



Best practice in spectrum licence renewals

A toolkit for licensing authorities



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1 Summary

Mobile broadband has grown to 2.3 billion subscriptions globally in just over a decade. On current rates more than half the world's population will have a mobile broadband subscription by 2018. The increasing demand for mobile services raises the importance of effective spectrum management and of a regulatory framework that supports ongoing high levels of network investment.

In the next few years, however, many existing mobile spectrum licences will come to the end of their term. In particular, a large number of operators that are supplying mobile services in Africa, Asia, Europe and Latin America have little certainty over whether they will continue to have access to the spectrum that is essential to the services they supply. Unless addressed by licensing authorities, this uncertainty risks deterring investments in extending networks and in deploying new services as well as reducing the incentive for operators to compete more aggressively to grow their customer bases. Consumers may not only be harmed directly but may also miss out on the wider economic benefits of ongoing strong growth in the communications industry.

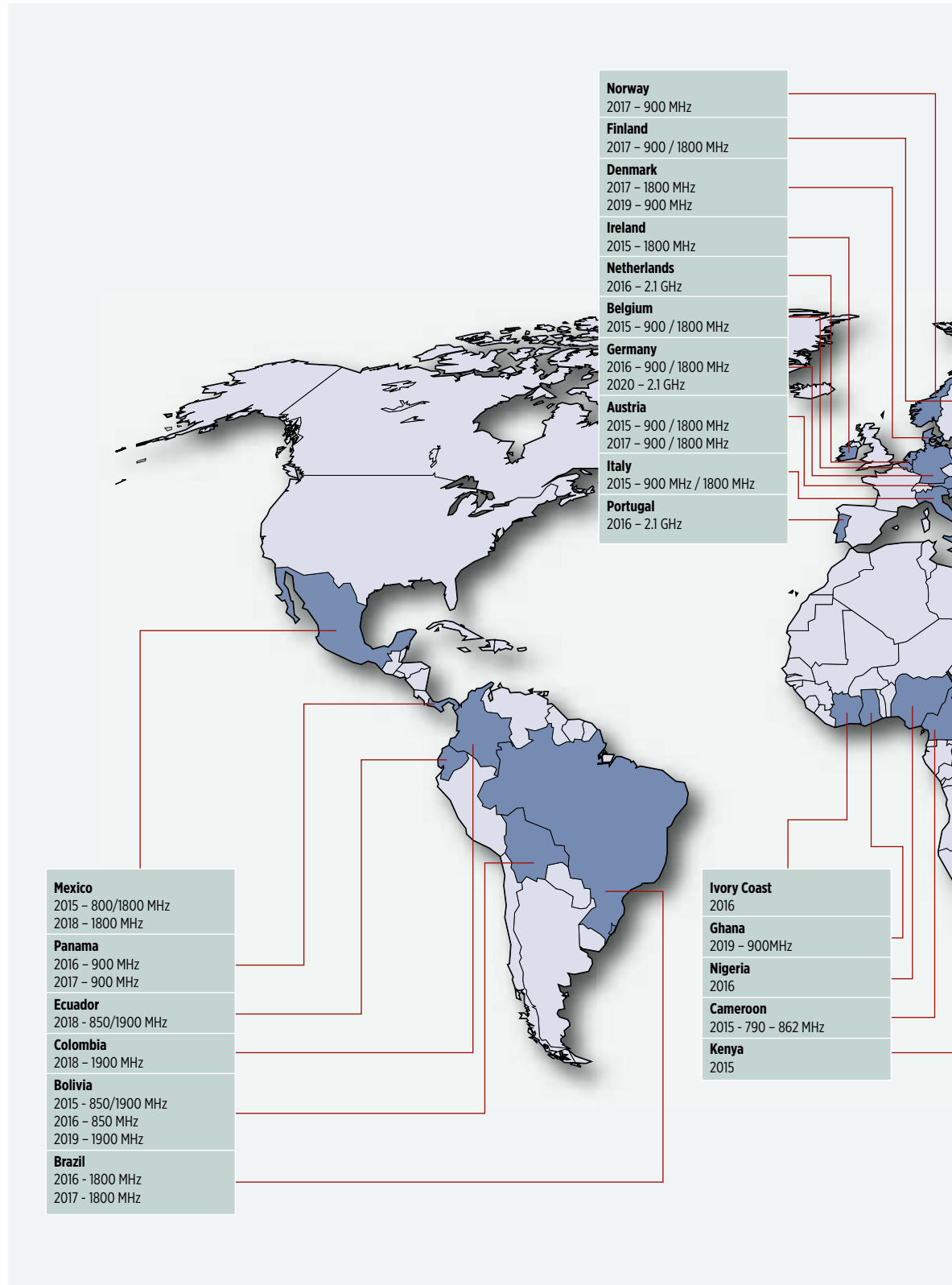
In this report, we set out international best practice in relation to the renewal of mobile spectrum licences. In particular, we identify the range of issues raised by licence renewal, assess the advantages and disadvantages of particular approaches by reference to relevant policy objectives and market factors and put forward a framework for choosing the best approach. While a poor approach to licence renewal can be costly, the renewal of licences also provides an opportunity for the terms and conditions attached to licences to be reviewed. By providing for greater certainty going forward and for the more flexible, market-driven use of spectrum, reforms to the licensing framework can build the foundation for a productive and innovative communications sector into the future.

How should authorities approach licence renewal?

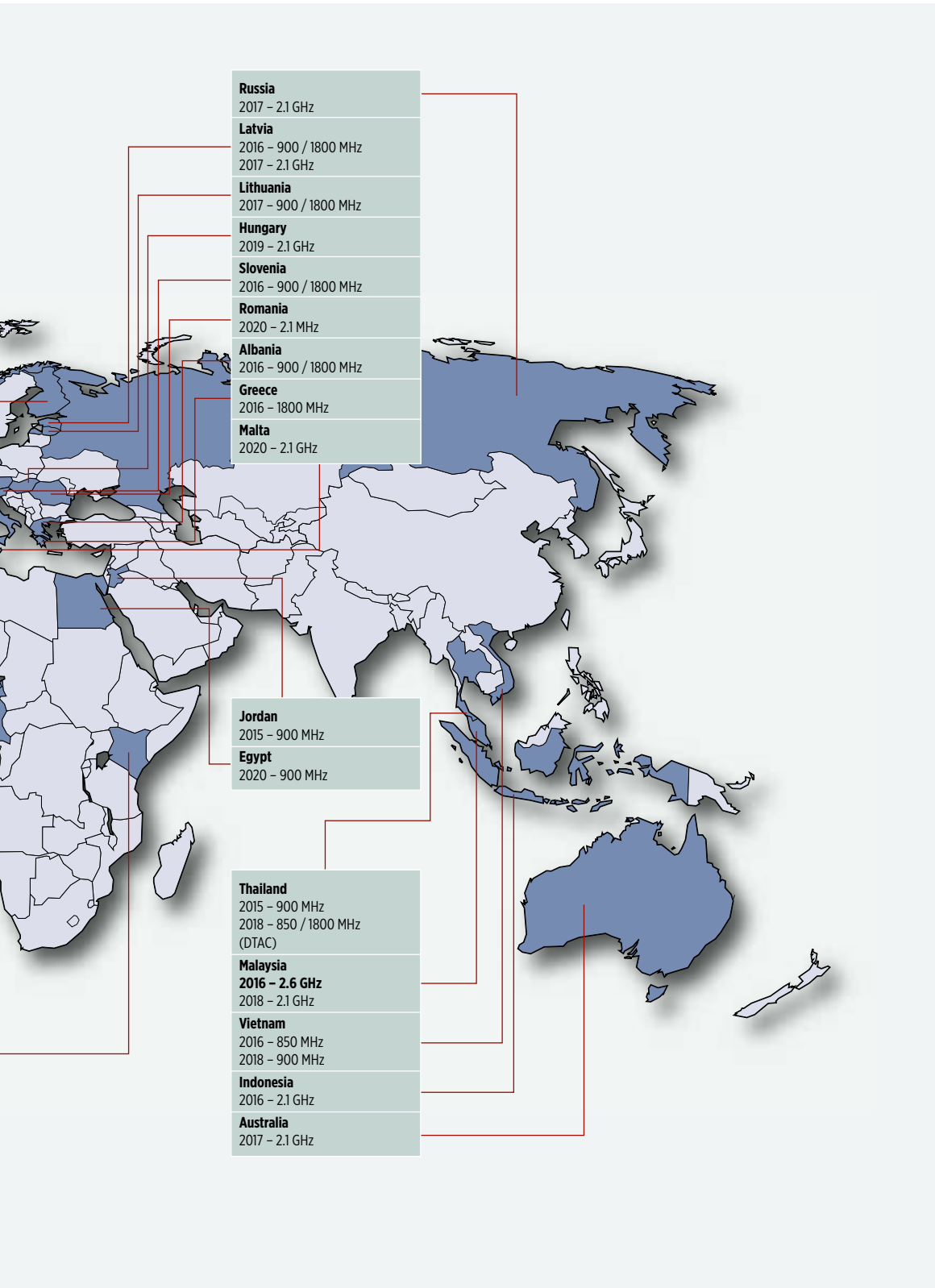
- 1. The best approach to licence renewal will depend on the licensing authority's policy objectives and the specific market circumstances.** There are three fundamental approaches to licence renewal: a presumption of renewal, auctioning and administrative re-assignment. Some regulators have also followed hybrid approaches which combine elements of the other approaches. There will be a strong case for presumption of renewal where spectrum is already likely to be in its best use, the market is effectively competitive and non-renewal would carry risks to investment and service continuity.
- 2. Auctions can be useful where there is uncertainty over the best use of the spectrum.** However, they may bring unnecessary costs where it is clear that the existing licence holder with an established network and customer base will value the licence more than others. Auctions also need to be designed carefully to avoid spectrum being assigned inefficiently or competition in the mobile market being reduced.
- 3. Authorities should follow a predictable, timely and open licence renewal process.** A decision to renew the licence should be made at least four to five years before the current licence expires so as to reduce the risk of investment being reduced or postponed.

