**3GPP TSG RAN WG1 Meeting #111 R1-221xxxx**

**Toulouse, France, November 14th – 18th, 2022**

**Agenda Item: 9.11.3**

**Source: Moderator (Lenovo)**

**Title: FLS#1 on disabling of HARQ feedback for IoT NTN**

**Document for: Discussion and decision**

# Introduction

In the RAN#94 plenary meeting, an enhancement work item for Rel.18 IoT NTN was approved. One of the objectives is to specify the following HARQ enhancements to IoT NTN.

*This work considers Rel-17 IoT-NTN as baseline as well as Rel-17 NR-NTN outcome and the further IoT-NTN performance enhancements objectives are listed below:*

*-* ***Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1,RAN2]***

*- Study and specify, if needed, improved GNSS operations for a new position fix for UE pre-compensation during long connection times and for reduced power consumption [RAN1]*

The following agreements on disabling of HARQ feedback for IoT NTN were achieved:

**RAN1-109e**

Agreement

*For IoT NTN, to configure/indicate enabling/disabling on HARQ feedback for downlink transmission, one or more of the following options can be considered:*

* *Option 1: per HARQ process via UE specific RRC signaling*
* *Option 2: per HARQ process via SIB signaling*
* *Option 3: explicitly indicated by DCI (e.g., new field or reusing existing field)*
* *Option 4: implicitly determined by existing configured/indicated parameter(s) (e.g., repetition number, TBS)*
* *Option 5: per HARQ process via MAC CE*
* *Other options or combinations are not excluded*

*Note: Option(s) for eMTC and NBIoT can be separately discussed.*

Agreement

*For IoT NTN, further study the potential issues due to enabling/disabling on HARQ feedback for downlink transmission*

* *Issue A: SPS PDSCH*
* *Issue B: (N)PDSCH/(N)PDCCH scheduling restriction*
* *Issue C: HARQ feedback for scheduling multiple TB*
* *Issue D: HARQ bundling for eMTC HD-FDD*
* *Issue F: NPRACH capacity*
* *Issue G: Serving cell/satellite change during data transfer (FFS: for eMTC and/or NB-IoT)*
* *Other issues are not excluded*

*Note: The “Issues” in common for eMTC and NB-IoT can be separately discussed.*

**RAN1-110**

Agreement

*For eMTC NTN, to configure/indicate enabling/disabling of HARQ feedback for downlink transmission, down select one or more from the following options:*

* *Option 1: per HARQ process via UE specific RRC signaling.*
* *Option 3: explicitly indicated by DCI (e.g., new field or reusing existing field).*
* *Option 4: implicitly indicated by existing configured/indicated/combined parameter(s) in the DCI (e.g., repetition number, TBS)*
* *Option 6: combinations of some options above.*

Agreement

*For NB-IoT NTN, to configure/indicate enabling/disabling of HARQ feedback for downlink transmission, down select one or more from the following options:*

* *Option 1: per HARQ process via UE specific RRC signaling*
* *Option 3: explicitly indicated by DCI (e.g., new field or reusing existing field)*
* *Option 4: implicitly indicated by existing configured/indicated/combined parameter(s) in the DCI (e.g., repetition number, TBS)*
* *Option 6: combinations of some options above*

Agreement

*For a DL HARQ process with disabled HARQ feedback in NB-IoT, at least the following UE behavior(s) can be considered:*

* *Option 1: UE is not expected to receive another NPDCCH carrying a DCI scheduling a NPDSCH for a given HARQ process that starts until X(ms) after the end of the reception of the last NPDSCH for that HARQ process.*
	+ *X =12*
* *Option 2: UE is not required to monitor NPDCCH in a period of Y(ms) from the end of reception of the last NPDSCH*
	+ *Y=12*

*Note: it may be different UE behaviors for different UE categories (e.g., UE with single/multiple HARQ processes).*

**RAN1-110bis-e**

Agreement

*For a DL HARQ process with disabled HARQ feedback in NB-IoT, UE is not required to monitor NPDCCH in a period of Y=12(ms) from the end of reception of the NPDSCH.*

Agreement

*For NB-IoT NTN, to configure/indicate enabling/disabling of HARQ feedback for downlink transmission, down select* ***ONE*** *from the following options at RAN1#111:*

* *Option 6a-1: Support RRC signaling configured between Option 1 and Option 3*
* *Option 6a-4: Support Option 1 by default, and support Option 3 to override default configuration for corresponding transmission*

This document provides the proposals and summary of discussions with detailed proposals from each company listed in appendix according to the inputs. Companies are encouraged to provide the inputs on Issue 1-8 in the discussion.

# [Active]Issue-1 Indication/configuration of disabling HARQ feedback

## Background

In NR NTN, disabling HARQ feedback for downlink transmission is semi-static configured by RRC signaling. The configuration is indicated per HARQ process index by a bitmap manner, e.g., 32bit bitmap if the configured HARQ process number is 32.

***PDSCH-ServingCellConfig* information element**

-- ASN1START

-- TAG-PDSCH-SERVINGCELLCONFIG-START

PDSCH-ServingCellConfig ::= SEQUENCE {

 codeBlockGroupTransmission SetupRelease { PDSCH-CodeBlockGroupTransmission } OPTIONAL, -- Need M

 xOverhead ENUMERATED { xOh6, xOh12, xOh18 } OPTIONAL, -- Need S

 nrofHARQ-ProcessesForPDSCH ENUMERATED {n2, n4, n6, n10, n12, n16} OPTIONAL, -- Need S

 pucch-Cell ServCellIndex OPTIONAL, -- Cond SCellAddOnly

 ...,

 [[

 maxMIMO-Layers INTEGER (1..8) OPTIONAL, -- Need M

 processingType2Enabled BOOLEAN OPTIONAL -- Need M

 ]],

 [[

 pdsch-CodeBlockGroupTransmissionList-r16 SetupRelease { PDSCH-CodeBlockGroupTransmissionList-r16 } OPTIONAL -- Need M

 ]],

 [[

 downlinkHARQ-FeedbackDisabled-r17 SetupRelease { DownlinkHARQ-FeedbackDisabled-r17 } OPTIONAL, -- Need M

 nrofHARQ-ProcessesForPDSCH-v1700 ENUMERATED {n32} OPTIONAL -- Need R

 ]]

}

PDSCH-CodeBlockGroupTransmission ::= SEQUENCE {

 maxCodeBlockGroupsPerTransportBlock ENUMERATED {n2, n4, n6, n8},

 codeBlockGroupFlushIndicator BOOLEAN,

 ...

