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Neutral Hosting as a Rural Mobile Network Solution

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***Abstract*—Rural mobile phone coverage has become an increasing priority for users and mobile network operators, as well as in all levels of government. With the roll-out of 5G networks set to do little to improve coverage in rural areas, alternative models of service provision need to be explored in rural areas as a matter of priority as plans to deprecate of 2G and 3G mobile networks in the UK and other countries are formed, or indeed executed. This session outlines the key challenges posed in delivery of rural mobile network coverage, and how active infrastructure sharing (commonly known as neutral hosting), combined with working with local communities, can deliver solutions to rural connectivity.**

I. Introduction

The UK mobile telecommunications market presents an interesting case study around rural mobile deployment challenges – it has a challenging geography and significant distances to outlying communities, with low population densities, as well as a range of isolated individual premises, often in mountainous terrain. The market has four incumbent mobile network operators (MNOs), one of which (Hutchison 3) was a new-entrant in the 3G auction. Another (EE) came about as a result of the merger of two predecessor MNOs (T-Mobile and Orange).

There are two mast-sharing joint ventures - O2 and Vodafone hold a joint venture called CTIL, Cornerstone Telecommunications Infrastructure Limited; and EE and 3 have a joint venture called MBNL, Mobile Broadband Network Limited. O2 and Vodafone make use of active RAN sharing in around 75% of sites (i.e. non-urban sites), and have “autonomy” on around 25% of sites, in 23 of the UK’s larger cities [1]. In contrast, MBNL’s network sharing arrangement is active for the 3G network, but passive for the 4G network [2]

In the UK, a Shared Rural Network (SRN) venture is being co-funded by Government and the mobile industry [3]. One of the options that this is exploring is neutral hosting [4], since there is often no economic case for the delivery of 4 parallel sets of equipment.

II. Economics of Rural Deployments

The UK Government funded the Mobile Infrastructure Project (MIP) from 2011 to 2016 [5], which delivered 75 mobile masts for £35.81m. This provides a baseline cost for a mobile site of £0.47m per site, on average. These 75 masts delivered connectivity to 7,199 premises that had previously lacked coverage, which equates to 10,576 residents. DCMS’ analysis estimated that 63 of the 75 sites built were not commercially viable to be built by operators, as they would cost more to build (pre premises) than the realistic profit over a 20 year investment cycle (£1000 per premises).

Rural network deployments are therefore commercially challenging, since it will generally be significantly easier to see a return on investment for infrastructure in a town or city, with higher population density, than it will in a rural environment. On average, across the overall MIP programme, each mast site served under 100 premises. With the relatively high build costs of reaching each site with power and backhaul, this demonstrates the commercial challenge in providing 4G connectivity to homes in rural environments.

In Scotland, a separate 4G infill programme [6] has found limited appetite for uptake of sites, even where the capital costs are covered by Government subsidy. 24 candidate sites have been removed from the programme, the majority of which were removed due to a lack of interest from operators, who would need to provide a service and cover the operating costs of the sites. This highlights how, even with capital investment covered, the operating costs of mobile sites are still significant, and can prove a barrier to service delivery.

III. Spectrum

Both of the above interventions were 4G (or combined 4G and earlier technology) interventions. We have yet to see a 5G-driven intervention, however various factors are likely to make it more difficult to deliver a 5G service. From a technical point of view, it may be argued that any 3GPP Release 15 (or beyond) service is 5G, however this is likely to be a stretch if sufficient spectrum is not available to deliver services meeting the IMT-2020 definition. While many of the requirements from IMT-2020 are focused on the technology, rather than on a specific implementation of it, meeting the 4ms and 1ms targets (for eMBB and URLLC respectively) is likely to prove difficult without use of higher frequency spectrum, giving access to greater throughputs, and supporting larger numbers of users.

Were ”5G” to be delivered using the same spectrum as in 4G, without the pioneer mid-3 GHz band spectrum, 5G services will be unable to deliver significantly enhanced performance to end-users, and they will be unlikely to see the benefits of it. The performance benefits for a user of 5G, at least to date, are likely to come about through the greater throughput available to users. This comes about from access to greater quantities of spectrum.

