SHEDDING LIGHT ON 5G POLICY

In part two of his discussion of the 'myth of 5G', **WILLIAM WEBB** examines regulatory factors, spectrum issues and whether fixed-wireless access will be more than a promise – plus scenarios for the next few years

There are wider factors shaping the future communications environment than just the mobile manufacturers and operators. The environment that they exist in is increasingly shaped by regulatory policy that controls mergers, obligations, prices and competition to varying degrees. And as I discussed in the first part of this article (*Intermedia,* April 2017), there is a strong alternative to cellular communications in Wi-Fi and commercial broadband. Fixed connections are a core part of our communications environment – it has been said that every connection is a mix of wired and wireless – the only variation is where the wires stop. So, for cellular, there is typically a wired connection from the core network to the base station, then wireless after that. Wi-Fi is wired to the router and wireless for the last few metres. As cells get smaller, the wired element gets larger and the wireless smaller.

TOO MUCH COMPETITION

The world of cellular communications is highly regulated. Access to a key input, spectrum, is controlled by regulators around the world such as the US FCC and the UK's Ofcom. They often place conditions on licence awards to bring about outcomes such as increased competition or improved coverage. As mobile communications has become part of the critical national infrastructure, regulators and governments have placed increasing pressure on mobile operators to deliver reliability. Equally, governments are keen to see new services roll out in their country and encourage operators to deploy the latest generation of mobile technology via early licence awards, exhortations and in some cases specific policies.

For many regulators, the most important factor is competition, for example with Sharon White, the chief executive of Ofcom saying: *"Competition is the lifeblood of today's telecoms market, spurring innovation, better coverage and fair prices. Just as President Hoover observed: 'Competition is not only the basis of protection to the consumer, but is the incentive to progress.'"*

Regulators believe that competition is a fundamental good in the industry as it results in innovation, lower consumer prices and enables regulators to take a light-touch approach to controlling the sector. (Conversely, for fixed line communications, where there is rarely effective competition, regulators often take a very interventionist approach, setting prices, controlling company structures, and influencing

investment strategy.) I won't discuss here whether this focus on competition is appropriate, but note its impacts:

● **Mergers are generally prevented.** Any mergers reduce the number of mobile operators, which would appear likely to lessen competitive pressures (although there is evidence to the contrary from Austria and elsewhere). For that reason, in most countries, attempts by operators to merge are declined by competition authorities. For example, in 2016 in the UK, Three attempted to merge with O2 (owned by Telefónica). The merger was referred to the European Commission (EC). In the meantime, Ofcom and the UK's Competition and Markets Authority both issued statements saying they did not support the merger. The EC eventually decided to block the request on grounds of reducing competition. Those in the industry feel that most mergers within a country will be impossible for the foreseeable future.

● **Fully shared networks are discouraged.** (Although partial sharing is encouraged.) Broadly, regulators would prefer that mobile operators all have their own networks. This maximises competition. However, it has been recognised that the economics of four or more nationwide networks are increasingly difficult to support and most regulators allow, or even encourage, a degree of network sharing where operators can share masts and associated elements such as power and backhaul. Most regulators draw the line at sharing spectrum, insisting that each operator only transmits in its allocated spectrum and does not provide transmission services for others.

Regulators fear that if full sharing were allowed this would open the door to a single network operated by a third party on behalf of all the operators, with the resulting loss of competition. However, there are elements of 5G, such as the proposal for dense millimetre deployments, that would only appear viable if full sharing were possible. Rural coverage would also benefit from full sharing (or national roaming). This is a position that may be more amenable to change as the economics of 5G become clearer.

● **Innovation in business models is constrained.** While regulators often target innovation in technology, trying to ensure that they pave the way to the next generation, they often inadvertently block innovation in business models through their concern about reduced competition or the impact on the consumer. This can happen via outdated regulation such as requirements to maintain emergency call capability, or via other concerns such as net neutrality. When such issues become apparent, regulators will often address them, but the regulatory process is slow. It can take many years to address the issues, by which time more nimble competitors may have delivered an alternative over the top (OTT) player, or by Wi-Fi.

