**TSG-RAN Working Group 4 (Radio) meeting #95-E *R4-2008855***

**Electronic Meeting, 25 May – 5 June, 2020**

**Source:** Ericsson

**Title:** TP to TR 37.941: Improvement of the Clause 6.3.3

**Agenda item:** 6.19.2

**Document for:** Approval

1. Introduction

The current text in clause 6.3.3 neglects the possibility of applying interpolation methods to the measured data in order to find the peak EIRP and its direction. Furthermore, there is misleading text on the application and reference angular steps in orthogonal cuts with pattern multiplication method. Finally, there is a mismatch between the data in Figure 6.3.3-1 and the text referring to the figure.

 In this contribution we have provided a text proposal to improve the applicability and readability of the clause by including interpolation, removing the misleading text and correcting the text according to the figure data. The text proposal is attached at the end of this contribution and is presented for approval.

1. Discussion

Based on the source text in the first merged version of TR 37.941 [1] a text proposal with improvements have been created.

For the angular alignment text, it’s unclear why any specific treatment of the orthogonal cut method would be required. As such, this text is removed in order to keep the angular step documentation general for all grid methods.

The primary issues to consider:

1. The reference steps are developed as an upper bound for retrieving the TRP from an EIRP pattern, i.e., the full sphere average.
2. When sampling close to a peak in a beam pattern the pattern cannot be well approximated by a straight line. At the peak the pattern is approximately a second order polynomial in the angle, without a linear term. This makes the proposed linear interpolation an unsuitable choice when estimating peak values.

The text also leads conclusion that HPBW/2 is chosen, there is no technical argumentation why this selection should be applied. It is therefore removed in order to avoid misleading information in the TR. There is of course an inherent relationship between measurement points and beam pattern accuracy resolution; simple sampling theory. However, taking into the account the beam characteristics as part of the equation has not been thoroughly explained in this section. In order to avoid incomplete explanations, it is proposed to remove the text.

Removal of the reference regarding frequency range is due to the fact that there is no different criteria relative to HPBW for FR1 and FR2. The method is applicable for both frequency ranges.

Furthermore this type of error is a post-processing error, and these are typically not considered in the MU tables as they are deemed to be small when handled correctly, with exception for the SE.

1. Conclusion

The attached text proposal is presented for approval.

1. References

[1] R4-2005609, “Draft TR 37.941 v0.2.0”, Huawei

TEXT PROPOSAL:

### 6.3.3 Angular alignment in TRP measurements

For the TRP test methods relying on finding EIRP peak measurements, guidance on how to find the peak with acceptable accuracy is required.

The following test methods relies on finding peak EIRP:

1. Beam-based direction (clause 6.3.2.2.4)

2. Orthogonal cut grid (clause 6.3.4.5)

3. Peak method (clause 6.3.2.5.3)

4. Equal sector with peak average method (clause 6.3.2.5.4)

For the above procedures, measuring maximum EIRP accurately is critical to the accuracy of TRP estimates. If the maximum value is not accurately sampled, this will result in measurement errors. In the worst case, the measurement error is larger than the MU, which is not acceptable. The measurement error is caused by angular misalignment which is the difference (in degrees) between the actual and the measured angular positions of the intended maximum EIRP. Figure 6.3.3-1 shows an example of angular misalignment, where the measured EIRP is at an angle equal to -2° while the actual angular position of the maximum EIRP is at 0° in the radiation pattern. This results in an absolute measurement error = $\left|maximum EIRP-measured EIRP\right|$ = 1 dB.



Figure 6.3.3-1: Angular misalignment

If the actual angular position of maximum EIRP is known (e.g., declared by manufacturers), measurement errors due to angular misalignment can be alleviated. However, if the actual angular position of maximum EIRP is not known, then the angular interval used in searching for the maximum EIRP employing the peak search method can contribute to the measurement errors due to angular misalignment. The search is performed in the proximity of the expected angular position of maximum EIRP (e.g., a boresight radiation pattern). To determine the magnitude of the measurement error caused by angular misalignment, the angular step size can be expressed in terms of half-power beam width (HPBW) of test beams. If the angular step size is set to HPBW, the absolute measurement error can be as large as 3 dB. Table 6.3.3-1 summarizes the maximum absolute measurement error versus different angular step sizes. The absolute measurement errors were derived assuming a linear approximation between the maximum EIRP and the 2 HPBW points as illustrated in figure 6.3.3-2. The linear approximation gives us the worst-case scenario as can be observed in figure 6.3.3-2.



Figure 6.3.3-2: Linear approximation of measurement errors

Table 6.3.3-1: Sampling grid step size vs measurement errors

|  |  |
| --- | --- |
| Angular misalignment | Maximum absolute measurement error (dB) |
| HPBW | 3 |
| $$^{HPBW}/\_{2}$$ | 1.5 |
| $$^{HPBW}/\_{3}$$ | 1 |
| $$^{HPBW}/\_{4}$$ | 0.75 |

Note, there is a trade-off between search time and angular misalignment (that is, the difference in actual and measured angular positions of intended peak EIRP).