**3GPP TSG-RAN WG4 Meeting # 99-e R4-21xxxxx**

**Electronic Meeting, May 19th – 27th, 2021**

**Agenda item:** 15

**Source:** Moderator (Apple)

**Title:** Email discussion summary for [99-e][161] US\_n77

**Document for:** Information

# Introduction

This document summarizes the email discussions on the topic of enabling US 3.45 – 3.55GHz spectrum usage in Band n77 which has been allocated in agenda item 15. There are total of 14 contributions in this email thread which consists of 4 discussion papers, 4 CRs for UE and 6 CRs for BS.

The goal in this meeting is to conclude the support of 3.45 – 3.55GHz range in US Band n77 with the necessary UE and BS CRs agreed as a package.

# Topic #1: Enabling US 3.45 – 3.55GHz in Band n77

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2109174**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109174.zip)  Type: Discussion  For: Approval | Mediatek India Technology Pvt. | **Title:** Discussion on enabling US 3.45 – 3.55GHz in Band n77  **Observation 1:** Regarding UE performance and power consumption for higher power class (PC), UE can be optimized for supporting frequency up to 3980MHz which is upper bound in US-n77 restriction ranges. In that sense, if there is no higher PC usage for n77 in other countries/regions, we think 2 options below can be candidates for modification of Note 12.   * Option1: “In the USA the Band n77 usage is restricted to outside the Band n48 frequency range and below 3980MHz.” * Option2: “In the USA this band is restricted to 3700 – 3980 MHz and 3450 – 3550 MHz (UE capability)”   **Observation 2**: In US region, for cell-searching efficiency, a device can perform n77 band scan only from 3450 – 3550 MHz and 3700 – 3980 MHz which aligns with option 2 in Observation 1.  **Proposal 1:** Keep Rel-15 RAN4 spec unchanged.  **Proposal 2:** In Rel-16, Note 12 in Table 5.2-1 in TS 38.101-1 is revised as: “In the USA this band is restricted to 3450 – 3550 MHz (depending on UE capability) and 3700 – 3980 MHz.  **Proposal 3:** In Rel-17 and onward, Note 12 in Table 5.2-1 in TS 38.101-1 is revised as: “In the USA this band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz.  **Proposal 4:** Introduce a new UE capability to indicate the supporting of DoD band in Rel-16. Network should assume the UE is not able to access DoD band if the capability is not reported.  **Observation 3**: For initial access, Rel-16 UE can read the Mobile Country Code in SIB1 to decide whether it can camp on the cell found in DoD band.  **Proposal 5:** NBC issue happens for Rel-15 legacy UEs. RAN4 to leave it to RAN2 on whether and how to resolve it. |
| [**R4-2109442**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109442.zip)  Type: Discussion  For: Approval | Apple, Skyworks Solutions Inc., T-Mobile USA | **Title:** Supporting evolving regulation in band n77 for US 3.45 to 3.55 GHz usage  **Proposal 1:** RAN4 shall adopt the band n77 note to read “In the USA this band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz.”  **Proposal 2:** The legacy UE issue identified last meeting is not possible to resolve outside of 3GPP scope.  **Observation 1**: The goal of the potential solution to the legacy UE issue is to allow the network to distinguish the two UE types in order to avoid the error conditions in handover and SCell/PSCell activation of the Type 1 UE in the Type 2 network.  **Observation 2**: If regulatory requirements for a band change within a release, then there is no signaling mechanism available for the UE to indicate that it can comply with a certain subset of the regulation and, consequently, a subset of the 3GPP conformance requirements.  **Proposal 3:** 3GPP shall introduce a method for the specification to phase in regional regulatory changes associated with a 3GPP band and for UEs to indicate to the network with which regulation the UE is in compliance.  **Proposal 4**: 3GPP shall define one modifiedMPR bit corresponding to band n77, such that if the UE sets the bit, then it implies that the UE supports the new sub-range 3.45-3.55 GHz, and if the UE does not set the bit, then it implies that the UE does not support the new sub-range (i.e. it only supports 3.7-3.98 GHz).  **Observation 3**: If there is a preference to associate the modifiedMPR bit with A-MPR requirements (which are set to 0 dB), then as an alternative to Proposal 4, 3GPP shall define a new NS flag NS\_X corresponding to the band n77 sub-range of 3.45-3.55 GHz, 0 dB A-MPR, and one modifiedMPR bit corresponding to NS\_X, such that if the UE sets the bit, then it implies that the UE supports the new sub-range 3.45-3.55 GHz, and if the UE does not set the bit, then it implies that the UE does not support the new sub-range (i.e. it only supports 3.7-3.98 GHz).  **Proposal 5**: 3GPP should discuss further whether explicit indication, via another modifiedMPR behavior bit, is needed to distinguish UEs which implement the Rel-15 version of band n77 requirements from UEs which implement the Rel-16 (May 2020) version of band n77 requirements. |
| [**R4-2110979**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110979.zip)  Type: Discussion  For: Discussion | Qualcomm Incorporated, AT&T | **Title:** Enabling usage of Band n77 for US 3.45 – 3.55 GHz  **Recommendation:**  Based on the observations made in this contribution, while it is recognized that there is a potential issue related to UE’s that support one portion of the Band n77 spectrum but not the other in the US, it is not expected to be a common occurrence nor is the outcome irrecoverable in most cases. On the other hand, we observe that the longer 3450 – 3550 MHz is delayed in 3GPP, the more likely there will be an increasing population of devices that do not support the frequency range and therefore the increasing significance of a potential issue. Therefore, it is proposed to adopt the changes in [4] to enable the US 3450 – 3550 MHz frequency range using Band n77. |
| [**R4-2111533**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111533.zip)  Type: Discussion  For: Approval | CableLabs, Charter Communications, Comcast, Google, Qualcomm and DISH Network | **Title:** TDD synchronization between bands n48 and n77  **Observation:** TDD synchronization between bands n48 and n77  **Proposal:** adding a note in Table 5.2-1 in TS 38.104. “NOTE 5: USA TDD base stations in bands n48 and n77 within frequency ranges 3.45 – 3.55 GHz and 3.7 – 3.98 GHz deployed in the same geographical area are recommended to operate with TDD synchronization to reduce the probability of inter-band downlink-to-uplink interference. TDD synchronization indicates base stations deployed in the same geographical area are cell phase synchronized as required in [5]-[6] and use the same or equivalent TDD configuration.” |
| [**R4-2111068**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111068.zip)  Type: Discussion  For: Approval | CableLabs, Charter Communications, Comcast, Google, Qualcomm and DISH Network | **Title:** TDD synchronization between bands n48 and n77  **Moderator’s Note:** This is a duplicate submission with the same contents as R4-2111533. This document has been withdrawn. |
| [**R4-2109443**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109443.zip)  Type: CR  For: Agreement  CAT: F  Rel-16  TS 38.101-1 | Apple, Skyworks Solutions Inc., T-Mobile USA | **Title:** Addition of 3.45-3.55 GHz and modifiedMPR behavior in Band n77 for the US  **Reason for change:**  In the USA the FCC has released new rules and auctioned the frequency range 3700-3980 MHz in 2020, and the corresponding frequency range restriction and coexistence requirements were captured into the Rel-16 specification. In March 2021 the FCC has released new rules for the frequency range 3450-3550 MHz, which is also covered by n77. Due to high demand of 3.5 GHz spectrum in the US, enabling the use of the new frequency range within band n77 as quickly as possible is a priority for the entire cellular ecosystem.  A potential change of the Rel-16 specification to allow both sub-ranges in n77 for US operation would create two different network types and also two different types of Rel-16 devices: one type (legacy or Type 1) which could not support 3450-3550 MHz operation, and another (Type 2) which does. The goal of the solution proposed in this CR is to allow the network to distinguish the two UE types in order to avoid the error conditions in handover and SCell/PsCell activation of the Type 1 UE in the Type 2 network.  **Summary of change:**  **Change 1**: in the US the FCC has only licensed the range from 3700 – 3980 MHz and plans to license the range from 3450-3550 MHz. Thus, other frequency ranges (e.g. 3300-3450 GHz; 3980-4200 GHz) within band n77 are not allowed by US regulation (and the range spanned by band n48 follows separate requirements). Based on this understanding, the note to band n77 is updated to read “In the USA this band is restricted to 3450-3550 MHz and 3700-3980 MHz"  **Change 2**: to resolve the legacy UE issue, the change defines one modifiedMPR bit corresponding to band n77, such that if the UE sets the bit, then it implies that the UE supports the new sub-range 3450-3550 MHz, and if the UE does not set the bit, then it implies that the UE does not support the new sub-range (i.e. it only supports 3700-3980 MHz). |
| R4-2109444  Type: CR  For: Agreement  CAT: A  Rel-17  TS 38.101-1 | Apple, Skyworks Solutions Inc., T-Mobile USA | **Title:** Addition of 3.45-3.55 GHz and modifiedMPR behavior in Band n77 for the US  **Note**: This is the mirror CR of R4-2109443. |
| [**R4-2110980**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110980.zip)  Type: CR  For: Agreement  CAT: F  Rel-16  TS 38.101-1 | Qualcomm Incorporated | **Title:** Addition of new spectrum in Band n77 for US  **Reason for change:**  Band n77 requirements apply only over the frequency range 3700 – 3980 MHz in the US.  **Summary of change:**  The frequency range applicability note for Band n77 is changed to exclude the Band n48 frequency range for the US rather than to apply only to 3700 – 3980 MHz. |
| R4-2110981  Type: CR  For: Agreement  CAT: A  Rel-17  TS 38.101-1 | Qualcomm Incorporated | **Title:** Addition of new spectrum in Band n77 for US  **Note**: This is the mirror CR of R4-2110981. |
| [**R4-2109393**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109393.zip)  Type: CR  For: Agreement  CAT: F  Rel-16  TS 38.104 | Nokia, Nokia Shanghai Bell | **Title:** CR to TS 38.104: Additional of FCC emission limits on US 3.45-3.55 GHz band  **Reason for change:**  FCC emission limits in US 3.45-3.55 GHz band are not specified for Band n77.  **Summary of change:**  Specify the FCC emission limits in US 3.45-3.55 GHz band as additional regional operating band unwanted emissions requirements for Band n77. |
| R4-2109394  Type: CR  For: Agreement  CAT: A  Rel-17  TS 38.104 | Nokia, Nokia Shanghai Bell | **Title:** CR to TS 38.104: Additional of FCC emission limits on US 3.45-3.55 GHz band  **Note**: This is the mirror CR of R4-2109394. |
| [**R4-2109395**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109395.zip)  Type: CR  For: Agreement  CAT: F  Rel-16  TS 38.141-1 | Nokia, Nokia Shanghai Bell | **Title:** CR to TS 38.141-1: Additional of FCC emission limits on US 3.45-3.55 GHz band  **Reason for change:**  FCC emission limits in US 3.45-3.55 GHz band are not specified for Band n77.  **Summary of change:**  Specify the FCC emission limits in US 3.45-3.55 GHz band as additional regional operating band unwanted emissions requirements for Band n77. |
| R4-2109396  Type: CR  For: Agreement  CAT: A  Rel-17  TS 38.141-1 | Nokia, Nokia Shanghai Bell | **Title:** CR to TS 38.141-1: Additional of FCC emission limits on US 3.45-3.55 GHz band  **Note**: This is the mirror CR of R4-2109395. |
| [**R4-2111536**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111536.zip)  Type: CR  For: Agreement  CAT: B  Rel-16  TS 38.104 | CableLabs, Charter Communications, Comcast, Google, Qualcomm, DISH Network | **Title:** CR to TS 38.104: adding a note on inter-band TDD synchronization between n48 and n77  **Reason for change:**  We submitted a contribution R4-2111533 that discusses the reason of change.  **Summary of change:**  Adding a note in Table 5.2-1 in TS 38.104. “NOTE 5: USA TDD base stations in bands n48 and n77 within frequency ranges 3.45 – 3.55 GHz and 3.7 – 3.98 GHz deployed in the same geographical area are recommended to operate with TDD synchronization to reduce the probability of inter-band downlink-to-uplink interference. TDD synchronization indicates base stations deployed in the same geographical area are cell phase synchronized as required in [21]-[22] and use the same or equivalent TDD configuration.” Adding references [21] and [22] that are cited in the note.  **Moderator’s Notes**:   1. This should be a category F CR. 2. CR number is missing |
| [**R4-2111066**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111066.zip)  Type: draftCR  For: Agreement  CAT: B  Rel-16  TS 38.104 | CableLabs, Charter Communications, Comcast, Google, Qualcomm, DISH Network | **Title:** draftCR to TS 38.104: adding a note on inter-band TDD synchronization between n48 and n77  **Moderator’s Notes**: This document has been withdrawn. |
| R4-2111531  Type: CR  For: Agreement  CAT: B  Rel-17  TS 38.104 | CableLabs, Charter Communications, Comcast, Google, Qualcomm, DISH Network | **Title:** CR to TS 38.104: adding a note on inter-band TDD synchronization between n48 and n77  **Note**: This is the mirror CR of R4-2111536.  **Moderator’s Note**: This should be a category A CR. |

## Open issues summary

**Issue 1.2-1: How to modify Note 12 in Table 5.2-1 in TS 38.101-1 to include the support of 3.45 – 3.55 GHz in addition to 3.7 – 3.98 GHz in US Band n77?**

### Option 1: “In the USA this band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz”

* Option 2: “In the USA the Band n77 usage is restricted to outside the Band n48 frequency range”
* Option 3: “In the USA this band is restricted to 3450 – 3550 MHz (depending on UE capability) and 3700 – 3980 MHz” for Rel-16; “In the USA this band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz” for Rel-17 and onward.

**Issue 1.2-2: Does the network need to distinguish devices supporting the new frequency range or not within the same release?**

### Option 1: Yes (R4-2109174, R4-2109442, impact on legacy UE and network efficiency due to handover and SCell/PSCell activation errors)

* Option 2: No (R4-2110979, impact is limited)

**Issue 1.2-3: Which one of the following solutions can be used to distinguish UE supporting the new frequency range or not?**

### Option 1: Use a modifiedMPR bit corresponding to Band n77 to indicate the support of the 3.45 – 3.55GHz range (R4-2109442)

* Option 2: Introduce a new UE capability to indicate the support of DoD band in Rel16 (R4-2109174)

**Issue 1.2-4: Will there be non-backward-compatibility (NBC) issue for Rel-15 legacy UE?**

### Option 1: Yes

* Option 2: No

**Issue 1.2-5: Is it agreeable to add a note in TS 38.104 Table 5.2-1 to recommend USA TDD base stations synchronization in bands n48 and n77 within frequency ranges 3.45 – 3.55 GHz and 3.7 – 3.98 GHz deployed in the same geographical area?**

### Option 1: Yes

* Option 2: No

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  | Issue 1.2-1: |
|  |  |
|  |  |

### Comment collection for discussion papers

|  |  |
| --- | --- |
| **Tdoc number** | **Comments** |
| [**R4-2109174**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109174.zip) | **Title**: Discussion on enabling US 3.45 – 3.55GHz in Band n77 |
| [**R4-2109442**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109442.zip) | **Title:** Supporting evolving regulation in band n77 for US 3.45 to 3.55 GHz usage |
| [**R4-2110979**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110979.zip) | **Title:** Enabling usage of Band n77 for US 3.45 – 3.55 GHz |
| [**R4-2111533**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111533.zip) | **Title:** TDD synchronization between bands n48 and n77 |

### CRs/TPs/LSs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2109443**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109443.zip) | **Title:** Addition of 3.45-3.55 GHz and modifiedMPR behavior in Band n77 for the US |
|  |
| [**R4-2110980**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110980.zip) | **Title:** Addition of new spectrum in Band n77 for US |
|  |
| [**R4-2109393**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109393.zip) | **Title:** CR to TS 38.104: Additional of FCC emission limits on US 3.45-3.55 GHz band |
|  |
| [**R4-2109395**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109395.zip) | **Title:** CR to TS 38.141-1: Additional of FCC emission limits on US 3.45-3.55 GHz band |
|  |
| [**R4-2111536**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111536.zip) | **Title:** CR to TS 38.104: adding a note on inter-band TDD synchronization between n48 and n77 |
|  |

## 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:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
|  |  |
|  |  |
|  |  |

## Discussion on 2nd round (if applicable)

The following CRs are returned to 2nd round to see if agreement can be reached with further clarifications or revisions.

|  |  |
| --- | --- |
|  | **Title:** |
|  |
|  | **Title:** |
|  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
|  |  |
|  |  |