

Strategic spectrum renewal

Maximising the efficient use of spectrum through a strategic approach to the renewal of existing spectrum assignments

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A strategic approach to the renewal process can deliver significant gains in spectral efficiencies of up to 40%

Introduction

Historically, spectrum licences were typically awarded for terms ranging from 10 to 20 years. In many markets, spectrum assigned up to two decades ago is due for renewal. Best practice generally recommends a presumption of renewal in favour of incumbents at low, administered prices, provided there are no competition concerns. However, the mobile industry today is unrecognisable from the industry of 10 to 20 years ago:

- revenue growth is negligible;
- consolidation and exit have generally resulted in fewer mobile operators;
- traffic is higher and continues to grow; and
- 2G and 3G networks are being shut down to make way for 4G and 5G networks with talk of 6G being launched in 2030.

The shift in technology in particular means that a presumption of renewal of existing spectrum assignment to existing spectrum holders is not necessarily in the best interests of the industry. A more strategic approach to renewals is required to optimise existing spectrum assignments to reflect the spectrum needs of current and future technologies.

Our research indicates that gains in spectral efficiencies from a strategic renewal process can reach up to 40%. New spectrum assignments are often expensive and are typically accompanied by costly coverage obligations – mobile operators should therefore aim to optimise their existing spectrum holdings before considering the acquisition of new spectrum. Optimising existing band plans can also increase the benefits from new spectrum acquisition by reducing potential future inefficiencies such as those arising from passive intermodulation (PIM) risk.

The gains from optimising existing spectrum assignments are potentially so large that it also makes sense for the mobile industry to take a proactive approach. Rather than waiting for a renewal process, which may be many years away, operators should engage with other operators and the regulator now to negotiate swaps and trades that deliver industry-wide win-win-win outcomes.

Regulators have a statutory duty to ensure that spectrum is used efficiently

In this paper we explore some of the ways in which existing assignments can be inefficient and what options are open to regulators and operators to optimise existing spectrum holdings. Indeed, most regulators have a statutory duty to optimise the efficient use of spectrum and so a strategic review of existing assignments is a process that regulators should be leading if they are to deliver on their statutory responsibilities.

Current spectrum assignments

Existing spectrum assignments often represent a jigsaw of poorly fitting pieces

Mobile operators today typically hold a portfolio of spectrum assets across a wide range of different frequency bands. In Europe, for example, spectrum assets typically encompass 700, 800, 900, 1500, 1800, 2100, 2300, 2600, and 3400-3800 MHz bands. In the US, operators are managing 600, 700, 850, PCS1900, AWS, AWS-3, WCS2300, 2500, 3450-3550, CBRS and 3700-3980 MHz and a similar situation can be found in many other markets, including developing markets. Unfortunately, the assignments typically consist of a badly fitting jigsaw of fragmented blocks arising from the piecemeal award of spectrum, historical spectrum policies and mergers and acquisitions within the market.

Existing spectrum assignments often reflect the needs of legacy technologies

Existing spectrum assignments often reflect the needs of legacy technologies such as 2G and 3G for which smaller channel sizes were the norm. The continuing importance of 4G in developing markets and the growing dominance of 5G in developed markets mean that existing spectrum assignments and band plans are no longer fit for purpose as these technologies are best deployed in wide, contiguous blocks of spectrum.

Some bands are becoming ever closer substitutes for each other

Spectrum bands are increasingly substitutable

Some bands are becoming ever closer substitutes for each other. Whilst propagation characteristics will always make 3.5 GHz a poor substitute for 700 MHz this is not the case for bands which are proximate to each other. For example, from a network deployment perspective, 1800 and 2100 MHz are close to perfect substitutes, especially as device support availability is close to identical. Furthermore, it is now the norm that 1800 and 2100 MHz are delivered through the same base station radio hardware. Historic perceived differences in the value of the two bands no longer exist and indeed the median spectrum auction prices for 1800 and 2100 MHz are now close to identical. Triple band base station radios supporting 1800, 2100 and 2600 MHz are emerging, and we are seeing a similar situation with 700, 800 and 900 MHz, and also potentially in the TDD 2300 and 2600 MHz bands.

This increasing substitutability means that mobile operators no longer need to hold spectrum in both the 700 and 800 MHz bands or in both the 1800 and 2100 MHz bands, for example, to be able to compete effectively in terms of network coverage and quality. Regulators should therefore now be less concerned about a concentration of a single band with just one or possibly two operators. Indeed, in Australia, spectrum consolidation in low band has occurred with Optus now owning the entire 2 x 25 MHz of 900 MHz spectrum.

Strategic approach to spectrum renewal

Renewing existing assignments in favour of incumbents is no longer always optimal

The 4G and 5G technological requirement for wider channels and the increased substitutability of bands in similar frequency ranges mean that simply renewing existing spectrum assignment based on existing band plans to the existing spectrum holders is no longer optimal. A more strategic approach is required. The industry should use the renewal process to optimise band plans and assignments to generate the highest levels of spectral efficiency whilst still maintaining the competitive status quo. Opportunities for optimisation include:

- reducing fragmentation;
- increasing the size of contiguous bandwidths available to operators;
- swaps to reduce the risk of passive intermodulation; and
- changes to the band plan to such as moving from a FDD to a TDD band plan in the 2.6 GHz band.

Our research across a range of markets indicates that spectral efficiency gains of up to 40 to 50% can be realised through strategic renewals without the release of any additional spectrum.

