**3GPP TSG RAN WG1#108 R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

**Agenda Item: 8.2.2**

**Source: Moderator (Lenovo)**

**Title: Email discussion [108-e-NR-52-71GHz-02] for B52.6 GHz PDCCH monitoring enhancements**

**Document for: Discussion, Decision**

# Introduction

As stated by the chairman:

[108-e-NR-52-71GHz-02] Email discussion for maintenance on PDCCH monitoring enhancements – Alex (Lenovo)

* 1st check point: February 25
* Final check point: March 3

Depending on the progress, new questions or proposals may be added for individual items.

# Discussion

FL NOTE: Excerpts from submitted documents are listed in Section 3.

## Topic A1: Blind Decoding Capability, Multi-slot monitoring

### Issue A1-1: Configuration of multi-slot monitoring, general MSM capability

#### First round discussion

**Proposal A1-1.1 (see R1-2201914): Adopt the following TP to cover the RAN1#107-e agreement:** BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.

|  |
| --- |
| **TS 38.213 Clause 13**============================= Unchanged part omitted =========================================**13 UE procedure for monitoring Type0-PDCCH CSS sets**If during cell search a UE determines from *MIB* that a CORESET for Type0-PDCCH CSS set is present, as described in clause 4.1, the UE determines a number of consecutive resource blocks and a number of consecutive symbols for the CORESET of the Type0-PDCCH CSS set from *controlResourceSetZero* in *pdcch-ConfigSIB1*, as described in Tables 13-1 through 13-10, for operation without shared spectrum channel access in FR1 and FR2-1, or as described in Tables 13-1A and 13-4A for operation with shared spectrum channel access in FR1, or as described in Tables 13-10A, 13-10B and 13-10C for FR2-2, and determines PDCCH monitoring occasions from *searchSpaceZero* in *pdcch-ConfigSIB1*, included in *MIB*, as described in Tables 13-11 through 13-15. and are the SFN and slot index within a frame of the CORESET based on SCS of the CORESET and and are the SFN and slot index based on SCS of the CORESET, respectively, where the SS/PBCH block with index overlaps in time with system frame and slot . The symbols of the CORESET associated with *pdcch-ConfigSIB1* in *MIB* or with *searchSpaceSIB1* in *PDCCH-ConfigCommon* have normal cyclic prefix. \*<omitted text>\*.For operation without shared spectrum channel access and for the SS/PBCH block and CORESET multiplexing pattern 1, for FR1 and FR2-1, a UE monitors PDCCH in the Type0-PDCCH CSS set over two consecutive slots starting from slot . For FR2, UE monitors PDCCH in the Type0-PDCCH CSS set over two slots, slot  and  , where if SCS of the CORESET for Type0-PDCCH CSS is 480kHz, and  if SCS of the CORESET for Type0-PDCCH CSS is 960kHz. For SS/PBCH block with index , the UE determines an index of slot  as  that is in a frame with system frame number (SFN)  satisfying  if , or in a frame with SFN satisfying  if .  and  are provided by Tables 13-11 and 13-12, and  based on the SCS for PDCCH receptions in the CORESET [4, TS 38.211]. The index for the first symbol of the CORESET in slots  and  and  is the first symbol index provided by Tables 13-11 and 13-12.For operation with shared spectrum channel access and for the SS/PBCH block and CORESET multiplexing pattern 1, a UE monitors PDCCH in the Type0-PDCCH CSS set over slots that include Type0-PDCCH monitoring occasions associated with SS/PBCH blocks that are quasi co-located with the SS/PBCH block that provides a CORESET for Type0-PDCCH CSS set with respect to average gain, quasi co-location 'typeA' and 'typeD' properties, when applicable [6, TS 38.214]. For FR1 and FR 2-1, for a candidate SS/PBCH block index , where , two consecutive slots starting from slot include the associated Type0-PDCCH monitoring occasions. For FR2, for a candidate SS/PBCH block index , where , two slots, slot and  , where if SCS of the CORESET for Type0-PDCCH CSS is 480kHz, and  if SCS of the CORESET for Type0-PDCCH CSS is 960kHz, include the associated Type0-PDCCH monitoring occasions. The UE determines an index of slot as that is in a frame with system frame number (SFN) satisfying if , or in a frame with SFN satisfying if . and are provided by Table 13-11, and based on the SCS for PDCCH receptions in the CORESET [4, TS 38.211]. The index for the first symbol of the CORESET in slots and is the first symbol index provided by Table 13-11. The UE does not expect to be configured with , or with , when .For the SS/PBCH block and CORESET multiplexing patterns 2 and 3, a UE monitors PDCCH in the Type0-PDCCH CSS set over one slot with Type0-PDCCH CSS set periodicity equal to the periodicity of SS/PBCH block. For the SS/PBCH block and CORESET multiplexing patterns 2 and 3, if the active DL BWP is the initial DL BWP, the UE is expected to be able to perform radio link monitoring, as described in Clause 5, and measurements for radio resource management [10, TS 38.133] using a SS/PBCH block that provides a CORESET for Type0-PDCCH CSS set. For a SS/PBCH block with index , the UE determines the slot index  and  based on parameters provided by Tables 13-13 through 13-15.============================= Unchanged part omitted ========================================= |

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We believe the technical aspect of this TP has already been addressed by current specification, and the TP is not using the latest version of the specification.  |
| Ericsson | Agree with Samsung that the agreement on monitoring in slots n0 and n0+X is already captured in the most recent version of 38.213. But we did notice a typo in Section 13 just now, and maybe we can agree on correcting it:For operation without shared spectrum channel access and for the SS/PBCH block and CORESET multiplexing pattern 1, a UE monitors PDCCH in the Type0-PDCCH CSS set over two slots . For SS/PBCH block with index , the UE determines an index of slot as that is in a frame with system frame number (SFN) satisfying if , or in a frame with SFN satisfying if where based on the SCS for PDCCH receptions in the CORESET [4, TS 38.211] .- For and for a SS/PBCH block index , the two slots including the associated Type0-PDCCH monitoring occasions are slots and . , , and the index of the first symbol of the CORESET in slots and are provided by Table 13-11 and Table 13-12.- For and for a SS/PBCH block index , the two slots including the associated Type0-PDCCH monitoring occasions are slots and . , , and the index of the first symbol of the CORESET in slots and are provided by Table 13-12A, where .- For and for a SS/PBCH block index , the two slots including the associated Type0-PDCCH monitoring occasions are slots and . , , and the index of the first symbol of the CORESET in slots and are provided by Table 13-12A, where . |

**Proposal A1-1.2 (see R1-2202273): Adopt the following TP to cover the agreement:** BD attempts for all Group (1) SSs are **restricted** to fall within the same Y consecutive slots.

FL Note: TP has been editorially modified by FL.

|  |
| --- |
| **TS 38.213 v17.0.0, Section 10**…For SCS configuration or , a UE can indicate a capability to monitor PDCCH according to one or more combinations , where and are numbers of consecutive slots, groups of slots are consecutive and non-overlapping, and the slots are within the slots. The first group of slots starts from the beginning of a subframe. The start of two consecutive groups of slots is separated by slots.If a UE monitors PDCCH on a cell according to combination , the UE can monitor PDCCH for Type1-PDCCH CSS set provided by dedicated higher layer signalling, Type3-PDCCH CSS sets, and USS sets in any slot of the slots, and the UE is not expected to monitor PDCCH for these CSS/USS sets in any other of the slots, and the UE can monitor PDCCH for Type0/0A/2-PDCCH CSS set and Type1-PDCCH CSS set provided in *SIB1* in any slot of the slots. The UE determines the number of monitored PDCCH candidates and the number of non-overlapped CCEs for combination based on all search space sets within the slots, as applicable according to the search space set configurations, and maximum corresponding values are provided in Table 10.1-2B and Table 10.1-3B, respectively. ... |

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We didn’t see a strong need of this proposal, since it’s already implied by current text.  |
| Ericsson | Agree with Samsung; this TP is not needed. The wording "… in any slot of the slots" means that the monitoring is restricted to the Ys slots. No need to clarify further. |

**Proposal A1-1.3 (see R1-2202273): In case that MO of Group (1) CSS is changed, the location of *Ys* within *Xs* can be adapted accordingly to include all CSS MOs (of Group(1) SS) that are monitored by UE.**

FL Note: TP has been editorially modified by FL.

|  |
| --- |
| **TS 38.213 v17.0.0, Section 10**…For SCS configuration or , a UE can indicate a capability to monitor PDCCH according to one or more combinations , where and are numbers of consecutive slots, groups of slots are consecutive and non-overlapping, and the slots are within the slots. The first group of slots starts from the beginning of a subframe. The start of two consecutive groups of slots is separated by slots until a new monitoring occasion of Type1-PDCCH CSS set is provided by dedicated higher layer signalling, or of Type3-PDCCH CSS sets is configured or indicated to the UE. If a UE monitors PDCCH on a cell according to combination , the UE can monitor PDCCH for Type1-PDCCH CSS set provided by dedicated higher layer signalling, Type3-PDCCH CSS sets, and USS sets in any slot of the slots, and the UE can monitor PDCCH for Type0/0A/2-PDCCH CSS set and Type1-PDCCH CSS set provided in *SIB1* in any slot of the slots. The UE determines the number of monitored PDCCH candidates and the number of non-overlapped CCEs for combination based on all search space sets within the slots, as applicable according to the search space set configurations, and maximum corresponding values are provided in Table 10.1-2B and Table 10.1-3B, respectively. |

Please comment whether the proposal and TP are agreeable.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Moderator | If agreeable, perhaps the second part of the change could be modified for improved clarity:[…], or *until a new monitoring occasion* of Type3-PDCCH CSS sets is configured or indicated to the UE. |
| Samsung | We don’t think this change is essentially needed, since there is no way of confusion in implementation.  |
| Ericsson | Fundamentally, this TP is not needed. It is always the case that a configuration holds until a new configuration is received. If it was needed to always specify what happens upon reconfiguration, then the spec would need to be updated in many places. |

### Issue A1-2: [High Priority] Support of optional/FFS (X,Y) values

#### First round discussion

**Proposal A1-2.1: Support as optional value for 480 kHz SCS with 10 maximum monitored PDCCH candidates and 16 maximum non-overlapped CCEs.**

**Proposal A1-2.2: Conclude that for 480 kHz SCS is not supported for multi-slot monitoring.**

FL Summary: Only few companies showed active support for in their contributions. The discussion in RAN1#107bis-e showed a majority not supporting it, so it seems fair to say that there is no consensus to adopt Proposal A1-2.1. Therefore FL suggests to adopt **Proposal A1-2.2: Conclude that for 480 kHz SCS is not supported for multi-slot monitoring.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | We support FL’s suggestion on Proposal A1-2.2. |
| Samsung | We prefer to support Proposal A1-2.1.  |
| Ericsson | We support Proposal A1-2.2.We think that (2,1) with BD/CCE budget of 10/16 is flawed in that the CCE budget is not enough for Type0-PDCCH monitoring which requires 4 + 8 + 16 = 28 non-overlapping CCEs according to Table 10.1-1.**Table 10.1-1: CCE aggregation levels and maximum number of PDCCH candidates per CCE aggregation level for CSS sets configured by *searchSpaceSIB1***

|  |  |
| --- | --- |
| **CCE Aggregation Level** | **Number of Candidates** |
| 4 | 4 |
| 8 | 2 |
| 16 | 1 |

 |

### Issue A1-3: [High Priority] Determination of X in case of multiple supported X values for multi-slot monitoring

#### First round discussion

**Proposal A1-3.1:**

**If the configured search space sets comply with the requirements of more than one of the reported PDCCH monitoring capability combinations, choose a combination from the complying reported set of combinations that results in the largest number of and for PDCCH monitoring.**

**FL Note: Many companies see it as unnecessary to additionally choose according to the smallest Ys value, however this could be added if a majority of companies identifies a benefit.**

**Proposal A1-3.2:**

**Introduce an RRC parameter to indicate a combination to be used for PDCCH monitoring. The parameter is UE-specific and has the value range {'xs4ys1', 'xs4ys2', 'xs8ys1', 'xs8ys4'}. If the parameter is absent, the UE uses (4,1) for 480 kHz and (8,1) for 960 kHz.**

FL Summary: Discussion in RAN1#107bis-e and documents submitted to this meeting shows a majority supporting a rule-based approach as in Proposal A1-3.1. Therefore FL suggests to adopt **Proposal A1-3.1.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | For Proposal A1-3.1, we prefer to add Ys to the decision rule. We understand that Ys doesn’t play a role on BD/CCE budget but Ys is essential to determine whether a CC follows mandatory or optional capability. That is, a CC with (Xs,Ys)=(4,1) and a CC with (Xs,Ys)=(4,2) are handled differently from UE implementation perspective, e.g., power saving and number of BD within Ys slots. Therefore, it is necessary to distinguish CCs with same Xs but different Ys. For Proposal A1-3.2, we can accept it due to the simplicity.  |
| Samsung | We support Proposal A1-3.1, and there is no need to choose a particular value of Ys, since it can be up to UE’s implementation.  |
| Ericsson | Our first preference is to introduce an RRC parameter for simplicity (like Proposal A1-3.2). However, we agree with Samsung that there is no need to configure a particular Ys, since only Xs is needed for the UE to know the slot group size (Xs) for evaluating dropping rules. Furthermore, for 480 kHz there is only one supported value of Xs (assume (2,1) is not supported). In summary, we suggest the following amendment to proposal A1-3.2:**Proposal A1-3.2a****Introduce an RRC parameter to indicate the slot group size Xs for PDCCH monitoring. The parameter is UE-specific and has the value range {'xs4', 'xs8'}. If the parameter is absent, the UE assumes Xs = 4 for 480 kHz and Xs = 8 for 960 kHz.**Regarding Proposal A1-3.1, we think that some further discussion would be needed to formulate a proper rule that takes into account compliance across all configured search spaces. |

### Issue A1-4: Multi-slot monitoring for IDLE UEs or prior to dedicated configuration (*monitoringCapabilityConfig*)

#### First round discussion

FL Summary: Most companies support to specify that for μ = 5 and for μ = 6 if *monitoringCapabilityConfig* is not provided. Discussion in RAN1#107bis-e showed that several companies don't see the need to change the wording from *for a serving cell* to *for an active DL BWP of a serving cell* in that context. FL provides two TPs with and without the change to *active DL BWP of a serving cell* and asks companies to show their preference.

FL Note: The TPs here assume that Issue A1-3 is resolved without introduction of an RRC parameter; otherwise, the text should change e.g. to "If the UE is not provided *monitoringCapabilityConfig* for μ ∈ {5,6} or is not configured with a combination for μ ∈ {5,6}, […]"

**Text Proposal A1-4.1: Change TS 38.213 Clause 10 as follows:**

|  |
| --- |
| If a UE is provided *monitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs - per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or - per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*- per group of slots according to combination , as in Tables 10.1-2B and 10.1-3B, if *monitoringCapabilityConfig* = *r17monitoringcapability*If the UE is not provided *monitoringCapabilityConfig* for μ ∈ {0,1,2,3}, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot. If the UE is not provided *monitoringCapabilityConfig* for μ ∈ {5,6}, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per group of slots according to combination for μ = 5 and for μ = 6 as in Tables 10.1-2B and 10.1-3B. |

**Text Proposal A1-4.2: Change TS 38.213 Clause 10 as follows** (change to Text Proposal A1-4.1 is highlighted)**:**

|  |
| --- |
| If a UE is provided *monitoringCapabilityConfig* for an active DL BWP of a serving cell, the UE obtains an indication to monitor PDCCH on the the active DL BWP of serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs - per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or - per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*- per group of slots according to combination , as in Tables 10.1-2B and 10.1-3B, if *monitoringCapabilityConfig* = *r17monitoringcapability*If the UE is not provided *monitoringCapabilityConfig* for μ ∈ {0,1,2,3}, the UE monitors PDCCH on the active DL BWP of a serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot. If the UE is not provided *monitoringCapabilityConfig* for μ ∈ {5,6}, the UE monitors PDCCH on the active DL BWP of a serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per group of slots according to combination for μ = 5 and for μ = 6 as in Tables 10.1-2B and 10.1-3B. |

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We support TP A1-4.2. One typo correction for TP A1-4.2, the inserted “the active DL BWP of” should be before “the” to avoid duplicated “the”. If a UE is provided *monitoringCapabilityConfig* for an active DL BWP of a serving cell, the UE obtains an indication to monitor PDCCH on the active DL BWP of the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs  |
| Ericsson | We support TP A1-4.1.Furthermore, we think that TP A1-4.1 works regardless of whether or not Issue A1-3 is resolved by supporting an RRC parameter for indicating an "effective" Xs for which all search space sets comply. The intent of the clause "if the UE is not provided *monitoringCapabilityConfig*" is to cover the initial access case. It is our understanding that for 480/960 kHz the UE will always be configured with *monitoringCapabilityConfig* = *r17monitoringcapability* once in CONNECTED mode, since we have agreed that per-slot group monitoring is mandatory and per-slot monitoring is not supported for these SCSs (see Proposal A1-4.3 below). If an RRC parameter is agreed for Issue A1-3, it would be used once the UE is in CONNECTED mode only if a UE indicates support for multiple (Xs,Ys) combinations and there is a need to indicate the value of Xs that the UE should assume. A default can be defined if this parameter is absent, but that is a separate issue that can be handled in the field description in 38.331for the new parameter (if agreed). We don't support TP A1-4.2 since we see no need to change the current spec from "for a serving cell" to "for an active DL BWP of a serving cell." In both cases the UE is monitoring on a serving cell, so the behavior is clear. |

**Proposal A1-4.3 (see R1-2201735):**

Inform RAN2 that the value range for the existing parameter *monitoringCapabilityConfig* needs to be be extended to include the new value *r17monitoringcapability*, and that for 480 and 960 kHz SCS, the UE expects to be configured with this value. A note can be added to the RRC parameter spreadsheet to propose that RAN2 updates the field description of the parameter as follows:

***monitoringCapabilityConfig***

Configures either Rel-15 PDCCH monitoring capability or Rel-16 PDCCH monitoring capability for PDCCH monitoring on a serving cell. Value *r15monitoringcapablity* enables the Rel-15 monitoring capability, and value *r16monitoringcapablity* enables the Rel-16 PDCCH monitoring capability. Value *r17monitoringcapablity* enables the Rel-17 PDCCH monitoring capability (see TS 38.213 [13], clause 10.1). When present, the UE expects to be configured with *r17monitoringcapablity* for 480 and 960 kHz SCS.

**Please comment whether Proposal A1-4.3 is acceptable.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | Ok with the change.  |
| Ericsson | Support the proposal as proponent.We emphasize that this would need to be added to the RRC parameter spreadsheet, so should be discussed prior to the RRC deadline on 2/24. |

### Issue A1-5: Other multi-slot monitoring behaviour

#### First round discussion

Apple suggests the following proposal in R1-2201765:

*For the slot group size (X) it should be concluded that:*

* *The configurable values for multi-slot PDCCH monitoring operation should be same as the reported X value(s). The UE is not expected to handle a scenario in which they are different, and a UE can report its monitoring capability for more than one (X,Y) combination.*
* *For each SCS 480 kHz and 960 kHz, the minimum configurable multi-slot PDCCH monitoring periodicity is the smallest value X that a UE supports when reporting its PDCCH monitoring capabilities for the corresponding SCS and are UE specific.*
* *Both statements may be either explicitly stated in the specification or as a conclusion in the Chairman’s notes.*

FL thinks that these points are or will be taken into account in the discussion e.g. for search space configuration parameters, and therefore a separate discussion/agreement on the proposal appears unnecessary.

## Topic A2: Search Space Configuration/Enhancement

### Issue A2-1: [High Priority] Open issues and revisions for agreement in RAN1#107bis-e

#### First round discussion

|  |
| --- |
| **Agreement (RAN1#107bis-e)**For search space set configuration of multi-slot PDCCH monitoring:* *monitoringSlotPeriodicityAndOffset* and *duration* are appended with "-r17", and
	+ *For monitoringPeriodicityAndOffset-r17*
		- The values represent slots
		- Add periodicity values {32,64,128,5120,10240,20480} to the existing values in *monitoringSlotPeriodicityAndOffset*
			* Note: Total list of supported periodicity values: {1,2,4,5,8,10,16,20,32,40,64,80,128,160,320,640,1280,2560,5120,10240,20480}
		- For each periodicity value Xp
			* The value range for the offset O is {0 .. Xp-1} slots
			* Note: There may be no need to introduce the term "Xp" in the specifications
		- The configured periodicity at least for Group (1) SSs is restricted to be an integer multiple of Xs slots
		- FFS: details of offset
	+ For *duration-r17*
		- The values represent slots
		- The value range is { 8, 12, …, 20476}
		- The configured duration is restricted to be an integer multiple of Xs slots at least for Group (1) SSs
		- FFS: need to revise the definition of *duration*
* *monitoringSymbolsWithinSlot* applies to each slot in a slot group configured for multi-slot PDCCH monitoring
	+ Note: This parameter can be directly re-used from earlier releases.
* Introduce new parameter *monitoringSlotsWithinSlotGroup-r17*
	+ Working assumption:
		- The size is 8 bits
		- Each bit in *monitoringSlotsWithinSlotGroup-r17* represents a slot in a slot group
		- A slot in the slot group is configured for multi-slot PDCCH monitoring if the corresponding bit in the slot group is set to '1'
			* Note: Further configuration of the monitoring symbols in such a slot is done by *monitoringSymbolsWithinSlot*
		- The slots indicated in the bitmap should be consecutive at least for Group (1) SSs
 |

FL Summary: Many companies have submitted their views especially on the FFS items and the working assumption. After review of the contributions, FL suggests the following update to the RAN1#107bis-e agreement. Note that aspects related to Group (2) monitoing are covered in Issue A2-2. The following picture (based on R1-2201471) is given for visualization of the parameters and their applicability.



**Proposal A2-1.1: Revise the RAN1#107bis-e agreement as follows:**

|  |
| --- |
| For search space set configuration of multi-slot PDCCH monitoring:* *monitoringSlotPeriodicityAndOffset* and *duration* are appended with "-r17", and
	+ *For monitoringPeriodicityAndOffset-r17*
		- The values represent slots
		- Add periodicity values {32,64,128,5120,10240,20480} to the existing values in *monitoringSlotPeriodicityAndOffset*
			* Note: Total list of supported periodicity values: {~~1,2,~~4,~~5,~~8,~~10,~~16,20,32,40,64,80,128,160,320,640,1280,2560,5120,10240,20480}
		- For each periodicity value Xp
			* The value range for the offset O is ~~{0 .. Xp-1}~~{0, 4, 8, …, } slots
			* Note: There may be no need to introduce the term "Xp" in the specifications
		- The configured periodicity at least for Group (1) SSs is restricted to be an integer multiple of Xs slots
		- The configured offset is restricted to be an integer multiple of Xs slots
		- ~~FFS: details of offset~~
	+ For *duration-r17*
		- The values represent slots
		- The value range is {8, 12, …, 20476} at least for Group (1) SSs
			* FFS: Applicable value if this field is absent
		- The configured duration is restricted to be an integer multiple of Xs slots at least for Group (1) SSs
		- This field indicates the number of consecutive slots where a *SearchSpace* exists.
		- ~~FFS: need to revise the definition of~~ *~~duration~~*
* *monitoringSymbolsWithinSlot* applies to each slot in a slot group configured for multi-slot PDCCH monitoring
	+ Note: This parameter can be directly re-used from earlier releases.
* Introduce new parameter *monitoringSlotsWithinSlotGroup-r17*
	+ ~~Working assumption:~~
		- ~~The size is 8 bits~~
		- The size is Xs bits, where Xs is either 4 or 8
		- Each bit in *monitoringSlotsWithinSlotGroup-r17* represents a slot in a slot group
		- The parameter *monitoringSlotsWithinSlotGroup-r17* is applied in each of the slot groups as determined by the *monitoringSlotPeriodicityAndOffset-r17* and *duration-r17*.
		- A slot in the slot group is configured for multi-slot PDCCH monitoring if the corresponding bit in the slot group is set to '1'
			* Note: Further configuration of the monitoring symbols in such a slot is done by *monitoringSymbolsWithinSlot*
		- The slots indicated in the bitmap should be consecutive at least for Group (1) SSs
		- The number of 1s in *monitoringSlotsWithinSlotGroup-r17* should be no larger than at least for Group (1) SSs
		- FFS: Applicable value if this field is absent
 |

**Please comment whether Proposal A2-1.1 is acceptable, and any suggestion you have for the case that are absent (e.g. it was proposed that a UE should assume a duration of 4 if *duration-r17* is absent). Note that updates to the descriptions RRC parameter lists should be discussed after having reached consensus on the above.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | Thanks to FL’s proposal and DOCOMO’s nice figure for visualization! We had one clarification question: how to determine Xs? Is it based on the bit-length of *monitoringSlotsWithinSlotGroup-r17?* If so, does it mean Issue A1-3 is resolved on the Xs part after we agree ProposalA2-1.1? |
| Samsung | We are ok with the change in principle, and have some further comments for clarification: * We understand the intention of equation , and want to comment that this equation is only for simply notation in RAN1 discussion, and capturing the offset in RAN2 specification may not need such equation.
* The configured offset at least for Group (1) SSs is restricted to be an integer multiple of Xs slots.
* Value of duration-r17 should be 4 if this field is absent
* The definition of “duration-r17” as “This field indicates the number of consecutive slots where a SearchSpace exists” may not be accurate. For example, in the figure provided by FL, duration-r17 is 8, but only 6 slots within the 8 slots includes SearchSpace.
* We prefer to keep the bitwidth as 8 from last meeting, and could further clarify only the first Xs bit is applicable from a UE point of view. The gNB may not know what’s the Xs determined at the UE side.
 |
| Ericsson | The proposal is heading in a reasonable direction; however, we have some comments/concerns:Comment #1:Regarding the following changes:* + - * {~~1,2,~~4,~~5,~~8,~~10,~~16,20,32,40,64,80,128,160,320,640,1280,2560,5120,10240,20480}
			* The value range for the offset O is ~~{0 .. Xp-1}~~{0, 4, 8, …, } slots
		- The configured offset is restricted to be an integer multiple of Xs slots

If these are agreed, then it would effectively mean that both the periodicity and offset are restricted to an integer multiple of Xs slots, even for Group (2) SSs. We can agree to that, but ONLY if it is simultaneously agreed that for Group (2), *monitoringSlotsWithinSlotGroup* has no restriction on the number of '1's and position of '1's in the bitmap so as to be compliant with the following agreement from last meeting:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.

Hence we can agree to the above only if the following is added:* + - The number of 1s in *monitoringSlotsWithinSlotGroup-r17* should be no larger than at least for Group (1) SSs
		- The number of 1s in *monitoringSlotsWithinSlotGroup-r17* can be up to for Group (2) SSs and are not restricted to be consecutive

Comment #2:Regarding the following changes for *duration-r17*:* + - The value range is {8, 12, …, 20476} at least for Group (1) SSs
			* FFS: Applicable value if this field is absent

Under the condition that *monitoringSlotsWithinSlotGroup* has no restriction on the number of '1's and position of '1's in the bitmap (see Comment #1), then we would be okay to remove "at least for Group (1) SSs" so that periodicity, offset, and duration are all restricted to integer multiple of Xs for both Group (1) and Group (2).Our view on the FFS is that if the field is absent, then the applicable value is the same as the configured length of the bitmap *monitoringSlotsWithinSlotGroup* (i.e., either 4 or 8).Comment #3:Agree with Samsung that the following description of the *duration-r17* parameter still needs some work.* + - This field indicates the number of consecutive slots where a *SearchSpace* exists.

Instead, wouldn't it make sense to define the duration such that the "configured number of slots for *duration-r17* corresponds to the number of consecutive slot groups in which monitoring is performed within a period"?Comment #4:We are suggest the following change for clarity:* + - The size is Xs bits, where Xs is ~~either~~ configurable as 4 or 8

Regarding MediaTek's question on how to determine Xs. In our view, in terms of the configuration of an individual search space, it would make sense that Xs is given by the configured length of the bitmap *monitoringSymbolsWithinSlot*. To answer the second part of MediaTek's question, we don't think this resolves issue A1-3. That is a separate question, since from a UE perspective, if the UE reports capability for more than one value Xs for a given SCS, then it is needed to look over all configured search spaces to determine what is the "effective Xs" to which all search spaces comply. This "effective Xs" is the one that the UE would use to determine search space dropping if overbooking is employed. This can be done either (1) by explicit configuration with a separate RRC parameter (outside of the search space configuration) – this is our preference, or (2) a rule in the spec as proposed by some other companies, but this rule needs discussion. We think (1) is simpler, since the gNB must configure search spaces in such a way to comply with the UEs indicated capability, so the gNB is in a position to indicate what "effective Xs" for the UE to use.Comment #5:Regarding the following for the monitoringSlotsWithinSlotGroup-r17 parameter:FFS: Applicable value if this field is absentThis seems to imply that the field can be absent. However, we think that the higher level question is whether or not the field can be absent. In our view, it makes more sense that it is always present since this parameter is an integral part of configuring a search space. Fundamentally 4 things are required in order to locate the MOs, especially when some parameters are restricted to an integer multiple of Xs: periodicity, offset, duration, and monitoringSlotsWithinSlotGroup. |
|  |  |

### Issue A2-2: [High Priority] Multi-slot monitoring for Group (2) SS

#### First round discussion

R1-2201689 proposes to clarify the following:

|  |  |
| --- | --- |
| Before discussing details of Group (2) SS handling, it is better to align the understanding of FG 3-1 especially ‘any of’ in the following bullet.

|  |
| --- |
| - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot |

There are two interpretations.* Interpretation #1: It is limited to single span in a slot for each Group (2) SS set, however the different Group (2) SS sets can be configured in different spans in the slot.
* Interpretation #2: It is limited to single span in a slot considering all configured Group (2) SS sets in the slot.