- 4. Charges for spectrum use should be limited to recovering the cost of spectrum management where a market-based licensing approach has been adopted.** If spectrum has not been auctioned nor spectrum trading allowed, there may be a case for authorities to also set charges to reflect the opportunity cost of spectrum. There is substantial scope for error in estimating the opportunity cost of spectrum including the risk that benchmarks will not be comparable because of differences in supply and demand conditions. Charges that are designed to reflect opportunity cost should be determined conservatively to avoid valuable spectrum being left idle.
- 5. Licences should be technology and service neutral.** Restrictive licensing requirements exacerbate spectrum scarcity increasing the cost of service provision and delaying the introduction of new, more efficient technology and services. International experience with re-farming provides a guide as to how liberalisation can be carried out in a way that avoids harmful interference.
- 6. Mobile licences should have a minimum 20 year term to provide sufficient certainty to support substantial new network investment.** Predictability can be further enhanced by introducing indefinite licence terms which combine a minimum initial term with ongoing rights to continue to use the spectrum beyond the initial term unless the authority decides to revoke the rights after giving sufficient notice.
- 7. Licence conditions unrelated to avoiding interference should be removed or kept to a minimum.** Competition together with targeted policies can better support coverage and universal access without putting at risk an operator's licence.
- 8. Measures to increase competition should be introduced only after assessing the benefits and costs of alternative options.** Re-assigning spectrum or changing licence conditions to boost competition will only make sense where the market is not already effectively competitive and there is a real prospect of better consumer outcomes. Even then, these measures may create larger costs than benefits such as in removing spectrum from the operators that have the greatest need for the spectrum or an ongoing need for regulation of access arrangements. Alternatives such as releasing additional spectrum or lowering tax and other imposts on the industry may better enable all players to supply lower priced services to customers. Accordingly, we would expect the re-assignment of spectrum for competition reasons to only be used in exceptional circumstances and only after a thorough assessment of the market and of potential alternative measures.
- 9. Voluntary spectrum trading should be allowed so as to promote the efficient use of spectrum over time.** By doing so, trading can support higher service volumes, lower cost and better quality services. Efficient trading should also be supported by a stable and predictable licensing and regulatory framework, long licence terms, licence renewal decisions being made well in advance and a notification process to maintain transparency over spectrum usage rights. Spectrum trades should also be subject to competition law and/or ex ante competition assessments.

EXAMPLES OF FORTHCOMING EXPIRY OF LICENCES



Note: These examples are not exhaustive. The licence expiry dates do not necessarily apply to all operators within the given country and spectrum frequency.



2 Importance of licence renewal

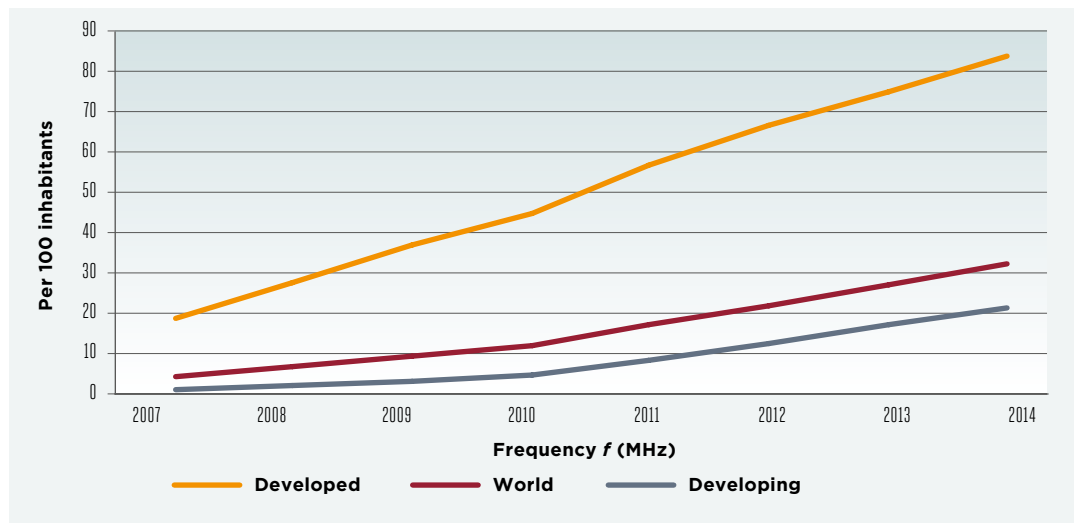
The mobile industry differs from most other industries in that the ongoing right to a critical input is often not guaranteed but subject to periodic reviews by authorities. In particular, many countries continue to license for finite periods the use of the spectrum that operators rely on to provide services. Depending on the approach taken to licence renewal, the consequence may be substantial uncertainty for operators and customers with harmful effects on investment, innovation, competition and efficiency.

Uncertainty over the future right to an important input would be damaging for any industry. The potential impact of uncertainty on the mobile industry is amplified by:

- **The high level of investment required over forthcoming years including for the capacity required by growing mobile broadband customer numbers, increasing data usage per customer, ongoing investment in extending coverage and upgrading networks for new technologies and services; and**
- **The long payback periods required to recoup substantial mobile network investments.**

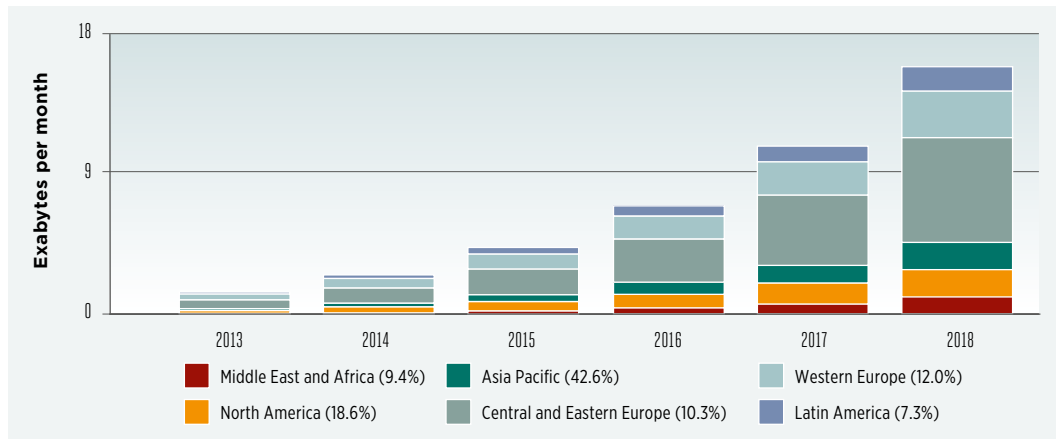
The number of mobile broadband subscriptions is expected to reach 2.3 billion in 2014 with annual growth in developing countries of 26%, now more than twice the 11.5% rate in developed countries.

FIGURE 1 - GROWING MOBILE BROADBAND SUBSCRIPTIONS



Source: ITU World Telecommunication/ICT Indicators database (*2014 estimate)

Mobile subscribers are also using mobile data services more intensely and global data traffic is forecast to grow by more than 10-fold between 2013 and 2018 with large increases in all regions.

FIGURE 2 - RAPIDLY GROWING DATA TRAFFIC VOLUMES

Figures in parenthesis refer to regional share in 2018.
Source: Cisco VNI Mobile, 2014

Mobile operators are preparing to make the large investments required to provide the needed capacity and to extend coverage. The GSMA expects total global investment by mobile operators of US\$1.7 trillion between 2014 and 2020. Ericsson forecasts that LTE coverage will grow from 10% of the world's population in 2012 to over 65% by 2019.¹

Mobile telecommunications is a capital intensive business and requires certainty on the future environment in order for long term investment decisions to be made. Spectrum licences are one of the biggest financial commitments made by operators. Certainty on the continued renewal of these licences is a key prerequisite for operators to make the necessary investments to deliver the networks of the future.

