**3GPP TSG-RAN WG4 Meeting # 104-e R4-221xxxx**

**Electronic Meeting, 15– 26 August 2022**

**Agenda item:** 12.4.5

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [104-e][128] LTE\_terr\_bcast\_bands\_UERF

**Document for:** Information

# Introduction

This document summarizes the email discussion for the following agenda items

* + 1. General and work plan [LTE\_terr\_bcast\_bands\_part2-Core]
    2. Band definition and system parameters [LTE\_terr\_bcast\_bands\_part2-Core]
    3. UE RF requirement maintenance [LTE\_terr\_bcast\_bands\_part2-Core]

for the Rel-18 work item on 5G Broadcast (RP-220518). Discussion of basestation Tx requirements is treated in thread 316 including Proposal 3 in documents R4-2211555, R4-2211981, R4-2211982, and R4-2212099 and Proposal 3 in R4-2211585. This document is organized by the following topics: system parameters, band definition, and UE RF requirements.

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Qualcomm Incorporated | Gene Fong | gfong@qti.qualcomm.com |
| SWR | Jochen Mezger | Jochen.mezger@br.de |
| ZTE Corporation | Fei Xue | Xue.fei25@zte.com.cn |
| T-Mobile USA | Bill Shvodian | bill.shvodian@t-mobile.com |
| Rohde & Schwarz | Niels Petrovic | niels.petrovic@rohde-schwarz.com |
| Huawei | Peng (Henry) Zhang | zhangpeng169@huawei.com |
| Ericsson | Dominique Everaere | dominique.everaere@ericsson.com |
| TDF | Pierre Brétillon | pierre.bretillon@tdf.fr |
| Nokia | Hisashi Onozawa | [hisashi.onozawa@nokia.com](mailto:hisashi.onozawa@nokia.com) |
| Sony | Olof Zander | Olof.zander@sony.com |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)

# Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2211555**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211555.zip) | SWR | Proposal 1:RAN4 to define a new band type for independent downlink-only transmissions.  Proposal 2:RAN4 to define a band for LTE based 5G Terrestrial Broadcast covering the spectrum range 470 – 698 MHz to be used in terms of 6, 7 or 8 MHz carrier bandwidth.  Proposal 3 is treated in thread 316. |
| [**R4-2211585**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211585.zip) | ROHDE & SCHWARZ | Proposal 1: Define the band 5B0 (470 – 698 MHz) for LTE based 5G Terrestrial Broadcast with bandwidths possibilities of 6, 7 and 8 MHz in respect to ITU recommendations as well as regional and local regulations within different ITU regions.  Proposal 2: Define a new band type Supplementary Downlink Only (SDO) to be used for LTE based 5G Terrestrial Broadcast.  Proposal 3 is treated in thread 316. |
| [**R4-2211981**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211981.zip) | Cellnex | Proposal 1:RAN4 to define a new band type for independent downlink-only transmissions.  Proposal 2:RAN4 to define a band for LTE based 5G Terrestrial Broadcast covering the spectrum range 470 – 698 MHz to be used in terms of 6, 7 or 8 MHz carrier bandwidth.  Proposal 3 is treated in thread 316. |
| [**R4-2211982**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211982.zip) | BNE | Proposal 1:RAN4 to define a new band type for independent downlink-only transmissions.  Proposal 2:RAN4 to define a band for LTE based 5G Terrestrial Broadcast covering the spectrum range 470 – 698 MHz to be used in terms of 6, 7 or 8 MHz carrier bandwidth.  Proposal 3 is treated in thread 316. |
| **[R4-2212071](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212071.zip" \t "_parent)** | Nokia, Nokia Shanghai Bell | Observation 1: Reference standards and regulations for this work item are for DTT transmission, which is different from the ones for cellular systems.  Observation 2: Although the coexistence study is not in the scope of this work item, at least the network deployment assumption needs to be studied w.r.t. whether the existing general UE and BS RF requirements for legacy bands can be reused for this new band or not. |
| [**R4-2212072**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212072.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: It is proposed to specify a new band(s) clearly distinguished from other conventional cellular bands in RAN4 specifications.  Proposal 2: It is further discussed whether RAN4 can specify a harmonized band for all the regions.  Proposal 3: It is further discussed where and how to define operating bands in the existing specifications.  Observation 1: FDD duplex mode can be used for this new band used only for a MBMS dedicated cell.  Proposal 4: Spectrum utilization 90% is specified in TS 36.101 and TS 36.104.  Observation 2: There is no specific requirement for channel spacing.  Proposal 5: 100 kHz channel raster is proposed for LTE based 5G broadcast band(s). It is FFS if only valid channel location is explicitly clarified in the specifications for each channel bandwidth.  Proposal 6: Once we agree how many bands are specified, operating band number(s) next to the one for NR\_600MHz\_APT is(are) reserved for LTE based 5G broadcast band(s).  Observation 3: E-ARFCN after 70655 is available for LTE\_TDD\_1670\_1675MHz and LTE based 5G broadcast band(s), which need to be coordinated among the WIs. |
| [**R4-2212073**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212073.zip) | Nokia, Nokia Shanghai Bell | Observation 1: The band is downlink only and is used for MBMS dedicated cell.  Observation: UE receiver RF requirement needs to be specified without the help of uplink or other simultaneous 3GPP bands.  Observation 2: UE receiver requirements, such as maximum input level, adjacent channel selectivity (ACS) and blocking characteristics (in-band, out-of-band) need to be evaluated for the DTT deployment scenarios.  Proposal 1: It is further discussed how to specify UE RF requirement for MBMS dedicated band considering the test aspects.  Proposal 2: The impact of mismatched channel bandwidth and channel filter bandwidth shall be further studied w.r.t. the impact of ACI if it can provide sufficient ACS. |
| [**R4-2212099**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212099.zip) | TDF | Proposal 1:RAN4 to define a new band type for independent downlink-only transmissions.  Proposal 2:RAN4 to define a band for LTE based 5G Terrestrial Broadcast covering the spectrum range 470 – 698 MHz to be used in terms of 6, 7 or 8 MHz carrier bandwidth.  Proposal 3 is treated in thread 316. |
| [**R4-2213698**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213698.zip) | ZTE Corporation | Proposal 1: to further discuss the highest frequency of LTE based broadcast with regional regulators.  Proposal 2: to define the lowest frequency of LTE based broadcast as 470MHz;  Proposal 3: the band number for LTE based broadcast could be 105 or 106 which depends on the ongoing discussion in Rel-18.  Proposal 4: to define the duplex mode of LTE based broadcast band as DL only.  Proposal 5: to follow the Rel-17 agreement for transmission bandwidth configuration for 6/7/8MHz.  Proposal 6: to follow the existing channel spacing for LTE base broadcast or not to define channel spacing for LTE based broadcast.  Proposal 7: use the carrier based approach to define the channel raster for LTE based broadcast with its granularity as 100kHz. |
| [**R4-2214002**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214002.zip) | Qualcomm Incorporated | Observation 1: 5G terrestrial broadcast may need new broadcast dedicated RF requirements  Observation 2: 5G terrestrial broadcast system does not have uplink but receiver performance can still be tested with the aid of application layer. Mapping of BLER metric to core RF requirements on throughput needs further discussion.  Observation 3: New FRC’s are needed for Rel-18 5G terrestrial broadcast RF performance requirements.  Observation 4: Regulatory documents indicated in the WID should be reviewed for possible inclusion into the 3GPP specifications. Not all of the documents are freely available within the public domain.  Proposal 1: How to handle 6, 7 and 8 MHz bandwidth in the specifications should be coordinated between UE and BS specifications.  Proposal 2: Two options are blocker placement shall be considered. The first is according to 10 MHz LTE channelization and the second is specific blocker placement according to 6, 7, and 8 MHz broadcast channelization. The power levels are still to be studied, but should take into consideration the assumption of coordination between nearby broadcast transmitters.  Proposal 3: Discuss whether the same reference sensitivity as LTE 10 MHz can apply for bandwidths of 6, 7, and 7 MHz in broadcast bands, whether it can be scaled to bandwidth, or whether more detailed study is warranted. |

# Topic #1: System parameters

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Open issues summary

The following open issues have been identified and presented in company contributions

Sub-topic 1-1 Coexistence

Sub-topic 1-2 New band type

Sub-topic 1-3 Channel bandwidths

Sub-topic 1-4 Channel spacing and channel raster

Sub-topic 1-5 Spectrum utilization

### Sub-topic 1-1 Coexistence

Aspects related to system parameters was discussed in a number of papers. It was recognized by all companies that the WID indicates coordination between systems operating in the same geography is expected

The operation and planning of transmitters in these bands is different from cellular. In most cases, coordination mechanisms are in place so that when a new transmitter is proposed to be deployed in a given region, appropriate measures are taken (e.g. in terms of specific requirements for that transmitter, or usage of guard channels) to ensure coexistence with other systems in the same geography.

Nonetheless, Nokia in R4-2212071 proposes that the HPHT deployment was not the scenario studied in 3GPP when the general coexistence parameters were derived and when MBMS was specified. Therefore, before applying the general coexistence parameters (ACLR, ACS, etc), some study should first be conducted. On the other hand, ZTE in R4-2213699 (treated in thread 316) agrees that currently TN BS is not applicable for HPHT scenario. However, for how to protect the DTT service, there were some discussions in the past e.g., Band 20 or Band n71 (9 MHz guard band) and its coexistence requirement were also captured in BS spec. ZTE suggest to follow the legacy regulatory requirement instead of further do the evaluation study again.

**Issue 1-1: Coexistence**

* Is a coexistence study for HPHT deployment needed?
  + Option 1: Yes
  + Option 2: No
* Recommended WF
  + Discuss in the first round.

### Sub-topic 1-2 New band type

It was recognized that the existing band types FDD, TDD, SDL are not well suited for the 5G broadcast band(s) and that a new type should be created. It was also suggested that a new suffix could be used to capture the specific requirements related to these downlink-only bands.

If there is a new band type created, is there any impact to other specifications in other working groups?

**Issue 1-2: New band type**

* Is a new band type needed?
  + Option 1: Yes
  + Option 2: No
* Recommended WF
  + If the answer is Yes, then please also comment whether there is impact to other WG’s
  + If the answer is No, then please comment on how existing band types could be used

### Sub-topic 1-3 Channel bandwidths

The bandwidths allocated for broadcast in the UHF band are 6, 7, and 8 MHz depending on the region. However, LTE specifications only define bandwidths of 1.4, 3, 5, 10, 15, and 20 MHz. One option is to explicitly define new 6, 7, and 8 MHz channels (recognizing on the UE side that new filters should not necessarily be assumed). The other option is to reuse the existing bandwidths, perhaps taking into account some of the ideas explored in the NR study item on efficient use of non-standard bandwidths.

**Issue 1-3: Channel bandwidths**

* How should the channel bandwidths be handled?
  + Option 1: New channel bandwidths 6, 7, and 8 MHz are defined in both BS and UE specifications, applicable only to the 5G broadcast bands. It is recognized that the UE will not necessarily incorporate a new filter, rather only the existing 10 MHz filter should be assumed.
  + Option 2: The existing LTE bandwidths are used to cover the 5G broadcast channels.
  + Option 3: Other solutions?
* Recommended WF
  + Based on the contributions submitted, companies seem to recommend option 1 but all options can be discussed in the first round.

### Sub-topic 1-4 Channel spacing and channel raster

The conventional channel raster resolution for LTE is 100 kHz. However, the broadcast channelization for the UHF band is fixed for 6, 7, or 8 MHz channels.

**Issue 1-4: Channel spacing and channel raster**

* How should the channel spacing and channel raster be handled?
  + Option 1: Maintain the 100 kHz channel raster for generality. Some channel raster points may not be used.
  + Option 2: Downsample the channel raster to 3 sets of possibilities, for 6, 7, and 8 MHz channelizations.
* Recommended WF
  + Decide between the two options for channelization stating the reason for your preference

### Sub-topic 1-5 Spectrum utilization

Table 2.3.1-1: Maximum transmission bandwidth configurations for MBMS

|  |  |  |  |
| --- | --- | --- | --- |
| Bandwidth | 6 MHz | 7 MHz | 8 MHz |
| NRB | 30 | 35 | 40 |

**Issue 1-5: Spectrum utilization**

* + Any concerns with the above? Any other aspect that needs consideration?

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1 Coexistence

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | Option 2. SWR as a network operator supports the view of ZTE. There were already discussions in the past. The decisive requirements are the legacy regulatory requirements for the coexistence between DTT/HPHT and TN/BS. For instance in ITU Region 1 there is the GE06 agreement in force that determines filter masks describing the maximum allowed interferences to/from neighbouring services. |
| ZTE | Option 2 is more preferred since it’s more straight forward to reuse the existing regulatory requirement which has been mandated in the past and work well from the coexistence perspective. |
| T-Mobile USA | Option 1: Yes. 3GPP often provides coexistence requirements to protect other bands which exceed regulatory requirements. |
| Huawei | Question for clarification:  As the clarification in WIDRP-220518, “RAN4 shall assume that coexistence among different systems in the portion of the UHF band allocated to broadcast (~470 - ~694/698 MHz) is ensured through coordination, in line with regional and national regulation.” In my understanding, there is no need to perform the coexistence study between HPHT deployment and IMT deployment. Not sure whether proponent wanted to consider the coexistence among same system, i.e. HPHT to HPHT adjacent channel coexistence? |
| Ericsson | Option 1, as mentioned by Nokia, HPHT was not considered in previous studies.  To Huawei: RAN4 should at least better understand what has been considered by the regulators, what’s the potential impact (if any) on requirements. |
| Qualcomm | We have a preference for option 2. Broadcast services have historically operated by coordination and it is expected they can continue to do so, even if MBMS broadcast is introduced. Regulations are generally technology agnostic so should continue to apply. |
| TDF | Option 2, as existing agreements in each region already guarantee coexistence of DTT and Telecom Networks. |
| Nokia | Existing 3GPP BS requirement is not aligned with DTT transmitter regulations.  It is unclear how the existing 3GPP UE requirement is concluded consistent with HPHT scenario without any study.  At least some analysis needs to made if the existing UE requirement (such as ACS and blocking) can ensure the coexistence. If 3GPP requirement is more relaxed than the existing DTT receiver requirement, the 5G broadcast receiver performance may be poor, i.e., interfered easily by adjacent channels. |
| Moderator | Comments from GTW Aug 17  SWR: we support Option 2. We did operate as the existing one. There is no need for further study.  Nokia: we are not sure how the existing requirements of ACLR.. can be reused. We are not sure if we can skip the study.  Ericsson: We would like to see the study since HPHT is not considered in 3GPP before.  Qualcomm: I have concern on the open-ended co-existence study. The HPHT deployment has been there for long time.  T-Mobile: we often have requirements on top of regulation requirements. We support the idea to study here.  Verizon: study is needed. We need align on the regulation requirements. |

Sub topic 1-2 New band type

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | Option 1. SWR is of the view that option 1 “new band type” is appropriate. Other band types like TDD, FDD or SDL do not reflect the downlink only character of broadcasting. As an operator we need this band type to deploy this kind of networks.  As there is no uplink involved the impact on other WG is at least reduced compared to option 2. |
| ZTE | Option 1, yes, the existing band definition e.g. FDD, TDD or SDL cannot be applicable for DTT bands. Regarding the impacts to other group, it’s better to send the LS to other group and let other WG to figure out the impacts. |
| Rohde & Schwarz | Option 1. Exsiting definitions do not match the needs for 5G broadcast. A DL only band type should be introduced. |
| Ericsson | Option 2 a priori, we think SDL type of band could be used, we have not seen any justification why it can’t be SDL, what would be the issue(s)?  But we are open for further discussion. |
| Qualcomm | Option 1. This does not fit into one of the existing band types. It is not SDL since this is standalone. A new band type for downlink only should be created. It is our understanding that the concept of MBMS dedicated cell already exists in RAN1 and RAN2, so it should be possible to map the new band type to that. |
| TDF | Option 1. An SDL band requires combination with another band, whereas broadcasting operates in standalone, downlink-only mode |
| Nokia | There is only TDD or FDD parameters in RAN1/RAN2, so FDD shall be mapped as a duplex mode like SDL bands in order to enable 100% downlink.  It is possible introduce a new terminology in RAN4, but it shall be only within RAN4 and should not impact RAN1/RAN2. No LS is needed.  A new type, if introduced, shall use FDD parameters defined in RAN1/RAN2. |
| Moderator | Comments from GTW Aug 17  SWR: we are in favor of Option 1.  Nokia: we only have FDD/TDD in RAN1 and RAN2. We can introduce the new band type in RAN4 but do not have impact on other WGs.  Ericsson: we are OK to define the new band type.  ZTE: this broadcast is different from SDL or other band.  T-mobile USA: do we need LS to other WG.  Qualcomm: something has already been included in other WGs.  ZTE: Feature has been captured in other WGs. Maybe we can send LS to RAN1/2 to check. The impact should be marginal.  Huawei: share the similar view as Qualcomm. In RAN1 the receiving only mode. For this mode UE has no need to report capability. We do not send LS.  Nokia: Agree with Qualcomm and Huawei. |

Sub topic 1-3 Channel bandwidths

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | Option 1. SWR thinks that option 1 suits best – noting that a new filter fitting to the 6, 7 and 8 MHz channel bandwidth would be better to improve the system performance.  Using existing LTE bandwidths to cover the 5G broadcast channels are likely to cause a degradation of the system performance. There is no regulatory possibility to use other bandwidths in a distinct broadcasting region. Splitting a channel into different sub-channels could lead to unused residual spectrum per sub-channel and therefore to a loss of system throughput. |
| ZTE | Option 1 is more preferred which is also aligned with the objective. |
| T-Mobile USA | Option 2: We support new channel BWs for the BS for RF requirements, but not the UEs. Several mobile operators requested bandwidths including 6 and 7 MHz be defined to match mobile licensed spectrum bandwidths. There was a lot of pushback from vendors about defining new UE channel bandwidths because new filters and testing would be required. RAN decided to create a study item for irregular channel BWs. For NR PRB blanking and overlapping carriers are being considered for irregular BWs like 6 and 7 MHz I the SI. It would be very unusual for 3GPP to refuse to create new carrier bandwidths for mobile operators while creating new bandwidths for terrestrial broadcasters. |
| Rohde & Schwarz | Option1, we support the introduction of new channel bandwidths |
| Huawei | Question for clarification:  I’d like to check companies’ view if any decision for Channel bandwidths in this WI will have an impact on irregular channel BWs WI or not? |
| Ericsson | We agree with new channel BWs for BS at least. |
| Qualcomm | Option 3. For the basestation, new channel bandwidths may be beneficial since the transmit masks are defined relative to 6, 7, and 8 MHz. For the UE, however, it may suffice to keep 10 MHz bandwidths only. Anyways, it has already been agreed that specialized UE filters should not be assumed. The details on guard band, spectrum utilization, ACS, blocking would need to be addressed.  To Huawei: It should not have an affect on the ongoing SI since this is LTE and the ongoing SI is for NR. |
| TDF | We support option 1, as new channel bandwidths consistent with existing band plan are required to use spectrum efficiently |
| Nokia | We are open to discuss all options. However, option 2 would need to solve contentious issues in the study item of irregular channel BW.  There are unresolved issues such as channel raster alignment. Furthermore, the implication of UE RX performance degradation of the larger CBW method (i.e., to use 10 MHz channel filer for 6/7/8MHz irregular CBW) is still unclear and would need to be concluded if the method is considered for this work item.  For the HPHT scenario with very high adjacent channel power, the implication of relaxing UE Rx filter requirement by allowing 10 MHz channel filter needs to be carefully studied. |
| Moderator | Comments from GTW Aug 17  SWR: go with Option 1.  ZTE: prefer to Option 1 since the band is dedicated.  T-Mobile USA: we have concern on defining the new UE channel bandwidths. Some mobile operators requires supporting of 6, 8 bandwidths. We got a lot of push-back from vendors. They do not want to support the bands. We discussed it for years. Why we should go ahead for broadcast spectrum but not for IMT spectrum?  Qualcomm: I have the similar view as T-Mobile. It seems quick significant change. It is possible to accommodate the broadcast in the existing requirements, like 10MHz filter. We want to see if the existing implementation before agreeing on defining the requirements.  Apple: agree with T-Mobile USA and Qualcomm.  Mediatek: regarding new channel bandwidths or irregular channel bandwidth, it is feasible from base station side. For UE, more discussion is needed.  Nokia: for irregular channel bandwidth, we have many issue (ACS or blocking) not being addressed. We need study more before going for option 2.  Huawei: I think we reach any agreement. It should have no impact on the NR on-going SI for irregular channel bandwidth. We do not have strong view to define 6,7,8Mhz. But we need the whole picture on whether the new bandwidth for BS or UE.  Qualcomm: in WID, we assume 10MHz filter. Nokia concern cannot be addressed anyway.  Ericsson: it makes sense to introduce new bandwidths on BS side. For UE we need more discussion.  ZTE: agree with Ericsson. For UE side, 10MHz filter is assumed. But how it can protect DTT system. Probably the degradation is expected.  Nokia: we have already had study, which is captured in the TR. There is quite large degradation. |

Sub topic 1-4 Channel spacing and channel raster

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | Option 1. SWR has no particular view on that. But we were told that option 1 is the common approach and would therefore create less implications to the standard. In some situations option 1 is maybe a more flexible solution. |
| ZTE | For option 2, basic granularity is also 100kHz and then just downselect to 6/7/8MHz carriers since DTT carrier freq position is fixed as illustrated in Figure 1 of [R4-2213698](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213698.zip), indeed this is also quite similar as LAA or NR-U channel raster design, therefore the option 2 is more straight forward and aligning with the legacy approach. |
| Rohde & Schwarz | Option 1 would be more in line with the common approach and leave more flexibility in the future. |
| Ericsson | Option 1 would be more flexible to deal with all possible options. |
| Qualcomm | Option 1 for flexibility. I have heard (but not confirmed) that some countries don’t align the center frequencies for broadcast even if they have the same 6, 7, or 8 MHz channel width. |
| Nokia | Option 1 has some benefits if carrier aggregation is possible in this band, then subcarrier grid alignment can be made across component carriers.  More features could be introduced later, so Option 1 would be better to keep some flexibility. |
| Moderator | Comments from GTW Aug 17  ZTE: Option 2. Fixed raster can make initial access easier.  SWR: Option 1 is flexible one.  Qualcomm: We favour option 1. Some country may off set the channel allocation. 100KHz would address that problem. We support flexibility.  Ericsson: Option 1.  ZTE: We are fine with Option 1 if no concern on the initial access complexity. If the offset 5 and 15khz, how to manage that?  Qualcomm: need further discussion. |

Sub topic 1-5 Spectrum utilization

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | If we compare the 8MHz case for the current DVB-T2 broadcasting system with 5G Broadcast it turns out that:  a) 5G Broadcast uses 40x0,18MHz=7,2MHz out of 8MHz, i.e.90% spectrum usage  b) DVB-T2 uses 7,61MHz and in extended mode even 7,77 MHz, i.e. 95%/97% spectrum usage  The consequence is a lower spectrum usage compared to traditional broadcasting systems. Is there a way to improve it? |
| ZTE | This has been agreed in Rel-17 and captured in RAN2 specification, we support the proposal |
| Rohde & Schwarz | We somewhat agree with the SWR comments, but no strong view on this. |
| Qualcomm | This was already agreed so should be the default position. Increasing spectrum utilization also has negative impact to guard bands and emissions. |
| Nokia | Ok. |
| Moderator | Comments from GTW Aug 17  SWR: this was already agreed. This is less efficient. If there is any solution for improvement we are happy. |

## Summary for 1st round

Agreements were made as follows

Sub-topic 1-1 Coexistence

A coexistence study is needed for HPHT scenario to at least verify the applicability of UE and BS coexistence parameters (UE ACS and BS ACLR) against regulations and acceptable performance.

Sub-topic 1-2 New band type

It was agreed that a new band type for “standalone downlink only” is needed. Most companies believed that RAN1 and RAN2 already accommodate downlink-only operation, but one company suggested an LS to confirm wouldn’t hurt.

Sub-topic 1-3 Channel bandwidths

It was agreed that 6, 7, and 8 MHz channel bandwidths at the basestation would be beneficial. However, there was no consensus on whether the new channel bandwidths are needed in the UE specifications. There was also discussion but not consensus on whether there is any relationship or possibility to leverage discussions with the ongoing study item on efficient usage of non-standard bandwidths for NR.

Sub-topic 1-4 Channel spacing and channel raster

Agreement to use 100 kHz channel raster to maintain compatibility with other LTE bands and to enable flexibility compared to fixed 6, 7, and 8 MHz channelization if needed.

Sub-topic 1-5 Spectrum utilization

Agreement to use 30, 35, and 40 RB’s for 6, 7, and 8 MHz channels respectively. It was pointed out by one company that the resulting spectrum utilization is smaller than what is available for DVB-T2, however.

### 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 #1-1 Coexistence** | *Tentative agreements:* A coexistence study for HPHT deployment is needed (agreed in GTW Aug 17)  *Candidate options:*  *Recommendations for 2nd round:* Concisely identify the scope of this coexistence study. What are the objectives and outcome (i.e., verify validity of IMT coexistence parameters UE ACS, BS ACLR in a HPHT scenario), what inputs are needed (i.e., which regulations, which parameters), and what assumptions (deployment layout, transmission power)? |
| **Sub-topic #1-2 New band type** | *Tentative agreements:*A new band type is needed (agreed in GTW Aug 17)  *Candidate options:*  *Recommendations for 2nd round:* No further discussion. Companies are encouraged to check internally if there is any impact to RAN1/RAN2. If found, please inform. |
| **Sub-topic #1-3 Channel bandwidths** | *Tentative agreements:* (Agreed in GTW Aug 17)  For BS, define new channel bandwidths 6, 7, and 8 MHz.  FFS for UE  *Candidate options:*  *Recommendations for 2nd round:* Companies are invited to further discuss the need, benefits, and costs of introducing 6, 7, and 8 MHz bandwidths in the UE specification compared to reusing 10 MHz bandwidth. Aspects needed for consideration should be identified. For the time being in accordance with the agreed WID, it is recommended to respect the assumption of 10 MHz filtering in the UE. |
| **Sub-topic #1-4 Channel spacing and channel raster** | *Tentative agreements:* Option 1: Maintain the 100 kHz channel raster for generality. Some channel raster points may not be used. (agreed in GTW Aug 17)  *Candidate options:*  *Recommendations for 2nd round:* No further discussion. |
| **Sub-topic #1-5 Spectrum utilization** | *Tentative agreements:*According to previous agreement of 30, 35, and 40 RB’s in 6, 7, and 8 MHz channels respectively.  *Candidate options:*  *Recommendations for 2nd round:* No further discussion. |

## Discussion on 2nd round (if applicable)

Sub topic 1-1 Coexistence

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We prefer a brief study rather than a full-blown coexistence simulation effort. In our view, the objective of the study is to confirm the BS ACLR and UE ACS is workable for 5G broadcast deployment. We should also carefully consider goodness criterion. Perhaps the criterion could be not worse than the existing DTT service (not sure how to quantify this) rather than the traditional cellular (5% throughput loss) criteria? |
| Ericsson | We agree to not redo a complete coex study here but some further analysis would still be needed. The proposed WF should have captured our intention. |

Sub topic 1-2 New band type

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

Sub topic 1-3 Channel bandwidths

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

# Topic #2: Band definition

## Open issues summary

One of the objectives of the WID RP-220518 is to specify band(s) within the UHF spectrum allocated to broadcast systems (~470 - ~694/698 MHz, depending on the region). A number of contributions provided suggestions on the number of bands, the lower edge, and the upper edge of such bands.

Some options to consider include

1. Single global band from 470 – XXX MHz defined for 6, 7, and 8 MHz bandwidths
2. Three bands from 470 – XXX MHz with one band for 6 MHz bandwidth, one band for 7 MHz bandwidth, and one band for 8 MHz bandwidth. Each of these bands would be intended for deployment in regions compatible with the defined channel bandwidth.

The advantage o f a single band is a single common ecosystem and global roaming. The disadvantage of a single band is the filter implementation would be expected to cover the entire superset band, therefore not able to provide any rejection in countries where only a portion of the band (i.e., only up to 694 MHz) is available. The advantage of three separate bands is the filter can be tailored to 694, 698, or 702 MHz for example. But the ecosystem is fragmented regionally since it is unlikely that a single device will implement all three bands with three distinct filters.

Another consideration is the current state-of-the-art filter technology may not support a single wideband filter across the entire UHF frequency range. Hence, split filters may be required. Technical data is welcomed.

Some companies proposed Band 105 or 106 for this band and EARFCN range, but the moderator proposes that such details can be resolved in later meetings after the number of bands and basic system parameters have been agreed.

### Sub-topic 2-1 Number of bands

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-1: Number of bands**

* Proposals
  + Option 1: Single global band from 470 – XXX MHz defined for 6, 7, and 8 MHz bandwidths
  + Option 2: Three bands from 470 – XXX MHz with one band for 6 MHz bandwidth, one band for 7 MHz bandwidth, and one band for 8 MHz bandwidth. Each of these bands would be intended for deployment in regions compatible with the defined channel bandwidth.
  + Option 3: Other
* Recommended WF
  + Discuss options in the first round

### Sub-topic 2-2 Frequency range

**Issue 2-2: Frequency range**

* Proposals
  + Option 1: Lower edge is 470 MHz, upper edge is TBD
  + Option 2: Lower edge is TBD, upper edge is TBD
* Recommended WF
  + Discuss options in the first round, though there may be a dependency on the number of bands Issue 2-1.

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1 Number of bands

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | Option 1: We think a single global band, e.g. 470-698MHz could be a solution. For 7 and 8 MHz the band 470-694 MHz and for 6 MHz the band 470-698 would be applied. |
| ZTE | Option 1 is more preferred to define one harmonized band for DTT service. |
| Rohde & Schwarz | Option 1, using a single global band is fine from our side. |
| Ericsson | Option 3: It might not be relevant to have a single band covering the full range, from 470MHz to 698/702 MHz.  We were not able to come with a concrete proposal in this meeting but would do it for sure for next RAN4 meeting. |
| Qualcomm | Option 3. This needs further discussion. A single large band may not be feasible in UE implementation. The filtering requirements have not yet been defined and it is unclear what relative bandwidth can be supported. We also see benefit in defining a smaller band, perhaps overlapping with the downlink of Band n71 and/or APT600 band. It may be possible to enable common (or mostly common) hardware to support the 5G broadcast within the frequency range and achieve a large scale ecosystem for UE devices without incurring the time, cost, effort of a completely new design effort. |
| TDF | Option 1: a single band is preferred, as a global solution for all regions |
| Nokia | Single band is preferred but it may depend on sub-topic 2-2. |
| Moderator | Comments from GTW Aug 17  Qualcomm: most companies are interested in global band. We do have concern about the feasibility. The relative bandwidth is very large. Using the existing filter technology, we do not think such wide band can be supported. We should use multiple bands. Do operators will use the whole spectrum? More interested part is the higher part of the band. There are some overlapping IMT band (71, APT). The hardware of n71 and APT can be used for this broadcast band. Our preference is to consider smaller band rather than massive global band.  SWR: a single band is very appealing. Higher part of band is more favourable since smaller antenna. There is another choise. To filter there is existing DTT receiver which can cover the whole band. Thus the single band can be supported.  Ericsson: We share the similar view as Qualcomm.  ZTE: In general, a global band is better. When taking about the DTT to support the whole band, it is for smart phone or other device?  SWR: we intend to have smart phone and tablet.  Qualcomm: I am not familiar with DTT. I concern the case in US. 71 is used for IMT. If there is no filter, the system will be hammered by band 71. We should consider the regional. |

Sub topic 2-2 Frequency range

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | We advocate for option 1. In all regions the lower edge is 470MHz. With regard to issue 2-1 the upper edge is then defined according to the channel bandwidth used. |
| ZTE | Option 1, for lower edge, we agree to use 470MHz, for the upper edge, we seek more inputs from the operators. |
| Rohde & Schwarz | Option 1, using 470 MHz as lower edge seems to be a common proposal among companies. |
| Huawei | Question for clarification:  If RAN4 decide to specify 470~XXX MHz frequency range, does that mean UE need to implement one analog band filter to support this band? |
| Ericsson | One band should at least starts at 470MHz, also depending on issue 2-1. |
| Qualcomm | Option 2. While ITU has allocated the frequency range starting at 470 MHz to broadcast, are there any broadcasters with intention to deploy 5G broadcast at 470 MHz? The lower frequencies require larger antenna and RF components, in addition to the very large bandwidth, may not be practical for smartphone form factors. Filtering requirements also have not been established so it is difficult to assess the filter feasibility. However, larger relative bandwidths with reasonable insertion loss across the band, antenna efficiency, etc. are known challenges. |
| TDF | Option 1, 470 MHz is the lower bound in all regions for broadcasting |
| Nokia | Option 1 is fine. We are open to discuss technical issues mentioned by Qualcomm. |

## Summary for 1st round

### Open issues

On the number of bands and the frequency ranges of bands for 5G broadcast in UHF, there was no agreement. The majority of companies favored a single large global band to maximize flexibility worldwide. It was commented that the UHF spectrum is the only spectrum available to broadcasters so this is the spectrum with which 5G broadcast would need to operate. On the other hand, there were concerns expressed about the technical feasibility of supporting such a wide band in the UE and the need to consider regional requirements, local filtering, not easily accommodated by a single wide band. There was also a possible motivation to enable the reuse of existing UE hardware for n71 or APT600 by defining a band only over the n71/APT600 downlink frequency range.

While no agreement was reached in the first round, the considerations of all interested parties was elucidated. It is suggested in the second round to try to bring new ideas to address all of the considerations as best as possible. The moderator suggests some possible ideas but others are welcome

* + - 1. Define one large single band 470 – [694/698/702] MHz in addition to multiple regional bands
      2. Define bands corresponding to TV channels (i.e., CH34, 35, 36, etc) but the UE would not be required to support all of them
      3. Define sub-bands of UHF, for example, lower UHF, middle UHF, upper UHF

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1 Number of bands** | *Tentative agreements:* None  *Candidate options:*   * + - 1. Define one large single band 470 – [694/698/702] MHz in addition to multiple regional (smaller) bands       2. Define one large single band 470 – [694/698/702] MHz, but the UE is only required to support a subset of this band       3. Define sub-bands corresponding to TV channels (i.e., CH34, 35, 36, etc) but the UE would not be required to support all of them       4. Define sub-bands of UHF, for example, lower UHF, middle UHF, upper UHF       5. Some hybrid of these options, or other options entirely   *Recommendations for 2nd round:* Further discussion in the second round based on the above listed options or others as companies propose. |
| **Sub-topic #2-2 Frequency range** | *Tentative agreements:* None  *Candidate options:*  *Recommendations for 2nd round:*Merge this discussion with the above sub-topic. |

## Discussion on 2nd round (if applicable)

Sub topic 2-1 Number of bands and frequency ranges

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Option 1 could be a solution, but some consideration would be needed to prevent a very large number of bands if they aren’t needed. An example band could be used and then future bands added later according to demand. |
| Ericsson | Option 5, a unique band for the lower part (e.g from 470 to 612MHz) and one (or more) band(s) covering the higher part overlapping IMT bands (e.g. from 612 to 702MHz). To be further investigated. |

# Topic #3: UE RF requirements

## Open issues summary

Two papers from Nokia R4-2212073 and Qualcomm R4-2214002 were submitted to the sub-agenda on UE RF requirements. It was recognized in both papers that the 5G broadcast is expected to operate in a standalone downlink-only configuration. Thus, UE Tx requirements are not applicable but moreover, UE uplink in this band or any other band is not available to verify UE Rx requirements. Both Nokia and Qualcomm stated that current LTE MBMS only specifies performance requirements and there may be a need to map performance requirements to core RF requirements. However, details are not provided. The two papers also indicate that additional requirements for 5G broadcast such as maximum input level, ACS, blocking should be evaluated in the context of HPHT deployment scenarios. Lastly, both papers also describe the need to assess the impact of a UE 10 MHz Rx filter for channels that are fundamentally spaced by 6, 7, and 8 MHz. Qualcomm discusses reference sensitivity and presents options to reuse the same reference sensitivity as Band 71, to scale with bandwidth, or to further analyze the expected front-end losses and noise.

### Sub-topic 3-1 Core requirement verification

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-1: Core requirement verification**

* Proposals
  + Option 1: In the absence of uplink, core requirements can be indirectly verified by performance (BLER) tests, but the mapping is TBD.
  + Option 2: New requirements or methods should be developed to verify the RF core requirements.
  + Option 3: Other
* Recommended WF
  + Discuss the options. Although details are scant at this time, comments and suggestions are welcomed.

### Sub-topic 3-2 ACS and blocker placement

**Issue 3-2: ACS and blocker placement**

* Proposals
  + Option 1: Specify ACS and blocking by the conventional LTE blocker placement for a 10 MHz channel.
  + Option 2: Specify ACS and blocking according to 6, 7, and 8 MHz channelization, but UE filter is assumed to be 10 MHz wide.
  + Option 3: Other
* Recommended WF
  + TBA

### Sub-topic 3-2 Reference sensitivity

**Issue 3-3: Reference sensitivity**

* Proposals
  + Option 1: Same as Band 71 10 MHz refsens
  + Option 2: Band 71 10 MHz refsens scaled to 6, 7, and 8 MHz
  + Option 3: More study is needed including expected FE losses and noise
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1 Core requirement verification

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | Option 1. The self-contained operation, i.e. no need for an uplink is crucial for us as a network operator to deploy 5G Broadcast. This shall not be sacrificed by developing new methods.  Broadcast network operators use state-of-the-art channel coding and prefer to have a variety of pilot patterns accessible for the trade-off between maximising payload and the necessary overhead to determine the current and local channel conditions. |
| ZTE | Option 2 is more preferred. In addition, the corresponding FRC for refenes should be also specified for 6/7/8MHz. |
| Qualcomm | Option 1 should be firstly studied and only if found infeasible, then alternatives can be considered. |
| Nokia | We’d need more study on this. |

Sub topic 3-2 ACS and blocker placement

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| SWR | Option 3. Maximising the system performance is important. Therefore, an adapted UE filter to the actually used channelization would be warmly welcomed.  In the legacy broadcasting system specifications “protection ratios” are determined. They can be translated into ACLR and ACS values. Therefore, in that respect option 2 seems to be more appropriate |
| ZTE | Option 2 is more preferred which is aligned with the WID objective. |
| Huawei | Question for clarification:  If we go option 2, are there any impacts on current ACS requirements and test parameters? |
| Qualcomm | This depends somewhat on whether RAN4 decides to introduce new 6, 7, and 8 MHz channel bandwidths for the UE or whether to reuse 10 MHz channels modified as needed. Although 10 MHz ACS and blocker do not map 1:1 to 6, 7, and 8 MHz channelization, they do verify the linearity of the receiver so can predict the performance for other spacings. Therefore, one possibility is to maintain the existing ACS and blocker placement but to study the C/I ratios to ensure coverage for the broadcast environment. |
| Nokia | We would need to first understand what ACS and blocking performance is required for the 5G broadcast system to work with HPHT scenario. Option 2 may indicate that ACS is worse than the current 3GPP requirement. Is that acceptable, if it means receiver may be interfered easily by adjacent channels? |

Sub topic 3-3 Reference sensitivity

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| ZTE | Option 2 and option 3 could be consider together to define the final Refsens value |
| Huawei | Option 3, more study is needed to consider the implementation of RF front end with specified frequency range. |
| Qualcomm | Agree with the comment from ZTE |
| Nokia | Support Option 3. It is strange to use n71 as a reference, since its REFSENS is affected by uplink and duplexer loss. For DL only band, maybe band 32 is a better reference? |
| Sony | Option 3. More study is needed. |

## Summary for 1st round

### Open issues

Sub topic 3-1 Core requirement verification

It was clear to companies that for the new downlink only band type, traditional method to verify receiver requirements is not possible due to lack of an uplink channel for ACK/NAK feedback. It was proposed that existing performance requirements could be used, but companies expressed the need for further study.

Sub topic 3-2 ACS and blocker placement

There was no agreement on ACS and blocker placement. However, it was commented by one company that it is first necessary to understand the blocking performance needed in a HPHT scenario via coexistence study. The moderator interprets this comment to be more relevant to the magnitude of the ACS and blocking specification rather than the offset of the ACS and blocker, but offset will still have an impact. It may be beneficial to understand the existing ACS and blocking requirements for a DTT receiver, if available.

Sub topic 3-3 Reference sensitivity

Companies overwhelmingly requested further study. Since band definition and filtering requirements are unknown, it may be difficult to make much progress on reference sensitivity in this meeting.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#3-1 Core requirement verification** | *Tentative agreements:* None  *Candidate options:*  *Recommendations for 2nd round:* Further discussion to characterize how existing performance requirements can be leveraged to verify core requirements. |
| **Sub-topic #3-2 ACS and blocker placement** | *Tentative agreements:*None  *Candidate options:*  *Recommendations for 2nd round:* Identify the ACS and blocking requirements for existing DTT receivers for handheld form-factors. Some aspects for possible consideration include: Are these requirements standardized? Are they in regulations? If not formalized, is there a de-facto standard? Is it purely implementation dependent? Do they vary from country to country? |
| **Sub-topic #3-3 Reference sensitivity** | *Tentative agreements:* None  *Candidate options:*  *Recommendations for 2nd round:*No further discussion unless there are new points you would like to bring up. |

## Discussion on 2nd round (if applicable)

Sub topic 3-1 Core requirement verification

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We prefer Option 1 in the WF |
| Ericsson | WF on UE RF - Option 1 |

Sub topic 3-2 ACS and blocker placement

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We are ok with Option 1 but would like to add the UE should be assumed to have a 10 MHz filter. The details of coordination should also be listed (or assumptions listed) since they will have impact on scenarios and conditions under which the UE will operate and are referenced in the WID. |
| Ericsson | WF on UE RF - Option 1 |

Sub topic 3-3 Reference sensitivity

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We would also like to include LTE Band 71 10 MHz reference sensitivity as a baseline/starting point. |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on … | YYY |  |
|  | LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  | WF on the scope of a coexistence study for HPHT 5G broadcast | Ericsson |  |
|  | WF on band definition for 5G broadcast in UHF | Nokia |  |
|  | WF on UE RF requirements for 5G broadcast | SWR |  |
|  | WF on system parameters for 5G broadcast | Qualcomm Incorporated |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-2211555 |  | BS requirements for 5G terrestrial broadcast | SWR | Noted |  |
| R4-2211585 |  | Discussion on Introduction of new bands and bandwidth allocation for LTE based 5G terrestrial broadcast | ROHDE & SCHWARZ | Noted |  |
| R4-2211981 |  | BS requirements for 5G terrestrial broadcast | Cellnex | Noted |  |
| R4-2211982 |  | BS requirements for 5G terrestrial broadcast | BNE | Noted |  |
| R4-2212071 |  | New bands and bandwidth allocation for LTE based 5G broadcast; general scope of the work item | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2212072 |  | LTE based 5G broadcast; general approach, specification impacts, band definition and system parameters | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2212073 |  | LTE based 5G broadcast; general approach for UE RF | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2212099 |  | BS requirements for 5G terrestrial broadcast | TDF | Noted |  |
| R4-2213698 |  | Discussion on system parameters for LTE based broadcast | ZTE Corporation | Noted |  |
| R4-2214002 |  | UE requirements for 5G terrestrial broadcast | Qualcomm Incorporated | 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** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx |  | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx |  | 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