**3GPP TSG RAN WG1 Meeting #109-e R1-220xxxx**

e-Meeting, May 9th – 20th, 2022

**Agenda item: 9.8.2**

**Source: Moderator (Fujitsu)**

**Title:** **Summary#2 on L1/L2 signaling for side control information**

**Document for: Discussion and Decision**

# Introduction

This contribution summarizes the proposals in the contributions submitted under AI 9.8 about L1/L2 signaling for side control information of network-controlled repeaters (NCR), based on the second objective of SID in RP-213700.

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| The study on NR network-controlled repeaters is to focus on the following scenarios and assumptions:   * Network-controlled repeaters are inband RF repeaters used for extension of network coverage on FR1 and FR2 bands, while during the study FR2 deployments may be prioritized for both outdoor and O2I scenarios. * For only single hop stationary network-controlled repeaters * Network-controlled repeaters are transparent to UEs * Network-controlled repeater can maintain the gNB-repeater link and repeater-UE link simultaneously   NOTE1: Cost efficiency is a key consideration point for network-controlled repeaters.  Study and identify which side control information below is necessary for network-controlled repeaters including assumption of max transmission power [RAN1]   * Beamforming information * Timing information to align transmission / reception boundaries of network-controlled repeater * Information on UL-DL TDD configuration * ON-OFF information for efficient interference management and improved energy efficiency * Power control information for efficient interference management (as Second priority)   Study and identify L1/L2 signaling (including its configuration) to carry the side control information [RAN1]  Study the following aspects of network-controlled repeater management   * Identification and authorization of network-controlled repeaters [RAN2, RAN3]   NOTE2: Coordination with SA3 may be needed. |

# L1/L2 signaling for side control information

This section summarizes companies view with respect to L1/L2 signaling for side control information. The summary is as follows:

* Beamforming information:
  + The backhaul link beamforming of the NCR-RU (also, donor link/ forwarding link at gNB side/ forwarding link between the NCR and the gNB)
    - View #1: The indicated beams of the NCR-MT can be reused for the backhaul link beams of the NCR-RU. New signaling is unnecessary [ZTE, NTT DOCOMO, Fujitsu].
    - View #2: The backhaul link beams of the NCR-RU can be semi-statically indicated [vivo, xiaomi, NTT DOCOMO].
  + The service link beamforming of the NCR-RU (also, access link/ forwarding link at UE side/ forwarding link between the NCR and the UE)
    - View #1: Dynamic beam indication can be adopted for the support of a dynamic beam adaptation for the service link. [Huawei, ZTE, Nokia, xiaomi, Apple, LGE, Qualcomm]
      * The dynamically indicated service link beams of the NCR-RU can be used to forward dedicated or UE-specific signals/channels of the UEs the NCR serves, e.g., PDCCH, PDSCH, PUCCH, PUSCH or UE-specific reference signals for channel quality or interference measurements. These channels/signals are transmitted in random directions, subject to individual scheduling decisions. Using dynamically indicated beams to forward these channels/signals can mitigate the interference caused by the NCR.
    - View #2: Semi-static beam indication can be used to forward common signal for the UEs the NCR serves, i.e., SSB, CORESET0 and RACH etc. [ZTE, vivo, Ericsson]
      * Semi-static beam indication for common signaling may provide better resource efficiency due that common signal is usually periodic or predictable.
* Timing information to align transmission / reception boundaries of network-controlled repeater
  + View #1: The NCR can determine the transmission / reception boundaries, if the NCR-MT can achieve DL synchronization and determine UL timing like a legacy UE. New signaling/dedicated side control information may be unnecessary. [ZTE, Nokia, CATT, NTT DOCOMO, LGE, Ericsson, Intel, Qualcomm]
    - One company provides detailed analysis and concludes that legacy UE UL timing framework has a sufficient granularity and requirements for UEs to be served over repeaters. [Ericsson]
  + View #2: Some companies consider the potential of the necessity of a new side control information/signaling of timing to align transmission / reception boundaries. But it seems no explicit proposal is put forward in this meeting.
* Information on UL-DL TDD configuration
  + View #1: No dedicated signaling/side control information is needed, if the NCR-MT can obtain UL/DL TDD configuration like a legacy UE, e.g., by reading SIB, receiving dedicated RRC signaling or decoding DCI format 2\_0. Semi-static UL/DL TDD configuration seems a baseline among companies. [Huawei, ZTE, Nokia, CATT, vivo, xiaomi, Samsung, Lenovo, CMCC, NTT DOCOMO, Ericsson, Intel, Qualcomm]
  + View #2: New signaling for dedicated side control information of UL/DL TDD configuration may be required, e.g., if the gNB configures the NCR-MT and the NCR-RU with independent UL/DL TDD patterns [Spreadtrum, Sony]
* ON-OFF information for efficient interference management and improved energy efficiency
  + View #1: Dynamic ON/OFF of the NCR is expected to mitigate interference caused by the NCR, e.g., when the gNB is serving UEs in other directions. [ZTE, Sony, LGE, Ericsson, Qualcomm]
  + View #2: Semi-static ON/OFF of the NCR is expected to improve the energy efficiency of the NCR, e.g., when no UE needs the NCR’s help. [ZTE, Spreadtrum, vivo, Apple, Ericsson]
* Power control information for efficient interference management (as Second priority)
  + View #1: Dynamic signaling can be adopted for indicating amplifying gain or maximum Tx power to the NCR. [Nokia, Huawei, ETRI]
  + View #2: Semi-static signaling can be adopted for indicating amplifying gain or maximum Tx power to the NCR. [ZTE, Rakuten, Huawei]

Besides, some companies propose to study the L1/L2 signalling for the NCR-MT considering impacts on signalling overhead, resource utilization, cost/complexity considerations, and specification efforts. [Intel, Samsung]

## [Active]Signaling for beamforming

* + 1. First round

According to the summary, the moderator suggests the following proposal:

