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

e-Meeting, May 9th – 20th, 2022

Source: Moderator (ZTE)

Title: Summary of AI 9.8.1 on Side control information to enable NCR

Agenda Item: 9.8.1

**Document for: Discussion and Decision**

# **Introduction**

In RAN1#109e meeting, the SI on NCR is initialized. According to the companies’ inputs, discussion on following essential aspects are summarized as below:

* Modelling and terminology of NCR
* Side control information: Beam information
* Side control information: ON-OFF information
* Side control information: TDD information
* Side control information: Timing information
* Side control information: PC information

Companies are encouraged to provide the inputs for corresponding topics.

# **Topic-1: Modelling and terminology of NCR**

As mentioned by companies that the terminology along with the reference modelling of NCR should be defined for this SI to facilitate the discussion. Based on the views shared by many companies e.g., contribution from [Huawei, ZTE, vivo, Sony, Samsung, Lenovo, CMCC, DoCoMo, LG, Ericsson, ETRI, QC] with corresponding illustration, compared to the legacy RF repeater, additional component to enable the communication between gNB and NCR to receive the control information is also needed. Regarding the protocol structure of this component, since it’s mainly determined by the design of side control information and others, it’s better to consolidate it later and according to the scope of this SI, supports of L1/L2 functionality can be the baseline. Then, the following including the modelling of network controlled repeater, definition of functionality and terminology are proposed by FL:

***Proposal 1-1:*** *Recommend to capture the following model of network-controlled repeater in TR 38.867.*



* *The NCR-MT is defined as a component to maintain the Control link (C-link) between gNB and NCR to enable the information exchanges (e.g., side control information). The C-link is based on NR Uu interface and in same frequency band as Forwarding-link (F-link as described below).*
* *The NCR-RU is defined as a component to perform the analog pass-through of all data between gNB and UE via F-link for backhaul (FLB) and F-link for service (FLS). The behavior of F-link will be controlled according to the received side control information from gNB.*
* *Note: As the baseline, the L1/L2 functionality is assumed be supported by the NCR-MT and the detailed protocol structure of NCR-MT will be further discussed.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

Meanwhile, regarding the reference structure (e.g., RF structure) for the NCR, as mentioned by companies, in general, either same or different RF component can be used at NCR side for C-link and FLB. And as highlighted by others, e.g., vivo, it’s better to ensure the QCL-relationship between C-link and FLB. Then, the following is proposed:

***Proposal 1-2:*** *Recommend to capture the following assumption of network-controlled repeater in TR 38.867.*

* *As the baseline, same RF component at NCR side is used for C-link and FLB.*
	+ *If dedicated RF components are used (e.g., antenna) at NCR side for C-link and FLB, respectively, these RF components should be co-located to ensure the quasi collocation relationships between C-link and FLB.*
* *Different RF components are used at NCR side for the gNB-NCR link (including C-link and FLB) and NCR-UE link (i.e., FLS).*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

In addition, some companies highlights that clarification on the operation between different links with different functionality and direction (e.g., gNB and NCR) is needed. Then, from FL’s perspective, following assumption seems to be reasonable:

***Proposal 1-3:*** *Recommend to capture the following assumption of network-controlled repeater in TR 38.867.*

* *The C-link and FLB in DL (from gNB to NCR) can be performed simultaneously or in TDM way.*
* *As the baseline, the C-link and FLB in UL (from NCR to gNB) is performed in TDM way.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

# **Topic-2 Beam information**

## **Company view (Round-1)**

For the beam information, as mentioned by majority that introduction of beam information as one side control information is beneficial for NCR operation and [HW, ZTE, vivo, Apple, LG, ETRI, MTK, Intel, DoCoMo] highlights that it is at least to control the beam at NCR side for FLS. In addition, the performance improvement after the introduction of the beam information is also further justified by the simulation results from [ZTE, vivo, Samsung, ETRI, QC] as below:

* [Source-1, ZTE] shows that the NCRs with beam information can improve the SINR performance, especially for the UE at 5%-tile, 50%-tile of CDF. Meanwhile, compared to the legacy RF repeater, the additional interference can be mitigated for the UE above 95%-tile of CDFs.
* [Source-2, vivo] shows that when the RU beam is fixed to set towards the cell edge, the SINR performance of the UEs is improved compared with the case when there is no repeater. Especially for the cell edge UE, SINR gain is 2.3 dB for the 10% UE with the worst SINR. When the RU beam is set dynamically towards the serving UE, the SINR performance of the UEs is further improved compared with the case of the fixed RU beam. Especially for the cell edge UE, SINR gain is about 6.3 dB for the 10% UE with the worst SINR.
* [Source-3, Samsung] shows that by introducing repeaters applying beamforming, 2.34 dB, 6.15 dB, and 6.53 dB gain can be achieved at 5%-tile, 50%-tile, and 95%-tile CDFs of the SINR compared to the NR system without repeaters, respectively. In addition, 2.03 dB, 5.18 dB, and 6.53 dB gains at 5%-tile, 50%-tile, and 95%-tile CDFs of the SINR can be achieved compared to the NR system with legacy repeaters, respectively.
* [Source-4, ETRI] shows that performance gain on SINR can be achieved by introducing semi-static repeater gain/power configuration, and additional performance gain can be achieved by introducing dynamic repeater gain/power configuration. More than 5 dB gain can be further achieved by using large SCI payload for beam control for large repeater-RU antenna configuration.
* [Source-5, QC] shows that Adaptive access-link (UE-side) beamforming will offer significant performance gain by providing a larger beamforming gain and reducing the interference (due to use of narrower beams), e.g., the median SINR can improve by 11dB.

[Charter Communication] also proposed to indicate the null information along with beam information.

Then, followings are proposed from FL’s perspective:

***Proposal 2-1*** *Beam information is beneficial and recommended as the side control information for network-controlled repeater to control the behaviour of NCR-RU*

* *FFS: Detailed mechanism of indication.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

More specifically, to enable the proper indication of beam information in the side control information, details, e.g., beam management procedure for each links, are also highlighted:

* ***gNB-NCR link (including control link and FLB)***

As mentioned by companies that clarification on the beam assumption at NCR side for the gNB-NCR link (i.e., FLB and C-link) is needed, e.g., static beam only or configurable beam. In addition, supports on the adaptive beam is highlighted by [Ericsson, CMCC, QC] with consideration on the potential beneficial for the low-height deployment of NCR [CMCC, QC].

Regarding the determination/indication of the beam information at NCR side for FLB and C-link, most companies prefer to assume same beam for these two links, but dedicated indication via side control information is also preferred by others.

Then, following proposal is recommended from FL:

***Proposal 2-2:*** *Both fixed beam and adaptive beam can be considered at NCR side for gNB-NCR link (i.e., C-link and FLB)*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

***Proposal 2-3:*** *Following options can be considered to determine the beam at NCR side for FLB:*

* *Option-1: The beam information is indicated via the side control information from gNB.*
* *Option-2: The same beam as the C-link is assumed.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

* ***NCR-UE link (i.e., FLS)***

The benefits to enable the beam information for the FLS have been justified by majority companies. Regarding the detailed mechanism on the determination and indication of this information, as mentioned by companies that solutions to indicate the beam to forward the cell-specific signal and UE-specified signal should be further discussed. In addition, at least, the dynamic indication is also highlighted companies for the FLS to forward the UE-specific signal [ZTE, vivo, QC, Apple].

Then, from FL’s side, following is proposed:

***Proposal 2-4:*** *At least the dynamic indication can be considered for the beam of FLS at NCR side*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

* ***Others***

Additional aspects related to the determination and indication of beam information are also proposed by companies. For example:

1. Regarding how to represent the beam information, potential solutions, e.g., introduce a new beam ID, reference signal ID, enhanced TCI states or time domain resource identifier, are proposed by companies [HW, ZTE, Samsung, vivo, Spreadtrum, LG, Fujitsu, Apple]. In these way, mapping between notation and NCR beam should be indicated by gNB to NCR. Also, different ways to map the SSB to NCR’s beam with potential indication are also mentioned [CMCC, ZTE, CableLabs, HW].

For this point, it’s valid issue from FL’s perspective and we can initialize the discussion by taking the above options as starting point.

1. Regarding the NCR capability, e.g., the supported number of beam [CATT, HW], boresight of antenna array and beam direction of NCR’s antenna for FLS link [ETRI] or antenna array configuration (e.g., using <N1, N2, O1, O2> structure) to the gNB [ETRI]. Meanwhile, the corresponding report of beam related capability is also proposed.

For this point, from FL’s perspective, the decision of NCR capability including the details on report can be handled in the normative phase later.

1. To avoid the auto-excitation of NCR, companies [vivo, CMCC] propose to study the necessity to introduce some methods, e.g., beam restriction, to alleviate the potential interference.

For this point, from FL’s perspective, this issue is addressed by implementation for legacy RF repeater and similar way is also applicable for NCR. But companies are also encouraged to check if additional solutions are needed.

1. Some companies also mentions that the study on the beam management to optimize the NCR beam for either FLB or FLS is needed [ETRI, Intel] with consideration on the signaling overhead, latency and complexity. From FL’s perspective, companies are encouraged to check if additional solution should be defined.

