Prepared (also subject responsible if other)		No.		
EAB/FJR/VAC Christer Gustavsson		EAB/FJR-11:0176 Uen		
Approved	Checked	Date	Rev	Reference
EAB/FJR/VAC [Klaes Holm]		2011-03-03	B	

In the matter of Draft Laboratory Division Publication

”Conducted emissions testing of transmitters with multiple outputs” (662911 D01 Multiple Transmitter out Output v01)

Ericsson respectfully submits comments and concerns in response to the Draft Laboratory Division Publication “Conducted emissions testing of transmitter with multiple outputs (draft publication 662911 D01).

Introduction

The draft publication gives guidance for measurements of conducted output emissions of devices that employ a single transmitter with multiple output ports in the same band, in terms of how to combine emissions from multiple outputs of a transmitter and how to include array gain in directional gain calculations. Ericsson has analyzed the guidance given for the two issues addressed and notes that application of the guidance for a device could result in ambiguous interpretation of conducted emission levels, as further outlined in this response. The analysis is made with reference to certain 3GPP technologies for mobile systems, such as spatial multiplexing/MIMO and beam-forming.

3GPP MIMO/Spatial multiplexing and beam-forming technologies

As formulated in the draft guidance, devices that employ a single transmitter with multiple outputs can be depicted as in figure 1.

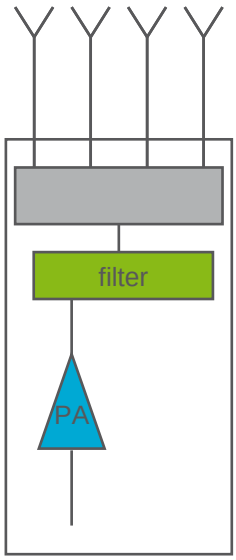

Figure 1: Single transmitter with multiple outputs

A device as shown in Figure 1, employing a single transmitter with multiple outputs which may be connected to an antenna array, is an application where the emission principles based on summation across the outputs or adjustments by 10*LOG (N) should apply as stated in the draft guidance.

The case in Figure 1 is however different from 3GPP MIMO/spatial multiplexing and beam forming technologies, where each antenna is driven by a separate and independent transmitter as shown in figure 2. Such an implementation should be seen as multiple transmitters with individual outputs.

In this context, it should be noted that the 3GPP technologies concerned are intended to improve the signal to noise ratio in proportion to the number of antennas and/or to achieve additional diversity against fading, which improves the data rates to accommodate fast mobile internet. 3GPP technologies such as pre-coder based spatial multiplexing are thus used to “orthogonalize” and increase the isolation between parallel transmissions of data streams to the same or multiple users.

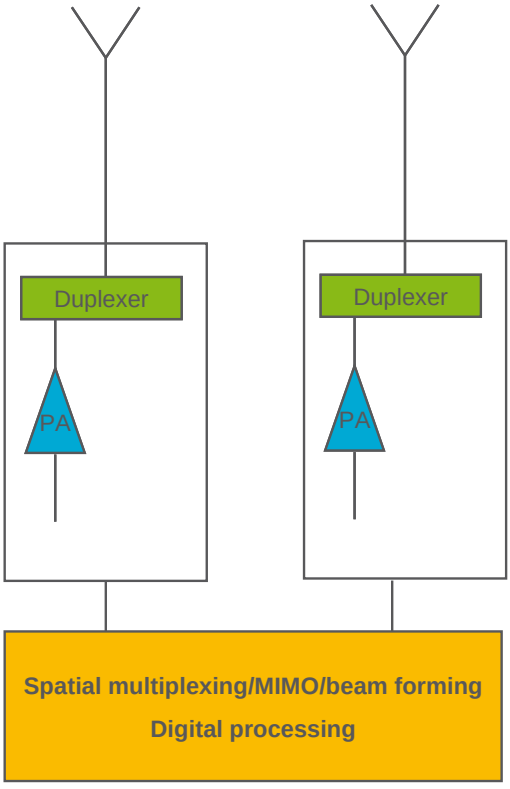

Figure 2: Example of dedicated transmitters are used per antenna

There are also device implementations with multiple independent transmitters embedded into a single device which can be deployed for spatial multiplexing/MIMO and beam-forming. In such devices, each antenna would still have dedicated independent transmitter as shown in figure 3 and should also be seen as multiple transmitters with individual outputs.