**Proposal 2-1-1**

* *As for the side control information of beamforming,* 
  + *Following two options can be considered regarding the backhaul link beamforming of the NCR-RU (also, donor link/ forwarding link at gNB side/ forwarding link between the NCR and the gNB).*
    - *Option #1-1 The indicated beams of the NCR-MT can be reused for the backhaul link beams of the NCR-RU. New signaling is unnecessary.*
    - *Option #1-2: The backhaul link beams of the NCR-RU can be semi-statically indicated.*
  + *Following mechanisms can either or both be considered regarding the service link beamforming of the NCR-RU (also, access link/ forwarding link at UE side/ forwarding link between the NCR and the UE).*
    - *Option #2-1: Dynamic beam indication can be adopted for the support of a dynamic beam adaptation for the service link.*
      * *The dynamically indicated service link beams of the NCR-RU can be used to forward dedicated or UE-specific signals/channels of the UEs the NCR serves, e.g., PDCCH, PDSCH, PUCCH, PUSCH or UE-specific reference signals for channel quality or interference measurements. These channels/signals are transmitted in random directions, subject to individual scheduling decisions. Using dynamically indicated beams to forward these channels/signals can mitigate the interference caused by the NCR.*
    - *Option #2-2: Semi-static beam indication can be used to forward common signal for the UEs the NCR serves, i.e., SSB, CORESET0 and RACH etc.*
      * *Semi-static beam indication for common signaling may provide better resource efficiency due that common signal is usually periodic or predictable.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
| Ericsson | **Agree.** Regarding Option 1-1, in our understanding this also implies that the MT and RU/forwarding functions will share BS side antennas since otherwise it is not really possible to reuse beams. |
| Nokia | Opt 1-1 and Opt. 1-2 seem closely related to the issue of FLB beam management in 9.81. It seems that the question of how beams are managed should first be addressed, and a third option where no signaling is specified for NCR-MT or FLB beam management could be considered.  Option 2-1 and option 2-2 do not seem to us to be mutually exclusive.  Alternatively, we may discuss support of semi-static and/or dynamic beam management for common channels and signals separately from dedicated channels and signals. Even in those scenarios the preferred design may not be either/or. As an e.g., beam management for SSBs may be configured on a semi-static basis, but beam management for CORESET0 may have to be indicated dynamically. |
| Moderator | Agree with Nokia that Option 2-1 and option 2-2 are not mutually exclusive.  The proposal is updated to reflect this intension. |
| Intel | We share similar view with Nokia that Opt 1-1/1-2 is closely relevant to proposal 2-2/2-3 for FLB in 9.8.1.  If fixed beam is considered for FLB, no signalling to be specified.  If adaptive beam is considered for FLB, we prefer to only consider option 1-1. Option 1-2 requires new procedure/signalling for beam management dedicated for FLB link with great standard effort, while the benefit is unclear.  For option 2-1 and 2-2, we’d like to clarify, whether option 2-2 intend to restrict the *Semi-static beam indication* only for common signal? In our view, semi-static beam indication can also be applied for unicast signal, it can be up to gNB to use dynamic or semi-static beam indication. |
| NTT DOCOMO | Support the proposal. |
| Apple | For backhaul beamforming information for NCR-RU, we agree with Nokia that this is quite closely related to Proposal 2-3 in the moderator summary for 9.8.1 (beam determination at NCR side for FLB). So, it is preferable to align the terminology and formulation of options across the two agendas.  For the service link beamforming information for NCR-RU, the two options Option 2-1 and option 2-2 are not different alternatives, rather they are two mechanisms for corresponding channel/signal type. Adding “either or both” in the main bullet still doesn’t fully solve the issue. For example, if only option 2-2 will be adopted, then the beam indication for dynamic channels/signals will not be defined.  Alternatively, to have an exhaustive list of options, we may formulate the options as follows:   * + - * Option 2-1: Only dynamic beam indication is adopted (for both dedicated and common channels/signals)       * Option 2-2: Only semi-static beam indication is adopted (for both dedicated and common channels/signals)       * Option 2-3: Both dynamic and semi-static beam indication are adopted   If above options are listed, then option 2-3 is preferable and further details on which indication type is supported for which channel/signal type can be later discussed. |
| AT&T | Support the proposal. |
| Vivo | Regarding option 2-2, we share view with Intel, that semi-static beam can be applied for UE-specific signals/channels of the UEs the NCR serves, which is similar as legacy repeater, the beam is always pointed to a given geo-location. |
| ZTE | Basically we think FL’s proposal could well reflect companies’ views on beam information, to refine the proposal, we have the following suggestions:   1. It’s better to align the terminology between 9.8.1 and 9.8.2 and then achieve unified format in TR, but it’s can be updated later once the decision is made in 9.8.1. 2. For Option 1-1 and 1-2, although they are relevant to proposal 2-2 in 9.8.1 regarding the assumption on beamforming capability at NCR side for gNB-NCR link, it’s still beneficial to list these options to reflect potential signaling solution. Meanwhile, in our view, both optimization can be considered for all assumption regardless of fixed or adaptive beam. 3. For Option 2-1 and 2-2, we also agree with Nokia that these 2 options are not mutual exclusive, instead, they are for different target signals, i.e. UE specific signals and common signals, and it’s possible to adopt both of them. In addition, Apple’s proposed version can reflect different combinations, but only semi-static beam indication is not reasonable. Meanwhile, the descriptive part under each option may not be necessary. So we propose the following updates for the forwarding link towards UE:    * *Following mechanisms can be considered regarding the service link beamforming of the NCR-RU (also, access link/ forwarding link at UE side/ forwarding link between the NCR and the UE).*      + *At least dynamic beam indication can be supported*        - *Dynamic beam indication can be used to forward dedicated or UE-specific signals/channels, e.g., PDCCH, PDSCH, PUCCH, PUSCH or UE-specific reference signals for channel quality or interference measurements.*      + *Semi-static beam indication can also be considered*        - *Semi-static beam indication can be used to forward common signal, i.e., SSB, CORESET0 and RACH etc.* |
| Sony | We agree with the following modifications.  To align with Proposal 1-2 in the parallel discussion [109-e-R18-Repeater-002], for both Option #1-1 and Option #1-2, signals transmitted to/from the NCR-RU backhaul link should use the same QCL sources as the NCR-MT control link. We believe this clarification is needed for Option #1-2, to narrow down discussions. For Option #1-1, this implies that implementations are not precluded from using different antenna panels for the NCR-MT control and the NCR-RU backhaul link, if they so wish: The only requirement is that one must be able to establish QCL relations between the two panels.  Regarding Option #2-1, we believe the last part is not needed “*The dynamically indicated service link beams of the NCR-RU can be used to forward dedicated or UE-specific signals/channels of the UEs the NCR serves, e.g., PDCCH, PDSCH, PUCCH, PUSCH or UE-specific reference signals for channel quality or interference measurements. ~~These channels/signals are transmitted in random directions, subject to individual scheduling decisions. Using dynamically indicated beams to forward these channels/signals can mitigate the interference caused by the NCR~~.*” It is unclear what is meant by “random directions.” It is also unclear why “dynamically indicated beams” can help mitigate interference caused by the NCR. In principle, semi-statically indicated beams and dynamically indicated ones can correspond to the *same*, in which case there seems to be no reason why dynamic indications might help reducing NCR-created interference compared to semi-static indications. |
| Lenovo | As the NCR-MT is in-band with the F-Link, we think *Option #1-1* is sufficient since the channel conditions for both NCR-MT and NCR-RU are almost same. We also think that we don’t need to restrict the indication for UE specific signals/channels to only dynamic indication. In some scenarios, semi-static indication might be beneficial. |
| CMCC | General fine with the proposal.  For the backhaul link beam indication, it is related to the discussion in AI 9.8.1. we also think the option 1-1 and option 1-2 are not mutually excluded. Since if the BH share the same link between NCR-MT and gNB, it is also possible to configured the BH beam of NCR-RU in a semi-static way. E.g. if the BH beam of NCR-RU is indicated to reuse the beam of PUCCH of NCR-MT.  For the option 1-1, we think it could be too early to conclude that even the BH beam will reuse the beam of NCR-MT, no new signalling is unnecessary. First, the signalling should be defined in the normative work phase. Second, for even the BH link could reuse the beams of NCR-MT, which specific beam should be used for the BH ? The beams of PDCCH, PDSCH, PUCCH, or PUSCH. Last and not least, the transmissions of C-link( gNB with NCR-MT) and forwarding link (both BH and AC link parts) are not exactly the same. The forwarding works with both receiving and transmitting at the almost the same time. But the NCR-MT works only in transmission or reception mode. NCR-MT does not need to considered the self-interference issues which could happen in the data forwarding procedures.  The updates could as below,   * + - Option #1-1 The indicated beams of the NCR-MT can be reused for the backhaul link beams of the NCR-RU. New signaling is unnecessary.   For the option 2-1 and 2-2, we share the similar view that both semi-static and dynamic indications may not be bundled with specific channels, at least in the current stage. |
| Fujitsu | We are fine with the proposal in principle, but we also think it is unnecessary to bundle semi-static/dynamic indications with common/UE-specific signals, respectively. And both can be supported. |
| Huawei, HiSilicon | We are generally fine with listed of options. As pointed out by several companies, there seems to be some overlap between this proposal and the discussion in 9.8.1. |
| Mediatek | Ok with the proposal. |
| LG | We agree with the intention of the proposal. However it seems duplication of the discussion in agenda item 9.8.1. And it is not clear to us the reason why the detailed purpose of dynamic/semi-static beam indication is described in the proposal. Further clarification would be appreciated. |
| CEWiT | Agree |
| NEC | Support. |
| IIT-K | Support. |
| Xiaomi | Support this proposal. |
| CableLabs | In our view, this question overlaps with 9.8.1 (e.g., same or different RFs between C-link and backhaul link). We support Option 1-1 which is aligned with same RFs in our view.  Regarding Option 2-1 and 2-2, we share views from Intel/Apple, and also seems overlapping with 9.8.1. We are open for both dynamic and semi-static signaling. |
| Charter | Since MT in NCR is expected to be similar to a legacy UE, Charter supports Option-1-1 for backhaul link beamforming of the NCR-RU. Adding side control information for backhaul link beams specific to NCR would lead to additional complexity and spec requirements.  For service link beamforming of the NCR-RU, Option-2-1 “dynamic beam indication” could be adopted for UE specific signals/channels while for cell-specific signalling Option 2-2 “semi-static beam indication” may be adopted. |
| CATT1 | First all, we need to be careful about the wording, for example, some terms like service link etc have not been defined.  Option1-1/1-2 : in principle fine.  Option 2-1/2-2: the term ‘*either or both*’ need to change. Not sure what ‘mechanism can either considered’ means here. We can lists both as candidate solutions . The subbullets should be FFS |
| Samsung | As mentioned by several other companies, the current formulation of the proposal appears to be more about NCR control information design, which is to be discussed in AI 9.8.1, rather than signalling aspects.  For the detailed proposal:   * For the first bullet, option #1-1 is preferred. The wording can be slightly updated to clarify that (i) the NCR-MT may operate with a single beam, and (ii) the beam for NCR-MT may be provide by semi-static configuration only, as the NCR is stationery. * For the second bullet, both Options #2-1 and #2-2 can be used, and each of them can have their own utility. In fact, their combination can be beneficial for signalling overhead reduction. Also, no need to limit the use-cases of Options #2-1 and #2-2 in this stage. * The sub-bullets below Option #2-1 and #2-2 are technical observations and is better to be removed.   Accordingly, we suggest the following modification:  **Proposal 2-1-1**   * *As for the side control information of beamforming,*    + *Following two options can be considered regarding the backhaul link beamforming of the NCR-RU ~~(also, donor link/ forwarding link at gNB side/ forwarding link between the NCR and the gNB)~~.*     - *Option #1-1 The configured/indicated beam(s) of the NCR-MT can be reused for the backhaul link beam(s) of the NCR-RU. New signaling is unnecessary.*     - *Option #1-2: The backhaul link beams of the NCR-RU can be semi-statically indicated.*   + *Either or both of Following mechanisms can ~~either or both~~ be considered regarding the service link beamforming of the NCR-RU ~~(also, access link/ forwarding link at UE side/ forwarding link between the NCR and the UE)~~.*     - *Option #2-1: Dynamic beam indication can be adopted for the support of ~~a~~ dynamic beam adaptation for the service link.*       * *The dynamically indicated service link beams of the NCR-RU can be used at least to forward ~~dedicated or~~ UE-specific signals/channels of the UEs the NCR serves~~, e.g., PDCCH, PDSCH, PUCCH, PUSCH or UE-specific reference signals for channel quality or interference measurements. These channels/signals are transmitted in random directions, subject to individual scheduling decisions. Using dynamically indicated beams to forward these channels/signals can mitigate the interference caused by the NCR~~.*     - *Option #2-2: Semi-static beam indication can be used at least to forward ~~common~~ cell-specific signals/channel for the UEs the NCR serves~~, i.e., SSB, CORESET0 and RACH etc~~.*       * *~~Semi-static beam indication for common signaling may provide better resource efficiency due that common signal is usually periodic or predictable.~~*     - *Other options are not precluded.* |
| Qualcomm | We do not agree.  Regarding the backhaul link beamforming of the NCR-RU,   1. FL Proposal 2-3 (in 9.8.1) addresses the same aspect and lists two options. At least those options should be captured here as well. Specifically, we propose to consider Option 1 (of FL Proposal 2-3 in 9.8.1) – which is “*The beam information is indicated via the side control information from gNB*” and a more general form of Option #1-2 above (w/o restricting this indication to be “semi-static”). 2. The two options are not mutually exclusive. For example, we can have Option #1-2 (its more general form w/o restriction to “semi-static” indication) as an optional indication. And in case, such an indication is not provided, NCR-MT’s beam may be reused (i.e., Option #1-1).   Therefore, we propose the following modification.   * + *Following ~~two~~ options can be considered regarding the backhaul link beamforming of the NCR-RU (also, donor link/ forwarding link at gNB side/ forwarding link between the NCR and the gNB).*     - *Option #1-1 The indicated beams of the NCR-MT can be reused for the backhaul link beams of the NCR-RU. New signaling is unnecessary.*     - *Option #1-2: The backhaul link beams of the NCR-RU can be ~~semi-statically~~ indicated via the side-control information.*     - *Option #1-3: both Option #1-1 and Option #1-2 can be supported.*   Regarding the service link beamforming, both options can be supported and there is no need to associate the options to different types of signals/channel. Similar to Apple’s suggestion (with a bit of more medications), we suggest the following.   * + *Following mechanisms can ~~either or both~~ be considered regarding the service link beamforming of the NCR-RU (also, access link/ forwarding link at UE side/ forwarding link between the NCR and the UE).*     - *Option #2-1: Dynamic beam indication can be adopted for the support of a dynamic beam adaptation for the service link.*       * *~~The dynamically indicated service link beams of the NCR-RU can be used to forward dedicated or UE-specific signals/channels of the UEs the NCR serves, e.g., PDCCH, PDSCH, PUCCH, PUSCH or UE-specific reference signals for channel quality or interference measurements. These channels/signals are transmitted in random directions, subject to individual scheduling decisions. Using dynamically indicated beams to forward these channels/signals can mitigate the interference caused by the NCR.~~*     - *Option #2-2: Semi-static beam indication can be used ~~to forward common signal for the UEs the NCR serves, i.e., SSB, CORESET0 and RACH etc~~.*       * *~~Semi-static beam indication for common signaling may provide better resource efficiency due that common signal is usually periodic or predictable.~~*     - *Option #2-3: both dynamic and semi-static beam indication can be used.* |

#### Summary

In Round 1, following companies are fine (or fine in principle) with the proposal: Ericsson, NTT DOCOMO, AT&T, CMCC, Fujitsu, Huawei, HiSilicon, Mediatek, CEWiT, NEC, IIT-K, Xiaomi. (12)

The concerns showed by companies:

1. The discussion here may somewhat overlap with the discussion in 9.8.1.

2. Whether the proposal suggest any about that ‘Option #1-1 and Option #1-2 are exclusive’ and/or ‘Option #2-1 and Option #2-2 are exclusive’.

