3GPP TSG RAN meeting #70
Sitges, Spain, December 7th – 10th, 2015

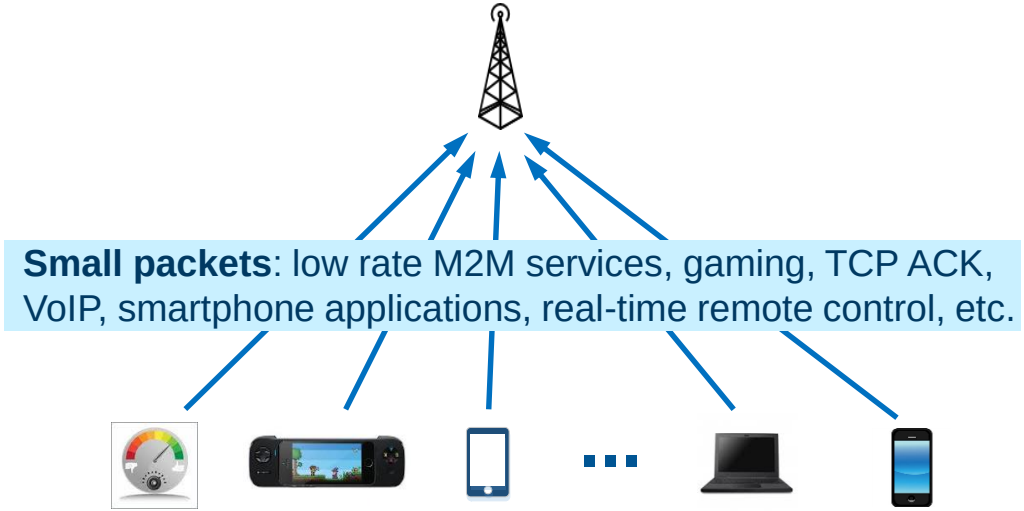
RP-151758

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

Intel Corporation

Goal

More efficient support for UEs that need to transmit small data of diverse characteristics in the uplink so as to support more # UEs or improve the overall system capacity.



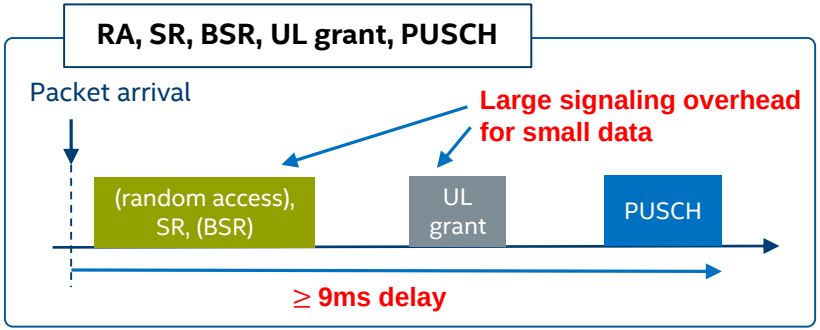
Background / Motivation

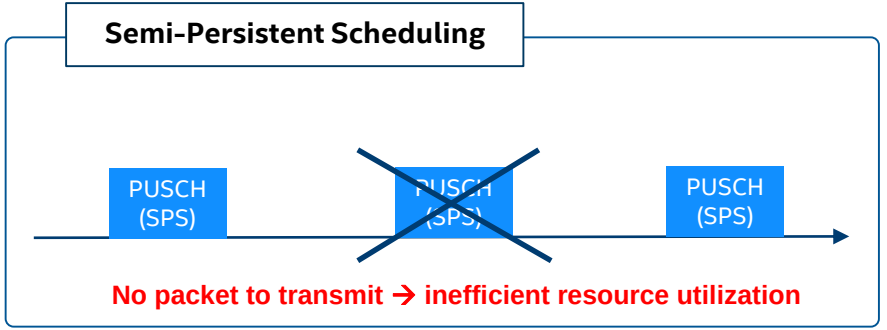
Assignment of exclusive RBs to UEs is suboptimal.

- It is well known that allowing simultaneous transmissions from multiple UEs on a common set of resources, along with the use of advanced receiver technologies such as SIC can significantly improve the UL system capacity in terms of # supportable UEs with small packets.

Inefficiency of SR based PUSCH and SPS for small data

- RA*, SR, BSR**, and grant: long latency (≥ 9ms) & large DL/UL control overhead for small packets
- SPS: inefficient resource utilization for non-periodic and/or intermittent traffic





*May not be needed in a connected state. **May not be needed if granted resources responding to the SR is large enough to accommodate all pending data.

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.

