



Use of U6 GHz band for mobile

Performance evaluation and
impact of shared use with RLANs

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Executive Summary

- 1 BT and Nokia have collaborated to conduct a proof of concept (PoC) trial of a mobile radio network operating in the Upper 6 GHz (U6 GHz) spectrum band at BT's Adastral Park facility near Ipswich, UK during May 2025. The purpose of the trial was twofold: (a) to explore the coverage and performance that can be achieved using the U6 GHz frequency band, and how this compares with other mid-band spectrum at 3.5 GHz that is available today; and (b) to understand the implications of possible shared use of the U6 GHz band between licensed mobile networks and licence-exempt Wi-Fi, as has been proposed for study by European regulators.
- 2 The results of the trial showed that the mobile coverage and performance achieved using U6 GHz frequencies compares favourably with that using 3.5 GHz at similar transmitter power levels: the U6 GHz downlink coverage and speeds being only slightly poorer than the 3.5 GHz – helped by the higher MIMO levels implemented in the newer U6 GHz equipment offsetting the higher propagation losses. This was the case for both indoors and outdoors static measurements and in drive testing of a larger area.
- 3 The results observed when operating Wi-Fi equipment using the same frequencies as mobile in the U6 GHz band revealed a high risk of substantial impact on performance of both mobile and Wi-Fi due to mutual interference. The exact interference mechanisms and impact on one application or the other depended on the particular deployment scenario – all of which were scenarios likely to occur in practice rather than ones specially contrived to demonstrate interference.
- 4 Overall the trial provides further evidence that the U6 GHz band would be very useful for mobile network capacity provision. It has potential to provide good connectivity to serve mobile users both indoors and outdoors. However, potential shared use of U6 GHz mobile with Wi-Fi in the same areas will be highly problematic for consumers in terms of impact of mutual interference, certainly if no interference mitigation measures are imposed at the outset and implemented in equipment standards. The commercial and technical viability of these possible mechanisms is under study within Europe, but the technical and commercial viability of possible measures has not yet been studied or demonstrated.

1 Interest in U6 GHz for mobile

The ITU World Radio Communications Conference 2023 identified the mobile band 6,425 – 7,125 MHz (U6 GHz) for use by International Mobile Telecommunications (IMT) in Europe and some other countries in other regions of the world. The mobile industry sees this band as crucial for supporting the evolution of 5G and meeting the growing demand for mobile data as well as providing suitable spectrum for initial introduction of future 6G. The use of this band by radio local access networks (RLANs) was also noted by WRC-23, reflecting such use in the United States and some other countries.

Within Europe there has been much debate as to whether some kind of future shared use of the U6 GHz band by mobile networks and RLANs should be facilitated, either on the same frequencies on a geographic basis (including indoor/outdoor) or by partitioning the band to prioritise one technology over the other (or some combination of these sharing approaches). Possible techniques to reduce risks of interference in shared use such as sensing and cross technology signalling have been discussed in regulatory circles, notably in the ECC PT1 group of CEPT, but no clear conclusions as to their technical or commercial feasibility are yet available.

The mobile industry has identified the U6 GHz band as a suitable band to deliver additional mobile capacity to customers. It sees this as suitable spectrum to deploy on existing macro sites alongside existing frequencies, while not excluding other deployments (including indoors). With advances in technology the U6 GHz band is anticipated to be able to deliver similar coverage to that achievable in today's 3.5 GHz band deployments. This white paper provides practical measurements to explore this hypothesis and an early

demonstration of how U6 GHz can perform with future mobile technology already in development today. As well as providing an important new source of additional capacity for mobile coverage to meet ever growing demand, the U6 GHz band is also of high interest for future initial mobile deployments of 6G mobile, ahead of eventual re-use of other bands that today accommodate earlier mobile technology generations. The U6 GHz band spans 700 MHz and would deliver the foreseen need for 200MHz channels per operator that would improve the commercial viability of 6G deployments and support future bandwidth hungry applications and high densities of mobile users.

Wi-Fi is also of critical importance for existing and future needs of consumers and is a vital adjunct to fixed networks. It is also part of the overall 6G vision and will increasingly play a key role in delivering mobile coverage in many indoor places and be part of a seamless converged fixed and mobile connectivity solution. The lower 6 GHz (L6 GHz) band is a key band for future Wi-Fi deployments that was made available only in recent years and is an important supplement to other Wi-Fi bands that carry most of the Wi-Fi traffic today (i.e. 5 GHz). Shared use of U6 GHz by Wi-Fi with mobile is generally not advocated by mobile operators due to the risks of interference with unpredictable effects. The results presented in this White Paper are made available to help inform that debate and any further work that is needed to assist regulatory authorities to reach conclusions on the optimal and efficient use of the U6 GHz band, and what changes are needed to standards if any form of shared use between mobile and RLANs (Wi-Fi) were to be pursued.

