STRATOSPHERIC PLATFORMS

5G HAPS Demo in the Kingdom of Saudi Arabia

Demo Report Summary

February 2022

1 SUMMARY

Operating in the stratosphere, unmanned High-Altitude Pseudo Satellites (HAPS) could bring connectivity to areas that are either not covered, or are only partially covered, by terrestrial cellular networks.

Stratospheric Platforms Limited (SPL), commissioned by the Kingdom of Saudi Arabia Communications and Information Technology Commission (CITC) in collaboration with The Red Sea Development Company (TRSDC), working with its partner Deutsche Telekom have successfully trialed pioneering technology, which demonstrates the provision of 5G network coverage from the stratosphere in Saudi Arabia at the Red Sea Projects located on the Red Sea coast.

The controlled tests are designed to validate the performance of the 5G waveform from the stratosphere in terms of the data rate and user experience in real world scenarios located at The Red Sea Project.

An airborne 5G New Radio (NR) cell concept was flown on a Grob aircraft flying in the Stratosphere providing 5G service with commercial off-the-shelf (COTS) user equipment (UE) – mobile smart phones.

Connectivity was successfully demonstrated over a wide area, in buildings, cars, boats and helicopters.

The trial successfully demonstrated that a HAP with a 5G payload provides a clear and evenly distributed signal, allowing HAPS to provide capabilities that include removal of mobile black spots, the Internet of Things (IOT), emergency communications, disaster recovery, temporary coverage for events, tourist hotspots, and terrestrial site backhaul.

2 TRIAL SETUP

The test topology contains a “flying 5G cell” consisting of 5G Base Station (gNB) on-board the aircraft, connected to a 5G Core Network (5GC) via a proprietary wireless backhaul link. The gNB creates an 5G service cell available for standard smartphones.

The measurement setup is depicted in Figure 1. The gNB operates on Band n1 (2100 MHz) using 10 MHz channel bandwidth. Test User Equipment were commercially available smartphones. The telecommunications ground station, was located in The Red Sea Development Company’s base camp premises.

Figure 1: Measurement setup diagram.

The test flight path is a circular pattern with 12 km radius at altitude of FL450 (approx. 14km), centered on TRSDC Base Camp. Flight path is illustrated in Figure 6, along with the test UE locations in Nadir, cell-edge, and at the Red Sea. The 7 km cell coverage radius is illustrated as magenta circle. The boat's location and base camp position is also shown.