● **Sector profitability is reduced.** Competition directly reduces profitability. In addition, regulators have placed further pressure on revenues with initiatives such as restrictions on roaming tariffs (in the EU), coverage obligations and other regulatory burdens. When the industry was highly profitable, such interventions could be borne by mobile operators. But with profitability reduced, further milking of the sector reduces the scope for investment. There is always a trade-off between delivering the lowest prices for consumers and enabling risky investment in future networks. If there is a need for the mobile operators to make significant infrastructure investments then it may be that the balance has shifted too far towards short-term consumer benefits.

> **Unsurprisingly, regulators tend to spend a large part of their time on the mobile sector.**

So regulators tend to spend a large part of their time on the mobile sector. This is unsurprising given the size and importance of the sector, but may be inappropriate in a Wi-Fi first world. For example, large teams consider clearance and auction of spectrum for the next generation of mobile, whereas the spectrum used by Wi-Fi gets much less focus. This will benefit 5G at the expense of other solutions by ensuring that it gains the spectrum it needs; it has resulted in competitive positioning between regulators keen to be the first to provide 5G spectrum in their country to deliver a commercial advantage to their manufacturers and operators. This is most apparent in the FCC's move in 2016 to open up 28 GHz for millimetre wave access in the US (see box below).

There is little to suggest to regulators that they should change their current position. The impression painted by the mobile industry is that 5G is in robust good health and that mobile operators are keen to deploy it as soon as possible. Although the picture is very confused, most expect 5G to be delivered in just the same way as previous generations – via mobile operators upgrading their networks encouraged by competitive pressure. But had the industry painted a picture of a more

MILLIMETRE WAVE: US MOVES AHEAD

There are many difficulties with millimetre wave, including the need to focus industry effort on cost reduction and innovation in radio components working at these frequencies. This would best be achieved with global agreement on a preferred frequency band. Such agreement often takes time and diplomacy, as countries have differing legacy uses, and time and studies are needed to understand the impact of changing allocations. It is not unusual for a new band to take five or more years to reach global agreement.

Debate had started on the optimal millimetre wave band but before consensus could be reached the US decided to unilaterally move ahead with 28 GHz – a band that suited its current use of spectrum and has also found some favour in early research activities. However, this band is highly problematic elsewhere, being used for satellites, and a change of frequency is impossible once a satellite is launched. It remains to be seen whether other countries will eventually feel that they have to follow the US lead, or whether there will be an alternative band suggested in other parts of the world. Regardless, this fragmentation is deeply unhelpful for 5G millimetre evolution.

difficult introduction of 5G it would have paved the way for discussions with regulators on how to ease competition and overcome issues such as planning permission. Talking up 5G has made it harder to introduce.

In summary, the industry is likely to have an inflexible structure as it enters the 2020s and the period when 5G might be deployed. Without a reduction in competition, mobile operators' finances will remain weak and their ability to use novel approaches, such as shared networks, limited.

UNCLEAR SPECTRUM

All new generations of cellular technology have had new spectrum associated with them. For 2G it was frequency bands at 900 MHz, for 3G at 2.1 GHz and for 4G at 800 MHz. Some have noted that 3G was an unsuccessful generation in that mobile operators probably failed to make returns on their 3G investments, and this may be in part because of its high frequency that required many more base stations with associated cost. Conversely, 4G returned to a lower frequency band, enabling the economics to work better.

For 5G the frequency bands to be used are far less clear but in so much as there is a trend it is towards 3.4–4.2 GHz and millimetre wave bands at 24–30 GHz. In addition, in some countries the 700 MHz band is assumed to be for 5G. (However, this has already been auctioned in the US, Australia and elsewhere and the total bandwidth of around 100 MHz means that if divided among, say, four operators, they would each have 2x10 MHz, with the remainder used for guard bands. Many already have similar amounts both at 800 and 900 MHz so it is hard to see how this could make any material difference.) The main 5G trends are clearly all well above the 2.1 GHz that caused problems for 3G and would result in much reduced coverage of 5G compared with existing generations.

However, the linking of generations to frequency bands is now less strong; 4G is being deployed into previous 2G and 3G bands and it may be that 5G is likewise used in frequencies already owned by operators. But many operators are in the process of refarming their 2G and 3G technologies to 4G. They would be disinclined to rapidly refarm these to 5G, preferring to leave 4G in the bands for many years, perhaps even a decade, to gain a good return on their investment.

