[91E][26][DSS_scope] - Version 0.0.4
RAN

3GPP TSG-RAN Meeting # 91-e

Electronic Meeting, March 16-26, 2021

RP-210883

Agenda item: 9.7.4

Source: Moderator (Nokia)

Document for: Information

1 Input documents covered

RP-210433, Status report for WI: Core part: NR Dynamic spectrum sharing (DSS), Rapporteur (Ericsson)

RP-210292, Views on Multi-Cell PDSCH Scheduling via a Single DCI, Samsung

RP-210449, Multi-cell PDSCH scheduling via a single DCI in DSS, Lenovo, Motorola Mobility

RP-210582, Views on Rel-17 NR dynamic spectrum sharing, CATT

RP-210604, Views on one DCI scheduling multiple PDSCHs on multiple carriers, ZTE, Sanechips

RP-210660, On DSS WID objective of single DCI for scheduling PDSCH on 2 cells, Huawei, HiSilicon

2 Introduction

RAN1 has conducted a study on single DCI scheduling PDSCH on multiple cells, but was not able to provide a recommendation on whether or not to proceed to specifying the feature. Companies should provide their view on the matter, with justification, so that RAN#91 can discuss and decide whether or not to specify the feature.

- Study, and if agreed specify PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells using a single DCI

- *The number of cells can be scheduled at once is limited to 2*

- *The increase in DCI size should be minimized*

3 Company views

Feedback Form 1: Company views on whether or not to specify the feature

Item	Company	Comments
1	KT Corp.	KT agrees to specify multi-cell PDSCH scheduling via a single DCI in Release-17. Overhead seems to be the one of the main obstacle on DSS and we believe this feature can beneficial to operators applying DSS to FDD low band where channel bandwidth is narrower than 3.5GHz.
2	Apple GmbH	Do not specify PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells using a single DCI First of all, it does not fit into DSS enhancement. For DSS enhancement, the main issue is that the existence of LTE CRS can impact the control capability and reliability of NR. Therefore, the cell that overlaps with LTE cell potentially even has issue scheduling itself. This is the reason we agreed in RAN1 and WID to specify sSCell to schedule SpCell which is not allowed in the current NR specification. This enhancement requires the DSS cell to schedule more than one cell which is even conflicting with the first agenda in eDSS which is enabling sSCell to schedule SpCell Secondly, this enhancement fits more into Cross Carrier Scheduling (CCS) enhancement. The benefit without potential impact of the scheduling flexility, is saving the 24 bit CRC plus a few extra bits in the DCI. However, if RAN1 is targeted to carry out the design, it is inevitably we have to discuss the potential optimization for each field in DCI one by one which is not driven by the deployment, but the arbitrary design preference from each company. For the URLLC enhancement, we already agreed on the compact DCI which can be used and we have already experienced extended discussion. This is another level of compression. It may provide limited benefit, however, compared to the KPI requirement of NR and the potential impact to the UE control monitoring complexity, we do not think it is justified to specify this feature in Rel-17, especially, under the DSS enhancement agenda.
3	InterDigital Germany GmbH	InterDigital agrees to specify multi-cell PDSCH scheduling via a single DCI in R17,
4	Qualcomm Incorporated	In our view, multi-CC scheduling is a useful feature; However, DSS does not really provide an appropriate framework for its specification. In particular, we think that when specifying multi-CC scheduling in the future, the work should be focused on a mechanism having the following attributes: • Applicable to intra-band NR CA • Applicable to same SCS only • Not limited to two CCs
5	Samsung Research America	Samsung does not support to specify this feature - reasons are summarized in RP-210292. RAN1 did not reach any conclusion for a benefit and RAN1 meetings are already highly challenging. We are open to consider efficient multi-cell scheduling, together with other potential CA enhancements, in Rel-18.