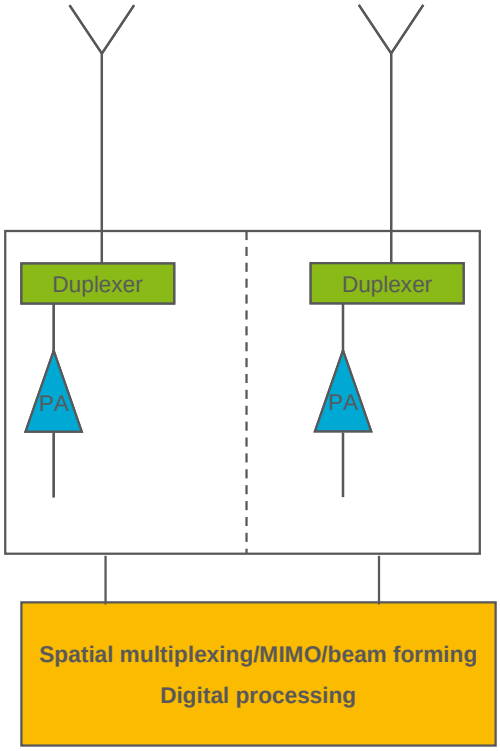

Figure 3: Example for multiple independent transmitters in a device.

3GPP spatial multiplexing/MIMO and beam-forming technologies are purely based on digital signal processing which is applied differently for the different parallel independent transmitters. The implication is that as long as the existing rules are fulfilled at each transmitter output, the emission requirement should also be tested according to the current rules, without applying additional requirements based on summation or application of 10*LOG (N) across transmitter outputs.

The use of spatial multiplexing/MIMO and beam-forming can be illustrated with an example for a 10 MHz licensed block, assuming the following two scenarios, as illustrated in Figure 4:

- **Scenario 1:** Two 3GPP LTE carriers of 5 MHz each are transmitted within a 10 MHz licensed block, where every carrier is handled by a separate independent transmitter.
- **Scenario 2:** One 10 MHz 3GPP LTE carrier operating in MIMO mode is transmitted within the same license block, using two separate independent transmitters.

The power transmitted per carrier is the same (P_{out}) at each transmitter output in the two scenarios above, implying that the total power transmitted in the 10 MHz license block is also $2 \cdot P_{out}$ for both scenarios.

