
# KEEP UP WITH 5G

The race to implement 5G is given a reality check by **STEFAN ZEHLE**, who looks at whether spectrum policies will meet the business case for investment

Policymakers have been captivated by 5G as they identify enhanced mobile broadband, the internet of things (IoT), massive machine type communication, and ultra-reliable and low latency communication as enablers for the fourth industrial revolution, smart cities and smart nations.

There appears to be an international race to become the world leader in 5G and policymakers have launched initiatives towards that goal. This is exemplified by the European Commission in its statement, "5G will enable industrial transformation through wireless broadband services provided at gigabit speeds" and the launch of an action plan to make this happen. Further policy direction came from the ministerial declaration in Tallinn, "Making 5G a success for Europe", which states in its opening paragraph, "We share a common vision for a fully connected society and the path towards the gigabit society. 5G will enable the delivery of a diverse set of applications beyond the focus of the traditional mobile broadband market." Top of the list of commitments is: "Make more spectrum available in a timely and predictable manner".

The 5G enthusiasm is not limited to developed markets. In emerging markets, a link is made between 5G and national development goals as typified by a statement made by the Bangladeshi telecoms and IT minister, Mustaf Jabbar: "We have missed three industrial revolutions; Bangladesh should be established as a leading country in the fourth industrial revolution. The whole world will enter into the era of 5G in 2020. The country will not be allowed to stay behind from this." (Speech at Junior Chamber International, 19 May 2018).

**Playing ball: a vision of 5G in action by Telefónica at this year's World Mobile Congress**

This all sounds wonderful, but there is a gap between the political rhetoric and telecoms regulatory action to achieve mobile broadband and 5G policy objectives. Furthermore, since the 2018 Mobile World Congress, mobile operators and equipment vendors started to sound rather more cautious about the business case for 5G. Without a change in government policy on spectrum availability, spectrum pricing and easing network deployment, in many countries mobile operators will not be in a position to deliver the lofty announcements made by politicians.

## INVESTMENT IN MOBILE BROADBAND AND 5G

To cater for mobile broadband traffic, mobile operators are continuing to invest large sums in 4G (LTE) radio access networks and backhaul infrastructure. Some advanced markets are already past the 4G investment peak but in many emerging markets 4G deployment capex is still increasing. But there are some markets where operators have pulled back investment, often due to a cashflow squeeze caused by high spectrum fees and other regulatory fees.

Several operators started to deploy massive MIMO (multiple-input, multiple-output) in combination with three-carrier aggregation, thus delivering gigabit speeds, and most 4G radio access network (RAN) investment currently taking place is software upgradable to 5G. In other words, investment in 5G is already under way. However, the transition to 5G requires further significant infrastructure investment. Deutsche Telekom CEO, Timotheus Hoettges, estimated the cost of providing 5G networks in Europe at €300-500 billion and Sprint's CEO Marcelo Claure stated at this year's Mobile World Congress that in the US, operators will invest $275 billion in their networks. On top of the huge network capex, operators need to acquire new spectrum below 1 GHz, in 2 GHz to 4 GHz, and in millimetre wave bands.

A 5G mobile network is also different from a traditional mobile network, which has relatively large cell sites. A 5G network looks much more like a fixed network with many small cell radio tails. The deployment of many thousands of small cells, for example on street furniture, requires an unprecedented investment in fibre and will push up network operating costs. Estimates as to the number of small cells required vary greatly, but over the next 10 years the number of outdoor cell sites in networks in advanced markets may increase by a factor of three – and more if indoor solutions such as Ericsson's Radio Dot system is included.

