

Source: NTT DOCOMO, INC.
Title: Offline summary for PDCCH structure and search space
Agenda Item: 7.1.3.1
Document for: Discussion and Decision

1. Introduction

This document summarizes the discussion points for PDCCH structure and search space. The topics to be discussed are described in Section 2 and Section 3. Companies are encouraged to check them and provide comment if any.

Note that following issues are somehow related to the search space aspects, but are assumed to be handled by other feature leads:

- **RA procedure**
 - QCL-source selection for CORESETs in case RA procedure (DOCOMO 11373)
- **DCI formats/contents:**
 - Identification between fallback DCI and non-fallback DCI (Huawei 10111)
 - Clarification on DCI size alignment (ZTE 10339)
 - Number of DCI format sizes for CA (ZTE 10339)
 - DCI format 1_0 sizing and RB indexing when no CORESET#0 is present (Intel 10754, Samsung 10842, DCM 11373, Ericsson 11488)
 - Padding bits handling (Panasonic 11397)
 - Where to map the TCI field for the DCI format 1_1 in a CORESET enabling tci-PresentInDCI (ASUSTEK 11423)
- **MIMO BM/BFR:**
 - Whether to support SSB/CORESET#0-based BFR (Huawei 10111, CATT 10520,)
 - TCI assumption for PDSCH (LGE 10256)
 - TCI-PresentInDCI for cross-carrier scheduling (MediaTek, 10421)
- **BWP:**
 - Condition on PDCCH monitoring for search spaces associated with the CORESET#0 if the DL BWP does not contain the initial DL BWP or uses different numerology (Intel 10754, Qualcomm 11234)

- TCI field interpretation and TCI-state configuration for BWP-switching (DOCOMO 11373)
- Default CSS configurations (DOCOMO 11373)
- **DL/UL scheduling procedure (or DCI formats/contents):**
 - Clarifications on the number of DCIs stored by a UE (DOCOMO 11373)
 - Clarification on 'Processing no more than one DCI with each RNTI in each of Type 0 CSS, Type 0A CSS, Type 1 CSS, Type 2 CSS, Type 3 CSS excluding unicast DCI per slot' (Panasonic 11397)

Following issue requires RAN2 feedback before RAN1 discussion:

- Search space and CORESET association for cross-carrier scheduling (ZTE 10339)

2. Remaining issues that need discussions

2.1 Simultaneous monitoring of PDCCHs with different QCL assumptions

This UE behavior is not yet clear. Following offline proposal has been made but not yet clarified.

Offline proposal:

- For a UE monitors multiple search spaces associated with different CORESETs,
 - if the monitoring occasions of the search spaces are overlapped in time [or are separated less than Threshold-Sched-Offset in time], the UE may assume that the DM-RS of PDCCHs in the search spaces are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest CORESET-ID among the CORESETs associated with the search spaces.

LGE proposes to approve the above proposal with deleting the red square bracket part (10256).

Vivo proposes to agree that a UE is not expected to monitor multiple PDCCHs on CORESETs with different QCL assumptions (10369).

CATT proposes that the UE shall monitor search spaces associated with a particular CORESET, where the particular CORESET could be the one associated by CSS (10520).

Nokia proposes *"If the starting symbol of a current monitoring occasion is separated from the last symbol of the most recent monitoring occasion by 1 to Threshold-Sched-Offset symbols, the UE may assume that the DM-RS of PDCCHs in the current monitoring occasion are quasi co-located with the RS(s) in the TCI state used for monitoring PDCCHs in the most recent monitoring occasion. Otherwise, UE assumes that the DM-RS of PDCCHs in the current monitoring occasion are quasi co-located with the RS(s) in the TCI state indicated for the CORESET with the lowest ID among CORESETs associated with monitoring occasions with the same starting symbol."* (10619).

Samsung proposes that the UE can assume QCL of the CORESET configured by dedicated RRC as that of CORESET#0 only when broadcast DCI (e.g., SI/P/RA-RNTI) is monitored in CORESET#0, otherwise, the original TCI state of the CORESET can be assumed in the overlapped occasion (10842).

Qualcomm proposes that for FR2, the NW shall ensure that multiple search spaces associated to different CORESETs with different QCL-TypeD are not configured to be monitored on the same OFDM symbol (11234).

Company	View
LG	We're wondering whether a NW can ensure no collision between CORESETs with different TCI state. For example, since CORESET#0 and CORESET associated with Type 3 CSS could be configured UE-group specifically, it is difficult to avoid collision between those CORESET and CORESET associated with USS for each UE. Moreover, it can cause scheduling restriction from the NW's perspective. Therefore, we propose to approve the offline proposal with deleting the red square bracket part. (In our understanding, the Threshold-Sched-Offset is not for PDCCH monitoring but for PDSCH buffering.)
NTT DOCOMO	We share the view with LG that it would be impossible to ensure/guarantee always overlapping search spaces associated with different CORESETs with different QCL-TypeD. The possible options are (1) select one QCL-TypeD and monitor one or more search spaces associated with the CORESETs having the selected QCL-TypeD (then drop others), and (2) select one QCL-TypeD to monitor all the search spaces based on the selected QCL-TypeD (i.e., ignore configured TCI-state). (2) seems requiring new UE behavior, but indeed, the behavior is just re-using existing way; monitoring already configured search spaces using already configured TCI-states. So our preference is to adopt LG proposal. Regarding "[or are separated less than Threshold-Sched-Offset in time]", we are open to discuss; our understanding is that this is the transient time for beam-switching. Should be smaller than the value of Threshold-Sched-Offset which is defined for PDSCH beam determination based on the DCI indication, but maybe not zero value in some cases.
vivo	We think the configurations for search space set are flexible enough to avoid any potential collisions, so additional specification changes are not needed for Rel-15 in this late stage. Further enhancements can be considered in Rel-16 MIMO enhancement.
CATT	The offline proposal made at the last meeting actually reverts the previous agreement that the QCL should be configured per-CORESET by RRC signaling. For PDSCH, we have to make an assumption for the PDSCH reception if the gap between PDCCH and PDSCH is smaller than a threshold. The motivation is UE doesn't have any knowledge on the transmitting beam of PDSCH(only if type-D QCL is configured) before it decode its PDCCH successfully and UE need some time to switch one analogue beam to another after obtain the DL assignment. For PDCCH reception, we don't have this issue. UE knows exactly which beam is associated with a configured CORESET. From this perspective, we think it is

	a much simpler solution that UE monitors search spaces associated with a single CORESET. Furthermore, the CORESET associated with CSS could have higher priority. Otherwise, the CORESET with lowest ID could be used as a reference. Therefore, we update our proposal as follows: If monitoring occasions of search spaces associated with different CORESETs are ~~overlapped in time~~ ~~for are~~ separated less than Threshold-Sched-Offset in time} and the CORESETs are configured with different QCL-TypeD properties, the UE monitors search spaces in a CORESET containing a CSS. If two or more CORESETs are respectively associated with configured CSS, the UE monitors search spaces associated with the CORESET with the lowest CORESET-ID from these CORESETs with configured CSS.
Samsung	We share the view of Vivo and Qualcomm, i.e., a UE can expect that a configuration having overlapped CORESETs with different QCL-TypeD can be avoided by the gNB. Even if it occasionally happens, it is safe to assume that a proper gNB implementation will not result to this being a frequent event requiring to define UE behavior. Further, if any prioritization is needed, the search space ID (e.g. lowest one as in other conflict cases), rather than the CORESET ID should be considered.
Nokia	Prioritize CORESET with the lowest ID.
Qualcomm	We think whether UE can monitor PDCCHs with different QCLs highly depends on UE's ability in handling general DL reception with different QCLs. Therefore, it would be better if this issue can be discussed in the MIMO BM/BFR session and have a unified solution for PDCCH and PDSCH.

Offline proposal:

- Opt.1: Use the QCL-TypeD of the CORESET with the lower ID.
 - For a UE monitors multiple search spaces associated with different CORESETs for a given BWP of a serving cell,
 - ✧ If the monitoring occasions of the search spaces are overlapped in time ~~{Threshold-Sched-Offset in time}~~, the UE may assume that the DM-RS of PDCCHs in the search spaces are quasi co-located with the RS(s) in the TCI state with respect to the QCL assumption parameter(s) used for PDCCH quasi co-location indication of the lowest CORESET-ID ~~[or of the QCL assumption for the CORESET associated with the BFR-search space when the UE is monitoring the BFR-search space]~~ among the CORESETs associated with the search spaces monitored in the monitoring occasions.
- Opt.2: Select one QCL-TypeD, and monitors search spaces only associated with the CORESET with the selected QCL-TypeD. The selection is based on which CORESET is associated by CSS.
 - For a UE monitors multiple search spaces associated with different CORESETs for a given BWP of a serving cell,

✧ If monitoring occasions of search spaces associated with different CORESETs are overlapped in time ~~for are~~ separated less than Threshold-Sched-Offset in time} and the CORESETs are configured with different QCL-TypeD properties, the UE monitors search spaces in a CORESET containing a CSS. If two or more CORESETs are respectively associated with configured CSS, the UE monitors search spaces associated with the CORESET with the lowest CORESET-ID from these CORESETs with configured CSS.

- Opt.3: UE does not expect the case where multiple search spaces with different CORESETs with different QCL-typeD

2.2 Simultaneous reception of PDSCHs with different QCL assumptions

Vivo proposes that in the case of simultaneous reception of multiple PDSCHs with different TCI states, the UE prioritizes the reception based on the RNTI; UE is not expected to receive multiple PDSCHs with different TCI states scheduled by the same RNTI (10369).

Company	View
LG	To schedule multiple PDSCH on same resources could be regarded as a scheduling error. On the other hand, potential PDSCH and scheduled PDSCH can be overlapped on same resources, where the potential PDSCH means PDSCH buffering for the region related to Threshold-Sched-Offset. In our view, TCI state priority among scheduled PDSCH, potential PDSCH and CORESET with different TCI states could be defined for UE Rx assumption. Our proposal is scheduled PDSCH > CORESET > potential PDSCH.
NTT DOCOMO	Need to understand the proposal further.
vivo	There are some cases where multiple PDSCHs with different TCI states may overlap in the same symbol(s): 1) Dedicated PDSCH (e.g. scheduled by C-RNTI) overlaps with broadcast PDSCH with different TCI states in the same symbol 2) Multiple dedicated PDSCHs on different CCs (especially for intra-band CA) with different TCI states overlap in the same symbol A UE may not be able to simultaneously receive these PDSCHs, e.g. given only one Rx beam. For simplification we propose in the case of simultaneous reception of multiple PDSCHs with different TCI states, the UE prioritizes the reception based on the RNTI. And for CA case, a UE is not expected to receive multiple PDSCHs with different TCI states scheduled by the same RNTI (C-RNTI, CS-RNTI, etc.).
CATT	We believe it could be avoided by scheduling.
Samsung	Would like to further discuss this issue.
Nokia	This is MIMO AI discussion
Qualcomm	Same as PDCCH with different QCLs, it would be better if this issue can be

	discussed in the MIMO BM/BFR session.

Offline proposal:



2.3 Type 0/0A/1/2-CSS monitoring for DL BWPs

Nokia proposes to ask RAN2 to clarify the consistency rule for *PDCCH-ConfigCommon* (10619).

- **Option-1:** For non-overlapping DL BWP, *PDCCH-ConfigCommon* for the DL BWP provides CSS configurations that could be inconsistent from what was configured by broadcast SIB1.
 - Consistency rule may need to be updated by RAN2 with the following “*pdccch-ConfigCommon does not need to be consistent with SIB1 on a BWP, if the BWP does not contain CD-SSB.*”
 - No RAN1 impact
- **Option-2:** For non-overlapping DL BWP, CSS configured in *PDCCH-Config* (i.e., Type3-CSS) is used to receive SI, Paging, random access.
 - No RAN2 impact
 - RAN1 spec clarifies that UE receives SI, Paging, random access, from Type3-CSS (this is what 213 spec editor Aris asked during CR review phase)

Samsung proposes to clarify following (10842):

- For any BWP other than initial BWP, *PDCCH-ConfigCommon* can configure CSS for SI/P/RA-RNTI and the configuration can be different from the one for the initial BWP
- A UE may not decode for a DCI format with CRC scrambled by SI/P/RA-RNTI in CSS Type-3 that is configured by *PDCCH-Config*.

Company	View
NTT DOCOMO	We are fine with Samsung proposal. It maybe good to ask RAN2 about consistency rule. For example, in TS38.331 <i>BWP-DownlinkCommon</i>, following is specified. It is not sure whether the consistency rule is applicable to the non-initial DL BWP of the PCell. – <i>BWP-DownlinkCommon</i> The IE <i>BWP-DownlinkCommon</i> is used to configure the common parameters of a downlink BWP. They are “cell specific” and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.
vivo	This proposal is fine to us.

Samsung	We continue to support the proposal
Nokia	Option 1, which is consistent (to our understanding) with what Samsung proposed
Qualcomm	It would be good to first clarify what can be inconsistent (e.g., searchSpaceSIB1, searchSpaceOtherSystemInformation, pagingSearchSpace, ra-SearchSpace, commonControlResourceSet) and what should be consistent (e.g., controlResourceSetZero and searchSpaceZero). Also, clarify the condition for consistent and inconsistent configuration.

Offline proposal:

● Following is the working assumption.

- For any BWP other than initial BWP, *PDCCH-ConfigCommon* can configure CSS for SI/P/RA-RNTI and the configuration can be different from the one for the initial BWP
- A UE may not decode for a DCI format with CRC scrambled by SI/P/RA-RNTI in CSS Type-3 that is configured by *PDCCH-Config*.

2.4 Monitoring occasions of Type0A/2-CSSs for RRC CONNECTED UE

Nokia proposes that if a TCI-state is with QCL-D TRS/CSI-RS having a SSB as a source, the UE monitors Type0/2-CSSs on a specific monitoring occasion associated to the selected SSB; otherwise the UE monitors Type0A/2-CSSs on all the monitoring occasions within the OSI/paging window/occasion defined by SearchSpace IE using the QCL-D provided by the TCI-state (10619).

DOCOMO proposes that the monitoring occasion of the SS#0 is based on the selected SSB, while the monitoring occasion of any SS other than SS#0 is based on the configured monitoring occasions using the QCL-D of the associated CORESET (11373).

Company	View
LG	DOCOMO's proposal is preferred
vivo	DOCOMO's proposal seems simpler, but we are not clear on the UE behavior in the following case: In the initial DL BWP, if CSS uses configuration other than SS#0 (i.e. associated to common CORESET other than CORESET#0), which TCI state should be used by the UE to monitor the PDCCH, given that no TCI state is configured to the common CORESET?
CATT	We agree with DCM in principle. We recall that the following agreements were achieved in RACH session: Agreements: ● Adopt the following TP to Section 8.2 of 38.213 (change shown in red color) ----- If a UE detects a DCI format 1_0 with the CRC scrambled by the corresponding RA-RNTI and receives the corresponding PDSCH that includes the DL-SCH transport block, the UE may assume same DM-RS antenna port quasi co-location properties, as

	described in [6, 38.214], as for a SS/PBCH block or a CSI-RS resource the UE used for PRACH association as described in Subclause 8.1, <u>regardless of whether or not the higher layer parameter <i>TCI-StatesPDCCH</i> is provided for the CORESET where the PDCCH is received</u>. If the UE attempts to detect the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers non-contention based random access procedure, the UE may assume that the PDCCH and the PDCCH order have same DM-RS antenna port <u>quasi co-location</u> properties. ----- The above agreement implies the QCL assumption made by a UE when it tries to receive PDCCH in type-1 CSS may different from the one configured for the CORESET. Furthermore, the monitoring occasion for type-1 CSS will be further refined by the higher layer parameter <i>ra-responseWindow</i>. Therefore, we think a clarification on the proposal should be made in order to fit into the RACH agreement above, e.g. the type-1 CSS should be excluded from the ‘any SS other than SS#0’.
Samsung	DOCOMO’s proposal is preferred especially since it is still open whether to support TCI-state configuration for CORESET#0.
Nokia	After TCI is indicated for a CORESET, unicast and broadcast shall have the same assumption. Pure SSB cannot be QCL-D source in RRC connected.
Qualcomm	We prefer to discuss this issue to BM and initial access sessions.

Offline proposal:

- Joint discussion between control and initial access including both connected and idle UEs.

2.5 PDCCH monitoring occasions until USS or Type3-CSS is configured

DOCOMO proposes that when a UE is performing RRC connection establishment and the UE is provided with Type 1 common search space set, after a UE receives an initial RRC message indicating the C-RNTI or MCS-C-RNTI (if configured) or CS-RNTI (if configured), the UE shall monitor PDCCH candidates for DCI format 0_0 and DCI format 1_0 with the C-RNTI or MCS-C-RNTI (if configured) or CS-RNTI (if configured) in the Type 1 common search space set until at least UE starts monitoring PDCCH candidates for DCI format 0_0/1_0/0_1/1_1 with the C-RNTI or MCS-C-RNTI (if configured) or CS-RNTI (if configured) in at least one of a user-specific search space set or a Type 3 common search space set (11373).

