**3GPP TSG-RAN WG4 Meeting # 98-bis-e Rev. of R4-2105197**

**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

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| **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

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| **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**

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| **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. |
| Qualcomm | Issue 1-1: We support option 1Issue 1-2a: We support option 1 to remove the noteIssue 1-2b. As noted by the moderator, this is a discussion that needs to happen at RAN plenary since it deals with work management and tracking. |
| Skyworks | Issue 1-1: Option 1 is the only viable option to develop cost effective NRU solutions that support WW 5GHz and 6GHz eco-system and also fully resues the WiFi 6 and 6E hardware. Even in this option it is possible to enable solutions that would only conform to the European spectrum like it exists for 5GHz alone.Issue 1-2a: To enable the uses n96 for North America and Europe but also Korea, Brazil and Saudi Arabia and more to come the note needs to be removed or modified. If needed the note can also elaborate on the valid spectrum for Europe so Option 2 may be needed.Issue 1-2b. This needs to be a RAN decision but RAN 4 may have a recommendation if it can be agreed. |
| ZTE | Issue 1-1: We support option 2, in addition,as mentioned by BT that, to define new band don’t prevent to leverage the existing implementation for n96. In addition, for BS perspective, to implement band n96 and new EU unlicensed 6GHz should be different especially on the front-end filter design, we need to be careful to protect the licensed 6GHz band in EU.Issue 1-2b: this should be up to RAN-P decision.  |
| Huawei | We still support option 2. As pointed out in R4-2106604, the BS requirements are band centric and hence a n96 BS would have a number or requirements which are different, specifically in the region outside the EU frequency range but inside n96 in this case it is more of an issue than other examples as the operating bandwidth difference between the EU band (480MHz) and band n96 (1200MHz) means that the FOUBE value will be different. Ultimately it would be necessary to have special notes and exceptions everywhere for band n96 saying “in Europe…..” . a n96 BS would not be compatible with using in Europe (In the Tx the emission requirements in the top of the band would not meet the EU requirements, and in the Rx there would potentially be out of band blockers inside the n96 operating band) so effectively we would have n96 BS and Europe n96 BS. If it has different requirements and a different frequency range it seems better to make it a new band. For a UE as the requirements are carrier centric rather than band centric the same issue may not apply but if the n96 requirements are identical to Europe n96 then the 2 bands can be approved at the same time so not sure why a new band is an issue?For UE we believe there is the potential for better performance with a smaller frequency range, if this is the case and as there are a number of reasons to use a different band number we don’t see the negative side of introducing a new band. |
| Ericsson | Issue 1-2a: option 2 Issue 1-2b. None of the options, it’s a RAN Plenary matter |
| CableLabs | Issue 1-1: Option 1.Issue 1-2a: Option 2, shall be modified. The regional restrictive notes for the U.S. markets should be kept. While notes for other regions/markets should be added. |
| Apple | **Issue 1-1**: Option 1, we prefer leveraging existing band n96. @**BT**: We already have a NOTE in the spec saying that the whole frequency range is applicable only in US. So a device built specifically for the EU market does not have to meet the US requirements. This can be of course checked further in RAN4. As a more general comment, as an OEM vendor we do not see any cost saving in making a transceiver that will cover band n46 and 5945-6425MHz range when compared to a transceiver that covers both band n46 and full band n96. In fact, one can argue that making a specific transceiver for the EU band conflated with a brand new 3GPP band will even increase cost as we will have to introduce support for the corresponding band and band combinations, test them, etc. @**ZTE**: There is no licensed 6GHz band in EU and there are no requirements to protect it. And since the outcome of further regulatory discussions is not known, we shall proceed with what we have avoiding speculations on what might happen. As a reminder, this WI was resumed with the assumption that we have all the regulatory decisions agreed. @**Huawei**: If we introduce a new band just because FOUBE is different, then we might end up introducing a new band even for other countries/regions that use the whole frequency range because the 6GHz band has slightly different parameters. **Issue 1-2a**: As we can see more and more countries adopting the whole 5925-7125MHz frequency range for the unlicensed operation, we should think of a more holistic approach to this NOTE. In principle we can keep it and update every time yet another country makes the corresponding decision, but this is not flexible. The easiest approach will be just to remove the NOTE. Having or not having this NOTE does not change local regulations, and the local deployments will anyway have to use only allowed frequencies.**Issue 1-2b**: We do not have a strong view on whether we should extend this WI or instantiate a new one (leveraging an existing WI will be the easiest way to avoid procedural overhead). What matters most for us is that we have one AI where we can discuss 6GHz regulations and how to support them in 3GPP specifications. |
| Nokia | Issue 1-1: Option 1Issue 1-2a: Option 1 - some note indicating restriction to shared spectrum operation shall remain.Issue 1-2b: This will rely on RAN discussion and agreement.  |
| BT plc. | Sub-topic 1-1.To address the issues raised by Skyworks and Apple.It’s our view that option 2 (a dedicated 6GHz NR-U band for Europe) would in effect become an extension for existing 5GHz Wi-Fi & NR-U transceivers. This effectively becomes the core band for all Wi-Fi and NR-U devices, combining the European and US markets (populations ~750M and ~330M respectively).3GPP standard should be written to permit device vendors to choose the most cost-effective implementation for regional markets. This is only permitted by option 2.The reason why this is important, is because 3GPP needs a viable ‘small cell’ solution for the majority of (low-cost) handsets. Not just high-end handsets supporting the mmWave band. |
| Vivo  | Issue 1-1: We support option 1, it could reduce implementation and compliance test effort.Issue 1-2a: We support option 1 or option 2. |

