3GPP TSG-RAN WG2 #110-e R2-20xxxxx

Electronic Meeting

Agenda Item: 5.4.3

Source: OPPO

Title: [AT110e][018][NR15] UE cap NE-DC and NGEN-DC (OPPO)

Document for: Discussion, Decision

# 1 Introduction

This document is to kick off the following email discussion:

[AT110e][018][NR15] UE cap NE-DC and NGEN-DC (OPPO)

Scope: Treat R2-2004313, R2-2004470, R2-2004472, R2-2004471, R2-2004473, R2-2004821, R2-2004822, R2-2004396, R2-2004397, R2-2004398, R2-2004399, R2-2004400, R2-2004823, R2-2004405 (proponents are responsible to explain and drive)

Part 1: Decision whether to make corrections or not, identify agreeable corrections. Deadline: June 4, 0700 UTC.

Part 2: For agreeable parts, continuation to agree CRs. Deadline: June 10, 0700 UTC

# 2 Discussion

Companies are requested to add their comments for each of the treated CRs of this email discussion in the boxes below (one for each CR to be treated).

### 2.1 Introduction of extended capabilities for NE-DC only BCs (*R2-2004470, R2-2004472, R2-2004396*) in TS 38.331

RAN2 discussed this issue during RAN2#109e meeting, and an LS is sent to RAN1 to clarify whether *dl-1024QAM-TotalWeightedLayers* (included in *supportedBandCombinationList-v1570*) an *fd-MIMO-TotalWeightedLayers* (included in *supportedBandCombinationList-v1560*) can be signaled for NE-DC.

Taking into account RAN1’s reply LS in R2-2004313 (R1-2002793). In the related contributions, the proposal is to

1. Add the *supportedBandCombinationListNEDCOnly-v15xy* field to the *RF-ParametersMRDC*, includes the extended features (i.e., *BandCombinationList-v1540/v1560/v1570/v1580/v1590*) for the NE-DC only BCs. And update the field description of *BandCombinationList-v1540/v1560/v1570/v1580/v1590*.

2. Update the field description of *supportedBandCombinationList* in *RF-ParametersMRDC*, clarify it applies to (NG)EN-DC only BC, or BC that supports both (NG)EN-DC and NE-DC.

Please note that the *R2-2004470* and *R2-2004472* are for Rel-15 capability, while *R2-2004396* is for Rel-16 capability.

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| *Company* | *Agree/Disagree with the necessity of CR to address the issue* | *Comments on the detailed content of the CR* |
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### 2.2 Applicability of UE MIMO capabilities for NE-DC (*R2-2004471, R2-2004473, R2-2004821, R2-2004822*) in TS 36/38.306

Based on RAN1’s reply LS in R2-2004313(R1-2002793), RAN1 confirms that the features of *dl-1024QAM-TotalWeightedLayers* and *fd-MIMO-TotalWeightedLayers* can be signaled to the LTE part of NE-DC case.

In the contributions of *R2-2004471* and *R2-2004473*, the proposal is to capture this in TS 38.306, while in the contribution of *R2-2004821* and *R2-2004822,* the proposal is to capture this in TS 36.306.

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| *Company* | *Agree/Disagree with the necessity of CR to address the issue* | *Comments on the detailed content of the CR* |
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### 2.3 Clean-up of ***L1*** features for NGEN-DC and NE-DC (*R2-2004397, R2-2004398*) in TS 38.306

Triggered by LS of *R2-2002221* and LS-reply in *R1-2002792*, RAN1 further clarify the support of NGEN-DC/NE-DC has no difference comparing with EN-DC, as clarified in a previous LS R1-1814106

Agreement:

The LS is agreed with the following replacements for the answers to questions Q4 and Q5.