In our view, Interpretation #2 is the correct understanding. Interpretation #1 will not bring any real complexity reduction at UE side compared to Interpretation #2. With Interpretation #1, though a single Group (2) SS set is limited to single span per slot, there can still be multiple spans in a slot due to multiple configured Group (2) SS sets. Consequently, UE must prepare for the worst case, i.e., to decode multiple spans per slot for Group (2) SS sets. **Proposal 2:** * Clarify that Interpretation #2 is the right understanding for FG 3-1
	+ Interpretation #2: It is limited to single span in a slot considering all configured Group (2) SS sets in the slot.
 |

**Any comments on Intel's analysis and proposal? Is it necessary to formally agree on Interpretation #2?**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | We agree with Intel that Interpretation#2 should be the correct one. If we go with Interpretation #1, then it basically provides no restriction on Group (2) SS set occasions, as mentioned by Intel. Also, if span is specified for each SS set in Group (2) SS sets as interpretation #1, we wonder how to define the relation between them if those spans are overlapped? At least in Rel-16, the spans are not allowed to be overlapped. |
| Samsung | We support Interpretation #2 as the right understanding for FG 3-1. We can be ok with a conclusion in the chairman notes.  |
| Ericsson | Clearly the interpretation is #2. Rel-15 allows, e.g., Type0-PDCCH to be in the middle of the slot and Type-2 to be in the beginning of the slot. There no enforcement either in the spec or in UE capabilities that all CSSs in Group (2) are aligned in the same 3 symbol span. The wording "any of" applies to each SS individually to prevent multiple MOs for the *same* SS within the *same* slot. |

Regarding alignment of Group (2) SSs with Group (1) SSs MSM configurations, several companies have expressed a preference to apply the same periodiicty and duration restriction to both Group (1) and Group (2) SSs, while others don't see a need for imposing any restriction.

**Proposal A2-2.1 (see R1-2201735):**

* For Group(2) SSs, the monitoring periodicity and duration are not restricted to be integer multiples of Xs slots.
* For Group(2) SSs, the slots indicated by the bitmap *monitoringSlotsWithinSlotGroup-r17* are not restricted to be consecutive.

**Proposal A2-2.2:** The configured periodicity and duration for Group (2) SSs is restricted to be an integer multiple of slots (as for Group (1) SSs).

**Proposal A2-2.3 (see R1-2201765):** To limit the complexity based on the Group (2) SS location across multiple slot groups, one or more of the following could be considered:

* Group (2) SSs could be placed within the same slot group
* If spread across multiple slot groups, for CSSs Type 0 (SIB1), Type 0A (SIBx) and Type 2 (Paging), the CSS periodicity for 480 kHz and 960 kHz should not be shorter than that for 120 kHz to ensure that the wake-up period is intermittent and limit the impact on the UE’s power consumption.
* Limit the number of times a Group (2) SS may be configured within a duration of M slot groups e.g. N SSs within M slot-groups where the N SSs are in consecutive slot groups

Proposal A2-2.4 (see R1-2202130):

* For Type1 CSS without dedicated RRC configuration and for Type0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) within a slot, with the monitoring occasions for any of Type1 CSS without dedicated RRC configuration, or Types0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot group of X0 slots.
	+ X0 = 4 for 480 kHz SCS and X0 = 8 for 960 kHz SCS

**Please state whether you support one or more of the proposals above.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | So far, we didn’t see an essential need to introduce limitation on Group (2) SS sets, and it may be better to clarify the issue of existing search space configuration to be applied to multi-slot PDCCH monitoring.  |
| Ericsson | In our contribution, we proposed that there should be no restriction for Group (2) SS sets, i.e., periodicity, offset, and duration need not be restricted to integer multiple of Xs.However, as we pointed out in Issue A2-1, if the following bullets from the FL proposal areagreed:* + - * {~~1,2,~~4,~~5,~~8,~~10,~~16,20,32,40,64,80,128,160,320,640,1280,2560,5120,10240,20480}
			* The value range for the offset O is ~~{0 .. Xp-1}~~{0, 4, 8, …, } slots
		- The configured offset is restricted to be an integer multiple of Xs slots

then it would effectively mean that both the periodicity and offset are restricted to an integer multiple of Xs slots, even for Group (2) SSs. We can be okay to that, but ONLY if it is simultaneously agreed that for Group (2), *monitoringSlotsWithinSlotGroup* has no restriction on the number of '1's and position of '1's in the bitmap so as to be compliant with the following agreement from last meeting:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.

Hence we can agree to impose restrictions on periodicity, offset, and duration only if the following is added:* + - The number of 1s in *monitoringSlotsWithinSlotGroup-r17* should be no larger than at least for Group (1) SSs
		- The number of 1s in *monitoringSlotsWithinSlotGroup-r17* can be up to for Group (2) SSs and are not restricted to be consecutive

This would then enable compliance with the above agreement. |

### Issue A2-3: Periodicity restrictions for group-common DCI formats

#### First round discussion

**Proposal A2-3.1 (see R1-2202130):**

For group common DCI formats, only the following periodicities are applicable:

|  |  |  |  |
| --- | --- | --- | --- |
|  | 120 kHz (same as FR2) | 480 kHz | 960 kHz |
| DCI format 2\_0 | sl1, sl2, sl4, sl5, sl8, sl10, sl16, sl20 | sl4, sl8, sl16, sl20, sl32, sl40, sl64, sl80 | sl8, sl16, sl32, sl40, sl64, sl80, sl128, sl160 |
| DCI format 2\_1 | sl1, sl2, sl4 | sl4, sl8, sl16 | sl8, sl16, sl32 |
| DCI format 2\_4 | sl1, sl2, sl4, sl5, sl8, sl10 | sl4, sl8, sl16, sl20, sl32, sl40 | sl8, sl16, sl32, sl40, sl64, sl80 |
| Highlighted: New periodicity values to be introduced for 480/960 kHz SCSs |

**Can we agree Proposal A2-3.1?**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We are ok with adding more periodicities for 480 kHz and 960 kHz.  |
| Ericsson | Support the above proposal |

### Issue A2-4: SS set group switching minimum time

#### First round discussion

**Proposal A2-4.1: Confirm the WA in RAN1 107-e, that is, support only search space set group switching processing capability 1 with with the following values**

|  |  |
| --- | --- |
|  | Minimum value for UE processing capability 1 [symbols] |
| **3** | **40** |
| **5** | **160** |
| **6** | **320** |

FL Summary: All companies discussing the minimum P\_switch value support the above proposal. Therefore FL suggests to formally agree on Proposal A2-4.1

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | We prefer to discuss this issue after the decision on Issue A2-5 and A2-6. |
| Samsung | We support confirming the WA.  |
| Ericsson | We support confirming the WA |

### Issue A2-5: SS set group switching behaviour

#### First round discussion

**Proposal A2-5.1: For multi-slot PDCCH monitoring for 480/960 kHz SCSs, the boundary of SSSG switching is always aligned with the boundary of a slot group.**

FL Note: In case SSSG switching supports different slot group sizes, the following should be added:

If the SSSGs before and after switching are associated with different slot group sizes Xs, the alignment is determined by the slot group boundary of the largest Xs value among the SSSGs.

FL Summary: Based on the submitted documents there seems to be almost consensus on the above proposal. Discussion in RAN1#107bis-e showed a majority support for the proposal. Therefore FL suggests to agree on Proposal A2-5.1

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We support Proposal A2-5.1.  |
| Ericsson | We support Proposal A2-5.1, but we don't think an additional restriction as suggested in the FL note is needed. If Xs in the new SSSG is different, it can be handled by existing dropping rules (dropping per slot group). |

**Text Proposal A2-5.2 to capture Proposal A2-5.1 (see R1-2200953):**

|  |
| --- |
| **10.4 Search space set group switching and skipping of PDCCH monitoring**\*\*\* Unchanged text is omitted \*\*\*If a UE is provided by *SearchSpaceSwitchTrigger* a location of a search space set group switching flag field for a serving cell in a DCI format 2\_0, as described in clause 11.1.1; - if the UE detects a DCI format 2\_0 and a value of the search space set group switching flag field in the DCI format 2\_0 is 0, the UE starts monitoring PDCCH according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, ~~for the serving cell at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0~~* for the serving cell with at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0, and
* for the serving cell with at the first slot of a slot group that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0

- if the UE detects a DCI format 2\_0 and a value of the search space set group switching flag field in the DCI format 2\_0 is 1, the UE starts monitoring PDCCH according to search space sets with group index 1, and stops monitoring PDCCH according to search space sets with group index 0, ~~for the serving cell at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0, and the UE sets the timer value to the value provided by~~ *~~searchSpaceSwitchTimer~~** for the serving cell with at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0, and
* for the serving cell with at the first slot of a slot group that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0,

and the UE sets the timer value to the value provided by *searchSpaceSwitchTimer*- if the UE monitors PDCCH for a serving cell according to search space sets with group index 1, the UE starts monitoring PDCCH for the serving cell according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, ~~for the serving cell at the beginning of the first slot that is at least symbols after a slot where the timer expires or after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2\_0~~* for the serving cell with at the beginning of the first slot that is at least symbols after a slot where the timer expires or after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2\_0, and
* for the serving cell with at the beginning of the first slot of a slot group that is at least symbols after a slot where the timer expires or after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2\_0

If a UE is not provided *SearchSpaceSwitchTrigger* for a serving cell,- if the UE detects a DCI format by monitoring PDCCH according to a search space set with group index 0, the UE starts monitoring PDCCH according to search space sets with group index 1, and stops monitoring PDCCH according to search space sets with group index 0, ~~for the serving cell at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format, the UE sets the timer value to the value provided by~~ *~~searchSpaceSwitchTimer~~* ~~if the UE detects a DCI format by monitoring PDCCH in any search space set~~* for the serving cell with at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format, and
* for the serving cell with at the first slot of a slot group that is at least symbols after the last symbol of the PDCCH with the DCI format

the UE sets the timer value to the value provided by *searchSpaceSwitchTimer* if the UE detects a DCI format by monitoring PDCCH in any search space set- if the UE monitors PDCCH for a serving cell according to search space sets with group index 1, the UE starts monitoring PDCCH for the serving cell according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, ~~for the serving cell at the beginning of the first slot that is at least symbols after a slot where the timer expires or, if the UE is provided a search space set to monitor PDCCH for detecting a DCI format 2\_0, after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2\_0~~* for the serving cell with at the beginning of the first slot that is at least symbols after a slot where the timer expires or, if the UE is provided a search space set to monitor PDCCH for detecting a DCI format 2\_0, after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2\_0, and
* for the serving cell with at the beginning of the first slot of a slot group that is at least symbols after a slot where the timer expires or, if the UE is provided a search space set to monitor PDCCH for detecting a DCI format 2\_0, after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2\_0

\*\*\* Unchanged text is omitted \*\*\* |

Please comment whether Text Proposal A2-5.2 is agreeable, provided proposal A2-5.1 is agreed.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We are ok with the TP in general (there seems some typo on the change mark, which can be handled if we try to agree on the TP).  |
| Ericsson | Agree with the intention of the TP, but maybe the spec implementation details can be left to the spec editor? The key point to agree on is that the UE starts or stops monitoring a SS not earlier than the first slot of a slot group that occurs after the slot in which the UE determines that a SSSG switch should occur (either by detecting DCI 2\_0, detecting a DCI format in Group0, or by timer expiry). |

### Issue A2-6: SS set group switching configuration with same or different

#### First round discussion

**Proposal A2-6.1: SSSG switching is supported between SSSGs that correspond to the same or different PDCCH monitoring combinations.**

**Proposal A2-6.2: SSSG switching is restricted to SSSGs that correspond to the same PDCCH monitoring combinations.**

FL Summary: A majority of submitted documents supports SSSG switching with different Xs,Ys combinations. Therefore FL suggests to agree on Proposal A2-8.1.

FL Note: Please see FL Note for Issue A2-5 in case Proposal A2-6.1 is agreed.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | We support Proposal A2-6.2. At least the same (Xs, Ys) before and after SSSG switching should be supported and used as baseline to discuss A2-6.2. Also, such basic SSSG switching behavior implies simple solution to at least issue A2-5 and A2-4, which is preferred in maintenance phase.  |
| Samsung | We prefer Proposal A2-6.1 for better flexibility.  |
| Ericsson | Support Proposal A2-6.1 for better flexibility. |

### Issue A2-7: [High Priority] Maximum value for *searchSpaceSwitchTimer*

#### First round discussion

**Proposal A2-7.1 (see R1-2202336): For operation with shared spectrum channel access, define 40/160/320 slots as the maximum value of *searchSpaceSwitchTimer* for 120/480/960 kHz SCS, respectively.**

FL Summary: Discussion in RAN1#107bis-e showed a majority support for the proposal. Therefore FL suggests to agree on Proposal A2-7.1.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We prefer to scaling the maximum value based on Rel-16 NR-U values: 20/40/80 for 15/30/60 kHz. We don’t think it’s reasonable to support a smaller maximum value for 120 kHz than 60 kHz.  |
| Ericsson | Agree with Samsung's view |

### Issue A2-8: [High Priority] Harmonization of SSSG switching with Rel-17 power saving (e.g. *searchSpaceSwitchTimer-r17,* PDCCH skipping)

#### First round discussion

Several documents show support for supporting Rel-17 PDCCH skipping feature also in FR2-2.

**Proposal A2-8.1 (see R1-2200953): In unit of slots, the supported values for *searchSpaceSwitchTimer-r17* and *PDCCHSkippingDuration* for 480 kHz and 960 kHz are respectively 4x and 8x of their supported values for 120 kHz.**

**Proposal A2-8.2 (based on R1-22001663):**

* **Support PDCCH skipping feature also in FR2-2**
* **PDCCH Skipping lasts till the next slot group boundary after the skipping duration expires**
* **Support following skipping durations**
	+ **{2,3,4,8,12,16,…636,640,720,…,1200,1280, 1440, 1600, 1760,…,3040,3200} for 480kHz SCS**
		- **Note: This is based on {2,3,[4:4:636],[640:80:1200],[1280:160:3200]}**
	+ **{2,4,7,8,16,24,…1280,1440,1600,2400,2560,2880,3200,…,6080,6400 } for 960kHz SCS**
		- **Note: This is based on {2,4,7,[8:8:1280],[1440:160:2560],[2880:320:6400]}**

Please comment whether you support any of proposals A2-8.1 and A2-8.2.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We support Rel-17 power saving in FR2-2, and support Proposal A2-8.1.  |
| Ericsson | Suppport Proposal A2-8.1. |

**Proposal A2-8.3 (see R1-2200953): A UE does not expect to be configured with Rel-16 SSSG switching parameters (such as *searchSpaceSwitchTimer* and *SearchSpaceSwitchTrigge*r) and Rel-17 SSSG switching parameters (such as *searchSpaceSwitchTimer-r17* and *searchSpaceGroupIdList-r17*) per cell simultaneously.**

Some documents show support for proposal A2-8.3. Please comment whether it can be agreed.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We support Proposal A2-8.3.  |
| Ericsson | Fine with Proposal A2-8.3 |

## Topic A3: BD Budget/Dropping

### Issue A3-1: BD/CCE budget (e.g. for Xs=4 at 960 kHz) for a single serving cell

#### First round discussion

**Proposal A3-1.1: Confirm the working assumption: BD/CCE budget of 960 kHz for** = **(4,2), (4,1) is half that of X=8 (i.e. 10/16)**

**Proposal A3-1.2 (see R1-2201471): Adopt BD/CCE budget of 960 kHz for** = **(4,2), (4,1) as 10/28**

**Proposal A3-1.3 (see R1-2202072): For Rel-17 960kHz multi-slot PDCCH monitoring, only (X,Y)=(8,1) and (8,4) are supported in a Pcell**

FL Summary: Most companies seemed to be fine with the confirming the working assumption without changing parameters or adding restrictions. One company raised a concern that the budget according to the WA is insufficient for monitoring CSS. Another company suggests that a PCell supports only (X,Y)=(8,1) and (8,4).

FL asks companies if they are supporting the increased CCE budget (Proposal A3-1.2) and/or the suggested limitation for a PCell (Proposal A3-1.3). Otherwise it is suggested to just confirm the WA (Proposal A3-1.1) as is.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | We support A3-1.3 and can be acceptable to A3-1.1. However, as mentioned in our Tdoc, the PDCCH monitoring BD/CCE budget for SS#0 has been agreed and we don’t see the feasibility to support SS#0 under the BD/CCE=10/16 requirement. The solution can be either increasing the BD/CCE limit budget as proposal A3-1.2 or simply restricting the use cases of X=4 for 960kHz not in Pcell. From the UE implementation point of view, we don’t prefer to optimize BD/CCE budget for such purpose at the huge cost of UE implementation complexity. Note that BD/CCE budget is highly replated to processing timelines, which have been agreed for both mandatory and optional PDCCH monitoring capability. Therefore, increasing BD/CCE budget should not be considered at this stage.  |
| Samsung | We are open to increase the BD/CCE budget for (4, 2) and (4, 1) with 960 kHz, and the exact value can be further discussed. We didn’t see a strong motivation to restrict using (4, 2) and (4, 1) with 960 kHz for PCell.  |
| Ericsson | These is a problem with Proposal A3-1.1. We think that (4,2) and (4,1) with BD/CCE budget of 10/16 is flawed in that the CCE budget is not enough for Type0-PDCCH monitoring which requires 4 + 8 + 16 = 28 non-overlapping CCEs according to Table 10.1-1.**Table 10.1-1: CCE aggregation levels and maximum number of PDCCH candidates per CCE aggregation level for CSS sets configured by *searchSpaceSIB1***

|  |  |
| --- | --- |
| **CCE Aggregation Level** | **Number of Candidates** |
| 4 | 4 |
| 8 | 2 |
| 16 | 1 |

To solve this issue, we suppport Proposal A3-1.2.With Proposal A3-1.2, there doesn't seem to be a need for Proposal A3-1.3. |

### Issue A3-2: BD/CCE budget for MSM in multiple serving cells (e.g. carrier aggregation)

#### First round discussion

The documents submitted to RAN#108-e and the summary of the second round discussion in RAN1#107b-e identified the following alternatives (FL Note: Alt 1-1 marked as deleted as there was no support for it):

* Alt 1: Serving cells with the same PDCCH monitoring type including multi-slot-based capability are grouped together for further BD/CCE budget calculation
	+ ~~Alt 1-1: Within a group of serving cells with multi-slot-based capability, the serving cells with the same SCS and value are grouped together to follow a total BD/CCE budget~~
	+ Alt 1-2: Within a group of serving cells with multi-slot-based capability, the serving cells with the same SCS and value are grouped together to follow a total BD/CCE budget
* Alt 2: Transform the serving cell with multi-slot-based capability to equivalent serving cell with slot-based capability for further BD/CCE budget calculation
	+ Alt 2-1: A serving cell with SCS and multi-slot-based capability is considered as an equivalent virtual cell with SCS and slot-based capability, where a slot group for the serving cell is considered as a slot for the virtual cell
	+ Alt 2-2: A serving cell with SCS and multi-slot-based capability is considered as an equivalent virtual cell with SCS and slot-based capability, where 4/8 slots for the serving cell with SCS is considered as a slot for the virtual cell
* Alt 3: For multi-cell operation, if the number of configured DL cells is greater than the reported capability of supported DL cells
	+ For a serving cell with mandatory X (i.e., X=4/8 for 480/960 kHz), BD/CCE budget is calculated by transforming the serving cell to the cell with 120 kHz SCS
	+ For a serving cell with optional X (e.g., X=4 for 960 kHz), the serving cells with the same SCS and Xs value are grouped together for BD/CCE budget distribution.

FL Summary: Most companies showed support for Alt 1-2 or any Alt 2. Alt 3 covers the approach from both Alt 1 and Alt 2.

FL asks companies for their opinion on the identified alternatives. From the submitted documents, there seems to be a slight preference for Alt 1-2.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | We apologize that we didn’t express our view clearly in our Tdoc. In fact, we support Alt1-1. As we commented in issue A1-3, a CC with (Xs,Ys)=(4,1) and a CC with (Xs,Ys)=(4,2) are handled differently from UE implementation perspective, e.g., power saving and number of BD per slot. Therefore, we prefer to take Ys into account when determining the BD/CCE limits for CA cases. We also like to point out that the BD/CCE budget specified for a group of cells might also have some impact on determining the minimum BD/CCE limit for a cell in the group of cells based on the following specification:For each scheduled cell from the downlink cells, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell more than PDCCH candidates or more than non-overlapped CCEs per slot.For example, assume a UE can support one DL cell and is configured with 2 CCs, one with (4,2) and the other one with (4,1). If we only consider Xs regardless of Ys when grouping cells of CC1 with (4,2) and CC2 with (4,1), then the min BD/CCE per cell for CC1 and CC2 can be twice of the min BD/CCE limit when grouping cells with different Ys.  |
| Samsung | We support Alt 1-2 to reuse the same principle for BD/CCE budget determination in CA mode in R15/16.  |
| Ericsson | We also support Alt 1-2 to reuse the principle from Rel-15 per-slot monitoring and view it as the most straightforward solution. |

### Issue A3-3: DCI processing

#### First round discussion

**Proposal A3-3.1 (see R1-2201765, R1-2202130):**

If a UE is provided

* one or more search space sets by corresponding one or more of searchSpaceZero, searchSpaceSIB1, searchSpaceOtherSystemInformation, pagingSearchSpace, or ra-SearchSpace, or a CSS set by PDCCH-Config, and
* a SI-RNTI, a P-RNTI, a RA-RNTI, a MsgB-RNTI, a SFI-RNTI,

then, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per slot group

**Proposal A3-3.2 (see R1-2202130):**

If PDCCH MOs of both Group (1) and Group (2) SS sets are configured in the same slot group, and there is at least one valid PDCCH MO of USS set(s) after overbooking and dropping, the UE does not monitor DCI formats 0\_0 and 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, and CS-RNTI in the Group(2) SS set(s).P

**Proposal A3-3.3 (see R1-2201689):**

* UE should be able to process one broadcast DCI for SI/RACH/paging in addition to the agreed number of processed unicast DCI in a slot group of X slots.
* To clarify whether a UE would be able to detect up to 8 unicast DCIs in a slot on the scheduling cell with SCS 15kHz
* The limitation on number of detected DCIs in a slot group should be discussed in UE feature for WI NR\_ext\_to\_71GHz

FL Summary: Only few companies commented on this aspect in their documents, one company (R1-2201735) observes that it is not needed to specify that within a group of Xs slots, the UE is not be expected to process information from more than one DCI format with CRC scrambled by a given RNTI associated with Group (2) SSs, i.e., SI-RNTI, P-RNTI, RA-RNTI, MsgB-RNTI.

FL asks companies if they are supporting Proposal A3-3.1, Proposal A3-3.2 or Proposal A3-3.3.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | For Proposal A3-3.1: We are ok with Proposal A3-3.1. For Proposal A3-3.2: We don’t think the UE behavior for DSS should be directly applied to multi-slot PDCCH monitoring. For Proposal A3-3.3: Can revisit after multiple-cell operation is more clear.  |
| Ericsson | Proposal A3-3.1: As we discusse in our contribution, we don't expect that the UE would need to process information from more than one DCI since regardless of the configured MO periodicity within *SearchSpace*, the MOs the UE actually monitors are separated at least by P\*N slots where P is the configured periodcity, and N is the number of transmitted SSBs. Our expectation is that P\*N is always greater than Xs in any practicaly deployment.Proposal A3-3.2: At least we are not aware that there is a similar restriction for a 120 kHz slot in the current spec. Hence, we don't think a restriction per slot group should be introduced since a 120 kHz slot and 480/960 kHz slot group have the same absolute time duration.Proposal A3-3.3: We are not aware of a similar restriction on processing only one broadcast DCI within a 120 kHz slot in the current spec. Hence, we don't think a restriction per slot group should be introduced since a 120 kHz slot and 480/960 kHz slot group have the same absolute time duration. |

### Issue A3-4: Dropping rules

#### First round discussion

One company (R1-2201352) observes that SS overbooking across different slot groups can be avoided by gNB implementation so that no dropping rule for this case is necessary.

Other companies have stated that due to UE mobility across beams or SSSG switching, the maximum number may be exceeded anyway, and this may need to be covered by a dropping rule in the specifications.

**Proposal A3-4.1 (see R1-2201689):**

* A span of SS sets configured in a slot group, if it is not monitored by the UE based on a semi-static rule, may not be counted in the number of monitored spans in the slot group.
* If the maximum number of spans in a slot group is exceeded, UE can drop one or more spans of at least the group (1) SS sets

**Proposal A3-4.2 (see R1-2201914):**

Additional dropping rules for PDCCH multi-slot monitoring should be defined to limit back-to-back SS monitoring between Group 1 and Group 2 SSs across multiple slot-groups. A window-based approach around the CSS maybe considered to determine whether or not a USS monitoring occasion is dropped or not for PDCCH monitoring.

**Proposal A3-4.3 (see R1-2202130):**

A dropping rule for PDCCH MOs may be applied for the first Ys consecutive slots after SSSG switching, if the separation between the two Ys consecutive slots before and after the SSSG switching boundary is less than Xs slots.

**Proposal A3-4.4 (see R1-2202190):**

To avoid the back-to-back problem, monitoring should not be done in the Xs slots before and after the SSSG boundary.

**Proposal A3-4.5 (see R1-2202409):**

When multi-slot PDCCH monitoring is applied with shifting of Group(2) SS due to n0 change, then dropping of Group (1) SS MOs and/or Group (2) SS MOs in the slot where the shift is first applied should be supported to avoid back-to-back monitoring issue.

FL asks companies for their comments to Proposal A3-4.1, Proposal A3-4.2, Proposal A3-4.3, Proposal A3-4.4 or Proposal A3-4.5.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | For Proposal A3-4.1, we don’t think “a span in a slot group” is well-defined in RAN1 specification, and wonder what’s the RAN1 impact of the proposal. For Proposal A3-4.2 and A3-4.5, we didn’t see the need of the proposals, and it has already been discussed to treat the back-to-back monitoring issue based on UE’s implementation when we made the comprise agreement. For Proposal A3-4.3 and Proposal A3-4.4, there is always a gap after SSSG switching, so we don’t think there is need to address the immediate change of the location of Ys. It can be handled by proper gNB’s implementation.  |
| Ericsson | Proposal A3-4.1: We don't support this proposal – not clear what a "span of SS sets in a slot group" is.Proposals A3-4.2, 4.3, 4.4, and 4.5: Do not support. Our original compromise in supporting per-slot group monitoring with small values of Ys was that additional rules on dropping considering adjacent slot groups would not be entertained. Dropping should be evaluated per-slot group, with no coupling between slot groups. |

Another issue concerns the detailed dropping following up on the agreement in RAN1#107-e:

|  |
| --- |
| **Agreement*** SS set overbooking can be allowed with multi-slot PDCCH monitoring capability same as the current specification but applied per slot group, i.e., SS set overbooking is allowed for USS in PCell and PSCell, and UE expects no overbooking for CSS in PCell and PSCell and no overbooking in SCell.
* The dropping rule for multi-slot PDCCH monitoring capability is the same as the current specification but evaluated per slot group, i.e., a UE drops UE specific search space set(s) in a slot group with higher index when SS sets are overbooked.
* Additional dropping rules are not precluded
 |

**Proposal A3-4.4 (see R1-2202130):**

If a SS set to be dropped by overbooking has multiple MOs within a slot group, they are dropped as a whole.

From the discussion in RAN1#107-e, FL assumed that Proposal A3-4.4 was the understanding when arriving at the agreement esp. in thesecond bullet. Companies are invited to state their views whether the proposal is in line with their understanding, and if this should be clarified/agreed in this meeting.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We share same understanding as FL, dropping per search space set was agreed in the second bullet, and we wonder the extra specification impact of the proposal. |
| Ericsson | We share the same understanding as the FL. 2nd bullet of the agreement already covers this issue. |

## Topic B: Multi-Beam Aspects

**R1-2201266:**

Proposal 2: the UE can share gNB COT only if the UL transmission resources are within the gNB COT and the UL transmission beam is covered by the gNB sensing beam for directional LBT.

Proposal 3: For higher layer configured CSI-RS reception, the UE performs the reception if the CSI-RS resources are within the gNB COT and the gNB’s sensing beam covers the CSI-RS beam.

Proposal 4: In FR2-2 unlicensed band, the pre-configured downlink reception is not only confirmed by the SFI indication but also by gNB’s sensing beam, e.g., UE should cancel the downlink reception within the gNB COT if the gNB sensing beam does not cover the downlink transmission beam.

Proposal 5: R17 should allow UE to skip PDCCH monitoring in the CORESET associated with a beam uncovered by the gNB sensing beam within the gNB COT.

**FL Note: As per chairman's guidance in RAN1#107bis\_e, the topics related to proposals in R1-2201266 were moved to AI 8.2.6 (channel access), therefore no discussion will occur in this AI.**

## Topic C: Multi-Cell Operation, Cross-carrier scheduling (except BD aspects)

### Issue C-1: [High Priority] MSM capability for multiple serving cells

#### First round discussion

**Proposal C1-1.1 (see R1-2201765):**

For Rel-17, 4 additional cases for UE capability signaling need to be defined:

* Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
	+ pdcch-BlindDetectionCA-R17 is equal to 4 {similar to Rel-15}
* Case 5: Capability on the number of CCS with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
	+ pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
	+ pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
	+ Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: [1:15]
		- The minimum of pdcch-BlindDetectionCA-R15 + The minimum of pdcch-BlindDetectionCA-R17) is equal to 4
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: [4:16]
* Case 6: Capability on the number of CCS with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
	+ pdcch-BlindDetectionCA-R16 for Rel-15 PDCCH monitoring capability
	+ pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
	+ Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: [1:15]
		- The minimum of pdcch-BlindDetectionCA-R16 + The minimum of pdcch-BlindDetectionCA-R17) is equal to 3
			* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: [3:16]
* Case 7: Capability on the number of CCS with Rel-15 monitoring capability , Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
	+ pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
	+ pdcch-BlindDetectionCA-R16 for Rel-17 PDCCH monitoring capability
	+ pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
	+ Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: [1:15]
		- The minimum of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + The minimum of pdcch-BlindDetectionCA-R17) is equal to 4
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17 : [4:16]

**Proposal C1-1.2 (see R1-2201765):**

For the case with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells (case 7) or any combination of 2 of the capabilities (i.e. case 5, and case 6), the UE will report one or more combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) as UE capability. If UE reports more than one combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17), as in Rel-16, the gNB configures which combination for the UE to use for scaling PDCCH monitoring capability if the number of CCs configured is larger than the reported capability.