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

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| **Company** | **Comments** |
| Qualcomm | Issue 1-3: Option 1. The ECC decision includes both LPI and VLP and in fact states that “It should be noted that the -45 dBm/MHz OOB limit below 5935 MHz for VLP would allow VLP initial market to take up”. So the ECC decision was purposeful to allow VLP initial market to take up. If 3GPP were to delay VLP, it would indicate a bias towards LPI which might not be the appropriate message to deliver. Which regulatory requirements are missing for VLP?Issue 1-4: Option 2, no further coex study neededIssue 1-5: Option 2, NB channels would require fundamental waveform design and is not supported by NR-U. |
| Skyworks | Issue 1-3: To enable UE outdoor to connect to an indoor BS VLP requirement should be developed => Option 1, at least for AMPR there are no unknown on VLP device requirementIssue 1-4: It is not clear to us whether there is any coexistence requirement uncertainty since the -45dBm/MHz emission requirement is defined.Issue 1-5: in our understanding NB channels have frequency hopping requirements that are not readily compatible with NRU. |
| Huawei | These discussions are linked to the outcome of 1-1 I think |
| Ericsson | Issue 1-3: Option 1Issue 1-4: Option 2: No, it’s not needed as ECC decision doesn’t contain any restriction on VLP operation. If any new requirements, new NS values can be defined.Issue 1-5: Option 3 |
| CableLabs | Issue 1-3: Option 1 |
| Apple | **Issue 1-3**: Option 2 will be Ok for us. As a remark, our understanding is that the VLP regulatory requirements are completed. What remains a bit unclear is whether we can/will have VLP deployments because outdoor operation anyway prohibits base station usage, even VLP. And for indoor, it is always more efficient to use LPI.**Issue 1-4**: We would prefer RAN4 to take a look at the scenario presented in our paper R4-2104883 to ensure that we will not unintentionally violate regulatory requirements by having outdoor UE that will operate under LPI base stations with higher transmission power. @**all**: There is no issue with VLP or co-existence requirements. The main problem is that a UE might end up following LPI parameters whereas it is outdoor and thus must use VLP.**Issue 1-5**: Option 2. Narrow-band operation with hopping channels is not likely to be covered by the NR-U.  |
| Nokia | Issue 1-3: Preference for option 1, but understand that others want to check furtherIssue 1-4: Option 2, there should be no additional need since the regulations are available.  |