* Answer for Q4: There are no physical layer features that are dependent on whether NGEN-DC or EN-DC is deployed. From RAN1 perspective, assuming there is no difference in which features are mandatory/optional between NGEN-DC and EN-DC and not considering IODT aspects, the UE capabilities for NGEN-DC can re-use all reported EN-DC capabilities. If IODT aspects are considered, it is possible that different features may be deployed for NGEN-DC and EN-DC and the band combinations or deployed functionality in the set of band combinations that are used/tested may be different, in which case, some IODT differentiation may be necessary. Decisions regarding IODT aspects should be made at the RAN plenary.
* Answer for Q5: There are no physical layer features, other than dynamic power sharing, that are dependent on whether NE-DC or EN-DC is deployed. From RAN1 perspective, not considering IODT aspects, the UE capabilities for NE-DC can re-use all reported EN-DC capabilities, except that for dynamic power sharing. If IODT aspects are considered, it is possible that different features may be deployed for NE-DC and EN-DC and the band combinations or deployed functionality in the set of band combinations that are used/tested may be different, in which case, some IODT differentiation may be necessary. Decisions regarding IODT aspects should be made at the RAN plenary.

For RAN1 features, as clarified by RAN1, it is suggested to clarify the support of NGEN-DC and NE-DC as well, except for dynamic power control. I.e., there is no need to differentiate the support of (NG)EN/NE-DC types for L1 features. The related contributions (*R2-2004397, R2-2004398*) are to clarify that in TS 38.306.

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| ***ca-ParametersEUTRA***  Contains the EUTRA part of band combination parameters for a given (NG)EN-DC/NE-DC band combination. |
| ***ca-ParametersNR***  Contains the NR band combination parameters for a given (NG)EN-DC/NE-DC and/or NR CA band combination. |
| ***mrdc-Parameters***  Contains the band combination parameters for a given (NG)EN-DC/NE-DC band combination. |
| ***dl-1024QAM-TotalWeightedLayers***  Indicates total number of weighted layers for the LTE part of the concerned (NG)EN-DC/NE-DC band combination the UE can process for 1024QAM, as described in TS 36.306 [15] equation 4.3.5.31-1. Actual value = (10 + indicated value x 2), i.e. value 0 indicates 10 layers, value 1 indicates 12 layers and so on. For an (NG)EN-DC/NE-DC band combination for which this field is not included, *dl-1024QAM-TotalWeightedLayers-r15* as described in TS 36.331 [17] applies, if included. |
| ***fd-MIMO-TotalWeightedLayers***  Indicates total number of weighted layers for the LTE part of the concerned (NG)EN-DC/NE-DC band combination the UE can process for FD-MIMO, as described in TS 36.306 [15] equation 4.3.28.13-1 and TS 36.331 [17] clause 6.3.6, NOTE 8 in *UE-EUTRA-Capability* field descriptions. For an (NG)EN-DC/NE-DC band combination for which this field is not included, *totalWeightedLayers-r13* as described in TS 36.331 [17] applies, if included. |
| ***diffNumerologyAcrossPUCCH-Group***  Indicates whether different numerology across two NR PUCCH groups for data and control channel at a given time in NR CA and (NG)EN-DC/NE-DC is supported by the UE. |