Please comment whether you agree to Proposal C1-1.1 and Proposal C1-1.2.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | For Proposal C1-1.1, we support it. For Proposal C1-1.2, we support it.  |
| Ericsson | Proposaal C1-1.1 and 1.2: We have large reservations of taking the discussion in this direction. The intention of introducing mult-slot monitoring is to equate the UE processing requirements in a 120 kHz slot to the UE processing requirement in a slot group of Xs slots. Hence, we think splitting the BD/CCE budget across cells configured with per-slot or per-slot group monitoring should follow the same approach without considering so many different cases. |

**Proposal C1-1.3 (see R1-2202072):**

For multi-cell operation, UE can report a capability on whether the location of the Y slots within a slot group of X slots is maintained across CCs associated with (X,Y) configuration.

Note: Figure 1 Example of non-aligned monitoring pattern across CCs



Please comment whether you agree to Proposal C1-1.3.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We prefer to handle it in UE capability discussion.  |
|  |  |

### Issue C-2: Cross-carrier scheduling limitations by SCS difference

FL Note: Discussion in earlier meetings has not shown consensus to introduce a cross-carrier scheduling limitation as a function of |μPDCCH − μPDSCH|. RAN1#107bis-e has produced the following conclusion:

**Conclusion**

Potential indications of UE capability related to a limited support of cross-carrier scheduling e.g. as a function of |μPDCCH − μPDSCH| can be discussed as part of the UE capability discussion.

**R1-2200953**: Cross-carrier scheduling is only supported for .

**R1-2201352**: In order to better support cross-carrier scheduling of the new SCS, i.e. 480 kHz and 960 kHz, the difference of SCS of cross-carrier scheduling should not be limited.

**FL Note: Due to the discussion in earlier meetings and the conclusion reached in RAN1#107bis\_e, these proposals are not further discussed in RAN1#108-e.**

# Contribution Details

The following sections show extracted discussion and proposals from the contributions submitted to this AI, by a pure subjective decision by the FL.

## Topic A1: Blind Decoding Capability, Multi-slot monitoring and corresponding (X,Y) values

List of issues, proposals, and suggestions for handling in the email discussion phase.

### R1-2200953 (Huawei, HiSilicon)

|  |
| --- |
| **Observation 1: In case that UE supports more than one combinations AND the configured search space sets comply with more than one supported combinations, determining the “active” for the UE does not change UE monitoring behavior and, therefore, is not required.** **Question 2: In case that UE supports more than one combinations AND the configured search space sets comply with more than one supported combinations, is it required to determine the “active” value of ?**For , only (4,1) and (4,2) are supported and they have the same BD/CCE budget. Therefore, if the active value of needs to be determined, there is no ambiguity that it would be For , a majority of companies argued in RAN1 107b-e that if UE supports more than one combinations AND the configured SS sets comply with more than one reported combinations, the “active” value of should be the one that corresponds to the combination that 1) all configured SS sets comply with; and 2) results in the largest BD/CCE budget. For instance, if UE supports (4,1) and (8,1) for and all Group (1) SSs of the UE are configured within a single slot every 8 slots, it is technically possible to determine active which means that BD/CCE budget of the Group (1) and potential Group (2) SS in the first 4 consecutive slots are 10/16, while the BD/CCE budget in the second 4 consecutive slots within the 8-slot period cannot be used for group (1) SS monitoring in the first 4 consecutive slots. If is assumed in the same scenario, the total BD/CCE budget for both Group (1) SS and Group (2) SS within those 8 slots is 20/32. Therefore, we also think that if UE supports more than one combinations AND the configured search space sets comply with more than one supported combinations, the “active” value of should be the one that corresponds to the combination that all configured search space sets comply with and results in the largest BD/CCE budget (or, equivalently, the largest in the set of complied combinations). Such a choice for active additionally provide more flexibility in monitoring group (2) SS. We propose the following:***Proposal 2: If the configured search space sets comply with more than one reported combinations, determine the “active” as the one that corresponds to the combination that all configured search space sets comply with and results in the largest BD/CCE budget (or, equivalently, the largest in the set of complied combinations).*** * ***Support TP 2 for 38.213.***

For an RRC\_IDLE UE or a UE during initial access, following observations can be made:1. UE does not monitor PDCCH for
2. For , even if UE supports both and , UE does not monitor Group (1) SS and, therefore, the considered value for is irrelevant. Further, for both and maximum BD and CCE budgets are equal to 20 and 32, respectively.
3. For UE mandatorily supports

Therefore, in our view, for , RRC\_IDLE UE or a UE during initial access (i.e., when *monitoringCapabilityConfig* is not provided) may monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs according to either of the combinations or as either or the combinations have exactly the same BD and CCE budget. As such, it seems to be more accurate to specify that, for , RRC\_IDLE UE or a UE during initial access (i.e., when *monitoringCapabilityConfig* is not provided) monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs according to . However, as a convention, it may be preferable to alternatively specify that, for , RRC\_IDLE UE or a UE during initial access (i.e., when *monitoringCapabilityConfig* is not provided) monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs according to combination simply because combination is mandatorily supported.Further, it can be clarified for that an RRC\_CONNECTED UE is expected to be provided with *monitoringCapabilityConfig=* r17monitoringcapability. Note that this does not mean that *monitoringCapabilityConfig=* r17monitoringcapability should always be present in *PDCCH-Config* as *monitoringCapabilityConfig* is an optional field “Need M” and its value is stored by the UE and upon receiving a message with the field absent, the UE maintains the current value.As such, we propose the following. 1. ***Support either of TP 1 or TP 1A for 38.213 to describe the default PDCCH monitoring behavior for .***
 |

### R1-2200988 (Futurewei)

|  |
| --- |
| In RAN1#107bis-e it was concluded that *r17monitoringcapability* it should be maintained for consistency purposes.In this case the specs should define the interpretation of this configuration parameter as well as the UE behavior when this parameter is not provided. We propose the following text change in **Proposal 4: Change the TS 38.213 Clause 10.1 as follows (changes are underlined):****“If a UE is provided *monitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs** **- per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or** **- per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*****- per group of slots according to combination , as in Tables 10.1-2B and 10.1-3B, if *monitoringCapabilityConfig* = *r17monitoringcapability.*** **If a UE is not provided *monitoringCapabilityConfig**** **For μ ∈ {0,1,2,3}, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot.**
* **For μ=5 the UE applies and for μ=6 the UE applies “**
 |

### R1-2201033 (InterDigital)

|  |
| --- |
| For 480 kHz, in addition to the agreed values of Xs (i.e., Xs=4 for 480 kHz and Xs=4 or 8 for 960 kHz), whether to support Xs=2 with Ys=1 was further discussed. The technical motivation was to allow more flexible network implementation with the identical absolute time window with Xs=4 with 960 kHz. In addition, it should be noted that the combination (2,1) is not a mandatory value, but an optional value, so that only capable UEs would support. As required discussion and corresponding specification impact can be minimized by reusing the values for 960 kHz with (4,1), support the combination (2,1) would be beneficial for better network flexibility and reducing latency for FR 2-2. ***Proposal 2:*** *Support the combination (Xs,Ys) = (2,1) for 480 kHz.* For 960 kHz, there was a proposal to reopen the discussion on the supported combination of (Xs,Ys). The proposal was to support only (Xs,Ys) = (8,1) and (8,4) without (4,2) and (4,1). The raised concern was whether BD/CCE limit for Xs=4 in 960kHz can satisfy Type-0 PDCCH monitoring BD/CCE number specified in the specification. However, as (4,2) and (4,1) are optional values which can be used when only available UEs report their capability, it is preferred to keep the existing agreement.***Proposal 3:*** *Do not reopen the discussion for the combinations of (Xs,Ys) for 960 kHz.** *Support the agreed combinations of (8,1), (8,4), (4,2) and (4,1) for 960 kHz.*

In RAN1#107bis-e [2], how to determine a combination of (Xs,Ys) values for PDCCH monitoring when UE reports multiple applicable (Xs,Ys) combinations as UE capability. To resolve this issue, the following two possible solutions are suggested:* Alt #1: Introduce RRC signaling to indicate a combination of (Xs,Ys) to be used for PDCCH monitoring. If the parameter is absent, the UE uses a default combination, i.e., (4,1) for 480 kHz and (8,1) for 960 kHz.
* Alt #2: If there are more than one combination complying with the SS configurations among the reported combinations of (Xs,Ys) , the UE monitors PDCCHs according to the complying combination (Xs,Ys) that is associated with the largest maximum number of BD/CCE budget (largest value of Xs).

Although Alt #1 provides a simplest solution to resolve the multi-capability issue, however, Alt #1 requires additional RRC specification impact to introduce the essential signaling. On the other hand, Alt #2 resolves the issue without introduction of any RRC signaling. In addition, it should be noted that Alt #2 is a simple way to extend Rel-16 UE behavior for span based PDCCH monitoring. Having said that, supporting Alt #2 is preferred to avoid unnecessary RRC specification impact.***Proposal 1:*** *UE monitors PDCCHs according to the complying combination (Xs,Ys) that is associated with the largest maximum number of BD/CCE budget (largest value of Xs), if there are more than one combination complying with the SS configurations among reported combinations of (Xs,Ys) via UE capability.*In RAN1#107bis-e [2], whether to capture default UE behavior of (Xs,Ys) was discussed. As the UE receives the parameter monitoringCapabilityConfig in PDCCH-Config via UE specific configurations not in PDCCH-ConfigCommon for cell-specific PDCCH configuration, the UE shall perform per-slot PDCCH monitoring for Type0/0A/2-PDCCH CSS set and Type1-PDCCH CSS set provided in SIB1. The UE behavior is not aligned with the agreement in RAN1#107-e [1]. Having said that, it is preferred to capture the UE default behavior and adopt the following TP in the specification. ***Proposal 4:*** *Adopt Text proposal #1 to reflect the UE default behavior with (Xs,Ys) = (4,1) and (8,1) for 480 kHz and 960 kHz, respectively.* |

### R1-2201086 (vivo)

|  |
| --- |
| Based on the above agreement, it is obviously that multiple (Xs, Ys) values may be reported by UE, i.e.* + - 480KHz PDCCH: (4, 1) mandatory, (4, 2) optional
		- 960KHz PDCCH: (8, 1) mandatory, (8, 4), (4, 2) and (4, 1) optional

If a UE indicates a capability to monitor PDCCH according to multiple combinations, how to determine the value of (Xs, Ys) for a scheduling cell should be specified. First, UE should determine a set of (Xs, Ys) values according to which the search space configuration meets the limitation, i.e. configured Group (1) SSs are located within Y consecutive slots within a slot group of X slots where the location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups. Among the set of (Xs, Ys) value, determine one or more (Xs, Ys) with the largest Xs value (i.e. the largest BD/CCE budget) first and then select (Xs, Ys) with the smallest Ys value.Proposal 1: Adopt TP1 in Appendix to implement the following:Select one (Xs, Ys) value from multiple (Xs, Ys) combinations reported by a UE according to the following steps: 1) Determine a set of (Xs, Ys) values according to which the search space configurations meets the limitation, i.e. configured Group (1) SSs are located within Y consecutive slots within a slot group of X slots; 2) Determine one or more (Xs, Ys) with the largest Xs value (i.e. the largest BD/CCE budget) first; 3) Select (Xs, Ys) with the smallest Ys value from the above selected (Xs, Ys) combinations.According to current spec in TS 38.213, PDCCH monitoring capability type is determined according to the following text:If a UE is provided *monitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs - per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or - per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*- per group of slots according to combination , as in Tables 10.1-2B and 10.1-3B, if *monitoringCapabilityConfig* = *r17monitoringcapability*If the UE is not provided *monitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot.In TS 38.331, *monitoringCapabilityConfig* is provided in *PDCCH-Config* that is configured per BWP. However, according to the above text “If a UE is provided *monitoringCapabilityConfig* for a serving cell”, it seems *monitoringCapabilityConfig* is provided per serving cell. For NR Rel-16, it could be understood that the value of *monitoringCapabilityConfig* should be the same for all BWPs in a serving cell. However, this is not possible for NR Rel-17. For example, assuming a case that there are two BWPs existing in one serving cell, i.e. one BWP with 120KHz SCS and the other BWP with 480KHz SCS, these two BWPs can’t be configured with the same PDCCH monitoring capability type according to current agreement. In this case, for the BWP with 120KHz SCS, *monitoringCapabilityConfig* may not be provided or provided with *r15monitoringcapability* in *PDCCH-Config*; for the BWP with 480KHz SCS, *monitoringCapabilityConfig* should be provided with *r17monitoringcapability*. Thus the above text “If a UE is provided *monitoringCapabilityConfig* for a serving cell” is not accurate anymore.Another issue is the default PDCCH monitoring capability type when *monitoringCapabilityConfig* is not provided for a BWP, which depends on the BWP SCS. Namely, when the BWP SCS is 15/30/60/120KHz, default PDCCH monitoring capability type is slot-based monitoring. When the BWP SCS is 480/960KHz, default PDCCH monitoring capability type is multi-slot-based monitoring. Besides, if a UE doesn’t indicate any combination , the UE applies for μ=5 and for μ=6.Proposal 2: Adopt TP2 in Appendix to implement the following:For NR Rel-17 UEs, PDCCH monitoring capability is defined per BWP;For NR Rel-17 UEs, default PDCCH monitoring capability type is adapted to BWP SCS. |

### R1-2201352 (CATT)

|  |
| --- |
| In RAN1#107-e meeting, it has been agreed that multiple combinations (X,Y) were supported, including (4,1),(4,2) for 480 kHz SCS and (8,1), (8,4), (4,2), (4,1) for 960 kHz SCS. One remaining issue is how to determine the combination (X,Y) for PDCCH monitoring capability if a UE indicates a capability with multiple combinations (X,Y) of 480 kHz/960 kHz. A potential solution is to reuse the (X,Y) combination determination method of Rel 16. For 480kHz/960kHz, if the UE indicate a capability to monitor PDCCH according to multiple combinations (X,Y) and a configuration of search space sets results to a separation of every two consecutive Y slots of slot groups is equal or larger than a value of X from multiple combinations (X,Y), the UE will monitor the PDCCH according to the combination (X,Y) that is associated with the largest maximum number of BD/CCE. For example, if the UE indicates a capability with combination (8,1) and combination (4,1) for 960kHz SCS, and a configuration of search space sets results in a minimal separation of 9 slots between two Group(1) SSs in two consecutive slot groups, the UE will monitor PDCCH according to the BD/CCE limit of combination (8,1). If a configuration of search space sets results in a minimal separation of 7 slots between two Group(1) SSs in two consecutive slot groups, the UE will monitor PDCCH according to the BD/CCE limit of combination (4,1).***Proposal 2: For 480kHz/960kHz, if the UE indicates a capability to monitor PDCCH according to multiple combinations (X,Y) and a configuration of search space sets results in a separation of every two consecutive Y slots of slot groups is equal or larger than a value of X from multiple combinations (X,Y), the UE will monitor the PDCCH according to the combination (X,Y) that is associated with the largest maximum number of BD/CCE.*** |

### R1-2201389 (ZTE, Sanechips)

|  |  |
| --- | --- |
| **Proposal 1: Further clarify in TS 38.213 that if the UE is not provided *monitoringCapabilityConfig* or not configured with any monitoring capability combinations , = (4, 1) or (8, 1) is mandatorily supported for SCS configuration or respectively.**

|  |
| --- |
| **TP for TS 38.213 (marked in red)**If a UE is provided *monitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs - per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or - per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*- per group of slots according to combination , as in Tables 10.1-2B and 10.1-3B, if *monitoringCapabilityConfig* = *r17monitoringcapability*For μ ∈ {0,1,2,3}, if the UE is not provided *monitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot. For μ ∈ {5,6}, if the UE is not provided *monitoringCapabilityConfig* or not configured with a combination , the UE assumes for μ=5 and for μ=6. |

Moreover, for SCS configuration or , a UE can indicate a capability to monitor PDCCH according to more combinations , different may correspond to different BD/CCE budget, we need to determine the combination. However, the determination of for multi-slot PDCCH monitoring is different from that in Rel-16. There is no mandatory capability among the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and and a UE can indicate a capability to monitor PDCCH according to one or more of the combinations in Rel-16 . Assuming that a similar rule as Rel-16 is extended to Rel-17 and the UE monitors PDCCH according to the combination that is associated with the largest maximum number of BD/CCE for the SCS. If a UE indicates a capability to monitor PDCCH according to multiple combinations and one or more multiple combinations can meet the configuration of search space sets to the UE for PDCCH monitoring on a cell, = 4 and 8 slots for 480 and 960 kHz respectively are almostly always chosen since those two values are mandatorily supported and associated with the largest BD/CCE budget. However, in our understanding, the value of should be configurable for more flexible operation in above 52.6 GHz band depending on UE capability. We need to consider introducing new RRC parameter to configure the with smaller value of for some scenarios such as low latency traffic and flexible scenarios. Also, the UE expects to monitor PDCCH according to the same combination in every slot group on the active DL BWP of a cell.**Proposal 2: If a UE indicates a capability to monitor PDCCH according to multiple combinations and one or more multiple combinations can meet the configuration of search space sets to the UE for PDCCH monitoring on a cell, we need to consider RRC signaling to configure the for flexible scheduling. Moreover, the UE expects to monitor PDCCH according to the same combination in every slot group on the active DL BWP of a cell.** |

### R1-2201471 (NTT DOCOMO)

|  |
| --- |
| In our understanding, the dropped USS can be different depending on which BD/CCE budget to apply. Thus, it is necessary to define the rule to avoid misunderstanding between UE and gNB on which BD/CCE budget to apply, especially for the case when UE supports multiple combinations of (Xs, Ys) and multiple combinations of them can meet the SS set configuration by gNB. For multi-slot PDCCH monitoring, BD/CCE budget is defined depending on the value of X, and Y is irrelevant. In that sense, it is sufficient to specify the rule to determine Xs when multiple (Xs, Ys) meet SS set configuration and which Y to apply can be implicitly indicated by SS set configuration. At the last RAN1 meeting, some companies pointed out that (X, Y) determination rule already exists for URLLC in Rel-16. More specifically, when UE indicates a capability to monitor PDCCH according to one or more of (X, Y) combinations and multiple combinations of them meet a SS set configuration to the UE, the UE monitors PDCCH according to the combination (X, Y) which associates with the largest maximum number of BD/CCE for span PDCCH monitoring. This rule can be expanded for multi-slot PDCCH monitoring, i.e., the UE monitors PDCCH according to the X which associates with the largest maximum number of BD/CCE. **Proposal 1: If a UE supports multiple combinations of (Xs, Ys) and more than one combination comply with SS set configuration by gNB, the UE monitors PDCCH on a cell with according to the Xs which associates with the largest maximum number of BD/CCE.** |

### R1-2201542 (Spreadtrum)

|  |  |
| --- | --- |
| As pointed out by many companies in the last RAN1 meeting, the determination of (X, Y) when multiple combinations are reported by UE is similar to Rel-16 span-based capability reporting. Since Rel-16 already specified a rule for this issue(as follows), the same handling method as Rel-16 URLLC can be used, i.e., the UE monitors PDCCH according to the combination (X,Y) that is associated with the largest maximum number of BD and CCE. While some other companies prefer a simple way to determine the active combination (X, Y), that is configure the actual (X,Y) value to the UE via RRC.

|  |
| --- |
| *38.213 10.1**If a UE indicates a capability to monitor PDCCH according to multiple combinations and a configuration of search space sets to the UE for PDCCH monitoring on a cell results to a separation of every two consecutive PDCCH monitoring spans that is equal to or larger than the value of for one or more of the multiple combinations , the UE monitors PDCCH on the cell according to the combination , from the one or more combinations , that is associated with the largest maximum number of and defined in Table 10.1-2A and Table 10.1-3A. The UE expects to monitor PDCCH according to the same combination in every slot on the active DL BWP of a cell.* |

From our perspective, similar rules from Rel-16 should be adopted, since the existing rule is workable here and we don’t see the need to introduce additional RRC signaling. ***Proposal 1: For the determination of (X,Y) in case of multiple supported combinations(X, Y), adopt similar rules from Rel-16, i.e., the UE monitors PDCCH according to the combination (X,Y) that is associated with the largest maximum number of BD and CCE.*** |

### R1-2201689 (Intel)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The following TP is proposed to capture additional X value 2 for SCS 480kHz.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **------------------------------ TP#1: TS 38.213 -----------------------------------**\*\*\* Unchanged text is omitted \*\*\*10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*Table 10.1-2B provides the maximum number of monitored PDCCH candidates, , per slot group for combination for a UE in a DL BWP with SCS configuration for operation with a single serving cell.Table 10.1-2B: Maximum number of monitored PDCCH candidates per slot group for combination for a DL BWP with SCS configuration for a single serving cell

|  |  |
| --- | --- |
|  | Maximum number of monitored PDCCH candidates per combination and per serving cell  |
|  | (2, 1) | (4, 1) | (4, 2) | (8, 1) | (8, 4) |
| 5 | 10  | 20 | 20 | - | - |
| 6 | - | 10 | 10 | 20 | 20 |

\*\*\* Unchanged text is omitted \*\*\*Table 10.1-3B provides the maximum number of non-overlapped CCEs, , for a DL BWP with SCS configuration that a UE is expected to monitor corresponding PDCCH candidates for combination for operation with a single serving cell.Table 10.1-3B: Maximum number of non-overlapped CCEs in a slot group for combination for a DL BWP with SCS configuration for a single serving cell

|  |  |
| --- | --- |
|  | Maximum number of non-overlapped CCEs per combination and per serving cell  |
|  | (2, 1) | (4, 1) | (4, 2) | (8, 1) | (8, 4) |
| 5 | 16  | 32 | 32 | - | - |
| 6 | - | 16 | 16 | 32 | 32 |

\*\*\* Unchanged text is omitted \*\*\* |

**Proposal 1:** * X=2 can be optionally supported for SCS 480kHz, which corresponds to combination (X, Y) = (2, 1). The BD/CCE budget for (2,1) can be half that of X=4
* Agree on TP 1 to capture additional X value 2 for SCS 480kHz

Based on the agreed framework, UE may report the capability to support multiple combinations (X, Y) for SCS 480/960kHz. The configured search space sets for the UE must satisfy at least one supported combination (X, Y). * For SCS 480 kHz: (X,Y) = (4,1), (4,2), (2,1)?
* For SCS 960 kHz: (X,Y) = (8,1), (8,4), (4,2), (4,1)

Further, if the configured search space sets of the UE satisfy two or more supported combinations (X, Y), the UE needs to identify the active combination (X, Y). Since the supported maximum numbers of BD/CCE is only determined by value X, UE can determine a combination (X, Y) with larger X which enables larger maximum numbers of BD/CCE for PDCCH monitoring for better flexibility. If multiple potential combinations (X, Y) have same value X, the active combination (X, Y) could be determined as the combination (X, Y) with smallest value Y. The following TP is proposed to determine the active combination (X, Y).

|  |
| --- |
| **------------------------------ TP#2: TS 38.213 -----------------------------------**\*\*\* Unchanged text is omitted \*\*\*10 UE procedure for receiving control information\*\*\* Unchanged text is omitted \*\*\*For SCS configuration or , a UE can indicate a capability to monitor PDCCH according to one or more combinations , where and are numbers of consecutive slots, groups of slots are consecutive and non-overlapping, and the slots are within the slots. The first group of slots starts from the beginning of a subframe. The start of two consecutive groups of slots is separated by slots. If a UE indicates a capability to monitor PDCCH according to multiple combinations and a configuration of search space sets to the UE for PDCCH monitoring on a cell is allowed by one or more of the multiple combinations , the UE monitors PDCCH on the cell according to the combination with largest and smallest . \*\*\* Unchanged text is omitted \*\*\* |

**Proposal 7:** * For a UE capable of multiple combinations (X, Y), if the configured SS sets are aligned with more than one combination (X, Y), the active combination (X, Y) is determined that is associated with the largest X and smallest Y.
* Agree on TP 2 to determine the active combination (X, Y).
 |

### R1-2201735 (Ericsson)

|  |
| --- |
| 1. Inform RAN2 that the value range for the existing parameter *monitoringCapabilityConfig* needs to be be extended to include the new value *r17monitoringcapability*, and that for 480 and 960 kHz SCS, the UE expects to be configured with this value. A note can be added to the RRC parameter spreadsheet to propose that RAN2 updates the field description of the parameter as follows:

***monitoringCapabilityConfig***Configures either Rel-15 PDCCH monitoring capability or Rel-16 PDCCH monitoring capability for PDCCH monitoring on a serving cell. Value *r15monitoringcapablity* enables the Rel-15 monitoring capability, and value *r16monitoringcapablity* enables the Rel-16 PDCCH monitoring capability. Value *r17monitoringcapablity* enables the Rel-17 PDCCH monitoring capability (see TS 38.213 [13], clause 10.1). When present, the UE expects to be configured with *r17monitoringcapablity* for 480 and 960 kHz SCS.1. Adopt TP#1 which definines the default PDCCH monitoring behavior for 480/960 kHz SCS when the parameter *monitoringCapabilityConfig* is absent

----------------------------------------- Text Proposal (TP#1) for 38.213, Section 10 ----------------------------------------\*\*\* Unchanged text omitted \*\*\*If a UE is provided *monitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs - per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or - per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*- per group of slots according to combination , as in Tables 10.1-2B and 10.1-3B, if *monitoringCapabilityConfig* = *r17monitoringcapability*For μ ∈ {0,1,2,3}, if ~~If~~ the UE is not provided *monitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot. For μ ∈ {5,6}, if the UE is not provided *monitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per group of slots according to combination for μ =5 and for μ =6 as in Tables 10.1-2B and 10.1-3B.\*\*\* Unchanged text omitted \*\*\*----------------------------------------------------------- End Text Proposal -----------------------------------------------------------In the previous meeting, there was discussion on how to handle the case if a UE indicates it is capable of operating with multiple (Xs,Ys) combinations for a given subcarrier spacing. For 480 kHz, the supported combinations are (4,1) and (4,2). For 960 kHz SCS, the supported combinations are (8,1), (8,4), (4,1), and (4,2). One approach is to agree on a rule for which combination the UE should assume for multi-slot PDCCH monitoring, and this may require some discussion. Alternatively, we think a far simpler approach would be to support an RRC parameter that enumerates all possible (Xs,Ys) combinations. The gNB can then configure the UE with the desired combination according to the use case. For example, a combination with a small value of Xs could be configured for more latency demanding applications. Conversely, a combination with a larger value of Xs could be configured when lower latency is not critical to achieve. Based on this we propose1. Support an RRC parameter for indicating the (Xs,Ys) combination the UE shall employ for multi-slot PDCCH monitoring based on that UEs indicated capability. The parameter is UE-specific and has the value range {'xs4ys1', 'xs4ys2', 'xs8ys1', 'xs8ys4'}. If the parameter is absent, the UE assumes the default value 'xs4ys1' if 480 kHz SCS is used or 'xs8ys1' if 960 kHz SCS is used.
 |

### R1-2201765 (Apple)

|  |
| --- |
| ***Proposal 1:*** *For the slot group size (X) it should be concluded that:** *The configurable values for multi-slot PDCCH monitoring operation should be same as the reported X value(s). The UE is not expected to handle a scenario in which they are different, and a UE can report its monitoring capability for more than one (X,Y) combination.*
* *For each SCS 480 kHz and 960 kHz, the minimum configurable multi-slot PDCCH monitoring periodicity is the smallest value X that a UE supports when reporting its PDCCH monitoring capabilities for the corresponding SCS and are UE specific.*
* *Both statements may be either explicitly stated in the specification or as a conclusion in the Chairman’s notes.*

***Proposal 2:****There is a need to define the UE default behavior in the case that the parameter r17monitoringcapability is absent or in RRC\_IDLE mode. This can be defined as follows:* * *For an active DL BWP of the serving cell where a UE has not been configured with a combination  the UE applies  for μ=5 and  for μ=6.*