3. The description of Option #2-1 and Option #2-2 may be unnecessary.

4. The scope of Option #2-2 should not be limited to common signal.

5. More details are necessary.

Moderator’s response to the concerns:

1. The proposals are reorganized to emphasize that the purpose of the discussion is for signaling design.

2. In moderator’s understanding, Option #1-1 and Option #1-2 are not exclusive. Option #2-1 and Option #2-2 are not exclusive neither.

3. The description of Option #2-1 and Option #2-2 are observation. The purpose to propose the observation is for the TR preparation. The proposal is reorganized to make this point clear.

4. In suggested proposal, common signal is observed as an example of Option #2-2. The moderator suggests approving the current observation first. If companies have other observations on Option #2-2, we can discuss and approve them in next round. Besides, ‘at least’ is added into the observation in case any further concern occurs.

5. We can discuss details in following rounds.

**Proposal 2-1-1-1:**

* *As for the signaling of the side control information of the backhaul link beamforming of the NCR-RU, following options can be considered:*
  + *Option #1-1 New signaling is unnecessary, if the indicated beams of the NCR-MT are reused for the backhaul link beams of the NCR-RU.*
  + *Option #1-2: New signaling is necessary, if the backhaul link beams of the NCR-RU are semi-statically indicated.*

**Proposal 2-1-1-2:**

* *From the perspective of signaling design, following mechanisms can be considered for the service link beamforming of the NCR-RU.*
  + *Option #2-1: Dynamic beam indication for dynamic beam adaptation.*
  + *Option #2-2: Semi-static beam indication.*
* *The following observations on Option #2-1 and Option #2-2 can be made:*
  + *For the service link of the NCR-RU,*
    - *The dynamically indicated beams can be used to forward dedicated or UE-specific signals/channels of the UEs the NCR serves, e.g., PDCCH, PDSCH, PUCCH, PUSCH or UE-specific reference signals for channel quality or interference measurements. These channels/signals can be transmitted in any directions within the area covered by the NCR, subject to individual scheduling decisions. Using dynamically indicated beams to forward these channels/signals can mitigate the interference caused by the NCR.*
    - *The semi-statically indicated beams can at least be used to forward common signal for the UEs the NCR serves, i.e., SSB, CORESET0 and RACH etc. Semi-static beam indication may provide better resource efficiency.*

After the first check point, Proposal 2-1-1-2 has been approved as follows.

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| **Agreement**  From the perspective of signaling design, following mechanisms can be considered for the access link beamforming of the NCR-FU.   * Option #2-1: Dynamic beam indication only * Option #2-2: Semi-static beam indication only * Option #2-3: Dynamic beam indication and semi-static beam indication |

* + 1. Second round

#### Proposal 2-1-1-1

The proposal 2-1-1-1 is the update of the first bullet of the Proposal 2-1-1 in the first round. To emphasize that the purpose of the discussion is for signaling design, the proposal is reorganized.

**Proposal 2-1-1-1:**

* *As for the signaling of the side control information of the backhaul link beamforming of the NCR-RU, following options can be considered:*
  + *Option #1-1 New signaling is unnecessary, if the indicated beams of the NCR-MT are reused for the backhaul link beams of the NCR-RU.*
  + *Option #1-2: New signaling is necessary, if the backhaul link beams of the NCR-RU are semi-statically indicated.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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***~~Proposal 2-1-1-2~~***

~~Proposal 2-1-1-2 is supported by a clear majority. The moderator suggests continuing the discussion on Proposal 2-1-1-2 in RAN1 reflector by mail.~~

#### Proposal 2-1-2-1

In the GTW session on May 12, the following agreement is achieved:

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| **Agreement**  At least for FR2, beam information is beneficial and recommended as the side control information for network-controlled repeater to control the behaviour of NCR at least for access link   * FFS: Detailed mechanism of indication. * Note: There are no supporting evaluation results on FR1 at this point to reach similar conclusion |

Based on the agreement, the Moderator suggests discussing the following new proposals in the second round. The new proposals are about the details of the access link beam indication.

Proposal 2-1-2-1 is to align the understanding on the access link beam sweeping/ the access link beam indication.

**Proposal 2-1-2-1**: *The access link beam sweeping is supported for the NCR.*

* *To support the access link beam sweeping, the gNB indicates the NCR a certain access link Tx/Rx beam(s)/spatial filter(s) and a corresponding time domain resource(s).*
* *The NCR utilizes the indicated Tx/Rx beam(s)/spatial filter(s) to transmit/receive the access link signal in the indicated time domain resource(s).*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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#### Proposal 2-1-2-2

This proposal is about how an access link beam is referred in the access link beam indication. According to the contributions submitted to this meeting, the following options are proposed/mentioned by companies.

**Proposal 2-1-2-2:** *In the access link beam indication, an access link beam can be referred by:*

* *Option 1: A beam index*
  + *Note: The corresponding time domain resource of the beam may be indicated independently.*
* *Option 2: An index of a reference RS (or a TCI-like indicator)*
  + *FFS: The definition of the reference RS. The corresponding time domain resource may be included in the definition of the reference RS.*
  + *FFS: The definition of the association between the reference RS and the indicated access link beam.*
* *Option 3: An indicated time domain resource*
  + *FFS: How to pre-configure the relation between the time domain resource and the indicated access link beam.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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***Proposal 2-1-2-3***

This proposal is about the time domain granularity of the access link beam indication. According to the contributions submitted to this meeting, the following options are proposed/mentioned by companies.

**Proposal 2-1-2-3:** *As for the time-domain granularity of the access link beam indication, the following options can be considered:*

* *Option 1: slot*
* *Option 2: symbol*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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***Proposal 2-1-2-4***

The moderator recommends companies to consider the application time of an access link beam indication to avoid misalignment between the gNB and the NCR.

**Proposal 2-1-2-4:** *The application time of the access link beam indication should be considered for the NCR.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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***Proposal 2-1-2-5***

The moderator recommends companies to consider the forwarding of SSB in the access link. The following options are summarized based on the contributions submitted to this meeting.

**Proposal 2-1-2-5:** *As for the forwarding of SSB signal in the access link, the following mechanisms can be considered:*

* *Option 1: SSBs are sent by the gNB in a legacy way. The NCR forwards the SSB(s) received in the backhaul link to the UE(s).*
* *Option 2: The NCR forwards SSBs to the UE(s) by using the access link beam sweeping.*
  + *FFS: The enhancement of SSB for the support of the access link beam sweeping.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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***Proposal 2-1-2-6***

According to SID, the NCR should be transparent to the UEs. The gNB may manipulate the access link beams of the NCR for the beam calibration of the UEs by using the access link beam indication. The moderator recommends companies to consider the need of the beam calibration with the UEs in the discussion on the access link beam indication.

**Proposal 2-1-2-6:** *The need of the beam calibration with the UE(s) should be considered for the access link beam indication of the NCR.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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#### Summary

(TBD)

## [Active]Signaling for timing

* + 1. First round

According to the summary, the moderator suggests the following proposal:

**Proposal #2-2-1**

* *As for the side control information of timing to align transmission / reception boundaries:*
  + *The NCR can determine the transmission / reception boundaries, if the NCR-MT can achieve DL synchronization and determine UL timing like a legacy UE. New signaling is unnecessary.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
| Ericsson | Agree |
| Nokia | We agree that no new signaling should be necessary for DL and UL timing synchronization, but there is still a question as to whether NCR-MT needs to support cell search, and RACH, or whether timing synch could be maintained by implementation. |
| Intel | Agree |
| NTT DOCOMO | Support |
| Apple | Support |
| AT&T | Support, but may need to consider the maintenance of timing in case of ON/OFF operation |
| vivo | We think the proposal is duplicated as in 9.8.1. companies propose to study whether processing time of repeater should be considered or not, if not considered, we can accept the proposal. |
| ZTE | We support this proposal in general with the following suggested updates:  **Proposal #2-2-1**   * *As for the side control information of timing to align transmission / reception boundaries:*   + *The NCR RU can determine the transmission / reception boundaries according to the timing of NCR MT, ~~if the NCR-MT can achieve~~ which can be achieved by DL synchronization and RACH procedure ~~determine UL timing~~ like a legacy UE. New signaling is unnecessary.* |
| Sony | We believe that this discussion needs to be put on hold until parallel discussion [109-e-R18-Repeater-002] has reached a conclusion on Proposal 5-1 and Proposal 5-2. As expressed in there, we essentially agree with the proposal for the NCR-RU backhaul link but we believe that further discussions are needed regarding the timing alignment of the NCR-RU service link and potentially required signaling. |
| Lenovo | Support. For Tx/Rx time alignment of the different links, we agree that no spec impact is foreseen. However, we think that the time information related to the application time of the control information on the F-link needs to be considered. i.e. at which symbol/slot the control information should take effect considereing the processing delay of the side control information at NCR-MT. |
| CMCC | As in the AI 9.8.1 that the impact of internal delay of NCR-RU is FFS, we are not sure if additional signalling is unnecessary. Considering the scope of this section is for L1/L2 signalling, the proposal should be more specific as updated below, which should also apply to the other proposals in the section 2.   * *New L1/L2 signaling is unnecessary.*   We prefer to wait for more information or discussions for the time issue to make decisions. |
| Fujitsu | Support the proposal.  In our view, to support communication between gNB and NCR-MT, NCR-MT must achieve DL synchronisation and determine UL timing. Regardless of how the timing for NCR-MT is acquired, the NCR-RU can determine transmission/reception boundaries referring to the timing for NCR-MT. |
| Huawei, HiSilicon | Support. Again, there seems to be some overlap between this proposal and the ones in 9.8.1. |
| Mediatek | Ok with the proposal |
| LG | We share similar view with vivo and CMCC. It seems duplication of agenda item 9.8.1. Whether the processing time of NCR is considered or not would impact this proposal. |
| CEWiT | Agree |
| NEC | Support if the NCR-MT has the capability to reuse the time synchronization procedure as the normal UE |
| IIT-K | Support. |
| Xiaomi | Agree |
| CableLabs | We consider this overlaps with 9.8.1, and like to clarify what legacy procedure we are referring here. |
| Charter | We agree timing synchronization can be achieved by using the legacy synchronization of a UE. |
| CATT1 | Prefer ‘*The NCR can determine the transmission / reception boundaries using legacy mechanisms.NO specification needed’*  We don’t need to describe how NCR achieve DL synchronization. |
| Samsung | As commented by a few other companies, the decision for any signalling (or not) is based on the outcome of the dual Proposal 5-1 in AI 9.8.1, especially the FFS “*FFS: the impact of internal delay of NCR-RU*”. |
| Qualcomm | We agree with other companies about the overlap between this proposal and proposals in 9.8.1.  Nonetheless, we want to bring up a point about RACH occasions. If the NCR is instructed to forward the UL signals on the resources overlapping with RACH occasions, it may not need to (or should not) apply any timing advance. This is an aspect to be further studied. |

#### Summary

In Round 1, following companies are fine (or fine in principle) with the proposal: Ericsson, Nokia, Intel, NTT DOCOMO, Apple, AT&T, vivo, ZTE, Lenovo, Fujitsu, Huawei, HiSilicon, Mediatek, CEWiT, NEC, IIT-K, Xiaomi, Charter.(19)

The concerns showed by companies:

1. The discussion here may somewhat overlap with the discussion in 9.8.1.

2. Whether processing time of repeater should be considered or not.

Moderator’s response to the concerns:

1. The proposals are reorganized to emphasize that the purpose of the discussion is for signaling design.

2. According to the contributions submitted to this meeting, the impact of the processing time of repeater on timing is unclear.