Item	Company	Comments
6	LG Electronics Inc.	LG does not agree to specify this feature for DSS in Rel-17 due to the same reasons with other companies: marginal gain, questionable benefit, unclear motivation, large workload causing significant spec impacts. This multi-CC scheduling feature could probably be considered as one of CA enhancements in later release, based on sufficient investigation/verification on use case, motivation and benefits.
7	CATT	CATT agree to specify this feature. This feature has been discussed for three RAN1 meetings and abundant simulation results from different aspects were provided across companies. At least the benefits coming from the following four aspects has been proved from the majority of simulaiton results or recognized by companies. Introduce more flexibility for network configuration and scheduling. Improve the throughput and consequently bring better experience for UE Reduce the possibility of PDCCH blocking and improve the system performance accordingly. Reduce power consumption as the required number of BD for the scheduling PDCCH is reduced.
8	MediaTek Inc.	We're supportive to continue normative specification works in Rel-17 under the condition with the consideration of forward compatibility to future enhancements covering more than 2 cells & intra-band NR CA cases. We see the system performance benefits to reduce PDCCH overhead as well as alleviate the required UE blind decoding complexity or PDCCH blocking issue for CA with more than 4 carriers together with multi-TRP deployment.

Item	Company	Comments
9	Huawei Tech.(UK) Co.. Ltd	RAN1 evaluations and agreed observations show PDCCH blocking rate reduction in scenarios that correspond to realistic and existing use cases especially when carrier bandwidth is limited (e.g. 10 or 20 MHz) with or without DSS. Therefore Huawei and HiSilicon support specifying PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells using a single DCI in Rel-17. The PDCCH blocking rate reduction can be converted to downlink cell capacity gains, as also observed in the RAN1 evaluations when the PDCCH blocking rate reduction is used for scheduling more UEs. The PDCCH blocking rate reduction could also be used for reducing latency for DL and/or UL scheduling. Gains are achieved as long as the network can configure the single DCI when it is beneficial for the network (downlink load is relatively high wrt the control resources with sufficient number of CA users, "as the number of NR devices in a network increases" as per the DSS WID justification), and as long as the DCI payload is configurable (e.g. by configuring which fields are shared for scheduling the two PDSCHs). This would allow the required adaptability needed for the network to enable the feature in an optimized manner depending on the actual deployment situation. Note that similar DCI design is already specified in Rel-16 for multi-slot PUSCH scheduling, and it is agreed to specify a similar DL DCI in Rel-17 for NR above 52.6 GHz. Therefore we propose the following objective revision: Specify PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells using a single DCI - The number of cells can be scheduled at once is limited to 2 - Allow configuration of DCI fields for scheduling the 2 PDSCHs We agree with the forward compatibility aspect mentioned by MediaTek.
10	Lenovo (Beijing) Ltd	Lenovo, Motorola Mobility: We support normative specification works on two-cell joint scheduling in Rel-17 with consideration of forward compatibility for uplink joint scheduling, more than 2 cells. We think the two-cell joint scheduling is an important feature for DSS scenario where NR PCell has limited control channel capacity. Throughout the three meetings in RAN1, majority companies show significant gains in reduced PDCCH blocking probability by using a single DCI to schedule two PDSCHs on two carriers compared to using two separate DCIs. Furthermore, the saved control channel resources can be used to improve DL throughput. As for the DCI size alignment issue and DCI format design raised by other companies, we believe those can be discussed in WI phase. At least, many fields in the DCI can be shared for two scheduled carriers and the payload size can be further reduced for intra-band CA case. In addition, the two-stage DCI can be also used to keep the first stage DCI with same payload size as a normal DCI.

Item	Company	Comments
11	ITRI	We support to continue this works in Rel-17 since RAN1 evaluations shown benefits regarding to PDCCH blocking probability, PDSCH throughput improvement, UE blind decoding reduction and power saving gain. While considering forward compatibility such as multi-CC scheduling or multi-TRP case in the future, it is proposed to work focus on intra-band NR CA.

