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From patchy to powerful: Creating a regulatory framework for high-quality universal mobile coverage that unlocks growth across the UK.

A policy paper by the University of Surrey's 5G/6G Innovation Centre.

The views expressed are solely those of the University of Surrey's 5G/6GIC.

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1.

Introduction

The UK has fallen well short of its original 5G ambitions. There is insufficient 'quality' mobile coverage. Experts at the University of Surrey's 5G/6G Innovation Centre have analysed the role of mobile regulation in this coverage shortfall. The finding is a significant 'pro-investment deficit' in the UK's current ageing mobile regulatory framework. A relatively simple piece of legislation could put this right. It would deliver the better performing 5G and later 6G mobile infrastructure needed for a flourishing digital economy in every part of the UK.



2.

Executive Summary

The UK has never managed to get the very basics of *universal* mobile connectivity perfected. Today it is falling behind in adding enough data capacity where it is needed. 5G technology, operating in wide radio channels, was intended to deliver this extra capacity at scale. This wide channel 5G would allow many more people to do what only a comparatively few could do simultaneously on 4G and do so consistently whilst on the move.

In addition, the huge numbers of gaps in basic coverage along many road and rail links could also be addressed. In 2015 the government set an ambition for the UK to be a global leader in 5G. However, all the drivers of deploying wide-channel 5G coverage at scale failed. Research reveals that the legislation in 2003, to set up the independent regulator Ofcom, lacked a principal duty towards the quality of universal coverage to counterbalance the short-term priority for lower prices. The result has been insufficient pro investment conditions, and this frustrated the government's laudable 5G ambition.

The next mobile network upgrade will be 6G and, as with 5G, it is likely to come with several options. The one that raises the quality of *universal* mobile coverage (the minimum quality everywhere) we know now would enable the UK's economic growth. But the investment challenges are likely to be greater than the technology ones and these are most impacted by the regulatory framework.

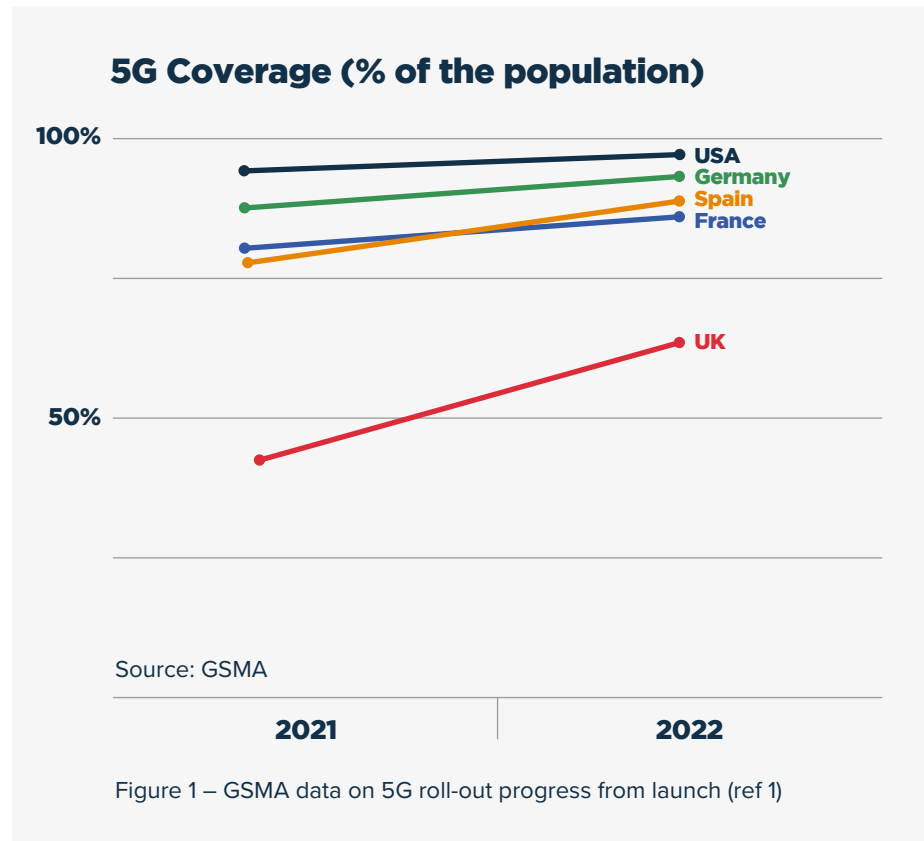
Rebalancing the mobile regulatory framework needs somebody to take ownership of the quality of universal mobile coverage. This role could sit in a government agency, in an independent infrastructure commission or in Ofcom. The right choice would be with Ofcom. Its independence provides stability, it has the expertise, and allows the conflicting demands between low prices (which remain especially important) and investment to be optimised. Investment levels can be kept affordable by spreading the improvements over 20 years. Primary legislation is needed to make this a principal duty for Ofcom to empower governments to set long-term goals that get delivered.