| ***diffNumerologyWithinPUCCH-GroupLargerSCS***  Indicates whether UE supports different numerology across carriers within a PUCCH group and a same numerology between DL and UL per carrier for data/control channel at a given time in NR CA, (NG)EN-DC/NE-DC and NR-DC.  In case of NR CA and (NG)EN-DC/NE-DC with one NR PUCCH group and in case of NR CA with two NR PUCCH groups, it also indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group up to two different numerologies within the same NR PUCCH group, wherein NR PUCCH is sent on the carrier with larger SCS for data and control channel at a given time.  In case of (NG)EN-DC/NE-DC with two NR PUCCH groups, it indicates whether the UE supports different numerologies across NR carriers up to two different numerologies within an NR PUCCH group in FR1, wherein NR PUCCH is sent on the carrier with larger SCS, and same numerology across NR carriers within another NR PUCCH group in FR2 for data and control channel at a given time.  In case of NR-DC, it indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group in MCG (in FR1) up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with larger SCS for data/control channel at a given time; and same numerology across NR carriers in SCG (in FR2). |
| ***diffNumerologyWithinPUCCH-GroupSmallerSCS***  Indicates whether UE supports different numerology across carriers within a PUCCH group and a same numerology between DL and UL per carrier for data/control channel at a given time in NR CA, (NG)EN-DC/NE-DC and NR-DC.  In case of NR CA and (NG)EN-DC/NE-DC with one NR PUCCH group and in case of NR CA with two NR PUCCH groups, it also indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group up to two different numerologies within the same NR PUCCH group, wherein NR PUCCH is sent on the carrier with smaller SCS for data and control channel at a given time.  In case of (NG)EN-DC/NE-DC with two NR PUCCH groups, it indicates whether the UE supports different numerologies across NR carriers up to two different numerologies within an NR PUCCH group in FR1, wherein NR PUCCH is sent on the carrier with smaller SCS, and same numerology across NR carriers within another NR PUCCH group in FR2 for data and control channel at a given time.  In case of NR-DC, it indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group in MCG (in FR1) up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with smaller SCS for data/control channel at a given time; and same numerology across NR carriers in SCG (in FR2). |
| ***supportedNumberTAG***  Defines the number of timing advance groups supported by the UE. It is applied to NR CA, NR-DC and (NG)EN-DC/NE-DC. For (NG)EN-DC/NE-DC, it indicates number of TAGs only for NR CG. The number of TAGs for the LTE MCG is signalled by existing LTE TAG capability signalling. For NR CA/NR-DC band combination, if the band combination comprised of more than one band entry (i.e., inter-band or intra-band non-contiguous band combination), it indicates that different timing advances on different band entries are supported. If absent, the UE supports only one TAG for the NR part. It is mandatory for the UE to support more than one TAG for NR-DC. |
| ***pa-PhaseDiscontinuityImpacts***  Indicates incapability motivated by impacts of PA phase discontinuity with overlapping transmissions with non-aligned starting or ending times or hop boundaries across carriers for intra-band (NG)EN-DC/NE-DC, intra-band CA and FDM based ULSUP. |
| ***twoPUCCH-Group***  Indicates whether two PUCCH group in CA with a same numerology across CCs for data and control channel [at a given time] is supported by the UE. For NR CA, two PUCCH group is supported with the same numerology across NR carriers for data and control channel at a given time. For (NG)EN-DC/NE-DC, two PUCCH group is supported with the same numerology across NR carriers for data and control channel at a given time, wherein an NR PUCCH group is configured in FR1 and another NR PUCCH group is configured in FR2. |