Uncertainty of renewal in Colombia

The experience of licence renewal in Colombia highlights the extreme uncertainty that renewal processes can generate. The 850MHz and 1900MHz licences of Claro and Movistar, which had been renewed in 2004, were due to expire on 28 March 2014. In addition, a court ruling in 2013 provided for the Government to take control of network assets of the operators upon the expiry of their licences. The Government did issue a resolution providing for the licences to be renewed but only on 27 March 2014, i.e. one day before their expiry. The failure of the renewal decision to be made well in advance meant that the operators had to make business decisions without knowing whether they would soon lose access to their main spectrum assets and even their networks.

The lack of advanced notification of renewal also prevented the operators from being able to engage with the Government on the terms and conditions to be applied to the renewed licences. The new licences include significant new obligations and the possibility of restrictions on the marketing of services that apply only to Claro and Movistar and not their competitors. The licences also include a provision for economic consideration which introduces ongoing uncertainty. Consultation on the proposed conditions prior to renewal would have enabled the Government to take into account the operators' concerns over the risk posed by the conditions for competition and the development of the sector.

The forthcoming expiry of a spectrum licence can give rise to three key risks, each of which could lead to a range of negative effects on the sector and on consumers.

Risk from licence expiry	Potential effects
An operator loses access to all its spectrum rights	The complete loss of access to spectrum would leave an operator unable to supply its existing customers or recover the costs of its investments. Even the risk of losing its spectrum rights in the years leading up to expiry would reduce the expected returns of investment (i.e. returns discounted for the probability of non-renewal) and lead to some investments no longer taking place because their expected return is below the cost of capital. Investments to launch new services may be delayed. Operators will also be less likely to cut prices to grow market share if they are uncertain over whether they will be able to serve new customers for a long enough period to recover their acquisition costs. The time taken to re-assign the licence may lead to valuable spectrum being left idle.
An operator loses access to part of its spectrum rights	To manage the risk of losing part of their spectrum rights, operators may redirect investment to providing additional capacity rather than extending coverage, improving quality or deploying new services. If an operator is allowed to retain all its spectrum then this precautionary investment may prove wasteful. The risk of losing some spectrum may also deter an operator from competing more aggressively for customers or from launching new services so as to limit its future need for capacity.
Uncertainty over future terms and conditions	Expected returns to investment depend not only on whether a licence will be renewed but the terms and conditions of the new licence. Economic theory of the 'hold-up' problem shows that the risk that a party may decide to capture a greater share of the return on an investment once it has been made can lead to under-investment. Accordingly, expectations and uncertainty in relation to future licence fees carry significant risks of deterring new investment with consequences for service quality and the timing of access to new services.

In the next two sections, we discuss how licensing authorities can greatly reduce risks by their choice of renewal approach and by following a timely and open renewal process. In section 4, we focus on how authorities should set licence fees. Licence renewal not only carries risks but also creates the opportunity to move towards a more flexible, market-driven licensing approach. In section 5, we examine the case for relaxing restrictions in the use of spectrum. In section 6, we ask under what circumstances would it be sensible for authorities to use the expiry of a licence to seek to inject further competition into the mobile market. Finally, in section 7, we examine how the introduction of spectrum trading together with indefinite or long-duration licences can help maintain the efficient spectrum use over time while avoiding or minimising the risks of licence renewal.



3 General approaches to licence renewal

As an existing spectrum licence approaches the end of its term, should a licensing authority simply renew the licence or, if not, how should they go about determining how to assign the future rights to use the spectrum and on what terms?

The choice of renewal approach can impact multiple objectives

- **Ensuring service continuity for customers**
- **Encouraging ongoing investment and innovation in the industry**
- **Obtaining maximum benefits for society from the use of the spectrum**
- **Promoting effective competition in communication markets and ensuring competitive neutrality between spectrum users**
- **Providing revenues to government**
- **Consistency with the legitimate expectations of affected parties**
- **Achieving a timely, practical and cost effective renewal process**

The extent to which different objectives are affected will depend on the particular market context. In some cases, an authority may be forced to balance competing objectives. Often, however, unnecessary costs are imposed on the industry and consumers by authorities failing to establish a sound, overall framework by which to consider renewal decisions.

What approaches can be applied to licence renewal?

Three fundamental approaches have been applied by authorities to determine future rights to spectrum where existing licences are due to expire. These are:

- **A presumption of renewal** – current licence holders are allowed to renew their licences except under certain defined circumstances which are expected to arise relatively rarely;
- **Auctioning the future rights to the spectrum** – current holders and other potential users are invited to bid for the future rights to use the spectrum; and
- **Administrative re-assignment** – the licensing authority decides to reassign the rights to use the spectrum to another user.

A World Bank report noted in 2006 that presumption of renewal was the most common approach to renewal and it continues to be the approach of many countries. For example, spectrum licences in Canada have a high expectation of renewal, unless a breach of licence condition has occurred, a fundamental reallocation of spectrum to a new service is required or an overriding policy need arises. The US also provides a strong presumption of renewal, but subject to a requirement for the licensee to be providing 'substantial service' to the licence service area. A presumption of renewal can be considered equivalent to the use of indefinite licence terms, such as in the UK for spectrum used for mobile purposes, where the licences can only be revoked after a minimum period on spectrum management grounds and subject to a specified minimum notice period.

Balancing predictability and spectrum management in the UK

As part of its overall review of spectrum management in the UK, Ofcom decided that new licences awarded by auction should generally have an indefinite term and with an initial term in which licensees would have high security of tenure. The initial term would be set taking into account the expected period required for a reasonable return on the investment and was set at 20 years for the 4G licences auctioned in 2013. During the initial term, licences would only be able to be revoked for a narrow range of reasons including breach of licence conditions and non-payment of the licence fee. Beyond the initial term, licensees would continue to have the rights to use the spectrum unless Ofcom decides to revoke the licence on spectrum management grounds after giving 5 years notice.

Ofcom noted that the combination of indefinite licence terms together with the introduction of spectrum trading would best promote investment to enable the efficient use of spectrum and do so in a relatively simple and low cost way. While Ofcom considered that tradability and liberalisation should generally ensure spectrum was being used optimally, the right to revoke licences on spectrum management grounds was retained because of the risk of specific market failures such as coordination problems caused by high transaction costs where a new service requires gaining spectrum rights from multiple current licensees.

Even were licensing authorities to move towards the use of indefinite or long duration licences over time, they would still need to determine what approach to take to existing licences approaching the end of their terms. Auctions and administrative re-assignment are also used frequently and hence it is important to understand what benefits and costs they carry. In examining their relative merits, we also assess the use of hybrid approaches. For example, the Hong Kong Communications Authority decided to renew rights to a part of an operator's spectrum holdings while the other part of the spectrum is put up for auction or re-assignment. Other authorities, such as Singapore's IDA, have offered existing licensees a right of first refusal by which spectrum rights are only auctioned or re-assigned if the existing licensees decide not to renew the rights on the terms offered.

In deciding on the optimal approach, a licensing authority should be careful to identify the different effects that may result from alternative approaches and make an assessment of their likely magnitude in the particular market context. The approach that is best for one set of licences at one time may not be appropriate in a different context.

Approach	Advantages	Disadvantages
Presumption of renewal	<ul style="list-style-type: none"> ■ High predictability supporting investment and the deployment of new services (including business planning and raising capital) ■ Ensures service continuity and minimises disruption to customers and operators ■ Supports ongoing competition ■ Can be used with spectrum trading to maintain efficient use of spectrum over time 	<ul style="list-style-type: none"> ■ In some cases, spectrum may be better re-assigned (eg spectrum replanning, serious breach of licence conditions, or spectrum being left idle or poorly utilized especially if trading is not allowed, or where there is the potential for significant gains in competition) ■ Switching to a presumption of renewal for already auctioned licences may raise concerns of unfair treatment of unsuccessful bidders ■ Regulator will need to determine the level of any spectrum fees
Re-auctioning	<ul style="list-style-type: none"> ■ Transparent and efficient way to assign spectrum to highest value use particularly where there are competing demands for the use of the spectrum ■ A robust auction process enables fees to reflect the market value of spectrum ■ Ensures all operators and potential new entrants an equal opportunity to acquire the spectrum 	<ul style="list-style-type: none"> ■ Introduces uncertainty that can chill investment (risking congestion and delayed access to new services) and deter competition for customers until future rights are decided ■ Authorities need to ensure a robust auction design to avoid spectrum being assigned to parties (including speculators) that are unable to make best use of the spectrum ■ Uncertainty and cost of the auction may be imposed unnecessarily if spectrum always likely to go to licensees with existing networks ■ Auctions that result in high fees may come at the expense of competition in the mobile market either directly in auction design or later if market conditions leave players unviable ■ Customers may lose their existing service
Administrative re-assignment	<ul style="list-style-type: none"> ■ Can be a practical way to re-allocate spectrum between uses ■ Can achieve a particular re-assignment of spectrum for competition reasons ■ Can avoid high spectrum fees of auctions and thereby better support operators' viability 	<ul style="list-style-type: none"> ■ Introduces uncertainty impacting investment and competition and can impose additional costs on customers losing existing service ■ Can be cumbersome, arbitrary, vulnerable to corruption and lead to long disputes ■ Licences may be assigned to the operator that presents an attractive proposal rather than the operator that generate the greatest benefits for society from the spectrum
Hybrid (part-automatic renewal and part re-assignment)	<ul style="list-style-type: none"> ■ Attempts to balance achieving some predictability and some flexibility 	<ul style="list-style-type: none"> ■ Risk of same type of problems as auctioning/re-assignment although potentially moderated to some extent (eg service may continue but with degraded quality) ■ Potential costs in reconfiguring networks ■ Trading off predictability for flexibility would only be beneficial in some circumstances

Assessing renewal approaches in Hong Kong

Hong Kong's Communications Authority (CA) decided in November 2013 to adopt a hybrid approach under which a right of first refusal to existing licensees was offered for two thirds of the spectrum (19.8 MHz each) with the remaining spectrum to be re-auctioned.

