3GPP TSG-RAN WG2 Meeting #109 electronic  *R2-200xxxx*

24 Feb – 6 Mar 2020

**Agenda item: 7.1.11 & 7.2.9**

**Source: ZTE (offline email discussion rapporteur)**

**Title: Report of [AT109e][418][eMTC/NB-IoT] Coexistence with NR: Open Issues (ZTE)**

**Document for: Report**

# 1 Scope of the offline email discussion

This document contains the summary of the offline email discussion “[AT109e][418][eMTC/NB-IoT] Coexistence with NR: Open Issues (ZTE)”, as indicated below:

* *[AT109e][418][eMTC/NB-IoT] Coexistence with NR: Open Issues (ZTE)*

*Scope: Further discussion to address the remaining issues and identify potential agreements.*

*Intended outcome: Report with a list of proposals categorized as agreeable, need further discussion, postpone. The outcome can be provided in R2-2001883*

*Deadline: Tuesday, Mar 3rd 17:00 CET*

# 2 Offline email discussion

According to the scope of WID, the coexistence of NB-IoT/eMTC with NR have mostly been discussed in RAN1. In the recent RAN1#98~#99meetings, several agreements have been achieved and RAN1 has proposed some parameters related to coexistence of eMTC/NB-IoT with NR in [2].

In the following sections, the proposals in the summary [1] will be further discussed. NB-IoT and eMTC are separated in different sections. In order try to reduce the length of the document, the related proposals are put together for discussion.

## 2.1 NB-IoT

### 2.1.1 RRC signaling for providing NB-IoT coexistence parameters

This section covers the following proposals in summary [1]:

|  |
| --- |
| **Proposal 1-1: For NB-IoT, resource reservation configuration for NR coexistence is only provided via dedicated RRC signalling.**  **Proposal 1-2: For NB-IoT, resource reservation configuration for NR coexistence is provided in *PhysicalConfigDedicated-NB*.**  **Proposal 1-3: RAN2 needs to discuss where to define new Rel-16 IE (s) for providing resource reservation configuration, in *PhysicalConfigDedicated-NB* or in the extension of *CarrierConfigDedicated-NB* in *PhysicalConfigDedicated-NB*.** |

During the online discussion, majority companies prefer to use dedicated RRC signaling instead of SIB for providing NB-IoT coexistence parameters. The main reasons which have been mentioned are as following:

1. For NB-IoT the coexistence parameters configuration is carrier specific and need to be configured for each non-anchor carrier. According to the parameter list from RAN1 and considering the following ASN.1 example in [3], we can see there have “big” parameters for slot-level configuration. The estimation on the size of parameter list would be nearly 200bits (DL and UL). And this is just a configuration for only one non-anchor carrier. As for NB-IoT, the maximum SIB and SI message size is 680 bits, it may be very difficult to accommodate so much bits for all the non-anchor carriers in a SIB.

Table 1

|  |
| --- |
| NR-ResourceReservationConfig-DL-NB-r16::= SEQUENCE {  periodicity-r16 ENUMERATED {ms10, ms20, ms40, ms80, ms160, spare1},  startPosition-r16 INTEGER (0..15),  resourceReservation-r16 CHOICE {  subframeBitmap-r16 CHOICE {  subframePattern10ms-r16 BIT STRING (SIZE (10)),  subframePattern40ms-r16 BIT STRING (SIZE (40))  },  slotConfig-r16 SEQUENCE {  slotBitmap-r16 CHOICE {  slotPattern10ms-r16 BIT STRING (SIZE (20)),  slotPattern40ms-r16 BIT STRING (SIZE (80))  }  symbolBitmap1-r16 BIT STRING (SIZE (5)) OPTIONAL,  symbolBitmapt2-r16 BIT STRING (SIZE (5)) OPTIONAL  }  }  } |

1. System information are continuously transmitted, at high power and with a high number of repetitions to reach all UEs. As a result, it impacts the power consumption and the system information acquisition delay for all UEs. It is not signalling efficient.
2. Considering more than 100 non-anchor carriers can be deployed for NB-IoT, if SIB is used to provide NR coexistence parameters, only paging or PRACH non-anchor carriers can be configured with resource reservation while other more service non-anchor carriers cannot be configured, e.g., cannot be used for NR coexistence.

At the same time, only one company thinks dedicated RRC signalling will not be efficient with the following reason:

1. ~200 bits need to be transmitted every time when UE enters connected mode.

According to the about summary, companies are invited to answer the following questions:

**Q1: Do you agree with proposal 1-1?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes. | In addition the above, the NB-IoT carrier used in unicast is currently signalled in dedicated signalling. Only a few are signalled in system information and they are the ones used for paging and random access. There is no reason to deviate from this. |
| Nokia | **Yes** | We agree, dedicated signalling is better option than broadcasting to all UE.  The number of fields in dedicated signalling can be optimised, if the existing parameter of valid-subframe information can also be reused for this purpose. |
| Qualcomm | **-** | It is unclear why different NB-IoT carriers within the NR system bandwidth (i.e. bandwidth used for NR in the cell) need to have different co-existence configuration. For eMTC such information is cell specific. We think it makes sense to ask RAN1 for justification to provide NR coexistence on per carrier basis for NB-IoT.  The IE name implies this configuration is for downlink but the uplink configuration is similar hence we think same IE can be used for uplink too.  It is also worth asking RAN1 whether the configuration can be the same for uplink and downlink.  In any case, we think specification should support NR coexistence information in broadcast and dedicated signalling. Dedicated signalling should allow UE to use broadcast or unicast configured co-existence information. |
| Ericsson | Yes | We agree for NB-IoT especially providing large configuration, especially when not supported by many UEs, may be problematic. Therefore, our thinking is that it would be better to provide the configuration in dedicated signalling. |

**Summary:** Four companies out of all five companies think for NB-IoT, it would be better to provide the configuration in dedicated signalling and agree with proposal 1-1. Here one company think the number of fields in dedicated signalling can be optimised by (somehow) making use of the existing parameter of valid-subframe information. Rapporteur think this can be further discussed during running CR review.

