

5G Regulatory Policy and Assignment Strategies

The spectrum management, policy and assignment challenges facing regulators in the 5G era

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Spectrum Management and Assignment in the 5G Era

Introduction

There is a broad consensus regarding what constitutes regulatory best practice today

The mobile industry will soon be celebrating its 40th birthday and the industry has steadily advanced, evolved and matured with each new generation of technology. Regulatory approaches to spectrum management and assignment have evolved in parallel and there is now a broad consensus regarding what constitutes regulatory best practice.



The introduction of 5G will be both evolutionary and revolutionary. Enhanced mobile broadband services (eMBB), supported by sub 6 GHz spectrum deployed mainly on existing macro networks, will be largely an evolution of existing 4G services. Current regulatory policies are likely to remain broadly relevant in the medium term although alternative approaches to assignment may well be required if the potentially large amounts of spectrum that can be made available result in insufficient demand relative to supply to justify the high cost of auctions to large operators.

Some aspects of 5G will be revolutionary and will require a fundamental reassessment of what constitutes spectrum management best practice

Other aspects of 5G however, will be revolutionary and will require a fundamental reassessment of what constitutes spectrum management best practice. The release of mm Wave spectrum in the 26 and 28 GHz range will, for example, see small cell networks of very high capacity which will fundamentally change the economics of the wireless industry. This change in network economics will require a shift in regulatory policy to ensure that the networks can be rolled out in a timely manner, competition is maintained or enhanced and potential new operators, targeting specific industry verticals, can develop viable businesses. These shifts in policy will be essential to underpin the creation of the anticipated socio-economic benefits promised by 5G.

Some of the greatest challenges will arise in relation to the customer requirement for rich media in high density populations, the growth of the Internet of Things (IoT) and high bandwidth 5G services under the banner of massive machine type communication (mMTC). The vast range of use cases across a wide range of industry verticals will see the potential for a wide range of new spectrum licence holders, each with a unique business model and spectrum needs.

In this paper we begin by highlighting the regulatory policy objectives which will be most critical to the success of 5G. We then examine the basic economics of the 5G

investment case before highlighting the implications for regulatory policy and spectrum assignment procedures. Issues of licensing and network sharing are touched on and are addressed in detail in other specific papers available on Coleago's website¹.

Regulatory Policy Objectives and 5G

Regulatory policy objectives are broadly similar for most regulators and two important aspects are investment and efficiency

Regulatory policy objectives are broadly similar for most regulators and typically encompass issues such as the efficient use of spectrum, protecting consumer welfare and the promotion of competition. However, there are two objectives which are likely to be at the forefront of the debate regarding appropriate regulation in the 5G era:

- Ensuring the efficient use of spectrum (where efficiency is defined in terms of maximising the socio-economic benefits from the use of spectrum); and
- Promoting investment and innovation.



Realising the 5G vision will require an enormous amount of investment as the deployment of spectrum above 6 GHz cannot utilise the existing macro networks that mobile operators have already built. Regulators will need to promote the investment in very small cell networks and the accompanying hybrid back haul systems that will be required to make the 5G vision a reality.

The high degree of uncertainty over 5G will make determining the most efficient use of spectrum very challenging

Today, there is considerable uncertainty over what 5G actually means and what will be the commercially viable use cases and business models that define it. Furthermore, regulators are coming under extreme pressure from consumers for the rapid roll-out of high-speed data networks, both wireless and wireline. Regulators will need to create an environment that encourages creativity and innovation so that businesses large and small can explore the possibilities created by 5G. The fact that there is so much uncertainty over what 5G is and that 5G services and applications will be in a constant state of evolution and flux for many years, will make determining the most efficient use of spectrum extremely challenging.

Incumbent mobile operators may not be the most efficient users of high frequency spectrum

Regulators currently presume, with a reasonable degree of certainty, that incumbent mobile operators, with their existing networks, are likely to be the best candidates for the most efficient users of spectrum. However, when spectrum deployment requires investment in new, small cell networks the presumption that incumbent mobile

¹ www.coleago.com

Infrastructure based mobile operators are not necessarily best placed to drive creativity and innovation

operators are the most efficient users of high frequency spectrum may no longer hold true.

