

**Source:** Motorola Mobility LLC, Sony, Intel  
**Title:** UTRA BHH TRP/TRS performance requirements  
**Agenda Item:** 6.1  
**Document for:** Approval

## 1. Introduction [R4-125719](#)

At the end of the 3GPP RAN4 #78 the TP to TS 37.144 [1] was approved without UE UTRA or E-UTRA BHH performance requirement values. This outcome was due to a lack of agreement on band VIII TRP, and bands V and VIII TRS.

## 2. Background

During the 3GPP RAN4 #77 meeting, the view was presented [2] that the pass/fail criteria associated with TRP/TRS certification values should be defined based on the complete set of frequency bands supported in the UE rather than a single band radiated performance as currently defined. The reason for this view is that a UE which declares support for four bands and fails to meet the performance requirement for any one of the four bands will fail certification. Based on this interpretation of the current available data the UE manufacturers believes the adoption of the pass/fail criteria definition on multi-band performance is a necessary requirement for today's multi-band devices.

The limited amount of available data for devices measured for all four bands indicates that two-thirds of these devices will fail to comply with any of the proposed requirements under consideration [2] when all four bands are considered. As the number of bands supported by devices increases, the failure rate is likely to be even higher.

## 3. Moving Forward

The authors supported the three month WI extension, and are looking forward to continuing constructive discussions with the objective of reaching a realistic consensus. Other important aspects of this complex problem should be addressed in the three month extension period such as:

### i. Performance requirement definitions for multi-band devices

There are no single band devices in the feature or Smartphone market nowadays, therefore any attempt to define UE radiated performance requirements must realistically address the larger RF front-end and antenna mismatch losses which are intrinsic to UE multi-band antenna designs. As noted, spec proposals to date are based on a specified failure rate for each band treated in isolation, such that these spec proposals are applicable only to a (non-existent) single-band device.

### ii. Definition of performance requirements for devices supporting carrier aggregation (CA)

Carrier aggregation support requires additional components in the signal path which increase insertion loss and thus devices supporting CA for *any band combination* are not covered by the requirements defined in this WI. A separate WI will be required for devices supporting CA.

**Proposal 1:** Any agreement on UTRA handset requirements based on the data currently available to RAN4 will include the following note:

*NOTE: TRP/TRS minimum performance requirements in Table x.x.x apply to HSPA and LTE UEs supporting only single carrier operation. Their applicability to multi-carrier operation is FFS. This is because it has not been verified whether the UEs measured to derive the requirements supported carrier aggregation or not.*

iii. The existing data-set and methodology has produced an irregular result

The current pool of data is biased by large samples of single market phones skewing results in one direction. This is evident in all of the proposed spec limit sets to date, by virtue of the gross difference in spec limits produced by the methodology for U.S. bands and non-U.S. bands (i.e. B2/B5 vs. B1/B8)

By way of illustration, consider the specification values in the DCM proposal [4] shown below. The DCM proposal is chosen here as an example because it adheres most closely with the current (single-band) framework [3] in that the methodology is strictly applied without arbitrary exclusion of selected data points from the CDF's.

Fundamentally, there is no reason why the TRP requirements should be different for bands I and II. However, in the proposal below, *the Band I requirement is 4.5 dB tighter than for Band II*. Similarly, there is fundamentally no reason why the TRP requirement for Band V should be different than Band VIII, and yet the proposed value for Band VIII is 1.5 dB tighter than for Band V. The reason for these disparities is the quantity and source of the datasets which has biased the outcome of the results.

Proposal of minimum average requirement		
Band	TRP	TRS
I	13.0	-100.0
II	8.5	-99.5
V	7.5	-96.0
VIII	9.0	-96.0

The reason for such discrepancy is the quantity and source of the data-sets, biasing the outcome results post-processed adopting of the current method. Note that other proposed spec sets have similar pronounced imbalance between B2/B5 and B1/B8. Shown here is the Vodafone proposed spec set [5]:

Band	TRP	TRS
I	13,5	-101,5
II	10	-100,5
V	8	-96,5
VIII	10,5	-97,5

If such an unbalanced specification were adopted, the result would be that carriers in some geographic regions would be disadvantaged by requirements that compromise performance in their own core bands in order to support overly aggressive requirements for bands which are roaming bands in their markets. For example, it would be necessary for a U.S. operator to accept reduced performance for Bands II and Band V in order to meet the very aggressive requirements for Bands I and VIII.

iv. The UTRA requirements *will affect* the LTE requirements

Very aggressive requirements for some bands will require that the antenna matching networks be defined to favor these bands at the expense of other bands. If a device supports both UTRA and LTE, then the same antenna matching networks must be used for both UTRA and E-UTRA. As a result, if Band I is favored at the expense of Band II with respect to the UTRA requirements, it follows that Band 2 performance will similarly be worse than Band 1 for E-UTRA.

v. Device width and applicable hand phantoms.

The data pool for the WI is based on devices measured in the "PDA hand" phantom, which are devices narrower than 72 mm. Results for wider devices measured in the new "Wide hand" are known to be different. Therefore, any performance limits generated in this WI should be limited to devices of 72 mm width or less.

**Proposal 2:** Any agreement on UTRA handset requirements based on the data currently available to RAN4 will include the following note:

*NOTE: TRP/TRS minimum performance requirements in Table x.x.x apply to UEs narrower than 72mm such that they can be measured using the hand phantoms defined in TR 25.914, subclauses 5.1.5 and 5.1.6.*

vi. Going forward with flawed framework will carry negative consequences for E-UTRA with respect to roaming vs. core bands, multi-band performance, and overall device dimensions.

As noted above, the antennas and matching networks are technology agnostic. Setting a spec for UTRA bands/modes will continue to impact device design and performance in all modes. Overly strict and unrealistic performance requirements for some bands will force manufacturers to grow devices in order to get the larger antenna volumes needed to achieve better radiated performance.

vii. We do not propose taking extra data or adopting a new framework; rather, we propose all parties reach agreement based on their best judgment, considering physics, business interests, etc.

The data set and agreed method have served a useful purpose in getting parties within 2 dB or so of a final agreed compromise, but as noted above the data set and method have limitations. All parties must work now in a spirit of compromise to finalize values that will serve all stakeholders and advance the industry as a whole. In this final note we emphasize that to have a fair assessment of realistic UE TRP/TRS performance requirements; we need to have more diverse carrier representation in these discussions to avoid biased decisions based on specific markets.

## 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
- [3] R4-75AH-TRPS-0018, Way Forward
- [4] R4-160379, BHH requirement for UMTS Band I, II V, and VIII
- [5] R4-161023, TRP TRS requirements proposal for BHH UMTS