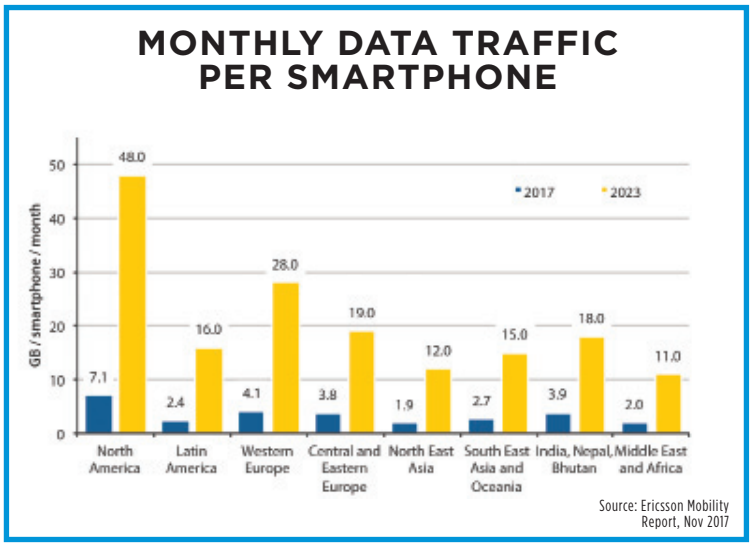
These thousands of new cell sites must be connected by fibre. A calculation by the Fiber Broadband Association of the US illustrates the size of the required investment: In an urban environment it will take 8 miles of fibre cable per square mile to connect small cells. The largest 25 metro areas in the US cover 173,852 square miles, which means that to provide 5G coverage will require around 1.4 million miles of fibre cable. Validating this analysis, in April 2017 Verizon stated that it will purchase from Corning up to 20 million kilometres of optical fibre each year from 2018 through 2020, with a minimum purchase commitment of $1.05 billion.

This illustrates how the mobile networks will start to look much more like fixed networks in terms of the extent of fibre deployment and the number of end-points.

## OPEX COST CHALLENGES AND FLAT REVENUE

So it is clear that mobile operators will need to invest huge sums into mobile broadband, be it 4G or 5G. For capex to take place there needs to be a return on investment (ROI). The ROI will come from cashflows generated by operations – in simple terms the difference between revenue and operating costs. Looking at the cost side (opex), operators will find savings as they move to virtualised networks and increase infrastructure sharing. However, operating a mobile network with a factor increase in the number of cell sites presents a network operating cost challenge.

But are there additional revenues to be had from mobile broadband? Mark Allera, CEO consumer, BT Group, commented in March 2018: "We will have to assume that consumers and businesses will be prepared to pay a little bit more for faster, higher quality access to the internet ..... getting some sort premium out of 5G as we did for 4G." In other words there is little or no revenue upside from enhanced mobile broadband (known as eMBB) which will account for the vast majority of 5G traffic.




While mobile broadband revenues are unlikely to show much of an increase, during the next 6 years the monthly traffic per smartphone user will increase by a factor of 6 to 7. Ericsson's Mobility Report provides insight. In North America traffic per smartphone is forecast to increase from 7.1 GB a month by the end of 2017 to 48 GB by the end of 2023. For Western Europe, traffic is estimated to grow from 4.1 GB to 28 GB and even in India data traffic may reach 18 GB in 2023.

Of course, 5G is a technology platform which opens up opportunities beyond enhanced mobile broadband, including serving "verticals" – smart cities, autonomous vehicles and robotics. Connectivity is the glue of the fourth industrial revolution. The amount of data generated by millions of sensors and other devices opens up opportunities in the application of artificial intelligence services. However, this is where the business case becomes uncertain. It is doubtful that big investments will be driven by business cases with a highly uncertain revenue potential.

While the IoT market is promising, connectivity revenue may only add around 5% to revenue, although the 5G IoT opportunity is greater if systems integration and platform revenue are added. Among operators striving to capture a slice of that revenue, three telecoms operators stand out as having a good systems integration business – Deutsche Telekom, Turkcell and Verizon. However, many operators will struggle to extract value from IoT unless they partner with other companies.

There are also some consumer market IoT revenues to be had. For example, in Germany T-Mobile offers a smart home package for €4.99 a month, but to attract customers the required hardware such as sensors, is either given away with the package or heavily discounted.