Company	View
vivo	Maybe I miss something, but given the following behavior in 213, I think it is already supported. <i>If a UE is provided one or more search space sets by corresponding one or more higher layer parameters <i>searchSpaceZero</i>, <i>searchSpaceSIB1</i>, <i>searchSpaceOtherSystemInformation</i>, <i>pagingSearchSpace</i>, <i>ra-SearchSpace</i>, and the UE is provided with a C-RNTI, an MCS-C-RNTI, or a CS-RNTI, the UE</i>

	<i>monitors PDCCH candidates for DCI format 0_0 and DCI format 1_0 with the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the one or more search space sets.</i>
CATT	Although we agree with DCM, we also find the following description in the current 213 which has allow UE to monitor DCI format 0-0/1-0 associated with C-RNTI, MCS-C-RNTI or the C-RNTI. If a UE is provided one or more search space sets by corresponding one or more higher layer parameters <i>searchSpaceZero</i>, <i>searchSpaceSIB1</i>, <i>searchSpaceOtherSystemInformation</i>, <i>pagingSearchSpace</i>, <i>ra-SearchSpace</i>, and the UE is provided with a C-RNTI, an MCS-C-RNTI, or a CS-RNTI, the UE monitors PDCCH candidates for DCI format 0_0 and DCI format 1_0 with the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the one or more search space sets. From this side, we think the proposed update is not needed.
Samsung	Same opinion with Vivo (if we understand the proposal from DOCOMO correctly)
Qualcomm	It seems sufficient for UE to only monitor C-RNTI if the purpose is to allow UE to receive MSG4.

Offline proposal:



2.6 TCI state configuration for CORESET#0

Following alternatives were identified at the RAN1#93 meeting:

Alt. 1: Clarify that broadcast PDSCH uses selected SSB as QCL source for receiving broadcast data and that configured TCI states for CORESET #0 are used for reception of unicast data scheduled by PDCCH on search spaces other than SS#0

Alt. 1': TCI state can be configured for CORESET #0 where the QCL reference is only an SSB. Once TCI state is configured for CORESET #0, the UE follows QCL assumption based on the TCI state configuration for both broadcast PDCCH and unicast PDCCH in the search space set(s) associated with the CORESET #0

Alt. 2: CORESET #0 is not RRC configured with TCI states. According to the agreement above, the selected SSB is used as the QCL reference for reception of both broadcast and unicast PDCCH transmitted in CORESET #0. The selected SSB is either (a) indicated explicitly to the UE by MAC-CE signalling. The MAC-CE message contains the ID of the selected SSB, or (b) determined by the UE through any contention based RACH procedure. The selected SSB is the most recent one between (a) MAC-CE and SSB selected as part of CBRA or CFRA(b).

Alt. 3: Any search space associated with the CORESET #0 cannot be used for unicast PDCCH with QCL Type D after RRC connection is established.

Alt. 3': Any search space associated with the CORESET #0 cannot be used for unicast PDCCH with QCL Type D after RRC connection is established. Align 6 PRB grid b/w CORESET #0 and other CORESETs. CORESET other than #0 can be configured for unicast PDCCH so that same physical resource configuration with the CORESET #0 with dedicated TCI-state configuration. In this case, no need to configure TCI state on CORESET #0 itself.

Note:

- Regardless of alternatives, for CFRA, RACH-ConfigDedicated configures one or more of SSB(s) or CSI-RS(s) to configure PRACH preamble/resource, then the selected SSB/CSI-RS will be the QCL reference for the new CORESET #0 after the CFRA.
- Regardless of alternatives, the SSB is selected by the UE for CORESET#0 after the CBRA.

At the RAN1#94 meeting, following conclusion has been achieved:

Conclusion:

- No new RRC signaling for TCI-state configuration for the CORESET#0 is introduced.
- No new MAC-CE for TCI-state indication for the CORESET#0 is introduced.
- FFS: Whether the existing RRC configuration and/or existing MAC-CE field can be used to configure/indicate dedicated TCI-state or SSB index for the CORESET#0
- FFS: Whether/how to support BFR for the CORESET#0

Huawei proposes that MAC-CE can be used to configure TCI-state for CORESET#0, and the fields TCI-stateID should include SSB index or the CSI-RSs QCLed with SSB indexes (10111).

LGE proposes that the TCI state of CORESET#0 is the most recent one between default TCI state and SSB selected as part of CBRA or CFRA, where the default TCI state is, e.g., the lowest indexed TCI state in the TCI pool configured in the PDSCH-Config (10256).

ZTE proposes to assume that TCI-state for the unicast PDCCH in the CORESET#0 is the same as that of another CORESET. If the “another CORESET” has the configurations of a particular TCI-state and all “0” of the frequency-domain resource allocation, the “another CORESET” is just a TCI-state reference to be used for the unicast PDCCH in the CORESET#0 (10339).

CATT, Samsung propose to use MAC CE for PDCCH TCI state indication (10520, 10842).

Nokia points out that TCI-state of the CORESET#0 can be indicated by the MAC-CE (10619).

DOCOMO considers that neither RRC-based solution nor MAC-CE-based solution is necessary; use of commonControlResourceSet with non-initial DL BWP can solve the problem (11373).

Company	View
LG	In our proposal, the TCI state of CORESET#0 can be reconfigured by the most recent one between SSB selected as part of CBRA or CFRA and the lowest indexed TCI state (=default TCI state) in a TCI pool. And the default TCI state can be reconfigured by existing RRC signaling.

	Regarding the MAC CE, we have two questions: 1) which pool is assumed for selecting TCI by MAC CE signaling? 2) Selected SSB by CBRA or CFRA is still available for TCI state of CORESET#0? In other words, only MAC CE can reconfigure TCI state of CORESET#0?
NTT DOCOMO	According to the latest TS38.331, all the search spaces in the <i>PDCCH-ConfigCommon</i> can be associated to the <i>commonControlResourceSet</i> in the <i>PDCCH-ConfigCommon</i> , in which case, the UE is not required to monitor any search space in the CORESET#0. For <i>commonControlResourceSet</i> , at least in non-initial DL BWP, TCI-states are configurable. So, even if TCI-state is not configurable for the CORESET#0, <i>commonControlResourceSet</i> can be used instead. If this understanding is correct, there is no need to make TCI-states configurable for the CORESET#0.
CATT	Actually our proposal is that the UE assumes that the DM-RS antenna port associated with PDCCH reception is QCL'ed with the SSB the UE identified during the most recent RA procedure or the TCI state ID for CORESET#0 is indicated by MAC CE whichever is most recent.
Samsung	For CORESET#0, the UE can assume TCI state pool as the SSB indices, so that existing MAC CE command can be directly applied to TCI change for CORESET#0.
Nokia	Currently, MAC-CE indicates TCI states as configured in pdsch-Config. We believe no more discussion is needed on this topic!
Qualcomm	We prefer to discuss this issue in beam management session.

Offline proposal:

- Joint discussion between control and beam management.

➤ Note that RAN1 has spent more than 10 hours on this issue and hence, preferable not to spend long time

2.7 CP type of CORESET#0

MediaTek points out that the spec does not state how to determine the CP length of CORESET#0, and proposes it is always NCP (10421).

Company	View
LG	We agree.
NTT DOCOMO	OK.
vivo	We are fine with this proposal.
ZTE	Support.
CATT	Agree in principle. Considering extended CP is optional and so can only be configured for UEs in connected mode, is this addition really needed? If the answer is yes, we would like to propose some refinement as following: - Spec text starts for TS 38.213 section 13 -----

	If during cell search a UE determines that a control resource set for Type0-PDCCH common search space is present, as described in Subclause 4.1, the UE determines a number of consecutive resource blocks and a number of consecutive symbols <u>based on normal cyclic prefix</u> for the control resource set of the Type0-PDCCH common search space from the four most significant bits of <i>pdccch-ConfigSIB1</i> as described in Tables 13-1 through 13-10 and determines PDCCH monitoring occasions from the four least significant bits of <i>pdccch-ConfigSIB1</i>, included in <i>MasterInformationBlock</i>, as described in Tables 13-11 through 13-15. <u>The control resource set of the Type0-PDCCH common search space has normal CP if the subcarrier spacing of the PDCCH is 60 kHz.</u> SFN_C and n_C are the SFN and slot index within a frame of the control resource set based on subcarrier spacing of the control resource set and $\text{SFN}_{\text{SSB},i}$ and $n_{\text{SSB},i}$ are the SFN and slot index based on subcarrier spacing of the control resource set, respectively, where the SS/PBCH block with index i overlaps in time with system frame $\text{SFN}_{\text{SSB},i}$ and slot $n_{\text{SSB},i}$. ----- Spec text ends for TS 38.213 section 13 -----
Samsung	Agree
Nokia	OK
Qualcomm	Agree with the proposal.

Offline proposal:

- For the CORESET#0, always NCP is used.

2.8 PDCCH BD/CCE for cross-carrier scheduling with different numerologies across scheduling cells

RAN#81 conclusions were following:

RP-182014 Way forward for handling cross carrier sched with different numerologies in REL-16 Nokia BWP: bandwidth part Nokia: early completion is due to the amount of work for this and not a prioritization within the WI Qualcomm: in REL-15 RAN2 specs we have a UE capability that is then not applicable in REL-15 RAN chairman: we task for RAN1 and RAN2 to check where an additional note is needed to indicate that this is not supported in REL-15 specs conclusion: way forward is endorsed with the following clarifications: ● target indicated in the way forward is not because of a prioritization ● June 19 target applies to RAN1 only - this way forward applies ● only to case 1 of RP-181727 slide 5 and not to case 2 (which is already covered) ● RAN1 and RAN2 are tasked to check where an additional note is needed to indicate that this is not supported in REL-15 specs	
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The document was endorsed.

Panasonic and Ericsson point out that Case 6-2 and Case 7-2 still need to be fixed (11397, 11488).

Relationship between 4, y and T	Self-scheduling		Cross-carrier scheduling		
	Same numerology	Mixed numerologies	Same numerology (for all DL serving cells)	Mixed numerologies	
				Different numerologies between scheduling cell and scheduled cell	Same numerology between scheduling cell and scheduled cell but different numerologies between scheduling cells
T=<4 or 4<T=<y	Case 1 The limit per CC per slot equal to the limit for non-CA case		Case 4 The limit of the scheduling CC per slot is (number of scheduled CCs)*limit for non-CA case	Case 6-1 (Postponed to Rel.16)	Case 6-2 (Need to be concluded for Rel.15)
T>4 and T>y	Case 2 The total limit across CCs is based on BD capability and can be split across CCs	Case 3 The total limit across CCs per μ is based on BD capability. The limit per μ is $y \cdot M(\mu)$ and proportion of the number of CCs with μ to the total number of CCs.	Case 5 The total limit across CCs is based on BD capability and can be split across CCs (same as case 2)	Case 7-1 (Postponed to Rel.16)	Case 7-2 (Need to be concluded for Rel.15)

Panasonic and Ericsson proposes to adopt (number of scheduled CCs)*limit for non-CA case (11397, 11488).

Panasonic and Ericsson propose to adopt option 1 for the Case 7-2 from the following (11397, 11488):

- Opt.1: BD/CCE limit is per numerology group
- Opt.2: BD/CCE limit is per scheduling CC (or per cross-carrier scheduling group)
- Example:
 - Conditions
 - ✧ $y = 4$
 - ✧ CC#0 : 15 kHz SCS, scheduling CC
 - ✧ CC#1 : 15 kHz SCS, scheduled CC scheduling from CC#0
 - ✧ CC#2 : 15 kHz SCS, scheduling CC
 - ✧ CC#3, CC#4 : 15 kHz SCS, scheduled CC scheduling from CC#2
 - ✧ CC#5 : 30 kHz SCS, scheduling CC
 - ✧ CC#6 : 30 kHz SCS, scheduled CC scheduling from CC#5
 - For Opt.1:
 - ✧ 15 kHz: $\text{Floor}\{4 * 44 \text{ BDs/1ms} * (5 \text{ CCs} / 7 \text{ CCs})\} = 125 \text{ BDs/1ms}$

- ✧ 30 kHz: $\text{Floor}\{4 * 36 \text{ BDs}/0.5\text{ms} * (2 \text{ CCs} / 7 \text{ CCs})\} = 41 \text{ BDs}/0.5\text{ms}$
- For Opt.2:
 - ✧ CC#0: $\text{Floor}\{4 * 44 \text{ BDs}/1\text{ms} * (2 \text{ CCs} / 7 \text{ CCs})\} = 50 \text{ BDs}/1\text{ms}$
 - ✧ CC#2: $\text{Floor}\{4 * 44 \text{ BDs}/1\text{ms} * (3 \text{ CCs} / 7 \text{ CCs})\} = 75 \text{ BDs}/1\text{ms}$
 - ✧ CC#5: $\text{Floor}\{4 * 36 \text{ BDs}/0.5\text{ms} * (2 \text{ CCs} / 7 \text{ CCs})\} = 41 \text{ BDs}/0.5\text{ms}$

Company	View
LG	Option 1 is preferred.
NTT DOCOMO	Option 1 is preferred.
vivo	We slightly prefer option 1.
CATT	Option 1 is preferred.
Panasonic	We agree with the following offline proposal.
Samsung	Option 2 is preferred.
Nokia	Option 1, also note that RAN conclusion had a mistake. It say that CASE 2 is already supported in RAN1, but it is not.
Qualcomm	Option 1 is preferred. In order to make a complete overbooking rule, we can further discuss • Split budget across CCs subject to non-CA limit • Separately count CCEs/BDs for CCs scheduled by the same CC

Offline proposal:

- For cross-carrier scheduling with the same numerology between scheduling cell and scheduled cell(s) but different numerologies between scheduling cell(s), and the number of DL-CCs is up to 4 or with up to T DL-CCs where the UE reports BD capability of $y \geq T$, the limit of BDs/CCEs per CC per slot is (the number of CCs schedulable by the scheduling CC) x (the limit of BDs/CCEs for non-CA case).
- For cross-carrier scheduling with the same numerology between scheduling cell and scheduled cell(s) but different numerologies between scheduling cell(s), and the number of DL-CCs is more than 4 and with up to T DL-CCs where the UE reports BD capability of $y < T$, the limit of BDs/CCEs per CC per slot is $\text{Floor}\{X_i / (X_0 + X_1 + X_2 + X_3) * (M_i \text{ or } N_i) * y\}$, where;
 - X_i ($i=0, 1, 2, 3$) denotes the number of DL-CCs per numerology i
 - M_i and N_i denote the number of BDs and CCEs per slot specified for non-CA case for numerology i , respectively

2.9 PDCCH BD/CCE when monitoring BFR-search space

At the RAN1#94 meeting, following agreements have been made:

Agreement
Concerning the questions in RAN2 LS (R1-1808166) on BFR

Question 1: After UE sending PRACH for contention-free BFR, does the UE continue monitoring PDCCH candidates in configured search spaces monitored before PRACH, in addition to the search space indicated by *recoverySearchSpaceId*?

- RAN1 response: Yes, all configured search spaces before dedicated BFR PRACH transmission for BFR are monitored

Question 2: If the answer to Question 1 is “Yes”, is the BFR RACH procedure considered successfully completed only if PDCCH is received in search space indicated by *recoverySearchSpaceId*?

- RAN1 response: Yes, only when a PDCCH transmission addressed to C-RNTI is received on the search space indicated by higher layer parameter *recoverySearchSpaceId*, i.e., SS-BFR, UE considers a contention-free BFR procedure is successfully terminated

LGE raises two issues: (1) how UE monitors PDCCHs if BFR-search space and other search spaces are overlapped in time and BFR-CORESET and the CORESET for the other search spaces are with different TCI-states, and (2) for BFR-search space monitoring, how UE handles the case where PDCCH BD/CCE exceeds the defined limit. For the first issue, the proposal is to not to monitor the other search spaces in this case. For the second issue, the proposal is to prioritize BFR-search space than any other search spaces including CSSs (10256).

ZTE proposes that the BFR-search space has the highest priority, but gNB should ensure that the PDCCH candidates in CSSs are not dropped even when BFR-search space is monitored (10339).

Vivo proposes that this should be resolved by implementation; BFR-search space can be prioritized by properly assign lower search space ID or configure the BFR-search space as common search space (10369).

Samsung and ASUSTeK propose to set the highest priority to BFR-search space than any other SSs including CSSs (10842, 11423).

Company	View
LG	In our understanding, non-fallback DCI can be transmitted in BFR-search space, and it means BFR-search space may be configured to USS. In addition, it is not desirable that BDs/CCEs for BFR SS set are counted on beams with good channel quality, because it can restricted scheduling flexibility. So, we propose that BFR SS set has highest priority for PDCCH mapping rule. In addition, PDCCH monitoring on CSSs which are configured on outdated beam could be skipped, if the total number of BDs/CCEs for (BFR SS + CSSs) exceeds the BD/CCE limit of the serving cell.
NTT DOCOMO	For the issue (1) how UE monitors PDCCHs if BFR-search space and other search spaces are overlapped in time and BFR-CORESET and the CORESET for the other search spaces are with different QCL-typeD, we prefer consistent handling as for Section 2.1: simultaneous monitoring of QCL assumptions. For the issue (2) for BFR-search space monitoring, how UE handles the case where PDCCH BD/CCE exceeds the defined limit, prioritizing BFR search space other than USS is enabled by configuring search space ID appropriately. Then

	the questions are whether the BD/CCE number for BFR-search space is always taken into account even outside of BFR-SS monitoring window, and whether the CSS dropping is acceptable during BFR-SS monitoring. The clarification may be necessary for the previous RAN1 agreements. We would like to hear companies views on these points. Agreements: ● PDCCH BD/CCE counting is only based on the configured PDCCH decoding candidates (i.e., irrespective of whether or not a PDCCH decoding candidate is dropped, e.g., due to collision with other channels/signals) ○ Check further offline on potential spec impact
vivo	Agree with DOCOMO that the first issue should be handled together with section 2.1. The second issue can be resolved by implementation. For the question raised by DOCOMO, in our view, BFR is considered as an exception case rather than a regular operation, then always counting the BD/CCE of BFR-SS that may never be monitored seems overkill. So, we think it is OK to not consider the BD/CCE number of BFR-SS out of the BFR window.
ZTE	In general, we think this can be handled by careful gNB configuration. Specification may not need to state that.
CATT	If BFR happens, that is the link quality is worse than the threshold and UE feedback a preferred beam, gNB could schedule this UE only with fallback DCI before the BFR is resolved. In this case, the SS-BFR could be configured as a CSS. We slightly prefer VIVO's proposal.
Panasonic	We prefer to resolve by implementation. However, we agree with DOCOMO that consistent handling as for Section 2.1 is necessary.
Samsung	We prefer to make BFR-SS have the highest priority for fast BFR and minimizing the unnecessary BDs as much as possible. We agree with DOCOMO that more discussion on the agreement is needed. We think that more exceptional cases need to be added which cannot be avoided fundamentally, e.g., CA (de)activation, BWP switching, BFR, and etc.
Nokia	The simplest would be that during BFR window, UE should monitor only for BFR response? No special rules needed for BFR CORESET or search-space-set
Qualcomm	We prefer to discuss this issue in BFR session.

