



5G small cells – Enhancing network experience for customers in their Moments that Matter

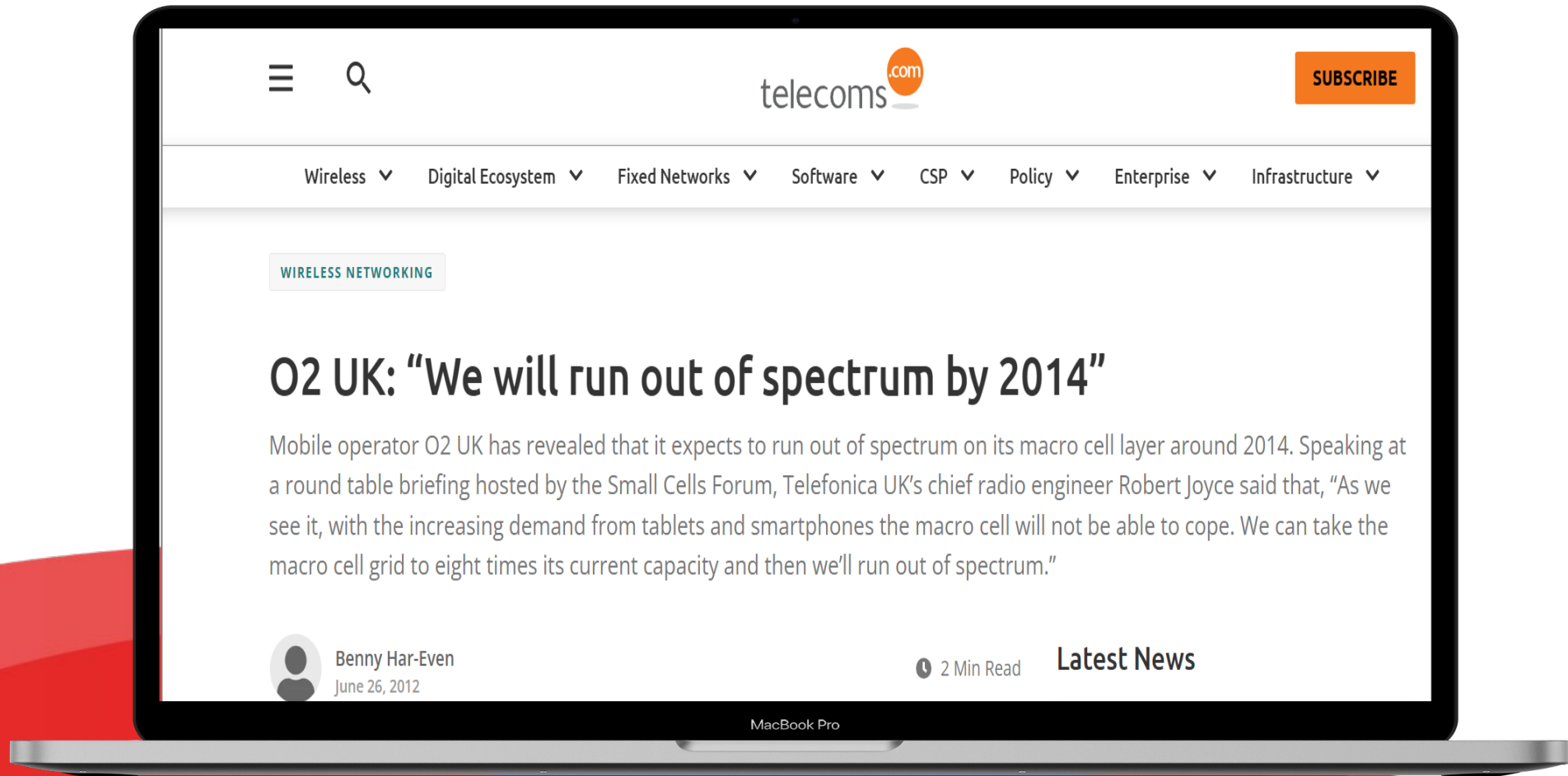
Dr Robert Joyce

Director Mobile Access Engineering

Virgin Media O2

June 2025

Hopefully it goes better than last time ...



