Insights from a strategic spectrum review

Opportunities for optimising existing spectrum assignments and the need for future spectrum

By Graham Friend

January 2025

coleagoconsulting

Insights from a strategic spectrum review

Introduction

Spectrum assignments typically consist of a badly fitting jigsaw of fragmented blocks

The mobile industry has been constantly asked to invest in new spectrum over the last 35 years. A multitude of new frequencies have been assigned since the original awards of spectrum in the 850 / 900 MHz range in the late 80s and early 90s. Today mobile operators in Europe, for example, have a portfolio of spectrum assets that typically encompass 700, 800, 900, 1500, 1800, 2100, 2300, 2600, and 3400-3800 MHz bands. In the US the operators are managing 600, 700 PCS, AWS, AWS-3, 3700-3980, CBRS and 3450-3550 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 and historical spectrum policies.

Furthermore, 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.

A Strategic Spectrum Review can identify opportunities for operators to engage in swaps and trades to optimise existing assignments, delivering win-win-win outcomes for not only multiple operators but also the regulator for whom an efficient allocation of spectrum is often a public policy objective. In many cases, existing spectrum licences are facing renewal and the renewal process offers regulators an opportunity to optimise existing holdings. However, even after optimising existing spectrum holdings, significant amounts of additional spectrum will be required earlier than many operators and regulators think.

In this paper we share the key insights from a recent Strategic Spectrum Review that we conducted across multiple developing markets.

Strategic spectrum management

An operator's portfolio of spectrum assets represents their most critically important strategic asset

An operator's portfolio of spectrum assets represents their most critically important strategic asset, especially now that many operators have sold their towers. Mobile operators should ensure that:

- they optimise existing spectrum assignments to deliver the maximum levels of spectral efficiency;
- they engage early with the regulator to ensure that the renewal process does not present a risk to the business but an opportunity to further optimise spectrum assignments (and to align the cost of spectrum with the challenging financial realities of the mobile industry today);
- they understand what their future spectrum requirements will be in terms of which bands, in which quantities and when; and
- they engage with the regulator now to ensure that future spectrum is made available on a timely basis and with an appropriate band plan.

Coleago developed its Strategic Spectrum Review service in order to help a developing market client address these four fundamental issues. We recently concluded the review of more than a dozen mobile businesses and the results were fascinating.

Coleago's Strategic Spectrum Review

A Strategic Spectrum Review is key starting point for developing a spectrum strategy

The scope of Coleago's review was as follows:

- an industry wide review of existing spectrum holdings to identify 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 current band plan and national radio frequency plan to identify opportunities for replanning existing bands and to identify the potential for future spectrum release and when the spectrum would be available;
- Passive Intermodulation (PIM) risk analysis of existing and potential future spectrum assignments;
- 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 re-farming of 2G and 3G spectrum, greater sectorisation and higher order MiMO deployments, etc;
- we then 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 build – we developed three alternative future spectrum scenarios.

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 finally
- 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.

Results from Coleago's Strategic Spectrum Review

Existing spectrum assets

We identified significant inefficiencies in existing spectrum assignments

In every market that Coleago studied we identified significant inefficiencies in existing spectrum assignments. Operators typically held a "mish-mash" of bands and fragmented blocks which were not optimised for 4G and 5G. The assignment reflected the piecemeal manner in which spectrum was historically released; the needs of the dominant technology at the time of release (i.e. narrower bands for 2G); and the more fragmented nature of the mobile market in the past with a larger number of operators as well as smaller operators including WiMAX and similar players. Coleago estimates that through a series of trades, swaps, potential acquisitions and re-planning of bands

from FDD to TDD (e.g. in the 2.6 GHz band), spectral efficiencies within existing spectrum holdings could be improved by between 10 and 30%.

These existing inefficiencies have wider implications as well. The disparate and fragmented assignments have meant that the 3GPP needs to specify 100's of block and band combinations for both 4G and 5G Carrier Aggregation and for 4G-5G Dual Connectivity configurations. This means not all devices support all band combinations thus limiting the ability for consumers to benefit from all of an operator's deployed spectrum.

A further consequence of sub-optimal existing spectrum assignments is reduced spectral inefficiencies arising from self-interference risks such as PIM, especially in low bands, including limiting the ability to exploit higher-order MIMO to enhance capacity.

With the timing of future spectrum releases uncertain in many markets and the continuing tendency of some regulators to seek high prices for spectrum when it is released, our study suggests that operators can materially reduce the need for expensive, new spectrum by seeking to optimise their existing spectrum assets.

