3GPP TSG RAN meeting #71
Göteborg, Sweden, March 7th – 10th, 2016

RP-160432

Motivation for SI: Uplink Non-Orthogonal Transmission for Small Data

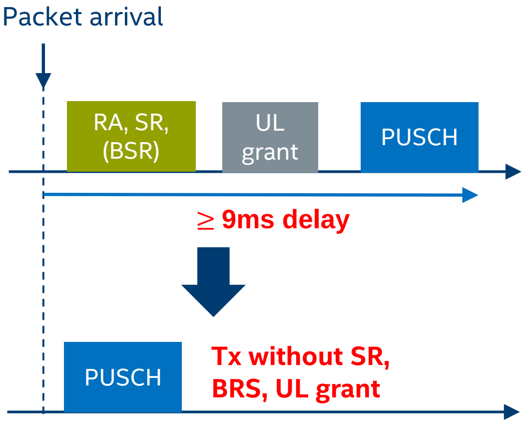
Agenda item: 10.1.1
Source: Intel Corporation
Document for: Discussion

Motivation

1) MBB improvement

UE autonomous transmission →

TCP performance improvement via latency reduction



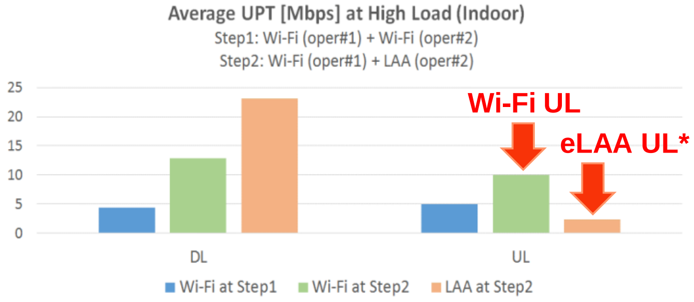
2) Support of larger # UEs

Can support larger # UEs via:

- Non-orthogonal MA
- Statistical multiplexing
- Adv. Rx at eNB (e.g., SIC)

3) eLAA UL improvement

eLAA UL performance can be much worse than Wi-Fi since PUSCH Tx should be scheduled by eNB in the coexistence scenario with Wi-Fi where each STA transmits w/o grant by AP.



Performance: Wi-Fi vs. (e)LAA

eLAA UL performance can be significantly improved by UE autonomous transmission (see slide xxx).

*May not exactly reflect the eLAA performance as eLAA is under development.

UL Non-Orthogonal Transmission (U-NOT) for Small Data

Grant-less non-orthogonal transmission of small data

- UE autonomous transmission without grant (DCI) on a shared RB pool possibly with a pre-configured MCS
- Statistical multiplexing gain with a large shared RB pool
- Negligible signaling overhead & reduced latency
- BSR can be sent to request a large #RBs as in the legacy LTE

Spreading over multiple PRBs

- Enable eNB to decode simultaneous transmissions from multiple UEs even at a low SINR by means of de-spreading
- Using a very low MCS is a special form of spreading
- UE specific hopping can maximize frequency/interference diversity

Detection of UL transmission(s) at eNB

- Via (potentially modified) DMRS and/or a new signal if necessary

Advanced receiver, e.g., SIC at eNB can significantly improve the performance.

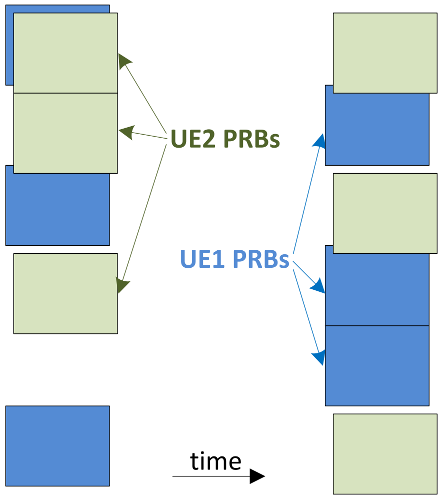
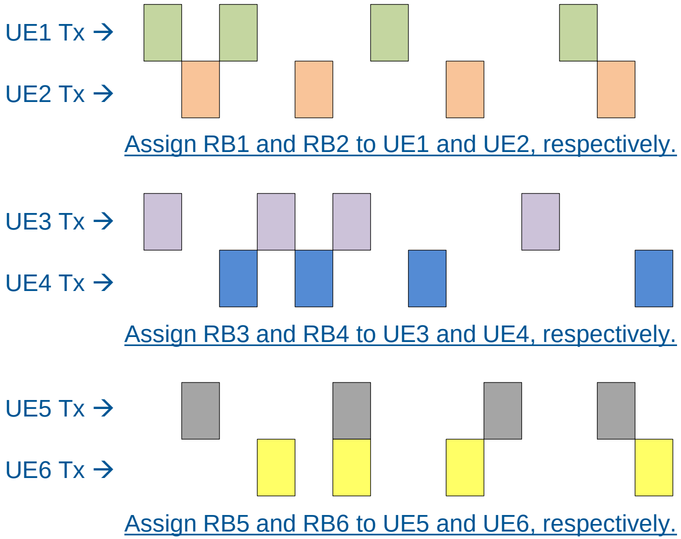
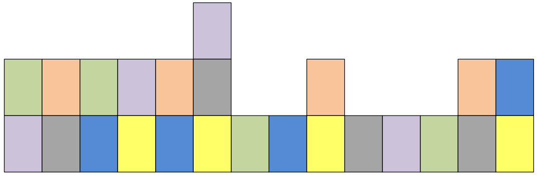