After establishing that there was competing demand for the 3G spectrum, the CA assessed whether to re-auction some or all of the spectrum against four criteria.

- **Customer service continuity – modelling was undertaken for the CA and for operators including of potential impacts from loss of existing usage rights on voice call congestion, data download speeds and indoor coverage as well as the practicality and cost of mitigation measures.**
- **Efficient spectrum utilisation – the CA considered that auctioning at least some of the spectrum would promote efficient spectrum use by enabling spectrum to be re-assigned to a higher value use, encouraging existing licensees to review their spectrum use and by enabling an operator to gain a sufficiently large holding to optimise the use of LTE technology.**
- **Effective competition – the CA particularly noted that an auction would provide an opportunity for new entry.**
- **Encouraging investment and innovative services – a number of effects were raised including potential investment of new entrants, incumbents upgrading their networks, realising the full potential of LTE to offer innovative services and, on the other hand, investment being deterred by the uncertainty of the process.**

The CA concluded that a hybrid approach was best overall because it would provide benefits to efficient spectrum utilisation, competition, investment and innovation while the risks in terms of existing services could be managed. The operators believed that the CA had overstated the potential benefits, particularly given the high levels of utilisation of the spectrum and competition in Hong Kong, while it had underestimated the likely harm to service continuity.

While the optimal approach in other markets will depend on the magnitude of the different effects in those markets, the analysis undertaken for the process in Hong Kong shows the range of issues that may need to be considered in deciding future rights to spectrum.

When should a licence not be renewed?

While a decision to not renew some or all of an operator's spectrum rights can give rise to significant costs and risks, in some circumstances reallocating spectrum may result in overall net benefits. There are four type of circumstances where reallocation or reassignment has the potential to lead to net benefits although whether it would be likely to and whether there might be better alternatives would need to be assessed in the specific market context.

Spectrum replanning

Many countries provide for licences to not be renewed where continuing the current use of the spectrum would be incompatible with the planned use of spectrum. The impetus for a change in use of the spectrum may arise from international radiofrequency planning and coordination or from national decisions. Such a provision can be an important means to enable new

technology platforms to be introduced particularly where spectrum management continues to be centrally planned. For example, the change from analogue to digital broadcasting greatly reduces the amount of spectrum needed to supply broadcast content which can free up spectrum for use for other services. The relatively low frequency band of this Digital Dividend spectrum makes it a key means by which societies can achieve widespread coverage for LTE services.

While spectrum replanning may be necessary to support efficient use of the spectrum on an ongoing basis, it is important that the benefits of different uses are carefully assessed and that where a change in use is contemplated, the cost of migrating or terminating the current use is taken into account. Further, spectrum plans should be announced as early as possible to give existing users sufficient notice. Finally, the need for regulatory-imposed spectrum replanning can be reduced by providing existing licensees with greater flexibility over the services for which the spectrum is used.

Poor use of spectrum

A licence may not be renewed where the existing licence holder is considered not to be making the best use of spectrum. Such a provision is often put forward as a means by which to guard against valuable spectrum being left idle or underutilised. While such provisions are reasonable in principle, there is a risk of error where a regulator seeks to assess whether spectrum is being poorly used. For instance, there may be sound economic reasons as to why spectrum is left idle for a period such as when new technology or equipment is expected to become available shortly. In that regard, a regulatory requirement to demonstrate substantial service may encourage operators to behave inefficiently such as by undertaking investments prematurely so as to avoid losing the spectrum.

Breach of licence conditions

Where the licence conditions are made clear at the time of the initial assignment of the licence, then not renewing the licence has been used in response to a breach of a condition. In some cases, a current licence may be revoked before the end of its term such as where the licensee continually breaches the licence's technical conditions causing intolerable interference to other uses.

Given the serious disruption to consumers and risks to investment, non-renewal or revocation of a licence should be used as a last resort. Determining proportionate responses to breaches of licence conditions can raise difficulties for regulators including the importance of fairness to other operators and to bidders who were unsuccessful in acquiring the original licence. Keeping licence conditions to the minimum necessary to manage interference can help avoid these issues arising in the first place.

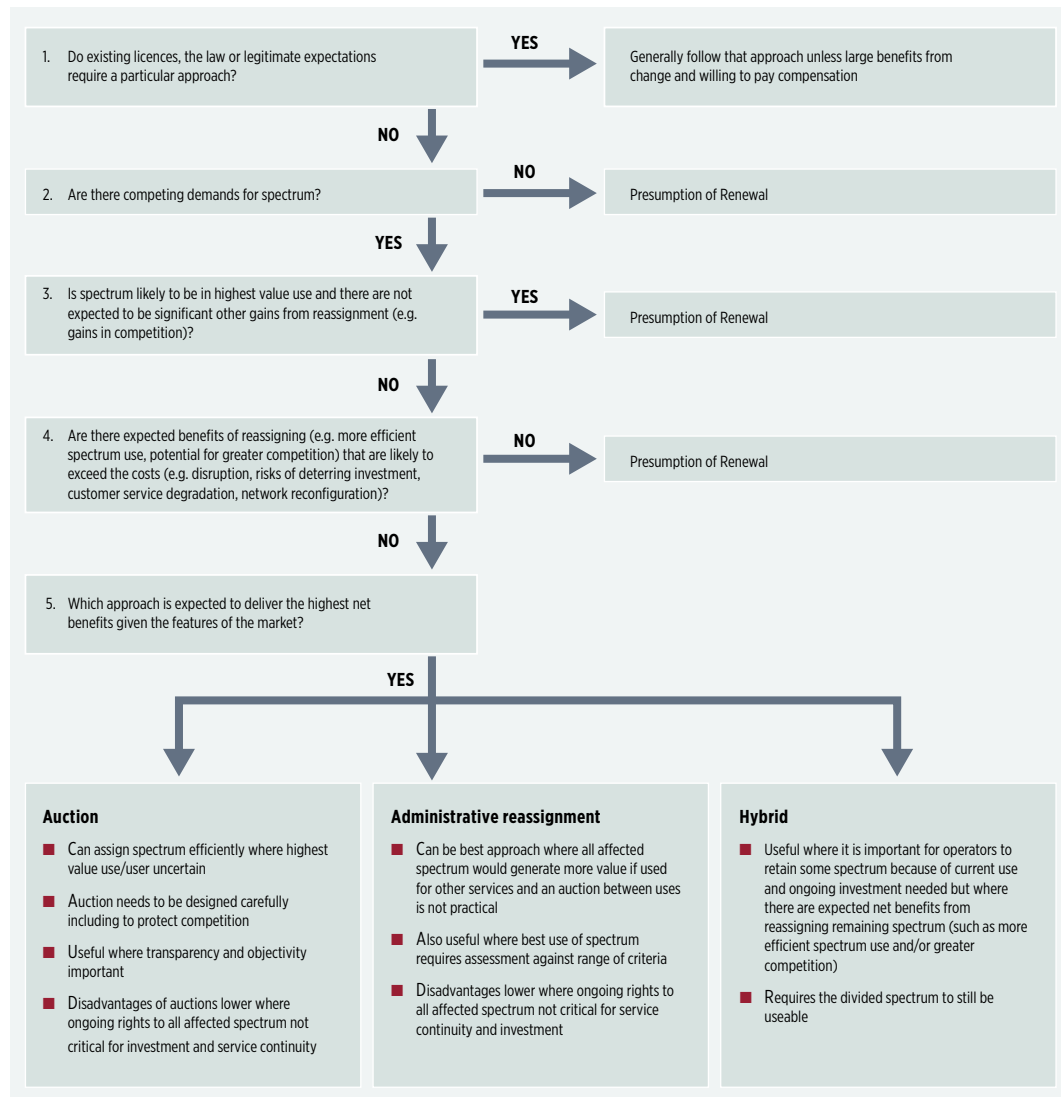
Risk of non-renewal of a licence in Kenya

Kenya's Ministry of ICT had to reassure consumers in May 2014 that Safaricom's licence would be renewed after concerns arose that the renewal might not take place because certain quality of service targets had been missed. There appears to have been issues with both the reliability of the quality of service measures and to the extent the operator was constrained by factors outside its control including limited access to spectrum and whether the high level of licence fees had diverted funds from network investment. Safaricom's licence was successfully renewed in June 2014.