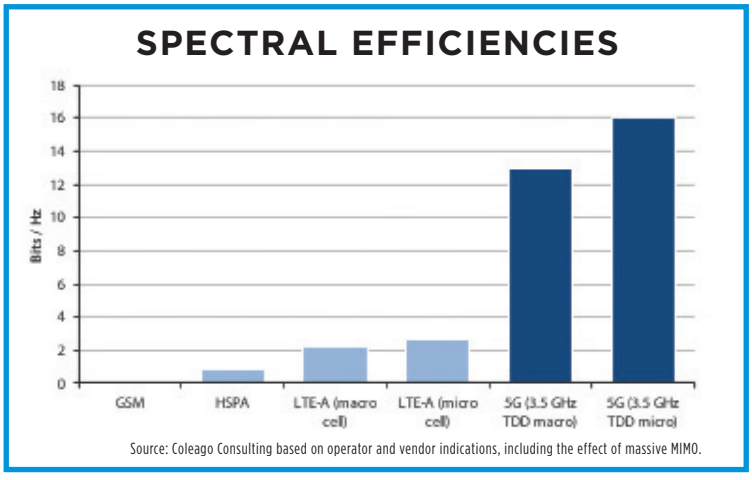
## CAPACITY FOR EMBB LIKELY TO BE THE KEY USE CASE

As we can see users get vastly better value for money in terms of $ per GB of traffic. This is simply the continuation of a by now familiar trend in digital services and products to offer ever better capabilities while the cost of ownership to users does not increase. How can the mobile industry deliver the capacity to cater for the vast increase in traffic while at the same time not seeing much of a revenue increase? The answer is the combination of 5G technology with more spectrum.

Let's look first at technology. New technology is spectrally more efficient, i.e. it allows mobile operators to create more mobile capacity per Hertz of spectrum. In an urban environment, depending on the frequency band, 4G is roughly 2.75 times spectrally more efficient than 3G, and 5G-New Radio (the new radio interface for 5G) has spectral efficiency up to 6 times higher than 4G if the effects of massive MIMO are included.

The other essential ingredient is the quantum of spectrum available to mobile operators. In principle, the more spectrum an operator can deploy on existing sites the lower the cost of capacity. Depending on the country, today mobile operators have around 600 MHz of spectrum deployed between them. For example, in most European countries mobile operators use spectrum in the range of 800 MHz to 2.6 GHz. We are now witnessing the assignment of 2x30 MHz of 700 MHz spectrum, 400 MHz in 3.4–3.8GHz, as well as spectrum in 1500 MHz and 2300 MHz. In the US operators have already acquired millimetre wave spectrum in 28 GHz and 39 GHz through secondary market transactions and the FCC announced auctions for spectrum in 28 GHz and 24 GHz. In Europe, post-2020 the assignment of millimetre wave band spectrum will commence, starting with potentially up to 3,000 MHz in the 26 GHz band (24.25–27.5 GHz).

The combination of 5G New Radio and additional spectrum will make it possible to serve high traffic densities in urban areas. The ITU's 5G design calls for the ability to serve 10 Mbps per square metre. Therefore the 5G business case may be mainly about catering for high traffic densities rather than any new business model; at least, this is the conclusion Ericsson appears to come to. In February 2018, Fredrik Jejdling, Ericsson's head of networks said: *"We also see an enhanced mobile broadband case that may not have been considered before and could become the first use-case for 5G. If we model traffic in our existing mobile broadband networks, we think that by 2023 we're going to see an 8x increase, and probably the best way to cost-efficiently handle that is by introducing 5G over time. We need to build networks that can deliver 8-10x lower cost per gigabyte. Evolving 4G into 5G makes sense, from a cost efficiency perspective, as traffic grows."*



Source: Coleago Consulting based on operator and vendor indications, including the effect of massive MIMO.

## THE COST OF SPECTRUM WILL WEIGH MORE HEAVILY ON INVESTMENT DECISIONS

As explained above, additional spectrum is an essential ingredient in the development of 5G. In Europe and elsewhere the near-term focus of assigning spectrum for 5G is on the 3.4–3.8 GHz band, also referred to as C-band. In its status report of February 2018, the Small Cell Forum notes: "C-Band spectrum will be the first midband spectrum to be allocated for 5G in many regions, and will be heavily used for small cells, sometimes as a separate layer to accompany an LTE coverage layer; sometimes in the same layer as 5G macro and mini-macrocells within a midband."