2 Field trials overview

The field trials were designed to address two primary objectives: (i) a comparative assessment of mobile coverage performance between the 3.5 GHz and U6 GHz bands, and (ii) an evaluation of interference

between mobile and Wi-Fi systems operating within the same frequency band. These objectives are further detailed in the following sub-sections.

2.1 Set Up & Technical Details

The field trial was conducted using two mobile base station radio units:



- A Massive MIMO 128 TRX concept radio based on the Nokia AirScale platform for the U6 GHz band.
- A Nokia AirScale Massive MIMO 32 TRX radio for the 3.5 GHz band.

Figure 1: U6 GHz (top) and 3.5 GHz (bottom) base station antennas

Both radios used the Nokia Sounding Reference Signal (SRS)-based beamforming, and the carrier bandwidth was 80 MHz in both frequency bands (a single 80 MHz channel for the U6 GHz radio, and two 40 MHz channels aggregated for the 3.5 GHz radio). The operation of the beamforming in both systems was validated at each measurement location and this validation step was essential for confirming the integrity and comparability of measurement results across the two bands.

Table 1 below provides the detailed parameters of the base stations used in the trials.

Table 1: Technical parameters of U6 GHz mobile base station equipment

Base station characteristics	U6 GHz concept radio	3.5 GHz commercial radio
Frequency	7.05 GHz	3.5 GHz
Bandwidth	80 MHz	40+40 MHz
Subcarrier Spacing	30 kHz	30 kHz
Tx/Rx channel	128	32
Maximum EIRP	75 dBm	75 dBm
Antenna Gain	30 dBi	24.5 dBi
Number of antenna elements	768	192
TDD frame structure	DDDSU	DDDSU
Antenna height (above the ground)	25 m	25 m

The pre-commercial test terminal (user equipment) used in the trial was equipped with integrated omnidirectional antennas supporting both the 3.5 GHz and U6 GHz frequency bands. The same key configuration

parameters were applied across both bands to ensure consistency in performance evaluation. The test device technical details are detailed in Table 2.

Table 2: Technical parameters of U6 GHz mobile device equipment

Test terminal characteristics	U6 GHz	3.5 GHz
Tx/Rx channel	2Tx / 4Rx	2Tx / 4Rx
Maximum transmit power	24 dBm (250 mW)	24 dBm (250 mW)

To generate network traffic and validate signal reception, the test terminal utilized the iPerf tool¹ based on the Transmission Control Protocol (TCP). In TCP communication, each received data packet must be acknowledged by the receiver. For instance, upon receiving a TCP downlink data packet, the user

equipment transmits an acknowledgment to the iPerf server via the uplink. At each measurement location, multiple iPerf TCP throughput tests were conducted in both downlink and uplink directions to capture the primary performance metrics.

3 Mobile coverage evaluation

A comparative assessment of mobile coverage performance between the 3.5 GHz and U6 GHz bands was one of the primary objectives of the field trial. This assessment is split into two:

1. static test (Outdoor-to-Indoor / Outdoor-to-Outdoor, stationary measurements)
2. drive test (throughput monitoring along a defined route)

The static test measurements capture the Reference Signal Received Power (RSRP) and the corresponding

downlink (DL) throughput under two deployment scenarios: Outdoor-to-Indoor (O2I) and Outdoor-to-Outdoor (O2O). Assessing indoor performance at frequencies above 6 GHz (referred to as U6 GHz) is particularly important due to the increased propagation losses associated with higher frequencies. These losses arise from shorter wavelengths and greater susceptibility to penetration attenuation compared to systems operating at 3.5 GHz. In parallel, drive tests were conducted to evaluate the mobility performance of the U6 GHz.

3.1 Coverage comparison - static tests

The outdoor and indoor coverage comparisons between the U6 GHz and 3.5 GHz were performed at static test positions located at various points around the Adastral Park site.

Figure 2 shows the static test positions within BT Adastral Park site. The indoor coverage tests were done by placing the UE indoors and connected to the outdoor base station (gNB).

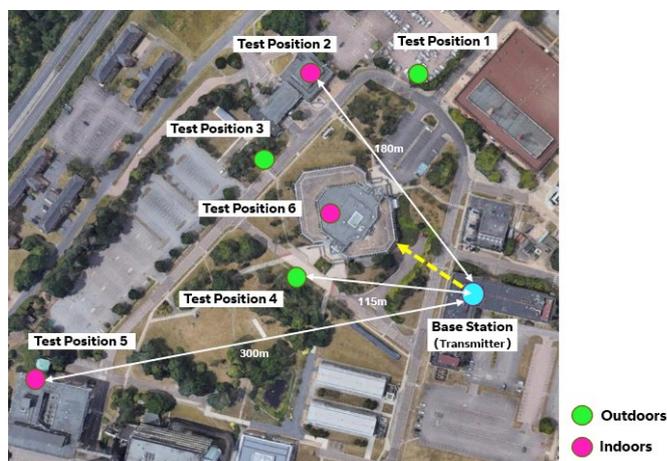


Figure 2: Location of test locations at the BT Adastral Park site

¹ <https://iperf.fr/>

The test positions were situated at distances ranging from approximately 100 to 300 meters from the base station transmitter, constrained by the physical boundaries of the site. These positions were strategically selected to ensure variation in both range and horizontal coverage. The coverage (and capacity) comparisons of these static measurement points are shown in Figure 3.

