

3GPP TSG RAN#77

Sapporo, Japan, 11-14 September 2017

RP-172017



LTE-NR uplink carrier sharing at the UE

Source: Vodafone

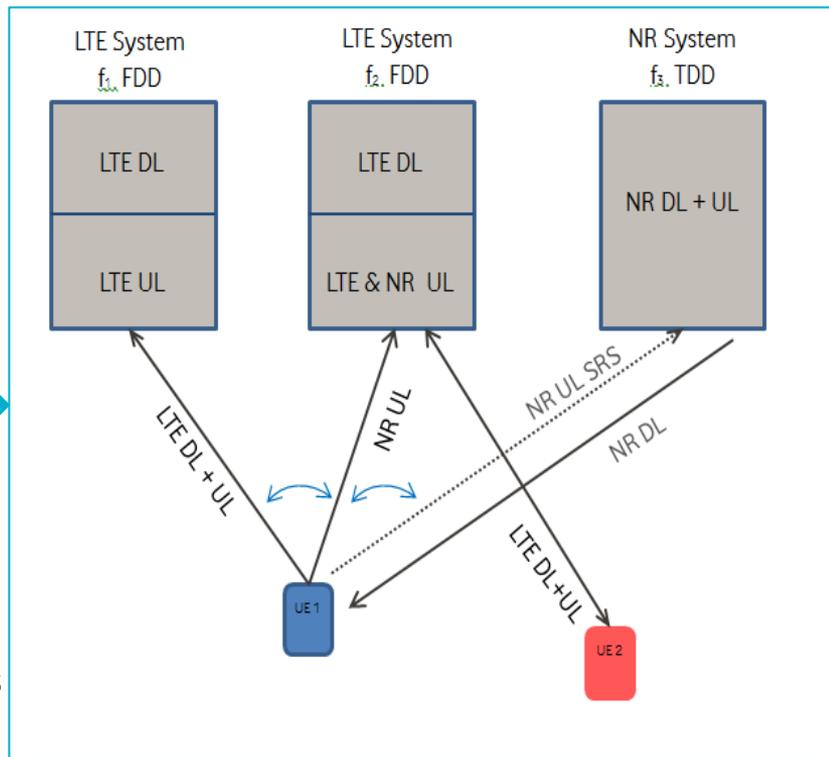
LTE-NR uplink sharing status

- Uplink LTE-NR sharing within a carrier has been agreed to be specified in the Release 15 work item:
 - Compensates downlink-uplink imbalance in frequency bands with wide bandwidth in macro deployments
 - Better coverage needs more time resources, which for TDD may be difficult to deal with without impacting HARQ feedback latency and overall e2e latency for customers
- Mapping the NR UL to an FDD band means this latency impact can be avoided, and allowing UL sharing means operators do not need to take 5MHz of spectrum away from existing LTE customers to send L1 control feedback
 - This also enables SDL deployment of NR with LTE anchor



Uplink sharing with EN-DC

- Uplink sharing for the EN-DC scenario was discussed in RAN#75
- To enable the benefits of uplink sharing without requiring the UE to support transmission of LTE and NR uplink signals on the same LTE carrier, RAN#75 considered [this scenario](#) →
- However this has some drawbacks:
 - Additional uplink carrier (f_2) used to operate the UE just to transmit L1 control information
 - Requires underlying coverage of two LTE carriers always to be available... quite restrictive for operators
 - IMD (see next slide)



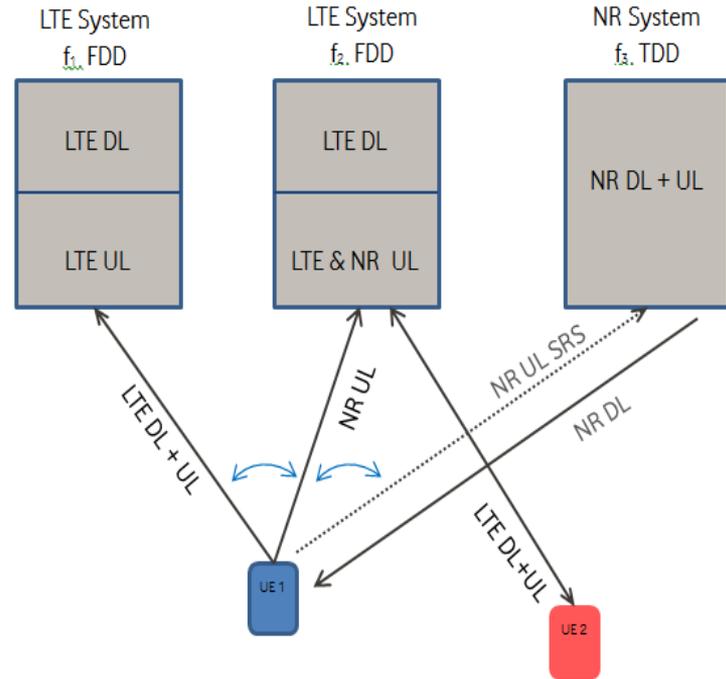
- **Enabling the UE to transmit application data + LTE control + NR control on the same common LTE FDD carrier would be very beneficial... although the 2UL scenario may still be useful where multiple LTE DL carriers are in use by the UE (e.g. $f_2 =$ LTE Scell)**



How does “single UL” proposed by Apple relate here?

- Single uplink assumes TDM switching between bands, to resolve the IMD issues
 - Enables UE to TDM between LTE f_1 and f_2 for EN-DC
 - Does not solve the other issues from previous slide
- Current solutions seem to increase the HARQ latency, impacting e2e latency for LTE+NR aggregated downlink traffic
 - Semi-static clearly increases LTE FDD latency, by reusing LTE TDD HARQ timing in LTE FDD carriers
 - Dynamic operation may offer more flexibility but unclear on the details of UE operation

We would like the 3GPP solution for single uplink for EN-DC to ensure that both the LTE and NR HARQ delay increases are minimised



Solutions for enabling LTE-NR uplink sharing from UE perspective

- Solution needs to be optimal in terms of not delaying HARQ feedback, so flexible enough to handle bursty low latency traffic, and not just assuming full buffer traffic
- Optimisations purely for the co-sited LTE and NR deployment case is acceptable from our perspective
- Option 1 – Granular TDM:
 - Could be re-used for single band and multiband single uplink
- Option 2 – Inserting RAT1 uplink control signals via RA2 uplink waveform (control piggybacking):
 - Insert the NR L1 control signalling into the LTE waveform (e.g. using new PUCCH format), or viceversa.

- **We request uplink LTE-NR sharing from UE perspective to be specified using a single uplink solution that doesn't lead to latency degradation for LTE+NR combined downlink data delivery – as combined LTE and NR operation will be important to NR success**
- **We request such a solution to be specified by June 2018 as part of Rel-15**