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

# **Topic-3 ON-OFF information**

## **Company view (Round-1)**

For the ON-OFF information, as mentioned by majority that introduction of ON-OFF information for NCR is beneficial. In addition, the performance improvement after the introduction of the ON-OFF information is also further justified by the simulation results from [ZTE, vivo, Samsung, QC] as listed below:

* [Source-1, ZTE] shows that NCRs with ON-OFF information can mitigate the interference for high SINR UEs while maintain the performance of low SINR UEs, and also ON-OFF information can provide efficient interference management in FR1.
* [Source-2, vivo] shows that about 9.8dB gain can be achieved for the 10% tile UEs on the SINR performance after introducing ON-OFF indication.
* [Source-3, Samsung] shows that additional gain is observed for the repeater by both applying beamforming and on/off management compare to the NR system with the repeater only applying beamforming.
* [Source-4, QC] shows that about 2 dB gains on median SINR can be achieved by introducing dynamic on-off information.

Then, followings are proposed from FL’s perspective:

***Proposal 3-1*** *ON-OFF information is beneficial and recommended as the side control information for network-controlled repeater to control the behaviour of NCR-RU.*

* *FFS: Detailed mechanism of indication.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

More specifically, to enable the indication of this information and how to perform the on/off by NCR-RU/MT, detailed solutions in either explicit (e.g., directly indication of ON/OFF state by dynamic [LG, QC, CMCC] or pattern-based signal [Sony, ZTE, vivo]) or implicit way (e.g., coupled with PC information or time domain resource allocation for NCR) is proposed.

Meanwhile, introducing the additional rule/criteria [Panasonics, Charter Communication] are also mentioned, e.g., taking the OFF as default state or the coverage of broadcast channels should not be impacted by NCR RU OFF [HW]. Potential extension of DRX procedure to control the on-off state of NCR-RU is also mentioned by [vivo, Spreadtrum, Apple, Ericsson, Fujitsu].

From FL’s perspective, we can start with the discussion by taking the above solution as potential options with following proposal:

***Proposal 3-2:*** *The ON-OFF information can be indicated to NCR by gNB with following options:*

* *Option 1: Explicit indication with the dynamic signalling or semi-static signal*
* *Option 2: Explicit indication with the on-off pattern*
* *Option 2: Implicit indication with the signalling of beam or PC information*
* *Option 4: Implicit indication with the extension of DRX procedure to NCR RU*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

# **Topic-4 TDD configuration**

## **Company view (Round-1)**

For the TDD configuration, many companies share the views that it’s necessary to let the NCR be aware of TDD UL/DL configuration. And this information is required to determine proper DL and UL forwarding in the similar way as legacy RF repeater [Nokia, ZTE, CMCC, CAICT, Qualcomm, Samsung, Intel]. Then, FL think it is necessary to identify TDD UL/DL configuration is needed for NCR in the TR.

Meanwhile, regarding details of TDD configuration, especially for the granularity of this information in time domain, following views are shared by companies:

* Option 1: Static DL/UL configuration [ZTE, CATT, Intel, Qualcomm]
* Option 2: Only semi-static DL/UL configuration [Huawei/HiSilicon, ZTE, Nokia/Nokia Shanghai Bell, Xiaomi, Lenovo, Samsung, CMCC, MediaTek, Intel, Ericsson, CATT, KDDI] with following reasons:
* In practical networks, dynamic TDD is rarely used and it would increase the chance of cross-link interference. [Huawei, ZTE, CMCC, Lenovo, Xiaomi, Intel, Ericsson, KDDI]
* For NCR, the coverage area is much smaller and hence a smaller number of covered UEs. Therefore, only a small portion of the overall time resources are expected to be required by the UEs connected via NCR. [Huawei]
* An NCR has higher energy efficiency and lower overhead if it is only ON in the semi-static UL and DL time, due to less dynamic UL-DL indication. [Huawei]
* Dynamic TDD is not strictly necessary although it can increase network flexibility at the cost of increased NCR signalling overhead, complexity and cost. [ZTE, Nokia, vivo]
* With consideration on the additional processing time and potential DL-UL switching time, the benefits for dynamic TDD is meaningless for the resource usage. [ZTE, Intel]
* To investigate the additional benefit due to the dynamic SFI, a model is needed for self-interference coupling across different DL/UL directions. Given the limited time for SI phase, suggest to not consider L1-signaling for dynamic TDD configuration for NCR in Rel-18.[MediaTek]
* Option 3: Both dynamic and semi-static DL/UL configuration [LGE, Qualcomm, vivo] with following reasons:
* Supporting dynamic TDD for Rel-18 NCR would be beneficial in terms of efficient resource utilization and short latency. [LGE, vivo]
* Dynamic change of the UL-DL information can better adapt to the traffic pattern while causing complicated interference problem. [Xiaomi]