Promoting competition

Another reason that has been used by some regulators for not renewing spectrum licences is where reassigning spectrum is used as a means of promoting competition. We assess the case for doing so in Section 6.

RECOMMENDED FRAMEWORK FOR CHOOSING THE RENEWAL APPROACH



The best renewal approach will depend on both the particular features of the market as well as the weight the authority attaches to competing policy objectives. There is a strong case for providing a presumption of renewal where spectrum is already likely to be in its highest value use, where there is effective competition in the mobile market, where high levels of ongoing investment are needed and where the removal of some spectrum would result in costly disruption and/or harm service quality.

At the other extreme, where spectrum is currently idle or poorly utilised or has been freed up by technological change and there are alternative valuable uses for the spectrum, then the authority may want to consider auctioning the spectrum or reassigning it. Auctions can be efficient and transparent means of assigning the spectrum to the highest value use although they do carry some costs and risks particularly where poorly designed. Administrative re-assignment may be more cost effective where there is a clear, highest value use for the spectrum but this approach is vulnerable to bias or misuse and can lead to protracted disputes.

Hybrid approaches may appear attractive where there is a clear ongoing need for spectrum by the existing licensees but where the regulator believes that there is the potential for substantial gains from re-assigning some spectrum. However, even the risk of re-assignment of some spectrum can create significant costs including in terms of distortions to investment and competition. Accordingly, whether a hybrid approach should be adopted will require a careful assessment of the likely benefits and costs.

Whichever the ultimate choice of approach, there are elements of good practice that can help ensure the decision is soundly based.

- **It is particularly important for authorities to ensure that all available spectrum is released. The release of spectrum help reduce costs and consumer prices, supports competition and minimises any need to take spectrum rights off existing operators.**
- **Choosing between approaches requires identifying the relevant trade-offs specific to that market context. An open, transparent process provides for all affected parties to present evidence on the likely effects and their magnitude. We return to this point in the next section.**
- **The detailed design of the approach matters. The conceptual advantages of any of the approaches can be lost or unnecessarily costs imposed if there are flaws in the process. For example, coordination during auctions may lead to spectrum being assigned on the basis of the ability to gain market power rather than by which operator can best deliver value to consumers. The apparent simplicity of administrative reassignment may not be realised if it results in drawn out litigation. Again, consultation over the design of the approach can help minimise these risks.**

4 A predictable, timely and open relicensing process

While the forthcoming expiry of a licence carries significant risks, the risks can be minimised by authorities adopting a process that follows a number of key principles of best practice. These principles help to avoid unnecessary costs and support more robust decision-making.

Predictability

Minimising uncertainty helps promote investment and efficient business decisions. There is no reason for authorities to delay setting out the overall framework that will be applied to licence renewal, even if the implementation of that framework occurs later. In particular, authorities should specify the approach that will be applied to renewal such as whether there will be a presumption of renewal or, under what circumstances, a licence will not be renewed. The framework should also provide information on the terms and conditions that will apply to renewed licences including how licence fees will be determined and whether any existing restrictions or obligations will be removed. In the event that a licence is not renewed, a minimum period should also be provided for the spectrum to be vacated and what compensation would be paid in the event of a conflict with operators' legitimate expectations.

Operators can also make better decisions as to whether to renew their rights to spectrum if they have good information on the country's overall spectrum plan, including the current assignment of spectrum rights, and a roadmap of planned future releases of spectrum and the introduction of spectrum trading and liberalisation.

A timely decision

The earlier renewal takes place before the date of licence expiry, the lower the risk of investment being reduced or postponed because of uncertainty over the period over which the operator will be able to recover the costs of the investment. A decision to renew the licence should be made at least four to five years before the current licence expires.

Consultation

Determining the best approach is likely to require identifying and weighing up benefits and costs to different industry players and customers for which their input is essential. In Singapore, the Info-communications Development Authority decided to switch from a proposed auction to grant incumbent mobile operators "first rights of refusal" after taking into account information provided during the consultation process on the risks of an auction in disrupting services to customers and increased costs to operators. Setting out the reasons for decisions and providing a right of appeal can also improve the quality of decisions by protecting the rights of affected parties and ensuring decisions are reasonably based.

5 Charges for spectrum licences

What factors should licensing authorities take into account in setting fees for spectrum licences and what approaches exist to determining the appropriate level of fees?

Key considerations in setting licence fees

Efficiency is promoted by prices reflecting costs including the opportunity cost of a resource being used for one purpose rather than in a different use.

Spectrum management does create administrative costs while benefitting spectrum users and it is reasonable that spectrum fees contribute to the recovery of an efficient level of these costs. Where there is excess demand for a particular spectrum band, spectrum prices above administrative costs and reflecting opportunity costs can help ensure that spectrum is assigned to the user that is able to generate the most value to society from its use. For example, in an auction the user with the highest valuation could win the licence by bidding slightly above what the user with the second highest valuation would be prepared to bid for the licence. Thus an auction can lead to the efficient allocation of spectrum with a price being paid for the licence based on the value of the licence in the second best use (which is the opportunity cost of the spectrum being assigned to the highest value use rather than the next best use). Similarly, spectrum trading can promote the efficient allocation of spectrum as the user who can generate the highest value from the spectrum can be expected to buy spectrum from other users by paying them a price at least as high as the value of the spectrum to them. Thus, market-based prices for spectrum will reflect the opportunity cost created by spectrum being assigned to one use.

Where a spectrum licence is to be renewed administratively (rather than by an auction) then the authority may seek to match the efficiency of market-based prices by setting a fee for the spectrum that reflects the opportunity cost of the use of the spectrum. Where there is not excess demand for the spectrum band, then the opportunity cost of the spectrum will be zero. Later in this section, we discuss how an authority can estimate the opportunity cost of spectrum where there is excess demand for the band.

Governments may, however, seek to go beyond an efficient level of charges by using licence fees to raise revenues. If a Government set charges at a very high level, then valuable spectrum may be left idle. For example, in the Digital Dividend auction in Australia in 2013 the level of reserve prices set by the Government led to one of the three Australian mobile operators withdrawing before the auction and 30 MHz of spectrum in the 700 MHz band being left unsold. The consequence is that this spectrum is not being used to supply services to consumers (potentially leading to higher priced and less competitively offered 4G services) and the Government failed to obtain revenues from the spectrum that may have been able to be sold if available at a lower price.

Even where operators are prepared to pay the licence fee, a high fee level can have harmful effects. High spectrum charges may mean that fewer operators are viable so that competition is lessened and prices to customers higher. A concentrated market may be the immediate result of the high spectrum charges or it may come about in time as operators with high debt levels will be more vulnerable to adverse changes in market conditions. High debt levels may also impair operators' abilities to raise capital at reasonable rates and hold back the level of investment in network rollout and service deployment. This would limit the contribution of the sector in boosting overall economic growth. High spectrum fees may even be counter-productive as a source of government revenue if lower economic growth leads to less general government revenue.

A government may be tempted to set higher renewal fees where it believes operators are currently profitable. However, it is important to recognise that where investments are risky, operators must have the opportunity to earn a particular level of returns if the investment succeeds to compensate for the risk of not receiving back their cost of capital if the investment does not succeed. Specifically, firms will only undertake risky investments if their expected return taking into account the probability of the investment not succeeding is greater than the cost of capital.²

Many entrants to mobile markets have not succeeded at a significant cost to their investors. If a government seeks to expropriate a significant share of the returns on the investments that have succeeded, then operators will be less likely to undertake risky investments in the future. There is a substantial economic literature on the hold-up problem in which one party is able to intervene after an investment has taken place to capture the return of the investment of another party where their investment requires significant sunk costs so that it cannot simply be recovered by redeploying the assets elsewhere. This literature shows that unless the parties can commit in advance as to how the future prices will be determined (such as a licence renewal fee that does not expropriate the return required to cover the cost of capital and compensate for risk) then the efficient level of investment will not take place.

Regulators concerned about maintaining investment incentives might still end up harming investment simply because of the inherent difficulty in accurately estimating efficient spectrum charges. The value of a band of spectrum is highly sensitive to market conditions that can change over time and vary significantly between countries. Given the risks of investment being deterred or even valuable spectrum being left idle, regulators should set spectrum charges conservatively. Over the time, the establishment of effective spectrum trading can ensure the efficient use of spectrum without the need for spectrum charges beyond the recovery of administrative costs. Indeed, as we discuss in Section 7, the continuation of significant administratively-determined spectrum charges would create a barrier to efficiency-enhancing spectrum trading because of the uncertainty introduced for potential buyers of spectrum.