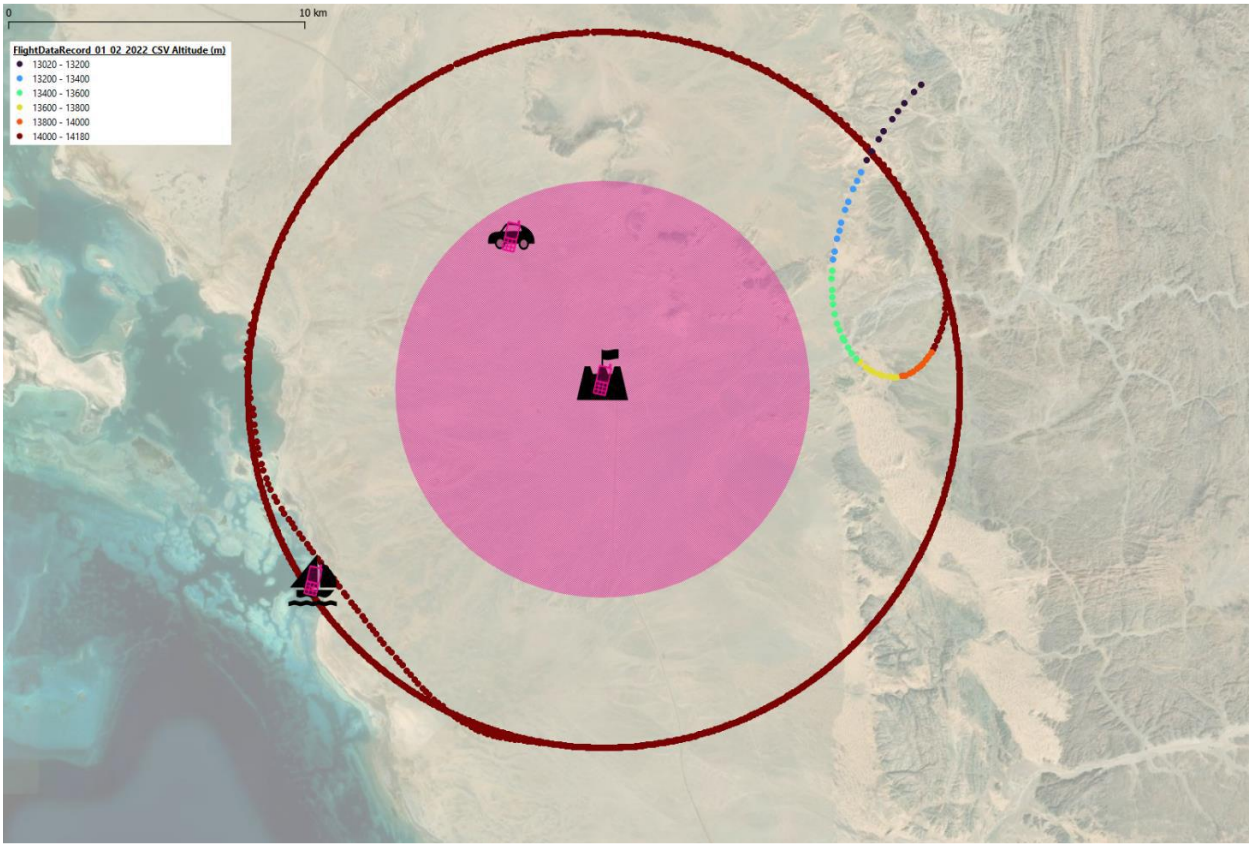

Figure 2 - Flight Path and cell boundary (magenta circle)

3 TESTING SUMMARY

During the drive test, the performance of HAPS 5G network was benchmarked against the terrestrial 4G-LTE network. Figure 3 and Figure 4 show the throughput performance of the two networks.

The HAPS network maintains a consistent high throughput performance while the terrestrial network suffers degradation as the distance from the cell centre increases, ultimately reducing to zero.

This drive test validates the assumption that a mobile phone connected through a HAP does not experience loss of performance due to ground fade effects (hills, houses, trees etc.).

