LTE DL slim carrier (LTE3145)

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Target point of contact:

1 Feature overview

Slim carrier functionality in LTE DL allows user to mark some PRBs from the lower and the upper part of the band (around the center frequency) as blanked, which means no PHICH, PCFICH, PDCCH, PDSCH and also CRSs traffic allowed on these PRBs.

The use case for slim carrier is an operator having bought an 8 MHz band, and willing to maximize the used bandwidth. They could set up a 5 MHz cell and a 3 MHz and operate them in the Carrier Aggregation manner, but that might not always be possible. It's advised, that they set up a 10 MHz cell, and blank an appropriate number of PRBs from the top and/or the bottom to only utilize the band they bought.

Note that this feature applies only for FDD.

2 Impact on TRX interfaces

2.1 Schema

New schema fields (src/trx5g/json_validator/sct_definition_schema/cell/lte/downlink/cell.json):

1. **dl_slim_carrier_activation**
   Activates/deactivates slim carrier functionality
   type: boolean
   mapps to PHY_DlCellSetupReq.actDlSlimCarrier
2. **blank_prbs_up** (should be configured by user only if dl_slim_carrier_activation = true)
   Specifies number of prbs which should be muted (no resources scheduled on them) from the top of bandwidth spectrum
   type/values: u32/{0, … , 20}
   mapps to PHY_DlCellSetupReq.numBlankDlPrbsUp and ParCell{}.<Standard=Eutra>RRC.SlimCarrier.BlankDlPrbsVec
3. **blank_prbs_down** (should be configured by user only if dl_slim_carrier_activation = true)
   type/values: u32/{0, … , 20}
   Specifies number of prbs which should be muted (no resources scheduled on them) from the bottom of bandwidth spectrum
   mapps to PHY_DlCellSetupReq.numBlankDlPrbsDown and ParCell{}.<Standard=Eutra>RRC.SlimCarrier.BlankDlPrbsVec

2.2 Validators

1. Total number of blanked PRBs:
   When slim cell is activated in the cell, user can blank **up to 20%** of the overall available PRBs. Note: overall available PRBs depends on cell bandwidth (20MHz cell = 100 PRBs, 15MHz cell = 75 PRBs etc.) User can blank PRBs according to below:
   a. All blanked PRBs from the top of BW spectrum
   b. All blanked PRBs from the bottom of BW spectrum

c. Some blanked PRBs from the bottom of bandwidth spectrum and some from the top of BW spectrum

2. No traffic allowed on blanked PRBs:
   For each PRB marked as “blanked” by user, scheduling any resources on it should be forbidden
3. This feature should be available only in LTE FDD DLPHY tests

2.3 Non real-time messages

New fields introduced in PHY_DlCellSetupReq (see DlPhyCell Spec 5.2)

1. hasDlSlimCarrierConfig (type: boolean) - should be set to:
   - True - if user correctly configures all sub-fields in new schema field: dl_slim_carrier_activation (see 2.1.1)
   - Otherwise, it should be set to false.
2. dlSlimCarrierConfig:
   a. actDlSlimCarrier (type: boolean) - see 2.1.1
   b. numBlankDlPrbsUp (type: u32) - see 2.1.1.a
   c. numBlankDlPrbsDown (type: u32) - see 2.1.1.b

2.4 Real-time messages

2.4.1 DLPHY requests

2.4.2 ULPHY requests

2.4.3 ULPHY responses

2.5 ULPHY input antenna data interface

2.6 DLPHY output antenna interface

2.7 Output CSVs

As a test result trx should check and compare if DLPHY correctly blanked these prbs, which were chosen by user in schema to be blanked. Blanked prbs means no data scheduled on them.

2.8 Capacity

2.9 Timings

3 Impact on XRT

LTE3145 feature introduces some changes in trx schema and PHY_DlCellSetupReq, so it impacts XRT according to below:

TRX schema fields (for details check 2.1):

- dl_slim_carrier_activation – new field introduced
- blank_prbs_up – new field introduced
- blank_prbs_down – new field introduced

PhyCell message (for details check 2.3):

- PHY_DlCellSetupReq.hasDlSlimCarrierConfig - new field introduced
- PHY_DlCellSetupReq.dlSlimCarrierConfig - new field introduced

4 Blockers and dependencies

4.1 Multi L1-L2L3 interface

ISAR interface (based on information in PHY_Cell document) is already integrated with this feature changes.

4.2 5gmax

If slim carrier functionality is activated on target side, 5gmax should also be properly modified, to generate correct reference data.