Offline proposal:

● Select one of the following:

- Opt.1: BD/CCE counting for BFR-search space is only after first transmission of a PRACH for BFR until the UE receives a MAC CE activation command for a TCI state or higher layer parameters *TCI-StatesPDCCH-ToAddList* and/or *TCI-StatesPDCCH-ToReleaseList*.
- Opt.2: BD/CCE counting for BFR search space is always regardless of whether or not the UE is in the BFR procedure.

➤ Opt.3: BD/CCE for BFR search space is no-count.

● Select one of the following:

➤ Opt.1: BFR-search space is prioritized over other search spaces including CSS for BD/CCE counting.

➤ Opt.2: BFR-search space is prioritized over any USS. NW ensures CSSs are not dropped.

➤ Opt.3: No special handling for BFR-search space.

✧ If NW wants to prioritize BFR-search space, NW can configure CSS as the BFR-search space, in which case the UE does not drop PDCCH candidates in the BFR-search space.

2.10 PDCCH BD/CCE limit for CA

For self-scheduling with different numerology, LGE proposes to specify the BD/CCE limit for the PCell to be the limit of non-CA case. ~~Compared to follow the existing formula, which is $N \text{ (or } M) / X$ where X is the number of DL-CCs with the numerology for PCell, higher scheduling flexibility for the PCell is available (10256).~~ In addition, The total number of BD/CCE to SCell(s) with numerology i is determined by $\text{Floor}\{(X_i/(X_0+X_1+X_2+X_3)) \cdot (M_i \text{ or } N_i) \cdot (y-1)\}$. (where X_j means the number of SCells with numerology j) (10256)

Company	View
LG	The agreed formula for CA limit (i.e., $\text{Floor}\{(X_i/(X_0+X_1+X_2+X_3)) \cdot (M_i \text{ or } N_i) \cdot y\}$) is defined for each numerology, while overbooking is allowed to PCell only. In that case, it is unclear how to assume the BD/CCE limit of PCell when the number of serving cells of a certain numerology (which includes PCell) is more than 1. For solving this problem, we propose that the BD/CCE limit for a PCell is always same with non-CA limit of corresponding numerology and agreed formula is only applied to SCells. For this solution, agreed formula can be modified as follows; The total number of BD/CCE to SCell(s) with numerology i is determined by $\text{Floor}\{(X_i/(X_0+X_1+X_2+X_3)) \cdot (M_i \text{ or } N_i) \cdot (y-1)\}$ (where X_j means the number of SCells with numerology j). This solution can provide more scheduling flexibility and opportunity to both PCell and SCells.
CATT	The modified formula may result a smaller total number of BD/CCE for each numerology set? For example, $T=8$ and $y=4$, two numerologies are assumed which contains 4 CCs respectively. The total number of BD is reduced from $2M_i$ to $9/7 \cdot M_1$ and $12/7 \cdot M_2$ respectively?
Panasonic	We think this issue is not critical. According to the following conclusion in the last meeting, the number of BD/CCE for PCell can be utilized up to non-CA limit, if the total limit(CA limit) for the numerology of PCell exceeds non-CA limit. Conclusion:

	At least for self-scheduling and for cross-carrier scheduling with the same numerology for all the DL serving cells, total number of CCEs or BDs corresponding to the remaining PDCCH candidates after PDCCH candidates are dropped based on the non-CA limit for the PCell (PSCell) and the configured PDCCH candidates for SCells is guaranteed by network to be no more than the CA limit.
Qualcomm	This proposal will change the previous agreement. We prefer to not change the agreement in this phase of Rel.15.

Offline proposal:



2.11 PDCCH BD/CCE number determination for BWP switching

SCS, CORESET, and search space configurations are BWP-specific. For BWP-switching, more than one BWP is configured, and active BWP is selected based on the DCI indication.

Vivo points out that it is not clear how the UE calculates number of BD/CCE if more than one DL BWP is configured and one of them is dynamically selected, and then proposes that the number is determined by the current active DL BWP, which requires re-calculation for the case of BWP-switching. Together with this, vivo proposes that the number is determined by the active DL cells, not by the configured DL cells (10369).

Vivo also points out that in case of CA with BWP-switching for a serving cell, BWP-switching with SCS change would impact on the PDCCH BD/CCE limit for other serving cells. The proposal is to keep the BD/CCE limit and search space mapping of all the cells until the slot or symbols that the new BWP on the serving cell is valid (10369).

Nokia proposes to determine the BD/CCE limit for a serving cell based on the lowest SCS configured for a DL BWP among different SCSs for different DL BWP configurations. The BD/CCE limit for other DL BWPs for the serving cell is linearly scaled down with rounding (10619).

Samsung proposes that at least for non-NR-NR-DC operation, the limit of BDs/CCEs is based on the active DL BWP of the cell (10642).

Company	View
LG	It is preferable that the limit of BDs/CCEs is based on the active DL BWP of the cell.
NTT DOCOMO	Same as for section 2.9, the conclusion depends on further clarification of the previous RAN1 agreements and implementation complexity.
vivo	We prefer to determine the BD/CCE limit based on the active DL BWP of the cell. And further, we would like to avoid the impact to other cells during the BWP switching of one scheduling cell.

Panasonic	We prefer to determine the BD/CCE limit based on the active DL BWP of the cell. If the BD/CCE limit is linearly scaled based on the lowest SCS, the BD/CCE limit for high SCS can be too small (e.g., if there are 15kHz BWP and 60kHz BWP, and 60 kHz BWP is activated, then the BD limit is 11 BDs/slot and the CCE limit is 14 CCEs/slot).
Samsung	Using the active BWP is sufficient. gNB can also largely avoid any potential issue by using SS sets with lower indexes to schedule the UE in the other cells.
Nokia	We think that “based on configured”, is easier for implementation.
Qualcomm	Regarding vivo’s proposal “The proposal is to keep the BD/CCE limit and search space mapping of all the cells until the slot or symbols that the new BWP on the serving cell is valid (10369)”, we would like to ask for a clarification on how “slot or symbols that the new BWP on the serving cell is valid” is defined. Regarding Nokia’s proposal “the BD/CCE limit for a serving cell based on the lowest SCS configured for a DL BWP among different SCSs for different DL BWP configurations. The BD/CCE limit for other DL BWPs for the serving cell is linearly scaled down with rounding (10619)”, suppose there are two SCSs 15kHz and 30kHz. If the active BWP’s SCS is 30kHz, is the PDCCH BD limit per 0.5ms slot 44 or 22?

Offline proposal:

- Joint discussion between control and BWP.

2.12 PDCCH BD/CCE number determination for NR-NR DC

Samsung points out that for NR-NR DC, it is not clear how the master node and secondary node know how many PDCCH BD/CCE the UE will monitor on their serving cells, and proposes to define inter-node signaling such that they can exchange the values of $N^{(DL,u)}_{cells}$ (10842). For this, LS to RAN2/3 might be necessary (10842).

Company	View
Panasonic	We are wondering whether exchanging $N^{(DL,u)}_{cells}$ is sufficient to solve this issue. For NR-NR DC, the number of BDs should be calculated for each cell group. On the other hand, if the number of BDs is equally split based on the number of cells in cell group, the number of BDs for PCell/PSCell can be insufficient. Some kind of mechanism to guarantee the number of BDs (e.g., the proposal from LGE in section 2.10) can be necessary.
Samsung	RAN1 needs to discuss this early to determine if an LS to RAN2 is needed
Nokia	I think RAN2 have not yet discussed NR-NR DC properly, so RAN1 LS would be beneficial for RAN2.
Qualcomm	It looks that SS assumes that a single PDCCH limit is used for all cells in both cell groups of NR-NR DC. We agree with this.

Offline proposal:



2.13 Collision between WB CORESET and other signals

Qualcomm proposes not to allow any collision with any cluster of a WB CORESET (11234).

Company	View
LG	If short monitoring periodicity (e.g., 1ms, 2ms) is configured to CORESET with WB-RS, the collision between SSB and the CORESET happens rarely (e.g., every 20ms) compared to periodicity of the CORESET. In that case, it is not efficient that multiple clusters for WB-RS CORESET are configured, because multiple clusters may decrease channel estimation performance. On the other hand, if the collision happens more frequently, multiple clusters are useful for avoiding collision. In our view, it is desirable that a NW can choose the number of clusters for WB-RS CORESET considering collision density and performance. Therefore, our proposal is that the collision between WB-RS CORESET and other signal (e.g., SSB) is allowed. In addition, if the WB-RS CORESET collides with other signal, WB-RS is rate-matched around the overlapped region.
vivo	As discussed in the Sanya meeting, the main motivation of introducing multiple clusters for WB CORESET is to avoid collision with other signals. Therefore, we don't have to additionally support rate-matching around other signals for WB CORESET. This proposal is OK to us.
CATT	It depends on NW how many clusters are configured once WB RS is configured for a CORESET. Considering the collision between PDCCH candidate and SSB/LTE-CRS, it is agreed that the PDCCH candidate should be dropped. We think the same behavior could be applied here, i.e. if one WB DMRS is collided with SSB/LTE-CRS, the corresponding PDCCH candidate should be dropped.
Samsung	Would like to discuss further including potential collisions of CORESETs for CSS and USS
Nokia	Our understanding that rate-matching behavior is already well defined for the WB DMRS
Qualcomm	We would like to clarify that our proposal is not to prohibit the configuration of WB-RS CORESET if any search space set occasion collides with LTE-CRS or SSB. Our proposal is to not monitor PDCCH only in the search space occasions that collides with LTE-CRS or SSB. In other search space occasions with WB-RS, UE still monitors PDCCH candidates.

Offline proposal:

2.14 DCI size budget for cross-carrier scheduling

MediaTek points out that following restriction implies that if a cell is cross-carrier scheduled by another cell, but the UE still monitors one or some DCIs in the cross-carrier scheduled cell, the DCI size budget need to be calculated taking into account DCIs across carriers, and proposes that the gNB ensures the number of DCI sizes for a cell does not exceed in case of cross-carrier scheduling (10421).

Company	View
LG	In our view, the DCI size budget is proportional to the number of scheduled cells. If the DCI size budget is fixed regardless of the number of scheduled cells, it will restrict scheduling flexibility of scheduled cells.
vivo	Agree with LG.
CATT	Don't quite understand the problem. If the cross-carrier scheduling is configured, the UE only monitors PDCCH candidate associated with scheduled cell on the scheduling cell, right? That is UE will not monitor PDCCH on both scheduling cell and serving cell. And the DCI budget is defined per cell, we don't quite understand this issue. Could MTK give some clarification in order to get a better understanding on this issue?
vivo	Agree with LG.
Nokia	At least +2 DCI sizes per each cross-scheduled cell.
Qualcomm	Currently PDCCH configuration for cross-carrier scheduling seems not finalized. It is good to first clarify the status of PDCCH configuration cross-carrier scheduling.

Offline proposal:

2.15 Type3-CSS monitoring

ZTE proposes to clarify when to monitor Type3-CSS, and it is at least one of DCI formats with the same size as DCI format 0-0/1-0 is configured for Type 3 CSS (10339).

Company	View
LG	In our view, NW will configure the DCI format size (e.g., DCI format 2-0, 2-1) in type 3 CSS to ensure the DCI size budget is fulfilled. So, it seems that spec. change is not needed.
NTT DOCOMO	ZTE's intention seems for DCI format 2_2 and 2_3, size alignment with DCI format 1_0 is necessary (as specified in 38.212) and hence, the NW should

	configure monitoring DCI format 1_0 when the UE is configured to monitor DCI format 2_2 and/or 2_3. If this is the intention, the proposal looks reasonable.
vivo	It is good to clarify. And in my understanding, a UE monitor C-RNTI or CS-RNTI only if DCI format 0-0/1-0 is configured for the Type 3 CSS.
CATT	We don't think any clarification on the spec is needed.
Samsung	In our understanding, NW does not need to configure DCI format 1_0 additional when the UE monitors DCI format 2_2/2_3 in Type 3 CSS. Instead, only the size of DCI format 1_0 (actually equal to initial BWP size) can be considered to determine the size of DCI format 2_2/2_3. For example, for SCell, DCI format 1_0 with C-RNTI or CS-RNTI is not monitored, and the NW does not need to configure it for the purpose of determining DCI format 2_2/2_3.
Qualcomm	ZTE's option 1 seems more reasonable. I.e., UE monitors C-RNTI or CS-RNTI only when DCI format 0-0/1-0 is configured for Type 3 CSS. It might worth clarifying this for the other RNTIs in 38.213 Section 10.

Offline proposal:

●

2.16 CORESET#0 for non-initial DL BWP

Samsung proposes to use a dedicate CORESET with all zero FDRA as the CORESET#0 for non-initial DL BWP (10842).

Company	View
CATT	CORESET#0 is unique and UE will realize the configuration of CORESET#0 after access to the network. If NW want to transmit a search space within CORESET#0 in a non-initial DL BWP, it can refer CORESET ID #0 when configure the search space.
Samsung	We continue to support the proposal
Nokia	Not needed, it is enough to configure index #0 for a CORESET. Then it is mapped to the one configured by PBCH if configured.
Qualcomm	It would be good if no change to spec is introduced in this stage of Rel. 15. To configure CORESET #0, we can use controlResourceSetZero in PDCCH-ConfigCommon of the initial BWP.

Offline proposal:

●

2.17 Default CSS configurations

DOCOMO proposes to reflect RAN2 agreements provided in the LS R1-1810070 as following (11373):

10.1 UE procedure for determining physical downlink control channel assignment

~

If a UE is not provided higher layer parameter *searchSpace-SIB1* for Type0-PDCCH common search space set for a configured BWP, the UE does not monitor the PDCCH candidate for a Type0-PDCCH common search space on the BWP~~determines a control resource set and PDCCH monitoring occasions for Type0-PDCCH common search space set as described in Subclause 13.~~

~

If the UE is not provided higher layer parameter *searchSpaceOtherSystemInformation* for Type0A-PDCCH common search space set for a configured BWP, the UE does not monitor the PDCCH candidate for a Type0A-PDCCH common search space on the BWP~~the Type0A-PDCCH common search space set is same as the Type0-PDCCH common search space set.~~

~

If a UE is not provided higher layer parameter *pagingSearchSpace* for Type2-PDCCH common search space set for a configured BWP, the UE does not monitor the PDCCH candidate for a Type2-PDCCH common search space on the BWP~~the Type2-PDCCH common search space set is same as the Type0-PDCCH common search space set.~~

~

Company	View

Offline proposal:

- Joint discussion between control and initial access.

3. Corrections/clarifications

3.1 Clarification on different BD counting for PDCCH with different scrambling sequences

ZTE proposes to clarify that different PDCCH payload scrambling sequences need separate PDCCH BD counting (10339).

-----Text Proposal for 38.213 section 10.1-----

If a UE is capable for operation with carrier aggregation with more than 4 downlink cells, and the UE indicates through *pdccch-BlindDetectionCA* a capability to monitor PDCCH candidates for $N_{\text{cells}}^{\text{cap}} \geq 4$ downlink cells, and the UE is configured with $N_{\text{cells}}^{\text{DL},\mu}$ downlink cells with subcarrier spacing configuration μ , and for scheduling on a same cell or for cross-carrier scheduling over the $N_{\text{cells}}^{\text{DL},\mu}$ downlink cells, the

UE is expected to be able to monitor a total of

$$M_{\text{PDCCH}}^{\text{total},\mu} = \min \left\{ N_{\text{cells}}^{\text{DL},\mu} \cdot M_{\text{PDCCH}}^{\text{max,slot},\mu}, \left\lceil N_{\text{cells}}^{\text{cap}} \cdot M_{\text{PDCCH}}^{\text{max,slot},\mu} \cdot N_{\text{cells}}^{\text{DL},\mu} / \sum_{\mu=0}^3 N_{\text{cells}}^{\text{DL},\mu} \right\rceil \right\}$$

PDCCH candidates for DCI formats with different size **and/or different PDCCH payload scrambling sequences** and/or different corresponding DM-RS scrambling sequences per slot over the $N_{\text{cells}}^{\text{DL},\mu}$ cells with subcarrier spacing configuration μ , and

$$\text{a total of } C_{\text{PDCCH}}^{\text{total},\mu} = \min \left\{ N_{\text{cells}}^{\text{DL},\mu} \cdot C_{\text{PDCCH}}^{\text{max,slot},\mu}, \left\lceil N_{\text{cells}}^{\text{cap}} \cdot C_{\text{PDCCH}}^{\text{max,slot},\mu} \cdot N_{\text{cells}}^{\text{DL},\mu} / \sum_{\mu=0}^3 N_{\text{cells}}^{\text{DL},\mu} \right\rceil \right\}$$

non-overlapped CCEs per slot over the $N_{\text{cells}}^{\text{DL},\mu}$ downlink cells with subcarrier spacing configuration μ . The maximum number of PDCCH candidates and the maximum number of non-overlapped CCEs per slot and per cell of the $N_{\text{cells}}^{\text{DL},\mu}$ downlink cells are $M_{\text{PDCCH}}^{\text{max,slot},\mu}$ and $C_{\text{PDCCH}}^{\text{max,slot},\mu}$, respectively.

