

3GPP TSG RAN WG1 #95

Spokane, WA, U.S.A., November 12 - 16, 2018

Agenda item 7.1.4

R1-1813402

Revision of R1-1811239

Maintenance for NR-LTE co-existence

Qualcomm

Background

- RAN1 has considered two UE types
 - UE capable of dynamic power sharing, a.k.a. Type 1
 - UE not capable of dynamic power sharing, a.k.a. Type 2
- In the EN-DC power control procedure, RAN1 has considered that 'NR' in the Type 1 UE modem knows about 'LTE' but not the other way around
 - This is because the different time-lines between LTE and NR
 - This resulted in the decision of not changing LTE power by RAN1 power control definition for Type 1 UEs
 - This resulted in the decision of not supporting sTTI in EN-DC

Background

- The 4ms LTE timeline has always been assumed for LTE
 - E.g. no look-ahead in LTE CA or LTE DC
- **R1-143517**, WF on “look-ahead” aspect in asynchronous dual connectivity, Ericsson, NTT DoCoMo, Softbank, Nokia Networks, Nokia Corporation, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent
- **Agreements:**
 - At least for PUCCH and PUSCH, for asynchronous dual-connectivity,
 - All remaining power is first made available to CG associate with earlier transmission
 - No-Look-ahead (for the case that transmission timing difference is larger than around 33 micro sec) is specified as the UE behavior
 - Definition of synchronous and asynchronous dual-connectivity is according to RAN4
 - Timing relationship in any TA groups should be clarified in RAN4
 - FFS: For asynchronous dual connectivity with the case that transmission timing difference is very small (e.g., around 33 micro sec)

Background

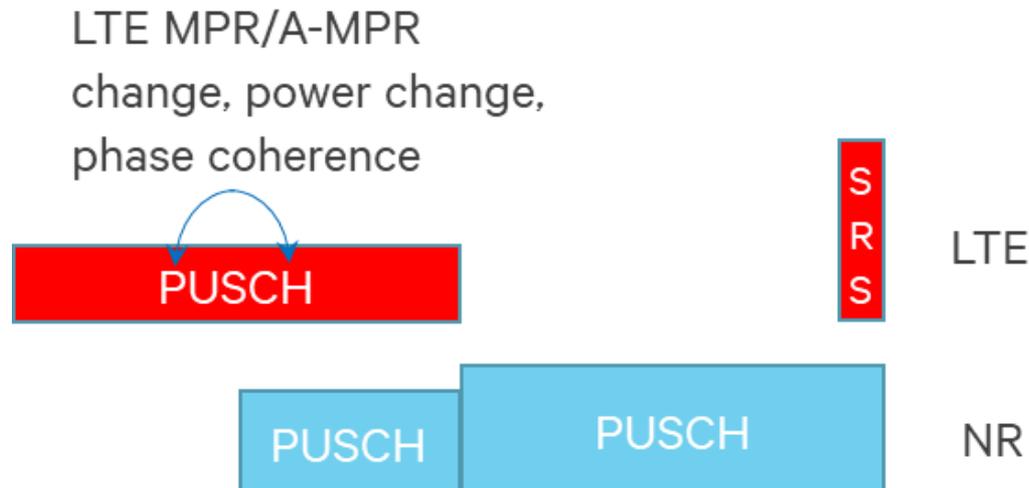
- The same assumption (no LTE look-ahead) has been made for EN-DC
- R1-1715185, Way forward on power sharing for LTE-NR NSA operation, Ericsson, CATT, Samsung, Mediatek, Nokia, NSB
- **Agreements:**
- At least for LTE-NR NSA operation
 - Maximum allowed power values for LTE (P_{LTE}) and NR (P_{NR}) are set separately
 - i.e., when UE is configured for NR, P_{LTE} can be configured up to P_{cmax} and P_{NR} can be configured up to P_{cmax} .
 - e.g. $P_{LTE} + P_{NR} > P_{cmax}$ or $P_{LTE} + P_{NR} = P_{cmax}$
 - Signaling details for P_{LTE} , P_{NR} are left to RAN2, RAN4.
 - Note: ' P_{cmax} ' is a limit that is similar to 'The configured maximum UE output power' that was specified for LTE.
 - Note: The network will still have flexibility to prioritize or reserve certain NR transmission power depending on network implementation
 - All UEs are mandated to handle $P_{LTE} + P_{NR} = P_{cmax}$ while handling of $P_{LTE} + P_{NR} > P_{cmax}$ depends on UE capability
 - At least, when DL/UL LTE sTTI/reduced UE processing time based operation is not configured for the UE, if total transmit power exceeds P_{cmax} when there is simultaneous NR and LTE UL tx,
 - For NR, UE scales down/drops NR transmission and NR power scaling details are left to UE implementation (note: it is not intended to have RAN4 test from RAN1 perspective)
- If there are two or more UL carriers, the power scaling or tx dropping can be performed for each of the UL carriers separately or jointly up to UE implementation
 - For LTE, no change in power control procedure
- FFS the case when DL/UL LTE sTTI/reduced UE processing time based operation is configured for the UE
- The following is FFS
 - The case when P_{NR} is configured such that $P_{NR} < P_{cmax}$, and UE can use power up to P_{cmax} in NR when it knows that there will be no UL transmission in LTE by semi-static configuration (e.g., measurement gap, DL/UL configuration)

