**3GPP TSG-2 Meeting #R2-2203365**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **1** | **CR** | **2953** | **rev** | **-** | **Current version:** | **0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:***  | Explicit Indication of SI Scheduling start position [SI-SCHEDULING] |
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| ***Source to WG:*** | , Verizon, Softbank, Deutsche Telekom, vivo |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | TEI17 |  | ***Date:*** | 14 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Implementation of below RAN2#116bis-e agreement.* Support Solution e (for all SIBs for R17 and onwards)

Based upon the input received for the email discussion R2-2200046, it is observed that:1. DSS based deployment can exist for many years to come. Hence, basic functionality such as broadcast of SIBs/posSIBs are supported in such deployment.
2. Majority view is that the problem of SI scheduling can occur also for non-DSS deployments.

In some of the deployments where there is need to broadcast several SIBs, it may be constrained because of the limitations posed by current solution. Even when there are empty slots available to be utilized, the NW cannot point to such resource for utimization.The ASN.1 in 38.331 suggests that a gNB may schedule up to 32 SI-messages in a cell:SI-SchedulingInfo ::= SEQUENCE { schedulingInfoList SEQUENCE (SIZE (1..maxSI-Message)) OF SchedulingInfo, si-WindowLength ENUMERATED {s5, s10, s20, s40, s80, s160, s320, s640, s1280}, si-RequestConfig SI-RequestConfig OPTIONAL, -- Cond MSG-1 si-RequestConfigSUL SI-RequestConfig OPTIONAL, -- Cond SUL-MSG-1 systemInformationAreaID BIT STRING (SIZE (24)) OPTIONAL, -- Need R ...}SchedulingInfo ::= SEQUENCE { si-BroadcastStatus ENUMERATED {broadcasting, notBroadcasting}, si-Periodicity ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512}, sib-MappingInfo SIB-Mapping}maxSI-Message INTEGER::= 32 -- Maximum number of SI messagesWith the parameters shown above, the network indicates the number of SI-messages being scheduled. While they all use the same si-WindowLength, the network can choose a different si-Periodicity for each message. The UE determines the start position of each SI message by the rules and formulas defined in 38.331 section 5.2.2.3.2. In short, the SI messages appear in the order in which they are listed in the *schedulingInfoList*. Each SI-message may occur for the duration of an *si-WindowLength*. The subsequent window of a particular SI-message occurs after one *si-Periodicity*. If different SI messages use different si-Periodicity values, some resources remain unused; i.e there are empty slots. The problem of this scheme is that the SI-message scheduled with the shortest periodicity limits the total number of SI-messages that can be scheduled. In other words, SI-windows that are left empty due to some SI-messages having larger periodicities cannot be used for other SI-messages. The algorithm defined in section 5.2.2.3.2 does not map them into those empty SI-Windows but rather on top of the most frequently recurring SI-messages.Further, rather than max 32 SI message as specified in RRC specification; the maximum number of SI that can be scheduled is given by below.$$Number of SI=\frac{shortest SI Periodicty}{SI window length}$$ |
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| ***Summary of change:*** | Instead of current consecutive start occurrence of SI, NW explictly points where an SI start position is. Addition of a new field and related procedure update to indicate the start position of the SI for NR SIBs and posSIBs are added from Rel-17.It should be noted that the chosen value range of the new field si-WindowPosition was a trade-off between signaling overhead in SIB1 and scheduling flexibility. The range does not allow addressing all positions when operating at a large SCS and configuring a small SI-Window in combination with a large SI-Periodicity. However, those extreme cases are unlikely to occur in practice and even if they do the chosen value range of the si-WindowPosition allows anyway to schedule a sufficiently large number of SI messages.In order to minimize the number of lists for SI scheduling, a common list *schedulingInfoList2* is provided |
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| ***Consequences if not approved:*** | NR SIBs and positioning SIBs from Rel-17 may not be scheduled in some deployments. |
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| ***Clauses affected:*** | 5.2.1, 5.2.2.3.2, 5.2.2.3.3, 6.3.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

*Beginning of Changes*

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## 5.2 System information

### 5.2.1 Introduction

System Information (SI) is divided into the *MIB* and a number of SIBs and posSIBs where:

- the *MIB* is always transmitted on the BCH with a periodicity of 80 ms and repetitions made within 80 ms (TS 38.212 [17], clause 7.1) and it includes parameters that are needed to acquire *SIB1* from the cell. The first transmission of the *MIB* is scheduled in subframes as defined in TS 38.213 [13], clause 4.1 and repetitions are scheduled according to the period of SSB;

- the *SIB1* is transmitted on the DL-SCH with a periodicity of 160 ms and variable transmission repetition periodicity within 160 ms as specified in TS 38.213 [13], clause 13. The default transmission repetition periodicity of *SIB1* is 20 ms but the actual transmission repetition periodicity is up to network implementation. For SSB and CORESET multiplexing pattern 1, *SIB1* repetition transmission period is 20 ms. For SSB and CORESET multiplexing pattern 2/3, *SIB1* transmission repetition period is the same as the SSB period (TS 38.213 [13], clause 13). *SIB1* includes information regarding the availability and scheduling (e.g. mapping of SIBs to SI message, periodicity, SI-window size) of other SIBs with an indication whether one or more SIBs are only provided on-demand and, in that case, the configuration needed by the UE to perform the SI request. *SIB1* is cell-specific SIB;

- SIBs other than *SIB1* and posSIBs are carried in *SystemInformation* (SI) messages, which are transmitted on the DL-SCH. Only SIBs or posSIBs having the same periodicity can be mapped to the same SI message. SIBs and posSIBs are mapped to the different SI messages. Each SI message is transmitted within periodically occurring time domain windows (referred to as SI-windows with same length for all SI messages). Each SI message is associated with an SI-window and the SI-windows of different SI messages do not overlap. That is, within one SI-window only the corresponding SI message is transmitted. An SI message may be transmitted a number of times within the SI-window. Any SIB or posSIB except *SIB1* can be configured to be cell specific or area specific, using an indication in *SIB1*. The cell specific SIB is applicable only within a cell that provides the SIB while the area specific SIB is applicable within an area referred to as SI area, which consists of one or several cells and is identified by s*ystemInformationAreaID*;

- The mapping of SIBs to SI messages is configured in *schedulingInfoList* and *schedulingInfoList2*, while the mapping of posSIBs to SI messages is configured in *posSchedulingInfoList* and *schedulingInfoList2.* SIBs and posSIBs are mapped in separate SI messages even when configured using a common *schedulingInfoList2*. Each SIB is contained only in a single SI message. In the case of posSIB, a posSIB carrying GNSS Generic Assistance Data for different GNSS/SBAS [49] is contained in different SI messages. Each SIB and posSIB, including a posSIB carrying GNSS Generic Assistance Data for one GNSS/SBAS, is contained at most once in that SI message;

- For a UE in RRC\_CONNECTED, the network can provide system information through dedicated signalling using the *RRCReconfiguration* message, e.g. if the UE has an active BWP with no common search space configured to monitor system information, paging, or upon request from the UE.

- For PSCell and SCells, the network provides the required SI by dedicated signalling, i.e. within an *RRCReconfiguration* message. Nevertheless, the UE shall acquire *MIB* of the PSCell to get SFN timing of the SCG (which may be different from MCG). Upon change of relevant SI for SCell, the network releases and adds the concerned SCell. For PSCell, the required SI can only be changed with Reconfiguration with Sync.

NOTE: The physical layer imposes a limit to the maximum size a SIB can take. The maximum *SIB1* or *SI message* size is 2976 bits.

### 5.2.2 System information acquisition

##### **<Skip Unmodified changes>**

##### 5.2.2.3.2 Acquisition of an SI message

For SI message acquisition PDCCH monitoring occasion(s) are determined according to *searchSpaceOtherSystemInformation*. If *searchSpaceOtherSystemInformation* is set to zero, PDCCH monitoring occasions for SI message reception in SI-window are same as PDCCH monitoring occasions for *SIB1* where the mapping between PDCCH monitoring occasions and SSBs is specified in TS 38.213[13]. If *searchSpaceOtherSystemInformation* is not set to zero, PDCCH monitoring occasions for SI message are determined based on search space indicated by *searchSpaceOtherSystemInformation*. PDCCH monitoring occasions for SI message which are not overlapping with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from one in the SI window. The [x×N+K]th PDCCH monitoring occasion (s) for SI message in SI-window corresponds to the Kth transmitted SSB, where x = 0, 1, ...X-1, K = 1, 2, …N, N is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1* and X is equal to CEIL(number of PDCCH monitoring occasions in SI-window/N). The actual transmitted SSBs are sequentially numbered from one in ascending order of their SSB indexes. The UE assumes that, in the SI window, PDCCH for an SI message is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB and thus the selection of SSB for the reception SI messages is up to UE implementation.