Although the number of test positions is limited, preliminary conclusions can still be drawn. As expected, the RSRP is slightly lower for the U6 GHz band compared to the 3.5 GHz band, primarily due to propagation characteristics. However, the downlink throughput remains comparable between the two bands.

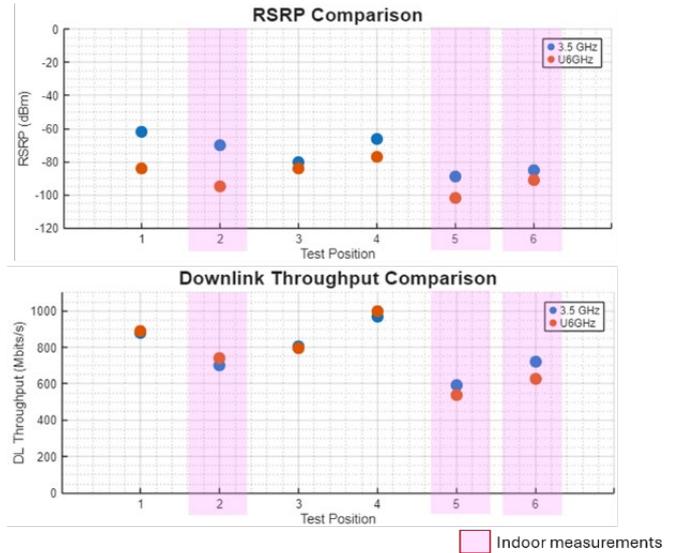


Figure 3 Capacity & Coverage Comparison

3.2 Coverage comparison - drive tests

The mobile coverage assessment was done by comparing the coverage of the U6 GHz with 3.5 GHz by performing drive tests along a specified route and the result is shown in Figure 4.

This drive test shows that downlink throughput of the U6 GHz is comparable to the 3.5 GHz. An additional static point (A) was taken to check against the measurements recorded during the drive test confirming this finding.

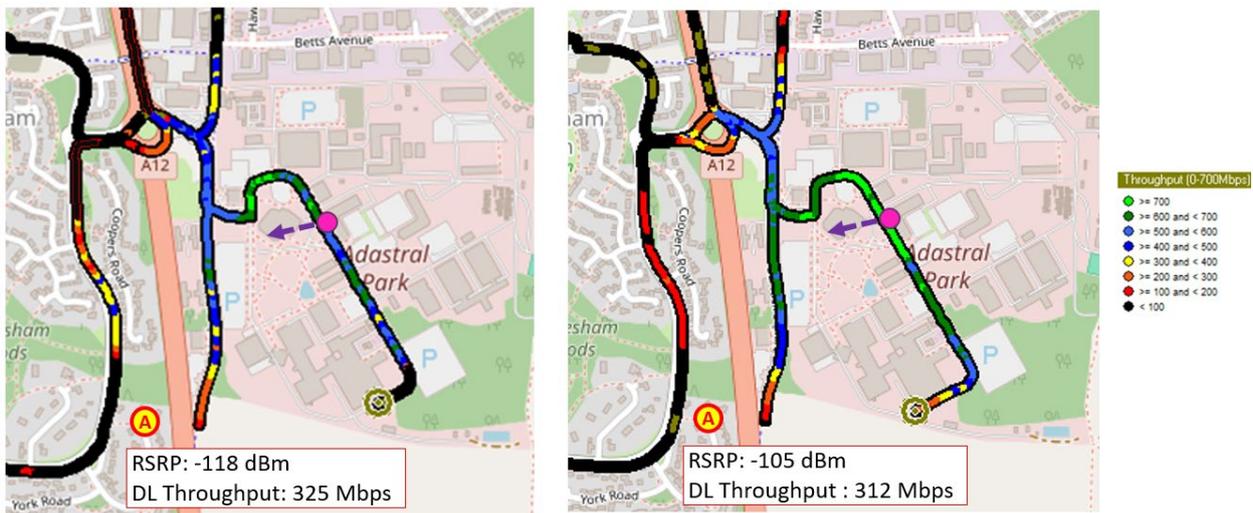


Figure 4: Drive test (left is U6 GHz and right is 3.5 GHz radio respectively)

4 Interference between mobile and Wi-Fi

These tests assessed the impact of interference and contention between the mobile network and an indoor Wi-Fi network when both are sharing the U6 GHz spectrum. The tests covered the cases where the

mobile UE was indoors in the same building as the Wi-Fi network (Indoor-to-Indoor), and where the mobile UE was outdoors (Outdoor-to-Indoor) potentially 10s of metres away from the Wi-Fi network.

