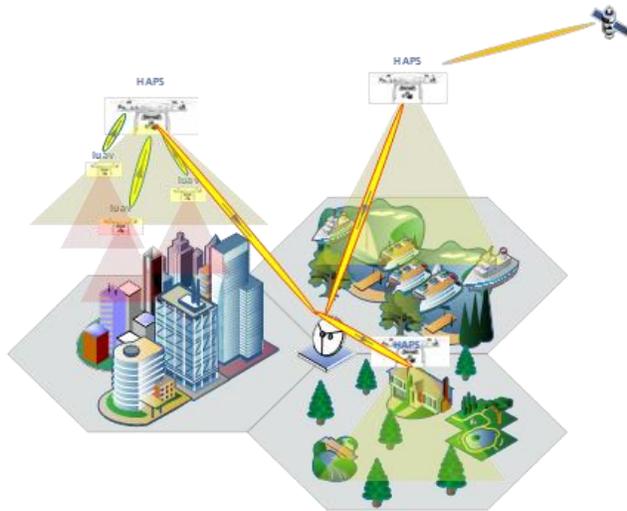


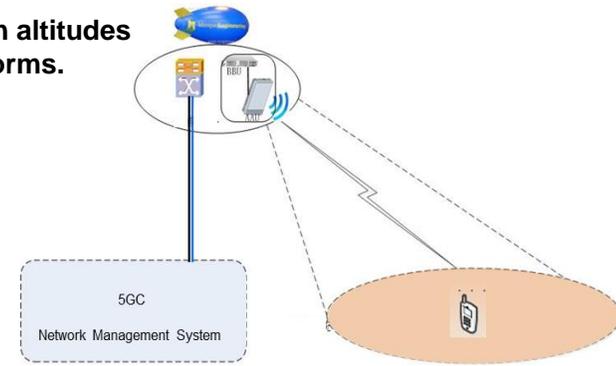
Motivation of 5G system with High Altitude Platform Station (HAPS)

Source: China Unicom

□ Background



HAPS: An airborne vehicle operating in altitudes 20-50 km including High Altitude Platforms.



- HAPS is expected to be deployed in remote / wide area to provide high data rate for UE and provide IoT services, in various scenarios including pedestrian, vehicular connectivity, airplanes connectivity, stationary stations, high-speed train, and wide area IoT (i.e. massive connection, relative lower data rate) connectivity.

□ 2 types of High altitude platforms

- **Airplane:** lower weight load, the weight of gNB carried in the airplane is limited in dozens of kilograms. Therefore, the requirements for HAPS gNB can be loosened.
- **Airship:** Higher weight load up to hundreds of kilograms. There may be several gNBs carried on one platform, and in hence, it is possible to provide a higher data rate services for users.

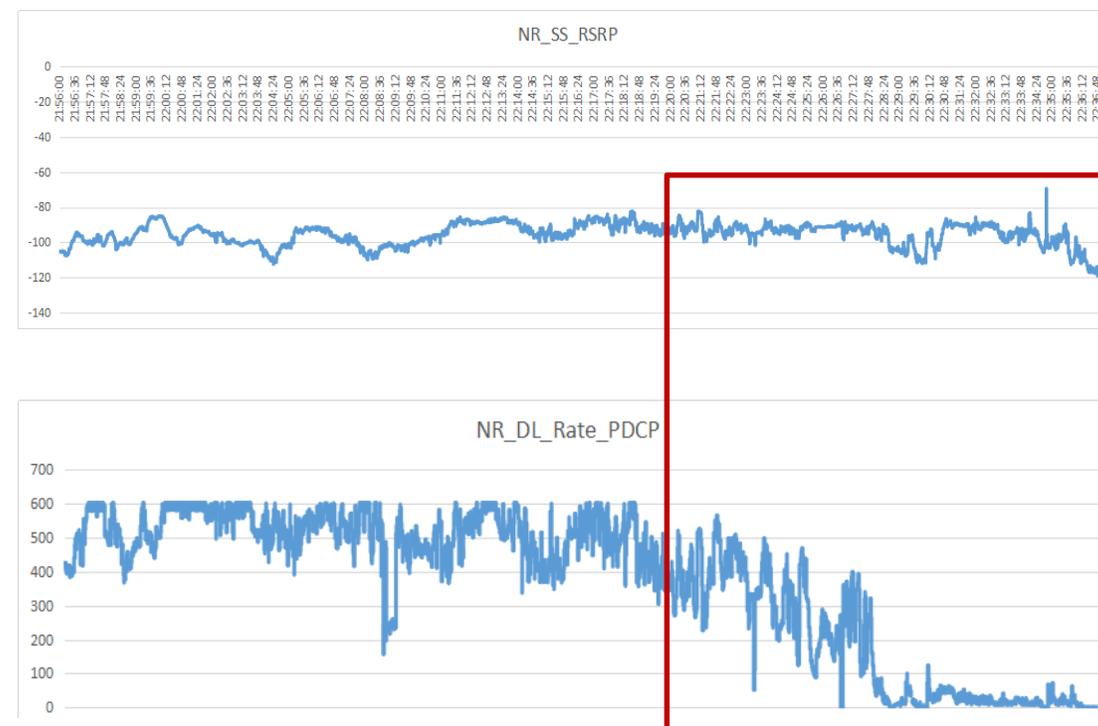
- ❑ Field trials have been launched in the altitude of 3km in 2020.
 - The results showed the Rel-15 NR gNB in HAPS scenarios can provide NR service, but the performance is not stable and some issues are identified to be solved.
 - China Unicom is planning to launch a trial in higher altitude (target 20km) in the end 2021 or H1 2022.
 - Detail parameters for field trails
 - Altitude : 1km (because of the instability of backhaul link, 3km is tried but the data are not included in statics)
 - Frequency band : 20MHz@2.1GHz , 100MHz@3.5GHz

