**3GPP TSG-RAN5 Meeting #95-e *R5-222477r1***

**Online, 9th May – 20th May 2022**

**Title: MU discussion on 40 cm Quiet Zone**

**Source:** Anritsu

**Agenda Item:** 5.3.19.8

**Document for:** Endorsement

**1. Introduction**

In the past RAN5 meetings, QZ above 30 cm was discussed [1][2][3][4][5]. However, there is no concrete consensus on the MU value. This paper provides the MU discussion on MU value for QZ size = 40 cm.

**2. Discussion**

When the QZ size is extended to 40 cm in the current test systems which was originally designed for 30 cm QZ, it will increase the measurement uncertainty. In [1] and ~~[2]~~ [6], R&S and Keysight analyzed the increase of QoQZ and XPD uncertainty as below.

[1] **Observation 3: the QZ extension of current test systems from 30cm to 40cm will require an increase of the Quiet Zone uncertainty contribution by 0.3dB.**

In the case of Influence of the XPD, there are also effects of reaching the physical limits for IFF methodology (i.e. Compact Antenna Test Range). Based on the preliminary evaluation, the worst case XPD is degraded by ~3dB when extending from 30cm to 40cm QZ. This corresponds to an increase of the Influence of the XPD uncertainty contribution in *Stage 2: DUT measurement* from 0.01dB to 0.02dB.

**Observation 4: the QZ extension of current test systems from 30cm to 40cm will require an increase of the Influence of the XPD uncertainty contribution by 0.01dB.**

~~[2]~~**~~Observation 3: A 0.2dB increase in QoQZ MU is expected for the 40cm QZ and that the 35cm QZ will likely have the same QoQZ MU as the 30cm QZ~~**

[6] **Observation 1: The 40 cm QoQZ performance at 23.45 GHz shows unexpectedly high MUs (expected to be an outlier)**

**Observation 2: The 40 cm QoQZ performance at 32.125 GHz through 49 GHz is similar to that of the 30 cm QoQZ performance**

**Proposal 2: Relax the XPD MUs for the 40 cm QZ, i.e., define an XPD MU of [0.03] dB for frequencies up to 40.8 GHz and [0.07] dB for frequencies beyond 40.8 GHz.**

In our analysis, an increase of QoQZ uncertainty is 0.2 dB, and a degradation of XPD is 5 dB which corresponds to an increase of XPD uncertainty from 0.01 dB to 0.03 dB.

Observation 1: An increase of QoQZ uncertainty is expected as 0.2 dB when the QZ size is extended from 30 cm to 40 cm.

Observation : An increase of influence of XPD is expected as 5 dB when the QZ size is extended from 30 cm to 40 cm.

We propose to adopt the maximum MU value estimated by each TE vendor. The following table shows the summary of MU estimation.

Table 1 Increase of QoQZ and XPD from QZ size = 30 cm to QZ size = 40 cm

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Uncertainty source** | **TE1 [1]** | **TE2 ~~[5]~~ [6]** | **TE3**  **(Observation 1)**  **(Observation 2)** | **Max {TE1, TE2, TE3}** |
| Quality of Quiet Zone | 0.3 dB | ~~0.2~~ [0] dB | 0.2 dB | 0.3 dB |
| XPD (up to 40.8 GHz) | 3dB | 4.8 dB Note | 5 dB | 5 dB |
| XPD (beyond 40.8 GHz) | 8.5 dB Note | 8.5 dB |
| Note: Calculated by 10\*LOG10(10^([0.03 or 0.07]/10)-1)-10\*LOG10(10^(0.01/10)-1). | | | | |

Proposal 1: For QZ size = 40 cm, define QoQZ uncertainty as 0.3 dB larger than that of 30 cm QZ.

Proposal a: For QZ size = 40 cm and frequencies up to 40.8 GHz, define influence of XPD as 5 dB larger than that of 30 cm QZ.

Proposal 2b: For QZ size = 40 cm and frequencies beyond 40.8 GHz, define influence of XPD as 8.5 dB larger than that of 30 cm QZ.