The 3 GHz spectrum substantially increases the amount of spectrum used by mobile operators. If operators in Europe start to use the 400 MHz in the range 3.4–3.8GHz for mobile, this will increase their spectrum holdings from around 600 MHz to 1,000 MHz. This increase of 66% in spectrum used by the mobile industry comes against a background of stagnant revenues and network operating cost pressure. The cost of spectrum is therefore a critical issue in rolling out 5G.

There are already some benchmarks from recent auctions for 3 GHz spectrum in Europe. In Ireland, operators paid on average 0.041 $ per MHz per head of population ($/MHz/pop) and in the UK 0.167 $/MHz/pop. While in terms of $/MHz/pop, prices for 3 GHz spectrum seem low, given that the band consists of 400 MHz the investment in spectrum assets for 5G means significant sums are extracted from the mobile industry. In many markets the entire band is not immediately available and hence the cash outflow for spectrum occurs over time, but it also means operators will not have the full 100 MHz band required for 5G efficient deployment.

Spectrum acquisitions appear in operators' accounts as "intangible" capex and of course the 5G deployment (tangible capex) has to be added to arrive at the total investment in rolling out 5G. Consequently, operators started to question the logic of desire by politicians for their countries to take a lead in 5G while at the same time extracting cash from the mobile industry. At the Deutsche Telekom shareholder meeting on 17 May 2018, CEO Timotheus Höttges summed up the situation: *"5G, the next-generation network, is on the horizon, and it will truly bring the internet of things to life. For this reason, 5G is of strategic importance to an industrialised nation like Germany. The spectrum auction in Germany is due to start soon. We appeal to you to take the long view. We can only spend each euro once: either on spectrum or on network build-out. My suggestion would be on build-out."*

## EXTRACTING CASH FOR SPECTRUM DOES NOT HELP THE 5G BUSINESS CASE

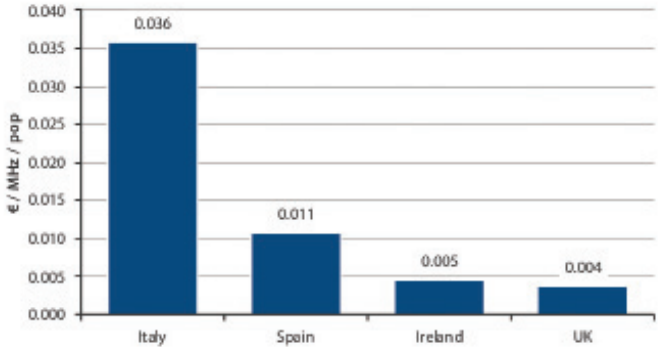
Germany, along with countries such as Sweden, has a history of setting low reserve prices in spectrum auctions. Others take a different view. In many markets the pattern of high reserve prices observed in previous spectrum auctions continues even in the light of a shaky business case for 5G.

Italy has a history of setting high reserve prices for spectrum and is repeating this in the spectrum assignments aimed at 5G. To the Italian government, the most important aspect in assigning 3 GHz and other so-called 5G pioneer bands appears to be how much money can be raised from the sale of spectrum rights. In a press release of 23 May 2018, AGCOM, the Italian regulator, announced: "The state expects an income from the awarding bid of at least 2.5 billion euros, half of which this year" – before even mentioning the benefits of the spectrum for 5G.

In Italy, the reserve price 200 MHz of spectrum in 3.6–3.8 GHz has been set at €426 million which equates to 0.036 €/MHz/pop (0.040 US$/MHz/pop). This is the same as the price paid in Ireland for 3 GHz spectrum in 2017. In contrast, in Ireland the reserve price in terms of €/MHz/op was 90% lower than in Italy. To make matters worse, in Italy the reserve for 700 MHz spectrum, the likely 5G coverage band, has been set at 0.59 €/MHz/pop which is around three times higher than prices actually paid for 700 MHz spectrum in auctions in Finland and Germany.

