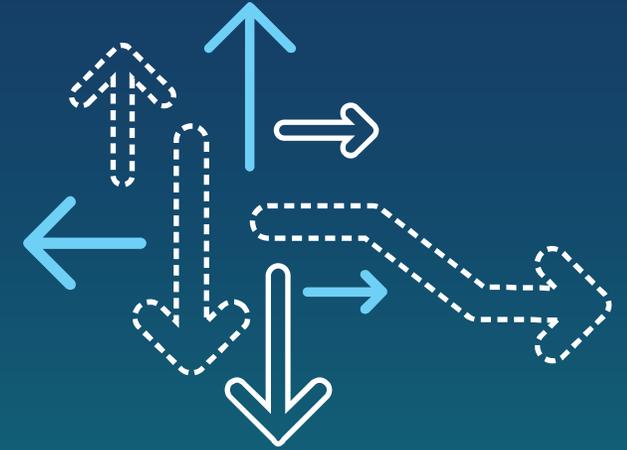


3GPP RAN #77
September 11 - 14, 2017
Sapporo, Japan
Agenda Item 9.2.1

RP-171606



Views on single Tx switched UL

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Introduction

- In this contribution we discuss views on single Tx switched UL
- We discuss the benefits and drawbacks of the single Tx and dual Tx approaches
- Give example scenarios and possible specification completion dates

Background: RAN1 agreements

Excerpt from RAN1 #89 Chairs notes

- Agreement
 - For NR NSA for a UE, NR supports the case that when the UE is configured with multiple UL carriers on different frequencies (where there is at least one LTE carrier and at least one NR carrier of a different carrier frequency), the UE operates on only one of the carriers at a given time among a pair of LTE and NR carriers
 - FFS whether or not there is specification impact
 - If there is RAN1 specification impact, aim to minimize the specification impact for NR
 - Note: this feature by itself is not intended to have any LTE RAN1 specification impact
 - Note: the other case of allowing simultaneous operation on two or more UL carriers is already agreed to be supported

The following questions were discussed but not yet decided

CA-based solutions

- Q1: Should it be allowed for the UE to declare single-Tx-only capability in any band combination (including those with no intermod issue)?
 - Q1a: How granular should the band combination categorization be?
- Q2: Should it be allowed for the UE to declare simultaneous dual-Tx capability even in those band combinations that do have intermod issue?
- Q3: Should it be allowed by the network to configure the UE in a single Tx mode in any band combination (including those with no intermod issue)?
- Q4: Should it be allowed for the UE to declare single Tx capability within NR DC at least in the band combinations that have intermod issue?

Q1

Should it be allowed for the UE to declare single-Tx-only capability in any band combination (including those with no intermod issue)?

- QC View:
 - In general, No
 - Switched UL has a negative impact on NR latency, which is one of the key figures of merit
 - Could be revisited in case NR UL MIMO becomes a baseline requirement
 - Especially if UL MIMO is the baseline requirement even when NR UL CA is configured, the number of required Tx chains in the UE will be quickly increasing

Q1a

How granular should the band combination categorization be?

- Examples of different levels of granularity are the following
 - Option 1: Each pair of UL CCs in a given band combination is categorized in a discrete manner: Is simultaneous Tx supportable? Yes/No
 - Note that in practice it should be a triplet of two UL CCs + one DL CC that should be categorized as problematic or not; however, this has no impact on the discussion here
 - Option 2: In addition to Option 1, consider also the location and BW of the CCs configured in the CA combination in the categorization
 - Option 3: In addition to Options 1 and 2, consider also other dynamic parameters, for example the RB allocations within the triplet of CCs
- QC View:
 - The selection is a trade off between optimization of system efficiency and RAN4 development time
 - → Leave the selection up to RAN4
 - Note the rest of the discussion in these slides applies equally for every option

Q2

Should it be allowed for the UE to declare simultaneous dual Tx capability even in those band combinations that do have intermod issue?

- QC View:
 - Yes
 - Different UEs can have different attributes, such as antenna-to-antenna isolation, trap filtering, interference cancellation, therefore it would be useful not to remove the incentive to utilize these capabilities when available

Q3

Should it be allowed by the network to configure the UE in a single Tx mode in any band combination (including those with no intermod issue)?