***Proposal 3:*** *(X,Y)=(2,1) for 480 kHz SCS is not supported* |

### R1-2201914 (Xiaomi)

|  |
| --- |
| It is already agreed in R1#107 meeting that BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.Related TP can be as follows,**TP#2 for TS 38.213 Clause 13**============================= Unchanged part omitted =========================================**13 UE procedure for monitoring Type0-PDCCH CSS sets**If during cell search a UE determines from *MIB* that a CORESET for Type0-PDCCH CSS set is present, as described in clause 4.1, the UE determines a number of consecutive resource blocks and a number of consecutive symbols for the CORESET of the Type0-PDCCH CSS set from *controlResourceSetZero* in *pdcch-ConfigSIB1*, as described in Tables 13-1 through 13-10, for operation without shared spectrum channel access in FR1 and FR2-1, or as described in Tables 13-1A and 13-4A for operation with shared spectrum channel access in FR1, or as described in Tables 13-10A, 13-10B and 13-10C for FR2-2, and determines PDCCH monitoring occasions from *searchSpaceZero* in *pdcch-ConfigSIB1*, included in *MIB*, as described in Tables 13-11 through 13-15. and are the SFN and slot index within a frame of the CORESET based on SCS of the CORESET and and are the SFN and slot index based on SCS of the CORESET, respectively, where the SS/PBCH block with index overlaps in time with system frame and slot . The symbols of the CORESET associated with *pdcch-ConfigSIB1* in *MIB* or with *searchSpaceSIB1* in *PDCCH-ConfigCommon* have normal cyclic prefix. \*<omitted text>\*.For operation without shared spectrum channel access and for the SS/PBCH block and CORESET multiplexing pattern 1, for FR1 and FR2-1, a UE monitors PDCCH in the Type0-PDCCH CSS set over two consecutive slots starting from slot . For FR2, UE monitors PDCCH in the Type0-PDCCH CSS set over two slots, slot  and  , where if SCS of the CORESET for Type0-PDCCH CSS is 480kHz, and  if SCS of the CORESET for Type0-PDCCH CSS is 960kHz. For SS/PBCH block with index , the UE determines an index of slot  as  that is in a frame with system frame number (SFN)  satisfying  if , or in a frame with SFN satisfying  if .  and  are provided by Tables 13-11 and 13-12, and  based on the SCS for PDCCH receptions in the CORESET [4, TS 38.211]. The index for the first symbol of the CORESET in slots  and  and  is the first symbol index provided by Tables 13-11 and 13-12.For operation with shared spectrum channel access and for the SS/PBCH block and CORESET multiplexing pattern 1, a UE monitors PDCCH in the Type0-PDCCH CSS set over slots that include Type0-PDCCH monitoring occasions associated with SS/PBCH blocks that are quasi co-located with the SS/PBCH block that provides a CORESET for Type0-PDCCH CSS set with respect to average gain, quasi co-location 'typeA' and 'typeD' properties, when applicable [6, TS 38.214]. For FR1 and FR 2-1, for a candidate SS/PBCH block index , where , two consecutive slots starting from slot include the associated Type0-PDCCH monitoring occasions. For FR2, for a candidate SS/PBCH block index , where , two slots, slot and  , where if SCS of the CORESET for Type0-PDCCH CSS is 480kHz, and  if SCS of the CORESET for Type0-PDCCH CSS is 960kHz, include the associated Type0-PDCCH monitoring occasions. The UE determines an index of slot as that is in a frame with system frame number (SFN) satisfying if , or in a frame with SFN satisfying if . and are provided by Table 13-11, and based on the SCS for PDCCH receptions in the CORESET [4, TS 38.211]. The index for the first symbol of the CORESET in slots and is the first symbol index provided by Table 13-11. The UE does not expect to be configured with , or with , when .For the SS/PBCH block and CORESET multiplexing patterns 2 and 3, a UE monitors PDCCH in the Type0-PDCCH CSS set over one slot with Type0-PDCCH CSS set periodicity equal to the periodicity of SS/PBCH block. For the SS/PBCH block and CORESET multiplexing patterns 2 and 3, if the active DL BWP is the initial DL BWP, the UE is expected to be able to perform radio link monitoring, as described in Clause 5, and measurements for radio resource management [10, TS 38.133] using a SS/PBCH block that provides a CORESET for Type0-PDCCH CSS set. For a SS/PBCH block with index , the UE determines the slot index  and  based on parameters provided by Tables 13-13 through 13-15.============================= Unchanged part omitted ========================================= |

### R1-2202005 (Samsung)

|  |
| --- |
| Similar to Rel-16 span-based PDCCH monitoring, a UE can indicate multiple combinations for multi-slot PDCCH monitoring in FR2-2, then the remaining issue is how to determine the combination that the UE will choose from the multiple indicated combinations. A similar approach as Rel-16 span-based PDCCH monitoring can be reused, wherein the maximum values on the BD and non-overlapping CCE are replaced by and , respectively.**Proposal 1: If a UE indicates a capability to monitor PDCCH according to multiple combinations, for a configuration of search space sets, a UE monitors PDCCH on the cell based on the following steps:*** **Step 1: Choose applicable combinations based on the configuration of search space sets;**
* **Step 2: Choose a combination, from the applicable combinations, that is associated with the largest maximum number of and ;**
* **Adopt TP#1 for TS 38.213.**

The discussion on multi-slot PDCCH monitoring was all based on UE capability, and one remaining issue is the UE behavior before the UE capability is reported. Since it has been agreed to not support single slot based PDCCH monitoring, a natural outcome is to support multi-slot PDCCH monitoring only before the UE capability is reported, and the only remaining issue which combination should the UE choose for such multi-slot based PDCCH monitoring. Since we anyway need to specify the selection of combination when multiple combinations are reported, a simply way could be reuse the same scheme before the UE capability is reported. **Proposal 2: Before a UE indicates a capability to monitor PDCCH, the UE monitors PDCCH on the cell based on the following steps:*** **Step 1: Choose applicable combinations based on the configuration of search space sets;**
* **Step 2: Choose a combination, from the applicable combinations, that is associated with the largest maximum number of and ;**
* **Adopt TP#2 for TS 38.213.**

There is a FFS on whether to support for 480 kHz SCS, as one of the reported UE capability. The intention of supporting a smaller value of , comparing to the mandatory UE capability with for 480 kHz SCS, is to allow flexible network configuration on the SS sets. Also, other than adding the corresponding values of and in the table, no other spec impact is expected, then it’s beneficial to support extra values of for better flexibility. **Proposal 3: Support for 480 kHz SCS.*** **Adopt TP#3 for TS 38.213.**
 |

### R1-2202190 (Sharp)

|  |
| --- |
| In RAN1#107-e meeting, the agreement for BD drop in multi-slot monitoring is achieved and it says “The dropping rule for multi-slot PDCCH monitoring capability is the same as the current specification but evaluated per slot group”. Then, the slot group is just described as “group of *Xs* slots according to combination (*Xs, Ys*)” or “group of *Xs* slots for a corresponding combination (*Xs, Ys*)” in TS38.213. When a UE reports multiple (*Xs, Ys*) combinations, there is no determination rule such that which value of *Xs* is used for BD dropping per group. Therefore, we should make it clear what is meant by the statements in “according” and “corresponding”. **Proposal 1: Introduce a new RRC parameter configuring *Xs* for allocation of PDCCH candidates when UE reports multiple (*Xs*, *Ys*) combinations.****Proposal 2: Adopt Text proposal #1.** |

### R1-2202273 (Panasonic)

|  |  |  |
| --- | --- | --- |
| As mentioned in section 1, the current 38.213 describe the following behavior regarding Group (1) SSs monitoring: “If a UE monitors PDCCH on a cell according to combination , the UE can monitor PDCCH for Type1-PDCCH CSS set provided by dedicated higher layer signalling, Type3-PDCCH CSS sets, and USS sets in any slot of the slots, …”Our view is the above description is not sufficient to reflect the earlier agreement that BD attempts for all Group (1) SSs are **restricted** to fall within the same Y consecutive slots. The reason is that the spec only describes that what UE “can” do for slots, but does not describe any UE behavior for slots outside slots. Without such restriction, it implies UE still needs to monitor slots outside outside slots for Group (1) SSs if configured by gNB via search space configuration. Then the whole multi-slot monitoring mechanism of becomes meaningless. Therefore, we propose the following changes to 38.213:**Proposal 1: To capture the earlier agreement that BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots in 38.213, adopt the following TP (with modifications highlighted in yellow).**

|  |
| --- |
| **TS 38.213 v17.0.0, Section 10**…For SCS configuration or , a UE can indicate a capability to monitor PDCCH according to one or more combinations , where and are numbers of consecutive slots, groups of slots are consecutive and non-overlapping, and the slots are within the slots. The first group of slots starts from the beginning of a subframe. The start of two consecutive groups of slots is separated by slots.If a UE monitors PDCCH on a cell according to combination , the UE can monitor PDCCH for Type1-PDCCH CSS set provided by dedicated higher layer signalling, Type3-PDCCH CSS sets, and USS sets in any slot of the slots and the UE is not expected to monitor any other slot of the slots than slots for PDCCH of the above-mentioned types, and the UE can monitor PDCCH for Type0/0A/2-PDCCH CSS set and Type1-PDCCH CSS set provided in *SIB1* in any slot of the slots. The UE determines the number of monitored PDCCH candidates and the number of non-overlapped CCEs for combination based on all search space sets within the slots, as applicable according to the search space set configurations, and maximum corresponding values are provided in Table 10.1-2B and Table 10.1-3B, respectively. ... |

The earlier agreement that “the location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups” cannot be true when new monitoring occasion is configured or indicated to the UE. If this case is not allowed, the system cannot operate correctly. Considering the TDMed-beam transmission of CSS (of Group (1)), UE may need to monitor a different slot for CSS when UE’s serving beam is changed. However, for USS, gNB can simply change the serving beam without changing the MO location since USS MO is unicast to the UE. In this case, it can happen that CSS MO becomes far away from the USS MO of the new serving beam such that cannot include both CSS and USS MOs anymore.The following Fig.1 illustrates above case more concretely. As shown, in the first slot group (UE is served by yellow beam), the location of is the first slot, covering USS MO and CSS MO of the yellow beam. When UE moves from the coverage of yellow beam to green beam in the second slot group, the corresponding CSS MO location for the UE has to be changed as well because the previous CSS MO would still be used for other UEs covered by the yellow beam. Consequently, the new CSS MO for the UE becomes outside the . According to the current spec, the UE may not receive such CSS because the location of cannot be changed.**Fig.1 Issue of fixed location of due to beam switching** To fix the above issue, the location of should be allowed to change if new MO is configured or indicated to the UE. Considering the fact that Group (1) SSs include both CSS and USS, CSS should be prioritized over USS in order not to miss important control information. In other words, location of should follow the new configured/indicated MOs of CSS (of Group (1)). Then USS MOs can be further included in from USS with lower to higher indices. Certain USS MO would be dropped if it cannot be included in .To reflect the above, the following TP is suggested:**Proposal 2: In case that MO of Group (1) CSS is changed, the location of *Ys* within *Xs* can be adapted accordingly to include all CSS MOs (of Group(1) SS) that are monitored by UE.** **Adopt the following TP to 38.213 (with modifications highlighted in yellow).**

|  |
| --- |
| **TS 38.213 v17.0.0, Section 10**…For SCS configuration or , a UE can indicate a capability to monitor PDCCH according to one or more combinations , where and are numbers of consecutive slots, groups of slots are consecutive and non-overlapping, and the slots are within the slots. The first group of slots starts from the beginning of a subframe. The start of two consecutive groups of slots is separated by slots until new monitoring occasion of Type1-PDCCH CSS set provided by dedicated higher layer signalling, or of Type3-PDCCH CSS sets is configured or indicated to the UE. If a UE monitors PDCCH on a cell according to combination , the UE can monitor PDCCH for Type1-PDCCH CSS set provided by dedicated higher layer signalling, Type3-PDCCH CSS sets, and USS sets in any slot of the slots, and the UE can monitor PDCCH for Type0/0A/2-PDCCH CSS set and Type1-PDCCH CSS set provided in *SIB1* in any slot of the slots. The UE determines the number of monitored PDCCH candidates and the number of non-overlapped CCEs for combination based on all search space sets within the slots, as applicable according to the search space set configurations, and maximum corresponding values are provided in Table 10.1-2B and Table 10.1-3B, respectively.  |

 |

### R1-2202336 (LG)

|  |  |
| --- | --- |
| Among the supported combinations, X=8 for 960 kHz and X=4 for 480 kHz are the mandatorily supported X values for multi-slot PDCCH monitoring operations. These values can maintain the PDCCH monitoring burden of the UE at a level similar to that of the 120 kHz SCS since the slot-group length and BD/CCE limit for them are the same as for 120 kHz SCS. In addition, for 960 kHz SCS, there is an optionally supported X, i.e., X=4, which can allow more diverse and flexible monitoring operation than what the mandatory X can do. However, for 480 kHz SCS, whether additional X other than X=4 is supported has not been decided yet. For a flexible multi-slot monitoring operation like 960 kHz, support for additional optional X may be required. With X=2 for 480 kHz, a possible combination (X,Y) can be (2,1). At the last meeting, there were some concerns about (X,Y)=(2,1) combination support for 480 kHz SCS. One concern mentioned for example is that monitoring based on X=2 may greatly increase power consumption and UE implementation complexity compared to X=4. However, (X,Y)=(2,1) for 480 kHz has the similar monitoring behavior as (X,Y)=(4,1) or (4,2) for 960 kHz which RAN1 have already decided to support. Therefore, it is not expected that the complexity or power consumption of the UE additionally increases due to (2,1)-based monitoring. Rather, it may have an advantage of being able to schedule flexible monitoring operation for an aggressive UE for 480 kHz, by supporting (2,1) combination. Another concern is about BD/CCE budget for (X,Y)=(2,1) combination. Assuming that the BD/CCE budget for (X,Y)=(2,1) is half that of (X,Y)=(4,1), the raised issue is that it is not feasible to monitor Type-0 PDCCH twice during 4 slots. However, it is not a valid issue since only one MO for Type-0 CSS, according to the previous agreement, can be configured per 4 slots for 480 kHz SCS. Furthermore, when (X,Y)=(2,1) is supported as an optional combination for SCell, there will be no additional issue due to the BD/CCE budget. In summary, there seems to be no critical issue from technical point of view to support an optional X=2 for 480 kHz SCS. However, monitoring based on the optional X can allow more diverse/flexible monitoring operation than what the mandatory X can do. It should be noted that X=2 for 480 kHz and X=4 for 960 kHz share the same absolute time and their BD/CCE budget could be the same. These mean that the UE supporting X=4 of 960 kHz can support X=2 for 480 kHz without additional burden. In this regard, we support (X,Y)=(2,1) as an optional combination for 480 kHz SCS.**Proposal #1: Support (X,Y)=(2,1) as an optional combination for 480 kHz SCS.**For multi-slot monitoring operation, the length X of the slot-group becomes the criterion for BD/CCE budget management. For example, for 960 kHz SCS, the UE has the BD budget of 20 per X=8 slots or [10] per X=4 slots. Since the slot-based monitoring is not supported for 480/960 kHz SCS, multi-slot monitoring becomes a mandatory monitoring operation including IDLE mode. Since UE assumption on the (X,Y) can affect BD/CCE budget handling within X slots, the default (X,Y) combination should be specified in the specification. At the previous meeting, RAN1 agreed to have a mandatorily supporting (X,Y) combinations for 480 kHz and 960 kHz SCS, i.e., (4,1) for 480 kHz and (8,1) for 960 kHz. These can be the default (X,Y) combination for each SCS, respectively. We propose to adopt the following text proposal to Clause 10 in TS 38.213 specification.**Proposal #3: Adopt the following text proposal in TS 38.213 Clause 10, to specify the default (X,Y) combination for multi-slot PDCCH monitoring.**

|  |
| --- |
| ============ Start of TP for TS 38.213 [1] ==================**10 UE procedure for receiving control information**<< Other parts are omitted >>If a UE is provided *monitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs - per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or - per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*- per group of slots according to combination , as in Tables 10.1-2B and 10.1-3B, if *monitoringCapabilityConfig* = *r17monitoringcapability*If the UE is not provided *monitoringCapabilityConfig* for =0, 1, 2, or 3, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot.If the UE is not provided *monitoringCapabilityConfig* for =5 or 6, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot group of slots according to combination =(4,1) for =5 or =(8,1) for =6.<< Other parts are omitted >>============ End of TP for TS 38.213 ================== |

When the UE reports multiple (X,Y) combinations for multi-slot monitoring, the UE should determine the (X,Y) combination based on the configured SS set configuration parameters (e.g., periodicity, offset, …). However, it may be ambiguous which (X,Y) the UE should assume to check BD/CCE budget if the configured monitoring occasions are aligned with multiple (X,Y) combinations. For example, when a UE reports (4,1) and (8,1) as capable (X,Y) combinations for 960 kHz and the configured monitoring occasions may be aligned with both (4,1) and (8,1) combinations, the UE should select an active (X,Y) combination to handle the BD/CCE budget. As a similar handling as Rel-16 URLLC, the active (X,Y) can be simply selected as that with the largest BD/CCE budget among the reported combinations which match the configured MOs. In multi-slot monitoring behavior, the largest X have the largest BD/CCE budget, so this rule is equivalent to selecting the combination with the largest X. Among the (X,Y) combinations with the largest X, it may be reasonable to select one with the smallest Y.**Proposal #4: In the multi-slot monitoring, when the monitoring occasions corresponding to multiple (X,Y) combinations are configured, the UE should monitor PDCCH candidates based on the (X,Y) combination corresponding to the largest X (and the smallest Y that can be combined therewith) among the reported combinations that match the monitoring occasions.** |

## Topic A2: Search Space Configuration/Enhancement

### R1-2200953 (Huawei, HiSilicon)

|  |
| --- |
| ***Observation 3: For Type0/0A/2-PDCCH CSS in Group (2) SS set, if searchSpaceID is set to 0, the configured periodicity in monitoringSlotPeriodicityAndOffset-r17 for the search space is irrelevant as the UE obtains the monitoring occasions based on the associated SSBs.******Observation 4: For Type0/0A/2-PDCCH CSS with searchSpaceID not equal to zero and Type1-PDCCH CSS, if periodicities is restricted to multiple of slots, then, only following periodicities cannot be used:**** ***For , periodicities of A1 = {1,2,5,10} slots***
* ***For , periodicities of A1 = {1,2,5,10} slots if both are supported and periodicities of A2 = {1,2,4,5,10,20} slots if only is supported.***

***As, in absolute time, A1 = {1,2,5,10} slots for is equal to B1 = {0.25, 0.5, 1.25, 2.5} slots for , and A2 = {1,2,4,5,10,20} slots for is equal to B2 = {0.125, 0.25, 0.5, 0.625, 1.25, 2.5} slots for none of the restricted periodicities in A1 or A2 is a supported value (in an absolute time) for a search space periodicity in Rel-15/16.*** In our view, the simplicity of using the same set of supported periodicities for both Group (1) SS and Group (2) SS along with above Observation 3 and Observation 4, strongly justify the following:***Proposal 4: In addition to the configured periodicity for Group (1) SSs, the configured periodicity for Group (2) SSs is also restricted to be an integer multiple of slots.***Further, let us take a look at the offset in *monitoringPeriodicityAndOffset-r17*. The offset in *monitoringPeriodicityAndOffset* in Rel-15/16 indicates the starting slot index of monitoring occasions. However, in Rel-17, the indication of starting slot within a slot group is already provided by *monitoringSlotsWithinSlotGroup-r17* and the offset in *monitoringPeriodicityAndOffset-r17* needs only to indicate the starting slot index of the slot group containing monitoring occasions. For example, suppose that the MOs start in the 5-th slot, as shown in Figure 1. In this case, the offset in *monitoringPeriodicityAndOffset-r17* can be 4 slots while *monitoringSlotsWithinSlotGroup-r17* = 0110000.e.g., *monitoringPeriodicityAndOffset-r17* = (sl32, 4 slots) and *duration-r17* = 12 slotsoffset = 4 slotsduration = 12 slots = 3 slot groupsperiodicity = 32 slots slots3 OSs3 OSs slots slots**…** slots**…***monitoringSymbolsWithinSlot* = 00111 00111 0000Figure 1 An example of search space configuration for a UE that supports multi-slot monitoring for 480 kHz SCS with with *monitoringSlotsWithinSlotGroup-r17* = 0110000***Proposal 7: The configured offset in monitoringPeriodicityAndOffset-r17 is restricted to be an integer multiple of slots and the invalid entries can be removed.***As for the definition of *duration-r17*, it is worth noticing that, unlike Rel-15/16, the search space is not necessarily consist of a consecutive number of slots in a period (occasion) because the group (1) SS in only located within consecutive slots of the slot group. Therefore, a valid definition of *duration-r17* is the total number slots in consecutive groups of slots that a search space lasts in each period. ***Proposal 5: Support the following definition for duration-r17:*** * ***Duration-r17 is the total number of slots in consecutive groups of slots that a SearchSpace lasts in every occasion, i.e., upon every period as given in the monitoringPeriodicityAndOffset-r17, for .***
	+ ***Use the above definition of duration-r17 in RRC parameter list***
	+ ***Adopt TP3 for 38.213***

We support the WA with a slight modification: Since the size of *monitoringSlotsWithinSlotGroup-r17* is set to 8 while the size of slot group is either 4 or 8, only the leftmost bits of *monitoringSlotsWithinSlotGroup-r17* represent a slot in a slot group.***Proposal 6: Confirm the working assumption on monitoringSlotsWithinSlotGroup-r17 with the following modification in the second sub-bullet:*** * ***Each of the leftmost bits in monitoringSlotsWithinSlotGroup-r17 represents a slot in a slot group.***

***Adopt TP4 for 38.213.***Given our earlier proposals (brought also above for the ease of reading) regarding the periodicity and offset values in *monitoringPeriodicityAndOffset-r17* and the fact that is only limited to 4 and 8 slots, every supported periodicity is an integer multiple of 4 slots. Further, for any periodicity of 4N slots, the permissible value range of offset is given by (0,3,…,4N-1). We propose to clarify this to RAN2 in the RRC parameter list as follows:***Proposal 8: Supported value range for periodicity and offset in monitoringPeriodicityAndOffset-r17 is provided below and is included in RRC parameter list to RAN2:*** monitoringSlotPeriodicityAndOffset-r17 CHOICE {sl4 INTEGER (0),sl8 INTEGER (0,3),sl16 INTEGER (0,3..15),sl20 INTEGER (0,3..19),sl32 INTEGER (0,3..31),sl40 INTEGER (0,3..39),sl64 INTEGER (0,3..63),sl80 INTEGER (0,3..79),sl128 INTEGER (0,3..127),sl160 INTEGER (0,3..159),sl320 INTEGER (0,3..319),sl640 INTEGER (0,3..639),sl1280 INTEGER (0,3..1279),sl2560 INTEGER (0,3..2559),sl5120 INTEGER (0,3..5119),sl10240 INTEGER (0,3..10239),sl20480 INTEGER (0,3..20479)}***Proposal 9: Confirm the WA in RAN1 107-e, that is, support only search space set group switching processing capability 1 with minimum values 40/160/320 symbols for 120/480/960 kHz SCS.*** Since the BD/CCE budget of multi-slot PDCCH monitoring is defined per slot-group, it would be easier for a UE to monitor according to the BD/CCE budget if SSSG switching occurs at a slot-group boundary rather than in the middle of a slot-group. Therefore, it is beneficial to align the SSSG switching boundary with the boundary of a slot-group.***Proposal 10: For multi-slot PDCCH monitoring for 480/960 kHz SCSs, a boundary of SSSG switching is always aligned with a boundary of a slot group.*** * ***Adopt TP 3 for 38.213.***

It has been discussed in RAN1 107b-e whether SSSG switching is only supported between SSSGs with the same PDCCH monitoring combination. We do not see why the two different SSSGs have to support the same combination. In our view, this is an unnecessarily conservative approach to guarantee that the distance between two consecutive SS slots on either side of the switching boundary is not less than . For instance (4,1) can switch to (8,1) as long as the distance between the last monitoring slot in (4,1) to the first monitoring slot in (8,1) is not less than 4. This can be easily supported by gNB implementation. Alternatively, UE can just drop monitoring the first SS in the “switched to” SSSG if the distance between two consecutive SS slots on either side of the switching boundary is not less than .***Proposal 13: SSSG switching is supported between SSSGs that correspond to the same or different PDCCH monitoring combinations.***In power saving enhancements WI, the value range for both SSSG switching timer *searchSpaceSwitchTimer-r17* and PDCCH skipping duration *PDCCHSkippingDuration* was agreed to be {1, 2, 3, …,160, 240, 320,400, 480, 640, 800} slots for120 kHz. Following other timeline related issues, it makes sense to scale the supported values of *searchSpaceSwitchTimer-r17* and *PDCCHSkippingDuration* for 120 kHz by 4 and 8 to obtain the supported values respectively for 480 kHz and 960 kHz.***Proposal 11: In unit of slots, the supported values for searchSpaceSwitchTimer-r17 and PDCCHSkippingDuration for 480 kHz and 960 kHz are respectively 4x and 8x of their supported values for 120 kHz.***Moreover, in addition to Rel-16 SSSG switching parameters, SSSG switching parameters *searchSpaceSwitchTimer-r17* and *searchSpaceGroupIdList-r17* were introduced in power saving enhancements WI. It is clear that when Rel-16 SSSG switching parameters are configured, a UE will perform the Rel-16 SSSG switching mechanism. Similarly, when Rel-17 SSSG switching parameters are configured, a UE will perform the Rel-17 SSSG switching mechanism. From our view, it does not make too much sense to allow a UE to perform both SSSG switching mechanisms simultaneously. Therefore, the gNB should not configure both Rel-16 and Rel-17 SSSG switching parameters at the same time.***Proposal 12: A UE does not expect to be configured with Rel-16 SSSG switching parameters (such as searchSpaceSwitchTimer and SearchSpaceSwitchTrigger) and Rel-17 SSSG switching parameters (such as searchSpaceSwitchTimer-r17 and searchSpaceGroupIdList-r17) per cell simultaneously.*** |

### R1-2200988 (Futurewei)

|  |
| --- |
| One remaining issue to be clarified in the above agreement is the “offset”. More precisely what is the offset basis? Following the existing specs we propose to maintain the same definition of the offset as presented in the TS 38.213.**Proposal 2: In TS 38.213, Clause 10.1 add the following text (the proposed addition is underlined):****“A UE determines a PDCCH monitoring occasion on an active DL BWP from the PDCCH monitoring periodicity, the PDCCH monitoring offset, and the PDCCH monitoring pattern within a slot. For search space set , the UE determines that a PDCCH monitoring occasion(s) exists in a slot with number [4, TS 38.211] in a frame with number if (. +-). The UE monitors PDCCH candidates for search space set for consecutive slots, starting from slot , and does not monitor PDCCH candidates for search space set for the next consecutive slots. For µ = {5,6} are integer multiples of the slot group duration.”**We propose to maintain the existing duration definitions for the multi-slot PDCCH monitoring where the duration it represents the time duration of the search space existence as an integer multiple of the basic monitoring pattern, which is the slot group.**Proposal 1: In TS 38.213, Clause 10.1 add the following text (the proposed addition is underlined) “- a duration of slots indicating a number of slots that the search space set exists by *duration”* to “- a duration of slots indicating a number of slots that the search space set exists by *duration.* For µ = {5,6} the duration is an integer multiple of the slot group duration.”**In RAN1#107bis-e it was agreed to introduce the RRC parameter *monitoringSlotsWithinSlotGroup-r17*. The design of this parameter was left as WA that needs to be confirmed. We support the WA confirmation.**Proposal 3: Confirm WA regarding the parameter *monitoringSlotsWithinSlotGroup-r17* design*.***Regarding the second bullet in above agreement, we prefer to allow full flexibility of the Group (2) SS. Besides, the necessity of further limitations on the number of spans per slot/slot group is not clear to us. Therefore, we prefer not to introduce other limitation for Group (2) SSs.***Proposal 3: Do not introduce other limitation for Group (2) SSs monitoring.*** |

### R1-2201033 (InterDigital)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| In RAN1#107bis-e [2], RRC parameter duration-r17 was agreed with the value range {8, 12, …, 20476} slots. The configured duration should be an integer multiple of Xs slots at least for Group (1) SS. However, there is an FFS bullet on whether there’s a need to revise the definition of duration. In our company view, we couldn’t find any issues to revise the existing definition of duration. ***Proposal 5:*** *Keep the agreed definition of duration and revise the agreement without the FFS bullet.* In RAN1#107bis-e [2], RRC parameter monitoringSlotsWithinSlotGroup-r17 was introduced to indicate a monitoring slot position in a slot group. For example, UE can monitor PDCCH within a slot of a multi-slot group where a corresponding bit indicates. In our company view, we couldn’t find any serious issues. Having said that, we propose to confirm the working assumption. ***Proposal 6:*** *Confirm the working assumption on monitoringSlotsWithinSlotGroup-r17.*In RAN1#107-e [1], minimum Pswitch value for search space set group switching were discussed with the following issues:* Whether to support multiple capabilities (capability 1 and capability 2 as in Rel-16).
	+ In Rel-16, UE cap report whether the UE supports search space set group switching Capability-2 via searchSpaceSwitchCapability2-r16.
* Value(s) for 120 kHz
	+ In Rel-16, Pswitch values for capability 2 are based on SPS release timeline. Having said that, 25 symbols were suggested for μ=3 with capability 2.
* Whether to scale the value(s) of 120 kHz by 4 and 8 times for 480 and 960 kHz, respectively.
	+ Most of UE capability values were determined based on scaled values by 4 or 8 times of 120 kHz value in NR 52-71.
* Whether to consider additional margin.