4.1 Trial Wi-Fi Setup

The Wi-Fi test network consisted of two 4x4 Wi-Fi6E devices, one configured as an Access Point and the second configured as a Wireless Extender client. These were connected back-to-back to replicate a 6GHz Wi-Fi mesh network backhaul connection similar to that used in the BT Smart Wi-Fi Pro product. The Wi-Fi

Access Point was configured for Low Power Indoor transmit power, 5dBm per MHz. Test application client/server devices were connected via 2.5GbE ethernet to both the Access Point and Wireless Extender.

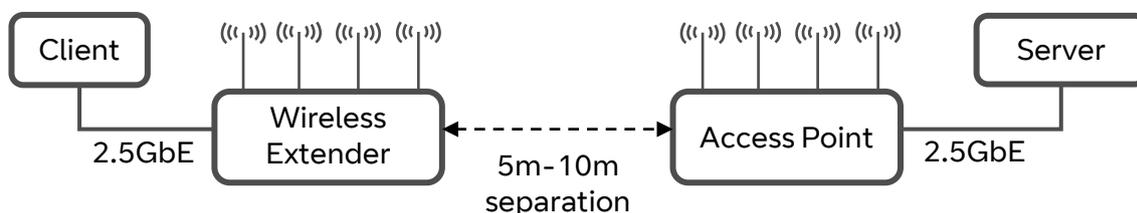


Figure 5 Wi-Fi Network Setup

Three indoor test locations were used for the Wi-Fi network.

- **A** indoor at the cell edge approximately 350m from the cellular base station
- **H** deep indoor non-line of sight, approximately 100m from the cellular base station
- **M** indoor but line-of-sight and approximately 100m base station

For Indoor-to-Indoor tests the mobile UE was in the same room as the Wi-Fi network. For Outdoor-to-Indoor testing the mobile UE was positioned at the outdoor test positions 1,3 and 4.

To assess how the specific Wi-Fi specific channel configuration chosen affected the interference impact, four Wi-Fi primary channel and channel width configurations were tested as described in Table 3 below.

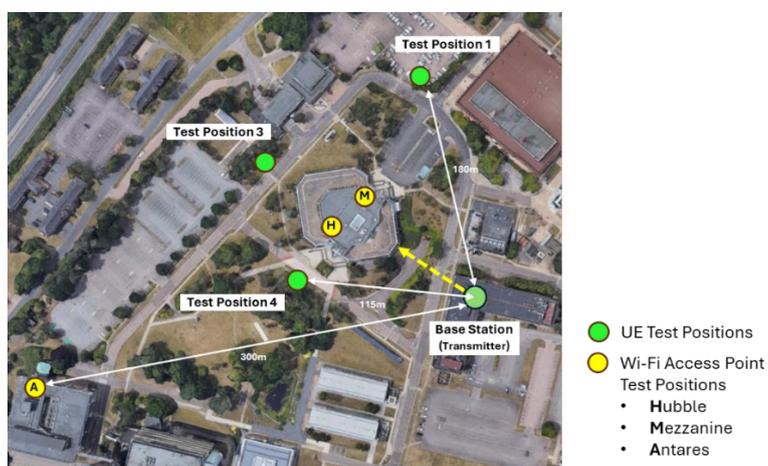


Figure 6 Interference Test Locations

Table 3: Wi-Fi Channel Configurations

Wi-Fi		<p>189/160 - Wi-Fi channel width of 160MHz with the primary 20MHz set to channel 189 (6895MHz) and no overlap with the 80MHz mobile channel</p>
Wi-Fi		<p>221/160 - Wi-Fi channel width of 160MHz with the primary 20MHz channel set to channel 221 (7055MHz) located in the centre of the 80MHz mobile channel</p>
Wi-Fi		<p>221/80 - Wi-Fi channel width of 80MHz with the primary 20MHz channel set to channel 221 (7055MHz) located in the centre of the 80MHz mobile channel.</p>
Wi-Fi		<p>193/160 - Wi-Fi channel width of 160MHz overlapping the mobile channel but with the primary 20MHz set to channel 189 (6915MHz) which is located outside of the 80MHz mobile channel.</p>

For each Wi-Fi channel configuration and test location, four mobile network traffic states were tested.

- **No_BTS** the mobile base station was off
- **No_UE** the mobile base station was on but there were no UEs attached
- **Idle_UE** the mobile base station was on, a single UE was attached but idle
- **Active_UE** the mobile base station was on, a single UE was attached with full buffer download test

4.2 Indoor-to-Indoor: Mobile UE impact on Wi-Fi downlink

Below we show the impact of the mobile network traffic state on the indoor Wi-Fi downlink TCP throughput for the different Wi-Fi network locations and channel configurations.

