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?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
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**Summary: TBD**

**Proposal: TBD**

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?**

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| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
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**Summary: TBD**

**Proposal: TBD**

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

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| 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.

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| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

### 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.**

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| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
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**Summary: TBD**

**Proposal: TBD**

**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

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| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

**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

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| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

### 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

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| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

### 2.1.4 UE capability

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

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| **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** |
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**Summary: TBD**

**Proposal: TBD**

**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

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| --- | --- | --- |
| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

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

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| --- | --- |
| **Company** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

## 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]:

|  |
| --- |
| **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** |
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**Summary: TBD**

**Proposal: TBD**

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** |
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**Summary: TBD**

**Proposal: TBD**

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** |
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**Summary: TBD**

**Proposal: TBD**

**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

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| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

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

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| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

### 2.2.3 DL subcarrier puncturing feature

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

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| **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?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

### 2.2.4 UE capability

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

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| **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?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
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**Summary: TBD**

**Proposal: TBD**

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

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| **Company** | **Yes/No** | **Detailed comments or any suggestion on rewording the proposal** |
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**Summary: TBD**

**Proposal: TBD**

**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

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| **Company** | **Option** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

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

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| **Company** | **Detailed comments** |
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**Summary: TBD**

**Proposal: TBD**

# 3 Conclusions

TBD

# 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