3.

Why wide channel 5G coverage is falling short

Figure 1 illustrates the UK's performance in rolling out 5G at scale relative to a number of countries one might benchmark the UK against.



To find the reasons for this underperformance we need to examine all of the potential drivers of wide channel 5G coverage. These are listed below.

1. *MNO capacity to step-up investment had been overly depleted.* The regulatory model in place for over 20 years has been too financially extractive. Added onto this has been the financial burden from the high-risk vendor decision.
2. *“Infrastructure” competition proved ineffective.* Allowing infrastructure sharing 10 years ago diminished the competitive drive.
3. *There was no 5G coverage obligation imposed by Ofcom.* 5G is the first mobile generation with no accompanying coverage obligation.
4. *5G lacked a compelling consumer proposition.* The shift from video down-loading to streaming shrunk demand for higher 5G data speeds. What now matters to consumers is capacity and not data speed.
5. *Spectrum policy was “financially extractive” and not “investment enabling.”* Ofcom spectrum auctions and pricing have been in cash and not in kind.
6. *There has been no government subsidy to extend wide channel 5G coverage.* The government is investing £500m in the rollout of a very low specification narrow-channel 4G Shared Rural Network. Over the same time, Ofcom will have extracted around £4.5 billion in auction and annual spectrum fees. The net public subsidy over this period is set to be minus £4 billion.

While no single item in the above list will come as any surprise, the new insight is the simultaneous failure of all of them *and where nobody is accountable for this overall result.*



4.

Origin of the current mobile regulatory framework shortcoming

Twenty years ago, when the 2003 Communications Act was drafted, nobody anticipated the huge economic disruption that would follow the emergence of the iPhone in 2007. Lawmakers focus was primarily on the immediate consumer interest, and it was assumed that 3G technology would suffice:

- In scope was promoting competition and furthering the interest of consumers (e.g., low prices)
- Out of scope was the periodic modernisation of the national mobile infrastructures to support future needs.

Investment shortcomings in the mobile infrastructure can be seen against a broader context of underinvestment across other regulated utility sectors. However, the distinguishing feature of mobile networks lies in the rapid pace of technological change and where the current regulatory framework is holding the UK behind the curve.

5.

Resulting legacy of a poor quality of universal mobile coverage across the UK

Nearly 40 years since the first cellular mobile call:

- Basic connectivity is not yet everywhere, with many gaps on transport routes and “not spots”.
- The Shared Rural Network has a poor “universal speed” spec (90% probability of 2 Mb/s down and zero up) and many lengths of rural roads have no mobile coverage.
- A population greater than the size of Denmark or Ireland is being left ever further behind in their quality of mobile coverage (the new digital divide).
- Much of the country depends upon “narrow channel” 4G or 5G, where the data capacity is wafer thin to meet rising data demand for on-the-move use that can drive economic growth.*
- Wide-channel 5G, on its current trajectory, will only ever eventually bring capacity relief to less than a third of the UK (see Annex 1) and it could be as low as 20% for some MNOs.

6.

