FOREWORD

Botswana Telecommunications Authority (BTA) is mandated by the Telecommunication Act, 1996 [No. 15 of 1996] to ensure the rational use of the radio frequency spectrum in Botswana. The BTA assisted by the Teleplan AS from Norway in association with ICT Consultants (Pty) Ltd from Botswana, is in the process of developing a comprehensive Spectrum Management Strategy. The spectrum management strategy has the following components :

- Review the current national radio frequency plan;
- Develop a spectrum allocation strategy for various radio services;
- Develop a spectrum licensing policy for various frequency bands; and
- Develop a spectrum pricing policy

This Consultation document addresses the spectrum licensing and pricing component, The BTA intends to implement a spectrum licensing and pricing policy that will lead to the maximum positive impact on Botswana's economic and social development, with a view to addressing the national infrastructure deficit, especially infrastructure required for wireless local loop and broadband access. In addition proper spectrum licensing and pricing will contribute to a successful implementation of the new licensing framework in Botswana. For more information on the spectrum licensing and pricing issues a detailed report is available at the BTA website at: **www.bta.org.bw/publications**

The Authority wishes to invite the industry stakeholders, (the operators, service providers, equipment suppliers, academics, and the public) to submit comments on the Consultation paper. The submissions should be clearly marked:- **"Response to Consultation document: A new policy for spectrum licensing and spectrum pricing in Botswana"** and should be addressed as follows :

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The submissions can be hand delivered, sent by post, facsimile or email and should reach the BTA on or before 5pm on 5 October 2007: Kindly note that the BTA will publish all submissions received unless the respondent has requested, with justification, that his/ her submission should not be published.

The Authority will hold an Industry Stakeholders consultation workshop on Spectrum licensing and pricing on **the 9-10 October 2007 at Gaborone International Conference Centre (GICC)** starting at 0800 A.M.

T. G. PHEKO

CHIEF EXECUTIVE OFFICER

Consultation document

Teleplan

In Association with

ICT Consultants

Submitted to

Botswana Telecommunications Authority

Consultation document:
A new policy for spectrum licensing and spectrum pricing in Botswana

August 2007

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1 Consultation document

1.1 Background

The Botswana Telecommunications Authority (BTA) has retained Teleplan AS, in association with ICT Consultants (Pty) Ltd, Botswana, for consultancy services to develop a Spectrum Management Strategy in Botswana. The objectives of the consultancy study performed by the Consultants are to undertake the following in consultation with industry stakeholders:

- Review the current national radio frequency plan;
- Develop a spectrum allocation strategy for various radio services;
- Develop a spectrum licensing policy for various frequency bands; and
- Develop a spectrum pricing policy

This Consultation document describes proposed spectrum management reforms related to spectrum licensing and pricing which could contribute to a successful implementation of the new licensing framework in Botswana. The consultants' aim has been to propose licensing and pricing policy that will lead to the maximum positive impact on Botswana's economic and social development, with a view to addressing the national infrastructure deficit, especially infrastructure required for wireless local loop and broadband access.

This consultative document summarises the key findings and the recommendations related to the spectrum licensing policy and the spectrum pricing policy. All interested parties are invited to submit their inputs with regard to the Consultants' recommendations.

1.2 Introduction

In general, the liberalisation of the telecommunications sector in a country brings new challenges for the radio spectrum manager. Liberalisation of a sector means that the rights to enter into any kind of business or industry in that sector are available to all interested parties. Instead of reserving the rights to provide certain kinds of goods or services to a monopolist or a restricted number of firms, anyone with the initiative, skill and financial backing is permitted to enter the markets for such goods and services. In a liberalised environment, the number of firms is not restricted by the government but by market demand, the availability of scarce resources and by the technological possibilities that evolve.

The liberalisation of an economy or an industry marks a significant change with respect to the methods that should be used to promote welfare and growth. Liberalisation implies that markets are used as the primary mechanism for allocating resources in a manner which leads to their efficient use; a state in which the resources available to society are used to produce the bundle of goods and services most desired by consumers at the lowest possible cost.

For centuries, the competitive marketplace has generated volumes of vital information beyond the capabilities of even the most sophisticated central planning authority. By using the price system, the marketplace transmits signals to thousands of producers

about the preferences and valuations of millions of consumers and enables the producers to compare the cost of production using various technologies with how much consumers value the goods and services that can be provided. The much maligned, but universally used, influence of profits serves as a force which pulls resources into their most productive use. Economic self-interest is then the primary engine for innovation, growth and welfare.

Although a liberalised market brings challenges with it and requires both an adequate legal infrastructure and a variety of regulatory bodies to bring the desired results, the supremacy of markets is now rarely contested. The question facing modern economies is in most cases not whether markets should be used as the primary resource allocation mechanism, but rather what the government should and shouldn't do to ensure that the market operates as intended.

The new licensing framework which was recently introduced in Botswana relies to an increasing degree on the use of markets to ensure that the telecommunications sector will continue to develop satisfactorily and meet the communications needs of the economy as a whole. Driven by convergence and the evolution of markets in Botswana, the new licensing structure embodies a broader, less prescriptive approach to telecommunications licensing. It is designed to allow maximum freedom for commercial management in the industry, in order to serve users of communications services in the most efficient way possible[1].

Traditional spectrum management practices were developed to manage radio spectrum resources closed monopolistic environments. When restrictions on the number of firms in a market are lifted as part of the liberalisation process, it may become impossible to assign spectrum to all firms that demand access to it using traditional spectrum management procedures. Thus a mechanism is needed to identify the firms which are most able to use the spectrum efficiently, and to assign it to those firms in a manner which makes the demand for spectrum equal to its availability.

Economists since Nobel-prize winner Ronald Coase have argued that allocating a scarce resource by administrative fiat makes little sense in a setting with liberalized service markets. They argue that establishing a market for spectrum, in which owners could buy, sell, subdivide and aggregate units of spectrum would lead to a much more efficient allocation.

The markets for Value-Added Services and Private Networks are fully liberalised in Botswana and any locally registered company is eligible to apply for a licence in these two categories. The number of licensees in these categories may only be limited by service demand and/or scarcity of resources such as spectrum and numbers. Some market segments, notably the market segments which are exclusively covered by the new, service-neutral PTO licences, can only be accessed by a restricted number of operators until 2009. By the end of 2009, these segments will be considered for further liberalisation.

[1] BTA statement: Service neutral licensing framework in the era of convergence, 13. March 2007.

The liberalisation process is beyond the scope of this project, and the number of possible paths towards full liberalisation is too high for the project to make recommendations for all contingencies. For the purpose of this document, we have assumed that market entry from 2010 onwards will happen on terms comparable to the ones that apply in fully liberalised markets such as the EU. This means that the number of service neutral licences will not be restricted to prevent market entry and that market demand for services and spectrum availability will determine the market structure and thus, in practice, the number of service neutral licences.

The fully liberalised scenario will not necessarily correspond fully to future events. We nevertheless believe that the advice we provide under our primary assumption will be relevant for the majority of cases and frequency bands, even if the government decides to proceed in a different manner. The fully liberalized segments of the markets are likely to grow the fastest, and the recommendations we provide can constitute a basis for an eventual policy for non- liberalised markets if the government decides to postpone full liberalisation for any significant period of time. Our recommendations could then be interpreted as recommendations for a general or default policy, which may be supplemented by provisions for "special cases".

The remainder of this document will describe the policies which, if adopted, will enable Botswana to reap the largest benefits from its liberalisation of the telecommunications markets. These policies should at the same time ensure that the fundamental international legal constraints on spectrum management are observed. Our primary advice is to implement simple and universally recognized best practises first, and to consider more complex, but potentially useful, reforms later.

1.3 Summary of discussions and recommendations

1.3.1 Economic efficiency as a primary objective

We recommend that the objectives of spectrum management should be consistent with the overall objective of maximizing the welfare of the citizens of Botswana. Thus, economic efficiency should be the default objective of radio spectrum management. By economic efficiency, we mean *a state in which the resources available to society are used to produce the bundle of goods and services most desired by consumers at the lowest possible cost.*

We do not suggest that economic efficiency should be the only objective pursued by the spectrum manager. Other policy objectives, which may lead to the allocation of resources in an economically inefficient manner, may exist. But if there are no such explicit objectives, then economic efficiency should be the default objective. We will explain why technical efficiency (as defined in economics) is a necessary, but not sufficient condition for economic efficiency. We also argue that while 'spectral efficiency' can be a useful metric for comparing technologies, it is meaningless as a policy objective in itself.

Adherence to international law enters into spectrum management not as an objective but as a constraint. In those cases where efficiency would require the spectrum to be

used in such a way in Botswana that international treaties would be violated, international law should take precedence.

The efficient level of interference between different users of spectrum is not zero. The reduction or avoidance of interference is therefore not meaningful as an objective in itself. We will argue that instead of attempting to optimise the interference levels by detailed planning of frequency use, the spectrum manager should restrict its attention to optimizing the expected interference levels between adjacent users at the time of the initial frequency assignment. In addition, the spectrum manager should provide a mechanism which allows for continuous re-optimization as technology and service markets evolve. This mechanism is most commonly referred to as a market.

