**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 7.38

**Source:** Moderator (Nokia)

**Title:** Email discussion summary for [98-bis-e][124] NR\_6GHz\_unlic\_EU

**Document for:** Information

# Introduction

During RAN#90 a WID on introduction of lower 6GHz NR unlicensed operation for Europe (RP-202592) was agreed.

The objectives of the core part work item are:

* Depending on the details of the European regulatory requirements, determine whether they are best handled by relevant updates (if any) of band n96 or whether a new band is needed.
  + If a new band is needed, determine the band plan for unlicensed operation in the range 5945-6425 MHz
* Define or update (if needed) system parameters such as channel bandwidths and channel arrangements
* Define or update (if needed) transmitter and receiver characteristics requirements for the UE
* Define or update (if needed) transmitter and receiver characteristics requirements for the BS

The objective of the performance part work item is:

* Define or update (if needed) conformance requirements for BS testing.

According to agreed work plan (R4-2101929) the target for this meeting is:

* 3GPP RAN4#98bis-e (Apr. 2021)
  + Agree or endorse TR 38.849 and revised WID if any updates
  + Discussions on core requirements for UE and BS

Some targets from last meeting is still not achieved as summarized in R4-2103320. As a result, they will also be included this meeting

* 3GPP RAN4#98-e (Jan. 2021)
  + Agree if the frequency range for unlicensed operation in Europe are best introduced to the specification by relevant updates (if any) of band n96 or whether a new band is needed.

## Rapporteur contributions

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2107196 | Nokia | draft TR 38.849 v0.2.0 – the document is reserved and proposed for email approval to capture agreements during RAN4#98-bis-e |

# Topic #1: Band plan and LPI and VLP deployment

The contributions and proposals/observations related to the band plan for the introduction of lower 6GHz NR unlicensed operation for Europe as well as LPI and VLP deployment is discussed under this topic and the contributions and relevant proposals/observations have been included in the Table 2.1.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104882 | Apple | **Proposal 1:** Leverage existing band n96 to support license-exempt usage of the 6GHz band in EU/CEPT countries. |
| R4-2106273 | Skyworks Solutions Inc. | **Proposal 1:** Band n96 definition is reused to support 6GHz European unlicensed spectrum on top of North America FCC spectrum and strive for the support of other regulation in the world like the recently announced cases in Korea, Brazil and Saudi Arabia which all cover the 1200MHz of n96.  **Proposal 2:** Note 14 in Table 5.2-1 is modified as shown below to enable the support of the European unlicensed spectrum with n96.  **Proposal 3:** Two new NS are allocated to band n96 to cover LPI and VLP devices and n96 channels in the 5945-6425MHz range are allocated to these NS and used according to above tables to restrict the operation in the 5945-6425MHz spectrum. |
| R4-2107197 | Nokia | **Proposal 1:** Introduce the 5945 MHz to 6425 MHz frequency range for unlicensed operation in Europe by adopting option 1 i.e. re-use already defined n96.  **Proposal 2:** The restriction of n96, for US operation only, should be discussed by RAN4.  **Proposal 3:** Introduce LPI deployment to 3GPP specification with priority but also include VLP with available requirements.  **Proposal 4:** RAN4 to investigate NB deployments in the 6GHz band |
| R4-2106604 | ZTE Corporation | **Proposal 1:** to define new band for Europe unlicensed 6GHz. |
| R4-2104883 | Apple | **Proposal:** We ask RAN WG4 to consider a scenario when an outdoor UE is connected to the indoor |
| R4-2104884 | Apple | **Proposal:** We ask RAN WG4 to consider how to introduce support for the 6GHz band in countries that are not covered by the scope of the existing WIs. |

## Open issues summary

### Sub-topic 1-1 - Bandplan

It is needed to come to an agreement if a new band should be defined or existing n96 can be updated. As agreed at RAN4#98 in R4-2103229 unlicensed operation in the range 5945-6425 MHz can be introduced by:

**Issue 1-1: New band or reuse n96**

* Proposals
  + **Option 1:** Re-using already defined band n96
    - FFS if additional notes and/or clarifications are needed. Regional specific requirements to be included in relevant specifications.
  + **Option 2:** Defining a new band n[xx]
    - On top of specific requirements provided by ECC, the new band shall reuse requirements already defined for n96, where possible.
* Recommended WF
  + Option 1 – how to add additional notes and/or clarifications are FFS

As argued in multiple contributions the notes (e.g. Note 14 in 38.101-1) restricting n96 to US operation might be to restrictive given other countries have adopted the same frequency range for unlicensed operation.

