**3GPP TSG-RAN WG4 Meeting #98-e R4-2103967
Electronic Meeting, Jan. 25-Feb. 5, 2021**

**Agenda item: 12.1.3**

**Source: vivo，Apple**

**Title: TP to TR38.884 v0.1.0 on polarization basis mismatch**

**Document for: Approval**

# 1 Introduction

In RAN4#97-e meeting, the agreement on solutions to address the polarization basis mismatch has been made [1][2]. The technical details of the enhanced solution should be updated to TR38.884.

This contribution provides the text proposals related to FR2 polarization basis mismatch issue.

# 2 Discussion

In the last RAN4 meeting, the initial conclusions on enhanced approach has been agreed [2]:

* **TPMI side condition method is agreed as applicable method to enhance EIRP measurement for partial UEs**
	+ **This method can be applied for:**
		- **Rel-15 coherent UEs**
		- **Rel-16 coherent UEs**
		- **Rel-16 nonCoherent UEs which support uplink full power transmission**
	+ **This method is not applied for Rel-15 nonCoherent UEs and Rel-16 nonCoherent UEs which do not support full power transmission**
* **TPMI side condition method shall be further refined under the umbrella of the hybrid methods in WF6.**
* **The DL pol. scan method is not a valid method to enhance UE EIRP measurement**
* **FFS if test mode to trigger TX diversity can be considered as a backup method under the umbrella of the hybrid methods in WF6**
* **The power up command to trigger TX diversity is not a valid method to enhance UE EIRP measurement**
* **Further discuss 2-port CSI-RS method under the umbrella of the hybrid methods in WF6 if above issues could be addressed**
* **Different approaches can be adopted based on UE capability, detailed applicability rule can be further discussed**
	+ **TPMI side condition test method is agreed to be introduced**
		- **FFS whether additional test methods need to be introduced (e.g. 2-port CSI-RS, test mode).**
		- **Whether an alternate method needs to be introduced and, if agreed it is needed, what it can be is FFS and is a secondary priority task within the objective**
	+ **TPMI method is applicable for EIRP measurement test cases for 1 layer transmission with 2 SRS ports configured.**
* **RAN4 confirms the dual polarization coherent receivers measurement setup as the enhancement which addresses the UE demodulation part of the polarization mismatch objective**

The TPMI based test method has been agreed as the 1st priority to address the polarization basis mismatch issue. DL pol. scan method and power up command are confirmed not valid methods to enhance UE EIRP measurement.

Alternative approach with Test Mode for the UEs those are not applicable for TPMI-based method, is under discussion.

# 3 References

1. R4-2017631, “Email discussion summary for [97e][331] FR2\_enhTestMethods,” Moderator (Apple), 3GPP RAN4#97-e, Nov 2020.
2. R4-2017689, “WF on solutions to minimize the impact of polarization basis mismatch between the TE and DUT on the RF testing,” Samsung, 3GPP RAN4#97-e, Nov 2020.
3. RP-201862, “Revised SID: Study on enhanced test methods for FR2,” Apple, vivo, RAN#89-e, Sep 2020
4. R4-2009961, “Remaining issues with polarization basis mismatch,” Apple, RAN4#96-e, Aug 2020
5. R4-2014725, “Discussion on FR2 EIRP measurement enhancement,” Samsung, RAN4#97-e, Nov 2020
6. R4-2011217, “On minimizing the impact of polarization basis mismatch between the TE and DUT on the RF testing,” Keysight Technologies, RAN4#96-e, Aug 2020

# 4 Text Proposal to TR 38.884

**--------------Start of text proposal 1-------------**

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.101-2: "User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[3] 3GPP TR 38.810: " Study on test methods ".

[4] 3GPP TS 38.211: "NR; Physical channels and modulation".

[5] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

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**--------------Start of text proposal 2-------------**

## 5.2 Polarization basis mismatch between the TE and DUT

### 5.2.1 General

The investigation of polarization basis mismatch enhancements to the FR2 test methodology includes the following aspects: scope of test cases with polarization basis mismatch between the TE and DUT issues, enhanced test methods, applicability of the enhanced test methods.

The initial testing methodology for FR2 UE RF requirement verification is defined in [3] and features a measurement antenna capable of

* transmitting and receiving on two orthogonal polarizations
* introducing linearly polarized downlink signals at the centre of the quiet zone one polarization at a time
* measuring the total uplink signal power by combining the power measured by two orthogonally polarized antennas sequentially or
* demodulating the signal received by a single polarization at a time.