}

PDSCH-CodeBlockGroupTransmissionList-r16 ::= SEQUENCE (SIZE (1..2)) OF PDSCH-CodeBlockGroupTransmission

DownlinkHARQ-FeedbackDisabled-r17 ::= BIT STRING (SIZE (32))

-- TAG-PDSCH-SERVINGCELLCONFIG-STOP

-- ASN1STOP

|  |
| --- |
| *PDSCH-ServingCellConfig* field descriptions |
| ***downlinkHARQ-FeedbackDisabled***Used to disable the DL HARQ feedback, sent in the uplink, per HARQ process ID. The first/leftmost bit corresponds to HARQ process ID 0, the next bit to HARQ process ID 1 and so on. Bits corresponding to HARQ process IDs that are not configured shall be ignored. The bit(s) set to one identify HARQ processes with disabled DL HARQ feedback and the bit(s) set to zero identify HARQ processes with enabled DL HARQ feedback. |

Regarding indication/configuration of disabling HARQ feedback for downlink transmission for IoT NTN, several options were discussed in previous RAN1 meeting. For NBIoT, the combined solution Option 6a-1 and Option 6a-4 were proposed for down-selection. The following table illustrates the moderator’s understanding of the two options.

|  |
| --- |
| **Option 6a-1**IF d*lHARQ-FeedbackDisabled-sw* is configured* In case *dlHARQ-FeedbackDisabled-sw = “RRC”*
	+ further configured with *downlinkHARQ-FeedbackDisabled*
	+ HARQ enabled/disabled is determined by *downlinkHARQ-FeedbackDisabled*
* In case *dlHARQ-FeedbackDisabled-sw = “DCI”*
	+ HARQ enabled/disabled is determined by corresponding DCI (e.g., explicit indication)

ELSE all HARQ enabled**Option 6a-4**IF *downlinkHARQ-FeedbackDisabled* is configured* + HARQ enabled/disabled is determined by *downlinkHARQ-FeedbackDisabled*
* [IF *dlHARQ-FeedbackDisabled-dci* is further configured]
	+ IF HARQ enabled/disabled for corresponding transmission is overridden by DCI indication (e.g., explicit indication)
		- HARQ enabled/disabled for the corresponding transmission is overridden from that determined by *downlinkHARQ-FeedbackDisabled*
	+ ELSE
		- Follow HARQ enabled/disabled determined by *downlinkHARQ-FeedbackDisabled*
* [ELSE
	+ Follow HARQ enabled/disabled determined by *downlinkHARQ-FeedbackDisabled*]

ELSEall HARQ enabled |

The following table lists/summarizes the pros and cros for different options (Option 6a-1 and Option 6a-4) from technical aspect.

|  |  |  |
| --- | --- | --- |
| Options | Advantage | Disadvantage |
| Option 6a-1:Support RRC signaling configured between Option 1 and Option 3. | 🡪Simple, no interaction between RRC-based mechanism and DCI-based disabling mechanism, less impact on the standard. [Huawei, Nokia]🡪 The DCI-based enabling/disabling HARQ feedback can be turned off when it is not needed so that it can avoid unnecessary signaling overhead in DCI (e.g., explicit indication in DCI field for enabling/disabling HARQ feedback) and switch back to Option 3 when dynamic indication is needed (e.g., for MAC-CE activation) via RRC reconfiguration. [Interdigital] | 🡪Once a specific mechanism is configured, UE without RRC reconfiguration capability (e.g. CP solution only) is not able to switch to the other mechanism. [Huawei]🡪Need to introduce additional RRC signaling to select one RRC-based methods to enabling/disabling of HARQ feedback. [ZTE]🡪 The RRC signaling is not timely, the switching may require long delay. If one HARQ process had been disabled feedback by RRC signaling, the additional RRC signaling cannot take effect immediately when the process is used for data transmission and subsequently used for control signaling. [CATT]🡪The HARQ feedback enabling/disabling option needs to be decided at the initial RRC connection setup only and not adaptable over time for the most of NB-IoT UEs. [Interdigital] |
| Option 6a-4:Support Option 1 by default, and support Option 3 to override default configuration for corresponding transmission | 🡪simpler and more flexible to adapt HARQ feedback based on situations from eNB scheduler perspective. [ZTE, Interdigital]🡪 avoids long delays for RRC signaling of on-demand HARQ feedback enabling. [Mavenir] |  |

Regarding the Option 3 DCI based indication. the following table lists/summarizes potential indication methods from several companies.

|  |  |
| --- | --- |
| Option 1: Explicit indication in DCI  | [Interdigital] A new DCI field to explicitly indicate HARQ enabling/disabling to override RRC configured status |
| Option 2: Reuse/reinterpret existing field in DCI | [Huawei] reinterpret ACK/NACK resource field[MTK] reinterpret ACK/NACK resource field in condition of repetition numbers[Spreadtrum] reinterpretation of some existing fields or using spare states[Mavenir] reinterpret NDI bit[Nordic] reinterpret ACK/NACK resource field |

Along with RAN1 discussion, in RAN2-119 and RAN2-119bis meeting, the following agreement has been achieved that from RAN2 perspective, for eMTC and NBIoT, enabling/disabling HARQ feedback can be configured per DL HARQ process at least via UE specific RRC signaling.

Agreements in RAN2-119e:

1. Disabling DL HARQ feedback is supported for NB-IoT and eMTC NTN. FFS on UE capability.
2. For UL HARQ operation, introduce two HARQ modes, i.e., HARQ mode A and HARQ mode B in IoT NTN (both NB-IoT and eMTC NTN), similarly to NR NTN.
3. From RAN2 perspective, at least for eMTC, enabling/disabling HARQ feedback can be configured per DL HARQ process at least via UE specific RRC signalling. FFS for NB-IoT (and especially for CP solution for NB-IOT).

