

Stirred, not shaken: a recipe for reassigning spectrum

From here to eternity?

Mobile spectrum licenses granted 15 to 20 years ago are nearing expiry in many countries. Current licensees have well-established market positions with little expectation of new entry.

Unsurprisingly, many mobile operators argue for extending their existing licenses or reassigning new licences to them directly rather than re-auctioning spectrum from scratch. They claim that demand for such spectrum is limited to current licensees who have already designed their networks for the spectrum they have. If those operators are not interested in acquiring a different spectrum portfolio and there is no potential for entry, then there is no contention and no need for competitive processes to reassign frequencies. Furthermore, they argue that competitive reassignment could disrupt current services if existing operators failed to secure frequencies needed for business continuity, negatively affecting consumers and weakening downstream competition.¹

There is clearly a strong public policy case for avoiding service disruption and ensuring business continuity. Equally, it is naïve to presume that, in such a dynamic industry, spectrum assignments made 20 years ago will remain optimal in perpetuity. Maintaining services does not mean precluding limited adjustments to spectrum holdings; indeed, expiring licence terms offer an ideal opportunity for such adjustments.

Is spectrum contested?

Whilst new entry into mature mobile markets has been rare, there are examples of new players coming into the market (such as Imagine in Ireland or 1&1 in Germany). The possibility of new entry should therefore not be dismissed out of hand, especially in fixed wireless markets.

However, more importantly, even where new entry is unlikely, current licence holders could have conflicting spectrum needs. Past acquisition of spectrum was driven by bidders' *expectations* about business and technology development at the time of the award. It would be surprising if no licensee were interested in subsequent adjustment of spectrum holdings in light of actual developments. Equally, an operator might have plans to offer new services or to build market share, which might require additional spectrum. Even if operators retain the same overall amounts of spectrum, there may be opportunity for defragmentation, allowing larger contiguous holdings within individual bands better suited to the latest technologies.

Such adjustments could in theory be made through spectrum trading. However, though trading is permitted in many jurisdictions, there are many practical impediments to realising gains from trade: markets are thin and potential trading parties may fail to identify each other; even simple bilateral trades may not complete if parties bargain too hard; and some spectrum rearrangements might involve three or more parties, adding complexity.

¹ Some additional arguments put forward against using a competitive process are: that this would create uncertainty over future spectrum holdings, which could discourage investment; that auctions would just result in high auction fees, soaking up funds that could otherwise be spent on investing in new technology; and that a competitive process is unnecessary because any potential efficient changes to current assignments can be resolved by spectrum trading. However, these arguments against the use of competitive processes and pricing have been put forward more generally, not only in the context of licence renewals, and seem to be driven mainly by an (unsurprising) interest in avoiding fees. Whilst arguably one should not load the industry with unnecessary costs, in this note we focus on the trade-off between mitigating the risk of service disruption and allowing the market to determine a potential reassignment of frequencies to allow for a more efficient use of this scarce resource.

Opting for a direct re-assignment or an extension of licence terms without first assessing the scope for conflicting demands on spectrum risks unreasonably restricting entrants, preventing expansion by incumbents and stopping efficient spectrum rearrangement. However, there is no ready means for spectrum authorities to determine whether there is such excess demand without inviting prospective spectrum users to state their needs.

Reconciling conflicting objectives: a bit of this, a bid for that

Given the potential for conflicting demands, there are strong arguments that competitive mechanisms still have a role to play in the re-assignment of legacy spectrum by revealing true demands and allowing adjustment of spectrum portfolios. At the same time, incumbent operators have legitimate needs for business stability. How should these two conflicting objectives be reconciled?

An automatic renewal or re-assignment of all spectrum that becomes available upon licence expiration rules out changes in spectrum allocation at the margin, regardless of whether fees are levied (as in Germany² or in the UK³) or new obligations placed on coverage or network upgrades (as in Portugal or France). Re-auctioning all spectrum, on the other hand, might expose existing licence holders to the risk of failing to re-acquire sufficient spectrum for service continuity, possibly even forcing an existing operator out of the market. If spectrum is very valuable for existing operators, the risk of such detrimental outcomes is low in typical open auction formats used for spectrum awards, but it is not zero. Furthermore, even if an incumbent being pushed out by new entrants is not very likely, there is also

a risk that some incumbents might expand their demand with the aim of denying spectrum to a competitor, reducing the number of effective competitors in the downstream market.

An obvious solution to mitigate the risk that existing users might lose access to the minimum bandwidth they need for business continuity is to reserve some of the spectrum for incumbents but use a competitive process to assign the rest. This can be done in several ways:

- Some spectrum could be assigned administratively and some assigned competitively, e.g. through an auction.⁴
- All available spectrum could be offered in a competitive award process, but subject to spectrum caps that are sufficiently tight to create implicit reservations incumbent operators if there is no new entry.
- The spectrum could be awarded in a competitive process that includes a limited number of 'spectrum portfolios' deemed sufficient to protect business continuity, with applicants being able to bid for at most one of these portfolios. This was the approach taken in the 2022 Belgian 5G auction (see below).

