3GPP TSG RAN Meeting #71
Göteborg, Sweden, March 7-10, 2016

RP-160310

Source: Huawei, China Unicom, China Telecom, HiSilicon
Document for: Information
Agenda Item: 10.1.4

RP-160310 Motivation for New SI on LTE bandwidth flexibility enhancements

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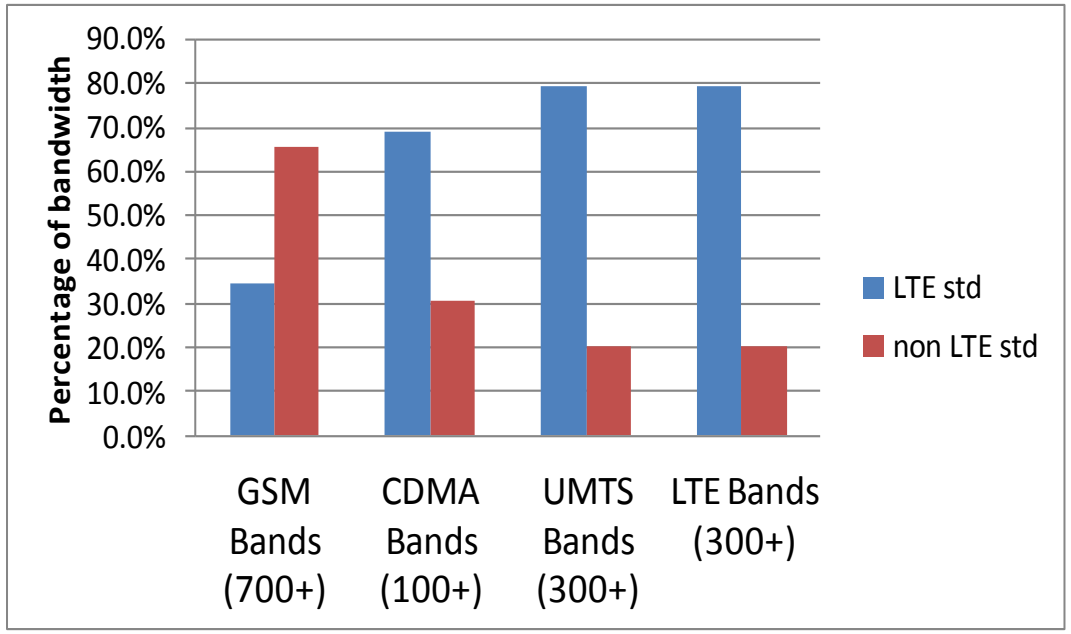
Motivation

- Parts of the spectrum identified for IMT-advanced are not efficiently utilized by LTE in licensed bands because in certain countries **the channelization plan results in spectrum blocks allocated to an operator that do not exactly correspond to the specified nominal LTE bandwidth sizes supported since Rel-8**. Such cases may also arise when spectrum is displaced/re-farmed from GSM or UMTS to LTE within one operator's licensed spectrum.
- **Spectrum allocations across the world show a large variety of non-standard spectrum block sizes** (e.g. 1.8, 2.0, 2.2, 4.4, 4.6, 6, 6.2, 7.8, 7.0, 8.0, 11, 14, 18, 19 MHz):
  - Difficult for 3GPP to address this problem by defining a few new standardized nominal LTE bandwidth sizes
  - The alternative to utilize carrier aggregation within a non-standard block sizes would still not fully utilize the spectrum, and would require the addition of many new band combinations
- **Enhancements to LTE should be specified such that the entire licensed spectrum block can be used by the network** with the minimal (possibly no) impact on the UE RF, and supporting legacy UEs in a backward compatible way.
- **The advantages of enhancing the LTE bandwidth flexibility are:**
  - **To enable the utilization of operator spectrum asset as much as possible**
  - **To increase the throughput on the available spectrum resources**

Available Spectrum with Non-standard Bandwidth

- **Large percentage of available non-standard frequency blocks of operators exist**



- **As indicated by last RAN, some specific use cases were provided by operators [1,2,3] in RAN4 #78 and summarized in the following table**

Operators	Block [MHz]
China Telecom	11,13.5
China Unicom	6
Dish	6
Rogers	1.5,2.5,6,11
Telus	2.5,6

Reference 1: R4-160026, “Motivation of new WI: Bandwidth Flexibility for LTE”, China Unicom.
Reference 2: R4-160360, “The requirement of Bandwidth flexibility”, China Telecom, Huawei.
Reference 3: R4-160631, “ Demand for bandwidth flexibility from the perspective of operators ”, Huawei, China Telecom, China Unicom.