Approaches to determining the level of spectrum charges

As discussed above, efficient spectrum charges will recover the administrative cost of spectrum management and, where there is excess demand for spectrum, reflect the opportunity cost of spectrum. There are a number of approaches by which authorities can estimate the efficient level of charges.

Re-auctioning

Auctioning of spectrum provides the most transparent and direct way of determining the market or efficient price for spectrum. As explained in Section 2, auctions can be particularly useful if there are a number of competing demands for the spectrum and it is unclear to which use and user the spectrum should be assigned so as to generate the highest value. However, in many cases there will be a clear best use of the spectrum and auctioning it may simply incur unnecessary costs. Flaws in the auction design may also lead to prices sometimes not supporting the efficient allocation and use of spectrum. In March 2013, the Czech regulator intervened to cancel the 4G auction taking place because of the level of bids being made. The CTU Chairman stated: *“Such high prices of the auctioned frequencies would have had a negative impact in the form of exorbitant rates for mobile broadband. We therefore consider it necessary to step in and prevent future negative consequences for consumers.”*

² For example, consider an operator that is considering making an investment of \$500m, with a cost of capital of 10% and a 20% risk of the investment failing with the consequence that they lose their full investment. The operator will need to earn back \$687.5m on the investment if it succeeds for this investment to have an expected return of 10% (i.e. $0.8 \times \$687.5m + 0.2 \times \$0m = \$550m$). However, if an operator expects the government to effectively expropriate any earnings above \$550m in the successful case then the expected earnings will fall to \$440m (i.e. $0.8 \times \$550m$), i.e. the operator would expect to lose money on the investment and not undertake it.

Even where spectrum is to be auctioned, licensing authorities may wish to estimate the value of the spectrum to help in determining what reserve price to set. Reserve prices in auctions help discourage non-serious bidders and can provide a floor price for spectrum in case competition for the licences is weak. However, reserve prices should be set conservatively rather than to try to match the expected market price. An auction will fail if the reserve price is set even slightly above the market value, which would lead to unnecessary administration costs and may harm consumers by creating a delay before the spectrum can be re-assigned for use at some later date.

Share of revenue

Annual charges levied on the basis of revenues or profits can be a way for the government to share risks with operators. This can support new entry and promote greater competition. However, it can lead to inefficient spectrum use as smaller players will not necessarily bear the actual opportunity cost of the spectrum. Royalties that vary with service volumes or revenues may also increase service prices and distort business decisions and investment. Higher fees for a more successful or more efficient operator effectively penalises success and can discourage efforts to improve efficiency or compete more aggressively. Where annual charges are to be imposed in addition to the spectrum being auctioned then for both efficiency and fairness, the charges or at least the methodology to be applied in determining the charges, should be established prior to the auction.

Modelling the marginal opportunity cost of the spectrum

A number of regulators have sought to estimate the opportunity cost of a spectrum band directly. More spectrum assigned to one operator leads to less spectrum for other operators. One approach to estimate the opportunity cost of spectrum is based on the premise that if a mobile operator loses access to a marginal increment of spectrum then it would need more base stations (and other inputs) to maintain the same volume of services and service quality. The operator should value that increment of spectrum (i.e. be prepared to pay for it) an amount equal to the additional network costs the operator incurs from being deprived of it. Thus the marginal opportunity cost of spectrum can be estimated by modelling how a network's costs would change with and without additional spectrum while maintaining the same quantity and quality of services. Where a change in an increment of spectrum would affect both revenues and costs then it may be necessary to model how the present value of cash flows would be affected by access to that spectrum.

Spectrum charges based on the estimated opportunity cost of spectrum can promote efficient spectrum use as an operator should only hold the amount of spectrum for which they are able to generate a greater value than that spectrum would provide to another operator, i.e. in terms of savings on network costs. However, the actual modelling of the opportunity cost is dependent on a host of assumptions with consequent uncertainty over the actual level. Choosing a conservative value from within the estimated range can reduce the risk of some spectrum being returned and left idle.

Benchmarking

Benchmarking can be used to estimate the market value of spectrum on the basis of prices determined in recent auctions and spectrum trades or by indexing forward past auction prices. The accuracy of benchmarking will depend on whether there exist efficient market prices for spectrum that would be expected to have a comparable value to the band being benchmarked or if robust adjustments can be made to account for differences in demand and supply factors impacting on the spectrum value. Later in this section, we identify the range of factors that can cause differences in the value of spectrum bands. Changes in these factors should also be taken into account if current market values are to be estimated on the basis of indexing forward past prices.

Pricing Approaches	Advantages	Disadvantages
Prices set to recover administrative costs of spectrum management	Appropriate where there is no excess demand for spectrum	May not lead to efficient spectrum use where there is excess demand for the spectrum and where spectrum assignment is not market based
Auction	Can provide a transparent and objective way to set prices that support efficient spectrum use	Auction prices may not be efficient if there are flaws in the design (such as excessive prices if auction does not lead to effective downstream competition or prices too low if there is coordination between bidders). Changes in market conditions may mean that auction prices turn out to have been too high with the risk that existing operators prove unviable and exit
Share of revenue	Shares risk between government and operator and can promote new entry	Can lead to inefficient spectrum use and increase service prices
Estimate incremental value of spectrum	Provides a direct estimate of the value of an increment of spectrum	Requires modelling based on assumptions with significant risk of error and danger of some spectrum being left idle - this risk can be reduced by setting prices conservatively
Benchmarking	Simple and transparent where close benchmarks exist	Will be inaccurate if the analysis does not fully account for differences in factors impacting on market value

Factors affecting spectrum value

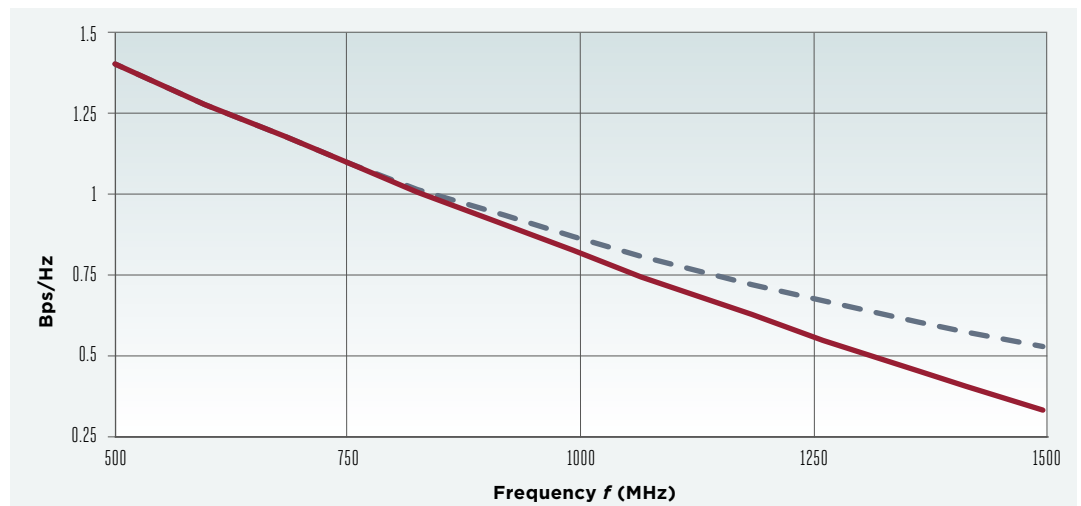
In setting spectrum fees and in setting reserve prices in auctions, licensing authorities often have regard to prices for spectrum set in auctions that have been achieved historically or in other countries. As noted above, it is important for a regulator to set prices conservatively (i.e. at a discount to their best estimate of the market value) because the uncertainty over actual market value implies a significant risk of error with the danger that valuable spectrum may not be put into use in delivering services for a protracted period.

The value of spectrum can differ significantly between countries or even over time in the same country because of a host of factors. In any benchmarking exercise, it is important that authorities consider whether a proposed benchmark is actually comparable or whether it is possible to make adjustments for the relevant differences. Such benchmarking exercises need to be carried out carefully and often prove highly contentious.

1. Characteristics of the spectrum

Lower spectrum bands have better signal propagation allowing for fewer sites to be needed to cover a given area and can provide for better in-building coverage. The need for fewer sites (and hence lower network costs) together with better service quality tends to make spectrum at a lower frequency bands more valuable than at a higher bands. The extent to which lower frequency bands provide benefits over higher frequency band will vary with the characteristics of the market to be served as well as being impacted by the other factors identified in this section. For example, the network cost disadvantage of higher frequencies is a greater issue in rural areas where sites are built predominantly for coverage reasons.