- Some of the stated justification for this network option was the following:
 - Assume that with simultaneous transmission, the UE will exceed the maximum allowed power but with individual transmissions it does not. Therefore by TDM-ing UEs, the link budget is helped on both links. Note that we don't agree with this stated justification, as explained below.
- QC View:
 - No, unless better use case can be found
 - In general, the effects of increasing link power and reducing the Tx duty cycle cancel each other out, so it is unclear how the stated benefit would be achieved

Q4

Should it be allowed for the UE to declare single Tx capability in NR DC at least in the band combinations that have intermod issue?

- The main difference between Q4 and Q1-Q3 is that Q4 applies to between NR-NR UL CCs, while Q1-Q3 applies to between LTE and NR CCs
- QC View:
 - No
 - When considering NSA mode, there is no alternative to using LTE-NR DC. Therefore there is no natural fallback when intermod issues occur.
 - On the other hand, when considering NR-NR DC (either in NSA or SA), there is an alternative, which is simply not using NR-NR DC. It can be argued that the potential benefit of NR-NR DC will be cancelled out by the single Tx limitation, therefore the NR-NR DC single Tx operating mode doesn't seem necessary.

Possible solution types

- Type 1: Fully eNB/gNB scheduler based TDM-ing
 - Minimal RAN1 specification impact
 - It assumes coordination between eNB and gNB
 - Coordination may be semi-static or dynamic
- Type 2: In-device coex based
 - Minimal RAN1 specification impact
 - Doesn't assume coordination between eNB and gNB
- Type 3: UE is configured with semi-static TDM pattern
 - Some change to LTE UE behavior
- Type 4: LTE-NR dropping rules for resolving Tx conflict
 - Not applicable to UEs that do not support dynamic LTE NR power control

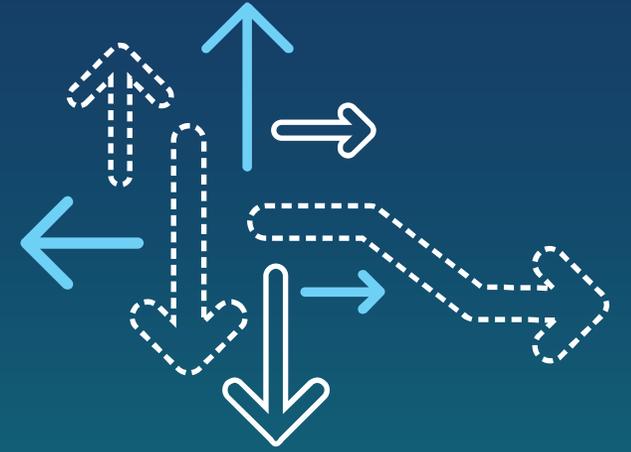
Conclusion

The following completion dates are for the various options

Rel-15 December version	Rel-15 June version	Not in Rel-15
Type 1: Fully eNB/gNB scheduler based TDM-ing Type 2: In-device coex based	Type 3: UE is configured with semi-static TDM pattern	Type 4: LTE-NR dropping rules for resolving Tx conflict

Annex

Switching scenarios



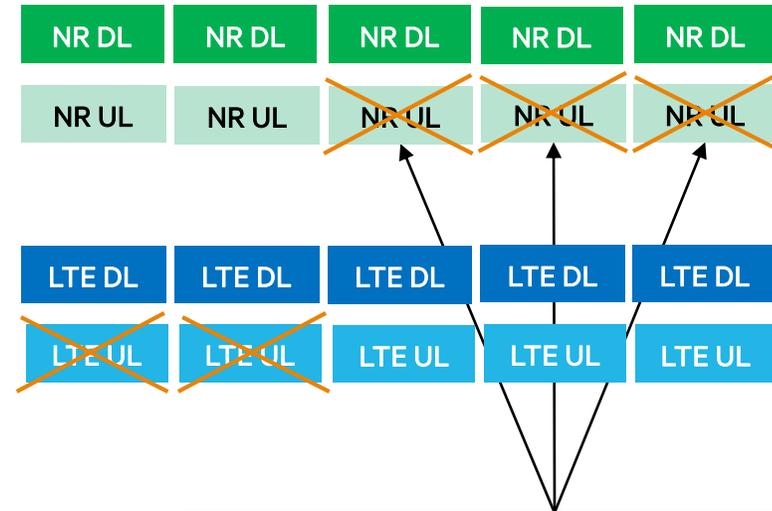
Example scenarios for semi-static pattern based switching

- TDD NR + FDD LTE



Schedule other LTE UEs to recover loss from system perspective

- FDD NR + FDD LTE



A mechanism is needed to recover loss from system perspective

Thank you

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