Company	View
CATT	Agree
Qualcomm	It looks that 213 editor has decided to not repeatedly mention the condition of different blind decodes and removed the condition “for DCI formats with different size and/or different corresponding DM-RS scrambling sequences”. He did it at other places but may miss this sentence.

Offline proposal:

- Further check.

3.2 Clarification for the association for SS set and CORESET in cross-carrier scheduling

A search space set is defined per cell in the specs. For cross-carrier scheduling, there is no association between search space set S in cross-carrier scheduled cell and control resource set P in the scheduling cell. ZTE propose to capture following description in section 10.1 of 38.213.

-----Text Proposal for 38.213 section 10.1-----

For each DL BWP configured to a UE in a serving cell, the UE is provided by higher layers with $S \leq 10$ search space sets where, for each search space set from the S search space sets, the UE is provided the following by higher layer parameter *SearchSpace*:

- a search space set index s , $0 \leq s < 40$, by higher layer parameter *searchSpaceId*;
- an association between the search space set s and a control resource set p by higher layer parameter *controlResourceSetId*; If configured with a carrier indicator field by higher layer parameter *CrossCarrierSchedulingConfig*, the search space set s for serving cell is associated with control resource set p of the scheduling cell based on higher layer parameter *controlResourceSetId* of the search space set s for the scheduling cell.

...

for a UE-specific search space, $M_{p,s,\max}^{(L)}$ is the maximum of $M_{p,s,n_{CI}}^{(L)}$ over all configured n_{CI} values for a CCE aggregation level L of search space set s ~~in control resource set p~~ ;

...

Company	View

Offline proposal:

- Wait for RAN2 discussion and progress.

3.3 Correction for SP-CSI-RNTI monitoring on Type3-PDCCH common search space

CATT proposes to clarify this as following (10520):

10.1 UE procedure for determining physical downlink control channel assignment

<-----omitted----->

- a Type3-PDCCH common search space set configured by *SearchSpace* in *PDCCH-Config* with *searchSpaceType = common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, or TPC-SRS-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, SP-CSI-RNTI, or CS-RNTI(s); and
- a UE-specific search space set configured by *SearchSpace* in *PDCCH-Config* with *searchSpaceType = ue-Specific* for DCI formats with CRC scrambled by C-RNTI, MCS-C-RNTI, SP-CSI-RNTI, or CS-RNTI(s).

<-----omitted end----->

<-----omitted----->

- if search space set *s* is a common search space set
- an indication by higher layer parameter *dci-Format0-0-AndFormat1-0* to monitor PDCCH candidates for DCI format 0_0 and DCI format 1_0 with CRC scrambled by a C-RNTI, an MCS-C-RNTI (if configured), a CS-RNTI (if configured), an SP-CSI-RNTI(if configured), RA-RNTI, TC-RNTI, P-RNTI, or a SI-RNTI

<-----omitted end----->

<-----omitted----->

If a UE is provided one or more search space sets by corresponding one or more higher layer parameters *searchSpaceZero*, *searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, and the UE is provided with a C-RNTI, an MCS-C-RNTI, an SP-CSI-RNTI, or a CS-RNTI, the UE monitors PDCCH candidates for DCI format 0_0 and DCI format 1_0 with the C-RNTI, the MCS-C-RNTI, the SP-CSI-RNTI, or the CS-RNTI in the one or more search space sets.

<-----omitted end----->

Company	View
Qualcomm	This seems ok according to the agreement.

Offline proposal:

- Adopt the following TP.

10.1 UE procedure for determining physical downlink control channel assignment

<-----omitted----->

- a Type3-PDCCH common search space set configured by *SearchSpace* in *PDCCH-Config* with *searchSpaceType = common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, or TPC-SRS-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, or CS-RNTI(s); and
- a UE-specific search space set configured by *SearchSpace* in *PDCCH-Config* with *searchSpaceType = ue-Specific* for DCI formats with CRC scrambled by C-RNTI, MCS-C-RNTI, SP-CSI-RNTI, or CS-RNTI(s).

<-----omitted end----->

3.4 Clarification on FDRA for CORESET

Nokia points out that it is not yet clear which bit of the bit-map indicates which 6 RB group, and proposes to clarify that the MSB bit of the bit-map indicates the first 6 RBs of the DL BWP (10619).

TS38.213 Section 10.1:

.....
For each control resource set in a DL BWP of a serving cell, a respective higher layer parameter *frequencyDomainResources* provides a bitmap. The bits of the bitmap have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL BWP bandwidth of N_{RB}^{BWP} PRBs with starting position N_{BWP}^{start} where the first common RB of the first group of 6 PRBs mapped to the MSB of the bitmap has index $6 \cdot \lceil N_{BWP}^{start} / 6 \rceil$. A group of 6 PRBs is allocated to a control resource set if a corresponding bit value in the bitmap is 1; else, if a corresponding bit value in the bitmap is 0, the group of 6 PRBs is not allocated to the control resource set.
.....

Company	View
CATT	Agree
Qualcomm	This is in line with our text proposal in RAN1-94. Besides Nokia's proposal, we think it worth clarifying that the starting position and index are defined in the CRB domain. RAN1-94 TP: For each control resource set in a DL BWP of a serving cell, a respective higher layer parameter <i>frequencyDomainResources</i> provides a bitmap. The bits of the bitmap have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL

	BWP bandwidth of N_{RB}^{BWP} PRBs with starting CRB position N_{BWP}^{start} where the first PRB of the ~~first~~ group of 6 PRBs indicated by the most significant bit of the bitmap has CRB index $6 \cdot \lceil N_{BWP}^{start} / 6 \rceil$. A group of 6 PRBs is allocated to a control resource set if a corresponding bit value in the bitmap is 1; else, if a corresponding bit value in the bitmap is 0, the group of 6 PRBs is not allocated to the control resource set.

Offline proposal:

- Adopt the above TP.

3.5 Correction on interleaver initialization

Nokia points out that n_{shift} for CORESET#0 may be configured by PBCH, SIB1, or dedicated configuration, and hence the spec should be updated (10619).

TS38.211 Section 7.3.2.2:

..... The interleaver is defined by $f(j) = (rC + c + n_{\text{shift}}) \bmod (N_{\text{REG}}^{\text{CORESET}} / L)$ $j = cR + r$ $r = 0, 1, \dots, R - 1$ $c = 0, 1, \dots, C - 1$ $C = N_{\text{REG}}^{\text{CORESET}} / (LR)$ where $R \in \{2, 3, 6\}$ is given by the higher-layer parameter <i>interleaverSize</i> and where - $n_{\text{shift}} = N_{\text{ID}}^{\text{cell}}$ for a PDCCH transmitted in a CORESET configured by the PBCH or ~~SIB1~~ by ControlResourceSetZero, and - otherwise $n_{\text{shift}} \in \{0, 1, \dots, 274\}$ is given by the higher-layer parameter <i>shiftIndex</i>.
--

Company	View
CATT	Agree with the TP. Typo in ControlResourceSetZero above should be corrected.
Qualcomm	It looks that the intention is to clarify that the first bullet in spec is for CORESET #0. Since "CORESET 0" has been used in 38.211, can we just say " $n_{\text{shift}} = N_{\text{ID}}^{\text{cell}}$ for a PDCCH transmitted in ~~a CORESET configured by the PBCH or SIB1~~ CORESET 0 , and"?

Offline proposal:

- Adopt the above TP.

3.6 Clarification of the 'primary cell' for PDCCH monitoring

Qualcomm points out that the 'primary cell' is defined as PCell and PSCell at the beginning of TS38.213 Section 10, but later on, it is said that SI and Paging are monitored on the 'primary cell'; it should be the 'primary cell' of the MCG (11234).

Text Proposal for Section 10 of TS 38.213:

- a Type0-PDCCH common search space set configured by *pdccch-ConfigSIB1* in *MasterInformationBlock* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a SI-RNTI on the primary cell of the MCG;
 - a Type0A-PDCCH common search space set configured by *searchSpaceOtherSystemInformation* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a SI-RNTI on the primary cell of the MCG;
- [...]
- a Type2-PDCCH common search space set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a P-RNTI on the primary cell of the MCG;

Company	View
CATT	Agree

Offline proposal:

- Adopt the above TP.

3.7 Clarification on Type0-CSS and its CORESET configuration

DOCOMO proposes to clarify that the CORESET for Type0-CSS is configured either by MIB or by *PDCCH-ConfigCommon* (11373).

4.1 Cell search

~

Upon detection of a SS/PBCH block, the UE determines that a control resource set for Type0-PDCCH common search space, as described in Subclause 13, is present according to MasterInformationBlock if $k_{SSB} \leq 23$ [4, TS 38.211] for FR1 or if $k_{SSB} \leq 11$ for FR2. The UE determines that a control resource set for Type0-PDCCH common search space is not present according to MasterInformationBlock if $k_{SSB} > 23$ for FR1 or if $k_{SSB} > 11$ for FR2, but may present according to PDCCH-ConfigCommon.

~

13 UE procedure for monitoring Type0-PDCCH common search space

If during cell search a UE determines that a control resource set for Type0-PDCCH common search space is present according to MasterInformationBlock, as described in Subclause 4.1, the UE determines a number of consecutive resource blocks and a number of consecutive symbols for the control resource set of the Type0-PDCCH common search space from the four most significant bits of *pdccch-ConfigSIB1* as described in Tables 13-1 through 13-10 and determines PDCCH monitoring occasions from the four least significant bits of *pdccch-ConfigSIB1*, included in *MasterInformationBlock*, as described in Tables 13-11 through 13-15.

If a UE determines that a control resource set for Type0-PDCCH common search space is present according to PDCCH-ConfigCommon, as described in Subclause 4.1, the UE determines a number of consecutive resource blocks and a number of consecutive symbols for the control resource set of the Type0-PDCCH common search space from controlResourceSetZero, as described in Tables 13-1 through 13-10, and determines PDCCH monitoring occasions from searchSpaceZero, included in PDCCH-ConfigCommon, as described in Tables 13-11 through 13-15.

~

Company	View
CATT	Change to Sec. 4.1 and first change in Sec. 13 are not needed because it clearly states that it is for cell search. The UE is not performing cell search when a PSCell or SCell is added.
Qualcomm	It is good to have joint discussion with initial access. Also need to wait for RAN2 decision on fallback DCI size determination.

Offline proposal:

- Adopt the above TP.

3.8 Clarification on the RAN1#94 agreements for BD/CCE limit

Ericsson proposes to clarify that one sentence in the RAN1#94 agreements for BD/CCE limit is only for self-scheduling as following blue highlight (11488):

- For self-scheduling with same numerology or for cross-carrier scheduling with the same numerology for all the DL serving cells, and the number of DL-CCs is more than 4 and with up to T DL-CCs where the UE reports BD capability of $y < T$, the limit of BDs/CCEs per CC per slot is
 - ✧ The total number of BDs/CCEs across CCs is based on UE BD capability.
 - ✧ For self-scheduling, it can be split across CCs, subject to the non-CA limit on each CC.
 - ✧ For SCell, NW ensures no overbooking based on non-CA case occurs. For cross-carrier scheduling, BDs/CCEs overlapped across DL serving cells are independently counted (i.e., counted per serving cell).

Company	View
CATT	Agree
Qualcomm	We think the intention of original assumption is to split across CCs for cross-carrier scheduling too. That is why the agreement further states that “for cross-carrier scheduling, BDs/CCEs overlapped across DL serving cells are independently counted (i.e., counted per serving cell)”.

Offline proposal:

- Adopt the above clarification.

4. Any other essential issues?

Company	View
CATT	At the RAN1 #93 meeting, RAN1 clarified its understanding of a RAN2 agreement on how a UE acquires CORESET #0 and SS #0. RAN2 had further discussion on this issue at the RAN2 AH-1807 meeting, with the following agreement: => Change "controlResourceSetZero" second sentence to "Even though this field is only configured in the initial BWP (BWP#0) the UE operating in a different BWP acquires the CORESET#0 if the conditions defined in FFS_Spec, section FFS_Section are satisfied)." Similar change to be made to the similar text in searchSpaceZero. => Change to be added to the rapporteur EN-DC CR The above agreement has been addressed in the latest version of 38.331. We propose the following TP for section 10.1 in 38.213 to capture the agreement. <u>If a UE is provided with the higher layer parameters controlResourceSetZero and searchSpaceZero in PDCCH-ConfigCommon the UE determines the corresponding control resource set and search space set according to the procedure described in Subclause 13. The UE monitors PDCCH candidates in a</u>

	<u>search space set associated with <i>controlResourceSetZero</i> only if the bandwidth determined for <i>controlResourceSetZero</i> in Subclause 13 is contained in the active DL BWP and the active DL BWP is configured with the same numerology as <i>controlResourceSetZero</i>.</u>
Qualcomm	We would like to add a proposal without which UE will have to decode two PDSCHs if TDRA ambiguity in DCI occurs between UESS and CSS in CORESET #0. For this we updated our previous proposal 6 in contribution 1811234 to the following Proposal 1: it is treated as an error case if the UE cannot distinguish a DCI defined in CSS from a DCI defined in UESS in CORESET #0. The network can easily avoid the ambiguity if it configures a scrambling ID to the UESS.

5. Agreements in the past RAN1 meetings

RAN1#88bis

Agreements

- UE can be configured to “monitor DL control channel” in terms of slot or OFDM symbol with respect to the numerology of the DL control channel
 - Specification supports occasion of “DL control channel monitoring” per 1 symbol with respect to the numerology of the DL control channel
 - Note: This may not be applied to all type of the UEs and/or use-cases
 - FFS whether or not total number of blind decodings in a slot when a UE is configured with “DL control channel monitoring” per symbol can exceed the total number of blind decodings in a slot when a UE is configured with “DL control channel monitoring” per slot
- Data channel (PDSCH, PUSCH) duration and starting position
 - Specification supports data channel having minimum duration of 1 OFDM symbol of the data and starting at any OFDM symbol to below-6GHz, in addition to above-6GHz
 - Note: This may not be applied to all type of UEs and/or use-cases
 - UE is not expected to blindly detect the presence of DMRS or PT-RS
 - FFS: Whether a 1 symbol data puncturing can be indicated by preemption indication
 - FFS: combinations of data duration and granularities of data position
 - Specification supports data having frequency-selective assignment with any data duration
- FFS: relations between “DL control channel monitoring” occasions and data channel durations
- Note: this is addition to the agreements at RAN1#86.
- Note : 1-symbol case may be restricted depending on the BW.

Working assumption:

- One-port transmit diversity scheme with REG bundling per CCE is used for NR-PDCCH
 - FFS the bundling size
 - FFS: REG bundling is also for localized mapping in time and/or frequency-domain
- Companies are encouraged to provide evaluation results for 10 MHz and 20 MHz for larger aggregation levels and 5 MHz and 10 MHz for smaller aggregation levels

Agreements:

- MU-MIMO is supported NR-PDCCH using at least non-orthogonal DMRS.
 - FFS: orthogonal DMRS for UE-specific NR-PDCCH

Agreement: NR-PDCCH can be mapped contiguously or non-contiguously in frequency with localized or distributed mapping of REGs to a CCE (in the physical domain)

- Note: The number of contiguous REGs in the CCE needs further discussion.
- Note: Localized/distributed mapping can be achieved without/with interleaving.

Agreements (from offline):

- A CCE may be mapped to REGs with interleaved or non-interleaved REG indices within a CORESET
- Definition of a REG bundle: The UE may assume that the same precoder is used for the REGs in a REG bundle and that the REGs in a REG bundle are contiguous in frequency and/or time
- REG bundling per CCE is supported for NR-PDCCH
 - FFS: Whether this applies to common search space
 - FFS: Whether all REGs have DMRS or not
 - FFS: Whether wideband precoding is supported and the definition of a REG bundle if it is supported
 - FFS: whether REG bundle size is different for mapping of NR-PDCCH with or without interleaved mapping of CCE to REGs
 - FFS on REG bundle size
 - FFS whether REG bundle size is configurable

Working assumption:

- A NR-CCE is defined as 6 REGs
 - Candidate bundle sizes for distributed REG-to-CCE mapping: 2 or 3 REGs if NR-CCE is defined as 6 REGs
- FFS: impact of the NR-CCE definition on CORESET size, CCE aggregation levels, data resource allocation granularity, etc.