Recommendation 1: Economic efficiency should be the default objective of radio spectrum management.

1.3.2 Introduce a mix of spectrum management models and increase the use of markets and unlicensed bands

Like most of its peers worldwide, BTA has traditionally taken a centralized approach to spectrum management, with allocation and assignment of licences largely determined by administrative decisions. In parallel with the liberalization of telecommunications markets worldwide, and the increased range of available technologies and services, spectrum managers have been introducing new instruments which allow greater use of market mechanisms in determining what spectrum is used for various services, how it is used, and by whom. These instruments allow regulators to respond with more flexibility to increased demand for spectrum in an era of rapid technological changes.

The three common models for assigning spectrum usage rights are:

- The traditional “Command-and-control” model.
- The market based “exclusive use” model where a licensee has exclusive and transferable rights to the use of specified spectrum.
- “Commons”, “unlicensed” or “open access” to non-exclusive rights.

BTA currently relies almost exclusively on only one of these models; the legacy command-and-control regulation appropriate for non-liberalized environments. The Consultants recommend that the BTA should base its spectrum management policy on a balance of the three basic spectrum rights models: an exclusive use (market-based) approach, a commons approach, and (to a more limited degree) a command-and-control approach.

Recommendation 2: The Consultants recommend that the BTA base its spectrum policy on a balance of the three basic spectrum rights models: an exclusive use (market-based) approach, a commons approach, and (to a more limited degree) a command-and-control approach.

Recommendation 3: BTA should alter the existing balance among these models by expanding the use of both the exclusive use and commons models throughout the radio spectrum, and limiting the use of the command-and-control model to those instances where there are compelling public policy reasons.

1.3.3 Trading, flexibility and the exposure to opportunity cost as primary instruments

We believe that if the principle of opportunity cost charging is not applied, then the inevitable consequence will be inefficient use of spectrum and a loss to Botswana's economy. Therefore, we believe that the main task of the spectrum manager should be to ensure that users of spectrum face the opportunity cost of their use in order to promote economic efficiency and growth. Opportunity cost, or economic cost, is the cost of something in terms of the most valuable forgone alternative (or highest-valued option forgone), i.e. the second best alternative. It should not be confused with accounting cost or financial cost.

Exposing spectrum users to the whole opportunity cost of their use is vital. Opportunity cost charging may be regarded as an esoteric economic concept, but the purpose of using it is simple enough: to create full and proper incentives to use spectrum efficiently. Unless this is done, there will be a substantial loss to the economy, one which will increase over time as communications services become more crucial to generating economic growth. The principle of opportunity cost charging can be applied in a number of different ways: by use of trading, auctions and pricing. Arguably, the most important method is by use of flexible and tradable block licences.

The introduction of trading is probably the simplest, least costly and least controversial reform the BTA could implement. It would also be one of the most important. Trading does not affect spectrum use directly because ownership is an entirely abstract concept which does not interact directly with the physical world. The initial controversy over the introduction of spectrum trading in Europe was caused by the term "trading" being used in a wider sense, notably one which included flexibility (the opportunity to change the use of the spectrum).

All parties involved in a trade gain from it. Most OECD countries have now implemented trading to a certain extent. Some have made practically all spectrum licences tradable, and the scope for trading is being steadily increased. We are not aware of any state which has reversed the implementation of trading.

Prohibiting trade not only prevents resources from being used efficiently; it is not logical if spectrum is assigned to publicly owned[2] companies. A company is then merely a legal entity whose identity is the only thing that needs to remain constant. All owners may be replaced and the entire staff and operations may be changed while the company legally remains the same. Even if the government does not allow spectrum trading between firms, the set of real owners of a licence may change when ownership to the company is changed. Since the entire staff of a firm can be replaced and the owners of a licensed company may also change, then the prohibition of spectrum trading between firms only prevents firms from becoming organized in an optimal manner.

Trading becomes more effective if it is coupled with the use of flexible usage rights. Flexibility means that the use of the spectrum can be changed, provided that adjacent users are not negatively affected. Flexible usage rights have been implemented in many states and the use of flexible rights in the most valuable frequency bands (e.g. the "GSM" and "3G" bands) will be imposed on those EU member states which have not implemented it[3]. Flexible rights are widely regarded as a prerequisite for innovation and growth. Service and technology neutrality cannot be fully implemented unless the usage rights to spectrum are designed to be flexible.

To enable opportunity cost charging to take effect and promote efficiency, we recommend that the BTA should rely primarily on technology neutral and flexible block licences when new frequency bands for exclusive licensing are opened up. We recommend that all frequency licences become tradable. In the longer term, we recommend that existing block licences be re-defined, or converted, into flexible licences.

Recommendation 4: Promote economic efficiency by ensuring that users of spectrum face the opportunity cost of their use of spectrum.

Recommendation 5: New licences should be made tradable.

Recommendation 6: As the BTA gathers experience with trading, existing licences could become tradable and legal infrastructure (e.g. in the form of regulations) that facilitates trading should be developed.

Recommendation 7: Trades should be notified or made subject to BTA's prior approval.

[2] A public company is a company which has issued securities through an offering, and which are now traded on the open market. It is also called publicly held or publicly traded and the shareholders may be both governments and private parties.

[3] Cf. e.g. EU Commission Proposal for a Directive of the European Parliament and of the Council repealing Council Directive 87/372/EEC on the frequency bands to be reserved for the coordinated introduction of public pan-European cellular digital land-based mobile communications in the Community COM(2007) 367 final.

Recommendation 8: As trading is introduced, government intervention in spectrum use should be restricted to cases where market mechanisms fail.

Recommendation 9: We recommend that the use of 'use it or lose it' conditions and the assessment of spectrum requirements on the basis of other criteria than willingness to pay (in money or in kind) be discontinued provided that spectrum trading is implemented.

1.3.4 Current inefficiencies

The aim of this study is not to identify precisely how spectrum is used inefficiently at present. Indeed, doing so is extremely difficult; even if one had detailed and accurate information of all relevant present use of the spectrum it would be practically impossible to acquire all the other information required, e.g. the technological possibilities and the value of numerous individual spectrum holders attach to its use. This is consistent with the main message in this document: it is unlikely that any individual or agency could describe in detail how spectrum can be efficiently used. Markets will normally outperform any known central-planning mechanism.

We nevertheless claim to be able to identify a major potential for improvement: Unused spectrum under the BTA's control is a certain source of inefficiencies. If spectrum for which there is positive demand is not assigned to anyone, then the economy cannot be in an efficient state. The costs of production are higher than they need to be, while service offering and welfare are lower. The inefficiency loss is continuous; the BTA cannot "save" the spectrum in any meaningful way. Thus, whenever spectrum is valuable, it should be released to the market.

In addition, there is a current systematic source of inefficiency which will constitute a major problem in a liberalised setting: Frequency users do not face the opportunity cost of their use. The incentives which promote the efficient use of the spectrum are not as strong as they could be.

Recommendation 10: Whenever spectrum is valuable, it should be released to the market.

1.3.5 Spectrum caps to safeguard against concentration of resources

If BTA decides to increase the amount of spectrum available to the market, it should consider implementing spectrum caps as a safeguard against unwanted concentration of resources among a small number of firms. In particular where block-licences (similar to the current GSM900 licences) are to be assigned, such safeguards could be appropriate. Spectrum caps limit the amount of spectrum any single entity may control within a single or a set of frequency bands.

Spectrum caps normally apply both in the initial assignment procedure and in the subsequent secondary market for spectrum. In general we recommend so called multiple-band caps except for in exceptional cases where single-band caps could be appropriate.

Even relatively stringent caps would permit most market players to acquire significantly more spectrum than they are currently using. We recommend that BTA should use stringent caps in the current phase of further liberalisation and spectrum management reform and to consider more relaxed caps, or even to reconsider the use of caps altogether, when the liberalisation process is complete and when markets for spectrum are functional. The major virtue of spectrum caps is their simplicity and predictability; their major disadvantage it that they could be too simplistic.

Our proposal for initial caps, presented in the table below are intended to illustrate how they can be implemented and to facilitate a focused discussion on the use of caps. The caps could be implemented simultaneously, but we propose that e.g. the band- specific 3.5 GHz cap be abolished once substitute spectrum in the 2.5 GHz band is available for licensing. As illustrated by our proposal, spectrum caps may "overlap", single-band caps may be replaced by multiple band caps, and the opening of new bands for licensing may imply that both the individual caps and the specification of which bands they apply to may need to be adjusted.

Recommendation 11: Use spectrum caps to protect against concentration of licences. Multi-band caps should be used unless there are strong reasons for using band-specific caps.

Recommendation 12: Implement relatively strict caps as described in table 1 below. As the liberalisation process is completed and markets mature, any caps that are no longer necessary to safeguard against hoarding of spectrum can be relaxed.

