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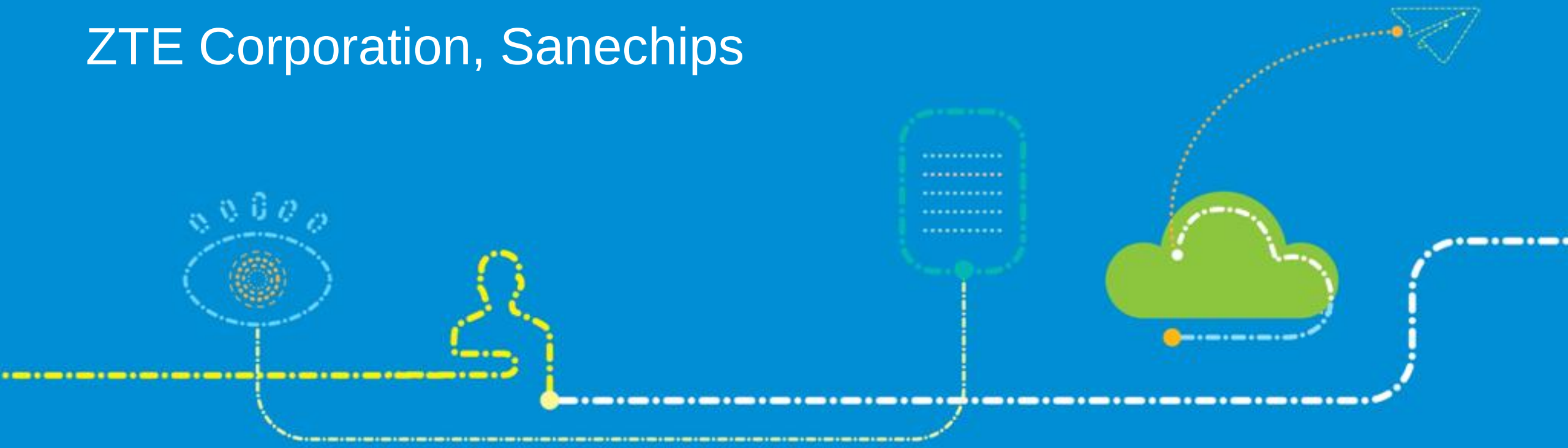
Motivation for WID on NR Support for Aerial Vehicles

ZTE Corporation, Sanechips



Application/Requirements of Aerial Vehicles

- Aerial vehicles services have increased dramatically:
  - Aerial vehicle as terminal (note: Aerial vehicles with altitude up to 300 m)
    - Multi-Drone operation
    - Cargo delivery including first aid delivery, organ transplant delivery
    - Entertainment and VR, e.g., flight experience with full view
    - Geographic information collection including structure/bridge/roof inspection, real estate assessment
    - Monitoring of oil/gas pipelines, grid and surveillance for traffic/security/fires
    - Offshore fields inspection and wildlife conservation
    - Agriculture and forestry service, e.g., pesticide spraying
    - Search and rescue
  - Aerial vehicle as Relay/gNB (on-demand, altitude up to 1000 m)
    - Coverage extension via airborne gNB, e.g., for IoT devices
    - Emergency communication
    - Air to ground service (ATG)

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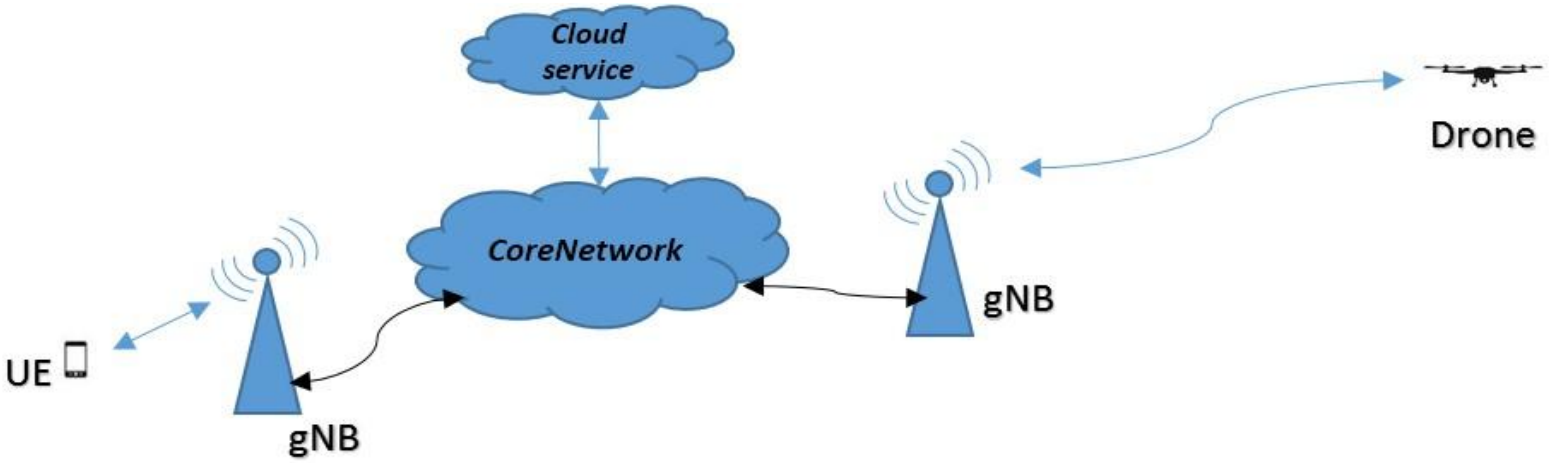
Service requirements

