

Best practice spectrum renewal and pricing

A review of international best practice and the lessons
for the Government of Bangladesh

prepared for

The World Bank

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1. Executive summary

1.1 Background

Four mobile operators face licence expiry in November 2011

The 15 year licences of four mobile operators in Bangladesh; Grameenphone, Banglalink, Robi and Citycell are due to expire in November 2011. The remaining two other mobile operators, state owned Teletalk and Airtel, were issued licences in 2004 and 2005 and these are not due for renewal until 2019 and 2020 respectively.

The regulator, the Bangladesh Telecommunication Regulatory Commission (BTRC), prepared “draft regulatory and licensing guidelines for issuing renewal license” following which, on 19th January 2011, the licensing authority, the Ministry of Posts and Communications, invited the mobile operators and other stakeholders, including the public, to provide comments by 9th February, 2011¹.

A number of parties, including the mobile operators themselves, the GSMA as well as other stakeholders, have expressed concerns about the proposals. Concerns include the fact that they are not aligned with international best practice and could damage the development of the mobile telecommunications sector in Bangladesh which is a key driver of economic growth.

According to press reports published by The Daily Star on the 5th May 2011 the ministry has indicated it plans to reduce the spectrum renewal fees from the originally proposed levels and to charge the same fees to all operators. The proposed fee is BDT 1.50 billion per MHz.

1.2 Report scope and objectives

The World Bank has asked Coleago Consulting to prepare a report on international best practice for spectrum renewal and pricing

The World Bank has asked Coleago Consulting Ltd (Coleago) to prepare a report on international best practice for spectrum renewal and pricing and to analyse the BTRC proposals in light of best practice. We have also been asked to offer recommendations on how the process can be aligned with best practice. We have based our analysis on the officially published guidelines and have not made any comments on the information published in the press.

Most mobile licences were first awarded 10 to 15 years ago and many countries now face the issue of renewal. The mobile industry has changed dramatically in the intervening years and so licence renewal provides regulators with the opportunity to update relevant regulation to better align the licensing framework and licence conditions with the mobile industry of today and to accommodate future developments. As a result, the scope of our report is very broad as spectrum renewal can only be considered effectively as part of a broad review of the approaches to spectrum management and regulation.

In this report we have surveyed a number of jurisdictions and examined both successful and not so successful spectrum renewal processes in order to derive a set of international principles of best practice for spectrum renewal and pricing. In doing so we have also sought to identify best regulatory practice in a broader sense as successful spectrum renewal processes depend, in part, on being conducted within a robust and effective overall regulatory regime.

The main body of our report covers:

- the process of spectrum renewal including both administered and market based approaches; and
- alternative methods for pricing spectrum.

¹ BTRC and Bangladesh MOPT website

1.3 Options for spectrum renewal

1.3.1 Alternative approaches

An administered procedure or market based mechanism are the two main alternative approaches to spectrum renewal

The two main approaches for spectrum renewal are:

- administrative approaches in which the licensing authority chooses which operator to licence based on a number of criteria; and
- a market based approach, such as an auction, in which the licence is assigned to the auction winner or winners.

1.3.2 When to use auctions

Regulators should generally prefer market based mechanisms

Regulators should generally prefer an auction based approach for the allocation of spectrum rather than an administrative procedure. An auction, if correctly designed, should award spectrum to those that value it most highly. If it is assumed that social values and private company values are reasonably closely aligned then an auction should yield an economically efficient outcome. Maximising the value of spectrum for society is often a key public policy objective for regulators. The additional advantage of an auction is that the process is fully transparent compared to administrative procedures which face a greater risk of regulatory capture by special interest groups.

In order for an auction to be effective the auction needs to be well designed and competitive. A competitive auction requires scarcity of licences or spectrum such that there is excess demand for the lots being auctioned. If an auction is not sufficiently competitive then it may fail to deliver economically efficient outcomes. Indeed if prior to the start of the auction demand equals or is less than supply then the auction will conclude after the first round of bidding and lots will be sold at their reserve prices. The auction effectively becomes an administered approach and the determination of the appropriate reserve prices becomes critical.

Auctions must be competitive to be effective

When contemplating the use of an auction the regulator should consider how competitive the auction will be. The results of recent spectrum auctions confirm that competition from potential new market entrants is likely to be low or non-existent. Regulators are therefore likely to have to rely upon competitive tension between the incumbents to ensure that auctions are sufficiently competitive.

Auctions are not appropriate in all circumstances

Regulators may seek to create scarcity and competition by packaging the spectrum in such a way to ensure that there is excess demand. However a fundamental objective for regulators is to maintain or increase the level of competition. Regulators will therefore also wish to package spectrum to ensure that spectrum is reasonably evenly distributed amongst the existing players to ensure effective competition after the auction. This overriding aim is therefore likely to reduce potential competitive tensions between incumbents and reduce the potential effectiveness of an auction process. In practice, auctions can therefore be used where:

- an appropriate auction design can be formulated that incorporates public policy objectives;
- there is excess demand for the lots to be awarded;
- the monetary value of the license is relatively high, justifying what can be a complex assignment procedure; or
- where there is a need to adopt a process which is highly transparent to avoid potential legal challenges and increase confidence in the regulatory body.

1.3.3 Administered procedures

Administered procedures can target a range of public policy objectives

Administered procedures involve the regulator determining a set of criteria against which applications for spectrum are evaluated. The applicants which best meet the criteria are awarded the spectrum. An administered approach is unlikely to be as

effective as an auction for achieving economic efficiency. However, administered procedures do allow the regulator to take into account a broader range of public policy objectives which may not be fully reflected in the private values placed on spectrum by bidders in an auction. Apart from not necessarily resulting in an economically efficient allocation of spectrum the process also lacks transparency. Administered procedures are more at risk from regulatory capture and the risk of legal action or a decline in investor confidence in the regulatory environment is higher than in the case of an auction.

There should be a presumption in favour of incumbents

In an auction context the existing holders of spectrum would most likely secure the spectrum were it to be auctioned. As a result there is a general presumption amongst regulators that existing spectrum should be renewed in favour of the incumbents unless there are special circumstances where re-assignment is deemed necessary. The conditions under which existing spectrum holdings should be re-assigned are expected to occur relatively infrequently and usually relate to; a material breach of licence conditions which cannot be remedied through other means, for spectrum re-planning purposes to achieve better harmonisation with regional telecoms policy for example or for competitive reasons.

Providing a presumption of renewal may promote increased investment by mobile networks and their investors. Encouraging investment and innovation is often another public policy objective. The pay back period (the time it takes for a project to pay back its initial investment) can be long for major network upgrades and is extremely long in the case of new market entry and so providing operators with a long time horizon can encourage investment, provide stability and assist with the raising of finance.

1.3.4 Survey of spectrum renewal procedures

Only Singapore has completed an auction for renewal although the auction concluded after the first round and spectrum was awarded at the reserve price

At the time of writing only Singapore has conducted an auction for spectrum renewal although the auction concluded after the first round and the spectrum was awarded to the incumbents at the reserve prices. Norway also planned to hold an auction but when only the incumbents registered the spectrum was once again awarded at the reserve. The price of renewal in Pakistan was based on the outcome of an earlier auction for two new licences. A number of countries such as Switzerland and Ireland are planning to hold auctions for spectrum renewal. In almost all other cases the process has been concluded through an administered approach.

1.4 Spectrum pricing

We distinguish between spectrum access and spectrum usage fees

1.4.1 Best practice principles of spectrum pricing

Spectrum pricing terminology varies by country. For clarity we have provided the following definitions which are used throughout the report and we use the term spectrum pricing to refer to all charges for access and the use of spectrum:

- Spectrum pricing: a general term relating to charges levied in relation to spectrum;
- Access fee: the fee that a successful applicant must pay to gain access to spectrum. This fee is typically determined through an administrative procedure or by auction. The fee is usually a one-off amount which is charged on the granting of the rights to use spectrum or over a relatively short period of time in staged payments following the award.
- Usage fee: the fee associated with the on-going usage of the spectrum. It is often paid on an annual basis for the duration of the licence term. In general, this fee is set out in advance of the award of the spectrum in order to allow the applicants to incorporate the on-going usage fees in their spectrum valuations.

Regulators should not regard spectrum renewal as an opportunity to generate high levels of revenue

Obtaining a return on a scarce natural resource for society is occasionally identified as a public policy objective². In the current global financial climate regulators may be tempted to see spectrum renewal as an opportunity to generate significant levels of revenue. Regulators however should take a broader view of the “return” the country will receive from the renewal of spectrum. The beneficial economic impact of mobile telephony has been widely publicised. In “The impact of telecoms on economic growth in developing countries” Leonard Waverman, Meloria Meschi and Melvyn Fuss estimate that a 10% increase in the penetration rate of mobile phones is associated with a boost in GDP per capita growth of around 0.59 per cent per year.

In Singapore, the government sought to maintain competition and encourage investment, acknowledging this would come at the expense of licence fee revenue. In response to consultation the government reduced the 2001 auction’s initial reserve of S\$150m to S\$100m. The Singaporean regulator, IDC has said

“the countries that have been most successful with 3G exacted the smallest, or no, fees at all because this allows carriers to invest the money into their network”³

Spectrum prices should be set conservatively

Regulators should have a preference for setting conservative or low spectrum prices for the following reasons:

- high prices may reduce the return on investment in infrastructure leading to lower levels of innovation and investment;
- high prices may present operators with capital constraints which reduce their ability to invest;
- high prices may result in spectrum being left unsold at auction or returned by existing users which would not represent an efficient use of spectrum;
- high prices may damage investor confidence and reduce the attractiveness of the country as a target for inward foreign investment; and
- high spectrum prices may be passed on to consumers through higher prices which will make mobile telephony less affordable.

In Europe spectrum access fees are usually determined by auction and usage fees are low or zero

A review of spectrum pricing in Europe shows that most countries determine spectrum access fees through an auction and that spectrum usage fees are low. The table below summarises spectrum usage fees for a range of European countries for 900MHz spectrum.

Exhibit 1: Spectrum Usage Fees in 900MHz for selected EU countries

	Usage fee per year per MHz (USD)	Comment	Population (million)	cent/MHz/pop /year
Ireland	91,423		4.4	2.07
Spain	1,114,913	2008 figures	45.2	2.46
France	768,960 (estimate)	Basis: 1% of revenues generated from spectrum usage. For spectrum awarded/renewed after 2005.	62	3.48 (estimate)
Belgium	111,240	2007 figure	10.7	1.04
Portugal	172,800	Twice as much for spectrum exceeding 35MHz.	10.7	1.61
Netherlands	None	All fees upfront	16.7	0.0
Cyprus	None	All fees upfront	0.8	0.0

² The ACMA of Australia for example includes this goal as one of its objectives

³ ZDNet Asia, “Licence Auctions Stifling Mobile Development”, Sep 2009

	Usage fee per year per MHz (USD)	Comment	Population (million)	cent/MHz/ pop /year
Denmark	10,908	2010 figure	5.5	0.20
Sweden	8,011	2010 figure, subject to NRA board approval	9.2	0.09
Italy	2,078,257	The first 15MHz are not charged for. Fee per MHz exceeding 15MHz.	58.9	1.77
Finland	26,267		5.3	0.49

Source: Regulatory websites and telephone interviews

Note: Exchange rate 1.44 USD/Euro

A review of the benchmarks for 900MHz spectrum reveals that most countries have either low or no annual spectrum usage fees. In the countries where no or very low usage fees are recorded the value of the spectrum is captured by the award process, be it an auction or administered pricing with a defined payment level, upfront and in a single payment.

Few countries have high spectrum usage fees. The Spanish figure partly reflects the relative failure of the Spanish 3G spectrum auction which took place in the aftermath of the Dot Com crash. In order to capture a reasonable share of the value of the spectrum the regulatory authority set a high level of spectrum usage fees to compensate for the low valuations achieved in the auction process.

France represents a special case as it is the only European country which bases the spectrum usage fees on a proportion of revenue. Our benchmark is an estimate based on reported revenues in the operators' company accounts. Italy also provides a high benchmark but it is important to note that no charge is made for the first 15MHz of spectrum.

There is not a significant difference between 900MHz and 1800MHz spectrum usage fees and prices are typically uniform for all operators

A review of the benchmarks for 1800MHz spectrum reveals a similar pattern in terms of levels. It is also relevant to note that there is not a significant difference between the spectrum usage fees for 900MHz and 1800MHz bands. The conclusions drawn from 900 and 1800 MHz benchmarks are reinforced by the benchmarks from 2100MHz. We summarise the main conclusions from our benchmarking study below:

- the greatest proportion of the total price paid for spectrum is set through an auction mechanism or, in the past, through judgement and these are paid upfront in the form of a spectrum access fee;
- most benchmarked countries have relatively low or no spectrum usage fees although Spain, France and Portugal do provide precedents for higher spectrum usage fees;
- most countries have only a small or no difference in the level of annual fees across different spectrum bands; and
- the same charges are applied to all operators.

In terms of determining the appropriate level of pricing, the following represent international best practice:

- market mechanisms, such as an auction, should be used when ever possible to determine spectrum access fees;
- where a market mechanism is not appropriate then some form of Administered Incentive Pricing should be used to encourage the efficient use of spectrum;
- spectrum access and usage fees should not lead to higher consumer prices and so should be charged in such a way that operators will treat them as a sunk cost and

they should also be set conservatively to minimise inflationary pressure on consumer tariffs; and

- there should be clear separation between spectrum pricing aimed at recovering the cost of spectrum management activities and pricing to support spectrum management objectives.

If an auction is not appropriate then spectrum usage fees should seek to mimic the discipline of the market

If an auction mechanism is not appropriate to determine spectrum access fees then Administered Incentive Pricing should be used to ensure that spectrum usage fees promote the efficient use of spectrum. AIP aims to mimic the efficiency and incentive effects of market based pricing. Market prices are based on the economic principle of opportunity cost where opportunity cost is defined as the highest value alternative foregone. There are a number of different approaches for determining the opportunity cost of which two of the more economically robust are:

- **Optimal Deprival Value:** ODV seeks to answer the question “what is the least cost system or bundle of assets needed to provide customers with the existing level and quality of services, should a certain existing asset be removed?” This approach can be applied to valuing spectrum rights by addressing the following: “If an operator were deprived of incremental spectrum rights, what incremental costs would be incurred to replicate the existing level and quantity of services using the remaining spectrum rights?” These costs are “avoided” by owning the incremental spectrum rights and so, in this context, represent the value of those rights. That is, the rights holder should be prepared to pay up to the value of the incremental costs to avoid being deprived of its spectrum rights, so long as the incremental costs are less than the present value of the free cash flows generated from the spectrum services.
- **Best Alternative Use or User:** BAU is another method of assessing the opportunity cost associated with a particular use of spectrum⁴. It is an extension to the ODV approach, bringing into consideration the highest value placed on an additional amount of spectrum by an alternative user. It is thus based on reviewing value both to an alternative technological use, and within its current use.

Optimal Deprival Value and Best Alternative User are credible pricing methodologies

We believe that ODV and BAU are both credible alternative methodologies when market based mechanisms such as auctions are not appropriate. As of 2010, relatively few countries are seeking to do more than recover administration costs from spectrum fees. However, there is a trend towards imposing fees designed to encourage the efficient use of spectrum.

Exhibit 2: Use of AIP approaches^{5,6,7}

Opportunity cost	Earnings valuation	Judgmental
Malta ⁸ (ODV)	Slovakia	Bahrain
Netherlands (ODV)		Canada
New Zealand (ODV)		France
Turkey (unclear)		Ireland
United Kingdom (ODV)		Italy
		Japan
		Sweden

Source: Coleago research and analysis

4 See Indepen, Aegis & Warwick University “An economic study to review spectrum pricing,” Feb 2004, for the first discussion of this approach

5 Radio Spectrum Policy Group, “Radio Spectrum Policy Group Report on Assignment and Pricing Methods”, 2009,

6 Plum, “Administrative Incentive Pricing of Radiofrequency Spectrum”, 2008

7 MCA, “Strategic Framework for the Management of Radio Spectrum 2007-2010”, 2008

8 Proposed AIP regime to be based on opportunity cost/ ODV pricing

1.4.2 Survey of spectrum renewal pricing

Spectrum renewal is a relatively recent issue for regulatory bodies and few countries have completed the spectrum renewal process. For those countries that have completed the process, with the exception of Pakistan, most have not sought to extract significant fees from the process of renewal. The price of renewal in Pakistan was based on the outcome of an earlier auction for two new licences.

Exhibit 3: Spectrum renewal benchmarks

Country	Details	Spectrum allocated	Fee US\$	Fee US\$ per paired MHz
Denmark	In 2010, 900 MHz and 1800 MHz licences were renewed without any renewal fee and material changes in license	95MHz	zero	zero
France	In 2005 Arcep renewed each operator's 900 MHz spectrum licence for a further 15 years under technology neutral terms for Euros 25 million per operator plus 1% of annual GSM service revenues.	35MHz	90 m	2.6 m
Hungary	Extension of license for 7.5 years for a fee of HUF 10 billion and commitment to a net HUF 20 billion in capital investment for the next 2 years	8MHz	49 m	6.2 m
Norway	At the end of 2004 the Minister announced that both incumbents would be offered license renewals for a lump sum fee of NOK 100 million (USD 17.4 million) and an annual fee of NOK 9.6 million (USD 1.7m). However, it was also announced that if any other party also expressed interest, then an auction would be held with the reserve price set at NOK 100 million. No third party expressed interest, thus, Telenor and Netcom received licenses received a renewal licence at the stated terms	9.6MHz	15 m	1.6 m
Pakistan	License renewal fee of USD 291m determined by an earlier open auction of 2 new licenses for 15 years.	13.6MHz	291 m	21.4 m
Singapore	Renewal was determined by auction – 30 MHz in the 900 frequency band and 60 MHz in the 1800 frequency band but due to participation only by the incumbents the spectrum was awarded at the reserve price.	90MHz	5 m	0.1 m
Sri Lanka	Etisalat Lanka's initial license was issued in September 1995 for 13 years. Renewed in September 2008 through an administrative process for 10 years.	13.5MHz	5 m	0.4 m

Source: Regulator websites, press and operator websites

1.4.3 Survey of auction reserve prices

Singapore provides the only example of renewal via auction that has been completed to date

Singapore provides the only benchmark at the time of writing for the auction of existing spectrum holdings. The auction was for the incumbents' existing 900MHz and 1800MHz spectrum. Singapore is a three player market and only the three incumbents sought to participate in the auction and as demand did not exceed supply the auction concluded after the first round and the spectrum was sold at the reserve price. The reserve implied a price of US\$ 0.005 / MHz / Pop.

Historically regulators have set low reserves

To date the approach adopted by most regulators has been to set low reserve prices thereby reducing the risk of spectrum lots going unsold. The notable exceptions have been Hong Kong, India (Metros and Category A) and the proposed Irish and Swiss auctions. In Hong Kong (2.6GHz TDD & FDD) despite a very competitive market (five incumbent bidders) the TDD spectrum remained unsold.

A trend may be emerging towards setting higher reserves

The proposed Swiss and Irish auctions may suggest that regulators are changing their approach from setting low to high reserve prices. In consultations that have been published the regulators have argued that they expect low levels of competition in the auction and so in order to extract a "reasonable return for society" or "to reflect market values of spectrum" the reserves have been set at relatively high levels compared to

Benchmarking has been used to set reserves in the Irish consultation

historic precedents. The reserves are usually determined based on some form of benchmarking exercise.

In Ireland the proposed reserve prices have been based on a benchmark study on historical auction data carried out by the economic consultancy Dot Econ. Our view is using such historic data to derive potential reserve prices is very questionable especially as the underlying data often includes the results of 3G auctions which took place at the height of the Dot Com boom and are now more than 10 years out of date. The methodology used to calculate the Swiss reserve prices has not been disclosed. The delayed Thai 3G auction also saw a proposed approach based on high reserve prices.

The table below provides a summary of the reserve prices for some recently concluded and proposed auctions.

Exhibit 4: Reserve prices for auctions of new spectrum

Country \$/MHz/Pop	800	900	1800	1900	2.1	2.6 FDD	2.6 TDD
Norway						0.004	0.004
New Zealand						0.002	0.002
Singapore						0.003	0.003
Sweden						0.004	0.004
Hong Kong						0.112	0.112
Netherlands						0.001	0.001
Denmark						0.003	0.003
Germany	0.004		0.004	0.004	0.004	0.004	0.004
Austria						0.006	0.006
Finland						0.004	0.004
India (Mumbai & Delhi)					0.4-0.5		
Ireland (proposed)	0.760	0.760	0.381				
Switzerland (proposed)	0.315	0.315	0.123	0.123	0.123	0.123	0.123

Source: Regulator websites and consultation documents

1.5 Case studies – India 3G and Singapore renewal

1.5.1 India 3G

The Indian telecoms market is divided into 22 telecoms circles and with a total country population of over a billion, each circle has an average population of 52 million. These 22 circles were further segmented into:

- Metros - Mumbai, Delhi, Kolkata
- Category A– Major wealthier regions
- Category B
- Category C - poorer regions with GDP per capita in some cases comparable to Bangladesh

The key features of the auction are presented in the table below.

Exhibit 5: Indian 3G auction overview

Criteria
Date

Criteria	
Spectrum available	Between 3-4 lots of 2x5MHz blocks
Number of participants	Depended on region but up to 11 incumbents

Source: Regulator websites

The auction was a simultaneous multi-round ascending regional auction (SMRA). The country was split into 22 regions or circles. The Governments stated objectives were:

- ensure an efficient allocation of spectrum;
- encourage a competitive environment;
- promote the rollout of 3G services;
- relieve 2G congestion; and
- revenue maximisation.

It is clear from the spectrum made available and the auction design that the regulator's primary objective was to maximise revenue.

Indian spectrum prices were high even when compared to the UK and German 3G auctions

India is the most competitive market in the world with up to 14 operators in some of the circles. The competitive nature of the market has resulted in some of the lowest telecoms prices globally. Despite these low prices the Indian auction continued for 34 days and 183 rounds. The auction raised nearly \$15bn and prices achieved in Mumbai and Delhi were higher than 3G licence prices at auction in the UK and Germany at the height of the Dot Com boom and even before adjusting for the differentials in GDP per capita.

The key factors driving the high prices achieved in the auction were:

- market landscape: Up to 14 players in some of regions with 11 of taking part in auction with between 3-4 slots in the regions;
- auction format: For existing incumbents there were synergies from acquiring additional spectrum in regions where they had existing 2G holdings;
- auction rules: The auction only ended when supply and demand were equal in all 22 circles. The prices continued to rise in individual circles even when supply = demand, prices only remained static if there was negative demand;
- existing spectrum holdings: Indian operators are some of the most spectrum starved operators in the world;
- voice congestion: In the Metros and category A circles many of the operators are facing severe voice congestion. Operators needed the 3G spectrum to support their voice business; and
- potential for mobile data: India has very poor fixed infrastructure. Mobile offers the most likely broadband access technology for the majority of the market. However with the limited spectrum released in the market the development of MBB is going to be limited.

The CEO of Bharti stated after the auction *"The auction format and severe spectrum shortage along with ensuing policy uncertainty drove the prices beyond reasonable levels. As a result, we could not achieve our objective of a pan-India 3G footprint in this round."*

The main winners of the Metro and Category A circles were Vodafone, Bharti and Reliance.

Exhibit 6: Indian auction outcomes

Operator	Spectrum acquired	US\$/MHz/Pop
Mumbai	2x5MHz	5.63
Delhi	2x5MHz	4.35
Average Metro and Cat A (excl Mumbai & Delhi)	2x5MHz	0.37
Category B	2x5MHz	0.18
Category C	2x5MHz	0.05
Average across India		0.33

Source: Regulator website

The process was transparent and well received

There are some important lessons for Bangladesh from the recent transparent 3G spectrum auctions in India and the BWA auction that followed it. The overall approach was positively received by participants because of its transparency. No “backroom dealing” was suggested which is in sharp contrast to the current issues in relation to the award of 2G spectrum. However, the approach taken by India raises a number of issues that are relevant for Bangladesh.

A holistic approach was not taken

First, contrary to best practice, the government has chosen to independently auction the 2.1 GHz 3G spectrum prior to concluding a consultative process on availability and re-farming the 2G spectrum and the pricing of 2G spectrum for recent new entrants and those operators whose licence are coming up for renewal in the next 2 to 3 years. This created uncertainty about the future allocation of spectrum and the pricing in a market which was already experiencing congestion and is spectrum deprived.

Spectrum renewal should have been addressed prior to the auction

The government is now faced with the difficult task of establishing a price for the 2G spectrum on the basis of the price discovered for the 3G spectrum. Various approaches have been proposed by committees constituted by the government to derive the price of 2G spectrum for 2G services from the 3G auction. However none of the current proposals have been accepted by the operators.

Package based bidding may have been more appropriate

Secondly, as the comments from Bharti suggest, a number of operators were seeking pan Indian spectrum holdings. We can presume that they envisaged synergies from a pan Indian footprint. The use of an SMRA presented the bidders with exposure risk⁹ and the use of a package based auction format such as the Combinatorial Clock design may have been more appropriate in the Indian context.

1.5.2 Singapore

The Singapore auction was not competitive

The auction was for the incumbents' existing 900MHz and 1800MHz spectrum. Singapore is a 3 player market. Demand did not exceed supply and as a result the auction concluded after the first round and the spectrum was sold at the reserve price.

Exhibit 7: Singapore auction overview

Criteria	
Date	February 2008
Spectrum available	900MHz – 5 lots of 2x5MHz 1800MHz – 13 lots of 2x5MHz
No of participants	3 incumbents

Source: Regulator website

⁹ See the glossary in the appendix for a definition of exposure risk

The blocks were to be auctioned on a generic basis. The allocation phase of the proposed auction was based on a SMRA format followed by an assignment stage.

The proposed assignment stage followed a 3 stage process:

- Incumbents given first right of refusal for a specific block position;
- A second initial offer; and
- A sealed bid combinatorial auction.

Exhibit 8: Singapore auction format rules

Criteria	
Format	SMRA
National/Regional	National
Caps	900MHz 2x15MHz Overall cap of 2x30MHz
Block size	2x5MHz
Specific/Generic blocks	Generic
Licence conditions	Service and Technology neutral. Licence term 8 years and 3 months.
Reserve price (\$/MHz/Pop)	0.005
Intent of auctioneer	Encourage new market entry Efficient allocation of resources

Source: Regulator websites

The combination of tight spectrum caps, high levels of available spectrum and the absence of any new entrants ensured that spectrum demand did not exceed supply and as a result the spectrum sold at reserve to the incumbents.

The role of the reserve is critical in auctions where little competition is anticipated

The Singaporean experience also raises some interesting issues for Bangladesh. The use of an auction format ensured that the process was highly transparent. The use of a low reserve would not have discouraged a new entrant had a new entrant believed there was a robust business case for a fourth player. The fact that a new entrant could have acquired spectrum but none chose to participate would have provided comfort for the IDA that incumbents were making the most efficient use of the spectrum. The use of a low reserve also ensured that all spectrum was allocated. The fact that the auction was uncompetitive and spectrum sold at reserve highlights the importance for Bangladesh of selecting an appropriate reserve price if it chooses to pursue an auction.