**Proposal #2-2-1**

* *As for the signaling of the side control information of timing to align transmission / reception boundaries:*
  + *The NCR can determine the transmission / reception boundaries, if the NCR-MT can achieve DL synchronization and determine UL timing like a legacy UE. New signaling is unnecessary.*
    1. Second round

#### Proposal #2-2-1

This proposal is relevant to Proposal 5-1 in 9.8.1 which is now under the discussion for email approval. To align with Proposal 5-1 in 9.8.1, the proposal #2-2-1 is updated as follows.

**Proposal #2-2-1**

* *As for the signaling of the side control information of timing to align transmission / reception boundaries:*
  + *New signaling is unnecessary, if the DL receiving timing of the NCR-FU is aligned with the DL receiving timing of the NCR-MT and the UL transmitting timing of the NCR-FU is aligned with the UL transmitting timing of the NCR-MT.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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#### Proposal #2-2-2

Proposal 5-1 in 9.8.1 is used to confirm that the NCR-FU can reuse the timing of the NCR-MT. The following proposal is used to discuss how the timing of the NCR-MT is obtained.

**Proposal #2-2-2**

* *The NCR-MT can achieve DL synchronization at least by detecting SSB.*
* *The NCR-MT can determine UL timing at least by transmitting Msg1 to and receiving Msg2 from the gNB.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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## [Close] Signaling for UL/DL TDD configuration

* + 1. First round

According to the summary, it seems that the difference between View #1 and View #2 comes from the different assumption on whether the UL/DL TDD configuration of the NCR-MT and the NCR-RU are always same. The moderator would like to clarify the assumption on the UL/DL TDD configuration first.



Figure 1 In-band NCR

Usually, a UL/DL TDD configuration is effective within a certain frequency resource, such as a carrier or a BWP. According to the discussion on the SID in RAN plenary meetings, the NCR-RU and the NCR-MT may have different bandwidth, as shown in Figure1. The bandwidth of the NCR-RU is larger than or equal to the bandwidth of the NCR-MT. The bandwidth of the NCR-RU is fixed or configured by OAM. The bandwidth of the NCR-MT is a BWP or a carrier which is always within the bandwidth of the NCR-RU.

**Clarification #2-3-1a:** *The gNB can guarantee the UL/DL TDD configuration indicated for the NCR-MT bandwidth ~~are~~ is always applicable to the NCR-RU bandwidth.*

**Clarification #2-3-1b:** *The gNB can guarantee the UL/DL TDD configuration indicated to the NCR-MT ~~are~~* *is always applicable to the NCR-RU.*

**Clarification #2-3-1c:** *The gNB can guarantee the UL/DL TDD configuration indicated to the NCR-MT is always applicable to the NCR-RU, provided the cells forwarded by the NCR-RU share TDD pattern with the NCR-MT’s serving cell.*

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| *~~Companies are encouraged to share your views on following questions.~~*   * *~~Q-a: What is your view on this clarification? Is it necessary?~~* * *~~Q-b: If the answer to Q-a is YES, which clarification do you prefer?~~*    + *~~Option 1: A~~*   + *~~Option 2: B~~*   + *~~Option 3: other suggested wording or update.~~*   Companies are encouraged to share your views. Which clarification do you support?  If you have any further concern, please propose the update you prefer. | | |
| **Company** | **Comments** | |
| Ericsson | UL/DL TDD pattern is defined per cell, i.e., over the full BW. 2-3-1a indicates that is not the case and is less preferred. | 2-3-1b is preferred, but even more so:  *The gNB can guarantee the UL/DL TDD configuration indicated to the NCR-MT is always applicable to the NCR-RU, provided the cells forwarded by the NCR-RU share TDD pattern with the MT’s serving cell.* |
| Nokia | This option would seem to require that the NCR-MT and NCR-RU are configured by different cells since the TDD-UL-DL is cell specific. Additionally, this option may not be possible if it is agreed that C-link and FSB link are using common radio hardware. | This is consistent with our understanding of the intended used case for TDD control for the NCR. |
| Moderator | The clarification suggested by Ericsson looks fine to the moderator. Now it is the option C.  Companies are encouraged to share your views. Which clarification do you support?  If you have any further concern, please propose the update you prefer.  Besides, two typos are corrected. | |
| Intel | Comparing Clarification #2-3-1c and Clarification #2-3-1b, does Clarification #2-3-1b mean, TDD configuration for all carriers forwarded by repeater should be aligned, while Clarification #2-3-1c implies the TDD configuration for multiple carriers forwarded by repeater can be different, e.g., assuming a repeater can support multiple non-consecutive pass-bands? | |
| NTT DOCOMO | We prefer clarification #2-3-1c | |
| Apple | In our view, clarification 2-3-1b is sufficient to conclude that same TDD configuration is ensured by gNB for both NCR-MT and NCR-RU. | |
| AT&T | We are ok with #2-3-1c | |
| vivo | We can accept the 1b and 1c, not sure about the difference between them. | |
| ZTE | We share similar view with Apple that clarification #2-3-1b is sufficient. The same TDD configuration irrespective of same or different bandwidth should be guaranteed for NCR-MT and NCR RU. | |
| Sony | Again, this question seems to overlap with the discussion in Sec. 4 of [109-e-R18-Repeater-002]. We prefer to finalize the discussion [109-e-R18-Repeater-002] first. Then, signalling can follow from conclusions reached in [109-e-R18-Repeater-002].  While we prefer Clarification 2-3-1b, we do not support any in their current form. We see several issues that need further discussion. For example, if several UEs served through the NCR are configured with UE-specific UL/DL TDD configurations, then when serving one of these UEs, the NCR-MT should be configured with a UL/DL TDD configuration specific to that UE. Then, when serving another such UE, a new UL/DL TDD configuration needs to be configured to the NCR-MT, and so on. This scheme appears to require frequent UL/DL TDD (re)configurations for the NCR-MT. Moreover, it impacts UEs served directly by the gNB on beams QCL:ed with NCR-MT signals, as those “see” the UL/DL TDD configuration of the NCR-MT. Alternatively, all the UEs served through the NCR should share the same UE-specific UL/DL TDD configuration, which lacks flexibility. We believe more discussions are needed. | |
| Lenovo | Shar same view with Ericsson. UL/DL TDD is for the carrier bandwidth and not for specific channel BW given that the NCR-MT is in-band with F-Link. We are ok with #2-3-1c | |
| CMCC | From our understanding, the forwarded data and the targeted UE and the NCR-MT should belongs to the same cell and under the control of same gNB. Then, the condition part in the option 2-1-1c seems redundant. And from our view, the option 1b and 1c are the same.  If there is thinking to use NCR-MT belongs to cell A to control NCR-RU belongs to Cell B and serving the Cell B’s UE, it should be proposed explicitly and justified.  In our view, the option 2-1-1b is clear enough. | |
| Fujitsu | We share some companies’ view that #2-3-1b is clear enough. | |
| Huawei, HiSilicon | 2-3-1b seems to be sufficient. Even though if C-link and F-link are in same frequency band, their UL/DL TDD configurations are expected to be the same for a practical deployment. | |
| Mediatek | Ok with #2-3-1b, can Ericsson clarify the difference between #2-3-1b and #2-3-1c? | |
| LG | Basically we agree that TDD pattern indicated for NCR-MT is provided for NCR-RU. In that sense, 2-3-1b and 2-3-1c is aligned to our view, and seems 2-3-1c seems clearer to us. | |
| CEWiT | Agree | |
| IIT-K | Support. | |
| Xiaomi | It seems both 2-3-1b and 2-3-1c can guarantee UL/DL TDD configuration of the NCR-MT and the NCR-RU are always same. We prefer 2-3-1c as the frequency domain resource allocation is more clear. | |
| CableLabs | We are fine with 2-1-1b | |
| Charter | We are fine with 2-3-1c because it addresses the multiple CCs scenario. | |
| CATT1 | We are fine with 2-3-1c. but the wording should be modified:  *The UL/DL TDD configuration indicated to the NCR-MT is always applicable to the NCR-RU, provided the cells forwarded by the NCR-RU share TDD pattern with the NCR-MT’s serving cell.* | |
| Samsung | We are OK to consider 2-3-1c as the baseline, assuming single cell or intra-band CA scenario for the ‘passband’ in which the NCR is operating. However, we think more study may be needed based on Rel-17 Repeater design in RAN4 if/when such assumptions do not hold (which can have potential impact on signaling design). Therefore, we propose the following modification:  **Clarification #2-3-1c:** *The gNB can guarantee the UL/DL TDD configuration indicated to the NCR-MT is always applicable to the NCR-RU, provided the cell(s) forwarded by the NCR-RU share TDD pattern with the NCR-MT’s serving cell.*   * *FFS: whether the cell(s) forwarded by the NCR-RU may not share TDD pattern with the NCR-MT’s serving cell, and how to acquire TDD configuration for NCR-RU in such case* | |
| Qualcomm | We also think Clarification #2-3-1b is clear enough.  However, as commented in 9.8.1, it is also important to discuss about the expected behaviour of NCR-RU within “flexible” resources of the indicated UL/DL TDD configuration. | |

#### Summary

According to the discussion, it seems that the gNB can guarantee the UL/DL TDD configuration indicated to the NCR-MT is always applicable to the NCR-RU, the bandwidth of the NCR-MT and the NCR-RU may be different though. Hence, Clarification #2-3-1b is clear enough.

**Proposal #2-3-1:** *The gNB can guarantee the UL/DL TDD configuration indicated to the NCR-MT is always applicable to the NCR-RU.*

(Clarification #2-3-1b in the discussion)

* + 1. Second round

(To improve the efficiency of the discussion, the discussion on Proposal #2-3-1 is merged to 9.8.1. In this meeting, this topic is closed here. Please provide your views in mail thread [109-e-R18-Repeater-02].)