The next phase of our network evolution is to build out reliable 5G coverage to where our customers live, work and play

We have a clear strategy and plan to significantly upgrade VMO2's mobile network over the next 3 years

Nationwide 5G rollout



- **Accelerated** nationwide 5G coverage
- **More High Band 5G** capacity for 'full speed' experience

Adding capacity



- **New Spectrum**
- **Re-farm 3G/4G->5G** to add coverage and capacity

Expanding coverage



- **Densification** adds in-fill coverage and capacity (macro & small cells)
- **Focus on key locations** (railway lines, motorways, airports, stadiums etc.)

Customer-led



- **Focus on customer needs and experience:** surveys, crowdsource, metrics & KPIs
- **Reliability & coverage** most important factors for customers, not peak speed

All under the umbrella of our recently announced Mobile Transformation Programme

Early beginnings (1995-2012)

As the UK's largest operator by customer/device numbers VMO2 have been pioneers in small cells for many years.

Telefónica



Spot the 1Gbps Small Cell?

Via: 3g4g.blogspot.com



Via: 3g4g.blogspot.com

Telefónica

UK Small Cells – The Future (Wifi + Femto)

Adaptor plates
attaches to Wifi
unit with two Flat
head M6 screws
per side



ALU Femto Unit
mounts to adaptor
plates.



Alcatel-Lucent

Telefónica

Via: 3g4g.blogspot.com

Small Cells: Solar Pole Test & Build



Telefónica UK's first Solar Powered 3G/4G/Wi-Fi Access Point

Via: 3g4g.blogspot.com

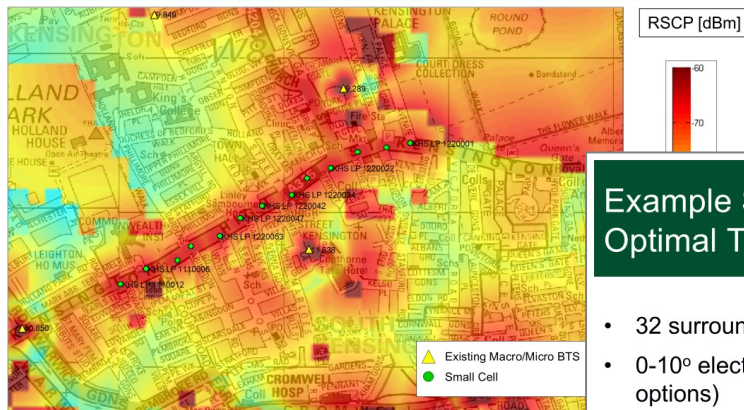
Telefónica

Early beginnings (1995-2012)

Our focus moved from 2G to 3G small cells around 2010 with the introduction of 3G smartphones when the focus changed from voice to data hotspots

Example 3G Small Cell Network Predicted Micro Coverage

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Lamppost microcells modelled with output power **+24dBm** (CPICH = Omni antenna and 3GPP 36.814 LoS propagation model. Modelling microcells with **+24dBm** output power will have dominance in street

Example Small Cell Network Optimal Tilts & Powers on Macro

- 32 surrounding Macros
- 0-10° electrical tilt range (11 options)
- 27 - 33dBm CPICH range (0.5dB steps – 13 options)

- Combinations

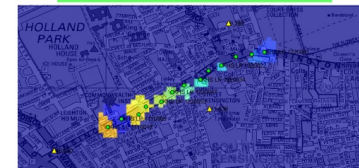
$$= (11 \times 13)^{(32 \times 3)}$$

$$= \underline{143^{96}}$$

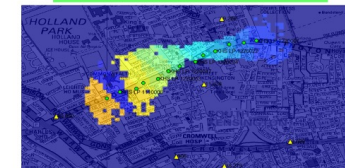
Small Cell SON Results Coverage Summary

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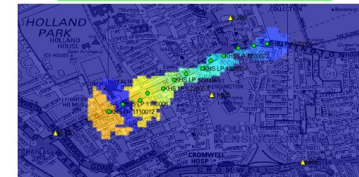
Un-optimised