**Issue 1-2a: Regional restriction for n96**

* Proposals
  + **Option 1:** The regional restrictive notes in the UE and BS specification shall be removed
  + **Option 2:** The regional restrictive notes in the UE and BS specification shall be modified
  + **Option 2:** The regional restrictive notes in the UE and BS specification shall not be removed or modified
* Recommended WF
  + Option 2 – FFS on how to define the notes.

Currently the WID related to this discussion summary is only concerning lower 6GHz NR unlicensed operation for Europe. It should be discussed how unlicensed operation in the 6GHz range can be included for other regions.

**Issue 1-2b: Use of n96 in other regions**

* Proposals
  + **Option 1:** The WID (RP-202592) shall be modified at next RAN to include unlicensed operation in the 6GHz range for other regions.
  + **Option 2:** A new WID shall be proposed at next RAN to include unlicensed operation in the 6GHz range for other regions.
* Recommended WF
  + Discuss the options above as this is a RAN decision.

### Sub-topic 1-2 - LPI and VLP deployment

Two types of deployments, LPT and VLP, are defined by ECC as described in detail in TR 37.890. As agreed at RAN4#98 in R4-2103229 LPI deployment shall be supported by 3GPP specification. However, support of VLP support are still FSS. It was during RAN4#98 noted that regulations for VLP deployments are still not fully mature meaning not all requirements are yet available from a regulatory perspective.

**Issue 1-3: Shall VLP deployment be supported by 3GPP specification**

* Proposals
  + **Option 1:** VLP deployment shall be introduced to 3GPP specification with available requirements.
  + **Option 2:** VLP deployments can be introduced to 3GPP specification at a later stage when regulatory requirements have been finalized.
* Recommended WF
  + Option 2 with the agreement that VLP deployments shall be supported by 3GPP specification when regulatory requirements have been finalized.

If it is decided to introduce VLP deployments to the 3GPP specification, then is it suggested in R4-2104883 that RAN4 should further consider a scenario when an outdoor UE is connected to the indoor LPI base station.

**Issue 1-4: Is further** **co-existence studies needed to enable VLP deployments**

* Proposals
  + **Option 1:** Yes
  + **Option 2:** No
  + **Option 3:** Too early to conclude
* Recommended WF
  + Option 3 – it is needed to have full understanding of the regulatory requirements for VLP deployments

Considering the ECC Decision (20)01, which allows channels lower than 20 MHz with a maximum ERIP density of 10 dBm/MHz shall RAN4 consider defining specifications for these narrow band channels.

**Issue 1-5: Shall RAN4 consider introduction of NB channels**

* Proposals
  + **Option 1:** Yes
  + **Option 2:** No
  + **Option 3:** Too early to conclude
* Recommended WF
  + Option 3 – this shall be further discussed

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 1-1 - Bandplan**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| BT plc | BT plc supports OPTION 2 and believes 3GPP should define a new band for 6 GHz NR-U in Europe.  This will enable the development of low-cost NR-U devices operating below 6425 MHz, by removing the requirements to operate up to 7125 MHz.  **We believe NR-U devices need to have zero additional cost compared to 5GHz Wi-Fi, to become financially viable**. **Option 1 would delay the development of low-cost 6GHz NR-U for the European market and be detrimental to the global success of NR-U.**  At present it is not possible to cover both bands n46 & n96 with a single transceiver. Hence, band n96 is only achievable at additional cost; whereas relaxing the upper frequency limit from 7125 MHz down to 6425 MHz, would facilitate the development of a single transceiver that can cover both band n46 and the European 6GHz NR-U band.  The problem with option 1 is that it mandates functionality that isn’t required in Europe and adds cost to NR-U devices.  We are not against device vendors choosing to leverage existing band n96 hardware to cover the new 6GHz NR-U band, defined for Europe. The 3GPP specifications **should be written to enable vendors the choice to develop either low cost 6GHz NR-U devices**, or to re-use existing n96 hardware. |