The economic case for better quality universal mobile coverage

There are two economic payback thresholds to consider. First is whether the benefits would justify the effort to pass legislation to rebalance the regulatory framework towards investment. The second is the level of economic benefits that would be essential to justify a particular level of new investment.

The first threshold is readily met. A study commissioned by the government (ref 2) produced numbers as high as £159 billion for the cumulative economic benefit of 5G over the period 2021-35. Since 5G cannot benefit what it does not cover, it would only need a few per cent increase in coverage to more than justify legislative effort.

There is also strong anecdotal evidence of productivity gains from

mobiles. The first mobile phones cost £2000 (£6000 in today's money). The surprise was that early customers were not just millionaires but plumbers, electricians and carpenters. It became clear that the smaller the enterprise the more personal productivity gated economic output. Today's smartphones outperform the early mobile telephones in potential productivity gains and the gains will increase again with online access to AI.

The second threshold is much higher. It requires a piece of important economic research to set the right investment levels and priorities. This research warrants early funding. The research is also needed to set an affordable goal for the quality of universal mobile coverage. An ideal would be a guaranteed minimum of 10-20 Mb/s *everywhere*.





The Government's Science and Technology Framework calls, among other things, for regulation to be pro-investment in critical technology areas. This has not been the case for successive technology upgrades of the UK's mobile infrastructures. Now is the time to turn this aspiration into action:

- 1.** The “pro-investment” deficit in the current regulatory framework can be put right with legislation that adds a new “principal duty” on Ofcom to secure the universal quality of mobile coverage goals set by the Government. Ofcom can only act effectively in this way against the pressure of its other principal duties, if Parliament has given it also as a principal duty.
- 2.** This would lead to a more optimal balance of priority between keeping prices low for consumers, making additional investment attractive to industry, and minimising the level of taxpayer subsidy needed to meet the Government's goals. Ofcom has the independence and stability to optimally balancing these priorities over the next 20 years.
- 3.** This would unlock the possibility of a far more ambitious universal mobile quality of coverage standard for the UK ie the very minimum that everyone gets everywhere. More research and economic study is needed to set a final “universal” figure but an ideal place to start would be a 100% guaranteed gap-free minimum of 10 Mb/s for all concurrent users along every road and rail link to every corner of the UK - a significant advance on the current 90% probability of a minimum of 2 Mb/s for only a single user and with massive numbers of gaps over most of the country).

Such a pro-investment regulatory framework would take the brakes off significantly expanding wide channel 5G coverage and open the exciting prospect for the UK of a new 6G era Network of Networks technology (convergence of cellular, satellite and WiFi), driven by an innovative pro-investment mobile regulatory framework and delivering highly reliable high quality mobile coverage over every part of the UK – a key enabler for a flourishing national digital economy.

About the 5G/6G Innovation Centre

The University of Surrey's 5G/6G Innovation Centre brings together leading academics and key industry partners in a shared vision to help define and develop the 5G/6G infrastructure.

