



Support of Wider Bandwidth for LTE-Advanced

Agenda Item:

11.1

Source:

Nortel Networks

Document for:

Discussion and Decision

Introduction

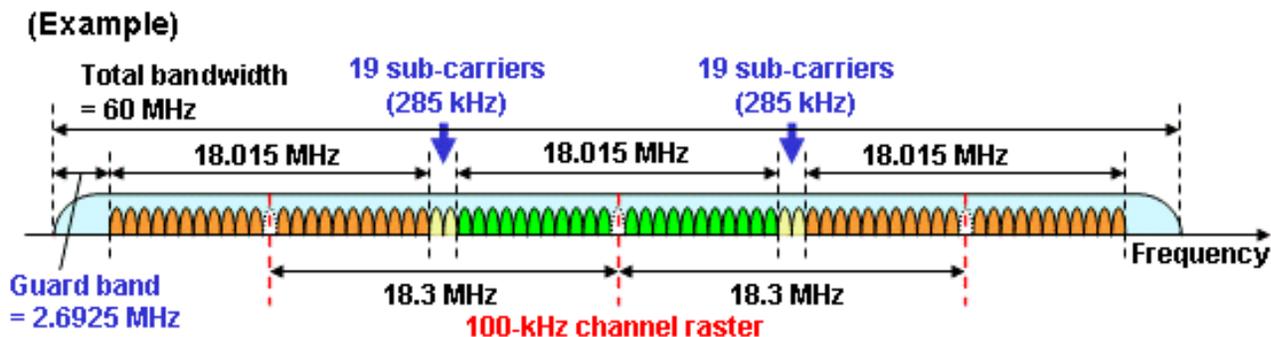


- It was agreed in RAN1#53bis for LTE-Advanced to consider carrier aggregation to support bandwidth larger than 20MHz.
- Various DL control channel design alternatives have been identified [1-6]
- We prefer the DL control channel structure to satisfy the followings
 - UE monitors PDCCH of one component carrier, i.e., anchor carrier, to save power
 - Limit the number of blind decoding attempts at UE
 - Easy to support new PDCCH formats for LTE-A features (relay, collaborative MIMO etc.) without increasing UE complexity
- This contribution
 - expresses our view on subcarrier arrangement in carrier aggregation with contiguous spectrum
 - proposes a new DL control channel structure to facilitate resource allocation for LTE-A UE across multiple component carriers

Subcarrier arrangement with contiguous spectrum

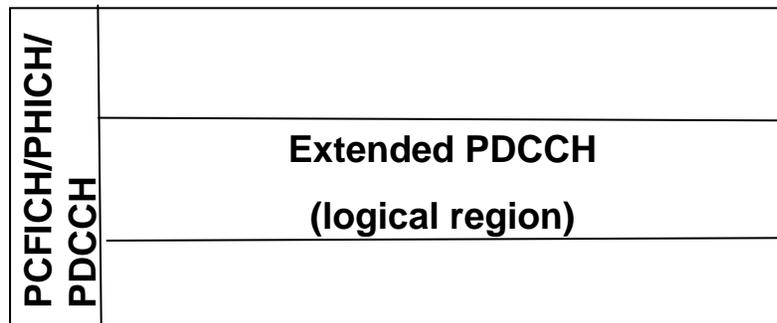


- We prefer
 - Evenly spaced subcarriers at 15 kHz spacing should be maintained
 - Center frequency of adjacent carriers to be placed on multiples of 100 kHz such that Condition 1 is satisfied (i.e., Option 2b of [2] as shown below)
 - Advantage: a single FFT operation can be used
 - Flexibility in using these as guard subcarriers in case any interference issue may be identified in the future
 - Extra (e.g., 19) subcarriers in between adjacent subcarriers cannot be used for Release 8 UEs, but they can be used to serve LTE-A UEs
 - Can be used as additional data or control resources
 - Resource block size could be 19 subcarriers, different than the regular RB size
 - UE specific RS may be used



Proposed downlink control channel structure

- Each component carrier can have an extended PDCCH (E-PDCCH) region. The E-PDCCH region may contain a number of distributed RBs.
- LTE-A UE monitors the legacy PDCCH region of its anchor component carrier
- A new compact DCI Format is introduced for LTE-A UE and transmitted on legacy PDCCH region of anchor carrier. This compact DCI format, served as a primary PDCCH for LTE-A UE, indicates UE the location of E-PDCCH within the E-PDCCH region on component carriers. The E-PDCCH carries the actual resource assignment information, served as the secondary PDCCH for LTE-A UE.
- E-PDCCH carries Rel-8 DCI formats and new DCI formats for LTE-A features
- Since the primary PDCCH explicitly tells LTE-A UE the location and size of E-PDCCH
 - UE decodes E-PDCCH without blind decoding
 - It is easy to support new DCI formats for LTE-A features with large payload size without concerning whether CCE aggregation level 8 is sufficient
- Rel-8 UE will not be scheduled to transmit traffic on E-PDCCH region





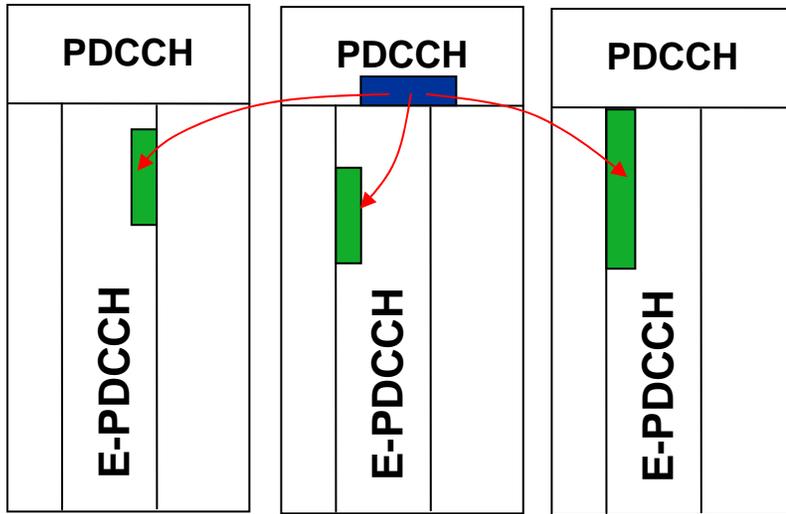
Primary PDCCH (1)