**Sub-topic 1-2 - LPI and VLP deployment**

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #2: UE related

Discussions related to how the introduction of unlicensed operation in the range 5945-6425 MHz for the UE specification shall be treated.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2106273 | Skyworks Solutions Inc. | **Proposal 2:** Note 14 in Table 5.2-1 is modified as shown below to enable the support of the European unlicensed spectrum with n96.  **Proposal 3:** Two new NS are allocated to band n96 to cover LPI and VLP devices and n96 channels in the 5945-6425MHz range are allocated to these NS and used according to above tables to restrict the operation in the 5945-6425MHz spectrum. |
| R4-2104882 | Apple | **Proposal 2:** Introduce new NS flag(s) to support CEPT regulatory requirements on the 3GPP band n96 (6GHz band). |
| R4-2106274 | Skyworks Solutions Inc. | **Observation** on in-band A-MPR for VLP devices: Aside for 20MHz BW which is in-band PSD limited, all higher bandwidths are EIRP limited. This conclusion is valid for Korean regulation too.  **Observation** on in-band A-MPR for VLP devices: It can be seen that PC5 offers a good compromise for LPI devices with MOP achieved for the 20MHz interlace waveform that drive the cell range   * In all bandwidth and waveforms no A-MPR is needed for the European 10dBm/MHz limit * For Korea however, all waveforms and bandwidths will require A-MPR except for the fully allocated 80MHz cases.   **Proposal 1** for VLP device in-band PSD A-MPR:   * A specific Band n96 NS is introduced * A mechanism is needed to limit MOP to 14dBm for VLP devices and use the associated NS. * A-MPR is defined versus this 14dBm limit and is 0dB for all waveforms and bandwidth except for 20MHz BW where 0.5dB A-MPR is granted for both CP-OFDM and DFT-s-OFDM   **Proposal 2** for LPI device in-band PSD A-MPR:   * A specific Band n96 NS is introduced * No A-MPR is needed |
| R4-2107198 | Nokia | **Proposal 1:** Introduce channels according to the NR-ARFCN and GSCN listed in the TPs  **Proposal 2:** NSs corresponding to deployments defined in EN 303 687 shall be defined in 38.101-1.  **Proposal 3:** Initially only introduce PC5 for NR unlicensed operation in Europe in the 5945 MHz to 6425 MHz frequency range. |
| R4-2107351 | Qualcomm Incorporated | A-MPR simulations were run for the European 6 GHz unlicensed band against the in-band PSD and additional spurious emission requirements. **An A-MPR table is proposed for PC5 LPI devices.** |

## Open issues summary

### Sub-topic 2-1 – NS definition

As agreed at RAN4#98 in R4-2103229 a NS shall be defined corresponding to LPI deployments and if introduced also VLP deployments. The inclusion of VLP deployments and if a new band should be defined or n96 reused is discussed under Topic 1 why the discussion under this topic is focused on how a NS can be defined.

**Issue 2-1:** **Is it sufficient to limit MOP for VLP deployment with NS,** **if VLP are to be supported by 3GPP specification**

* Proposals
  + **Option 1:** Yes – reusing existing PC5 with additional NS limitations to TX power is sufficient
  + **Option 2:** No – a new PC is needed defined for VLP deployments
* Recommended WF
  + Option 1 – based on provided contributions this and last meeting requirements can be meet.

**Issue 2-2: How to capture the NS(s) in 38.101-1**

* Proposals
  + **Option 1:** Use the TP provided in R4-2106274 and capture this by TP to TR 38.849
  + **Option 2:** Request compagnies to provide draftCR or TP at next meeting
* Recommended WF
  + Postpone this discussion until it is aged if a new band should be defined or n96 reused.

### Sub-topic 2-2 - NR-ARFCN and GSCN

As agreed at RAN4#98 in R4-2103229 NR-ARFCN and GSCN already defined for n96 should be re-used in the frequency range applicable to 6GHz NR unlicensed operation in Europe. This is independent if n96 is reused or a new band is defined. In R4-2107198 the NR-ARFCN and GSCN of n96 corresponding to the 5945 MHz to 6425 MHz frequency range have been listed.

**Issue 2-3: List of NR-ARFCN and GSCN**

* Proposals
  + **Option 1:** The lists given in the TP of R4-2107198 is correct
  + **Option 2:** The lists given in the TP of R4-2107198 needs to be corrected
* Recommended WF
  + Agree a list of NR-ARFCN and GSCN to be included to specifications which shall be captured by TP to TR 38.849

### Sub-topic 2-3 – MPR and A-MPR

MPR studies have been conducted based on the agreed assumptions at RAN4#98 in R4-2103229. Two compagnies have provided result at this meeting in R4-2106274 and R4-2107351. Since the introduction of VLP deployments are discussed under different topics this will only focus on agreeing values for LPI deployments.