Item	Company	Comments
12	ZTE Corporation	We prefer NOT to introduce one DCI scheduling two PDSCHs on two carriers in Rel-17 due to the questionable PDCCH/PDSCH gain and unclear motivation. Based on our analysis in RP-210604, we have the following detailed comments based on our observations from RAN1 evaluation. **For PDSCH simulation**: based on RAN1's simulation results, 4 out of 6 companies showed less than 3% PDSCH throughput gain under ideal simulation assumption, e.g., 100% CA UE, no other DCIs, unused CCE can be effectively reused by PDSCH, etc. The gain will be much smaller (almost zero) in practical networks considering the smaller ratio of CA UEs, other DCIs, dynamic change of the unused CCE resource, etc. **For PDCCH simulation**: With more reasonable assumption on DCI size, the average gain of PDCCH blocking rate has been drastically reduced to only around 1.5% 7.2% compared to the maximum gain observed by some companies. The maximum gain observed by some companies was more than 20% for different simulation combinations but this was achieved by the unrealistic assumption of 72bits DCI size and 100% CA UEs in the system. It is questionable to have one DCI with 72bits to schedule two PDSCHs on two different carriers considering that only 12 additional bits are reserved for indicating separate DCI fields (baseline DCI size = 60bits). 12 bits are even not sufficient for separate TDRA/FDRA indication in most cases. As indicated above, with the increase of DCI size, the average gain has been reduced to around 1.5% 7.2%. If the percentage of CA UEs is reduced and if different SCS is considered, the PDCCH blocking gain will be further decreased to a minor value. **Motivation**: the purpose of multi-cell scheduling in this WI is to improve the scheduling capacity in DSS scenarios. However, currently, RAN1 has identified Scell-scheduling-PCell in DSS WI and Multi-TTI scheduling for PDSCH in NR*ext*to_71GHz WI for the same purpose. With Scell-scheduling-PCell and Multi-TTI scheduling for PDSCH already approved in WIs, the motivation of introduction of one DCI scheduling two PDSCHs on two carriers is not clear from our perspective. **TU budget**: During the previous meetings, RAN1 didn't have any specific discussion on the solutions or spec impacts for Multi-cell scheduling. It is not like other SI (e.g., URLLC) that companies discussed and analyzed the detailed spec impacts of each candidate solution during the study phase, in that case the normative workload can be well under control. In this case, the spec impacts of Multi-cell scheduling can be huge and the discussion will be time consuming. As indicated by companies' contributions, RAN1 may need to discuss and debate whether to have separate indication or shared indication for each DCI filed and for shared indication, how to realize the shared indication. In addition to that, the spec impacts further include HARQ-ACK feedback mechanism, BD/CCE budget, DCI size alignment, etc. So far, only 1 TU is allocated for DSS + MR-DC (i.e., fast SCell activation) for RAN1. Given the tight Rel-17 timeline, we should avoid adding extra normative work which may jeopardize the progress of the already agreed features that have clearer benefits on DSS.

Item	Company	Comments
13	Ericsson LM	We prefer to stop working on this objective going forward in RAN1 for Rel17. The current objective for the feature has "the increase in DCI size should be minimized" and as also commented by other companies, this requires significant specification effort as RAN1 will have to discuss and agree whether/how to 'compress' each DCI field (discussions span many L1 features). RAN1 evaluations have not shown clear benefit (there is no consensus) and several companies (including us) have shown results that marginal or no performance gains are expected from the feature.
14	Nokia Corporation	Nokia is in principle supportive of the feature but shares the view of Qualcomm that the interesting use case is not in DSS, but in intra-carrier CA with same SCS and with > 2 cells and consider the simplifications to the DCI design that can be derived from these boundary conditions. As these are not compatible with the current DSS WI assumptions, and given the negative responses of many companies, we acknowledge that changing the direction of this work to what we are suggesting may be too much to ask for in Rel-17, and hence we should reconsider the scope in future releases.
15	Intel Belgium SA/NV	Intel is supportive to specify 2-cell scheduling. From the available evaluation results in RAN1, there is a clear benefit on reduced PDCCH blocking rate. There are results showing the gains of throughput too. On the other hand, we also understand the concerns from implementation perspective. In this sense, the specification changes should be minimized.
16	VODAFONE Group Plc	We believe that there may be some useful benefits from this feature, but acknowledge that this imposes more work on RAN 1.
17	Classon Consulting	A few points: 1. As with many features, the benefits will be there under certain network and traffic conditions and not in other cases. It is both hard to show there will always be gain, or to prove in every possible operator deployment that there cannot be meaningful gain. 2. The objective was included in DSS as there is some relation with DSS, though it is also expected to be available in general. This is similar to many FGs that can be used in additional use cases. The discussion to include or not the objective already happened, here we should not focus on scope. 3. Similarly, for workload or TU, some of the aspects mentioned were already known when the study and specify objective was included, such as what minimizing overhead would entail. It is not an undue (or unusual) burden here to continue working on the objective. A decision can be made later in the release, along with objectives in other WI, whether any downscoping needs to occur given the progress of R17. That said, given the comments above it would be good to continue discussing whether any focusing of the scope (e.g., considering fwd compatibility, minimizing spec changes, etc) can be done to better position the work for complettion.
18	Classon Consulting	[the previous comment was for FUTUREWEI]

4 Summary and way forward after the initial round

After the first round of discussions the following different views can be observed:

1. Do NOT proceed to the specification phase with the feature due to limited benefit in the scenario evaluated and the workload impose. 5 companies seemed to be strongly of this view,two additional companies seemed to think that the work should not proceed in its current scope, but should be done in future with a focus on >2 carriers and intra-band CA. Further, one additional company acknowledged the additional workload proceeding would impose on RAN1.

