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Contact in RAN WG4: Sami Jokinen, Nokia Networks
sami.a.jokinen@nokia.com, +358-8-5650111

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1. Introduction

In [2] ARIB is asking 3GPP TSG RAN WG4 for to reconsider the decision on handling of measurement uncertainty in WG4 specifications. This document explains the alternatives considered in WG4 and the rationale of the chosen method. It also considers the implications of the proposal in [2].

In this document and in RAN WG4 specifications 'measurement uncertainty' is considered to be the same as measurement device inaccuracy, it does not include any other errors due to measurement set-up.

2. History

Measurement uncertainty and it's impact on the requirements was first faced during the discussions on the tolerance of UE maximum output power in TSG RAN WG4 meeting #3 in Tokyo in March 1999. In this particular case it was recognised that the required tolerance leads to extremely small implementation margin. UE manufacturers wanted to know the effect of measurement uncertainty into the requirement, i.e. what is the measurement device accuracy in UE output power measurement. Even though an exact answer was not available, it became clear that the measurement uncertainty would have an effect into implementation margin. This lead to a more general discussion on topic, and it became clear that the measurement device accuracy is related to measurement set-ups (which for UE are being considered in another working group in 3GPP) and differ somewhat from measurement equipment manufacturer to another.

At this point RAN WG4 had two choices – either to ignore measurement uncertainty or to define a practical way of handling measurement uncertainty. As it is in everybody's interest to guarantee best possible system performance, it was agreed that WG4 has to consider all factors influencing to system performance. This means that WG4 has considered e.g. own system performance, adjacent system performance, implementation complexity and measurement device accuracy

Definition of conformance testing procedure can be defined only after a requirement is relatively stable. Therefore the influence of measurement uncertainty can not be fully known at the time when a new requirement is created. This is especially true for a new system using new technology. It was then acknowledged that it would not possible for WG4 to include the measurement uncertainty in the core specification requirements (25.101, 25.102, 25.104, 25.105, 25.132 and 25.133). In effect this ruled out the possibility to use 'shared risk' principle for all requirements in a controlled manner.

As an alternative method it was agreed to take measurement uncertainty into account by recording allowed measurement uncertainty in conformance test specifications and by relaxing the core

requirement by the allowed uncertainty to attain approval limit. Term 'never fail good DUT' has been used to describe this method.
The approach to consider measurement uncertainty separately was thought to bring also other advantages:

- The measurement uncertainty is clearly visible making it easy to control and follow that the allowed uncertainty is the best achievable.
- The effect of measurement uncertainty can later be evaluated by comparing the allowed uncertainty to implementation margin and core requirement.
- The allowed measurement uncertainty can be changed without changing core specification as measurement devices improve.
- It has been possible to set the core requirements tight to ensure good system performance. At the same time it has been possible to accept small implementation margins as the measurement uncertainty is handled separately.

To record the accepted procedure, the following text was added to the core specifications [1]:
The requirements given in this specification do not include measurement uncertainties related to conformance testing as used e.g. in regulatory testing or production testing. Conformance testing is specified in [reference to the appropriate document].
This text in UE and BS core specifications and the related text in BS conformance specifications were updated several times in order to better reflect the agreed principle. Unfortunately WG4 was only able to come up with a clear definition in WG4#11 in San Diego after TSG T WG1 had pointed out the possibility of misinterpretation.

Currently WG4 is in the process of defining allowed measurement uncertainties for base stations. Working assumptions are recorded in [3] and [4], which the measurement equipment manufacturers are reviewing to guarantee state-of-the-art equipment will be used. For UE the measurement uncertainties are defined in TSG T WG1.

3. Impact of proposal in R4-000419

RAN WG4#12 discussed the ARIB proposal in [2] to add a possibility to use 'shared risk' principle as a regional requirement.

Global circulation and free roaming are essential for WCDMA terminals. To make this possible the UE requirements and conformance test limits need to be the same regardless of the country of manufacture or sale. Therefore it is not possible to adopt regional requirements or conformance test limits or principles. Principle of global requirements should be applied also to base stations as largely as possible as has been done in 3GPP.

Later in the reflector discussions ARIB commented that the purpose of the proposal was not to use 'shared risk' regionally, but 3GPP to adopt 'shared risk' for the items covered in the Japanese Radio Law ordinances, the reason being that this is the practice used by the regulators in Japan.

If 'shared risk' would be applied to all current WG4 specifications without changes in core specifications at least the following three consequences can be identified:

1. *Requirement for which the measurement uncertainty is relatively small compared to required tolerance or to implementation margin*. Tightening of the conformance test limit may lead to increased implementation complexity and cost and to delayed system launch. BS frequency accuracy requirement can be an example of such requirement.
2. *Requirement for which the measurement uncertainty is significant when compared to required tolerance or implementation margin*. Tightening of the conformance test limit will lead to extensive changes in product design and possibly making the product economically unfeasible. Most of the requirements would fall into this category. UE output power, reference sensitivity of both UE and BS can be used as an example of such cases (implementation margin for BS and UE receiver sensitivity is 2dB, measurement uncertainty is assumed to be 0.8dB).
3. *Requirement for which the measurement uncertainty is larger than the required tolerance or implementation margin*. Tightening of the conformance test limit would make it impossible to meet the limit. Power control step size tolerance is an example of such requirement – requirement is ±0.25dB and the assumed measurement uncertainty is ±0.3dB.

Based on the previous examples it is clear that it is not possible for WG4 to change the handling of measurement uncertainty without considering the impact of uncertainty for each requirement separately.

If applied to all requirements, in most cases a change to 'shared risk' would lead to changes in core specifications. In any case, such a change process would take time from productive work in WG4 and is seen in WG4 as an undesired solution.

Nevertheless, some test limit of the core specifications may be critical with relation to the system performance; therefore in such cases, taking into account the necessary implementation margins, a ‘never pass a bad DUT’ or 'shared risk' approach could be used [5].

However, WG4 recognises that 'shared risk' should be applied to the requirements that are adopted from specifications outside 3GPP. For some essential requirements WG4 may reconsider handling of measurement uncertainty to guarantee system performance. WG4 will be working on this topic in its next meeting. Examples of requirement for which 'shared risk' possibly will be applied are:

- PHS co-existence requirements adopted from ARIB
- GSM co-existence requirements adopted from ETSI specifications
- spurious emission requirements adopted from ITU-R recommendation SM.329

4. Conclusions

The rationale for the choices made in handling of measurement uncertainty in WG4 has been presented. The proposal presented by ARIB in [2] in RAN WG4#12 has been considered by WG4 and its impact has been evaluated. System performance is not compromised by using the current principle of handling measurement uncertainty, as it has been the assumption from the beginning. It is believed that system performance would not be improved by changing the handling of measurement uncertainty to 'shared risk' for every test without changing core specification but would have a direct impact on the complexity and cost of WCDMA.

Unfortunately WG4 is at the moment unable to find satisfactory solution, but is willing to continue discussion with ARIB and MPT of Japan to come to an agreement.

References

[1] R4-99208 TS25.104 v.1.0.0, TSG RAN WG4#4, editor
[2] R4-000419 Proposal on Measurement Uncertainty, TSG RAN WG4#12, ARIB
[3] TS25.141 Base Station Conformance Testing (FDD) v.3.1.0
[4] TS25.142 Base Station Conformance Testing (TDD) v.3.1.0
[5] R4-000499 The impact of Measurement Uncertainty on the distribution of equipment performance, TSG RAN4#12, Agilent