Where the legacy spectrum comprises frequencies in multiple bands, the last two options give more flexibility, as portfolios and caps may be specified across several bands. This supports greater restructuring of spectrum holdings that might be desirable in response to technological developments supporting wider carriers. Conversely, a pre-determined split into administratively and competitively assigned spectrum is essentially a special case of the portfolio approach, but one where the spectrum

² The five-year extension of the licences acquired by the MNOs in the 2010 digital dividend auction announced by BNetzA in 2024 came with an assignment fee of EUR 800 million in addition to obligations for extending coverage and sharing spectrum and extending roaming with 1&1 (see <https://5gobservatory.eu/germany-to-extend-mobile-spectrum-licences-by-five-years/>)

³ In the UK, licences typically do not have a fixed term but allow licensees to use the assigned spectrum indefinitely, subject to compliance with regulatory conditions. Annual licence fees are payable after an initial term if users wish to continue using the spectrum. Ofcom retains the right to revoke or modify licences under certain conditions and will set fees that are intended to reflect the economic value of the spectrum.

⁴ This corresponds to the description of 'partial renewal' as a 'hybrid process in which part of the spectrum is awarded via administrative renewal whilst the remaining spectrum is awarded via a competitive award process' (see Aetha, Ensuring European spectrum renewals are aligned with Digital Decade targets, Report for Ericsson, October 2022).

manager also decides what spectrum is assigned to each existing user.

Any of these approaches requires assessment of how much spectrum existing licence holders genuinely need to continue their services without material disruption.

Tight spectrum caps to create implicit reservations

Spectrum caps are widely used to prevent excessive concentration of spectrum holdings. However, tight caps can also be used to guarantee that a minimum number of bidders can have access to a minimum amount of spectrum. Nevertheless, this use of tight caps can lead to excessive restrictions:

- First, tight spectrum caps might leave spectrum inefficiently unsold if there is deficient demand. For example, to ensure that at least three bidders will be able to win some minimum amount of spectrum, then caps must be tight enough to ensure that two bidders acquiring up their caps would still leave enough spectrum for the third. However, if only two bidders participate, then the spectrum effectively reserved for a third bidder will go unsold.
- Second, because spectrum caps limit the amount of spectrum each individual bidder can win, they may need to be excessively tight to leave enough spectrum for a single bidder if every other bidder bids up to the cap. Such tight caps may prevent reasonable splits of the available spectrum, especially if spectrum needs of different bidders are asymmetric (for example because of differences in market share or technologies used).⁵

Offering spectrum portfolios for business continuity

An alternative to tight caps is to offer a number of pre-defined spectrum portfolios deemed sufficient spectrum to ensure business continuity, under the restriction that each bidder can acquire at most one of these portfolios. Any remaining spectrum would then be auctioned in the form of smaller blocks.

Depending on the available frequencies, these portfolios may include spectrum across several bands and may even be defined in a flexible way, offering alternative configurations across bands so that bidders can select their preferred one.

Depending on the auction format, portfolios and smaller spectrum blocks could be offered simultaneously. Alternatively, spectrum portfolios could be offered in a preliminary stage, followed by a second stage in which all the remaining spectrum (including spectrum associated with any portfolios that may have remained unsold in the first stage) is offered, potentially without spectrum caps, or subject to much looser spectrum caps.

Using separate stages can simplify the mechanics of the process and well as bid strategy. The 2022 Belgian 5G auction provides a good example of this multi-stage approach (see box below).

One advantage of the spectrum portfolios approach relative to direct renewal of licences is that, rather than simply replicating current spectrum holdings, portfolios could include larger blocks in fewer bands. This could defragment existing assignments and provide greater spectral efficiency with new radio technologies. As only some of the spectrum would be offered in the form of portfolios, there is also scope for varying the overall distribution of spectrum within pre-defined limits.

⁵ For instance, suppose 2x70 MHz is available and we want to ensure that at least three bidders can each obtain at least 2x20 MHz. This requires a cap of 2x25 MHz on each bidder. Such a cap would prevent an outcome in which one bidder obtains 2x30 MHz and the other two 2x20 MHz each, which could be a reasonable split if bidders have different needs and would still be consistent with ensuring that three bidders have access to 2x20 MHz. However, setting a looser cap of 2x30 MHz, would guarantee only 2x10 MHz for a third bidder.