Table 1: Proposed initial spectrum caps

Frequency band	Cap	Comment
900 MHz band	2 x 8 MHz	
900 MHz, 1800 MHz and 3G core band combined	2 x 40 MHz	
1785-1800 MHz	5 MHz	Might also comprise 1900-1920 MHz in the future, in which case the cap could be relaxed to e.g. 10 or 15 MHz combined
3G core band and 2.5 GHz band combined	60 MHz	
2.5 and 3.5 GHz band combined	60 MHz	Might also comprise 3.6-3.7 GHz band

Frequency band	Cap	Comment
3.5 GHz band	30 MHz	Assuming (i) Time Division Duplex operation (ii) that the 3.5 GHz band is opened to licensing prior to the 2.5 GHz band and (iii) that the cap is abolished once the 2.5 GHz band is open for licensing
10 GHz and 18 GHz band combined	2x168 MHz	
23 and 26 GHz band combined	2x168 MHz	

1.3.6 Nature of the rights assigned by BTA

We recommend that the BTA continue to assign spectrum both as exclusive and as non-exclusive rights.

Frequency bands in which non-exclusive rights are believed to be optimal are determined outside Botswana in large markets such as the US and the EU. Other markets, such as China and India may become increasingly influential, and the South African market may be important already, more due to its proximity than its absolute size. Some bands will probably be most efficiently used with only non-exclusive rights. In other frequency bands, a mix of exclusive and non-exclusive rights may be called for[4]. Yet other bands should be assigned as exclusive rights only.

When frequency bands are assigned as non-exclusive rights in major markets, products which are designed to be used in such spectral environments will emerge. Due to the sizes of e.g. the EU or the US market, products can be produced in large volumes at low costs. The existence of such products increases the value of the use of similar, non-exclusive rights in small markets like Botswana as well. At the same time, the availability of such products increases the cost of protecting exclusive rights to those bands. Products that are useful to consumers and firms and easy to transport or buy from abroad will inevitably enter the market. In such cases, it will be better if the licensing policy in Botswana is harmonized with the prevalent licensing policy in the most relevant markets abroad.

For exclusive usage rights, we recommend increased use of technology neutral and flexible block licences to promote efficiency. This is consistent with international best practices and there are several reasons for this recommendation. Block licences

[4] Those who have discovered the apparent logical inconsistency associated with the use of both exclusive rights and non- exclusive rights to the same part of the spectrum should note that we apply the lawyers' notion of usage rights as a "bundle of rights" here. This is consistent with the prevailing terminology. Sometimes the terms overlay and underlay rights are used about this phenomenon.

provide a more predictable and favourable environment for investments. The transaction costs associated with change of use in response to evolving technologies and markets are lower than for traditional site-licences. Administrative costs will be reduced and the incentives to use spectrum efficiently will be stronger.

Our recommendations relate to the nature and size of rights as they are assigned by the BTA, i. e. at the point in time when rights are assigned. The recommendations are not intended as constraints on the holders of block licences. If a holder of a block licence should wish to sell or lease the spectrum to others as site-licences or even to make it available to other users on a non-exclusive basis, then that should generally be permitted, as long as such use will not cause violations to the conditions of the block licence issued by BTA.

Block licences and site licences constitute opposite endpoints on a continuum of possible licence sizes. Since it is generally less costly to sub-divide than to aggregate usage rights, the BTA should err on the block licence side rather than using site-licences whenever there is uncertainty about the optimal size of the usage rights.

Recommendation 13: Follow the lead of the large foreign markets when assigning spectrum for unlicensed use in dedicated unlicensed bands or as underlay rights in bands with exclusive rights.

Recommendation 14: When new exclusive rights are assigned in higher frequency bands, we recommend increased use of flexible block licences designed on the basis of transmitter or EIRP masks. BTA should continue the use of site-licences in most frequency bands which are already encumbered with such licences.

Recommendation 15: The technology neutrality principle should be accommodated by the use of flexible licences in combination with spectrum trading. We do not consider the use of masks corresponding to particular standards to violate the principle of technology neutrality as long as flexibility is allowed.

Recommendation 16: We recommend that BTA should continue the use of pre-determined licences (assuming it is combined with spectrum trading) until the BTA has gained some experience with market based spectrum management.

Recommendation 17: Licence size should be determined by demand; although it could be considered appropriate with some kind of spectrum cap.

Recommendation 18: Block licences can be introduced in some bands encumbered by site licences by grandfathering some or all existing site-licences in the band and assigning block licences for the remainder of the spectrum.

Recommendation 19: Since the demand for spectrum is limited, holders of block licences may not see any profits in leasing or selling site licences in their blocks. BTA could ‘retain’ blocks and issue site licences in them in order to ensure that spectrum is also available in ‘small units’.

1.3.7 Tenure: What should the duration of licences be?

Investments are only made because there is an expectation that the investments will generate a revenue stream which is sufficiently large to yield a positive return given the risk of the project. If tenure is uncertain, the risk associated with the project is increased and the level of investment will be lower than it would have been with less uncertainty.

Different models for the duration of licences have been discussed. The main argument for time-restricted rights (usage rights that are not for perpetuity) is the requirement for periodical re-planning of the spectrum or to facilitate eventual taxation of spectrum resources in the future.

We recommend a policy which is more explicit about tenure than the BTA's policy today. We consider the introduction of perpetual usage rights to be premature and recommend that block licences either be assigned with a fixed duration, i.e. of 15 -30 years or by the use of an un-determined licensing period with an initial "grace" period like the one introduced in the UK.

If a fixed term is used, the intended method for re-assignment of future usage periods should be clear and predictable. The assignment procedure for future usage periods should be completed well within the expiry of the current right. Existing licences could be given a tenure which coincides with the duration of the Service Licences.

If the "UK model" is adopted; a model where block licences are assigned on a rolling term basis with a fixed notice period, then the notice period should be sufficiently long to provide for business certainty. An example could be an initial 10 years "grace" period followed by a five-year notice period.

For site- licences, we recommend implementing (as a default) a rolling term approach where the next year's usage right is granted automatically upon the payment of the current year's charge or fee. Such licences could be revoked or changed to the detriment of the user e.g. three to five years subsequent to a formal notice.

Recommendation 20: We recommend a policy which is more explicit about tenure than today. We consider the introduction of perpetual usage rights to be premature and recommend that block licences either be assigned with a fixed duration of 15 -30 years or by the use of an un-determined rolling licensing period with a notice period of 5-10 years.

Recommendation 21: For site- licences, we recommend implementing (as a default) a rolling term approach where the next year's usage right is granted automatically upon the payment of the current year's charge or fee. Such licences could be revoked or changed to the detriment of the user e.g. three to five years subsequent to a formal notice.

1.3.8 Formal procedures for demand assessment

Competitive procedures (auctions or beauty contests) are costly both to the BTA and to the bidders. Efficiency only dictates competitive procedures to be used when demand is higher than supply, i.e. when there actually is competition for resources. Otherwise, a first come, first served procedure is preferable.

In larger countries, excess demand can very often be assumed to exist, especially if regulatory constraints and costly usage conditions have been removed. Very small units of bandwidth in less valuable bands have been sold in competitive auctions in the US. In small countries like Botswana, excess demand is likely to occur only in a few special cases. Unfortunately, the level of demand cannot be observed directly.

In practice, what the BTA needs to know is whether demand would exceed supply if the spectrum were offered at some given, pre-determined cost to the applicants. Traditional demand surveys or interviews are generally unreliable because interested parties may have incentives to misrepresent their demand. We therefore recommend that BTA implements formal procedures for demand assessment to reveal whether demand for block licences exceeds availability in frequency bands open for all applicants. The Consultants recommend procedures similar to those successfully implemented in Guatemala and Norway as outlined in Annexure B.

Recommendation 22: As it should be possible to meet all demand for access to most frequency bands in Botswana, we recommend that first come, first served is maintained as the primary method for spectrum assignment in Botswana.

Recommendation 23: Implement a formal procedure for demand assessment to reveal whether demand for block licences exceeds availability in frequency bands open for all applicants. The Proposed demand assessment procedure for Botswana is outlined in Annexure A.

1.3.9 The use of auctions to assign usage rights to spectrum when demand exceeds availability

An inevitable consequence of liberalisation of service markets is that there will be increasing competition for access to spectrum. To promote efficient use of spectrum, the assignment procedure should assign the usage rights to those who value it the most. In addition, the costs and distortions caused by the procedure itself should be minimized.

Consistent with international best practice and a predominant movement away from traditional methods, we recommend the use of auctions as the default assignment procedure where demand for spectrum is determined to be higher than supply. Contrary to the messages in many consultancy reports, there is nothing exotic about auctions; they have been in use for centuries. The experience from the European 3G auctions shows that even when the markets severely misjudge the value of spectrum, auctions outperform other methods. The owners of companies that arguably overpaid for licences suffered financial losses similar to investors who overpaid for other assets

just prior to the burst of the IT bubble. There is no evidence of negative real consequences (as opposed to financial consequences) in those markets where the 3G auction revenue was large, e.g. in Germany and the UK. In those countries, the general taxpayer benefited from the revenue raised by the government. In countries where 3G spectrum was assigned by “beauty contests”, large resources have been used unproductively by governments (to enforce licence conditions) and private firms (lobbying for change of licence conditions) since the licence assignments. The taxpayers in those countries did not generally benefit from the assignment of the licences although some consumers may have benefited from multiple, parallel networks being rolled out in areas where consumer demand alone would not have supported the establishment of networks.

