

3GPP RAN Rel-19 Workshop

RWS-230185

June 15th-16th, 2023, Taipei, Taiwan

Agenda Item: 5

UAVs

Qualcomm Incorporated

UAVs Phase 2 WI: Key Objectives

- PC5 aspects:
 - PSCCH DMRS with reduced # of cyclic shifts, PSFCH with reduced # of cyclic shifts [RAN1]
 - Rel-18 leftover on BRID/DAA over PC5, if any [RAN2/RAN1] (TBD towards end of R18)
- Uu aspects:
 - Mobility enhancement: CHO based on height and flight path; inter-RAT HO (e.g., propagate UAV subscription info); LTM enh for UAV [RAN2/RAN3/RAN1]
 - FR1 beamforming: gNB uptilt beam for UAV measurement/reporting (to reduce # of beam meas and reporting); UE antenna config selection for UL beamforming (to improve UL interference control); [RAN1]
 - PRACH enhancement: height-based PRACH config, e.g., with reduced # of cyclic shifts for UAVs to access far-away gNB [RAN1]
- Other:
 - No transmit zone (related to ECC decision 22(07)) [RAN2/RAN1]

PSCCH DMRS and PSFCH Enhancement

Reduced # of cyclic shifts

- In case of UAV PC5 unicast/broadcast, the propagation delay could be much larger than V2X due to longer distance in case of LOS channel.
- The PSCCH DMRS and PSFCH may not support long distance because of the timing uncertainty resulted from large propagation delay.
 - E.g., for PSCCH with SCS = 30kHz, the max distance is 825m with max propagation delay of $N/(4*3) = N/12$, where N is the OFDM symbol duration without cyclic prefix and UE randomly selects one of 3 cyclic shifts (CSs) of PSCCH DMRS.
 - E.g., for PSFCH with SCS = 30kHz, PSFCHs with different cyclic shifts cannot be uniquely identified with beyond link distance of 825m with maximum propagation delay of $N/12$, if $N_{CS}^{PSFCH} = 6$ CS pairs are configured.
- Therefore, to extend the PC5 communication range for UAVs, the cyclic shifts for PSCCH DMRS and PSFCH needs to be restricted, separate from that of terrestrial UEs.

Mobility Enhancements

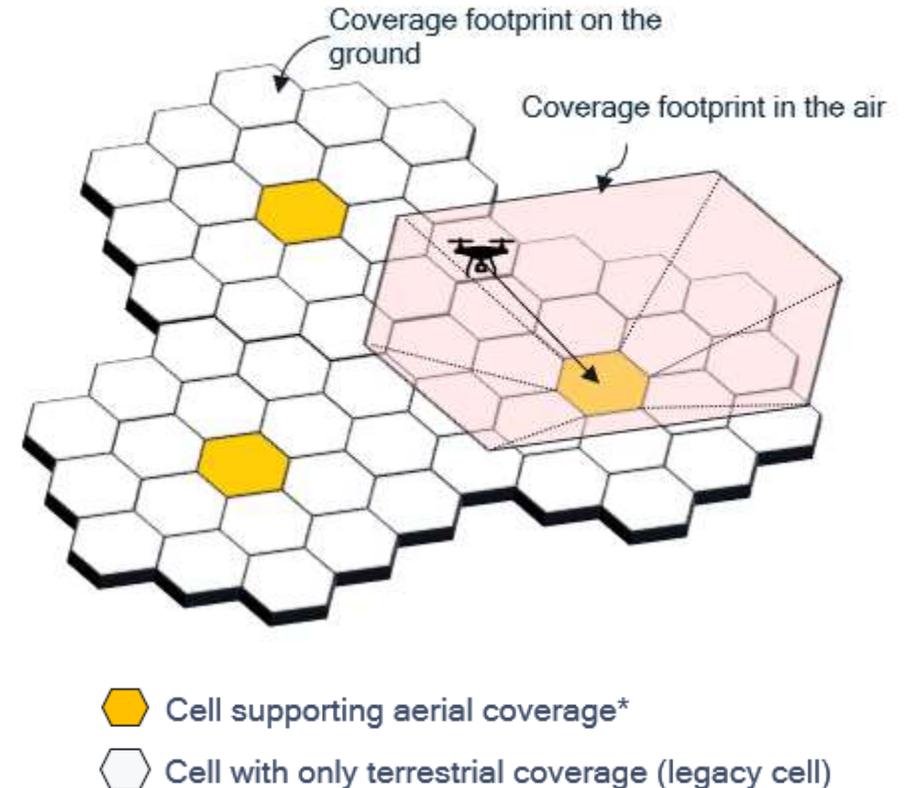
UAV specific minor enhancements

- CHO enhancements
 - Rel-16 NR introduced CHO triggers based on various RRM measurements.
 - Rel-17 NTN introduced distance and time-based CHO.
 - UAV specific CHO can be based on height and UE's flight path.
- Inter-RAT HO enhancement
- Rel-18 UAV will introduce subscription-based UAV identification.
 - Example enhancement includes propagating UAV subscription info during inter-RAT HO.
- LTM enhancements for UAV, e.g.,
 - Enable L1-based reporting for non-serving cells while reducing the amount of measurement and reporting considering UAV-specific conditions, e.g., based on height and flight path.
 - TA maintenance.