An example for the definition of spectrum portfolios: the Belgian 5G auction

Procedure A of the Belgian 5G auction of 2022 included both legacy spectrum in the 900, 1800 and 2100 MHz bands; and new spectrum in the 700 MHz band. Each incumbent operator had the option of taking a pre-defined spectrum portfolio at a set price. The size of the portfolio depended on whether there was new entry. If there was interest from new entrants, there would also be a single pre-defined portfolio available for new entrants (subject to competition if more than one entrant was interested in acquiring this portfolio).

- Without new entry, portfolios would include at most 2x10 MHz in the 900 MHz band (exceeding the pre-auction holdings of Telenet); 2x20 MHz in the 1800 MHz band; and 2x10 MHz in the 2100 MHz band. The portfolios would include almost 60% of the available spectrum in these bands.
- With new entry, portfolios would include 2x5 MHz less in both the 900 and 1800 MHz bands. However, in this case, a spectrum portfolio would be set aside for new entrants, comprising 2x5 MHz in the 900 MHz band; 2x15 MHz in the 1800 MHz band; 2x5 MHz in the 2100 MHz band; and 2x5 MHz in the 700 MHz band.

The remaining spectrum would be offered in an auction, along with any spectrum from portfolios that had not been taken up.

Prices for portfolios were calculated by adding up the reserve prices of the individual blocks included in the portfolio (and turned out to be slightly below the sum of starting prices, as these had to be rounded to multiples of EUR 10,000).

In the event, the auction for incremental spectrum took 99 rounds to complete. Prices more than quadrupled in the 1800 and 2100 MHz bands and tripled in the 700 MHz band but barely increased in the 900 MHz band.

In contrast to the blunt instrument of tight spectrum caps, spectrum portfolios can provide more fine-grained control and a greater range of options.⁶

In addition, potential distortions of bidding incentives are reduced. With any auction format that uses a pay-as-bid pricing rule and achieves (largely) uniform per-block prices, bidders have an incentive to moderate their demand if this results in lower expected prices. This is because

competition for incremental spectrum drives up the price of all blocks a bidder wins, including the portion that is effectively uncontested under tight caps. As a result, bidders may suppress their true demand for incremental blocks, and the outcome may be inefficient, with marginal lots not being assigned to those bidders who value them most.⁷ If portfolios are offered separately at a separate price, these prospective savings from suppressing demand for incremental spectrum only apply to additional lots, but not to spectrum portfolios, whose price is unaffected by competition for incremental spectrum. Incentives to suppress demand for incremental blocks to moderate prices are much reduced.

Competition for the pre-defined portfolios will be limited unless there is interest from a potential new entrant. There may be some competition if portfolios differ in their composition or if there are additional obligations (such as extended coverage or access obligations) linked to some of them. However, the potential for competition for portfolio will typically be limited by because of the objective is to safeguard business continuity. Indeed, it may indeed be necessary to restrict access to portfolios to existing operators to achieve this. However, even if competition for portfolios is open to new entrants, the use of portfolios guarantees that in the case where an entrant outbids an incumbent operator such an entrant will have access to sufficient spectrum to be an effective competitor downstream, so we can expect a replacement of an incumbent by the entrant rather than a reduction in the number of competitors downstream.

Pricing of portfolios

Given that competition for portfolios is limited – possibly even by design – the question then becomes at what price they should be offered. Whilst the need to promote business continuity necessarily shelters incumbents from competition for spectrum to some degree, this should not give

⁶ For instance, in the above example of 2x70 MHz of available spectrum, we have seen that it is not possible to set caps to achieve an outcome in a three-bidder case where every bidder obtains at least 2x20 MHz without also precluding a possible split where one bidder acquires 2x30 MHz. However, using portfolios, this objective could be straightforwardly implemented.

⁷ There is an argument that this may be beneficial because it should result in a more symmetric distribution of spectrum. However, if ensuring a symmetric distribution were an objective, then it is not clear that using a competitive process in which bidders can express their demand for marginal lots is the most appropriate mechanism for determining the assignment of lots.

large windfall gains to incumbents compared to other, more conventional approaches (such as setting renewal fees to reflect the economic value of spectrum). Portfolios should be priced appropriately to avoid outcomes that would be difficult to justify from a public policy perspective.

One option is to link payment for spectrum portfolio to the prices set by competition for incremental spectrum. However, this approach has several problems:

- First, operators must decide whether to accept the assignment of such portfolios without knowing the price, which is set only later. This may be procedurally problematic.
- Second, as the auction price also affects the price payable for the portion of spectrum exposed to limited (if any) competition, there would be similar incentives to reduce demand for incremental spectrum to keep prices low, just as with using implicit reservations created through tight caps.
- Finally, the value of incremental spectrum may materially differ from that of portfolios, so the price of incremental spectrum may be a poor reflection of the value of spectrum assigned through portfolios.