2. Proceed to the specification phase according to the current scope. 8 companies appeared to be of this opinion, while at least two of those conditioning this view to the work being future-proof towards supporting >2 carriers and intra-band CA and at least one company seeing that there maybe some benefits from this feature.

Moderator proposal after the initial round: After the RAN1 evaluation work there is a fairly wide camp that is not convinced that there is gain that would justify the complexity and work effort, and an additional set of companies who seem to believe that the scope of the work should be amended for the feature to be useful. It does not seem likely that the opposition can be convinced in RAN#91 to accept this feature to be moved to a specification phase. **Hence the inevitable outcome of this discussion is NOT to proceed to the specification phase in the Rel-17 DSS enhancements WI.**

Feedback Form 2: Company views on the moderator proposal after the initial round

Item	Company	Comments
1	Qualcomm Incorporated	We are ok with the Moderator's proposal.

Item	Company	Comments
2	Huawei Tech.(UK) Co.. Ltd	Dear Karri and All, While we understand the counting process, it is clear that only a minority of responses argued about the lack of gains (with unconvincing analysis, more on that below), while a majority of responses see benefits in scenarios in scope of the WI objective (2 carriers) or in additional scenarios with more carriers. With this logic, we wouldn't specify 90% of the enhancements we have in 3GPP. **The fact is that no company has shown a lack of gain when single DCI size is 96 108 bits, with sufficient DL CA traffic, when the scheduling carrier is 20 or 10 MHz, and when the scheduler converts the PDCCH blocking rate reduction to schedule more users with MU-MIMO.** **Workload** The workload of this objective is not fundamentally different than e.g. one objective of the Rel-17 URLLC WI. RAN1 has already designed common DCI for multi-slot PUSCHs in Rel-16 (NRU, extended to licensed operation in UE capabilities), and will do the same for multi-slot PDSCHs in Rel-17 (NR extension to 71 GHz). The feasibility and complexity of this type of design is well understood. The workload is only relative, there are other WIs with a larger or similar ratio of #objectives/#TU: R17 FeMIMO WI has 14 RAN1-led sub-objectives (some very open-ended) for 3 4 RAN1 TUs R17 URLLC/IIoT WI has 6 RAN1-led sub-objectives for 2 3 RAN1 TUs Having two objectives for 1 RAN1 TU cannot be argued insufficient. How the RAN1 agenda is organized is another issue, since this single RAN1 TU is also shared with the RAN1 impact of a RAN4-led WI, but this is just an artifact. This RAN4-led item could as well take TU from FeMIMO or be handled in LS agenda, or better have its clearly identified and dedicated RAN1 TU budget. **Gains** We can of course go on debating forever about the gains, but we'd like to point out that the companies who argue about the lack of gains very wisely used or assumed inappropriate scheduling algorithms. Moreover, concluding based on assumptions where there is not enough DL CA traffic obviously leads to declaring there is no gain, but again this is a choice of network configuration and the network should be smart enough to use the feature when needed. Two companies did not even put the efforts in to provide SLS but just provided a back-of-the-envelope analysis with simplified overhead reduction assumptions. When PDCCH capacity saves a few CCE, it is obvious that just increasing the allocation of one PDSCH to a few more PRBs won't provide significant throughput gains. But instead the gNB could schedule more users with MU-MIMO to achieve larger gains. These companies chose not to analyze this case. One company who provided SLS but argued about the lack of gains used too much DCI size reduction (84 bits), leading to strong scheduling restrictions in time/frequency resource allocation. This company chose not to provide results with 96 bits. The same company, in case of 108 bits size for single DCI, explained that they also expanded the PDSCH allocation to a few more RBGs for a non-blocked UE instead of using the reduced PDCCH blocking rate for scheduling more UEs. **Way Forward**