1.6 Learning from best practice for Bangladesh

1.6.1 Overview

There are a number of aspects of the BTRC proposals which do not accord with best practice

There are some aspects of the renewal process being conducted by the BTRC which do not accord with international best practice, especially in relation to spectrum pricing and technology neutrality and there are significant concerns over issues of transparency, fairness and clarity in many elements of the process.

1.6.2 Spectrum planning and technology neutrality

The time of licence renewal is an opportune time for regulators to review the spectrum planning and align spectrum policy and use with international developments. The best practice in this area, as outlined in the appendix, is a policy of technology neutrality and a starting point for this is allowing 3G services in 2G bands.

The draft licence guidelines restrict the spectrum use to legacy GSM and CDMA technologies. However, the government has taken a forward looking approach by articulating in the guidelines:

- “the Commission will publish Guidelines on technology neutral services which will be applicable to operators”
- “the Licensee may be allowed to migrate/convert from 2G network to 3G network with the same existing access frequency”

We believe that allowing 3G in 2G bands will further enable Bangladesh to unleash the possibilities of higher speed data services, more innovative mobile applications and propel the country towards accomplishing the goals of the government set out in the policy documents *Government Vision 2021*¹⁰ and *Digital Bangladesh*¹¹.

Spectrum should be awarded on the basis of full technology neutrality

Furthermore, as outlined in the appendix, the regulator should go a step further, in line with international best practice, and consider awarding spectrum on the basis of full technology neutrality and initiate spectrum re-farming to support the introduction of 3G and eventually LTE networks in the 2G bands. This should apply to both the GSM and CDMA bands which will also remove any notion of discrimination towards GSM operators arising from CDMA operators offering EVDO services on their current licence which in some quarters is seen as a 3G offering.

1.6.3 Consultation on spectrum management for migration from 2G to 3G

The government has also shown foresight by outlining their thinking on the allocation of spectrum in other bands for 3G and re-farming of existing spectrum. The guideline states that

- “spectrum in the 3G Bands of 2100 MHz will be made available for auction”
- “re-farming will be allowed after publishing necessary guidelines and required consultation.”

The regulator must now initiate a consultation process to assess 2G spectrum availability, rationalise existing frequency allocations and plan a migration strategy according to the principles of best practice in spectrum management discussed in the appendix.

A national spectrum plan should be introduced to address spectrum fragmentation

The exercise should cover the entire holdings of 2G spectrum and should not be limited to spectrum that is due for renewal. The existing frequency allocation for the 2G licensees is currently fragmented. For instance, some of the existing GSM licensees occupy 2x7.4 MHz and the CDMA licensee occupies 2x8.8 MHz while 3G and newer technologies make use of carriers with bandwidth in multiples of 2x5 MHz. The BTRC, through a consultative process, must arrive at a channel plan and a migration process from 2G to 3G to avoid any adverse impacts to the customers as the industry readies itself to deploy new technologies. The consultation process should be initiated well in advance of the spectrum allocation date and provide enough time for the stakeholders to respond to the issues raised and adapt their network plans accordingly.

1.6.4 Separation of spectrum and operator licence:

The BTRC should seek to separate the licensing of services from spectrum

The draft guidelines and licence agreement relates to both the operation of the network and services and use of spectrum. We note in the appendix that the current trend is to separate operating and spectrum licensing. Since the government has taken a step in the right direction by announcing that it is working towards introducing technology neutrality and is also considering spectrum trading we believe separation of the licences can pave the way for these important developments.

¹⁰ <http://boi.gov.bd/about-bangladesh/government-and-policies/government-vision-2021>

¹¹ <http://boi.gov.bd/about-bangladesh/government-and-policies/digital-bangladesh-overview>

1.6.5 Unified licensing

The regulator has to be commended for announcing in the guidelines that is taking steps to evolve the operating licensing regime towards a unified licence model.

“the Commission has taken initiative to issue unified license. The regulations and guidelines which will be approved by the Commission in this respect shall be binding to the existing Licensees”

Current licence conditions are contrary to the spirit of unified licensing

However, in this process it should ensure that clauses in the present guidelines that go against the spirit of unified licence should be addressed. For example, there are clauses that make a distinction between access and transmission, clauses that restrict the use of technology and offering of value added services that are not in line with the spirit of unified licences. As outlined in the appendix on best practices in licensing frameworks, Bangladesh can “future proof” the licences to take full advantage of the future benefits from developments in technology, business models and services that are specifically evolving for developing countries in the areas of e-governance, e-health, e-education, e-inclusion, etc.

1.6.6 Homogeneity of licence conditions

Licence conditions should be applied to all operators including those who are not yet subject to the renewal process

As a general principle homogeneity of licences is desirable as it allows for competition between operators on equal terms. Our interpretation of the proposed guidelines is that there is uniformity of licence conditions for similar operators or similar bands for those subject to renewal. The government has not clarified if the new set of guidelines and licence conditions in the renewal licence will apply to the other two operators whose licence is not due for renewal. A level playing field in terms of regulatory environment is essential to promote effective competition.

1.6.7 Other non-price licence conditions

A large number of issues have been left open and this does not provide operators with certainty or clarity which discourages investment

The framework developed for licence renewal is not in line with international best practice as described in the appendices to this report. In particular operators expect, “regulatory certainty and predictability achieved through a fair, transparent and participatory renewal process.”¹² The best practice approach is to provide certainty and clarity and keep the non-technical licence conditions to a minimum. The government has taken the approach of specifying a large number of non-price licence conditions such as those relating to MVNOs, infrastructure sharing, NGN technology, green technology, number portability, international revenue sharing etc. but has left them open ended without any clarity on purpose. These issues have a bearing on spectrum values and such open clauses should not form part of any licence agreement or renewal process.

1.6.8 Comparison with best practice for price related issues

Spectrum pricing proposals suffer from a lack of transparency

Bangladesh has chosen to administratively determine spectrum prices for renewal. This is appropriate where market mechanisms cannot be effectively deployed. A key element of best practice however, is the adoption of a fair and transparent process. In the current guidelines the proposals suffer from a considerable lack of transparency.

While not explicitly articulated in the Telecom Policy of Bangladesh a vision of “universal service at affordable cost without compromising quality” would be consistent with the twin public policy objectives of low cost access through promoting highest value use of spectrum. Such a policy objective should have encouraged the administration to adopt spectrum pricing methodologies that:

- lower spectrum prices as this will reduce costs to operators and is likely to encourage further investment resulting in better coverage and more affordable services; and

¹² Mobile Licence Renewal, World Bank 2005.

Spectrum usage fees should be low, reflecting only the costs of administration and they should be the same for all operators and there should be no difference between bands

- reward intense use of spectrum rather than punishing it; firms that make better use of spectrum will be better placed to offer competitive rates which will make services more affordable.

We believe that the pricing proposals in Bangladesh do not correspond with international best practice. The use of the utilisation factor severely penalises operators who efficiently use spectrum and creates market distortions. In light of the market price based spectrum access fee being sought by Bangladesh we believe that the spectrum usage fees should seek to recover only the costs of administration and should not seek to reflect market values. Spectrum usage fees should also allow operators to compete on even terms and the current proposals for asymmetric spectrum usage fees do not create such an environment. The spectrum fees also differ by band which is not consistent with the practice in Europe. The use of a revenue share for spectrum pricing may lead to market distortions and may increase the cost of mobile telephony to consumers. The revenue share also penalises those operators making the most efficient use of spectrum. Revenue sharing should not be used as the basis for charging for spectrum. Spectrum access fees should be transparently determined and not set at high levels to avoid the risk of spectrum remaining unsold at auction or being returned by existing holders. The proposed spectrum pricing in Bangladesh is not consistent with Bangladesh's own vision nor does it comply with international best practice.

1.7 Recommendations for spectrum renewal in Bangladesh

1.7.1 Non price recommendations

Existing licences should be extended while the BTRC conducts a full consultation process in accordance with best practice

The mobile sector has played a key role in Bangladesh's social and economic development. It has brought access to communications, provided a source of income to millions and stimulated economic growth. To maintain this trend and realise the vision articulated by the countries leaders, it is absolutely essential that the government promote regularity certainty and predictability through a fair, transparent and consultative led renewal process. We therefore suggest that the government take the following steps:

- initiate a consultative process to examine the licence renewal in the context of the best practice outlined in this report and supporting appendices; and
- in the meantime, to ensure continuity of service, extend the licences beyond November 2011 on the same terms and conditions as the current licences. The government may consider charging a spectrum usage fee for the interim period at an annual rate derived from the annuity value over a 20 year period based on the price level range proposed below in section 1.8.2.

The consultation should address the principles of best practice highlighted in this report

The time bound consultative process, which should take no more than 9 months, should consider as a minimum the following issues:

- separation of spectrum and operating licences;
- a spectrum management plan that prepares the way for the award of spectrum with unrestricted use in the 900/1800/2100 band in keeping with the current best practice and in consultation with all the six mobile operators and other key stakeholders;
- prepare for an administrative pricing decision or auction incorporating all the features of best practice outlined in this report; and
- in the event of an auction, set a reserve price after careful assessment of demand and supply but exercise conservatism to ensure that spectrum is not left unsold.

An auction may be regarded as more transparent

The use of an auction with appropriately determined reserve prices may offer a more transparent process and less subjectivity which may increase investor confidence and encourage continued investment in Bangladesh.

1.7.2 Price recommendations

Bangladesh may wish to use an auction to increase transparency

Bangladesh may wish to consider using an auction process as was the case in Singapore. The advantage of an auction is that the process will be highly transparent. However, as was also the case in Singapore, the auction may well not be competitive and spectrum would then be awarded at the reserve price. The determination of a suitable reserve is therefore critical but must also be examined in the context of other aspects of spectrum pricing.

Spectrum usage fees should be determined first before deciding upon spectrum access fees

Best practice in spectrum pricing usually incorporates a spectrum access fee and on-going spectrum usage fees. The spectrum usage fees should be determined and publicised in advance of setting the spectrum access fee as operators will need to incorporate the level of spectrum usage fees into their valuations before assessing spectrum access fees.

Spectrum usage fees should be low, non-distortionary and non-discriminatory

If an auction or administered procedure is to be used to determine spectrum access fees to ensure an efficient allocation of spectrum, then usage fees should:

- be low or close to zero;
- aim to only cover the administration costs of managing spectrum;
- not vary significantly between bands;
- be a flat fee as opposed to a share of revenue so as to avoid market distortions; and
- be the same for all operators.

If a market based approach to determining spectrum access fees is not adopted and access fees are not market orientated based on appropriate benchmarks the spectrum usage fees should be set to encourage the efficient use of spectrum. Usage fees should be determined using some form of administered incentive pricing such as ODV or BAU.

Spectrum access fees should not be set too high as to risk spectrum not being sold or returned

Spectrum access fees should ideally be determined through a market mechanism such as an auction. If a market mechanism is not appropriate then the regulator should be conservative in determining access fees either in the context of an auction reserve price or a stated access fee. The regulator should recognise that the impact of any regulatory error in setting prices too high is much greater than that of setting them too low.

Setting spectrum access fees requires an assessment of the value of spectrum

In the absence of a market mechanism spectrum access fees or auction reserves may be set so as to capture a proportion of the value of a scarce natural resource for society. In order to set an appropriate access fee the regulator needs to base the fee on an assessment of the value of spectrum. Where market mechanisms are not available the assessment of spectrum value can be performed either through a modelling exercise or more typically through the use of benchmarks.

The use of modelling to determine spectrum value is challenging

The use of modelling is not particularly common as it presents a number of issues. The issues include:

- regulatory bodies often do not have the expertise to perform the task;
- the process is time consuming;
- the process is highly subjective and estimates of value will be subject to wide margins of error;
- the process may suffer from a lack of transparency; and
- the exercise will give rise to different values for different operators.

Benchmarks are commonly used but conclusions must also be treated with care

In light of the issues of modelling most regulators use some form of benchmarking exercise based on other auctions to ascertain the value of spectrum. Whilst commonly used, benchmarking is also not without challenges. Auction prices are heavily influenced by relative levels of supply and demand for spectrum and auction design and the extent to which they reflect the underlying value of spectrum will vary

significantly. Furthermore, the choice of appropriate benchmarks is also important not only in terms of countries included in the benchmark study but also the timing of when the auction took place. Benchmarks should be used with care and Bangladesh should be conservative in its choice of benchmarks when determining spectrum access fees.

There are no directly comparable benchmarks for the Bangladesh situation

As we note in section 3, as of 2010, very few countries, if any, have renewed 2G spectrum on a restricted use basis (as is the proposed approach in Bangladesh) and relatively few countries are seeking to do more than recover administration costs from spectrum access fees. Only Singapore has held an auction for spectrum renewal and all other countries have adopted an administered approach. Therefore, there are no relevant benchmarks for spectrum renewal prices at auction to directly compare with the Bangladesh situation.

Benchmarks for new spectrum awards must be used

In the absence of directly comparable benchmarks recourse must be made to auction prices for the award of new spectrum. In the consultation on spectrum renewal in Ireland the regulator used an econometric study¹³ performed by the consulting firm Dot Econ. The study was one of the most comprehensive publicly available analyses of spectrum pricing. A range of data sets were used including all mobile, European, all GSM only awards and awards in countries with similar GDP to Ireland. The results varied dramatically from US\$ 0.18 / MHz / Pop to US\$ 0.81 / MHz / Pop for European only and similar GDP respectively. If the similar GDP figure is adjusted to reflect the difference in GDP per capita between Ireland and Bangladesh the resulting benchmark is US\$ 0.03 / MHz / Pop. Whilst this figure is interesting the database upon which it is based contains spectrum awards that are more than 10 years old and should be treated with great care.

Local benchmarks from Bangladesh provide the best indicators of spectrum value

We believe that most relevant benchmarks would be the prices derived in Bangladesh from the 2005 and 2008 assignments of spectrum. The first mobile licence was issued in Bangladesh in 1989 when spectrum in the 800 MHz band was issued for CDMA operation. Subsequently three GSM licences in the 900MHz / 1800MHz bands were issued in 1996 by a beauty contest and in 2005 a GSM licence in the 900MHz / 1800MHz bands was issued through an open auction. This was the first instance when a market price was established for the GSM spectrum. 15MHz in 1800 MHz band was auctioned to a new entrant, the fourth operator, at US\$ 50 million which implies US\$3.33 million / MHz or US\$0.02 / MHz / pop.

A spectrum access fee was first introduced when 17.5 MHz of new spectrum in the 1800 MHz band was offered to the three GSM operators but only 12 MHz was taken up. In setting the access fee of \$11.6 million / MHz (8 Mn BDT/MHz) or \$0.08 / MHz / pop the authorities did not use any of the administrative pricing models. The price was purely judgemental which probably explains why only 70% of the spectrum offered was taken up.

These events provide a potential benchmark range of US\$3.33 million / MHz (paired) to US\$ 11.6 million / MHz (paired) or US\$ 0.02 to US\$ 0.08 MHz / Pop. The 2005 award of spectrum to Warid represented an award to a new entrant and so it is reasonable to assume that the value of spectrum to an incumbent is above this level. It should also be kept in mind that the spectrum concession at the time of the 2008 award was for 18 years and only 70% of the spectrum offered was taken up suggesting the value of spectrum should be below this level. The GDP adjusted benchmark from the Irish study of US\$ 0.03 / MHz / Pop would confirm a price above the Warid benchmark but considerably lower than the 2008 award. The average price from the C circles in India of US\$ 0.05 / MHz / Pop, which will be more comparable with the GDP of Bangladesh than the metros, category A and some category B circles, also suggests that the price of spectrum in Bangladesh should be towards the lower end of the range. We believe that an appropriate benchmark range would be US\$ 0.03 to US\$ 0.06 / MHz / Pop for a 20 year licence term. If restrictions on the use of technology remain in place as per the current proposals then we would recommend a price towards the lower end of the range. If technology neutrality were to be introduced then this may

¹³ "Award of 900MHz and 1800MHz spectrum – update report on benchmarking" September 2010, Dot Econ

justify a potentially higher price but we continue to recommend the exercise of conservatism in setting spectrum prices.

1.8 Report structure

The main body of the report begins with a review of the alternative approaches to spectrum renewal before examining issues related to spectrum pricing. In the final section of the report we analyse the proposals in Bangladesh and make comparisons with best practice before setting out a range of recommendations.

In the appendices to this report we have covered a range of other regulatory issues which should be included as part of the process of renewal. These include: a review of regulatory objectives; best practice in spectrum management; commentary on the licensing framework; as well as recommendations on non-price material licence conditions. The appendix also includes a range of benchmarks on spectrum prices and usage fees as well as background reading on different auction formats and auction terminology as well as a comprehensive list of references.

2. Approaches to spectrum assignment and renewal

2.1 Section overview

Market maturity and the strength of incumbents implies that in an auction the incumbents will secure the majority of the spectrum

Regulatory bodies face challenging decisions in relation to spectrum renewal. Increasing global market maturity the strong position of incumbents implies that their spectrum valuations will be high relative to potential new market entrants. In a market based award mechanism, such as an auction, the incumbents are almost certain to be awarded the majority of spectrum unless specific measures are taken to prevent this. In this section we look at administered versus market based approaches to spectrum renewal and provide guidance as to which approach is appropriate under different conditions. We also offer practical guidance on implementing each approach.

2.2 Administered versus market based approaches

2.2.1 Overview of alternative approaches

The two main approaches for spectrum renewal are:

- market based approaches, such as an auction, in which the licence is assigned to the auction winner or winners where winner determination is based on the rules of the auction; and
- administrative approaches in which the licensing authority chooses which operator to licence based on a number of criteria (such approaches are sometimes called 'beauty contests' or "beauty parades").

2.2.2 Market based approaches

Auctions can lead to economically efficient outcomes

Auctions have the desirable property of assigning the licence to the operator that attaches the highest value to the licence, which will generally be the operator that can generate the greatest benefits to society from the licence. While the final assignment will be determined by price, non-price regulatory policy objectives can also be targeted such as extending coverage or maintaining competition through the appropriate choice of licence conditions such as roll-out requirements and spectrum caps. Auctions can also be highly transparent and maximise revenue for the government given the number of licences being assigned. Auction outcomes may not always be efficient however, particularly where poor auction rules lead to coordination between bidders or other forms of strategic bidding which damage economic efficiency or where there is simply insufficient competitive tension within the auction.

Auctions need to be competitive in order to be effective

In order for an auction to be effective the auction needs to be well designed and competitive. A competitive auction requires scarcity of licences or spectrum such that there is excess demand for the lots being auctioned. If an auction is not sufficiently competitive then it may fail to deliver economically efficient outcomes. Indeed if prior to the start of the auction demand equals or is less than supply then the auction will conclude after the first round of bidding and lots will be sold at their reserve prices. The auction effectively becomes an administered approach and the determination of the appropriate reserve prices becomes critical.

Consolidation and exit rather than new market entry is typical of mature markets

Competition in an auction may be generated by existing operators and by potential new market entrants. In most developed countries mobile markets are mature and indeed many developing markets are also exhibiting signs of increasing maturity. As markets mature the tendency is towards consolidation and exit rather than new market entry. The table below provides examples of consolidation and exit from a range of mature mobile markets.

Exhibit 9: Examples of consolidation and exit

Country	Example
Portugal	Oniway closed its 3G operations in early 2003 after shareholders agreed to sell-off its assets. Analysts had forecast that Oniway would have had to spend up to €800m over four years to break into the Portuguese market, where 85% of the population already have a mobile phone. The remaining three operators - Vodafone Telecel, TMN and Optimus - have divided most of Oniway's assets between them. ¹⁴
The Netherlands	In 2005 KPN acquired Telfort. In 2007, Orange Netherlands was purchased by T-Mobile Netherlands and broken into separate companies.
Austria	In 2005, T-Mobile acquired the assets of tele.ring, the fourth-largest mobile operator in Austria.
United Kingdom	T-Mobile and Orange (the number 3 and number 4 players respectively) merged in July 2010. This resulted in the formation of a new company, Everything Everywhere.
Switzerland	In 2010, Orange and Sunrise attempted to merge, but the plan was blocked by Switzerland's competition commission. The Swiss foundation for consumer protection described Orange and Sunrise as "stubborn" for "failing to consider the welfare of consumers." ¹⁵
Italy	In 2002, Italy's fourth largest mobile operator Blu ceased operations and sold its assets to the remaining networks. This followed Blu's withdrawal from a 3G licence auction in 2000, and lengthy litigation to recover its deposit from the government.
Norway	Norway awarded four identical 2 X 15 MHz plus 5 licences in December 2000. However two of its licencees (Tele2 Norge and Broadband Mobile) failed, leaving only Telenor and NetCom (now owned by TeliaSonera). The rollout requirements were relaxed in 2003 in order to encourage new entrants. Hi3G bought one of the two unused licences and was given several years to begin to roll out its network. To-date however it has not done so, and has now received extensions until 2012. The fourth licence was sold in a sealed bid with only one bidder, to the third facilities-based GSM provider, Mobile Norway, which teamed up with mobile reseller Tele2. It also has not yet rolled out 3G services.
Sweden	Orange Sverige (a subsidiary of France Telecom) withdrew from the Swedish market in 2004 in direct response to the "pressures placed upon it by the 3G licence requirements and current market conditions". Vodafone was also forced to exit its Swedish business by selling it to Telenor for €1bn in 2005. This is despite the operator being the third-largest operator in Sweden with just over 1. million subscribers and a 16% market share.
Germany	Mobilcom and Quam abandoned their 3G roll-out plans in 2002/2003. Rival German mobile operation E-Plus later acquired Mobilcom's UMTS network for €20 million in order to boost its ability to meet licence commitments and offer 3G services

¹⁴ 3G Newsroom, "Oniway to Close Down 3G Operation", Dec 2002

¹⁵ Swissinfo.ch article, "Orange and Sunrise abandon merger," 2010

Australia Hutchison 3G Australia was forced to merge with Vodafone in 2009 following the Hutchisons inability to establish itself as a major player. Other smaller players have also exited the market. One.Tel spent over A\$500m on spectrum to support consumer mobile services, but was unable to capitalise on its investment and went bankrupt. iBurst, a wireless mobile broadband operator, acquired spectrum in 2002, launched in 2004, and closed down in 2008. More recently, Qualcomm, the US-based telecoms equipment company also sold the 2.1GHz spectrum that it had acquired in 2001 to Optus without having built out any network.

Source: Coleago research

Competition in 2.6GHz auctions from new market entrants has been weak

The results of recent spectrum auctions confirm that competition from potential new market entrants is likely to be low or non-existent (see the table below). In the 2.6GHz auctions held to date in Europe only in the cases of the Netherlands and Sweden did the award of new spectrum result in new market entry. In the remaining countries the spectrum was secured by the incumbents and in a number of cases only the incumbents contested the auction. A report summarising European experience on GSM licence renewal for the Dutch Ministry of Economic Affairs has noted that “So far there has been little or no interest from potential new entrants in acquiring spectrum for use for GSM”¹⁶.

¹⁶ Analysys, A study of the considerations and circumstances of GSM licence renewals in EU countries, 2 September 2005. Further, even in relation to 3G auctions which were associated with substantial more uncertainty than would accompany the re-auctioning of a GSM licence, incumbent 2G operators secured 3G licences in virtually all EU countries in which auctions were held.

Exhibit 10: New market entry in recent spectrum auctions

Country	Number of New Entrants	Auction outcome
Sweden (2011)	0	<ul style="list-style-type: none"> 800MHz band All incumbents participated although two formed a bidding consortium Potential new entrants Com Hem AB and Netett Sverige AB also participated but did not secure spectrum
Austria (2010)	0	<ul style="list-style-type: none"> 2.6GHz band All incumbents participated in the auction
Denmark (2010)	0	<ul style="list-style-type: none"> 2.6 GHz band Contested solely and won by the four current mobile operators in Denmark¹⁷ All of whom with the exception of the incumbent TDC will be allocated both unpaired and paired frequency blocks
Netherlands (2010)	2	<ul style="list-style-type: none"> 2.6 GHz band Attracted two new entrants beyond the current three incumbent operators It was widely felt that this was because band-specific spectrum caps were imposed on the incumbents The new entrants already had an existing foothold and infrastructure (the first entrant, Ziggo 4 is a joint venture between the two largest cable operators in the country whilst the second entrant, Tele2, already has an MVNO business in the Netherlands¹⁸)
Germany (2010)	0	<ul style="list-style-type: none"> 2.6 GHz band All licences were awarded to existing market players The regulator stated that no new entrants participated after one company withdrew its interest and another was not admitted¹⁹
Finland (2009)	0	<ul style="list-style-type: none"> 2.6 GHz band All licences were won by the 4 existing market players, DNA, Elisa and TeliaSonera and Pirkanmaan Verkko (an association of regional operators) The sole non-incumbent bidder was Cypriot company WiMAX Finance which was interested in the TDD spectrum, but was outbid by Pirkanmaan Verkko²⁰
Hong Kong (2009)	0	<ul style="list-style-type: none"> 2.3 GHz and 2.5 GHz bands Three licences were awarded to the existing market

17 GLG, "Denmark's 2.5GHz Auction: A European Opening for TD-LTE", May 2010

18 Analysys Mason, "Dutch 2.6GHz Auction Raises Just EUR2.6 million", May 2010

19 Rethink Wireless, "German Spectrum Auction Kicks Off", Apr 2010

20 Analysys Mason, "Rock-Bottom Prices Paid for Finland's 2.6 GHz Spectrum", Nov 2009

players - CSL Limited, Genius Brand Limited (owned by PCCW and Hutchison) and China Mobile Hong Kong Company Limited²¹

Sweden (2008)	1	<ul style="list-style-type: none"> • 2.6 GHz band • Auction saw only a single newcomer, Intel, who bid for the TDD spectrum to allow it to roll-out a WiMax network. • The remaining FCC spectrum went to incumbent operators H3G Access, Tele2, Telenor and TeliaSonera Mobile Networks²²
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Source: Coleago research, regulator websites

Spectrum subject to renewal will be more highly valued by the incumbents

The auctions for 800MHz and 2.6GHz spectrum represented auctions of new spectrum. In these auctions the incumbents will value the spectrum more highly than potential new entrants as incumbents do not have to build entirely new networks on which to deploy the new spectrum and will also incorporate the value of blocking new market entry into their valuations. In the case of spectrum renewal the differentiations in valuations between new entrants and incumbents will be greater due to the additional value to the incumbents of avoiding service disruption from the loss of existing spectrum holdings.

Maintaining competitive tension after the auction will limit competition in the auction

Regulators are therefore likely to have to rely upon competitive tension between the incumbents to ensure that auctions are sufficiently competitive. Regulators may seek to create scarcity and competition by packaging the spectrum in such a way to ensure that there is excess demand. However a fundamental objective for regulators is to maintain or increase the degree of competition. Avoiding concentration in spectrum holdings is a key element of ensuring effective competition. Regulators will therefore wish to package spectrum in such a way to ensure that spectrum is reasonably evenly distributed amongst the existing players. This overriding aim is therefore likely to reduce potential competitive tensions between incumbents and reduce the potential effectiveness of an auction process.