RAN1#89

Agreements:

- CCE = 6 REGs (confirm Working Assumption)

- One of following is configured for REG-to-CCE mapping for a 1-symbol CORESET:
 - Opt.1: No interleaving – 6 REGs for a given CCE are grouped to form a REG bundle and all REGs for a given CCE are consecutive
 - CCE(s) of one PDCCH is/are also consecutive
 - FFS: Whether the UE can assume the same precoder across multiple REG bundles
 - Opt.2: Interleaving – [2 or 3 or 6] REGs for a given CCE are grouped to form a REG bundle and REG bundles are interleaved in the CORESET
 - FFS: Whether the UE can assume the same precoder across multiple REG bundles
 - FFS: down selection among {2}, {3}, {2,3}, {2,6}, {3,6}, {2,3,6}
 - Note: UE can assume the same precoder within a REG bundle
- For REG-to-CCE mapping for a CORESET with more than 1-symbol;
 - REG bundle is defined in time and frequency-domain
 - At least support following:
 - Time-first mapping where one of the following is configured
 - Support REG bundle in time-domain being equal to the CORESET semi-statically configured time duration
 - Opt.1: Non interleaving - 6 REGs for a given CCE are grouped to form a REG bundle and all REGs for a given CCE are time and frequency localized
 - FFS: Whether the UE can assume the same precoder across multiple REG bundles
 - Opt.2: Interleaving – [2 or 3 or 6] REGs for a given CCE are grouped to form a REG bundle and REG bundles are interleaved in the CORESET
 - FFS: Whether the UE can assume the same precoder across multiple REG bundles
 - FFS: time-domain precoder-cycling
 - Support REG bundle in time-domain being equal to 1 symbol, or;
 - Support following:
 - REG-to-CCE mapping is exactly same as the case where a CORESET with 1 symbol
 - A PDCCH candidate can be mapped across OFDM symbols

Agreements:

- Confirm working assumption:
 - One-port transmit diversity scheme with REG bundling per CCE is used for NR-PDCCH
- FFS: DMRS RE overhead for the REG transmitting DMRS is 1/3
 - FFS on DMRS pattern

Agreements:

- In time domain, a CORESET can be configured with one or a set of contiguous OFDM symbols
 - The configuration can indicate the starting OFDM symbol and time duration
- A CORESET is configured with only one CCE-to-REG mapping

Working assumptions:

- For a time-duration of a CORESET:
 - Support 1-3 OFDM symbol as time duration for a CORESET on the NR carrier with less than or equal to X PRBs
 - Support 1-2 OFDM symbol as time duration for a CORESET on the NR carrier with wider than X PRBs
 - FFS: X values
 - FFS: Other time duration
 - FFS: Relationship of a first PDSCH DMRS symbol with one or more symbols of a CORESET for slot-based scheduling
 - FFS: restriction in the certain conditions

RAN1#NR-AH2

Agreements:

For a 1-symbol CORESET with interleaving,

- At least REG bundle size = 2 is supported
- Working assumption:
 - REG bundle size = 6 is also supported
 - FFS whether configuration between 2 and 6 is explicit or implicit
 - Precoder granularity in frequency domain is equal to the REG bundle size in the frequency domain

For a 2 or 3 symbol CORESET with interleaving,

- At least REG bundle size = CORESET length is supported
- Working assumption:
 - REG bundle size = 6 is also supported
 - FFS whether configuration between CORESET length and 6 is explicit or implicit
 - Precoder granularity in frequency domain is equal to the REG bundle size in the frequency domain

(Note: REG bundle size = REGs in frequency domain x symbols in time domain)

Agreement

- DMRS is mapped on all REGs on all the OFDM symbols of a given PDCCH candidate
 - The DMRS density is the same on all REGs

Agreements:

- For a CORESET which is configured by UE-specific higher-layer signalling, at least following are configured.
 - Frequency-domain resources, which may or may not be contiguous
 - Each contiguous part of a CORESET is equal to or more than the size of REG-bundle in frequency
 - FFS: exact size and number of contiguous parts for a CORESET
 - Starting OFDM symbol

- Time duration
- REG bundle size if the configuration is explicit
- Transmission type (i.e., interleaved or non-interleaved)
- More parameters may be added if agreed
- For a CORESET which is configured by UE-specific higher-layer signalling, at least following is configured.
 - Monitoring periodicity
 - FFS: it is a configuration per CORESET or per one or a set of PDCCH candidates
 - FFS: relation with DRX
 - FFS: default/fallback value

Agreements:

- For PDCCH blind decoding, at least for the non-initial access, at least the following can be configured:
 - Number of PDCCH candidates per CCE aggregation level, per DCI format size that the UE monitors
 - Set of aggregation levels
 - FFS explicit or implicit configuration
 - Set of DCI format sizes
 - FFS explicit or implicit configuration
 - FFS: per CORESET not used for initial access or search space
 - FFS: Signalling details
 - Note that the number of candidates can be zero
- UE blind decoding capability is known by NW
 - FFS: How the capability is derived

RAN1#90

Agreements:

- Working assumptions are confirmed with the following details.
 - For 1/2/3-symbol CORESET, REG bundle size of 6 is supported.
 - A REG bundle size is as part of CORESET configuration for a CORESET configured by UE-specific higher-layer signalling.
 - FFS: CORESET(s) configured by non UE-specific signaling.
- ~~FFS~~ UE assumes that precoder granularity in frequency domain is equal to the REG bundle size in the frequency domain
 - FFS: gNB can inform to the UE whether or not to assume the same precoder over multiple REG bundles.
- Note: more than one CORESET(s) with the UE-specific higher-layer signaling can be configured for the same UE

Agreements:

- Interleaving operates on REG bundles
 - FFS: interleaving in the case if and when gNB informs to the UE to assume the same

precoder over multiple REG bundles

Agreements:

- For interleaving CORESET, the interleaving pattern is derived by the CORESET configuration and is not dependent on other CORESET configuration.
- Note: Following metrics can be considered
 - Good frequency distribution of REG bundles within the CORESET
 - Blocking probability for potential overlapped CORESET(s)
 - Inter-cell/inter-TRP interference randomization

Agreements:

- DMRS density for a CORESET is down-selected between 1/3 or 1/4.
 - FFS: need of additional DMRS density.
- Sequence, density, and applicability of MU-MIMO is still under discussion

Working assumption:

- DM-RS density per REG is 1/4 at least for normal CP
 - FFS: orthogonal DMRS for MU-MIMO at RAN1 NR AH#3.
 - FFS: URLLC

Agreement:

- The CORESET used to schedule the PDSCH containing the RMSI can be configured to contain also UE-specific PDCCH(s)

Working assumptions:

- For slot-based scheduling, the first DMRS position either on 3rd symbol or 4th symbol is configured by [PBCH].
 - Maximum time duration of a CORESET is 2 symbols if the first DMRS position of a PDSCH with slot-based scheduling is on 3rd symbol, and is 3 symbols otherwise
- This replaces the past working assumption linking DMRS position to bandwidth X

Agreements:

- Supported aggregation levels for NR-PDCCH are at least 1, 2, 4, 8
- FFS 16 and 32 aggregation levels and also other numbers

Agreements:

- A PDCCH search space at an aggregation level in a CORESET is defined by a set of PDCCH candidates
- For the search space at the highest aggregation level in the CORESET, the CCEs corresponding to a PDCCH candidate are derived as following
 - The first CCE index of a PDCCH candidate is identified by using at least some of the followings
 - (1) UE-ID, (2) candidate number, (3) total number of CCEs for the PDCCH

candidate, (4) total number of CCEs in the CORESET, and (5) randomization factor

- The other CCE indexes of the PDCCH candidate are consecutive from the first CCE index
- Searching space design for the lower aggregation level can be discussed separately

Working assumptions:

- In the case when only CORESET(s) for slot-based scheduling is configured for UE, the maximum number of PDCCH blind decodes per slot per carrier is X
 - The value of X does not exceed 44
 - FFS the exact value of X
 - FFS for multiple active BWP, multiple TRP, multiple carriers, multi beams
 - FFS for non-slot based scheduling
 - FFS numerology specific X

RAN1#NR-AH3

Agreements:

- Confirm the following working assumption:
 - DM-RS density per REG is 1/4 at least for normal CP.
 - FFS: orthogonal DMRS for MU-MIMO at RAN1 NR AH#3.
 - FFS: URLLC
- DMRS density per REG for extended CP is same as that for normal CP

Working assumption

- For a CORESET, precoder granularity in frequency domain is:
 - Configurable between i) equal to the REG bundle size in the frequency domain; or ii) equal to the number of contiguous RBs in the frequency domain within the CORESET
 - For ii), DMRS is mapped over all REGs within the CORESET.

Agreement: DMRS positions for PDCCH

- **Working assumption:** Equally-distributed within a REG

Working assumption:

- Re-use NR DL RA Type 0 basis in units of 6 RBs, where no restriction on the maximum number of segments for a given CORESET.

Agreements:

- At least two DCI sizes are defined.
 - One DCI size, which is at least for the purpose of fallback.
 - FFS: for other purposes.
 - One DCI size depending on configuration
 - FFS: whether both DL and UL have the same size or different.
 - FFS: for group-common DCI/PDCCH
 - Note: the UE is not necessarily required to monitor two DCI sizes at the same

monitoring occasion

Agreement:

- In a given CORESET
 - Alt 1: different DCI formats
 - Alt 2: different search spacescan have different monitoring periodicities.
 - FFS which one

RAN1#90bis

Agreements:

- Support for a UE, configurable ID for PDCCH DMRS at least for the initialization of DMRS sequence/scrambling.
 - FFS: whether this is used also for other purpose.
 - FFS details including the applicability of configurable ID

Agreements:

- NR support the following interleaver
 - The number of rows A configured from {2, 3, and 6}, and the number of columns (P/A), where P is the number of interleaving unit for the given CORESET, and write in the row and read in the column
 - No any further permutation is introduced
 - Cyclic shift of the interleaving unit is applied based on the configurable ID which is independent parameter from the configurable ID for DMRS

Agreements:

- Confirm the WA: DMRS is evenly distributed within a REG
 - DMRS REs are #1, #5, #9

Agreements:

- DMRS sequence is a Gold sequence as in LTE
 - Note: in case if new Gold sequence is introduced for NR, this would be revisited
 - DMRS sequence for NR-PDCCH is obtained according to a reference point in frequency domain.
 - FFS the reference point

Agreements:

- Confirm the WA with the following clarifications (**in red**):
- For **each** CORESET, precoder granularity in frequency domain is:
 - Configurable between i) equal to the REG bundle size in the frequency domain; or ii) equal to the number of contiguous RBs in the frequency domain within the CORESET
 - For ii), DMRS is mapped over all REGs within CORESET.
 - **RAN1 assumes that CORESET for PDCCH scheduling RMSI can be configured with Option i)**
 - **In Option ii) UE may assume DMRS is present in all REGs within the set of**

contiguous RBs of the CORESET where and when at least one REG of a candidate is mapped.

Agreements:

- Confirm the WA 'Re-use NR DL RA Type 0 basis in units of 6 RBs, where no restriction on the maximum number of segments for a given CORESET' with the following clarifications:
 - This is for the case when the CORESET is configured by at least UE-specific RRC signalling.
 - FFS the RB indexing for resource allocation especially considering interaction with DL BWP
 - Details of resource allocation should take into account the interaction with DL BWP – FFS details

Agreements:

- For slot-based scheduling;
 - Confirm the following working assumption with updates:
 - The first DMRS position either on symbol #2 or symbol #3 is configured by PBCH
 - Maximum time duration of a CORESET is 2 symbols if the first DMRS position of a PDSCH with slot-based scheduling is on symbol #2, and is 3 symbols otherwise.
 - The starting OFDM symbol of a CORESET can be symbol #0, #1, or #2, in a slot.
 - However, the ending OFDM symbol of a CORESET is not later than symbol #2 in a slot.

Agreements:

- In a given CORESET, two types of search spaces (e.g., UE-common search space and UE-specific search space) can have different periodicities for a UE to monitor
 - FFS details of the corresponding search spaces

Agreements

PDCCH candidates having different DCI payload sizes count as separate blind decodes

PDCCH candidates comprised by different sets of CCE(s) count as separate blind decodes.

PDCCH candidates in different CORESETs count as separate blind decodes.

PDCCH candidates having the same DCI payload size and comprised by the same set of CCE(s) in the same CORESET count as one blind decodes.

Agreements:

- For non-CA and for PDCCH monitoring periodicity of 14 or more symbols, the maximum number of PDCCH blind decodes per slot is:
 - Working assumption: 44 for SCS = 15kHz.
 - Working assumption: less than 44 at least for SCS = 60kHz and 120kHz.
 - For the given SCS, all UEs support the maximum number of PDCCH blind decodes per slot.
- Companies are encouraged to complete the following table.
 - Aiming to finalize this at RAN1#91.

No. of PDCCH BDs per slot	SCS
---------------------------	-----

	15kHz	30kHz	60kHz	120kHz
Periodicity of 14 or more symbols	44	[22-44]	[11-44]	[6-44]
Periodicity of less than 14 symbols	[44-86]	[22-86]	[11-44]	[6-44]

Agreements:

- Companies are encouraged to provide the views on the following aspects:
 - Whether to specify upper limit of channel estimations a UE can perform for PDCCH;
 - If yes, how channel estimation is defined (e.g., per CCE or per REG bundle, whether common counting principle between narrowband RS and wideband RS), and;
 - What is the exact value of the upper limit of channel estimation a UE can perform for PDCCH.

No. of CCEs that the UE can perform channel estimation per slot	SCS			
	15kHz	30kHz	60kHz	120kHz
Periodicity of 14 or more symbols	[48-74]			
Periodicity of less than 14 symbols				

Agreements:

- For CA with up to N CCs, maximum number of PDCCH blind decodes per slot for a UE depends on the number of configured CCs.
 - All UEs supporting CA with the same set of CCs supports the same maximum number of PDCCH blind decodes.
 - No explicit UE capability signaling to inform the maximum number of PDCCH blind decodes is reported.
- For CA with more than N CCs, maximum number of PDCCH blind decodes for a UE depends on the explicit UE capability.
 - All UEs supporting CA with the same set of CCs supports at least the same number of PDCCH blind decodes.
- FFS: the value of N (no more than 8).

Agreements:

- For each SCS, whether or not separate UE capabilities for PDCCH monitoring periodicities are needed is concluded at RAN1#91.

	SCS			
	15kHz	30kHz	60kHz	120kHz
Need of separate UE capabilities for (i) PDCCH monitoring of 14 or more symbols and (ii)	Y/N	Y/N	Y/N	Y/N

PDCCH monitoring of less than 14 symbols				
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Agreements:

- Take the same hash function of LTE EPDCCH as the hash function for NR-PDCCH
 - Further refinements can be further considered till next meeting if necessary

Agreements:

- One set of the following parameters determines a set of search spaces
 - A set of aggregation levels
 - The number of PDCCH candidates for each aggregation level
 - PDCCH monitoring occasion for the set of search spaces

Agreements:

- At least for cases other than initial access, to identify a set of search spaces, following parameters are configured by UE-specific RRC signaling:
 - The number of PDCCH candidates for each aggregation level of {1, 2, 4, 8, [16]}
 - One value from {0, 1, 2, 3, 4, 5, 6, 8}
 - PDCCH monitoring occasion for the set of search spaces
 - One value of from {1-slot, 2-slot, [5-slot], [10-slot], [20-slot]} (at least 5 values)
 - One or more value(s) from 1st symbol, 2nd symbol, ..., 14th symbol within a monitored slot
 - Each set of search spaces associates with a CORESET configuration by RRC signaling

Agreements:

- For PDCCH monitoring occasion of 1-slot, 2-slot, [5-slot], [10-slot], and [20-slot],
 - Slot-level offset value for PDCCH monitoring occasion is also supported.
 - ✧ For N-slot monitoring occasion, the offset is one from [0, N-1].
 - Note: symbol-level bit-map of monitoring occasion within a slot agreed at RAN1#90bis is still available.

Agreements:

- For the DMRS of NR-PDCCH in a CORESET,
 - The QCL configuration/indication is on a per CORESET basis (Alt.1).

Agreements:

- The value(s) of TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, and/or TPC-SRS-RNTI, are provided by RRC signaling.
- The association between at least each of the following RNTIs and a DCI format is specified in the specification.
 - C-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, INT-RNTI, SFI-RNTI. FFS: other RNTI(s).
- The value of C-RNTI is obtained as part of random access procedure.
- The association between a DCI format and a type of search space (UE-common search space and UE-specific search space) is specified in the specification.
 - UE-common search space contains a DCI format of C-RNTI, RNTI(s) for SPS/grant-free, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, and INT-RNTI.

- UE-specific search space contains a DCI format of C-RNTI and RNTI(s) for SPS/grant-free.

Agreements:

- By PBCH, a UE obtains at least one CORESET configuration at least for PDCCH scheduling RMSI associated with a given SS block.
 - The set of aggregation levels and candidates per aggregation level for PDCCH scheduling RMSI is specified in the specification.
 - ✧ FFS the indication of the support of aggregation level 16 in the cell
 - FFS: Set of search spaces for OSI, random access, and paging.
- By RMSI, the UE can be configured with at least one CORESET configuration at least for PDCCH for random access.
 - If not configured by RMSI, the CORESET configuration(s) for random access is/are the one(s) configured by PBCH.
 - FFS: whether the CORESET configuration can be configured outside of the initial active DL BWP.
- By UE-specific RRC signalling, the UE can be configured with one or more CORESET configuration(s) at least for PDCCH scheduling UE-specific data.
 - Each CORESET configuration is associated with one or more sets of search spaces.
 - Note: each set of search spaces is associated with one CORESET configuration.