Baseline Wi-Fi throughput without any mobile network present (**No_BTS**) was >2300 Mbps for a 160MHz wide channel and >1500Mbps for an 80MHz wide channel. For wider 160Mhz channels, performance was limited by the 2.5 GbE connection between the client/server devices connected to the Wi-Fi Access Point and Wireless Extender

Note: For the location **Antares** tests the Wireless Extender was further away from the Access Point and so Wi-Fi PHY rates were lower resulting in lower maximum throughput.

The results show the impact of the mobile network on Wi-Fi performance depends on the mobile network state, the Wi-Fi channel configuration and the Access Point location relative to the mobile base station.

- When the Wi-Fi and Mobile channels are non-overlapping with a sufficient guard band

separation (ch.**189/160**), then Wi-Fi performance was unaffected by the mobile network.

- When there was overlap between the Wi-Fi and mobile channels then even an idle mobile base station (**No UE**) reduced Wi-Fi throughputs by >25%.
- When the Wi-Fi and mobile channels overlap but the Wi-Fi primary 20MHz channel is outside of the mobile channel, then Wi-Fi throughput is stable but reduced significantly when the mobile state was **Idle UE** or **Active UE**.
- If the Wi-Fi primary channel is within the mobile channel, then Wi-Fi throughput is significantly impacted reducing to zero for significant periods of time when the UE is Active, with mean throughput reduced by >99% to 62Mbps in the worst case test (Location **Hubble** + channel **221/160** + **Active UE**).
- Wi-Fi Location **H**, which was non-line of sight to the mobile base station, was more adversely affected by mobile traffic than Wi-Fi location **M** which although a similar distance to the base station was line-of-sight.

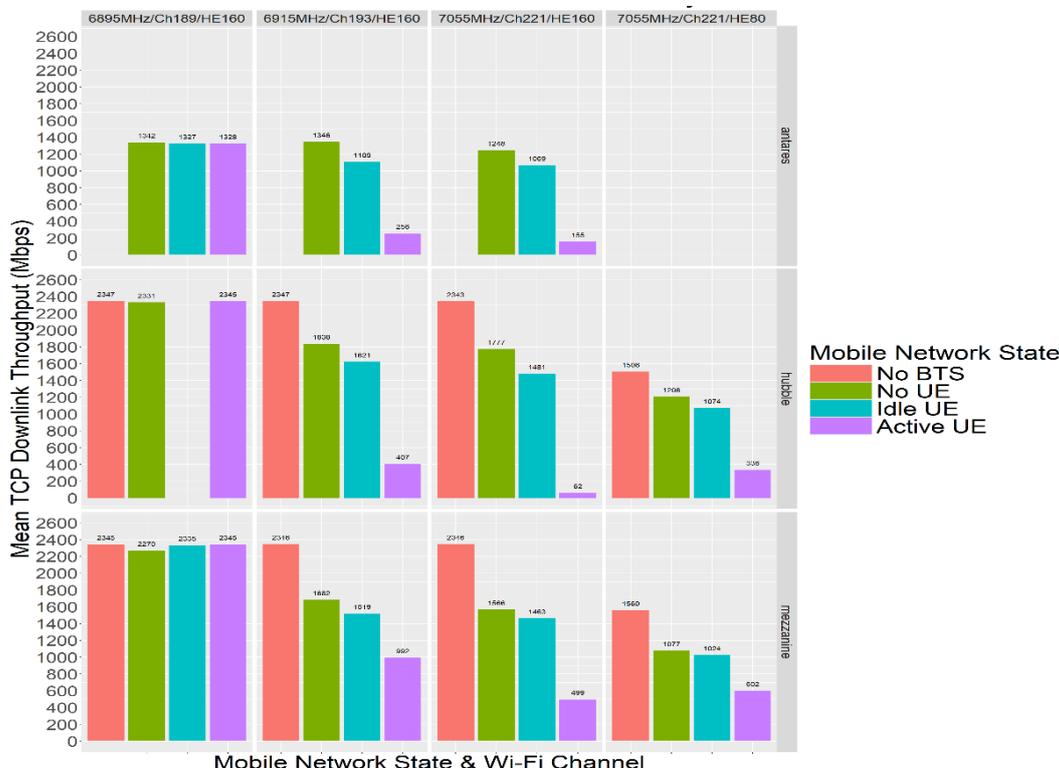


Figure 7: Impact of mobile network on Wi-Fi throughput

The tests also measured the impact of the Wi-Fi network on the downlink TCP throughput of an indoor cellular UE in the same room as the Wi-Fi network. For a test conducted in the location **M** with Wi-Fi channel **221/80** there was severe impact from the Wi-Fi network on mobile performance. When the Wi-Fi

network is idle then the indoor mobile UE achieved >500Mbps, however once the Wi-Fi throughput test begins then mobile throughput is severely impacted, dropping to zero for several seconds on multiple occasions and overall mean throughput of <100Mbps (>80% reduction).