One company think it is unclear why different NB-IoT carriers need to have different co-existence configuration and suggest to ask RAN1 for justification. This company also think specification should support NR coexistence information in broadcast and dedicated signalling. Rapporteur think NB-IoT WID has already mentioned to specify resource reservation for NB-IoT non-anchor carriers and it may not useful/efficient to ask justification at this late stage.

Following the majority views, rapporteur suggest to agree the previous proposal 1-1, e.g., to provide NR coexistence configuration only in dedicated RRC signalling for NB-IoT.

**Proposal:**

**Proposal 1-1:** Resource reservation configuration for NR coexistence is only provided via dedicated RRC signalling.

As mentioned in the contributions, the resource reservation specifies the subframes / slots / symbols level configuration, thus it should be part of the physical channel configuration.

**Q2: Do you agree with proposal 1-2?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes. | . |
| Nokia | **Yes** |  |
| Qualcomm | **Yes** |  |
| Ericsson | **Yes** |  |

**Summary:** All of the five companies can agree the proposal 1-2. For one company (QC), according to their comments for Q1, rapporteur think what they are considering may be the physical channel configuration in both broadcast and dedicated signalling. Anyway, following the majority views, rapporteur suggest to agree the previous proposal 1-2.

**Proposal:**

**Proposal 1-2:** Resource reservation configuration for NR coexistence is provided in *PhysicalConfigDedicated-NB*.

About Proposal 1-3, two options have been mentioned in the contributions. The ANS.1 examples are as following:

|  |
| --- |
| Option 1 [3]:  PhysicalConfigDedicated-NB-r13 ::= SEQUENCE {  carrierConfigDedicated-r13 CarrierConfigDedicated-NB-r13 OPTIONAL, -- Need ON  ......  [[ nr-ResourceResvConfigFddDl-r16 NR-ResourceResvConfigFddDl-NB-r16 OPTIONAL, -- Cond FDD  nr-ResourceResvConfigFddUlOrTdd-r16 NR-ResourceResvConfigFddUlOrTdd-NB-r16 OPTIONAL -- Need ON  ]]  } |

|  |
| --- |
| Option 2 [4]:  PhysicalConfigDedicated-NB-r13 ::= SEQUENCE {  carrierConfigDedicated-r13 CarrierConfigDedicated-NB-r13 OPTIONAL, -- Need ON  ......  }  CarrierConfigDedicated-NB-r13 ::= SEQUENCE {  dl-CarrierConfig-r13 DL-CarrierConfigDedicated-NB-r13,  ul-CarrierConfig-r13 UL-CarrierConfigDedicated-NB-r13  }  DL-CarrierConfigDedicated-NB-r13 ::= SEQUENCE {  dl-CarrierFreq-r13 CarrierFreq-NB-r13,  ......  [[ nr-CoexistenceConfig-r16 NR-CoexistenceConfig-NB-r16 OPTIONAL, -- Need OR  ]]  [[ nr-CoexistenceConfig-UL-r16 NR-CoexistenceConfig-NB-r16 OPTIONAL -- Cond TDD1  ]]  }  UL-CarrierConfigDedicated-NB-r13 ::= SEQUENCE {  ul-CarrierFreq-r13 CarrierFreq-NB-r13 OPTIONAL, -- Need OP  ......  [[ nr-CoexistenceConfig-r16 NR-CoexistenceConfig-NB-r16 OPTIONAL, -- Need OR  ]]  } |

**Q3: Companies who agree with dedicated RRC signalling are invited to give your preferred option for extension of *PhysicalConfigDedicated-NB*:**

* Option 1: new Rel-16 IE (s) in *PhysicalConfigDedicated-NB*
* Option 2: extension of *CarrierConfigDedicated-NB* in *PhysicalConfigDedicated-NB*
* Other option.

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option 1 | Considering *carrierConfigDedicated-r13* may not be provided in some cases, e.g., no carrier reconfiguration in Msg4 and the service non-anchor carrier is just the PRACH non-anchor carrier, now we are also prefer option 1. |
| Huawei, HiSilicon | **option 1** | RAN2 has defined some specific rules to avoid signalling the *carrierConfigDedicated* when the eNB configures the UE with the carrier used during the random access procedure.  1> if the *carrierConfigDedicated* is not included in the received *physicalConfigDedicated*:  2> if the UE is configured with a carrier configuration previously received in *carrierConfigDedicated*:  3> use the carrier configuration received in *carrierConfigDedicated*;  2> else:  3> use the carrier configuration received in system information for the uplink and downlink carrier used during the random access procedure;  1> else:  2> use the carrier configuration received in *carrierConfigDedicated*;  As resource reservation will not be signalled in SIB22-NB (it will not fit), if it is included *carrierConfigDedicated*, the optimisation above cannot be used leading to extra signalling.  Note, with option 1, it can be clarified in the IE description that the configuration is carrier specific. |
| Nokia | **NA** | Further discussion needed to optimise the contents of dedicated signalling. |
| Qualcomm | **Modified Option 1** | We are fine to include NR resource reservation configuration as part of the existing carrier configuration, but dedicated signalling should allow use of configuration from SID or explicitly included in dedicated signalling |
| Ericsson | **Option 1** | Assume QC above means "from SIB"?  Based on ZTE and HW comments Option 1 seems OK. |

**Summary:** Four companies out of all five companies agree the option 1(or with some modification). One company suggest to further discuss. Following the majority views, rapporteur suggest the below proposal.

**Proposal:**

**Proposal 1-3:** New Rel-16 IE (s) can be introduced in *PhysicalConfigDedicated-NB*for providing resource reservation configuration for NR coexistence.