It is difficult to find any scientific recommendations which favour other methods over auctions. Many countries have abandoned the use of beauty contests in favour of auctions. The number of countries that have used beauty contests subsequent to auctions is low, and we are not aware of any countries that have reverted to the use of traditional methods as a policy. The use of beauty contests seem to be largely unmotivated by efficiency concerns and little documentation of the reasons for their use exists.

Auctions yield better results with lower costs and less effort. The apparent complexity of some auctions is primarily due to the increase in ambitions which follow with the capabilities of auctions. In addition to substituting auctions for beauty contests, governments normally ‘aim higher’ with respect to the fulfilment of the objectives of the procedure. If everything else is kept equal, for example if the number of licences is fixed and their size is pre-determined, then auctions will normally be both faster and cheaper to run than beauty contests.

Auctions do not increase the costs of services. If licences are given away below their market value, profits increase, but investments and prices will remain unaffected. Those who doubt this could test the theory by giving money to telecommunications operators and observe whether prices are subsequently reduced. Auctions where licences are paid with coverage obligations, will normally lead to misallocation of capital, that is capital invested in projects with lower return than the best of the existing alternatives. In most cases where the government e.g. wishes to increase network coverage beyond the level supplied by the market alone, an auction of spectrum combined with a separate procurement procedure for network coverage outside commercially viable coverage areas, would yield a more cost-efficient result. Common misconceptions associated with the use of auctions are addressed below.

Recommendation 24: Use auctions to assign licences when demand for spectrum exceeds its availability.

Recommendation 25: Use simple and well-known auction formats in the first auctions to keep administrative costs at a reasonable level relative to the value of the spectrum.

Recommendation 26: Do not use roll-out conditions as payment for licences. Monetary payments can be used more efficiently to promote the objectives traditionally promoted by roll-out conditions.

Recommendation 27: Abstract lots should be used whenever possible to simplify auction design. Pre-determined licence sizes may also simplify the implementation of auctions.

1.3.10 Administrative charges to finance the government

We recommend that the practice of financing spectrum management by the use of administrative charges should be continued.

We make this recommendation even if the traditional arguments for implementation of administrative charges; that they make the costs and benefits of government services more visible[5], apply only to a very limited degree with respect to spectrum management. Since most of the costs of spectrum management are joint costs, the charge associated with each licence is only loosely related to the costs of issuing and protecting it.

On the other hand, administrative charges, set at a level well below the expected value of the licences, do not distort the economy. Provided that the charges can be collected in an administratively efficient manner, it could be better to fund the BTA's spectrum management activities by the use of administrative charges than by grants-in-aid from revenues raised by general taxation.

There are other reasons to maintain the current system as well. Annual charges can provide an incentive for licensees to inform the BTA about change of ownership if trading is introduced. If the registered licence holder is responsible for all payments until the BTA has received notice about the new licence holder, then the registered licensee has an incentive to inform the BTA about a trade. If the system for the collection of annual charges is kept in place, then a potential future decision to introduce "Administrative Incentive Pricing" (AIP) would be easier to implement. Thus, by maintaining the current system, more policy options remain open.

The use of administrative charges can only be defended if their benefits are larger than their costs. Therefore it is important to keep the administrative costs associated with collecting administrative charges as low as possible. We recommend maintaining a simple fee structure where fees grow at an annual rate similar to the consumer price index, preferably with a lag to simplify the determination of the rate of inflation. This saves the costs associated with periodically adjusting the fee level. Even if the current fee level is used as a starting point, the total revenue raised each year would be expected to grow faster than inflation. The reason for this is that the intensity of the use of the spectrum, and the number of licences, can be expected to grow. Such an

[5] See e.g. Organization for Economic Cooperation and Development, Public Management Committee, Best Practice Guidelines for User Charging for Government Services (18th Annual Meeting of Senior Budget Officials, Paris, June 10-11, 1997), p. 2.

increase beyond inflation appears appropriate to align revenue with BTA's total administrative cost attributable to spectrum management.

The proposal to open additional frequency bands for licensing and to expand the use of block licences requires a revision of the existing licence fee model. Given that cost recovery is the primary reason for collecting fees and the premise that the fees should not, to the extent possible, distort the use of spectrum, the proposal for a revised fee model is intended to let individual fees reflect both the administrative cost of licensing and value of the licences.

For block licences, we propose a model where fees are set at a level which is assumed to correspond roughly to the value of each licence. For other licences, we propose to adjust and expand the current fee model in a way that makes individual fees depend more on the amount of spectrum occupied by each licence. The model allows BTA to distinguish between licences in urban and rural areas. In addition it enables BTA to adjust many fees on a band-by-band or service-by-service basis in cases where the initial assumptions about valuations were inaccurate. This facility could also be used if BTA should decide to implement AIP by incremental fee changes in the future.

It is recommended that BTA should consider making all spectrum users, including all government users, subject either to licence fees or to other fees intended to cover the costs associated with spectrum management. We will argue that the use of auctions as an allocation mechanism greatly simplifies the setting of administrative charges, as vertical and horizontal equity considerations lose much of their significance. Auctions "level out" any underlying cost differences between licences. We recommend that if auctions are used, then the revenues from the auctions could partly be used to cover the costs of setting them up.

Recommendation 28: With respect to administrative charges, the Consultants recommend that the BTA should continue the use of such charges and that the BTA should adopt the following objectives related to the determination of charges: (i)the revenue raised from such charges should at least cover the BTA's administrative costs related to spectrum management; (ii) charges should be transparent and predictable; (iii) charges should not cause market distortions; (iv) administrative costs related to the collection of such charges should be as low as possible.

Recommendation 29: Charges should generally be adjusted annually using the CPI in order to avoid large increases at less frequent intervals.

Recommendation 30: The amount of the charges should if possible be linked to objective criteria, preferably parameters already known by the BTA. For block licences, such criteria could be population covered by the licence (not the actual system), bandwidth and spectral position for block licences. For site licences, charges could be determined by bandwidth, spectral position, emitted power and possibly geographical location. This would keep administrative costs down since no information would have to be collected and processed for the sole purpose of collecting charges.

Recommendation 31: We recommend that BTA should require entities exempted from the radio licence requirement in terms of section 42(3) of the Telecommunications Act (the Botswana Defence Force, Botswana Police Service, the Department of Civil Aviation and Botswana Railways) and, where the Authority so desire institutions exempted pursuant to section 42(3)(e) to pay all other fees related to services rendered to these institutions, including services related to spectrum management.

1.3.11 Administrative incentive pricing to promote efficiency

Administrative incentive pricing is significantly different, and more complex, than the use of user fees to fund spectrum management activities. The purpose of administrative incentive pricing is to expose the users of spectrum to its opportunity cost; the benefits foregone from assigning spectrum to the best use instead of the next best use. Administrative incentive pricing attempts to direct the spectrum to users that value it the most (i.e. those who will make the optimal use of it). This requires that the fees are set at a level that reflects the opportunity costs.

The problem is that without a market for spectrum, the opportunity cost, or hypothetical market clearing price, is almost impossible to estimate with any accuracy. The opportunity cost changes continuously, and the problem of estimation is even more difficult if spectrum is used as an input in markets where market conditions are changing rapidly. Examples of such changes of market conditions are liberalisation of service markets and changing spectrum management policies, in other words, the changes that are going on in Botswana right now.

The UK's model for administrative incentive pricing relies on the so-called NERA-Smith approach which uses a proxy for the opportunity cost. The proxy is "the cost of the least cost alternative to using spectrum that would enable the same output to be produced". This could be achieved via an alternative technology such as fibre cables in the case of fixed wireless links, or simply by moving to a less congested spectrum band. Determining the least cost alternative is obviously not a straightforward task either; it requires a lot in terms of input data, and changing market conditions are an additional challenge for this approach.

The contrast with administrative charges is large. Administrative charges need only be set at a level *between* zero and the level of the opportunity cost in order to be non-distorting. If administrative incentive prices are to work as intended, they must be set *close to* the level of the opportunity cost. Thus, the requirement for accuracy is greatly increased, as is the risk of overshooting.

Now, the rationale behind technology neutral, flexible licences and spectrum trading is exactly to expose spectrum users to the opportunity costs of spectrum. A spectrum market achieves this faster, cheaper and with more flexibility than any known administrative incentive pricing policy. The estimation process and administrative procedures associated with incentive pricing are complex and costly. If efficient use of the resources is the objective, then pricing would only be called for where markets

cannot be expected to work properly and where it is possible for users to respond to price changes by adjusting their behaviour (use of spectrum).

There are obvious economies of scale in the implementation of a system for spectrum pricing, and we doubt that such a system can be implemented in Botswana in a cost-effective manner. The BTA's resources can probably be put to better use elsewhere within the field of spectrum management. We do not preclude entirely the use of administrative incentive pricing after the reforms of both spectrum management and the telecommunications sector as a whole are completed. However, at the moment, cheaper, less controversial and more effective efficiency promoting reforms, such as auctions and trading, are available, and we recommend that these be introduced first.

Recommendation 32: The consultants recommend against the implementation of AIP at this point in time. In order to enable itself to assess the costs and benefits of AIP, the BTA should implement other market based policies and complete the liberalisation before AIP is reconsidered as a spectrum management tool.