When acquiring an SI message, the UE shall:

1> determine the start of the SI-window for the concerned SI message as follows:

2> if the concerned SI message is configured in the *schedulingInfoList*:

3> for the concerned SI message, determine the number *n* which corresponds to the order of entry in the list of SI messages configured by *schedulingInfoList* in *si-SchedulingInfo* in *SIB1*;

3> determine the integer value *x = (n – 1) × w*, where *w* is the *si-WindowLength*;

3> the SI-window starts at the slot #*a*, where *a* = *x* mod N, in the radio frame for which SFN mod *T* = FLOOR(*x*/N), where *T* is the *si-Periodicity* of the concerned SI message and N is the number of slots in a radio frame as specified in TS 38.213 [13];

2> else if the concerned SI message is configured in the *schedulingInfoList2*

3> determine the integer value *x = (si-WindowPosition -1) × w*, where *w* is the *si-WindowLength*;

3> the SI-window starts at the slot #*a*, where *a* = *x* mod N, in the radio frame for which SFN mod *T* = FLOOR(*x*/N), where *T* is the *si-Periodicity* of the concerned SI message and N is the number of slots in a radio frame as specified in TS 38.213 [13];

2> else if the concerned SI message is configured in the *posSchedulingInfoList* and *offsetToSI-Used* is not configured:

3> create a concatenated list of SI messages by appending the *posSchedulingInfoList* in *posSI-SchedulingInfo* in *SIB1* to *schedulingInfoList* in *si-SchedulingInfo* in *SIB1*;

3> for the concerned SI message, determine the number *n* which corresponds to the order of entry in the concatenated list;

3> determine the integer value *x = (n – 1) × w*, where *w* is the *si-WindowLength*;

3> the SI-window starts at the slot #*a*, where *a* = *x* mod N, in the radio frame for which SFN mod *T* = FLOOR(*x*/N), where *T* is the *posSI-Periodicity* of the concerned SI message and N is the number of slots in a radio frame as specified in TS 38.213 [13];

2> else if the concerned SI message is configured by the *posSchedulingInfoList* and *offsetToSI-Used* is configured:

3> determine the number *m* which corresponds to the number of SI messages with an associated *si-Periodicity* of 8 radio frames (80 ms), configured by *schedulingInfoList* in *SIB1*;

3> for the concerned SI message, determine the number *n* which corresponds to the order of entry in the list of SI messages configured by *posSchedulingInfoList* in *SIB1*;

3> determine the integer value *x* = *m* *× w +* (*n* – 1*)* *× w*, where *w* is the *si-WindowLength;*

3> the SI-window starts at the slot #*a*, where *a* = *x* mod N, in the radio frame for which SFN mod *T* = FLOOR(*x*/N) +8, where *T* is the *posSI-Periodicity* of the concerned SI message and N is the number of slots in a radio frame as specified in TS 38.213 [13];

1> receive the PDCCH containing the scheduling RNTI, i.e. SI-RNTI in the PDCCH monitoring occasion(s) for SI message acquisition, from the start of the SI-window and continue until the end of the SI-window whose absolute length in time is given by *si-WindowLength*, or until the SI message was received;

1> if the SI message was not received by the end of the SI-window, repeat reception at the next SI-window occasion for the concerned SI message in the current modification period;

NOTE 1: The UE is only required to acquire broadcasted SI message if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located.

NOTE 2: The UE is not required to monitor PDCCH monitoring occasion(s) corresponding to each transmitted SSB in SI-window.

NOTE 3: If the concerned SI message was not received in the current modification period, handling of SI message acquisition is left to UE implementation.

NOTE 4: A UE in RRC\_CONNECTED may stop the PDCCH monitoring during the SI window for the concerned SI message when the requested SIB(s) are acquired.