## [Close]Signaling for ON/OFF

* + 1. First round

According to the summary, the moderator suggests the following proposal:

**Proposal #2-4-1**:

* *As for the side control information of ON-OFF for efficient interference management and improved energy efficiency, both dynamic and semi-static indication can be considered for the following reasons:*
  + *Dynamic ON/OFF of the NCR is expected to mitigate interference caused by the NCR, e.g., when the gNB is serving UEs in other directions.*
  + *Semi-static ON/OFF of the NCR is expected to improve the energy efficiency of the NCR, e.g., when no UE needs the NCR’s help.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
| Ericsson | **Support.** It should be clarified that ON/OFF is limited to the repeater’s forwarding function. If OFF is a default state, as some companies propose, ON signaling may be implicitly indicated or configured by indicating or configuring beams. ON in this sense is *any* beam, eliminating the need for dedicated ON/OFF signaling. |
| Nokia | It seems that we need to first address whether on/off control is implicit or explicit before we discuss signaling details of the indication. |
| Intel | Support. |
| NTT DOCOMO | Support in general. On the other hand, we share similar view with Nokia. Because both explicit and implicit indication are considered as candidate option in 9.8.1, maybe it can be clarified in the proposal that the indication may be explicit or implicit. |
| Apple | Similar to Proposal 3-2 in the moderator’s summary for 9.8.1, it should be discussed whether implicit and/or explicit indication for ON-OFF information is considered. And in case of explicit indication, the two options of dynamic and semi-static ON/OFF can be listed. |
| AT&T | Support but agree with Nokia and DOCOMO that details of the signaling depend on whether explicit and/or implicit indication can be supported. |
| vivo | The motivation of semi-static and dynamic on-off can be the same, no need to add the sub-bullets. Moreover, we share view that implicit on-off can be also considered. |
| ZTE | We agree with the proposal. |
| Sony | In principle, support, but we believe that this proposal collides with Proposal 3-1 and Proposal 3-2 in the companion discussion [109-e-R18-Repeater-002]; we suggest to down prioritize the signaling discussion until conclusions on side control information have been reached in [109-e-R18-Repeater-002]. |
| Lenovo | Support the proposal. Efficient interference management in a slot level can be achieved with dynamic ON/OFF information, while energy saving, similar to network energy saving, can be semi-statically indicated with coarse granularity/ large time scale. |
| CMCC | General fine with the proposal. In our view, the 1st priority is to identify the necessary functions in the SI phase. And in this agenda, semi-static and dynamic indication should be identified first to determine L1/L2 signalling or the configuration is needed. And then we can discuss whether to combine the on-off indication with other functions or the indications. |
| Fujitsu | We support the proposal. |
| Huawei, HiSilicon | The benefits of ON-OFF is discussed in 9.8.1, and it should be addressed there. Explicit indication of ON-OFF is unnecessary. We propose to address it in the proposal:  *As for the side control information of ON-OFF for efficient interference management and improved energy efficiency, both implicit and explicit ~~both dynamic and semi-static~~ indication can be considered ~~for the following reasons:~~*   * + *~~Dynamic ON/OFF of the NCR is expected to mitigate interference caused by the NCR, e.g., when the gNB is serving UEs in other directions.~~*   + *~~Semi-static ON/OFF of the NCR is expected to improve the energy efficiency of the NCR, e.g., when no UE needs the NCR’s help.~~* |
| Mediatek | Ok with the proposal. |
| LG | Since whether implicit and/or explicit indication of ON/OFF operation for NCR is being discussed in other agenda item, it is our understanding that this proposal should be revisited after that decision.  On the other hand, we are okay to support both of dynamic and semi-static ON/OFF of the NCR if explicit ON/OFF operation is supported, however it is quite questionable to us why the purpose of dynamic and semi-static ON/OFF is described in this proposal. Further clarification would be grateful. |
| Moderator | Clarification on the difference between the proposal #2-4-1 and the proposal 3-2 in the summary on 9.8.1:  In the moderator’s understanding, from the perspective of signaling design, dynamic ON/OFF indication and semi-static ON/OFF indication can be considered.  ‘Implicit’ and ‘explicit’ are further solutions for dynamic/semi-static signaling. |
| CEWiT | Agree |
| NEC | Agree in general. It would be nice if the ON-OFF information for NCR-MT and NCR-RU are discussed separately. |
| IIT-K | Support. |
| CableLabs | We are supportive to consider both dynamic/semi-static ON/OFF indications, however, example scenarios seem unnecessary. |
| Charter | We support both dynamic and semi-static indication as that gives the system the flexibility to support multiple level of traffic. |
| CATT1 | We prefer to remove the sub-bullet which is not necessary. Does dynamic on-off only benefit interference mitigation? Current wording suggest that. |
| Samsung | We support dynamic ON/OFF and can see its relation with dynamic beam indication.  However, we would like more clarification about the motivation and assumptions for semi-static ON/OFF, for example, the event of “no UE needs the NCR’s help” does not appear to be semi-static.  In addition, more discussion is needed on how to enable dynamic ON/OFF. For example, RAN1 should study how the gNB and/or NCR can determine that the “gNB is serving UEs in other directions” or “when no UE needs the NCR’s help”. For this purpose, we suggest to study signalling to provide gNB with FLS information. So, suggest to add the following:  FFS: methods and signalling about FLS information to enable dynamic ON/OFF (e.g., to determine presence of UEs in the NCR coverage area), including legacy/implementation methods or new control information/signalling. |
| Qualcomm | We support Huawei’s suggested modifications.  There is no need to list the benefits in the proposal. Also, we should first discuss whether any explicit indication is supported. |

#### Summary

In Round 1, following companies are fine (or fine in principle) with the proposal: Ericsson, Intel, NTT DOCOMO, AT&T, ZTE, Sony, Lenovo, CMCC, Fujitsu, Mediatek, CEWiT, NEC, IIT-K, CableLabs, Charter. (15)

The concerns showed by companies:

1. The discussion here may somewhat overlap with the discussion in 9.8.1. It is unclear about the dynamic/semi-static and the implicit/explicit.

2. Whether the benefit/scenario description is needed.

Moderator’s response to the concerns:

1. In the moderator’s understanding, from the perspective of signaling design, dynamic ON/OFF indication and semi-static ON/OFF indication can be considered. ‘Implicit’ and ‘explicit’ are further solutions for dynamic/semi-static signaling. The moderator has no intention to mention any about ‘implicit’ and ‘explicit’ here. It can be further discussed/considered if necessary.

2. The description is for TR preparation.

**Proposal #2-4-1**:

* *As for the side control information of ON-OFF for efficient interference management and improved energy efficiency, both dynamic and semi-static indication can be considered for the following reasons:*
  + *Dynamic ON/OFF of the NCR is expected to mitigate interference caused by the NCR, e.g., when the gNB is serving UEs in other directions.*
  + *Semi-static ON/OFF of the NCR is expected to improve the energy efficiency of the NCR, e.g., when no UE needs the NCR’s help.*

((Same as the proposal in the discussion))

After the first check point, Proposal 2-4-1 has been approved as follows.

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| **Agreement**  For indication of NCR-FU ON-OFF for efficient interference management and improved energy efficiency, both dynamic and semi-static indication can be considered   * FFS: RAN1 to consider whether/how to handle the forwarding of broadcast and cell-specific signals/channels. |

* + 1. ~~Second round~~

#### ~~Proposal #2-4-1~~

~~Proposal 2-4-1 is supported by a clear majority. The moderator suggests continuing the discussion on Proposal 2-4-1 in RAN1 reflector by mail.~~

## [Active]Signaling for power control

* + 1. First round

According to the summary, the moderator suggests the following proposal:

**Proposal #2-5-1**:

* *As for the side control information of power control for efficient interference management, either dynamic or semi-static indication can be considered.*
  + *Option 1: The amplifying gain is indicated to the NCR.*
  + *Option 2: The maximum Tx power is indicated to the NCR*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
| Ericsson | **Partly support.** We fail to see how Option 2 will work together with UE power control without having impact on the legacy UE PC. Hence, in our understanding Option 1 is the only viable solution. |
| Nokia | This can only be discussed if we have agreement that gain/power control will be considered and not down-prioritized. Additionally, when considered it should be clarified if this is intended for UL, DL, or both. |
| Intel | We share same view with Nokia, we’d better first decide whether to down-prioritize power control in 9.8.1. |
| NTT DOCOMO | At this stage, we suggest adding the possibility that both dynamic and semi-static indication are considered.  And we share similar view with Nokia that it should be clarified if the power control is for UL or DL or both. |
| Apple | Similar view as Nokia that first it needs to be agreed if power control indication will be consider or down-prioritized. |
| AT&T | We support the proposal. For Option 2, coexistence with UE PC can be handled if the adaptation time frame is on a much longer time scale or targeted for specific resources |
| vivo | We support the proposal |
| ZTE | We agree with the main bullet of the proposal and can focus on the granularity firstly. Although we prefer semi-static power control, it’s fair to parallel semi-static and dynamic solution given similar support from companies. |
| Sony | We can consider both options. However, we again suggest to down prioritize signaling discussions until conclusions on side control information have been reached in [109-e-R18-Repeater-002]. |
| Lenovo | Fine with the proposal. We prefer option 1 that the PA gain is indicated to the NCR.  We think that power control can also implicitly indicate the ON/OFF information. For example, power control value of 0 indicates OFF state, while any other values indicate ON state. |
| CMCC | Fine with the proposal. For the 2nd option, is it should be the tx power and not the maximum Tx power. Since for the power control procedure, the transmit power is the outcome of the power control functions.   * + Option 2: The *~~maximum~~* Tx power is indicated to the NCR   And whether dynamic or semi-static indication is required depends on the discussion of the NCR functionalities. |
| Fujitsu | We are generally fine with the proposal. However, we would like to suggest one more option as below for consideration. We are not sure whether current Option 1 covers it or not.   * + *Option 3: The maximum amplifying gain is indicated to the NCR* |
| Huawei, HiSilicon | We think that both dynamic and semi-static indication can be considered, rather than down select one from them. For example, both semi-static and dynamic indicate are used together to guarantee a stable power for the NCR RU over the time-varying forwarding links. Thus, the proposal should be revised as:   * *As for the side control information of power control for efficient interference management, ~~either~~ both dynamic and ~~or~~ semi-static indication can be considered.*   + *Option 1: The amplifying gain is indicated to the NCR.*   + *Option 2: The maximum Tx power is indicated to the NCR* |
| Mediatek | Both options 1 and 2 can be considered in our view. However, discussion for this topic can be continued after the proposal 6-1 in AI 9.8.1 is agreed. Besides, we suggest to deprioritize power control for FR2 since we expect less co-channel interference due to narrow beam transmission. |
| LG | It seems duplication of discussion since the identical options is being discussed in agenda item 9.8.1. Furthermore it seems the proposal is about the contents of information rather than the signalling method. It is our understanding that we should focus on signalling perspective in this agenda item. |
| CEWiT | Fine with the proposal. It needs to be clarified if this is for DL/UL/both. |
| NEC | Support generally. And we think it’s too early to limit the indicated parameters as the two options. |
| IIT-K | Support. |
| CableLabs | As power control for interference management is second priority, we like to deprioritize this at this point. |
| Charter | We are fine with both options. But we would like a study done to determine the time constant of this signalling as it may interact with UE power control which may not be beneficial to the network. |
| CATT1 | Need further discussion to agree this one. Gain control seems out of scope. |
| Samsung | The feasibility, motivation, and benefits for NCR power control are not clear to us. We prefer to make progress on the need for power control first (in AI 9.8.1), before discussing necessary signalling. |
| Qualcomm | We do not support.  We should first discuss this in 9.8.1. In case we conclude power control is supported, then we will discuss the associated signalling. |

#### Summary

The controversial points in this discussion are:

1. About the sub-bullet

2. About the priority of the discussion

Maybe, we can try to approve a simple version as follows first, as the first step.