FIGURE 3 - VALUE OF SPECTRUM AS A FUNCTION OF FREQUENCY COMPARING MODELLED VALUATION FOR RURAL DEPLOYMENT WITH AUCTION PRICES FOR AREAS WITH A RANGE OF POPULATION DENSITIES



Source: Peha, J.M., "Updating the spectrum screen", Comment provided to FCC in Policies Regarding Mobile Spectrum Holdings The State of Mobile Wireless Competition, 2012.

When a particular band is harmonised internationally for use for a specific service, equipment suppliers are able to achieve much greater scale economies in producing network equipment and devices for use with that band. This can also lead to significant savings in network costs and in the value of the band to operators compared with other bands that are not harmonised internationally.

The amount of spectrum available that is suitable for particular services can also lead to differences between countries and over time. The greater the availability of substitutable spectrum, the less critical it will be for an operator to acquire a particular band of spectrum.

Operators with relatively small spectrum holdings will need to incur much higher network costs (such as by splitting cells) to provide the same capacity as an operator with larger spectrum holdings. Countries that have released more spectrum can reduce the cost of service provision and support a larger number of competitors. Small spectrum holdings can also impair the quality of the service, such as slower speeds for LTE. The services that can be supported by a particular spectrum assignment will depend on technology and hence the value of that spectrum can change over time as technology changes.

2. Cash flows of the downstream services

Operators acquire spectrum as an input to the supply of downstream services such as mobile voice and data services. The more profitable the supply of the downstream services, the higher the value that will be attached to acquiring a licence to be able to supply those services. The acquisition of spectrum can affect both future revenues and costs.

The size of the population in the coverage area will determine the potential customer base and auction prices are often compared on a per MHz per head of population basis to account for differences in population between licence areas. National income levels will influence the percentage of the population that takes up the service and the extent to which they use those services. The expected level of competition in the downstream market will also affect expected Average Revenue per User and thereby lead to differences between markets in the value of spectrum.

The higher the cost of supplying services in a country, the less valuable will be the licences (holding other factors constant). Costs will be higher the more that the population is spread out over a larger coverage area. Geographic terrain and planning regulations can also lead to differences in network costs. The profitability of the downstream services will also depend on the cost of other inputs. While some inputs will be sourced internationally, others will depend on local conditions. High taxes and any annual licence fees will also raise costs and reduce how much operators are prepared to bid for licences.

3. Terms and conditions of the licence and the award process

The value of the licence to an operator will be affected by its specific terms and conditions including its duration, upfront or instalment payments, any restrictions on the use of the spectrum and any obligations attached to it such as coverage obligations or providing access to other operators or MVNOs.

The auction design itself can also affect the auction prices. For example, spectrum caps or the reservation of some spectrum for new entrants may prevent an existing operator from being able to bid for some of the spectrum being offered. Reserved prices may lead to spectrum being sold at above its opportunity cost (i.e. where its value in the next highest use is below the reserve price). Sealed bid and multiple round ascending price auctions can also lead to different prices even when the underlying market factors are similar.

4. Summary on benchmarking factors

While benchmarking can provide useful information, it is important to identify the range of factors that may cause differences in value and consider their significance in relation to the specific data. It is also important to take into account the interrelationships between the factors as an adjustment that is appropriate in one context may be inaccurate in another because of such interrelationships. Econometric analysis enables the impact of multiple factors to be considered simultaneously and thus can help support more accurate benchmarking where there is a sufficient data set.

6 Enabling flexible spectrum use

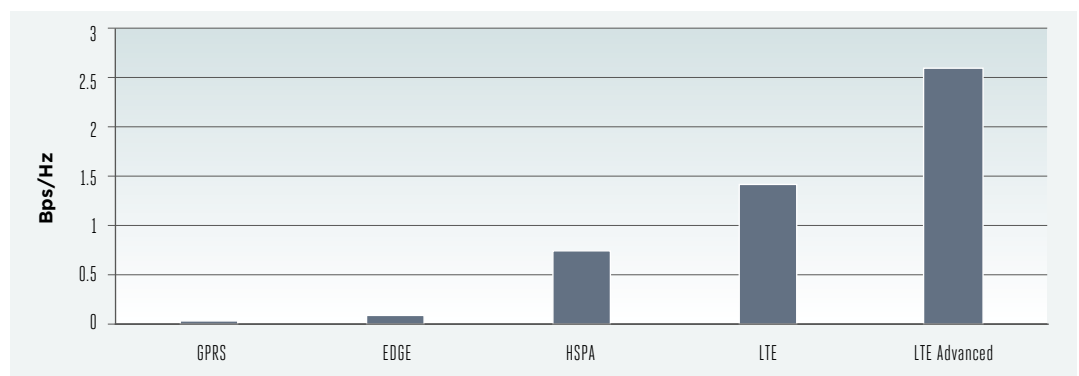
For society to gain the maximum value from its spectrum resources, licence holders need to have the incentive and opportunity to put spectrum to its most productive use. Licensing authorities play an important role in supporting efficient spectrum use through managing potential interference between competing users as well as facilitating international harmonisation of the use of specific spectrum bands. However, many authorities have gone further by imposing restrictions on the use of spectrum beyond those necessary for interference management. In markets as dynamic as modern communications markets with new technologies becoming available and shifting consumer preferences, restrictions on the use of spectrum can prevent the best use of scarce spectrum and delay investment in new services. Licensing authorities should support greater flexibility for spectrum users by relaxing restrictions on existing licences and limiting conditions imposed on renewed licences.

Technology neutrality and change of use

The traditional command-and-control approach to spectrum management tightly restricts the use of specific spectrum bands to particular services and particular technologies. This worked reasonably well where there was a clear best use for the spectrum band and sufficient spectrum available to meet demand. However, usage restrictions have not kept pace with changes in technology and demand. Such restrictions can exacerbate spectrum scarcity by restricting what spectrum is available for the most valuable uses and by preventing the introduction of new technologies that utilise spectrum more efficiently to provide greater capacity to meet rapidly growing demand.

An increasing number of countries have moved towards allowing more flexible use of spectrum. Technology neutrality allows for the use of any compatible, non-interfering technology in any frequency band. Technology neutrality has been used to enable mobile operators to refarm their existing spectrum assignments for use with newer technologies. In particular, operators have been permitted to replace 2G GSM technology with third-generation (UMTS) technology and fourth generation (LTE) technology. By allowing spectrum to be refarmed for use with newer mobile technologies, authorities can support increased throughput, higher download and upload speeds, lower service costs and better coverage compared with limiting new technology deployment to higher frequency bands.

FIGURE 4 - NEW TECHNOLOGY BRINGS LARGE GAINS IN SPECTRAL EFFICIENCY (DOWNLINK CAPACITY FOR 2X10MHZ)



Source: FCC, National Broadband Plan, 2009 and LTE Advanced projected capacity from Rysavy Research, The 3GPP wireless evolution, August 2013.

While the benefits of refarming and more generally of liberalisation can be substantial, authorities do need to consider a number of implementation issues.

- **Interference issues will continue to require careful management. There is now significant practical experience in addition to technical studies as to the implementation of refarming and liberalisation without causing harmful interference. More generally, the IMT technologies (GSM/GPRS/EDGE/UMTS/HSPA/LTE) have been standardised based on criteria for technical co-existence and backward compatibility.**
- **Operators will need to maintain continuity for current services while freeing up spectrum for the introduction of new technologies. The more spectrum available for operators, the lower the costs and the faster the likely transition period.**
- **There may be a need to manage liberalisation in a way that protects current competition such as by releasing additional spectrum or redistributing existing spectrum if effective competition would otherwise be undermined and the measures can be implemented in a cost effective way.**

Minimum 20-year terms for new licences

The longer the duration of renewed licences, the greater certainty provided to support new investment in rolling out networks and deploying new technologies and services. On the basis of the expected payback period for substantial new network investments, many countries including Canada, New Zealand and the UK have decided to provide for a minimum term of 20 years for new mobile licences and the European Parliament has proposed 25-year terms. In other countries, such as the US, investment is supported by a strong presumption of renewal.

Longer licence terms both support and are supported by a move towards a more market-based approach to spectrum management. With longer licence terms, operators will have the certainty to take advantage of increased flexibility to introduce new technologies and be more willing to trade spectrum with the consequence of promoting efficient spectrum use over time. The risk that a long licence term may lead to spectrum being locked into an inefficient use is much less likely where licensees are allowed to change the use of the spectrum themselves or to sell the rights of use to a party that could make better use of the spectrum.

Consider alternative approaches to achieve other policy objectives

Obligations are often attached to spectrum licences with the aim of achieving particular policy objectives such as widespread coverage, universal access to services or to ensure the spectrum is actually put to use.³ However, such obligations can often result in greater costs than benefits. For example, in competitive markets, operators themselves will face incentives to secure early and widespread access to their services to make a commercial return. In some cases, however, there will be sound reasons for delaying rollout such as if an improved technology is about to become available or where an entrant is experiencing short-term cashflow problems. An obligation to continue with the rollout may lead to inefficient outcomes or exacerbate financial difficulties for the entrant.