If the regulator wishes to ensure that post auction spectrum holdings are evenly balanced to maintain or increase market competitiveness then an auction may well result in only the incumbents participating and the auction concluding quickly with lots selling at the reserve with no change in the allocation of existing spectrum holding pre and post the auction. This was the experience of Singapore, the only country at the time of writing which has auctioned renewal spectrum. The re-auctioning of spectrum was proposed in Norway, although only the existing licensee applied so that they were awarded the spectrum without the need for an auction. The Norwegian approach first required potential bidders to register (including providing bank guarantees for the reserve price) which afforded an opportunity for new entrants to compete for spectrum while avoiding unnecessary costs should no other player believe that they would attach greater value to the licences than the incumbent operators.

Spectrum renewal may be best conducted using an administered approach although an auction will be seen as being more transparent

If the outcome of the auction process is likely to be that the status quo will be maintained with spectrum selling at reserve then the uncertainty and costs that organising an auction impose may lead the regulator to prefer an administered approach. In countries where the transparency and fairness of regulatory processes have been challenged in the past the regulator may prefer to adopt an auction to reduce the risk of legal challenge and to be seen to be employing transparent and objective procedures. In this case the choice of reserve prices will be extremely important as spectrum is likely to be sold at the reserve prices. We discuss the issue of reserves in more detail later in the report.

²¹ Telecom Engine, "Hong Kong Awards Three 4G Licences", Jan 2009

²² James Middleton, "Sweden: Hammer Falls on 2.6 GHz Auction", Telecoms.com article, May 2009

2.2.3 Administered approaches

Administered approaches can take account of a broader range of public policy objectives

Administrative approaches are often seen as desirable on the grounds of allowing a range of criteria to be taken into account such as coverage plans or the range of services to be offered. The details of the operator's plans are presented in a business plan or "bid book" which is reviewed by the regulator. The licence or spectrum is awarded to the operators who best meet the regulators assessment criteria. The approach is also accompanied by administratively determined spectrum prices. Administratively set spectrum prices may well be below the prices that would arise in some auction formats as regulators often set prices conservatively in order to ensure that spectrum is not left idle

Administrative approaches may be cost efficient where there is no real competition for the licence such as where sunk costs imply that the incumbents or a subset of existing players is expected to win any competitive process. On the other hand, administrative approaches may result in licences being assigned to the operator that presents an attractive proposal rather than necessarily the operator that can use the licence to generate the greatest benefits for society.

Administrative approaches are more subjective and risk regulatory capture and may become subject to legal challenge

A further issue with administered approaches is that commitments provided at the time of award are later not met. Administrative discretion is also more vulnerable to bias or even corruption of officials and perceived bias can lead to administrative approaches ending in legal disputes. This typically occurs in instances where clear tender procedures and evaluation criteria are not applied. Finally, while there are grounds to believe that high spectrum prices will have a limited impact on future investment (in terms of that investment being based primarily on the expected returns on that future investment), it may be the case that high prices increase an operator's cost of capital and this can result in lower investment than otherwise.

2.2.4 Selecting the appropriate approach

Auctions can be efficient and can capture excess profits

There are two key distinctions between auctions and administered approaches. Firstly, if the auction is well designed and competitive the spectrum should be awarded to the firm or firms that value the spectrum most highly. If a firm's private values provide a good estimate of social value then the resulting allocation will be economically efficient.

Second, in a competitive auction and, depending on the design, the approach can see any operator profits in excess of a reasonable rate of return flow to the government. Under an administrative approach the ability to achieve economic efficiency depends on the knowledge and information available to the regulator. As the regulator is likely to have imperfect information about mobile operator valuations (as the operators do not usually have an incentive to share this information with the regulator) then there is a possibility that the resulting allocation may not be efficient. Furthermore, the regulator will have to set arbitrary spectrum usage and access fees if it wishes to raise revenue from the award of spectrum and these spectrum fees may be too low and fail to capture appropriate levels of excess profits or too high resulting in spectrum remaining unsold which is economically inefficient.

Regulators should therefore generally prefer market based award mechanisms for the allocation of spectrum rather than an administrative procedure due to the formers ability to deliver economic efficiency. It is also possible to combine aspects of the two main approaches such as where the licensing authority initially selects a short-list of bidders based on administrative criteria and then holds an auction to assign the licence between the selected bidders. The pre-qualification phase however can be subjective and subject to legal challenge arising from a lack of transparency and is generally not advised.

In practice, auctions can therefore be used where:

- an appropriate auction design can be formulated that incorporates public policy objectives;
- there is excess demand for the lots to be awarded;

- the monetary value of the license is relatively high, justifying what can be a complex assignment procedure; or
- where there is a need to adopt a process which is highly transparent to avoid potential legal challenges and increase confidence in the regulatory body.

An administered approach should be used where the criteria for using an auction are not met. The criteria for using an auction may not be met in the case of spectrum renewal mainly due to a lack of potential competition in an auction. An administered approach is also likely to be less costly than an auction.

2.3 Practical issues in adopting administered approaches

In the previous section we argued that in the case of spectrum subject to renewal an auction may not be appropriate and that an administered approach may be more cost effective. In this section we examine a number of criteria for determining when spectrum should be renewed or potentially re-assigned.

2.3.1 Presumption of renewal in favour of incumbents

There is a general presumption that existing spectrum should be renewed in favour of the existing holders

In an auction context the existing holders of spectrum would most likely secure the spectrum were it to be auctioned. As a result there is a general presumption amongst regulators that existing spectrum should be renewed in favour of the incumbents unless there are special circumstances where re-assignment is deemed necessary.

In contrast to this presumption Singapore's IDA²³ made the following arguments as to why spectrum should not automatically be renewed in favour of the incumbents.

- Opportunity for interested buyers to procure a scarce resource – Spectrum is a scarce resource with an inherent economic value. Existing 2G operators have benefited from the value of the Spectrum Rights for the duration of the rights. New entrants, or existing 2G operators that have interest in a spectrum band currently not allocated to them, should be given the opportunity to procure the right to use that spectrum and reap the associated benefits;
- Avoid perpetuating legacy imbalances – The distribution of spectrum in each of the existing 2G Spectrum Rights is different, with each operator having rights to different amounts and different bands of spectrum. Such differences were maintained for the duration of the Spectrum Rights. Any further preference accorded to each operator, based on its historical allocation, may perpetuate legacy imbalances and distortions beyond the duration of the Spectrum Rights;
- Ensure most efficient use of spectrum – Reallocating the spectrum based on market demands rather than historical allocations will ensure that operators acquire as much spectrum as necessary based on their commercial considerations, at the market value of the spectrum, thereby providing the economic incentives for operators to optimise usage of the spectrum;
- Part of normal business risks – The expiry of the Spectrum Rights without any residual right to the spectrum has been made known to the operators since the Spectrum Rights were issued. The business risks that existing 2G operators have to bear by having to acquire spectrum in the allocation exercise rather than through a preference given by IDA is part of the normal business risks of the operator. Nonetheless, IDA expects operators to ensure that they would be able to provide service continuity to existing customers.

We have already argued that in an auction context the existing holders of spectrum are likely to secure spectrum and recent experience suggests that new market entry is unlikely. In the absence of controls over foreign investment any interested party wishing to gain access to a market could do so through acquisition. An auction could

23 Proposed framework for the reallocation of spectrum in the 900MHz and 1800MHz frequency bands, 28th June 2007

therefore represent a costly and time consuming event that does not alter the dynamics of the market and therefore imposes unnecessary uncertainty and cost on the industry.

In the following chapter on spectrum pricing we argue that spectrum for mobile telephony is the highest value use of spectrum so there would be no economic benefit in re-assigning spectrum for other uses. Benefits arising from re-distributing spectrum amongst existing users could arise from increasing effective competition and we discuss this issue in more detail below. However, a more balanced allocation of key spectrum bands could be achieved through the auction of subsets of spectrum holdings or through the award of alternative, substitute bands which would eliminate the need for a full auction of all existing spectrum rights.

Spectrum trading or the introduction of AIP based spectrum usage fees can provide effective mechanisms for ensuring the efficient use of spectrum. A spectrum auction of existing rights will not ensure on-going efficient use of spectrum if market or technology changes differ from those anticipated by the participants in the auction at the time at which they placed their bids.

Whilst operators would have been aware of the risk of licence expiry without renewal providing a presumption of renewal may promote increased investment relative to the levels had there been no presumption. The pay back period (the time it takes for a project to pay back its initial investment) can be long for major network upgrades and is extremely long in the case of new market entry and so providing operators with a long time horizon can encourage investment. The security that long presumed tenure provides may also facilitate the raising of finance to fund the network investment.

Mobile services have been shown to generate wide economic benefits and so ensuring continuity of service is also important. Re-assigning spectrum away from the existing users could therefore potentially result in operators facing additional costs associated with re-planning and implementing changes to their networks in response to the loss of spectrum and potential disruption of service which could impose a wider cost on the economy.

Only Singapore and Norway have either used or planned for auctions

At the time of writing only Singapore has conducted an auction for the renewal of existing spectrum rights. Norway proposed the use of an auction but when only the incumbents registered for the auction the spectrum was awarded to the incumbents at the reserve. OFTA in Hong Kong adopted a "right of first refusal" approach and in all other cases which we have identified (New Zealand, Sweden, France, Germany, Portugal, United Kingdom, Pakistan, Belgium, Denmark, Hungary and Sri Lanka) an administered approach in favour of the incumbents was used. There are currently consultations on-going in Ireland and Switzerland and the current proposals from the regulators are for auctions of existing spectrum holdings. These proposals have been strongly criticised by operators in their responses to the consultation process.

2.3.2 Promoting competition

A case may be made for re-assigning spectrum for competitive reasons

The issue of spectrum renewal does become more complex when competitive considerations are introduced. For historical reasons the first operators in mobile markets were often awarded sub 1GHz spectrum such as 900MHz in the case of Europe. Later entrants were often awarded only 1800MHz spectrum and with the award of 3G spectrum around 2000 some later new entrants were awarded spectrum only in the 2.1GHz frequency range. Low frequency spectrum is often seen as providing the holders with competitive advantage due to its superior propagation characteristics both in terms of wide geographic coverage in rural areas and better in-building penetration in urban and dense urban areas. These advantages are perceived to have grown with the developments in mobile broadband as access to low frequency spectrum combined with re-farming allows sub 1GHz holders to roll-out mobile broadband services more extensively or at lower cost compared to those holding higher frequency spectrum. The award of 2.6GHz spectrum as well as the Digital Dividend has been extensively delayed in the United Kingdom as a result of legal

The benefits of re-assignment must exceed the costs

challenges and extensive consultation, of which much has been focused on issue of the relative holdings of sub 1GHz spectrum for the different players in the market.

For spectrum to be re-assigned on the basis of increased competition the benefits of increased competition would need to more than compensate for the costs imposed by re-assignment arising from reduced incentives for investment and potential disruption to service. The GSMA²⁴ has proposed the following three tests to ensure that the benefits would outweigh the costs.

- First, a decision to not renew a licence so as to promote competition only makes sense where competition in the market has already been assessed as not being effective. In this regard, the evidence suggests that the presence of a relatively small number of mobile operators may be sufficient to ensure competitive outcomes. For instance, of the 20 EU national regulators that had assessed the competitiveness of their national markets for mobile access and outgoing calls as at 26 July 2007, 15 had found the markets to be effectively competitive with the only markets not to be found to be competitive being those containing 2 operators and some of the markets with 3 operators²⁵.
- Second, it may be possible to ensure competitive outcomes by making available other spectrum that does not require an existing operator to give up their spectrum. For instance, the transition to digital broadcasting should free up substantial spectrum currently used for analogue broadcasting services (the so called “Digital Dividend”). This is the approach that is likely to be used in the United Kingdom where caps on sub 1GHz spectrum holdings should ensure that all players obtain access to these key bands.
- Finally, even where it was anticipated that re-assigning spectrum could result in a competition benefit and that benefit was not achievable by other means, a judgement would need to be made that the magnitude of the competition benefit would outweigh the potential harm to investment.

The cases where re-assignment is the only appropriate remedy are likely to be few

The cases where spectrum re-assignment is the only available remedy for increasing competition are likely to be relatively few. Where re-assignment is the only remedy then the regulator must ensure that the benefits will exceed the costs of reduced investment and potential disruption. If re-assignment is deemed necessary then the regulator should seek to re-assign only a subset of the operators’ frequencies and to ensure that sufficient time is allowed for the operator and market to adjust to the changes.

2.3.3 Spectrum management

Spectrum may not be renewed for spectrum management and planning reasons

There will always remain some requirement for an element of the “command and control” approach to spectrum management due to national security, interference and national and international coordination issues which cannot be effectively addressed through market mechanisms. The impetus for a change in use of the spectrum may arise from international radio frequency planning and co-ordination or from national decisions. It may be appropriate not to renew spectrum if a major spectrum re-planning exercise will generate significant benefits which outweigh the costs of the resulting disruption. Where such a re-planning exercise is deemed necessary then the plan should be announced as early as possible to enable existing operators to adapt their plans and expectations accordingly. Of course, the preference would be to avoid the need for re-planning in the first place and this could be facilitated by flexible and neutral licensing.

24 Licensing for growth – reforming the licensing of mobile operators in developing countries, GSMA, 2007

25 European Commission, Article 7 Competition/ Regulation First Round Overview Table, 26 July 2007.

Breach of licence conditions may provide a reason not to renew a licence but this must represent a proportionate response to the breach

2.3.4 Breach of licence conditions

Licences represent a contractual agreement between the regulatory body and the licensee. If the licensee breaches licence conditions then this can provide grounds for revoking the licence or not renewing the licence. Licence revocation or not renewing a licence are very severe penalties and impose significant costs not only on the operator subject to the sanction but also customers and the economy as well. Operators are aware that regulators recognise the costs of revocation and so they may be willing to test the resolve of the regulators through infringing licence conditions. Regulatory bodies are able to impose a range of sanctions including fines, “naming and shaming” or drawing down funds from a performance bond posted by the operator²⁶. Indeed regulators must act to ensure they retain credibility and to avoid legal action from other operators who have met their licence conditions and perceive those that are in breach as being treated differently. For instance, in Norway, one operator received a fine for not meeting its 3G coverage requirements based on the expected savings to the operator from not completing its coverage²⁷. Any sanctions should be proportionate to the breach and revocation or not renewing a licence should be used as a measure of last resort. Issues of licence compliance will also be eased if licence conditions are reduced to the minimum levels.

2.4 Practical issues in adopting market based approaches

2.4.1 International use of auctions

From the early 1980s spectrum was typically awarded through the use of administered approaches such as “beauty contests.” However in the last twenty years spectrum auctions have become the norm for allocating spectrum and licences. The most commonly used auction is the Simultaneous multi-round ascending auction or SMRA format. However, in Europe in recent years increasing use has been made of the Combinatorial Clock Auction or CCA design. In Scandinavia a variation on the SMRA has been used which incorporates the ability to switch bids – this design is referred to as the SMRA with augmented switching. A brief description of each format is provided in the appendix to this report.

The table below shows the use of different auction designs in recent auctions around the world. The auctions were mainly for 2.6GHz. It should be noted that the first combinatorial clock auction for spectrum was held in 2008 by Ofcom. If the table were to be extended to earlier years to include the award of 3G spectrum and other bands in the period from approximately 1999 then the SMRA format would be revealed as the most common by a considerable margin. The use of the CCA format is a very recent phenomenon.

Exhibit 11: International use of alternative auction formats

Country	Year	SMRA	SMRA-AS	Combinatorial Clock	Other
Norway	Nov 2007		✓		
New Zealand	Dec 2007				✓
Singapore	Feb 2008	✓			
Sweden	April 2008		✓		
Hong Kong	Jan 2009	✓			
Netherlands	April 2010			✓	
Denmark	May 2010			✓	

²⁶ The use of performance bonds is relatively uncommon although this is an approach adopted by ComReg the Irish regulator

²⁷ Bird & Bird, “Crunch time in the roll-out of UMTS in Swedish electronic communications markets”, 16 February 2005.

Country	Year	SMRA	SMRA-AS	Combinatorial Clock	Other
Germany	May 2010	✓			
Austria	Sept 2010			✓	
Finland	Nov 2010		✓		
Sweden	H1 2011		✓		

Source: Coleago research

2.4.2 Best practice in auction design

Developing a preference for a particular auction design will require the regulator to trade-off a range of different auction features. In this section we highlight the principles of best practice in auction design.

Auction design should promote participation

Promote participation and enhance competition

For an auction to be competitive there needs to be excess demand for spectrum relative to the available supply. The auction design should promote competition. There are many measures which can be used to promote participation. Commonly used measures include:

- Setting low reserve prices;
- Providing bidder credits (as used in some FCC auctions);
- Specifying differential activity rules which favour new entrants;
- Setting aside spectrum for new entrants; and
- Careful spectrum packaging and the use of spectrum caps.

Sequential auctions should be avoided

Simultaneous rather than sequential auctions

Regulators through auctions, seek to promote economically efficient outcomes. Ensuring participants have access to information is important for economic efficiency. The disadvantage of sequential auctions is that they limit information available to bidders and further limit how the bidders can use any information that does become available. Bidders' strategies are also more complex in sequential auctions as bidders face the possibility of regret if they purchased early at high prices or failed to purchase early at low prices. Simultaneous auction awards are likely to be more economically efficient than sequential auctions. However, simultaneous auctions can offer scope for some forms of strategic bidding.

Spectrum packaging should be aligned with regulatory objectives and where possible generic lots should be used

Spectrum packaging

Spectrum packaging is a critical issue in the context of any auction design. In assessing how best to package spectrum regulators should:

- Incorporate technical considerations and packaging should recognise the importance of contiguous spectrum and the spectral efficiencies of wider channels;
- Seek to avoid generating unnecessary exposure risk for bidders by aggregating spectrum at the appropriate level where strong value interdependencies exists for all bidders; and
- Seek to avoid an uncompetitive concentration of spectrum.

Spectrum can be auctioned either as specific lots where each lot relates to a particular set of frequencies or as generic lots where the lots relate to unspecified blocks within a particular frequency range. In the case of the latter a supplementary process is

required to allocate the specific blocks. The regulator should prefer generic lots where possible for the following reason:

- It reduces the complexity of the auction.

Package bidding

Unless there are high levels of exposure risk package bidding should be avoided

Package bidding is appropriate where bidders face high levels exposure risk²⁸. Geographical exposure risk can be eliminated through national licences. Fragmentation risk (a form of exposure risk) can be eliminated through the use of generic lots and an assignment stage. Inter-band exposure risk is often not regarded as particularly material. When there is limited exposure risk there is little advantage of a package based auction design. Furthermore, package based auctions introduce a much higher level of complexity and uncertainty and the 2nd price rule which is often deployed to encourage sincere bidding can give rise to significant variations in prices for similar lots and a lack of transparency in outcomes and pricing.

The regulator should prefer not to use a combinatorial auction design with package bidding when exposure risk is low or can be effectively eliminated through other methods for the following reasons:

- Package bidding is computationally burdensome and difficult for bidders to comprehend;
- The implementation of package bidding leads to a lack of transparency; and
- The implementation of package bidding can result in very significant differences in prices paid for similar lots.

Reserve prices

Reserve prices should be set conservatively

If reserve prices are set too high this may discourage auction participation from serious bidders. If reserves are high there is a risk that lots will go unsold and the auction may be presented in the press as a “failure.” Such an outcome will also be economically inefficient if the lot could have been sold at a price below the reserve. If too high a reserve results in lots going unsold the regulator must then address the issue of what to do with the unsold lot. If the lot is re-auctioned with a lower reserve this may damage the regulator’s credibility for future awards and could lead to legal action on the part of bidders. The regulator should favour low reserves for the following reasons:

- Encourages participation;
- Avoids lots going un-sold; and
- Avoids damaging economic efficiency.

Information transparency

Information should be made available

Generally the more information that is made available in an auction then the more efficient the outcome provided that collusion or forms of strategic bidding are not present. In situations where bidders’ valuations depend upon their view of other bidders valuations (information is said to be affiliated) and there are common value elements any mechanisms which increases information can reduce the winner’s curse and encourages more aggressive bidding and result in higher auction revenues. The regulator should prefer a format with greater availability of information as:

- Greater transparency is generally beneficial for increasing auction efficiency;
- Greater transparency helps reduce common value uncertainty; and

28 See the appendix for a definition of auction terms

- Reduced common value uncertainty leads bidders to bid more aggressively leading to higher revenues.

Pricing rules

Prices should be uniform or close to uniform for similar lots

Any decision on the appropriate pricing mechanism cannot be determined without considering the auction format in which the pricing rule will be used. In an SMRA the two most appropriate pricing rules are uniform prices and discriminatory prices. The regulator may prefer uniform prices as this may accord with a sense of “fairness” provided that spectrum lots are reasonably similar. The regulator should prefer a pricing rule which leads to similar prices for similar lots:

- Charging a similar price for similar items accords with a general sense of fairness.

Certainty of outcomes

Bidders should be able to predict the auction outcome when they place a bid

When bidders place a specific bid in an auction there is a general preference for certainty as regards to what will be the outcome of that bid in terms of what lot will be won and at what price. However, in certain auction formats like CCA (see section) uncertainty over outcomes is particularly high. If bids and outcomes are closely correlated the transparency of the auction process will be greater and bidders will have more confidence in the process and are less likely to question and challenge the final outcome.

Regulators will have a preference for a transparent, open process with a high degree of accountability (nobody should be in doubt that everything is being done in a correct manner) and a process that ensures all participants are given the opportunity to act rationally and without making mistakes or errors. However, they may be prepared to trade a degree of transparency for the attainment of other auction objectives.

Bidders are likely to have strong preferences for certainty over the outcomes arising from bids placed. The feedback²⁹ from participants in CCA auctions which suffer from a lack of transparency, indicate that auction participants do indeed have a strong preference for certainty. However, provided that bidders are confident in and trust the auction mechanism they may, like regulators, be prepared to trade a reduced level of transparency for the attainment of other auction objectives.

Valuation complexity

The design should seek to reduce valuation complexity

Valuation complexity can be present in all auction formats. Efficient auction designs typically assume that bidders can determine the value for all available lots and combinations of lots and can do so without cost. A very significant challenge with combinatorial or package auctions is that as the number of available lots increase the number of possible combinations grows exponentially. For example, in an auction with 20 available lots the number of combinations exceeds a million. Valuation exercises for the bidder and evaluation by the regulator gets complex for large lots in which case a simpler auction structure is desirable.

Cost and speed of implementation

Cost and speed are secondary issues

The cost and speed of implementation is an issue common to all auction formats. If an auction takes a long time to complete there is a risk that an external event triggers a re-evaluation of the value of the spectrum below levels that they had already bid. Furthermore, the longer the process, the greater is the period of uncertainty for all bidders. However, an auction that progresses very quickly does not afford bidders the time to potentially adjust their valuations based on information revealed during the

²⁹ We present the actual feedback on CCA auctions later in this report

auction. Too quick an auction may also result in errors in terms of bid strategy and the execution of specific bids.

The regulator as well as all the bidders will prefer a process that is reasonably quick to reduce the costs associated with managing and participating in the auction. However the process should not be too fast that it prevents the ability to respond to price information or it puts the bidders under pressure. Generally, given the importance of spectrum auctions and the material valuations likely to be placed on the spectrum, the speed and cost of implementation are likely to be the least significant factor in determining the appropriate auction design.

Selecting a preferred auction format

In selecting a preferred auction format the regulator should evaluate the auction format against the design principles summarised below:

- spectrum should be awarded through a simultaneous, rather than a sequential, auction;
- if the differences between spectrum lots are not material then generic lots should be used however if the differences are large then specific blocks should be preferred;
- all spectrum should be awarded at the national level;
- package bidding should be avoided;
- transparency should be high;
- There should be certainty over prices paid and a preference for uniform prices if spectrum blocks are similar;
- There should be certainty over outcomes in terms of lots received when bids are placed;
- There should be certainty over total expenditure commitments when placing a bid; and
- The auction design, valuations and bid strategy should be easy to explain.

The table below compares different auction formats against the criteria for best practice in auction design.

Exhibit 12: Comparison of different auction formats

Design principle	SMRA	SMRA-AS	CCA
Simultaneous award of spectrum in multiple bands	✓✓✓	✓✓✓	✓✓✓
Flexibility over the use of specific or generic lots	✓✓	✓✓	✓
Consistent with national level licences	✓✓✓	✓✓✓	✓✓✓
Capable of implementation without package bidding	✓✓✓	✓✓✓	x
Transparency of bidders and bids	✓✓✓	✓✓✓	✓✓
Low reserve prices	✓✓✓	✓✓✓	✓✓✓
Certainty over prices paid	✓✓✓	✓✓✓	x
Certainty over lots awarded	✓✓✓	✓✓✓	x
Certainty over total expenditure	✓✓✓	✓✓	✓
Simplicity and ease of presentation and transparency of results	✓✓✓	✓✓	x

Source: Coleago analysis

2.5 Case studies – The Indian and Singaporean experiences

2.5.1 India 3G auction

The Indian telecoms market is divided into 22 telecoms circles and with a total population of over a billion, each circle has an average population of 52 million. These 22 circles were further segmented into:

- Metros - Mumbai, Delhi, Kolkata
- Category A– Major wealthier regions
- Category B
- Category C - poorer regions in India with GDP per capita in some cases similar to those of Bangladesh

India is the most competitive market in the world with up to 14 operators in some of the regions. The competitive nature of the market has resulted in some of the lowest telecoms prices worldwide. Despite these low prices the auction raised nearly \$15bn and prices achieved in Mumbai and Delhi were higher than 3G licence prices in UK and Germany (2000) before adjusting for the GDP differentials.

Exhibit1: India auction overview

Criteria	
Date	May 2010
Spectrum available	Between 3-4 lots of 2x5MHz blocks
No of participants	Depended on region but up to 11 incumbents

Source: [Regulators website](#)

The auction was an SMRA regional auction. The country was split into 22 regions. The Governments stated objectives were:

- ensure an efficient allocation of spectrum;
- encourage a competitive environment;
- promote the rollout of 3G services;
- relieve 2G congestion; and
- revenue maximisation.

It is clear from the spectrum made available and the auction design that the regulator's primary objective was to maximise revenue.

Exhibit 2: India auction format and rules

Criteria	
Format	SMRA
National/Regional	Regional (22 regions)
Caps	1 block in each region
Block size	FDD 2x5MHz,
Specific/Generic blocks	Specific
Licence conditions	20 year licence In metros 90% coverage requirement within 5 years Cat A, B, C: 50% coverage of which 15% must be in rural areas within 5 years
Reserve price (\$/MHz/Pop)	Mumbai \$ 0.5 Delhi \$ 0.4
Intent of auctioneer	Profit maximisation

Source: Regulator website

The auction consisted of a clock round phase. In this phase bidders could bid on as many circles as their eligibility points would allow. In the auction a bidder's initial eligibility points were related to their deposits. Where demand exceeded supply the price of the lots was increased each round according to the following table.

Exhibit 3: India round price increases

Excess demand	Increase in round price
negative	0%
0	1%
1	1%
2	5%
3 or more	10%

Source: Regulator website

It was evident from round-by-round auction analysis that some bidders were employing "parking" strategies. The huge disparity in eligibility points between Metros and Cat C circles, coupled with the high excess demand for the Metros/Category A circles encouraged bidders interested only in Category B and C circles to "park" their bids on the Metros and Category A circles until the demand in those circles fell. This strategy contributed to price inflation in the Metros/Category A circles.