### 2.1.2 IE design for configuration

This section covers the following proposals in summary [1]. For the companies who prefer to use SIB, we think it’s still feasible for them to provide comments on IE design details, e.g., to give answer to the questions related **Proposal 1-4 ~ Proposal 1-6.** In the following discussion, the IE means the field, e.g., *nr-ResourceResvConfigFddDl-r16*, the IE structure means the details structure for the IE, e.g., *NR-CoexistenceConfig-NB-r16.*

|  |
| --- |
| **Proposal 1-4: For FDD, two new Rel-16 IEs for DL and UL resource reservation configuration can be introduced.**  **Proposal 1-5: For TDD, RAN2 needs to discuss whether two Rel-16 IEs for DL and UL resource reservation configuration need to be introduced for TDD. And whether DL and UL resource reservation configuration for FDD can be reused for TDD.**  **Proposal 1-6: RAN2 needs to choose one from the following alternatives for new IE structure:**   * Alt1: Separate and independent IE structures for providing FDD UL and FDD DL resource reservation configuration, moreover, same ASN.1 structure as for FDD UL can be used for TDD DL/UL (proposal in [3]) . * Alt2: Only one IE structure for providing FDD UL, FDD DL and TDD DL/UL resource reservation configuration. In the structure, only the symbol-level configuration parameter is differentiated for DL and UL (Option A in [4]). * Alt3: Separate and independent IE structures for providing UL and DL resource reservation configuration, for both TDD and FDD (Option B in [4]). |

RAN1 has agreed separate parameters for DL and UL resource reservation and all the parameters can be applied to both FDD and TDD. RAN1 also noted that FDD and TDD may require different signaling.

For FDD, it may be straightforward to provide two new IEs for providing DL and UL configurations separately. According to RAN1 parameter list, we can notice FDD have different sizes for the symbol bitmaps in DL and UL (5 bits for DL and 7 bits for UL). This is the only difference between DL and UL.

For TDD, as the NRS pattern is complex for special subframe, RAN1 agree same 7 bits size of symbol bitmaps for both DL and UL. Therefore, one company [3] think TDD UL and DL can share the same configuration and same ASN.1 structure as for FDD UL can be used. Whereas the other company has different understanding and think there has no explicit restriction that UL and DL for TDD would share the same configuration [4].

Based on the above summary, companies are invited to give your answer to the following questions (please note, the IE name just example and surely could be changed later by running CR rapporteur):

**Q4: Do you agree with proposal 1-4? E.g., *nr-ResourceResvConfigFddDl* for FDD DL and *nr-ResourceResvConfigFddUL* for FDD UL.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes | For FDD, we prefer two new IEs for DL and UL resource reservation configuration. The IE naming can be decided later. |
| Huawei, HiSilicon | **yes** | RAN1 has agreed that UL/DL can be configured separately |
| Nokia |  |  |
| Qualcomm | **Yes** | There is lot of commonality between uplink/downlink parameters hence where possible delta configuration should be considered. |
| Ericsson | **Yes** | Possibilities for optimisations can be considered further. |

**Summary:** All of the five companies agree for FDD, two independent parameters in UL and DL are needed for providing UL/DL configuration separately. One company suggest to consider possible delta configuration according to a lot of commonality between uplink/downlink parameters. Rapporteur think this can be further discussed for signalling optimization.

**Proposal:**

**Proposal 1-4:** For FDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

**Q5: Companies are invited to give your preferred option for new IEs for TDD:**

* Option 1: One new IE for both TDD DL and TDD UL. Share with FDD UL IE, e.g., *nr-ResourceResvConfigFddULorTDD*
* Option 2: Two new IEs for TDD DL or TDD UL separately.
* Other option

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option2 | For TDD, we also think it’s better to use two Rel-16 IEs for providing DL and UL resource reservation configuration separately. And FDD IEs in Q4 can be reused for TDD. For example, the two new IEs can be named as *nr-ResourceResvConfigFddOrTdd-DL-NB* and *nr-ResourceResvConfigFddOrTdd-UL-NB.* |
| Huawei, HiSilicon | **option 2** | We assume the question is about two independent parameters in UL and DL rather than two separate IE types.  We have proposed option 1 in our document but this was a misunderstanding of the RAN1 agreements. After further checking, our understanding is that, also for TDD, there is no dependency in the configuration parameters in UL and DL |
| Nokia | **Option 1** | The concept used in the valid subframe configuration for NB-IOT TDD can be reused. |
| Qualcomm | **Option 2** |  |
| Ericsson | **Option 2** |  |

**Summary:** Four companies out of all five companies have the same understanding for TDD, two independent parameters in UL and DL are also needed. One company think the concept used in the valid subframe configuration for NB-IOT TDD, e.g., only DL configuration for both UL/DL, can be reused, but rapporteur think the situation for NR coexistence may be a little different as finer granularity are needed for resources reservation. Following the majority views, rapporteur suggest the below proposal.

**Proposal:**

**Proposal 1-5:** For TDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

**Q6: Companies are invited to give your preferred option for new IE structure definition:**

* Option 1: Two new IE structures for separate DL or UL configuration, e.g., *NR-ResourceResvConfigFddDl-NB* and *NR-ResourceResvConfigFddUlOrTdd-NB*
* Option 2: One new IE structure for both DL and UL, and for both TDD and FDD, e.g., *NR-CoexistenceConfig-NB.*
* Other option

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option 2 | For example,  *{ nr-ResourceResvConfigFddOrTdd-DL-NB NR-CoexistenceConfig-NB*  *nr-ResourceResvConfigFddOrTdd-UL-NB NR-CoexistenceConfig-NB*  *}*  Moreover, for the details in *NR-CoexistenceConfig-NB,* we suggest to take *NR-CoexistenceConfig-NB-r16* in [4] as start point for discussion. |
| Huawei, Hisilicon | **Option2** | Although we have proposed option 1 in our contribution, considering that the parameters for UL and DL are almost identical, it is better to have a common IE for both in order to reduce the size of the ASN.1. we can have a choice in the structure as proposed in [4]. |
| Nokia | **Option 2** |  |
| Qualcomm | **Option 2** |  |
| Ericsson | **Option 2** |  |

**Summary:** All of the five companies agree with one new IE structure for both DL and UL, and for both TDD and FDD, considering that the parameters for UL and DL are almost identical.