Furthermore, as the success of Over-the-Top (OTT) players such as Facebook, Amazon, Netflix, Google and the like have demonstrated time and again, infrastructure based mobile operators are not necessarily best placed to drive creativity and innovation in services and business models.

To invest a business must anticipate earning a Return on its Capital Employed that is greater than its Cost of Capital

The Economics of 5G Investment

The wireless industry is no different to any other and basic economic theory tells us that for a business to invest it must anticipate earning a Return on its Investment or Capital Employed that is greater than its Cost of Capital. These terms are explained in more detail below:

- Return on Investment (ROI) or Return on Capital Employed (ROCE) is simply the anticipated future Returns for the business divided by the Capital or cash that had to be invested to generate them.
- The Return represents the profits of the firm and is the difference between revenues from customers less the costs of generating those revenues.
- Capital Employed reflects the investments in the assets of the business needed to generate the returns. In the case of a wireless business the two most expensive assets are almost always spectrum and the cost of building the network. These items together constitute the two main elements of Capital Employed.
- The Cost of Capital² is the return that the providers of capital to a business could expect to earn had they invested their cash elsewhere in a business with the same level of risk. The Cost of Capital represents the return on the next best alternative investment of similar risk. The higher the risk of the investment the higher the Cost of Capital.

Many mobile operators are currently generating returns that are either close to or below their cost of capital so incentives for investing in 5G are currently weak

Returns within the wireless or mobile industry today are low due to previous high levels of investment in spectrum and the high cost of radio infrastructure and tough competition, especially from virtual OTT players. Various studies across all markets have demonstrated that many mobile operators are currently generating returns that are either close to or below their cost of capital. This means that the incentive for mobile businesses to continue to invest in 4G, let alone 5G, are currently weak.

² Sometimes referred to as the Weighted Average Cost of Capital or WACC



The 5G vision will usher in a new era of investment in both spectrum and very small cell networks along with the infrastructure that will together make up the connectivity layers for very high capacity, very high data rates and the Internet of Things. To promote this investment Regulators must create an environment where investors anticipate future returns above the Cost of Capital. From a regulatory perspective this means three things:

- First, adopting policies that allow investors to generate sufficient returns. Regulatory policy impacts revenues and costs. In a voice centric world for instance, mobile termination rate regulation directly impacts revenues. Across all services the imposition of annual spectrum usage fees directly impacts costs.
- Secondly, adopting policies that reduce the level of investment required so that less capital is needed to generate future returns. To have a material impact on the ROCE this will mean adopting policies that reduce the cost of spectrum and lower the cost of network investment.
- Thirdly, seeking to minimise the risk of investment. In some markets one of the greatest risks faced by investors is regulatory uncertainty. Regulators need to ensure that regulatory risks are minimised as well as other risks associated with investment in spectrum and networks.

In the following sections we explore the regulatory policy options to support future anticipated Returns that are above the Cost of Capital to encourage investment, innovation and creativity in the 5G era.

Improving Anticipated Future Returns

Returns can be increased by either increasing revenues or reducing costs. A policy that directly impacts returns is the duration of the licence term for spectrum. The longer the licence term the longer the mobile operator has to generate returns from 5G. An empirical study on behalf of the European Commission³ revealed that the longer the licence term the greater the levels of capital expenditure within the wireless industry. In light of the uncertainty surrounding 5G, Regulators should assign spectrum with long licence terms of say twenty-five years or longer or adopt the policy of Ofcom, the United Kingdom Regulator, of awarding spectrum with indefinite licence terms. Where

Long licence terms will be necessary to provide sufficient time to generate adequate 5G returns

³ Study on Spectrum Assignment in the European Union, 2017

Regulators do assign spectrum on the basis of a finite time horizon then there should be a strong presumption of renewal in favour of incumbent licence holders.



The rapid pace of change within the 5G era however means that on a 25-year time horizon those that acquire the spectrum today may not be the most efficient users of it in the future. Whilst long licence terms reduce regulatory risk and create an opportunity for higher returns they also present a regulatory risk that spectrum use in the future becomes inefficient. Regulators should therefore ensure that spectrum can be traded in the future so that a mechanism exists that allows spectrum to move to where it can be employed most efficiently.