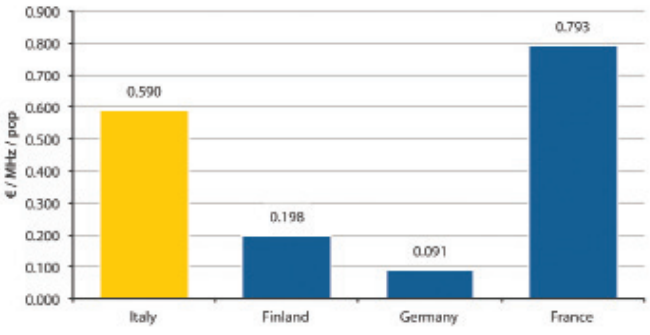
As a result, Italy is currently not alone in what appears to be conflicting policies. The UK extracted £ 1.4 billion from auctioning 150 MHz of 3 GHz spectrum and 40 MHz of 2300 MHz spectrum. And yet in a press release on 10 March 2018, the British government congratulated itself for its commitment to 5G by announcing, "On the first anniversary of its digital strategy, the government has today announced the winners of a £25 million competition to pave the way for a future rollout of 5G technology in the UK" and says this "highlights progress to date on its strategy to create a digital economy fit for the future". But £25 million is only 1.8% of the cash extracted from the UK mobile industry for 5G suitable spectrum.

### RESERVE PRICES FOR SPECTRUM IN 3.4–3.8 GHZ




Source: Coleago Consulting

### 700 MHZ RESERVE PRICE IN ITALY VS PRICES PAID AT AUCTION IN EUROPE




Source: Coleago Consulting

## PRESSURE TO RAISE REVENUES

In middle and low income countries where government revenues are thinner the pressure to raise cash from spectrum auctions is enormous. In many emerging markets development of mobile broadband is hindered by pricing spectrum beyond the levels where a business case for 4G use is justified let alone for 5G.

A recent example from February 2018 is the spectrum auction in Bangladesh where 66% of spectrum on offer remained unsold and this despite the fact that the industry is woefully short of spectrum. Yet, shortly after the auction, the telecoms and IT minister, Mustafa Jabbar, said: "The world will embrace 5G in 2020. So, we too will have to accept new technology and must move on to 5G. There is no option for procrastination." The reality is that Bangladesh only introduced 4G after the February 2018 spectrum auction, making it the last country in Asia to do so.

Policymakers need to understand that mobile telecoms operators will allocate investment where there is a business case. Why would anyone invest if a better return on investment can be found in other markets? Increasingly, governments are facing a situation where they are in effect in competition with other jurisdictions for the allocation of capital by multinational mobile operators such as Vodafone, Orange, Telefonica and Deutsche Telekom, as well as regionally focused operators such as MTN, Millicom, Ooredoo, Axiata and VEON.

The demand from shareholders for regular dividends means that these operators have a finite amount of cash to invest. The boards of these companies need to decide how best to allocate cash across their portfolio of markets in order to achieve the highest level of ROI, as illustrated by the statement from Catherine Bohill, director of spectrum at Telefónica: "*Assignment conditions must allow operators the breathing room to innovate and invest. In those countries that have long licence terms and reasonable conditions, operators have lower risk and are more likely to invest. Portfolio trade-offs do exist and where spectrum assignment conditions are unrealistic, operators will endeavour to convey these shortcomings to the relevant authorities but ultimately may have to abstain from processes that place scarce capital at risk. This is a very*

*unsatisfactory outcome and must be avoided. It is, however, an ever increasing phenomenon with high profile cases happening across the world."*

When cash is limited, that cash will be invested in the markets that offer the highest return. To attract the investment in mobile broadband and 5G to achieve connectivity policy goals, governments must adjust the cost of spectrum to a sustainable level in the context of their own market.