Background

- RAN4 has defined MPR/A-MPR definitions [R1-1807805, “LS on RAN4 agreement on intraband EN-DC A-MPR”], which made different set of assumptions
 - ‘LTE side knows about NR side’, even if NR UL grant arrives much later than LTE grant
 - LTE PHR has a dependency on NR grant, even if NR UL grant arrives much later than LTE grant
- The RAN4 decisions require substantial changes in the LTE processing time requirements, even though the NR Work Item was aimed to minimize impact resulting from NSA to LTE physical layer

Background

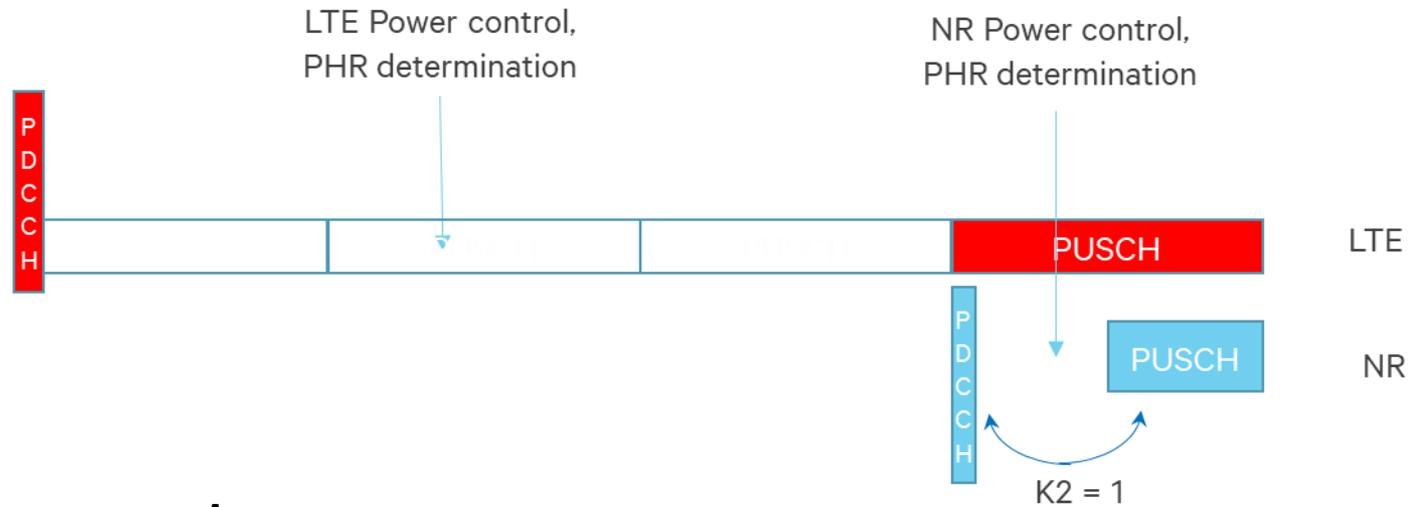
- Consider that LTE and NR use different slot formats, numerologies, the situations depicted below will occur for Type 1 UEs