## 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.*

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|  | **Status summary**  |
| **Issue 1-1** | *Tentative agreements:*No change since last meeting, there are still companies supporting both options and it does not seem like they are converging.*Candidate options:** + **Option 1:** Re-using already defined band n96 – **6 supporting companies**

(Qualcomm, Skyworks, CableLabs, Apple, Nokia, Vivo)* + **Option 2:** Defining a new band n[xx] - **3 supporting companies**

(BT plc, ZTE, Huawei)*Recommendations for 2nd round:*Further discuss the issue. If possible GTW time is requested to resolve this in the sake of progress. |
| **Issue 1-2a** | *Tentative agreements:*Since no company supported not to modify the regional restrictive notes in the UE and BS specification for n96 and only one company only support removing the note it is proposed to compromise to option 2 and modify the note.*Candidate options:** + **Option 1:** Remove Note – **4 supporting companies**

(Qualcomm, Apple, Nokia, Vivo)* + **Option 2:** Modify Note- **6 supporting companies**

(Skyworks, Ericsson, CableLabs, Apple, Nokia, Vivo)* + **Option 3:** Don’t modify Note – **0 supporting companies**

(None)*Recommendations for 2nd round:*Further discuss how the note shall be modified. The agreement or options to be captured in WF. |
| **Issue 1-2b** | *Tentative agreements:*All companies suggested to leave this for RAN discussion or had no strong preference. As a result, no further discussion is needed.*Candidate options:** + **Option 1:** Include 6GHz range for other regions to the EU WID
	+ **Option 2:** Include 6GHz range for other regions by new WID
	+ *Recommendations for 2nd round:*

No further discussion at this meeting. |
| **Issue 1-3** | *Tentative agreements:*Only small changes in company opinions since last meeting, there are still companies supporting both options. Further discussion is needed.*Candidate options:** + **Option 1:** Include VLP - **5 supporting companies**

(Qualcomm, Skyworks, Ericsson, CableLabs, Nokia)* + **Option 2:** Wait with including VLP - **2 supporting companies**

(Huawei, Apple)*Recommendations for 2nd round:*Further discuss the issue in 2nd round and capture agreements in WF or TR. |
| **Issue 1-4** | *Tentative agreements:*Companies either think there is no need for further studies or want to investigate specific scenario. Further discussion is needed. *Candidate options:** + **Option 1:** Further co-existence studies for VLP - **0 supporting companies**

(None)* + **Option 2:** No Further co-existence studies for VLP - **3 supporting companies**

(Qualcomm, Ericsson, Nokia)* + **Option 3:** Co-existence studies for VLP is FFS/unclear - **2 supporting companies**

(Skyworks, Apple)*Recommendations for 2nd round:*Further discuss the issue in 2nd round. |
| **Issue 1-5** | *Tentative agreements:*Companies either state that NB channels are not supported by NR-U or want to investigate further. It is suggested not to discuss this further this meeting and interested companies can return next meeting with further information.*Candidate options:** + **Option 1:** Yes to NB channels - **0 supporting companies**

(None)* + **Option 2:** No to NB channels - **3 supporting companies**

(Qualcomm, Skyworks, , Apple)* + **Option 3:** NB channels are FFS - **1 supporting companies**

(Ericsson)*Recommendations for 2nd round:*No further discussion at this meeting. |

