3GPP TSG RAN Meeting #70
Sitges, Spain, December 7 - 10, 2015

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Motivation for new work item proposal on LTE bandwidth flexibility enhancements

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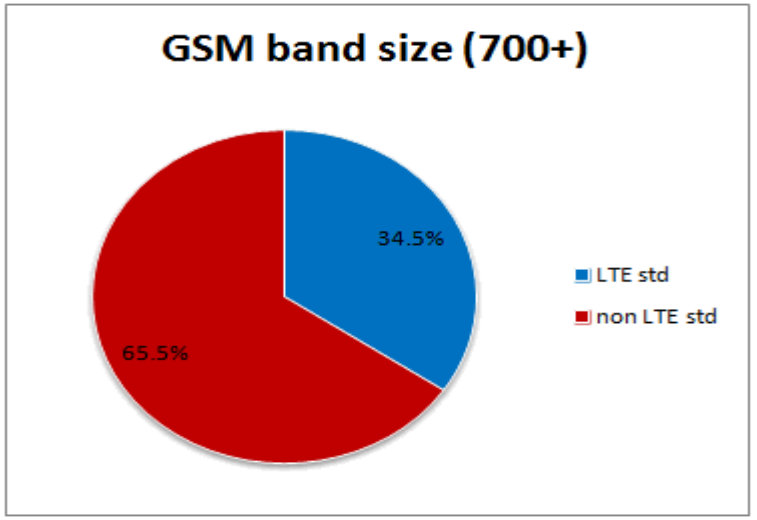
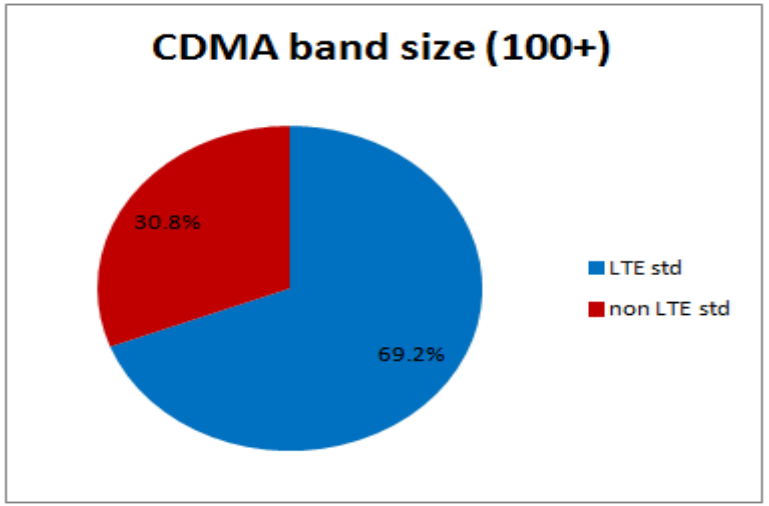
HUAWEI TECHNOLOGIES CO., LTD.