RAN1#91

Agreements:

- For each CORESET configured by PBCH, physical cell ID is used for DMRS sequence initialization
- **Working assumption:** For each CORESET configured by RMSI, it can be configured with a configurable ID for DMRS sequence initialization via RMSI (if not configured, physical cell ID is used for DMRS sequence initialization)
 - **Working assumption:** The value range of the configurable ID is the same as that for physical cell ID
- For each CORESET configured by UE-specific RRC signalling, a UE is configured with a configurable ID for DMRS sequence initialization
 - **Working assumption:** The value range of the configurable ID is the same as that for physical cell ID in Rel-15 → NOTE: there is subsequent agreement made in 7.2 which replaces working assumption

Agreements:

- No new RRC parameter is necessary to identify the reference point for DMRS generation for the given CORESET.
- For a CORESET configured by UE-specific RRC signaling, a configurable ID for cyclic shift of the interleaving unit.
 - The value range of the configurable ID is {0 - 274}.
- For a CORESET configured by PBCH/RMSI, physical cell ID is used for the cyclic shift of the interleaving unit.

Agreements:

- The same length-31 Gold sequence with LTE is used for scrambling PDCCH and DMRS for

PDCCH.

Agreements:

- Reference point for DMRS generation for PDCCH is,
 - PRB 0 of common PRB indexing for UE-specific CORESET
 - PRB 0 of the initial active DL BWP for CORESET configured by PBCH/RMSI

Agreements:

- RRC parameter "*CORESET-start-symb*" is deleted from the RRC parameter list.

Agreements:

- For NR PDCCH associated with the CORESET(s) configured by PBCH, AL=16 is supported.
- For NR PDCCH associated with the CORESET(s) configured by RMSI or UE-specific RRC signaling, AL=16 is supported
 - Note: additional complexity, if any, for NR PDCCH channel estimation is to be discussed separately
 - Discuss further offline whether or not AL=16 is associated with wideband RS only

Agreements:

- CORESET configured by RMSI is confined within the initial active DL BWP

Agreements:

- For a CORESET configured by UE-specific RRC signaling, DL BWP-specific RB indexing + RB-offset are used to configure frequency-domain resource.
 - The length of the bit-map is $\text{Floor}((N_{\text{RB}} - (\text{ceil}(\text{BWP\_start}/6) * 6 - \text{BWP\_start}))/6)$
 - CORESET starting RB is $\text{ceil}(\text{BWP\_start}/6) * 6$
- For a CORESET configured by PBCH/RMSI, RB indexing is for the initial DL BWP.

Agreements:

- C-SS in each DL BWP of the PCell/PSCell
 - On C-SS, $Y_{p,kp} = 0$.
 - In Rel.15,
 - For scheduling RMSI, OSI, Paging, UE monitors common search space in the PCell only
 - In addition, for random access and fall back, UE monitors common search space in the PCell and PSCell only
 - **Working assumption:** The UE is not expected to be configured without C-SS on the PCell (PSCell) in the active DL BWP
 - NOTE: RAN1 does not expect additional impact on the UE behavior due to not having PRACH resource in the BWP
- **Working assumption:** In Rel.15,
 - A UE is expected to monitor C-SS (if configured) in the activated BWP
 - Full functionalities of C-SS (scheduling RMSI, OSI, Paging, random access, etc) are supported by the C-SS configured by UE-specific RRC signaling.
 - All RRC parameters defined for UE-SS are also defined for C-SS that is configured by UE-specific RRC signaling.

Agreements:

- C-SS (at least for SFI/PI if configured) in a Scell:
 - On C-SS, $Y_{p,kp} = 0$.
 - Working assumption: All RRC parameters defined for UE-SS are also defined for C-SS that is configured by UE-specific RRC signaling.

Agreements:

- Introduce a linkage between search space set and CORESET via an index to the CORESET configuration
 - CORESET is removed from the search space configuration
- In Rel-15, the max no. of CORESETs configurable for a BWP in a cell for a UE is [3]
- In Rel-15, the max no. of search space sets configurable for a BWP in a cell for a UE is [10]

Agreements:

- Scrambling for PDCCH (after channel coding) is supported.
 - No additional RRC parameter is necessary.
 - Re-use the ID for DMRS initialization.

Conclusion:

- It is clarified that $M_{p,max}^L$ is the maximum of “configured” number of PDCCH candidates for the given aggregation level L across all serving cells scheduled by the search space

Agreements:

- UE is not expected to receive PDSCH type A in the same slot if the PDCCH monitoring is after the first two or three symbols of a slot
 - Note: PUSCH mapping is up to MIMO decision

Agreements:

- For information, the following cases are clarified:
 - Case 1: PDCCH monitoring periodicity of 14 or more symbols
 - Case 1-1: PDCCH monitoring on up to three OFDM symbols at the beginning of a slot
 - Case 1-2: PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot
 - For a given UE, all search space configurations are within the same span of 3 consecutive OFDM symbols in the slot
 - Case 2: PDCCH monitoring periodicity of less than 14 symbols
 - Note: this includes the PDCCH monitoring of up to three OFDM symbols at the beginning of a slot
- The numbers in bracket in the following table can be further adjusted but not to be increased
- $X \leq 16$, $Y \leq 8$
 - FFS whether or not to have case 2', where the values of X and/or Y can be smaller than case 2

Max no. of PDCCH BDs per slot	SCS			
	15kHz	30kHz	60kHz	120kHz
Case 1-1	44	36	22	20

Case 1-2	[44]			-
Case 2	[44+X]	[36+Y]	[22+Y]	[20]

Working assumption:

- For PDCCH monitoring for receiving RMSI, the number of PDCCH candidates are following:
 - 4 candidates for AL = 4
 - 2 candidates for AL = 8
- DCI size for RMSI scheduling and DCI size for OSI scheduling are the same
 - FFS: Paging and fallback

Conclusion:

- RAN1 common understanding is that the PDCCH channel estimation complexity is not negligible at least in some cases.
 - FFS: Possible solutions to resolve the channel estimation complexity issue together with the impact on PDCCH blocking probability
 - Opt.1: Define the limits of “the number of CCEs for PDCCH channel estimation which refers to the union of the sets of CCEs for PDCCH candidates”
 - Note: the overlapped CCEs associated with different CORESETs are counted separately.
 - FFS: CCEs for the same precoder-granularity are counted as one channel estimation
 - FFS: whether/how to handle the variation on the actual number of CCEs for PDCCH channel estimation and BDs over time
 - Application of overbooking is considered
 - Strive for not having specific UE capability to report the maximum number of CCEs for PDCCH channel estimation.
 - Study the solutions considering the cases 1-1, 1-2, 2, and 2’.
 - Opt.2: Modify the hashing function
 - Opt.3: Increase the size of the precoder granularity

RAN1#NR-AH1801

Agreements:

- Adopt following text proposal for PDCCH scrambling (TS38.211 Section 7.3.2.3)

==

The scrambling sequence generator shall be initialized with

$$c_{init} = (n_{RNTI} \cdot 2^{16} + n_{ID}) \bmod 2^{31}$$

where

- $n_{ID} \in \{0, 1, \dots, 2^{16} - 1\}$ equals the higher-layer parameter *Control-scrambling-Identity* if configured and RNTI is equal to C-RNTI, $n_{ID} = N_{ID}^{cell}$ otherwise, and
- n_{RNTI} is C-RNTI for PDCCH in USS, while is 0 for PDCCH in CSS.

Companies can check whether the above agreements are consistent with previous coding discussion/agreements or not

Agreements:

- DM-RS sequence for PDCCH is initialized with an equation with at least symbol index, slot index, and the ID.
 - FFS: further randomization to avoid consistent collisions over frames.
- DMRS sequence for PDCCH is generated per symbol.

Agreements:

- The TP in R1-1801278 for 38.211 is endorsed
 - The last sentence is subject to editor's refinement

Agreements:

- The maximum number of CORESETs per BWP per cell is 3
 - For the 3rd CORESET, i.e., for $p=2$, $A_p=39839$.
- Confirm 10 as the maximum number of search space sets per BWP per cell.

Agreements:

- CORESET ID of the CORESET configured by PBCH is 0.
- Search space ID of the search space configured by PBCH is 0.

Agreements:

- A UE can be configured with a search space configuration by UE-specific RRC signaling which includes following:
 - CORESET ID (range: 0-11, to indicate which CORESET the search space is mapped to)
 - The search space can be associated with any CORESET configuration
 - When the CORESET ID is UE-specifically configured to be 0, it is mapped to the one configured by PBCH
 - Search space ID (range: 0-39)
 - When the search space ID is UE-specifically configured to be 0, it is mapped to the one configured by PBCH

Agreements:

- DCI format 0_1 and 1_1 are monitored only in USS.
- DCI format 0_0 and 1_0 are monitored in CSS.
- DCI format 0_0 and 1_0 can be monitored in USS.
 - They have the same DCI payload size.
- One of the following is configured by RRC signaling for the USS:
 - Monitoring DCI format 0_1 and 1_1 only
 - Monitoring DCI format 0_0 and 1_0 only

Agreements:

- NR supports a DCI format having the same size as the DCI format 1_0 to be used for scheduling RMSI/OSI, for Paging, and for random access.

Agreements:

- For each search space configuration configured by UE-specific RRC signaling, the UE is

informed whether the search space configuration is CSS or USS, together with the following information, as part of the search space configuration:

- Which DCI format(s) to monitor
 - For a CSS,
 - DCI format 0_0 and DCI format 1_0
 - In which case, the UE monitors the DCI format with CRC scrambled by C-RNTI, CS-RNTI (if configured), SP-CSI-RNTI (if configured), RA-RNTI, TC-RNTI, P-RNTI, SI-RNTI
 - DCI format 2_0
 - In which case, the UE monitors the DCI format with CRC scrambled by SFI-RNTI, and the SFI-related parameters SFI-PDCCH is provided as part of the search space configuration
 - FFS: how to select one or two decoding candidates if the configured PDCCH candidates are larger than the value
 - DCI format 2_1
 - In which case, the UE monitors the DCI format with CRC scrambled by INT-RNTI, and the PI-related parameters Preemp-DL is provided as part of the search space configuration
 - DCI format 2_2
 - In which case, the UE monitors the DCI format with CRC scrambled by TPC-PUSCH-RNTI or TPC-PUCCH-RNTI
 - DCI format 2_3
 - In which case, the UE monitors the DCI format with CRC scrambled by TPC-SRS-RNTI
 - Monitoring of multiple DCI formats can be configured for one CSS
 - For USS,
 - A UE monitors the DCI format with CRC scrambled by C-RNTI, CS-RNTI (if configured), TC-RNTI (if a certain condition is met), and SP-CSI-RNTI (if configured)
 - Further discussion offline the association of the RNTIs with DCI formats
 - Monitoring of multiple DCI formats can be configured for one USS

Agreements:

- For a search space configuration, monitoring periodicity of slot(s) is updated as follows:
 - For all SCS, {1, 2, 4, 5, 8, 10, 16, 20} slots
 - For INT-RNTI, a subset of {1,2,4} slots is applied
 - FFS: the case when concatenated semi-static DL/UL assignments is configured

Working assumption:

- At least for case 1-1 and case 1-2, all UE supports channel estimation capability for 48 CCEs for a given slot per scheduled cell
 - FFS: cross-carrier scheduling
 - FFS: wideband RS
 - FFS: overbooking and/or nested structure
 - FFS: exceptional case of CCE counting

- FFS: for case 2

Agreements

- For the following previous agreement, N=4

Agreements:

- For CA with up to N CCs, maximum number of PDCCH blind decodes per slot for a UE depends on the number of configured CCs.
 - All UEs supporting CA with the same set of CCs supports the same maximum number of PDCCH blind decodes.
 - No explicit UE capability signaling to inform the maximum number of PDCCH blind decodes is reported.
- For CA with more than N CCs, maximum number of PDCCH blind decodes for a UE depends on the explicit UE capability.
 - All UEs supporting CA with the same set of CCs supports at least the same number of PDCCH blind decodes.
- FFS: the value of N (no more than 8).

RAN1#92

Agreements:

- Adopt the following TP for 38.211, 7.4.1.1.1

=== Start ===

The pseudo-random sequence generator shall be initialized with

$$c_{init} = (2^{17}(14n_{s,f}^{\mu} + l + 1)(2N_{ID} + 1) + 2N_{ID}) \bmod 2^{31}$$

Where l is the OFDM symbol number within the slot, $n_{s,f}^{\mu}$ is the slot number within a frame, and

- $N_{ID} \in \{0, 1, \dots, 65535\}$ is given by the higher-layer parameter *PDCCH-DMRS-Scrambling-ID* if provided $N_{ID} = N_{ID}^{cell}$ otherwise.

=== End ===

Conclusion:

- Regarding the issue of cyclic shift for PDCCH interleaver as discussed in Section 2 of [R1-1803298](#):
 - No spec update is necessary

Agreements:

- For RMSI CORESET, interleaved CCE-to-REG mapping with
 - REG-bundle size of 6
 - R=2
 - All RMSI CORESET configurations are with precoder granularity = REG-bundle size.

Agreements:

- To adopt the following TP (Section 7.3.2.3, 38.211)

=== Start ===

The scrambling sequence generator shall be initialized with

$$c_{\text{init}} = (n_{\text{RNTI}} \cdot 2^{16} + n_{\text{ID}}) \bmod 2^{31}$$

where

- For a PDCCH in a UE-specific search space, $n_{\text{ID}} \in \{0, 1, \dots, 65535\}$ equals the higher-layer parameter *Control-scrambling-Identity* if configured,
- $n_{\text{ID}} = N_{\text{ID}}^{\text{cell}}$ otherwise

and where n_{RNTI} is given by the C-RNTI for a PDCCH in a UE-specific search space if *Control-scrambling-Identity* is configured and $n_{\text{RNTI}} = 0$ otherwise for a PDCCH in a common search space.

=== End ===

Agreements:

- If a PDCCH decoding candidate having a CCE overlapped, even partially, with the configured SSB, the UE is not required to monitor the PDCCH with the decoding candidate.

Agreements:

- To adopt the following TP for 38.211:

=== Start ===

7.3.2.5 Mapping to physical resources

The UE shall assume the block of complex-valued symbols $d(0), \dots, d(M_{\text{symb}} - 1)$ to be scaled by a factor β_{PDCCH} and mapped to resource elements $(k, l)_{p, \mu}$ not used for the associated PDCCH DMRS in increasing order of first k , then l , in the resource-element groups used for the monitored PDCCH. The antenna port $p = 2000$.

=== End ===

Agreements:

- To adopt the following TP for 7.4.1.3.2 of 38.211

=== Start ===

7.4.1.3.2 Mapping to physical resources

The UE shall assume the sequence $r_l(m)$ is mapped to resource elements $(k, l)_{p, \mu}$ according to

where the following conditions are fulfilled

- they are within the resource element groups constituting the PDCCH the UE attempts to decode if the higher-layer parameter *CORESET-precoder-granularity* equals *CORESET-REG-bundle-size*,
- all resource-element groups within the set of contiguous resource blocks in the CORESET where the UE attempts to decode the PDCCH if the higher-layer parameter *CORESET-precoder-granularity* equals the size of the CORESET in the frequency domain.

=== End ===

Agreements:

- Adopt following TP:

=== Start ===

For interleaved CCE-to-REG mapping, $L \in \{2,6\}$ for $N_{\text{sym}}^{\text{CORESET}} = 1$ and $L \in \{N_{\text{sym}}^{\text{CORESET}}, 6\}$ for

$N_{\text{sym}}^{\text{CORESET}} \in \{2,3\}$ where L is configured by the higher-layer parameter *CORESET-REG-bundle-size*.

The interleaver is defined by

$$f(j) = (rC + c + n_{\text{shift}}) \bmod (N_{\text{REG}}^{\text{CORESET}} / L)$$

$$j = cR + r$$

$$r = 0, 1, \dots, R-1$$

$$c = 0, 1, \dots, C-1$$

$$C = N_{\text{REG}}^{\text{CORESET}} / (LR)$$

where $R \in \{2,3,6\}$ is given by the higher-layer parameter *CORESET-interleaver-size* and where

- n_{shift} is ~~a function of~~ $N_{\text{ID}}^{\text{cell}}$ for a PDCCH transmitted in a CORESET configured by the PBCH or RMSI
- $n_{\text{shift}} \in \{0, 1, \dots, 274\}$ is ~~a function of~~ the higher-layer parameter *CORESET-shift-index*

Agreements:

- Confirm the value for Case 1-2. X=0 and Y=0 for Case 2. No consensus on additional Case 2'.

Max no. of PDCCH BDs per slot	SCS			
	15kHz	30kHz	60kHz	120kHz
Case 1-1	44	36	22	20
Case 1-2	[44]			-
Case 2	[44+X]	[36+Y]	[22+Y]	[20]

Agreements:

- To adopt the TP for TS38.213 Section 10.1
- Also add one sentence in the spec saying “when the number of REGs is not sufficient for a given aggregation level, the UE is not required to monitor candidates of the given aggregation level”
 - Up to spec editor for final wording

=== Start ===

Table 10.1-1: CCE aggregation levels and max number of candidates per CCE aggregation level for Type0/Type0A/Type2-PDCCH common search space

CCE Aggregation Level	Number of Candidates
4	4
8	2
16	<u>1</u>

=== End ===

Agreements:

- The number of CCEs for PDCCH channel estimation which refers to the union of the sets of CCEs for PDCCH candidates to be monitored, regardless of which REG-bundle size or precoder granularity.
 - Overlapped CCEs associated with different CORESETs are counted separately.
 - Overlapped CCEs associated with different PDCCH starting symbols with the same or different search space sets with the same CORESET are counted separately.
 - Overlapped CCEs associated with same or different search space sets with the same PDCCH starting symbol associated with the same CORESET are counted one.
 - Note: in the above, the overlapping CCEs for candidates for a given search space set with different starting symbols are assumed to be supported.