### CRs/TPs

*N/A*

## Discussion on 2nd round (if applicable)

**Issue 1-1**

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| **Company** | **Comments** |
| Deutsche Telekom | We support option 2. Manufacturer shall have the freedom to implement devices and equipment for Europe. A separate band will not prevent manufacturer to leverage benefits of creating products that serve all regions.  |
| TIM | We also support the definition of a new band n[xx], i.e. option 2. |
| BT plc. | BT remains in favour of a dedicated European band for 6GHz NR-U ( 5945 ~ 6425 MHz - option 2).We see no evidence that NR band n96 can coexist alongside 6 GHz IMT without harmful interference. The proponents of NR band n96 should show evidence that; NR band n96 devices can comply with article 3.2 of the European directive 2014/53/EU, when operating nearby a 6GHz IMT system. 6GHz RLANs and 6GHz IMT systems will be deployed in close proximity to each other; and operate in adjacent bands.1) A band n96 receiver will have no filter rejection in the range 6.425 ~ 7.125 GHz to limit receiver blocking, from a nearby 6GHz IMT terminal or base station.**It should be noted that**, the draft harmonised ETSI standard ( EN 303 687 v 0.0.12 ) for 6GHz RLANs in Europe does not test ‘receiver blocking’ performance for frequencies above 6424 MHz. Hence, the current draft of the harmonised ETSI standard does not show compliance with the European Radio Equipment Directive (RED); given ‘receiver blocking’ isn’t tested!<https://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=58036>2) The ECC Decision (20)01 hasn’t specified ‘out of band’ emissions, above 6425MHz (considering f). The lack of a defined OOB value, does not remove the need for all radio equipment to comply to article 3.2 of the European directive 2014/53/EU.**We believe that a dedicated 6GHz NR-U band for Europe (option 2) is necessary to comply with the Radio Equipment Directive 2014/53/EU**. It should enable lower device costs for the European Market (as it will allow a single transceiver to cover both the 5 and 6GHz bands), as well as improve radio performance. |
| Apple | It seems that this discussion and arguments just go in circles. Referring back to the comment from BT, there is no 6GHz IMT and, as the result, there are naturally no EU/CEPT requirements for that. Irrespective of the fact whether there is a new band or not, we cannot implement requirements that do not exist. And similarly, if new requirements emerge, they can be implemented in the same way irrespective of the fact whether we have a new 3GPP band or leverage band n96.  |
| Skyworks | Regarding the aspect of coexistence with IMT licensed band we cannot account for that and it has already been agreed that no filtering above 6425MHz is assumed. It was formaly discussed in RAN that this WI should only start once the regulation is available for the work, which all companies agreed this was the case with referencing to the “ECC Decision (20)01, On the harmonised use of the frequency band 5945-6425 MHz for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) approved 20 November 2020”. With the A-MPR evaluation (ie MPR is sufficient) done, the UE can meet the emission requirement in that document, so we do not see what we should prove any further. In any case of additional/changes requirement this can be handled by NS (whatever the band).Moreover, the WiFi 6E is claiming applicability to Europe as is which just the limitation to the relevant sub-band (like for the 5GHz band) and is not considering any additional protection of the IMT bands beyond complying with the emissions. |
| Apple | We would like to echo what Skyworks indicated - the WI indeed was resumed with an understanding that we followed agreed and existing regulatory requirements captured in the corresponding ECC document. And that document does not specify any potential requirements for the IMT 6GHz band, if any. As an additional piece of information, do please refer to the latest ECC PT1 #68 (April 2021) meeting notes regarding WRC23 AI. The official EU/CEPT standpoint for the 6425-7025 and 7025-7125MHz frequency range is “TBD”, there is no official decision/assumption regarding how the aforementioned frequency range will be used and whether any specific requirement will be devised. And existing requirements for 5945-6425MHz were developed without any assumption for what might be used in higher blocks (i.e. we do not need to worry what if IMT will operate there). Based on that we kindly ask companies to stay within the scope of the agreed WI. |

**Issue 1-2a**

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| **Company** | **Comments** |
| Qualcomm | We can support the modified note in a generic form as shown in option 2 of the WF, “This band is only applicable subject to regional and/or country specific restrictions.” |
| Nokia | We suggest using the generic note in WF; “This band is only applicable subject to regional and/or country specific restrictions”, for band n96.  |
| Apple | The generic note is preferred as it will cover countries/regions that have been adopting the 6GHz band (and there will be no need to update the note every time a new country adopts 6GHz). |
| Skyworks | The note should be changed to make sure n96 can apply to new countries/regions that adopt 6GHz |