In addition, according to the simulation results from [QC], about 4.5 dB gain on median SINR can be achieved by introducing TDD-awareness as listed below:

* [Source-1, QC] shows that a TDD-aware repeater (i.e., with full information about UL-DL TDD configuration) has a superior performance compared to a repeater that forwards signals blindly in both DL/UL directions with increased coverage (e.g., by ~10%), and improved the throughput (e.g., a median SINR improvement of ~4.5dB).

Then, from FL’s perspective, followings are proposed:

***Proposal 4-1:*** *At least semi-static TDD UL/DL configuration is needed for network-controlled repeater to ensure the proper DL/UL behavior.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

In addition, regarding whether to introduce additional TDD DL/UL configuration into side control information, different views are shared by companies as below:

* Side control information: [Spreadtrum, Sony, Charter, CableLabs, CEWiT/IIT-K, Sharp, Qualcomm].

In this way, as commented by companies, some benefits can still be achieved, e.g., introduction of NCR-specific TDD pattern as side control information to avoid limiting the deployment [Charter].

* Reuse the legacy configuration for UE in Rel-17:[Intel, ZTE, Ericsson, Fujitsu]

In this way, companies think that it seems sufficient that NCR obtains TDD UL/DL configuration simply by receiving cell broadcast information. NCR switches to DL/UL chain for DL and UL symbols and NCR could stop forwarding and prepare for switch in flexible symbol. Therefore, there is no motivation to transmit TDD UL/DL information by side control information.

From FL’s perspective, this aspect related to the detailed signalling design can be handled in AI 9.8.2 by taking above two as candidate solutions.

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

# **Topic-5 Timing information**

## **Company view (Round-1)**

For this topic, according to the views of most companies, regarding the timing alignment for DL/UL transmission of NCR for both C-link and forwarding link (including FLB and FLS), following three assumptions are proposed:

* Option 1: The UL and DL timings of the NCR-RU are aligned with the DL timing of the NCR-MT [Samsung]
* Option 2: The DL timing of the NCR-RU is aligned with the DL timing of the NCR-MT. The UL timing of the NCR-RU is aligned with the UL timing of the NCR-MT. [Huawei/HiSilicon, ZTE, Nokia/Nokia Shanghai Bell, Intel, Ericsson, Samsung, CMCC]

Meanwhile, if the internal delay of NCR-RU (e.g., group delay) is not negligible, the corresponding impacts should also be considered to determine the boundary, i.e., the DL Tx timing of NCR-RU is based on the the DL Rx Timing and internal delay of NCR-RU; The UL Rx timing of NCR-RU is based on the UL Tx timing of NCR-MT/RU and internal delay of NCR-RU [LGE, Qualcomm]

However, two companies [Ericsson, ZTE] think any possible internal delay can be handled by implementation, more companies think it should be taken into consideration.

* Option 3: The UL and DL timings of NCR-RU are aligned with the DL timing of gNB [Samsung]

For these solution,

* In Option 1, to achieve the alignment of UL and DL timing of NCR-RU, it seems that the UE need to compensate the TA between NCR and UE. However, since the NCR is transparent to the UE, the UE can neither know a propagation delay between itself and the NCR nor a TA to be compensated for its UL transmission to the NCR. The above assumption may not be applicable and the UE can only maintain one global TA. Meanwhile, all of timings of the NCR-RU are aligned with the DL Rx timing of the NCR-MT. The DL Tx timing and the UL Rx timing at the gNB side is not aligned. Thus the timing of the NCR-RU UL Tx signals arriving at the gNB side cannot be aligned with the timing of other UL signals from the NCR-MT and other gNB-served UEs. It will cause resource collision and interference.
* In Option 2, the timing of NCR-RU mainly follows the timing of NCR-MT. And regarding the DL/UL of NCR-RU part, it's aligned with the assumption of legacy RF repeater.

Regarding the impacts of internal delay of RU, it can also be handled in the similar way as legacy repeater without spec impact.

* In Option 3, it has similar problems as Option 1. The misalignment of received UL signals at the gNB side from NCR-RU, NCR-MT and other gNB-served UEs will cause interference. It is difficult to ensure that NCR-RU UL Rx is aligned with NCR-RU DL Tx as the NCR is transparent to the UE. In addition, Option 3 also requires the NCR to have the function of caching and can control the forwarding time of NCR RU, which will increase delay, complexity and cost.