PRACH enhancement

Separate PRACH resource with limited CS

- The current PRACH configuration is mainly for terrestrial UEs without considering the aerial coverage.
- However, the terrestrial and aerial coverage may be very different since the aerial UEs may be connected to a cell far away via side-lobe.
- Moreover, not all cells need to support aerial UEs in some deployments.
- PRACH enhancement for aerial UEs may be needed, e.g. height-based separate random access resource configuration with limited cyclic shifts
 - Otherwise, timing advance pre-compensation (e.g., based on locations) would be needed.



*not all cells need to support aerial UEs

FR1 beamforming

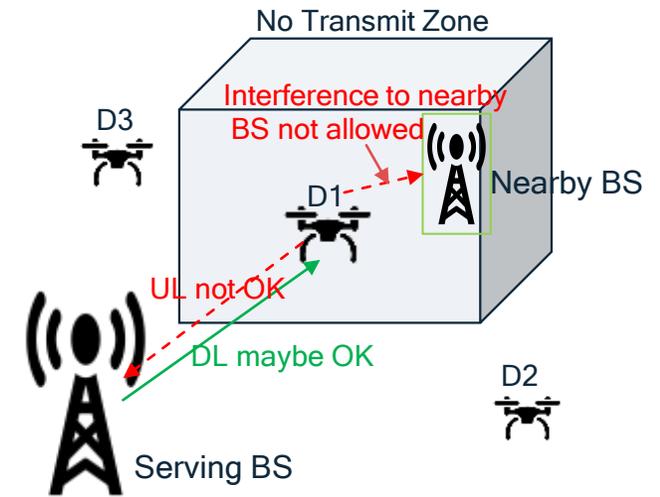
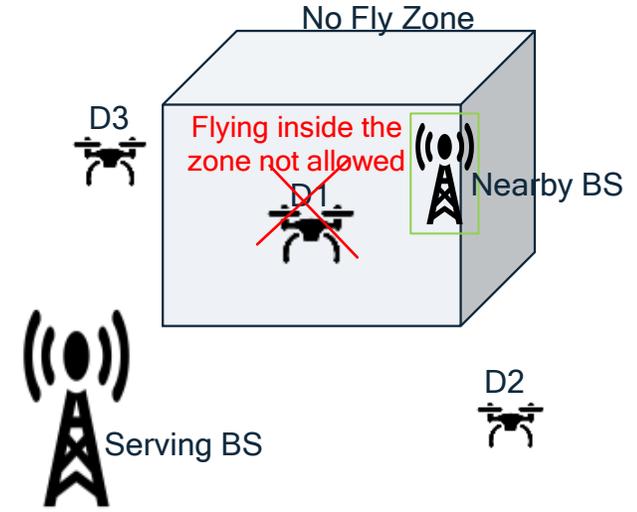
UE capability and RRC configuration

- In Rel-18, RAN1 studied the UAV FR1 beamforming based on beam switching among the fixed directional antennas but had no consensus on whether/how to report UE beamforming capabilities
 - Main concern was that the awareness of beamforming capabilities only may not be sufficient to support gNB to configure/control the FR1 beamforming.
- If network knows the beam information of aerial UEs, gNB can select the beam for UAVs using directional antennas and further set proper power control parameters with manageable inter-cell interference
 - E.g., with the use of 4 directional antennas for aerial UEs, the UAV command and control (C&C) traffic latency can be improved 40~45% by boosting the power while keeping terrestrial UEs' user throughput degradation within 6% margin, much better than 10~30% loss by using omni antenna for aerial UEs.
- Rel-19 should support non-transparent FR1 beamforming, e.g.,
 - Support UAV UE to optionally report the capabilities of beam information via RRC signalling
 - Enable gNB to configure the association of the TCI-state/RS for UL beams and the UE antenna port with directional antennas.

No transmit zone

Related to ECC decision 22(07)

- ECC report 348 states there can be no-transmit zones (NTZ) (or sometimes simply called no-fly zones) which are imposed to limit the transmissions from drones, e.g., in order not to cause too much interference to a nearby base station.
- ECC decision (22)07 on harmonized framework on aerial UE usage in MFCN harmonized bands states “a mechanism is necessary to ensure that aerial UE respect no-transmit zones”.
- RAN2 should study the impact of this decision, e.g.
 - whether to introduce any mechanisms for signalling of such NTZ
 - whether to trigger measurement reports due to moving in/out of such zones
 - whether to switch the uplink transmission to other band/carrier without NTZ restriction when UE is in such zones





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