels (low, middle and high) from BHHL and BHHR within any given band.

Table 2: TRP proposals from manufacturers, operators and the MSG Chairman

Band	UE vendors (dBm)	Operators (dBm)	Chairman's Proposals (dBm)
B1	10,5	11,25	10,9
B3	10,5	11,25	10,9
B7	10,5	11,25	10,9
B8	7,0	8,25	7,6
B20	7,0	8,25	7,6
B28	7,0	8,25	7,6
B38	10,5	11,25	10,9
B40	10,5	11,25	10,9

Table 3: TRS proposals from manufacturers, operators and the MSG Chairman

Band	UE vendors (dBm)	Operators (dBm)	Chairman's Proposals (dBm)
B1	-85	-88,2	-86,6
B3	-85	-88,2	-86,6
B7	-85	-88,2	-86,6
B8	-81	-85	-83,0
B20	-81	-85	-83,0
B28	-81	-85	-83,0
B38 (20 MHz)	-82	-85,2	-83,6
B40 (20 MHz)	-82	-85,2	-83,6
NOTE: Unless specified, the default bandwidth is 10 MHz.			

6.2 Final Agreement

At the ad hoc MSG TFES meeting #34 on 7 July 2020, proposals were submitted [i.13], [i.14] and an agreement, shown in Table 4, was reached among all but one participant. In this case, the MSG chairman declared Table 4 as the final agreement by majority decision.

Table 4: The agreed OTA requirements

Band	TRP (dBm)	TRS (dBm)
B1	10,9	-86
B3	10,9	-86
B7	10,9	-85,7
B8	7,6	-82,5
B20	7,6	-82,5
B28	7,2 (T1), 7,6 (T2)	-81,6 (T1), -82,5 (T2)
B38	10,9	-82,5 (20 MHz)
B40	10,9	-82,5 (20 MHz)
NOTE: Unless specified, the default bandwidth is 10 MHz.		

The LTE UE OTA BHH requirements in Tables 2, 3 and 4 are for devices whose width is less than or equal to 72 mm and larger than or equal to 56 mm.

The LTE OTA TRP TRS requirements in Table 4 are derived per band basis however a device failing to fulfil one band requirement is considered as failing all the bands. In addition, a device failing one of the TRP or TRS requirement is considered as failing both the requirements.

The T1 and T2 dates are specified in order to represent a phased approach allowing manufacturers to improve device performances.

T1 is when ETSI EN 301 908-13 (V13.2.1) enters into force and T2 is 18 months after ETSI EN 301 908-13 (V13.2.1) is cited in the Official Journal or 31st December 2022, whichever date comes earlier.

The implementation of these OTA TRP and TRS requirements in ETSI EN 301 908-13 [i.22] represent the limits without any additional Test Tolerance or Measurement Uncertainty on top. According to [i.20], "*After some reminders of the EC rules, there was a group agreement on that setting limit/s without to add any tolerance or relaxation on top of those limits. Any eventual tolerance/relaxation should be considered as included within the limit in self*".

Not all selected devices used in the assessment pass the derived OTA requirements in Table 4, as the failing devices are not optimized for European bands and BHH mode. However by the time this standard is enforced, it is expected most devices will meet these requirements because they will be designed to meet these requirements and achieve the aim of driving performances and technologies forward.

7 Conclusion

Despite the different interests of the companies that were involved in this work, MSG TFES OTA working group has succeeded in deriving LTE OTA TRP TRS values based on technical discussions and compromises. The MSG chairman also played a key role in guiding the members through some difficult discussions.

Annex A:
Change History

Date	Version	Information about changes
July 2020	v1.1.1	Creation of ETSI TR 103 803
12 October 2020	v1.1.2	After the review session held on 12 October 2020
29 October 2020	v1.1.3	After the review session held on 29 October 2020

History

Document history		
V1.1.1	December 2020	Publication