## THE ECONOMICS OF 5G DEPLOYMENT ARE AFFECTED AT MUNICIPAL LEVEL

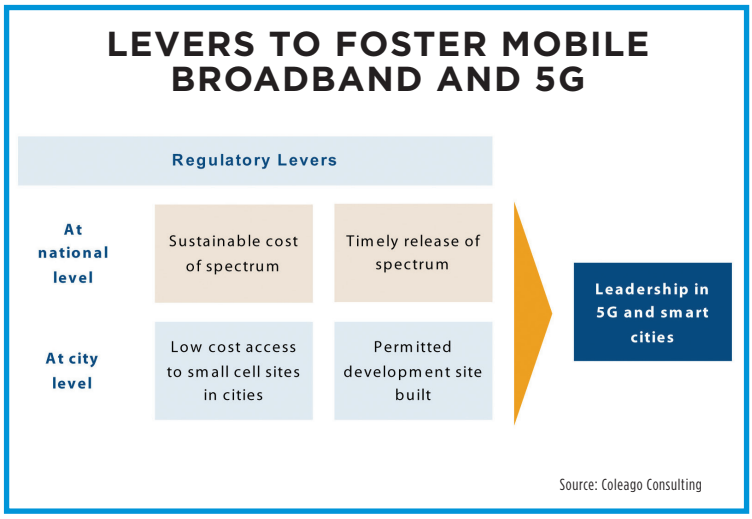
There is also a more local aspect to 5G investment. Given the imperative to deploy many small cells in cities, operators will prioritise investment in cities where it can be done quickly at a cost that makes business sense. Therefore, not only is there competition for investment between countries, but with 5G we are also seeing the emergence of competition for investment between cities within a country. The Small Cells Market Status Update of February 2018 showed results from a survey among 78 mobile operators as to the barriers to small cell deployment. Asked what are the top three barriers, total cost of ownership (TCO) or ROI is mentioned by 58%, site cost and availability by 47%, and site approvals by 23%.

At the ministerial programme of the 2018 Mobile World Congress, Nicki Palmer, chief network officer for Verizon Wireless pointed out that there is a great deal of divergence in how municipalities in the US support the deployment of small cells with access to municipal infrastructure such as lampposts and street furniture. Some cities look at granting access to municipal infrastructure as a way to maximise revenue. Others see it as an opportunity to encourage mobile operators to invest and place their city at the forefront of smart city development.

Operators are also concerned about getting approvals for site installations. While it may have been appropriate to go through a full planning application procedure for relatively large macro sites, applying the same procedures to several thousands of small cells would cause delays and add to costs. Given their small size, the environmental impact of small cells is minimal.

In the US this issue was recognised some time ago. Former FCC chairman Thomas Wheeler stated in his speech before the Competitive Carriers Association in Seattle in September 2016: *"Estimates are that 5G will require a 10x growth in cell sites, and potentially significantly more. ... Which raises a key question: how can we work with siting authorities to allow the plethora of antennas that will be required quickly and at a reasonable cost? .... the nature of the technology makes the review and approval by community siting authorities, and the associated costs and fees, all the more critical. There are just over 200,000 cell towers in the US, but there may be millions of small cell sites in the 5G future. If siting for a small cell takes as long and costs as much as siting for a cell tower, few communities will ever have the benefits of 5G."*

In Europe, the site permitting issue is dealt with in the new European Electronic Communications Code where Article 56 addresses small cells and directs that permits should not be needed for smalls cell below a certain threshold, yet to be defined. The code also addresses obstacles to fibre deployment. In June 2018, Virgin Media announced that it is taking a county council in England, Durham, to court over unreasonably high land access charges for fibre routes. Tom Mockridge, CEO of Virgin Media stated: "By demanding money for land access Durham County Council is now putting up a broadband blockade to thousands of homes and businesses across the county." Let' see whether the code helps to support Virgin's case.




## REGULATORY LEVERS TO ENCOURAGE 5G DEVELOPMENT

As summarised in figure 5, governments and regulators at national level and cities and municipalities at local level can pull levers to encourage investment in mobile broadband and 5G.

When a government seeks to attract investment into their country or cities, for example a manufacturing facility or startups, they usually provide incentives. With mobile operations it seems to be other way around. Investment is taxed in the form of up-front spectrum fees or in some countries technology neutrality fees and site build restrictions hinder network deployment. It is not sufficient for governments to say wonderful things about mobile broadband and 5G. To tilt the finely balanced 5G business case into fast forward mode, national and local government must use the levers at their disposal to achieve this.

For central government this means setting sustainable reserve prices for spectrum and releasing spectrum as soon as possible. In this context creating artificial scarcity is the worst decision governments can make.

For municipalities this means cost-based access to lampposts and other municipal infrastructure and ensuring small cell deployment, below a certain size, is treated as permitted development, i.e. with no need for planning permission.

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