**Proposal:**

**Proposal 1-6:** One new IE structure for resource reservation configuration for both DL and UL, and for both TDD and FDD are introduced.

### 2.1.3 The slot and symbol-level parameters

This section covers the following proposals in summary [1]:

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| --- |
| **Proposal 1-7: RAN2 needs to discuss whether it needs to explicitly indicate the dependence between the value of *Periodicity* and value range of *startPosition.*** |

With the answer for the above questions and parameter value givens by RAN1, it may be easy to provide ASN.1 definition, we will not discuss the details. Only this specific issue may need to be discussed.

Considering the above example in Table 1, the value of reserved resource start position can be arbitrary select among INTEGER (0..15) and correct configuration may depend on network implementation. While in [4], the dependence between periodicity and start position is applied, e.g., the value range of start position would be depended on the selected value for periodicity, see the following Table 2:

Table 2

|  |
| --- |
| NR-CoexistenceConfig-NB-r16 ::= SEQUENCE {  valid-subframe-config-r16 ENUMERATED {10ms, 40ms}  slot-reserved-resource-config-r16::= CHOICE {  bitPattern1 BIT STRING (SIZE (20)),  bitPattern2 BIT STRING (SIZE (80)),  }  symbol-reserved-resource-config-second-slot-r16::= CHOICE {  dl BIT STRING (SIZE (5)),  ul BIT STRING (SIZE (7)),  } OPTIONAL, -- Cond slot-reserved-resource-config  symbol-reserved-resource-config-first-slot-16 CHOICE {  dl BIT STRING (SIZE (5)),  ul BIT STRING (SIZE (7)),  } OPTIONAL, -- Cond slot-reserved-resource-config  reserved-resource-time-periodicity-16 ENUMERATED {10ms, 20ms, 40ms, 80ms, 160ms}  reserved-resource-time-start-position-r16 CHOICE {  Periodicity10ms ENUMERATED {0},  Periodicity20ms ENUMERATED {0, 10},  Periodicity40ms ENUMERATED {0, 10, 20, 30},  Periodicity80ms ENUMERATED {0, 10, 20, 30, 40, 50, 60, 70},  Periodicity160ms ENUMERATED {0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150}  }  } |

**Q7: For periodicity and start position definition, Companies are invited to give your preferred option:**

* Option 1: Independent definition for periodicity and start position, like example in Table 1.
* Option 2: Dependent definition for periodicity and start position, like example in Table 2.
* Other option

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option 2 | With such dependence, we further think it may be possible not to have the periodicity IE. The example may be as following:  reserved-resource-time-periodicity-and-start-position-r16 CHOICE {  Periodicity10ms ENUMERATED {0},  Periodicity20ms ENUMERATED {0, 10},  Periodicity40ms ENUMERATED {0, 10, 20, 30},  Periodicity80ms ENUMERATED {0, 10, 20, 30, 40, 50, 60, 70},  Periodicity160ms ENUMERATED {0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150}  ) |
| Huawei, HiSilicon | **Option 1** | Option 1 is preferred as more compact  Note that Option 1 does not mean that the configuration is independent of the periodicity. In our proposal, we clarify the dependency in the field description:  INTEGER (0..15). Unit in multiple of 10 milliseconds.  E-UTRAN configures the value of *startPosition* such as *startPosition \* 10 < periodicity.* |
| Nokia | **Option 1** |  |
| Qualcomm | **Option 1** | Option 1 requires 4 bits always to signal start position.  Option 2 requires between 5 (4+1) to 9 (4+5) bits.  Therefore, option 1 is efficient. |
| Ericsson | **Option 1** |  |

**Summary:** Four companies out of all five companies agree with independent definition for periodicity and start position parameters, considering that such definition can save signalling bits. One company prefer dependent definition for periodicity and start position. Following the majority views, rapporteur suggest the below proposal.

**Proposal:**

**Proposal 1-7:** Independent definition for periodicity and start position parameters are introduced and the dependency between them can be clarified in the field description**.**

### 2.1.4 UE capability

This section covers the following proposals in summary [1]:

|  |
| --- |
| **Proposal 1-8: Introduce two UE capabilities *nr-ResourceResvUL-r16* and *nr-ResourceResvDL-r16* in PhyLayerParameters-NB-v16xy.**  **Proposal 1-9: RAN2 needs to discuss whether to introduce two additional UE capabilities for TDD. If not, whether the above UE capabilities in Proposal 1-8 can be applied to both FDD and TDD**  **Proposal 1-10: Introduce two new items *nr-ResourceResvUL-r16* and *nr-ResourceResvDL-r16* in 36.306. RAN2 needs to discuss whether they are capabilities or IOT bits.** |

RAN1 has agreed complete independence between UL and DL resource reservation, so the company propose to introduce separate capability for UL and DL.