Agreements in RAN2-119bis-e:

1. For NB-IoT, enabling/disabling HARQ feedback can be configured per DL HARQ process at least via UE specific RRC signaling (e.g. RRCConnectionSetup). This does not preclude other options (e.g. DCI-based). We can also revert this decision if requested by RAN1.
2. Disabling HARQ feedback is supported for NB-IoT with single HARQ process, and it is up to eNB implementation whether to disable the HARQ feedback

Working Assumption:

1. Blind retransmission can be used in IoT NTN when HARQ feedback is disabled and when HARQ mode B is used (RAN2 assumes there is no spec change for this)

In this meeting, preference options from companies are summarized as follow:

**NBIoT**

For NB-IoT NTN, to configure/indicate enabling/disabling of HARQ feedback for downlink transmission, down select **ONE** from the following options at RAN1#111:

* Option 6a-1: Support RRC signaling configured between Option 1 and Option 3

Supported by: Huawei, OPPO, Nokia, CMCC, Ericsson

* Option 6a-4: Support Option 1 by default, and support Option 3 to override default configuration for corresponding transmission

Supported by: Huawei, MTK, ZTE, CATT, Xiaomi, OPPO, Mavenir, Ericsson, Apple, Lenovo, Samsung, Qualcomm, NEC, Nordic

**eMTC**

For eMTC NTN, to configure/indicate enabling/disabling of HARQ feedback for downlink transmission, down select one or more from the following options

* Option 1: per HARQ process via UE specific RRC signaling

Supported by: Lockheed Martin, CATT, CMCC, Interdigital, Apple, Lenovo, Samsung, Qualcomm, Nordic

* Option 6a-1 or Option 6a-4: combination (same mechanism as NBIoT)

Supported by: Huawei, OPPO, Ericsson, Qualcomm

## Company views

In summary, from moderator’s perspective, NR NTN disabling HARQ feedback configuration can be a starting point for IoT NTN.

For NBIoT NTN, as RAN2 has agreed to take Option 1 as the baseline solution. From RAN1 perspective, in order to address the concern/drawback of RRC configuration/reconfiguration back-and-forth signaling overhead/latency and MAC CE activation issues, eNB needs to update/override the configuration of the HARQ disabling for a particular transmission, especially for NBIoT with single HARQ process, DCI based solution can be additional supported besides RRC based solution as Option 6a-4, which is aligned with majority companies. Regarding the Option 6a-4, there are still some clarification issues need to be addressed by the group, these issues are listed in the sub-bullets for further discussion.

**[Proposal 1-1a]:**

For NB-IoT NTN, to configure/indicate enabling/disabling of HARQ feedback for downlink transmission, down select **~~ONE~~** ~~from the following options at RAN1#111:~~

* ~~Option 6a-1: Support RRC signaling configured between Option 1 and Option 3~~
* Option 6a-4: Support Option 1 by default, and support Option 3 to override default configuration for corresponding transmission
	+ FFS #1: Option 3 DCI-based overridden mechanism is applied to both semi-statically HARQ enabled and disabled processes or only applied to semi-statically HARQ disabled processes
	+ FFS #2: additional RRC signaling to enable Option 3 or automatically enable Option 3 if enable Option 1
	+ FFS #3: whether/how to support Option 3 overriding default configuration for corresponding transmission for multiple TBs scheduled by single DCI

For eMTC, as RAN2 has agreed to take Option 1 as the baseline solution, and some companies hope to take the same mechanism for both NBIoT and eMTC. However, if the group agrees that DCI based solution is also needed for eMTC, we should re-evaluate the Rel.18 workload to support DCI based solution to SPS PDSCH (e.g., how to override the default configuration without any DCI scheduling except the activation DCI) and multiple TB scheduled by single DCI (e.g., how to override the default configuration for up to 8 TB scheduled by single DCI). The following proposals are listed as majority views.

**[Proposal 1-2a]:**

For eMTC NTN, to configure/indicate enabling/disabling of HARQ feedback for downlink transmission, down select **ONE** from the following options at RAN1#111:

* Option 1: Support per HARQ process via UE specific RRC signaling
* Option 6a-4: Support Option 1 by default, and support Option 3 to override default configuration for corresponding transmission
	+ FFS #1: Option 3 DCI-based overridden mechanism is applied to both semi-statically HARQ enabled and disabled processes or only applied to semi-statically HARQ disabled processes
	+ FFS #2: additional RRC signaling to enable Option 3 or automatically enable Option 3 if enable Option 1
	+ FFS #3: whether/how to support Option 3 overriding default configuration for corresponding transmission for SPS PDSCH and multiple TBs scheduled by single DCI

Please provide your views and comments.

|  |  |
| --- | --- |
| **Company** | **Comments and Views** |
| **Ericsson** | **For Option 6a-1, we share the same understanding as the FL:**IF d*lHARQ-FeedbackDisabled-sw* is configured* In case *dlHARQ-FeedbackDisabled-sw = “RRC”*
	+ further configured with *downlinkHARQ-FeedbackDisabled*
	+ HARQ enabled/disabled is determined by *downlinkHARQ-FeedbackDisabled*
* In case *dlHARQ-FeedbackDisabled-sw = “DCI”*
	+ HARQ enabled/disabled is determined by corresponding DCI (e.g., explicit indication)

ELSE all HARQ enabled**For Option 6a-4, both “Option 1 & Option 3” are in place at the same time, i.e., Option 3 can either align or override Option 1 at any time. Thus, Option 3 cannot be optionally further configured (i.e., it cannot be optional since the RRC-based switching is not timely because of the HL-ACK). In terms of an “IF-ELSE” statement option 6a-4 overall should be as follows:**IF d*lHARQ-FeedbackDisabled-sw* is configured* + HARQ enabled/disabled is determined by *downlinkHARQ-FeedbackDisabled &*

for the corresponding transmission HARQ enabled/disabled is unchanged/changed by corresponding DCI (e.g., explicit indication).ELSE all HARQ enabled |

# [Active]Issue-2 SPS PDSCH

## Background

Since SPS is only supported in CE mode A and the corresponding SPS period can be configured from 10ms to 640ms. While the reference value of RTT for LEO and GEO are 25.77ms and 541.46ms respectively. The HARQ stalling issue is not obvious in LEO scenario but do exist in GEO scenarios. Based on that, it is beneficial to configure HARQ disabling at least for GEO scenarios in eMTC. Similarly, for NR NTN SPS, the SPS period can also be configured from 10ms to 640ms, and the supported HARQ process is even larger than that of eMTC, the SPS HARQ disabling was introduced in Rel.17 NR NTN.

In NR NTN, it was agreed that for HARQ feedback of each PDSCH, UE follows the per-process HARQ feedback enabled/disabled configuration for the associated HARQ process except for the first SPS PDSCH after activation if additionally enabled, where ACK/NACK is always reported by UE for the first SPS PDSCH.