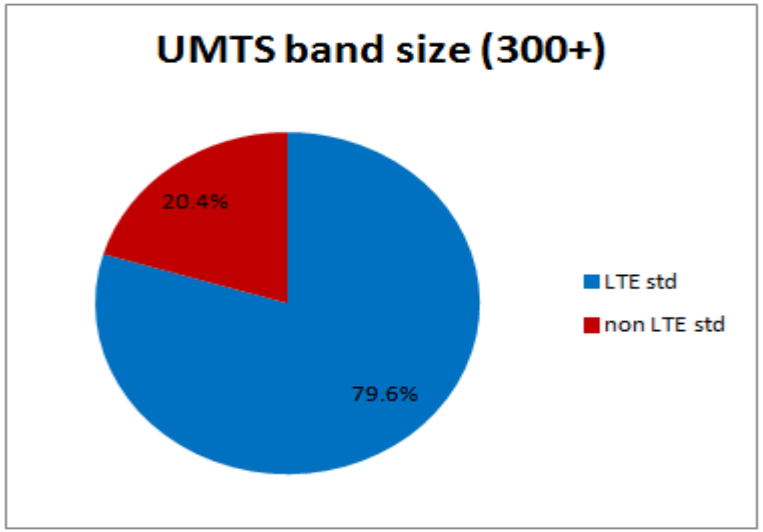
Motivation

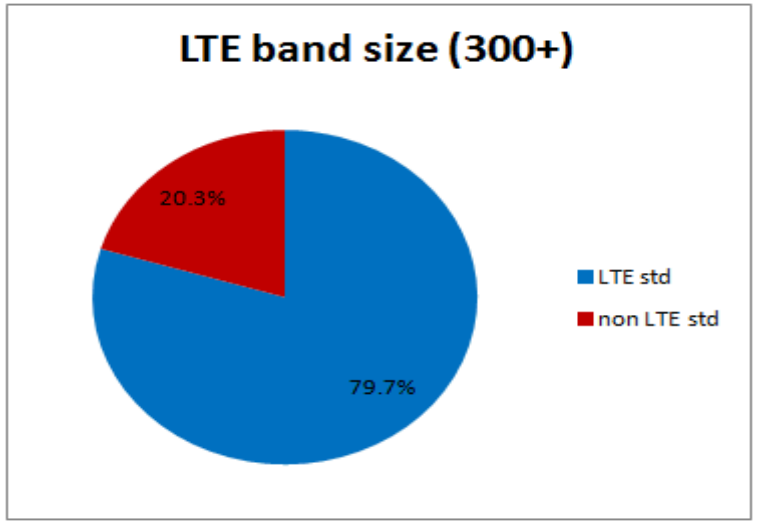
- Parts of the spectrum identified for IMT-advanced are not efficiently utilized by LTE in licensed bands because in certain countries **the channelization plan results in spectrum blocks allocated to an operator that do not exactly correspond to the specified nominal LTE bandwidth sizes supported since 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 except in special cases, 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 possibility to schedule different UEs in different parts of the spectrum block, while limiting (or avoiding) any 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





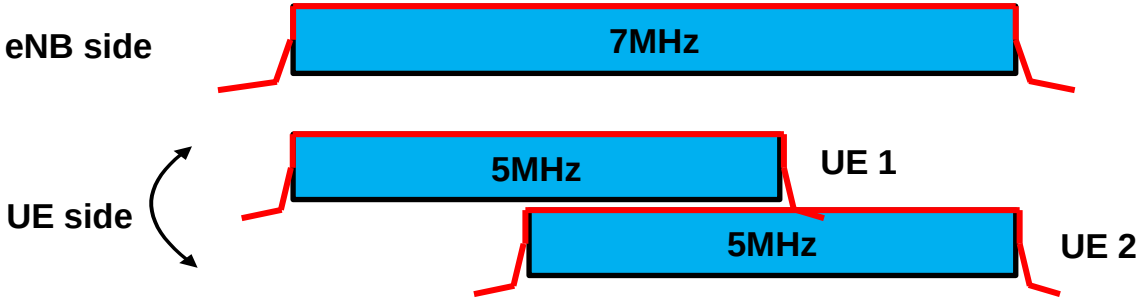




The numbers in brackets are a count of spectrum holdings

Examples of use cases and performance gain

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



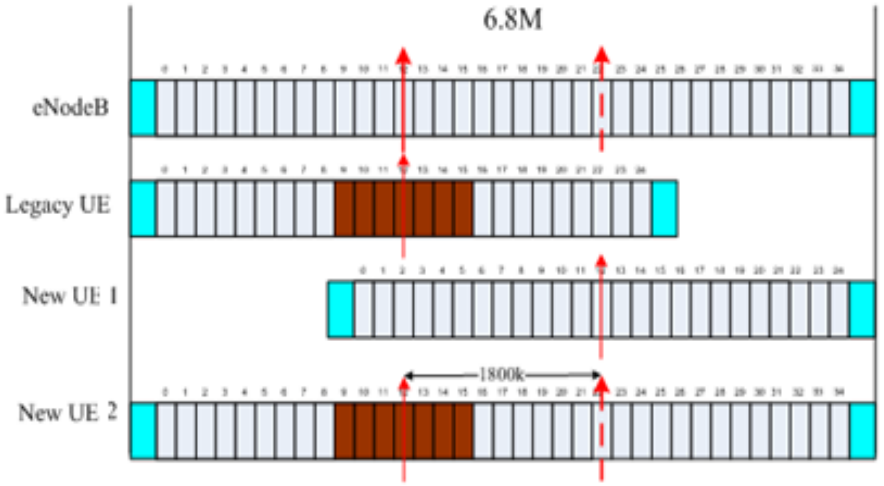
Performance Gain: Example for a 7MHz block