Agreements:

- Change $Y_{\{p, k_p\}}$ to $Y_{\{p, n_{s,f}^{\mu}\}}$ in the search space hashing function in subclause 10.1 of 38.213, where the index $n_{s,f}^{\mu}$ is the slot number.
 - (Working assumption) The reset of the update is per radio frame

Agreements:

- The UE capability signaling for PDCCH BDs in CA is integer value from $\{4, \dots, 16\}$.
 - Discuss further whether or not to restrict the combination of the number of CCs that a UE can support vs. the number of PDCCH BDs indicated via UE capability signalling

Agreements:

- $M_{p,max}^L$ is $M_{p,s,max}^L$ which is the maximum number of PDCCH candidates for the given aggregation level L across all serving cells for the given search space set s for the given CORESET p

Agreements:

- Specify PDCCH candidate mapping rules.
 - PDCCH candidates are mapped to search-space-sets until either or both limit(s) of (number of blind decodes, CCEs for channel estimation) is/are met at least with the following rule
 - SS type order, e.g. CSS before USS
 - FFS: further rule within a search space set/type

Agreements:

- Confirm the following working assumption, with updates:
- At least for case 1-1 and case 1-2, all UE supports channel estimation capability for following numbers of 48 CCEs for a given slot per scheduled cell
 - 56 CCEs for SCS = 15kHz and 30kHz
 - 48 CCEs for SCS = 60kHz
 - 32 CCEs for SCS = 120kHz
 - FFS: cross-carrier scheduling
 - ~~FFS: wideband-RS~~
 - FFS: overbooking and/or nested structure
 - FFS: exceptional case of CCE counting
 - FFS: for case 2

Agreements:

- Adopt following TP (38.213)

=== Start ===

A UE determines a PDCCH monitoring occasion from the PDCCH monitoring periodicity, the PDCCH monitoring offset, and the PDCCH monitoring pattern within a slot. For the search space set s in the control resource set p , the UE monitors PDCCH in a slot where $(n_f N_{slot}^{frame, \mu} + n_{s,f}^{\mu} - o_{p,s}) \bmod k_{p,s} = 0$ is satisfied, with n_f being the frame number.

=== End ===

RAN1#92bis

Agreements:

- NW and UE maintain the same understanding on SSB/CORESET#0/SS#0 in connected_mode at least for non-broadcast PDCCH
 - Solutions FFS
- For the broadcast PDCCH, it is up to UE which common search space to monitor based on which SSB in both connected, in-active, and idle modes
- Unicast PDSCH can be scheduled by a DCI associated with the CORESET #0

Agreements:

- The size of DCI 1_1 is the same (by zero-padding when necessary) across CORESETs of a BWP of a serving cell

Agreements:

- For WB RS CORESET, the UE is expected to be configured with the CORESET only with the following possibilities:
 - Up to 4 clusters, each cluster consisting of contiguous RBs.
- It is clarified that the counting rule of CCE for channel estimation is the same between NB RS CORESET and WB RS CORESET, which implies following:
 - The number of CCEs for channel estimation in case of WB RS CORESET is counted as the union of the sets of CCEs for PDCCH candidates to be monitored and hence BW of the WB RS CORESET is not restricted by CCE limit for channel estimation.
 - Note: it is up to RAN4 whether UE may perform channel estimation within a BW smaller than the maximum number of contiguous RBs within the WB RS CORESET

Agreements:

- For Rel.15 December 2017 version of Case 2, number of CCEs for channel estimation per slot is {56, 56, 48, 32} CCEs for SCS {15kHz, 30kHz, 60kHz, 120kHz}

Agreements:

- UE is not expected to be configured with PDCCH monitoring in CSS(s) for more than what UE can monitor in terms of numbers of BDs/CCEs

Agreements:

- Following **working assumption** is made:
 - For a UE supporting CA with up to X DL-CCs with the same numerology with $X \leq 4$, maximum number of PDCCH blind decodes per slot the UE shall support is $X \cdot M$, and;
 - For a UE supporting CA with up to Y DL-CCs with the same numerology $Y > 4$, maximum number of PDCCH blind decodes per slot the UE shall support is $y \cdot M$, where;
 - $M = \{44, 36, 22, 20\}$ for $SCS = \{15\text{kHz}, 30\text{kHz}, 60\text{kHz}, 120\text{kHz}\}$
 - y is an integer from $\{4, \dots, 16\}$ and is reported as UE capability to the network.
 - For a UE supporting CA with up to X DL-CCs with the same numerology with $X \leq 4$, maximum number of CCEs for channel estimation per slot the UE shall support is $X \cdot N$, and;
 - For a UE supporting CA with up to Y DL-CCs with the same numerology with $Y > 4$, maximum number of CCEs for channel estimation per slot the UE shall support is $y \cdot N$, where;
 - $N = \{56, 56, 48, 32\}$ for $SCS = \{15\text{kHz}, 30\text{kHz}, 60\text{kHz}, 120\text{kHz}\}$
 - y is an integer from $\{4, \dots, 16\}$ and is reported as UE capability to the network.

Agreements:

- The working assumption as part of the agreements below is confirmed:
 - Change $Y_{\{p, k_p\}}$ to $Y_{\{p, n_{s,f}^{\mu}\}}$ in the search space hashing function in subclause 10.1 of 38.213, where the index $n_{s,f}^{\mu}$ is the slot number.
 - (Working assumption) The reset of the update is per radio frame

Agreements:

- A UE is not expected to be configured to monitor PDCCH across a slot boundary.

Working assumption:

- For a common search space configured with *RMSI-PDCCH-Config*, *osi-searchSpace*, *paging-searchSpace*, and *ra-searchSpace*, DCI format 0_0/1_0 with C-RNTI is monitored in non-DRX occasions after C-RNTI is available.
- For a common search space configured with *RMSI-PDCCH-Config*, *osi-searchSpace*, *paging-searchSpace*, and *ra-searchSpace*, DCI format 0_0/1_0 with CS-RNTI is monitored in non-DRX occasions after CS-RNTI is available.

Agreements:

- Following is to be clarified in 213:
 - Type0-CSS is configured by *RMSI-PDCCH-Config* provided by *MIB* or is configured by *searchSpace-SIB1* provided by *PDCCH-ConfigCommon*
 - Type0A-CSS is configured by *searchSpace-OSI* provided by *PDCCH-ConfigCommon*
 - Type1-CSS is configured by *ra-SearchSpace* provided by *PDCCH-ConfigCommon*
 - Type2-CSS is configured by *pagingSearchSpace* provided by *PDCCH-ConfigCommon*
 - Type3-CSS is configured by a *SearchSpace* with the *searchSpaceType* "common" provided by *PDCCH-Config*

Working assumption:

- At least for Case 1-1 and Case 1-2, map all candidates of USS search-space-set with lower SS set ID before candidates of USS with higher ID
 - If all candidates in a SS set can't be mapped, any candidates in the SS set and in any subsequent SS sets are dropped (not mapped)

- Case 2 FFS

RAN1#93

Agreements:

- To adopt the TP to 7.3.2.2 of 38.211

For both interleaved and non-interleaved mapping, the UE may assume

- the same precoding being used within a REG bundle if the higher-layer parameter *precoderGranularity* equals *sameAsREG-bundle*
- the same precoding being used across the all resource-element groups within the set of contiguous resource blocks in the CORESET if the higher-layer parameter *precoderGranularity* equals *allContiguousRBs*

Agreements:

- To adopt the TP to 7.4.1.3.2 of 38.211
- subcarrier 0 of the lowest-numbered resource block in the CORESET if the CORESET is configured by the PBCH or SIB1,

Agreements:

- To adopt the TP to 10.1 of 38.213:

an indication for a presence or absence of a transmission configuration indication (TCI) field for DCI format 1_1 transmitted by a PDCCH in control resource set p , by higher layer parameter *TCI-PresentInDCI*

Agreements:

Confirm the following working assumptions with updates:

- ~~At least for Dec. Drop, Case 1-1 and Case 1-2,~~ map all candidates of USS search-space-set with lower SS set ID before candidates of USS with higher ID
 - If all candidates in a SS set can't be mapped, any candidates in the SS set and in any subsequent SS sets are dropped (not mapped)
- ~~Case 2 FFS~~

Agreements:

- For following, regardless of whether one or more numerologies, the limit of BDs/CCEs per CC per slot is equal to the limit of BDs/CCEs for non-CA case.
 - Self-scheduling with up to 4 DL-CCs
 - Self-scheduling with up to T DL-CCs where the UE reports BD capability of $y \geq T$
 - ✧ y is integer from (4, ..., 16)
 - ✧ T is integer from (1, ..., 16)
- For cross-carrier scheduling where the scheduling CC and all the CCs schedulable by the scheduling CC have the same numerology and the number of DL-CCs is up to 4 or with up to T DL-CCs where the UE reports BD capability of $y \geq T$, the limit of BDs/CCEs of the scheduling CC per slot is (the number of CCs schedulable by the scheduling CC) x (the limit of BDs/CCEs for non-CA case)
 - Note: this is inline with the previous agreements at RAN1#92bis meeting

Agreements:

- For self-scheduling with the same numerology or different numerologies, and the number of DL-CCs is ≤ 4 or with up to T DL-CCs where the UE reports BD capability of $y \geq T$, network ensures the number of BDs/CCEs on any SCell does not exceed the non-CA limit.

Agreements:

- For self-scheduling with same numerology, and the number of DL-CCs is more than 4 and with up to T DL-CCs where the UE reports BD capability of $y < T$, the limit of BDs/CCEs per CC per slot is
 - ✧ The total number of BDs/CCEs across CCs is based on UE BD capability. It can be split across CCs, subject to the non-CA limit on each CC.
 - For SCell, NW ensures no overbooking based on non-CA case occurs.

Agreements:

- For UE BD capability reporting $y = \text{integer}(4, \dots, 16)$, at least for self-scheduling,
 - For UE not supporting CA with different numerologies, the reported value equally applies to all numerologies
 - (Working assumption) For UE supporting CA with different numerologies,
 - When the UE is configured with CA with the same numerology, the reported value applies
 - When the UE is configured with CA with different numerologies, the reported value applies to each set of DL-CCs with the same numerology, i.e.:
 - If a UE is configured with DL-CCs of X0, X1, X2, X3, where Xi denotes the number of DL-CCs with the numerology i, the **limit total number** of (BDs or CCEs) for the DL-CCs with the numerology i is given by $\text{Floor}\{X_i / (X_0 + X_1 + X_2 + X_3) * (M_i \text{ or } N_i) * y\}$ per slot of the numerology i
 - Where Mi and Ni represent the number of BDs and CCEs per slot specified for non-CA case, respectively
 - Note: some of the values of Xi may be zero depending on the CA configuration
 - For each CC, the non-CA limit still applies
 - FFS the impact of BWP, if any

Agreements:

- TC-RNTI is not monitored on USS

Agreements:

- To adopt the following TP to 10.1 of 38.213:

~~If, for a search space set s , a CCE aggregation level L , and a control resource set p , any CCE index for a second PDCCH candidate $m_{s,p_{CI}}$ overlaps with any CCE index for a first PDCCH candidate with index $m_{s,p_{CI}}$, where the PDCCH candidates are indexed in ascending order of a respective first CCE index, the UE is not expected to monitor the second PDCCH candidate with index $m_{s,p_{CI}}$~~

Agreements:

- For a given SS set or across SS sets, the UE is not expected to be configured with PDCCH monitoring occasion/periodicity causing partial time-domain overlapping for the same CORESET.
 - Partial-overlapping in time-domain for the same CORESET means the case of that the separation between two monitoring occasions is smaller than the CORESET duration but

greater than 0.

Conclusion:

- It is understood that configuration of cross-carrier scheduling for a CC is UE-specific, i.e., applicable to all USS sets containing 0-1/1-1 configured on the active DL BWP of the scheduling cell enabled with cross-carrier scheduling with CIF.

Agreements:

- To reply LS in R1-1807732
 - Regarding RAN2 agreements 1 & 2
 - Agree to the answer in red on slide 4 of R1-1807838, with one update
 - “contains the CORESET#0...”
 - “as long as the CORESET#0...”
 - Regarding RAN2 agreements 3a
 - Answer: this is only for CSS configurations
 - For other RAN2 agreements, no comments from RAN1

Agreements:

- PDCCH with CRC scrambled by C-RNTI and CS-RNTI are not monitored on Type3-CSS on SCell
- When a UE is configured with cross-carrier scheduling and CS-RNTI for a CC, the UE monitors DCI format(s) 0_1 and/or 1_1 with CIF with CRC scrambled by CS-RNTI
 - For CS-RNTI, the CIF field is used to indicate cross-carrier activation of SPS/configured grant Type2

Agreements:

Update previous agreements as follows:

- NW and UE maintain the same understanding on SSB/CORESET#0/SS#0 in connected_mode at least for non-broadcast PDCCH and for broadcast PDCCH
 - Solutions FFS
- For the broadcast PDCCH, it is up to UE which common search space to monitor based on which SSB in both connected, in-active, and idle modes
- Unicast PDSCH can be scheduled by a DCI associated with the CORESET #0

Agreements:

- Clarify the agreements at RAN1#91 as follows:
 - Case 1: PDCCH monitoring of all SS sets that are monitored in a slot occurs within 3 consecutive OFDM symbols that have fixed positions in each slot, periodicity of 14 or more symbols
 - Case 1-1: PDCCH monitoring on up to three OFDM symbols at the beginning of a slot
 - Case 1-2: PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot
 - For a given UE, all search space configurations are within the same span of 3 consecutive OFDM symbols in the slot
 - Case 2: PDCCH monitoring other than Case 1 periodicity of less than 14 symbols
 - Note: this includes the PDCCH monitoring of up to three OFDM symbols at the beginning of a slot

Agreements:

- For self-scheduling with different numerologies, and the number of DL-CCs is more than 4 and with up to T DL-CCs where the UE reports BD capability of $y < T$, the limit of BDs/CCEs per CC per slot is
 - (Working assumption) The total number of BDs/CCEs across CCs per numerology is based on UE BD capability. It can be split across CCs for the given numerology, subject to the non-CA limit on each CC.
 - If a UE is configured with DL-CCs of X0, X1, X2, X3, where Xi denotes the number of DL-CCs with the numerology i, the limit of (BDs or CCEs) for the DL-CCs with the numerology i is given by $\text{Floor}\{X_i / (X_0 + X_1 + X_2 + X_3) * (M_i \text{ or } N_i) * y\}$ per slot of the numerology i
 - For SCell, NW ensures no overbooking based on non-CA case occurs

Agreements:

- For clarification on association b/w CORESET and A0/A1/A2, select one option from the following.
 - For a CORESET with ControlResourceSetId, the corresponding A_p that is used in the PDCCH hashing is determined by $p = \text{ControlResourceSetId} \bmod 3$.

Agreements:

- The TP in R1-1807901 is endorsed

RAN1#94

Conclusion:

- It is understood that the parameter “duration” in the search space configuration is applicable to any CSS configurations.

Agreements:

- PDCCH BD/CCE counting is only based on the configured PDCCH decoding candidates (i.e., irrespective of whether or not a PDCCH decoding candidate is dropped, e.g., due to collision with other channels/signals)
 - Check further offline on potential spec impact

Agreements:

- In 38.213 Section 11.1.1, change $\log_2(\text{maxSFIindex})$ to $\max(\lceil \log_2(\text{maxSFIindex}+1) \rceil, 1)$ when computing the SFI field length.

Conclusion:

- No new RRC signaling for TCI-state configuration for the CORESET#0 is introduced.
- No new MAC-CE for TCI-state indication for the CORESET#0 is introduced.
- FFS: Whether the existing RRC configuration and/or existing MAC-CE field can be used to configure/indicate dedicated TCI-state or SSB index for the CORESET#0
- FFS: Whether/how to support BFR for the CORESET#0

Agreements:

- From RAN1 perspective, the parameters *monitoringPeriodicity* and *nrofPDCCH-Candidates* under *dci-Format2-3* in the RRC IE *SearchSpace* have no use. It is up to RAN2 to delete or disable these two parameters
 - Note: No RAN1 spec impact is expected
- Send LS to RAN2 about the agreements – [R1-1809856](#), which is approved, and final LS in [R1-1809966](#)

Agreements:

RAN1#93 agreements are updated as follows (to cover Case 5):

- For self-scheduling with same numerology or for cross-carrier scheduling with the same numerology for all the DL serving cells, and the number of DL-CCs is more than 4 and with up to T DL-CCs where the UE reports BD capability of $y < T$, the limit of BDs/CCEs per CC per slot is
 - ✧ The total number of BDs/CCEs across CCs is based on UE BD capability. It can be split across CCs, subject to the non-CA limit on each CC.
 - ✧ For SCell, NW ensures no overbooking based on non-CA case occurs. For cross-carrier scheduling, BDs/CCEs overlapped across DL serving cells are independently counted (i.e., counted per serving cell).

Agreements:

- Adopt following TP for TS 38.213 Section 10.

If the UE is configured with a SCG, the UE shall apply the procedures described in this clause for both MCG and SCG except for PDCCH monitoring for Type0/0A/2-PDCCH common search spaces, in which case the UE is not required to apply the procedures in this clause for SCG.

Agreements:

- Adopt following TP for TS38.211 Subclause 7.4.1.3.2.