**Q8: Do you agree with proposal 1-8?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes |  |
| Huawei, HiSilicon | **yes** | Whether capabilities or IOT bits is RAN1 to decide. In both cases, RAN2 needs to introduce the signalling. |
| Nokia | **No** | If the UE have the capability to skip resources based on the bitmap, it can be applied for both links based on the configuration, then single capability should be sufficient. |
| Qualcomm | **Yes** | Same comments as Huawei. |
| Ericsson | **Yes** | Yes, these are also indicated as separate components in the latest UE feature list from RAN1. |

**Summary:** Four companies out of all five companies can agree the **Proposal 1-8**, e.g., for FDD, to introduce separate capability for UL and DL resources reservation. But companies also mentioned we need to wait RAN1 decision on whether capabilities or IOT bits are needed. One company think only one capability for both UL and DL is enough. Considering the situation, rapporteur suggest we can have a working assumption on UE capability reporting.

**Proposal:**

**Proposal 1-8:** Working assumption: Introduce two UE capabilities for handling resources reservation on DL or UL in *PhyLayerParameters-NB-v16xy*.

**Q9: For TDD capability, companies are invited to give your preferred option:**

* Option 1: The capabilities in proposal 1-8 can be reused for TDD, e.g., no need for additional TDD capabilities
* Option 2: New additional UE capability(es) for TDD.
* Other option

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option 1 | No strong opinion, Option 2 is also acceptable. |
| Huawei, HiSilicon | **TBD** | FDD/TDD differentiation is needed at least for testing, RAN1 also indicated FDD/TDD differentiation in their UE feature list document.  However, this does not require to introduce separate capabilities, this only means that the UE can report separate values for FDD and TDD. |
| Qualcomm | **Option 2** | UE must be able to indicate whether it supports NR coexxistance for the operating mode.  Typically UE operates in TDD more or FDD mode hence from UE capability point of view a single capability should be sufficient. |
| Ericsson |  | Agree with HW comments. |

**Summary:** Three companies of four companies agree FDD/TDD differentiation is needed at least for testing, but this doesn’t require introduce separate capabilities and maybe single capability with separate values for FDD and TDD is enough. One company keeps neutral. Following the majority views, rapporteur suggest the below working assumption.

**Proposal:**

**Proposal 1-9:** Working assumption: Two UE capabilities for handling resources reservation on DL or UL in *PhyLayerParameters-NB-v16xy* can be applied to both FDD and TDD, e.g., with separate values for FDD or TDD.

**Q10: Companies are invited to give your comments on changes for NB-IoT in 36.306?**

|  |  |
| --- | --- |
| **Company** | **Detailed comments** |
| ZTE | We tend to understand this feature is optional for NB-IoT UE with UE capability report. |
| Huawei, Hisilicon | We agree to introduce the two new capabilities in36.306, we propose that they are introduced in section 4.3.4.  It is up to RAN1 (and not RAN2) to decide whether they are capabilities or IOT bits. |
| Nokia | Depends on decision on above question |
| Qualcomm | Optional UE capability and Proposal 1-10 looks reasonable. |
| Ericsson | Agree with two capabilities and optional with capability reporting, also indicated as such in UE feature list. |

**Summary:** Four companies out of all five companies agree two new capabilities can be introduced in 36.306. But it is up to RAN1 (not RAN2) to decide whether they are capabilities or IOT bits. Considering the situation, rapporteur suggest we can have the below working assumption.

**Proposal:**

**Proposal 1-10:** Working assumption: Two UE capabilities for handling resources reservation on DL or UL can be introduced into TS 36.306, e.g., section 4.3.4.

## 2.2 eMTC

A little different from NB-IoT, for coexistence of eMTC with NR, RAN1 has agreed two features: resource reservation and DL subcarrier puncturing. DL subcarrier puncturing for a maximum of two eMTC DL subcarriers (excluding CRS) can reduce the number of NR resource blocks that need to be reserved for eMTC when eMTC is deployed within an NR carrier.

### 2.2.1 RRC signaling for providing eMTC coexistence parameters

This section covers the following proposals in summary [1]:

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| --- |
| **Proposal 2-1: For eMTC, configurations related to resource reservation and DL subcarrier puncturing for NR coexistence are provided via dedicated RRC signalling.**  **Proposal 2-2: The configurations related to resource reservation and DL subcarrier puncturing for NR coexistence can be provided in *PhysicalConfigDedicated.*** |

During the online discussion, eMTC part hasn’t been touched. Considering the following example in [5], the size of parameter list may be similar as or a little less than that of NB-IoT.

Table 3

|  |
| --- |
| NR-ResourceReservationConfig-r16::= SEQUENCE {  periodicity-r16 ENUMERATED {ms10, ms20, ms40, ms80, ms160},  startPosition-r16 INTEGER (0..15),  resourceReservationFreq-r16 CHOICE {  rbg\_bw1dot4MHz BIT STRING (SIZE (6)),  rbg\_bw3MHz BIT STRING (SIZE (8)),  rbg\_bw5MHz BIT STRING (SIZE (13)),  rbg\_bw10MHz BIT STRING (SIZE (17)),  rbg\_bw15MHz BIT STRING (SIZE (19)),  rbg\_bw20MHz BIT STRING (SIZE (25))  } OPTIONAL, -- Cond DL  slotConfig-r16 SEQUENCE {  slotBitmap-r16 CHOICE {  slotPattern10ms-r16 BIT STRING (SIZE (20)),  slotPattern40ms-r16 BIT STRING (SIZE (80))  },  symbolBitmap1-r16 BIT STRING (SIZE (7)) OPTIONAL,  symbolBitmap2-r16 BIT STRING (SIZE (7)) OPTIONAL  }  } |

As eMTC has no non-anchor carriers, the concerns related to non-anchor carriers for using SIB may not exist while the other concerns may be similar.

companies are invited to answer the following questions:

**Q11: Do you agree with proposal 2-1?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes | As there has no issue on service non-anchor carrier resources reservation in eMTC, we think perhaps the need to use unicast signalling for coexistence configuration in eMTC is not as strong as that in NB-IoT, e.g., to use SIB may be acceptable to eMTC. However, even for eMTC, there may still exist the flexible configuration requirements, then unicast way may be more future-proof than broadcast way.  Therefore, we prefer to use same unicast way for providing NR coexistence configuration for both NB-IoT and eMTC. |
| Huawei, HiSilicon | **Yes** | We do not think that providing the configuration in SIB is signalling efficient from the NW point of view. On the UE side, this is beneficial if the UE accesses many times from the same cell, but there is the same benefit when using the resume procedure.  In general, only the parameters that are needed when the UE is in IDLE (/INACTIVE) mode shall be signalled in SIB. Otherwise, the scheduling period of the system information increases, which introduces additional delay for the system information acquisition and affects all UEs. Also, unless the configuration is provided in a separate SystemInformation message, this affects the power consumption of all legacy UEs. |
| Nokia | **Yes** | Agree with Huawei and ZTE |
| Qualcomm | **-** | RAN1 agreement is for cell specific NR coexistence configuration hence we think this configuration is better in SIB. But for inter-cell mobility this configuration may also needs to be supported in dedicated signalling.  Therefore, just as with NB-IoT we think NR coexistence configuration should be supported both in dedicated and broadcast signalling. |
| Ericsson | **(Yes)** | In general, prefer to align with NB-IoT but considering in general for LTE-M it would not be as problematic to provide the information over SI, e.g a new SIB, we are OK to further discuss this option as well. |

**Summary:** Rapporteur understand for eMTC, all of the five companies can agree to provide the configuration related to resource reservation and DL subcarrier puncturing for NR coexistence via dedicated signalling. Among them, one company think NR coexistence configuration should also be supported in broadcast signalling while another company is ok to further discuss this option of new SIB.

Following the majority views, rapporteur suggest for eMTC, we can firstly agree to specify NR coexistence configuration via dedicated RRC signalling. Whether and how the configuration can also be provided via new SIB is FFS and postponed to next meeting.

**Proposal:**

**Proposal 2-1:** Configurations related to resource reservation and DL subcarrier puncturing for NR coexistence are provided via dedicated RRC signalling.

**Proposal 2-1a:** FFS for eMTC, whether and how configurations related to resource reservation and DL subcarrier puncturing for NR coexistence are also provided via SI, e.g, a new SIB.

Similar as NB-IoT, the resource reservation and DL subcarrier puncturing for eMTC specifies the subcarrier /subframes / slots / symbols level configuration, thus it should be part of the physical channel configuration.

**Q12: Do you agree with proposal 2-2?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes |  |
| Huawei, HiSilicon | **yes** |  |
| Nokia | **Yes** |  |
| Qualcomm | **Yes** |  |
| Ericsson | **Yes** |  |

**Summary:** All of the five companies can agree previous **proposal 2-2.**

**Proposal:**

**Proposal 2-2:** The configurations related to resource reservation and DL subcarrier puncturing for NR coexistence can be provided in *PhysicalConfigDedicated.*

According to the structure of *PhysicalConfigDedicated*, if proposal 2-2 can be agreed, it’s straightforward that new R16 IEs would be defined in *PhysicalConfigDedicated*. No other issue needs to be discussed.

### 2.2.2 IE design for configuration

This section covers the following proposals in summary [1]:

|  |
| --- |
| **Proposal 2-3: For FDD, two new IEs for separate and independent UL and DL resource reservation configuration can be introduced.**  **Proposal 2-4: For TDD, RAN2 needs to discuss whether two Rel-16 IEs for DL and UL resource reservation configuration need to be introduced. And whether DL and UL resource reservation configuration for FDD can be reused for TDD.**  **Proposal 2-5: A same IE structure, e.g., *NR-ResourceReservationConfig-r16* can be defined for UL and DL resource reservation configuration, for both TDD and FDD.** |

RAN1 has agreed separate parameters for DL and UL resource reservation for eMTC FDD. It may be straightforward to provide two new IEs to provide DL and UL configurations separately.

For TDD, company [5] also think TDD UL and DL can share the same configuration, so only one IE for TDD is enough. As RAN1 has no explicit restriction for this, rapporteur suggest to discuss this.

Based on the above summary, companies are invited to give your answer to the following questions (please note, the IE name just example and could be changed later by running CR rapporteur):

**Q13: Do you agree with proposal 2-3? E.g., *ce-NR-ResourceResvConfigFddDl* for eMTC FDD DL and *ce-NR-ResourceResvConfigFddUl* for eMTC FDD UL.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes | Similar as NB-IoT, for eMTC FDD, we also prefer two new IEs for DL and UL resource reservation configuration. The IE naming can be decided later. |
| Huawei, HiSilicon | **yes** |
| Qualcomm | **Yes** |  |
| Ericsson | **Yes** |  |

**Summary:** All of the four companies agree for FDD, two independent parameters in UL and DL are needed for providing UL/DL configuration separately.

**Proposal:**

**Proposal 2-3:** For FDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

**Q14: Companies are invited to give your preferred option for new IEs for TDD:**

* Option 1: One new IE for both TDD DL and TDD UL. Share with FDD DL IE, e.g., *ce-NR-ResourceResvConfigFddDlOrTdd*
* Option 2: Two new IEs for TDD DL or TDD UL separately.
* Other option

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option2 | Similar as NB-IoT, for eMTC TDD, we also think it’s better to use two Rel-16 IEs for DL and UL resource reservation configuration separately. And FDD IEs can be reused for TDD. For example, the two new IEs can be *nr-ResourceResvConfigFddOrTdd-DL* and *nr-ResourceResvConfigFddOrTdd-UL.* |
| Huawei, HiSilicon | **option 2** | Assuming that the question is about the configuration parameter not the IE type. |
| Nokia | **Option 2** |  |
| Qualcomm | **Option 2** |  |
| Ericsson | **Option 2** | Agree with HW comment |

**Summary:** All of the four companies agree for TDD, two independent parameters in UL and DL are needed for providing UL/DL configuration separately.