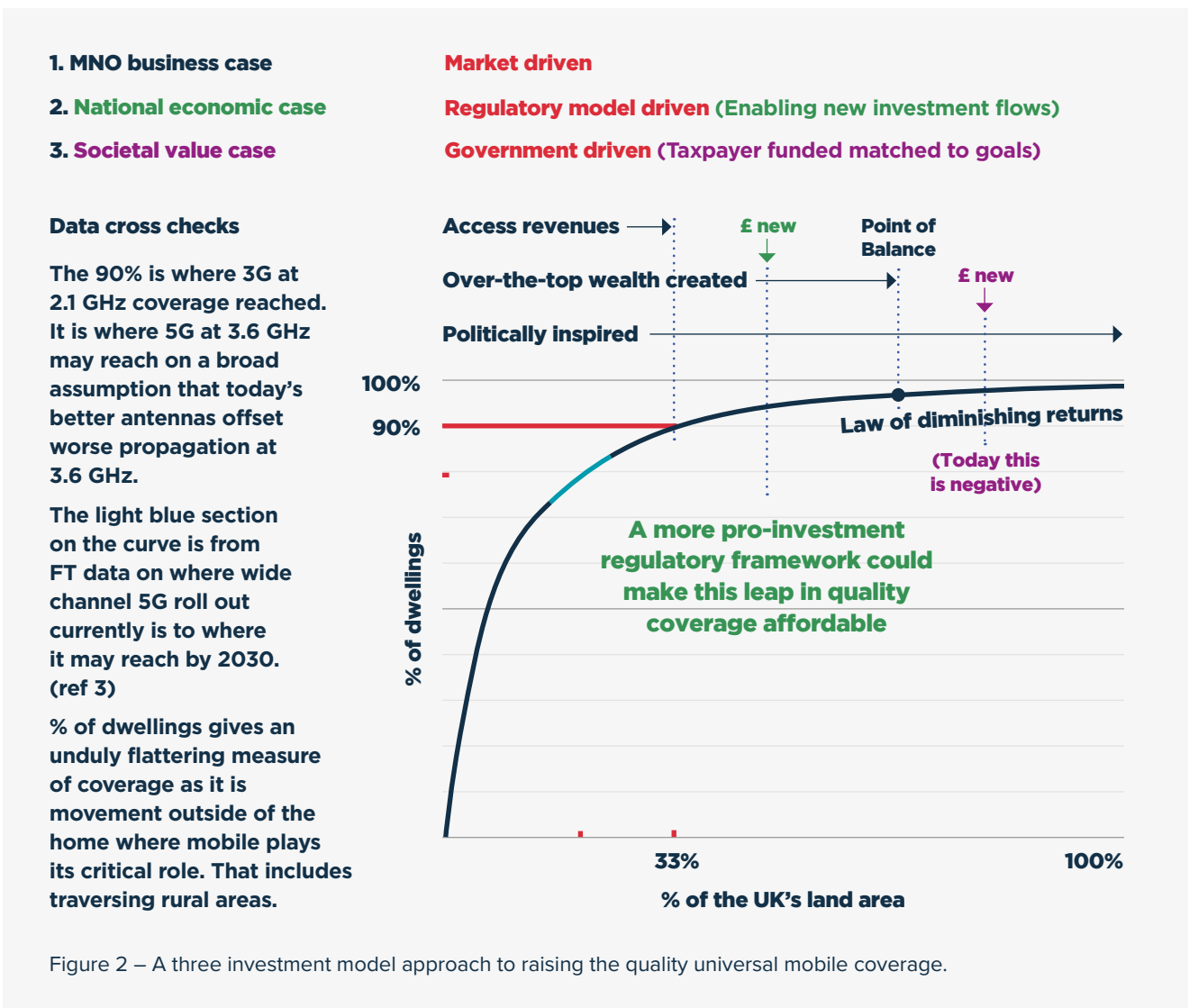
ANNEX 1

A more in-depth look at the missing investment in the “national economic case”

“Coverage” is the very essence of the national mobile service promise – connectivity wherever and whenever a consumer needs it. A mobile showing it is in coverage is no longer sufficient. Today “Quality of coverage” is also essential, which means sufficient data capacity at that location to meet all concurrent demands.

In 1985 the service revenues generated by mobile networks nearly all went to the MNOs. This broadly aligned the optimal coverage to suit the MNOs businesses with the optimal economic outcome for the country. This situation has radically changed with the rise of the smartphone and a digital economy across the Internet. The mobile element of all this new economic value travels “over-the-top” of mobile networks and none can be captured in the MNOs business investment cases. Thus the optimal coverage to suit the MNOs investment cases falls short of the optimal coverage that would maximise the economic (and societal) benefits to the country. “Regulation” has simply not kept up with this radical economic transformation.

This gap can be explained in more detail once the graph in figure 2 is understood.