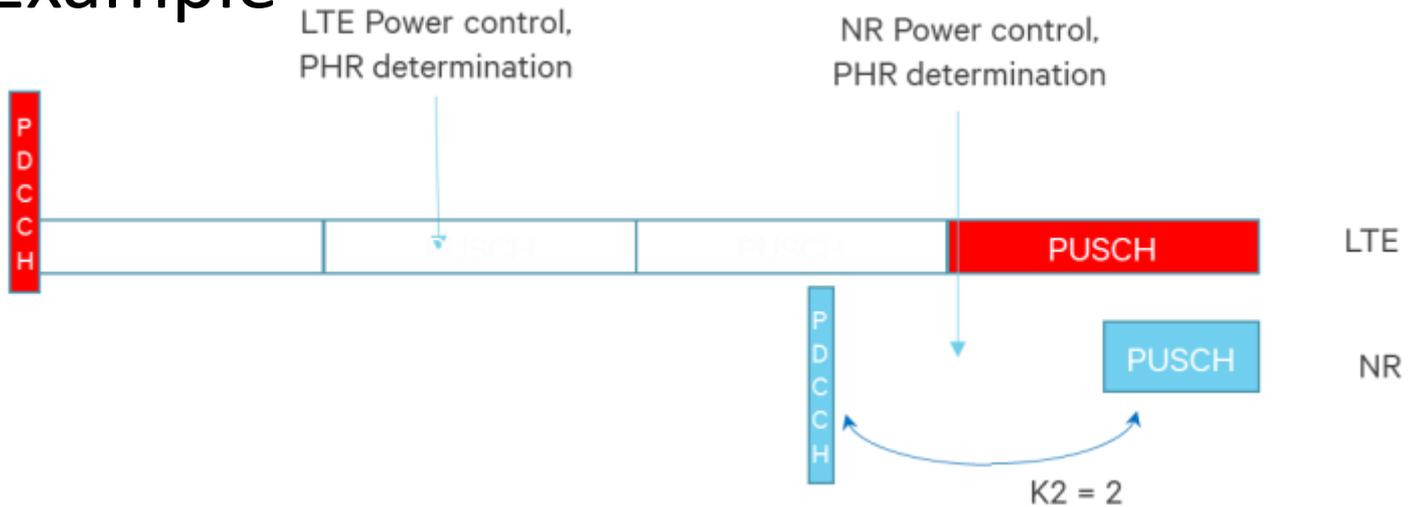
- The RAN4 decision results in LTE power changes within the LTE subframe, which is not supported in the LTE air-interface