**Proposal:**

**Proposal 2-4:** For TDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

Different from NB-IoT, for eMTC FDD, the symbol level configuration have same type for DL and UL(e.g., 7 bits for both DL and UL). Therefore, company [5] understand UL and DL resource reservation parameters can have same type definition. Even this is the case, there still have difference between DL and UL configuration, e.g., frequency domain can only be configured for DL. But as the frequency domain can be configured with condition on DL, same type definition for DL and UL may be feasible and simple.

**Q15: Companies are invited to give your preferred option for new IE structure definition:**

* Option 1: Two new IE structures for separate DL or UL configuration, and for both TDD and FDD, e.g., *NR-ResourceReservationConfigDL* and *NR-ResourceReservationConfigUL*
* Option 2: One new IE structure for both DL and UL, and for both TDD and FDD, e.g., *NR-ResourceReservationConfig.*
* Other option

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option 2 | For example,  *{ nr-ResourceResvConfigFddOrTdd-DL NR-CoexistenceConfig*  *nr-ResourceResvConfigFddOrTdd-UL NR-CoexistenceConfig*  *}*  Moreover, for the details in *NR-CoexistenceConfig,* we suggest to take *NR-ResourceReservationConfig-r16* in [5] as start point for discussion. |
| Huawei, HiSilicon | **option 2** | As for NB-IoT, we think it is beneficial to have a single IE type to reduce the size of the ASN.1. |
| Qualcomm | **Option 2** |  |
| Ericsson | **Option 2** |  |

**Summary:** All of the four companies agree with one new IE structure for both DL and UL, and for both TDD and FDD, with the similar reason for NB-IoT, e.g., considering that the parameters for UL and DL are almost identical.

**Proposal:**

**Proposal 2-5:** One new IE structure for resource reservation configuration for both DL and UL, and for both TDD and FDD are introduced.

### 2.2.3 DL subcarrier puncturing feature

This section covers the following proposals in summary [1]:

|  |
| --- |
| **Proposal 2-6: Separate configuration for DL subcarrier puncturing can be introduced for both FDD and TDD, e.g., *ce-NR-PuncturedSubcarrierDL-r16* in *PhysicalConfigDedicated*.** |

DL subcarrier puncturing is a separate feature different from resources reservation. RAN2 needs to provide configuration of maximum number of punctured downlink subcarriers and their locations.

**Q16: Do you agree to introduce a new separate IE for DL subcarrier puncturing configuration?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments** |
| ZTE | Yes |  |
| Huawei, HiSilicon | **yes** |
| Nokia | **Yes** |  |
| Qualcomm | **Yes** |  |
| Ericsson | **Yes** |  |

**Summary:** All of the five companies can agree the previous **proposal 2-6.** With reference to the proposal 2-3 and 2-4, rapporteur simplify the text of the proposal.

**Proposal:**

**Proposal 2-6:** A parameter for providing DL subcarrier puncturing configuration can be introduced in *PhysicalConfigDedicated*, which is for both FDD and TDD.

### 2.2.4 UE capability

This section covers the following proposals in summary [1]:

|  |
| --- |
| **Proposal 2-7: Introduce four UE capabilities for resource reservation in UL and DL, e.g., ce-ModeA-NR-ResourceResvUL-r16, ce-ModeA-NR-ResourceResvDL-r16, ce-ModeB-NR-ResourceResvUL-r16 and ce-ModeB-NR-ResourceResvDL-r16.**  **Proposal 2-8: Introduce two UE capabilities for DL subcarrier puncturing, e.g., ce-ModeA-NR-SubcarrierPuncturing-r16, and ce-ModeB-NR-SubcarrierPuncturing-r16.**  **Proposal 2-9: RAN2 needs discuss whether two separate UE capability IEs for TDD and FDD need to be introduced.**  **Proposal 2-10: Introduce six new items *ce-DL-resourceReservation-CE-ModeA-r16, ce-DL-resourceReservation-CE-ModeB-r16, ce-UL-resourceReservation-CE-ModeA-r16, ce-UL-resourceReservation-CE-ModeB-r16, ce-DL-subcarrierPuncturing CE-ModeA -r16* and *ce-DL-subcarrierPuncturing CE-ModeB -r16* in 36.306. RAN2 needs to discuss whether they are capabilities or IOT bits.** |

Based on RAN1 agreements, in order to separately indicate UE capabilities for resource reservation in UL/DL and for CE MODE A/ CE MODE B, and also separate indicate UE capabilities for subcarrier puncturing in CE MODE A/ CE MODE B. Separate UE capabilities are needed.

**Q17: Do you agree with proposal 2-7?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes |  |
| Huawei, HiSilicon | **yes** |
| Nokia | **No** | Slightly prefer single capabiility. |
| Qualcomm | **Yes** |  |
| Ericsson | **Yes** | Four capabilities are needed, also indicated so by RAN1 so far. |

**Summary:** Four companies out of all five companies can agree the Proposal 2-7, e.g., for FDD, to introduce separate capability for UL and DL, and for CE mode A and CE mode B resources reservation. One company think only one single capability is enough. Rapporteur think for eMTC, we may also need to wait for RAN1 decision on whether capabilities or IOT bits are needed. Therefore, rapporteur suggest we can have a working assumption on UE capability reporting.