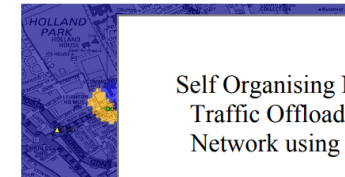
AL1 – Post Based



AL2 – MDT RF based



AL3 – Hybrid



Self Organising Network Techniques to Maximise Traffic Offload onto a 3G/WCDMA Small Cell Network using MDT UE Measurement Reports

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Abstract—This paper presents a number of Self-Organising Network (SON) based methods using a 3GPP Minimisation of Drive Testing (MDT) approach or similar and the analysis of these geo-located UE measurements to maximise traffic offload onto lamppost mounted 3G/WCDMA microcells. Simulations have been performed for a real 3G/WCDMA microcell deployment in a busy area of central London and the results suggest that for the network studied a traffic increase on the microcell layer of up to 175% is achievable through the novel SON methods presented.

INTRODUCTION

Telefonica UK, was the first UK cellular operator to deploy large numbers of 3G/Wideband Code Division Multiple Access (3G/WCDMA) microcells (small cells) into central London in order to cope with the increasing mobile data demand generated by an increasing number of smartphones on the Telefonica UK O2 network [1]. For these or any microcells to be effective they must offload significant traffic from the macro cellular network.

II. REVIEW OF PREVIOUS SMALL CELL SON OPTIMISATION TECHNIQUES

There have been many papers related to SON for macrocell networks and many papers applying SON to small cell (micro/pico/femto) networks but very few focussing on using SON together with MDT to maximise the traffic offload from the macrocell layer onto the small cell layer.

SON for macrocell networks has been the topic of many research papers and indeed entire European research projects [3]. References [4, 5, 6] for example present three typical approaches to SON when applied to antenna tilt in macrocellular networks, namely brute force, simulated annealing and methods based on network Key Performance Indicator (KPI) feedback. While all macrocell methods presented in the literature generally result in an improved network performance, none specifically address the problem of traffic offload to an under laid low power microcellular layer by applying SON techniques to the tilt and power settings of the macrocell layer as is proposed here in this paper.

Automated planning and SON optimisation key to maximising the effectiveness of small cells

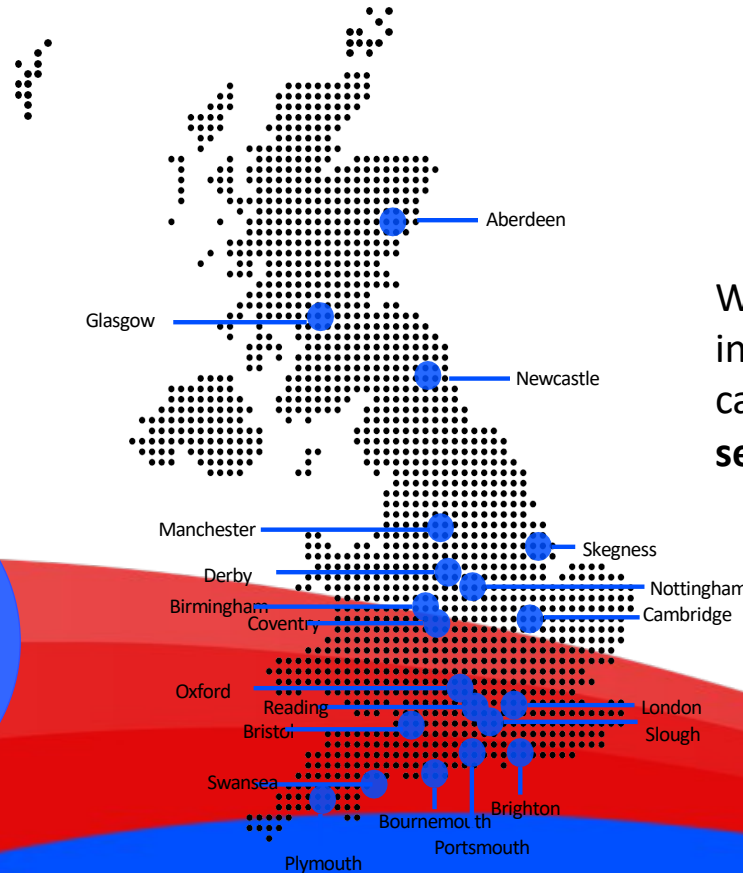
Our Small Cell Deployment today

Today our small cell deployment is all about providing infill coverage and capacity to meet our customers voice and predominantly data needs to support them in their moments that matter