NOTE 5: A UE capable of NR sidelink communication and configured by upper layers to perform NR sidelink communication on a frequency, may acquire *SIB12* from a cell other than current serving cell (for RRC\_INACTIVE or RRC\_IDLE) or current PCell (for RRC\_CONNECTED), if *SIB12* of current serving cell (for RRC\_INACTIVE or RRC\_IDLE) or current PCell (for RRC\_CONNECTED) does not provide configuration for NR sidelink communication for the frequency, and if the other cell providing configuration for NR sidelink communication for the frequency meets the S-criteria as defined in TS 38.304 [20] and TS 36.304 [27].

1> perform the actions for the acquired SI message as specified in sub-clause 5.2.2.4.

##### 5.2.2.3.3 Request for on demand system information

*Next Change*

### 6.3.2 Radio resource control information elements

#### – *AdditionalSpectrumEmission*

The IE *AdditionalSpectrumEmission* is used to indicate emission requirements to be fulfilled by the UE (see TS 38.101-1 [15], clause 6.2.3, and TS 38.101-2 [39], clause 6.2.3).

*AdditionalSpectrumEmission* information element

***<Skip unmodified changes>***

– *SI-SchedulingInfo*

The IE *SI-SchedulingInfo* contains information needed for acquisition of SI messages.

***SI-SchedulingInfo* information element**

-- ASN1START

-- TAG–SI-SCHEDULINGINFO-START

SI-SchedulingInfo ::= SEQUENCE {

 schedulingInfoList SEQUENCE (SIZE (1..maxSI-Message)) OF SchedulingInfo,

 si-WindowLength ENUMERATED {s5, s10, s20, s40, s80, s160, s320, s640, s1280},

 si-RequestConfig SI-RequestConfig OPTIONAL, -- Cond MSG-1

 si-RequestConfigSUL SI-RequestConfig OPTIONAL, -- Cond SUL-MSG-1

 systemInformationAreaID BIT STRING (SIZE (24)) OPTIONAL, -- Need R

 ...,

 [[

 schedulingInfoList2-r17 SEQUENCE (SIZE (1..maxSI-Message)) OF SchedulingInfo2-r17 OPTIONAL -– Need R

 ]]

}

SchedulingInfo ::= SEQUENCE {

 si-BroadcastStatus ENUMERATED {broadcasting, notBroadcasting},

 si-Periodicity ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512},

 sib-MappingInfo SIB-Mapping

}

SchedulingInfo2-r17 ::= SEQUENCE {

 si-BroadcastStatus-r17 ENUMERATED {broadcasting, notBroadcasting},

 si-WindowPosition-r17 INTEGER (1..256) OPTIONAL, -- Cond FIRST-SI

 si-Periodicity-r17 ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512},

 sib-MappingInfo-r17 SIB-Mapping-v17xy

}

SIB-Mapping ::= SEQUENCE (SIZE (1..maxSIB)) OF SIB-TypeInfo

SIB-Mapping-v17xy ::= SEQUENCE (SIZE (1..maxSIB)) OF SIB-TypeInfo-v17xy

SIB-TypeInfo ::= SEQUENCE {

 type ENUMERATED {sibType2, sibType3, sibType4, sibType5, sibType6, sibType7, sibType8, sibType9,

 sibType10-v1610, sibType11-v1610, sibType12-v1610, sibType13-v1610, sibType14-v1610,

 spare3, spare2, spare1,... },

 valueTag INTEGER (0..31) OPTIONAL, -- Cond SIB-TYPE

 areaScope ENUMERATED {true} OPTIONAL -- Need S

}

SIB-TypeInfo-r17 ::= SEQUENCE {

 sibType-r17 CHOICE {

 type1-r17 ENUMERATED {FFS}

 type2-r17 SEQUENCE {

 posSIBType-r17 ENUMERATED {FFS }

 encrypted-r17 ENUMERATED { true } OPTIONAL, -- Need R

 gnss-id-r17 GNSS-ID-r16 OPTIONAL, -- Need R

 sbas-id-r17 SBAS-ID-r16 OPTIONAL -- Need R

 }

 }

 valueTag-r17 INTEGER (0..31) OPTIONAL, -- Cond SIB-TYPE

 areaScope-r17 ENUMERATED {true} OPTIONAL -- Need S

}

-- TAG-SI-SCHEDULINGINFO-STOP

-- ASN1STOP

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| ***SchedulingInfo* field descriptions** |
| ***areaScope***Indicates that a SIB is area specific. If the field is absent, the SIB is cell specific. |
| ***si-BroadcastStatus***Indicates if the SI message is being broadcasted or not. Change of *si-BroadcastStat*us should not result in system information change notifications in Short Message transmitted with P-RNTI over DCI (see clause 6.5). The value of the indication is valid until the end of the BCCH modification period when set to *broadcasting*. |
| ***si-Periodicity***Periodicity of the SI-message in radio frames. Value *rf8* corresponds to 8 radio frames, value *rf16* corresponds to 16 radio frames, and so on. |