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| *Company* | *Agree/Disagree with the necessity of CR to address the issue* | *Comments on the detailed content of the CR:*   1. *Which IE should be covered / is missed in the clarification?* 2. *For the related IEs, how should the clarification be done (if different from the CR)* |
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### 2.3 Clean-up of ***L2*** features for NGEN-DC and NE-DC (*R2-2004400, R2-2004823*) in TS 36/38.306

For RAN2 features, RAN2 need to discuss to clarify the support of NGEN-DC and NE-DC. Since this issue may need detailed check by RAN2, two-level question is provided as follows:

***Q2.3-1***: Do you agree RAN2 should try to clarify the relationship between L2 UE capabilities NGEN-DC and NE-DC?

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| *Company* | *Yes/No* | *Comments* |
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In the related contributions, the clarification is provided for the following IEs:

For 38.306, it at least relates to the following IEs

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| ***eutra-CGI-Reporting***  Defines whether the UE supports acquisition of relevant information from a neighbouring E-UTRA cell by reading the SI of the neighbouring cell and reporting the acquired information to the network as specified in TS 38.331 [9] when the (NG)EN-DC is not configured. It is mandated if the UE supports EUTRA. |
| ***eventA-MeasAndReport***  Indicates whether the UE supports NR measurements and events A triggered reporting as specified in TS 38.331 [9]. This field only applies to SN configured measurement when (NG)EN-DC is configured. For NR SA, this feature is mandatory supported. |
| ***handoverFDD-TDD***  Indicates whether the UE supports HO between FDD and TDD. It is mandated if the UE supports both FDD and TDD. This field only applies to NR SA (e.g. PCell handover) and NE-DC. For PSCell change when (NG)EN-DC is configured, this feature is mandatory supported. |
| ***handoverFR1-FR2***  Indicates whether the UE supports HO between FR1 and FR2. Support is mandatory for the UE supporting both FR1 and FR2. This field only applies to NR SA(e.g. PCell handover) and NE-DC. For PSCell change when (NG)EN-DC is configured, this feature is mandatory supported. |
| ***handoverInterF***  Indicates whether the UE supports inter-frequency HO. It indicates the support for inter-frequency HO from the corresponding duplex mode if this capability is included in *fdd-Add-UE-NR-Capabilities* or *tdd-Add-UE-NR-Capabilities*. It indicates the support for inter-frequency HO from the corresponding frequency range if this capability is included in *fr1-Add-UE-NR-Capabilities* or *fr2-Add-UE-NR-Capabilities*. This field only applies to NR SA (e.g. PCell handover) and NE-DC. For PSCell change when (NG)EN-DC is configured, this feature is mandatory supported. |
| ***independentGapConfig***  This field indicates whether the UE supports two independent measurement gap configurations for FR1 and FR2 specified in clause 9.1.2 of TS 38.133 [5]. The field also indicates whether the UE supports the FR2 inter-RAT measurement without gaps when (NG)EN-DC is not configured. |
| ***intraAndInterF-MeasAndReport***  Indicates whether the UE supports NR intra-frequency and inter-frequency measurements and at least periodical reporting. This field only applies to NE-DC and SN configured measurement when (NG)EN-DC is configured. For NR SA, this feature is mandatory supported. |
| ***nr-CGI-Reporting***  Defines whether the UE supports acquisition of relevant information from a neighbouring intra-frequency or inter-frequency NR cell by reading the SI of the neighbouring cell and reporting the acquired information to the network as specified in TS 38.331 [9] when (NG)EN-DC is not configured. |

***Q2.3-2a:*** if Yes to ***Q2.3-1***, what is your view on the *R2-2004400* (R16 shadow would be provided after the content is consolidated) for TS 38.306?

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| *Company* | *Agree/Disagree with the necessity of CR to address the issue* | *Comments on the detailed content of the CR:*   1. *Which IE should be covered / is missed in the clarification?* 2. *For the related IEs, how should the clarification be done (if different from the CR)* |
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For 36.306, it at least relates to the following IEs - since the support of NGEN-DC has been clarified in 36.331, it is just to clarify/align the description in 36.306.

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| 4.3.11.4 *reportCGI-NR-EN-DC-r15* This parameter defines whether the UE supports acquisition of relevant information from a neighbouring NR cell by reading the SI of the neighbouring cell and reporting the acquired information to the network as specified in TS 36.331 [5] when the (NG)EN-DC is configured. |
| ***r***4.3.11.5 *reportCGI-NR-NoEN-DC-r15* This parameter defines whether the UE supports acquisition of relevant information from a neighbouring NR cell by reading the SI of the neighbouring cell and reporting the acquired information to the network as specified in TS 36.331 [5] when the (NG)EN-DC is not configured. |
| 4.3.15.15 *inDeviceCoexInd-ENDC-r15* This parameter defines whether the UE supports in-device coexistence indication for (NG)EN-DC operation as specified in TS 36.331 [5]. A UE that supports in-device coexistence indication for (NG)EN-DC operation shall also support in-device coexistence indication. |

***Q2.3-2b:*** if Yes to ***Q2.3-1***, what is your view on the *R2-2004823* (only the L2 feature related IEs, *reportCGI-NR-EN-DC-r15, reportCGI-NR-NoEN-DC-r15, inDeviceCoexInd-ENDC-r15,* R16 shadow would be provided after the content is consolidated) for TS 36.306?

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| *Company* | *Agree/Disagree with the necessity of CR to address the issue* | *Comments on the detailed content of the CR:*   1. *Which IE should be covered / is missed in the clarification?* 2. *For the related IEs, how should the clarification be done (if different from the CR)* |
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### 2.4 Clean-up of ***RAN4*** features for NGEN-DC and NE-DC (*R2-2004823, R2-2004405*) in TS 36/38.306

For RAN4 features that are related to RF and RRM: for 36.306, the following IE has been clarified in 36.331, so it is straightforward to clarify in 36.306 for alignment

#### 4.3.34.2 *supportedBandListEN-DC-r15*

Only applicable if the UE supports E-UTRA NR Dual Connectivity or NG-RAN E-UTRA-NR Dual Connectivity. This field includes the supported NR bands as defined in TS 38.101-1 [33] and TS 38.101-2 [34]. The presence of this field also indicates that the UE can perform both NR SS-RSRP and SS-RSRQ measurement in the included NR band(s) as specified in TS 38.215 [36].

