3GPP TSG-RAN WG4 Meeting #100-e R4-2114964

Electronic Meeting, Aug. 16 – Aug. 27, 2021

Agenda Item: 9.4.3 and 9.4.6.3

Source: Apple

Title: WF on FR2 enhancement part 2: UL gaps

Document for: Discussion

# 1 Tx power management: RF aspect

Summary of 1st round email discussion is captured in [1]. The following agreements are captured during GTW discussion.

Agreement:

* Baseline is to verify that UE correctly behave without phantom and ensure the feasible requirement gain in Rel-17 with different test methods.

Agreement:

* + - “P-MPR report+peak EIRP without phantom”, X dB EIRP gain and P-MPR requirement of Y when UL gap is activated should be achieved compared to the case where no gap is activated
		- Decide range for X value in this meeting for making decision in future meeting
			* Option 1: at least 6dB
			* Option 2: A value between 6dB and 3dB, which is typical in the field
		- Further discussion on the definition of Y in this meeting
			* Option 1: Y is absolute value
			* Option 2: Y is the relative value of gain
			* Option 3: no P-MPR requirement of Y
		- FFS on the implementation margin

# 2 UL Tx power management: RRM aspect

Summary of 1st round email discussion is captured in [1]. The following agreement are captured during GTW session.

Agreement:

* UL gap should be explicitly activated by NW via signaling
	+ How can UE indicate the NW UL gap activation is needed?
		- Option 1: UE explicitly indicates to NW by signaling
		- Option 2: UE implicitly indicate to NW by P-MPR reporting. The exact P-MPR value is FFS.
	+ Network can activate UL gap without the indication from UE
* UL gap should be explicitly deactivated by NW via signaling
	+ How can UE indicate the NW UL gap deactivation is needed?
		- Option 1: UE explicitly indicates to NW by signaling
		- Option 2: UE implicitly indicate to NW by [TBD] reporting.
	+ Network can deactivate UL gap without the indication from UE.

Agreement: Two approaches will be considered

* #1: UL gap should be explicitly configured and activated/deactivated directly by RRC signaling
* #2: UL gap should be explicitly configured by RRC and activated and deactivated by MAC CE

Agreement:

* The switching time should be included in gap period.

Further discussion on down-selection of gap configurations.

* Candidate gap configurations: UGL (UL gap length), UGRP (UL gap repetition periodicity)
	+ UGL: 0.5ms, UGRP: 20ms (Huawei)
	+ UGL: 1ms, UGRP:20ms (Huawei, apple)
	+ UGL: 1.25ms, UGRP: 20ms (apple)
	+ UGL: 0.5ms, UGRP:40ms (Huawei)
	+ UGL: 1ms, UGRP:40ms (Huawei)
	+ UGL: 0.125ms, UGRP:5ms (Qualcomm)
	+ UGL: 0.125ms, UGRP:10ms (Qualcomm)
	+ UGL: 0.125ms, UGRP:20ms (Qualcomm)
	+ UGRP: 160ms (Sony, vivo, Ericsson, intel)
	+ UGRP: 320ms (Sony, vivo, Ericsson, intel)

**In addition, the following WF is agreed:**

Further down-select candidates based on UL overhead, the ratio UGL and UGRP, of 5%, 2.5%, 1.25% and 0.625% and gain achieved in the RF requirements.

* 5% Example configuration: UGL: 1ms, UGRP:20ms
* 2.5% Example configuration: UGL: 0.5ms, UGRP:20ms or UGL: 0.125ms, UGRP: 5ms
* 1.25% Example configuration: UGL: 0.125ms, UGRP:10ms
* 0.625% Example configuration: UGL: 0.125ms, UGRP:20ms or UGL: 1ms, UGRP: 160ms

On how can UE indicate to the NW UL gap activation/de-activation is needed:

* UL gap should be explicitly activated by NW via signaling
	+ How can UE indicate to the NW UL gap activation is needed?
		- If needed, UE explicitly indicates to NW by signaling
* UL gap should be explicitly deactivated by NW via signaling
	+ How can UE indicate to the NW UL gap deactivation is needed?
		- If needed, UE explicitly indicates to NW by signaling

# 3 UL coherent MIMO

Summary of 1st round email discussion is captured in [1].

WF on performance gain evaluation:

* The gain of UL MIMO with UL gap configured has been shown by simulation with UL throughput, but it has not yet been shown how to achieve the same throughput gains in the UE requirements. For the feasibility of UL gaps for UL coherent MIMO it is necessary to show that performance gains are obtained in the UE requirements.
	+ Observations:
		- In R4-2111383, it shows 20.3% mean throughput gain and maximum 40.7% throughput gain with 40 degree phase error.
		- In R4-2114492, it shows further 8% throughput gain can be reached by further improve relative phase error requirement.
* Study how to ensure throughput gains in the UE requirements. Identify metric(s) for the UE requirement gain, which ensures that gains are achieved if UL gaps are used. Identify how the requirements and tests could be defined to ensure performance gains in the requirements.
	+ Throughput gain in the UE requirements is evaluated and throughput gain in the UE requirements with UL gaps compared to the case without UL gaps needs to be achieved to justify UL gaps. i.e.:
		- Option 1: Current coherent UL MIMO requirement gain reflected with value and/or condition
		- Option 2: new requirement if identified
* Companies are encouraged to provide analysis for gains achieved for gap pattern examples
	+ Other gap pattern is not precluded

# References

[1] R4-2114730, “Email discussion summary for [100-e][130] NR\_RF\_FR2\_req\_enh2\_Part\_2”, Apple

[2] Draft WF on FR2 RF UL gap\_after GTW.