As a result, the spectrum position is not a good one for 5G. There is a lack of consensus globally on 5G spectrum allocations, leading to fragmented economies of scale and slow introduction of equipment and devices. The spectrum identified is at relatively high frequencies making extensive coverage unlikely. Refarming of existing holdings is possible but operators will be disinclined to do this, and it may take many years before 5G equipment is available across the 40 or more frequency bands used around the world by the mobile operators.

So the cellular spectrum position is far from ideal for 5G and will slow deployment and tend to restrict it to urban areas. But spectrum for the internet of things (IoT) and for Wi-Fi is available now.

REGIONAL DIFFERENCES

The approach to 5G is not homogeneous around the world. While the same technology would be adopted, and the same services likely to be used, governments and regulators often have very different approaches. Also, larger countries such as the US and China have sufficient economies of scale that they can pursue national frequency bands and slight local variations.

Clearly, the US is biased towards the support of innovation while Europe is more focused on harmonisation and the establishment of test-beds. Historically, the US approach has been more successful in fostering companies such as Qualcomm and the relatively early deployment of new technology. However, it is unclear whether this will hold true in a more uncertain future.

Some Asia-Pacific countries such as China and Korea tend to have a more interventionist approach, where governments seek to ensure advantages for their local manufacturers. This can be seen in the desire for early deployments in South Korea and industrial plans in China, Korea and Japan. Operators in these countries are more likely to deploy 5G early to meet government expectations, even if they do not expect it to be profitable.

None of these differences change the underlying problems with 5G. However, they do change the likelihood of operators deploying some 5G elements at an early stage – for example early millimetre wave test-beds in the Asia-Pacific region.

FIXED-WIRELESS ACCESS: HAS ITS TIME COME?

With the advent of almost every new wireless technology, someone suggests that it can, finally, realise the vision of fixed-wireless access (FWA) – the idea of using wireless to provide a broadband pipe to the home rather than copper or fibre. It is no surprise that 5G has prompted some to suggest it is the answer to FWA – in particular Verizon in the US is a supporter and manufacturers such as Nokia see it as a key 5G use case. Will 5G finally crack the FWA conundrum?

> **The US is biased towards innovation while Europe is more focused on harmonisation.**

It is worth reminding ourselves of history. FWA really came to the fore around 1996 as GSM achieved data rates as fast as the then best fixed line speeds. High profile launches included Ionica in the UK, exploiting a purpose-built technology from Nortel. But by 2000 all had failed. The costs of FWA deployment in the real world proved much higher than expected and the telecoms providers reacted by upgrading their fixed lines and reducing their prices. Since then there have been many attempts such as Clearwire (2.5 GHz WiMAX), Verizon HomeFusion (LTE), and PCCW UK Broadband (3.5 GHz WiMAX). All failed to gain significant numbers of subscribers.

There have also been attempts to use frequency bands above 20 GHz – Radiant in the UK pioneered mechanically steerable antennas that could form a mesh but deployment proved harder than

It is in rural areas where the problems of connectivity are most acute and the demand for alternatives highest.

anticipated. Motorola had a solution based in the LMDS bands but again that proved too expensive.

Has anything changed since then? Data rate expectations to the home have steadily increased as have data volumes, providing a moving target that wireless is struggling to keep up with. Wired home broadband services that deliver in excess of 50 Mbits/s and provide more than 50 GB/month are now commonplace in developed countries and with new systems such as G.fast, data rates are likely to continue to grow for the coming decade. Prices have been constant despite the ever-improving service, making the economics more challenging.

Does 5G bring anything new to the table? FWA may have a millimetre wave component with beam-forming antennas and the capability to deliver data rates in excess of 100 Mbps. This, in principle, makes it competitive with wired connections on data rates. But it will have limited range – typically 100m or so, although with directional antennas on both ends of the link and line-of-sight propagation then 500m might be viable, as long as it is not raining heavily. The short range was why Radiant went for a mesh solution, with connectivity bouncing from house to house. If 5G is widely deployed, then economies of scale might also reduce equipment cost. Beyond that, there is little new.

The problem with short range is that it means the system is best suited for urban and suburban areas. In rural areas, house density is too low for there to be more than one or two homes per base station, making the system uneconomic. But it is in rural areas where the problems of connectivity are most acute and the demand for alternatives highest. Rural areas are often best served by wireless in the lowest frequency bands, which have long range – one of the reasons TV white spaces were seen as a possible game changer for FWA in rural areas (and is being deployed in the US).