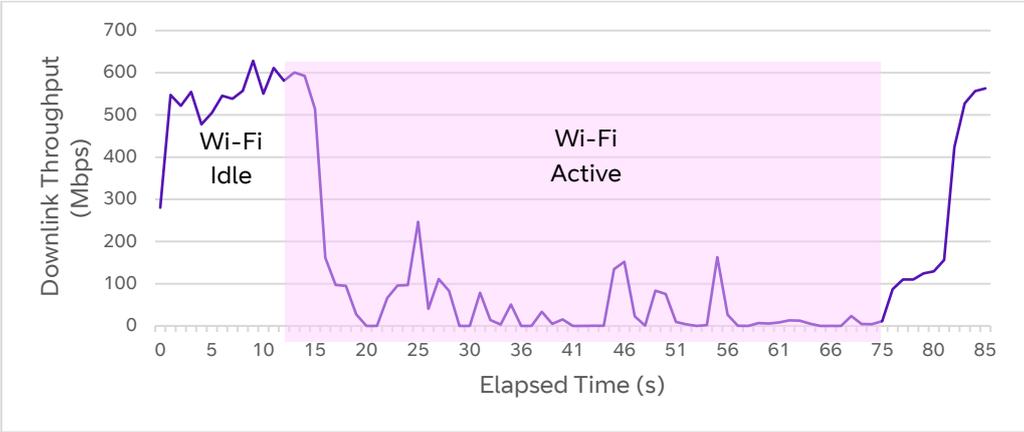


Figure 8: Impact of Wi-Fi on Indoor mobile UE performance

A further test was performed for Wi-Fi location **H** where the distance between the mobile UE and the Wi-Fi Access Point was varied (1m to 11m to 1m) over time. In this test Wi-Fi throughput was severely affected by an indoor UE regardless of its distance to the Wi-Fi Access Point, however, as shown below, mobile UE throughput was only affected when the UE was near to the Access Point. Once the mobile UE was sufficiently faraway (>7m) then throughput returned

to that achieved when the Wi-Fi Access Point was turned off.

In summary, the Indoor-to-Indoor test results show that both the cellular and Wi-Fi indoor performance exhibit significant degradation when the two networks attempt to share the same spectrum. The level of impact is affected by a variety of factors including channel configurations, relative locations and traffic levels.

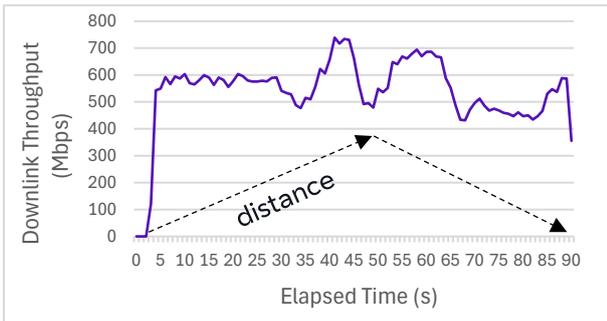


Figure 9 Mobile UE Throughput (Wi-Fi off)

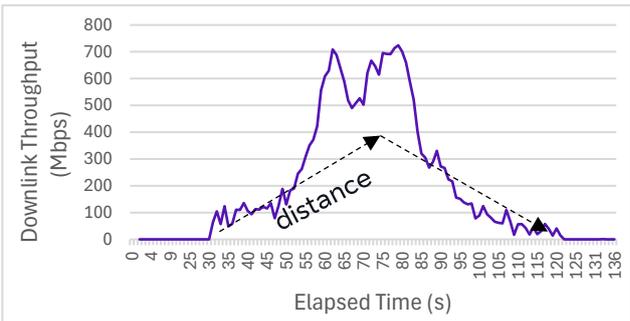


Figure 10 Mobile UE Throughput (Wi-Fi active)

4.3 Outdoor-to-Indoor: Impact of outdoor cellular UE on Wi-Fi

These tests examined the impact of an outdoor mobile UE on indoor Wi-Fi throughput (and vice versa). Two Wi-Fi AP locations (**Hubble** and **Mezzanine**) and three outdoor UE positions (1,3 and 4) with two mobile network states **Idle UE** and **Active UE** were tested.

For these tests the Wi-Fi Access Point was configured for channel **221/80** i.e. fully overlapping with the mobile network channel.

The baseline indoor Wi-Fi performance for these locations without the outdoor mobile UE was:

- **No BTS** 1500Mbps
- **No UE** 1000Mbps.

The tests show that Wi-Fi network performance was severely affected by mobile network traffic from an outdoor mobile UE regardless of the mobile UE position. Mean Wi-Fi throughput was reduced by between 40% and 90% (compared to the **No UE** case) depending on the relative AP and mobile UE location. In the worst cases Wi-Fi throughput was often reduced to zero for many seconds.