Renewals process and optimisation

The renewal process offers an opportunity to optimise spectrum assignments

Many of the bands originally assigned for 2G and 3G, bands such as 900, 1800 and 2100 MHz are increasingly up for renewal. The renewal process offers a further opportunity to optimise spectrum assignments to achieve large, contiguous assignments. Device availability used to play a significant role in determining the value of different bands however today such differences are much less pronounced. For example, there is no material difference in device availability between 1800 and 2100 MHz and so these two bands can increasingly be seen as close to perfect substitutes. Operators no longer require holdings in both the 1800 and 2100 MHz bands and so regulators can use the renewal process to ensure that market players can be allocated large, contiguous blocks of spectrum within the same band without compromising competitiveness considerations. The same argument can be made in low-band spectrum as well, 800 and 900 MHz are increasingly inter-changeable. As an example, Optus in Australia holds the entire 900 MHz band which is ideal for delivering a 5G/NR25 channel in the future, thus maximising spectral and coverage efficiencies.

Traffic growth and future spectrum requirements

Our study revealed a combined compound annual growth rate of over 20% for the next 15 years

Unlike some highly developed mobile markets where the rate of data traffic growth is beginning to slow considerably or even show signs of decline, the developing markets in our study all revealed high levels of continued growth. Our study revealed a combined compound annual growth rate of over 20% across all markets for the next 15 years.

The high level of growth was driven by the high proportion of customers who today still only have a 2G only device, migrating directly to 4G and existing 4G customers slowly migrating to 5G. It was interesting to note that 3G only device owners represented a small proportion of the base. The evolution of device ownership means that 4G will remain the dominant source of traffic until 2030 after which 5G becomes dominant and then continues to grow significantly. The continued dominance of the less spectrally efficient 4G technology in the short and medium term is what drives the need for significant additional site build in the absence of new spectrum.

Our modelling indicated that nearly all the operators within our study would face a capacity crunch within the next four years although the capacity situation would not be critical for the majority until 2027 and 2028. In the absence of any new spectrum, we estimate that the operators would need to more than double the size of their existing site portfolio by the end of the forecast in order to meet demand.

Future spectrum would be needed to mitigate excessive new site build and in our mid-case for new spectrum acquisition, the typical operator would need between 100 and

150 MHz of additional spectrum within the next five years. In some cases, this would represent more than a doubling of existing spectrum holdings. If the operators were able to acquire this quantity of spectrum, it would reduce the required future site build by around 70%.

Spectrum costs

Our study revealed that the annualised total cost of spectrum ownership was generally relatively low

Our study revealed that the annualised total cost of spectrum ownership was generally relatively low and typically less than 5% of revenue. Total spectrum ownership costs were generally higher where regulators had used auctions to assign spectrum. However, with significant amounts of new spectrum required in the future, the cost of spectrum ownership is likely to increase and operators should continue to lobby for low spectrum prices to ensure operators can continue to earn a reasonable return on their invested capital.

Significant opportunities for improving the regulatory environment

The greatest opportunities for improvement were in creating the scope for effective secondary market spectrum trading and swaps

Our survey of regulators revealed some interesting insights. Regulators generally scored well in relation to technology neutrality but where licences remained technology specific it represented a major challenge for the operators and resulted in a major loss of efficiency and consumer benefits. The renewals process was also generally well-defined and new spectrum was also released in a sensible manner. The greatest opportunities for improvement were in creating the scope for effective secondary market spectrum trading and swaps which would allow operators to address many of the inefficiencies we identified. Spectrum sharing regulations and to a lesser extent, active network sharing, were also areas which could be improved. One of the greatest concerns was the absence of a well-defined spectrum roadmap for many regulators. This was particularly alarming given the need for significant amounts of additional spectrum in the next four to five years.

Conclusions

Coleago's Strategic Spectrum Review is an essential tool for mobile operators to manage spectrum related risks

Capacity concerns will increasingly dominate the need for additional spectrum in the next five years if excessive, costly and environmentally unfriendly site build is to be avoided. Our study of spectrum prices (Spectrum Auction Price Trends, March 2023 – available on request) revealed that whilst the price of low frequency "coverage" bands was declining, the price for mid and upper frequency "capacity" bands was increasing. Operators have the opportunity to reduce their reliance on potentially expensive new spectrum awards by optimising their existing spectrum assets through swaps, trades and a well-managed renewals process.

Coleago's Strategic Spectrum Review is an essential tool for mobile operators to manage spectrum related risks, optimise existing spectrum assets and understand future spectrum requirements and their likely cost.

About Coleago Consulting Ltd

Graham Friend, M.A., M.Phil., (Cantab), ACA, is an economist, an award-winning author and the Managing Director and Co-Founder of Coleago Consulting. Coleago is a specialist telecoms strategy consulting firm and advises regulators and operators on issues relating to spectrum, regulation and network strategy. If you would like to discuss any of the issues raised in this paper, then please contact Graham.

Email: graham.friend@coleago.com

Mobile: +41 798 551 354