In urban and suburban areas wired connectivity is often already good, so the wireless solution has to compete on price or on data rate, or both. Urban areas are often so cluttered that line-of-sight is problematic for many homes within the nominal coverage radius of a base station, and base station locations are hard to come by because the best have already been taken by mobile operators. Suburbia might be a suitable compromise location but the competition issues still exist.

The economics of FWA are harsh. A base station costs around $20k – more if the antenna array is expensive – and another $20k to deploy. Site rental and backhaul costs can easily be $10k/year. Home installation is typically another $300 for the equipment and $200 to install and align rooftop antennas. On top of that is marketing which needs to be substantive to persuade homeowners to switch provider, perhaps adding $200-400 to customer acquisition costs. Suburban density in the US is around 1,000 people/km^2, or perhaps 400 homes/km^2. With a coverage range of 500m, a base station covers around 75%, or 300 homes. If 10% could be persuaded to switch, and were able to be connected, then there would be just 30 homes per base station.

Interestingly, outside of the US, broadband packages are around $40/month but in the US prices can reach $100/month. This suggests that either there is an opening in the US for FWA that does not exist elsewhere or that competitive forces have yet to reduce US broadband costs to those of the rest of the world. Verizon appears to be betting on the former in its desire to roll out a millimetre wave FWA solution based on its own specifications that it is claiming is 5G. It is using 37 GHz – yet another different frequency band – for deployment, which could also add confusion and fragmentation.

CONCLUSION

Regulatory forces and governmental policy have an impact on the mobile sector and the form and timing of the introduction of 5G. While regulators profess a strong desire to promote innovation and new technologies, in practice their focus on competition is likely to undermine the ability of mobile operators to find innovative solutions to the problem of financing 5G deployments. A better regulatory approach would be to allow mergers, deployment of shared networks and the emergence of various OTT and virtual operator models.

But given the impression portrayed by the industry that 5G is thriving and imminent it is unsurprising that regulators see no need to change their current positions – indeed they may conclude they are helping to speed 5G implementation. The net effect will be unhelpful but this will only become apparent over the next few years.

And see next page for some predictions...

WILLIAM WEBB *is CEO of the Weightless SIG, the standards body developing a M2M technology. This article is adapted from his book 'The 5G Myth: And why consistent connectivity is a better future'.*

THE UK AND 5G: AN ENDORSEMENT

In March this year, the UK goverment published a 5G strategy.* My view is it opens the door to start moving towards a more sensible vision for 5G by addressing some of the criticisms I have of the mainstream thinking I've set out in this and my previous article. The strategy has initiatives to improve coverage alongside railways and roads. It looks at ways to make cell planning cheaper, and share infrastructure and spectrum to help wider deployment of networks. It recognises that 4G will evolve for some time and that there is little reason to rush to a new technology.

Most importantly of all it encourages debate about what 5G might be, with a single entity coordinating discussion and a dedicated team within government. It suggests widespread test-beds to understand not just technology but also business cases and deployment models. My hope is that these allow us to discover more about what 5G really needs to be and realign it away from the current vision and towards one that really works for all.

** Next generation mobile technologies: a 5G strategy for the UK. bit.ly/2mY6luo*

WHAT WILL HAPPEN? A LOOK AHEAD...

2017

The realisation dawns that consumers have gradually moved to a Wi-Fi first world. Collecting data on the amount of Wi-Fi usage has always been problematic but apps running in the background on handsets show that over 85% of data from a smartphone is sent via Wi-Fi, mostly in the home and office. With over 80% of all tablets and laptops being Wi-Fi-only this implies well over 95% of all of consumer data is travelling over Wi-Fi, with the percentage growing as Wi-Fi becomes more pervasive and increasingly free.

The first serious Wi-Fi-cellular connectivity model gains ground – Google's Project Fi, which allows subscribers to sign up to Google rather than to a mobile operator. Handsets attempt to connect initially via Wi-Fi but, if not, hand over to a mobile network that has agreements with Google.