Illustration of UL non-orthogonal transmission with spreading over multiple PRBs & UE specific hopping

Statistical Multiplexing of Randomly Transmitted Small Packets



Higher packing efficiency via U-NOT



Assign {RB1, RB2, RB3} to {UE1, …, UE6}

More efficient to assign a large shared resource pool to many UEs

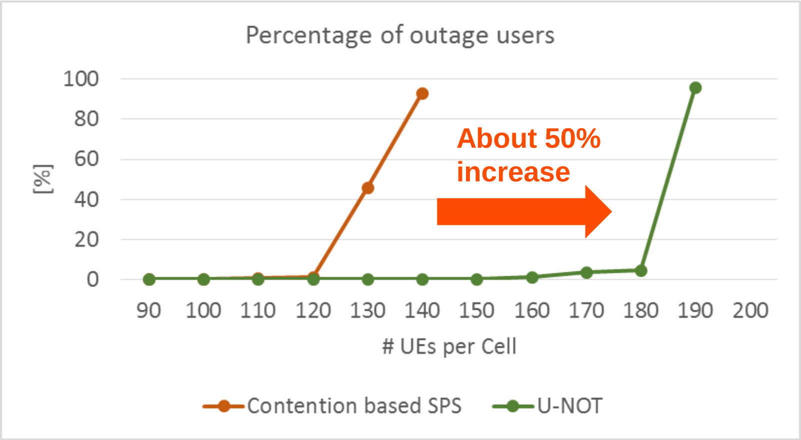
Objectives of the SI

- Define an evaluation methodology: deployment scenarios, traffic model with outage criteria, performance metrics (e.g., # supportable UEs, latency), eNB receivers [RAN1].
- Identify necessary enhancements to LTE [RAN1]. For instance,
  - Spreading method(s).
  - Rate (or MCS) allocation for non-orthogonal transmission.
  - Means to increase freq/interference diversity, e.g., new PUSCH hopping pattern if necessary.
  - Enhancements to DMRS if necessary.
  - Detection at eNB of PUSCH transmission, e.g., based on DMRS potentially with modifications and/or based on a new signal.
- Identify the specification impact of the above identified enhancements [RAN1].
- Evaluate the performance benefits of U-NOT based on the above evaluation methodology and the identified enhancements [RAN1].

Initial Performance Evaluation Results

Support of larger # UEs

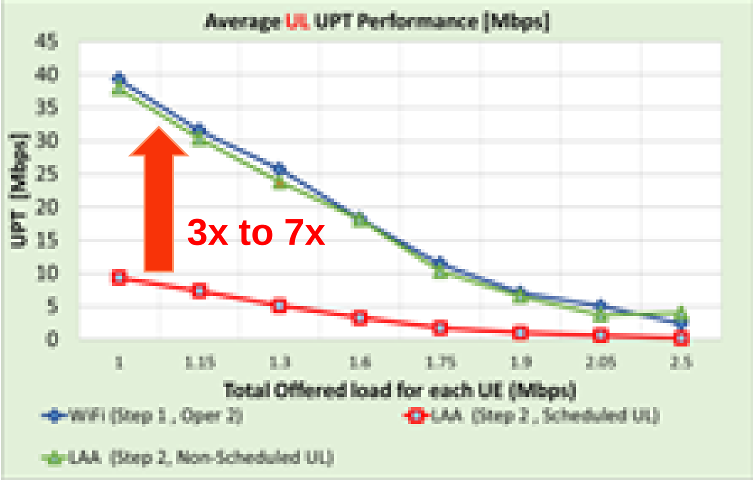
Much larger # UEs with small data can be supported by **UE autonomous (grant-less) non-orthogonal transmission**.



Simulation assumptions: Homogenous macro cell deployments, 3 cells/site, 57 cells, cell radius 500 m, carrier frequency 2GHz, RSRP based cell association, UE max power 23dBm, information block size: 288 bits, Poission packet arrival with a mean of 80ms, QPSK & 6RBs for each PUSCH, Shared RBs for U-NOT: 12 PRBs (= 2.16MHz), open loop power control w/o CL correction, #UE Tx ant: 1, #eNB Rx ant: 2. CW level SIC receiver at eNB.

eLAA UL performance improvement

The eLAA UL performance is significantly improved **by UE autonomous (grant-less) transmission** in coexistence scenario with Wi-Fi.



Detailed simulation assumptions and discussions can be found in R1-160425 and R1-160428.

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