Figure 11: Effect of Outdoor UE on Indoor Wi-Fi Performance

The tests also examined the impact of the active Wi-Fi network (purple region) on the outdoor cellular UE downlink TCP throughput.

We can see from the below graphs, mobile UE downlink throughput can reduce to zero when the

Wi-Fi AP is active and its location is in line-of-sight (**Mezzanine**) to the base station. When the Wi-Fi AP position is sufficiently indoors (**Hubble**) outdoor mobile UE downlink throughput was unaffected by an active Wi-Fi network.

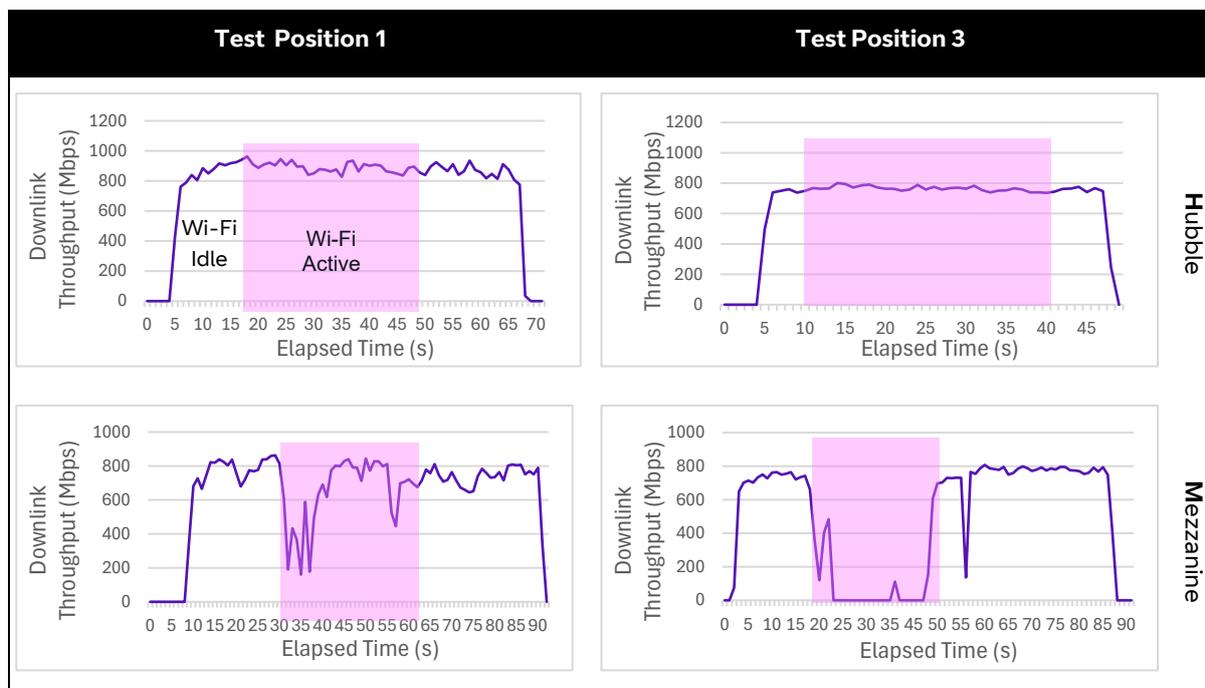


Figure 12: Effect of Wi-Fi on Outdoor UE performance - TCP throughput vs time

4.4 Summary of Mobile/Wi-Fi interference testing

Wi-Fi and mobile performance was unaffected when there was 100MHz separation between the channels. Further testing is required to determine the lower bound for this channel separation.

An idle mobile base station caused significant reductions in Wi-Fi throughput when the Wi-Fi channel partially or fully overlapped the mobile channel. Simultaneous active use of the U6 GHz spectrum by both Wi-Fi and mobile networks led to severe performance reductions for both technologies. When the mobile UE was indoors within the same room as the Wi-Fi network then there were severe reductions in performance for both networks.

When the mobile UE was outdoors the performance impacts depended on the position of the Wi-Fi AP relative to the mobile base station. If the Wi-Fi network is indoors but in line-of-sight of the mobile base station then even outdoor mobile UEs which are far away from the Wi-Fi network can see severe reductions in performance. If the Wi-Fi network was non-line of sight to the mobile base station then mobile UEs saw little impact from the Wi-Fi network, however in all cases the indoor Wi-Fi performance was severely degraded by the outdoor mobile UE. More testing is required to understand exactly the mechanisms by which the Wi-Fi and network physical transmission are affected by the spectrum sharing.