As higher frequencies are used, propagation distances reduce. This means that in a rural environment, with undulating landscape, it is more challenging to reach devices, and the effective radius of a cell will, absent other action, reduce. This worsens the commercial case for rural 5G deployment.

One way that this can be addressed is through the use of supplementary uplink (SUL), to harvest existing 4G FDD spectrum, and use the uplink channels of these bands as dedicated uplink spectrum for handsets to communicate with the network - given the lower power output of handsets relative to base stations, this helps to avoid the need to increase the density of underlying cells [7].

This, however, effectively defers the reality of delivery of 5G services to rural areas – it will cost more per capita to deliver the same service than it will in an urban environment. To deliver eMBB services, it will require densification of cells in areas where cell density is already unable to deliver a commercially viable service using existing 4G network technology.

IV. Neutral Hosting as an Option

Neutral hosting presents a possible solution to the challenging economics of rural deployments — by sharing the costs of deployment between operators, and by reducing the quantity of equipment to be installed on a mobile site, both capital and operating costs can be reduced. A neutral host cell site could provide a service on behalf of up to 6 operators, without the user experience impact that would be presented by national roaming. By sharing both capital and operating costs among operators, it will become more feasible to deliver services into currently unserved locations. The SRN project has started this process, but it will not deliver coverage to everyone — Scotland in particular will see 4G coverage rise from 42% to 74%, but this will still leave a quarter of the country without coverage.

Local authorities have good visibility of the reality of coverage in their local area, as they already manage information about connectivity for Building Digital UK (BDUK) and other publicly funded connectivity intervention programmes. They are also able to work with local communities to gain access to infrastructure that can assist with deploying sites, and may be able to work with local independent internet service providers to have fibre laid to mast sites at costs lower than national fibre providers. The 5G RuralDorset project is Government-funded example of this, where a local authority (Dorset Council) is working closely with a consortium of industry, academia and other public sector bodies to demonstrate that the problem of poor connectivity is a local one, where local knowledge can help to deliver economically viable solutions.

The Shared Rural Network, while a good start, simply does not aim to deliver parity between rural and urban areas — it is a 4G-only network [8] at a time when 5G is being deployed in much of the world. At this stage, it is not clear that neutral hosting will be required of operators [4], merely that Mobile UK are "open to all options". The programme appears to be designed to be a single national roll-out, rather than take the opportunity to work with local communities to deliver solutions in their own areas, which might include active neutral hosting.

Facilitating local deployments of neutral-hosted base stations, coupled with Ofcom's recent shared access [9] and local access licence [10] regimes would make it possible for communities to address their own mobile coverage blackspots on a local basis, rather than relying on a national-level intervention. The SRN programme shows that infrastructure sharing can be delivered in a commercially viable way, but it is important to ensure that local communities are able to be a part of the solution, rather than allowing operators to determine where connectivity will be provided. Specific generations of technology should also not be put "off-limits", in order to avoid rural communities perpetually sitting one generation behind urban areas – a shared network should be deployed as a 5G network, with fallback support for 4G, rather than as a 4G-only network.

V. Conclusion

The economics of rural connectivity are challenging, as has been demonstrated by a number of public-funded connectivity interventions. Active neutral hosting technology, where radios are shared between operators, presents a solution to some of these commercial challenges - capital and operating costs can be shared between multiple operators. The Shared Rural Network programme has not committed to delivery of neutral hosted sites, and past interventions have showed that many rural cell sites (like those from the Mobile Infrastructure Project) are not generally commercially viable to deliver. Many will not see an improved service from SRN, and there will still be significant land-mass unserved. It is important to develop sustainable solutions and work with local communities, to ensure their connectivity needs are met. Sharing of radio infrastructure through neutral hosting is one way to achieve this, as is working with local communities to reduce costs of backhaul through direct-buried fibre.

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