***Q2.4-1:*** Companies are invited to share the view on *R2-2004823* (only the RAN4 feature related IE, *supportedBandListEN-DC,* R16 shadow would be provided after the content is consolidated) for TS 36.306?

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| *Company* | *Agree/Disagree with the necessity of CR to address the issue* | *Comments on the detailed content of the CR:*   1. *Which IE should be covered / is missed in the clarification?* 2. *For the related IEs, how should the clarification be done (if different from the CR)* |
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For 38.306, LS is needed for RAN4 to clarify the support of NGEN-DC and NE-DC.

| ***supportedBandwidthCombinationSet***  Defines the supported bandwidth combination for the band combination set as defined in the TS 38.101-1 [2], TS 38.101-2 [3] and TS 38.101-3 [4]. For NR SA CA, NR-DC, inter-band EN-DC without intra-band EN-DC component and intra-band EN-DC with additional inter-band NR CA component, the field defines the bandwidth combinations for the NR part of the band combination. For intra-band EN-DC without additional inter-band NR and LTE CA component, the field indicates the supported bandwidth combination set applicable to the NR and LTE band combinations. Field encoded as a bit map, where bit N is set to "1" if UE support Bandwidth Combination Set N for this band combination as defined in the TS 38.101-1 [2], TS 38.101-2 [3] and TS 38.101-3 [4]. The leading / leftmost bit (bit 0) corresponds to the Bandwidth Combination Set 0, the next bit corresponds to the Bandwidth Combination Set 1 and so on. It is mandatory if the band combination has more than one NR carrier (at least one SCell in an NR cell group) or is an intra-band EN-DC combination or both. |
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| ***supportedBandwidthCombinationSetIntraENDC***  Defines the supported bandwidth combination for the band combination set as defined in the TS 38.101-3 [4]. For intra-band EN-DC with additional inter-band CA component(s) of LTE and/or NR, the field defines the bandwidth combinations for the intra-band EN-DC component. Field encoded as a bit map, where bit N is set to "1" if UE support Bandwidth Combination Set N for this band combination as defined in the TS 38.101-3 [4]. The leading / leftmost bit (bit 0) corresponds to the Bandwidth Combination Set 0, the next bit corresponds to the Bandwidth Combination Set 1 and so on. It is mandatory if the band combination is an intra-band EN-DC combination with additional inter-band NR/LTE CA component. |
| ***supportedBandwidthCombinationSetEUTRA***  Indicates the set of supported bandwidth combinations for the LTE part for inter-band EN-DC without intra-band EN-DC component and intra-band EN-DC with additional inter-band LTE CA component. The field is encoded as a bit map, where bit N is set to "1" if UE support Bandwidth Combination Set N for this band combination. The leading / leftmost bit (bit 0) corresponds to the Bandwidth Combination Set 0, the next bit corresponds to the Bandwidth Combination Set 1 and so on. The UE shall neither include the field for a EN-DC combination which has only one LTE carrier, nor for a EN-DC combination which has more than one LTE carrier for which the UE only supports Bandwidth Combination Set 0 for the LTE part. If the inter-band EN-DC has more than one LTE carrier, the UE shall support at least one bandwidth combination for the supported LTE part. |
| ***asyncIntraBandENDC***  Indicates whether the UE supports asynchronous FDD-FDD intra-band EN-DC with MRTD and MTTD as specified in clause 7.5 and 7.6 of TS 38.133 [5]. If asynchronous FDD-FDD intra-band EN-DC is not supported, the UE supports only synchronous FDD-FDD intra-band EN-DC. |
| ***intraBandENDC-Support***  Indicates whether the UE supports intra-band EN-DC with only non-contiguous spectrum, or with both contiguous and non-contiguous spectrum for the EN-DC combination as specified in TS 38.101-3 [4].  If the UE does not include this field for an intra-band EN-DC combination the UE only supports the contiguous spectrum for the intra-band EN-DC combination. |
| ***simultaneousRxTxInterBandENDC***  Indicates whether the UE supports simultaneous transmission and reception in TDD-TDD and TDD-FDD inter-band EN-DC. It is mandatory for certain TDD-FDD and TDD-TDD band combinations defined in TS 38.101-3 [4]. |
| ***ul-SharingEUTRA-NR***  Indicates whether the UE supports EN-DC with EUTRA-NR coexistence in UL sharing via TDM only, FDM only, or both TDM and FDM from UE perspective as specified in TS 38.101-3 [4]. |
| ***ul-SwitchingTimeEUTRA-NR***  Indicates support of switching type between LTE UL and NR UL for EN-DC with LTE-NR coexistence in UL sharing from UE perspective as defined in clause 6.3B of TS 38.101-3 [4]. It is mandatory to report switching time type 1 or type 2 if UE reports *ul-SharingEUTRA-NR* is *tdm* or *both*. |