Based on the discussion, the following values with only one capability (i.e., UE processing capability 1) was agreed as a working assumption.

|  |  |
| --- | --- |
|  | Minimum value for UE processing capability 1 [symbols] |
| 3 | 40 |
| 5 | 160 |
| 6 | 320 |

As the values do not have any serious issues, it is preferred to agree the working assumption as it is. ***Proposal 7:*** *Confirm the working assumption on the minimum Pswitch value.* |

### R1-2201266 (OPPO)

|  |
| --- |
| The difference for FR2-2 is that the UE does not monitor PDCCH in all the slots configured by the *duration-r17* parameter. This necessitates to introduce another parameter, i.e., *monitoringSlotsWithinSlotGroup-r17,* to indicate which of the slots to be monitored within the slots configured by *duration-r17* parameter. However, we think that to make the search space configuration work, the restriction of the length of *duration-r17* is integer of Xs slot should be modified. This because the Xs value is directly linked to the 8-bit of *monitoringSlotsWithinSlotGroup-r17*. The bit position should be aligned with Xs value in order for the UE to derive the monitored slots from a one-to-one mapping indication. If the Xs value is not equal to 8, the UE does not know how to interpret the bit-map. Given that for 480kHz SCS, UE only supports Xs=4 but for 960kHz SCS, UE may support Xs=4 or 8, we suggest that the *duration-r17* is defined in a virtual slot group length of Xs=8, so that the *duration-r17* should be an integer number of Xs=8. Thus the *monitoringSlotsWithinSlotGroup-r17* can indicate the monitored slot based on Xs=8 slot basis and the corresponding configuration examples as shown in Fig. 2.**Proposal 1: the value configured by *duration-r17* should be an integer number of Xs=8 and make the previous working assumption as agreement.**  |

### R1-2201352 (CATT)

|  |  |
| --- | --- |
| The difference between option 1 and option 2 is how to use the *monitoringSlotsWithinSlotGroup-r17* for 480kHz. It was agreed in the RAN1#107b-e meeting that the configured duration for 480 kHz is restricted to be an integer multiple of 4 slots at least for Group(1) SS. If option 2 is adopted and the value of duration is 12, the number of consecutive 8-slots group will be 1.5(12/8) that is not a integer. This may bring complexity to the definition of the specification. ***Proposal 1：For search space set configuration of multi-slot PDCCH monitoring, the following definition is suggested:**** ***Offset: the value of offset can be configured as one of the value in {0 .. Xp-1}***
* ***Duration: It is used to configure the number of consecutive slots that a SearchSpace lasts in every periodicity. For 480kHz SCS, if the value of duration-r17 is N, the number of consecutive 4-slots group is N/4 that a SearchSpace lasts in every periodicity. For 960kHz SCS, if the value of duration-r17 is N, the number of consecutive 8-slots group is N/8 that a SearchSpace lasts in every periodicity.***
* ***monitoringSlotsWithinSlotGroup-r17*: *For 480kHz SCS, only the first four most significant(left) bit are applicable and can be used to configure the slot for PDCCH monitoring that a SearchSpace lasts in every 4-slots. For 960kHz SCS, all the 8 bits are applicable and can be used to configure the slot for PDCCH monitoring that a SearchSpace lasts in every 8-slots.***

The search space group set switching was introduced in Rel-16 NR-U with 15 kHz SCS, 30 kHz SCS and 30 kHz SCS for dynamic switching between different search spaces. Before the gNB obtains the COT, the frequent monitoring enables the gNB to transmit DCI as soon as possible if gNB’s LBT is successful. However, frequent monitoring is not conducive to power saving of the UE during the COT. When the search space group set switching is configured, the gNB can indicate to UE switching between a search space with long periodicity and a search space with short periodicity to meet different scheduling requirements. In RAN1#107bis-e discussion, it is generally the common understanding that the legacy SSSG switching mechanism should be reused for the 120 kHz SCS, 480 kHz SCS and 960 kHz SCS in 60GHz NR-U. Also the following was agreed

|  |
| --- |
| **Conclusion**The SSSG switching timer is in units of slots. |

The next issue is the switching boundary. To simplify the behavior and reduce specification effort, it is suggested to align the boundary with the boundary of a slot group.***Proposal 4:***  ***The SSSG switching boundary is aligned with the boundary of a slot group.*** |

### R1-2201389 (ZTE, Sanechips)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| For *monitoringSlotPeriodicityAndOffset-r17* and *duration-r17*, according to the agreement made in RAN1#107bis e-meeting, other appropriate periodicity values { sl32, sl64, sl128, sl5120, sl10240, sl20480} are added in addition to the existing configurable values. Moreover, additional restrictions are needed to make sure that the values of periodicity/duration for multi-slot PDCCH monitoring in FR2-2 are an integral multiple of slot groups. The configuration of periodicity/duration is intended not only for Group (1) SSs but also for Group (2) SSs, so we suggest changing the wordings in the agreement “The configured periodicity/duration at least for Group (1) SSs is restricted to be an integer multiple of slots” to “The configured periodicity/durationis restricted to be an integer multiple of slots for both Group (1) SSs and Group (2) SSs”.**Proposal 4: The configured periodicity in *monitoringSlotPeriodicityAndOffset-r17* and duration in *duration-r17* are restricted to be an integer multiple of slots for both Group (1) SSs and Group (2) SSs.**Moreover, the current definition of *duration* is “Number of consecutive slots that a SearchSpace lasts in every occasion”. For slot-group based PDCCH monitoring, duration is restricted to be an integer multiple of Xs of a slot group and its unit is slot based on the agreement made in RAN1#107bis e-meeting, we propose to clarify the definition of *duration-r17* as “number of slots that a SearchSpace lasts for a couple of consecutive slot groups in every occasion”. If *duration-r17* is absent, the UE applies the value 4 slots, except for DCI format 2\_0.**Proposal 5: Further clarify the definition of *duration-r17* as: Number of slots that a SearchSpace lasts for a couple of consecutive slot groups in every occasion. If *duration-r17* is absent, the UE applies the value 4 slots, except for DCI format 2\_0.**Basically, we are fine with introducing a new parameter *monitoringSlotsWithinSlotGroup-r17* to indicate which slots have monitoring occasions within a slot group for SCS 480/960 kHz. However, we think the configuration of parameter *monitoringSlotsWithinSlotGroup-r17* should align with the configuration of offset in *monitoringSlotPeriodicityAndOffset-r17*. The value range for the offset O is {0 .. Xp-1} slots for each periodicity value Xp and its unit is slot. The offset indicates the slot offset between PDCCH monitoring occasion and frame boundary according to the current specification in TS 38.213 as follows:

|  |
| --- |
| - a PDCCH monitoring periodicity of slots and a PDCCH monitoring offset of slots, by *monitoringSlotPeriodicityAndOffset*A UE determines a PDCCH monitoring occasion on an active DL BWP from the PDCCH monitoring periodicity, the PDCCH monitoring offset, and the PDCCH monitoring pattern within a slot. For search space set , the UE determines that a PDCCH monitoring occasion(s) exists in a slot with number [4, TS 38.211] in a frame with number if (. +-). The UE monitors PDCCH candidates for search space set for consecutive slots, starting from slot , and does not monitor PDCCH candidates for search space set for the next consecutive slots.  |

In other words, the slot offset between the first slot in the slot group indicated in *monitoringSlotsWithinSlotGroup-r17* for a PDCCH monitoring occasion and subframe boundary is equal to the offset indicated in *monitoringSlotPeriodicityAndOffset-r17*.**Proposal 6: If new parameter *monitoringSlotsWithinSlotGroup-r17* is introduced, the offset indicated in *monitoringSlotPeriodicityAndOffset-r17* is equal to the slot offset between the subframe boundary and the first slot in the slot group indicated in *monitoringSlotsWithinSlotGroup-r17* for a PDCCH monitoring occasion.****Proposal 7: Confirm the working assumption: Support only search space set group switching processing capability 1 with the following values**

|  |  |
| --- | --- |
|  | Minimum value for UE processing capability 1 [symbols] |
| **3** | **40** |
| **5** | **160** |
| **6** | **320** |

The SSSG switching boundary is aligned with the slot boundary in Rel-15/16, the UE switches from one SSSG to another SSSG at the first slot after at least symbols. Similar rule can be extended for multi-slot PDCCH monitoring in Rel-17, the SSSG switching boundary, i.e. the time of applying the switching, is aligned with the boundary of a slot group to avoid increasing complexity.**Proposal 8: For multi-slot PDCCH monitoring in Rel-17, the SSSG switching boundary, i.e. the time of applying the switching, is aligned with the boundary of a slot group to avoid increasing complexity.**Moreover, even though we think SSSG switching between two different capabilities of multi-slot PDCCH monitoring for 480/960kHz should be supported, in our understanding, the UE expects to monitor PDCCH according to the same combination in every slot group on the active DL BWP of a cell. Therefore, we can conclude that SSSG is only supported between SSSGs that have the same PDCCH monitoring capability on the active DL BWP of a cell. **Proposal 9: Conclude that SSSG is only supported between SSSGs that have the same PDCCH monitoring capability on the active DL BWP of a cell.** |

### R1-2201471 (NTT DOCOMO)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| According to the agreement, an RRC parameter *monitoringSlotsWithinSlotGroup-r17* is newly supported for multi-slot PDCCH monitoring which indicates monitored slot(s) within a slot group. However, given that *monitoringSlotsWithinSlotGroup-r17* indicates monitored slot(s), the definition of *duration-r17* needs to be revisited as captured as FFS since the RRC parameter *duration* in the current specification also indicates monitored consecutive slot(s) in every monitoring occasion indicated via *monitoringSlotPeriodicityAndOffset*. In our understanding, it makes more sense if *duration-r17* is revised to indicate slots where *monitoringSlotsWithinSlotGroup-r17* is applied in every monitoring occasion. The value range of *duration-r17* was agreed as {8, 12, …, 20476} which are scaled from the values in the current specification based on the supported SCSs in FR2-2. According to the current specification, it is also specified that a UE applies the value 1 slot if *duration* is absent. We believe this default value should also be scaled in the same manner as for the exact values for *duration-r17*, i.e., a UE applies the value 4 slots if *duration-r17* is absent.As per the above discussion, *duration-r17* indicates multiple of Xs slots that *monitoringSlotsWithinSlotGroup-r17* is applied. In that sense, the starting slot of *duration-r17* should be aligned with slot group boundary, thus, the periodicity and offset also should be the multiple of Xs slots. Furthermore, it is preferable to support unified configuration principle between Group(1) SSs and Group(2) SSs. Therefore, both *monitoringSlotPeriodicityAnd Offset-r17*and *duration-r17* should be an integer multiple of Xs slots regardless of SS type.Figure 1 shows an example as for SS set configuration with *monitoringSlotPeriodicityAndOffset-r17, duration-r17* and *monitoringSlotsWithinSlotGroup-r17* when a UE reports the support of (Xs, Ys)=(4, 2)*.*テキスト  自動的に生成された説明Fig.1: SS set configuration for multi-slot PDCCH monitoring.Based on the discussion, we make the following proposal.**Proposal 3: The following agreement at RAN1#107bis-e meeting should be supported with revision in red and the working assumption should be confirmed.**

|  |
| --- |
| For search space set configuration of multi-slot PDCCH monitoring:* *monitoringSlotPeriodicityAndOffset* and *duration* are appended with "-r17", and
	+ *For monitoringPeriodicityAndOffset-r17*
		- The values represent slots
		- Add periodicity values {32,64,128,5120,10240,20480} to the existing values in *monitoringSlotPeriodicityAndOffset*
			* Note: Total list of supported periodicity values: {~~1,2,~~4,~~5,~~8,~~10,~~16,20,32,40,64,80,128,160,320,640,1280,2560,5120,10240,20480}
		- For each periodicity value Xp
			* The value range for the offset O is {0 .. Xp-1} slots
			* Note: There may be no need to introduce the term "Xp" in the specifications
		- The configured periodicity ~~at least for Group (1) SSs~~ is restricted to be an integer multiple of Xs slots
		- The configured offset is restricted to be an integer multiple of Xs slots
		- ~~FFS: details of offset~~
	+ For *duration-r17*
		- The values represent slots
		- The value range is {8, 12, …, 20476}
			* If this field is absent, a UE applies the value 4 slots.
		- The configured duration is restricted to be an integer multiple of Xs slots ~~at least for Group (1) SSs~~
		- This field indicates the number of consecutive slots that a *SearchSpace* lasts *monitoringSlotsWithinSlotGroup-r17* is applied in every occasion, i.e., upon every period as given in the *monitoringSlotPeriodicityAndOffset-r17*.
		- ~~FFS: need to revise the definition of~~ *~~duration~~*
* *monitoringSymbolsWithinSlot* applies to each slot in a slot group configured for multi-slot PDCCH monitoring
	+ Note: This parameter can be directly re-used from earlier releases.
* Introduce new parameter *monitoringSlotsWithinSlotGroup-r17*
	+ Working assumption:
		- The size is 8 bits
		- Each bit in *monitoringSlotsWithinSlotGroup-r17* represents a slot in a slot group
		- A slot in the slot group is configured for multi-slot PDCCH monitoring if the corresponding bit in the slot group is set to '1'
			* Note: Further configuration of the monitoring symbols in such a slot is done by *monitoringSymbolsWithinSlot*
		- The slots indicated in the bitmap should be consecutive at least for Group (1) SSs
 |

As per the discussion in AI 8.2.2, most companies agreed that SSSG switching and PDCCH skipping feature introduced in Rel-17 UE power saving enhancement WI can be extended for NR operation in FR2-2 with 480 and 960 kHz SCS, then the exact values need to be discussed.We believe the scaled values from that for 120 kHz by 4/8 for 480/960 kHz SCS (shown below) can be a good starting point to determine the exact values for larger SCSs:* + - {[4,8,12,16,...,640,1280,1600,2560,3200]} for 480kHz SCS,
		- {[8,16,24,32,..., 1280,1600,2560,3200,6400]} for 960kHz SCS.

We think it would be sufficient to just use the values above for larger SCSs in FR2-2, i.e., the values scaled based on SCS. From power saving perspective, we believe the same “absolute” time duration should be considered even when larger SCS is configured. The simplest solution to achieve this would be the simple scaling. Some companies argued that the values should be discussed separately for LBT and non-LBT cases since maximum COT duration should be considered for LBT case. However, the values which are scaled based on the values for Rel-17 power saving shown above includes the values for LBT case, i.e., 160/320 slots, and the single value set shown above seems sufficient configuring per BWP. Thus, we think it is not necessary to specify SSSG switching timer and PDCCH candidates skipping values for 480/960 kHz SCS as NR-U based value sets and Rel-17 power saving based value sets separately.**Proposal 4: Support the candidate skipping values and SSSG switching initial timer values in slots as follows:** * + **The candidate skipping values can be configured as**
		- **{[4,8,12,16,...,640,1280,1600,2560,3200]} for 480kHz SCS,**
		- **{[8,16,24,32,..., 1280,1600,2560,3200,6400]} for 960kHz SCS.**
	+ **The value of the SSSG switching timer in slots can be configured as,**
		- **{[4,8,12,16,...,640,1280,1600,2560,3200]} for 480kHz SCS,**
		- **{[8,16,24,32,..., 1280,1600,2560,3200,6400]} for 960kHz SCS.**

Considering the discussion at last RAN1 meeting, while our first preference is to support 25/100/200 symbols for 120/480/960 kHz SCS (i.e., either Alt-1 or Alt-2b), we can accept the values captured as working assumption to SSSG switching even for the unlicensed band operation in FR2-2.**Proposal 5: Confirm the following working assumption:****Working assumption****The following values are adopted as minimum value of for 120/480/960 kHz*** **Support only search space set group switching processing capability 1 with the following values**

|  |  |
| --- | --- |
|  | **Minimum value for** **UE processing capability 1 [symbols]** |
| 3 | 40 |
| 5 | 160 |
| 6 | 320 |

 |

### R1-2201542 (Spreadtrum)

|  |
| --- |
| As multi-slot PDCCH monitoring is based on slots within a slot group, and the X is 4 and 8 slots for SCS 480 and 960 kHz, respectively. Therefore, the bit string size of *monitoringSlotsWithinSlotGroup-r17* set to 8 to support both 480 and 960 kHz SCS is reasonable. For the monitoring symbols in such a slot, it can be done by *monitoringSymbolsWithinSlot*. However, *monitoringSymbolsWithinSlot* is used to determine the symbols within a slot. For multi-slot case, we think monitoring symbols in each slots can be the same. Thus, a justification can be added to the note, e.g., Note: Further configuration of the monitoring symbols in such a slot is done by monitoringSymbolsWithinSlot, and monitoring symbols in each slot are the same.***Proposal 2: Confirm the following revised working assumption.**** + ***Working assumption:***
		- ***The size is 8 bits***
		- ***Each bit in monitoringSlotsWithinSlotGroup-r17 represents a slot in a slot group***
		- ***A slot in the slot group is configured for multi-slot PDCCH monitoring if the corresponding bit in the slot group is set to '1'***
			* ***Note: Further configuration of the monitoring symbols in such a slot is done by monitoringSymbolsWithinSlot,*** ***and monitoring symbols in each slot are the same.***
		- ***The slots indicated in the bitmap should be consecutive at least for Group (1) SSs***
 |

### R1-2201593 (TCL Communication)

|  |
| --- |
| For FR2-2, the PDCCH is monitored in a slot-group manner. The recent conclusion indicates this is the default capability of a UE. In the last RAN1 107bis-e meeting, there are intensive discussions about the design of the search space for PDCCH monitoring in FR 2-2, there are some pending parameters without agreement reached. The designs related to Group (1) SS is indicated. For example,*monitoringPeriodicityAndOffset-r17* * The configured periodicity at least for Group (1) SSs is restricted to be an integer multiple of Xs slots

Those for Group (2) SS is missing. We prefer a unified design for Both Group (1) SS and Group (2) SS.For *duration-r17,* there are two possible options.* Option 1: *duration-r17* indicates a continuous range which should be monitored. This the same as FR1 and FR2-1, The PDCCH is monitored in a continuous range within the monitoring period.
* Option 2: *duration-r17* indicates dis-continuous ranges which should be monitored. This is useful for intermittent traffic or power saving case. A bitmap would complete this feature, whereas that brings more overhead.

The monitored symbol within a slot group is configured by *monitoringSymbolsWithinSlot*. It is a tradeoff that whether monitored symbols in each monitored slot in the slot group should be same. That brings a balance between flexibility and signaling overhead. Since there are various UEs and the UE capability is different. The UE capability will cover this tradeoff.**Proposal 1: For the search space configuration design, a unified framework for both Group (1) SS and Group (2) SS is preferred. That reduces the specification workload.****Proposal 2: the PDCCH monitoring duration can be dis-continuous ranges in terms of slot group for FR 2-2. This flexibility gives more chances for power saving UE and intermittent traffics.****Proposal 3: Whether the** *monitoringSymbolsWithinSlot***is same for each monitoring slot in a slot group leads to a tradeoff. The UE capabilities will cover this tradeoff. We support the both designs of** *monitoringSymbolsWithinSlot***. It can be either a bitmap of 14bits, or a bitmap with more bits mapped to each symbol in the slot group.**  |

### R1-2201663 (Nokia, Nokia Shanghai Bell)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The working assumption is well inline with the principle applied widely for all the processing times (i.e., apply the same absolute time for all SCSs: 120 kHz, 480 kHz and 960 kHz). Based on that we just propose to convert the working assumption to an agreement.***Proposal 5:*** Support only search space set group switching processing capability 1 with the following values

|  |  |
| --- | --- |
|  | Minimum value for UE processing capability 1 [symbols] |
| 3 | 40 |
| 5 | 160 |
| 6 | 320 |

It was concluded in RAN1 #107bis-e that “*The SSSG switching timer is in units of slots*”. One of the open questions for SSSG switching for 480/960 kHz SCSs is when to perform the SSSG switching. We think that the switching should happen always at the slot group boundary. Otherwise, there can be ambiguity e.g. in the CCE/BD budget determination.***Proposal 6:*** *For multi-slot PDCCH monitoring for 480/960 kHz SCSs, a boundary of SSSG switching is always aligned with a boundary of a slot group.*We think that it makes sense to support Rel-17 PDCCH skipping feature also in FR2-2. And it makes sense to scale the values the values corresponding for 120 kHz by 4 and 8 for 480 and 960 kHz SCS, respectively (as the corresponding working assumption has been done in UE power saving AI already there is no need to do a separate agreement in this agenda item). When considering the PDCCH skipping for higher sub-carrier spacings, we think that the skipping duration is always extend till slot group boundary. In this case the skipping duration granularity could be same as for X, and the minimum value, to enable skipping of one ‘slot group period’, would be X-Y+1 (i.e. at the second last slot on the group, min. 2 slots). Other approach is that skipping duration is not bound by slot group, thus skipping duration could end during the multi-slot monitoring of a slot group. This requires to support durations down to one slot for 960kHz. As this would result enabling ‘sub slot-group’ skipping for 960 kHz, it may not have much practical use from UE power saving perspective. Therefore it is proposed that the skipping duration would always assumed to be extended till slot group boundary.***Proposal 7:*** *Skipping duration is always extended till slot group boundary.*Corresponding to this it proposed to support following skipping durations * {2,3,4,8,12,16,…636,640,720,…,1200,1280, 1440, 1600, 1760,…,3040,3200} for 480kHz SCS
	+ I.e. {2,3,[4:4:636],[640:80:1200],[1280:160:3200]}
* {2,4,7,8,16,24,…1280,1440,1600,2400,2560,2880,3200,…,6080,6400 } for 960kHz SCS
	+ I.e. {2,4,7,[8:8:1280],[1440:160:2560],[2880:320:6400]}

As discussed in RAN1 #107bis-e there are differences between Rel-16 and Rel-17 approaches: the SSSG timer configuration of Rel-16 SSSG switching is per-cell, while the SSSG timer for Rel-17 SSSG switching is per-BWP. Based on that, it makes sense to avoid simultaneous usage of Rel-16 feature (defined originally for LBT scenario) and Rel-17 feature (defined for non-LBT scenario). However, it would be more natural to make such decision in UE power saving WI. That would ensure that the agreement is not limited to FR2-2 & 480/960 kHz SCSs.***Proposal 8:*** *Agreements related to simultaneous usage of Rel-16 SSSG switching and Rel-17 SSSG switching are done in UE power saving WI.* ***Proposal 9:*** Confirm the following working assumtion* Introduce new parameter *monitoringSlotsWithinSlotGroup-r17*
	+ Working assumption:
		- The size is 8 bits
		- Each bit in *monitoringSlotsWithinSlotGroup-r17* represents a slot in a slot group
		- A slot in the slot group is configured for multi-slot PDCCH monitoring if the corresponding bit in the slot group is set to '1'
			* Note: Further configuration of the monitoring symbols in such a slot is done by *monitoringSymbolsWithinSlot*
		- The slots indicated in the bitmap should be consecutive ~~at least for Group (1) SSs~~

***Proposal 10:*** *revise the definition of duration in the following way:** *If duration ≤ 8, UE considers up-to “duration” bits as valid bits in the bitmap*
* *If duration >8, UE creates a new bitmap by repeating the monitoringSlotsWithinSlotGroup-r17, and considers up-to “duration” bits as valid bits in the new bitmap.*

***Proposal 11:*** *revise the value range for offset as:** *value range for offset is {0, 4, 8, …, Xp-1} slots.*
 |

### R1-2201689 (Intel)

|  |  |  |  |
| --- | --- | --- | --- |
| Before discussing details of Group (2) SS handling, it is better to align the understanding of FG 3-1 especially ‘any of’ in the following bullet.

|  |
| --- |
| - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot |

There are two interpretations.* Interpretation #1: It is limited to single span in a slot for each Group (2) SS set, however the different Group (2) SS sets can be configured in different spans in the slot.
* Interpretation #2: It is limited to single span in a slot considering all configured Group (2) SS sets in the slot.

In our view, Interpretation #2 is the correct understanding. Interpretation #1 will not bring any real complexity reduction at UE side compared to Interpretation #2. With Interpretation #1, though a single Group (2) SS set is limited to single span per slot, there can still be multiple spans in a slot due to multiple configured Group (2) SS sets. Consequently, UE must prepare for the worst case, i.e., to decode multiple spans per slot for Group (2) SS sets. **Proposal 2:** * Clarify that Interpretation #2 is the right understanding for FG 3-1
	+ Interpretation #2: It is limited to single span in a slot considering all configured Group (2) SS sets in the slot.

In general, it is not preferred to limit the maximum number of slots that can be simultaneously configured for PDCCH monitoring in a slot group for Group (2) SS configuration flexibility. That is, the Group (2) SS can be simultaneously configured in all slots in a slot group. On the other hand, the maximum number of configured spans in a slot may remain to be 2 to align with Group (1) SS for the Y=1 slot. Since UE mandatorily supports Y=1 for the multi-slot PDCCH monitoring capability, the design on handling group (2) SS can take existing agreement for Y=1 as baseline, i.e., FG3-5b extension. That is, UE must be capable to monitor up to two spans of Group (1) SS in a slot in a slot group. To avoid excessive increase of UE complexity, it is preferred that the maximum number of monitored spans per slot in a slot group for the two groups of SS sets remains to be 2. Further, the total number of monitored spans of SS sets in a slot group should be carefully designed. A larger number of spans provide a better flexibility for PDCCH transmission. However, it also increases UE complexity and power consumption. To balance various factors, it is preferred that UE should be capable to monitor up to 3 or 4 spans of all SS sets in a slot group which includes spans for all Group (1) and Group (2) SS sets. **Proposal 3:** * The limitation on Group (2) SS sets should be clarified from two aspects
	+ Whether to limit the number of slots/spans on which the SS set(s) can be simultaneously configured in a slot group for a UE.
	+ Whether to limit the number of slots/spans on which the SS set(s) can be simultaneously monitored in a slot group by a UE.

**Proposal 4:** * For SS set configuration
	+ The Group (2) SS sets can be simultaneously configured in all slots in a slot group.
	+ The maximum number of configured spans in a slot remains to be 2 considering all SS sets.
* For PDCCH monitoring at UE
	+ The maximum number of monitored spans per slot in a slot group remains to be 2 considering all SS sets
	+ UE is capable to monitor up to 3 or 4 spans of SS sets in a slot group considering all SS sets.
* Discuss the exact number of limited configured/monitored spans in a slot or in a slot group in UE feature for WI NR\_ext\_to\_71GHz

The configured search space configuration in the two SSSGs may have different requirements on the PDCCH monitoring capability. Figure 1 provides two examples for the SSSG switching with corresponding switching between combination (4, 1) and (4, 2). In Figure 1A, at the time for SSSG switching, UE needs to decode more PDCCHs if no additional restriction is introduced. Since the agreed Pswitch values are much larger than the slot group size X=4/8, UE can know in a quite early time that there happens burst PDCCH detections at the time of SSSG switching. As a result, a simple solution is that UE can cancel the PDCCH detection in X slots before the time of SSSG switching. On the other hand, Figure 1B shows another example that there exists a distance between the slots for PDCCH monitoring before or after SSSG switching. There is practically no problem to monitor all PDCCHs around the time of SSSG switching. In this case, it is desired if PDCCH in the first SSSG in the X slots before the time of SSSG switching can still be detected. Based on Figure 1A/1B, a unified solution could be that UE can monitor the PDCCHs in the X slots before the time of SSSG switching in the slots that are the intersection of the slot patterns of combinations (X, Y) used before and after SSSG switching. **Figure 1: SSSG switching resulting in burst PDCCH detections**The following TP is proposed to do SSSG switching with different multi-slot PDCCH monitoring capability combinations (X, Y).

|  |
| --- |
| **------------------------------ TP#4c: TS 38.213 -----------------------------------**\*\*\* Unchanged text is omitted \*\*\*10.4 Search space set group switching\*\*\* Unchanged text is omitted \*\*\*If a UE is provided by *SearchSpaceSwitchTrigger* a location of a search space set group switching flag field for a serving cell in a DCI format 2\_0, as described in clause 11.1.1; - if the UE detects a DCI format 2\_0 and a value of the search space set group switching flag field in the DCI format 2\_0 is 0, the UE starts monitoring PDCCH according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, for the serving cell at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0- if the UE detects a DCI format 2\_0 and a value of the search space set group switching flag field in the DCI format 2\_0 is 1, the UE starts monitoring PDCCH according to search space sets with group index 1, and stops monitoring PDCCH according to search space sets with group index 0, for the serving cell at a first slot that is at least symbols after the last symbol of the PDCCH with the DCI format 2\_0, and the UE sets the timer value to the value provided by *searchSpaceSwitchTimer*- if the UE monitors PDCCH for a serving cell according to search space sets with group index 1, the UE starts monitoring PDCCH for the serving cell according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, for the serving cell at the beginning of the first slot that is at least symbols after a slot where the timer expires or after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2\_0If a UE indicates a capability to monitor PDCCHs according to multiple combinations , the search space sets with group index 0 and 1 are respectively associated with different combinations and , the UE monitors PDCCHs of search space sets with group index *g* in the slot(s) that belongs to both the slots of combinations and the slots of combinations within the slots prior to PDCCH monitoring according to search space sets with group index *1-g*.\*\*\* Unchanged text is omitted \*\*\* |

**Proposal 9:*** Dynamic SSSG switching is supported for all SCSs 120, 480 and 960kHz.
* PDCCH monitoring following the second SSSG can start right after the time of SSSG switching
* The search space set configurations of the two SSSG can correspond to two different PDCCH monitoring capabilities combinations (X, Y)
* UE can monitor the PDCCHs in the X slots before the time of SSSG switching in the slots that are the intersection of the slot patterns of the two combinations (X, Y) before and after SSSG switching
* Agree on TP 4 to do SSSG switching with different multi-slot PDCCH monitoring capability combinations (X, Y).

According to the above WA, *monitoringSlotsWithinSlotGroup-r17* has a size of 8 bits, which may exceed value X. for example, it is X=4 for SCS 480kHz, the *monitoringSlotsWithinSlotGroup-r17* can indicate the slots with configured MOs in two consecutive slot groups of X=4. UE can expect that the configured MOs are in same position in both slot groups. The 8-bit bitmap allows full flexibility for SS set configuration, however, it is unnecessary for a typical SS set configuration if Y=1. Since the agreed value range for the offset O is {0 .. Xp-1} slots, the offset O can indicate a right slot index with configured MOs in a slot group, i.e., mod(offset, X). In this case, *monitoringSlotsWithinSlotGroup-r17* can be omitted. One more remaining issue is on the definition of *duration*. *duration* indicates the number of consecutive slots for PDCCH monitoring according to a combination (Xs, Ys) upon every period as given in the *monitoringSlotPeriodicityAndOffset.* The following TP is proposed for SS set configuration.

|  |
| --- |
| **------------------------------ TP#5: TS 38.213 -----------------------------------**\*\*\* Unchanged text is omitted \*\*\*10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*For each DL BWP configured to a UE in a serving cell, the UE is provided by higher layers with search space sets where, for each search space set from the search space sets, the UE is provided the following by *SearchSpace*: - a search space set index , , by *searchSpaceId* - an association between the search space set and a CORESET by *controlResourceSetId* or by *controlResourceSetId-v1610*- a PDCCH monitoring periodicity of slots and a PDCCH monitoring offset of slots, by *monitoringSlotPeriodicityAndOffset* or by *monitoringSlotPeriodicityAndOffset-r17*- a PDCCH monitoring pattern within a slot, indicating first symbol(s) of the CORESET within a slot for PDCCH monitoring, by *monitoringSymbolsWithinSlot* - a PDCCH monitoring pattern within a group of slots, indicating consecutive slots in the group of slots for PDCCH monitoring, by *monitoringSlotsWithinSlotGroup-r17. If monitoringSlotsWithinSlotGroup-r17* is not configured, the slot for PDCCH monitoring is indicated by PDCCH monitoring offset - a duration of slots indicating a number of slots that the search space set exists by *duration* or by *duration-r17*\*\*\* Unchanged text is omitted \*\*\* |

**Proposal 10:** * In search space set configuration,
	+ *duration* indicates the number of consecutive slots for PDCCH monitoring according to a combination (Xs, Ys) upon every period as given in the *periodicityAndOffset*
	+ *Revise the WA:*
		- *monitoringSlotsWithinSlotGroup-r17* can indicate the slots with configured MOs in two consecutive slot groups of X=4. UE can expect that the configured MOs are in same position in both slot groups.
		- if *monitoringSlotsWithinSlotGroup-r17* is not configured, the SS set is only configured in slot in a slot group
* Agree on TP 5 for SS set configuration
 |

### R1-2201735 (Ericsson)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The following open issues from this agreement are identified:1. For Group (2) SSs
	1. Whether or not the monitoring periodicity and/or duration are restricted to be integer multiples of Xs slots
	2. Whether or not the slots indicated by the bitmap *monitoringSlotsWithinSlotGroup-r17* need to be consecutive
2. Details of the offset configured by the parameter *monitoringPeriodicityAndOffset-r17*
3. Whether or not the definition of the parameter *duration* needs to be revised

Regarding Issue 1a, according to the agreement for mandatory Group (2) monitoring capability below, the UE shall be capable of monitoring a particular Group (2) search space in a single span within each slot of the slot group. Hence, this agreement would already preclude that the monitoring periodicity and duration are restricted to be integer mulitples of Xs slots.**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.