- Remote control of aerial vehicle (end-to-end)
  - Latency
    - For support services, e.g., Cargo delivery and multi-drone operation, end-to-end delay should be 13~15ms ($\Delta_{Dis} = 0.58 \sim 0.67m$ if $V_{Drone} = 160\ km/h$), which means that the one way delay from gNB to drone should be <5ms. [Note: In the previous LTE-based SI for drone, for C&C, the supported one way latency is 50ms with 10-3 Packet Error Loss Rate]
  - Reliability
    - For control data: Similar requirement as V2X is expected, e.g., for multi-drone (Reliability = 10^{-5})



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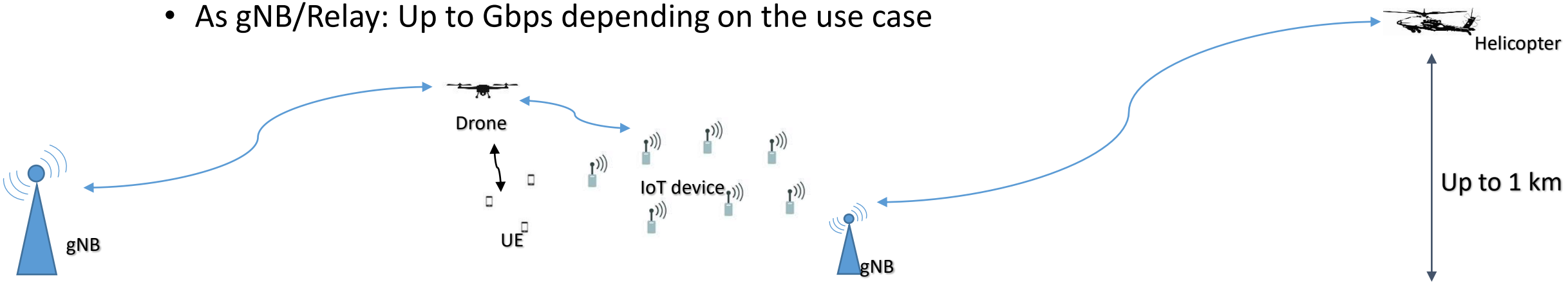
Service requirements

- Real-time data transfer
  - For UL (Aerial vehicle to gNB)
    - As terminal: Up to 60 Mbps (**stabilized** data rate for multiple-HD video stream/Geographic information collection) without performance degradation of terrestrial UE
    - As gNB/Relay: Up to Gbps depending on the use case
  - For DL (gNB to Aerial vehicle)
    - As terminal: Up to 100 Kbps for C&C service
    - As gNB/Relay: Up to Gbps depending on the use case



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Advantages of NR comparing with LTE on support for aerial vehicles

- Network slicing with enhanced QoS
  - Capable of supporting ‘customized’ and ‘delay-sensitive’ services
- Non-slot based scheduling
  - Much lower latency and higher reliability
- Flexible DL-UL configuration to allow dynamic TDD
  - More efficient to manage the transmission based on variation of service type within one cell (E.g., larger demand for DL throughput for terrestrial UEs, but UL throughput for aerials)
- Flexible BWP(s) allocation
  - Dynamic resource management to enable the service for aerial vehicles with either same or dedicated frequency resources as other UEs (Terrestrial/Airborne) among cells
  - Significant interference mitigation between both DL and UL, negligible performance loss can be expected.
  - Flexible frequency allocation for ATG and terrestrial service

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Advantages of NR comparing with LTE on support for aerial vehicles

- MIMO with enhanced capability and large bandwidth
  - Both DL/UL interference can be mitigated with more directive transmission/reception, which will lead to significant performance gain (benefits even with less antenna at BS have already been verified in the previous LTE-based SI for drones)
  - Large beamforming gain allows to extend the coverage
  - Beam tracking enables continuous coverage in vertical domain
  - Increased data rate
- UE-specific configuration of power control parameters
  - Support UE specific fractional pathloss compensation factor, which is captured in the scope of LTE-based WI due to the obvious UL performance gain

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