5 Conclusions and Recommendations

1. The trial confirms that the U6 GHz band is well suited for providing additional 5G mobile capacity and supporting future 6G service capabilities. The field tests showed that U6 GHz can deliver useful coverage in the uplink (device to base station) direction, and in the downlink (base station to device) direction it can deliver close to the performance achieved today in the 3.5 GHz band. So long as U6 GHz mobile base stations are authorised to transmit at similar power density levels as that used for 3.5 GHz today, they could serve users with high quality mobile services both indoors and outdoors, typically using existing mobile base station site grids.
2. Unmodified Wi-Fi equipment and mobile network equipment cannot share the same U6 GHz frequencies without significant risk of mutual interference, which can be very detrimental to user experiences. The interference mechanisms and their effects are very dependent on the particular deployment scenario and any mitigations that may be available. Partially overlapping channels also lead to interference effects, the severity and nature of which can depend on whether the primary 20 MHz sub-channel within the wider bandwidth Wi-Fi channel overlaps the mobile channel.
3. Adjacent channel mobile and Wi-Fi operation in U6 GHz may require a guard band to reduce risk of mutual interference to acceptable levels. The limited testing suggests this would certainly be less than 100 MHz, but further studies are needed to identify the size of the guard band (if any) that may be required.
4. The tests did not look at specific techniques that might be introduced to reduce risk of interference, such as database control, sensing or cross technology signalling that have been discussed at a theoretical level within European regulatory forums. Such techniques would need to be carefully evaluated to better understand their technical and commercial viability and then standardised and implemented in equipment if any proved to be viable. Practical investigations are recommended before taking forward in regulations to first demonstrate that any chosen method to facilitate sharing works in practice.
5. Broad industry agreement that shared use is a commercially attractive proposition should be a pre-requisite initiating standards work to facilitate shared use of the U6 GHz band (or parts thereof) between Wi-Fi and Mobile. Without such consensus the standardisation work could be hard to accomplish in a timely manner.

Author bios



Chris Cheeseman, Senior Manager, Spectrum Policy and Regulation, BT Group

Chris works in BT's Research and Network Strategy function where he leads on spectrum policy and related regulatory issues. He has in-depth experience of wireless communications

and the associated national and international spectrum management issues. He leads for BT with Ofcom and Government on a wide range of spectrum and regulatory issues, including participation in Ofcom's past spectrum auctions, spectrum licence fees and other regulatory consultations related to wireless and spectrum.



Frank Scahill, Research Manager, BT Group

Frank is the technical lead for Wi-Fi within BT's Wireless Research team. He has over 25 years of experience in Mobile and Wi-Fi technologies helping launch BT's first Mesh Wi-Fi and more recently the UK's first ISP provided Wi-Fi7 products. His current research is

focused on the future of Wi-Fi for BT's residential customers and the role of Wi-Fi in converged services. He is active contributor to industry standards such as Wi-Fi Alliance Data Elements and EasyMesh.



Ryan Husbands, Wireless Research Specialist within BT Group

Ryan is a Wireless Research Specialist within BT Group's Wireless Centre of Excellence. His expertise lies within wireless communications and signal processing, specifically focusing on 5G & 6G architectures for future radio

access. As part of this role, he represents BT in various standards bodies, such as 3GPP and Small Cell Forum (SCF). He has coauthored several industry papers, conference papers, and journals, inclusive of standards contributions.



Anvar Tukmanov, Senior Manager, Research, Wireless and Mobile, BT Group

Anvar leads BT's Wireless Research Team at Adastral Park, where his team focuses on emerging technologies in Radio Access and Wi-Fi systems, as well as the new services they enable. Previously Anvar led research in MIMO

communication systems, contributing to the development and commercialisation of 5G NR air interface technologies. Since 2015, Anvar has represented BT in the 3GPP RAN1 Working Group, and since 2024, he has also contributed to demodulation topics in RAN4. He is a recipient of the UKRI Future Leaders Fellowship (2020) and is a Distinguished Engineer at BT.



Tuck Yeen Poon, Principal Standardisation Lead, Nokia

Tuck is the Principal Standardisation Lead from Nokia UK Ltd. He had spent more than a decade in R&D on wireless communication technology and over seven years on technical regulation with Ofcom before moving to Nokia in March 2022. He continues to be

involved in international (ITU-R) and regional (CEPT & APT) regulatory work.



Timo Lehesvuori, Technical Leader, Nokia

Timo is the Technical Leader at Nokia. He has been working for several years in different roles within the telecoms industry, from 2G to 5G and now 6G. He continues to support customers in 5G new product introduction projects, as well as 6G trials.



Olli Jarvinen, Senior NPI Support Engineer, Nokia

Olli is the Senior NPI Support Engineer at Nokia. He has worked many different roles in the telecoms sector over a number of years, including focusing on fixed switching, core network products SGSN, EPC, CMM, mobile network 4G, 5G and now 6G. He continues to support customers in 5G new product

introduction projects, as well as 6G trials.



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