Mobile operators may not be best placed to exploit the IoT opportunity

Mobile operators have been providing machine to machine (MTM) connectivity for decades and yet the revenues from MTM services represent only a tiny fraction of total mobile operator revenues. Orange for example recently revealed that MTM SIMs represent 14% of all SIMs yet their contribution was less than 1% of total revenue. There is considerable hyperbole surrounding the future revenues that will result from 5G and IoT. It is not obvious that existing industry players are well placed to generate those revenues and Regulators should explore policies that provide 5G access either through the direct assignment of spectrum or indirectly through appropriate wholesale arrangements to innovative, dynamic and agile businesses that may be better placed to exploit the full range of 5G services including IoT revenue opportunities.

Regulators may need to compromise some aspects of Net Neutrality to promote investment

A controversial policy measure would be to reconsider regulations related to Net Neutrality which prevent Internet Service Providers from discriminating between traffic streams across their networks. Ajit Pai, Chairman of the Federal Communications Commission in the United States, recently reversed the Net Neutrality rules ratified during the Obama era. Net Neutrality mandates that network operators must treat all data traffic with the same priority and access control and cannot throttle specific services to allow premium services through to generate additional revenues. Net Neutrality remains a common feature in many markets today, including Europe. Allowing network owners, for example, to charge different prices for different service speeds would certainly provide scope for greater future revenues. However, abandoning Net Neutrality regulations would be highly controversial as many believe that without such rules, innovation and creativity will be hampered. Regulators may be prepared to consider some form of compromise where a minimum level of performance is guaranteed for all Internet users, but operators can provide a differentiated service for speeds above the minimum.

Regulators should also explore policy changes that directly or indirectly reduce the cost burden on the industry

Regulators should also explore policy changes that directly or indirectly reduce the cost burden on the industry. Reducing or eliminating regulatory charges such as spectrum usage fees would improve profitability. In many markets spectrum usage fees are based on formulas that typically begin with a base price which are then subject to a number of adjustments, such as the propagation characteristics of the spectrum. A common driver in the formulae is the amount of bandwidth assigned to an operator. In the 5G era, where assigned spectrum could be measured in the 1,000s of MHz, such formulae will need to be dramatically revised to avoid placing an unsupportable cost burden on the industry.

Reducing Capital Employed

Reducing Capital Employed means that Regulators need to explore policies that lower the cost of spectrum and reduce the cost of building the networks necessary to deploy that spectrum.



Regulators should set low Reserve Prices for 5G spectrum auctions

Reducing the cost of spectrum is one of the key policy measures that Regulators can adopt to promote investment

Regulators should either refrain from imposing 5G coverage obligations or ensure that the obligations are commercially viable

Lowering the cost of spectrum involves reviewing the approaches to assigning spectrum. If Regulators adopt the use of Auctions, then Regulators should set low Reserve Prices⁴. Studies on behalf of the GSMA and the European Commission all reveal a positive correlation between high reserve prices leading to high spectrum prices and so delaying large scale roll-out. If Auctions are no longer appropriate for spectrum assignment in a 5G era, as we believe may well be the case, then alternative considerations, other than price, should be used to determine the basis upon which spectrum is assigned. Reducing the cost of spectrum is one of the key policy measures that Regulators can adopt to promote investment. Regulators should become well versed in making the case to Governments that it is better to forgo short term auction revenues in lieu of the higher socio-economic benefits that will accrue from high levels of investment and innovation in 5G and new services such as IoT. Instead, government revenue might be increased through small changes to taxation regarding spectrum and service providers.

Coverage obligations are a key driver of the cost of network build. Operators will continue to expand coverage provided that the marginal revenue of building a new site is greater than the costs of the site. If Regulators impose coverage obligations that exceed commercially optimal levels, then this will depress returns through increased capital investment in new sites. Spectrum allocated for 5G services will primarily be

⁴ The minimum price that operators must pay to acquire spectrum in an auction and the Reserve Price is set by the Regulator

based on higher frequency bands with poorer propagation and so aggressive coverage obligations will be particularly damaging for returns. Regulators should either refrain from imposing 5G coverage obligations or ensure that the obligations are commercially viable.