For IoT NTN, As highlighted by [ZTE, CATT, Spreadtrum, Xiaomi, OPPO, CMCC, Apple, Qualcomm, Lenovo], that the same mechanism for NR NTN could be applied to IoT NTN. UE follows the per-process HARQ feedback enabled/disabled configuration for the associated HARQ process except for the first SPS PDSCH after activation. For SPS PDSCH, ACK/NACK is reported by UE for the first SPS PDSCH regardless of network configuration of enabled/disabled for this HARQ process if additional signal indicated. However, As proposed by [Nokia, NEC], HARQ feedback should be always enabled for the first SPS PDSCH after activation to avoid the repetition resource wasted, [NEC] further propose that HARQ feedback enabled/disabled for the first SPS PDSCH after activation is indicated by DCI. [Nokia] further propose that the configuration allows a process to report one HARQ-ACK for every n TBs received in SPS. From moderator’s understanding, the HARQ process number is determined by subframe index for SPS, so whether to report HARQ-ACK or not can be implemented by proper SPS configuration and HARQ enabling/disabling configuration. The solution adopted in NR can be the baseline that the HARQ feedback for SPS PDSCH follow the per-process HARQ feedback enabled/disabled configuration. We are still open to consider Nokia proposed solution for further study to check the benefit of reporting HARQ-ACK every n TB in addition to NR solution.

As mentioned by [Samsung], for IoT NTN, the considered scenarios are not latency sensitive. The gNB can activate at a time where the first SPS PDSCH has a HARQ process with enabled HARQ-ACK report, so the additional HARQ feedback for SPS activation is not needed.

In this meeting, preference options from companies are summarized as follow:

For HARQ feedback for eMTC SPS PDSCH, UE at least follows the per-process HARQ feedback enabled/disabled configuration for the associated HARQ process except for the first SPS PDSCH after activation.

* for the first SPS PDSCH after activation,
	+ Option 1: If HARQ feedback for SPS activation is additionally enabled, ACK/NACK is reported by UE for the first SPS PDSCH after activation regardless of network configuration of enabled/disabled for this HARQ process, and follow per-process HARQ feedback enabled/disabled configuration otherwise.

Supported by: ZTE, CATT, Spreadtrum, Xiaomi, OPPO, CMCC, Apple, Lenovo, Qualcomm

* + Option 2: ACK/NACK is always reported by UE for the first SPS PDSCH after activation regardless of network configuration of enabled/disabled for this HARQ process.

Supported by: Nokia, NEC

* + Option 3: follow the per-process HARQ feedback enabled/disabled configuration for the associated HARQ process.

Supported by: Samsung

As highlighted by [Spreadtrum, Lenovo, Apple], for DCI indicating SPS PDSCH release, HARQ-ACK report is performed as legacy.

## Company views

From moderator’s perspective, if the indication/configuration of disabling HARQ feedback in eMTC follows that of NR NTN in previous section, the NR configuration of HARQ feedback enabling/disabling for SPS PDSCH can be the starting point /baseline for eMTC NTN. Furthermore, further study the benefit of reporting HARQ-ACK every n TB (e.g., reporting HARQ-ACK every SPS occasion) and if DCI based HARQ enabled/disabled indication is supported for eMTC, study on whether the corresponding solution can be used for SPS PDSCH.

According to the above summary, the following proposals are listed as majority views:

**[Proposal 2-1a]:**

For HARQ feedback for eMTC SPS PDSCH, UE at least follows the per-process HARQ feedback enabled/disabled configuration for the associated HARQ process except for the first SPS PDSCH after activation

* for the first SPS PDSCH after activation,
	+ Option 1: If HARQ feedback for SPS activation is additionally enabled, ACK/NACK is reported by UE for the first SPS PDSCH after activation regardless of network configuration of enabled/disabled for this HARQ process, and follow per-process HARQ feedback enabled/disabled configuration otherwise.
	+ ~~Option 2: ACK/NACK is always reported by UE for the first SPS PDSCH after activation regardless of network configuration of enabled/disabled for this HARQ process.~~
	+ ~~Option 3: follow the per-process HARQ feedback enabled/disabled configuration for the associated HARQ process.~~

**[Proposal 2-2a]:**

For DCI indicating SPS PDSCH release, HARQ-ACK report is performed as legacy in eMTC.

Please provide your views and comments.

|  |  |
| --- | --- |
| **Company** | **Comments and Views** |
| **Ericsson** | We suggest discussing SPS once we have taken a decision on the “enabling/disabling switching” and the “scheduling restriction” for LTE-MTC. Please note that for LTE-MTC the “enabling/disabling switching” and the “scheduling restriction” have not reached yet the same level of progress as NB-IoT. |
|  |  |

# [Active]Issue-3 (N)PDSCH/(N)PDCCH scheduling restriction

## Background

In NR NTN, additional gap is considered to avoid the continuous reception of PDSCH with same HARQ process at UE side as specified in TS38.214.

**TS38.214 Section 5.1**

When HARQ feedback for the HARQ process ID is disabled, the UE is not expected to receive another PDCCH carrying a DCI scheduling a PDSCH or set of slot-aggregated PDSCH scheduled for the given HARQ process or to receive another PDSCH without corresponding PDCCH for the given HARQ process that starts until Tproc,1 after the end of the reception of the last PDSCH or slot-aggregated PDSCH for that HARQ process.

For NBIoT, it was agreed that *UE is not required to monitor NPDCCH in a period of Y=12(ms) from the end of reception of the NPDSCH* to align the NBIoT legacy behavior that UE is not required to monitor NPDCCH and decode NPDSCH simultaneously.

However, in addition to the above NPDCCH monitoring restriction, [Ericsson] further proposes complementary “no monitoring” rules to clarify the UE NPDCCH monitoring behavior to avoid the Tx/Rx collision (e.g., skip/terminate the NPDCCH monitoring in NPUSCH format 2 transmission accounting for the RU length/number of repetitions and the UL-to-DL switching subframe). From moderator’s understanding, due to the NBIoT UE half-duplex feature, UE is not expected to receive any DCI in configured/scheduled uplink subframe obviously, and the “issue” is not new with the introduction of HARQ disabling if the issue is justified by the group. Based on that, we need to further study whether and how to solve the issue (e.g., complementary “no monitoring” rules) proposed by [Ericsson].

For eMTC, as proposed by [ZTE, CATT, Nordic, Apple, Qualcomm, Lenovo], following NR PDSCH/PDCCH scheduling restriction, the similar mechanism should be introduced to eMTC NTN. However, as mentioned by [Ericsson] that there is a delay between the “MPDCCH and the scheduled PDSCH”, afterwards there is at least a 3 ms delay between the end of PDSCH and the start of PUCCH which accounts for sufficient PDSCH decoding time at the devices, and further propose that UE is not required to monitor PDCCH in a period of Y(ms) from the end of reception of the closest PDSCH not simultaneously receiving MPDCCH and that has an empty subframe next to it (e.g., the UE won’t be required to monitor subframe #18, #19, #20, #21, #22, and #23 and therefore it would be able to start monitoring in DL from subframe #24 for a potential reception of a subsequent DL scheduling in the following table 7), please find the detail in R1-2211767.