Item	Company	Comments
3	Ericsson LM	We are OK with the moderator's proposal
4	Orange	Orange does not agree with the proposed way forward. Apologies for not sharing our views in time for the first round of discussions, but we do see a real interest in this feature. As illustrated by simulations from Huawei, scheduling 2 CCs with a single DCI could bring interesting gains. Since the benefits are particularly visible in cases of low bandwidths (10 - 20 MHz), we see a clear interest to operate this feature with FDD bands in NR, especially with DSS. Given the fact that signaling overhead is high with DSS, features allowing gains in capacity are extremely valuable. As a result, we are supportive of the way forward proposed by Huawei, i.e. 2 carriers in Rel17, and more than 2 carriers in Rel18.
5	TELEFONICA S.A.	Telefonica is supportive of the way forward proposed by Huawei: "going ahead in Rel-17 with a focus on 2 DL carriers with the same SCS, with a possibility to expand in Rel-18 to more than 2 DL carriers"
6	vivo Communication Technology	Given the discusison so far, we would be open to one of the following alternatives as wayforward Alt1: To specify multi-cell scheduling in Rel-17 for simplified scenarios, e.g. 2DL CCs with same SCS, etc. and consider potential extention to general intra-band CA case in Rel-18 Alt2: To stop working on this feature in Rel-17 DSS WI, while making a clear RAN level conclusion that the multi-cell scheduling for general intra-band CA case will be addressed in Rel-18
7	Nokia Corporation	We would prefer directly specifying support for up to 4-carrier intra-band CA with same SCS, but it is evident that there is no agreement in the study phase of this feature to move forward regardless of how the scope is formulated. Hence we can accept the moderator proposal, but we are also open for compromise options such as proposed by Huawei above, if a consensus can be found around it.
8	Lenovo (Beijing) Ltd	We don't support this way forward. Based on the agreed simulation assumptions which have been extensively discussed in previous RAN1 meetings, majority companies observed significant gain in reduced PDCCH blocking rates. For those companies who question the performance gains, their observations are based on numerical estimation, biased simulation assumptions and inappropriate scheduling algorithms, which definitely leads to a biased conclusion. For those companies who didn't provide any simulation results in the previous three RAN1 meetings, their observations are not convincible. Regarding the work load, we don't see this feature requires much standardization effort. Since many fields, like DAI, TPC, PRI, identifier, HARQ timing indicator, can be shared for two scheduled carriers, and other fields are configurable dependent on gNB, the standardization effort is minor. For possible way forward, we agree with Huawei that only 2 carriers for DL scheduling is specified in Rel-17. More than 2 carriers for DL and joint scheduling for UL can be discussed in Rel-18.

Item	Company	Comments
9	China Telecommunications	China Telecom supports Huawei's way forward "going ahead in Rel-17 with a focus on 2 DL carriers with the same SCS, with a possibility to expand in Rel-18 to more than 2 DL carriers. " We are interested about the gains and the standardization effort is considered to be affordable.
10	Samsung Electronics Co., Ltd	We share moderator's view and support the moderator's proposal.
11	KPN N.V.	We are not OKE with the proposed WF. And as a compromise we do support the way forward proposed by Huawei «going ahead in Rel-17 with a focus on 2 DL carriers with the same SCS, with a possibility to expand in Rel-18 to more than 2 DL carriers». We see benefits in this feature, especially the PDCCH/PDSCH capacity gain in DSS and non-DSS scenario's for NR FDD bands with lower bandwidths (10 or 20 MHz).
12	LG Electronics Inc.	We also agree with the moderator's observation and support the moderator's proposal.
13	TELECOM ITALIA S.p.A.	Same view as Orange and other operators (sorry for missing the first round of discussions)
14	InterDigital Germany GmbH	We also disagree with the moderators proposal, more support Huawei and Lenovo's viewpoint
15	ZTE Corporation	We are fine with the proposal from the moderator. As many companies stated before, the gain of multi-cell DL scheduling is not justified at least with the current setup for inter-band CA defined under this DSS WI. More studies are needed to see if this multi-cell scheduling is beneficial when it is extended to other scenarios e.g., intra-band CA for more than 2 CCs, and multi-cell scheduling for UL CA, etc. By including multi-cell UL scheduling together, we can potentially design a common framework for both DL and UL supporting more CCs to reduce implementation/standardization complexity.
16	China Unicom	China Unicom has different view on the proposed way forward. Simulation results of multiple companies show that the feature of "PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells using a single DCI" will improve system performance and bring better experience for UE. It is proved that the feature is beneficial for FR1 FDD band, in practical, 1.8GHz band and 2.1GHz band can share the same DCI, and 900MHz band can be combined with 1.8GHz/2.1GHz band. Therefore, we think that 2 DL carriers with the same SCS can be supported at present. As for the potential benefits of >2 carriers proposed by multiple companies, we support and think it can be further studied.