1.3.12 The government's own use of spectrum

In general, a government's use of frequencies can be divided into two sub-categories. The first is frequency use which is inherently linked to government activities, such as the military's use of frequencies for weapon systems or intelligence or for example the aeronautical authorities' use of frequencies to control and direct air traffic. This document does not concern such use because the current reform of the telecommunications sector does not affect such uses to any significant degree, other than to the extent that these government entities will share the frequencies with other market players.

The other government use of the spectrum is for frequencies used by the government for the production of services which could just as well be provided by the private sector. While this part of the government's use of the spectrum is not directly affected by market reforms either, there is scope for beneficial reforms, and some of the recommendations in this report naturally extend to such government uses and users. In particular, if other branches of government were able to sell off unused or underused parts of the spectrum and were permitted, or even required, to compete for access to additional spectrum on equal terms with private firms, then there would be scope for additional gains in efficiency.

A recent study in the UK revealed a large potential for improvements and suggests the use of market mechanisms to achieve the right balance between private and government use of the spectrum. Although such reforms are not at the core of our recommendations, we believe that the BTA should be open to reconsider whether there are potential gains to be made. By conducting regular discussions with those government agencies that use spectrum for such 'inherently' governmental purposes, the BTA could reveal whether e.g. technological or strategic developments have freed up spectrum which could be used for production of valuable services by the private sector.

Recommendation 33

The BTA should consider whether there are potential gains to be made by the use of market mechanisms to achieve the right balance between private and governmental use of the spectrum. By conducting regular discussions with those government agencies that use spectrum for 'inherently' governmental purposes, the BTA could reveal whether e.g. technological or strategic developments have freed up spectrum which could be used for production of valuable services by the private sector.

1.3.13 Equity issues

Even when everybody gains from a reform, some may gain more than others. One issue that may arise where existing users of spectrum have their licences converted into tradable and flexible usage rights is the increased potential for capital gains; someone received rights of use in the past and a reform increased the value of those rights more than anyone had envisaged. New entrants may have to pay large amounts for similar rights. This is sometimes referred to as "legacy issues" and they are more related to equity considerations than to efficiency. Such issues have been a source of controversy and have been permitted to delay spectrum reform in some countries.

Most of the spectrum assignments in Botswana are held by government bodies and government owned companies. The most valuable ones among those held by private companies (GSM 900), were assigned through a competitive tender procedure and are presumably already put to their highest valued use. In addition, spectrum licences have limited duration, and the potential for substantial windfall gains for others than the government itself (or entities owned by the government) seems limited. Windfall gains do not have any negative consequences for efficiency and growth, the costs of taxing such gains are high and the potential revenue from such taxes is probably low. Our recommendation is that considerations related to legacy issues such as windfall gains should not be permitted to delay reforms.

Another equity related issue is the preferential treatment of designated entities. This means discriminating in favour of particular groups such as minorities, citizens, youth, women or small and medium sized businesses. In Botswana, citizen empowerment was an issue which was raised during the initial stages of the consultative process.

The question of whether particular groups should receive favourable treatment in general is beyond the scope of this consultation. However, by promoting the economically efficient allocation and use of the spectrum, the spectrum manager contributes to improve the conditions for the downstream service markets. A better-functioning telecommunications infrastructure is a benefit both to consumers and to businesses for which telecommunications services are an essential input. Thus, by promoting the efficient use of spectrum, the spectrum manager contributes to increasing value creation in society, employment, and tax revenue available for re-distribution.

Extensive experience with preferential treatment within the general framework of spectrum licensing policy exists. In general, little seems to have been accomplished and the law of unintended consequences seems to apply in full.

Recommendation 34: Considerations related to windfall gains should not be permitted to delay reforms. The issue is most appropriately addressed by selling new licences at market prices by the use of auctions.

Recommendation 35: Should it be considered to implement preferential treatment into the spectrum management policy, we would recommend that the experience from other countries such as the US and New Zealand is studied carefully in order to reduce the likelihood of the most unfavourable outcomes.

1.4 Recommended order of implementation

We do not recommend a "big bang" approach to reforms; but rather a phased transition. The principles underlying our recommendations are:

- Unlicensed (or lightly – licensed) bands should be opened in accordance with international best practice.
- New, exclusive licences should be designed as flexible usage rights using a "spectrum mask" approach.
- The block licence approach should be the default method for new bands with exclusive licences.
- The conversion of existing rights should be postponed until the BTA has gained some experience with the new approach.
- A method for determining whether demand exceeds supply should be introduced.
- Auctions should be implemented whenever the demand for new licences is larger than the availability of spectrum.
- Simple auction formats should be used before more sophisticated ones are implemented.
- Existing licence holders should not experience very large changes in administrative charges associated with their licences; there is larger scope for changing the fee levels for new licences.
- All new licences should be made tradable, and we recommend that existing licences are made fully tradable as well.
- As the BTA gains experience with market based spectrum management, some governmental licences should be considered for inclusion into the new regime.

We recommend that administrative incentive pricing should not be introduced now. This policy could be reconsidered when the majority of frequency bands are tradable and licences have been converted into flexible usage rights. Concrete examples of market based re-farming strategies and procedures intended to reveal whether demand is larger than supply, are included below.

1.5 Impact on the role of the spectrum manager

The liberalization of the telecommunications sector will have a major impact on the tasks and responsibilities of the spectrum manager. Its major concern will be to ensure that spectrum is allocated efficiently between competing uses and users by means of markets, whilst at the same time ensuring that relevant obligations under international law are observed. The use of competitive assignment procedures may become a more frequent event and the conditions for unlicensed uses of the spectrum must be frequently revised. In addition, the BTA's role as an advisor and as a provider of information about spectrum uses and the international regulatory development will become even more important.

We do not believe it will be possible to manage the spectrum efficiently by traditional methods alone when the effects of liberalisation set in. Not only is it unlikely that a regulator would be able to gather and use enough information to rival the information-revealing properties of markets; the workload associated with an attempt to do so would outgrow any realistic budget. By proactively implementing a market-based approach to spectrum management, the BTA could be able to offset the rapid growth of the value of spectrum and the increased variation in spectrum uses. Even if the value of spectrum grows and the number of alternative uses increases, it should be possible to ensure an optimal use of spectrum by using the BTA's existing resources. Small countries both in the developed and the developing parts of the world have reformed their spectrum management policies without increasing in size. The spectrum manager's size and budget need not grow proportionally to the value of the spectrum if it is willing to further develop the skills of its staff and to adapt its policies and working methods to the changing environment.

2 Radio licence fee model

2.1 General proposal

The proposed new model builds to a large extent upon the existing model. In general, annual adjustments using the CPI is proposed. In addition, it is proposed to include a pricing parameter which allows BTA to decrease fees that are too high relative to the value of licences or to implement AIP by incremental fee changes if appropriate.

2.2 Proposed model for block licences

If the BTA adopts the recommendation to rely increasingly on the use of block licences, new fee levels need to be adopted. The proposed model is intended for block licences and covers all frequency bands where block licences could be used. If BTA decides to assign site licences in some of the bands covered by the model, one of the site licence or terminal licence fee models should be used.

The fees should reflect the fact that holders of licences benefit from regulation and that the joint costs of spectrum management should be allocated between licences such that a larger portion of the cost is recovered from the most valuable licenses.

As a point of departure for establishing rough estimates for the value of the various frequency bands, we propose to use the current GSM 900 licence fees. The reason for this is that the current fee levels do not appear to be higher than the value of the GSM 900 spectrum (at the margin) and so should not distort frequency allocation. Since price comparisons between countries are generally unreliable, we propose to use the current observation related to the GSM 900 licences and assumptions about the relation between the value of the GSM 900 band and other frequency bands as a basis for setting fee levels. We will propose a methodology which would allow BTA to adjust the fee levels of individual bands as information is revealed about the true value of those bands.

A simple fee structure could be to define annual fees for new block licences for two different classes of frequency bands. The first class would contain frequency bands which could be considered to be exceptionally valuable, either due to standardisation and international harmonisation or due to favourable physical properties. The second class uses spectral position of the licences as a rough proxy for their value.

Fees in both classes are linked to the existing fees in the 900 MHz band. If the models appear overly simplistic, remember that the objectives are simple too. Simplicity is also a virtue in a situation where the BTA's spectrum management resources may become tied up with other demanding reforms.

The fees proposed here are to be paid irrespective of method of assignment. Note that in cases where demand for licences in a frequency band exceeds supply, a competitive procedure such as an auction would be used to decide the assignment of licences. As a result of such a procedure, a one-off lump sum payment would have to be made in addition to the annual charges. For example, if the BTA sets the annual charges for a block licence in some frequency band to, say, BWP 10 000 per year (subject to annual adjustments based on the CPI) per MHz and demand for such block licences still exceed availability, then auction winners would have to pay their bids in the subsequent auction in addition to the annual charges. The auction thus determines the one-off lump sum payment, but not the annual charges.

