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)

Propose further down-select candidates based on UL overhead, the ratio UGL and UGRP, of 5%, 2.5%, 1.25% and 0.625%.

* 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

Proposed WF:

* UL gap should be explicitly activated by NW via signaling
	+ How can UE indicate the NW UL gap activation is needed?
		- Option 1: If needed, UE explicitly indicates to NW by signaling
* UL gap should be explicitly deactivated by NW via signaling
	+ How can UE indicate the NW UL gap deactivation is needed?
		- Option 1: If needed, UE explicitly indicates to NW by signaling

# 3 UL coherent MIMO

Summary of 1st round email discussion is captured in [1]. Proposed WF will be updated based on 2nd round discussion.

Proposed WF on performance gain evaluation:

* The gain of UL MIMO with UL gap configured has been shown by simulation with UL throughput.
	+ 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.
* The metric of the performance gain for further discussion:
	+ - Option 1: By removing side conditions of coherent UL MIMO requirement, the requirement for relative phase/power keep the same, i.e. 40 degree/4dB
		- Option 2: By improving the requirement for relative phase/power, e.g. 30 degree for relative phase
		- Option 3: New requirement to prove the performance gain by using the gap
* Companies are encouraged to provide analysis based on 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.