[R1-2211767] Table 7: 4 HARQ processes where “HARQ feedback” is enabled for the 1st, 2nd, and 3rd HARQ processes and disabled for the 4th HARQ process for a Cat-M1 HD-FDD UE for NTN

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ↓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | … |
| Subframe# | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
| MPDCCH | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  |  | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  |  | 0 | 0 |
| PDSCH |  |  | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  |  | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  |  |
| PUCCH |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0{0,1,2} | 0{0,1,2} | 0{0,1,2} | 0{0,1,2} |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0{0,1,2} | 0{0,1,2} | 0{0,1,2} | 0{0,1,2} |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | No-monitoring MPDCCH |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | No-monitoring MPDCCH |  |  |

The minimum gap between the end of PDSCH and the start of corresponding HARQ-ACK is 3ms for eMTC defined in 36.213, which accounts for PDSCH decoding time and corresponding uplink data preparation at the devices. Furthermore, eMTC UE has the ability to decode MPDCCH and PDSCH in the same subframe and there is NO MPDCCH monitoring restriction in legacy eMTC shown in Figure 1 (e.g., UE has the ability to decode PDSCH and monitor/decode MPDCCH simultanously even for the PDSCH with HARQ enabling/disabling, as subframe #2 in Figure 3-1).





Figure 3-1 Minimal gap between PDSCH and PUSCH

**TS36.213 Section 10.2**

For FDD, a BL/CE UE shall upon detection of a PDSCH intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response using the same  derived according to Clause 10.1.2.1 in subframe(s) *n+ki* with *i =0,1, …, N-1*, where

- subframe *n-k-K*offset is the last subframe in which the PDSCH is transmitted, where

- if the UE is in half-duplex FDD operation and is not configured with higher layer parameter *ce-PDSCH-14HARQ-Config* and is configured with CEModeA and higher layer parameter *ce-HARQ-AckBundling* and the 'HARQ-ACK bundling flag' in the corresponding DCI is set to 1, or if the UE is configured with higher layer parameter *ce-SchedulingEnhancement*

- $k$ is given by the 'HARQ-ACK delay' field in the corresponding DCI, and the HARQ-ACK delay value $k$ is determined based on the higher layer parameters according to Table 7.3.1-2;

- if the UE is in half-duplex FDD operation and is configured with higher layer parameter *ce-PDSCH-14HARQ-Config* and is configured with CEModeA, and 'PDSCH scheduling delay and HARQ-ACK delay for 14 HARQ' field is present in the corresponding DCI,

- $k$ is given by the HARQ-ACK delay value as defined in [4], in the corresponding DCI,

- otherwise

- $k=4$

*- 0≤k0<k1<…,kN-1* and the value of and  is provided by higher layer parameter *pucch-NumRepetitionCE-format1,* if configured, otherwise it is provided by higher layer parameter *pucch-NumRepetitionCE*-*Msg4-Level0-r13, pucch-NumRepetitionCE-Msg4-Level1-r13, pucch-NumRepetitionCE-Msg4-Level2-r13* or *pucch-NumRepetitionCE-Msg4-Level3-r13* depending on whether the most recent PRACH coverage enhancement level for the UE is 0, 1, 2 or 3, respectively; and

In NR NTN HARQ disabling, the gap of PDSCH scheduling restriction for HARQ disabling is defined as subframes between previous PDSCH and next PDCCH of scheduling the same HARQ process for dynamic PDSCH transmission, and subframes between previous PDSCH and next PDSCH of the same HARQ process for SPS PDSCH. In order to reuse NR design, unified minimal gap of PDSCH scheduling restriction can be considered for dynamic PDSCH and SPS PDSCH (including FDD and HD-FDD case) for eMTC, the minimal gap is used for UE PDSCH decoding.

Regarding the minimal gap value proposed by majority companies: X=3ms. Following gives some illustration of the scheduling restriction for different scenarios.

* For FDD eMTC of dynamic PDSCH transmission, due to the cross subframe scheduling of eMTC, the minimal gap of PDSCH scheduling restriction between previous PDSCH and next PDCCH of scheduling the same HARQ process is 3ms (e.g., subframe 3 4 5 for HARQ process #0 as shown in Figure 3-2), the corresponding gap between previous PDSCH and next PDSCH for the same HARQ process is 5ms (e.g., subframe 3 4 5 6 7 for HARQ process #0 as shown in Figure 3-2), and 5ms gap for PDSCH-to-PDSCH is enough for UE PDSCH decoding.
* For FDD eMTC SPS PDSCH, due to SPS without DCI scheduling, the minimal gap of PDSCH scheduling restriction between previous PDSCH and next PDSCH of the same HARQ process is 3ms, and 3ms gap for PDSCH-to-PDSCH is enough for UE PDSCH decoding as shown in Figure 3-3(e.g., assuming the HARQ process number of #0, #1, #2, #3 is determined by subframe index).
* For HD-FDD eMTC without HARQ bundling or without HARQ delay enhancement (e.g., HARQ feedback delay of 4ms), due to the cross subframe scheduling of eMTC, the minimal gap of PDSCH scheduling restriction between previous PDSCH and next PDCCH of scheduling the same HARQ process is 3ms, the corresponding gap between previous PDSCH and next PDSCH for the same HARQ process is 5ms, and 5ms gap for PDSCH-to-PDSCH is enough for UE PDSCH decoding as shown in Figure 3-4. (e.g. if there is uplink subframe scheduled between two DL transmission, the gap between previous PDSCH and next PDCCH of scheduling the same HARQ process may be longer due to switching subframes and uplink transmission in half-duplex FDD)
* For HD-FDD eMTC HARQ bundling or HARQ delay enhancement (e.g., HARQ feedback delay dynamically indicated), due to the cross subframe scheduling of eMTC, the minimal gap of PDSCH scheduling restriction between previous PDSCH and next PDCCH of scheduling the same HARQ process is 3ms, the corresponding gap between previous PDSCH and next PDSCH for the same HARQ process is 5ms, and 5ms gap for PDSCH-to-PDSCH is enough for UE PDSCH decoding as shown in Figure 3-5.



Figure 3-2 Minimal gap for PDSCH scheduling restriction



Figure 3-3 Minimal gap for PDSCH scheduling restriction



Figure 3-4 Minimal gap for PDSCH scheduling restriction



Figure 3-5 Minimal gap for PDSCH scheduling restriction

However, [Qualcomm] proposes that in one case of HD-FDD timeline, the earliest an eMTC UE expects to receive a retransmission for the same HARQ process is in subframe N+6 due to UL-to-DL switching, which is X=5ms after the end of last PDSCH for the same HARQ process.