The Indian auction finished after 34 days and 183 rounds. The auction raised \$15 billion with prices in Mumbai and Delhi at levels higher than the 3G auctions in the UK and Germany (taking no account of the GDP differentials).

The key factors driving the high prices achieved in the auction were:

- Market landscape: Up to 14 players in some of regions with 11 of taking part in auction with between 3-4 slots in the regions;
- Auction format: For existing incumbents there were complementarities in regions where they had existing 2G holdings;
- Auction rules: The auction only ended when supply and demand were equal in all 22 circles. The prices continued to rise in individual circles even when supply = demand, prices only remained static if there was negative demand;
- Existing spectrum holdings: Indian operators are some of the most spectrum starved operators in the world;
- Voice congestion: In the Metros and category A circles many of the operators are facing severe voice congestion. Operators needed the 3G spectrum to support their voice business; and
- Potential for mobile data: India has very poor fixed infrastructure. Mobile offers the most likely broadband access technology for the majority of the market. However with the limited spectrum released in the market the development of MBB is going to be limited.

The CEO of Bharti stated after the auction "The auction format and severe spectrum shortage along with ensuing policy uncertainty drove the prices beyond reasonable levels. As a result, we could not achieve our objective of a pan-India 3G footprint in this round."

The main winners of the Metro and Category A circles were Vodafone, Bharti and Reliance.

Exhibit 4: India auction outcomes

Operator	Spectrum acquired	\$/MHz/Pop
Mumbai	2x5MHz	5.63
Delhi	2x5MHz	4.35
Average Metro and Cat A (excl Mumbai & Delhi)	2x5MHz	0.37
Category B	2x5MHz	0.18
Category C	2x5MHz	0.05
Average across India		0.33

Source: [Regulator website](#)

There are some important lessons for Bangladesh from the recent transparent 3G spectrum auctions in India and the BWA auction that followed it. The overall approach was positively received because of its transparency. No “backroom dealing” was suggested compared to the current issues in relation to the award of 2G spectrum. However, the approach taken by India raises a number of issues that are relevant for Bangladesh.

A holistic approach was not taken

First, contrary to best practice, the government has chosen to independently auction the 2.1 GHz 3G spectrum prior to concluding a consultative process on availability and re-farming the 2G spectrum and the pricing of 2G spectrum for recent new entrants and those operators whose licence are coming up for renewal in the next 2-3 years. This created uncertainty about the future allocation of spectrum and the pricing in a market which was already experiencing congestion and is spectrum deprived.

Spectrum renewal should have been addressed prior to the auction

The government is now faced with the difficult task of establishing a price for the 2G spectrum on the basis of the price discovered for the 3G spectrum. Various approaches have been proposed by committees constituted by the government to derive the price of 2G spectrum for 2G services from the 3G auction however none of the current proposals have been accepted by the operators.

Package based bidding may have been more appropriate

Secondly, as the comments from Bharti suggest, a number of operators were seeking pan Indian spectrum holdings. We can presume that they envisaged synergies from a pan Indian footprint. The use of an SMRA presented the bidders with exposure risk³⁰ and the use of a package based auction format such as the Combinatorial Clock design may have been more appropriate in the Indian context.

2.5.2 Singapore 900MHz and 1800MHz auction

There are three incumbents in Singapore. The auction was for the incumbents' existing 900MHz and 1800MHz spectrum.

Exhibit 5: Singapore auction overview

Criteria	
Date	February 2008
Spectrum available	900MHz – 5 lots of 2x5MHz 1800MHz – 13 lots of 2x5MHz
No of participants	3 incumbents

Source: [Regulator website](#)

The blocks were to be auctioned on a generic basis. The allocation phase of the proposed auction was using a SMRA format.

30 See the glossary in the appendix for a definition of exposure risk

The proposed assignment stage followed a 3 stage process:

- Incumbents given first right of refusal for a specific block position;
- A second initial offer; and
- A sealed bid combinatorial auction.

Exhibit 6: Singapore auction format and rules

Criteria	
Format	SMRA
National/Regional	National
Caps	900MHz 2x15MHz Overall cap of 2x30MHz
Block size	2x5MHz
Specific/Generic blocks	Generic
Licence conditions	Service and Technology neutral. Licence term 8 years and 3 months.
Reserve price (\$/MHz/Pop)	0.005
Intent of auctioneer	Encourage new market entry Efficient allocation of resources

Source: [Regulator websites](#)

The combination of tight spectrum caps, supply of available spectrum and the absence of any new entrants ensured that spectrum demand did not exceed supply as a result the auction spectrum sold at reserve.

The Singaporean experience raises some interesting issues for Bangladesh. The use of an auction format ensured that the process was highly transparent. The use of a low reserve would not have discouraged a new entrant had a new entrant believed there was a robust business case for a fourth player. The fact that a new entrant could have acquired spectrum but none chose to participate would have provided comfort for the IDA that incumbents were making the most efficient use of the spectrum. The use of a low reserve also ensured that all spectrum was allocated. The fact that the auction was uncompetitive and spectrum sold at reserve highlights the importance for Bangladesh of selecting an appropriate reserve price.

3. Approaches and benchmarks for spectrum pricing

Spectrum pricing is challenging as auctions may not be competitive enough to determine market prices for renewed spectrum

3.1 Section overview

Spectrum pricing is becoming increasingly challenging especially in markets where auction based awards of spectrum for renewal are unlikely to be competitive. In this section we begin by identifying a number of considerations for spectrum pricing before providing a set of definitions for different types of spectrum charges used in this report. We then consider a range of methodologies which can be deployed under an Administered Incentive Pricing (AIP) regime which are designed to ensure economically efficient use of spectrum in the absence of effective market mechanisms such as auctions or spectrum trading. The methodologies reviewed include optimal deprivation value and best alternative use or user. We then provide some practical implementation advice and benchmarks from across Europe and world wide on spectrum usage fees. Finally, we conclude this section with comments and benchmarks on the setting of reserve prices in auctions.

3.2 Considerations for spectrum pricing

3.2.1 Spectrum management objectives

When considering spectrum pricing the regulator should keep in mind the following key objectives of spectrum management:

- maximizing the economic benefits to the country obtained from use of the spectrum resource;
- ensuring the efficient use of the spectrum resource by ensuring sufficient incentives are in place;
- ensuring that users benefiting from the use of the spectrum resource pay for the cost of using spectrum;
- covering the costs of spectrum management activity incurred by the spectrum management authority; and
- providing revenue to the government arising from the use of scarce national resource.

Developing spectrum pricing strategies invariably involves alignment with the government's revenue goals and objectives. Spectrum pricing will involve discussions with key stakeholders such as the Ministry of Finance, Ministry of Communications and telecommunications service providers.

3.2.2 Spectrum pricing and investment incentives

The higher the charges for the use of spectrum the lower the incentives to invest

The basic principles of investment appraisal reveal that if capital markets are perfect then operators will invest in all projects which generate a positive net present value³¹. In reality capital markets are not perfect, operators face cash constraints and so they must allocate resources to those projects that yield the highest return on investment. A relationship can therefore be presumed to exist between the level of spectrum prices and the incentives to invest. Indeed in the extreme case where spectrum prices exceed the value of the spectrum no investment will take place. As spectrum prices fall so the

³¹ Net present value is derived from the application of discounted cash flow analysis and adjusts future cash flows for risk and the time value of money. Theory predicts that companies will undertake all projects that generate positive NPVs provided they do not face capital constraints.

return on investing in the network infrastructure required to generate a return from spectrum assets increases.

Hazlett and Munoz in their paper “What Really Matters in Spectrum Allocation Design” comment

“The more effective is the system in appropriating innovators’ gains, the lower the investment in such activity”³².

High spectrum fees can damage the operators’ ability to raise finance

Large fees can also impact innovation and investment by depriving operators of necessary funds. At the time of the initial 3G auctions, some argued that (from a policy perspective) the extremely high prices did not matter, since once they were sunk costs, operators had exactly the same investment incentives they would have had anyway. However, in reality companies operate with capital constraints. As their funding needs grow their cost of capital rises and their range of profitable investment narrows. In certain cases, further funding may simply be unavailable (whether from a parent company or the financial markets)³³.

Spectrum fees should be treated as sunk costs and therefore should not impact pricing decisions

Even if a given fee does not distort investment incentives and lead to inefficiency, the net benefit to the community will also depend on the extent to which the cost of the spectrum is passed through to consumers (amongst other factors). In classical economic theory, a firm will maximise its profits by setting its prices such that its marginal revenue equals its marginal cost. In this theoretical world, pricing decisions are independent of fixed or sunk costs, such as a spectrum licence fee. Under this construct, none of the cost of the licence fee will be passed through to the consumer³⁴.

Of course in reality firms do not price this way. As Al-Najjar, Baliga & Sandeep³⁵ have observed:

“Economic theory offers the unambiguous prescription that only marginal cost is relevant for profit-maximizing pricing decisions. On-going fixed costs or previously incurred sunk costs, although relevant for entry and exit decisions, are irrelevant for pricing. This theoretical prescription stands in stark contrast with evidence that pricing decisions of real world firms display a sunk cost bias ... [M]ost [US] firms price their products based on costing methodologies that treat fixed and sunk costs as relevant for pricing decisions. Leading textbooks on managerial and cost accounting paint a similar picture. Maher, Stickney, and Weil ... assert that, when it comes to pricing practices, “[o]verwhelmingly, companies around the globe use full costs rather than variable costs.” ... Horngren, Foster, and Datar ... another leading accounting textbook, report other surveys in which a majority of managers in the United States, the United Kingdom and Australia take fixed and sunk costs in to account in pricing.”

In practice spectrum fees may well be passed on to consumers

Thus the practical reality is that consumer prices may well be increased by the imposition of fixed costs such as licence fees. Al-Najjar, Baliga & Sandeep believe this is most likely in markets that are neither completely competitive, nor monopolies – in other words, markets that are very similar in structure to mobile markets. To the extent to which spectrum fees are passed through, they effectively become a consumer tax – a tax that will suppress demand for a service which is known to have significant economic and societal benefits, a tax that will make mobile services less affordable for the digitally disadvantaged.

Some governments are actively thinking more widely than the revenue to be gained from licence fees. For example, in Singapore, the government sought to maintain competition and encourage investment, acknowledging this would come at expense of

³² Hazlett and Munoz, “What Really Matters in Spectrum Allocation Design”, 2010,

³³ For discussions of the practical reality of capital constraints, see for instance William J. Baumol and Richard E. Quandt, “Investment and Discount Rates Under Capital Rationing--A Programming Approach,” , The Economic Journal, Vol. 75, No. 298, 1965 or Fazzari, Steven M., Petersen, Bruce C. and Hubbard, R. Glenn, “Financing Constraints and Corporate Investment,” NBER Working Paper Series, Vol. w2387, 1988

³⁴ For an exposition of this view, see for instance McMillan, J., “Why Auction the Spectrum?” Telecommunications Policy 19(3), 191-199. 1995

³⁵ Al-Najjar, Nabil I., Baliga, Sandeep and Besanko, David A, “The Sunk Cost Bias and Managerial Pricing Practices”, October 2005

licence fee revenue. In response to why the government had reduced the auction's initial reserve of S\$150m to S\$100m (in the 2001 spectrum auctions), the Minister for Communications and Information Technology Yeo Cheow Tong said:

"High 3G licence costs in some of the early European auctions have led to debt downgrades throughout the telecoms industry. As a result, many large players have lost their investment grade ratings. This will in turn lead to higher financing costs for, and may slow down, the rollout of 3G networks and services – an outcome which is not in the consumer's best interest"³⁶

This debt downgrades problem was seen by winners of the April 2000 UK 3G spectrum auction as well as those that won in the subsequent German auctions³⁷. For example, Vodafone won spectrum in both of these auctions and saw debt levels increase ten-fold between 1999 and 2001, with their Moody's Long-Term Rating falling three steps from Aa2 to A2 over this period³⁸. IDC's view is that:

"the countries that have been most successful with 3G exacted the smallest, or no, fees at all because this allows carriers to invest the money into their network"³⁹

Recommendations for best practice:

- Spectrum prices should be set conservatively to encourage investment and to ensure low prices to promote the adoption of affordable telephony services.

3.2.3 Spectrum pricing and efficiency

Economic benefit rises with the intensity at which spectrum is utilised

Our earlier discussions have highlighted that the use of spectrum provides wide economic benefits. The more intensely spectrum is used the greater the economic benefit. Spectrum pricing should seek to promote the most efficient use of spectrum. This suggests that a firm's own valuation of spectrum (possibly revealed through an auction) may not necessarily be appropriate for directly determining spectrum prices.

A firm's own view of the value of spectrum may not be appropriate for determining spectrum prices

The use of a firm's own valuation to determine spectrum prices may result in higher charges for those using spectrum intensely compared to less efficient competitors. Consider two firms with equal spectrum, but one with twice the customers of the other (say from a better product offering or greater investment in network capacity). The larger firm is making more intense use of its spectrum, and will certainly place a higher value on it than the smaller one. However, if spectrum charges reflect this, the larger firm will effectively be 'punished' for its efficiency – it would pay a higher price than its rival. This would badly distort investment incentives, and weaken price competition by imposing extra costs on the market player that might otherwise be expected to be the price leader.

This issue is recognised by some regulatory bodies. In Sweden the government announced that it would set spectrum pricing so that fees are structured to ensure that

"holders with large spectrum holdings and a low degree of deployment will pay higher fees while those with smaller amounts of bandwidth and/or high build-out will have reductions in their charges"⁴⁰.

Spectrum pricing should reward the efficient use of spectrum rather than penalise it

This is all the more relevant in developing countries where affordable access is critical to supporting development. Firms that make better use of spectrum will be better placed to offer competitive rates and will help drive the tariff down to make the service widely available. When measured using the spectrum utilisation measure of busy hour traffic per square kilometre per MHz in dense urban areas, several Indian operators are

36 ZDNet Asia, "Singapore Lowers 3G Auction Price; Telcos Give Thumbs-Up", May 2001

37 Rishabh, K. "Winners curse in 3G spectrum auctions: What is expected in India?", Towers Watson, 2010

38 Ghosh, Aggarwal, Singh and Marwaha, "3G Telephony Services: Implications for Indian Operators," ICRA, 2009

39 ZDNet Asia, "Licence Auctions Stifling Mobile Development", Sep 2009

40 Rethink Wireless, "Sweden Makes Spectrum Fees Dependant on Built Out Progress", Sep 2009

extracting around eight times more capacity than operators in the UK, Hong Kong, or Singapore⁴¹.

Recommendation for best practice:

- Spectrum pricing should encourage intense use of spectrum rather than penalise it

3.3 Types of spectrum pricing

Spectrum pricing terminology varies by country and different terms have different interpretations in different jurisdictions. For clarity we have provided our own set of definitions in relation to spectrum pricing which we will use throughout the remainder of this report.

3.3.1 Spectrum access fee

Spectrum access fees are the amount charged for assigning the right to use spectrum assets

This is the fee that a successful applicant must pay to gain access to spectrum (e.g. to obtain a spectrum right of use or to obtain a renewal of an existing GSM licence). This is the price charged by the administration to a licence holder for the grant of rights of use of spectrum.

This fee is typically determined through an administrative incentive pricing scheme or by a spectrum auction. The fee is usually a one-off amount which is charged on the granting of the licence or over a relatively short period of time in staged payments following the award.

The fee may be used to cover administrative costs incurred in the management, control and enforcement of the authorisation scheme (this may include costs for e.g. international cooperation, harmonisation and standardisation, monitoring and enforcement) but it may well also incorporate an element of operator's excess profits appropriated by the regulator to provide a return to society for the private use of a scarce, public, natural resource.

3.3.2 Spectrum auction reserve prices

Reserve prices are the minimum amount a regulator will accept to provide access to spectrum in an auction context

Reserve prices are established for use in a spectrum auction. They represent the minimum amount at which the regulator is prepared to award the spectrum. If in an auction the spectrum is sold at the reserve price then the reserve price effectively determined the spectrum access fee. Reserve prices can therefore be seen as the minimum spectrum access fee which the regulator is prepared to accept.

3.3.3 Spectrum usage fee

Spectrum usage fees are usually associated with the on-going use of spectrum

This is the fee associated with the on-going usage of the spectrum by the licensee. It is often paid on an annual basis for the duration of the licence term. In general, this fee is set out in advance of the award of the spectrum in order to allow the applicant to incorporate the on-going usage fees in their spectrum valuation.

This fee, at a minimum, is used to cover administration costs. However, spectrum usage fees may also be used to provide incentives for the efficient use of spectrum especially when an auction may not be appropriate such as in the case of spectrum renewal. A range of procedures can be adopted for setting spectrum usage fees. Where the procedure is designed to provide incentives for efficient spectrum use the approach is described as Administered Incentive Pricing or AIP.

41 An assessment of spectrum management in India, a report by Aegis and Plum a report to the GSM Association December 2008

Penalty fees are used to enforce compliance with licence conditions

3.3.4 Penalty fees

These fees are designed to incentivise the licensee to meet its spectrum licence conditions like coverage and timing of roll out and are only triggered in the event of non-compliance.

3.3.5 Spectrum pricing in practice

Regulators typically combine spectrum access fees determined through an auction, for example, with spectrum usage fees, which are determined by some form of administered procedure. In the context of an auction the spectrum usage fees must be clearly stated before the auction so that the bidders are able to reflect these fees in their valuations.

3.4 Best practice principles for spectrum pricing

Recommendations for spectrum pricing:

- Market mechanisms, such as an auction, should be used when ever possible to determine spectrum access fees. When market mechanisms are to be used to determine access fees any accompanying usage fees should be restricted to the recovery of administrative costs. Usage fees should be clearly stated prior to the auction.
- Where a market mechanism is not appropriate for the determination of spectrum access fees then some form of Administered Incentive Pricing should be used to determine spectrum usage fees to encourage the efficient use of spectrum.
- Spectrum access and usage fees should encourage investment and so should be set conservatively to ensure that spectrum is not left idle.
- Spectrum access and usage fees should not lead to higher consumer prices and so should be charged in such a way that operators will treat them as a sunk cost and they should also be set conservatively to minimise inflationary pressure on consumer tariffs. Spectrum usage fees should be flat, annual charges rather than, for example, based on a share of revenues which can generate distortions and lead to higher consumer prices.
- There should be clear separation between fees aimed at recovering the cost of spectrum management and fees to support spectrum management objectives. Such a separation not only increases transparency of the financing of spectrum management, but also encourages the regulatory body to concentrate on its objectives when designing and imposing fees.

3.5 Administered incentive pricing

3.5.1 Overview

AIP should aim to mimic the effects of market mechanisms

Administratively determined spectrum usage fees have been used by regulators to promote efficient spectrum use. Usage fees should be set in such a way that they create incentives for spectrum licensees to provide services efficiently both in productive⁴² and allocative⁴³ terms. When market mechanisms are used to determine the charges for spectrum, as in the case of auctions, efficient outcomes occurs automatically. A government regulator setting prices in an AIP context should aim to mimic the efficiency and incentive effects of market based pricing as far as practicable. Such market mimicking prices are based on the economic principle of opportunity cost.

42 Productive: Spectrum users deploy inputs (capital, labour, and spectrum) in order that services are produced at the lowest overall cost.

43 Allocative: Spectrum should be such that the right final mix of spectrum related products is being made available.

Spectrum usage fees should be determined by marginal cost

The efficient market clearing price of spectrum is equal to the opportunity cost of the marginal unit of the spectrum. Opportunity cost is defined as the highest value alternative foregone.

Most markets used subjective judgements for determining spectrum access fees

With the exception of New Zealand and the UK who have adopted AIP for spectrum usage fees, the level of usage fees in other markets have not been related to opportunity cost. Usage fees have been set based on subjective assessments and are heavily influenced by historical precedent.

The underlying principle of opportunity cost pricing is that spectrum should be priced according to the amount of spectrum denied. That implies that opportunity cost pricing differs according to the circumstances. In cases where demand exceeds supply there are alternative uses of spectrum and as such prices should be based on the highest value alternative use.

In cases where supply exceeds demand, there is unlikely to be alternative productive uses of spectrum and therefore the opportunity cost of the spectrum should be zero or negligible. In a report⁴⁴ for New Zealand the authors state,

“while this appears to be a possible scenario, it cannot be determined with certainty. In the last five years, there has been sufficient competition at auction for operators to pay more than zero. Equally market conditions may also have changed since then.”

The application of a market-based approach to spectrum management started in 1998 in UK with the introduction of AIP in bands where there was excess demand for spectrum. While this was an administrative and not a market intervention, it was used to provide financial incentives for efficient spectrum use in circumstances where licences had been assigned by administrative means (i.e. for all licences at that time). Auctions of vacant spectrum soon followed and then in 2004 spectrum trading and liberalisation started to be introduced.

Cost based measures for AIP are less subjective but uncertainty over future demand makes all approaches challenging

The key lessons from the UK and New Zealand experience in deriving opportunity cost estimates are:

- depending on the frequency band under consideration opportunity cost can be derived from valuing the cost savings from access to additional spectrum (the “least cost alternative” approach) or from the revenues that additional spectrum may generate;
- value based on cost savings rather than net revenues are much easier to implement, because less information on the future development of services is required. Uncertainty over future market developments is a major problem when estimating opportunity cost for many communications services; and
- estimates of opportunity costs are necessarily approximate and as adjustments to administratively determined prices can only be made periodically, it is necessary to consider the direction of “bias” in estimates that is likely to minimise potential economic losses.

We now present four approaches to estimating spectrum price.

44 PWC-Nzier report on, @Renewal of Spectrum Rights for Cellular Services Pricing Methodology, @ July 2006

3.5.2 Optimised deprival value

Deprival value answers the question “what is the least cost system or bundle of assets needed to provide customers with the existing level and quality of services, should a certain existing asset be removed?”

Deprival value is a cost-based valuation approach that answers the question “what is the least cost system or bundle of assets needed to provide customers with the existing level and quality of services, should a certain existing asset be removed?”

This approach can be applied to valuing spectrum rights by addressing the following: “If an operator were deprived of incremental spectrum rights, what incremental costs would be incurred to replicate the existing level and quantity of services using the remaining spectrum rights?” These costs are “avoided” by owning the incremental spectrum rights and so, in this context, represent the value of those rights. That is, the rights holder should be prepared to pay up to the value of the incremental costs to avoid being deprived of its spectrum rights, so long as the incremental costs are less than the present value of the free cash flows generated from the spectrum services.

The ways in which output might be maintained after deprival of a block of spectrum include: increasing the density of the network by building more cell sites; migrating traffic to Wi-Fi, making use of other bands and so on. The cost of the cheapest of these (or other) options represents the opportunity cost of the spectrum, or ODV.

ODV is based on an average operator as it seeks to replicate market clearing prices

ODV is based on a calculation of the deprival value of an “average” or “typical” operator⁴⁵. That is, rather than there being a separate calculation for each operator in a sector, a single calculation is made for the entire sector. This is because ODV is seeking to simulate a market price, and “in competitive markets the ‘market clearing price’ for a good or service would equal its value to the marginal or additional user”⁴⁶. In other words, it is a figure that is the same for all players in the market, regardless of the particular value they themselves put on the spectrum.

The ODV value should lie between the highest and lowest private values of the actual operators

As a consequence, the calculated value per MHz (applied to all operators) should lie between the highest and lowest private values of all the individual operators. Those making more intense use of the spectrum will have a higher private value than the average operator. Those not using the spectrum efficiently, for instance by leaving some idle, will have a lower private value – their cost of deprival will be lower than that of the average firm, since (for instance) they could lose the idle capacity with no disruption to their services.

ODV stimulates efficient use of spectrum

In theory therefore, ODV stimulates efficient use of the resource by incentivising spectrum hoarders to release it or put it to more productive use. The ODV-based spectrum charge will be higher than the value of marginal spectrum to these operators, giving them an incentive to release this marginal spectrum back to the government.

In the table below we comment on the effectiveness of ODV in relation to the international best practice objectives in relation to spectrum management:

Exhibit 13: Assessment of Optimised Deprival Value

Criterion	Comment
Promotes highest value use	Has the potential to encourage reallocation to the most efficient mobile operator
Promote innovation and investment	Sets appropriate price signals. However relatively high fees may reduce investment capacity
Promotes competition	If finely targeted, can improve chances that no operator is spectrum constrained, though in practice may have limited reallocation impact
Promotes customer convenience	If an operator faced with an ODV charge reengineers its network in order to release spectrum, costs may be imposed on customers (e.g. requirement for new handsets).

45 See NERA and Smith System Engineering (§ 3.3), “Study into the Use of Spectrum Pricing”, 1996 or “Opportunity Cost Pricing of Spectrum”, 2009, ACMA (p 13)

46 NERA and Smith System Engineering (§ 3.3), “Study into the Use of Spectrum Pricing”, 1996

Provides rate of return to the community Appropriate market price signals sent to operators, encouraging efficient outcomes. Since ODV represents an upper bound on what spectrum holders will be willing to pay, no other methodology is likely to provide materially higher fees

Source: Coleago analysis

ODV (also known as the 'Smith-NERA' or 'least cost alternative' method) is the basis of New Zealand spectrum pricing regime as well as of the UK's Administered Incentive Pricing (AIP) system. Below we provide case studies from both of these markets.

Case Study: AIP in the UK

Under the Wireless Telegraphy Act (1998), the UK regulator was permitted to reflect considerations other than cost recovery when charging fees for spectrum use. The Radio Communications Agency (an Ofcom predecessor) introduced AIP in 1999 to ensure that spectrum was "used optimally". More specifically, AIP was meant to "ration demand by means of a price" in the face of excess demand for spectrum resources. It was thought that the absence of such a regime would encourage users to "hoard [spectrum] or use it in greater quantities than if it was realistically priced".

Prices were set on the premise that "the distribution of a scarce resource, such as spectrum, will be optimised in terms of economic welfare if it is priced at its marginal value". This marginal value was estimated based on an estimate of its opportunity cost: "Where there is congestion, this cost is principally the unrealised cost savings of those who are excluded from using the spectrum" (Smith Nera originally developed this concept). Methodologies based on a licensee's revenue or profits were explicitly rejected: "these do not necessarily optimise the allocation of spectrum. The amount a user can afford to pay is not necessarily an indicator of the value of the activity to the economy, especially if radio contributes a relatively minor part of its activities."

However, both for pragmatic political reasons and because of the greater adverse consequences of setting prices too high rather than too low, actual fees were generally set at 50% of the calculated opportunity cost.

AIP is now applied to a wide range of spectrum uses in the UK, including mobile cellular, defence, science, satellite earth stations, point to point fixed links, ships' radio and many others. Ofcom recently conducted a policy review of AIP, which concluded that it had met its objectives, and contributed to the efficient allocation of spectrum.

Case Study: Incremental ODV in New Zealand

In 2007, New Zealand's Ministry of Economic Development (MED) implemented the use of the Incremental ODV approach for calculating the market value of spectrum rights. This was chosen over other approaches, notably auctions, because "given uncertainty about whether there would be new entry or not, it would be necessary to develop the inputs to [a] simulated auction." This would make the auction an "increasingly subjective and difficult exercise, typically requiring vital information about the likely attitudes and behaviour of the incumbents". An auction was also rejected because of the "complexity of the exercise and the time required for its implementation [which] were neither consistent with its objectives of a simple licensing process nor with the timetable for the renewals process".