Mobile operators mostly ignore the implications. With 5G on the way, IoT emerging, interest in fixed-wireless access (FWA) rekindled by 5G smart antenna systems, and promising partnerships in automotive developing, there is much for them to focus on. Further, their strategy teams are kept busy with merger discussions (which are often blocked by regulators), spectrum auctions, roaming regulations and more. And after all, they are the big players in this space, what do they have to fear from new connectivity models?

2018

Wi-Fi continues to gain, with some governments sponsoring city-wide free deployments, others deploying Wi-Fi in all hospitals, museums, schools, universities and government buildings and making it freely available with a single sign-in needed across all domains, only on the first time of use. Wi-Fi on trains is also more widely deployed.

Google continues the steady growth of Project Fi and availability of its Wi-Fi Assistant. Take-up is slow at first; regulation requiring mobile operators to offer virtual operator access in many countries helps. Governments allow their networks to become part of Wi-Fi Assistant. Not to be outdone, Apple offers an equivalent service for its devices.

Voice over Wi-Fi via WhatsApp and similar grows fast. This is aided by difficulties in voice over LTE/4G implementation.

User satisfaction surveys show an increasing understanding that consistent connectivity rather than speed is most important, with coverage from providers like Google seen as substantially better than through any one mobile operator. Conversely, high speed on cellular is seen as unnecessary, and indeed, after various cases of phone batteries catching fire, manufacturers stop using the most powerful processors that demand high power consumption. Despite this, governments continue to demand their country be well placed in broadband speed league tables.

The cellular community is in poor health but regulators continue to block mergers. The supplier base also suffers, with Ericsson and Nokia announcing losses, and even Huawei seeing a fall in mobile infrastructure sales.

In the world of IoT, the cellular community fails to gain much traction, with narrowband-IoT being slower to appear than expected while agencies for unlicensed technologies finally group together into a standards body to present a unified front.

2019

Cisco's market projections are the first ever to predict that data growth on cellular will be minimal over the coming years. This is based on the observation that data volumes have stopped growing in many markets for reasons including attempts by mobile operators to increase prices, increased offload to Wi-Fi and a degree of saturation of uses for mobile phones. Data growth over Wi-Fi, however, is still predicted to be in the region of 30-40% a year. Alongside some operators, others now enter the market pioneered by Google to provide connectivity across multiple platforms and operators. Amazon launches its offering worldwide as do Facebook and WhatsApp.

With Wi-Fi becoming more pervasive, regulators require Wi-Fi sign-in from business providers. This means that automated sign-in is now widespread. Some regulators also monitor congestion in Wi-Fi spectrum, giving it quasi-licensed status.

There is outcry that regulators are heavily constraining mobile operators but have no equivalent regulation for the connectivity providers, resulting in a situation where the mobile operators are unable to react effectively. Privately, most regulators acknowledge this, but the pace of regulatory change is slow, and few are willing to admit their focus on competition is no longer working.

2020

In the first quarter, for the first time more subscribers sign up to connectivity platform providers than to mobile operators. With declining subscriber numbers, a few major operators start to withdraw from the market. Others move towards a wholesale model, shutting retail stores and reducing customer services. They also withdraw from the IoT market, as they are undercut by unlicensed providers using simpler technologies.

There is little interest in the first 5G auctions for millimetre wave spectrum in the 24 and 28 GHz bands. Work on millimetre wave systems is quietly shelved, even in academia.

It becomes the norm for individuals and households to share their Wi-Fi with the public using a second identity, protected by a firewall. Regulatory guidance in Europe and the US recognises the changed world and suggests that regulators focus on connectivity platforms. There is increasing concern that Google is dominating this space.

2021

The cellular industry is very much the underlying bit-pipe. Mobile operator brands disappear from the high street and no longer take out advertising. Few offer direct subscriber contracts any more. Most countries consolidate to two operators, often with some sharing of assets between them. Instead, consumers look to Google, Apple, Amazon and others for their connectivity contracts, which provide lower cost, unlimited data, free roaming and better coverage through the ability to switch between the different cellular networks still available.

Substantial changes become apparent to research and regulatory activity, which now concentrates on Wi-Fi and how to ensure seamless links across to cellular where Wi-Fi is not available. Bodies such as 3GPP and GSMA refocus and even the Mobile World Congress is rebranded to the Global Connectivity Congress. It is here where keynote speeches from CEOs of mobile operators and equipment manufacturers reflect on how it could all have been so different….

William Webb