**Issue 1-3**

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| **Company** | **Comments** |
| Qualcomm | We continue to support including VLP into the specifications since regulatory rules are available in the same ECC report and to the same level as LPI. Apple acknowledges that the VLP regulatory requirements are completed, but questions whether there will be VLP deployments. If 3GPP does not include VLP requirements in its specifications, then there is a very good chance that there will not be VLP deployments! It does not look favorable upon 3GPP to refuse to define requirements that the regulators are expecting because one company does not understand how it might be deployed. The ECC has already written “The VLP outdoor use is intended to cover short range applications for small area direct communications.” LPI cannot satisfy this usage since LPI is not allowed to operate outdoors. |
| Nokia | The concern related to very specific deployment is in our opinion addressed when developing the regulatory requirement related to VLP. Therefor we se no reason not to introduce these to specification enabling VLP support by the 3GPP standard.  |
| Apple | @**Qualcomm**: We never claimed that EU/CEPT regulatory requirements are incomplete. What we emphasize is that it is clear that outdoor VLP base stations are not allowed (not only in EU, but also in South Korea and Brasil, where the VLP-like operation is also possible). Based on that we kindly request companies to clarify which deployments they envision if the VLP NR-U base stations are prohibited. And our understanding is that short range peer-to-peer like VLP operation is out of scope of NR-U. |

**Issue 1-4**

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| **Company** | **Comments** |
| Qualcomm | No further coexistence studies are needed as they have already been performed by ECC. Apple points out a potential indoor/outdoor problem but this was already identified previously in R4-2102416. We expect these are specific deployment problems that, if they occur, will have to be solved by deployment practices. We do not expect a UE RF solution to this problem. |
| Nokia | Similar comment as for Issue 1-3, we believe the concerns have been addressed when developing the regulatory requirements. There should be no further need for studies within 3GPP.  |
| Apple | Referring to R4-2102416 (Qualcomm), the paper also acknowledges that the problem exists: “*A potential problem exists if a UE operating outdoors connects to an indoor base station. In this case, the UE will receive the NS\_XX indication from the LPI base station and potentially transmits in violation of VLP MOP, PSD, and ASE. Solutions for this problem if needed are beyond the scope of UE RF specifications*.”. This is exactly the same use case that we have described also in our document. Which solution we will/might have should be discussed further in RAN4, but neglecting this problem will lead to UEs violating the regulatory requirements.  |

# 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

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| **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** |
| Qualcomm | Issue 2-1: Option 1 for now. In the future, if the need arises, we can consider a different PC for VLP. |
| Skyworks | Issue 2-1: using PC5 with PCmax limitation is straightforward for now. If justified Issue 2-2: if use of n96 is agreed, the method proposed in R4-2106274 can be used as astarting point. One critical aspect is the power limitation for VLP devices |
| Ericsson | Issue 2-1: Option 1 |
| Apple | Issue 2-1: Option 1. It should be sufficient to re-use existing PC5 with the corresponding NS flags.Issue 2-2: We are Ok to use TP provided in R4-2106274 assuming that VLP use case will be discussed further (technically NS flags for VLP are ok).  |
| Nokia | Issue 2-1: Option 1Issue 2-2: We have no strong preference but would recommend to capture agreed text in the TR. |

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Skyworks | Issue 2-3: the list in R4-2107198 is correct and the same than in R4-2106273, just a different format. But the question is whether it should be linked to NS or not. |

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 2-4: Option 2. The values in R4-2106274 only consider the in-band PSD and not the spurious emissions and are therefore incomplete. But we certainly welcome checking of the values proposed in R4-2107351. |
| Skyworks | Issue 2-4: indeed we could only look into the in-band PSD limited cases and we could agree on those first, and discuss the OOB limited case values based on R4-2107351 this meeting, provided we can check them for next meeting. |
| Apple | Issue 2-4: Our preliminary simulation results for LPI have A-MPR very close at least to what presented in R4-2107351. We can take these values as a starting point and calibrate them further next meeting when we complete our A-MPR simulations.  |
| Nokia | Issue 2-4: We are fine adopting either proposal or a combination as option 3. The values can be captured in the TR in backets for further checking.  |

### 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**  |
| **Issue 2-1** | *Tentative agreements:*All companies are supporting that reusing existing PC5 with additional NS limitations to TX power is sufficient to limit MOP for VLP. Hence, option 1 should be agreed*Candidate options:** + **Option 1:** Yes, NS is sufficient to limit MOP - **5 supporting companies**

(Qualcomm, Skyworks, Ericsson, Apple, Nokia)* + **Option 2:** No, NS is not sufficient to limit MOP - **0 supporting companies**

(None)*Recommendations for 2nd round:*Capture agreement for Option 1 in WF. |
| **Issue 2-2** | *Tentative agreements:*It seems premature to make this decision now given other discussions needs to be resolved. Therefor it is proposed to return to this next meeting on the basis of TPs or draftCRs submitted for discussion.*Candidate options:** + **Option 1:** Use the TP provided in R4-2106274 - 2 **supporting companies**

(Skyworks, Apple)* + **Option 2:** Provide draftCR or TP at next meeting - **0 supporting companies**

(None)*Recommendations for 2nd round:*No further discussion at this meeting. |
| **Issue 2-3** | *Tentative agreements:*As commented by one company the list in R4-2107198 is correct and the same as the one in R4-2106273. Hence, it is suggested to capture the list of NR-ARFCN and GSCN points in the TR 38.849 by TP to discussed in 2nd round.*Candidate options:** + **Option 1:** NR-ARFCN and GSCN list is correct - **2 supporting companies**

(Skyworks, Nokia)* + **Option 2:** NR-ARFCN and GSCN list is not correct - **0 supporting companies**

(None)*Recommendations for 2nd round:*Discuss a TP with the list of NR-ARFCN and GSCN points for the TR 38.849. |
| **Issue 2-4** | *Tentative agreements:*It seems companies are okay with the MPR values proposed in R4-2107351. However, they would like to check further until next meeting. As a result, the values are proposed by R4-2107351 is suggested captured in WF in brackets. *Candidate options:** + **Option 1:** Adopt MPR from R4-2106274 - **0 supporting companies**

(None)* + **Option 2:** Adopt MPR from R4-2107351- 2 **supporting companies**

(Qualcomm, Apple)* + **Option 3:** Merge the values from R4-2106274 and R4-2107351 - 2 **supporting companies**

(Skyworks, Nokia) *Recommendations for 2nd round:*Capture tentative agreement for MPR in brackets in the WF. |

### CRs/TPs

*N/A*

## Discussion on 2nd round (if applicable)

**Issue 2-1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | The summary from round 1 for candidate options lists Option 1 for yes and Option 2 for no. However, both options say “NS is sufficient to limit MOP”. The WF document is fine. |
| Nokia | Apologies for the missing “not” in option 2. It should be correct in the WF and are now also added in this summary. |

**Issue 2-3**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | A draft TP is shared in the draft inbox for further discussion.  |

**Issue 2-4**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | A WF with values in [ ] have been shared, companies are encouraged to suggest apocopate modifications.  |
| Skyworks | The values in the WF are aligned with our input but what it shows is that MPR is sufficient to meet LPI requirements in Europe. So as capturing the values it is fine but in out view the A-MPR for LPI in EU could be simply captured with a sentence saying that the MPR is sufficient to meet NSXX requirements |

# 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  ZTE | Reply on the band definition and propose to postpone the discussion for BS RF. |
| Huawei | This really depends on the outcome of 1-1 as to how the EU band is handled. |
| Nokia  | Issue 3-1: Option 1 - we believe this correctly covers the range. The list should be captured in the TR for further reference |

Sub-topic 3-2 - ΔfOBUE and ΔfOOB

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | reply on the band definition and propose to postpone the discussion for BS RF. |
| Huawei | As the frequency range for the EU band is smaller than n96 the FOUBE will be different(40MHz) |
| Ericsson | Option 3 |
| Nokia | Issue 3-2: Option 2 |

