

Source: Motorola Mobility LLC, SONY Mobile
Title: E-UTRA BHH TRP/TRS performance requirements
Agenda Item: 8.26
Document for: Approval

1. Introduction [R4-125719](#)

At the end of the 3GPP RAN4 #79 the TP to TS 37.144 [1] was approved with UE UTRA BHH performance requirement values but without UE E-UTRA values.. Discussions since have highlighted [2][3] some fundamental issues with the current methodology, which impede compromise and finalization of limits, and have recommended that OEMs and Operators bridge the final gap by a good-faith effort to propose final specifications that they can actually support. This submission builds upon the finally agreed UTRA values in a scientific way to propose E-UTRA values that can serve as a starting point again for final negotiation between companies, based on good-faith effort to compromise business and technical realities.

2. Background

The UE UTRA performance requirements agreed in [1] resulted from an original pool of UTRA device TRP/TRS data to inform a starting point, followed by some compromise and negotiation at the end to adjust for what was viewed by many participants to be some shortcomings [2][3] in the original data-processing methods, which had come to light during the process. In the end, this had the good result of producing limits that are technically challenging but within reach of OEMs in practice. In this submission, these already-agreed UTRA limits are taken as a starting point and basis for calculating new proposed limits for UEs for E-UTRA, based on a principle that antenna efficiency at a given frequency does not change depending on technology, for a multi-mode device already supporting both technologies.

Specifically, the agreed UTRA values for B1 and B8 were used together with known actual conducted output power and sensitivity values for these UTRA bands, for real devices, to calculate equivalent TX and RX antenna efficiencies in the high bands (above 1 GHz) and low bands (824 ~ 960 MHz), respectively. Assuming that most modern devices support diversity for UTRA modes, the equivalent RX antenna efficiency intrinsically accounts for the average combined efficiency of main + diversity antennas, as they were represented in the original data pool. These calculated equivalent efficiencies in each band set were then combined with known conducted output powers and sensitivities of the E-UTRA bands, again based on real device performance (which is known in many cases to exceed 3GPP minimum conducted requirements), to generate the proposed TRP/TRS limit values for these E-UTRA bands.

Additionally, for the ultra-low E-UTRA bands in the range of 698 ~ 824 MHz, the calculated low bands' equivalent efficiencies were derated by an additional 1 dB, accounting approximately for the known sharp roll-off in efficiency at these frequencies, as the device size becomes smaller relative the operating wavelength. This ultra-low band equivalent efficiency was used to calculate the proposed E-UTRA values in those bands.

The resulting proposed values were also compared against actual TRP/TRS performance of existing devices [at Motorola], and deemed to be very challenging, but probably within reach of OEMs to meet in marketable form factors. It is Motorola and SONY's view, considering all products we make in all bands and modes, that these proposed limits offer *the most performance that we can support across all bands and modes, with acceptable industrial design and cost compromises*. This includes considerations such as growing dimensions of the phone to enlarge antenna keep-outs, limitation of use of metal exterior elements of the phone, and expense of antenna tuner devices of varying performance capabilities.

It is suggested that other companies can either make a similar set of calculations to reach their own derived E-UTRA proposed limits, or simply compare the limits proposed here to their internal data, technical understanding, business need, etc., as a starting point for negotiating final values.

Aside from the obvious value to industry of a complete specification for all bands and modes, we believe it is also important for participants in the current discussion to view such a complete set of implied limits, so that all bands are treated on an equal basis.

3. E-UTRA Performance Requirements proposal

Adhering to the rational approach shown in [3] and further analysis the following performance requirements proposed in RAN4 #78 bis in [4], are revised and proposed in the following table:

Band & Mode	BW (MHz)	TRP Spec (dBm)	TRS Spec (dBm)
L1	10	13.25	-89.00
L2	10	13.25	-88.00
L3	10	12.50	-88.50
L4	10	13.25	-89.00
L5	10	9.40	-84.50
L7	10	12.50	-88.50
L8	10	9.40	-84.50
L12	10	8.40	-82.75
L13	10	8.40	-82.75
L17	10	8.40	-82.75
L20	10	8.40	-82.75
L25	10	13.25	-88.00
L26	10	9.40	-84.25
L28	10	8.40	-83.25
L29	10		-82.75
L30	10	13.25	-88.00
L39	10	13.25	-89.00
L40	10	13.25	-88.00
L41	10	13.25	-87.50

These final limits are offered with these specific provisos:

1. All values are dBm, avg across L-M-H channels and left-right sides, with both receivers active, per 3GPP TS 34.114;
2. Applicable to devices up to 72 mm wide, that fit in CTIA PDA hand phantom;
3. Exclude devices supporting Carrier Aggregation (or consider CA relaxation for future study);
4. Include multi-band/multi-mode devices, and apply either to core or roaming bands;
5. Exclude Test Tolerance. Specifically, these limits are acceptable only if Test Tolerances of 0.7 dB TRP and 0.9 dB TRS are taken as a relaxation from the limits to generate the final drop-dead pass/fail thresholds for certification in e.g. GCF. This would follow the same practice as has been taken with the current TS 34.114 head-only limits;
6. LTE TRP is applied to the case of 12 RB uplink allocation in 10 MHz bandwidth [9].

For simplicity, all LTE bands limits are given for an assumed bandwidth of 10 MHz; these can be adjusted if desired for any other BW based on simple known calculations.

One can observe that E-UTRA TRP values can resume corresponding UTRA bands' TRP values. The reason is that the conducted output power also in reality is the same, as demonstrated by Docomo in [7], despite the different nominal powers of 24 and 23 dBm for UTRA and E-UTRA respectively. Furthermore GSMA recognize in their specification [8] a relaxation for E-UTRA bands' TRP figures as compared to UTRA bands TRP sharing the same bands (for example at BHH band 1 UMTS TRP=15 dBm whereas LTE=13.5 dBm in [8]). Consequently for RAN 4 one can at least state that E-UTRA bands' TRP requirements shall not suggest higher values than what's been agreed on for UTRA corresponding bands.

Parties in 3GPP have agreed on values for UTRA bands based partially in the method described here and [5] as well as conclusions drawn from original measured data, now we extrapolate these values to E-UTRA bands based on a principle of equivalent antenna efficiency. Upon request Motorola can provide the spreadsheet with complete explanation of the process taken for these data, to make it easy for other companies to investigate these trade-offs.

4. References

- [1] R4-161467, TP for TS 37.144 Introduction of new TRP/TRS requirements
- [2] R4-157939, "Framework analysis of TRP and TRS data for multi-band mobile devices", Motorola Mobility, Huawei, Sony Mobile, Intel, RAN4#77
- [3] R4-161506, "UTRA BHH TRP/TRS performance requirements" Motorola Mobility, Sony Mobile, Intel, RAN4#78-BIS
- [4] R4-162583, "UTRA BHH TRP/TRS performance requirements proposal for Bands I, II, V and VIII", Motorola Mobility LLC, Sony, RAN4 #78-BIS
- [5] R4-163071, "UTRA BHH TRP/TRS performance requirements", Motorola Mobility, Sony Mobile, Intel, Huawei and AT&T, RAN4 #78-BIS.
- [6] R4-163553, "E-UTRA BHH TRP/TRS performance requirements", Motorola Mobility LLC, RAN4#79
- [7] R4-150410, "Comparison of TRP between UMTS and LTE". NTT DOCOMO, RAN4#74
- [8] GSMA: TS 24 v.3.0, "Operator acceptance values for device antenna performance".
- [9] 3GPP TS 36.521-1 v13.2, "User Equipment (UE) conformance specification Radio transmission and reception Part 1: Conformance Testing (Release 13)", 2016-06.