**RAN-R18-WS-crossFunc-Apple - Version 0.0.3**
**RAN**

**3GPP TSG RAN Rel-18 workshop**

**Electronic Meeting, June 28 - July 2, 2021**

Agenda Item: 4.3

Source: Apple Inc.

Title: Email discussion summary for [RAN-R18-WS-crossFunc-Apple]

Document for: Discussion/Decision

# 1 Introduction

This document is created to provide Q&A regarding the Apple contributions for the thread [RAN-R18-WS-crossFunc-Apple], which covers the following Apple contribution:

RWS-210505, "Study on AI for physical layer design enhancement"

# 2 Round 1 Q&A

In case, companies have general comments and questions regarding Apple contribution for the cross function related Rel-18 work, please use the feedback form below:

**Feedback Form 1:**

## 2.1 Comments/Questions to RWS-210505

In the contribution RWS-210505, "Study on AI for physical layer design enhancement", we provided the motivation of AI/ML for physical layer design enhancements. Three motivating examples: (1) beam management, (2) channel estimation (3) hybrid beamforming weight optimization are elaborated, and performance gain is shown comparing to traditional methods. The proposals are listed as below for easy reference

Proposal 1: Study AI/ML related physical layer enhancement use case and evaluation methodology.

Proposal 2: Study required signalling between NW and UE per use case.

For round 1, please provide your comments and questions regarding RWS-210505 in the feedback form below

**Feedback Form 2:**

**1 – Intel Technology India Pvt Ltd**

thanks for the tdoc. The beam selection and channel estimation use-cases are aligned with our thinking as in RWS-210373. Could you pls. clarify what is the envisioned spec impact of hybrid BF use-case? Also you mentioned detailed AI model is out of scope and input/output should be studied - could you provide your views on how much details is proposed to be studied/specified (e.g. whether NN structure, layers, weights, biases etc. can be left to implementation)

**2 – Sony Corporation**

Thanks for the contribution. We have a question.

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About "*Study required signalling between NW and UE per use case.*" in proposal 2, what signalling information do you assume? Could you clarify the proposal 2?

## 2.1 2.2 Response to comments/questions to RWS-21050

Response to Intel comments:

On Q1, The hybrid beamforming use case is an example where use AI to solve complex optimization problem. The exact specification impact needs further study. In current design, beam management and CSI feedback are typically designed separately. With AI enabled joint design of digital and analog beam vector, potential enhancement can be possible.

On Q2, the AI model is out of scope for specification. However for study phase, to cross validate performance gain over traditional method, NN structure, layers and weights/biases can be provided for evaluation.

Response to Sony comment:

Required signalling can be different per use case in our view. Examples include UE capability per use case, required UE feedback for gNB NN training/inferencing, and enhancement on existing RS design and CSI framework etc.

# 3 2nd round Q&A

**Feedback Form 3:**

# 4 Summary

AI based physical layer enhancement is proposed for study in this contribution. Questions are raised in use case of hybrid beam-forming, evaluation methodology and potential specification impact and signaling.

In general, it is important for 3GPP to study and establish a common evaluation methodology to evaluate different use cases and specification impact to apply AI/ML in air interface design.