**Proposal:**

**Proposal 2-7:** Working assumption: Introduce four UE capabilities for handling resources reservation on UL and DL, and for CE mode A and CE mode B separately, in *PhyLayerParameters-v16xy.*

**Q18: Do you agree with proposal 2-8?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
| ZTE | Yes |  |
| Huawei, HiSilicon | **yes** |
| Qualcomm | **Yes** |  |
| Ericsson | **yes** |  |

**Summary:** All of the four companies can agree previous **proposal 2-8.**

**Proposal:**

**Proposal 2-8:** Working assumption: Introduce two UE capabilities for handling DL subcarrier puncturing for CE mode A and CE mode B separately, in *PhyLayerParameters-v16xy.*

**Q19: For TDD capability, companies are invited to give your preferred option:**

* Option 1: The capabilities in proposal 2-7 and 2-8 can be reused for TDD, e.g., no need for additional TDD capabilities
* Option 2: New additional UE capability(es) for TDD.
* Other option

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
| ZTE | Option 1 | No strong opinion, Option 2 is also acceptable. |
| Huawei, HiSilicon | **TBD** | FDD/TDD differentiation is needed at least for testing, RAN1 also indicated FDD/TDD differentiation in their UE feature list document.  However, this does not require to introduce separate capabilities, only allows reporting different values for FDD and TDD. |
| Qualcomm | **Option 1** | Same comments as for Question 9. |
| Ericsson |  | Agree with HW |

**Summary:** Similar comments as that for NB-IoT.

**Proposal:**

**Proposal 2-9:** Working assumption: Six UE capabilities mentioned in **Proposal 2-7 and Proposal 2-8** for handling resources reservation or DL subcarrier puncturing can be applied to both FDD and TDD, e.g., with separate values for FDD or TDD.

**Q20: Companies are invited to give your comments on changes for eMTC in 36.306?**

|  |  |
| --- | --- |
| **Company** | **Detailed comments** |
| ZTE | We tend to understand this feature is optional for eMTC UE with UE capability report. |
| Qualcomm | This feature is optional and Proposal 2-10 looks reasonable. |
| Ericsson | Agree with ZTE |

**Summary:** Similar comments as that for NB-IoT.

**Proposal:**

**Proposal 2-10:** Working assumption: Six UE capabilities for handling resources reservation or DL subcarrier puncturing can be introduced into TS 36.306.

# 3 Conclusions

As almost all the proposals (working assumptions) have majority support, rapporteur list almost of them under the section of easy to be agreed, except only one:

**Potential easy agreements:**

**For NB-IoT:**

**Proposal 1-1:** Resource reservation configuration for NR coexistence is only provided via dedicated RRC signalling.

**Proposal 1-2:** Resource reservation configuration for NR coexistence is provided in *PhysicalConfigDedicated-NB*.

**Proposal 1-3:** New Rel-16 IE (s) can be introduced in *PhysicalConfigDedicated-NB* for providing resource reservation configuration for NR coexistence.

**Proposal 1-4:** For FDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

**Proposal 1-5:** For TDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

**Proposal 1-6:** One new IE structure for resource reservation configuration for both DL and UL, and for both TDD and FDD are introduced.

**Proposal 1-7:** Independent definition for periodicity and start position parameters are introduced and the dependency between them can be clarified in the field description.

**Proposal 1-8:** Working assumption: Introduce two UE capabilities for handling resources reservation on DL or UL in *PhyLayerParameters-NB-v16xy.*

**Proposal 1-9:** Working assumption: Two UE capabilities for handling resources reservation on DL or UL in *PhyLayerParameters-NB-v16xy* can be applied to both FDD and TDD, e.g., with separate values for FDD or TDD.

**Proposal 1-10:** Working assumption: Two UE capabilities for handling resources reservation on DL or UL can be introduced into TS 36.306, e.g., section 4.3.4.

**For eMTC:**

**Proposal 2-1:** Configurations related to resource reservation and DL subcarrier puncturing for NR coexistence are provided via dedicated RRC signalling.

**Proposal 2-2:** The configurations related to resource reservation and DL subcarrier puncturing for NR coexistence can be provided in *PhysicalConfigDedicated.*

**Proposal 2-3:** For FDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

**Proposal 2-4:** For TDD, two independent parameters in UL and DL are needed for providing UL and DL resource reservation configuration separately.

**Proposal 2-5:** One new IE structure for resource reservation configuration for both DL and UL, and for both TDD and FDD are introduced.

**Proposal 2-6:** A parameter for providing DL subcarrier puncturing configuration can be introduced in *PhysicalConfigDedicated*, which is for both FDD and TDD.

**Proposal 2-7:** Working assumption: Introduce four UE capabilities for handling resources reservation on UL and DL, and for CE mode A and CE mode B separately, in *PhyLayerParameters-v16xy.*

**Proposal 2-8:** Working assumption: Introduce two UE capabilities for handling DL subcarrier puncturing for CE mode A and CE mode B separately, in *PhyLayerParameters-v16xy.*

**Proposal 2-9:** Working assumption: Six UE capabilities mentioned in **Proposal 2-7 and Proposal 2-8** for handling resources reservation or DL subcarrier puncturing can be applied to both FDD and TDD, e.g., with separate values for FDD or TDD.

**Proposal 2-10:** Working assumption: Six UE capabilities for handling resources reservation or DL subcarrier puncturing can be introduced into TS 36.306.

**Candidates to postpone**

**For eMTC:**

**Proposal 2-1a:** FFS for eMTC, whether and how configurations related to resource reservation and DL subcarrier puncturing for NR coexistence are also provided via SI, e.g, a new SIB.

# 4 List of referenced documents

1. [R2-2002024](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2002024.zip), Summary of Coexistence with NR, ZTE, discussion, Rel-16 LTE\_eMTC5-Core, NB\_IOTenh3-Core, RAN2#109-e
2. R1-1913673, Updated consolidated parameter list for Rel-16 LTE, RAN1#99
3. R2-2000625, Coexistence with NR for NB-IoT, Huawei, HiSilicon, RAN2#109-e
4. R2-2001215, RAN2 impacts of coexistence between NB-IoT and NR, ZTE Corporation, Sanechips, RAN2#109-e
5. R2-2001068, Coexistence with NR for eMTC, Huawei, HiSilicon, RAN2#109-e