The ODV method was therefore chosen as an economically-sound and practical way of finding the market value of spectrum, without observation. The approach simulates what would happen in a competitive market where "prices will not exceed the amount needed to cover efficient operating costs and provide a return of and return on capital invested in an optimally configured system of modern equivalent, efficient assets.

Assuming no barriers to entry, prices for services will be set by the operator with the most efficient costs (operating and capital).” ODV is therefore “an approach to quantifying efficient capital costs.”

Further to this economic reasoning MED concluded that the “incremental ODV methodology will require a relatively limited set of relatively readily available information.” The approach was therefore deemed simple to implement but with the “strong underlying logic” of a proxy for market value.

3.5.1 Best alternative use

BAUse / User considers the value placed on an additional amount of spectrum by alternative user

Best Alternative Use or User (BAU) is another method of assessing the opportunity cost associated with a particular use of spectrum⁴⁷. It is an extension to the ODV approach, bringing into consideration the highest value placed on an additional amount of spectrum by an alternative user. It is thus based on reviewing value both to an alternative technological use, and within its current use.

Aegis, in their work on aeronautical and maritime spectrum pricing for Ofcom⁴⁸, commented:

“In bands where there are competing demands for the spectrum AIP should be set at the best estimate of the opportunity cost for the band – this will generally lie between the opportunity cost in the existing use and the highest value alternative potential use.”

Thus the calculation of the BAU may require modelling of the value of the spectrum in alternate uses (if this value is likely to be material relative to its value in the current use).

Best alternative use and ODV are likely to be identical

As a general matter, adding consideration of alternate uses is clearly an improvement over a pure and simple ODV calculation. If there is a superior use for spectrum, it would lead to an inefficient result to price spectrum purely on the opportunity cost within its current use. However, in the case of mobile spectrum there is no other superior use, and so in practice the BAU figure is simply the opportunity cost within the current use. As discussed above, if this is calculated on an ODV basis, the best alternative use figure will be identical to the ODV figure. In this scenario best alternative use would have exactly the same merits and weaknesses as ODV.

Best alternative USER may promote greater efficiency

Best alternate USER however has the potential to be more effective at ‘promoting highest value use’ than ODV, since inefficient users are likely to pay a higher rate than under ODV, therefore giving greater incentives to relinquish spectrum (or change their usage). Higher spectrum charges can lead to spectrum lying idle, a very sub-optimal outcome. However, this risk is somewhat mitigated under best alternate user, since the most efficient operator is paying a price based on the value to a less efficient operator. Thus spectrum relinquished by other operators should (in theory) be attractively priced for the efficient operator. Thus the efficient operator would likely acquire this spectrum, and it would not lie idle.

As with ODV, best alternate user does not directly discourage investment, since it does not capture the returns from that investment. However, again as with ODV, it has the potential to reduce investment capacity and incentives (indeed somewhat more so, since the average fee is higher). Best alternate user is also less ‘economically pure’ than ODV, since it does not set a single market price (that should give appropriate investment signals). Instead it generates different prices for different operators.

As regards promotion of competition and customer convenience, best alternate user is broadly similar to ODV. However it is slightly more supportive of competition in that the incentives for reallocation of spectrum between operators are greater. For the same reason, it is somewhat less supportive of customer convenience, in that spectrum reallocation is a prime cause of consumer inconvenience.

47 See Indepen, Aegis & Warwick University “An economic study to review spectrum pricing,” Feb 2004, for the first discussion of this approach

48 Aegis & Indepen “Aeronautical and maritime spectrum pricing,” April 2007

The approach is computationally more demanding

Regarding 'appropriate return to the community', best alternate user is again less economically pure than ODV promoting efficient outcomes, since it is not setting a market price. However, it has the potential to raise slightly higher fees over the long term, by encouraging the shift of spectrum to more intense use.

Another important issue though not related to public policy objectives is the contention and complexity in a calculation method. This is one of the disadvantages of best alternate user. It requires three calculations of ODV rather than one, based on different networks, spectrum allocations and demand profiles. It also raises issues of confidentiality, since operator A's spectrum fee will be based on characteristics of operator B's network. Thus while the theory of best alternate user creates a legitimate case for different prices for different operators, it may be difficult to implement in practice.

In the table below we comment on the effectiveness of BAU in relation to the international best practice objectives in relation to spectrum management:

Exhibit 14: Best alternative user

Criterion	Comment
Promotes highest value use	Should encourage reallocation to the most efficient operator
Promote innovation and investment	Does not discourage investment by directly capturing returns, but not as economically pure as ODV in giving market price signals
Promotes competition	Can improve chances that no operator is spectrum constrained
Promotes customer convenience	Relatively likely to impose switching costs on customers
Provides rate of return to the community	May lead to economically sub-optimal allocations (since not pure market price based). Should provide fees close to ODV

Source: Coleago analysis

3.5.2 Benchmarking

Benchmarking is the process of setting prices against a proxy taken from another, comparable market

Benchmarking is the process of setting prices against a proxy taken from another, comparable market. In this context benchmarks could be taken against spectrum auctions and purchases, either within the country of interest or around the world (more recent and relevant benchmarks might be assumed to be closer to approximating current market value), or administrative pricing values.

Benchmarking has been incorporated in spectrum price setting in markets such as France and New Zealand, though it has been used as a sanity check or back-up rather than as a prime methodology.

Benchmarking is an essentially arbitrary process which can produce misleading results. As a consequent there is a significant risk of regulatory error

Considering benchmarking against the general public policy objectives detail is challenging, precisely because the process can lead to somewhat arbitrary results, which may lie above or below the true market value for the spectrum market in question. It can result in figures that are either above the highest private deprivation value (resulting in wasteful relinquishment of spectrum by all players) or below the lowest (so that spectrum charging has no impact on efficiency at all).

We believe that benchmarks are only appropriate as a secondary method to assess value, in supplement to a primary method such as ODV or BAU.

In the table below we comment on the effectiveness of benchmarking in relation to the international best practice objectives in relation to spectrum management:

Exhibit 15: Benchmarking for setting spectrum usage fees

Criterion	Comment
Promotes highest value use	High degree of uncertainty in adjustment of benchmarks to the case in question means results are essentially arbitrary.
Promote innovation and investment	The potential for benefits is offset by risk of significant regulatory error.
Promotes competition	Benchmarking on local trading results has the disadvantage of distorting that market (high prices now may set precedents for high prices later), potentially reducing spectrum receipts.
Promotes customer convenience	
Provides rate of return to the community	If benchmarks are based on private value, this effectively punishes the most efficient operators.

Source: Coleago analysis

3.5.3 Enterprise valuation

An enterprise valuation approach seeks to price spectrum based on the future cash flows that are made possible by holding the spectrum.

An enterprise valuation approach seeks to price spectrum based on the future cash flows that are made possible by holding the spectrum. The cash flow to the owner can arise from either using the asset or trading it, but in the long term, value will be a function of cash flow from utilisation.

An enterprise valuation would involve valuing the business of a generic or hypothetical mobile operator, and extracting a valuation of the value of the spectrum rights. As identified by New Zealand Ministry of Economic Development, this calculation can be undertaken through a number of approaches⁴⁹:

- A simplified approach. This involves developing a proxy for net cash flow. This is used to forecast future cash flows that are discounted to a present value.
- Full earnings valuation. A full discounted cash flow analysis, involving development of detailed financial projections and an assessment of risk.
- The Covec formula approach. Similar in approach, but with a proxy for growth in cash flow applied to the original auction price.
- Disaggregating market capitalisation: Attempting to split the evidenced value of a business (derived from its market capitalisation) into its component parts

Enterprise valuation can create significant disincentives to dynamic competition

Enterprise valuations fair very poorly against the general public policy objectives criteria. By capturing the benefits of more intense use of spectrum, they actually discourage the highest value use, and provide a disincentive to investment – why invest in equipment to expand the capacity of a given tranche of spectrum, if all the extra profit is simply clawed back through a spectrum fee? Since the profit motive is one of the key drivers of competition, and an enterprise valuation methodology severely mutes this motive, competition is likely to suffer also. For all the reasons above, enterprise valuations are inimical to economically efficient outcomes, and so will not provide a good return to the community (though may, in the short term, lead to higher fees).

In the table below we comment on the effectiveness of enterprise valuation in relation to the international best practice objectives in relation to spectrum management:

⁴⁹ PWC, Nzier “Methodology for pricing the renewal of spectrum rights for cellular services,” Chapter 5 Potential Valuation Approaches, 2006

Exhibit 16: Enterprise value for setting spectrum usage fees

Criterion	Comment
Promotes highest value use	Does not do so, since lower value uses will attract lower fees
Promote innovation and investment	Creates substantial disincentives to investment
Promotes competition	By 'punishing' larger firms, may reduce the likelihood of a single dominant player, but generally creates disincentives to dynamic competition
Promotes customer convenience	n/a
Provides rate of return to the community	Can provide high fees in the short term, but over time will drive substantial value out of the market

Source: Coleago analysis

3.5.4 Conclusions

ODV and best alternative user represent credible alternatives to auctions

Given the above analysis, we believe that Optimal Deprival Value and Best Alternate User are both credible alternative methodologies when market based mechanisms such as auctions are not appropriate. The use of ODV enjoys greater international precedent however. As one of the regulators has noted:

*"There is a relatively broad acceptance amongst spectrum economists that, in principle, [opportunity cost] is the most appropriate basis for pricing administratively allocated spectrum when the regulator is seeking to promote an efficient allocation of spectrum and circumstances are such that market mechanisms may not create sufficient incentives"*⁵⁰

As of 2010, relatively few countries are seeking to do more than recover administration costs from spectrum fees. However, there is a clear trend to imposing fees designed to encourage the optimal use of spectrum - almost all European countries surveyed by the EU's Radio Spectrum Policy Group for example, noted that their spectrum management policies either aimed to ensure that prices reflect 'economic value' or otherwise create incentives for more efficient usage.⁵¹

In a number of countries charging fees, these are set on a 'judgmental' basis. However, amongst those taking an analytical approach, opportunity cost is the clearly preferred method. The UK, Netherlands, New Zealand and Turkey already use opportunity cost based methods of allocation whilst Malta is planning the introduction of ODV.

Exhibit 17: Use of AIP approaches^{52,53,54}

Opportunity cost	Earnings valuation	Judgmental
Malta ⁵⁵ (ODV)	Slovakia	Bahrain
Netherlands (ODV)		Canada
New Zealand (ODV)		France
Turkey (unclear)		Ireland
United Kingdom (ODV)		Italy

50 ACMA, "The ACMA response to public submissions: Opportunity cost pricing of spectrum", 2010

51 Radio Spectrum Policy Group, "Radio Spectrum Policy Group Report on Assignment and Pricing Methods", 2009

52 Radio Spectrum Policy Group, "Radio Spectrum Policy Group Report on Assignment and Pricing Methods", 2009,

53 Plum, "Administrative Incentive Pricing of Radiofrequency Spectrum", 2008

54 MCA, "Strategic Framework for the Management of Radio Spectrum 2007-2010", 2008

55 Proposed AIP regime to be based on opportunity cost/ ODV pricing

Opportunity cost	Earnings valuation	Judgmental
		Japan
		Sweden

Source: Coleago analysis

3.6 Spectrum pricing implementation issues

In this section we address the detailed implementation issues of the spectrum fees. The approach to these issues has been informed by experience in Europe and in particular the UK⁵⁶. Timing of payments

3.6.1 Timing options for spectrum access fee payments

There are a number of options in relation to the timing of the payments of spectrum access fees. Choosing the appropriate option will require the consideration of a number of factors including when the spectrum becomes available (which may be a number of years after the award of the licence as in India), the risk of gaming strategies by operators and the current financial climate in which raising significant levels of finance may be challenging.

Options for spectrum access fees include:

- A single upfront payment immediately;
- A single upfront payment when the spectrum becomes available; and
- An upfront payment and a series of annual payments (the timings may also vary if they are linked to when the spectrum becomes available).

We believe that an immediate and material upfront payment is essential to avoid the risk of spoiler bids or default. An operator could bid for and win the spectrum which would prevent another operator from being able to develop their strategy and plans based on the rights to additional spectrum. If there is no immediate upfront payment the operator could return the licence prior to having to pay the deferred upfront fee which would result in unutilised spectrum and require the regulator to conduct another auction which would be disruptive to the market and costly to administer as well as creating non co-terminus licence end dates. The same outcome could occur as a result of default on the part of the operator due to financial difficulties, for example. This consideration alone is sufficient to justify an immediate and material upfront payment.

When considering the option to defer a proportion of the fees it should be noted that in the presence of perfect capital markets the deferral of all or part of the access fee should have a relatively low impact as all cash flows are considered at a single point in time through discounted cash flow analysis. Any deferrals will result in higher valuations by potential bidders which will only lead to higher auction results (and therefore a higher upfront fee). Still, offering a (partial) deferral of the upfront access fee may be attractive to some (mainly new) investors having difficulties in securing such finance in the current capital markets.

In order provide some phasing of the potentially large monies that must be paid as a result of the auction the regulator could offer as an alternative to the single upfront payment a significant upfront payment combined with a subsequent series of payments but with an interest rate which is close to the cost of capital of the operators. It should be noted in selecting an interest rate close or equal to the cost of capital of operators the deferred payments will effectively be indexed as the use of a nominal cost of capital includes an effective indexation element as expected returns are considered in nominal terms.

Multiple factors should be considered for the timing of spectrum access fee payments

We believe that an immediate and material upfront payment is essential to avoid the risk of spoiler bids or default

Deferrals can benefit new entrants and those with capital constraints

⁵⁶ Policy evaluation report: AIP, Ofcom, July 2009

Best practice recommendations include:

- a single and immediate upfront payment of the spectrum access fee; or
- at least 50% of the auction price paid immediately as an upfront payment and the balance paid over 3 to 5 years but subject to a rate of interest which is unattractive and close or equal to the operators cost of capital.

3.6.2 Timing options for spectrum usage fee payments

Fees could be waived during early years to support roll-out

In relation to spectrum usage fees the main options include annual spectrum usage fees to be paid fully each year versus waiving or reducing the fees during the initial rollout years in the case of new entrants or new technologies. Another option would be to reduce fees initially but to recoup the forgone monies with higher fees at a later stage.

Once again, in theory, with perfect capital markets, the timing of these payments is irrelevant as any timing benefits will simply be reflected in the spectrum valuations to all bidders which will then be re-captured, in part, through the auction process. However, in the case of new entrants access to capital may be limited particularly in the current economic environment.

The approach could be discriminatory

One problem with this approach is that it would appear to be a reasonable option for a new operator but much less justified for some of the existing operators. Ideally then the reduction should only be offered to new operators (or a sub-set of potential operators) but this could be considered to be discriminatory, particularly if the reduction is not recouped at a later date. Thus, if the reduction or waiving of fees is only provided to a new entrant it may be necessary to recoup the forgone fees later in order to avoid concerns of discrimination.

However, there is a further potential concern with waiving or reducing fees. In the first two to three years this policy will primarily assist operators in rolling out their networks to urban areas (those covered in the first two to three years) but will not provide assistance thereafter. Coverage and roll-out requirements will mean that operators are obliged to roll out their networks to rural areas but the financial means to achieve such a roll-out may not be supplemented by reduced fees.

Given the complexity and potentially discriminatory nature of phased fees our recommendation is for a constant, annual fee.

Best practice recommendations include:

- Annual usage fees to be paid in full each year.

3.6.3 Indexation and review of annual spectrum fees

Spectrum usage fees are static, i.e. they are not adjusted by inflation in many countries and indexed in some like Hong Kong, Singapore. The main advantages of indexation are:

- Linking fees with overall economic development (assuming that telecommunications cash flows are correlated with price trends) may result in a perceived reduction in uncertainty leading to higher spectrum valuations; and
- Protects the value of the spectrum usage fees in real terms to the government.

However, there are also disadvantages, mainly:

- Adding an (uncertain) set of future inflation indices to the business cases of potential bidders will increase the uncertainty of these business cases, thus reducing the expected spectrum valuations prior to the auction. Based on our extensive experience of valuing spectrum for operators the inclusion of an indexation element will be deemed to increase uncertainty and decrease cash flows and therefore spectrum valuations as the cost of spectrum usage fees will be

higher than if it were not indexed but operators will not adjust their discount rates to reflect the arguably lower perceived risk;

- Adding complexity to licence conditions (e.g. by defining the timeframes and key dates for setting appropriate applicable indices); and
- Adding complexity to overall licence administration.

We believe that the only effective benefit of indexation would be to protect the value of spectrum usage fees to the government in real terms. However the same outcome could be achieved by simply setting an equivalent (in present value terms) higher, constant spectrum usage fee. The increased uncertainty and administrative burden of indexation and a simple and straightforward alternative for achieving the same end leads us to recommend that indexation is not included.

Best practice recommendations include:

- Spectrum usage fees should not be indexed.

3.7 Survey of spectrum renewal pricing

As of 2010 very few countries, if any, have renewed 2G spectrum on a restricted use basis. With the exception of Pakistan most countries have not sought to extract significant fees from the process of renewal. The price of renewal in Pakistan was based on the outcome of an earlier auction for two new licences.

Exhibit 18: Spectrum renewal benchmarks

Country	Details	Spectrum allocated	Fee US\$	Fee US\$ per paired MHz
Denmark	In 2010, 900 MHz and 1800 MHz licences were renewed without any renewal fee and material changes in license	95MHz	zero	zero
France	In 2005 Arcep renewed each operator's 900 MHz spectrum licence for a further 15 years under technology neutral terms for Euros 25 million per operator plus 1% of annual GSM service revenues.	35MHz	90 m	2.6 m
Hungary	Extension of license for 7.5 years for fee of HUF 10 billion and commitment to net HUF 20 billion in capital investment for next 2 years	8MHz	49 m	6.2 m
Norway	At the end of 2004 the Minister announced that both would be offered license renewals for a lump sum fee of NOK 100 million (USD 17.4 million) and an annual fee of NOK 9.6 million (USD 1.7m). However, it was also announced that if any other party also expressed interest, then an auction would be held with the reserve price set at NOK 100 million. No third party expressed interest, thus, Telenor and Netcom received licenses renewal at the stated terms	9.6MHz	15 m	1.6 m
Pakistan	License renewal fee of USD 291m determined by open auction of 2 new licenses for 15 years.	13.6MHz	291 m	21.4 m
Singapore	License renewal fee determined by auction – 30 MHz in the 900 frequency band and 60 MHz in the 1800 frequency band at the reserve price.	90MHz	5 m	0.1 m
Sri Lanka	Celltel Lanka's initial license was issued in September 1995 for 13 years. Renewed in September 2008 through an administrative process for 10 years.	13.5MHz	5 m	0.4 m

Source: Regulator websites, press and operator websites

The UK is currently consulting on spectrum renewal and its current proposals are to link the spectrum usage fees of renewed 900MHz and 1800MHz spectrum to the prices

derived in an auction for 800MHz and 2.6GHz spectrum. The proposals are not particularly clear and are likely to be challenged by the operators.

3.8 Survey of spectrum usage fee pricing benchmarks

3.8.1 Spectrum usage fees in different EU countries

In this section we present benchmarks of spectrum usage fees for 900MHz, 1800MHz and 2100MHz frequency bands in select EU countries.

Exhibit 19: Spectrum Usage Fees in 900MHz for selected EU countries

	Usage fee per year per MHz (EUR)	Comment	Population (million)	Eurocent/ MHz/ pop /year
Ireland	63,488		4.4	1.44
Spain	774,245	2008 figure.	45.2	1.71
		Basis: 1% of revenues generated from spectrum usage.		
		For spectrum awarded/renewed after		
France	534,000 (estimate)	2005.	62	2.42 (estimate)
Belgium	77,250	2007 figure.	10.7	0.72
		Twice as much for spectrum exceeding		
Portugal	120,000	35MHz.	10.7	1.12
Netherlands	None	All fees upfront	16.7	0.0
Cyprus	None	All fees upfront	0.8	0.0
Denmark	7,575	2010 figure	5.5	0.14
		2010 figure, subject to		
Sweden	5,563	NRA board approval	9.2	0.06
		The first 15MHz are not		
		charged for. Fee per		
Italy	1,443,234	MHz exceeding 15MHz.	58.9	1.23
Finland	18,241		5.3	0.34

Source: Regulatory websites and interviews

Most EU countries have low or no spectrum usage fees

A review of the benchmarks for 900MHz spectrum reveals that most countries have either low or no annual spectrum usage fees. In the countries where no or very low usage fees are recorded the value of the spectrum is captured by the award process, be it an auction or administered pricing with a defined payment level, upfront and in a single payment.

Few countries have high spectrum usage fees. The Spanish figure partly reflects the relative failure of the Spanish 3G spectrum auction which took place in the aftermath of the Dot Com crash. In order to capture a reasonable share of the value of the spectrum the regulatory authority set a high level of spectrum usage fees to compensate for the low valuations achieved in the auction process.

France represents a special case as it is the only Euro country which bases the spectrum usage fees on a proportion of revenue. Our benchmark is an estimate based on reported revenues in the operators' company accounts. Italy also provides a high benchmark but it is important to note that no charge is made for the first 15MHz of spectrum.

Exhibit 20: Spectrum Usage Fees in 1800MHz for selected EU countries

	Usage fee per year per MHz (EUR)	Comment	Population (million)	Eurocent/MHz/ pop /year
Ireland	47,615		4.4	1.08
Spain	619,648	2008 figure.	45.2	1.37
France	285,500 (estimate)	Basis: 1% of revenues generated from spectrum usage. For spectrum awarded/renewed after 2005.	62	2.05 (estimate)
Belgium	77,250	2007 figure.	10.7	0.72
Portugal	120,000	Twice as much for spectrum exceeding 35MHz.	10.7	1.12
Netherlands	None	All fees upfront	16.7	0.0
Cyprus	None	All fees upfront	0.8	0.0
Denmark	7,575	2010 figure	5.5	0.14
Sweden	5,563	2010 figure, subject to NRA board approval	9.2	0.06
Italy	1,443,234	The first 15MHz are not charged for. Fee per MHz exceeding 15MHz.	58.9	1.23
Finland	13,680		5.3	0.26

Source: Regulator websites and interviews

There is not a significant difference between 900MHz and 1800MHz spectrum usage fees

A review of the benchmarks for 1800MHz spectrum reveals a similar pattern in terms of levels. It is also relevant to note that there is not a significant difference between the spectrum usage fees for 900MHz and 1800MHz bands.

Exhibit 21: Spectrum Usage Fees in 2100MHz for selected EU countries

	Usage fee per year per MHz (EUR)	Comment	Population (million)	Eurocent/MHz/ pop /year
Ireland	74,068		4.4	1.44
Spain	774,135	2008 figure.	45.2	1.71
France	1% of revenue generated by spectrum use.	Basis: 1% of revenues generated from spectrum usage. Upfront fee: 24 million EUR per MHz for 20 years licence term	62	1.61 (estimate)
Belgium	72,200	2007 figure.	10.7	0.67
Portugal	120,000	Twice as much for spectrum exceeding 35MHz.	10.7	1.12
Netherlands	None	All fees upfront	16.7	0.0
Cyprus	None	All fees upfront	0.8	0.0
Denmark	7,575	2010 figure	5.5	0.14
Sweden	2,596	2010 figure, subject to NRA board approval	9.2	0.03

	Usage fee per year per MHz (EUR)	Comment	Population (million)	Eurocent/ MHz/ pop /year
Italy	1,443,234	The first 15MHz are not charged for. Fee per MHz exceeding 15MHz.	58.9	1.23
Finland	13,680		5.3	0.26

Source: Regulator websites and interviews

The conclusions drawn from 900 and 1800 MHz benchmarks are reinforced by the benchmarks from 2100MHz.

3.8.2 Main observations from benchmarking

Below we summarise the main conclusions from our benchmarking study:

- The greatest proportion of total spectrum fees is set through an auction mechanism or, in the past, through judgement and these are paid upfront in the form of a spectrum access fee.
- Most benchmarked countries have relatively low or no annual usage fees although Spain, France and Portugal do provide precedents for higher spectrum usage fees.
- Most countries have only a small or no difference in the level of annual fees across different spectrum bands. However, spectrum access fees generated through auctions reveal a much higher degree of variation.

3.9 Spectrum auction reserves

The reserve price is the amount a bidder needs to pay as spectrum access fee even if there is no competition. In pursuing efficient allocation and use of spectrum, there are a number of issues to be considered when setting a reserve price:

- the price should not be set so high as to deter serious bidders;
- the price should not be set so low that there is participation by frivolous bidders;
- the price should at the least recover the administrative costs of running the auction;
- the price should be such that collusion incentives can be controlled; and
- the price should be high enough to promote economic efficiency if it is likely that demand may not exceed supply.

There are potentially three approaches to estimate a non trivial reserve price and one or more of the approaches listed below have been used in the auctions held so far:

- from comparable auctions that can serve as a benchmark; however, historical data may not be relevant when technology and economic conditions are changing;
- through a modelling exercise based on one of the methods suggested in the administrative incentive pricing section; and
- by assessing the cost of administering the spectrum management function.

3.9.1 Spectrum renewal auction reserve prices

Singapore provides the only example of a reserve price for spectrum renewed through auction

Singapore provides the only benchmark at the time of writing for the auction of existing spectrum holdings. The 2G 900MHz and 1800MHz spectrum was renewed in 2010 and the reserve was set at the equivalent of US\$0.005 / MHz / Pop. The auction was for the incumbents' existing 900MHz and 1800MHz spectrum. Singapore is a three player market and only the three incumbents sought to participate in the auction and as

demand did not exceed supply the auction did not take place and the spectrum was sold at the reserve price.

3.9.2 New spectrum auction reserve prices

Historically regulators have set low reserves

To date the approach adopted by most regulators has been to set low reserve prices thereby reducing the risk of spectrum lots going unsold. The notable exceptions have been Hong Kong, India (Metros and Category A) and the proposed Irish and Swiss auctions. In Hong Kong (2.6GHz TDD & FDD) despite a very competitive market (five incumbent bidders) the TDD spectrum remained unsold.

A trend may be emerging towards setting higher reserves to

The Swiss and Irish auctions may suggest that regulators are changing their approach from setting low to high reserve prices. In consultations that have been published the regulators have argued that they expect low levels of competition in the auction and so in order to extract a “reasonable return for society” or “to reflect market values of spectrum” the reserves have been set at relatively high levels compared to historic precedents.

Benchmarking has been used to set reserves in the Irish consultation

In Ireland the proposed reserve prices have been based on a benchmark study on historical data carried out by the economic consultancy, Dot Econ. Our view is using such historic data to derive potential reserve prices is very questionable especially as the underlying data often includes the results of 3G auctions which took place at the height of the Dot Com boom and are now more than 10 years out of date. The methodology used to calculate the Swiss reserve prices has not been disclosed. The delayed Thai 3G auction also saw a proposed approach based on high reserve prices.

The table below provides a summary of the reserve price and the auction results for some recently concluded auctions.