The first class would contain all frequency bands below 450 MHz, the 450 MHz band, the GSM900 and GSM1800 band and the 3G core band. The large amount of available bandwidth in the GSM1800 and 3G core bands suggests that the marginal value of those bands could be somewhat lower than the GSM900 band. Subsequent to the introduction of full liberalisation, it may be appropriate to adjust the fees in those bands if the initial fee level is such that spectrum in those bands remain idle. This could be done by adjusting the model parameter P (described below) below its default value of 1 for each of the two bands. Although data on the relative value of the 450 MHz and the 900 MHz bands are scarce, data from Norway and Sweden (where the 450 MHz band were auctioned off as block licences) suggest that the marginal value of the 450 MHz band may be close to the marginal value of spectrum in the 900 MHz band. Should it be considered to assign block licences in the 470-870 MHz band; then that band could possibly be included into this fee class.

For other frequency bands above 870 MHz, the model is based upon the assumption that the value of spectrum licences is roughly inversely dependant upon spectral position. Using the GSM 900 MHz band as a reference, fees per MHz*POPs could be set at a level equal to $0.92/f_c$, multiplied by some constant V smaller than one, where f_c is the centre frequency in the frequency band in question measured in GHz. Using this model, the fees in the 2.6 GHz band would be V*0.9/2.6 = approximately k/3 of the fee per MHz in the 900 MHz band unless the parameter P is set different from 1. If it turns out that the fees resulting from this model are such that large portions of a frequency band remains unused, then the parameter P can be set smaller than 1 to reflect the low valuation of the band in question.

Model parameters:

Variable	**Explanation**
C_{900}	Actual GSM900 fee (2x8 MHz licence) in 2007.
V	Calibration parameter determining the level of fees in other bands relative to the exceptional valuable bands. $0 < V \leq 1$; V is initially assumed to be set to 1/5.
P	Pricing parameter which is set individually for each band. This allows the BTA to adjust the model as further information of the value of frequency bands becomes available. If, subsequent to the full liberalisation, large portions of a frequency band remain unused, P could be gradually reduced from its initial level of 1.
BW	Bandwidth of licence.
f_c	Frequency band midpoint in MHz.
$Index_t$	Price index at time t where $Index_{2007} = 1$.
POP_c	Population covered by licence. $0 < POPc \leq POP$, where POP is the total population in Botswana.

In the first class of frequency bands; the exceptionally valuable bands; the annual licence fee per MHz for a licence of bandwidth BW in year t would be given by the formula:

$$1/16*C_{900}*BW*P*Index_t*POP_c/POP \qquad \text{Formula 1}$$

Under the initial assumptions, P=1 and for a national licence, the fee in year t would be $=1/16*C_{900}*BW*Index_t$.

Annual fees for block licences of bandwidth BW in all other bands at time t would be given by the formula:

$$1/16*C_{900}*V*920/fc*BW*P*Index_t*POP_c/POP \qquad \text{Formula 2}$$

With our initial assumption that V = 1/5 and P=1, the annual fee in year t would be = $1/16*C_{900}*1/5*920/fc*BW*Index_t$.

The model described above is simple while it nevertheless will be flexible since it includes parameters which will enable BTA to further adjust fees in each band in accordance with information revealed as reforms are implemented.

Example 1:

Using the model described above, with initial parameters V = 1/5 and P=1, the annual fee for a licence of 30 MHz of bandwidth in the 3,5 GHz band would be

$1/16*C_{900}*1/5*920/3500*30*Index_t = 69/700*C_{900}*Index_t$,

i.e. roughly 1/10 times the annual GSM900 licence fees in year t.

2.3 Proposed model for site licences

The proposed model covers frequency bands which may be appropriate for block licensing and so should only be used where BTA actually chooses to implement site licences for radio links in the frequency band in question and only in cases where fees are not determined in other provisions. The model is intended to replace current fee codes E31-33. Currently, annual fees are BWP 300 for links below 790 MHz, BWP 150 for links between 790 MHz and 10 GHz and BWP 100 for links above 10 GHz.

For site licences above 790 MHz, the model establishes BWP100 as a fixed fee component which should be paid irrespective of frequency band, licence bandwidth or the geographical location of the site. In addition to the fixed component, there is a component which is determined by frequency band, licence bandwidth and the geographical location of the radio station. We propose that fees should be adjusted annually by some price index which is considered relevant to BTA costs. For site licences below 790 MHz, the fixed component is proposed to be BWP200.

With respect to geography, we propose to define an urban category, consisting of Gaborone and Francistown, and a rural category, consisting of all other areas. A parameter R allows the frequency determined component to be reduced in rural areas compared to urban ones if this is considered appropriate. We propose to initially set R = 1 and that the BTA considers differentiating between urban and rural areas as reforms have been implemented and it has gained some experience with the model.

For the frequency bands below 10 GHz the model is calibrated such that the fees for links with a typical bandwidth in urban areas remain unchanged. For example, if the most common bandwidth of a licence in a frequency band between 790 MHz and 10 GHz is 3.5 MHz, then such a licence would still be subject to an annual fee of BWP 150 under the new model (albeit adjusted for inflation) unless the pricing parameter P is set to be different from 1. A 7 MHz licence in the same band and area would be subject to a fee of [100+7/3.5*50] = 200.

The proposed model is specified for all relevant frequency bands. This will enable BTA to adjust fees in each frequency band individually (by adjusting the pricing parameter P) as information becomes available about the demand for licences in each band.

Model parameters:

Variable	Explanation
C_{fixed}	Fixed fee component= 100 in bands above 790 MHz and 200 in bands below 790 MHz
R	Rural parameter which decides how much the frequency and bandwidth determined fee component should be reduced in rural areas compared to urban ones.
P	Pricing parameter which is set individually for each band. This allows the BTA to adjust the model as further information of the value of frequency bands becomes available. If, subsequent to the full liberalisation, large portions of a frequency band remain unused, P could be gradually reduced from its initial level of 1.
BW	Bandwidth of licence.
BW_r	Reference bandwidth
$Index_t$	Price index at time t where $Index_{2007}$ =1

For site licences above 790 MHz, the annual fee of a licence of bandwidth BW at time t would be equal to

$[100+BW/BW_r*50*P*R]*Index_t$ Formula 3

In urban areas, R=1. In rural areas, R may be smaller than 1.

For site licences below 790 MHz, the annual fee of a licence of bandwidth BW at time t would be equal to

$[200+BW/BW_r*100*P*R]*Index_t$ Formula 4

In urban areas, R=1. In rural areas, R may be smaller than 1.

Example 2:
If the most common bandwidth of a licence in a frequency band between 790 MHz and 10 GHz is 3.5 MHz, then such a licence in an urban area would be subject to an annual fee of

$[100+BW/BW_r*50*P*R]*Index_t = [100 + 3,5/3,5*50*1*1]*Index_t = 150*Index_t$.

unless the pricing parameter P is set to be different from 1.

A 7 MHz licence in the same band and area would be subject to a fee of $[100+7/3.5*50*1*1]* Index_t= 200*Index_t$.

Recommendation 36: We recommend that BTA should implement a simple fee model based on principles similar to those described above. Such a model will enable BTA to inform licensees about the amount of the annual fees of any band in advance of an application. Fees could be reduced or re-balanced as the towards the end of the liberalisation process, as markets mature and more certain information about the value of the various frequency bands becomes available.

Annexure A: Recommended procedures for demand assessment and assignment of exclusive block licences

The consultants have identified two alternative procedures, outlined below, for assignment of spectrum licences. Both procedures conform to the principles recommended above. The first procedure is particularly relevant in situations where the demand for spectrum has built up over time.

Under this alternative, the assignment procedures are initiated by the BTA and this gives the BTA more control over the timing of eventual assignment procedures in such situations. The second procedure is intended as a procedure for more general use. Under the second procedure, assignment is initiated by the applicants themselves.

Similar procedures have been used in a number of countries. It is anticipated that in the majority of cases demand will not exceed supply and a competitive assignment procedure will not be necessary. The main virtue in such cases is that it becomes incontestable that all potential competitors to a new licence would have been given a fair chance of expressing their interest in the licence. The transparency of the procedures protects against allegations of unfairness in the assignment of frequencies.

A third alternative would be to skip steps 1-3 in alternative 1 in cases where it is obvious that the demand for spectrum will exceed supply.