Over
2000
4G/5G
small cells live

1st
UK operator to
deploy 5G
standalone
small cells

+400
New small cells
planned for
2025

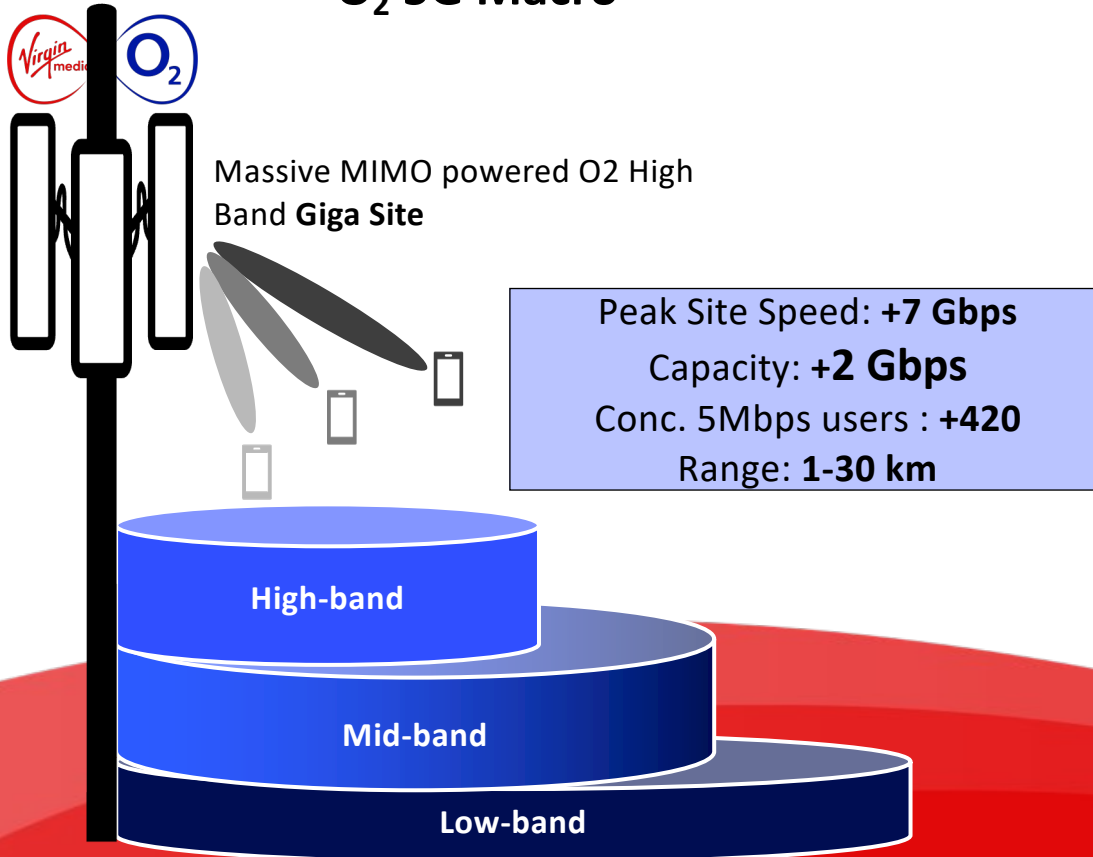


What began in London's financial core has scaled into a nationwide rollout, strategically enhancing capacity in **high-density urban centres and seasonal hotspots.**