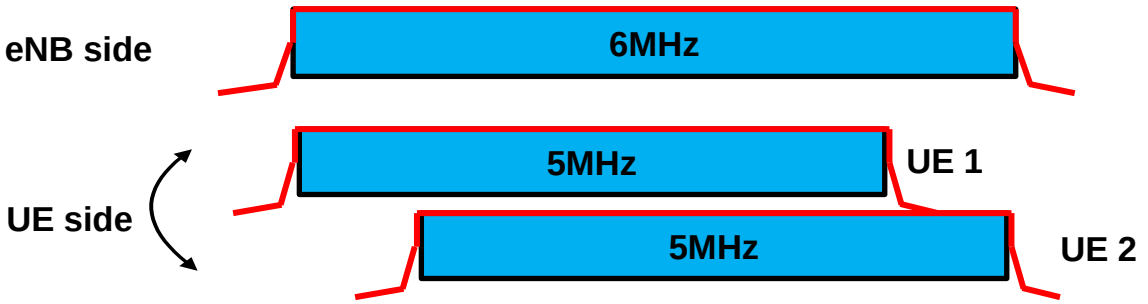
Disadvantages of Carrier Aggregation Solution

- **Carrier aggregation may be one of the solutions with the combination of many small bandwidth(e.g. 1.4/3) carrier**
  - For example, 6MHz: 3MHz+3MHz , 11MHz: 5MHz+ 3MHz+3MHz and 12MHz: 10MHz + 1.4MHz etc
- **There are several disadvantages for carrier aggregation solution:**
  - Lots of spectrum blocks (such as 12MHz by using 10MHz and 1.4MHz) are still not efficiently utilized.
  - There will be large standard effort in RAN4 to define diversified CA band combinations, and the issue is also raised for small bandwidth, e.g. in TS 36.104, all scenarios for channel bandwidths of the outermost carrier less than 5 MHz are FFS.
  - CA with small bandwidths is inefficient due to the excessive common control signaling, the separate PDCCH scheduling and UCI feedback for each component carrier.
  - Small bandwidths significantly degrade UE throughput especially for legacy UEs and non-CA capable UEs (shown in the next page). Alternatively, CA capability is needed at least for R10 and beyond UEs even for small bandwidths.
  - Many small bandwidths may need to be combined to maximize the network spectrum efficiency, for example 11MHz by using 5+3+3MHz, the network complexity is quite high.

- **Observation: New efficient solution rather than CA should be considered for the non-standard LTE bandwidth**

Examples of use cases and performance gain

Example of use case: The available spectrum block size is not one of the legacy LTE bandwidths.



Performance Gain: Example for a 6MHz block

Available bandwidth (MHz)	LTE Baseline 1	LTE with bandwidth flexibility	Network gain (example)
6	1x5 MHz carrier Usable: 4.5 MHz	5.4MHz (+20%)	20% (5.4 vs. 4.5 MHz)

Available bandwidth (MHz)	LTE Baseline 2	LTE with bandwidth flexibility	Non-CA UE gain (5 MHz filter)
6	2x3 MHz CA Usable: 5.4 MHz	5.4 MHz (0%)	**67%** (4.5 vs. 2.7 MHz)

Objectives of the Study Item

- This study item is to investigate the effectiveness of different proposals that are aimed to support bandwidth flexibility with limited impact on hardware implementation and RAN4 specifications, under the following assumptions:
  - The eNB operates in the entire N MHz block (1.4 < N < 20).
  - The UE operates in legacy channel bandwidths and no new channel bandwidth will be introduced
- The study item particularly covers the following aspects:
  - Impact to BS/UE RF requirements together with implementation
  - cell search performance for legacy UE
- Based on the outcome of the above studies, the following specification-related work will be identified pending approval of the related Work Item:
  - Constraints to the LTE air interface design for bandwidth flexibility
  - Necessary change for RAN4 specifications

Proposed RAN study plan

- **From RAN71 (March 2016) to RAN72 (Jun 2016)**
  - 2 WG meetings for RAN4 study on core aspects
  - 1 WG meeting for RAN1 study

Thank you

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