**Issue 2-4: MPR and A-MPR for LPI deployments**

* Proposals
  + **Option 1:** Adopt the proposed values from R4-2106274
  + **Option 2:** Adopt the proposed values from R4-2107351
  + **Option 3:** Merge the values from R4-2106274 and R4-2107351 to a combined proposal
* Recommended WF
  + Option 3 – the agreed values are to be captured by TP to TR 38.849

## Companies views’ collection for 1st round

### Open issues

Sub-topic 2-1 - NS definition

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub-topic 2-2 - NR-ARFCN and GSCN

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub-topic 2-3 - MPR and A-MPR

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### CRs/TPs comments collection

TPs provided is discussed in the previous section.

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: BS related

Discussions related to how the introduction of unlicensed operation in the range 5945-6425 MHz for the BS specification shall be treated.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2106604 | ZTE Corporation | **Proposal 1:** to define new band for Europe unlicensed 6GHz. |
| R4-2106659 | ZTE Corporation | draftCR |
| R4-2107199 | Nokia | **Proposal 1:** Introduce channels according to the NR-ARFCN and GSCN listed in TPs that are included.  **Observation 1:** There is no need to modify or add additional unwanted emission requirements besides the ones already defined for band n96.  **Observation 2:** There is no need to modify or add receiver requirements besides the ones already defined for band n96.  **Proposal 2:** ΔfOBUE and ΔfOOB shall follow n96  **Observation 3:** There is no need to modify or add additional requirements for output power besides the ones already defined for band n96.  **Observation 4:** There is no need to modify or add additional requirements for REFSENSE besides the ones already defined for band n96. |

## Open issues summary

The inclusion of VLP deployments and if a new band should be defined or n96 reused is discussed under Topic 1 why the discussion under this topic is focused only on other aspects.

### Sub-topic 3-1 - NR-ARFCN and GSCN

As agreed at RAN4#98 in R4-2103229 NR-ARFCN and GSCN already defined for n96 should be re-used in the frequency range applicable to 6GHz NR unlicensed operation in Europe. This is independent if n96 is reused or a new band is defined. In R4-2107199 the NR-ARFCN and GSCN of n96 corresponding to the 5945 MHz to 6425 MHz frequency range have been listed.

**Issue 3-1: List of NR-ARFCN and GSCN**

* Proposals
  + **Option 1:** The lists given in the TP of R4-2107199 is correct
  + **Option 2:** The lists given in the draftCR R4-2106659 is correct
* Recommended WF
  + Agree a list of NR-ARFCN and GSCN to be included to specifications which shall be captured by TP to TR 38.849

### Sub-topic 3-2 – ΔfOBUE and ΔfOOB

As the captured in WF at RAN4#98 in R4-2103229 if ΔfOBUE/ ΔfOOBB should follow n46 or n96 is FFS.

**Issue 3-2: ΔfOBUE and ΔfOOB**

* Proposals
  + **Option 1:** ΔfOBUE/ ΔfOOBB should follow n46
  + **Option 2:** ΔfOBUE/ ΔfOOBB should follow n96
  + **Option 3:** ΔfOBUE/ ΔfOOBB should be further discussed
* Recommended WF
  + Option 3 – given only two compagnies have contributed with different opinion

### Sub-topic 3-3 – BS maximum output power

As the captured in WF at RAN4#98 in R4-2103229 it is FFS if BS maximum output power should be specified further in 38.104.

**Issue 3-3: BS maximum output power**

* Proposals
  + **Option 1:** There should not be further clarifications as compared to those given for n96 in 38.104
  + **Option 2:** There should be additional clarifications added to 38.104
* Recommended WF
  + Option 1 – it should not be needed to add additional clarifications than those included for other unlicensed bands

### Sub-topic 3-4 – REFSENS requirements

As the captured in WF at RAN4#98 in R4-2103229 it is FFS if REFSENS requirements should be specified further in 38.104.

**Issue 3-4: REFSENS requirement**

* Proposals
  + **Option 1:** There should not be additional REFSENS requirements as compared to those given for n96 in 38.104
  + **Option 2:** There should be additional REFSENS requirements added to 38.104
* Recommended WF
  + Option 1 – it should not be needed to add additional REFSENS requirements other than those included for n96

## Companies views’ collection for 1st round

### Open issues

Sub-topic 3-1 - NR-ARFCN and GSCN

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub-topic 3-2 - ΔfOBUE and ΔfOOB

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub-topic 3-3 - BS maximum output power

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub-topic 3-4 - REFSENS requirements

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| **R4-2106659** | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents