[94e-04-R18-Duplex] - Version 0.0.5
RAN

3GPP TSG RAN Meeting #94-e **RP-213484**

Electronic Meeting, December 6 - 17, 2021

Agenda Item: 8.6.1

Source: CMCC (Moderator)

Title: Moderator's summary for discussion [94e-04-R18-Duplex]

Document for: Information & Decision

The thread covers the discussion [94e-04-R18-Duplex] as identified in the email "[94e-01-Organizational] RAN R18 summary RP-213469, list of email threads for RAN R18 discussion, and Monday's GTW" from the RAN Chair.

The goal of this NWM discussion is to finalize the details of the SID. The deadlines for the discussion can be found in the first page of "Draft RAN#94-e_Timeplan v0.zip" from the RAN Chair.

A summary of the Rel-18 Package, the proposed TU budget, and proposed detailed scope for each potential WI or SI are provided in RP-213469 from the RAN Chair.

Per the guidance from the RAN Chair, the draft SID from the October email discussion summary (RP-212707) was updated based on the proposed detailed scope for Evolution of duplex operation in RP-213469 as the starting point for further discussion in RAN#94-e. The updated SID with change marks can be found with the following link.

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5b94e-04-R18-Duplex%5d

Based on the comments during the NWM discussion in RAN#94-e, further updates of the draft SID may be provided in this draft folder.

1 Initial Round

1.1 Text for SID Justification Section

[Text Start]

TDD is widely used in commercial NR deployments. In TDD, the time domain resource is split between downlink and uplink. Allocation of a limited time duration for the uplink in TDD would result in reduced coverage and increased latency. As a possible enhancement on this limitation of the conventional TDD operation, it would be worth studying the feasibility of allowing the simultaneous existence of downlink and uplink, a.k.a. full duplex, or more specifically, subband non-overlapping full duplex at the gNB side within a conventional TDD band.

The NR TDD allows the dynamic/flexible allocation of downlink and uplink in time and CLI handling and

RIM for NR were introduced in Rel-16. Nevertheless, further study may be required for CLI handling between the networks of different operators to enable the dynamic/flexible TDD in commercial networks. The inter-operator CLI may be due to either adjacent-channel CLI or co-channel-CLI, or both, depending on the deployment scenario. The main problem not addressed in the previous releases is gNB-to-gNB CLI.

This study aims to identify the feasibility and solutions of duplex evolution in the areas outlined above to provide enhanced coverage, reduced latency, improved system capacity, and improved configuration flexibility for NR TDD operations in unpaired spectrum.

[Text End]

Feedback Form 1: Comments on Text for SID Justification Section

1 – vivo Communication Technology

We are fine with the justification texts.

2 – HUAWEI TECHNOLOGIES Co. Ltd.

Dynamic/flexible TDD, as one of the duplex enhancement areas, addresses near-term commercial interests for large UL capacity demands. Multiple operators requested dynamic/flexible TDD to be further enhanced targeting real deployment. Without referring to any systematic analysis, the justification of current SID limits CLI handling to inter-operator scenario only. Such limitation may lead to incomplete solution for dynamic/flexible TDD in Rel-18. Moderator explains the motivation of not including CLI handling between gNBs of the same operator is for the purpose of avoiding the past discussion. But we noticed that a note in the objective (Note: For potential enhancements on dynamic/flexible TDD, utilize the outcome of discussion in Rel-15 and Rel-16 while avoiding the repetition of the same discussion.) already intend to avoid repetition of the same discussion. So we did not see the motivation to not include same operator scenario in the justification part. We therefore suggest changes below:

*The NR TDD allows the dynamic/flexible allocation of downlink and uplink in time and CLI handling and RIM for NR were introduced in Rel-16. Nevertheless, further study may be required for CLI handling between the ~~networks~~ **base stations** of **the same and** different operators to enable the dynamic/flexible TDD in commercial networks. The **intra-operator and** inter-operator CLI may be due to either adjacent-channel CLI or co-channel-CLI, or both, depending on the deployment scenario. The main problem not addressed in the previous releases is gNB-to-gNB CLI.*

3 – Sony Europe B.V.

Fine with the justification text.

4 – SHARP Corporation

"Enhanced coverage" is for uplink. It should be clarified in the scope. Otherwise, the scope is too broad. What is the metric of "improved configuration flexibility"?

5 – NTT DOCOMO INC.

We are fine with the justification texts.

6 – China Mobile Com. Corporation

@SHARP, the ”improved configuration flexibility” refers to dynamic/flexible TDD, which enables dynamic/flexible TDD UL/DL configuration

7 – ZTE Corporation

We are generally fine with the justification.

One minor comment from our side is for the last sentence in the 2nd paragraph, i.e., ‘*The main problem not addressed in the previous releases is gNB-to-gNB CLI*’. We understand that RAN has done some work to address the address the UE-to-UE CLI and one of the left problems not addressed is gNB-to-gNB CLI. Rel-18 or later release may introduce some solutions to further address UE-to-UE CLI, which will also be applicable to dynamic TDD configuration. However, the current wording seems to preclude such enhancements derived in duplex SI (or subsequent WI) to be applied for UE-to-UE CLI for dynamic TDD configuration.

To address this, maybe we can directly delete this sentence, or update it as following.

~~*The main*~~ *One of the problems not addressed in the previous releases is gNB-to-gNB CLI.*

8 – China Unicom

From operator’s point of view, dynamic/flexible TDD is the important feature to enable flexibility for 5G commercial network in the near term, especially for 5G vertical deployment. Thus we think the scenario of CLI handling between gNBs of the same operator is necessary and valuable for 5G real deployment. Moderator adds a note in the motivation part as “Note: For potential enhancements on dynamic/flexible TDD, utilize the outcome of discussion in Rel-15 and Rel-16 while avoiding the repetition of the same discussion.” We understand the intension, but the intra-operator scenario could be included in the justification part.

For the suggested wording of this part, we support Huawei’s suggestion.

9 – China Mobile Com. Corporation

@SHARP, regarding your question on the metric of “improved configuration flexibility”, I think the metric can be either one or more of UL coverage, latency, and capacity.

10 – TELECOM ITALIA S.p.A.

We have some general comment on the Justification part:

- Regulators in many countries force the frame structure to avoid inter-operator interference. Therefore we need to study solutions to allow flexible TDD to go back to Regulators and see if different frame structures can be allowed in the same frequency band. This is the short term priority and should be the priority of this project
- If flexible TDD is not allowed, full duplex (or new duplex schemes) are not usable in practice, unless there is again full inter-operator synchronization. Therefore, flexible TDD is required to enable xDD
- the unbalance between DL and UL does not only limit coverage and increase latency, but also strongly limit UL capacity, which is a key requirements by some users (in particular some Verticals)
- We also support the modifications proposed by Huawei and ZTE.

See below our proposed modifications based on Huawei and ZTE text):

TDD is widely used in commercial NR deployments. In TDD, the time domain resource is split between downlink and uplink. Allocation of a limited time duration for the uplink in TDD would result in ***reduced user throughput, reduced*** *coverage and increased latency. As a possible enhancement on this limitation of the conventional TDD operation, it would be worth studying the feasibility of allowing the simultaneous existence of downlink and uplink, a.k.a. full duplex, or more specifically, subband non-overlapping full duplex at the gNB side within a conventional TDD band.*

The NR TDD ***specifications allow*** *the dynamic/flexible allocation of downlink and uplink in time and CLI handling and RIM for NR were introduced in Rel-16.* ***However, in many countries Regulators force (in the same band) inter-operator frame and time synchronization to avoid interference. Also the deployment of "full duplex" solutions may be limited by the current regulations.*** *~~Nevertheless, further~~* ***Further*** *study* ***is*** *~~may be~~ required for CLI handling between the ~~networks~~* ***base stations*** *of* ***the same and*** *different operators to enable the dynamic/flexible TDD in commercial networks. The* ***intra-operator and*** *inter-operator CLI may be due to either adjacent-channel CLI or co-channel-CLI, or both, depending on the deployment scenario. ~~The main~~ One of the problems not addressed in the previous releases is gNB-to-gNB CLI.*

11 – Spreadtrum Communications

We are fine with the justification texts.

12 – CEWiT

We are fine with the text.

13 – LG Electronics Inc.

We are fine with the justification texts.

14 – Samsung Electronics Co.

We do not see any need to update the regulation part in the justification, we already included the regulatory issue in the objective (Summarize the regulatory aspects that have to be considered for deploying the identified duplex enhancements in TDD unpaired spectrum (RAN4).) And how to solve the regulation issues is not the scope of 3GPP WG.

15 – Motorola Mobility UK Ltd.

The current SID Justification section is fine with us.

16 – Beijing Xiaomi Electronics

We are fine with the current SID justification.

17 – Nokia Corporation

We are ok with the justification text but also agree with Telecom Italia that the short term deployment needs for supporting flexible DL/UL allocation for TDD should be prioritized first.

18 – VODAFONE Group Plc

We support the modifications proposed by Telecom Italia.

19 – Ericsson France S.A.S

We agree with the moderator proposed text.

In our understanding, it is essential to understand and if possible manage both intra- and inter- operator CLI. If intra-operator CLI occurs then the Full Duplex gains may be lost and if inter-operator CLI occurs then it may be that Full Duplex cannot be deployed. We should take care not to repeat previous work on CLI though. We also note that for the sub-band Full Duplex, the inter-operator co-existence problem may be somewhat simplified if only DL slots are used for Full Duplex as there is effectively a guard around the UL transmissions (Intra-operator UE-UE problems may occur though).

We are also generally OK with the proposed text from Telecom Italia, but we should add that previous studies should be a starting point and not repeated.

20 – CableLabs

We are OK with the proposed text. The regulatory aspects were included in the Objectives.

21 – Verizon UK Ltd

We are fine with the proposed justification.

22 – Intel Corporation (UK) Ltd

We support the suggested change from Huawei to capture the intra-operator scenarios for investigations into potential CLI handling solutions to support flexible/dynamic TDD.

23 – InterDigital

We are okay with the current SID justification.

24 – Qualcomm Korea

We are fine with the proposed justification text.

25 – CATT

Fine with the proposed text

26 – Orange

We support this important SID and agree with TIM's revisions. To our mind intra-operator is also key (since it generates more interference than inter-operator).

27 – New H3C Technologies Co.

We are fine with the justification texts. with Huawei's modification

28 – Fraunhofer HHI

We are fine with the proposed text on SID justification.

1.2 Text for SID Objective Section

[Text Start]

The objective of this study is to identify and evaluate the potential enhancements to support duplex evolution for NR TDD in unpaired spectrum.

In this study, the followings are assumed:

- Duplex enhancement at the gNB side
- Half duplex operation at the UE side
- No restriction on frequency ranges

The detailed objectives are as follows:

- Identify applicable and relevant deployment scenarios and use cases (RAN1).
- Develop evaluation methodology for duplex enhancement (RAN1).
- Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD (RAN1, RAN4).
  - Identify possible schemes and evaluate their feasibility and performances (RAN1).
  - Study inter-gNB and inter-UE CLI handling and identify solutions to manage them (RAN1).
    - ~~Study their impacts on inter-gNB interfaces if needed (RAN3).~~
    - Consider intra-subband CLI and inter-subband CLI in case of the subband non-overlapping full duplex.
  - Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).
    - Study the impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).
  - Study the impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4).
  - ~~Study the impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4)~~
  - RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.
  - Summarize the regulatory aspects that have to be considered for deploying the identified duplex enhancements in TDD unpaired spectrum (RAN4).

Note: For potential enhancements on dynamic/flexible TDD, utilize the outcome of discussion in Rel-15 and Rel-16 while avoiding the repetition of the same discussion.

[Text End]

Feedback Form 2: Comments on Text for SID Objective Section

1 – vivo Communication Technology

As commented in our contribution RP-213267, the Rel-18 duplex evolution study will focus on NW side duplex enhancements and therefore we think it would be highly preferable to avoid UE hardware/RF changes. However, during the study, existing UE RF requirements can be assumed to evaluate the performance impact due to CLI at the UE side, i.e.

- For adjacent channel (i.e. inter-operator) CLI study, existing UE ACLR (Adjacent Channel Leakage Ratio) at Tx side, ACS (Adjacent Channel Selectivity) at Rx side are assumed.
- For inter sub-band (i.e. intra-operator) CLI study, existing UE IBE (In-band Emission) at Tx side, IBB (In-band Blocking) at Rx side are assumed

Therefore we suggest to add a note to reflect the above, i.e.

- Study the impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4).
  - **Note: The existing UE RF requirement is assumed in the study**

2 – HUAWEI TECHNOLOGIES Co. Ltd.

We support the SID revision from the moderator (and from RP-213469).

3 – Samsung Electronics Co.

We support the moderator's update on SID objectives. Regarding Vivo's comment, we are not quite sure whether such a note is needed. Since RAN4 will study the impact on RF requirements, this study will consider both the existing requirement and necessary requirements for handling duplex enhancements natually.

4 – Sony Europe B.V.

On the following objective:

- Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).
  - Study the impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).

Why is the study of RF requirement impact in RAN4 a sub-bullet of this objective? Is the RF requirements being studied for the identified schemes? Or does this mean RAN4 can only start this study once RAN1 has identified the candidate schemes? Would appreciate some clarification.

5 – Apple France

As mentioned in our contribution RP-212993, it has been common understanding that R18 shall assume minimum specification impact to UE and with no new RF requirements at the UE side. Indeed, current objectives are all based on such consideration in mind, for example full-duplex operation at gNB only, TDD band and non-overlapping sub-bands, as anything else (like FDD band or partially/fully overlapping sub-bands) would bring new RF requirements at the UE side for CLI. Thus, the purpose of studying the UE RF requirements is to identify and avoid (for example by scheduler) scenarios that may impact the "existing" UE RF requirements. We propose that, in order to facilitate the future discussions, it is clarified and captured in draft SID, under the assumptions, that no new UE RF requirement is assumed in Rel-18 study, as follows

In this study, the followings are assumed:

- Duplex enhancement at the gNB side
- Half duplex operation at the UE side
- No restriction on frequency ranges
- **No new RF requirement at the UE side**

6 – Nokia Corporation

In our view it has not been assumed during the earlier discussions that no new UE RF requirements will be defined. Only assumption made so far is that UE is not required to support full duplex operations. Half Duplex operations are sufficient. Also in our view it is not possible to define this type of a study without having possibility to impact UE requirements if needed e.g. due to potential adjacent channel co-existence issues or issues with legacy operations. Thus we cannot agree to Vivo's and Apple's proposal to limit the study to the existing UE RF requirements.

7 – Spark NZ Ltd

Per Spark input document RP-212815 we provided the following suggestions:

Study inter-gNB and inter-UE CLI handling and identify solutions to manage them (RAN1), **identify UE impacts. Inter operator gNB should only be studied once Intra gNB (own operator) is shown to be feasible.**

Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1), assuming no impact on adjacent channels. **Performance must be specified with respect to I/N values achieved. Performance of digital interference cancellation must be studied under different SNR conditions (corresponding to cell edge, median and good) including the impact of CSI imperfections.**

○ Study the impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4). **Identify isolation requirements, guard bands if any required for inter operator spectrum filtering.**

○ Study the impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4). **Identify filtering requirements for adjacent channel co-existence vs I/N achieved.**

○ RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression. **The antenna RF design and digital filtering will have an impact on the antenna form factor and power consumption. This should be identified.**

Can we ask that these additions are considered as part of the discussion moving forward.

8 – Spark NZ Ltd

Per Apple's comments (#5) we agree with "No new RF requirement at the UE side".

Additionally the study should be limited same operator intra-gNBs.

9 – Futurewei Technologies

We support the moderator's updated SID objectives. In our opinion, notes on additional restrictions on potential new RF requirements at the UE side are not necessary in the SI objectives. We expect that one of the SI's outcomes will be whether new RF UE requirements (if any) are necessary or not. Without a proper study, it would be hard to decide if new RF UE requirements are necessary for the duplex enhancements feasibility or how restrictive (extensive) they may be.

10 – Samsung Electronics Co.

Regarding Spark NZ comments, we think such details should be considered when SI is started in WG. Whether to use guardband, filter, and performance metrics are not needed in SID.

11 – AT&T

As we motivated in our contribution **RP-213004**, we strongly believe that it is beneficial for the study item to consider both overlapping and non-overlapping subband operation for at least scenarios where the commonalities between the two modes of operation are highest (at least from the perspective of performance and feasibility evaluation in RAN1 and RAN4). While understanding the need for balancing the overall SI scope with the benefits of a common evaluation framework for overlapping/non-overlapping scenarios, we propose the following update to the third main objective:

Study the subband non-overlapping **(for FR1 and FR2 bands) and overlapping (only FR2 bands)** full duplex and potential enhancements on dynamic/flexible TDD (RAN1, RAN4).

12 – CATT

We think the that ' potential enhancements on dynamic/flexible TDD' is only for CLI handling, and we should make this clear to eliminate unnecessary confusing. Therefore 'Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD' should be replaced with 'Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD for CLI handling'.

13 – Samsung Electronics Co.

Regarding SID scope, we do not agree to include the full overlapped case mentioned by AT&T. First we already have seen super majority for supporting subband non-overlapped full-duplex during previous NWM discussion. Second, regarding TU, it is not easy to increase the scope to be finalized all RAN1 and RAN4 studies with 2TUs, Third, we cannot find feasibility for using full overlapped full-duplex in access link due to CLI issue. Since subband non-overlapped full duplex is less challenging than the full overlapped case, the current approach is reasonable for Rel-18 SID. Lastly, as in RP-213466, we have sensed from many companies to support the current work scope.

14 – China Mobile Com. Corporation

@Sony, Regarding sony's comments on the RF requirement impact considering adjacent-channel co-existence with the legacy operation, I think the reason to move it as a sub-bullet is that it is also talking about the impact on legacy operation for the co-existence scenario, similar as the bullet for RAN1. I think there is no intention to restrict that RAN4 can only start this study after RAN1 has identified the candidate schemes. From moderator point of view, RAN1 and RAN4 can both start their studies on the co-existence , but some

LS between RAN1 and RAN4 may be needed, and some RAN4 input may also be needed for RAN1, but that can be discussed after the SI starts.

15 – vivo Communication Technology

@Samsung,@Nokia, regarding UE RF impacts for better CLI handling, we wonder how to deal with the large number of legacy UEs in the system? In a network operating enhanced duplexing mechanisms for CLI handling (intra-/inter-operator), the legacy UEs can either be aggressor or victim, therefore some enhanced scheduler based solution for interferecne avoidance is anyway needed, which should be the baseline, rather than trying to push more stringent UE RF requirements.

16 – Samsung Electronics Co.

@vivo, as we explained, our understanding is not to push more stringent UE RF requirements based on this study, our thinking is that we should consider both based on legacy UE RF requirements and also need to study RF requirements for better support if needed. And this is already well captured in the current SID.

- **Study the impact on RF requirements considering** the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB **and the inter-subband CLI and inter-operator CLI at UE** (RAN4).

17 – SHARP Corporation

We have similar view with Samsung. The exact solution can be discussed in SI phase. Objectives in SID should say what kind of issues should be discussed/solved.

18 – NTT DOCOMO INC.

We support the updated SID objective.

19 – OPPO

We share the same concerns as vivo and Apple, regarding to the potential modifications upon the existing UE RF requirements to make them more stringent. It should be clear that there is no way to change the RF implementation of the existing UEs, which are based on existing RF requirement in the spec. The advanced duplex deployment should not make the legacy UE perform worse than before.

So we prefer to Apple's wording of "[The Rel-18 study targets] **no new RF requirement at the UE side**". In our understanding, this does not conflict to the objectives saying "**Study the impact on RF requirements considering ....**". In other words, WGs can study the RF impacts, but the purpose of such study is not to change the UE RF requirements, at least it is not an agreeable target at this time.

20 – ZTE Corporation

We support the above objectives with one question for clarification.

Regarding the following parts, only the RF requirements for adjacent-channel co-existence is mentioned. Do we need to also include "co-channel co-existence" in the sub-bullet? For example, for full duplex BS coexisting with legacy BS in co-channel case, the receiver requirement of legacy BS (e.g. dynamic range requirement and In channel selectivity requirements) should also be taken into account.

- *Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).*

[2] *Study the impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).*

21 – KDDI Corporation

We support the moderator's update on SID objectives. No new additional restriction is needed in the SID objectives.

22 – China Unicom

We support this version of SID objective.

23 – MediaTek Inc.

It's not clear to us what use cases we're going to study in the 1st objective. If use case remains unclear till now, we're worried that the study scope may expand vastly after kicking off the study in WGs and existing TU estimation may not be fully justified. It's suggested to remove it in the 1st objective as below and clarify the use cases in the justification section if any.

- Identify applicable and relevant deployment scenarios ~~and use cases~~ (RAN1).

Regarding Apple's & vivo's comments on UE RF requirement assumption, we think whether UE RF requirements are impacted to support subband non-overlapping full duplex or not is actually bundled with the performance study and it may be too early to assume no or any impact on UE RF requirements before concluding the study. Existing objective description is sufficient to us but we're okay to clarify both legacy UE RF requirements and potential new UE RF requirements are considered in the study.

24 – TELECOM ITALIA S.p.A.

thanks to the moderator for the updated proposal. We are generally fine with it but:

- to avoid this study to be a paper exercise, we think priority should be given to the objectives on flexible TDD. We propose to start the study with the following objectives, and after their conclusion to start the rest of the activity:

•Study inter-gNB and inter-UE CLI handling and identify solutions to manage them (RAN1).

–Study their impacts on inter-gNB interfaces if needed (RAN3).

–Consider intra-subband CLI and inter-subband CLI in case of the subband non-overlapping full duplex.

Therefore the above text in italic should be moved at the very beginning of the Objective Section

- would prefer to keep the bullet related to RAN3 (*Study their impacts on inter-gNB interfaces if needed*)
- It should be clarified that the xDD solution is not affecting legacy equipment (BTSs and UEs).

25 – Spreadtrum Communications

We are quite understand the concerns from some UE vendors as there are large number of legacy UEs. As it is pure SI for the whole release 18, we suggest adding one sentence based on Apple's version.

In this study, the followings are assumed:

· Duplex enhancement at the gNB side

· Half duplex operation at the UE side

· No restriction on frequency ranges

· **Rel-17 UE RF requirement is the baseline for initial evaluation, if found necessary to impact UE RF requirements, we can revisit it in the middle of the SI, e.g. at RAN#98**

26 – ZTE Corporation

Adding one more comment for the ”UE requirement”. From our perspective, it is obvious that for legacy UEs, their requirements would NOT change. But for UEs supporting R18 duplex, at least for some high-end UEs, they may have some higher requirements to fully enjoy the gain of full duplex. This can be part of the working group discussion, it is too premature to conclue that ”no new RF requirement at the UE side” now.

27 – CEWiT

We are fine with the text.

28 – LG Electronics Inc.

* In general, we support the moderator’s update on SID objectives.

* Regarding the comment on the feasibility of overlapped full duplex, we tried to provide technical evidence to observe a potential benefit of full duplex operation including both non-overlapped full duplex and overlapped full duplex based on SLS evaluation, Measurement result of field test and Implementation of full duplex. Based on the investigation, we can conclude there is a potential benefit of full duplex in terms of performance and implementation. Furthermore, from the SLS evaluation result, we observed that overlapped Full Duplex is feasible when handling of BS-BS CLI is applied. Nevertheless, because we think non-overlapped full duplex itself can be a good starting point of introducing full duplex operation in wireless communication field, we support to study non-overlapped full duplex only in Rel-18.

29 – Samsung Electronics Co.

Regarding comments on UE requirement, we also support comment from ZTE. In addition, for prioritization, we don’t need any necessity to doing between flexible TDD and subband non-overlapped full duplex.

30 – NEC Corporation

We are fine with this version of SID objective.

31 – Motorola Mobility UK Ltd.

Fine with the updated SID Objective section. Can include a note stating that “RAN3 is included for normative work, if CLI handling schemes that require RAN3 specification work are identified and included in Work Item”.

32 – Beijing Xiaomi Electronics

We are fine with this version of SID objective.

33 – Nokia Corporation

Like mentioned in earlier comment in our view it has not been assumed during the earlier discussions that no new UE RF requirements will be defined. The only assumption made so far is that the UE is not required to support full duplex operations. Half Duplex operations are sufficient. Also, in our view it is not possible to define this type of a study without having possibility to impact UE requirements if needed e.g. due to potential adjacent channel co-existence issues or issues with legacy operations. Based on performance results of full duplexing with legacy and advanced UE RF requirements in the SI phase, a decision can be made for successive normative work. But deciding already now for normative work with flexible duplexing at the gNB and no additional requirements for the UE may end up with solutions that add complexity and

cost to the gNB with no or only marginal gains at system level. Thus, we cannot agree to limit the study to the existing UE RF requirements only.

Furthermore, we think that RAN4 should be added to the objective: "Identify applicable and relevant deployment scenarios and use cases", to ensure that the agreed deployment scenarios and use cases can meet the feasible RF requirements set by RAN4.

· *Identify applicable and relevant deployment scenarios and use cases (RAN1, **RAN4**).*

Somewhat related to that, in the following objectives not only the impact on RF requirements but the feasibility of requirements, i.e. whether requirements could realistically be satisfied with commercial implementations, should be included to avoid creating specifications which are not realistic:

· *Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).*

o *Study the **feasibility of and** impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).*

· *Study the **feasibility of and** impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4).*

34 – VODAFONE Group Plc

We are in favour of the proposed changes from CATT and Telecom Italia. Priority should be given to flexible TDD and CLI handling. We do not support including overlapping bands in the scope considering the complexity, CLI feasibility and previous majority consensus on the topic.

35 – Ericsson France S.A.S

We support the existing objectives based on SBFD. We propose a small clarification on who is responsible for inter and intra co-existence:

Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel (**RAN1**) and adjacent channels (**RAN4**).

In our view, studying inter operator co-existence is very important and should have the same priority as intra-, because even if intra- operator coexistence can be made to work, lack of inter-operator co-existence could still limit the deployment scenarios significantly.

Regarding the UE requirements, we oppose any restriction to not consider UE requirements in this SI. We sympathize with Oppo and Apple to the extent that it is undesirable to introduce any new or updated UE requirements without a strong motivation and it is extremely desirable for Full Duplex to work with legacy UEs, and we should bear these these two things in mind. However, we need to study whether the existing requirements enable deployment in all scenarios or the range of scenarios would be restricted with existing requirements. Also, it may be that in some (or all) scenarios UEs with existing requirements would operate but enhancements are feasible. Since this is a study, we should not restrict consideration of UE requirements at this stage.

36 – Verizon UK Ltd

Support the proposal. We have similar view with Samsung. The exact solution can be discussed in SI phase.

37 – CableLabs

We are open to study overlapping and non-overlapping sub-band duplex operation

- prioritizing non-overlapping sub-band operation
- applying common features (when applicable) to both operations

38 – Intel Corporation (UK) Ltd

We are mostly fine with the latest version of the objectives. However, the following re-wording is suggested for the following to be captured as a technical objective.

Change from:

- RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.

to:

- ~~**RAN4 should be involved early to provide necessary information to RAN1 as needed and to s**~~ Study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression **(RAN4)**.
  - **Note: RAN4 should be involved early to provide necessary information to RAN1 as needed**

Regarding impact to UE RF requirements, it may not be prudent to preclude options that may have any level of impact to UE RF requirements before these are identified. Certainly, it may be concluded that any impact to UE RF requirements be avoided for corresponding normative work, but this should follow from the study.

Lastly, it is not clear why the following objective has been deleted. Is it only in expectation that RAN3 involvement may not necessary during the SI phase?

- ~~**Study their impacts on inter-gNB interfaces if needed (RAN3).**~~

39 – InterDigital

We support the comments from Samsung and ZTE, as we see the current SID objectives do not exclude any potential outcomes that companies may expect. So, it is premature to include unnecessary restrictions in the SID objectives, e.g., for UE RF requirements, and those should be considered as a part of studies after the SI starts.

40 – Qualcomm Korea

We support the moderator proposal.

41 – Orange

We agree with TIM's revisions. The main objective should be flexible TDD. Enhancing duplex operation and CLI are means to acheive flexible TDD.

42 – Apple France

It seems there are different views on the purpose of study the ”impact” of UE requirement. We support OPPO’s modification which is a middle ground when we look at views from other camp (Samsung, ZTE, Nokia)

43 – OPPO

@ZTE,@Samsung, could you please explain what ”UEs supporting R18 duplex” means, given Rel-18 duplex is agreed just on network side? Does this SID assume there would be some UE in the end not be able to support Rel-18 duplex? If yes, please explain how those UEs (opposite to high-end UE as ZTE quoted) can survive in a practice of full-duplex deployment.

44 – New H3C Technologies Co.

We support the moderator’s update on SID objectives with spreadtrum’s suggestion.

1.3 Other parts of the SID

Feedback Form 3: Comments on other parts of the SID

1.4 Moderator Summary and Recommendation

1□Justification

- Based on the comments, the justification is updated as below.

[Text Start]

TDD is widely used in commercial NR deployments. In TDD, the time domain resource is split between downlink and uplink. Allocation of a limited time duration for the uplink in TDD would result in reduced coverage, ~~and~~ increased latency and reduced capacity. As a possible enhancement on this limitation of the conventional TDD operation, it would be worth studying the feasibility of allowing the simultaneous existence of downlink and uplink, a.k.a. full duplex, or more specifically, subband non-overlapping full duplex at the gNB side within a conventional TDD band.

The NR TDD specifications allow~~s~~ the dynamic/flexible allocation of downlink and uplink in time and CLI handling and RIM for NR were introduced in Rel-16. Nevertheless, further study may be required for CLI handling between the ~~networks~~ gNBs of the same or different operators to enable the dynamic/flexible TDD in commercial networks. The ~~inter-operator~~inter-gNB CLI may be due to either adjacent-channel CLI or co-channel-CLI, or both, depending on the deployment scenario. ~~The main~~One of the problem~~s~~ not addressed in the previous releases is gNB-to-gNB CLI.

This study aims to identify the feasibility and solutions of duplex evolution in the areas outlined above to provide enhanced UL coverage, reduced latency, improved system capacity, and improved configuration flexibility for NR TDD operations in unpaired spectrum.

[Text End]

2 Objective

- OPPO/vivo/Apple prefer to restrict that existing UE RF requirement is assumed in the study, while many other companies prefer to not have such limitation, and some of them think the impact on UE RF requirements can be studied for better support of full duplex if needed, but it does not mean we will specify more stringent UE RF requirement in the WI, which should be further discussed based on the outcome of the SI when going to the WI.
- @Spark NZ, regarding the detailed objectives added by you, I think they can be considered when SI is started in WG, and we may not need to mention whether to use guard band, filter, and performance metrics in SID.
- @AT&T, regarding your comment to include overlapping full-duplex case, based on previous NWM discussions, majority prefer to focus on subband non-overlapped full-duplex. Some companies also raise that it is not easy to further increase the scope considering the TU allocation.
- @CATT, I think it should be common understanding that potential enhancements on dynamic/flexible TDD is for CLI handling instead of self-interference handling.
- @ZTE, for co-channel co-existence with legacy gNB, my understanding is that the performance evaluation in RAN1 can take into account the receiver requirement of legacy gNB (e.g. dynamic range requirement and In channel selectivity requirements) if it is needed.
- @MTK, regarding your first comment, I think "deployment scenarios" basically reflects most of the intention of this objective, but based on the previous NWM discussion, I think it would be better to keep "use cases" here, since companies may have different preference/priorities for different use cases, e.g., same or different UL-DL subband assignments across cells, etc.
- @Telecom ITALIA, based on previous rounds of NWM discussion, both subband non-overlapped full-duplex and dynamic/flexible TDD have many supporting companies, the current arrangement is a balance after a lot of debates in October. I think prioritizing one over another may lead to more debates, and we may go back to the October stage. In addition, in previous discussions, some companies argued that dynamic/flexible TDD is more challenging to handle the inter-operator CLI compared to subband non-overlapped full-duplex. As commented by some companies, for the subband non-overlapped full-duplex, the inter-operator CLI may be relaxed if only DL slots are used for Full Duplex as there is effectively a guard around the UL transmissions.
- @Telecom ITALIA/Intel, Regarding the RAN3 part, my understanding is it is not necessary to involve RAN3 during the SI phase, if during the study phase it is identified by RAN1 that some enhancement schemes require RAN3 specification work, RAN1 can send LS to RAN3 to confirm its feasibility, and if feasible it can be taken into account when going to the WI.
- @Nokia, regarding your suggestion to add RAN4 to the objective of "Identify possible schemes and evaluate their feasibility and performances", my understanding is that RAN1 will identify/prioritize some scenarios in the initial stage of the SI, and LS regarding the decision on the scenarios can be sent to RAN4 to confirm the feasibility.
- @Ericsson, regarding your first comment, I think the sub-bullet "Study the impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4)" has already covers RAN4's work relevant to the adjacent-channel co-existence. For the bullet of RAN1, my understanding is that the performance evaluation should take into account both co-channel co-existence and adjacent-channel co-existence.
- Based on the comments, the objective is updated as below.

[Text Start]

The objective of this study is to identify and evaluate the potential enhancements to support duplex evolution for NR TDD in unpaired spectrum.

In this study, the followings are assumed:

- Duplex enhancement at the gNB side
- Half duplex operation at the UE side
- No restriction on frequency ranges

The detailed objectives are as follows:

- Identify applicable and relevant deployment scenarios and use cases (RAN1).
- Develop evaluation methodology for duplex enhancement (RAN1).
- Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD (RAN1, RAN4).
  - Identify possible schemes and evaluate their feasibility and performances (RAN1).
  - Study inter-gNB and inter-UE CLI handling and identify solutions to manage them (RAN1).
    - Consider intra-subband CLI and inter-subband CLI in case of the subband non-overlapping full duplex.
  - Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).
    - Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).
  - Study the feasibility of and impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4).
  - RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.
  - Summarize the regulatory aspects that have to be considered for deploying the identified duplex enhancements in TDD unpaired spectrum (RAN4).

Note: For potential enhancements on dynamic/flexible TDD, utilize the outcome of discussion in Rel-15 and Rel-16 while avoiding the repetition of the same discussion.

[Text End]

3□Other parts of the SID

– There are no comments.

2 Intermediate Round

2.1 Text for SID Justification Section

[Text Start]

TDD is widely used in commercial NR deployments. In TDD, the time domain resource is split between downlink and uplink. Allocation of a limited time duration for the uplink in TDD would result in reduced coverage, ~~and~~ increased latency and reduced capacity. As a possible enhancement on this limitation of the conventional TDD operation, it would be worth studying the feasibility of allowing the simultaneous existence of downlink and uplink, a.k.a. full duplex, or more specifically, subband non-overlapping full duplex at the gNB side within a conventional TDD band.

The NR TDD specifications allow~~s~~ the dynamic/flexible allocation of downlink and uplink in time and CLI handling and RIM for NR were introduced in Rel-16. Nevertheless, further study may be required for CLI handling between the ~~networks~~ gNBs of the same or different operators to enable the dynamic/flexible TDD in commercial networks. The ~~inter-operator~~inter-gNB CLI may be due to either adjacent-channel CLI or co-channel-CLI, or both, depending on the deployment scenario. ~~The main~~One of the problems not addressed in the previous releases is gNB-to-gNB CLI.

This study aims to identify the feasibility and solutions of duplex evolution in the areas outlined above to provide enhanced UL coverage, reduced latency, improved system capacity, and improved configuration flexibility for NR TDD operations in unpaired spectrum.

[Text End]

Feedback Form 4: Comments on Text for SID Justification Section

1 – New H3C Technologies Co. We support the moderator's update on SID justification section.
2 – Samsung Electronics Co. We support updated justification by the moderator.
3 – Spark NZ Ltd This SID still first needs to proove the intra operator CLI can be handled between gNBs without any performance degradation before handling the inter operator use-case. In the later case regulatory issues will pose a requirement that the adjacent operators must not face a performance degradation, spectrum usage limitations and associated deployments costs.
4 – Spreadtrum Communications We support updated justification by the moderator.

5 – TELECOM ITALIA S.p.A.

Many thanks for the updated version.

We still prefer to add a sentence on regulatory constraints that limit TDD flexibility and therefore the need to find solutions (see proposed text during the initial round)

6 – SHARP Corporation

We support the proposed text for justification section.

7 – Panasonic Corporation

We support the proposal.

8 – CATT

We support the proposed text for justification section.

9 – ZTE Corporation

We are fine with the above justification.

Regarding the regulatory constraints mentioned by companies, since there is already a RAN4 objective to study and summarize the corresponding regulatory aspects, it seems working groups will anyway take the regulatory aspects into account.

10 – Beijing Xiaomi Electronics

We support the proposed text for justification section.

11 – CHTTL

Support

12 – HUAWEI TECHNOLOGIES Co. Ltd.

We support the proposed text for justification.

13 – Futurewei Technologies

We support the updated text for justification.

14 – LG Electronics Inc.

We support the modified text.

15 – VODAFONE Group Plc

We have similar views to TELECOM ITALIA and Spark NZ. We prefer to find solutions to TDD and CLI handling without performance degradation.

16 – Intel Corporation (UK) Ltd

We are supportive of the updated justification from the moderator.

17 – Ericsson France S.A.S We support the moderator propsoal
18 – InterDigital We support the updated text by moderator for the SID justification.
19 – Apple France We support the updated justification text by moderator
20 – Motorola Mobility UK Ltd. We support the updated SID justification text.
21 – Orange We support these revisions
22 – Samsung Electronics Co. We still think regulation aspect is just for infomation and not need to include in justification.
23 – Sony Europe B.V. We support the justification texts.

2.2 Text for SID Objective Section

[Text Start]

The objective of this study is to identify and evaluate the potential enhancements to support duplex evolution for NR TDD in unpaired spectrum.

In this study, the followings are assumed:

- Duplex enhancement at the gNB side
- Half duplex operation at the UE side
- No restriction on frequency ranges

The detailed objectives are as follows:

- Identify applicable and relevant deployment scenarios and use cases (RAN1).
- Develop evaluation methodology for duplex enhancement (RAN1).

- Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD (RAN1, RAN4).
  - Identify possible schemes and evaluate their feasibility and performances (RAN1).
  - Study inter-gNB and inter-UE CLI handling and identify solutions to manage them (RAN1).
    - Consider intra-subband CLI and inter-subband CLI in case of the subband non-overlapping full duplex.
  - Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).
    - Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).
  - Study the feasibility of and impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4).
  - RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.
  - Summarize the regulatory aspects that have to be considered for deploying the identified duplex enhancements in TDD unpaired spectrum (RAN4).

Note: For potential enhancements on dynamic/flexible TDD, utilize the outcome of discussion in Rel-15 and Rel-16 while avoiding the repetition of the same discussion.

[Text End]

Feedback Form 5: Comments on Text for SID Objective Section

1 – New H3C Technologies Co. We support SID objective part.
2 – Samsung Electronics Co. Support update objectives by the moderator.
3 – Spark NZ Ltd As stated previously on the objectives that tightened the scope. We feel these need to be reconsidered as guidance for the SID. We also stated the UE should be excluded from this SID. We should first evaluate the performance of the solution without involving the UE, and if the UE needs to be involved then we need evaluate the impacts on it. This should be part of the objectives.
4 – Spreadtrum Communications Thank moderator for the great efforts. We are mostly fine with the updated SID, but we want to clarify the intention or consequence on “Study the feasibility of and impact on RF requirements……”.

Does it mean feasibility evaluation will be conducted both based on R17 UE RF requirement and new UE RF requirement simultaneously? If so, we have great concern on the workload.

So we suggest the rewording the above SID sentence as "Study the feasibility **based on R17 requirements** and impact on RF requirements **if found necessary**……"

5 – KDDI Corporation

We support the moderator's update on SID objectives.

6 – SHARP Corporation

We support the proposal for objective section.

7 – Panasonic Corporation

We support the proposal.

8 – China Mobile Com. Corporation

@Spreadtrum, 'study the feasibility of RF requirements' here basically means studying whether the RF requirements could realistically be satisfied with commercial implementations to avoid creating specifications which are not realistic. Hope that clarifies it.

9 – CATT

We support the proposal.

10 – ZTE Corporation

We are fine with the above objectives.

Regarding the co-channel requirements (e.g., dynamic range requirement and In channel selectivity requirements), we are ok to go with the current objective with the understanding that we will take the receiver requirement of legacy gNB into account when performing simulation/study in working groups.

11 – MediaTek Inc.

Thanks for moderator's kind explanation. However, we think the example of "same or different UL-DL subband assignments across cells etc." can be covered by the following objective.

- Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD (RAN1, RAN4).
  - **Identify possible schemes and evaluate their feasibility and performances (RAN1)**.

Without clear definition on "use cases", we're worried that different companies may have different understandings on the study scope, which will make WG-level discussion diverge. Therefore, we still suggest to remove "use cases" in the 1st objective as below.

- Identify applicable and relevant deployment scenarios ~~**and use cases**~~ (RAN1).

If really necessary, it would be better to list all of them for the use cases we're going to discuss in RAN1.

12 – Beijing Xiaomi Electronics

We support the proposal.

13 – CHTTL

support

14 – HUAWEI TECHNOLOGIES Co. Ltd.

We support the revision from moderator.

15 – Futurewei Technologies

We support the moderator's updates on SID objectives.

16 – LG Electronics Inc.

We support the modified text.

17 – Nokia Corporation

Following the moderator's summary and recommendation from the Initial round we propose the corresponding update to the SID text to align with the moderator's recommendation.

@Nokia, regarding your suggestion to add RAN4 to the objective of "Identify possible schemes and evaluate their feasibility and performances", my understanding is that RAN1 will identify/prioritize some scenarios in the initial stage of the SI, and LS regarding the decision on the scenarios can be sent to RAN4 to confirm the feasibility.

SID update to align with the moderator's recommendation:

- Identify applicable and relevant deployment scenarios and use cases**, and liaise the information to RAN4 to be confirmed** (RAN1).

18 – Intel Corporation (UK) Ltd

We are mostly fine with the updated list of objectives.

However, the bullet with "RAN4 should be involved ..." sounds more like a recommendation, and with feasibility studies added in other RAN4 objectives, this bullet should be changed to a note.

- ***Note:*** *RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.*

19 – Ericsson France S.A.S

Regarding "Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).", this bullet appears to suggest that also RAN1 study co-existence in adjacent channels. Adjacent channel co-existence is not normally studied by RAN1 and interaction with RAN4 would be needed. It is very important to consider adjacent channel co-existence (at least in RAN4) though and it may impact the feasibility and performance, so we

are OK to leave the bullet as it is, although further discussion will be needed in RAN1 to clarify which aspect of adjacent channel co-existence they should consider distinctly from RAN4.

Also, presumably co-channel co-existence means interference from other BS or UE of the same operator ? (i.e., It is not co-existence between operators ?)

There is no FF for providing comments on TU here, so we add here that in our view, the RAN4 TU assumption needs to be increased. In R4-213469 0.25 - 0.5 RAN4 TUs are indicated. However, there is a significant RAN4 workload for this SI, including adjacent channel co-existence, analysis of antenna/IM supression etc. The allocation should be at least 1 TU. Also, for this SI RAN4 should start at the same time as RAN1 in order that information essential to the RAN1 study is not delayed.

20 – Intel Corporation (UK) Ltd

As another comment, we noticed the moderator's response to Sony's question in the previous round, but would still prefer that the following bullets are treated at the same level to avoid potential confusion during the SI phase.

- Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).
- **Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).**

Alternatively, we suggest adding RAN4 to the first bullet:

- Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1**, RAN4**).
    - Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).

21 – InterDigital

We support the updates and moderator proposal for the SID objectives.

22 – Apple France

We support the modification by moderator to the objective text.

23 – Verizon UK Ltd

Support the objectives in the SID Objective Section - no strong opinion on others

24 – Motorola Mobility UK Ltd.

We support the updated objective text.

25 – Samsung Electronics Co.

@Nokia @CMCC, we do not need to confirm deployment scenaios to RAN1 and RAN4, it's up to each WG to decide evaluation scenarios based on their interest. We think Moderator's comment on confirmation is to for feasibility in terms of RAN4 aspect not deployment scenario that decided by RAN1.

26 – Sony Europe B.V.

We are fine with the objectives and also support Intel's suggestions, i.e.:

Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).

- ***Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).***

OR

- *Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1**, RAN4**).*
  - *Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).*

2.3 Moderator Summary and Recommendation

1□Justification

- @Spark NZ, Thanks very much for your comments and suggestions. Based on previous NWM discussions, I think most companies agree that the inter-operator use case is an important aspect for study to build a common understanding on the performance impact, so I keep the current formulation with this understanding.
- @Telecom ITALIA, based on your comments, I added one sentence regarding the regulatory aspects in the end as "In addition, the regulatory aspects need to be examined for deploying identified duplex enhancements in TDD unpaired spectrum considering potential constraints".

2□Objective

- @Spark NZ, Thanks very much for your comments and suggestions, I think the detailed objectives suggested by you in previous round can be considered when SI is started in WG.
- @Spreadtrum, 'study the feasibility of RF requirements' here basically means studying whether the RF requirements could realistically be satisfied with commercial implementations to avoid creating specifications which are not realistic.
- @Nokia, Thanks very much for your further comments and suggestions on the objective of deployment scenario. Sorry that my reply in previous round is not so clear, 'confirm the feasibility' in my reply is for RAN4 to determine their simulation assumption. My intention is it is up to each WG to make their own simulation assumption on deployment scenario for study as we did before. Based on this understanding, I still keep the previous version for this objective. Are you OK with this?
- @Ericsson, I share the same understanding as you regarding that the co-channel co-existence means interference from other BS or UE of the same operator (not co-existence between operators).
- Based on the comments, the objective is updated as below.

[Text Start]

The objective of this study is to identify and evaluate the potential enhancements to support duplex evolution for NR TDD in unpaired spectrum.

In this study, the followings are assumed:

- Duplex enhancement at the gNB side
- Half duplex operation at the UE side
- No restriction on frequency ranges

The detailed objectives are as follows:

- Identify applicable and relevant deployment scenarios ~~and use cases~~ (RAN1).
- Develop evaluation methodology for duplex enhancement (RAN1).
- Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD (RAN1, RAN4).
  - Identify possible schemes and evaluate their feasibility and performances (RAN1).
  - Study inter-gNB and inter-UE CLI handling and identify solutions to manage them (RAN1).
    - Consider intra-subband CLI and inter-subband CLI in case of the subband non-overlapping full duplex.
  - Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).
  - **Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).**
  - Study the feasibility of and impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4).
  - Note: RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.
  - Summarize the regulatory aspects that have to be considered for deploying the identified duplex enhancements in TDD unpaired spectrum (RAN4).

Note: For potential enhancements on dynamic/flexible TDD, utilize the outcome of discussion in Rel-15 and Rel-16 while avoiding the repetition of the same discussion.

[Text End]

3□TU allocation

- Ericsson raised that the RAN4 TU assumption needs to be increased compared to the TU allocation indicated in RP-213469. We can first finalize the objective and then I will report to RAN and WG Chairs to check the TU allocation.
- Ericsson also raised that RAN4 should start at the same time as RAN1. However, since based on RP-213469 the earliest time that RAN4 can start Rel-18 is Q3'2022, I think it is not possible to start RAN1 and RAN4 together for Rel-18. Considering RAN1 needs to time to conclude what information is needed from RAN4, so I think RAN1 can start first and consult with RAN4 later as needed.

3 Final Round

3.1 Text for SID Justification Section

[Text Start]

TDD is widely used in commercial NR deployments. In TDD, the time domain resource is split between downlink and uplink. Allocation of a limited time duration for the uplink in TDD would result in reduced coverage, increased latency and reduced capacity. As a possible enhancement on this limitation of the conventional TDD operation, it would be worth studying the feasibility of allowing the simultaneous existence of downlink and uplink, a.k.a. full duplex, or more specifically, subband non-overlapping full duplex at the gNB side within a conventional TDD band.

The NR TDD specifications allow the dynamic/flexible allocation of downlink and uplink in time and CLI handling and RIM for NR were introduced in Rel-16. Nevertheless, further study may be required for CLI handling between the gNBs of the same or different operators to enable the dynamic/flexible TDD in commercial networks. The inter-gNB CLI may be due to either adjacent-channel CLI or co-channel-CLI, or both, depending on the deployment scenario. One of the problems not addressed in the previous releases is gNB-to-gNB CLI.

This study aims to identify the feasibility and solutions of duplex evolution in the areas outlined above to provide enhanced UL coverage, reduced latency, improved system capacity, and improved configuration flexibility for NR TDD operations in unpaired spectrum. In addition, the regulatory aspects need to be examined for deploying identified duplex enhancements in TDD unpaired spectrum considering potential constraints.

[Text End]

Feedback Form 6: Comments on Text for SID Justification Section

1 – New H3C Technologies Co. We are fine with the description of SID Justification section
2 – TELECOM ITALIA S.p.A. Many thanks to the moderator for updating the text. The new version does not capture the intention of our proposal, but we can accept the current version as a basis to keep into account the problem. Just for clarification, the issue is that current Regulations in many country do not allow flexible TDD

(and therefore also full duplex operations) since they cause inter-operator interference in the same band. Therefore the need to study techniques to discuss with regulators how to allow new duplexing schemes and flexible TDD (if feasible)
3 – LG Electronics Inc. We support the text for SID justification section.
4 – SHARP Corporation We support the text for SID justification section.
5 – MediaTek Inc. Thanks a lot for moderator's efforts. We support moderator's proposal.
6 – ZTE Corporation Thanks a lot for moderator's efforts. We support moderator's proposal.
7 – Sony Europe B.V. We support the justification text.
8 – Ericsson France S.A.S We are OK with the text
9 – Tejas Networks Ltd. Thanks a lot for this update. We support this justification from moderator.
10 – CATT Thanks a lot for efforts. We support the proposal.
11 – Intel Corporation (UK) Ltd We are fine with the latest version from the moderator.
12 – InterDigital We support the added text updated by moderator

3.2 Text for SID Objective Section

[Text Start]

The objective of this study is to identify and evaluate the potential enhancements to support duplex evolution for NR TDD in unpaired spectrum.

In this study, the followings are assumed:

- Duplex enhancement at the gNB side
- Half duplex operation at the UE side
- No restriction on frequency ranges

The detailed objectives are as follows:

- Identify applicable and relevant deployment scenarios ~~and use cases~~ (RAN1).
- Develop evaluation methodology for duplex enhancement (RAN1).
- Study the subband non-overlapping full duplex and potential enhancements on dynamic/flexible TDD (RAN1, RAN4).
  - Identify possible schemes and evaluate their feasibility and performances (RAN1).
  - Study inter-gNB and inter-UE CLI handling and identify solutions to manage them (RAN1).
    - Consider intra-subband CLI and inter-subband CLI in case of the subband non-overlapping full duplex.
  - Study the performance of the identified schemes as well as the impact on legacy operation assuming their co-existence in co-channel and adjacent channels (RAN1).
  - **Study the feasibility of and impact on RF requirements considering adjacent-channel co-existence with the legacy operation (RAN4).**
  - Study the feasibility of and impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE (RAN4).
  - Note: RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.
  - Summarize the regulatory aspects that have to be considered for deploying the identified duplex enhancements in TDD unpaired spectrum (RAN4).

Note: For potential enhancements on dynamic/flexible TDD, utilize the outcome of discussion in Rel-15 and Rel-16 while avoiding the repetition of the same discussion.

[Text End]

Feedback Form 7: Comments on Text for SID Objective Section

1 – Spreadtrum Communications Thank Fei a lot for your great efforts. The updated SID version resolved our concern. We support the SID and would like be the supporting company. Thanks.
2 – Spark NZ Ltd Re UE requirement to be half duplex – as per moderators first round summary of feedback we should leave this to the study item to evaluate if required rather than having it mandated as written above.

3 – New H3C Technologies Co.

We are fine with the desciption of SID objective section

4 – TELECOM ITALIA S.p.A.

many thanks to the moderator. The current text is ok for us and therefore we would like to confirm Telecom Italia as a supporting company.

Just to be clear I would like to restate that for us the key objective is to find solutions to approach the Regulators and allow flexible TDD and new duplex schemes in the same band. Full duplex is clearly a long term scope.

5 – LG Electronics Inc.

We support the text for SID objective section.

6 – SHARP Corporation

We support the text for SID objective section.

7 – MediaTek Inc.

Thanks a lot for moderator's efforts. We support moderator's proposal.

8 – ZTE Corporation

Thanks a lot for moderator's efforts. We support moderator's proposal.

9 – Sony Europe B.V.

We support the moderator's proposed SID objectives.

10 – Nokia Corporation

Thank you for the excellent moderation. We support the moderator's SID proposal.

11 – Ericsson France S.A.S

We are generally OK with the text but prefer not to add the word "note" before the following bullet:

Note: RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.

The reason is that it is not fully clear what the implication of "note:" is, but it is clearly needed for RAN4 to consider these issues and to be involved earlier than RAN4 is involved for other kinds of studies.

Regarding the TUs, in our view around 1 TU should be allocated for RAN4 in Q3/4 2022 and 1.5 TU in 2023 considering the work eneded to evaluate feasibility, requirements and CLI. We realize that there is an agreement not to start RAN4 work before Q3, but still wonder what would be the view on as a special case making a small TU allocation for Q2 to RAN4 to discuss a workplan and what is needed, since it is important to get RAN4 input in time for the overall SI progress.

12 – CATT

Thanks a lot for efforts. We support the proposal.

13 – Intel Corporation (UK) Ltd

We support the latest version from the moderator.

14 – InterDigital

We support the updated SID objectives.

3.3 Collecting Supporting IM

Feedback Form 8: Collecting Supporting IM names

1 – New H3C Technologies Co.

Please include H3C in the list of supporting IM. Thanks so much.

2 – TELECOM ITALIA S.p.A.

many thanks to the moderator. The current text is ok for us and therefore we would like to confirm Telecom Italia as a supporting company.

Just to be clear I would like to restate that for us the key objective is to find solutions to approach the Regulators and allow flexible TDD and new duplex schemes in the same band. Full duplex is clearly a long term scope (i.e. low priority for us)

3 – CHTTL

Please include CHTTL in the list of supporting IMs as well, thank you for the great effort

4 – HUAWEI TECHNOLOGIES Co. Ltd.

Thanks moderator for the great effort. We would like to confirm Huawei and HiSilicon are happy to be listed as supporting companies.

5 – China Telecommunications

Thank you moderator for the great effort. We are fine with the SID justification and objective. We would like to confirm China Telecom as a supporting company.

6 – NTT DOCOMO INC.

Thank you moderator for the great effort. We support the SID justification and objective and would like to keep NTT DOCOMO as a supporting company.

7 – Spreadtrum Communications

Spreadtrum Communications is happy to be added in the supporting company list. Thank you.

8 – SHARP Corporation

Thank you moderator for the great effort. SHARP would like to be added in the supporting company list.

9 – CEWiT

Thank you moderator for the great effort. Please add CEWiT to the list.

10 – MediaTek Inc.

Thanks a lot for moderator's efforts. MediaTek is happy to be added in the supporting company list.

11 – Panasonic Corporation

Thanks a lot. Panasonic would like to be supporting company.

12 – ZTE Corporation

Thanks a lot for moderator's efforts. Please add ZTE and Sanechips as the supporting company.

13 – KDDI Corporation

Thank you moderator for the great effort. We would like to confirm KDDI as a supporting company.

14 – Futurewei Technologies

Many thanks for the moderator's efforts. Futurewei would like to be added as a supporting company.

15 – Nokia Corporation

Thank you for the excellent moderation. Please include Nokia, Nokia Shanghai Bell as supporting companies

16 – Sony Europe B.V.

Thanks Moderator for his effort. Please add Sony as one of the supporting companies.

17 – Beijing Xiaomi Electronics

Thank you moderator for the great effort. We would like to confirm Xiaomi as a supporting company on the final SID.

18 – vivo Communication Technology

Please add vivo to the supporting company list. Thanks!

19 – Deutsche Telekom AG

Please add Deutsche Telekom as supporting company.

20 – Ericsson France S.A.S

Thanks to the moderator for your great effort, and please add Ericsson as a supporting company

21 – Honor

Please add "HONOR" to the list of supporting companies. Thanks.

22 – OPPO Thanks moderator for his efforts. Please include OPPO as a supporting company.
23 – Motorola Mobility UK Ltd. Please add Lenovo, Motorola Mobility as supporting companies. Thank you.
24 – Intel Corporation (UK) Ltd Thanks for the moderator's efforts! Please add Intel as a supporting company. Thank you! In addition, we would like to note that the SID title is "Study on Evolution of Duplex Operation". Based on MCC guidance the SI/WI title shall refer to the specific technology (LTE/NR/MR-DC), so it could be changed to "Study on Evolution of Duplex Operation **for NR**".
25 – InterDigital Please add InterDigital as supporting companies. Thank you.

3.4 Moderator Summary and Recommendation

The final SID is uploaded in **RP-213557**. All companies are OK with current justification and objective.

- Ericsson prefers not to add the word "note" in the objective "Note: RAN4 should be involved early to provide necessary information to RAN1 as needed and to study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression". Considering there is no time to further check with other companies if they are OK to delete the word "note", I tend to keep it there, but I think, regardless of with or w/o the word "note", the common understanding is RAN4 should provide necessary information to RAN1 as needed and RAN4 should study the feasibility aspects due to high impact in antenna/RF and algorithm design, which include antenna isolation, TX IM suppression in the RX part, filtering and digital interference suppression.
- Regarding Ericsson's suggestion on the TU allocation, I will report it to RAN Chair and RAN4 Chair.