The reference point for k is

- subcarrier 0 of the lowest-numbered resource block in the CORESET if the CORESET is configured by the PBCH or by the controlResourceSetZero in the PDCCH-ConfigCommon SIB1,
- subcarrier 0 in common resource block 0 otherwise

Agreements:

- To adopt the following TP to 38.213:

10 UE procedure for receiving control information

[...]

If consistent control information is not detected in a PDCCH, the PDCCH is discarded.

[...]

Agreements:

- The TP at the end of Section 3.5 in R1-1809855 is endorsed

Conclusion:

- At least for self-scheduling and for cross-carrier scheduling with the same numerology for all the DL serving cells, total number of CCEs or BDs corresponding to the remaining PDCCH candidates after PDCCH candidates are dropped based on the non-CA limit for the PCell

(PCell) and the configured PDCCH candidates for SCells is guaranteed by network to be no more than the CA limit.

Agreements:

- To adopt the following TP to TS 38.213 Section 10 (subject to Editor's refining of wording):
If the higher layer parameter *monitoringSymbolsWithinSlot* indicates to a UE ~~only one PDCCH monitoring occasion within a slot to monitor PDCCH of all search space sets on a span of up to 3 consecutive OFDM symbols at the same position in every slot~~, the UE does not expect to be configured with a PDCCH subcarrier spacing other than 15 kHz ~~for the corresponding search space set *s* if the control resource set associated with the search space if the span~~ includes at least one symbol after the third symbol ~~of the in any~~ slot.

Agreements:

- Send LS to RAN2:
 - RAN1 is discussing how the UE knows the number of PDCCH candidates for each scheduled cell in case of cross-carrier scheduling. RAN1's understanding is that:
 - Without ASN.1 signaling change with possible field description updates:
 - Search space with ID#s configuration configured on a BWP of a scheduled cell is used to determine the number of PDCCH candidate(s) for each aggregation level monitored in a search space with ID#s of a BWP of the scheduling cell for the BWP of the scheduled cell
 - Otherwise, RAN1 would like to know whether it is possible to realize previous RAN1 conclusion by modifying the ASN.1, e.g., update of *crossCarrierSchedulingConfig*, *PDCCH-Config*, *SearchSpace*, etc.
 - If not possible, RAN1 will discuss further on how to handle.
- In the LS, will include the previous RAN1 conclusion accordingly. Draft LS in **R1-1809968**, which is approved with final LS in **R1-1810009**

Conclusion:

- The following is RAN1's common understanding (no spec impact):
 - For initial DL BWP of the PCell, PDCCH-ConfigCommon is provided by SIB1, and for other DL BWPs, PDCCH-ConfigCommon is provided by dedicated RRC signaling. For a SCell, PDCCH-ConfigCommon for any DL BWP is provided by dedicated RRC signalling. Then, PDCCH-ConfigCommon other than the initial DL BWP can be different from the PDCCH-ConfigCommon provided by SIB1. However, PDCCH-ConfigCommon has a description "The IE *PDCCH-ConfigCommon* is used to configure cell specific PDCCH parameters provided in SIB as well as during handover and PCell/SCell addition". RAN1 view is that the PDCCH-ConfigCommon can be provided by dedicated RRC signalling also for each DL BWP of any cell including the PCell.
 - *searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *paging-SearchSpace*, and *ra-SearchSpace* can be associated with *controlResourceSetZero* or *commonControlResourceSet* in the PDCCH-ConfigCommon, or can be associated with *controlResourceSet* configured in the PDCCH-Config. However, the current description of *commonControlResourceSet* does not allow association to the *searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, and *paging-SearchSpace*. Moreover, it is not clear whether *searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *paging-SearchSpace*, and *ra-SearchSpace* can be associate with *controlResourceSet* in the PDCCH-Config. RAN1's understanding is that these

are possible.

- After RRC connection setup, UE monitors common search space(s) based on the search space configuration(s) provided by PDCCH-ConfigCommon (which are Type0/0A/1/2-PDCCH common search spaces) and by PDCCH-Config (which is Type3 PDCCH-common search space).
- If a UE is configured to monitor DCI format 0_0/1_0 in a CSS in the SearchSpace of the PDCCH-Config on the PCell, the UE monitors all the RNTIs that UE is configured to monitor, based on the SearchSpace configuration.

Send an LS to RAN2 regarding the first and the second sub-bullets above – **R1-1809969**, which is approved with update “review if the above”, with final LS in **R1-1810010**

R1-1809970 Draft reply LS on PDCCH common search space configurations NTTDCM
Which is **approved** (by accepting all change marks). Final LS in **R1-1809971**

Search space related agreements from initial-access:

Agreements:

- If a UE is not provided higher layer parameter searchSpaceOtherSystemInformation for Type0A-PDCCH common search space set, the UE determines the Type0A-PDCCH common search space set as the same as Type0-PDCCH common search space set (i.e., default Type0A-PDCCH common search space set).
- If a UE is not provided higher layer parameter pagingSearchSpace for Type2-PDCCH common search space set, the UE determines the Type2-PDCCH common search space set as the same as Type0-PDCCH common search space set (i.e., default Type2-PDCCH common search space set).
- Separate default Type0A-PDCCH common search space set is not needed.
- Separate default Type2-PDCCH common search space set is not needed.
 - Note: the above 2 sub-bullets have no spec impact

Agreements:

Regarding the issues related to RAN2 LS in R1-1808172:

- It is RAN1 understanding that the Paging Frame (PF) is a starting point for the first PO (defined by ‘S’ valid PDCCH monitoring occasions). In addition, the concatenated POs corresponding to one PF can overlap into the next radio frame(s) and/or next PF(s). Based on this understanding, RAN1 has the following questions:
 - Is the first PDCCH monitoring occasion of the first PO of a PF starting from the starting location of the pagingSearchSpace in that frame?
 - RAN1 would like to understand the motivation of introducing PF_offset? Is it intended to avoid overlapping such as to avoid the collision of valid PDCCH monitoring occasion and e.g. SSB transmission.
- Within the UE PO for the non-default association, RAN1 is considering the valid PDCCH monitoring occasion associated to which SSB index to limit the UE monitoring time.
- RAN1 is also discussing if paging PDSCH resource allocation impacts the validity of paging PDCCH monitoring occasion.

Draft LS in **R1-1809959**, which is **approved** (updating “RAN2 answers” to “RAN2 to answer”).
Final LS in **R1-1809965**

Search space related agreements from random-access:

Agreements:

- To adopt the following TP to 38.213, Section 10.1:

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE is not expected to monitor a PDCCH for Type0/0A/2/3-PDCCH common search space, if the SS/PBCH block or the CSI-RS the UE selects for PRACH association, as described in Subclause 8.1, does not have same QCL-TypeD [6, TS 38.214] with a DM-RS for monitoring the PDCCH for Type0/0A/2/3-PDCCH common search space, and if the reception of the PDCCH or PDSCH scrambled by the RNTIs associated for Type0/0A/2/3-PDCCH common search space overlapped with PDCCH or PDSCH scrambled by the RNTIs associated with Type1-PDCCH common search space in at least one symbol.

Agreements:

- Adopt the following TP to Section 8.2 of 38.213 (change shown in red color)

If a UE detects a DCI format 1_0 with the CRC scrambled by the corresponding RA-RNTI and receives the corresponding PDSCH that includes the DL-SCH transport block, the UE may assume same DM-RS antenna port quasi co-location properties, as described in [6, 38.214], as for a SS/PBCH block or a CSI-RS resource the UE used for PRACH association as described in Subclause 8.1, regardless of whether or not the higher layer parameter *TCI-StatesPDCCH* is provided for the CORESET where the PDCCH is received.

If the UE attempts to detect the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers non-contention based random access procedure, the UE may assume that the PDCCH and the PDCCH order have same DM-RS antenna port quasi co-location properties.

Search space related agreements from beam management:

Agreement

Concerning the questions in RAN2 LS (R1-1808166) on BFR

Question 1: After UE sending PRACH for contention-free BFR, does the UE continue monitoring PDCCH candidates in configured search spaces monitored before PRACH, in addition to the search space indicated by `recoverySearchSpaceId`?

- RAN1 response: Yes, all configured search spaces before dedicated BFR PRACH transmission for BFR are monitored

Question 2: If the answer to Question 1 is “Yes”, is the BFR RACH procedure considered successfully completed only if PDCCH is received in search space indicated by `recoverySearchSpaceId`?

- RAN1 response: Yes, only when a PDCCH transmission addressed to C-RNTI is received on the search space indicated by higher layer parameter *recoverySearchSpaceId*, i.e., SS-BFR, UE considers a contention-free BFR procedure is successfully terminated

Response LS to RAN2 is endorsed in **R1-1809887**

Agreement

When *TCIpresentinDCI* is enabled, the TCI field in DCI in the scheduling CC points to the activated TCI states in the scheduled CC/BWP

Agreement

The indicated TCI should be based on the candidate TCI states in the slot with the scheduled PDSCH

- Applies for single slot PDSCH

For RAN1#94bis:

Companies are encouraged to check whether the existing radio resource control element

ControlResourceSet could be used to configure TCI state for CORESET #0 or not

Search space related agreements from DL/UL scheduling and HARQ procedure:

Working assumption:

- The UE is not required to store more than 16 scheduling DCI for PDSCH on a given cell, among all scheduling DCI received prior and up to the current slot
 - FFS the applicability to broadcast PDSCH or not
 - FFS the applicability to activation/deactivation DCI
- The UE is not required to store more than 16 scheduling DCI for PUSCH on a given cell, among all scheduling DCI received prior and up to the current slot

Search space related agreements from BWP:

Agreements:

- **Issue #1:** In case multiplexing pattern 2 or 3 is used for the initial DL BWP, for an active DL BWP that overlaps with the initial DL BWP but not with the SS/PBCH block associated to the initial DL BWP, is it possible for the UE to:
 - **Question #1a:** Perform BM based on the SS/PBCH block associated to the initial DL BWP?
 - **Answer:** No, a UE is not expected to perform BM based on the SS/PBCH block outside the active DL BWP. Note that the scenario can be supported with appropriate CSI-RS configuration.
 - **Question #1b:** Perform BFD based on the SS/PBCH block associated to the initial DL BWP?
 - **Answer:** No, a UE is not expected to perform BFD based on the SS/PBCH block outside the active DL BWP. Note that the scenario can be supported with appropriate CSI-RS configuration.
 - **Question #1c:** Perform RLM based on the SS/PBCH block associated to the initial DL BWP?
 - **Answer:** No, a UE is not expected to perform RLM based on the SS/PBCH block outside the active DL BWP. Note that the scenario can be supported with appropriate CSI-RS configuration.
 - **Question #1d:** Monitor the SS/PBCH block associated to the initial DL BWP to receive broadcast SI / paging based on CORESET#0 and searchspace#0? (assuming the same SCS is used in the active BWP as that of initial BWP)
 - **Answer:** No, a UE is not expected to monitor the SS/PBCH block outside the active DL BWP and associated to the initial DL BWP to receive broadcast SI / paging based on CORESET#0 and searchspace#0.
- **Issue #2:** For an active DL BWP that overlaps with neither the initial DL BWP nor with the SS/PBCH block associated to the initial DL BWP (from now on: "non-overlapping" active DL BWP), RAN2 understands that additional CORESET/search space(s) need to be configured in the active DL BWP to provide SI broadcast and paging to a connected UE. What is not clear is whether an SS/PBCH block necessarily needs to be associated to the additional CORESET/search space(s) and, specifically, if a UE needs to monitor such SS/PBCH block.
 - **Question #2a:** In a "non-overlapping" active DL BWP, does a UE necessarily need to monitor an SS/PBCH block associated to the additional CORESET/search space to be able to receive SI broadcast? If yes, could this be the SS/PBCH block associated to the initial DL BWP? And under which conditions, if any, could the UE monitor it for this purpose?
 - **Answer:** No, a UE does not necessarily need to monitor an SS/PBCH block

associated to the additional CORESET/search space to be able to receive SI broadcast. The UE can be configured with TCI states for the additional CORESET/search space to enable SI broadcast reception.

- **Question #2b:** In a "non-overlapping" active DL BWP, does a UE necessarily need to monitor an SS/PBCH block associated to the additional CORESET/search space to be able to receive paging? If yes, could this be the SS/PBCH block associated to the initial DL BWP? And under which conditions, if any, could the UE monitor it for this purpose?
 - **Answer:** No, a UE does not necessarily need to monitor an SS/PBCH block associated to the additional CORESET/search space to be able to receive paging. The UE can be configured with TCI states for the additional CORESET/search space to enable paging reception.

Agreements:

- Modify the agreements in RAN1#92bis as follows.
 - When monitoring for DCI in a BWP, the size of DCI format 0-0/1-0 is given by
 - For format 0-0/1-0 (regardless of RNTI) in CSS, the size is given by ~~the initial DL BWP~~CORESET#0
 - For format 0-0/1-0 in USS, the size is given by the active BWP as long as the DCI size budget is fulfilled
 - Otherwise, for format 0-0/1-0, the size is given by ~~the initial DL BWP~~CORESET#0
 - For DCI format 1-0 in CSS with P-RNTI, SI-RNTI, RA-RNTI, C-RNTI, CS-RNTI, or TC-RNTI:
 - the RB numbering for the scheduled PDSCH starts from the lowest RB in the CORESET the DCI is received in
 - the maximum number of RBs possible to indicate in the DCI is given by the size of ~~the initial DL BWP~~CORESET#0.
 - Payload sizes for 2-2 and 2-3 are padded (if needed) to match the size of formats 0-0/1-0 ~~as defined by the initial BWP in CSS~~
- Modify the agreements in RAN1#91 as follows if Option #2 is supported in PCell
 - CORESET configured by RMSI is confined within ~~the initial DL BWP~~the bandwidth of CORESET#0
- For PCell, the initial DL BWP can be configured in SIB1 to be the same as or different with the initial DL BWP as initially defined by CORESET#0
 - The initial DL BWP configured in SIB1 includes the bandwidth of CORESET#0
 - If the initial DL BWP configured by SIB1 is different with the initial DL BWP as initially defined by CORESET#0, the configuration of the initial DL BWP configured by SIB1 is applicable after the initial access
- For PSCell and SCell, the initial DL BWP of a cell can be configured to be the same as or different with the initial DL BWP as defined by CORESET#0 of the cell
 - The initial DL BWP of a cell includes the bandwidth of CORESET#0 of the cell
- Note: RAN1 assumes that the above agreements related to PCell, PSCell and SCell have no RAN1 specification impact and will be captured in RAN2 specs
- Send LS to RAN2 to ask RAN2 to capture the above agreements related to PCell, PSCell and SCell in RAN2 specs, draft LS in **R1-1810000**, which is **approved** with final LS in **R1-1810002**

Agreements:

Update the following agreement as follows:

- When a PDCCH candidate collides with **any** RB-level resource (RateMatchPattern) **configured without controlResourceSetId**, where PDSCH is semi-statically not mapped, as described in TS38.214 Section 5.1.4.1 then
 - The UE is not required to monitor the PDCCH candidate overlapping with the resource even only by one RE
- Note: the current spec already reflects the above updated agreements

Agreements:

- To adopt the following TP to 5.1.4 of 38.214:
within a BWP, a frequency domain resource of a CORESET with *controlResourceSetId* and time domain resource determined by the higher layer parameters *monitoringSlotPeriodicityAndOffset*, ***duration*** and *monitoringSymbolsWithinSlot* of search-space-sets **configured by SearchSpace and time domain resource of search-space-set zero configured by pdcch-ConfigSIB1 or searchSpaceZero** associated with the CORESET with *controlResourceSetId* **as well as CORESET duration configured by ControlResourceSet with controlResourceSetId**. This resource not available for PDSCH can be included in one or two groups of resource sets (higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2*).

Agreements:

- To adopt the following TP to 5.1.4.1 of 38.214:
If a PDSCH scheduled by a PDCCH would overlap with resources in the CORESET containing the PDCCH, the resources corresponding to a union of the detected PDCCH that scheduled the PDSCH and associated PDCCH DM-RS are not available for the PDSCH. When *precoderGranularity* configured in a CORESET where the PDCCH was detected is equal to *allContiguousRBs*, the associated PDCCH DMRS are DMRS in all REGs of the CORESET. Otherwise, the associated DMRS are the DMRS in REGs of the PDCCH.

6. References

TDoc	Title	Source
R1-1810111	Remaining issues for physical downlink control channel	Huawei, HiSilicon
R1-1810256	Remaining issues on downlink control channel	LG Electronics
R1-1810339	Remaining issues on NR physical downlink control channel	ZTE
R1-1810369	Remaining issues on physical downlink control channel	vivo
R1-1810421	Maintenance for physical downlink control channel	MediaTek Inc.
R1-1810520	Open issues and corrections for NR PDCCH	CATT
R1-1810619	On maintenance for DL control	Nokia, Nokia Shanghai Bell
R1-1810754	Remaining issues on NR PDCCH	Intel Corporation
R1-1810842	Remaining Issues on PDCCH and Search Space Design	Samsung
R1-1811234	Maintenance for physical downlink control channel	Qualcomm Incorporated
R1-1811373	Maintenance for physical downlink control channel	NTT DOCOMO, INC.
R1-1811397	Maintenance for physical downlink control channel	Panasonic Corporation
R1-1811423	Remaining issues on downlink control channel	ASUSTEK COMPUTER (SHANGHAI)
R1-1811488	Maintenance issues of physical downlink control channel	Ericsson