Activation and configuration of slim carrier in 5gmax:

ParCell{}.<Standard=Eutra>RRC.SlimCarrier.BlankDlPrbsVec
values: {-1, … , 99} (means which specific PRBs should be muted)
default: -1 (means no PRBs muted/slim carrier deactivated)

Correct values for *BlankDlPrbsVec* are provided by user in new schema field: blank_prbs_up and blank_prbs_down (see 2.1)

5 CFAM requirements

FTM-18588

5.1.1.1.1 4.3.1.1.2.4 PhyCell (LTE RROM - DL PHY)

FTM-18589

new parameters are added into PHY_DlCellSetupReq:

hasDlSlimCarrierConfig	M	0 .. . 1	TBoolean" "TBoolean	408 … 411	This field specifies whether the "dlSlimCarrierConfig" field contains a valid value.
dlSlimCarrierConfig	O		SDlSlimCarrierConfig" "SDlSlimCarrierConfig	412 … 423	Slim Carrier Configuration (FDD only)

SDlSlimCarrierConfig

IE/Group Name	**Pr**	**Value range**	**IE Type**	**Byte range**	**Description**

actDlSlimCarrier	M	0...1	TBoolean" "TBoolean	0 .. 3	Activate Slim Carrier Flag Default value: 0
numBlankDlPrbsDown	M		u32" "u32	4 .. 7	Number of blanked PRBs from the bottom
numBlankDlPrbsUp	M		u32" "u32	8 .. 11	Number of blanked PRBs from the top
Size: 12 bytes					

PHY_DlCellSetupReq

hasDlSlimCarrierConfig	M	0...1	TBoolean	532 ... 535	This field specifies whether the "dlSlimCarrierConfig" field contains a valid value.
dlSlimCarrierConfig	O		SDlSlimCarrierConfig	536 ... 547	Slim Carrier Configuration (FDD only)

6.1.1.15 SDlSlimCarrierConfig

Slim Carrier Configuration

IE/Group Name	Pr	Value range	IE Type	Byte range	Description
actDlSlimCarrier	M	0...1	TBoolean	0 ... 3	Activate Slim Carrier Flag Default value: 0
numBlankDlPrbsDown	M		u32	4 ... 7	Number of blanked PRBs from the bottom
numBlankDlPrbsUp	M		u32	8 ... 11	Number of blanked PRBs from the top
Size: 12 bytes					

▼ ParCell{}.<Standard=Eutra>RRC.SlimCarrier

[---]

struct Show in GitWeb

- ParCell{}.<Standard=Eutra>RRC.SlimCarrier.BlankDlPrbsVec

RRC: Slim Carrier

Mute specific PRBs (zero-based); -1 means no muted PRB

INT[] [-1] -1, ..., 99 Show in GitWeb

FTM-2173		Internally linked object for RRM_LTE_SFS_RRM.10573 Blanked PRBs for slim carrier operation When LTE3145 is activated in the cell the operator can blank up to 20% of the overall available PRBs on the lower and upper part of the spectrum by configuration of respective O&M parameters. These PRBs are not available for dynamic scheduling on the PDSCH. Furthermore, since slim carrier operation is only available with LTE2354 activated, non-blanked PRBs within blanked RBGs will also not be used by DL-S for dynamic data scheduling on the PDSCH, as they should preferably be used for common channel transmissions.

FTM-1826 5.1.1.1.2 4.3.1.1.2.3 MacCell(LTE RROM - LTE MAC)

3 parameters (actDlSlimCarrier, numBlankDlPrbsDown, numBlankDlPrbsUp) are added for LTE3145 in SCommonCellParamsWmp of MAC_CellSetupReq/MAC_CellReconfigurationReq.

actDlSlimCarrier	M	0...1	TBoolean" "TBoolean	696... 699	This field specifies whether the Slim Carrier is enabled or not. (Introduced by LTE3145, FDD only) It can be set to TRUE only the parameter “dlsDciCch” is set to 1A(TRUE). Default value is "FALSE".

					For TDD, the value is always “FALSE”.
numBlankDlPrbsDown	O	0...20	u32" "u32	700...703	The number of blanked downlink PRBs at the lower edge of the spectrum. The value of the parameter is meaningful only if the parameter “actDlSlimCarrier ” is set to “TRUE”. The number of PRBs to be blanked in the lower and the upper spectrum part such that no more than 20% of the total available PRBs.
numBlankDlPrbsUp	O	0...20	u32" "u32	704...707	The number of blanked downlink PRBs at the upper edge of the spectrum. The value of the parameter is meaningful only if the parameter “actDlSlimCarrier ” is set to “TRUE”. The number of PRBs to be blanked in the lower and the upper spectrum part such that no more than 20% of the total available PRBs.