* UE receives a PDSCH in subframe *N*
* UE transmits HARQ-ACK in subframe *N+4*
* UE retunes to downlink in subframe *N+5*
* UE starts monitoring for MPDCCH in subframe *N+6*

From moderator’s understanding, the minimal gap period is used for UE PDSCH decoding for a particular HARQ process as Tproc,1 in NR, not related to the potential MPDCCH monitoring subframe, where 3ms is enough for PDSCH decoding both HD-FDD and FDD in eMTC. After the 3ms period of PDSCH scheduling restriction, whether the gNB transmits PDCCH scheduling the PDSCH with the same HARQ process is up to eNB implementation. There may be UL-to-DL switching subframes and invalid DL subframe after the 3ms period, eNB and UE have the common understanding on these subframes, and eNB will not transmit any DCI in these subframes. Furthermore, besides the HD-FDD timeline illustrated by [Qualcomm], there is another HD-FDD timeline in Figure 3-5 where the UE is expected to receive the transmission/retransmission for the same HARQ process after a period of 3ms instead of 5ms. Based on that, the minimal gap period is designed for UE PDSCH decoding, X= 3ms can cover “all” cases to balance the PDCCH monitoring power saving and UE decoding capability and we don’t need to set an “infinite” value of minimal gap period to cover “corner” case for UE power saving consideration.

## Company views

According to the above summary, reusing NR PDSCH scheduling restriction can be a starting point for eMTC. Regarding the value of X, as the minimum gap is defined as 3ms, the PDSCH scheduling restriction duration should be 3ms.

**[Proposal 3-1a]:**

For a DL HARQ process with disabled HARQ feedback in HD-FDD eMTC and NBIoT, further study the complementary “no monitoring” rules to clarify the UE (N)PDCCH monitoring behavior to avoid the Tx/Rx collision (e.g., skip the (N)PDCCH monitoring in uplink transmission and UL-to-DL switching subframe).

**[Proposal 3-2a]:**

For a DL HARQ process with disabled HARQ feedback in eMTC, UE is not expected to receive another MPDCCH carrying a DCI scheduling a PDSCH for a given HARQ process or to receive another PDSCH without corresponding MPDCCH for the given HARQ process that starts until X=3 (ms) after the end of the reception of the last PDSCH for that HARQ process.

Please provide your views and comments.

|  |  |
| --- | --- |
| **Company** | **Comments and Views** |
| **Ericsson** | * Ok with [Proposal 3-1a]. Just please add “M” in inside the parenthesis as to have “(N/M) PDCCH”.
* For [Proposal 3-2a], the wording includes “PDSCH without corresponding MPDCCH” which seems to correspond to SPS? We think we should discuss the “scheduling restriction” in its simplest form without accounting for SPS yet.

We can also discuss the wording suggested by Qualcomm in R1-2212138: “*For a DL HARQ process with disabled HARQ feedback in eMTC, UE is not expected to receive an MPDCCH scheduling the same HARQ process in a period of Y=5(ms) from the end of the reception of the PDSCH*”. The value to be taken by the variable in the proposed statements (i.e., “X” in Proposal 3-2a, and “Y” in Qualcomm’s proposal) needs further discussion. |

# [Active]Issue-4 HARQ bundling for eMTC HD-FDD

## Background

eMTC HD-FDD HARQ bundling by multiple DCIs is introduced in Rel.14 and enhanced in Rel.17. The design of disablement of HARQ feedback should handle the case where HARQ feedback is bundled, and HARQ feedback is enabled for some HARQ processes and is disabled for others. Similar as enhancement of NR NTN HARQ codebook Type-1, [Speadtrum, CATT, Apple] proposes that ACK is assumed for a feedback-disabled HARQ process in the logical AND operation. However, [Lenovo]mentions due to PDSCH number restriction (e.g., 10 PDSCH for each scheduling cycle) and PUCCH feedback resource restriction for each scheduling cycle (e.g., 3 for PUCCH resource for each scheduling cycle), if ACK is assumed for HARQ disabling scenarios (e.g., this HARQ feedback of ACK will occupy a PDSCH number and a PUCCH resource of HARQ bundling), there is no available PDSCH and corresponding PUCCH resource in the scheduling cycle and it is equivalent that HARQ disabling feature is not supported in HD-FDD HARQ bundling.

Similar as enhancement of NR NTN HARQ codebook Type-2, [OPPO, Qualcomm] proposes UE only report the HARQ feedback for HARQ process enabled by setting “*HARQ-ACK bundling flag=0*” for HARQ disabled process as shown in Figure 4-1, and further mentions that the legacy HARQ bundling only includes the bundling of HARQ enabled process in legacy TS36.213.

[NEC] proposes that ACK is assumed for the disabled HARQ process when performing a logical AND operation if not all the bundled TB is disabled HARQ feedback, and if all the bundled TB is disabled HARQ feedback, then HARQ bundling function will not apply even it is configured.



Figure 4-1 HARQ disabling in HARQ bundling by multiple DCIs for eMTC HD-FDD

TS36.213 h20

## 10.2 Uplink HARQ-ACK timing

[……]

For FDD, a BL/CE UE shall upon detection of a PDSCH intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response using the same  derived according to Clause 10.1.2.1 in subframe(s) *n+ki* with *i =0,1, …, N-1*, where

- subframe *n-k**-**K*offset is the last subframe in which the PDSCH is transmitted, where

- if the UE is in half-duplex FDD operation and is not configured with higher layer parameter *ce-PDSCH-14HARQ-Config* and is configured with CEModeA and higher layer parameter *ce-HARQ-AckBundling* and the 'HARQ-ACK bundling flag' in the corresponding DCI is set to 1, or if the UE is configured with higher layer parameter *ce-SchedulingEnhancement*

- $k$ is given by the 'HARQ-ACK delay' field in the corresponding DCI, and the HARQ-ACK delay value $k$ is determined based on the higher layer parameters according to Table 7.3.1-2;

- if the UE is in half-duplex FDD operation and is configured with higher layer parameter *ce-PDSCH-14HARQ-Config* and is configured with CEModeA, and 'PDSCH scheduling delay and HARQ-ACK delay for 14 HARQ' field is present in the corresponding DCI,

- $k$ is given by the HARQ-ACK delay value as defined in [4], in the corresponding DCI,

- otherwise

- $k=4$

[….]

TS36.213 h20

### 7.3.1 FDD HARQ-ACK reporting procedure

[….]