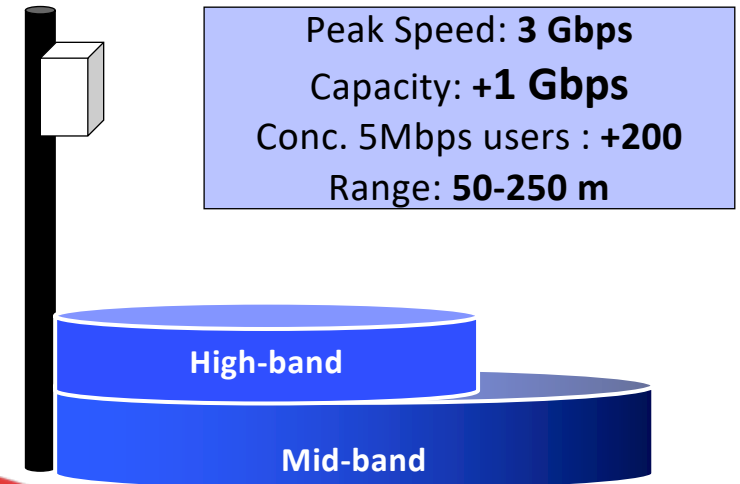
5G small cells deployed nationally

Macro vs. Small Cells

O₂ 5G Macro



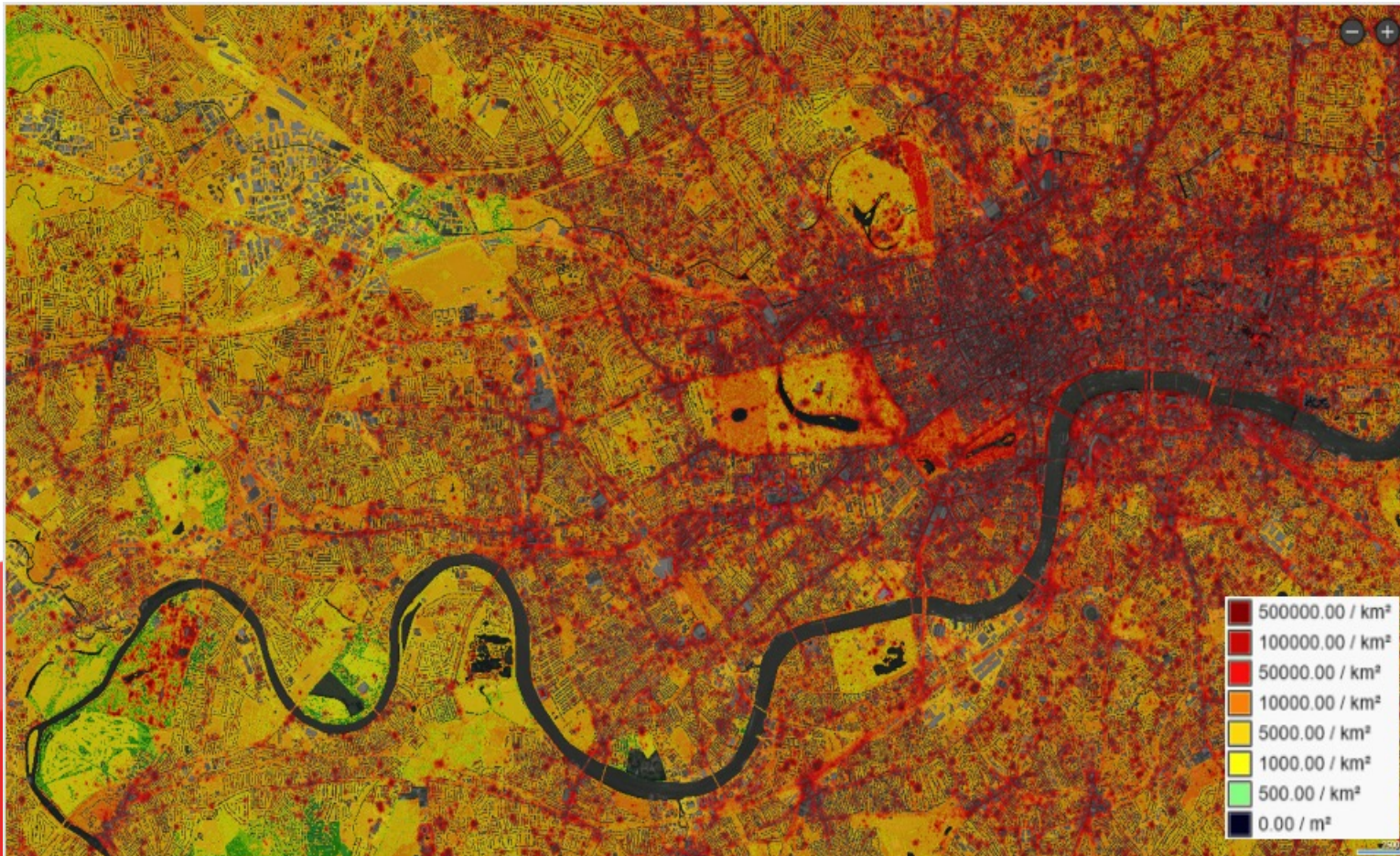
O₂ 5G Small Cell



5G Small Cells deliver significant capacity/km²

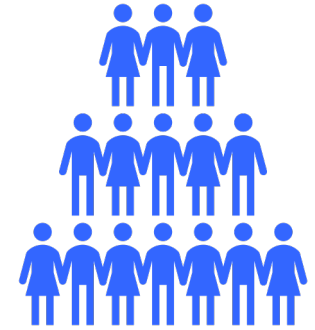
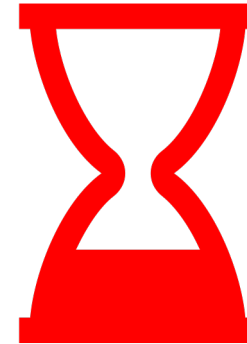
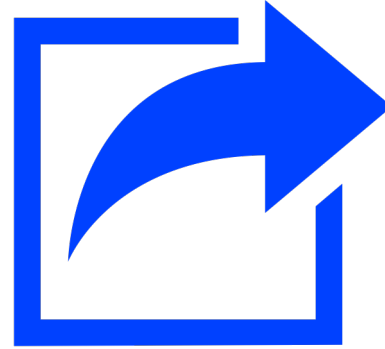
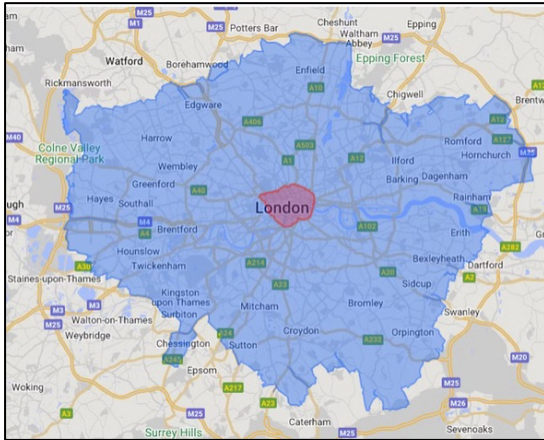
Small Cell Planning

Accurate data is crucial for effective small cell design and localised traffic insights ensure optimal placement



Our Small Cell Deployment today – traffic supported

Today our small cell deployment is all about providing infill coverage and capacity to meet our customers voice and predominantly data needs that support them in their moments that matter



35%

of all 4G data in London Zone 0 is carried by small cells under

25%

of data traffic share under macro footprint is carried by small cells in the wider London area

5G

Both NSA and SA small cells deployed across the network

9/10

Small cell users receive what independent benchmarks class as an Excellent Service

Small cells are offloading our macro network in the busiest areas, and the results are evident

Examples of O2 small cells (1)

Today our small cell deployment is all about providing infill coverage and capacity to meet our customers voice and predominantly data needs that support them in their moment that matter