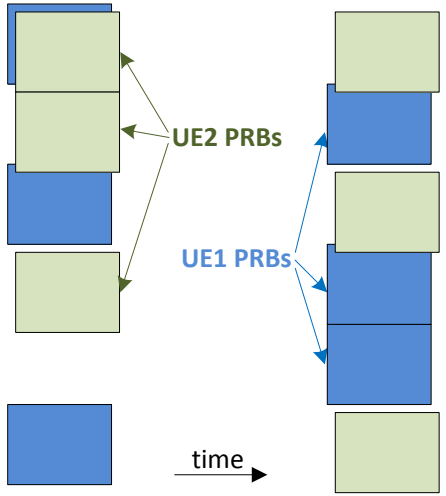
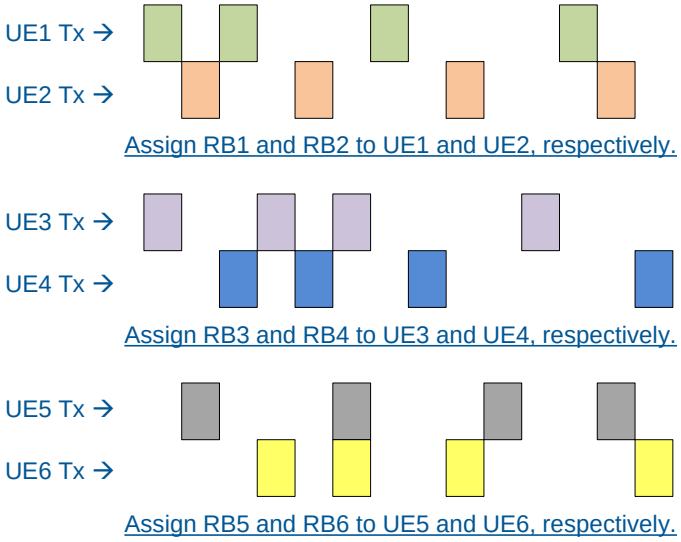
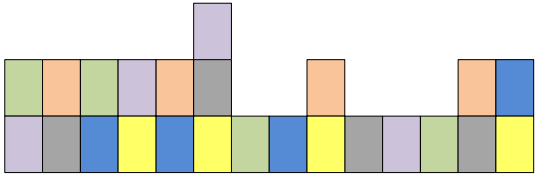


Illustration of UL non-orthogonal transmission with spreading over multiple PRBs & UE specific hopping

Statistical Multiplexing of Randomly Transmitted Small Packets



Higher packing efficiency via U-NOT



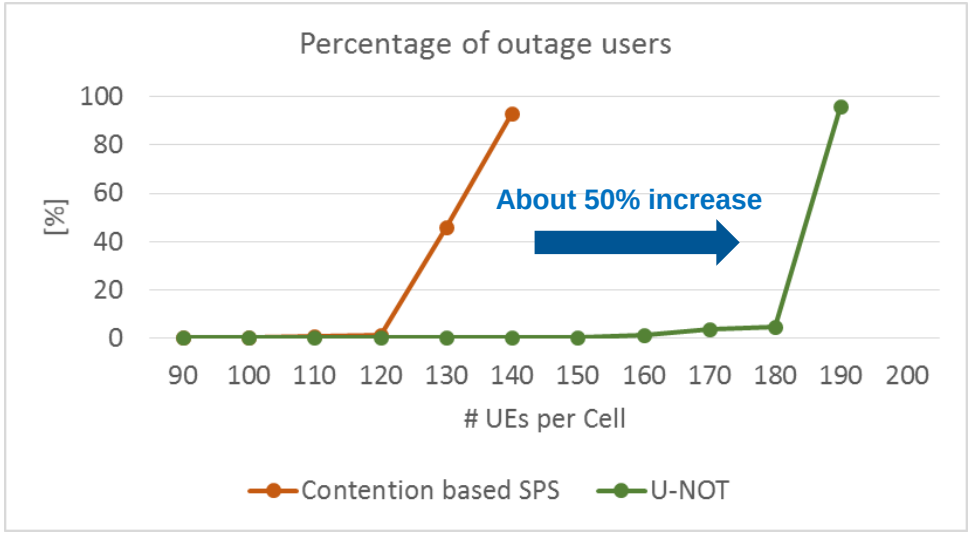
Assign {RB1, RB2, RB3} to {UE1, …, UE6}

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 Result



* Contention based SPS: SPS with periodicity of 1ms. Thus, UE can send PUSCH anytime. A collision can happen.
* Definition of outage user: 98%-tile delay > 25 ms.

Note: U-NOT gain over the legacy LTE in DL control overhead reduction is not captured here.

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.


intel®
experience
what's inside™