For a BL/CE UE in half-duplex FDD operation, if the UE is configured with CEModeA, and if the UE is configured with higher layer parameter *ce-HARQ-AckBundling* and the 'HARQ-ACK bundling flag' in the corresponding DCI is set to 1,

- for HARQ-ACK transmission in subframe *n*, the UE shall generate one HARQ-ACK bit by performing a logical AND operation of HARQ-ACKs across all  BL/CE DL subframes for which subframe *n* is the 'HARQ-ACK transmission subframe'.

- if subframe *n-k1* is the most recent subframe for which subframe *n* is the 'HARQ-ACK transmission subframe', and if the 'Transport blocks in a bundle' field in the corresponding DCI for PDSCH transmission in subframe *n-k1* indicates a number of transport blocks in a bundle other than , the UE shall generate a NACK for HARQ-ACK transmission in subframe *n*.

[…..]

TS36.212 h30

- HARQ-ACK bundling flag – 1 bit, where value 0 indicates HARQ-ACK bundling is not enabled and value 1 indicates HARQ-ACK bundling is enabled as defined in clause 7.3 of [3]. This field is only present when the higher layer parameter *ce-HarqAckBundling-config* is configured and the DCI is mapped onto the UE-specific search space given by the C-RNTI as defined in [3].

## Company views

According to the above summary, in eMTC HD-FDD HARQ bundling by multiple DCI, whether to bundle the HARQ-ACK to single one depends on the DCI field *HARQ-ACK bundling flag* indicationin legacy. To make the discussion simpler, it is possible to specify or schedule HARQ-ACK bundling to the avoid the HARQ bundling between HARQ feedback for downlink transmission with HARQ process disabled and that with HARQ process enabled or with another HARQ process disabled. The following proposals are listed:

**[Proposal 4-1a]:**

For eMTC HD-FDD single TB scheduled by single DCI and without HARQ bundling, HARQ feedback is not reported for downlink transmission with HARQ process disabled.

* HARQ feedback for downlink transmission with HARQ process disabled scheduled by DCI#1 is not expected to be HARQ bundled with HARQ feedback for downlink transmission with HARQ process enabled/disabled scheduled by DCI#2 (e.g., by setting DCI field *HARQ-ACK bundling flag* of DCI #1 to 0)

For eMTC HD-FDD single TB scheduled by single DCI and with HARQ bundling, HARQ feedback follows legacy behavior. (i.e., all HARQ processes in the HARQ bundle are HARQ process enabled)

~~For eMTC HD-FDD HARQ bundling by multiple DCIs, the following UE behaviors are considered for the downlink transmission with HARQ process disabled:~~

* ~~Option 1: ACK is assumed/reported for the downlink transmission with HARQ process disabled regardless of decoding results of corresponding transmission (including bundle size equal to 1).~~
* ~~Option 2: HARQ feedback is reported only for downlink transmission with HARQ process enabled (e.g., HARQ feedback is not reported for downlink transmission with HARQ process disabled by setting DCI field~~ *~~HARQ-ACK bundling flag~~* ~~to 0)~~
* ~~Other options are not excluded~~

Please provide your views and comments.

|  |  |
| --- | --- |
| **Company** | **Comments and Views** |
| **Ericsson** | I’m under the impression that the updated [Proposal 4-1a] became more confusing (e.g., because of the notation “DCI#1” and “DCI#2” in a RAT that at a given point in time can use several HARQ processes). Was [Proposal 4-1a] intended to reflect what you wrote above: “*to the avoid the HARQ bundling between HARQ feedback for downlink transmission with HARQ process disabled and that with HARQ process enabled or with another HARQ process disabled*”?To me for this issue, it will be easier/better to base the decision on what is going to be the status of the “*HARQ-ACK bundling flag*” for the HARQ processes with HARQ feedback disabled. If the “scheduling restriction rules” are robust enough (e.g., to avoid a Tx/Rx issue, and to avoid ending-up with no time for re-tuning from UL-to-DL) then perhaps it will be straight forward to decide the status of the flag for the HARQ processes with HARQ feedback disabled.  |

# [Active]Issue-5 HARQ feedback for scheduling multiple TB

## Background

eMTC/NBIoT multiple TB scheduling with single DCI is introduced in Rel.16. In HARQ feedback disabling for downlink transmission, solutions should be designed for the case of transmitting HARQ feedback for a multi-TB block where some TBs (or TB bundles) have feedback enabled, while some others have feedback disabled.

For NR NTN HARQ disabling, two types of HARQ codebook are enhanced as:

* For Type-1 HARQ codebook in NR NTN, the UE will consistently report NACK-only for the feedback-disabled HARQ process regardless of decoding results of corresponding PDSCH.
* For Type-2 HARQ codebook in NTN:
* Reduce codebook size with HARQ-ACK codebook only including HARQ-ACK of PDSCH with feedback-enabled HARQ processes
* For the DCI of PDSCH with feedback-enabled HARQ processes, the C-DAI and T-DAI are the count of only feedback-enabled processes

Similar as enhancement of NR NTN HARQ codebook Type-1, as proposed by [ZTE, CATT, Spreadtrum], ACK is assumed for a feedback-disabled HARQ process in the HARQ feedback for scheduling multiple TB scenario. While similar as enhancement of NR NTN HARQ codebook Type-2, as proposed by [Xiaomi, Huawei], UE only reports the HARQ information for the HARQ enabled process, corresponding UE behavior and timing relationship as shown in Figure 5-1. Specially for NBIoT, as proposed by [Huawei], UE do not feedback HARQ-ACK if two TBs are scheduled by single DCI and HARQ feedback is disabled for both processes, and HARQ feedback are assumed enabled for both of the scheduled TBs if the two TBs have different HARQ feedback assumptions for multiple TB scheduling with single DCI. As proposed by [NEC], HARQ feedback enabling/disabling is indicated by NDI field of DCI or a new DCI field. Optionally, the indication of new DCI field can be applied to all scheduled TBs, the first scheduled TB, the last scheduled TB or the middle-scheduled TB.



