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

RP-151886

Document for: Discussion
Agenda Item: 14.1.1

Motivation and scope of Rel-14 work on LAA

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Background and Motivation

- SI on LAA for LTE (TR 36.889)
  - The study recommended category 4 LBT for DL operation based on coexistence evaluations
  - The study identified options for LBT for UL operation based on coexistence evaluations
- WI on LAA for LTE
  - Core specification work is completed at RAN#70
  - RAN1 identified candidate procedures for UL LBT with self-carrier scheduling and cross-carrier scheduling
  - Only DL is specified in the first LAA WI in Rel-13
- Sufficient progress has been made on the uplink in RAN1 to start normative for uplink work right away, given that RAN1 work on the DL for Rel-13 is done. Further enhancements to the DL of LAA should also be considered in Rel-14.

- The work on extending LTE and 3GPP services to unlicensed spectrum must continue without a break in 3GPP to provide enhanced wireless services over unlicensed spectrum
  - IEEE 802 is pursuing the work on 802.11ax
  - ETSI BRAN will update EN 301 893 in multiple stages to account for evolutions of Wi-Fi and LAA

Proposed WI Objectives

- Objective 1: Channel access framework including clear channel assessment for uplink
  - Support at least one of the UL LBT candidate procedures identified by RAN1 for self-carrier scheduling and for cross-carrier scheduling

- RAN1 has identified candidate procedures (RAN1#82):
  - For self-carrier scheduling, and for cross-carrier scheduling if it is supported that an LBT operation is performed on the SCell to send a grant on another Cell, the following UL LBT candidate procedures should be considered:
    - A CCA duration of at least 25 us before the transmission burst where the sensing duration in a CCA slot can be less than the CCA slot duration
    - A category 4 LBT scheme with a defer period of 25 µs including a defer duration of 16 us followed by one CCA slot, and a maximum contention window size chosen from X={3, 4, 5, 6, 7}
  - For cross-carrier scheduling, when an LBT operation is not performed on the SCell, one or more of the following UL LBT procedures should be supported:
    - A CCA duration of at least 25 us before the transmission burst where the sensing duration can be less than the CCA duration
    - A category 4 LBT scheme with a defer period of 25 µs including a defer duration of 16 us followed by one CCA slot
  - FFS: Whether and under what conditions the following option may be used: transmission without LBT when an UL transmission burst on a carrier follows a DL transmission burst on that respective carrier with a gap of at most 16 µs between the two bursts

Proposed WI Objectives

- Objective 2: UE support for frame structure type 3 with time division duplexing of DL and UL, and transmission of PUSCH with asynchronous HARQ, PUCCH and SRS
  - Start from recommendations and agreements from SI/WI. Further enhancements are not precluded, e.g. shorter delay between UL grant and the corresponding PUSCH subframe, multi/cross-subframe scheduling, UL contention-based access, etc
  - Support for UL TTI shorter than 1 ms with reduced UL RTT (based on conclusions of the latency reduction SI)
  - 256QAM in UL
- RAN WGs have progressed on the UL design in the study and work item phases:
  - In case of a eNB operating DL+UL LAA over the same unlicensed carrier, DL transmission burst(s) and UL transmission burst(s) on LAA can be scheduled in a TDM manner over the same unlicensed carrier
  - For PUSCH, extending the current single and dual cluster allocation to multi-cluster (>2) allocation (e.g. RBs/subcarriers spaced uniformly in frequency) is identified as a candidate waveform
  - Asynchronous UL HARQ for UL HARQ operation, PHICH is not used, UL grant DCI contains HARQ process number and redundancy version. Every retransmissions needs to be scheduled by PDCCH
  - Support of SRS transmissions on LAA SCell is recommended for LAA UL. For a UE, SRS transmission with PUSCH is supported
  - LBT for UL data transmission will impact MAC. Configure per bearer/logical channel whether UL can be offloaded to LAA SCells or whether it may only be served by licensed carriers

Proposed WI Objectives

- Objective 3: Enhancements to the LAA DL
  - Support for DL TTI shorter than 1 ms with reduced DL RTT, based on conclusions of the latency reduction SI
  - Other DL enhancements can be considered, including leftovers from the LAA WI (e.g. initial signal, fast carrier selection, enhancements to the spatial frequency reuse, enhancements to CSI measurements and reporting to be able to measure other RATs)

- Motivation:
  - Supporting a shorter TTI can reduce the amount of time an LAA eNB has to defer its transmission after successfully completing a LBT random backoff.
  - Measurements in resources where LAA is not transmitting allow to better adapt to the presence of other (non-LAA) RATs, to improve coexistence, link adaptation, and frequency reuse.
  - Some optimizations from Rel-13 for downlink were not prioritized due to time constraint.

Proposed WI Objectives

- Objective 4: Carrier bandwidth(s) larger than 20 MHz for DL and UL
  - Candidate bandwidths for the 5 GHz band are 40 MHz, 80 MHz and 160 MHz
- Objective 5: Complete specifications for 5 MHz, 10 MHz and 15 MHz carrier bandwidths

- Motivation:
  - Adapt carrier bandwidth to match accessible band
  - Improve channel use efficiency and reduce implementation complexity
  - Better PAPR (3 dB and more) at UE
  - Enable scalable bandwidth and reduce power consumption