Item	Company	Comments
17	Classson Consulting	[for FUTUREWEI] Given the strong operator support more effort should be spent trying to find a way to continue the work on the objective rather than giving. As commented earlier, there will be benefits under certain network and traffic conditions. From some earlier responses it seems the results against the proposal were either not full evaluations. In any case, the operator inputs here should not be ignored.
18	VODAFONE Group Plc	We believe that there may be some useful benefits from the Huawei proposal, but acknowledge that this imposes more work on RAN 1.
19	BT plc	We support specifying multi-cell PDSCH scheduling via a single DCI in Rel-17
20	Intel Belgium SA/NV	Intel is supportive of the way forward proposed by Huawei.
21	OPPO	[OPPO] As a UE vendor, we prefer to reaching a goal without doing redundant specification and implementation. If the ultimate target here is to support single DCI scheduling >2 carriers in 3GPP, it seems not quite attractive to firstly specify single DCI scheduling =2 carriers. In that sense, we are open to either of the following two directions: Alt1: RAN1 continues to work on single DCI scheduling two cells of the same SCS in R17, but with a plenary guidance that 3GPP is less likely to support single DCI scheduling more than two cells in near-future releases. Alt2: RAN1 stops working on single DCI scheduling two cells in R17, but expecting a new WI in near-future release that is more fit with CA framework in supporting single DCI scheduling N (N>1) cells. We have a slight preference on Alt2.
22	CATT	We support the proposed wayforward from HW. As mentioned by many companies, the gain has been justified from several aspects and the standard workload is controllable.

5 Summary and way forward after the 1st intermediate round

Way forward proposal based on the 1st round for not continuing to the specification phase received support from 5 companies as-is with additional 3 companies indicating that that is one option they could be OK with with some caveats. A total of 13 companies did not agree with the proposal and most of them supported a simplified way forward suggested by Huawei. This way forward was considered acceptable the same additional 3 companies that were open for several options. While Huawei way forward proposal included a provision for future extension to > 2 carriers, two of the companies indicated that if the Huawei way forward is adopted, there should be no additional work should be taken to extend to >2 carriers in near-future releases. As this is not critical for the discussion at hand, it maybe better not to engage in discussion of the contents of the future releases.

Given the results of the intermediate round, let's have another round on Huawei proposal.

Moderator Proposal for Way Forward after the first intermediate round:

Proceed to specify a single DCI scheduling PDSCH on two DL carriers with the same SCS. Update the WID as follows:

~~**Study, and if agreed**~~ specify PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells **with the same SCS** using a single DCI

- The number of cells can be scheduled at once is limited to 2

- The increase in DCI size should be minimized

Feedback Form 3: Company views on the moderator proposal after the first intermediate round

Item	Company	Comments
1	Samsung Research America	We do not support the latest proposal after the first intermediate round and do not support for RAN1 to specify a single DCI scheduling PDSCH on two DL carriers. There are no throughput gains, even under the most optimistic assumptions, and the gains in blocking probability were based on assumptions that are detached from reality and consider 5-10+ UEs being scheduled all the time with DL CA on 1-2 carriers of small BW, from a single CORESET with small BW, without existence of any other PDCCH. Almost all chipset vendors and almost all network vendors have not been supportive of such specification. RAN1 had extensive discussions and did not conclude on any benefit. Although the sudden influx of aligned input from operators is, and should be, noteworthy, it is unclear how they arrived in such input. It is also not correct to say that RAN1 impact will be small, such as limited to specifying fields of the DCI format that do not need to be duplicated. This feature will require new UE and network implementations that go well beyond defining a new DCI format. RAN1 has already spend more time on this topic than on all other topics under the DSS WI, combined. Features without any consistently agreed benefit should not be introduced and the time and efforts of RAN1 should be respected, especially under the current working conditions.
2	InterDigital Germany GmbH	We support the proposed way forward.