Exhibit 22: Reserve prices for auctions of new spectrum

Country \$/MHz/Pop	800	900	1800	1900	2.1	2.6 FDD	2.6 TDD
Norway						0.004	0.004
New Zealand						0.002	0.002
Singapore						0.003	0.003
Sweden						0.004	0.004
Hong Kong						0.112	0.112
Netherlands						0.001	0.001
Denmark						0.003	0.003
Germany	0.004		0.004	0.004	0.004	0.004	0.004
Austria						0.006	0.006
Finland						0.004	0.004
India (Mumbai & Delhi)					0.4-0.5		
Ireland (proposed)	0.760	0.760	0.381				
Switzerland (proposed)	0.315	0.315	0.123	0.123	0.123	0.123	0.123

Source: Regulator websites and consultation documents

4. Lessons and recommendations for Bangladesh

4.1 Current status of the renewal process in Bangladesh

The 15 year licences of four mobile operators, Grameenphone, Banglalink, Robi and Citycell are due to expire in November 2011. The remaining two other mobile operators, state owned Teletalk and Airtel, were issued licence in 2004 and 2005 are not up for renewal until 2019 and 2020 respectively.

The regulator, Bangladesh Telecommunication Regulatory Commission (BTRC), prepared “draft regulatory and licensing guidelines for issuing renewal license” following which, on 19th January 2011, the licensing authority, the Ministry of Posts and Communications, invited the mobile operators and other stakeholders including the public to provide comments by 9th February, 2011⁵⁷. We are not aware of any consultation prior to the drafting of the guidelines.

According to press reports published by The Daily Star on the 5th May 2011 the ministry has indicated it plans to reduce the spectrum renewal fees from the originally proposed levels and to charge the same fees to all operators. The proposed fee is BDT 1.50 billion per MHz.

In the next section we provide a summary of the official guidelines published on the 19th January 2011 before analysing the proposed licence renewal process in the light of the best practices discussed in this document.

4.2 Summary of the Bangladesh spectrum renewal process

4.2.1 Spectrum related conditions

Spectrum Re-farming: “The Commission will implement the spectrum re-farming policy in the future when required for spectrum harmonization as per the recommendations of ITU and the Licensee shall abide by the decision of the Commission. Re-farming will be allowed after publishing necessary guidelines and required consultation.”

Neutrality-technology: “The Commission will publish Guidelines on technology neutral services which will be applicable to operators.”

Spectrum Obligation: “The licensee will be allowed to provide service with this spectrum according to the conditions of the cellular mobile licensee.”

Spectrum for 3G and migration from 2G to 3G: “The Licensee may be allowed to migrate/convert from 2G network to 3G network with the same existing access frequency and for such migration, a migration/conversion fee shall be charged on the Licensee by the Commission.” “... spectrum in the 3G Bands of 2100 MHz will be made available for auction.”

Spectrum trading: “The Commission may publish detailed Guidelines on Spectrum Trading which will allow operators to trade spectrum between among them selves.” (sic)

4.2.2 Duration and coverage

Duration: “initially be for a term of 15 years; upon expiry of the 1st renewal term, the license may be renewed for subsequent terms, each of 5 years in duration subject to the approval from the Commission, payment of necessary fees and charges, and to

⁵⁷ BTRC and Bangladesh MOPT website

such terms & conditions, as may be specified herein and/or by the Commission under the Act in the time of each renewal.”

Coverage Roll out Obligation: “The Licensee shall undertake to achieve the targets of the Roll Out Plan and any other plan for providing GSM/CDMA Cellular Mobile Telecommunication Services to the subscribers of both the urban and rural areas equally.”

4.2.3 Infrastructure, technology, services

Infrastructure Equipment purchase: “The licensee shall not import/purchase any telecommunication/radio equipment for their network without taking prior permission of the Commission.”

Infrastructure and facility sharing: “The Licensee will only be allowed to build their own network when no existing infrastructure is available which shall be shared with other operators. The pricing for sharing infrastructure (including backbone) shall be as per Infrastructure Sharing Guidelines of the Commission. Unless expressly exempted, the Licensee shall be bound to obtain necessary permissions/Permits under Section 40 of the Act for sharing of any of its installations or systems or any apparatus, infrastructure or facilities by which Cellular Mobile Services can be provided.”

Separation of access and transmission: “The licensee shall not engage in reselling its own transmission capacity to the market as other infrastructure licensee(s) are present in the market.”

Green technology requirement: “The Licensee shall use green technology (e.g renewable energy etc.) in their systems. The Licensee shall ensure the use of the green technology in at least 20% (twenty percent) of its BTS within 5 (five) years after the date of the issuance of the renewal license.”

NGN technology: “Licensees will be expected to introduce NGN technologies to their networks as quickly as possible.”

Mobile number portability: “The Licensee shall implement number portability...”

MVNO: “A detailed framework or guidelines for which will be prepared by the Commission within a short time. After issuing the said guidelines by the Commission, all Licensees will be permitted to support MVNO services.”

Revenue share for International calls: “Specified in licencing agreement”

Quality of Service: “The Licensee shall achieve the QoS standards as set out by the International Telecommunication Union (ITU) and also by the Commission from time to time and maintain records of the same.”

4.2.4 Financing related

IPO: “Each Licensee shall float at least 30% (thirty percent) of its share to Initial Public Offer (IPO) within two years from the date of awarding the Renewal of their Licenses.”

Prior approval for debt: “The Licensee shall take prior written permission of the Commission to take any loan.”

Pledging licence: “This License shall not be assigned or pledged as security.”

4.2.5 Competition and corporate

Significant Market Power (SMP): “BTRC will incorporate provisions of anti-competitive practices in the licenses for SMP.”

Corporate social responsibility: “The Licensee shall have the obligation to corporate social responsibilities as decided by the Commission from time to time.”

Employment regulation: “The Licensees shall make a uniform HR/Employment Services Regulation which must be submitted to the Commission before awarding the Renewal License. In this regard, the Commission may give direction to the Licensee from time to time which shall be binding to the licensee.”

4.2.6 Licensing framework

Unified licencing and migration: “The Commission has taken initiative to issue unified license. The regulations and guidelines which will be approved by the Commission in this respect shall be binding to the existing Licensees.”

Prior approval for VAS: “The Licensee is authorized to provide the following services through its own network of Cellular Mobile system: (d) Value Added Services (VAS) (as and when approved by the Commission).”

4.2.7 Access spectrum pricing

Application fee:	BDT 50,000 payable in full
Assignment fee	BDT 1500 Mn (1800 MHz and 800 MHz CDMA) BDT 3000 Mn (900 MHz) payable in full

The above assignment fees shall be multiplied by a utilization factors specific to an operator and the total amount shall be applicable for the respective operators.

Annual spectrum fee is the product of a unit rate of BDT 70 and multiplicative factors, one each for the spectrum band, bandwidth, subscriber numbers and area factor. The fees are payable quarterly.

Operating Licence fee:

Application fee:	BDT 100,000 payable in full
Renewal fee:	BDT 100 Mn payable in full
Annual fee:	BDT 50 Mn payable in full
Annual revenue share:	5.5% of gross revenue payable quarterly
Annual revenue share fee –USO:	1.5% of gross revenue payable quarterly

Social obligation Fund: “The Licensee shall have obligation to contribute in social obligation fund as decided by the Commission according to the Act.”

4.3 Comparison with best practice for non-price related conditions

4.3.1 Administrative approach

The BTRC has adopted an administrative approach to spectrum renewal rather than using a market based mechanism such as an auction. As we have noted an auction is not always appropriate in the case of spectrum renewal given the high likelihood of the spectrum being won by the incumbents and possibly at or close to the auction reserve prices.

The use of an administered approach is consistent with best practice provided that the process is conducted in a fair and transparent manner and accords with the other aspects elements of best practice. There are some aspects of the renewal process being conducted by the BTRC which do not accord with best practice, especially in relation to spectrum pricing, and there may be concerns over the transparency and fairness of other elements of the process.

The use of an auction may increase investor confidence and encourage additional investment

The use of an auction with appropriately determined reserve prices may offer a more transparent process and less subjectivity which may increase investor confidence and encourage continued investment in Bangladesh.

Renewal in favour of the incumbents is the appropriate policy

4.3.2 Presumption of renewal in favour of the incumbents

Our understanding of the BTRC proposals is that Bangladesh has as established a presumption of renewal in favour of incumbents who have not breached any of their licence conditions. The mobile licences that are scheduled to expire in November 2011 and subject to annual renewal by BRTC thereafter upon fulfilment of terms and conditions specified in the licence agreement⁵⁸. This policy makes eminent sense for Bangladesh where the continuity of mobile service, which is a source of livelihood to millions and is well recognised globally as a sector that has contributed significantly to the countries development, is important. Furthermore, investments in the sector are by nature long term and capital intensive, hence predictability in the licence tenure is of utmost importance to secure investment into the sector and for a successful IPO.

It is important to consider whether the process of spectrum renewal should be used to promote increased competition

4.3.3 Promoting competition

An important issue to consider is the current level competition within the Bangladesh mobile sector and whether the government should seek to use the process of spectrum renewal to promote increased levels of competition. This may be achieved through a re-distribution of existing spectrum holdings and / or through the encouragement of new market entry.

The competitive framework section of the Bangladesh Telecom Policy states,

“the approach is to encourage a sound and orderly competition between the private and public sector as well as among the various private sector operators themselves to achieve efficient and quality service concentrating initially on the value- added services⁵⁹. However, the Government retains the sole authority to determine the number of competitors that are economically viable for certain services. The strategy is to provide equal and rational opportunities to all competitors⁶⁰.”

In exercising the sole authority the government has chosen not to encourage new entrants. We now look at the merits of the decision. Currently Bangladesh is a six player market. The table below provides details of the operators, their market share and spectrum holdings.

Exhibit 23: Mobile operators in Bangladesh

	Subscribers Millions	Market Share	800MHz	900MHz	1800MHz
Pacific	1.87	2.8%	8.8	-	-
Grameenphone	28.84	43.4%	-	7.4	14.6
Orascom	18.84	28.3%	-	5.0	10.0
Axiata	12.06	18.1%	-	7.4	7.4
Teletalk	1.20	1.81%	-	5.2	10.0
Airtel	3.80	5.70%	-	5.0	10.0

Source: Operator website and annual accounts

Bangladesh does not appear to have set any criteria for determining significant market power (SMP). Grameenphone is the market leader with over 40% of the market in terms of subscriber numbers. Orascom and Axiata together have over 45% share of customers and with three other players we believe the market is competitive. Even if concerns were raised over the degree of competition in the market place or the dominance of Grameenphone this cannot be accounted for in terms of spectrum holdings. Whilst Grameenphone holds the greatest amount of spectrum its holding in the key sub 1 GHz band is the same as Axiata and the other players all have sufficient

⁵⁸ Grameen Phone, IPO prospectus

⁵⁹ Mobile service was considered as a value added service at the time of issuing the telecom policy document in 1998

⁶⁰ Bangladesh National Telecommunications Policy 1998.

holdings in either 900MHz or 1800MHz bands to ensure that spectrum does not provide any player with a source of competitive advantage.

Information on revenues is not publicly available as only one of the operators is quoted. Other than India, most countries do not have more than five mobile operators and more normally three or four. Subject to additional available spectrum it is doubtful whether the level of competition in Bangladesh can be meaningfully increased by either increasing the number of operators or re-distributing existing spectrum holdings.

The decision not to promote new market entry is the right one

Furthermore, there is no domestic or foreign investment restrictions in the sector and the share holdings in several of the operators have changed hands with the entry of the likes of Orascom, Docomo and Bharti demonstrating that there is opportunity for new players to enter the market by acquisition. Therefore, the decision to limit new entrants for 2G licences is reasonable in our judgement.

4.3.4 Spectrum planning and technology neutrality:

The time of licence renewal is an opportune time for regulators to review the spectrum planning and align spectrum policy and use in line with international developments. The best practice in this area as outlined in section 0 is a policy of technology neutrality and a starting point for this is allowing 3G services in 2G bands.

The draft licence guidelines restrict the spectrum use to legacy GSM and CDMA technologies. However, the government has taken a forward looking approach by articulating in the guidelines:

- *“the Commission will publish Guidelines on technology neutral services which will be applicable to operators”*
- *“the Licensee may be allowed to migrate/convert from 2G network to 3G network with the same existing access frequency”*

We believe that allowing 3G in 2G bands will further enable Bangladesh to unleash the possibilities of higher speed data services, more innovative mobile applications and propel the country towards accomplishing the goals of the government set out in the policy documents *Government Vision 2021*⁶¹ and *Digital Bangladesh*⁶².

Spectrum should be awarded on the basis of full technology neutrality

Further, as outlined in section 0 the regulator should go a step further, in line with international best practice and consider awarding spectrum on the basis of full technology neutrality and initiate spectrum re-farming to support the introduction of 3G and eventually LTE networks in the 2G bands. This should apply to both the GSM and CDMA bands which will also remove any notion of discrimination to GSM operators arising from CDMA operators offering EVDO services on their current licence which in some quarters is seen as a 3G offering.

4.3.5 Consultation on spectrum management for migration from 2G to 3G

The government has also shown foresight by outlining their thinking on the allocation of spectrum in other bands for 3G and re-farming of existing spectrum. The guideline states that

- *“spectrum in the 3G Bands of 2100 MHz will be made available for auction”*
- *“re-farming will be allowed after publishing necessary guidelines and required consultation.”*

The regulator must now initiate a consultation process to assess the 2G spectrum availability, rationalise existing frequency allocations and plan a migration strategy according to the principles of best practice in spectrum management discussed in section 0.

⁶¹ <http://boi.gov.bd/about-bangladesh/government-and-policies/government-vision-2021>

⁶² <http://boi.gov.bd/about-bangladesh/government-and-policies/digital-bangladesh-overview>

A national spectrum plan should be introduced to address spectrum fragmentation

The exercise should cover the entire holdings of 2G spectrum and should not be limited to spectrum that is due for renewal. The existing frequency allocation for the 2G licensees is currently fragmented. For instance, some of the existing GSM licensees occupy 2x7.4 MHz and the CDMA licensee occupies 2x8.8 MHz while 3G and newer technologies make use of carriers with bandwidth in multiples of 2x5 MHz. The BTRC through a consultative process must arrive at a channel plan, interference migration techniques and a migration process from 2G to 3G to avoid any adverse impacts to the customers as the industry readies itself to deploy new technologies. The consultation process should be initiated well in advance of the spectrum allocation date and provide enough time for the stakeholders to respond to the issues rose.

The BTRC should seek to separate the licensing of services from spectrum

4.3.6 Separation of spectrum and operator licence

The draft guidelines and licence agreement relates to both the operations of the network and services and use of spectrum. We noted in section 0 that the current trend is to separate operating and spectrum licensing. Since the government has taken a step in the right direction by announcing that it is working towards introducing technology neutrality for spectrum allocation and is also considering spectrum trading we believe separation of the licences can pave the way for spectrum trading.

Current licence conditions are contrary to the spirit of unified licensing

4.3.7 Unified licensing

The regulator has to be commended for announcing in the guidelines that is taking steps to evolve the operating licensing regime towards a unified licence model.

“the Commission has taken initiative to issue unified license. The regulations and guidelines which will be approved by the Commission in this respect shall be binding to the existing Licensees”

However, in this process it should ensure that clauses in the present guidelines that go against the spirit of unified licence should be addressed. For example, there are clauses that make a distinction between access and transmission, clauses that restrict the use of technology and offering of value added services that are not in line with the spirit of unified licences. As outlined in section 0 on best practices in licensing framework, Bangladesh can “future proof” the licences to take full advantage of the full benefits from developments in technology, business models and services that are specifically evolving for developing countries in the areas of e-governance, e-health, e-education, e-inclusion etc.

Licence conditions should be applied to all operators including those who are not yet subject to the renewal process

4.3.8 Homogeneity of licence conditions

As a general principle homogeneity of licences is desirable as it allows for competition between operators on equal terms. Our interpretation of the proposed guidelines is that there is uniformity of licence conditions for similar operators or similar bands for those subject to renewal. The government has not clarified if the new set of guidelines and licence conditions in the renewal licence will apply to the other two operators whose licence is not due for renewal. A level playing field in terms of regulatory environment is essential to promote healthy competition.

A large number of issues have been left open and this does not provide operators with certainty or clarity

4.3.9 Other non-price licence conditions

The government has taken a comprehensive approach by identifying a number of non-price licence conditions like MVNO, infrastructure sharing, NGN technology, green technology, number portability, international revenue sharing etc. but has left them open ended without any clarity on purpose. These issues that have a bearing on the financials and operations of the business and such open ended clauses should not form part of the agreement. The framework developed for licence renewal is not in line with the international best practice as described in this document, in particular section 0. In particular operators expect, “regulatory certainty and predictability achieved

through a fair, transparent and participatory renewal process.”⁶³ The best practice approach is to provide certainty and clarity and keep the non-technical licence conditions to a minimum and these are discussed in greater detail in the appendix.

4.4 Comparison with best practice for price related issues

Spectrum pricing proposals suffer from a lack of transparency

Bangladesh has chosen to administratively determine spectrum prices for renewal. As we have noted above this is appropriate where market mechanisms cannot be effectively deployed. A key element of best practice however, is the adoption of a fair and transparent process for arriving at key regulatory decisions. In the current guidelines the proposals suffer from a considerable lack of transparency.

In section 3.4 we have discussed the various methodologies that regulators have adopted in administratively determining spectrum prices. While not explicitly articulated in the Telecom Policy of Bangladesh a vision of “universal service at affordable cost without compromising quality” would be consistent with the twin public policy objectives of low cost access through promoting highest value use of spectrum. Such a policy objective should have encouraged the administration to adopt pricing methodologies that:

- lower spectrum prices as it will reduce costs to operators and likely to encourage further investment resulting in better coverage and more affordable access; and
- reward intense use of spectrum rather than punishing it; firms that make better use of spectrum will be better placed to offer competitive rates which will make services more affordable.

The proposed spectrum fees are not consistent with Bangladesh’s vision of affordable access nor do they comply with international practice

The regulator should also have recognised that the impact of any regulatory error in setting prices too high is much greater than that of setting them too low. The proposed spectrum and licence fees are not consistent with Bangladesh’s own vision nor do they comply with international practice.

As we have noted above, as of 2010, very few countries, if any, have renewed 2G spectrum on a restricted use basis and relatively few countries are seeking to do more than recover administration costs from spectrum access fees. Therefore, there are no relevant benchmarks for current spectrum prices to directly compare with the Bangladesh situation. Singapore renewed 2G spectrum in 2008 on an unrestricted basis for the equivalent of US\$ 0.005 / MHz / Pop.

In the absence of directly comparable benchmarks recourse must be made to auction prices for the award of new spectrum. In the consultation on spectrum renewal in Ireland the regulator used an econometric study⁶⁴ performed by the consulting firm Dot Econ. The study was one of the most comprehensive and publicly available analyses of spectrum pricing. A range of data sets were used including all mobile, European, all GSM only awards and awards in countries with similar GDP to Ireland. The results varied dramatically from US\$ 0.18 / MHz / Pop to US\$ 0.81 / MHz / Pop for European only and similar GDP respectively. If the similar GDP figure is adjusted to reflect the difference in GDP per capita between Ireland and Bangladesh the resulting benchmark is US\$ 0.03 / MHz / Pop. Whilst this figure is interesting the database upon which it is based contains spectrum awards that are more than 10 years old and should be treated with great care.

Local benchmarks from Bangladesh provide the best indicators of spectrum value

We believe that most relevant benchmarks would be the prices derived in Bangladesh from the 2005 and 2008 assignments of spectrum. The first mobile licence was issued in Bangladesh in 1989 when spectrum in the 800 MHz band was issued for CDMA operation. Subsequently three GSM licences in the 900/1800 were issued in 1996 by a beauty contest and in 2005 a GSM licence in 900/1800 MHz band was issued through an open auction. This was the first instance when a market price was established for the GSM spectrum. 15MHz in 1800 MHz band was auctioned to a new entrant, the

⁶³ Mobile Licence Renewal, World Bank 2005.

⁶⁴ “Award of 900MHz and 1800MHz spectrum – update report on benchmarking” September 2010, Dot Econ

fourth operator, at US\$ 50 million which implies US\$3.33 million / MHz or \$0.022 / MHz / pop.

A spectrum access fee was first introduced when 17.5 MHz of new spectrum in the 1800 MHz band was offered to the three GSM operators but only 12 MHz was taken up. In setting the access fee of \$11.6 million / MHz (8 Mn BDT/MHz) or \$0.077 / MHz / pop the authorities did not use any of the administrative pricing models. The price was purely judgemental which probably explains why only 70% of the spectrum offered was taken up. The payment terms were for a 25% down payment on and the balance in 8 equal monthly instalments.

These events provide a potential benchmark range of US\$3.33 million / MHz (paired) to US\$ 11.6 million / MHz (paired). The 2005 award of spectrum to Warid represented an award to a new entrant and so it is reasonable to assume that the opportunity cost of spectrum to an incumbent is above this level. It should also be kept in mind that the spectrum concession at the time of the 2008 award was for 18 years and only 70% of the spectrum offered was taken up suggesting the value of spectrum should be below this level.

The utilisation factor creates significant distortions, punishes efficient use of spectrum and is contrary to international best practice

The other major distortion in the access is the use of the utilisation factor that severely penalises operators who efficiently use the spectrum. We have argued earlier that the pricing approach should reward intense use of spectrum rather than punishing it. This distortion on top of the proposed high spectrum access fee will not promote adoption of mobile telephony in Bangladesh and is contrary to the principles of international best practice.

Spectrum usage fees are high and the linkage to subscribers is contrary to international best practice

In terms of the spectrum usage fee as discussed in section 3.8.2 most EU countries have relatively low or no usage fees and there is no material difference in the fees across the various spectrum bands. In contrast the proposed annual usage fee in Bangladesh works out to about 1.5% of the operators' gross revenue and there is again a distortion in linking the fee to the subscriber base which is not in line with the best practice outlined in section 3.8.2.

4.5 Recommendations for spectrum renewal in Bangladesh

4.5.1 Non price recommendations

The mobile sector has played a key role in Bangladesh's social and economic development. It has brought access to communications, provided a source of income to millions and stimulated economic growth. To maintain this trend and realise the vision articulated by the countries leaders, it is absolutely essential that the government promote regularity certainty and predictability through a fair, transparent and consultative led renewal process.

We have examined the draft policy guidelines document for renewal of existing mobile licences and we find that the guidelines do not reflect international best practice. Implementation of the current guideline will significantly jeopardise, not only the growth of the telecoms sector, but have a wider impact on the Bangladesh economy. We therefore suggest that the government take the following steps:

- Initiate a consultative process to examine the licence renewal in the context of the best practice outlined in this document; and
- In the meantime, to ensure continuity of service extend the licences beyond November 2011 on the same terms and conditions as the current licences. The government may consider charging a spectrum usage fee for the interim period at an annual rate derived from the annuity value over a 20 year period based on the price level range proposed below in section 1.8.2.

The time bound consultative process, which should take no more than 9 months, should consider as a minimum the following issues:

- separation of spectrum and operating licences;

- a spectrum management plan that prepares the way for the award of spectrum with unrestricted use in the 900/1800/2100 band in keeping with the current best practice and in consultation with all the six mobile operators;
- prepare for an administrative pricing decision or auction incorporating all the features of best practice outlined in this report;
- in the event of an auction set a reserve price after careful assessment of demand and supply but exercise conservatism to ensure that spectrum is not left unsold.

4.5.2 Price recommendations

We believe that the pricing proposals in Bangladesh do not correspond with international best practice. The proposals create distortions and punish efficient use of spectrum.

The BTRC has determined to set a spectrum access fee which reflects the market value of spectrum. The BTRC should select a spectrum access conservatively. The awards of spectrum in Bangladesh provide a benchmark range of US\$3.33 million / MHz (paired) to US\$ 11.6 million / MHz (paired) or US\$ 0.02 to US\$ 0.08 MHz / Pop. The 2005 award of spectrum to Warid represented an award to a new entrant and so it is reasonable to assume that the opportunity cost of spectrum to an incumbent is above this level. It should also be kept in mind that the spectrum concession at the time of the 2008 award was for 18 years and only 70% of the spectrum offered was taken up suggesting the value of spectrum should be below this level. The GDP adjusted benchmark from the Irish study of US\$ 0.03 / MHz / Pop would confirm a price above the Warid benchmark but considerably lower than the 2008 award. The average price from the C circles in India of US\$ 0.05 / MHz / Pop, which will be more comparable with the GDP of Bangladesh than the metros, category A and some category B circles, also suggests that the price of spectrum in Bangladesh should be towards the lower end of the range. We believe that an appropriate benchmark range would be US\$ 0.03 to US\$ 0.06 / MHz / Pop. If the licences remain technology specific then the selected price should be at the lower end of the range. The introduction of technology neutrality would allow for a higher price but we continue to recommend the exercise of a conservative approach.

In light of the market price based spectrum access fee which is proposed we believe that the spectrum usage fees should seek to recover the costs of administration and should not seek to reflect market values. Spectrum usage fees should also be the same for all operators and there should be no significant difference between bands. The use of revenue sharing can lead to market distortions, higher prices for consumers and punishes efficient use of spectrum. The use of a revenue share should no longer be included as part of the spectrum pricing regime.

Appendices

Appendix A: Policy objectives and implications for managing spectrum

Best practice can only be determined by the extent to which it meets public policy objectives

Section overview

The degree to which a process for spectrum award or renewal and pricing represents best practice depends in the first instance on the public policy objectives and their implications for spectrum management. In this section we survey the public policy objectives of a selection of countries in order to establish a set of common international spectrum management objectives. Different approaches to spectrum renewal and spectrum pricing can be assessed against these objectives in order to arrive at a conclusion regarding best practice.

Survey of public policy objectives

Exhibit 24: Examples of public policy objectives for selected countries

Regulatory body	Objectives
Australia (ACMA)	<ul style="list-style-type: none"> promote highest value use of spectrum promote investment and innovation promote competition promote customer convenience provide an appropriate return to the community
United Kingdom (OFCOM)	<ul style="list-style-type: none"> principal duty to further the interests of citizens secure optimal use of spectrum secure the availability of a wide range of electronic communications services throughout the UK encouraging investment and innovation
Hong Kong (OFTA)	<ul style="list-style-type: none"> to ensure choice of services to provide stable investment environment to ensure efficient use of spectrum to ensure continuity to customer service to maintain technology neutrality
Singapore (IDA)	<ul style="list-style-type: none"> promoting effective and stable competition promoting facilities based competition relying on market forces adopting proportionate regulation remaining technology neutral

Source: Regulator websites and consultations

There are five key themes in relation to broad public policy objectives

Public policy objectives vary from country to country. However a number of common themes emerge. These are:

- promote efficient use of spectrum;
- promote investment and innovation;
- promote competition;
- promote benefits to consumers; and in some instances
- provide an appropriate return to society.

In the following section we examine these themes in more detail and translate them into a set of specific objectives for spectrum management.

Public policy objectives and implications for spectrum management

Efficient use of spectrum

Efficient use of spectrum implies allocating spectrum to those that value it most highly

One of the primary stated objectives of spectrum management in a number of countries is to promote the most efficient use of spectrum. Efficiency from an economic perspective implies allocating spectrum to those that value it most highly. The implicit assumption is that the private values to owners of spectrum rights correspond closely to the overall social value of spectrum. A large number of studies have examined the alternative uses of spectrum and their conclusions indicate that the greatest potential value from spectrum in the 700MHz, 900MHz, 1800MHz, 2.1GHz and 2.6GHz bands can be generated through the provision of mobile telephony services.