Regulators should avoid setting quality of service obligations

5G promises to deliver very high levels of network performance although what the actual level of performance delivered to customers will be remains uncertain. In light of the uncertainty, Regulators should avoid setting quality of service obligations and let market forces and competition between operators determine network performance. The risk for a Regulator is that if they impose a quality obligation which is above the commercially justifiable levels they will once again damage returns and thus the incentives for investment.

Regulators should also take steps to ensure that operators are able to access sites quickly and at low cost

Regulators should also take steps to ensure that operators are able to access sites quickly and at low cost. Planning permission challenges can add significantly to the cost and time for an operator to roll out a network. In the 5G era these planning concerns are likely to be greater as small cell deployments will require many times more sites and operators will be seeking access to potential locations such as street furniture including lampposts, bus stops, and so on.

Some form of neutral host network or single wholesale network, whilst typically rejected by operators, may well be the only viable solution for some aspects of 5G deployment

In some markets, network equipment is subject to a range of import duties and taxes. These levies increase the cost of the equipment and so add to the cost of roll-out and the capital employed by an operator. Furthermore, as they increase the cost of rolling out each additional site they reduce the level of commercially viable coverage. Governments determined to see a rapid and widespread deployment of 5G and to realise the economic benefits that the technology offers should forgo the short-term tax receipts and customs duties in lieu of increases in productivity, efficiency, GDP growth and wider consumer benefits.

Network sharing and, in some markets, spectrum sharing, are already important features of operator network roll-out strategies. Sharing will become even more important with 5G and in some contexts, such as small cell network deployments, the sharing of networks may be the only physically viable solution and probably the only commercially viable solution as well. The cost of deploying an extensive small cell network may be so high that it is only economically viable for one player to undertake the build, therefore creating a natural monopoly. Some form of neutral host network or single wholesale network, whilst typically rejected by operators, may well be the only viable solution for some aspects of 5G deployment.

The assignment of 27 GHz highlights many of the challenges

27 GHz may see many new types of companies applying for spectrum licences or seeking spectrum on a licence exempt basis

Deploying saturation coverage using 27 GHz and small cells will never be economic for any operator either as a stand-alone or as a contiguous overlay to an existing network. However, the ability of existing network operators to integrate large numbers of unmanaged “pseudo cell sites” or small cells into their networks has already been demonstrated with femto cells in the home. The appetite for many companies and local area councils to provide free to use internet access within very small areas is stable and growing as demonstrated by current public WiFi networks which have a service range of 100m maximum. The challenge for regulators will be how to support the general large-scale deployment of networks and systems in the 27 GHz region while producing reasonable revenue for the government and ensuring that operators can grow their revenue streams using this very high capacity connectivity. This new regulatory landscape will likely see many different types of operator applying for spectrum licences, and these licences will increasingly be issued on a non-exclusive basis. Types of operator class could include:

- Traditional large-scale mobile operators who are seeking to add a new “capacity layer” to their existing RAN;
- New niche market operators seeking to start new services including rural FWA, Campus based super-fast broadband, Host-neutral capacity expansion in public or private areas and WiFi replacement services in commercial/hospitality locations, Business/science park areas, large-scale housing complexes, large-scale shopping areas etc;
- Existing virtual operators who want to deploy highly targeted on-net areas to reduce air-time costs;
- High security operators such as military bases, hospitals and emergency service locations; and
- Common RAN operators, who currently provide shared towers, may move towards providing a net-neutral very high capacity RAN in areas where service area competition has been reduced.

The scope for small niche players to enter the market created by assigning 27 GHz spectrum is due to significant changes in the equipment required

The scope for small niche players to enter the market created by assigning 27 GHz spectrum is due to significant changes in the equipment required. Historically, radio cell sites have been physically large, required air-conditioning and battery back-up with antennas mounted as high as possible. As many as four large antennas would be required per logical cell with high RF power being necessary to deliver a service area of tens of kilometres. Deploying a 27 GHz RAN in highly targeted areas or even single building locations will be possible for small niche players due to the change in the type of radio infrastructure required.