Business Districts



Staycation Spots



Stadiums

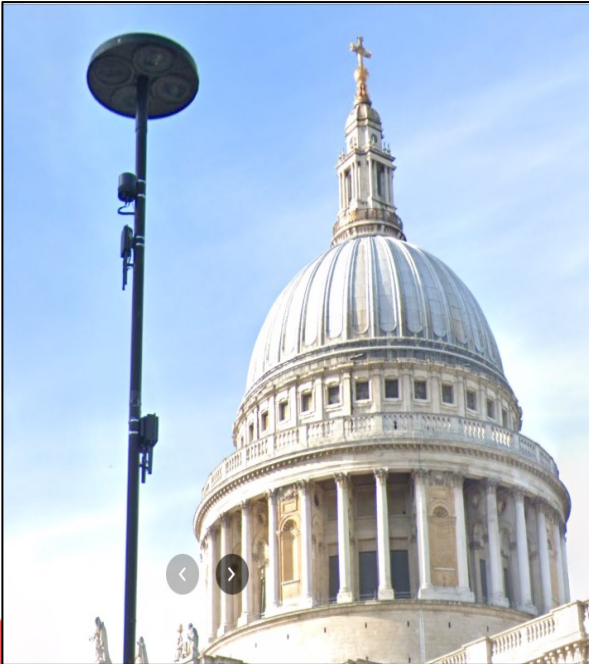


Points of Interest

Small cells enhancing connectivity in diverse locations

Examples of O2 small cells (2)

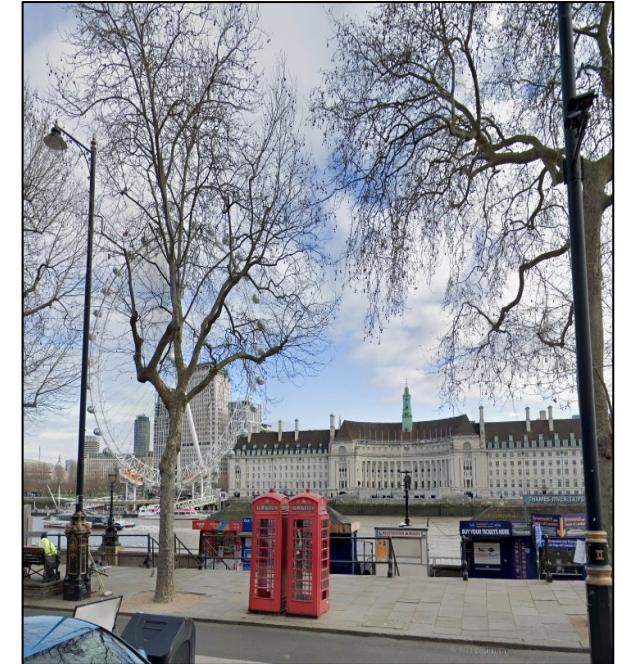
Today our small cell deployment is all about providing infill coverage and capacity to meet our customers voice and predominantly data needs that support them in their moment that matter



Lampposts



Bus Shelters



Phone boxes

Small cells can be deployed anywhere where there's power, backhaul and customer demand

Stadium Small Cells/DAS solutions

Today our small cell deployment is all about providing infill coverage and capacity to meet our customers voice and predominantly data needs that support them in their moment that matter