Plum and Aegis in the UK considered a range of alternative users for this spectrum, including fixed point-to-point, single site deployments and broadcasting, and found that

Mobile telephony provides the highest value use of spectrum

“the potential value is greatest from cellular mobile applications, followed by Private Business Radio then fixed links. There are orders of magnitude differences in value between these applications⁶⁵.”

Their analysis suggests that the potential value from mobile applications per 2 x 1MHz of spectrum could be up to £240m (based on an evaluation period of 10 years), compared to £2.8m for a 2 x 2 MHz block of the next most valuable use (Private Business Radio).

Indeed, it has been suggested that there would be net incremental value in reallocating broadcast spectrum to mobile - in a study of the potential uses of the digital dividend in Europe, Value Partners found that

“the net value added of allocating some UHF to mobile instead of broadcasting is between €63bn and €145bn⁶⁶”

A similar study in Australia found that the economy would be boosted by up to A\$10 billion if at least 120MHz of useable spectrum unlocked from the Digital Dividend was made available for mobile broadband use⁶⁷.

Spectrum use should be encouraged and not punished

These studies suggest that the efficient use of spectrum can be promoted by encouraging rather than punishing the use of spectrum within the mobile telecommunications sector and that spectrum should be awarded to those companies that value it most highly. Regulatory objectives in relation to efficient spectrum use are therefore:

- to promote the use of spectrum for the provision of mobile telephony services;
- to award spectrum to those companies that value it most highly; and
- to encourage rather than punish the use of spectrum.

Promote competition

Promoting competition is a common policy objective in its own right

The benefits of competition are well established both in the economic literature and in practice. Promoting competition is often a public policy objective in its own right as well as an enabler for other objectives such as promoting investment and innovation which we discuss in more detail in the next sub section⁶⁸.

65 Plum and Aegis, “Estimating the Commercial Trading Value of Spectrum”, 2009

66 Value Partners, “Getting the Most Out of the Digital Dividend in Australia”, 2008

67 Value Partners, “Getting the Most Out of the Digital Dividend in Australia”, 2008

68 See for instance: Sanghoon Ahn, “Competition, Innovation and productivity growth: A review of theory and evidence,” OECD Economics Working Paper No. 317, 2002

Spectrum is a key determinant of the level of competition

Spectrum is one of the fundamental core assets for facilities based mobile operations and therefore the allocation of spectrum is a critical determinant of the level of competition within a market. Indeed if the growth in mobile data continues as anticipated by most market commentators the role of capacity based competition will further enhance the role of spectrum in determining competitive dynamics. As networks become congested it is reasonable to presume that, subject to other considerations such as brand, customer service, customer inertia and so on, customers will tend to migrate to the network with the lowest level of congestion. As spectrum plays a significant role in determining network capacity the share of spectrum will determine share of industry capacity and therefore potentially share of customers.

In the US a concentration in spectrum holdings has reduced competition

In countries where spectrum becomes unduly concentrated, the mobile services market does also. For instance, in the US there have not been caps on spectrum holdings since July 2003, and as a result AT&T and Verizon have been able to build holdings that have enabled them to capture 60 percent of the country's mobile subscribers and revenue, and they continue to grow at the expense of smaller operators such as T-Mobile USA and Sprint Nextel. As a result, in their 2010 report the FCC stated that they do not believe that the U.S. mobile industry has "effective competition"⁶⁹.

India has widely dispersed spectrum holdings and intense levels of competition

In contrast, in India where spectrum licences are issued regionally across each of the 22 telecoms territories or circles, the competition among mobile operators is intense. In most circles the number of competing operators ranges from 6 to 12. Strong competition has resulted in the lowest air time rates in the world leading to services being provided to those who had been denied access in the past and as a result high levels of mobile penetration despite the relative poverty of the country.

As markets mature there is a tendency for competition to diminish through exit and merger. Competition however is key to a vibrant telecommunications sector. At a minimum regulatory policy in relation to spectrum should:

- encourage competition through reducing concentration in spectrum holdings or as a minimum preventing any increase in concentration.

Promote investment and innovation

Competition can promote investment and innovation

Many factors contribute to the level and nature of investment and innovation, but a key one is competition. It is generally agreed⁷⁰ that higher levels of competition tend to promote increased investment and innovation. In contrast, where industries are characterised by high levels of concentration and limited levels of competition investment can be stifled. This can be seen from the following example.

The U.S. mobile broadband industry has, according to the Federal Communications Commission (FCC), become increasingly concentrated over the past five years⁷¹. Over this period, network capital investment is reported to have slowed in relation to revenue growth. The FCC calculated that investment had declined from 20% of industry revenue to just 14%, adjusted for inflation⁷². As markets mature the share of investment relative to revenues does tend to decline over time and furthermore, tends to vary as new global standards are introduced periodically. However, if a mobile operator is not under pressure from competitors to innovate and invest then shareholder interests are often best served by maximising the return from existing investments rather than making new ones. Therefore, regulatory policy in relation to the award of spectrum should be to encourage where appropriate competition rather than reduce it.

69 FCC, "Mobile Wireless Competition Report", 2010.

70 See for instance: Sanghoon Ahn, "Competition, innovation and productivity growth: A review of theory and evidence," OECD Economics Working Paper No. 317, 2002

71 FCC, "Mobile Wireless Competition Report", 2010

72 FCC, "Mobile Wireless Competition Report", 2010

Mobile operators must expect to earn a reasonable return if they are to invest and innovate

In order to invest however a mobile operator needs to anticipate earning a return on its investment that exceeds its cost of capital. Mobile operators are subject to economies of scale and a minimum level of market share is required to generate reasonable returns. If the award of spectrum results in a market structure which sees some operators operating at a level which is sub-scale then this may discourage future investment. The available evidence suggests that, in most countries, the benefits of additional competition diminish rapidly once the number of operators exceeds four. In addition there are reasons to believe that the intensity of market competition might even diminish, if and when spectrum shortages lead to unavoidable congestion in dense urban areas for the most successful operators⁷³.

Spectrum policy must therefore seek to ensure an appropriate level of competition which promotes rather than detracts from investment. Furthermore, if the award process is designed to appropriate all the future value of spectrum then this will also prevent an operator from earning a reasonable return and may also discourage investment.

Regulatory objectives in relation to spectrum and encouraging innovation and investment are therefore:

- spectrum should be awarded to encourage effective competition which will promote innovation and investment; and
- spectrum awards and pricing should provide operators with an expectation of earning a reasonable return on their investment.

Benefit consumers

There is a causal relationship between mobile penetration and economic growth

A wide range of economic and social benefits can be promoted through encouraging the mobile telecommunications sector. The division of India into 22 different telecommunication “circles”⁷⁴ provides a wealth of data for cross-sectional analysis from which interesting conclusions can be drawn regarding the impact of mobile telephony on economic growth.

A recent study⁷⁵ has used the diversity between circles to examine the economic impacts across states, economic sectors and population segments. The study notes:

“the econometric analysis reported here extends the conclusion that there is a causal relationship within the same country between higher mobile penetration in a region and higher economic growth. Indian states with high mobile penetration can be expected to grow faster than those states with lower mobile penetration rates, by 1.2% points a year more on average for every 10% increase in the penetration rate. Furthermore, there are important network effects which magnify the economic impact of mobiles on development when the level of mobile penetration exceeds a critical mass of around 25%.”

To benefit consumers, public policy should promote mobile adoption through extending mobile coverage and increasing affordability to encourage higher penetration rates across wider geographic and social levels within society.

The expiry of existing licences presents additional challenges for regulatory policy

In nearly all countries the mobile sector is well established and mobile telephony services have been provided in some instances from the early and mid 1980s. Indeed, many of the original holders of spectrum are facing expiry of their early licences. This raises additional issues for regulatory policy as in some cases the renewal process could result in a re-distribution of spectrum amongst operators or possibly some spectrum being returned and potentially lying idle.

73 An assessment of spectrum management policy in India – a final report to GSMA , Aegis spectrum engineering and Plum , December 2008.

74 A state usually corresponds to a circle but in some instances more than 1 state may be included in a circle.

75 Vodafone Policy Paper Series, “India: the impact of mobile phones - An econometric analysis of the impact of mobile, “ January 2009

Any substantial re-distribution of existing spectrum holdings could have profound implications for consumers

Any reallocation of existing spectrum holdings could have a potentially significant impact on consumers. Consumers may experience disruption of their current mobile service if the re-distribution of spectrum reduces or ends completely coverage or quality of service due to network reconfiguration or the requirement for a new handset, for example. If a consumer has to migrate to a new operator this may also impose switching costs on the consumer. Customers face switching costs from a range of sources when changing mobile phone network. They may need to pay a fee to get their handset unlocked for use on another network. They may face contract exit costs if they are not near the end of their contract term (typically 24 months). If unable or unwilling to exit, customers may need to endure reduced network coverage and quality. Even those customers that were not locked into a contract would face searching costs when looking for another mobile provider, in that it takes time and effort for consumers to decide which new package is best, and to sign up to it⁷⁶. However, high levels of churn in many markets suggest that these switching costs may not be particularly high.

Consumer benefit may be significantly compromised however if the renewal process results in a reduction in competition. If the renewal process is flawed in some way, such as spectrum prices being too high, then there is a risk that operators will not renew their spectrum holdings and return the spectrum. As we have already discussed above policy objectives should seek to encourage rather than reduce the use of spectrum.

The Irish Commission for Communications Regulations (ComReg) in its consultative document for the renewal of 800 and 900 MHz band has observed:

“the circumstance that the customers of Vodafone and O2, who together account for around 75% of the Irish subscriber base, would run a potential risk of disruption is a relevant, and potentially important, consideration for ComReg to take into account”⁷⁷.

A process designed to re-allocate existing spectrum holdings must balance the benefits against the costs

Any substantial realignment of existing spectrum holdings may well force customers to migrate between networks. This migration may be costly. Even if an alternative allocation of existing spectrum may produce incremental consumer benefits the regulator must weigh the additional benefits against the costs imposed by disruption to consumers.

Regulatory objectives in relation to consumer benefits therefore include:

- promote mobile penetration and coverage; and
- avoid significant customer disruption.

Provide an appropriate rate of return to the community

Raising cash through the award of spectrum is likely to be an important aim for many governments

Public policy objectives are usually first couched in terms of promoting economic efficiency and benefits for consumers. In the current financial climate however, where government's are seeking to reduce budget deficits, there is an increasing focus on ensuring that regulatory policy is able to provide an appropriate return to society for scarce natural resources such as spectrum. In the early 1980s spectrum was usually awarded through the use of “beauty parades” and spectrum charges were either low or in some cases non-existent. In the last 20 years auctions have become increasingly common as they can promote the efficient use of spectrum as well as potentially raising significant levels of cash for the government. Even if raising cash is not a stated regulatory objective it is likely to be an important consideration for broader government policy.

Public policy positions vary in relation to revenue generation

The radio spectrum policy framework of Hong Kong explicitly states that Hong Kong's spectrum policy and management aims to facilitate the most economically and socially

⁷⁶ National Economic Research Associates for the OFT and the DTI, “Switching Costs: Economic Discussion Paper 5” Annex C - Case Studies, 2003

⁷⁷ Commission for Communications Regulation, Consul

efficient use of spectrum with a view to attaining maximum benefit for the community⁷⁸. However, in 2002, the Australian Communication Authority wrote that:

“charges to users of spectrum should...deliver a fair return to the community for the private use of a community resource”⁷⁹.

Although this was not stated as the primary goal of the Australian regulator.

An appropriate return should be considered broadly and is more than simply cash receipts

Regulators should recognise that the return to the community is far more than the direct cash payment made to the government for spectrum alone. In developing spectrum policy regulators must balance the need to raise cash with the wider economic benefits of a vibrant and appropriately competitive telecommunications market. Indeed this trade-off is implicitly accepted by governments. If revenue raising was the primary objective then regulators would simply auction the rights to operate a mobile monopoly as this would undoubtedly raise the highest level of revenue. However, a sufficient in-depth consideration of the wider social and economic benefits of promoting the telecommunications sector has not always been evident in some regulatory decisions.

There are many studies which have considered the indirect consumer and economic benefits of mobile telephony. These indirect benefits include increased innovation, economic growth through wider broadband coverage and increased incentives for infrastructure investment. Access Economics⁸⁰ estimated that the majority of the A\$17.4bn that the mobile industry contributed to the Australian economy in 2009 was through indirect means.

Arguments in favour of a wider consideration of value, rather than licence revenues alone, have been made by Hazlett and Munoz, amongst others⁸¹. They note:

“In short, to maximise consumer welfare, spectrum allocation should avoid being distracted by side issues like government licence revenues.”

Their analysis of societal and economic value versus licence fees in the U.S. (where fees have been high) suggests that:

“The ratio of social gains is of the order of 240-to-1 in favour of services over licence revenues...Delicate adjustments that seek to juice auction receipts but which also alter competitive forces in wireless operating markets are inherently risky. A policy that has an enormous impact in increasing licence revenues need impose only tiny proportional costs in output markets to undermine its social utility.”

Regulators should place relatively little weight on direct cash receipts when considering the return to society

Regulators, when considering the return to the community, should place relatively little weight on the direct cash receipts from the allocation process itself. Ensuring that spectrum is being used and being used for the highest value use is of much greater importance. An award or renewal process which seeks to extract excessive cash receipts may result in operators declining to participate or relinquishing spectrum with the implication that governments fail to raise any cash and society is deprived of the wider benefits of mobile telephony.

- take a broad view of the returns of the mobile industry to society.

Conclusions and recommendations

Spectrum regulatory policy is derived from broader public policy objectives. A survey of countries highlights that public policy objectives are usually couched in terms of:

- promoting the efficient use of spectrum;

78 Communications and Technology Branch, Commerce, Industry and Technology Bureau, Government of Hong Kong, “Radio Spectrum Policy Framework”, April 2007

79 Department of Broadband, Communications and Digital Economy “Public Interest Criteria for “Re-Issue of Spectrum Licences”, 2009

80 Access Economics, “Economic Contribution of Mobile Telecommunications in Australia”, 2009

81 Hazlett and Munoz, “What Really Matters in Spectrum Allocation Design”, 2010

- promoting investment and innovation;
- promoting competition;
- promoting benefits to consumers; and in some instances
- providing an appropriate return to society for scarce natural resources.

Applying these broad objectives to spectrum management allows us to identify international best practice for spectrum management policy objectives. International best practice can be summarised as:

- promoting the use of spectrum for the provision of mobile telephony services;
- awarding spectrum to those companies that value it most highly;
- encouraging rather than punish the use of spectrum;
- encouraging or protecting existing levels of competition through reducing or maintaining the concentration of spectrum;
- encouraging effective and appropriate levels of competition which will promote innovation and investment; and
- providing operators with an expectation of earning a reasonable return on their investment;
- promoting mobile penetration and increased coverage;
- in the case of spectrum renewal, avoiding significant customer disruption; and
- in relation to pricing an renewal, taking a broad view of the returns of the mobile industry to society.

Appendix B: Best practice principles of spectrum management

Section overview

Spectrum renewal and pricing must be considered as part of a coherent and holistic approach to spectrum management

In order to meet public policy objectives the process of spectrum renewal and pricing must be completed in the context of a coherent and effective overall approach to managing spectrum. In this section we highlight the changing trends in approaches to spectrum management and provide a broad statement of best practice and specific comments in relation to renewal.

Trends in spectrum management

Historically a “command and control” approach has been adopted

Spectrum management is an extremely important part of telecommunications policy and regulation. Historically, spectrum management has followed a “command and control approach” where by:

- the Government, or the authorised regulatory body acting on behalf of the government, makes (or accepts from an international body such as the Economic Union) the allocation of a frequency band for a particular purpose;
- spectrum within the band is assigned to one or more licensees in the past through an administrative process (often termed a “beauty parade”) although increasingly through auctions;
- a charge or spectrum usage fees representing one-off, on-going or a combination of charges may be levied on licensees, normally to cover administrative costs although increasingly to raise revenues; and
- the licence usually authorizes the licensee to utilize spectrum-using equipment specified as to location, power and other variables, the restrictions being designed to avoid interference with other licensees in adjoining geographical areas or frequency bands.

Whilst some degree of central coordination is required the command and control approach has significant limitations

The key feature is that restrictions on allowable uses of spectrum are made by the regulatory body. Users of spectrum can make proposals for changes to assignments and uses but these cannot be implemented without regulatory approval. As may be anticipated, such approaches can be slow and may not allow the industry to be sufficiently responsive to new technological opportunities. Such an approach requires a high level of knowledge and foresight on the part of the regulator which may not always be present. Whilst some degree of frequency coordination is required to ensure that spectrum is used efficiently the command and control approach is becoming increasingly outdated.

Spectrum management is increasingly market based

The telecoms sector has always been subject to high levels of change and uncertainty. A broad consensus has arisen that the “command and control” policies of the past may not be appropriate to meet the needs of a fast changing and dynamic sector which generates significant benefits for consumers. Indeed, in some cases, policies may have delayed the introduction and growth of new beneficial technologies and services, or artificially increased the cost of service. More recently the dramatic growth in demand for mobile data services and the need for more spectrally efficient technologies has led policy makers and regulators worldwide to recognise their fallibility and to approach spectrum management differently. The “command and control” approach for spectrum management of the past is now shifting to a “market-based approach” where by market forces are used to ensure the efficient use of spectrum.

The most common market based tool is an auction

Market based approaches, such as auctions, are almost always used in modern spectrum management for the award of new spectrum. In the case of spectrum renewal the use of auctions varies as they may not always be the most appropriate approach. However, where administered solutions are implemented in lieu of auctions these approaches seek to replicate the workings of the market. In some jurisdictions

such as New Zealand and the UK the regulatory bodies have also sought to introduce spectrum trading in order to provide continuous market pressures to encourage the efficient use of spectrum.

Best practice in spectrum management

Independence

The governance of spectrum regulators differs throughout the world but broadly falls into two categories

The governance of spectrum regulators differs throughout the world but broadly falls into two categories:

- the regulator is an independent agency, normally established by statute, with specified powers and responsibilities; or
- part of a government ministry.

Spectrum should be managed transparently and fairly

Good governance involves transparent arrangements for accountability and fairness. While decisions on spectrum management should reflect public policy objectives, government or political interference in detailed decisions, such as which firm should receive a particular license, should be avoided. The benefit of transparency and fairness is greater investor confidence which encourages investment. Higher levels of investment should ultimately benefit the end consumer.

The regulator should be free of undue influence from special interest groups

Whether an independent agency or a government body is better for spectrum regulation will depend on particular circumstances and the risk of regulatory capture. In some countries, agencies may be more susceptible to capture by special interest groups and in others, government ministries. It is therefore difficult to provide a definitive statement on best practice in relation to the nature and governance of the regulatory body. However, best practice can be summarised as establishing a regulatory body which is:

- transparent;
- fair; and
- free of undue influence from special interest groups.

Transparency

Clarity and certainty are critical for promoting investment

Spectrum management objectives include promoting investment and innovation. Investment can be encouraged by providing investors with increased confidence that they will earn a reasonable return on their investment. Confidence is increased through transparent, clear and consistent regulation. Transparency should form the basis of all work done by a regulator and should be a feature of every process related to telecoms regulation, especially in relation to such a critical asset as spectrum.

Regulation should be transparent

The public and all stakeholders should understand the functions of the regulator and the way the body is managed and governed. They should be able to see the work of the regulatory authority as open, accessible, and accountable. In terms of any processes followed, they should find the processes both predictable and fair. These principles are of course, easy to state, but difficult to implement in practice when stakeholders have such diverse ambitions, views and opinions. The benefits of transparent regulation are summarised as follows.⁸²

Efficiency and Effectiveness – Open processes enhance consensus and create confidence in the regulator. Increased public participation promotes diverse ideas in decision making and increases support for rules and policies, making implementation easier. In addition, transparency can lead to greater efficiency by ensuring that duplication of functions is avoided.

82 ITU – Trends in Telecommunication Reform, 2002, Chapter 6.

Accountability and Independence – Openness promotes accountability and legitimacy, reinforces regulatory independence, and reduces political and industry interference. Stakeholders can thus have confidence that their views will be heard, without bias, by the regulator. When regulatory actions are open to public, regulators are more likely to engage in careful and reflective decision-making.

Certainty and Reliability – Regulatory credibility and legitimacy builds stability and is essential for attracting investment. This is particularly important in newly liberalized markets, where potential entrants need to have trust that their investments will be protected from arbitrary action and that further commercial development will not be thwarted by sudden changes in “rules of the game.”

Continuity – A stable set of rules governing transparency will transcend political changes and outlast political appointments, ensuring a continuous regulatory record regardless of who is in charge of the regulatory agency or which political party is in office.

Adequate planning and time

Planning for spectrum renewal is essential for avoiding consumer disruption and continuing to promote investment

Strategic and timely planning for spectrum licence renewal is essential for avoiding consumer disruption and continuing to promote investment and innovation. Licence renewal can present mobile operators and their investors with high levels of uncertainty and increased perceived levels of business risk. The process needs to be managed carefully if investment is to continue and disruption to services avoided.

Sufficient time for completing the renewal process is required

The principle and procedures for renewal in developed countries are usually stipulated in the legislation and regulatory instruments of the country. In the case of the United Kingdom a statutory instrument was laid before parliament which directed Ofcom as to the principles of the renewal process. In many developing countries there is a tendency to leave the renewal process to the discretion of the licensing authority without providing many details of the terms, criteria and conditions for renewal. There is also a tendency to not allow sufficient time to complete the process in a manner which provides investors with the confidence and clarity they require. The renewal process is time consuming and should be started early enough to ease investor concerns and for operators to continue to invest in their networks. Sufficient time and effective planning are essential.

In France the renewal process must be initiated at least two years before licence expiry

In France, under the French Post and Telecom Code, the regulator has to initiate the renewal process at least two years before the expiry date of the license. Any proposed new conditions for renewal to the Minister of Telecommunications, which then notifies the license holders of the new terms. In application of this legislative requirement, the regulator ART launched a public consultation in July 2003 well ahead of the renewal date.

In Australia if an operator is to be re-offered a licence this should occur 5 years before the expiry of the licence

The practice in Australia provides an example for the timing of the renewal process. In Australia in 2002, a Radio-communications Consultative Council (RCC) Working Group conducted a review of license tenure and identified measures to ease investor's potential concerns. The “forward review” of the market and spectrum needs was conducted well in advance of license expiry or renewal - with sufficient time for government and investors to plan ahead and to adjust plans going forward. The same working group suggests that licensees that hold licenses with maximum terms (five to 10 years) would be offered the opportunity to extend their license up to three years after the publication of each forward review. This offer would not be made if the forward review identified the band in which the license is held has a reasonable expectation of being re-planned, before or within, the additional three years. In general, if a spectrum licensee is offered the re-issue of a license, then that offer should be made at least five years prior to the expiry date of the relevant spectrum license⁸³.

83 Auction.ac.gov.au/tenure/tenure/tenure_report.pdf

Spectrum renewal processes should be initiated 3 to 5 years prior to expiry and concluded within two years of expiry

In the case of spectrum renewal the regulatory body should commence and plan to complete the renewal process well ahead of the expiry of the licences. In light of the diversify opinions of stakeholders and the risk of legal challenge the earlier the process is initiated the better in order to reassure investors and allow them to alter plans if required.

International best practice suggests that the process of spectrum renewal should be completed at least two years prior to the expiry of the licences and this would imply initiating the process 3 to 5 years before licence expiry.

Consultation is essential but does not ensure the absence of legal challenge

Consultation

Public consultation is an important process for engaging stakeholders in the decision-making process, and reinforces the perception of a transparent process⁸⁴. It also allows the new terms and conditions for renewal to take into account the concerns of the operators and reflect the needs of the consumers. There are many users and stakeholders ranging in power and size who are affected by allocation and assignment decisions including a large number of differing businesses and public bodies directly involved as users of spectrum. While it is seldom practical to consult with each individual spectrum user, effective consultations can take place by also allowing associations or bodies representing groups of users to contribute. In the end the process will maximise the chances of a successful outcome of the renewal process. Extensive consultation however does not guarantee a smooth process. Ofcom, the UK regulator, has consulted extensively in relation to both spectrum liberalisation, renewal and the award of additional spectrum but this has not prevented delays due to legal action.

Regulators can use the consultation process to reveal their initial thinking in relation to renewal

In Hong Kong the Telecommunications Authority (TA) initiated a consultation process in August 2003 for renewal of 2G licence that was due to expire in July 2005 with a stated purpose that a decision on future licensing arrangements should be made as early as practicable. In the consultative paper TA outlined its preliminary thinking on the licensing arrangements, the issue relating to spectrum fee and the licensing conditions to be imposed on the new licences.⁸⁵ Through this process the TA was able to reach an agreement on issues like whether a spectrum usage fee should be imposed, a coverage obligation specified, which operators should be offered "right of first refusal" and alignment of dates of new licences⁸⁶.

Singapore concluded the consultation process in 6 months but more time should be allowed

The Infocomm Development Authority (IDA) of Singapore issued a consultation paper in June 2007 for renewal of 2G licences due to expire in September 2008. IDA was able to conclude the consultation process in six months by January 2008 and issue an Information memorandum on the auction of spectrum rights.

Some helpful guidelines for conducting consultation process effectively include the following⁸⁷:

- involve, as much as possible, all the stakeholders that need to be heard, irrespective of their size or affiliations - companies, industries, consumer, community groups, individuals;
- articulate clearly the various issues and the different options under consideration in the decision making;
- facilitate those with views to respond fully and in an informed way;
- provide an analysis of the response, preliminary conclusions and hold further consultations if required; and

84 How will Ofcom consult? A guide to our consultation process

85 Licencing of Mobile Services on Expiry of Existing Licences for Second Generation Mobile Services: Consultation Paper, Telecom Authority, Hong Kong, 1 August 2003.

86 Licencing of Mobile Services on Expiry of Existing Licences for Second Generation Mobile Services: Analysis of Comments & further Consultation Paper, Telecom Authority, Hong Kong, 1 9 March 2004.

87 Telecommunication Regulations Handbook, H. Interven, M. Tetrault, infoDev 2000

- do this clearly and openly avoid taking too much time with the consultations, as markets change quickly.

Market mechanisms

Economic efficiency is achieved when a marginal unit of spectrum generates the same marginal benefit across uses or users

As discussed above a public policy objective of spectrum management is to promote the most efficient use of spectrum⁸⁸. Economic efficiency is achieved when the allocation of spectrum to different uses or users generates the same marginal economic benefit. For example, suppose that a given quantity of spectrum is available for use in only two sectors, mobile communications and commercial broadcasting. From an economic efficiency viewpoint, the spectrum should be divided in such a way that the benefits to the economy at large from an additional amount of assigned spectrum are the same in each use. Whilst a heroic assumption it is often assumed that the private value of spectrum to a mobile operator, for example, is the best proxy for the value of spectrum to society or the economy at large.