Proactive approach to optimising the band plan

Efficiency gains are so large that operators should not wait for the formal renewal process to commence

Whilst a spectrum renewal process offers an obvious opportunity for reviewing existing spectrum assignments, mobile operators can also take a proactive approach to realise the benefits of optimising the band plan earlier. Similar results can be achieved through engaging with other operators and the regulator to identify opportunities for swaps, trades and options for band replanning to deliver win-win-win outcomes for all stakeholders. Identifying these opportunities requires an industry-wide, strategic review of spectrum assignments.

Another approach in optimising existing band plans has been the introduction of and promotion of spectrum sharing by regulators, especially for 5G. A multi operator core network (MOCN) architecture allows two (or more) operators to share base station radios and antennas like a multi operator radio access network (MORAN), but also to share pooled spectrum. This provides four key advantages:

- reduction in Capex by using shared hardware assets – similar to MORAN;

- exploit wider channel bandwidths. In 5G NR channel bandwidths can be as wide as the band itself – thus maximising utilisation of spectrum;
- if two operators have different traffic demand profiles in space, time, or services, a shared channel provides some statistical multiplexing gains, and a corresponding increase in average speeds, peak speeds and capacities; and
- in 5G NR, the dual connectivity (DC) feature set allows devices to connect to 4G assets and 5G assets which may be deployed at different base stations.

Mobile operators should undertake a strategic spectrum review

A Strategic Spectrum Review can identify opportunities for efficiency gains

Coleago has developed a strategic spectrum review service to address the opportunities highlighted in this paper. We recently concluded a review across more than a dozen mobile markets in Africa and identified potential spectral efficiency gains as high as 30 to 40% from optimising existing spectrum assignments. The scope of Coleago's review extended beyond existing assignments and included:

- an industry-wide review of existing spectrum holdings to identify sub-optimal holdings in terms of spectrum assignments for 4G/5G (i.e. in less than 2 x 5 MHz multiples), and fragmented assignments. We explored the opportunities for swaps, trades and potential acquisitions to optimise the spectral efficiency of existing spectrum assignments – we looked for win-win-win opportunities that would benefit all parties as otherwise other operators would have no incentive to cooperate;
- a review of the regulatory conditions of spectrum licences which consider technology and service neutrality, tradable spectrum, and shareable spectrum. We found some countries still restricting certain bands to 2G or 3G and therefore unable to trade which severely restricts potential capacity, as the country moves to 4G and 5G;
- a review of the current band plan and national radio frequency plan, and any regulator spectrum roadmap to identify opportunities for replanning existing bands and to identify the potential for future spectrum release and when the spectrum would be available;
- current and future self-interference risk through a passive intermodulation (PIM) analysis when more of the operator's spectrum in its allocated bands are needed to be transmitted via multi-band radios. For example, defragmenting spectrum assignments and ensuring the optimal spectrum positions can allow PIM-free, multi-band, higher-order MIMO through the same radio and antenna hardware thus maximising capacity;
- a bottom-up modelling exercise that forecast future customer traffic growth (enhanced mobile broadband and fixed wireless access) for the next 15 years and the future site build that would be required to meet the traffic growth based on existing spectrum holdings only and planned network capacity enhancements including refarming of 2G and 3G spectrum, greater sectorisation and higher order MIMO deployments, etc;
 - we studied the evolution of site growth to identify when site build began to accelerate significantly which indicated that the business was facing a shortage of spectrum and a 'capacity crunch'; and
 - next, we combined our review of the national radio frequency band plan with our traffic and site growth projections to identify which spectrum bands, in which quantities and when would be needed to alleviate the need for un-economic site builds – we developed three alternative future spectrum scenarios;
- current and potential future interference risks especially in border areas due to lack of band harmonisation and service assignment. For example:
 - some countries have adopted FDD 2600 MHz band plan, some have adopted TDD 2600 MHz, some have not adopted anything yet. This primarily impacts

border areas, but services can be significantly impacted hundreds of kilometres away in regions having tropospheric propagation conditions;

- analogue TV switch-off and transition to digital terrestrial TV (DTT) has moved at different paces in different countries, with some actively looking to issue 600 MHz and some who still have TV broadcasting in the 700 and 800 MHz bands. Again, border areas are most susceptible and areas which might have higher levels of anomalous propagation;
- identification of assigned spectrum which may be more or less suitable for carving out for non-terrestrial networks (NTN) use. This is an area of intense interest, especially as emerging NTN providers are now able to relay an operator's spectrum from LEO satellite constellations. However, different portions of the spectrum may have different value as NTN or may have different interference risks to/from neighbouring countries and operators in both uplink and downlink.

In addition, the review looked at the cost of spectrum:

- where possible, we compared the price paid by the operator for spectrum with auction benchmarks to determine whether the market was a high or low spectrum cost market;
- we also calculated the total cost of spectrum ownership, taking account of upfront fees and annual spectrum usage fees, and expressed this as a proportion of revenue to compare total spectrum costs across the different markets; and
- the cost of future spectrum needs based on adjusted spectrum auction benchmark prices.

Finally, we compared the regulatory regime with best practice across a range of topics related to spectrum which included the renewals process, new spectrum assignment, technology and service neutrality, swaps and trading, active network sharing, spectrum sharing and a future spectrum roadmap. Based on the analysis we provided recommendations for priorities in terms of a regulatory engagement strategy.

Summary

Existing spectrum assignments are not efficient and the costs of acquiring new spectrum are increasing, especially for capacity bands. Mobile operators should therefore optimise their existing spectrum holdings before seeking to acquire additional spectrum. Operators can either wait for the renewals process or take a proactive approach and conduct a strategic spectrum review to benefit from efficiency gains earlier.

About Coleago Consulting Ltd

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