Figure 5-1 HARQ disabling in multiple TB scheduling

## Company views

According to the above summary, similar as discussion in NR HARQ codebook Type 1, Type 2 enhancement, before we conclude the impact of multiple TB scheduling with HARQ disabling, we should firstly achieve the high-level UE behavior for the downlink transmission with the HARQ process disabled no matter what kinds of indication are adopted and the following proposals are listed as majority views:

**[Proposal 5-1a]:**

* For NBIoT single TBs scheduled by single DCI, HARQ feedback is not reported for downlink transmission with HARQ process disabled.
* For NBIoT two TBs scheduled by single DCI, the following UE behaviors are considered for the downlink transmission with HARQ process disabled：
	+ Option 1: ACK is assumed/reported for the downlink transmission with HARQ process disabled regardless of decoding results of corresponding transmission
	+ Option 2: HARQ feedback is reported only for downlink transmission with HARQ process enabled (e.g., HARQ feedback is not reported for downlink transmission with HARQ process disabled)
	+ Option 3: HARQ feedback is reported or not depending on the other TBs HARQ-enabled/HARQ-disabling scheduled by single DCI
	+ Other options are not excluded

**[Proposal 5-2a]:**

* For eMTC FDD single TB scheduled by single DCI, HARQ feedback is not reported for downlink transmission with HARQ process disabled.
* At least for eMTC FDD/HD-FDD multiple TBs scheduled by single DCI without HARQ bundling, the following UE behaviors are considered for the downlink transmission with HARQ process disabled：
* Option 1: ACK is assumed/reported for the downlink transmission with HARQ process disabled regardless of decoding results of corresponding transmission
* Option 2: HARQ feedback is reported only for downlink transmission with HARQ process enabled (e.g., HARQ feedback is not reported for downlink transmission with HARQ process disabled)
* Other options are not excluded
* FFS: scenarios for eMTC FDD/HD-FDD multiple TBs scheduled by single DCI with HARQ bundling

Please provide your views and comments.

|  |  |
| --- | --- |
| **Company** | **Comments and Views** |
| **Ericsson** | We suggest sorting out first the Single-TB grant case in the previous issue before moving to the Multi-TB grant case. |

# [Active]Issue-6 NPRACH capacity

## Background

With the support of disabling HARQ feedback, NPRACH capacity issue is raised up by [Nokia] that if HARQ feedback is disabled, NB-IoT UE will need to transmit the SR on NPRACH, while if HARQ feedback is always enabled in legacy, NB-IoT UE can transmit the SR piggyback with HARQ feedback. The impact of NB-IoT scheduling request when HARQ feedback is disabled needs further study. [Nokia] observes that when SR is only indicated by NPRACH, the required NPRACH capacity may be very high for a NTN cell and further proposes that when HARQ feedback is disabled, NPUSCH format 2 resources can be allocated for SR and ACK/NACK transmission to reduce the load requirement on PRACH.

However, [Huawei] mentions that with dynamic HARQ disabling, the issues on NPRACH capacity starvation and lack of reference for open loop link adaptation can be alleviated by eNB implementation.

## Company views

According to the above summary, further studies are needed for companies.

**[Proposal 6-1a]:**

Further study the issue and potential solution of disabling HARQ feedback impact on NPRACH capacity.

Please provide your views and comments.

|  |  |
| --- | --- |
| **Company** | **Comments and Views** |
| **Ericsson** | As we have stated before, in our opinion the possibility of enabling/disabling HARQ feedback can help to alleviate this issue. For example, in scenarios where the disabling approach is used, from time to time the eNodeB can enable the HARQ feedback as to create the opportunity for the UE to incorporate a SR as part of the ACK/NACK response. |
|  |  |

# [Active]Others

## Background

NOTE: The issues in this section identified by companies are related to HARQ disabling and corresponding standard impact/enhancement. Since the views from companies are still diverged and the necessity for corresponding enhancement is not fully justified. Then, from moderator’s perspective, it is better to discuss these issues more. Companies are encouraged to give comments on these issues and show views in this meeting and even next meeting contributions.

Performance enhancement for disabling HARQ feedback

For enhancing transmission performance, different solutions including potential parameter configurations are proposed by companies. Following aspects are categorized according to the views from each company:

* UCI/UE assistant information
	+ a new CSI reporting method or a one-bit feedback to suggest an increase or decrease in MCS or repetition value of NPDSCH [Nordic, Nokia], reporting buffer status for HARQ operation, explicit indication to request enabling/disabling HARQ feedback [Samsung]. However, as mentioned by [Huawei], no need to enhance link adaptation when dynamic HARQ feedback disabling is introduced.

## Company views

According to the above summary, further studies are needed for companies.

**[Proposal 7-1a]:**

Further study the issue and potential solution on performance enhancement for disabling HARQ feedback.

Please provide your views and comments.

|  |  |
| --- | --- |
| **Company** | **Comments and Views** |
| **Ericsson** | N/A  |

# Proposals for discussion at Online sessions (Nov 16)

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# References

1. 3GPP TR 36.763 V1.0.0 (2021-06)
2. RP-213596, New WID on IoT NTN enhancements MediaTek Inc, RAN#94e
3. R1-2205555, Feature lead summary #3 on disabling of HARQ feedback for IoT NTN, Moderator (Lenovo)
4. R1-2210874, Discussion on disabling of HARQ feedback for IoT NTN, Huawei, HiSilicon
5. R1-2210947, Considerations for Disablement of HARQ in IoT NTN, Lockheed Martin
6. R1-2211095, Disabling of HARQ for IoT NTN, MediaTek Inc.
7. R1-2211111, Discussion on disabling of HARQ feedback for IoT-NTN, ZTE
8. R1-2211178, Discussion on remaining issues of disabling of HARQ feedback for IoT NTN, CATT
9. R1-2211248, Discussion on disabling of HARQ feedback for IoT NTN, Spreadtrum Communications
10. R1-2211344, Discussion on the HARQ operation for IoT NTN, xiaomi
11. R1-2211462, Discussion on disabling of HARQ feedback for IoT NTN, OPPO
12. R1-2211548, Disabling of HARQ feedback for NB-IoT/eMTC over NTN, Nokia, Nokia Shanghai Bell
13. R1-2211700, Discussion on disabling of HARQ feedback for IoT NTN, CMCC
14. R1-2211734, Disabling of HARQ feedback in IoT-NTN, InterDigital, Inc.
15. R1-2211756, On disabling HARQ feedback for IOT-NTN, Mavenir
16. R1-2211767, On disabling HARQ feedback for IoT NTN, Ericsson
17. R1-2211830, On HARQ Feedback Disabling for IoT NTN, Apple
18. R1-2211884, Disabling of HARQ feedback for IoT NTN, Lenovo
19. R1-2212066, Disabling of HARQ feedback for IoT NTN, Samsung
20. R1-2212138, Disabling HARQ Feedback for IoT-NTN, Qualcomm Incorporated
21. R1-2212367, Disabling of HARQ feedback for IoT NTN, NEC
22. R1-2212432, Disabling of HARQ feedback for IoT NTN, Nordic Semiconductor ASA