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| ***SI-SchedulingInfo* field descriptions** |
| ***si-RequestConfig***Configuration of Msg1 resources that the UE uses for requesting SI-messages for which *si-BroadcastStatus* is set to notBroadcasting. |
| ***si-RequestConfigSUL***Configuration of Msg1 resources that the UE uses for requesting SI-messages for which *si-BroadcastStatus* is set to notBroadcasting. |
| ***si-WindowLength***The length of the SI scheduling window. Value *s5* corresponds to 5 slots, value *s10* corresponds to 10 slots and so on. The network always configures *si-WindowLength* to be shorter than or equal to the *si-Periodicity*. |
| ***systemInformationAreaID***Indicates the system information area that the cell belongs to, if any. Any SIB with *areaScope* within the SI is considered to belong to this *systemInformationAreaID*. The systemInformationAreaID is unique within a PLMN/SNPN. |

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| *SchedulingInfo2* field descriptions |
| ***encrypted***The presence of this field indicates that the pos-sib-type is encrypted as specified in TS 37.355 [49]. |
| ***gnss-id***The presence of this field indicates that the positioning SIB type is for a specific GNSS. Indicates a specific GNSS (see also TS 37.355 [49]) |
| ***posSibType***The posSIBs as defined in TS 37.355 [49] mapped to SI for scheduling using*schedulingInfoList2*. The following *type* values should not be used in *SchedulingInfo2* to ensure backwards compatibility: posSibType1-1, posSibType1-2, posSibType1-3, posSibType1-4, posSibType1-5, posSibType1-6, posSibType1-7, posSibType1-8, posSibType2-1, posSibType2-2, posSibType2-3, posSibType2-4, posSibType2-5, posSibType2-6, posSibType2-7, posSibType2-8, posSibType2-9, posSibType2-10, posSibType2-11, posSibType2-12, posSibType2-13, posSibType2-14, posSibType2-15, posSibType2-16, posSibType2-17, posSibType2-18, posSibType2-19, posSibType2-20, posSibType2-21, posSibType2-22, posSibType2-23, posSibType3-1, posSibType4-1, posSibType5-1,posSibType6-1, posSibType6-2, posSibType6-3. |
| ***si-WindowPosition***This field indicates the SI window start position of the associated SI-message.  |
| ***sib-MappingInfo***Indicates which SIBs are contained in the SI message.  |
| ***type1***The SIBs mapped to SI for scheduling using*schedulingInfoList2*. The following *type* values should not be used in *SchedulingInfo2* to ensure backwards compatibility: sibType2, sibType3, sibType4, sibType5, sibType6, sibType7, sibType8, sibType9, sibType10, sibType11, sibType12, sibType13, sibType14. |
| ***sbas-id***The presence of this field indicates that the positioning SIB type is for a specific SBAS. Indicates a specific SBAS (see also TS 37.355 [49]). |

| **Conditional presence** | **Explanation** |
| --- | --- |
| *MSG-1* | The field is optionally present, Need R, if *si-BroadcastStatus* is set to *notBroadcasting* for any SI-message included in *SchedulingInfo*. It is absent otherwise. |
| *SIB-TYPE* | The field is mandatory present if the SIB type is different from *SIB6*, *SIB7* or *SIB8*. For *SIB6*, *SIB7* and *SIB8* it is absent. |
| *SUL-MSG-1* | The field is optionally present, Need R, if *supplementaryUplink* is configured in *ServingCellConfigCommonSIB* and if *si-BroadcastStatus* is set to *notBroadcasting* for any SI-message included in *SchedulingInfo*. It is absent otherwise. |
| *FIRST-SI* | The field is mandatory present for the first SI message in the *schedulingInfoList2*. Otherwise, it is optionally present, Need S. If this field is absent for the subsequent SI messages, the field value is the value of the previous entry in the *schedulingInfoList2* plus 1, i.e the SI messages are scheduled in consecutive SI window order (plus one) until the field is present again. |

*End Of Changes*