The release of additional spectrum and allowing for new technologies to be used at lower frequency bands may be able to achieve coverage objectives at lower costs and without the need for a restrictive licence obligation. Government funding can also be used to target the extension of coverage to specific areas without putting at risk an operator's continuing licence. The higher licence fees that would be achieved by auctioning a less restrictive licence can provide the revenues to cover such funding. If, after reviewing alternative options, a licensing authority believes that a coverage obligation would still be required, the authority should consider the most efficient way to implement such an obligation. For example, coverage objectives could be achieved at lower cost by attaching the obligation to one licence rather than all licences and thereby avoiding the need for multiple networks to be built in uneconomic areas. Any coverage obligation should also be limited to lower frequency bands which are better suited to providing wide area coverage.

³ This latter reason of ensuring the spectrum is used rather than hoarded would not be relevant in most renewal cases as operators will already be able to demonstrate their use of the spectrum.

7 Licence renewal and competition

The upcoming expiry of a licence may be taken by the licensing authority as an opportunity to consider whether measures should be taken to boost competition in the market.

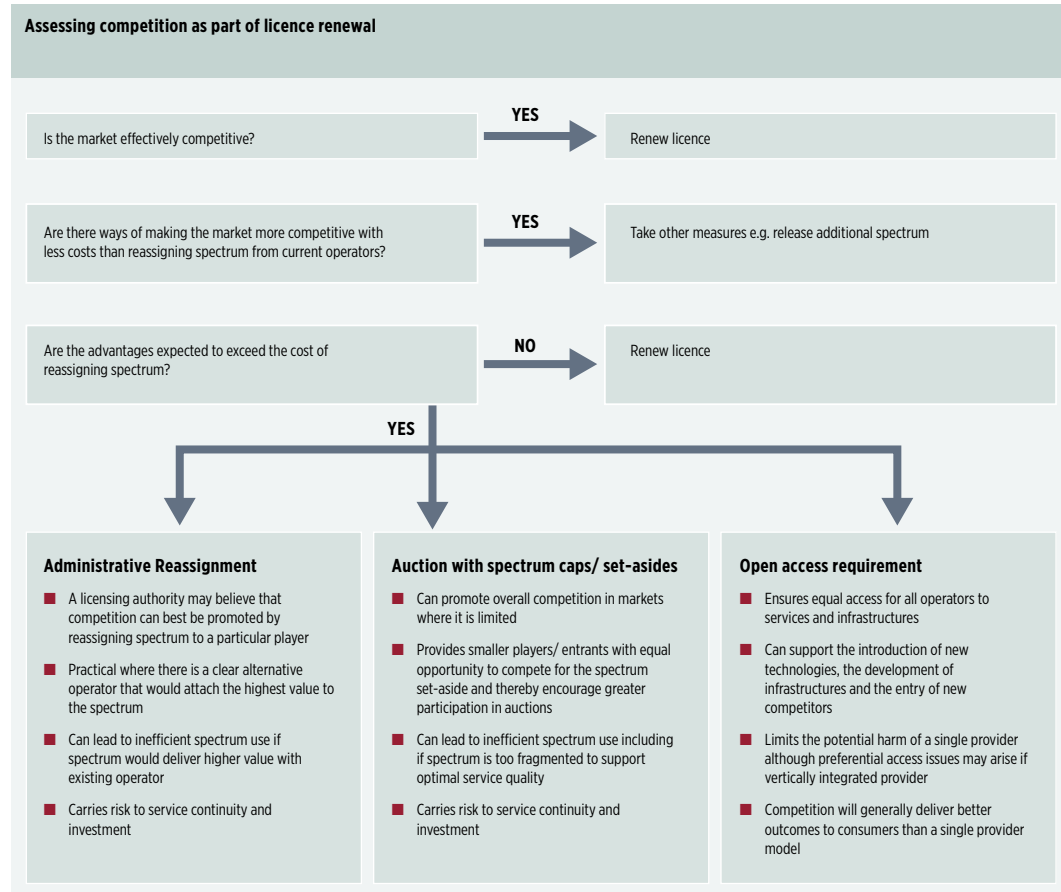
Measures to increase competition only make sense where competition is not already effective in a market and where additional players would be viable or where a smaller player could make efficient use of additional spectrum. Competition authorities such as the European Commission in a number of merger decisions have found that effective competition in mobile markets is consistent with 3 to 4 network operators together with a number of service providers. Re-assigning spectrum to additional players in such markets may lead to operators being unable to fully realise scale economies and consequent higher prices for consumers.

Consideration should also be given to whether there are alternative ways to promote competition that do not carry the risks to service continuity and investment of re-assigning spectrum. For example, reducing mobile-specific taxes and licence fees may improve the viability of all players in the market while there could be the potential for additional spectrum to be made available for mobile services. Such measures would also protect the incentive for operators to compete which may be weakened if successful operators are expected to be penalised by having their spectrum rights re-assigned to players that have failed to attract as many customers.

Where an authority does decide to re-assign spectrum either administratively or through an auction, the authority should assess the expected benefits and costs of reassigning different amounts of spectrum. The more spectrum that an existing operator is required to release, the more likely it is that the operator will need to turn to costlier solutions to try to retain sufficient capacity to serve existing customers and the greater the risk that service quality will suffer. On the other hand, an entrant with a relatively small customer base would not be expected to need the same capacity as a larger player. Spectrum caps and the amount of any spectrum set aside for new entrants should be carefully determined so that all operators can deploy networks in a technically and economically efficient manner. Further, before such caps and set-asides are applied, authorities should undertake a rigorous market analysis to ensure that there are in fact players or potential new entrants who can make efficient use of the spectrum.

An alternative means of promoting competition is to require or allow the spectrum licence holder to provide wholesale access to its services to other operators and service providers. Shared use of a network can avoid costly duplication, make it economic to extend coverage in rural areas and provide additional capacity in congested areas where space for sites and towers is limited. Depending on the form of sharing and the market circumstances, sharing can lower the cost of service provision while maintaining the ability for operators to compete with differentiated services. However, where competition is viable, consumer outcomes are likely to be better where there are competing networks rather than a single provider. Further, where an authority requires a provider to provide access to other operators and service providers it may be called upon to determine issues that it is not well placed to address such as over the pace and direction of technology upgrades, how scarce capacity is to be allocated between access seekers and the reasonable level of charges for access. Thus, regulatory imposed sharing requirements carry significant risks of errors and of investment being deterred or mis-directed.

ASSESSING COMPETITION AS PART OF LICENCE RENEWAL



8 Spectrum trading

Allowing the spectrum rights provided in new and renewed licences to be sold between operators is an important way by which to maintain the efficient use of spectrum over time. In particular, trading allows for spectrum rights to be exchanged between an operator that is under-utilising the spectrum and an operator that can generate greater value from the use of those rights. In being voluntary, spectrum trading enables the parties that have the best information as to the value that they can generate from the spectrum to determine whether a specific trade would be value enhancing (i.e. a buyer will only acquire the rights if they are prepared to pay a price at least equal to the seller's valuation of the spectrum).

In helping to reduce spectrum shortages faced by some operators while ensuring valuable spectrum does not lie fallow, trading can allow for a country's spectrum resources to be used more intensely supporting higher volumes of services, increased service quality and lower costs of service provision. Voluntary trading also reduces risks for operators as players will be able to sell rights that they turn out not to need while having the potential to acquire new rights as they grow.

There is growing experience with spectrum trading globally including in Australia, Canada, Europe, Guatemala, New Zealand and the USA. This experience highlights that certain measures can help facilitate trading in the interests of consumers.

- **Trading is more likely to take place where there is substantial available spectrum and where there is high degree of predictability including in relation to future spectrum availability, the regulatory and policy framework that will apply to licensees and where licences have sufficiently long terms for the buyer of the rights to undertake investments to make use of the spectrum. Spectrum trading is made difficult where decisions about whether licences are to be renewed and the conditions that will be attached to the new licences are made close to the expiry date of the existing licences.**
- **Authorities should be notified of the trades taking place so that it is transparent which entities hold spectrum usage rights. Information on current spectrum holdings can also facilitate future spectrum trades.**
- **Notification also enables authorities to assess whether a proposed trade would create any risks to competition. Spectrum trading could be subject to competition law or to specific ex ante competition assessments.**
- **While some authorities have been concerned that spectrum trading may lead to windfall gains, it should be recognised that it is the potential for gains that creates the incentive for efficient spectrum trades to take place. Further, while some operators may make gains, there are other operators that have incurred significant losses in acquiring spectrum. Accordingly, a gain may actually be a return on the risks incurred. There is no reason to tax gains from spectrum sales any more than gains from the sales of other business assets.**

Given the opportunity for significant gains to the development and flexibility of the industry, there is a strong case for countries to establish a regulatory framework that supports voluntary spectrum trading.





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