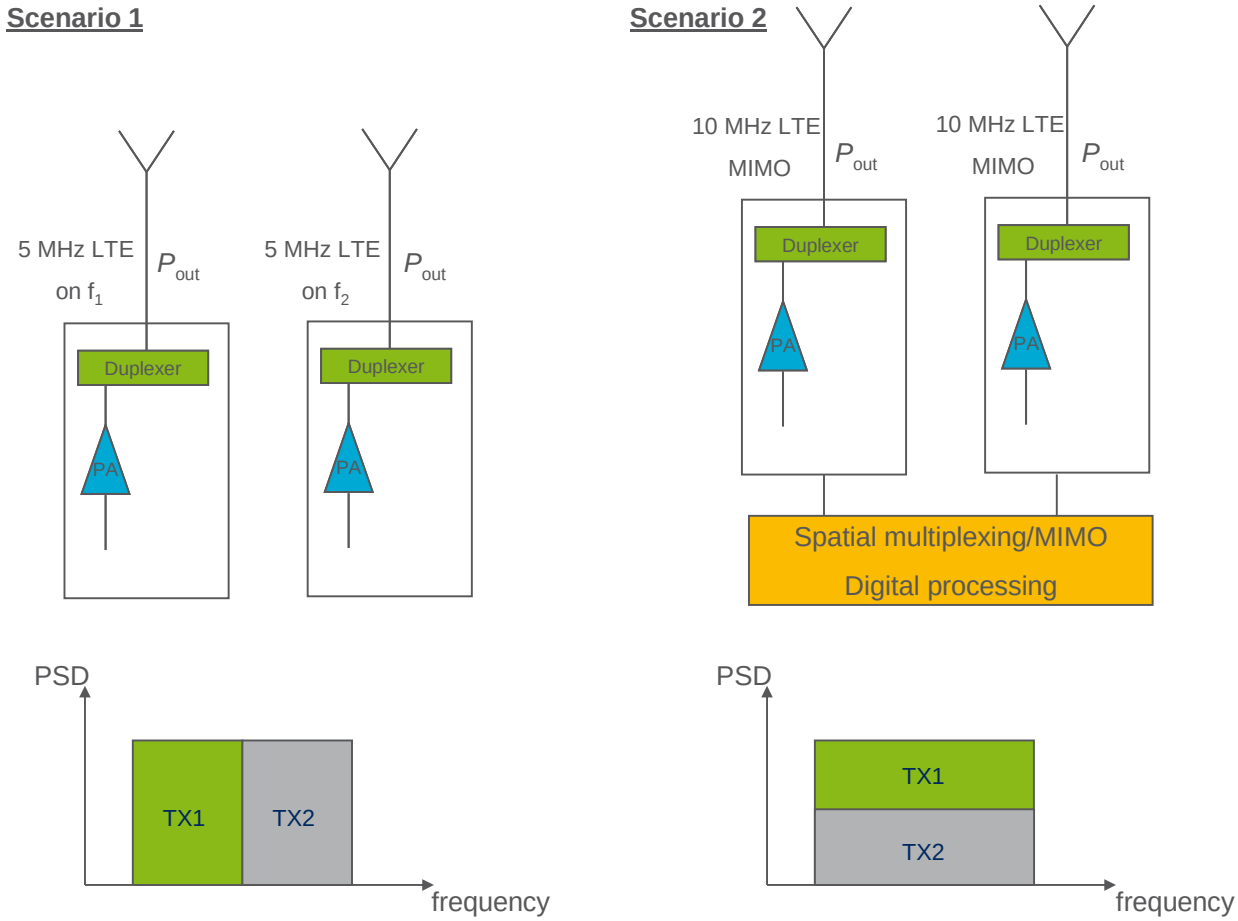

Figure 4: Example with two scenarios in a 10 MHz license block.

For Scenario 1, the existing emission requirements apply per transmitter output. For Scenario 2 however, the proposed guidance would pose a 3 dB more stringent requirement on each transmitter. Noting that both scenarios have the same PSD characteristics, the proposed guidance based on summation or application of 10* LOG(N) would create an ambiguity in the rules and also pose stricter requirements given similar circumstances, which could discriminate specific technologies and/or implementations.

Imposing summation or application of 10*LOG (N) is a direct change of the emission rules per transmitter and would discriminate the 3GPP technologies identified and consequently restrict the achievable data rates by imposing unmotivated stricter emission levels.

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Summary

In this response, 3GPP technologies such as spatial multiplexing/MIMO and beam-forming were discussed in relation to the draft guidance for “Conducted emissions testing of transmitters with multiple outputs”. Due to the inherent nature of such technologies and the fact that each antenna is connected to a separate and independent transmitter, we respectfully ask to apply the current emission rules per transmitter without imposing summation or application of 10*LOG (N) for the identified 3GPP technologies.

If summation or application of 10*LOG (N) were to be applied to technologies where dedicated independent transmitters are deployed per antenna, it would result in unmotivated restrictions which would create ambiguities, possibly discriminate specific technologies and could result in reduced data rates for mobile broadband deployments. The guidance could also be interpreted as discriminating towards specific technologies, since individual technologies are identified as examples.