It may, therefore, be more appropriate to set a separate price for portfolios. This may involve a premium relative to the reserve prices set for incremental spectrum (and potentially even over the expected price for such marginal blocks). However, in setting the price for portfolios, too high a premium risks applicants rejecting the portfolios and taking their chances in the competitive process in the expectation of obtaining a lower price – unless this loophole is closed by making further bidding opportunities contingent on having applied for a portfolio.

An alternative option is to link the award of portfolios to additional obligations, such as obligations to extend coverage, improve service quality or provide access for MVNOs. This mirrors the approach taken in jurisdictions such as Germany where licences have been extended in

exchange for taking on additional obligations on top of the fees payable for extension.

Flexible composition of portfolios

When spectrum in multiple bands is available for re-assignment, portfolios could be offered with flexible configurations. For example, one could define portfolios as a given bandwidth across a range of bands and let each applicant specify the division across bands.⁸

In this case it may be necessary to ask applicants to specify multiple options and express their preference through bids for the different options to resolve conflicting demands and using a second price approach to resolve preference conflicts efficiently.

The example on the next page provides an illustration.

Conclusions

It is possible to balance providing business continuity for existing operators and the potential benefits for allowing adjustments in spectrum holdings at the margin. Offering basic spectrum portfolios aimed at providing service continuity by incumbents is a good option:

- Portfolios are likely to be subject to limited competition, especially if there is no serious attempt at large-scale entry. However, if there is entry, portfolios ensure that an entrant can secure enough spectrum to impose the competitive pressure that might otherwise be lost.
- Remaining spectrum outside these portfolios can then be offered with little or no restriction. This provides for market-determined outcomes with some guiderails. Defragmentation of spectrum holdings is possible to allow larger contiguous blocks of spectrum within a band, supporting wider channels and more spectral efficiency in services.

⁸ For example, the portfolios offered to incumbents in the Belgian 5G auction could have provided for incumbents to be assigned 2x35 MHz across the higher frequency bands and asking on application for the preferred distribution across 1800 and 2100 MHz.

Resolving conflicts in demand for flexible portfolios

Suppose that we assign spectrum across the 1800 and 2100 MHz bands where 2x75 MHz and 2x60 MHz respectively are available and that three operators can acquire portfolios that include 2x35 MHz across the two bands. If every operator were only asked to specify the preferred distribution across bands and all operators preferred to receive all spectrum in the same band, the assignment of the preferred portfolios would not be possible with the available spectrum.

To address this problem, we would need to ask operators to specify their preferences for all possible assignments, i.e. invite bids for all possible splits of 2x35 MHz across the two bands. We could then select the combination of portfolio bids with the highest value that can be assigned with the given spectrum and set prices so that every operator (and every group of operators) pays opportunity cost.

For example, suppose that we have received the following bids from three operators (X, Y and Z), indicating a preference for having a large endowment in one band compared with a split across both bands:

Portfolio	1800 MHz	2100 MHz	Bid X	Bid Y	Bid Z
A		2x35 MHz	80	60	
B	2x5 MHz	2x30 MHz			
C	2x10 MHz	2x25 MHz			
D	2x15 MHz	2x20 MHz	30	20	40
E	2x20 MHz	2x15 MHz	40	20	50
F	2x25 MHz	2x10 MHz			
G	2x30 MHz	2x5 MHz			
H	2x35 MHz		100	100	100

We cannot award the preferred portfolio to every operator. We can accommodate two operators with 2x35 MHz in the 1800 MHz band, but the third operator would have to be assigned spectrum in the 2100 MHz band. The operator who places the smallest incremental value on being in the 1800 MHz band relative to being in the 2100 MHz band is operator X. The best option is to assign portfolio A to operator X and portfolio H to each of operators Y and Z.

Prices can be set to reflect the opportunity cost of assigning portfolios in line with the winning outcome: Operator X would have been willing to pay an additional 20 to win portfolio H instead of portfolio A, which it would have won in the absence of either of Y or Z. Therefore, each of Y and Z cause an opportunity cost of 20, which is what they would need to pay in addition to the reserve price of the portfolio.

- Offering such basic spectrum portfolios is more flexible than using tight caps, which are blunt instruments. They may not only lead to unsold spectrum if not all existing users bid for spectrum effectively reserved for them but will necessarily impose greater restrictions on potential outcomes in terms of the distribution of spectrum.
- Spectrum portfolios can also reduce incentives for strategic demand reduction by de-coupling the payment for inframarginal spectrum from the prices set through competition for marginal blocks. This is a serious risk in a situation where competition may be limited to incumbents only and the historic spectrum allocation provides a natural outcome that bidders may drop back to. Competition at the margin over limited spectrum rearrangements is then encouraged and is likely to lead to more efficient outcomes.
- Finally, offering such portfolios in a preliminary stage can also simplify bidding mechanics and bid strategy.