Item	Company	Comments
3	Qualcomm Incorporated	We appreciate the new compromise proposal but in a sense it makes the use case even weaker. In our view, the restriction to same SCS, while a welcome simplification, makes the DSS applicability really limited. We understood the most relevant DSS used case to be FDD+TDD CA, which will no longer be supported under the currently proposed compromise. At the same time, applicability and benefits in the intra-band use case, which we would be mostly interested in, remains to be also quite limited due to the two-CC restriction. While the gains can be debated, what should be generally accepted is that the solution scales and possible gains become more relevant when one DCI schedules eight CCs, for example, in intra-band CA. As we have seen it with the ongoing DC location reporting discussion, specifying up to two CCs in Release n and more than two CCs in Release n+1 is not a good idea in general. We would prefer to do this together. Whether in Rel-17 or Rel-18, we are open to both, but we do not support the current compromise proposal limiting the applicability to two CCs.
4	Ericsson LM	We are not OK with the compromise either. Having the SCS to be the same makes the feature almost irrelevant for DSS deployments and combined with the limited gains we have observed, the usefulness of this feature is questionable.
5	ZTE Corporation	As also commented by other companies, doing 2 cells in one release and doing more than 2 carriers in next release would potentially result in incompatible design, which complicates the standardization/implementation, we should try to avoid this. Moreover, it would be more appropriate to do it together with multi-cell UL scheduling. In addition, after restricting the same SCS here, it does not seem to be relevant to DSS any more. This feature can hardly be used to enhance DSS scenario. It seems inappropriate to keep it in DSS WI. More studies are needed to extend this to other scenarios where we may find higher potential benefits. Therefore, the latest proposal from the moderator does not sound like a proper way forward to us.
6	Lenovo (Beijing) Ltd	We support the latest way forward from the moderator. We fully understand the latest way forward is a compromised proposal in order to specify this feature step by step: (1) two DL-carrier joint scheduling in Rel-17; (2) more than two carriers joint scheduling for DL and UL in Rel-18. With current limitation in the latest way forward, definitely, it is not the best way. However, at least it addresses the concern of standardization effort in Rel-17. Moreover, so many operators are supportive of this feature and would see the outcome in Rel-17. Such business interests from operators should not be neglected. As for the concern whether this feature is inappropriate in DSS scope, I agree that the joint scheduling is more like a CA feature. That is the reason why the WID mentions that the joint scheduling can be extended to non-DSS scenario. Regarding the standardization effort, companies have spent much time and effort on link level simulation and system level simulation for half year. Those work should be respected.
7	China Telecommunications	We support the moderator proposal for way forward. As for the potential benefits proposed by multiple companies, we also support the further extension to > 2 carriers.

Item	Company	Comments
8	Spreadtrum Communications	We support the Moderator's latest way forward. One DCI scheduling multi-cell PDSCHs can provide benefits which are shown in the observations from the RAN1 104e meeting. It is useful feature. So we prefer to specify it in Rel-17. Also we think it is reasonable to divide it into two-steps. In Rel-17, RAN1 continues to work on same SCS and up to 2 DL cells scheduled by 1 DCI, as same as the latest way forward. In Rel-18, more than 2 cells and different SCS can be further studied.
9	Nokia Corporation	As said earlier, Nokia would prefer directly specifying support for up to 4 carriers, but we can accept the latest way forward proposal as well if consensus is found around it. However, we recognize that the potential benefits are not that large and the consensus may be difficult to find, and can also accept not to proceed to the WI phase with this feature in the DSS WI.
10	Intel Belgium SA/NV	Intel is supportive to the Moderator's way forward. 2-cell joint scheduling can be specified in Rel-17. Having a restriction of same SCS can largely reduce the efforts. On the other hand, joint scheduling of >2 cells can be considered in later release. The future work can be compatible to 2-cell joint scheduling. Therefore, we don't think there is an issue with such step-by-step standardization.
11	Telstra Corporation Limited	Option #2 performance will be suboptimal in many markets where large legacy LTE spectrum is currently used to support option #3 deployments. While DSS is core to expose this spectrum in option #2, it comes at a heavy capacity cost. So any enhancements that improve customer experience are helpful, no matter how marginal they are. While we are support the moderators way forward, we would prefer directly supporting up to 4 DL cells.
12	Huawei Tech.(UK) Co.. Ltd	Huawei continues supporting the WF from the moderator. As summarized, 16 companies out of 21 acknowledged the benefits and some also propose expanding the applicability of the feature to more (e.g. 4) carriers. Huawei would be open to consider expanding the target to 4 carriers in Rel-17. Note that our proposal to focus on 2 carriers with the same SCS was not motivated by workload but just to focus on the scenario where we saw the most gains from the set of scenarios evaluated in RAN 1 (and those gains increase with DSS). We think a unified design for 2 to 4 carriers is doable in Rel-17 if companies agree to work constructively towards that target.
13	Orange	Orange supports the WF as a first step, and support Huawei's proposal to extend to 4 carriers if possible. We would also be interested in addressing multiple SCS in order to apply this feature to a mix of n78 and FDD bands.
14	BT plc	We are not okay with the way forward, we are okay with limiting to 2DL cell, but the restriction for same SCS would limit the functionality in a DSS scenario.

