

**Source:** Ericsson  
**Title:** Summary of email discussion on UL control signaling  
**Agenda Item:** 6.1.4  
**Document for:** Discussion and Decision

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## 1. Introduction

Between RAN1#51bis and RAN1#52, an e-mail discussion on uplink control signaling took place. The topics discussed are summarized below.

## 2. Multiplexing of control and data on PUSCH

The details on multiplexing of control and data on PUSCH remain open in the specifications. There is a general agreement from RAN1#50 stating that control should be located next to RS and there are some description on 36.212 capturing this. However, the treatment of ACK/NAK vs CQI when both of them are transmitted on PUSCH are not yet settled.

Three alternatives were proposed in an e-mail from LG:

1. *CQI mapping consecutive to RS + ACK/NACK mapping consecutive to RS by puncturing CQI symbols*
2. *CQI mapping consecutive to RS + ACK/NACK mapping next to CQI by puncturing Data symbols (farther from RS)*
3. *ACK/NACK mapping consecutive to RS + CQI time-first mapping (near-RS mapping is not considered)*

*Among those 3 alternatives, we currently think the alternative 3 is preferable way considering ACK/NACK protection and simplicity in specifications (R1-080267 has detailed description). Alternative 1B and 2 are also described in detail in R1-080483.*

Discussions expressed support for alternative 3 both from a simplicity and performance perspective (ACK/NAK is more important than CQI, especially at high speeds where the CQI anyway tends to be less useful).

One company suggested to place the ACK/NAK bits two modulation symbols (not SC-FDMA symbols) from the RS in order not to conflict with time windowing. No comments were received related to this.

One company proposed to reserve ACK/NAK resources next to RS and then map CQI next to ACK/NAK (modified alternative 3) to improve CQI performance. The CQI position is independent on whether the ACK/NAK is present or not.

**Proposed way forward:** Adopt alternative 3 above.

## 3. Coding for CQI on PUSCH

From kick-off email:

*It would be good to settle the coding scheme for control on PUSCH (it has already been settled for PUCCH). As the number of bits in CQI reports transmitted on PUSCH can be higher than on PUCCH, it seems to make sense to use the convolutional coding and rate matching mechanism already agreed for PDCCH and PBCH also for CQI reports on PUSCH. Can we agree on this?*

Comments received on the reflector supported reusing convolutional coding/rate matching as specified in 36.212 for PBCH and PDCCH for the “larger” CQI reports (verify if adjustments needed to support the CQI payload sizes).

The need for a CRC for CQI reports on PUSCH and its associated size (16 bits?) was brought up without conclusion.

One company commented that a configurable offset between the PUSCH data MCS and the PUSCH control code rate is needed as the BLER operating point for data varies over a larger span (depending on the scheduler

implementation) than the control part (linking the control MCS to the data MCS has already been agreed in the past).

**Proposed way forward:** Coding for CQI on PUSCH uses

- convolutional coding + rate matching as specified for PBCH and PDCCH for “large” CQI reports (above approx. 10 bits)
- the PUCCH block code for small CQI reports