Regarding Issue 1b, we note that the legacy monitoring behavior defined in 38.331 and 38.304 for SI acquisition and paging (i.e., Type0A/2 SSs), respectively, are defined in terms of slots not slot groups. We prefer to avoid any changes to that legacy behavior, which may be required if configuration restrictions on *monitoringSlotsWithinSlotGroup-r17* are introduced. We note that even if the monitoring periodicity for Type0A/2 SSs is configured to be quite small (e.g., 1 or 2 slots), the actual monitoring occasions within the SI window/paging frame are spaced much wider than the configured periodicity due to how the MOs are associated with transmitted SSBs (see discussion in Section 2.3).Based on the above we make the following pair of proposals:1. For Group(2) SSs, the monitoring periodicity and duration are not restricted to be integer multiples of Xs slots.
2. For Group(2) SSs, the slots indicated by the bitmap *monitoringSlotsWithinSlotGroup-r17* are not restricted to be consecutive.

According to the above agreement on search space configuration, the periodicity indicated by the parameter *monitoringPeriodictyAndOffset-r17* is restricted bo be an integer multiple of Xs slots for Group (1) SSs. As we discussed previously (see Proposal 3), we propose that this restriction does not apply to Group (2) SSs. As agreed last meeting, for both Group (1) and Group (2), the value range of the parameter *monitoringPeriodictyAndOffset* is extended such that it allows for configuration of a number of slot groups that cover an equivalent time duration as the number of slots for 120 kHz. This needs to be captured in the field description of the RRC parameter. Furthermore, in the field description currently in 38.331, the allowed periodicities for monitoring for DCI formats 2\_0, 2\_1, and 2\_4 are restricted to a certain number of slots, e.g., for DCI format 2\_0 the periodicity is restricted to {1, 2, 4, 5, 8, 10, 16, or 20} slots. For the case of multi-slot PDCCH monitoring, it makes sense to extend the applicable values up to 160 slots to cover the case when either Xs = 8 or Xs = 4 is used.1. In the RRC parameter spreadsheet, provide a recommendation to RAN2 to update the field description of the parameter *monitoringPeriodictyAndOffset* as follows including additional allowed periodicities at least for DCI format 2\_0 (DCI formats 2\_1 and 2\_4 can be separately discussed):

|  |
| --- |
| ***monitoringSlotPeriodicityAndOffset***Slots for PDCCH Monitoring configured as periodicity and offset. If the UE is configured to monitor DCI format 2\_1, only the values 'sl1', 'sl2' or 'sl4' are applicable. If the UE is configured to monitor DCI format 2\_0, only the values ′sl1′, ′sl2′, ′sl4′, ′sl5′, ′sl8′, ′sl10′, ′sl16′, and ′sl20′ are applicable (see TS 38.213 [13], clause 10) and additionally the values 'sl32', 'sl40', 'sl64', 'sl80', 'sl128', and 'sl160' are applicable if a UE monitors PDCCH according to a slot group combination (,) (see TS 38.213 [13], clause 10). If the UE is configured to monitor DCI format 2\_4, only the values 'sl1', 'sl2', 'sl4', 'sl5', 'sl8' and 'sl10' are applicable.If a UE monitors PDCCH in a Type-1 CSS with dedicated RRC configuration, or a type 3 CSS, or a USS on a cell according to a slot group combination (,) (see TS 38.213 [13], clause 10), only values 'slN' are applicable where N=n\*Xs and n is an integer greater than or equal to 1.For IAB-MT, If the IAB-MT is configured to monitor DCI format 2\_1, only the values 'sl1', 'sl2' or 'sl4' are applicable. If the IAB-MT is configured to monitor DCI format 2\_0 or DCI format 2\_5, only the values ′sl1′, ′sl2′, ′sl4′, ′sl5′, ′sl8′, ′sl10′, ′sl16′, and ′sl20′ are applicable (see TS 38.213, clause 10). |

Regarding Issue 2 above, the following is already specified in 38.213 Section 10:If a UE can indicate a capability to monitor PDCCH according to one or more combinations , where and are numbers of consecutive slots, groups of slots are consecutive and non-overlapping, and the slots are within the slots. The first group of slots starts from the beginning of a subframe. The start of two consecutive groups of slots is separated by slots. This says that the location of the slot groups is fixed and aligned from the beginning of a subframe. Given the prior agreement that the Y consecutive slots in which PDCCH is monitored in Group (1) SSs can be located anywhere within a slot group, and that the slot(s) in which the UE monitors PDCCH in Group (2) SSs can be anywhere within a slot group, it is essential that the offset configured with the parameter *monitoringPeriodicityAndOffset* can be configured with slot level granularity, i.e., unrestricted. Based on this, we propose the following:1. For both Group (1) and Group (2) SSs, the offset configured by the parameter *monitoringPeriodicityandOffset-r17* is not restricted to be an integer multiple of Xs slots.

As shown in the above agreement on search space configuration, the value range {8,12, …, 20476} for the parameter *duration-r17* supports integer multiples of Xs both for Xs = 4 and 8 which applies to Group (1) SSs. However, as discussed above for Group (2) SSs, the periodicity and duration should not be restricted to integer multiples of Xs (see Proposal 3). Hence, for the parameter duration-r17 to be usable for both Group (1) and Group (2) search spaces, the value range should be augmented to include all integer values from 2 .. 20479. If the value range is not augmented in this way, then a separate duration parameter would be needed for Group (2) SSs, and we don’t think this is a preferrable solution.Based on this discussion, we makes the following pair of proposals:1. For the parameter *duration-r17*, augment the agreed value range {8, 12, …, 20476} to include all integer values in the range {2 .. 20479}. For Group (1) SSs, the configured duration is restricted to be integer multiples of Xs as previously agreed. For Group (2) SSs, the configured duration is not restricted.
2. In the RRC parameter spreadsheet, provide a recommendation to RAN2 to update the field description of the parameter *duration* as follows:

|  |
| --- |
| ***duration***Number of consecutive slots that a SearchSpace lasts in every occasion, i.e., upon every period as given in the *periodicityAndOffset*. If the field is absent, the UE applies the value 1 slot, except for DCI format 2\_0. The UE ignores this field for DCI format 2\_0. The maximum valid duration is periodicity-1 (periodicity as given in the *monitoringSlotPeriodicityAndOffset*).If a UE monitors PDCCH in a Type-1 CSS with dedicated RRC configuration, or a type 3 CSS, or a USS on a cell according to a slot group combination (,) (see TS 38.213 [13], clause 10), the duration can only be configured such that it is an integer multiple of with minimum value . If the field is absent, the UE applies the value slots except for DCI format 2\_0. The UE ignores this field for DCI format 2\_0.For IAB-MT, duration indicates number of consecutive slots that a SearchSpace lasts in every occasion, i.e., upon every period as given in the *periodicityAndOffset*. If the field is absent, the IAB-MT applies the value 1 slot, except for DCI format 2\_0 and DCI format 2\_5. The IAB-MT ignores this field for DCI format 2\_0 and DCI format 2\_5. The maximum valid duration is periodicity-1 (periodicity as given in the *monitoringSlotPeriodicityAndOffset*). |

Some companies expressed a concern that if the SSSG switch occurs early in the slot group and the new SSSG is based on a different location of the Y slots for Group (1) monitoring, then decisions on search space dropping may need to be re-evaluated. To avoid this complication, it was suggested to specify that SSSG switches are always aligned with a slot group boundary. This seems like a reasonable restriction to avoid specifying complicated UE behavior. Furthermore, it does not conflict with the conclusion above. It can be specified that upon timer expiry, the UE performs the switch at the next slot group boundary.1. For a serving cell, if if a UE is configured with *monitoringCapabilityConfig* = *r17monitoringcapability* and is provided a group index for a search space by *searchSpaceGroupIdList*, the UE starts or stops monitoring search spaces in the corresponding search space set group (SSSG) not earlier than the beginning of the first symbol of the first group of Xs slots that occurs after the slot in which the UE determines that a SSSG switch should occur.

The two working assumptionsWorking assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8Working assumptionThe following values are adopted as minimum value of for 120/480/960 kHz* Support only search space set group switching processing capability 1 with the following values

|  |  |
| --- | --- |
|  | **Minimum value for** **UE processing capability 1 [symbols]** |
| 3 | 40 |
| 5 | 160 |
| 6 | 320 |

have been captured and approved in TR 38.213 [3]. In our view, both can be considered confirmed. |

### R1-2201765 (Apple)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposal 6:*** *To limit the complexity based on the Group (2) SS location across multiple slot groups, one or more of the following could be considered:** *Group (2) SSs could be placed within the same slot group*
* *If spread across multiple slot groups, for CSSs Type 0 (SIB1), Type 0A (SIBx) and Type 2 (Paging), the CSS periodicity for 480 kHz and 960 kHz should not be shorter than that for 120 kHz to ensure that the wake-up period is intermittent and limit the impact on the UE’s power consumption.*
* *Limit the number of times a Group (2) SS may be configured within a duration of M slot groups e.g. N SSs within M slot-groups where the N SSs are in consecutive slot groups*

***Proposal 8:*** *To finalize the design of the Search Space configuration parameters for multi-slot PDCCH monitoring , the following should be agreed upon:** *The configured value of the offset at least for Group (1) SSs is restricted to be an integer multiple of Xs slots*
* *The Working Assumption on the new parameter monitoringSlotsWithinSlotGroup-r17 should be accepted.*

***Proposal 12:*** *The following WA made in RAN1 #107-e should be confirmed:**Working assumption**The following values are adopted as minimum value of  for 120/480/960 kHz** *Support only search space set group switching processing capability 1 with the following values*

|  |  |
| --- | --- |
|  | Minimum  value for UE processing capability 1 [symbols] |
| 3 | 40 |
| 5 | 160 |
| 6 | 320 |

***Proposal 13:*** *Rel-16 and Rel-17 SSSG switching are not simultaneously configured* |

### R1-2201899 (NEC)

|  |
| --- |
| For operation in unlicensed band beyond 52.6GHz, in our understanding, the legacy SSSG switching can be reused for 120 kHz SCS, since it has been concluded: for 120 kHz SCS, no multi-slot UE capability for PDCCH monitoring is needed. So the monitoring capability before and after the SSSG switch is the same, both are per-slot based. While for 480 kHz and 960 kHz SCS, it was agreed in RAN1#107-e [2], there are several supported combinations of (X, Y). If a UE supports multiple (X, Y) combinations, it will be more flexible to support SSSG switching between different (X, Y) combination. For example, to handle those use cases with low-latency, denser PDCCH monitoring occasion may be configured in some period, then PDCCH monitoring capability combination will be changed along with SSSG switching, e.g. for 960 kHz SCS, there are 2 configured SSSG, PDCCH is configured to be monitored per 8-slots by the first search space set group, and the second search space set configures PDCCH to be monitored per 4-slots. In this case, the monitoring capability is different before and after the switching. In our view, SSSG switching between SSSGs that have the different (X, Y) PDCCH monitoring combination should be supported.**Proposal 1: For operation in unlicensed band with 480 kHz and 960 kHz SCS, support SSSG switching between SSSGs that have the different (X, Y) PDCCH monitoring combination.**In Rel-16, the switching boundary is the first slot that is at least symbols after some switch indication. For 480 kHz and 960 kHz SCS, PDCCH monitoring capability is multi-slot based, e.g. 4 slots for 480 kHz SCS and 4/8 slots for 960 kHz SCS, the switching boundary should be naturally extended to slot group based accordingly, and it can avoid monitoring two search space set groups in one slot group.**Proposal 2: For operation in unlicensed band with 480 kHz and 960 kHz SCS, the switching boundary is aligned with the boundary of a slot group** |

### R1-2201914 (Xiaomi)

|  |
| --- |
| It was agreed that for *duration-r17*, the value range is {8, 12, …, 20476}, and values represent slots. The configured duration is restricted to be an integer multiple of Xs slots at least for Group (1) SSs. Our understanding for *duration-r17* is the number of consecutive slots that cover a SearchSpace in every periodicity, and search space can only exist within the slot(s) that is(are) indicated as ‘1’ by *monitoringSlotsWithinSlotGroup-r17.* For example, if *duration-r17* is configured as 8, and Xs =4, *monitoringSlotsWithinSlotGroup-r17*=10001000.It is clear the intention is not to have consecutive 8 slots for the searchspace, rather, there is only 2 slots, 1 slot out of every 4 slots, for the search space within a periodicity. ***Proposal 2: duration-r17 is the number of consecutive slots that cover a SearchSpace in every periodicity, and search space can only exist within the slot(s) that is(are) indicated as ‘1’ by monitoringSlotsWithinSlotGroup-r17****.* |

### R1-2202005 (Samsung)

|  |
| --- |
| In the last meeting, a framework for search space configuration applicable to multi-slot based PDCCH monitoring was agreed, and there are remaining issues to be resolved based on the framework.First, there is a FFS on the offset of search space set. Based on current framework, the periodicity and duration of the search space set are both integer multiple of , and hence, the offset should also be an integer multiple of such that the duration of a search space set starts from a boundary of a group of slots. Also, there is a FFS on the definition of duration for the search space set. For legacy search space set configuration, the field duration refers to “number of consecutive slots that a *SearchSpace* lasts in every occasion”, which is obviously not applicable to Group (1) SSs. The description should be revised for multi-slot based PDCCH monitoring, and a UE should assume a *SearchSpace* may last in a subset of the consecutive slots according to the newly introduced bitmap *monitoringSlotsWithinSlotGroup-r17*. Lastly, it was agreed to have the limitation that the bits taking value of 1 in the bitmap for indicating slots including Group (1) search space set (i.e., *monitoringSlotsWithinSlotGroup-r17*) should be consecutive, and it should be further clarified that the number of bits taking value of 1 should be no larger than in order to be compatible with the framework for multi-slot based PDCCH monitoring.  **Proposal 4: For search space set configuration of multi-slot PDCCH monitoring:*** **the configured offset at least for Group (1) SSs is restricted to be an integer multiple of slots;**
* **“duration-r17” refers to “number of consecutive slots that formulates a number of groups of slots where a *SearchSpace* locates according to *monitoringSlotsWithinSlotGroup-r17* in each of the group of slots”;**
* **The number of slots indicated by “monitoringSlotsWithinSlotGroup-r17” should be no larger than .**
 |

### R1-2202072 (MediaTek)

|  |
| --- |
| In RAN1 #107-e meeting, the framework of multi-slot PDCCH monitoring and BD/CCE limit within a slot group in a single cell has been specified. Further in RAN1 #107bis-e meeting, enhancements of search space set configuration were discussed. Two IEs are introduced, *duration-r17* and *monitoringSlotsWithinSlotGroup-r17,* to address the flexibility of multi-slot PDCCH monitoring configuration but no clear definition is captured. In our understanding, the purpose of *duration-r17* is to specify the “duration” of slot-group and the purpose of *monitoringSlotsWithinSlotGroup-r17* is to specify which slots within a slot group are configured to monitor. That is, for a search space set , UE will monitor PDCCH in the slots indicated by *monitoringSlotsWithinSlotGroup-r17* within a slot group of slots and the same monitoring pattern within a slot group will be performed in consecutive slot groups, where *duration-r17*=. It was also discussed that the slots indicated in the bitmap should be consecutive at least for Group (1) SSs. In our view, the same restriction should be applied to Group (2) SSs since it is unlikely that UE will monitor a Group (2) SS more than once in a slot group.**Proposal 2: For a search space set configuration, UE is provided a PDCCH monitoring pattern within a slot group of size slots indicating a duration of consecutive slots that a search set s exists by *monitoringSlotsWithinSlotGroup-r17*. The same monitoring pattern within a slot group will be performed in consecutive slot groups indicated by *duration-r17*=.** |

### R1-2202130 (Qualcomm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Based on the agreement, associated with a SS set, slot(s) for PDCCH monitoring in a slot group is determined by the new parameter, *monitoringSlotsWithinSlotGroup-r17*. In the legacy SS set configuration, however, the monitored slot within a period (or with respect to SFN = 0) is determined by the offset (i.e., *monitoringSlotPeriodicityAndOffset*). As such, in Rel-17, there are two distinct parameters of similar purposes. To avoid the duplication and to keep the configuration consistent, it would be fair to split the roles. That is, if *monitoringSlotsWithinSlotGroup-r17* is configured to indicate a slot offset, the offset parameter (indicated by *monitoringSlotPeriodicityAndOffset-r17*) may indicate a slot group offset, i.e., the starting slot of the slot group where the first MO in a duration (indicated by *duration-r17*) is located. Proposal 4: For multi-slot PDCCH monitoring, when *monitoringSlotsWithinSlotGroup-r17* is provided, the offset parameter given by *monitoringSlotPeriodicityAndOffset-r17* of the search space set configuration is restricted to be an integer multiple of Xs slots.* **The offset parameter indicates a slot group offset, i.e., the first slot of the slot group where the first MO in a duration indicated by duration-r17 is located.**

For the granularity of the periodicity, since the new parameter *monitoringSlotPeriodicityAndOffset-r17* is dedicatedly used for multi-slot PDCCH monitoring configuration, any values that are not integer multiples of Xs are unnecessary. Thus, the granularity of periodicity and offset parameters may be restricted to only support integer multiples of Xs.Proposal 5: *monitoringSlotPeriodicityAndOffset-r17* is dedicatedly used for multi-slot PDCCH monitoring configuration.* **The range of the periodicity is {~~1,2,~~4,~~5,~~8,~~10,~~16,20,32,40,64,80,128,160,320,640,1280,2560,5120,10240,20480}.**
* **For a periodicity value Xp, the range of the offset is {0,4,8,…,}.**

In Rel-15/16, the periodicity configuration for some group-common DCI formats is restricted. Thus, for multi-slot PDCCH monitoring in Rel-17, similar restriction should be applied. To maintain the same level of flexibility as 120 kHz SCS in FR2-1, the restricted set of periodicities for 480/960 kHz SCSs may be determined by simple scaling.Proposal 7: For group common DCI formats, the following periodicities are only applicable:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **120 kHz (same as FR2)** | **480 kHz** | **960 kHz** |
| **DCI format 2\_0** | **sl1, sl2, sl4, sl5, sl8, sl10, sl16, sl20** | **sl4, sl8, sl16, sl20, sl32, sl40, sl64, sl80** | **sl8, sl16, sl32, sl40, sl64, sl80, sl128, sl160** |
| **DCI format 2\_1** | **sl1, sl2, sl4** | **sl4, sl8, sl16** | **sl8, sl16, sl32** |
| **DCI format 2\_4** | **sl1, sl2, sl4, sl5, sl8, sl10** | **sl4, sl8, sl16, sl20, sl32, sl40** | **sl8, sl16, sl32, sl40, sl64, sl80** |
| **\* Highlighted: New periodicity values to be introduced for 480/960 kHz SCSs** |

When a UE reports more than one (Xs,Ys) values for the multi-slot PDCCH monitoring capability, the search space set configuration should comply with at least one of the reported (Xs,Ys) values. At the same time, there should be no ambiguity in the search space set configuration between the UE and the gNB. In RAN1 #107b-e, a working assumption was made that the new parameter *monitoringSlotsWithinSlotGroup-r17* is given by a bitmap of a fixed size, i.e., 8 bits. For Xs = 8 slots, the bitmap can indicate the consecutive Y slots within a slot group of 8 slots. Likewise, for Xs = 4 slots, only the first 4 bits of the bitmap may be used, while the rest 4 bits are left unused. However, depending on how the unused bits are marked, there could be an ambiguity between the UE and the gNB. For example, if the unused bits are set to ‘0’, a bitmap of ‘10000000’ may results in different MO configurations depending on whether it is interpreted with Xs = 8 slots or Xs = 4 slots, as illustrated in Figure 1.Figure 1: PDCCH MO configuration ambiguity for *monitoringSlotsWithinSlotGroup-r17* = 10000000.To address the ambiguity issue, the bitmap, *monitoringSlotsWithinSlotGroup-r17*, can have a variable size, e.g., 4 bits or 8 bits. The size of the configured bitmap can implicitly indicate the selected Xs value by the gNB, among the multiple values supported by the UE.Proposal 6: The bitmap size of the new parameter, *monitoringSlotsWithinSlotGroup-r17*, is Xs bits, where Xs is either 4 or 8.In RAN1 #107b-e, the following has been agreed:

|  |
| --- |
| **Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.
 |

FG 3-1, which is the basic slot-based PDCCH monitoring capability, restricts the MOs for Type1 CSS without dedicated RRC configuration and Type0/0A/2 CSSs within a slot. However, for multi-slot PDCCH monitoring, since it does not restrict the overall CSS MOs within a slot group, it may run into the same issues that we confronted with the design of SS set #0 in RAN1 #107-e: If a UE is required to monitor more than one MO for different types of CSS sets within a slot group, the BD/CCE budget may get exhausted. Thus, similar to the new design of SS set #0 (i.e., monitoring slot *n*0 and *n*0+*X*0), it would be desirable to limit the number of MOs for any of different types of CSSs within a slot group.During the RAN1 #107b-e discussion, it was argued that, at least for Type2 CSS, the MO is determined by the association with SSBs and, thus, the number of Type2 CSS MO per slot group is intrinsically limited without any explicit restriction. For example, if a MO for Type2 CSS is configured in every slot (i.e., *searchSpaceId* ≠ 0 for Type2 CSS) and the number of actually transmitted SSBs is *N*, the UE shall monitor the Type2 CSS only in a slot out of the *N* consecutive slots within a paging occasion, associated with the measured/preferred SSB. However, in some cases, the number of SSBs may be small, e.g., less than 4, and the UE may be required to monitor more than one Type2 CSS MO within a slot group. Furthermore, for Type1 CSS, when *searchSpaceId* ≠ 0, the UE can still be configured to monitor more than one MO per slot group. Proposal 2: For Type1 CSS without dedicated RRC configuration and for Type0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) within a slot, with the monitoring occasions for any of Type1 CSS without dedicated RRC configuration, or Types0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot group of X0 slots.* **X0 = 4 for 480 kHz SCS and X0 = 8 for 960 kHz SCS**

When a UE reports more than one (Xs,Ys) combinations for its multi-slot PDCCH monitoring capability, the two SSSGs may be associated with different (Xs,Ys) values. For example, when a UE with 960 kHz SCS supports (4,1) and (8,1), SSSG#0 may be configured according to (4,1), and SSSG#1 may be configured according to (8,1). SSSG#0 may provide more frequent PDCCH MOs, once in 4 slots, although the BD and CCE budgets are limited (i.e., 10 BD and 16 CCEs). On the other hand, SSSG#1 may be configured with PDCCH MOs with a periodicity larger than or equal to 8 slots and provide improved power efficiency and scheduling flexibility (i.e., 20 BD and 32 CCEs). In the same situation, on the contrary, if the two SSSGs are restricted to have the same (Xs,Ys) value, (4,1) should be applied for both SSSGs. This will limit the BD and CCE budgets of both SSSGs to 10 BD and 16 CCEs and, as a results, may harm the scheduling flexibility of SSSG#1. Thus, it is beneficial to allow different (Xs,Ys) values, if supported, for different SSSGs.Proposal 8: When a UE supports more than one (Xs,Ys) combinations for multi-slot PDCCH monitoring, the applied (Xs,Ys) value is determined per SSSG.In the legacy design of search space set group (SSSG) switching, the switching boundary is aligned with a slot boundary. However, when SSSG switching and multi-slot PDCCH monitoring are jointly applied, the legacy SSSG switching design may lead to a complicated transient behavior. For example, if the SSSG switching occurs in the middle of a slot group and, as a result, if SS sets from both SSSG#0 and SSSG#1 are included in the same slot group, BD/CCE counting, overbooking, and dropping should be re-calculated. Therefore, it would be desirable to always align the SSSG switching boundary with the slot group boundary.In RAN1 #107b-e, it was concluded that the SSSG timer operates in a slot unit, which implies that the expiration of the timer may not always aligned with the slot group boundary. Thus, once the timer expires at a slot in the middle of a slot group, the actual SSSG switching can occur at the next slot group boundary. If the UE supports more than one (Xs,Ys) values, and the two SSSGs are associated with different Xs values, the slot group boundary would be determined by the largest Xs value between the two SSSGs.Proposal 9: For multi-slot PDCCH monitoring for 480/960 kHz SCSs, a boundary of SSSG switching is always aligned with a boundary of a slot group.* **When the SSSGs are associated with different slot group sizes Xs, the slot group boundary is determined by the largest Xs value between the two SSSGs.**

Further related to the joint configuration of multi-slot PDCCH monitoring and SSSG switching, a situation shown in Figure 2 may be considered. That is, SSSG switching occurs from the first SSSG to the second SSSG. Then, at the boundary of SSSG switching, the locations of the two Y consecutive slots in the slot groups before and after the switching boundary may be different. In another case, the two SSSGs may be associated with different (Xs,Ys) values according to Proposal 8. Thus, in such cases, the separation between the two Y consecutive slots may be less than Xs slots. To avoid such a situation in Figure 2, a rule for dropping PDCCH MOs may be considered. For example, when the separation between the two Ys consecutive slots before and after the switching boundary is less than Xs slots, where Xs is according to the first (source) SSSG, some or all of the MOs in the Ys consecutive slots in the second (target) SSSG after the switching boundary may be dropped.Proposal 10: A dropping rule for PDCCH MOs may be applied for the first Ys consecutive slots after SSSG switching, if the separation between the two Ys consecutive slots before and after the SSSG switching boundary is less than Xs slots.Figure 2: An example of SSSG switching for multi-slot PDCCH monitoring. |

### R1-2202190 (Sharp)

|  |
| --- |
| In RAN1#107-e meeting, the working assumption for SSSG switching at 120/480/960kHz is achieved. The working assumption was directly described in 38.213, and the minimum switching time *Pswitch* was defined as one value for each SCS. Here, we have one concern about the SSSG switching at 480kHz/960kHz, which is that it may cause a back-to-back problem when switching. It is important to avoid this problem, which we have been considering for a long time in past meetings. In the current specification, SSSG-related monitoring is stopped and started at the same time in the first slot after the *Pswitch*. However, in multi-slot monitoring, SSSG switching may be performed after the UE has monitored in a later slot of the slot group, and monitoring may start in the slot immediately after. In this case, a back-to-back problem occurs. To avoid this situation, it is possible to not monitor the *Xs* slots before and after the SSSG boundary. This can be achieved by dropping PDCCH candidates in the *Xs* slots before or after the switchover, or by setting different *Pswitch* values to stagger the stop and start of monitoring.**Figure 1:Possible problem with SSSG switching with multi-slot monitoring.****Proposal 3: To avoid the back-to-back problem, monitoring should not be done in the Xs slots before and after the SSSG boundary.****Proposal 4: Adopt Text proposal #2-1 or #2-2.** |

### R1-2202234 (Transsion Holdings)

|  |
| --- |
| In RAN1#107-e meeting, it was agreed that the same units for parameters *monitoringSlotPeriodicityAndOffset, duration* and *monitoringSymbolsWithinSlot* are reused in FR 2-2. Regarding the mechanism to determine monitoring slots within a slot group, sine the three parameters have been reused, a simple approach is to introduce a new parameter to indicate which slots within a slot group can be used to monitor the PDCCH instead of modifying the existing three parameters.***Proposal 3: Confirm the working assumption that a new parameter monitoringSlotsWithinSlotGroup-r17 should be introduced.***In unlicensed band, it is beneficial to access the channel as soon as possible, when gNB passes the LBT. For this reason, the PDCCH monitoring occasion needs to occur frequently in the time domain. However, frequent monitoring of PDCCH consumes a plenty of power on the UE side, which is not beneficial for UE. In order to resolve this issue, a mechanism of search space set group switching is introduced to balance the channel access possibility from gNB side and the power consumption on PDCCH monitoring of UE side.Regarding the parameter , in NR-U the value of is based on SPS release timeline. For 120kHz SCS, the value of SPS release timeline is 25 symbols. Considering the implementation margin, 40 symbols is reasonable for 120kHz SCS. Then, the values for 480/960kHz SCS can be directly scaled by a factor of 4/8.Furthermore, when SSSG switching operates on a slot group basis, it is also necessary to determine to which slot the switching operation applies. When reusing the Rel 16 rule, if the first slot after the time of symbols is in the middle of the slot group, some potential issues may arise. Considering the SS set configuration can be switched in a slot group, the UE may be required to monitor two search space set groups during a slot group, in that case the BD/CCE budget may exceed the the limitation of the UE. As a result, unnecessary search space dropping occurs. Therefore, SSSG switching mechanism should take the slot group as the unit. ***Proposal 4: Confirm the working assumption that the value of should be 40, 160, 320 respectively for 120/480/960 kHz SCS.******Proposal 5: SSSG switching mechanism should take the slot group as the unit.*** |