**Proposal #2-5-1**:

* *As for the side control information of power control for efficient interference management, dynamic and semi-static indication can be considered.*
  + 1. Second round

The proposal is update. To put the focus on the main bullet, the sub-bullets are removed.

#### Proposal #2-5-1:

**Proposal #2-5-1**: *As for the side control information of power control for efficient interference management, dynamic and semi-static indication can be considered.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
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#### Summary

(TBD)

# Configuration of L1/L2 signaling for side control information

To receive the L1/L2 signaling, some companies point out that an NCR-MT should at least be able to receive PDCCH and PDSCH from the gNB and obtain the relevant configuration for the reception of PDCCH and PDSCH [LGE, Ericsson, Intel]. Besides, some companies propose that the signaling for side control information can be DCI, UCI, MAC CE, SI etc [ZTE, vivo, LGE, Ericsson, Intel].

Some companies assume the NCR-MT can receive the configuration like a legacy UE when the side control information and the corresponding L1/L2 signaling are discussed in the contributions. Some companies discuss the protocol stack of the NCR-MT and consider a full protocol stack (L1/L2/L3) and a simple protocol stack (L1/MAC) [ZTE, CATT, LGE, Fujitsu]. One company prefers to leave the whole discussion on the NCR architecture/protocol stack to RAN2/RAN3 and proposes that NCR-MT’s features/capabilities are discussed after discussing/deciding about the architecture [Qualcomm]. One company prefers OAM rather than RRC [Nokia].

The moderator agrees that the final decision of the architecture/protocol stack of NCRs should be made by RAN2/RAN3. But considering the tight schedule of the SID, RAN2/RAN3 has only one WG meeting in SI phase. To make RAN1 discussion in SI phase more reasonable, the moderator prefers to confirm that an NCR-MT can receive the necessary configuration.

## [Close]Configuration method

* + 1. First round

According to the summary, the moderator suggests the following proposal.

**Proposal 3-1-1:** *The NCR-MT can obtain the necessary configuration for receiving the L1/L2 signaling of the side control information.*

* *Option 1: The necessary configuration is from RRC.*
* *Option 2: The necessary configuration is from OAM or hard-coded.*
* *Option 3: The necessary configuration is partially configured by RRC and partially configured by OAM or hard-coded.*

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| --- | --- |
| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
| Ericsson | Support, however, we don’t think this is a matter for RAN1 to discuss or decide. |
| Nokia | Support |
| Intel | Support.  Just to clarify, the proposal does not imply RAN1 should decide any options, because this is RAN2’s scope. We only need to conclude by either one of options, the necessary configuration can be obtained. |
| NTT DOCOMO | Support |
| Apple | In principle, we support the proposal, but this discussion should be avoided in RAN1 |
| AT&T | Support the proposal. Even though it is up to RAN2 to decide the signalling details, if necessary L1/L2 parameters are already existing (e.g. in RRC messages), it is useful to identify them and inform RAN2. |
| vivo | We support the proposal and option 1 is preferred. |
| ZTE | We support FL Proposal 3-1-1.  Although we agree that the decision requires the involvement of RAN2, it’s more efficient if RAN1 could list all the possible candidates because RAN1 is the only WG involved in signaling and configuration discussion in SID. In normative phase, RAN2 may further decide to adopt which one to be selected.  From our understanding, Option 1 corresponds to full UE protocol stack, and Option 2/3 correspond to simplified protocol stack. Of course with full stack, the complicated configuration mechanism can have higher flexibility to support the signalling exchanges between gNB and NCR MT. However, considering the deployment scenario (e.g., single hop stationary) and limited requirement for information exchanges (e.g., delivering the necessary side control information), there is possibility to further simplify the configuration of signalling. |
| Sony | Support to discuss all three options. |
| Lenovo | Support the proposal. We are fine with all options. |
| CMCC | Fine with the proposal. Share the similar idea as AT&T, though the detailed signalling design is not RAN1’s scope, but RAN1 should conclude the basic functions and which kind of signallings are required, e.g. L1/L2 or RRC configurations.  From our side, reuse the chipset of UEs could reduce the cost of NCR. And most functions could refer to normal UEs or be reused for the NCR, which also relieve the standard efforts. |
| Fujitsu | Support the proposal. |
| Huawei, HiSilicon | Support |
| Mediatek | We support the proposal and prefer option 1. |
| LG | Support and we are open to discuss for the options |
| CEWiT | Support |
| NEC | Support |
| IIT-K | Support |
| Xiaomi | Support |
| CableLabs | Support |
| Charter | We support Option-1 if cost is not an issue and companies don’t want to do extra standardization work. If cost of NCR becomes non-competitive w.r.t. IAB node then extra standardization work could be taken up to strip down L1/L2/L3 stack to the bare minimum for supporting NCR. OAM or hard-coded configuration may not be very useful in deployment scenarios where the propagation conditions are variable with possibility of blockage such as for FR2. |
| CATT1 | First of the discussion should not happen in ran1. We also want to note that option 1 implies full protocol stack need be to implemented at NCR. |
| Samsung | Support the proposal. Among the options, we prefer Option 1. |
| Qualcomm | We support this proposal, and like some other companies, believe RAN1 should NOT make any related decisions. |

#### Summary

This proposal is in line with the majority view. Almost all companies support this proposal.

The only concern showed by companies is the intention of this proposal.

The moderator would like to clarify that there is no intention to decide or down-select any options. This proposal is used to confirm that an NCR-MT can obtain the necessary configuration.

**Proposal 3-1-1:** *The NCR-MT can obtain the necessary configuration for receiving the L1/L2 signaling of the side control information.*

* *Option 1: The necessary configuration is from RRC.*
* *Option 2: The necessary configuration is from OAM or hard-coded.*
* *Option 3: The necessary configuration is partially configured by RRC and partially configured by OAM or hard-coded.*

(Same as the proposal in the discussion)

This proposal is agreed in the GTW session on May 12. This topic is closed in this meeting.

|  |
| --- |
| **Proposal 3-1-1:**  The NCR-MT can obtain the necessary configuration for receiving the L1/L2 signaling of the side control information.   * Option 1: The necessary configuration is from RRC. * Option 2: The necessary configuration is from OAM or hard-coded. * Option 3: The necessary configuration is partially configured by RRC and partially configured by OAM or hard-coded. |

## [Active]Necessary configurations for L1/L2 signaling

* + 1. First round

The moderator suggests companies to discuss the following proposal from the point of view to accelerate the discussion on the configuration for L1/L2 signaling.

**Proposal 3-2-1:** *For an NCR-MT, the necessary configuration for receiving the L1/L2 signaling of the side control information may contain:*

* *The configurations of PHY channels to carry the L1/L2 signaling:*
  + *The configurations for receiving PDCCH and PDSCH.*
  + *The configurations for transmitting PUCCH and PUSCH, if needed.*
* *The configurations of L1/L2 signaling:*
  + *The configurations for DCI.*
  + *The configurations for UCI, if needed.*
  + *The configurations for MAC CE, if needed.*

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| --- | --- |
| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
| Ericsson | **Clarification needed.** To us, the above configurations can be provided to the repeater-MT just as it is provided for UEs. What may differ is the content carried by the above channels and signals. That will require repeater-specific IEs, DCIs, etc. Such repeater-specific capabilities need to be provided to the gNB ahead of configuration. |
| Nokia | Support. |
| Intel | Support. |
| NTT DOCOMO | Support |
| Apple | Support |
| AT&T | Support |
| vivo | Suppprt |
| ZTE | We support Proposal 3-2-1.  We partially agree with Ericsson that some discussion on repeater specific IE or DCI or RNTI is needed, but it can be separately discussed after the candidates of L1/L2 signaling are stable. E.g. if DCI is decided to carry side control information, we can further discuss whether to introduce NCR specific RNTI, whether to introduce new DCI format, such like that. |
| Sony | We agree with Ericsson. In our view, the NCR-MT behaves like a regular UE. Given the tight timeline for the NCR topic, we suggest assuming that NCR-MT supports a full UE stack. Time can be rather spent discussing new signaling required for the NCR-RU component required to support side control information. |
| Lenovo | We agree with the proposal to list the necessary configuration. We have a minor re-wording to the proposal text as the configuration is for receiving the side control information as well as for the feedback:  *For an NCR-MT, the necessary configuration for ~~receiving~~ the L1/L2 signaling of the side control information may contain:*  For configuration of PHY channels, we think not only physical channel but also physical DL/UL RS such as configuration for CSI-RS, SRS should also be considered.  We also think that an NCR specific DCI format might be needed which carries only repeater related information and omitting all unnecessary information, e.g. decoding/frequency scheduling info. Etc. |
| CMCC | Fine with the proposal.  And share the above companies views that we should focus on the NCR specific functions. And for the NCR-MT, it should at least work as a normal UE. And the control information of NCR-RU could be carried in the control or the data channels of the NCR-MT. |
| Fujitsu | Support the proposal. |
| Huawei, HiSilicon | We think the configurations of PHY channels to carry L1/L2 signalling should reuse the existing R15/R16/R17 configurations for NCR MT.  **Proposal 3-2-1:** *For an NCR-MT, the necessary configuration for receiving the L1/L2 signaling of the side control information may contain:*   * *The configurations of PHY channels to carry the L1/L2 signaling should reuse NCR MT configurations:*   + *The configurations for receiving PDCCH and PDSCH.*   + *The configurations for transmitting PUCCH and PUSCH, if needed.* * *The configurations of L1/L2 signaling:*   + *The configurations for DCI.*   + *The configurations for UCI, if needed.* |
| Mediatek | Support |
| LG | Since the proposal is only for the receiving of L1/L2 signalling, we think modification is needed. To receive L1/L2 signalling, both of DCI and MAC CE is needed. And the channel carrying the DCI and MAC CE would be PDCCH and PDSCH. After receiving PDSCH, MT should report HARQ-ACK via PUCCH. Therefore configurations except for PUSCH in the proposal is needed. One thing we would like to point out is, UCI rather than HARQ-ACK, i.e., SR and CSI payload is not required for receiving L1/L2 signalling. Therefore we propose following modification.  **Proposal 3-2-1:** *For an NCR-MT, the necessary configuration for receiving the L1/L2 signaling of the side control information may contain:*   * *The configurations of PHY channels to carry the L1/L2 signaling:*   + *The configurations for receiving PDCCH and PDSCH.*   + *The configurations for transmitting PUCCH ~~and PUSCH, if needed~~.* * *The configurations of L1/L2 signaling:*   + *The configurations for DCI.*   + *The configurations for UCI (HARQ-ACK only)~~, if needed.~~*   + *The configurations for MAC CE~~, if needed.~~*   On the other hand, whether the NCR-MT reports or not should be discussed for the decision of configuration of PUSCH is needed or not. |
| CEWiT | Agree with the proposal in general.  We think the PUCCH and UCI are necessary, however, the content will be specific to NCR, for e.g., NCR specific feedback for side control information. |
| NEC | Support. |
| IIT-K | We agree with the proposal. And share the same view with above companies regarding focus on the NCR specific functions. |
| Xiaomi | Generally support.  NCR-MT is assumed to be able to support partly UE capability and necessary channels and signalling to support side control functions as discussed in 9.8.1 should be discussed. We are fine with LG’s revision and focus on the necessary channels and signalling. |
| CableLabs | In principal, we are okay to consider downlink channels with FFS on uplink channels/MAC CEs. |
| Charter | We are open to the different configurations for signalling. The DCI in PDCCH and MAC-CE in PDSCH could carry the L1/L2 signalling as a side control information. However, this may require reformatting or mapping the existing DCI format and defining a new MAC-CE specifically for an NCR-MT. |
| CATT1 | *For an NCR-MT, the necessary configuration for receiving the L1/L2 signaling of the side control information may contain*  *🡪At least the following can be considered necessary NCR-MT configuration for receiving L1/L2 signalling of the side control information.*  *(should avoid ‘configuration contain configuration’)* |
| Samsung | Generally OK with the proposal. Suggest to change “may contain” to “at least includes”. |
| Qualcomm | We agree with Ericsson.  Also support Lenovo’s suggested change: “*For an NCR-MT, the necessary configuration for ~~receiving~~ the L1/L2 signaling of the side …*” |