Item	Company	Comments
15	MediaTek Inc.	Support moderator's proposal with the following revision. ~~**Study, and if agreed**~~ specify PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells **with the same SCS** using a single DCI - The number of cells can be scheduled at once is limited to 2 - The increase in DCI size should be minimized **- Strive for a unified design with forward compatibility to more than 2 cells**
16	Classon Consulting	[for FUTUREWEI] Not every company is going to be interested in every feature that 3GPP develops. Given the high level of interest and the gains achievable in certain scenarios and scheduling, we should specify the feature. The moderator WF is fine, but if needed given the various comments we are OK if some limitation is removed for the design. In any case given the work put into the current evaluations it is important not to stop the objective now and continue in the WG.
17	VODAFONE Group Plc	Vodafone supports the WF as a first step in line with the views expressed by Huawei and Orange. We would also be interested in addressing multiple SCS, but understand the desire to restrict the initial scope to the scenarios where RAN1 observed the most gains.
18	LG Electronics Inc.	We are not supportive to the new compromise proposal due to the same reasons with other companies. Fundamentally, we think that, limiting SCS combination across CCs and the number of CCs just to proceed introduction of this feature in Rel-17 without considering expected DSS deployments and expandability, is not desirable for the completeness of specification. Furthermore, standard workload to specify this feature in remaining Rel-17 is expected to be significant (compared to benefit from having it with combination restriction) since this feature is quite different from the multi-TTI PUSCH scheduling feature introduced in Rel-16 NR-U, in terms of designing DCI field details, scheduled CC indication, PDCCH search space, HARQ-ACK codebook aspects, and so on.

6 Summary after the 2nd intermediate round

Way forward after the first intermediate round to continuing to the specification phase but limit the scope to carriers with the same SCS received support from 11 companies, of which one company wanted to add a comment on forward compatibility to > 2 cells. In addition, one company was interested in proceeding with the work, but was not OK with the restriction to the same SCS. Again 5 companies indicated that they are not OK to proceed to specify the feature.

7 Overall summary and conclusion

RAN1 had completed a study phase for the DSS work item's objective "Study, and if agreed specify PDCCH of P(S)Cell/SCell scheduling PDSCH on multiple cells using a single DCI" and the RAN#91 discussion thread [91E][26][DSS_scope] was tasked to determine whether RAN1 could

proceed to the specification phase with the feature.

Three rounds of were conducted

Initial round: Initial round where companies were asked whether or not to specify the feature. 5 companies gave a clear preference to stop the work while 8 companies gave a clear preference to proceed to the specification phase.

1st intermediate round: As there was no agreement to specify in the initial round, companies were asked to comment on a way forward NOT to specify the feature. Altogether 8 companies were OK with this proposal while 13 companies did not agree to conclude that the work on the feature should be stopped. A simplified way forward restricting the operation to the same SCS carriers only emerged

2nd intermediate round: The simplified way forward with restricting the operation to two carriers with the same SCS was proposed. 11 companies supported the way forward of which one company wanted to add a comment on forward compatibility to > 2 cells. In addition, one company was interested in proceeding with the work, but was not OK with the restriction to the same SCS. Again 5 companies indicated that they are not OK to proceed to specify the feature. One company indicated that they'd be OK with the WF, but would also be OK not to proceed with the specification work.

In conclusion: The thread [91E][26][DSS_scope] was not able to agree to proceed to the specification phase with the feature, but the thread was not able to agree to stop the work on the feature either.