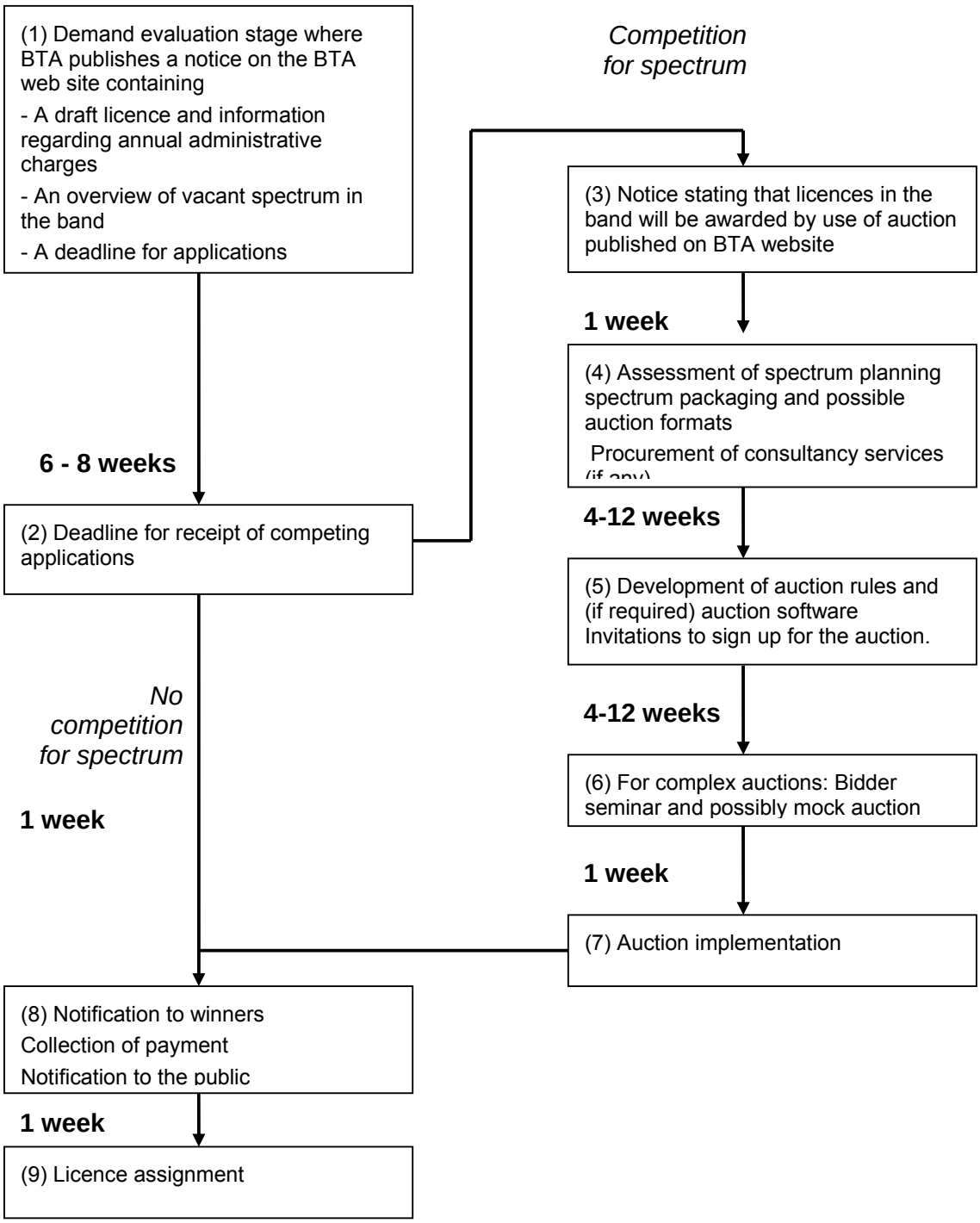
Alternative 1: Procedures initiated by the BTA

The procedure consists of 9 steps.

1. The BTA divides the relevant frequency band into pre-specified licences or lots. If we use the 2.6 GHz band as an example, we can assume that BTA has divided the band e.g. into six unpaired licences consisting of 30 MHz of bandwidth each. Licence conditions, applicable charges and possibly additional reserve prices are defined in a way that enables potential applicants to assess the value of the licences. An overview of the frequency band, licences and relevant licence conditions is published on BTA's web-site site and other media (e.g print media). Applications for licences are invited within a specified timeframe e.g. 6-8 weeks. The BTA requires applications to be accompanied by a deposit or a guarantee covering one or two years of administrative charges and any additional reserve price. If the licences are sufficiently similar, the BTA may decide that only applications for abstract lots will be accepted. That is, applicants can only apply for access to a band and for the amount of bandwidth specified by BTA but they will not be allowed to specify which part of the band in question they want.
2. Upon the expiry of the deadline, the BTA assesses whether all applications can be met. It does not consider the financial strength of the applicants, their technical ability or their documented need for frequencies because all such considerations are assumed to be taken care of by the applicant itself, its owners and its financers.
3. If it is concluded that demand exceeds supply or that some of the applications are mutually exclusive, then the entire band will be assigned by auction. A notice containing this conclusion is posted on the BTA web site and other media.
4. Spectrum planning and packaging and possible auction formats are assessed. For more complex cases, consultancy services may be procured.
5. Auction rules and possibly auction software are developed. During this period, an invitation to sign up for the auction is published along with an outline of the auction format.
6. If the auction format is not among the simplest standard formats, a bidder seminar or a mock auction may be called for.
7. Auction implementation.
8. Auction result is notified to the winners and to the public. Payment is collected.
9. Assignment of licences. If all applications can be met, steps 3-8 is skipped and licences can be assigned immediately.

The following figure illustrates the flow of the procedure. The duration for each step is merely for illustrative purposes only.

Figure1: Procedures initiated by BTA

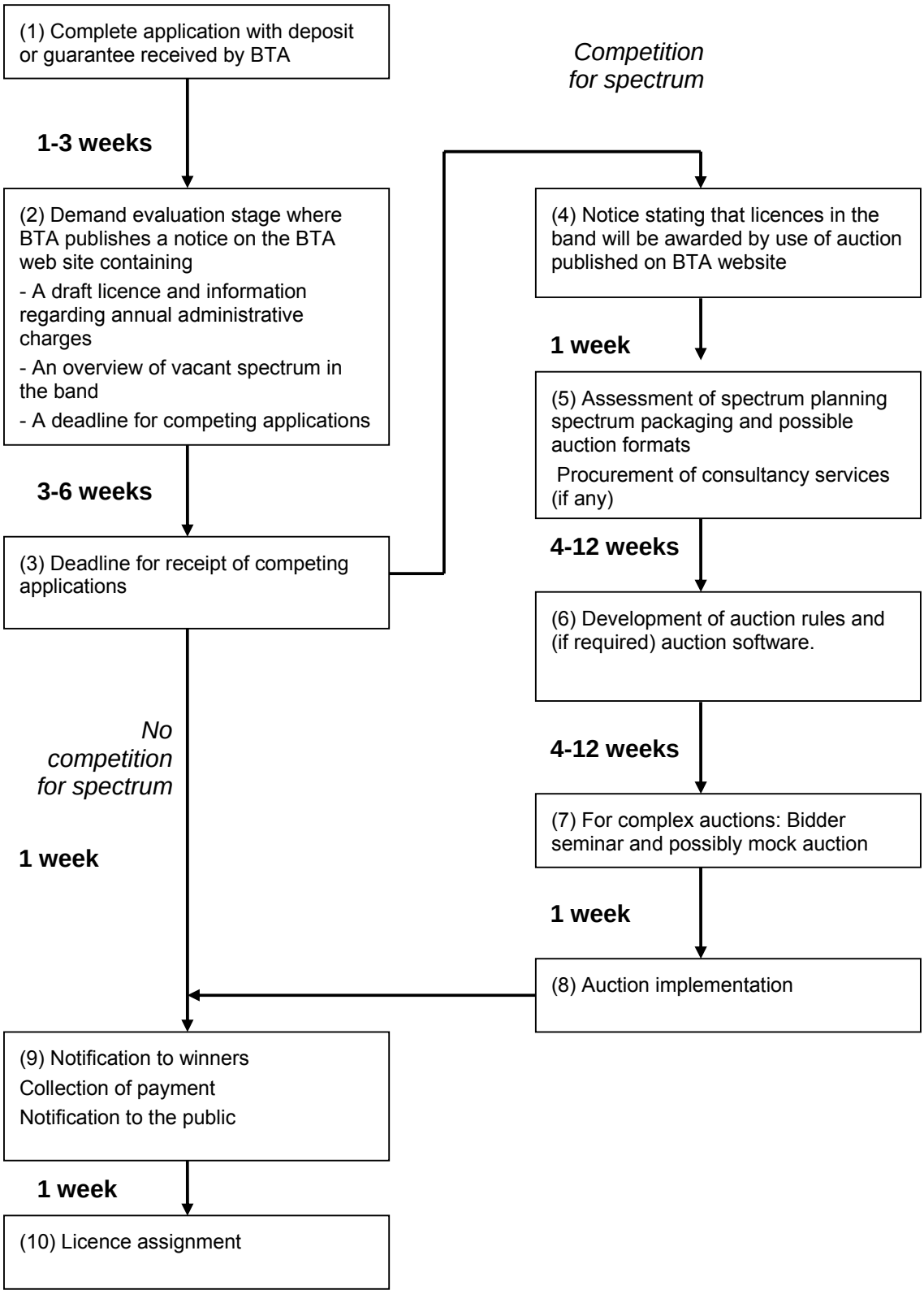


Alternative 2: Procedures initiated by applicants

This procedure is very similar to the former one. It is different only in the way the procedure is initiated. This is assumed to be a candidate for a standard procedure which could apply when the transition to a market based regime is completed and BTA and the market players have become familiar with the new principles. Experience from other countries suggests that in most cases, spectrum can be assigned without the use of competitive procedures.