### R1-2202336 (LG)

|  |
| --- |
| In Rel-15, the definition of *duration* is the number of consecutive slots in which the SS set exists within (i.e., the configured period). However, for multi-slot monitoring in Rel-17, can be set across multiple slot-groups and UE can monitor Group (1) SS only in limited number of slots within a slot-group, so the slots in which the SS set exists within may be non-consecutive. In order to indicate such non-consecutive monitoring slots within , it is required to configure two different parameters jointly. One is the *duration-r17* indicating the number of consecutive slots in which MO may exist within (which is a parameter similar to *duration* for Rel-15 except that MO does not always need to exist in the slot indicated by *duration*), and the other is *monitoringSlotsWithinSlotGroup-r17* indicating the monitoring slots within each slot-group. With these two parameters, UE can determine the exact monitoring occasions within . Therefore, for multi-slot monitoring, *duration-r17* can be defined as “the number of consecutive slots that a monitoring occasion may exist within periodicity indicated by *monitoringSlotPeriodicityAndOffset-r17*”. It is noted that not all slots indicated by *duration-r17* need a valid monitoring occasion to exist.**Proposal #5: For Group (1) SS, *duration-r17* should indicate the number of consecutive slots (within periodicity indicated by *monitoringSlotPeriodicityAndOffset-r17***) **in which a monitoring occasion can exist. Among these slots, a slot whose corresponding bit in *monitoringSlotsWithinSlotGroup-r17* is set to ‘1’ can be a valid monitoring slot.**In addition, the default value of *duration-r17* for Group (1) SS sets should be discussed. According to the agreement above, the configured duration is restricted to be an integer multiple of Xs slots at least for Group (1) SS. So, the default value for Group (1) SS should be defined differently for each SCS. Considering that the default value of Rel-15 *duration* is 1 slot (which is the minimum value for *duration*), the default value of *duration-r17* can be defined as 4/8 slots for 480/960 kHz, respectively. **Proposal #6: For Group (1) SS, define the default value of *duration-r17* as 4 slots for 480 kHz or 8 slots for 960 kHz.**The parameter *monitoringSlotsWithinSlotGroup-r17* is newly defined for multi-slot monitoring. As a working assumption, 8-bit bitmap was agreed to indicate the monitoring slots within a slot-group for 480 kHz or 960 kHz. Each bit in this parameter represents a slot in a slot-group and each bit is set to ‘1’ if MO exists in the corresponding slot. One thing to emphasize is that the monitoring slots configured by this parameter should be valid only for slots indicated by *duration-r17*. **Proposal #7: *monitoringSlotsWithinSlotGroup-r17* should be valid only for slots indicated by *duration-r17*.**Among the supported (X,Y) combinations, *monitoringSlotsWithinSlotGroup-r17*does not need to be set for the (X,Y) combinations that are mandatorily supported. This is because, for these combinations, a UE monitors PDCCH candidates only in one slot per slot-group, and the corresponding slot can be indicated by *monitoringSlotPeriodicityAndOffset-r17*. That is, even if this parameter is not set for the mandatorily supported (X,Y) combinations, the UE may recognize one slot for each X slots as a monitoring slot. Of course, the corresponding monitoring slot is only valid for slots indicated by *duration-r17*. Alternatively, default value of *monitoringSlotsWithinSlotGroup-r17* can be used for the mandatorily supported (X,Y) combinations. For instance, the default value can be defined as '10000000'. If *monitoringSlotsWithinSlotGroup-r17* is not configured when multi-slot monitoring is based on mandatorily supported (X,Y) combination, the first slot of each slot-group (only for slots indicated by *duration-r17*) can be determined as the monitoring slot according to the default value.**Proposal #8: *monitoringSlotsWithinSlotGroup-r17* doesn’t need to be configured for the mandatorily supported (X,Y) combinations.****Proposal #9: Define the default value of *monitoringSlotsWithinSlotGroup-r17* as ‘10000000’ for 480 kHz or 960 kHz.**Regarding SSSG switching, in Rel-15/16 NR, one SSSG could be switched to another SSSG at the slot boundary after at least P\_switch symbols from the switching triggering. However, for the multi-slot monitoring, if SSSG switching occurs at the slot boundary inside the slot-group rather than the slot-group boundary, the complexity of the UE may increase. For example, when a switch occurs within the X slot-group, it may operate as SSSG#0 before the switching and may operate as SSSG#1 after that. At this time, since the BD/CCE budget for 480/960 kHz SCS is checked in units of slot-group, SSSG change in the middle of slot-group may cause to increase UE complexity compared to that for the SSSG switching at slot-group boundary. In addition, given that the boundaries of slot-groups and SSSG switching are aligned and the location of Y within the X slot is maintained across slot-groups even if SSSG is switched, back-to-back monitoring issue would be avoided. In this regard, SSSG switching should be performed at the slot-group boundary. **Proposal #11: For 480 kHz or 960 kHz multi-slot monitoring, SSSG switching should be performed at the slot-group boundary** **after at least P\_switch symbols from the switching triggering.**In Rel-16 NR-U, timer-based SSSG switching was introduced. A UE sets the timer value to the number of slots provided by *searchSpaceSwitchTimer* when SSSG switching is triggered from the default SS group (SSSG#0) to the other one (SSSG#1). The UE decrements the timer value by one after each slot based on the smallest SCS among all configured DL BWPs in the serving cell. The maximum value of *searchSpaceSwitchTimer* is 20/40/80 for 15/30/60 kHz, respectively. These are values derived from the maximum COT duration, 20 msec, for the NR-U in Rel-16. However, the maximum COT duration in FR2-2 was determined to be 5 msec, therefore the maximum value of *searchSpaceSwitchTimer* can be defined as the number of slots corresponding to that time for each SCS, at least for operation with shared spectrum channel access. **Proposal #12: For operation with shared spectrum channel access, define 40/160/320 slots as the maximum value of *searchSpaceSwitchTimer* for 120/480/960 kHz SCS, respectively.** |

### R1-2202409 (Lenovo, Motorola Mobility)

|  |
| --- |
| According to the working assumption, the size of the new parameter *monitoringSlotsWithinSlotGroup-r17* is 8 bits regardless of the slot group size. In our opinion, the size of the parameter can be aligned with the slot group size for the corresponding search space configuration, so that for X=4 the bitmap is 4 bits wide and for X=8 the bitmap is 8 bits wide. This can be efficiently implemented in RRC.***Proposal 2: Confirm the working assumption from RAN1#107bis-e with the following modification:**** ***The size of monitoringSlotsWithinSlotGroup-r17 is equal to the number of slots per slot group (i.e. X).***
 |

## Topic A3: BD Budget/Dropping

### R1-2200953 (Huawei, HiSilicon)

|  |
| --- |
| The discussion on monitoring capability for multiple serving cells in RAN1#107b-e lead to the the formulation of the following two alternatives [1]:* Alt 1: Serving cells with the same PDCCH monitoring type including multi-slot-based capability are grouped together for further BD/CCE budget calculation
	+ Alt 1-1: Within a group of serving cells with multi-slot-based capability, the serving cells with the same SCS and value are grouped together to follow a total BD/CCE budget
	+ Alt 1-2: Within a group of serving cells with multi-slot-based capability, the serving cells with the same SCS and value are grouped together to follow a total BD/CCE budget
* Alt 2: Transform the serving cell with multi-slot-based capability to equivalent serving cell with slot-based capability for further BD/CCE budget calculation
	+ Alt 2-1: A serving cell with SCS and multi-slot-based capability is considered as an equivalent virtual cell with SCS and slot-based capability, where a slot group for the serving cell is considered as a slot for the virtual cell
	+ Alt 2-2: A serving cell with SCS and multi-slot-based capability is considered as an equivalent virtual cell with SCS and slot-based capability, where 4/8 slots for the serving cell with SCS is considered as a slot for the virtual cell

Alt 1 is similar to the BD/CCE budget calculation for per-span PDCCH monitoring in Rel-16 and is straightforward. However, since the value of in does not impact the maximum BD/CCE budget, there is no need to calculate the BD/CCE budgets of serving cells with the same SCS and yet different separately. Hence, Alt 1-2 is least preferred.As pointed out by some companies in [1], there are the following 3 cell types in NR Rel-17: serving cells with slot-based PDCCH monitoring capability, serving cells with span-based PDCCH monitoring capability, and serving cells with multi-slot PDCCH monitoring capability. If Alt. 1 is adopted, i.e., the MOs of different PDCCH monitoring capabilities for each numerology are counted separately, it might be a burden on the UE side. Therefore, Alt 2 seems a better solution to us. ***Proposal 14: Support to transform the serving cell with multi-slot-based capability to an equivalent serving cell with slot-based capability for further BD/CCE budget calculation.*** |

### R1-2201086 (vivo)

|  |
| --- |
| Therefore, in multi-cell operation scenario, BD/CCE budget calculation becomes more complex by introducing such multi-slot-based BD/CCE budget definition, i.e. more additional cases as described above. The following alternatives could be considered:**Alt. 1**: Serving cells with the same PDCCH monitoring type including multi-slot-based capability are grouped together for further BD/CCE budget calculation* Alt. 1-1: Within a group of serving cells with multi-slot-based capability, the serving cells with the same SCS and (Xs, Ys) value are grouped together to follow a total BD/CCE budget
* Alt. 1-2: Within a group of serving cells with multi-slot-based capability, the serving cells with the same SCS and Xs value are grouped together to follow a total BD/CCE budget

As a straightforward alternative, the BD/CCE budget calculation adopts the same way for NR Rel-16, i.e. serving cells with the same PDCCH monitoring type are grouped together for further handling. Particularly, the follows steps apply:* Determination of : UE needs to report respective for different cases, i.e. Case 1-7 as described above. For the case with mixed capability, *L* values need to be reported where *L* is the number of capability types in that case (e.g. 3 in case 7);
* Determination of total limit for each group of serving cells:
	+ If the group adopts slot-based or span-based capability, legacy way is used;
	+ If the group adopts multi-slot-based capability, further divide the cell group into different parts depending on SCS and/or value of X/Y. Then BD/CCE budget for the serving cells will follow one total limit. Note that there may have certain limits in the group or part of serving cells.

**Alt. 2**: Transform the serving cell with multi-slot-based capability to equivalent serving cell with slot-based capability for further BD/CCE budget calculation* Alt. 2-1: A serving cell with SCS and multi-slot-based capability (Xs, Ys) is considered as an equivalent virtual cell with SCS (Xs) and slot-based capability, where a slot group for the serving cell is considered as a slot for the virtual cell
* Alt. 2-2: A serving cell with SCS and multi-slot-based capability is considered as an equivalent virtual cell with SCS and slot-based capability, where 4/8 slots for the serving cell with SCS is considered as a slot for the virtual cell

As another alternative, the serving cell with SCS µ and multi-slot-based capability can be transformed to an equivalent virtual serving cell with SCS µ’ and slot-based capability, e.g. e.g. cell A with 480KHz SCS and BD/CCE budget per 4 slots is equivalent to a virtual cell A’ with 120KHz and BD/CCE budget per slot. After this, legacy operation as NR Rel-16 could be reused to calculate the BD/CCE budget.By comparing the above alternatives, Alt. 2 works well with less spec impact. Thus, Alt. 2 is preferred to handle multi-slot PDCCH monitoring capability for multi-serving cell case.**Proposal 3: For multi-cell operation, support the following method to handle multi-slot PDCCH monitoring capability for multi-serving cell case, i.e. transform the serving cell with multi-slot-based capability to equivalent serving cell with slot-based capability for further BD/CCE budget calculation.** |

### R1-2201352 (CATT)

|  |
| --- |
| In RAN1#107-e meeting, the definition for multi-slot PDCCH monitoring capability was agreed. The remaining issue on SS overbooking across different slot groups requires further study. Since Group (2) SS monitoring locations can be anywhere within a slot group, the total number of BD/ CCE for those Group(2) SSs within the current slot group and SSs within the next slot group may exceed the BD/ CCE budgets for a slot group, as shown in Figure 3. In our view, the SS overbooking across different slot groups can be avoided by gNB implementation. No additional dropping rule is needed.Figure 3: SS overbooking across different slot groups***Proposal 3: It can be up to gNB implementation to avoid the overbooking issue across different slot groups.*** |

### R1-2201389 (ZTE, Sanechips)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Proposal 3: Confirm the working assumption: BD/CCE budget of 960 kHz for (4,2), (4,1) is half that of X=8.**Table 1: Maximum number of monitored PDCCH candidates per slot group for combination for a DL BWP with SCS configuration for a single serving cell

|  |  |
| --- | --- |
|  | Maximum number of monitored PDCCH candidates per combination and per serving cell  |
|  | **(4, 1)** | **(4, 2)** | **(8, 1)** | **(8, 4)** |
| **5** | **20** | **20** | **-** | **-** |
| **6** | **10** | **10** | **20** | **20** |

Table 2: Maximum number of non-overlapped CCEs in a slot group for combination for a DL BWP with SCS configuration for a single serving cell

|  |  |
| --- | --- |
|  | Maximum number of non-overlapped CCEs per combination and per serving cell  |
|  | **(4, 1)** | **(4, 2)** | **(8, 1)** | **(8, 4)** |
| **5** | **32** | **32** | **-** | **-** |
| **6** | **16** | **16** | **32** | **32** |

In principle, we think serving cells with the same PDCCH monitoring type including multi-slot-based capability should be grouped together for further BD/CCE budget calculation. Since the value of Ys in (Xs, Ys) does not impact the maximum BD/CCE budget, the serving cells with the same SCS and Xs value are grouped together to follow a total BD/CCE budget.**Proposal 10: For a group of serving cells with multi-slot PDCCH monitoring capability, the serving cells with the same SCS and Xs value are grouped together to follow a total BD/CCE budget.** |

### R1-2201471 (NTT DOCOMO)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Since RAN1 has agreed that overbooking is not allowed for CSS even for multi-slot PDCCH monitoring, by defining the maximum number of CCEs as 16, the available configurations for CSS monitoring are restricted. Since type0-PDCCH monitoring can consume all the BD/CCE budgets in a slot group with Xs=4, a UE cannot monitor other SSs including other CSSs than type0-PDCCH CSS in the same slot group, or configurations, e.g., number of CCEs or aggregation level for other SSs would be limited.In addition, at RAN1#107-e meeting, it was pointed out by companies that if two consecutive slots in the same slot group are monitored for type0-PDCCH CSS of SSB/CORESET#0 multiplexing pattern 1, the required number of BD/CCE would be at most 14/56 considering the above requirement for type0-PDCCH CSS monitoring, and thus UE may not be able to monitor the CSS with the BD/CCE budget for Xs=4/8 slots for SCS 480/960 kHz (i.e., 20 BD and 32 CCE). As a result, it was agreed that the monitored slots for type0-PDCCH CSS is n0 and n0+X0 slots to distribute the monitoring occasions for the CSS into different slot groups.In that sense, it seems fair to ensure enough PDCCH candidates/CCEs configuration flexibility even for Xs=4 slots for 960 kHz SCS which is supported as an optional UE capability.Therefore, regarding maximum number of CCE for 960 kHz SCS, we suggest considering larger value for Xs=4 slots, e.g., 28 CCE as maximum, than the simply halved value from that for Xs=8 slots.**Text Proposal #1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **-------------------------- Start of Text Proposal for TS 38.213 --------------------------****<Unchanged parts omitted>**10.1 UE procedure for determining physical downlink control channel assignment**…**Table 10.1-3B provides the maximum number of non-overlapped CCEs, , for a DL BWP with SCS configuration that a UE is expected to monitor corresponding PDCCH candidates for combination for operation with a single serving cell.Table 10.1-3B: Maximum number of non-overlapped CCEs in a slot group for combination for a DL BWP with SCS configuration for a single serving cell

|  |  |
| --- | --- |
|  | Maximum number of non-overlapped CCEs per combination and per serving cell  |
|  | (4, 1) | (4, 2) | (8, 1) | (8, 4) |
| 5 | 32 | 32 | - | - |
| 6 | ~~16~~ [28] | ~~16~~[28] | 32 | 32 |

**<Unchanged parts omitted>****-------------------------- End of Text Proposal for TS 38.213 --------------------------** |

At the last RAN1 meeting, some companies pointed out that BD/CCE budget for multi-cell operation, and , need to be specified since the definitions are unclear while they are used in TS 38.213.According to the specification, for Rel-16 URLLC, the total number of BD/CCE budget and is determined to be shared for the cells which are configured with same SCS and same (X, Y) value for span PDCCH monitoring, which should be considered as a baseline.For multi-slot PDCCH monitoring in Rel-17, considering that Ys does not have any impact on maximum BD/CCE budget for multi-slot PDCCH monitoring, the total number of BD/CCE can be shared for the cells which have same Xs configuration for multi-slot PDCCH monitoring. In addition, some companies proposed that the total BD/CCE budget can be shared for the cells which have same duration for BD/CCE budget, i.e., 1 slot for 120 kHz SCS and 4/8/ slots for 480/960 kHz SCS. However, it means that the total BD/CCE budget can be shared between the cells which have different SCSs (i.e., slot based PDCCH monitoring for 120 kHz SCS and multi-slot based PDCCH monitoring for 480/960 kHz SCS may share the BD/CCE budget) and may result additional complexity.**Proposal 2: The total number of BD/CCE for multi-cell operation and is determined to be shared between the cells using the same SCS configuration and the same Xs for multi-slot PDCCH monitoring.** |

### R1-2201593 (TCL Communication)

|  |
| --- |
| The Multiple-Cell PDCCH monitoring capabilities have not reached any agreement in the last RAN1 meeting. In FR1 and FR2-1, the multiple-cell PDCCH monitoring budget are allocated to each cell proportionally. In FR2-2, the allocation of the multiple-cell PDCCH monitoring budget should follow same spirit.**Proposal 4: In FR2-2, the allocation of the multiple-cell PDCCH monitoring budget should follow the same spirit as that in FR1 and FR2-1. The multiple-cell PDCCH monitoring budget are allocated to each cell proportionally.**For FR2-2, the PDCCH monitored is monitored in slot group in 480KHz and 960KHz SCS. The and are noted in the CR for 38.213 [3]. The and can be are replaced by and respectively for and . The underlying problem is how to map PDCCH monitoring capability of one active BWP of a cell with (X, Y) to the PDCCH monitoring in the time unit of a slot. The PDCCH monitoring capability for 120KHz SCS can be a reference when determining the mapping scheme. One feasible way is to consider the value of “X” in the (X, Y) pair. When the candidate values of and are determined, only the values of “X” is concerned in [4].**Proposal 5: The PDCCH monitoring capability for 120KHz SCS, in terms of maximum number of monitored PDCCH candidates per slot for a DL BWP and maximum number of non-overlapped CCEs per slot for a DL BWP , can be a reference when determining the mapping scheme from and to and .** |

### R1-2201663 (Nokia, Nokia Shanghai Bell)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| We propose to convert the working assumption to an agreement. At the same time, we should agree the exact values for the BD/CCE budgets for different multi-slot PDCCH monitoring scenarios. We provide a proposal for the values in Table 1.Table 1. Proposed valus for BD / CCE budget per slot

|  |  |  |  |
| --- | --- | --- | --- |
| SCS | (X,Y) | BD budget per X slots | CCE budget per X slots |
| 480 kHz | (4,1) | 20 | 32 |
| 480 kHz | (4,2) |
| 960 kHz | (8,1) |
| 960 kHz | (8,4) |
| 960 kHz | (4,1) | 10 | 16 |
| 960 kHz | (4,2) |

***Proposal 1:*** The maximum number of monitored PDCCH candidates per X slots for a single serving cell is 20* + For SCS 480 kHz: (X,Y) = (4,1)
	+ For SCS 480 kHz: (X,Y) = (4,2)
	+ For SCS 960 kHz: (X,Y) = (8,1)
	+ For SCS 960 kHz: (X,Y) = (8,4)

***Proposal 2:*** The maximum number of non-overlapped CCEs per X slots for a single serving cell is 32* + For SCS 480 kHz: (X,Y) = (4,1)
	+ For SCS 480 kHz: (X,Y) = (4,2)
	+ For SCS 960 kHz: (X,Y) = (8,1)
	+ For SCS 960 kHz: (X,Y) = (8,4)

***Proposal 3:*** The maximum number of monitored PDCCH candidates per X slots for a single serving cell is 10* + For SCS 960 kHz: (X,Y) = (4,1)
	+ For SCS 960 kHz: (X,Y) = (4,2)

***Proposal 4:*** The maximum numberof non-overlapped CCEs per X slots for a single serving cell is 16* + For SCS 960 kHz: (X,Y) = (4,1)
	+ For SCS 960 kHz: (X,Y) = (4,2)
 |

### R1-2201689 (Intel)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The following TP is proposed to capture additional X value 2 for SCS 480kHz.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **------------------------------ TP#1: TS 38.213 -----------------------------------**\*\*\* Unchanged text is omitted \*\*\*10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*Table 10.1-2B provides the maximum number of monitored PDCCH candidates, , per slot group for combination for a UE in a DL BWP with SCS configuration for operation with a single serving cell.Table 10.1-2B: Maximum number of monitored PDCCH candidates per slot group for combination for a DL BWP with SCS configuration for a single serving cell

|  |  |
| --- | --- |
|  | Maximum number of monitored PDCCH candidates per combination and per serving cell  |
|  | (2, 1) | (4, 1) | (4, 2) | (8, 1) | (8, 4) |
| 5 | 10  | 20 | 20 | - | - |
| 6 | - | 10 | 10 | 20 | 20 |

\*\*\* Unchanged text is omitted \*\*\*Table 10.1-3B provides the maximum number of non-overlapped CCEs, , for a DL BWP with SCS configuration that a UE is expected to monitor corresponding PDCCH candidates for combination for operation with a single serving cell.Table 10.1-3B: Maximum number of non-overlapped CCEs in a slot group for combination for a DL BWP with SCS configuration for a single serving cell

|  |  |
| --- | --- |
|  | Maximum number of non-overlapped CCEs per combination and per serving cell  |
|  | (2, 1) | (4, 1) | (4, 2) | (8, 1) | (8, 4) |
| 5 | 16  | 32 | 32 | - | - |
| 6 | - | 16 | 16 | 32 | 32 |

\*\*\* Unchanged text is omitted \*\*\* |

**Proposal 1:** * X=2 can be optionally supported for SCS 480kHz, which corresponds to combination (X, Y) = (2, 1). The BD/CCE budget for (2,1) can be half that of X=4
* Agree on TP 1 to capture additional X value 2 for SCS 480kHz

When CA is considered, the total number of BD/CCEs that are shared by multiple cells/TRPs. , need to be determined considering both SCS configuration and the combination (X, Y) of the scheduling cells. Three options are discussed as below. * *Option 1: is determined and shared by all cells that are configured with scheduling cells having same SCS configuration and same combination (X, Y).*

Based on the agreed framework, the slot group always starts from the subframe boundary. Consequently, the slot groups of difference cells must be aligned if same SCS configuration are configured. On the other hand, though the group (1) SS is limited to the Y slots, the group (2) SS can be configured in any slot in a slot group. Since the PDCCH monitoring for the two scheduled cells may not be fully aligned due to the arbitrary MOs for group (2) SS, it is not necessary to align the Y slots in the slot group for multiple cells for BD/CCE sharing. Based on the above discussions, option 1 can be considered without alignment of the Y slots. * *Option 2: is determined and shared by all cells that are configured with scheduling cells having SCS configuration and same value X in combinations (X, Y).*

In the option 1, the BD/CCE for the scheduling cells with combination (X, Y) of same value X and different value Y are separately handled. In fact, since the maximum numbers of BD/CCE is only determined by SCS configuration and value X, but not the value Y, it is possible to share the BD/CCE for the scheduling cells with same value X of the combinations (X, Y). This option can provide gNB more freedom to share the PDCCH scheduling capability for more cells. * *Option 3: is determined and shared by all cells that are configured with scheduling cells having same duration of slot or slot group.*

A slot of SCS 120kHz and a slot group of X=4/8 slots for SCS 480/960kHz are fully overlapped in time with same the maximum numbers of BD/CCE. It is then expected the UE implementation on the PDCCH detection could be common in some extent. Consequently, it can be considered to share the BD/CCE for the scheduling cells with SCS 120kHz and for SCS 480/960kHz if X=4/8 slots apply. Option 3 can provide even more flexibility on PDCCH transmission than Option 2. However, Option 3 also requires UE to jointly share maximum BD/CCE budget across cells with different numerology, which results in additional complexity. Based on the above analysis, we prefer Option 2 since it provides a good balance between flexibility and complexity. The following TP is proposed to determine , .

|  |
| --- |
| **------------------------------ TP#3: TS 38.213 -----------------------------------**\*\*\* Unchanged text is omitted \*\*\*10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*If a UE - does not report *pdcch-BlindDetectionCA* or is not provided *BDFactorR*, - reports *pdcch-BlindDetectionCA*, the UE can be indicated by *BDFactorR* either or If a UE is configured with downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cells using SCS configuration , and with of the downlink cells using combination with same for PDCCH monitoring, where , the UE is not required to monitor, per a group of slots on the active DL BWPs of the scheduling cells,- more than PDCCH candidates or more than non-overlapped CCEs for each scheduled cell when the scheduling cell is from the downlink cells, or- more than PDCCH candidates or more than non-overlapped CCEs for each scheduled cell when the scheduling cell is from the downlink cells- more than PDCCH candidates or more than non-overlapped CCEs for CORESETs with same *coresetPoolIndex* value for each scheduled cell when the scheduling cell is from the downlink cellsIf a UE - is configured with downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cells using SCS configuration , and - with of the downlink cells using combination with same for PDCCH monitoring, where , and- a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor, per a group of slots on the active DL BWP with SCS configuration of the scheduling cells* for the , downlink cells more than PDCCH candidates or more than non-overlapped CCEs.
* for each scheduled cell from the downlink cells, more than PDCCH candidates or more than non-overlapped CCEs.
* for each scheduled cell from the downlink cells,
* more than PDCCH candidates or more than non-overlapped CCEs
* more than PDCCH candidates or more than non-overlapped CCEs for CORESETs with same *coresetPoolIndex* value

\*\*\* Unchanged text is omitted \*\*\* |

**Proposal 8:** * , needs to be determined and shared by all cells that are configured with scheduling cells having same SCS configuration and same value X in combinations (X, Y).
* Agree on TP 3 to determine ,

**Proposal 6:** * UE should be able to process one broadcast DCI for SI/RACH/paging in addition to the agreed number of processed unicast DCI in a slot group of X slots.
* To clarify whether a UE would be able to detect up to 8 unicast DCIs in a slot on the scheduling cell with SCS 15kHz
* The limitation on number of detected DCIs in a slot group should be discussed in UE feature for WI NR\_ext\_to\_71GHz

It is desirable if gNB can provide proper SS set configuration so that the total number of spans for all SS sets in any slot group does not exceed the defined maximum number of spans per slot group. However, there is also the case that the maximum number can be exceeded in a slot group. Further, if the SS/PBCH block for the UE is changed, the slot/symbol position of the SS set with *searchSpaceId* = 0 moves accordingly, which may impact the total number of spans in a slot group. A span of SS sets configured in a slot group, if it is not monitored by the UE based on a semi-static rule, may not be counted in the number of spans in the slot group. If the maximum number of spans in a slot group is exceeded, UE can drop one or more spans of at least group (1) SS sets so that the maximum number is not exceeded in the slot group. **Proposal 5:** * A span of SS sets configured in a slot group, if it is not monitored by the UE based on a semi-static rule, may not be counted in the number of monitored spans in the slot group.
* If the maximum number of spans in a slot group is exceeded, UE can drop one or more spans of at least the group (1) SS sets
 |

### R1-2201735 (Ericsson)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The two working assumptionsWorking assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8Working assumptionThe following values are adopted as minimum value of for 120/480/960 kHz* Support only search space set group switching processing capability 1 with the following values

|  |  |
| --- | --- |
|  | **Minimum value for** **UE processing capability 1 [symbols]** |
| 3 | 40 |
| 5 | 160 |
| 6 | 320 |

have been captured and approved in TR 38.213 [3]. In our view, both can be considered confirmed.In the following text from 38.213 Section 10.1 [3], the quantities and are used but not defined:The UE allocates PDCCH candidates for monitoring to USS sets for the primary cell having an active DL BWP with SCS configuration in a slot if the UE is not provided *monitoringCapabilityConfig* for the primary cell or if the UE is provided *monitoringCapabilityConfig* = *r15monitoringcapability* for the primary cell, or in the first span of each slot if the UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for the primary cell, or in a group of slots for a corresponding combination if the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* for the primary cell, according to the following pseudocode. If for the USS sets for scheduling on the primary cell the UE is not provided *coresetPoolIndex* for first CORESETs, or is provided *coresetPoolIndex* with value 0 for first CORESETs, and is provided *coresetPoolIndex* with value 1 for second CORESETs, and if or , the following pseudocode applies only to USS sets associated with the first CORESETs. A UE does not expect to monitor PDCCH in a USS set without allocated PDCCH candidates for monitoring. In the following pseudocode, if the UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for the primary cell,and are replaced by and respectively, and and are replaced by and respectively. In the following pseudocode, if the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* for the primary cell,and are replaced by and respectively, and and are replaced by and respectively.The quantities can be defined following the same Rel-15 PDCCH monitoring capability allocation for carrier aggregation cases. The main difference for Rel-17 is that, in addition to difference in numerology , different cells may be configured with different . Since slot groups start at a subframe boundary, the slot groups for serving cells with identical and are aligned. The configuration of does not impact the slot group alignment between different serving cells. Note further that and depend on , but not * In our view, the distribution of available BD/CE budgets amongst multiple cells can be properly done based on the grouping of numerology and configuration of of cells as follows. If the number of cells is no more than than , and .
* If the number of cells is more than than , the number of blind decodes is distributed to based on a weighting of number of cells with numerology among all cells configured with the same ; and the total number of available channel estimation CCEs is distributed to based on a weighting of number of cells with numerology among all cells configured with the same . Both quantities are still upper bounded by and , respectively.

There is no need to further sub-divide this grouping based on the configuration of . Furthermore, conversion of numerology and configuration of to equivalent numerology with slot-based monitoring, as proposed by some sources, appears unnecessary optimization that complicates and impedes stabilization and finalization of the Rel-17 specs.1. For per-slot group monitoring, and should be defined in TS 38.213 following the same PDCCH monitoring capability allocation for carrier aggregation cases for the case of per-slot monitoring, except the grouping is based on numerology and configuration of .