Although the RRM/RF capability are likely agnostic to DC-type, it would be proper to ask for confirmation by RAN4 via LS.

***Q2.4-2a:*** Do you agree to use a LS to RAN4 to clarify the applicability of RAN4 feature related IEs to NGEN-DC and NE-DC?

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| *Company* | *Yes/No* | *Comments* |
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***Q2.4-2b:*** if Yes to ***Q2.4-2a***, what is your view on the detailed content of *R2-2004405*?

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| *Company* | *Comments on the detailed content of the draft-LS* |
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# Conclusion

In the previous sections we made the following observations:

Based on the discussion in the previous sections we propose the following:

# References

1. R2-2004313 Reply LS on the applicability of UE capabilities for NE-DC (R1-2002792; contact: ZTE) RAN1 LS in Rel-15 NR\_newRAT-Core To:RAN2
2. R2-2004470 CR on introduction of extended capabilities for NE-DC only BCs ZTE Corporation, Sanechips, OPPO CR Rel-15 38.331 15.9.0 1445 2 F NR\_newRAT-Core R2-2002220
3. R2-2004472 CR on introduction of extended capabilities for NE-DC only BCs ZTE Corporation, Sanechips, OPPO CR Rel-16 38.331 16.0.0 1603 - A NR\_newRAT-Core
4. R2-2004471 CR on applicability of UE MIMO capabilities for NE-DC ZTE Corporation, Sanechips, OPPO CR Rel-15 38.306 15.9.0 0305 - F NR\_newRAT-Core
5. R2-2004473 CR on applicability of UE MIMO capabilities for NE-DC ZTE Corporation, Sanechips, OPPO CR Rel-16 38.306 16.0.0 0306 - A NR\_newRAT-Core
6. R2-2004821 Clarification on L1 features of NGEN-DC and NE-DC OPPO CR Rel-15 36.306 15.8.0 1760 - F NR\_newRAT-Core
7. R2-2004822 Clarification on L1 features of NGEN-DC and NE-DC OPPO CR Rel-16 36.306 16.0.0 1761 - A NR\_newRAT-Core
8. R2-2004396 Band combination list for NE-DC (Cat-F) OPPO, ZTE Corporation, Sanechips CR Rel-16 38.331 16.0.0 1596 - F NR\_newRAT-Core
9. R2-2004399 Clarification on NGEN-DC and NE-DC support OPPO discussion Rel-15 NR\_newRAT-Core
10. R2-2004397 Clarification on L1 features of NGEN-DC and NE-DC OPPO CR Rel-15 38.306 15.9.0 0298 - F NR\_newRAT-Core
11. R2-2004398 Clarification on L1 features of NGEN-DC and NE-DC OPPO CR Rel-16 38.306 16.0.0 0299 - A NR\_newRAT-Core
12. R2-2004400 Clarification on L2 features of NGEN-DC and NE-DC OPPO CR Rel-15 38.306 15.9.0 0300 - F NR\_newRAT-Core
13. R2-2004823 Clarification on L2 and RAN4 features of NGEN-DC and NE-DC OPPO CR Rel-15 36.306 15.8.0 1762 - F NR\_newRAT-Core
14. R2-2004405 [Draft] LS on Clarification on RAN4 features of NGEN-DC and NE-DC OPPO LS out Rel-15 NR\_newRAT-Core To:RAN4