1. An application conforming to BTA requirements is received by BTA. The application is either specific (e.g. “the uppermost 112 MHz licence in the 26 GHz band) or generic (“a 112 MHz licence in the 26 GHz band”). Normally, the applicant will have contacted the BTA in advance in order to obtain information on the size of the deposit or guarantee which is required to accompany the application. The amount of the deposit or guarantee will normally be set to cover one or two years of administrative charges. By requiring such a deposit, BTA avoids having to process applications from persons or firms which are not able to pay the annual charges.
2. BTA initiates a demand assessment stage, where competing applications are invited. In order to enable potential competing applicants to assess whether they wish to apply to the same or to similar spectrum, a draft licence and information regarding annual charges and other relevant conditions are published. An overview of the frequency band which shows existing licences and vacant spectrum will also be helpful to potential applicants when they evaluate whether to apply for a licence. Competing applicants must also submit a deposit or a guarantee, just like the initial applicant. The value of the licences should be taken into account when the deadline is set. More time should be allowed for “large” decisions, i.e. decisions to apply for valuable licences.
3. Upon the expiry of the deadline, the BTA assesses whether all applications can be met. It does not consider the financial strength of the applicants, their technical ability or their documented need for frequencies because all such considerations are assumed to be taken care of by the applicant itself, its owners and its financers.
4. If it is concluded that demand exceeds supply or that some of the applications are mutually exclusive, then the entire band will be assigned by auction. A notice containing this conclusion is posted on the BTA web site and other media (e.g. print).
5. Spectrum planning and packaging and possible auction formats are assessed. For more complex cases, consultancy services may be procured.
6. Auction rules and possibly auction software are developed. During this period, an invitation to sign up for the auction is published along with an outline of the auction format.
7. If the auction format is not among the simplest standard formats, a bidder seminar or a mock auction may be called for.
8. Auction implementation.
9. Auction result is notified to the winners and to the public. Payment is collected.
10. Assignment of licences. If all applications can be met, steps 4-9 is skipped and licences can be assigned immediately.

Figure 2: Procedures initiated by applicants



Annexure B: Demand Assessment Procedure at Guatemala, El Salvador & Norway

Guatemala

Guatemala is an example of a developing country which has implemented one of the world's most modern and efficient spectrum management regimes. The application for spectrum usage is described by Ibarguen (2003) as "simple" and is implemented as follows.

- An interested party surveys existing spectrum use in the spectrum registry of SIT.
- The party applies to SIT for the right to use an unoccupied frequency as specified in the application form.
- The application is evaluated by SIT, which deems it accepted, incomplete or rejected in three days or less. Grounds for rejection include technical interference and request for reserved or radio amateur bands. Reserved bands are for government use only.
- If the application is accepted, public notice is issued. Parties objecting to the new use file formal complaints. Grounds for opposition are limited to technical interference.
- Complaints are adjudicated via binding arbitration, a process that cannot exceed ten days.
- Other interested parties are allowed to file competing claims to requested spectrum rights.
- If no competing claims are filed, then the petitioner receives rights without payment.
- If competing claims are filed, then SIT must schedule an auction within 35 days of the end of the opposition period.[6]

Since liberalisation in 1996, the SMA has held more than 40 spectrum auctions and has issued around 5000 TUFs (usage titles to spectrum) to more than 1000 users. Guatemalan authorities report very few problems associated with spectrum allocation and assignments. Problems related to enforcement against pirate broadcast radios is said to be the only significant exception.

[6] Ibarguen (2003).

El Salvador

In El Salvador, new users of spectrum are accommodated much as in Guatemala.

Interested parties, including foreigners, can petition the General Superintendent of Electricity and Telecommunications, or SIGET to receive a concession.

The adjudication process is found in Articles 78-82 of the 1997 law:

- An interested party may petition the SIGET for the right to a concession.
- The SIGET must consider the application. Grounds for rejecting a petition are specific and limited, including: The spectrum is granted to another party and there is no compatibility in use. The spectrum requested does not require a concession for use (e.g., free use spectrum). The requesting party has an outstanding sanction related to the existing telecom law. The requesting party is not eligible to receive a concession under the existing law.
- Upon receipt of a request for concession, the SIGET must publish this request, and other parties have 20 days to respond.
- Opposing parties must receive a hearing within ten days of their response.
- During the response period, SIGET's Manager of Telecommunications must produce a technical evaluation of the request.
- In the event the Manager of Telecommunications provides a favourable report and there are no parties opposing the request, the concession is granted as requested. If the Manager of Telecommunications provides a favourable report and there are additional spectrum claimants, the SIGET must hold an auction within 60 days.

Norway

Since 2001, the Norwegian Post and Telecommunications Authority (NPT) has accepted applications for rights of use to any part of the radio spectrum which is not already assigned, at any time. In addition, applications for rights of use to part of the spectrum which is currently assigned, are accepted if such licences are due to expire within three years. In neither case does the NPT discriminate between the incumbent license holder and other interested parties. Any legal entity, person or undertaking, established in any country, may apply for a frequency license.

The NPT's procedure for assessment of demand was developed to facilitate cost efficient assignment procedures compliant with EU/EEA law, according to the following principles:

- Applicants may initiate assignment procedures at any time.
- Auctions are relatively costly to implement and should only be used when there is reason to believe that demand exceeds supply. A mechanism for assessing demand is therefore needed.
- When demand does not exceed supply, the procedure should be possible to complete within 6 weeks from the application date.
- Auctions should be completed (and licenses assigned) within 8 months from the application date.
- Assignment procedures should be transparent, easy to understand and should not be very costly for applicants.

The 'standard procedure' for demand assessment, which we describe below, has evolved over the last five years. It is very similar to the procedures implemented in El Salvador and Guatemala. Is not in itself legally binding for NPT, however, it can be expected that deviations from the procedure will either be specifically justified or constitute an evolution of the procedure itself, as Norwegian administrative law and practice requires a certain level of consistency.

NPT has also developed an 'alternative procedure', which we also describe below. This has been used a number of times for licenses approaching expiry. In these cases, NPT set deadlines and invited applications for the licenses, dividing the licenses into four groups that were 'released' for applications over four 'rounds'. Although, technically, this approach was an exception, it has not been of lesser practical importance than the standard approach. Further, NPT has also chosen on a number of occasions to forego the demand assessment phase and proceed straight to an auction. This is only done for bands where spectrum is perceived as relatively high value and there is a reasonable likelihood of excess demand.

The 'standard procedure'

When NPT receives a complete application for a spectrum licence, a notification of the receipt of an application will be published on a dedicated page on the Frequency Portal. Those subscribing to NPT e-mail news services will receive information about the received application. Since journalists subscribe to the e-mail services, articles in industry journals and websites contribute to the distribution of information about spectrum availability. Normally, a draft license, or at least key terms and conditions

such as duration, estimated fees and charges, and a description of the spectrum itself, will be published along with the notification.

When the notification is published, NPT will set a deadline for competing applications. Normally NPT sets a deadline for competing applications to 3-4 weeks and undertakes to process applications within the timeframe of six weeks.

The NPT offers applicants the right to remain anonymous until a license is granted (or until a decision is made about the level of transparency in a subsequent auction). Norwegian administrative law permits this, and most applicants prefer to preserve their anonymity. The reason for granting this opportunity is to lower the barriers to entry by reducing dominant firms' opportunity to act strategically to prevent entry.

Previously, all applicants were required to submit a guarantee payable on demand, accompanied by a legal declaration, along with the application. Since July 2007, the requirement only applies to competing applicants, not the one initiating the procedure. Applications submitted without the guarantee and declaration will not be considered.

If no competing applications are received within the deadline, the initial applicant will normally be awarded the spectrum licence applied for, but NPT may decide to conduct an auction even if no competing applications have been received. If competing applications are filed within the deadline, an auction procedure will normally be set up. So far, only one auction procedure has been initiated this way (2.3 GHz band).

The 'alternative procedure'

The alternative procedure was used in 2003 and 2004 when a great number of licenses were approaching expiry and NPT needed to carry out an open and transparent reassignment procedures in a particularly efficient manner. In order to cope with a large number of licenses and applications, a more planned approach was implemented, where NPT decided when a particular set of licenses could be applied for (in contrast to the standard approach, where applicants initiate the procedure). NPT published overviews of the spectrum bands and invited both the current licensee and any other interested party to apply for future spectrum licences within specific deadlines for each 'round'. Those subscribing to NPT e-mail news services received information about new 'rounds' and received applications.

Unassigned spectrum was included in subsequent rounds, and after four rounds, any vacant spectrum was made continuously available under the standard procedure. Where demand was deemed to exceed supply, auctions were implemented. This situation occurred twice: the 3.5 GHz band (auctioned in November 2004) and the 11 GHz band (auctioned in May 2005). This alternative procedure resembles the initial stage of the current assignment procedures used by Ofcom.

The alternative procedure has also been used in allocating broadcasting spectrum in the FM band.

Other cases

The Ministry of Transport and Communications (MTC) and NPT may also decide to implement an auction without carrying out procedures to evaluate the level of demand. This has been done in several cases, for example in the 450 MHz band, the second 3G auction in 2003 and the forthcoming 2.6 GHz auction.

It seems unlikely that any other country has assigned a higher amount of spectrum than the amounts assigned by Norway in the period 2001-2007. It has only needed to conduct four auctions (apart from the 450 MHz, GSM and 3G auctions) as a result of the procedures, and Norway has not experienced a single legal challenge against assignment procedures carried out this way.