The introduction of 2.6 GHz and 3.5 GHz services has seen the required radio equipment reduce in size by a factor of 10 with the peripheral equipment of batteries and antennas making up a disproportionately large area compared to the RAN equipment. 27 GHz 5G NR will likely be a small single box per logical cell with potentially the antenna built-into the case. A second small box will house the 27 GHz self-configuring backhaul equipment. Both boxes can be easily mounted on a street light post or other street furniture with typical heights of between 8m and 10m. No back-up battery will be required as multiple overlapping cells will be deployed within the local area and so the loss of any one cell will only reduce capacity. Such installations could be supplied with power from mainly renewable sources and if a small battery were included then a low-cost battery back arrangement would also be provided in areas without capacity overlap. Installation would require a very minimal two-person team to meet health and safety requirements and would take less than two hours per cell. The equipment will be self-configuring and so no RAN optimisation will be necessary. Deploying small cell based networks will be possible for a much wider range of companies, often very locally focused and the regulatory licensing environment will need to support such deployments.

Another important factor for Regulators to consider, therefore, is reducing the level of risk faced by operators

Reducing Regulatory Risk

To invest we have already highlighted that operators require a Return above their Cost of Capital and that the Cost of Capital increases with the risk associated with the investment. The higher the risk the higher the Cost of Capital. Another important factor for Regulators to consider, therefore, is reducing the level of risk faced by operators. One of the biggest risks that operators often encounter is regulatory risk and so Regulators should ensure that they provide operators with a low regulatory risk environment in which to invest.



As a general principle Regulators should seek to act in a transparent, consistent and predictable manner. Regulators should clearly state spectrum management strategies and policies and then act accordingly. In addition, there are specific risk areas that Regulators can address directly.

One of the gravest areas of uncertainty and risk for operators is around the renewal of their existing spectrum holdings

One of the gravest areas of uncertainty and risk for operators is around the renewal of their existing spectrum holdings. An operator approaching the end of their current licence term will reduce investment if there is uncertainty over whether and on what terms they will be able to renew their spectrum. Providing clarity over the renewal of existing spectrum and the renewal process for newly assigned spectrum (assuming spectrum is not assigned on an indefinite basis) is one of the simplest things a regulator can do to reduce risk and encourage investment.

Another strategy to reduce risk is to enact the necessary legal instruments and put in place the policies to enable spectrum trading. Providing operators with the opportunity to trade their spectrum if they are unable to realise their anticipated returns provides an important safety net when they consider their initial 5G spectrum investment. The ability for the industry to quickly recycle spectrum into alternative uses as the 5G use cases and business models evolve is key to ensuring innovation and that spectrum is used efficiently.

Improving the incentives for 5G investment and innovation is mainly about Regulators ensuring that they have adopted the well-established principles of best practice spectrum management. Where 5G really presents operators with a new set of challenges, and where best practice is yet to be determined, is in the process of assignment and pricing.

The Challenges of Spectrum Assignment in the 5G Era

Current best practice in spectrum assignment recommends the use of market-based mechanisms

Current best practice in spectrum assignment recommends the use of market-based mechanisms, such as auctions, to assign spectrum. The use of a competitive and well-designed Auction, accompanied by a low Reserve Price, should generate an efficient allocation of spectrum. The critical requirement for an efficient outcome is that the Auction is competitive.

We believe that in the 5G era best practice in assignment will no longer point towards the use of auctions

In a four-player market in Europe where, say 2 x 30 MHz of 700 MHz is being assigned, and an allocation of 2 x 10 MHz represents the minimum commercially viable allocation, then the Auction is very likely to be competitive and the resulting allocation efficient. However, as many markets comprise only three players even auctions for 700 MHz may encounter concerns about levels of excess demand and competition.

However, when we consider mm Wave spectrum such as 26 or 28 GHz, there is sufficient contiguous spectrum available that each operator can be assigned a block of say 500 MHz and the regulator will still have some to spare. As we are increasingly seeing in many current auctions, operators often prefer to reduce their demand to end an auction early at low prices rather than fighting for a disproportionate share of spectrum at high prices with potentially dubious benefits in terms of competitive advantage. Given the uncertainties associated with 5G we believe most bidders will prefer to obtain a fair share or close to fair share of spectrum at the lowest possible price rather than competing for a larger allocation. Consequently, we believe that auctions for mm Wave spectrum and possibly also for frequencies around 3.5 GHz are unlikely to exhibit the competitive tension required to realise the benefits in terms of allocative efficiency. We believe that in the 5G era best practice in assignment will no longer point towards the use of auctions.