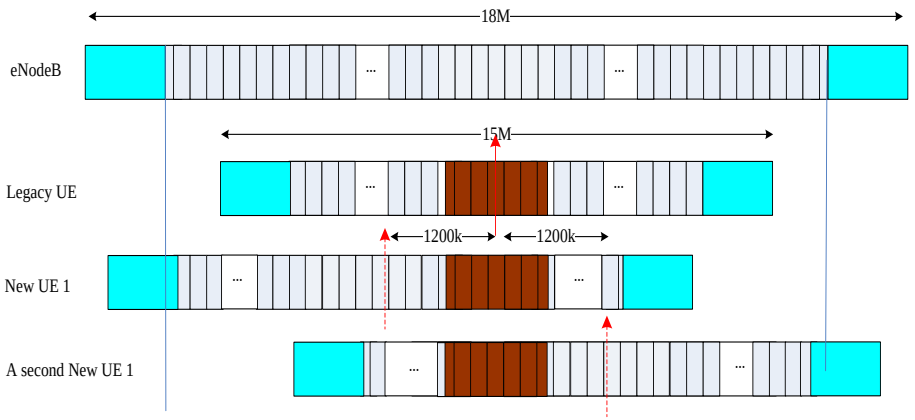
Available bandwidth (MHz)	LTE Baseline 1	LTE with bandwidth flexibility	Network gain (example)
7	1x5 MHz carrier Usable: 4.5 MHz	6.3 MHz (+40%)	40% (6.3 vs. 4.5 MHz)

Available bandwidth (MHz)	LTE Baseline 2	LTE with bandwidth flexibility	Non-CA UE gain (5 MHz filter)
7	5+1.4 MHz carrier Usable: 5.58 MHz	6.3 MHz (+13%)	40% (6.3 vs. 4.5 MHz)

Solution for maximizing the bandwidth utilization

- **Solution of flexible bandwidth (examples for a 6 MHz or 18 MHz spectrum block size)**
  - **Legacy UE**: access 5 MHz of a legacy carrier with a fixed center frequency
  - **New UE 1** : 5 MHz bandwidth with a single RF chain (no hardware impact compared to a legacy UE)
  - **New UE 2** : Full bandwidth but potentially with CA-like solution, and peak data rate can be achieved
  - OFDM mapping and resource allocation to ensure baseband orthogonality with legacy UEs
  - Solutions to receive common control channels should be investigated if the new carrier is configured as a PCell





Objectives of the Work

- The solution should support backward compatible operation of UEs over a legacy carrier occupying part of a non-standard spectrum block.
- In this use case, the objective of this work item is to specify a solution such that UEs (except legacy UEs) can be scheduled for downlink and uplink in the non-legacy parts of the block, under the following constraints:
  1. The eNB operates in the entire N MHz block (1.4 ≤ N ≤ 20).
  2. All legacy UEs operate in the same legacy carrier with a fixed central frequency within the N MHz block.
  3. A non-legacy UE operates within a configured sub-block of the N MHz block:
     - the sub-block size is one of 3/5/10/15/20 MHz;
     - the sub-block contains the central 6 PRBs of the legacy carrier;
  4. A non-legacy UE can operate in the legacy carrier and the sub-block simultaneously;
  5. A non-legacy UE and a legacy UE can be scheduled in adjacent PRBs with orthogonal subcarriers.

- The solution should allow a non-legacy UE to be scheduled in PRBs of the legacy carrier.
- The solution may allow that CRS are not transmitted in PRBs outside the legacy carrier.
- The solution should reuse LTE design as much as possible.
- The work will not define new UE RF requirements.

Note 2: backward compatibility for BS RF is ensured for a block of at least 5 MHz (cf page 7)

RF impact and co-existence analysis

- A detailed overview of the impact to the BS and UE RF was provided in RP-141912. In summary:

- BS RF impact analysis
  - In current specifications, for Channel Bandwidth (CBW) larger than or equal to 5MHz, one uniform emission mask is defined for BS. As long as the new BW is larger than 5MHz, this mask can be re-used.
  - In current specifications, the BS receiver requirements are defined based on 25 RB for CBW no less than 5MHz. Hence for new CBW larger than 5MHz the receiver requirements can be re-used.
  - Existing RF requirements for the BS can guarantee co-existence with adjacent systems

- UE RF impact analysis
  - Legacy channel bandwidths are re-used and existing UE RF requirements such as transmitter unwanted emission and receiver blocking requirements can be re-used.
  - The overlapping bandwidth of Rel-13 UE and legacy UE will not bring more mutual interference than when different UEs transmit partial bandwidth within one legacy carrier.
    - The sub-carriers are orthogonal.
    - The filter provides additional attenuation.

Proposed RAN Workplan

- 4 WG meetings for RAN1/2/4 core work
  - From RAN70 (Dec 2015) to RAN73 (Sep 2015)

- Performance part until RAN73

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