Twickenham
485 Mbps



Wembley
200 Mbps

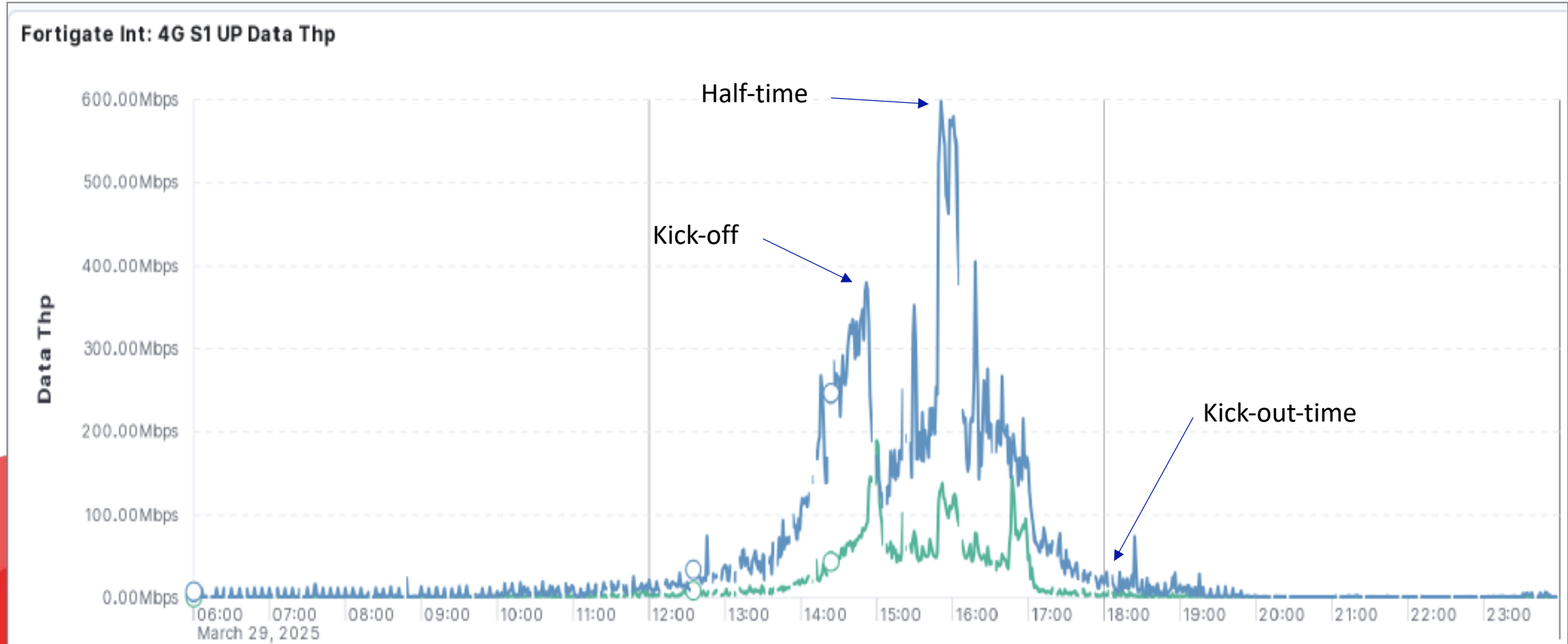


Sunderland
750 Mbps

Stadiums are key moments that matter for our customers and crucial focus areas for VMO2

Stadium Small Cells/DAS solutions

Traffic profile from inside a Premiership Stadium



Home/Enterprise Small Cells

Home and enterprise small cells feature heavily in the network



Over 50,000 3G Boostboxes deployed.
Now being retired as part of 3G Switch off Mainly
delivered for voice coverage



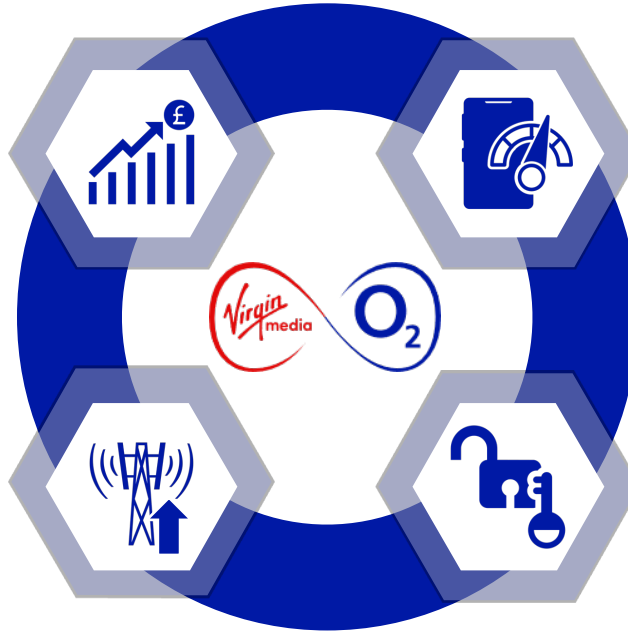
Replacement Femto product for Enterprises
4G and 5G capable units
CaaS (Connectivity as a Service)

3G Femto now end of life with Wi-Fi/VoWi-Fi targeted for consumer solution

Using 5G Small Cells to enhance network experience for customers in their Moments that Matter

We have a **clear strategy and plan** to significantly upgrade VMO2's 5G mobile network over the next 3 years

We have **increased network investment** through our £700m Mobile Transformation Programme and we are already seeing **significant positive results**



We are **refreshing our RAN equipment** across our full Macro and small cell grid to **future-proof the network** and ensure it's **5G / 5G Advance Ready**

Building upon our pioneering work in this area we are using **small cells** to surgically target coverage and capacity hotspots in the network to deliver **reliable service** for our customer in their **moments that matter**.

We're building a 5G network fit for the future

Thank you