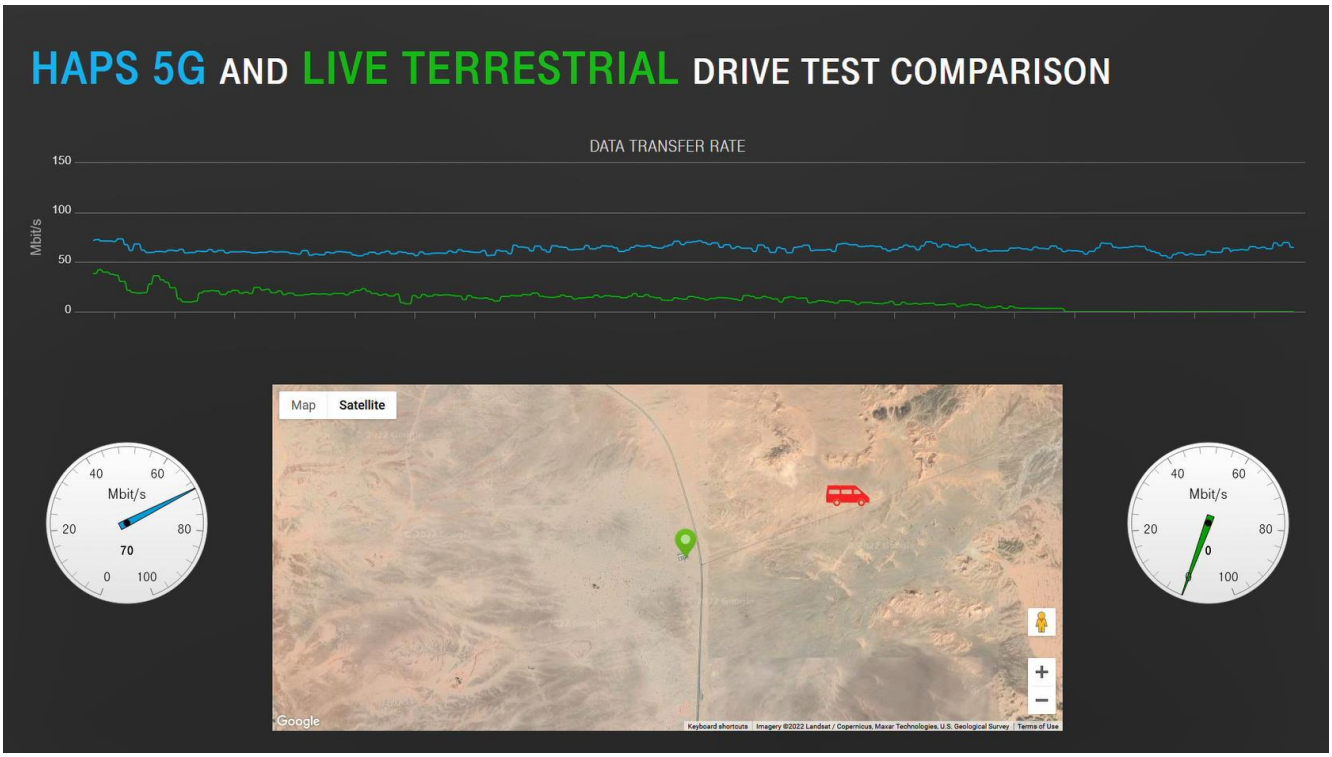

Figure 3 - Drive test comparison of HAPS network and the terrestrial network

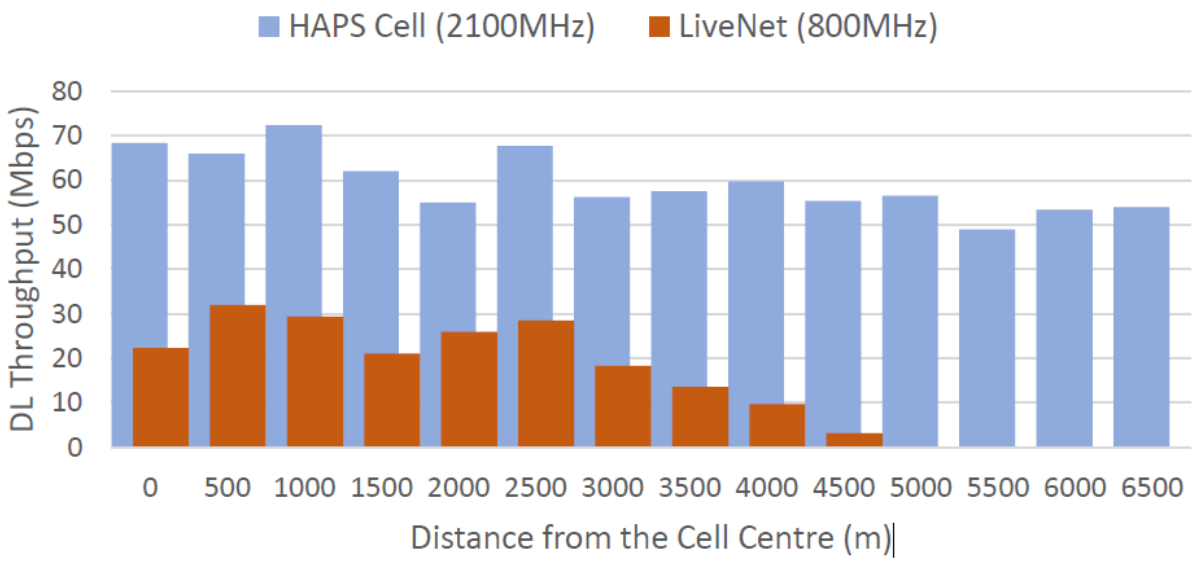

Figure 4 - Throughput comparison of the HAPS network against the terrestrial network

During the testing peak downlink throughput was 86 Mbps and average downlink throughput was 50.8 Mbps.

Further testing was performed, from within a building at the Red Sea base camp, from a boat in the red sea and from a helicopter. All the users, through the HAP were able to video conference with each other and through the internet to users located at CITC headquarters in Riyadh.

Figure 5 - Images from aircraft taken from the Stratosphere

Figure 6 - His Excellency Mohammed Altamimi attending a video conference using 5G from the stratosphere

Figure 7 - Video call from the boat through the stratosphere

Figure 8 - AW139 helicopter used for in-flight video conference call via the stratosphere

The demonstration successfully proved the effectiveness of 5G HAP communication in a wide variety of land, sea and air 5G communication scenarios. Simultaneous users were able to perform video calls and video streaming through the HAP, using off the shelf smartphones.

Operation of UE onboard a boat and in a flying helicopter was not noticeably different compared to a user on land. High data rates were obtained – even for simultaneous users – proving that a HAP system is capable of connected the unconnected, even in challenging environments which include a flying helicopter and a boat out at sea. Use of 5G HAP communications systems allows airborne and users at sea to experience the same level of smart phone service levels as a user located next to a mobile phone mast.

In particular, the demonstration showed that a HAP can provide 3D coverage, i.e., connectivity to UE in an aircraft, at any altitude, below the HAP.

4 FUTURE SYSTEMS

The demonstration successfully proved the utility of 5G telecommunications from the stratosphere and is an important step in the development of HAPS.

Stratospheric Platforms Limited is developing the Stratomast aircraft which connects the unconnected at super-fast speeds over a huge area.

Figure 9 - Stratomast Aircraft

The civil certified Stratomast flies at an altitude of 60,000ft delivering 5G telecom services directly to existing end user devices. Each aircraft provides high-Mbit-per-second service to half a million users over an area of 15,000km^2 (larger than Qatar). The Stratomast covers the equivalent area of 450 terrestrial masts, works over land and sea, and integrates seamlessly with existing mobile networks. The aircraft is hydrogen powered and can use 100% renewable energy, emitting only water vapour from the exhaust. A fleet of Stratomast aircraft provides 24/7 service, where each aircraft flies for a week before landing to be refuelled, maintained and upgraded when necessary. One Stratomast could circumnavigate the globe in one flight, in any direction, at any time of the year