Recommend TP#2 to the spec editor which defines how to allocate the BD/CCE budget to 480/960 kHs SCS cells configured for per-slot group monitoring. Note: this still requires that for cells with SCS ≤ 120 kHz configured for per-slot or per-span monitoring, adjustment of the Rel-15/16 allocation formulas will be needed.1. It is not needed to specify that within a group of Xs slots, the UE is not be expected to process information from more than one DCI format with CRC scrambled by a given RNTI associated with Group (2) SSs, i.e., SI-RNTI, P-RNTI, RA-RNTI, MsgB-RNTI.
 |

### R1-2201765 (Apple)

|  |
| --- |
| ***Proposal 4:*** *Accept the working assumption Based on the working assumption, the BD/CCE budget for X = 4 with 960 kHz, ie. (X,Y) = {(4,2), (4,1)} is half that of X=8 i.e. BD/CCE = 10/16.** *The gNB should configure the aggregation levels to match the CCE budget e.g. only AL 4 and 8 allowed.*

***Proposal 5:*** *If a UE is provided* *- one or more search space sets by corresponding one or more of searchSpaceZero, searchSpaceSIB1, searchSpaceOtherSystemInformation, pagingSearchSpace, or ra-SearchSpace, or a CSS set by PDCCH-Config, and* *- a SI-RNTI, a P-RNTI, a RA-RNTI, a MsgB-RNTI, a SFI-RNTI,**then, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per multi-slot****Proposal 7:*** *Additional dropping rules for PDCCH multi-slot monitoring should be defined to limit back-to-back SS monitoring between Group 1 and Group 2 SSs across multiple slot-groups. A window-based approach around the CSS maybe considered to determine whether or not a USS monitoring occasion is dropped or not for PDCCH monitoring****Proposal 11:*** *Within a group of serving cells with multi-slot-based capability, the serving cells with the same SCS and Xs value are grouped together to follow a total BD/CCE budget* |

### R1-2201914 (Xiaomi)

|  |
| --- |
| From previous agreement, UE has a mandatory PDCCH monitoring capability and can also report an optionally supported capability to gNB. So it would be possible that gNB may configure optional PDCCH monitoring capability on some serving cells but leave other cells with mandatory capapbility. And there can be different SCS on different serving cells, so the applied multi-slot PDCCH monitoring capability can also be different. From our point of view, since we have very few time left, it is more preferred not to do PDCCH monitoring capability sharing among multiple serving cells. When UE is configured with multiple serving cells, within each serving cell, UE apply multi-slot PDCCH monitoring capability for a single serving cell independently. ***Proposal 1: When UE is configured with multiple serving cells, within each serving cell, UE apply multi-slot PDCCH monitoring capability*** ***for a single serving cell independently.***Related TP can be as follows,**TP#1 for TS 38.213 Clause 10**============================= Unchanged part omitted =========================================**10 UE procedure for receiving control information**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 in Type0/0A/2-PDCCH CSS sets where the UE is not required to apply the procedures in this clause for the SCG- When the procedures are applied for MCG, the terms 'secondary cell', 'secondary cells' , 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells, serving cell, serving cells belonging to the MCG respectively.- When the procedures are applied for SCG, the terms 'secondary cell', 'secondary cells', 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells (not including PSCell), serving cell, serving cells belonging to the SCG respectively. The term 'primary cell' in this clause refers to the PSCell of the SCG.A UE monitors a set of PDCCH candidates in one or more CORESETs on the active DL BWP on each activated serving cell configured with PDCCH monitoring according to corresponding search space sets where monitoring implies decoding each PDCCH candidate according to the monitored DCI formats.If a UE is provided *monitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs - per slot, as in Tables 10.1-2 and 10.1-3, if *monitoringCapabilityConfig* = *r15monitoringcapability*, or - per span, as in Tables 10.1-2A and 10.1-3A, if *monitoringCapabilityConfig* = *r16monitoringcapability*- per multi-slot, as in Tables [xxx,TBD], if *monitoringCapabilityConfig* = *r17monitoringcapability*For FR1 and FR2-1, if the UE is not provided *monitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per slot. For FR2-2, if the UE is not provided *monitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs per X multi-slot as in Tables [xxx,TBD], with X=4 for SCS configuration of  and X=8 for SCS configuration of .For FR2-2, if the UE is configured with multiple serving cells, within each serving cell, UE apply multi-slot PDCCH monitoring capability for a single serving cell independently.A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. If a UE monitors PDCCH on a cell according to combination , the UE supports PDCCH monitoring occasions in any symbol of a slot with minimum time separation of symbols between the first symbol of two consecutive spans, including across slots. A span starts at a first symbol where a PDCCH monitoring occasion starts and ends at a last symbol where a PDCCH monitoring occasion ends, where the number of symbols of the span is up to .============================= Unchanged part omitted ========================================= |

### R1-2202005 (Samsung)

|  |
| --- |
| When a UE supports CA or NR-DC operation in NR from 52.6 GHz to 71 GHz, UE can be configured with multiple downlink cells for multi-slot based PDCCH monitoring. It’s necessary to determine a capability to monitor a maximum number of PDCCH candidates and a maximum number of non-overlapped CCEs that corresponds to downlink cells, which is in analogy to for slot-based PDCCH monitoring capability introduced in NR Rel-16 and for span based PDCCH monitoring capability introduced in NR Rel-17.The legacy mechanism for determine can be extended to determine a capability of for multi-slot based PDCCH monitoring considering scenarios, such as* Case 1: UE is configured with CA but not NR-DC operation, and UE is configured with only *R17monitoringcapability* for all downlink cells
* Case 2: UE is configured for NR-DC operation, and UE is configured with only *R17monitoringcapability* for all downlink cells

When the UE is configured for carrier aggregation operation over more than 2 cells, or for a cell group when the UE is configured for NR-DC operation, the UE does not expect to monitor per group of slots according to combination a number of PDCCH candidates or a number of non-overlapped CCEs that is larger than the maximum number as derived from the corresponding value of .**Proposal 5: Adopt TP#4 for TS 38.213 to determine a capability to monitor a maximum number of PDCCH candidates and a maximum number of non-overlapped CCEs per slots that corresponds to downlink cells, i.e.** It was agreed in RAN1#107-e meeting to support PDCCH dropping per slots based on combination . The PDCCH dropping rule should be applied to both single cell case and CA. For UE configured with CA or NR-DC operation, the PDCCH candidates and non-overlapping CCE limits should be determined based on downlink cells for all scheduling cells. The same scaling rule to determine and for *R16monitoringcapability* can be reused to determine and for *R17monitoringcapability* in CA mode when the number of downlink cells is larger than . **Proposal 6: Adopt TP#5 for TS 38.213 to determine maximum number of PDCCH candidates, and a maximum number of non-overlapped CCEs,** , **per slots in CA mode.** |

### R1-2202072 (MediaTek)

|  |
| --- |
| One remaining discussion is the BD/CCE budge for (X,Y)=(4,2) and (4,1) under 960kHz. In our view, the significance and usage of configuration (X,Y)=(4,1) and (4,2) are not clear compared to (8,1) and (8,4) and we prefer to remove such configurations. Furthermore, if the configuration (X,Y)=(4,1) and (4,2) were considered, based on the discussion so far, the associated BD/CCE limit should be around half of the ones for (X,Y)=(8,1) and (8,4). Consequently, the PDCCH scheduling will be impacted, especially when Type-0 PDCCH monitoring is involved where monitoring in consecutive slot-groups is needed. To alleviate the scheduling inflexibility due to the decreased BD/CCE limit, it is not desirable to configure X=8 in Pcell with 960kHz. **Proposal 1: For Rel-17 960kHz multi-slot PDCCH monitoring, only (X,Y)=(8,1) and (8,4) are supported in a Pcell.**Another essential discussion to complete the multi-slot PDCCH monitoring design is how to extend the framework to multi-cell operation and how to specify the BD/CCE limit for multi-cell operation. To address those aspects, it is necessary to discuss whether the fixed pattern of slot groups is the same across CCs with (X,Y) multi-slot PDCCH monitoring configuration. Based on the RAN1 #106bis-e agreement * + - The start of the first slot group in a subframe is aligned with the subframe boundary
		- The start of each slot group is aligned with a slot boundary

it can be concluded that all the CCs with (X,Y) multi-slot PDCCH monitoring configuration share the same pattern of slot groups. Observation 1: All the CCs with the same subcarrier spacing and same (X,Y) in multi-slot PDCCH monitoring configuration share the same pattern of slot groupsConsequently, it is natural to link the slot group notion in 480kHz or 960kHz and the slot notion in 120kHz, and it is desirable to reuse the multi-cell BD/CCE budget calculation method specified for slot-based PDCCH monitoring when determining the multi-cell BD/CCE budget calculation method for slot-group based PDCCH monitoring. That is, when the number of scheduled cells is less than or equal to the number of cells UE can support, UE is not required to monitor more than the BD/CCE limit per slot-group specified for a single cell on a DL BWP of scheduling cell. When the number of scheduled cells is larger than the number of cells UE can support, the multi-cell BD/CCE budget per slot group across CCs UE will follow can be derived based on the multi-cell BD/CCE budget calculation method specified for slot-based PDCCH.**Proposal 3: The Rel-15/16 multi-cell BD/CCE budget calculation method specified for slot-based PDCCH monitoring should be considered as the baseline for the multi-cell BD/CCE budget calculation for slot-group based PDCCH monitoring in 480kHz and 960kHz.** |

### R1-2202130 (Qualcomm)

|  |  |  |  |
| --- | --- | --- | --- |
| In RAN1 #107-e, a relevant issue was discussed in the dynamic spectrum sharing agenda, and the following has been agreed:

|  |
| --- |
| **Agreement*** Following approaches for PDCCH monitoring and BD limit handling is supported for Type A UE
	+ Additional simplifications to PDCCH monitoring
		- Type A UE as per RAN1#105-e agreement and
			* no simultaneous monitoring between ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
			* simultaneous monitoring of ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC not scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
 |

In Short, if there is a USS sets monitored on the sSCell, the UE is not required to monitor DCI formats 0\_0 and 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in the CSS sets in the overlapping slot on the sPCell. The motivation behind the above agreement is removing redundancy and improving power efficiency. Therefore, in the same vein, when the UE is required to monitor both Group (1) and Group (2) SS sets in the same slot group, if there is at least one valid PDCCH MO of Group (1) SS sets, considering overbooking and dropping, the UE may refrain from monitoring DCI formats 0\_0 and 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in Group (2) SS sets.Proposal 1: If PDCCH MOs of both Group (1) and Group (2) SS sets are configured in the same slot group, and there is at least one valid PDCCH MO of USS set(s) after overbooking and dropping, the UE does not monitor DCI formats 0\_0 and 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, and CS-RNTI in the Group(2) SS set(s).In addition, in Rel-15, the following rule is applied for CSS monitoring within a slot:

|  |
| --- |
| TS 38.213, Section 10.1:If a UE is provided-     one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, or a CSS set by *PDCCH-Config*, and-     a SI-RNTI, a P-RNTI, a RA-RNTI, a MsgB-RNTI, a SFI-RNTI, an INT-RNTI, a TPC-PUSCH-RNTI, a TPC-PUCCH-RNTI, or a TPC-SRS-RNTIthen, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per slot. |

Thus, a similar design should be extended for multi-slot PDCCH monitoring.Proposal 3: Per slot group of X0 slots, a UE does not expect to process information from more than one DCI format with CRC scrambled by a RNTI from any of SI-RNTI, RA-RNTI, MsgB-RNTI or P-RNTI.Further related to the joint configuration of multi-slot PDCCH monitoring and SSSG switching, a situation shown in Figure 2 may be considered. That is, SSSG switching occurs from the first SSSG to the second SSSG. Then, at the boundary of SSSG switching, the locations of the two Y consecutive slots in the slot groups before and after the switching boundary may be different. In another case, the two SSSGs may be associated with different (Xs,Ys) values according to Proposal 8. Thus, in such cases, the separation between the two Y consecutive slots may be less than Xs slots. To avoid such a situation in Figure 2, a rule for dropping PDCCH MOs may be considered. For example, when the separation between the two Ys consecutive slots before and after the switching boundary is less than Xs slots, where Xs is according to the first (source) SSSG, some or all of the MOs in the Ys consecutive slots in the second (target) SSSG after the switching boundary may be dropped.Proposal 10: A dropping rule for PDCCH MOs may be applied for the first Ys consecutive slots after SSSG switching, if the separation between the two Ys consecutive slots before and after the SSSG switching boundary is less than Xs slots.Figure 2: An example of SSSG switching for multi-slot PDCCH monitoring.In RAN1 #107-e, the following has been agreed:

|  |
| --- |
| **Agreement*** SS set overbooking can be allowed with multi-slot PDCCH monitoring capability same as the current specification but applied per slot group, i.e., SS set overbooking is allowed for USS in PCell and PSCell, and UE expects no overbooking for CSS in PCell and PSCell and no overbooking in SCell.
* The dropping rule for multi-slot PDCCH monitoring capability is the same as the current specification but evaluated per slot group, i.e., a UE drops UE specific search space set(s) in a slot group with higher index when SS sets are overbooked.
* Additional dropping rules are not precluded
 |

For the detailed dropping rules in the third bullet of the agreement, two alternatives were identified: If a SS set has multiple monitoring occasions within a slot group,* Alt 1: All MOs of the SS set shall be dropped as a whole​.
* Alt 2: Each MO of the SS set shall be dropped individually​.

An example showing the difference of the two alternatives is illustrated in Figure 3.Figure 3: Alternatives of dropping rules.Between the two alternatives, Alt 2 has a benefit over Alt 1 in some cases, like the one shown in Figure 3. That is, Alt 2 may accommodate more PDCCH candidates than Alt 1 under the same BD/CCE budget. However, as an expense, the overbooking procedure may get complicated. Furthermore, the impact of Alt 1 on the existing specification is marginal, since it is a simple extension of Rel-15 overbooking. On the other hand, Alt 2 may require some changes of the specification. Therefore, to keep the design simple and reduce the burden of standardization, Alt 1 would be preferred.Proposal 11: If a SS set to be dropped by overbooking has multiple MOs within a slot group, they are dropped as a whole. |

### R1-2202190 (Sharp)

|  |
| --- |
| In RAN1#107-e meeting, the working assumption for SSSG switching at 120/480/960kHz is achieved. The working assumption was directly described in 38.213, and the minimum switching time *Pswitch* was defined as one value for each SCS. Here, we have one concern about the SSSG switching at 480kHz/960kHz, which is that it may cause a back-to-back problem when switching. It is important to avoid this problem, which we have been considering for a long time in past meetings. In the current specification, SSSG-related monitoring is stopped and started at the same time in the first slot after the *Pswitch*. However, in multi-slot monitoring, SSSG switching may be performed after the UE has monitored in a later slot of the slot group, and monitoring may start in the slot immediately after. In this case, a back-to-back problem occurs. To avoid this situation, it is possible to not monitor the *Xs* slots before and after the SSSG boundary. This can be achieved by dropping PDCCH candidates in the *Xs* slots before or after the switchover, or by setting different *Pswitch* values to stagger the stop and start of monitoring.**Figure 1:Possible problem with SSSG switching with multi-slot monitoring.****Proposal 3: To avoid the back-to-back problem, monitoring should not be done in the Xs slots before and after the SSSG boundary.****Proposal 4: Adopt Text proposal #2-1 or #2-2.** |

### R1-2202234 (Transsion Holdings)

|  |
| --- |
| ***Proposal 1: Confirm the working assumption that the maximum number of PDCCH candidates and the maximum number of non-overlapped CCEs should be 10 and 16 for combination (4, 2), (4, 1).***In the current specification, slot-group based PDCCH monitoring capability has been specified and the overbooking rule is performed on slot group basis. With these methods, UE can handle the slot-group based PDCCH detection very well. However, when the PDCCH monitoring occasions change, the UE may need to perform PDCCH detection on consecutive slots belonging to different slot groups, which may result in the UE being unable to perform blind detection in time. For example, for SS/PBCH block and CORESET#0 multiplexing pattern 1, the PDCCH monitoring occasions are located within two consecutive slot groups which are associated with the SS/PBCH block. However, when the UE changes SS/PBCH block it tracks due to mobility, the relevant PDCCH monitoring occasions may be changed based on the slot index of n0. In a special case, for the Type0 CSS or Type0A/Type 2 CSS if “*searchSpaceId=0*”, the PDCCH monitoring occasions may be changed to the end of the slot group. If the PDCCH monitoring occasions of the Group (1) SS are located in the first slot of an adjacent slot group, then the requirement for the PDCCH detection capability of the UE is almost doubled, which may exceed the BD/CCE limit of the UE. Considering that it is difficult for gNB to avoid this back-to-back issue, it is better to drop the USS in these adjacent slot groups to ensure that the UE’s PDCCH detection budget does not exceed its BD/CCE limit.***Proposal 2: Drop the USS with the higher index in these adjacent slot groups, when back-to-back issue happens.*** |

### R1-2202336 (LG)

|  |
| --- |
| Regarding the BD/CCE budget for (X,Y) combinations with optional X, there is a working assumption for 960 kHz SCS. Considering UE implementation complexity and power consumption, current working assumption seems reasonable. There were concerns at the last meeting that the CCE budget of (X,Y) with X=4 for 960 kHz is too small to cover the Type-0 CSS monitoring budget, but from our understanding, such (X,Y) combination with optional X doesn't seem to be an issue when they applied to SCell. So, we support changing the above working assumption to an agreement. Similarly, BD/CCE budget for (X,Y) with X=2 can be simply defined as half that of X=4, for 480 kHz SCS. **Proposal #2: Determine the BD/CCE budget for (X,Y) combination with optional X is half that of mandatory X.*** + **For 960 kHz, BD/CCE budget for (X,Y) with X=4 is half that of X=8, i.e., confirm the WA.**
	+ **For 480 kHz, BD/CCE budget for (X,Y) with X=2 is half that of X=4, if supported.**

According to this, the serving cells with the same PDCCH monitoring type can be grouped together for the BD/CCE budget distribution. That is, the serving cells for slot-based monitoring or span-based monitoring are treated as separate groups when distributing the BD/CCE budget. However, if three different monitoring capabilities associated to a carrier aggregation including multi-slot monitoring, the number of separate groups will be increased and the BD/CCE distribution mechanism becomes complicated, which may increase the complexity of the UE. Meanwhile, for the mandatorily supported X=4/8 for 480/960 kHz, the absolute time of the slot-group and the BD/CCE limit per X=4/8 (resp.) are the same as those for 120 kHz. In this case, when the multi-slot monitoring is configured with multiple serving cells with X=4/8 slots for 480/960 kHz, the BD/CCE budget distribution for serving cells with these SCS can be calculated as if they were serving cells with 120 kHz SCS. With this, BD/CCE budget distribution for CA can be simplified. Additionally, the number of DL serving cells for multi-slot monitoring may be reported by *pdcch-BlindDetectionCA*, whose value indicates total the number of DL serving cells for both single-slot based monitoring and multi-slot based monitoring. Through this, the UE will be able to further simplify BD/CCE budget distribution for the multi-cell operation.**Proposal #13: For multi-cell operation, the number of configured DL cells is greater than the number of reported DL cells, consider followings for BD/CCE budget distribution,*** + **For a serving cell with mandatory X (i.e., X=4/8 for 480/960 kHz), BD/CCE budget is calculated by transforming the serving cell to the cell with 120 kHz SCS.**
	+ **For a serving cell with optional X (e.g., X=4 for 960 kHz), the serving cells with the same SCS and Xs value are grouped together for BD/CCE budget distribution.**
 |

### R1-2202409 (Lenovo, Motorola Mobility)

|  |
| --- |
| From the above agreement, there could be the issue of back-to-back monitoring across slot groups e.g. when the beam changes, e.g. with respect to the above proposal when n0 changes and also when the periodicity of Group(2) SS MO is every slot group. ***Observation 1: For supporting NR between 52.6 GHz and 71 GHz with high subcarrier spacing values including 480kHz and 960kHz, when multi-slot PDCCH monitoring is applied with shifting of Group(2) SS due to n0 change, then potential back-to-back monitoring issue can arise across slot groups where the shift is applied, and periodicity of Group(s) SS MOs is every slot group***One potential solution could be to drop any Group(1) SS MOs and/or Group(2) SS MOs in the slot group in which shifting needs to be applied such that back-to-back monitoring issue can be avoided. ***Proposal 1:*** ***For supporting NR between 52.6 GHz and 71 GHz with high subcarrier spacing values including 480kHz and 960kHz, then dropping of Group(1) SS MOs and/or Group(2) SS MOs in the slot where the shift is first applied should be supported to avoid back-to-back monitoring issue.*** |

## Topic B: Multi-Beam Aspects

### R1-2201266 (OPPO)

|  |
| --- |
| Since gNB can perform directional LBT and RAN1 has agreed that the sensing beam should cover the transmission beams, it implies that the transmission beams within the initiated gNB COT should be covered by the sensing beam. Moreover, the remaining COT duration indication in DCI 2\_0 was used in R16 for the UE to determine whether the UE can share the gNB COT and also whether the UE should perform reception on the pre-configured downlink transmissions, e.g. CSI-RS. Thus, it would be more reasonable that the COT sharing as well as the legacy P-CSI-RS reception behavior should be checked by the sensing beam or the transmission beams. For COT sharing mechanism, in the legacy system, the UE can share gNB’s COT as long as the uplink transmission resources in time and frequency domain are within the gNB COT. However, when directional LBT is applied at gNB side, a beam level condition should be added such that the gNB LBT sensing beam should cover the UE’s transmission beam, otherwise, the gNB COT should not be considered sharable by the UE. The ‘cover’ definition can reuse the same definition in the directional LBT procedure. **Proposal 2: the UE can share gNB COT only if the UL transmission resources are within the gNB COT and the UL transmission beam is covered by the gNB sensing beam for directional LBT.** For P-CSI-RS reception within the gNB COT, in NRU system due to the FR1 frequency range, the UE only checks whether the CSI-RS resources are within the gNB COT to decide if the reception is to be canceled or not. But for FR2-2, if the gNB’s sensing beam does not cover the CSI-RS beam, the CSI-RS is not expected to be transmitted. In this case, if the CSI-RS resources are within the gNB’s remaining COT duration, as long as the gNB sensing beam does not cover the CSI-RS beam, the UE should also cancel the CSI-RS reception. **Proposal 3: For higher layer configured CSI-RS reception, the UE performs the reception if the CSI-RS resources are within the gNB COT and the gNB’s sensing beam covers the CSI-RS beam.** In the unlicensed spectrum, when COT duration indication is not configured in DCI 2\_0, the COT duration is determined by the SFI periodicity. Moreover, the higher layer configured downlink reception, e.g. CSI-RS and PDSCH, is to be confirmed by the SFI indication. In FR2-2 with unlicensed spectrum where LBT is mandatory by the regional regulation, similar to the proposal 2, the confirmation should take into account the gNB sensing beam, because if the sensing beam does not cover the transmission beam, the pre-configured reception should also be canceled, as the gNB is not allowed to transmit in the direction uncovered by the directional LBT. **Proposal 4: In FR2-2 unlicensed band, the pre-configured downlink reception is not only confirmed by the SFI indication but also by gNB’s sensing beam, e.g., UE should cancel the downlink reception within the gNB COT if the gNB sensing beam does not cover the downlink transmission beam.** When it comes to SSSG switching, the motivation of introduction of this feature is to allow UE to reduce the PDCCH monitoring effort in the gNB COT. With the similar reasoning as described above, when the transmission beam is not covered by the gNB sensing beam, the gNB is not allowed to perform this transmission within the gNB COT. Therefore, if a CORESET beam is not covered by the gNB sensing beam, the UE should be allowed to skip the PDCCH monitoring in the CORESET. **Proposal 5: R17 should allow UE to skip PDCCH monitoring in the CORESET associated with a beam uncovered by the gNB sensing beam within the gNB COT.**  |

## Topic C: Multi-Cell Operation, Cross-carrier scheduling (except BD aspects)

### R1-2200953 (Huawei, HiSilicon)

|  |
| --- |
| The benefit to support scheduling between two carriers with large is questionable. For example, for and , a DCI with 15 kHz SCS would schedule 64 PDSCH slots with 960 kHz SCS. In such a case, the flexibility is poor and the latency is large. Therefore, we support to reuse the same limitation as in FR1 and FR2-1, i.e., .***Proposal 15: Cross-carrier scheduling is only supported for .*** |

### R1-2201352 (CATT)

|  |
| --- |
| In the RAN1#107bis-e, the maximum difference of SCS of cross-carrier scheduling, i.e.,, has been discussed. In the Rel-16, the maximum difference of SCS is equal to 3. However, 480 kHz SCS and 960 kHz SCS have been supported for 52.6-71GHz. We believe the maximum difference of SCS of cross-carrier scheduling should be expanded to support of new SCS, and there is no motivation to limit the difference of SCS of cross-carrier scheduling.***Proposal 5：In order to better support cross-carrier scheduling of the new SCS, i.e. 480 kHz and 960 kHz, the difference of SCS of cross-carrier scheduling should not be limited.*** |

### R1-2201765 (Apple)

|  |
| --- |
| ***Proposal 9:*** *For Rel-17, 4 additional cases for UE capability signaling need to be defined:** *Case 4: Capability on the number of CCs with Rel-17 monitoring capability only*
	+ *pdcch-BlindDetectionCA-R17 is equal to 4 {similar to Rel-15}*
* *Case 5: Capability on the number of CCS with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells*
	+ *pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability*
	+ *pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability*
	+ *Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: [1:15]*
		- *The minimum of pdcch-BlindDetectionCA-R15 + The minimum of pdcch-BlindDetectionCA-R17) is equal to 4*
			* *Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: [4:16]*
* *Case 6: Capability on the number of CCS with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells*
	+ *pdcch-BlindDetectionCA-R16 for Rel-15 PDCCH monitoring capability*
	+ *pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability*
	+ *Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: [1:15]*
		- *The minimum of pdcch-BlindDetectionCA-R16 + The minimum of pdcch-BlindDetectionCA-R17) is equal to 3*
			* *Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: [3:16]*
* *Case 7: Capability on the number of CCS with Rel-15 monitoring capability , Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells*
	+ *pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability*
	+ *pdcch-BlindDetectionCA-R16 for Rel-17 PDCCH monitoring capability*
	+ *pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability*
	+ *Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: [1:15]*
		- *The minimum of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + The minimum of pdcch-BlindDetectionCA-R17) is equal to 4*
			* *Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17 : [4:16]*

***Proposal 10:*** *For the case with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells (case 7) or any combination of 2 of the capabilities (i.e. case 5, and case 6), the UE will report one or more combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) as UE capability. If UE reports more than one combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17), as in Rel-16, the gNB configures which combination for the UE to use for scaling PDCCH monitoring capability if the number of CCs configured is larger than the reported capability.* |

### R1-2202072 (MediaTek)

|  |
| --- |
| The other open issue is the location of the Y slots within a slot group of X slots across CCs. Compared with the fixed location of the Y slots within a slot group across CCs, non-aligned locations of Y slots can provide potential scheduling flexibility with the cost of less power saving. For example, without any restriction, it is possible that the monitoring slots in a cell with (X,Y) multi-slot PDCCH monitoring configuration might be close to the monitoring slots in another cell with the same (X,Y) multi-slot PDCCH monitoring configuration, which is illustrated in Figure 1. In this example, both CCs follow (X=4,Y=1) multi-slot PDCCH monitoring configuration and UE has to monitoring PDCCH in different slots across CCs without any chance of micro-sleep due to the non-aligned PDCCH monitoring pattern. On the other hand, if the PDCCH monitoring pattern is aligned across CCs, UE will monitor the same slots across CCs and improve PDCCH monitoring power consumption accordingly. Proposal 4: For multi-cell operation, UE can report a capability on whether the location of the Y slots within a slot group of X slots is maintained across CCs associated with (X,Y) configuration.Figure 1 Example of non-aligned monitoring pattern across CCs  |

## Topic D: Other

# List of submitted TDocs

The following TDocs have been used to compile above summary:

**R1-2200953 Remaining issues of PDCCH monitoring enhancement for 52-71GHz spectrum Huawei, HiSilicon**

**R1-2200988 On the remaining issues in multi-slot PDCCH monitoring for Beyond 52.6GHz FUTUREWEI**

**R1-2201033 Remaining issues for PDCCH monitoring enhancements InterDigital, Inc.**

**R1-2201086 Remaining issues on PDCCH monitoring enhancements for NR operation from 52.6GHz to 71GHz vivo**

**R1-2201266 Discussion on remaining issue for PDCCH monitoring enhancement OPPO**

**R1-2201352 Remaining issues on PDCCH monitoring enhancements for up to 71GHz operation CATT**

**R1-2201389 Remaining issues on the PDCCH monitoring enhancements for 52.6 to 71GHz ZTE, Sanechips**

**R1-2201471 Remaining issues on PDCCH monitoring enhancements for NR in FR2-2 NTT DOCOMO, INC.**

**R1-2201542 Remaining issues on the PDCCH monitoring enhancements for 52.6 to 71GHz Spreadtrum Communications**

**R1-2201593 Remaining Issues on PDCCH onitoring Enhancements in FR2-2 TCL Communication**

**R1-2201663 PDCCH monitoring enhancements Nokia, Nokia Shanghai Bell**

**R1-2201689 Discussion on PDCCH monitoring enhancements for extending NR up to 71 GHz Intel Corporation**

**R1-2201735 PDCCH Monitoring Enhancements Ericsson**

**R1-2201765 On remaining issues for PDCCH Monitoring Apple**

**R1-2201899 Remaining issues on PDCCH enhancement for NR operation from 52.6GHz to 71GHz NEC**

**R1-2201914 Remaining issues on PDCCH monitoring enhancement for NR 52.6-71GHz Xiaomi**

**R1-2202005 Maintenance on PDCCH monitoring enhancements for NR from 52.6 GHz to 71 GHz Samsung**

**R1-2202072 Remaining discussion on PDCCH monitoring enhancement for 52.6-71 GHz NR operation MediaTek Inc.**

**R1-2202130 PDCCH monitoring enhancements for NR in 52.6 to 71GHz band Qualcomm Incorporated**

**R1-2202190 PDCCH monitoring enhancements Sharp**

**R1-2202234 Remaining issues of PDCCH monitoring enhancements for above 52.6GHz Transsion Holdings**

**R1-2202273 PDCCH monitoring for NR operation from 52.6 to 71 GHz Panasonic**

**R1-2202336 PDCCH monitoring enhancements to support NR above 52.6 GHz LG Electronics**

**R1-2202409 Remaining issues on PDCCH for NR from 52.6 GHz to 71GHz Lenovo**