Then, from FL’s perspective, Option-2 is proposed:

***Proposal 5-1:*** *For the timing of NCR, the following assumption is considered as baseline:*

* *The DL timing of the NCR-RU is aligned with the DL timing of the NCR-MT.*
* *The UL timing of the NCR-RU is aligned with the UL timing of the NCR-MT.*

*FFS: the impact of internal delay of NCR-RU.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

In addition, regarding the DL/UL timing determination of the NCR-MT, following options are summarized

* Option 1: the same as normal UE, e.g. obtained by SSB measurement [Huawei, ZTE, vivo, Lenovo, Samsung, Nokia/Nokia Shanghai Bell, CATT, Intel, KDDI, Spreadtrum]
* Option 2: timing information is included in side control information or derived from the channel carrying the side control information [Spreadtrum, Sony]
* Option 3: Based on the implementation during the deployment [Spreadtrum]

According to the above summary, it’s clear that majority prefer to reuse legacy timing mechanisms for NCR-MT. And from FL’s perspective, since the NCR-MT at least has the capability to process the L1/L2 signalling, it’s reasonable to reuse the legacy mechanism and the following proposal is recommended:

***Proposal 5-2:*** *The determination of DL/UL timing for NCR-MT follows the legacy timing mechanism in Rel-17.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

# **Topic-6 Power control information**

## **Company view (Round-1)**

For the power control information, although it’s proposed as the 2nd priority in this SI, many companies [Huawei, ZTE, Spreadtrum, vivo, NEC, Lenovo, Charter, DCM, CMCC, Panasonic, ETRI, CEWiT, AT&T, Rakuten Moible] still prefer to support this feature for NCR. [Ericsson] also highlights that study on gain control and associated signaling is needed for self-interference management due to repeater oscillation. The benefits of this information is also justified by the simulation results from [Huawei, vivo, ETRI] as listed below:

* [Source-1, Huawei] shows that for the uplink transmission via NCR, a fixed NCR amplifying gain may lead to interference to the gNB or NCR UL coverage loss. For the downlink transmission via NCR, a fixed NCR amplifying gain may lead to NCR RU saturation or NCR DL coverage loss.
* [Source-2, vivo] shows that the optimal system performance can be achieved when repeater’s gain is set to a proper value.
* [Source-3, ETRI] shows that dynamic repeater gain/power control can provide additional SINR gain over semi-static repeater gain/power configuration.

However, others [CATT, LG, Samsung, CAICT, MTK, KDDI, Qualcomm, Fujitsu] prefer to deprioritize the discussion.

Then, from FL’s perspective, following is proposed:

***Proposal 6-1*** *Power control information is beneficial for network-controlled repeater to control the behaviour of NCR-RU.*

* *FFS: Detailed mechanism of indication.*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

In addition, regarding on the detailed solution for PC information indication, as mentioned by [CMCC, QC, ZTE, ETRI, HW], controlling of either amplifying gain or transmission power can be considered. Then, from FL’s perspective, following is proposed as starting point.

***Proposal 6-2:*** *The following options can be considered to enable the power control of NCR*

* *Option-1: Amplifying gain control*
* *Option-2: Transmission power control*

Companies are encouraged to share your views and if there is concern, please directly propose the corresponding updates.

|  |  |
| --- | --- |
| Companies | Comments and Views |
|  |  |
|  |  |

# **Proposals for discussion at GTW sessions**

# **Conclusion**

# **Appendix**

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

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

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

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

R1-2203376 Discussions on side control information to enable NR network-controlled repeaters InterDigital, Inc.

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

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

R1-2203697 Discussion on side control information for network-controlled repeaters NEC

R1-2203741 Considerations on side control information to enable NR network-controlled repeaters Sony

R1-2203832 Discussion on side control information to enable NR network-controlled repeaters xiaomi

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

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

R1-2204066 Side Control Information for Network-Controlled Repeaters Charter Communications, Inc

R1-2204086 Side Control Information for supporting initial access CableLabs

R1-2204119 Side control information for network-controlled repeaters SHARP Corporation

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

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

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

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

R1-2204565 Discussion on side control signals for network-controlled repeaters Panasonic

R1-2204610 Discussion on side control information to enable NR network-controlled repeaters CAICT

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

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

R1-2204688 Side control information for network-controlled repeaters MediaTek Inc.

R1-2204757 Discussion on Side control information to enable NR network-controlled repeaters CEWiT, IITK

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

R1-2204847 Discussion on side control information to enable NR network-controlled repeaters KDDI Corporation

R1-2204864 Side control information to enable NR network-controlled repeaters AT&T

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

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

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