Background

- FDD Example

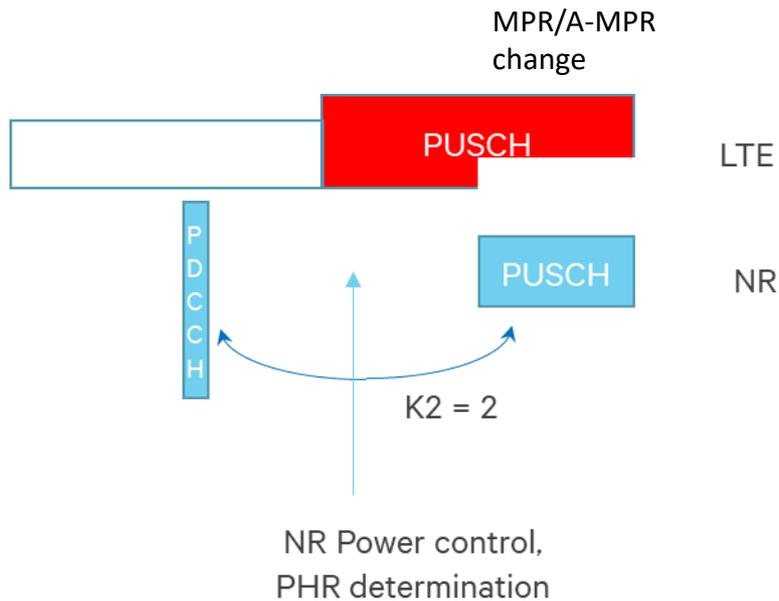


- TDD Example

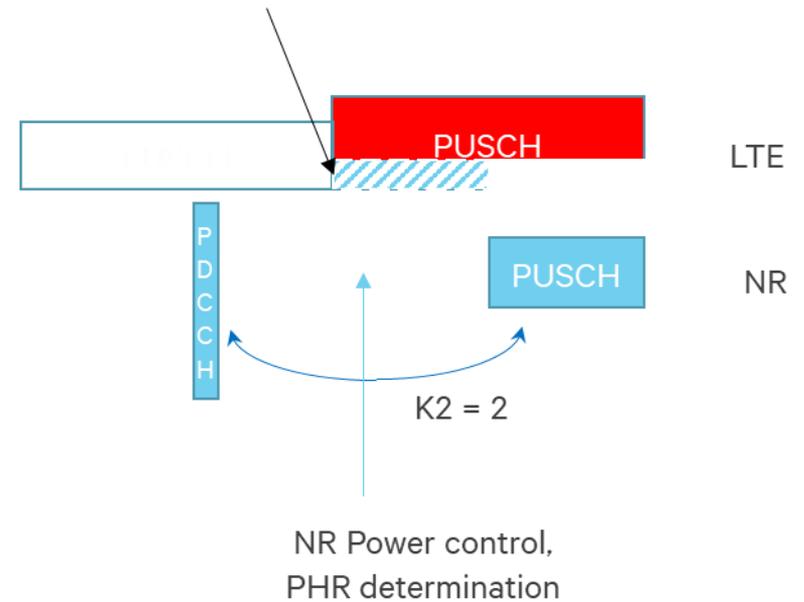


Background

- Example



UE would be allowed to apply to same MPR/AMPR in first slots in second slot but even NR timeline is not met



Proposal 1

- Adopt RAN1 #94bis Alt.1 with the following modification
 - UE is allowed to drop NR if the NR power scaling (related to MPR and power cap) is more than XdB
 - X is [0, 2, 4, 6]dB
- No new signaling for LTE processing time capability

Background to Proposal 1

- Alt.1. MPR/A-MPR applies to combined power
 - LTE power is determined independent of NR (i.e. with assuming no NR transmission)
 - LTE power is not changed if NR grant is received
 - UE is expected to adjust NR power to take advantage of relaxation provided by MPR

Note: Alt.1 requires no RAN1 specification changes

Note: Alt.1 does not depend on timeline constraints

Note: Whether Alt.1 needs new MPR/A-MPR values is up to RAN4

Proposal 2 (PHR)

- The PHR reported in LTE is not dependent on NR allocation, i.e. the LTE PHR in EN-DC is always calculated with the assumption of no NR transmission

Note: If Proposal 1 is adopted then adopting Proposal 2 requires no specification change.

Proposal 3 (NE-DC)

- Adopt RAN1 #94bis Option 1a
- For NE-DC dynamic power sharing, the following are specified:
 - UE is configured with p_{LTE} for LTE, $r(\leq 1)$, and with p_{NR} for NR
 - For an LTE subframe that overlaps with any possible NR UL symbol(s), set LTE power limit $P_{max} \leq p_{LTE} * r$; otherwise, set power LTE limit $P_{max} \leq p_{LTE}$.
 - A possible NR UL symbol is identified as an NR symbol configured as flexible or UL based on cell-specific or UE-specific (if configured) `tdd_UL_DL_Configuration_Common/dedicated`.
 - The remaining power up to p_{NR} is allocated to NR by setting NR power limit as $P_{max} \leq \min(p_{NR}, p_{total} - p_{lte_actual})$ where p_{lte_actual} is the power allocated to LTE.

Background to Proposal 3 (NE-DC)

- LTE power setting with and without potential collision with NR is depicted in the following figure.