When Proposal 1 and Proposal 2a are endorsed, the total MU for each test case will be increased. For example, the total MU of EIRP, TRP, and EIS are shown below. The attached file “Total MU calculation for QZ size = 40 cm\_v1.xlsx” shows the calculation in detail.

Table Total MU for QZ size = 40 cm

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TC** | **Frequency** | **Total MU [dB]** | | |
| **QZ size = 30cm** | **QZ size = 40cm** | **Difference [dB]** |
| EIRP | 23.45GHz <= f <= 32.125GHz | 5.17 | 5.61 | 0.44 |
| 32.125GHz < f <= 40.8GHz | 5.37 | 5.81 | 0.44 |
| TRP | 23.45GHz <= f <= 32.125GHz | 4.70 | 5.13 | 0.43 |
| 32.125GHz < f <= 40.8GHz | 4.90 | 5.33 | 0.43 |
| EIS | 23.45GHz <= f <= 40.8GHz | 5.45 | 5.85 | 0.40 |

Proposal : For QZ size = 40 cm, define total MU for EIRP, TRP, and EIS as shown in Table 2.

According to Proposal 3, TT for each test case is defined as below for QZ size = 40 cm.

Table 3 TT for QZ size = 40 cm

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TC** | **Frequency** | **TT [dB]** | | | |
| **QZ size = 30cm** | **QZ size = 40cm** | **Difference [dB]** | **Formula** |
| EIRP | 23.45GHz <= f <= 32.125GHz | 3.04 | 3.31 | 0.27 | TT = 0.60 x (MU -0.1) |
| 32.125GHz < f <= 40.8GHz | 3.04 | 3.31 | 0.27 | TT = 0.60 x (MU -0.3) |
| TRP | 23.45GHz <= f <= 32.125GHz | 2.82 | 3.08 | 0.26 | TT = 0.60 x MU |
| 32.125GHz < f <= 40.8GHz | 2.94 | 3.20 | 0.26 |
| EIS | 23.45GHz <= f <= 40.8GHz | 2.45 | 2.63 | 0.18 | TT = 0.45 x MU |

Proposal 4: For QZ size = 40 cm, define TT for EIRP, TRP, and EIS as shown in .

**3. Conclusion**

RAN5 is asked to endorse following proposals.

**Observation 1: An increase of QoQZ uncertainty is expected as 0.2 dB when the QZ size is extended from 30 cm to 40 cm.**

**Observation 2: An increase of influence of XPD is expected as 5 dB when the QZ size is extended from 30 cm to 40 cm.**

**Proposal 1: For QZ size = 40 cm, define QoQZ uncertainty as 0.3 dB larger than that of 30 cm QZ.**

**Proposal 2a: For QZ size = 40 cm and frequencies up to 40.8 GHz, define influence of XPD as 5 dB larger than that of 30 cm QZ.**

Proposal 2b: For QZ size = 40 cm and frequencies beyond 40.8 GHz, define influence of XPD as 8.5 dB larger than that of 30 cm QZ.

**Proposal 3: For QZ size = 40 cm, define total MU for EIRP, TRP, and EIS as shown in Table 2.**

**Proposal 4: For QZ size = 40 cm, define TT for EIRP, TRP, and EIS as shown in Table 3.**

**4. References**

[1] R5-211235, “Discussion on the size of Quiet Zone above 30cm”, Rohde & Schwarz, RAN5#90-e

[2] R5-211949, “On Larger Quiet Zone Sizes with Grey Box”, Keysight Technologies, RAN5#90-e

[3] R5-213193, “Discussion on the size of Quiet Zone above 30cm”, Rohde & Schwarz, RAN5#91-e

[4] R5-213813, “Discussion on Grey-Box Applicability”, Keysight Technologies, RAN5#91-e

[5] R5-213857, “On QoQZ Reference Points for Larger Quiet Zones”, Keysight Technologies, RAN5#91-e

[6] R5-222553r1, “On QoQZ for 40cm QZ”, Keysight Technologies, RAN5#95-e