Some form of Administered Assignment may be the only approach for some 5G frequency bands

Another argument put forward for the use of auctions is that it addresses the asymmetry of information about the value of spectrum between bidders and the Regulator. A competitive Auction will see participants' bids determining the value of spectrum. However, in the absence of competition, the Auction will end in the first round at the Reserve Price which is set by the Regulator. If the majority of 5G spectrum auctions are going to end at the Reserve Price, Regulators might as well avoid the time, cost and complexity associated with designing and implementing an Auction and simply assign spectrum using some form of Administered approach.

If an Administered approach to assigning 5G spectrum is to be used, this then raises some very significant challenges for Regulators although many of these challenges have already been faced once before in the early days of the mobile industry.

The first issue relates to what are the appropriate pre-qualification criteria for participation in the assignment process in the 5G era

The first issue relates to what are the appropriate pre-qualification criteria for participation in the assignment process in the 5G era. Previously, experience in building and operating mobile networks was a key criteria, along with evidence of suitable funds to make the necessary investment in roll-out. In the 5G era, and especially in relation to high frequency spectrum, experience in building and operating large macro cell-based networks is less relevant. There is great uncertainty as to who will make 5G a success, especially in the arena of the Internet of Things and small cell network builds. The issue is particularly acute in relation to business models and use cases around industry verticals. It is very difficult to predict exactly who will be building these networks and where and so Regulators may only require that applicants have sufficient funds to invest.

Some form of comparative assessment based on mainly objective criteria may provide a potential solution

The second issue is the assignment process. In the early days of mobile spectrum was assigned through lotteries and there are a number of stories of dentists winning spectrum and subsequently selling the spectrum to operators and benefitting from a significant windfall. The use of a "first come, first served" approach is still present in some markets such as Africa but suffers from many flaws and is particularly susceptible to corruptive practices. An approach which was very common for many years was the use of some form of comparative assessment – often referred to as a "beauty parade." Applicants were often required to describe their technology and roll-out plans as well as the products and services they would offer. The main benefit of a

comparative assessment was that the Regulator could impose a wide range of requirements on the applicants to reflect policy objectives, but the downsides were the time it took to complete the process, a lack of transparency and the risk of corruption. However, some form of comparative assessment based on mainly objective criteria may provide a potential solution. Uncertainty over 5G services means the criteria should focus primarily on commitments around investment, technology, roll-out and the openness of the network. Such criteria would be more easily assessed on an objective basis and then subsequently monitored.

Regulators will wish to avoid having to estimate the value of 5G spectrum in order to determine a price for the spectrum

The final question relates to the price to be charged for the spectrum. Those seeking 5G spectrum will have developed their business cases and models and will have estimated the value of the spectrum, but it will be subject to a very high degree of error. Valuing spectrum for 3G and 4G is subject to high margins of error, they will be wider still in the early years of the 5G era. In setting a price for spectrum the Regulator would have to perform a similar valuation exercise as meaningful benchmarks will be non-existent or as they do evolve will be even more of a blunt instrument for valuation than they are for 4G spectrum. In light of the uncertainty over valuation, Regulators may decide to make nothing more than a nominal charge to cover the costs of the assignment process itself. However, the nominal charge should be accompanied by a significant commitment to invest which should be closely monitored by the Regulator. Making a nominal charge avoids the risk of pricing the spectrum too high and seeing it left unutilised. A nominal price also provides the maximum incentive for investment and innovation. However, the Regulator should put in place procedures for spectrum trading to ensure that the market will create an opportunity cost of holding spectrum to promote efficiency.

The 5G era will present investors and regulators with a great many challenges. Regulators will need to be as agile and flexible as those likely to make a success of 5G businesses if the 5G vision is to be realised.

About Coleago Consulting Ltd

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