- Two design options for the primary PDCCH
- Option 1:
 - Primary PDCCH format
{Carrier #1, E-PDCCH location & size in E-PDCCH region;
Carrier #2, E-PDCCH location & size in E-PDCCH region;
...
Carrier #M, E-PDCCH location & size in E-PDCCH region}
where M is the number of carriers supported by the system; or the number of carriers supported/configured by the UE
 - Separate E-PDCCH per component carrier; E-PDCCH indicates the resource assignment on the corresponding component carrier
- Option 2:
 - Primary PDCCH format
{Carrier ID, E-PDCCH location & size in E-PDCCH region}
 - The primary PDCCH points UE to E-PDCCH on one component carrier. The E-PDCCH on this component carrier indicates the resource assignment across all component carriers, i.e., one joint E-PDCCH for all component carriers.
- Comparing to Option 2, Option 1 has more overhead in E-PDCCH due to repeating certain fields of DCI formats for all component carriers, however, it has better robustness.



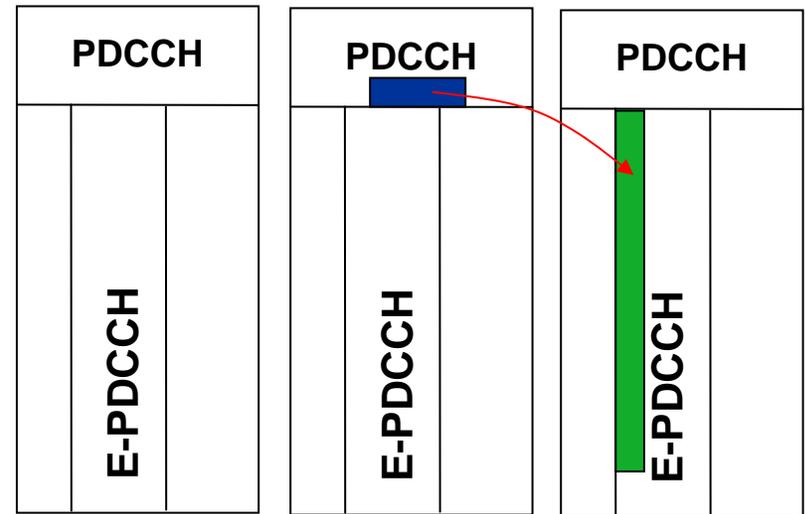
Primary PDCCH (2)

Option 1



-  Primary PDCCH (logical channel)
-  Secondary PDCCH (logical channel)

Option 2



-  Primary PDCCH (logical channel)
-  Secondary PDCCH (logical channel)

Signaling of Extended PDCCH region



- For LTE-A UE to know the resource allocation (location and size) of E-PDCCH region, we could have the following two options
 - Option 1:
 - Indicates the starting RB location and the number of RBs of E-PDCCH region, and gap in the case of DVRB
 - Option 2:
 - Specify the number of RBs of E-PDCCH region only
 - UE finds out the starting RB location by itself via predefined frequency hopping pattern which could be a function of cell ID and subframe index
- For eNB to signal LTE-A UE the resource allocation of E-PDCCH region, we could have the following two options
 - Option 1: define a new DCI format to indicate the resource allocation of extended PDCCH region on each component carrier
 - Transmitted on legacy PDCCH region
 - CRC scrambled by LTE-A-RNTI, for all LTE-A UEs with multi-carrier capability
 - Option 2: carried by higher layer signaling, e.g., RRC, SIB etc., as system information
 - Option 1 might increase the number of blind decoding attempts due to a new DCI format, however, it can change the amount of resource allocation for E-PDCCH region on a subframe basis



Benefit of proposed DL control structure

- The proposed DL control channel structure is applicable to both continuous and non-contiguous spectrum aggregation
- To save power, UE monitors DL control channel of its anchor carrier and turns on other component carriers if necessary.
- Limited blind decoding for LTE-A UE. No blind decoding for E-PDCCH due to explicitly signaling of location and size of E-PDCCH.
- With the proposed E-PDCCH, it is easy to support new DCI formats for LTE-A features of large payload size without concerning whether CCE aggregation level 8 is sufficient
- Primary PDCCH is not expected to have a large payload size, hence it should not overload the legacy PDCCH region.
- E-PDCCH may achieve better performance than legacy PDCCH. Intercell interference can be better controlled on E-PDCCH as it is less challenge to avoid E-PDCCH collision from neighboring cells.



References

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2. 'Update views on Support of wider bandwidth in LTE-Advanced', R1-083677, RAN1 #54bis, DoCoMo, Oct. 2008
3. 'Issues on Uplink SU-MIMO for E-UTRA', R1-083529, RAN1 #54bis, Texas Instrument, Oct. 2008
4. 'L1 control signaling with carrier aggregation', R1-083730, RAN1 #54bis, Nokia and Nokia Siemens Networks, Oct. 2008
5. 'DL/UL asymmetric carrier aggregation', R1-083706, RAN1 #54bis, Huawei, Oct 2008
6. 'Carrier aggregation', R1-083750, RAN1 #54bis, Ericsson, Oct 2008



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