Regarding polarization basis mismatch between the UE TE and DUT, there are two main issues:

* DL polarization basis mismatch for EIRP measurement. The mismatch between the TE and UE may lead such UEs to disable a Tx chain associated with one DL polarization and may result in an EIRP measurement which fails to include the polarization gain at some test points;
* UL polarization basis mismatch for demodulation. Some UE implementations may support uplink transmission diversity schemes which, although transparent to the specification, impact the demodulation performance when the UL signal is demodulated on just a single polarization.

Therefore, these two issues are addressed separated with different approach. The potential solutions to minimize the impact of polarization basis mismatch address two distinct goals: to enhance the EIRP measurement of UEs with various capabilities, and to enhance the test equipment demodulation performance in the uplink, such that a test mode to disable Tx diversity at the UE is no longer necessary for the UE to perform conformance testing.

### 5.2.2 Enhanced test method for EIRP measurement

#### 5.2.2.1 TPMI method

Transmitted Matrix Precoding Indicator (TPMI) is the basis of codebook based transmission enabling multi-port antenna transmission. TPMI method is identified as applicable method to enhance EIRP measurement, which is able to activate dual polarization transmission in EIRP measurement. The applicability of this method is defined in Clause 5.2.2.2.

For FR2 UEs support the TPMI method, the precoding matrix $W$ is given by Table 5.2.2.1-1 (same as Table 6.3.1.5-1 in TS 38.211 [4]). 2Tx TPMI index 2-5 can force UE single-layer transmission using two antenna ports. Among them, only one proper precoding matrix is selected for EIRP measurement.

Table 5.2.2.1-1: Precoding matrix  for single-layer transmission using two antenna ports.

|  |  |
| --- | --- |
| TPMI index | (ordered from left to right in increasing order of TPMI index) |
| 0 – 5 |  |  |  |  |  |  | - | - |

The permitted test methods (i.e. DFF, IFF and NFTF) in [3] are all applicable for TPMI method with the additional procedure that the UE should be configured with TPMI index and working at single-layer transmission using two antenna ports, before performing EIRP-based test procedures in Clause 5.2.1.3 in TR38.810 [3].:

* Peak EIRP Measurement Procedure
* TRP Measurement Procedure
* TX Beam Peak direction search and EIRP Spherical Coverage

#### 5.2.2.2 Applicability of TPMI side condition method

TPMI is applicable for one layer transmission with multi-port antenna. In FR2, dual polarization can be regarded as dual antenna ports, so it is natural to activate dual polarization transmission with TPMI side condition in EIRP measurement procedure. However, for TPMI supporting dual antenna ports, the number of SRS ports (*nrofSRS-Ports*) is configured as 2 for both one layer transmission with ‘full power transmission’ and two layers transmission with regular UL MIMO, as specified in clause 6.1 of TS 38.101-2 [2]:

|  |
| --- |
| For a UE that supports 'UL full power transmission' and is configured to transmit a single layer with *nrofSRS-Ports* = 2, the requirements for UL MIMO operation apply only when it is configured for any of its declared full power modes in IE *FullPowerTransmission-r16* (as defined in TS 38.331[13]).For a UE configured to transmit 2 layers, transmitter requirements for UL MIMO operation apply when the UE transmits on 2 ports on the same CDM group. The UE may use higher MPR values outside this limitation. |

Thus, TPMI method is applicable for the following FR2 UEs:

* Rel-15 Coherent UE
* Rel-16 Coherent UE
* Rel-16 UE supporting UL full power transmission mode1 (*ul-FullPowerTransmission = fullpowerMode1*)

Other UEs are not applicable for TPMI based test method.

#### 5.2.2.3 Alternative test method

A number of open issues have been identified with the configuration of 2-port CSI-RS method, and a conclusion whether this method is a feasible enhancement is TBD.

### 5.2.3 Enhanced test method for UL demodulation measurement

#### 5.2.3.1 Test equipment Zero-forcing MIMO receiver

As an enhancement to the FR2 test equipment topology, it has been proposed to adopt a zero-forcing MIMO receiver architecture so that dual-polarization transmissions by the UE can be demodulated by the test equipment receiver. Further details of the implementation are FFS.

**--------------End of text proposal 2-------------**