The graph illustrates the UK demographics challenge facing mobile network planners. The 0%,0% point on the graph is the densest of dense urban areas. The 100%,100% point is the most remote of remote rural areas. The steep part of the curve secures the greatest traffic with the least investment in coverage. One tall tower on a high spot in London will quickly be loaded with traffic 24x7. Conversely, the part of the curve labelled “the law of diminishing returns” is where evermore towers are picking up ever less traffic. Towers in the most remote areas may only get traffic from occasional ramblers.

The universal coverage curve has been divided into three categories representing the very different investment conditions:

1. “The MNO business investment case.” The optimal commercial roll out of wide-channel 5G by the mobile network operators, reflecting the access fees they collect, will only be up to the bend in the curve that broadly equates to where 90% of the population live. Much beyond this and the extra cost of coverage will never be recovered by extra access fees.
2. “The national economic investment case.” When the economic value to the country of all the “over the top” services is added into the business case it would justify significantly more geographic coverage. The new regulatory challenge is how to transform the economics of this additional coverage that makes it a viable investment proposition.
3. “The societal value case.” A point will be reached along the part of the curve labelled “the law of diminishing returns,” where no further coverage can be justified purely on economic grounds. But there may be political reasons to complete the universal coverage, such as digital inclusion, that warrants a public subsidy.

How to make the national economic investment case affordable

The almost sole solution over of the past 20 years to stretching coverage beyond what is optimal for the MNO investment case has been to load the cost onto the MNOs. Intense competition has ensured none of the burden falls on consumers. Spectrum policy has more than driven out the taxpayer subsidy. Section 2 has shown that this imbalanced approach has passed its breaking point. The core problem is “optimising” between conflicting policy objectives of keeping consumer prices low enough for all, affordability of new investment to the industry and least burden on the taxpayer (the Government setting that limit). Political processes rarely deliver optimal outcomes and certainly ones that last over the life of an infrastructure. Ofcom, with its independence and stability, is therefore better situated to seek more optimal outcomes but they must be given the mandate with the appropriate legal basis, powers and resources to do the job. This more pro-investment framework then needs to be energised with economically transformative regulatory innovations that might include:

- A refreshed version of the market expansion model set out by DCMS in 2018;
- Innovations that allow integration of public and privately provided coverage to mutual benefit (including indoor coverage in key buildings);
- Innovative spectrum management on the principle of “public spectrum for public good”;
- Ever more advanced spectrum sharing (where Ofcom is already on the case)
- Reducing the cost of coverage e.g., granting free aerial attachment rights to public and utility infrastructures in rural areas.

These are just examples. Once Ofcom officials have better quality of universal mobile coverage as a new principal duty, they will come view every daily decision through the prism of how it contributes to their new principal duty (as they have been successfully doing with their existing duty to further the interest of consumers).

A long-term planning framework of 20 years would allow the country to get itself on a path of significant incremental gains in the quality of universal mobile coverage without needing a significant public subsidy. This makes it a ready component part of a national economic growth strategy. It will build a powerful new mobile infrastructure capability to add on top of the stretching ambitions set out in the government’s recent wireless infrastructure strategy.

ANNEX 2

Our 6G vision

Our vision is to set an ambition to enable a world where everything is provided wirelessly to the end device by a fixed and mobile (converged) infrastructure that functions across the whole geography.

The 5G/6G vision includes:

- Indoors and outdoors
- Dense urban centres with capacity challenges
- Sparse rural locations where coverage is the main challenge
- Places with existing infrastructure, and areas where there is none.

In our view 5G/6G infrastructure should be far more demand/user/device centric with the agility to marshal network/spectrum resources to deliver “always sufficient” data rate and low latency to give the users the perception of infinite capacity. This offers a route to much higher-performing networks and a far more predictable quality of experience that is essential for an infrastructure that is to support an expanding digital economy and connected society.



REFERENCES

- Reference 1:** Years 2021 and 2022 from GSMA Mobile Connectivity Index and for the 5G rollout of the five countries shown.
- Reference 2:** Realising the Benefits of 5G (publishing.service.gov.uk).
- Reference 3:** FT Lex June 14, 2023, quotes figures of 5G coverage moving from 73% and 82% of the population.



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