	2.1GHz	3.5GHz
Work mode	FDD	TDD DDDSU/DDSUU
GP	-	10:2:2 8:4:2(for long distance)
Antenna	4T4R	64T64R
Output Power	320W	200W
Antenna gain	15dBi	25dBi

❑ Interference from the TN gNB has a great impact on the performance for the UEs accessed in HAPS

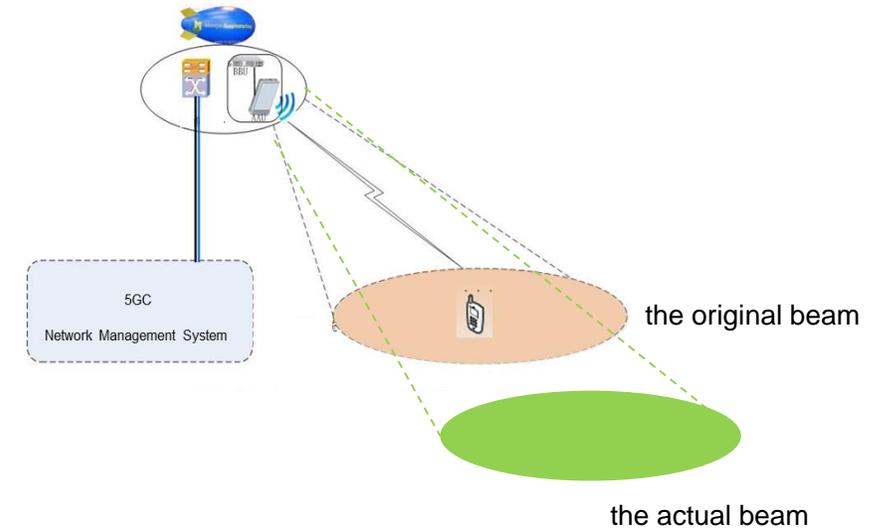
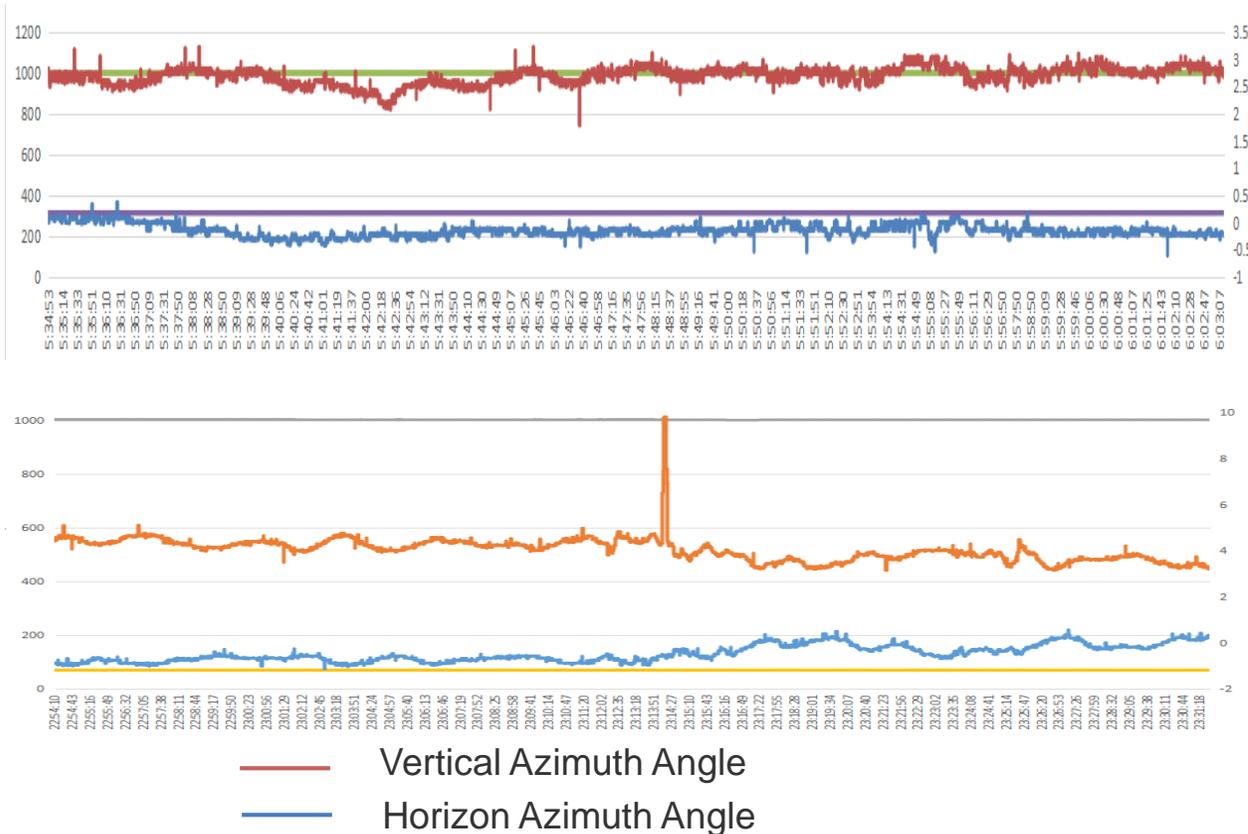
1. Adjacent channel interference
2. Co-channel interference