Sub-topic 3-3 - BS maximum output power

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Fine with recommended WF |
| Ericsson  | Option 1 |
| Nokia | Issue 3-3: Option 1 |

Sub-topic 3-4 - REFSENS requirements

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Fine with recommended WF |
| Ericsson | Option 1 |
| Nokia | Issue 3-4: Option 1 |

### 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**  |
| **Issue 3-1** | *Tentative agreements:*Companies propose to postpone this discussion until band definition is clear.*Candidate options:** + **Option 1:** NR-ARFCN and GSCN list in R4-2107199 - **1 supporting companies**

(Nokia)* + **Option 2:** NR-ARFCN and GSCN list is R4-2106659 - **0 supporting companies**

(None)*Recommendations for 2nd round:*No further discussion at this meeting. |
| **Issue 3-2** | *Tentative agreements:*Companies propose to postpone this discussion until band definition is clear.*Candidate options:** + **Option 1:** ΔfOBUE/ ΔfOOBB should follow n46 - **1 supporting companies**

(Huawei)* + **Option 2:** ΔfOBUE/ ΔfOOBB should follow n96 - **1 supporting companies**

(Nokia)* + **Option 3:** ΔfOBUE/ ΔfOOBB should be further discussed - **1 supporting companies**

(Ericsson)*Recommendations for 2nd round:*No further discussion at this meeting. |
| **Issue 3-3** | *Tentative agreements:*All companies agree there is no further need for clarifications as compared to those given for n96 in 38.104 for BS maximum output power.*Candidate options:** + **Option 1:** There should not be further clarifications - 3 **supporting companies**

(ZTE, Ericsson, Nokia)* + **Option 2:** There should be further clarifications - **0 supporting companies**

(None)*Recommendations for 2nd round:*Capture agreement for Option 1 in WF. |
| **Issue 3-4** | *Tentative agreements:*All companies agree there is no further need for additional REFSENS as compared to those given for n96 in 38.104.*Candidate options:** + **Option 1:** There should not be additional REFSENS - 3 **supporting companies**

(ZTE, Ericsson, Nokia)* + **Option 2:** There should be additional REFSENS - **0 supporting companies**

(None)*Recommendations for 2nd round:*Capture agreement for Option 1 in WF. |

### 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)

**Issue 3-3**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | The WF have been shared in draft folder capturing option 1. |

**Issue 3-4**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | The WF have been shared in draft folder capturing option 1. |

*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** |
| R4-2105383 - WF on introduction of lower 6GHz NR unlicensed operation for Europe | Nokia |  |
| R4-2105384 - TP to TR 38.849 on NR-ARFCN and GSCN points | Nokia |  |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-2104882 | Band plan for lower 6GHz NR unlicensed operation for Europe | Apple | Noted |  |
| R4-2106273 | RF front-end supporting NRU in 6GHz EU spectrum with band n96 | Skyworks Solutions Inc. | Noted |  |
| R4-2107196 | draft TR 38.849 v0.2.0 | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2107197 | On system parameters for the lower 6GHz NR unlicensed operation | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2106274 | A-MPR due to in-band PSD limit for 6GHz EU unlicensed spectrum | Skyworks Solutions Inc. | Noted |  |
| R4-2107198 | On UE RF aspects for the lower 6GHz NR unlicensed operation | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2107351 | A-MPR for European NR-U 6 GHz band | Qualcomm Incorporated | Noted |  |
| R4-2106604 | Discussion on BS RF requirements for Europe unlicensed 6GHz | ZTE Corporation | Noted |  |
| R4-2106659 | draft CR for introduction of Europe unlicensed 6GHz | ZTE Corporation  | Not Pursued | It is premature to endorse draftCR since discussion is still ongoing on how to capture the frequency range in specification |
| R4-2107199 | On BS RF aspects for the lower 6GHz NR unlicensed operation | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2104883 | On simultaneous low power and very low power operation | Apple | Noted |  |
| R4-2104884 | Apple | Apple | Noted |  |

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