#### Summary

In Round 1, following companies are fine (or fine in principle) with the proposal: Nokia, Intel, NTT DOCOMO, Apple, AT&T, vivo, ZTE, Lenovo, CMCC, Fujitsu, Mediatek, CEWiT, NEC, IIT-K, Xiaomi, CableLabs, Samsung (17).

The concerns showed by companies:

1. ‘Receiving’ in the main bullet is unclear.

2. The clarification on whether the above configurations can be provided to the repeater-MT just as it is provided for UEs.

Moderator’s response to the concerns:

1. Agree. ‘Receiving’ is deleted.

2. The moderator is afraid that the clarification may be relevant to the protocol stack of NCR-MT. The intention of this proposal is to list the potential necessary configurations as a guideline for the discussion in following rounds.

**Proposal 3-2-1:** *For an NCR-MT, the necessary configuration for ~~receiving~~ the L1/L2 signaling of the side control information may contain:*

* *The configurations of PHY channels to carry the L1/L2 signaling:*
  + *The configurations for receiving PDCCH and PDSCH.*
  + *The configurations for transmitting PUCCH and PUSCH, if needed.*
* *The configurations of L1/L2 signaling:*
  + *The configurations for DCI.*
  + *The configurations for UCI, if needed.*
  + *The configurations for MAC CE, if needed.*
    1. Second round

#### Proposal #3-2-1

Proposal 3-2-1 is supported by a clear majority. The moderator suggests continuing the discussion on Proposal 3-2-1 in RAN1 reflector by mail.

***Proposal #3-2-2***

The proposal 3-1-1 is used to confirm that the NCR-MT can obtain the necessary configurations of L1/L2 signaling, i.e. from either RRC or OAM(or hard-coded) as what we agreed. The proposal 3-2-1 is trying to answer the question what kinds of configuration is necessary for L1/L2 signaling. In the following proposal, the Moderator is trying to generally consider the parameters of the necessary configuration for L1/L2 signaling. For example, as the container of L1 signaling, PDCCH is needed. The necessary configuration for PDCCH may include the parameters of CORESET for PDCCH monitoring.

The moderator suggests companies to consider the following proposal to accelerate the progress of this topic. To avoid any unnecessary misunderstanding, the moderator would like to clarify that the parameters of the necessary configuration for L1/L2 signaling can be from RRC/OAM(or hard-coded) as what we already agreed, though similar parameters are configured by RRC in legacy NR. Considering that these parameters for L1/L2 signaling are highly related to PHY channels/signals, in moderator’s understanding, the relevant discussion can be done in RAN1.

**Proposal 3-2-2:** *As for the parameters in the necessary configurations for L1/L2 signaling,*

* *The existing parameters for PDCCH, PDSCH, PUCCH, PUSCH, DCI, UCI and [MAC CE] in legacy NR are the starting point.*

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| Companies are encouraged to share your views. Please directly propose the suggested update if you have any concern. | |
| **Company** | **Comments** |
|  |  |
|  |  |

#### Summary

(TBD)

# Contact information

In order to facilitate the contact between the moderator and delegates, please feel free to add your company/responsible delegates/email information in the following table.

|  |  |  |
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[R1-2204259](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204259.zip) Discussion on L1/L2 signaling for side control information Apple

[R1-2204322](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204322.zip) Discussion on L1/L2 signaling for side control information CMCC

[R1-2204394](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204394.zip) Discussion on L1/L2 signaling for side control information NTT DOCOMO, INC.

[R1-2204533](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204533.zip) Discussion on L1/L2 signaling for side control information LG Electronics

[R1-2204643](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204643.zip) Signaling of control information for NW-controlled repeaters Ericsson

[R1-2204654](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204654.zip) Discussions on L1/L2 signaling for side control information ETRI

[R1-2204689](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204689.zip) L1/L2 control signaling for enabling network controlled repeaters MediaTek Inc.

[R1-2204758](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204758.zip) Discussion on L1/L2 signaling for side control information for NCR CEWiT, IITK

[R1-2204814](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204814.zip) Disucssion on L1/L2 signaling for side control information Intel Corporation

[R1-2205048](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2205048.zip) On L1-L2 signaling for side control information for NCR Qualcomm Incorporated

[R1-2205069](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2205069.zip) Initial view on signaling for Network-controlled repeater Rakuten Moible

[R1-2205086](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2205086.zip) NR network-controlled repeaters receive signaling of side control information Fujitsu Limited

# Appendix

## Company proposals related to ‘Proposal #2-1-1’

### R1-2203237 Discussion on side control information to enable NR network-controlled repeaters ZTE

Proposal 8: The beam indication for the C-link 1&2 can be reused by the F-link 1&2 to ensure the same channel condition of control signaling and backhaul forwarding without extra signaling cost.

Proposal 9: To enable the forwarding of common channel, the beam information can be achieved in static or semi-static way by:

• Configuring the mapping relationship between DL/UL channel & signal and the NCR’s beams

• Indicating the beam information along with the applicable time instant directly

### R1-2203238 Discussion on L1/L2 signaling for side control information ZTE

Proposal 7: The indicated beam for the C-link is recommended to be reused for the F-link 1&2.

Proposal 12: For the dedicated signal forwarding, the dynamic indication of beam information with explicit logic beam indexes along with the applicable time instant is recommended for F-link 3&4.

### R1-2204394 Discussion on L1/L2 signaling for side control information NTT DOCOMO, INC.

Proposal 1: For beamforming of repeater function to gNB, following options can be considered.

− Option1: repeater function to gNB applies beam indicated for UE function. New signaling is not needed.

− Option2: beam of repeater function to gNB is indicated by side control information where an indicated beam can be applicable for a time duration.

### R1-2205085 Side control information for NR network-controlled repeaters Fujitsu

Proposal 2: For network-controlled repeaters, the beam indication of the communication beams can be reused directly for the forwarding beams at gNB side.

 No new side control information of the beam indication of the forwarding beams at gNB side is needed.

### R1-2203579 Discussion on signaling for side control information vivo

Proposal 3: To convey beam control information, both semi-static signaling and dynamic signaling are used.

### R1-2203833 Discussion on L1/L2 signalling for side control information xiaomi

Proposal 1: The beam information for the backhaul link between gNB and NetCon-repeater can be semi-statically configured.

Proposal 2: The beam information for the service link between UE and NetCon-repeater can be dynamically indicated.

### R1-2203134 Discussion on L1/L2 signaling for side control information Huawei, HiSilicon

Proposal 4: If beamforming is supported for NCR, MAC-CE based NCR AC beam activation/deactivation should be studied.

Proposal 5: If beamforming is supported for NCR, DCI based NCR AC beam indication and the timeline should be studied.

### R1-2203354 Discussion on side control information to enable NR network-controlled repeaters Nokia, Nokia Shanghai Bell

Proposal 2.3: Support of dynamic access link beam management is contingent on support for dynamic PDSCH and PUSCH transmission.

### R1-2204258 Potential side control information for NW-controlled repeater Apple

Proposal 2: Support beamforming side control information for NC-Repeater to enable a dynamic beam adaptation for forwarding links.

Proposal 5: Support a dynamic indication of Tx/Rx beams for access link to improve the efficiency and reduce latency.

### R1-2204532 Discussion on side control information for NCR LG Electronics

Proposal 1: Dynamic adaptation of DU-Tx/UL-Rx beam of RU is considered for NCR.

### R1-2204643 Signaling of control information for NW-controlled repeaters Ericsson

Proposal 3 For efficient resource utilization, both semi-static and dynamic signaling of beamforming should be studied.

### R1-2205047 On side control information for network controlled repeaters (NCR) Qualcomm Incorporated

Proposal 6: Support side control info to provide dynamic access-link (UE-side) beamforming configuration

## Company proposals related to ‘Proposal #2-2-1’

### R1-2203237 Discussion on side control information to enable NR network-controlled repeaters ZTE

Proposal 5: The legacy mechanism for DL synchronization by detecting the SSB is applicable for NCR.

Proposal 6: The following timing alignment is proposed for NCR, and no additional spec impact is expected.

‐ NCR C-link: its DL Rx timing (C1) and UL Tx timing (C2) can be determined as for a “UE”.

‐ NCR F-link: ideally, the same timing as NCR C-link is expected

• F-link DL Rx timing (F1) = C-link DL Rx timing (C1)

• F-link DL Tx timing (F3) = F-link DL Rx timing (F1)

• F-link UL Tx timing (F2) = C-link UL Tx timing (C2)

• F-link UL Rx timing (F4) = F-link UL Tx timing (F2)

### R1-2203354 Discussion on side control information to enable NR network-controlled repeaters Nokia, Nokia Shanghai Bell

Proposal 2.6: Support cell search as specified in TS 38.213 as an OTA mechanism for DL timing synchronization for NCR C-plane and F-plane.

### R1-2203476 Discussion on side control information for NR network-controlled repeaters CATT

Proposal 4 Timing information can be obtained by NCR implementation, and is not required to be carried by SCI.

### R1-2204064 Discussion on side control information for network controllable repeater Lenovo

Proposal 7: For timing and TDD configuration, legacy solutions can work without additional enhancement.

### R1-2204394 Discussion on L1/L2 signaling for side control information NTT DOCOMO, INC.

Proposal 5: For timing information, repeater function follows DL/UL boundary of UE function. New signaling for timing information of repeater function is not needed.

### R1-2204532 Discussion on side control information for NCR LG Electronics

Proposal 8: It can be considered that DL-Rx and UL-Tx timing boundary of RU are determined based on DL-Rx/DL-Tx timing boundary of MT without explicit information.

### R1-2204642 Control information for enabling NW-controlled repeaters Ericsson

Proposal 7 Legacy UE UL timing framework has a sufficient granularity and requirements for UEs to be served over repeaters. For that reason, timing is down-prioritized in Rel-18.

### R1-2204643 Signaling of control information for NW-controlled repeaters Ericsson

Proposal 4 No additional timing information is specified unless RAN1 agrees that improved synchronization (TA) is required.

### R1-2204813 Discussion on Side control information to enable NR network-controlled repeater Intel Corporation

Proposal 3: Do not support side control information for timing information.

（Observation 4: Same DL timing/UL TA for NCR MT obtained by legacy way can be applied for DL/UL forwarding by NCR RU.）

### R1-2205047 On side control information for network controlled repeaters (NCR) Qualcomm Incorporated

Proposal 7: A repeater is expected to properly set its DL and UL forwarding time, based on the available information including DL RX timing (e.g., by tracking DLRS like SSBs), NCR-UE’s UL TX timing (e.g., via UL TAC received by NCR-UE), and knowledge about the repeater’s group-delay.

(Observation 9: A repeater uses DL RX timing from the gNB for forwarding DL signals to the UE.

Observation 10: A repeater may leverage the available guard periods, its own timing advance value, and/or knowledge of group delay to properly set its UL forwarding window.)

## Company proposals related to ‘Proposal #2-3-1’

### R1-2203133 Discussion on side control information to enable NR network-controlled repeaters Huawei, HiSilicon

Proposal 7: Only semi-static UL-DL configuration is considered for NCR, e.g., obtained by SIB1 or dedicated RRC configuration.

### R1-2203237 Discussion on side control information to enable NR network-controlled repeaters ZTE

Proposal 3: The indication of TDD UL-DL configuration to NCR in semi-static/static way is recommended

Proposal 4: TDD UL-DL configuration dedicated to NCR is not necessary.

### R1-2203238 Discussion on L1/L2 signaling for side control information ZTE

Proposal 2: At least following approaches to enable the static or semi-static cell-specific TDD configuration for the NCR can be considered.

‐ Indicated via by OAM or hard-coded

‐ Indicated via the SIB1(i.e., TDD-UL-DL-ConfigCommon)

### R1-2203354 Discussion on side control information to enable NR network-controlled repeaters Nokia, Nokia Shanghai Bell

Proposal 2.11: An NCR must be provided updates to its semi-static TDD configuration via its parent gNB if the TDD pattern changes.

### R1-2203476 Discussion on side control information for NR network-controlled repeaters CATT

Proposal 5 UL-DL TDD configuration is important information for NCR, and it can be obtained from at least one of:

• SIB1 of donor gNB

• Side control information

• OAM configuration

### R1-2203579 Discussion on signaling for side control information vivo

Proposal 4: To convey timing/TDD information, at least semi-static signaling is used.

(Regarding timing and TDD, RAN1 should decide whether the repeater needs to know the dynamic TDD information or not. If not, legacy signaling (e.g., SIB) or a new L2 signaling is sufficient for the control.)

### R1-2203833 Discussion on L1/L2 signalling for side control information xiaomi

Proposal 4: Semi-static UL-DL TDD configuration via RRC signalling is supported as the baseline for Net-Con repeater operation.

### R1-2203921 Side control information to enable NR network-controlled repeaters Samsung

Proposal 11: For the UL-DL TDD configuration for the NCR, the legacy UL-DL TDD configuration can be reused as much as possible.

 E.g., the semi-static UL-DL TDD configuration

### R1-2204064 Discussion on side control information for network controllable repeater Lenovo

Proposal 7: For timing and TDD configuration, legacy solutions can work without additional enhancement.

(Therefore, static TDD configuration of UEs served by the repeater would be preferred vs dynamic TDD configuration.)

### R1-2204321 Discussion on Side control information to enable NR network-controlled repeaters CMCC

Proposal 11: TDD configuration is to facilitate the NCR to determine the forwarding direction for each transmission. But the TDD configuration could be acquired by NCR through gNB system information either as a normal UE or by the MT part of NCR.

Proposal 12: The motivation to introduce dynamic TDD into NCR is not strong, since the dynamic TDD may not event used in the gNB which is the parent node of NCR.

### R1-2204394 Discussion on L1/L2 signaling for side control information NTT DOCOMO, INC.

Proposal 4: For UL/DL information, repeater function follows TDD configuration of UE function. New signaling for UL/DL information of repeater function is not needed.

### R1-2204642 Control information for enabling NW-controlled repeaters Ericsson

Proposal 9 There is no need for additional TDD configuration, provided the repeater follows the cell-specific TDD pattern of the gNB.

### R1-2204643 Signaling of control information for NW-controlled repeaters Ericsson

Proposal 5 There is no need for additional TDD configuration provided the repeater follows the gNB TDD pattern.

### R1-2204813 Discussion on Side control information to enable NR network-controlled repeater Intel Corporation

Proposal 2: Do not support side control information for TDD UL/DL configuration.

(Observation 2: For semi-static TDD, NCR can obtain TDD UL/DL configuration by OAM or by SIB1 from gNB.)

### R1-2205047 On side control information for network controlled repeaters (NCR) Qualcomm Incorporated

Proposal 3: Support side control info to provide UL-DL TDD configuration information, especially for the deployments with dynamic TDD (“flexible” resources).

### R1-2203343 Discussion on side control information to enable NR network-controlled repeaters Spreadtrum Communications

Proposal 2: On top of legacy UL-DL TDD configuration, additional signaling should introduced for gNB-Smart Repeater communication.

### R1-2203742 Considerations on L1/L2 signaling for side control information Sony

Proposal 4. The gNB should be able to configure the NCR-MT and NCR-RU with independent UL/DL TDD patterns.

Proposal 5. For side control UL/DL TDD information, consider L2/MAC CE signaling to configure an UL/DL TDD pattern compatible with cell-specific UL/DL TDD configuration. Also, consider L1/DCI signaling to configure UL/DL TDD patterns to enforce UE-specific UL/DL TDD configurations.

## Company proposals related to ‘Proposal #2-4-1’

### R1-2203237 Discussion on side control information to enable NR network-controlled repeaters ZTE

Proposal 13: Support at least large time scale ON-OFF configuration on the whole forwarding link for NCR.

Proposal 14: Finer granularity of ON-OFF information, e.g. slot level and link level configuration, can also be considered for NCR forwarding links

### R1-2203238 Discussion on L1/L2 signaling for side control information ZTE

Proposal 13: At least semi-static on-off configuration is beneficial and recommended for NCR forwarding links with following options:

• Option 1: Explicit indication based on periodicity configuration

• Option 2: Implicit on-off information based on discontinuous forwarding(DF) mode or association to the common channel

Proposal 14: Dynamic on-off indication can also be considered with following options:

• Option 1: Explicit indication with new DCI field

• Option 2: Implicit indication by re-interpreting existing DCI field

### R1-2203742 Considerations on L1/L2 signaling for side control information Sony

Proposal 7. For side control ON/OFF information, both L1/DCI and L2/MAC CE signaling can be considered. For example, MAC CE commands can configure and activate periodic activity patterns and pre-configure a set of aperiodic activity patterns. DCI signaling can activate aperiodic activity patterns at specific slots or OFDM symbols.

### R1-2204532 Discussion on side control information for NCR LG Electronics

Proposal 4: Dynamic ON/OFF switching of RU is considered for NCR.

### R1-2204642 Control information for enabling NW-controlled repeaters Ericsson

Proposal 10 Study semi-static and dynamic repeater-Fwd ON/OFF for interference mitigation.

### R1-2205047 On side control information for network controlled repeaters (NCR) Qualcomm Incorporated

Proposal 4: Support side control info to provide dynamic ON-OFF information.

### R1-2203343 Discussion on side control information to enable NR network-controlled repeaters Spreadtrum Communications

Proposal 3: DRX procedure could be regarded as a starting point for the study of on-off information for smart repeater.

### R1-2203578 Discussion on side control information to enable NR network-controlled repeaters vivo

Proposal 10: ON-OFF indication for network-controlled repeater should be supported, at least based on the semi-static pattern.

### R1-2203579 Discussion on signaling for side control information vivo

Proposal 5: To convey on-off information, at least semi-static signaling is used.

### R1-2204258 Potential side control information for NW-controlled repeater Apple

Proposal 6: Study potential DRX functionality extension for NC-Repeater to reduce power consumption.

## Company proposals related to ‘Proposal #2-5-1’

### R1-2203354 Discussion on side control information to enable NR network-controlled repeaters Nokia, Nokia Shanghai Bell

Proposal 2.17: Dynamic DL gain control is not considered for Rel-18 NCR.

Proposal 2.18: Dynamic UL gain control is either not considered or managed via implementation for Rel-18 NCR.

### R1-2203133 Discussion on side control information to enable NR network-controlled repeaters Huawei, HiSilicon

Proposal 10: Dynamic control of amplifying gain in both UL and DL is beneficial for NCR operation.

### R1-2203134 Discussion on L1/L2 signaling for side control information Huawei, HiSilicon

Proposal 3: If power control is supported for NCR, RRC-based NCR amplifying gain configuration should be studied.

Proposal 6: If power control is supported for NCR, DCI based NCR amplifying gain indication and the timeline should be studied.

### R1-2203237 Discussion on side control information to enable NR network-controlled repeaters ZTE

Proposal 15: Power control information can be applicable for both UL and DL forwarding links.

### R1-2203238 Discussion on L1/L2 signaling for side control information ZTE

Proposal 16: The power control parameter (e.g. amplified gain or maximum output power) for the F-link of NCR can be configured in static/semi-static via L2 signalling.

### R1-2204393 Discussion on side control information to enable NR network-controlled repeaters NTT DOCOMO, INC.

Proposal 8: Study UL Tx power control for NW-controlled repeater for mitigate interference.

### R1-2204653 Discussions on side control information for network-controlled repeater ETRI

Proposal 6. RAN1 to support dynamic repeater gain/power control via SCI.

### R1-2205068 Initial view on Network-controlled repeater Rakuten Moible

Proposal 4: For power control to the link between repeater and donor gNB, study semi-static/static power setting for further study.