❑ As shown in this Figure, when the UE got into suburban area where terrestrial gNBs were deployed, the variations of RSRP was quite limited but the PDCP data rate decreased quickly.



Scenarios

- Issue: The HAPS gNB antenna surface is not stable in the stratosphere and may jerk up and down by 1° even the stabilizing device is already deployed at the HAPS in the altitude of 1km.

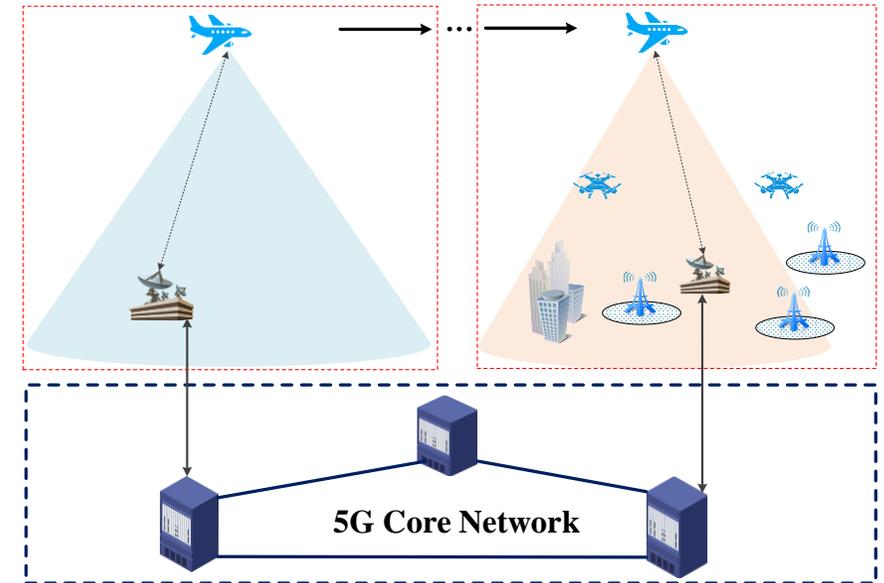


- The outer beam may depart the original direction by 1-2 kms, which may cause some issues, for example, new neighbor cell issues, inaccurate beam measurement and then unnecessary handover between beams in one HAPS/between HAPS/ between HAPS and TN or beam failure.

Scenarios

□ Issue: The HAPS gNB will move in the stratosphere in an area

1. As the HAPS may move to the area where TN is deployed. The new neighbor cell issues with terrestrial networks need to consider.
2. Mobility issue of 5GC
 - The coverage of HAPS will change as HAPS moves, the original feed link ground station may be out of the current coverage, so the HAPS need to switch to another backhaul link ground station.
 - The HAPS may also need to switch to another 5GC



□ The handheld UE can access in the HAPS directly but the margin is small and it is easily influenced by clutter loss and topography.

- It is needed to define HAPS gNB to provide accessibility of both legacy UE and possible new types of UE for airplane and airship if necessary.
- Necessary performance optimization for UE to support the link budget.

Objectives

- Evaluate Co-channel interference issue btw HAPS and TN and study the potential solution.

- Identify and solve the mobility issue, i.e. neighbor cell identification, etc.
 - Study the HAPS gNB handover via NG interface between the backhaul link ground stations and between 5GCs.
 - Study to identify new neighbor cell relationship with terrestrial networks.
 - Beam measurement and beam management enhancement to solve the problems caused by the instable HAPS gNB antenna surface.

- Specify core specifications of RF requirements for coexistence between HAPS and IMT terrestrial network
 - Identify the FR1 potential band(s) to be used as example for HAPS
 - FR1 co-existence evaluation for HAPS network (e.g. ACLR, ACS)

- Specify RF requirements HAPS network
 - Specify new BS type(s) for HAPS network for airplane and airship respectively, if necessary.
 - Specify RF requirements for HAPS gNB if needed.

- Network performance optimization for UE to support the link budget.