Market mechanisms are likely to result in more efficient use of spectrum

In the traditional “command and control” model to ensure economic efficiency the regulator must be able to correctly estimate the marginal value of spectrum to different uses or users and allocate the spectrum accordingly. Operators themselves find it challenging enough to value spectrum and so the chances of an administered allocation resulting in an economically efficient outcome is very low. Market-based approaches such as auctions and spectrum trading are more likely to result in an allocation of spectrum which is closer to an economically efficient outcome.

Continual market discipline arises through the introduction of spectrum trading

An auction only provides market discipline for the initial award of spectrum. If changes in the market or technology take place then the initial award may no longer be efficient. Economic efficiency may be higher if spectrum could be re-distributed. Secondary spectrum trading seeks to provide continual market discipline for spectrum assignment and for spectrum allocation. To be effective spectrum trading should be accompanied by flexibility over the use of spectrum. For many, spectrum trading is the next key step for spectrum management in order to maximise the benefits for consumers. However, a move toward spectrum trading must be accompanied by adequate competition law to ensure that market structures which are not conducive to economic efficiency, such as monopoly, are avoided. It may also be necessary for the regulator to have the power to scrutinize and, if appropriate, prohibit certain spectrum trades.

Spectrum tradability

An increasing reliance on market mechanisms naturally leads towards introducing spectrum trading. The ability to trade spectrum has a number of potential benefits:

- It provides a dynamic market mechanism to sell unused or underused spectrum potentially resulting in more efficient use of spectrum;
- Can facilitate change in use and users of spectrum in response to changes in market demand and technology innovations.
- Potentially increases the level of competition and reduces the barriers to market entry.
- Increased transparency of the value of spectrum.
- Facilitates a quick response by operators to changing market demand.
- There is no need for fixed licence expiry dates giving greater investment certainty to the operators and reducing the costs of regulation.

The costs of spectrum trading are:

- Potentially high transaction costs

88 ITU – Trends in Telecommunication Reform, 2002, Chapter 6.

- Increased risk of interference
- Possible windfall gains
- Low trading activity
- Reduced ability to achieve public interest objectives
- Could result in inefficient use of spectrum

Spectrum trading is now available in a number of markets including Australia, UK, New Zealand, Austria, and Germany. In Australia (1998-2008) there were a total of 425 spectrum trades. The majority of these trades were for licensees in administration. In Austria spectrum trading was used to reassign unutilised 3G spectrum. Many countries allow spectrum trading but attach conditions. In Spain spectrum trading is possible in the 3.5 GHz band but the spectrum cannot be transferred to licences in the same band for 4 to 5 years. There were similar conditions in the 2008 AWS auctions in Canada, where the conditions prevent new licensees from being sold to anyone that does not meet the requirement of a new entrant (less than 10% market share) for 10 years.

A European Commission study (2004) identified benefits of between €8 to €9bn from liberalisation and spectrum trading were introduced in a consistent way across Europe. Of this, 30% of the benefits were derived from the introduction of spectrum trading. In UK Ofcom (29/09/04) carried out a study which estimated the net benefits of spectrum trading to range between £67m-£144m.

Regulatory bodies should consider spectrum trading as a longer term goal.

Managing expectations, transitions and avoiding shocks

Spectrum renewal presents regulators with a challenging balance act

Spectrum is a finite resource and therefore at the time of licence renewal the regulatory body has to address issues like preserving rights to frequencies for incumbents, allowing new entrants to gain access to currently used spectrum, negotiating compensation for operators who have been adversely affected by renewal decisions and for whom compensation is appropriate and the migration of customers from operators who surrender their spectrum. In approaching these issues regulators should seek to strike a balance between encouraging the ongoing investment and continuity of service from existing holders and obtaining the optimal exploitation of the spectrum resources through a possible re-distribution.

Pakistan had to create a win-win situation in order to promote increased competition

In Pakistan in 2003, when action was taken to issue two more mobile cellular licenses, the need for a proper spectrum allocation mechanism and roadmap arose. During the consultation, it was concluded that if new licensees are not to be disadvantaged against incumbents in their spectrum assignments, it would be desirable to offer them some 900 MHz channels as well as some in the 1800 MHz GSM band. This initiated the re-farming of 900 MHz. The obvious choice was to claw back some of the already assigned spectrum from incumbents. Because of statutory protections, the only option was to win their consent for an amicable re-farming. In return for some of their existing 900MHz channels, incumbent operators were given: (1) certainty of 15 years renewal on expiry of their initial tenure; (2) additional rights to self-build regional backbone within each of the 14 telecom regions; and (3) assignment of additional frequencies in the 1800 MHz band in exchange for a lesser amount of spectrum in the 900 MHz band⁸⁹.

In Hong Kong providing sufficient time was essential for managing licence expiry

In Hong Kong in 2004, upon the expiry of their licences, the CDMA and TDMA licensees were required to vacate the frequency spectrum that they were currently assigned. The Telecom Authority (TA) determined that 70,000 customers may be

89 How Pakistan Handled Spectrum: Lessons for Others? URL: <http://www.voicendata.ciol.com/content/ContributoryArticles/110053102.asp>

Developments in India have severely damaged investor confidence

affected as a result of this. The TA provided sufficient advance notice and facilitated a smooth migration arrangement for the customers⁹⁰.

In India GSM spectrum was assigned to operators at different points in time. Operators currently face uncertainty over the amount of spectrum that has been assigned to them i.e. 4.4 MHz or 6.2 MHz and the fee that has to be paid for the additional assignment. The authorities announced that they were considering charging operators who held spectrum in excess of 4.4MHz a fee several times the current fee for 4.4MHz for any spectrum in excess of this amount. The high levels of uncertainty as well as the high level of proposed charges, along with the on-going scandal associated with the award of some licences, has severely damaged investor confidence.

Government use of spectrum should be reviewed periodically

Review spectrum holdings for government use

For historical reasons large blocks of spectrum have been assigned for government use and these include defence and space. Most countries have allocated between 2x90 MHz and 2x110 MHz of spectrum suitable for GSM services. India has so far allocated between 2x40 and 2x70 MHz⁹¹. This reflects the fact that parts of the 2G spectrum identified by ITU is still used by the Government in India and is only gradually being released. There is a possibility that the Government agencies may be using some of the spectrum assigned to them for strategic purposes. However, for reasons discussed earlier, spectrum which is being used for non-strategic purposes should be re-farmed for use in commercial services. The Telecom Regulatory Authority of India in its recommendation⁹² has suggested that the spectrum which is being utilized for the non-strategic purposes should be re farmed for use of commercial services and their use reviewed periodically.

The use of spectrum should be reviewed every three years

In Australia, the ACMA commissioned an Independent Review of Government Spectrum Holdings (IRGSH) in 2006 on the issues of stocktaking of government spectrum holdings, opportunity cost of government spectrum, identification of sharing or reallocation opportunities and spectrum regulation. One of the major recommendations of IRGSH was that all defence allocations should be reviewed at regular intervals and not more than every three years. Hong Kong has recommended that the efficiency of the use of Government spectrum be reviewed every three years⁹³.

Government reservations of spectrum should be reviewed every three years and its use limited to strategic purposes.

Conclusions and recommendations

General principles of best practice in spectrum management are:

- The government should establish and adequately resource an independent regulator with responsibility for spectrum management;
- The regulator should conduct all activities with a high degree of transparency;
- Adequate time should be allowed for the process of spectrum renewal. The process should be completed at least two years prior to the expiry of the licences and this would imply initiating the process 3 to 5 years before licence expiry;
- Spectrum management should be conducted with a high degree of consultation with key stakeholders;

90 Licensing of Mobile Services on Expiry of Existing Licences for Second Generation Mobile Services: Analysis of Comments Received, TA, Hong Kong March 2004

91 An assessment of spectrum management policy in India – a final report to GSMA, Aegis spectrum engineering and Plum, December 2008.

92 Telecom Regulatory Authority of India: "Recommendations on Spectrum Management and Licensing Framework," 11th May, 2010

93 Communications and Technology Branch, Commerce, Industry and Technology Bureau, Government of Hong Kong, "Radio Spectrum Policy Framework", April 2007

- Market mechanisms such as auctions and spectrum trading should be introduced, subject to appropriate safeguards, to promote economic efficiency;
- In the case of renewal expectations need to be carefully managed to avoid shocks which may damage investor confidence to the detriment of consumers; and
- Government use of spectrum should be reviewed every three years.

Appendix C: Developing an appropriate licensing framework

Section overview

Spectrum renewal provides an opportunity to adapt the licensing framework

Many regulatory bodies are using the renewal of existing spectrum and licences to review and adapt their licensing framework to reflect the dramatic changes that have taken place within the telecommunications industry since many of the first licences were awarded some 10 or 15 years ago. In this section we discuss the broad trends in licensing and highlight some of the approaches adopted. We conclude by providing a set of recommendations regarding the overall licensing framework in which spectrum renewal should take place.

Trends in licensing

Licences were traditionally very prescriptive and often covered both allowable activities and rights to spectrum

Historically a mobile operator's licence defined their rights and obligations in both price and non-price terms in relation to the provision of telecommunication services as well as often including their rights to use particular spectrum frequencies. Licence conditions were often extensive and prescriptive and limited operators' ability to evolve and innovate.

In light of the rapid change in consumer behaviour and technological development highly prescriptive and restrictive licences risked damaging industry development and innovation. Furthermore, if licence conditions and rights differed from operator to operator this also risked distorting competition if operators were not able to compete on an equal basis.

Some countries are adopting more flexible licensing and separating rights to offer service from rights to spectrum

In response to industry change a number of countries are introducing increasing flexibility in operating licences as well as separating the licensing of the right to offer service with the rights to use spectrum. Some countries have introduced unified or converged licences, in which a single licence type applies to a wide range of services and network technologies. Class licences have also been introduced, providing the right for anyone to supply services of a particular type or class. Some countries have gone further and have abolished operating licences in favour of general authorisations in which different types of networks can be developed and services supplied without specific approval being required by a licensing authority⁹⁴.

Transitional issues will need to be managed carefully

While greater flexibility in the terms of licence conditions is attractive the shift from one licensing regime to another can present significant challenges and needs to be managed with care. Regulatory objectives which were specifically targeted through certain licence conditions will need to be addressed through other regulatory or legal devices and these need to be in place before the licence conditions can be amended. Furthermore, investor confidence needs to be managed as investors who invested on the basis of one set of licence conditions may have a legitimate claim for compensation if they are now expected to operate under very different conditions which are not aligned with their reasonable expectations at the time they made their original investment. There are a number of strategies that can be deployed to manage these transitional issues such as payment of compensation or the earlier liberalisation of other bands. Such transitional issues highlight the importance of effective consultation as part of the renewal process.

Licensing approaches

Promoting competition and market entry

⁹⁴ Licensing for growth – reforming the licensing of mobile operators in developing countries, GSMA, 2007

Facilitating new market entry, competition and innovation is the key to a successful licensing regime

In keeping with the objectives of spectrum management the developments that are occurring in relation to service and spectrum licensing are focused on increasing flexibility and increasing competition. There are a number of developments that are taking place around the world including separating spectrum and service provision licenses as well as introducing unified or converged licences or replacing the licensing regime with general authorisations. The key issue from the perspective of best practice is that whatever licensing regime is selected it should seek to maximise flexibility and facilitate new market entry and competition.

Licensing of the rights to offer service should be separated from the rights to use spectrum

Separation of operating and spectrum licences

There are a number of advantages of separating operating licences from spectrum licences. Separate licences make it easier to apply conditions relating to service provision on a neutral basis to all network operators and service providers. Spectrum licences can focus on conditions that are specific to spectrum use such as managing interference. A further advantage is that licence separation allows operators to reconsider their spectrum holdings and potentially release or acquire additional spectrum without concerns over the implications for their ability to offer service. If a regulator is moving towards spectrum trading then the separation of service and spectrum licences becomes of even greater importance. The separation of licensing along with spectrum trading should result in more efficient use of spectrum. However, as discussed in the introduction to this section other powers need to be in place, for example to address competition issues arising from an excessive concentration of spectrum.

Among developing countries when in 2010 India auctioned 3G spectrum it de-linked spectrum licence from operating licence paving the way for M&A activity and market consolidation. In Nigeria, the ability to offer mobile services is dependent on having access to spectrum which is separately licensed.

Complex licensing prohibits innovation and competition

Unified licences

Historically regulators have often issued a large number of different types of licences relating to different types of communication services. Prior to the re-organisation of its licensing regime Malaysia issued 56 licences for different categories of service and 24 licenses for categories of facilities⁹⁵. In addition to the administrative burden and cost, not only on the operators but also the regulator, such an approach is increasingly incompatible with developments in the industry. The telecommunications sector along with media and technology continues to show high levels of convergence and a complex licensing regime limits operators' ability to provide converged services. Furthermore, different licence requirements and condition may prohibit or reduce the effectiveness of competition which is often detrimental to the consumer.

Unified or converged licences provide a solution

An increasingly common response to the challenge of convergence, competition and technological change is for regulators to introduce unified or converged licences. In this regime a single operating licence type applies to all providers of telecommunication networks and services regardless of the technology they deploy or the services they offer.

A shift in licensing in India made a dramatic difference to competition and subscriber growth

In India in 2003, nearly ten years after telecom service was privatised the Government introduced the Unified Access Service (UAS) licensing regime which permitted an access service provider to offer both fixed and/or mobile services under the same licence, using any technology. The existing operators were given the option to continue under the present licensing regime or migrate to the new UASL in their existing service areas, with their existing contracted spectrum. The majority of licensees migrated to the UASL regime which saw a consolidation of fixed wireline and wireless operators with full freedom on choice of GSM/CDMA technology. This was a

⁹⁵ Licensing for growth – reforming the licensing of mobile operators in developing countries, GSMA, 2007

Nigeria has introduced Universal Access Services Licences

major development for the growth of mobile subscribers in India as it offered the potential for greater competition for operators using different technologies to supply similar services in competition with one another.

Nigeria introduced Universal Access Services Licences in February 2006 that covered fixed telephony (including fixed wireless services), digital mobile services, regional and national long distance services and international gateway services. The new licences are available to existing licence holders who have met certain minimum requirements (e.g., existing network infrastructure, a minimum existing customer base or evidence of financial capability and being up to date with payment of regulatory charges and tax) as well as new entrants who meet specific requirements. Around eight operators have already acquired Nigeria's Universal Access Services Licences including a new GSM operator.⁹⁶

General authorisations seek to further reduce barriers to entry

General authorisations

Barriers to entry prevent or reduce competition and the presence of any licensing regime can limit competition by artificially imposing a limit on the number of service providers or impeding the entry of new market participants. In keeping with an increasing reliance on market mechanisms some countries have introduced general authorisations which do away with the need to seek approval or a licence to offer service. The potential service provider is deemed best able to judge whether the market is capable of supporting another service provider. One example of a framework developed, to meet those standards, is the European Union's framework. The general authorisation regime of the EU has abolished the requirement of operations licence to promote market entry. In developing countries, authorisations tend to be used on a more restricted, class basis making provision for particular services or activities that fall within that class to be undertaken without the requirement for the individual service provider to receive explicit approval to offer the service. Class licences are often used for Internet service providers, value added services and private networks. India has adopted this approach for ISP and infrastructure provision.

Homogeneity of licence conditions

As a general principle, homogeneity of licences i.e. a similar set of conditions - is desirable as it allows for competition between operators on equal terms. Homogeneous licence terms also make the market more transparent and make the administration and oversight of operators by the regulators less costly.

Of the countries studied as part of our benchmarking exercise, all had homogenous conditions apart from Hong Kong which have a USO obligation on the largest player.

We do believe that certain difference in licence conditions may be desirable in certain cases. For example, the licence conditions for new entrants could differ from those of existing operators in regard to the rights to national roaming and coverage rollout.

In some countries entrants have the right to a national roaming service from an incumbent in order to provide national coverage to its customers while it is building its network. Such a condition might be limited in time so that the entrant is encouraged to build its own infrastructure within a reasonable time.

We also believe that licence conditions for 900MHz spectrum may be different to conditions for spectrum greater than 1GHz. This is due to the critical role that 900MHz spectrum plays in providing coverage. Although licences for 900MHz may differ to the licences for say 2.1 or 2.6GHz spectrum, the conditions for all 900MHz licences should be homogeneous, subject to our earlier comments regarding new entrants and existing operators.

96 See CIPACO, Unified licences: what benefits for the telecoms sector, 17 January 2007.

A change in the licensing regime should be part of a coherent overall regulatory strategy

Managing the transition in licensing frameworks

Licensing has traditionally been used as one of the key tools for achieving certain public policy objectives such as managing market power, achieving universal service or providing access and interconnection. Before the licensing regime can transition towards a more flexible and adaptable basis the regulator must ensure that either certain licence conditions are retained or additional regulation is introduced to ensure that desirable policy objectives can still be achieved. Putting in place additional regulation may well require changes to the law and possibly institutional arrangements. The ability to effect such changes may limit the ability to move towards a more flexible licensing model. Any fundamental change to the licensing regime must be part of a coherent and holistic approach to regulation of the sector. Until a predictable overall regulatory framework and approach is in place, retaining certain rights in licences may be essential for ensuring public policy objectives are achieved and also offers greater certainty for investors and networks in the short to medium term.

Where existing operators' legitimate expectations are compromised they should be offered compensation

When making significant investments in new infrastructure mobile operators and their investors will have developed a set of expectations regarding the future regulatory environment in which they expect to operate. To ensure that the market remains attractive for on-going investment the regulatory body must be seen to be treating the investors fairly. If a change in the regulatory regime is likely to significantly adversely affect an existing operator then it may be appropriate to provide some form of compensation. That compensation may be financial or it could also take the form of granting rights to offer new services or relaxing other obligations. In Malta, the incumbent operator's monopoly on international gateway services was relinquished at an early stage partly in return for the operator being allowed to commence supplying mobile services.

Those providing similar services should compete on the basis of the same licence conditions

To promote competition operators offering similar services should be subject to the same terms and conditions. For example, those wishing to offer new services should be expected to meet similar obligations to those already providing the service. For instance⁹⁷, Basic Service Operators in India were originally restricted to offering only limited mobility Wireless Local Loop services (i.e., customers were only able to use their service within a single cell site area). With the introduction of India's new unified licensing regime, the Basic Service Operators were allowed to acquire unified licences allowing fully mobility services to be offered but on the condition that they paid an additional fee so that their total fee would be the same as the fourth mobile operator in that area and that they complied with similar rollout and other obligations as the fourth mobile operator.

Conclusion and recommendations

Best practice in relation to spectrum licensing includes:

- establish a licensing regime which facilitates market entry, competition and innovation;
- separate spectrum licensing from the licensing of services and networks;
- simplify the licensing regime and move towards unified, converged or general authorisations rather than specific, detailed licences;
- ensure that providers of similar services compete on the basis of the same licence conditions;
- ensure that any shift in the licensing regime takes place in the context of a coherent regulatory framework to ensure that sufficient tools are in place to achieve public policy objectives and provide clarity and certainty for investors; and

⁹⁷ Licensing for growth – reforming the licensing of mobile operators in developing countries, GSMA, 2007

- consult extensively on any change and be prepared to consider claims for compensation when investors and operator's legitimate expectations are compromised.

Appendix D: Determining appropriate non-price conditions

Section overview

Licence conditions can have a significant impact on spectrum valuations and therefore spectrum pricing considerations

Spectrum renewal provides regulators with the opportunity to change licence conditions to reflect the changes that have taken place in the telecommunications sector as well as changes in public policy objectives. Licence conditions can have a significant impact on the value of spectrum and are therefore key considerations when considering issues relating to spectrum awards, renewal and pricing.

Licence conditions

Some licence conditions are inevitable

As we highlighted in the previous section the general trend within the telecommunications sector is to move away from detailed and prescriptive licensing regimes. Flexibility in licensing promotes innovation, competition and increased economic efficiency. However, there are some public policy objectives which may not be achieved if market forces are not managed appropriately and so some specific conditions are often required. Furthermore, investors prefer clarity and certainty and so licence conditions that dispel any doubts or uncertainties are also of value provided they do not adversely impact upon flexibility.

Demanding licence conditions can impact the value of service or spectrum licences

Licence conditions, especially those relating to coverage and quality of service for example, can have a significant impact on the value of the operating or spectrum licence. Licence conditions, public policy objectives and spectrum pricing must be considered collectively as mobile operators will incorporate the proposed licence conditions into their valuations. The more demanding the roll-out conditions, for example, the less attractive and valuable the licence. Demanding licence conditions will potentially reduce the revenues raised at auction or limit the level of spectrum usage fees that can be charged.

There are a great many potential licence conditions which can be applied to both service providers and the holders of spectrum rights. In this report we have limited our analysis to non-technical licence conditions which have a material impact on the value of a service or spectrum licence. The most material licence conditions relate to:

- duration;
- geography;
- coverage;
- spectrum caps;
- neutrality;
- service quality;
- use it or lose it;
- infrastructure sharing; and
- national roaming obligations.

Duration

Long tenures encourage investment and provide increased certainty

An integral part of a licence is its duration. The time required for operators to make an adequate return on investment is a function of the size of investment and the potential future cash streams arising from that investment. For existing operators the additional investment costs associated with new technology, new spectrum or new services are often considerably lower than those of a potential new entrant. The duration needs be of a sufficient length for:

- a new entrant to have the opportunity to earn a sufficient return on investment; and

Short tenures were historically attractive to regulators as they provided an early opportunity to re-plan the use of spectrum

- existing operators to continue to invest in new technologies and innovative services.

If licence lengths are too short, operators cannot recover their investment and earn a reasonable return. Duration is also an issue from a spectrum management perspective. A very short tenure may reduce incentives for investment but it affords the regulator the ability to re-plan spectrum frequencies sooner rather than later in response to new technological developments for example. However, as we have argued previously, the trend is increasingly towards allowing market forces to determine the allocation and use of spectrum

There is considerable variation in licence duration

International benchmarks on licence duration vary considerably across the world. In Europe licences tend to be between 15-20 years. In the markets where 900MHz has been renewed, with the exception of New Zealand and Singapore, all have been on 15 year tenures. In recent licences, tenure greater than 15 years and into perpetuity have been introduced in markets where spectrum trading is allowable.

Exhibit 25: Licence duration

8 Years 3 months	10 Years	15 Years	20 years	Perpetuity
	Canada (potentially into perpetuity)	Sweden Norway Hong Kong		
Singapore (900MHz)	Singapore(2.6 GHz)	Australia Germany Norway	New Zealand	UK

Source: Coleago research

Singapore is the only country at the time of writing to have renewed spectrum through auction

Singapore is the only territory identified in our research that has offered 900MHz via a “greenfield” auction allocation (i.e. no preference given to existing operators). The auction failed to attract interest from any potential new entrants with all lots being allocated to existing operators at the reserve price. Whilst there may be numerous reasons why the auction failed to attract any new entrants the short licence duration of 8 years would have done little to encourage any potential new entrant.

Future licences should also be awarded such that they are co-terminus and of equal duration. As licence conditions should be homogenous for operators any current disparity in terms of licence end should be addressed through extensions of existing licences rather than awarding licences of mixed duration.

Best practice is licence duration of between 10 and 15 years or perpetuity accompanied by spectrum trading

Whilst a longer licence period encourages investment both from existing operators and potential new entrants the efficient management of spectrum is more challenging if spectrum trading is not available. In order to balance the need to encourage investment with the opportunity to potentially re-allocate spectrum periodically to ensure its efficient use we believe that a tenure of 10-15 years represents best practice from an investment and spectrum management perspective and such a level is also supported by international benchmarks.

Best practice recommendation:

- granted for a minimum duration of between 10 to 15 years; and
- all new licences should be co-terminus in relation to the expiry date.

Geographic licence

Whether licences should be awarded nationally or regionally is another licence condition that regulators have to consider. Offering regional rather than national licences offers the potential of creating a more competitive market structure.

The benefits of regional licences are:

- increased market competition. The number of players vary region by region reflecting market demand, this is particularly important in countries where there are significant variations in income, geography, culture or language such as India;
- encourages new entrants as the investment costs will be lower;
- greater competition in the auction resulting in higher auction revenues being generated;
- faster rollout of the network and services as operators are covering smaller areas; and
- operators are free to choose which regions they may operate in.

The costs of regional licences are:

- it is difficult for regional players to compete against larger national players as they do not benefit from the same economies of scale;
- increased administration costs for the regulator;
- it is likely that some regions may attract limited numbers of bidders resulting in reduced competition for those areas. i.e. rural areas
- it is likely to be less spectrally efficient. To avoid interference between providers of adjacent regions there may be a need to leave some spectrum unused which may not be the case with national licences.

Countries with large populations and large land masses tend to favour regional licences

In Europe with the exception of the recent 2.6GHz licence in Norway, licences have been offered on a national basis. Largely it has only been countries with large geographic areas and large populations with significant variations in geography and culture e.g. India, Brazil, US and Canada, that have offered licences on a regional basis. Regional licences are also proposed for the 2.6GHz auctions in Spain.

Market consolidation has been a key feature in all the markets where regional licences were offered. In India the regional licences were consolidated by major players to create a national footprint. However, many of the regional players in the US struggled to create viable businesses leading to their ultimate acquisition by a larger player. This suggests that in the long term the initial benefits of increased competition generated through regional licences are short lived.

Exhibit 26: Geographic and regional licences

National	Regional
New Zealand	Canada
Australia	Norway (2.6 Only)
Europe	US
Hong Kong	India
Singapore	Brazil

Source: Coleago research

The use of regional licences in the Norwegian 2.6GHz auction did little to stimulate a competitive auction. Only in the region including Oslo, did one of the FDD lots go to a new entrant. For countries with relatively small populations and geographies it would be difficult for regional players to compete against the national players. It is likely, as was the case in Norway, that only the regional containing the national capital or main commercial city, which tends to have higher population density and greater wealth, would attract new entrants.

Best practice recommendation:

- Licences should be awarded nationally unless the country is large geographically, in terms of population and exhibits significant variations between regions.

Coverage

Extending coverage is a critical public policy objective

Extending mobile coverage is often a public policy objective and an area where market forces may not provide an outcome which is compatible with public policy goals. In the absence of a coverage requirement mobile operators will only provide service to those areas which are commercially viable to do so. Any requirement to extend coverage beyond these levels reduces the value of the service or spectrum licence.

Defining coverage is challenging

Defining coverage is often the first challenge in developing an appropriate licence condition. Coverage can be expressed in terms of % of area covered, % of population covered or specific coverage requirements such as highways and railway lines or in-building coverage in urban areas. What constitutes coverage also needs to be carefully considered and defined.

Population, geographic and in-building coverage requirements were a feature of most GSM 900 licences and also many 1800MHz licences and UMTS licences. Due to its propagation characteristics 900MHz is the spectrum by which coverage can be provided most economically in less densely populated areas.

The requirement for in-building coverage was essentially a quality of service requirement. The requirement for geographic coverage was often set in the context of covering facilities that were of economic importance to a country such as key roads, ports and airports. Both of these issues are well addressed by market forces and therefore give no grounds to maintain in the current licence conditions.

There are other regulatory devices for providing coverage in rural areas

The requirement for population coverage or rural village coverage was to force operators to provide service in smaller towns and rural areas. The issue is particularly acute in developing countries like Bangladesh not least because of its geo-demographic characteristics but also because these countries tend to have the highest percentages of mobile users who do not have a fixed line. The issue of service availability outside the commercially most attractive areas is not resolved by market forces. This is specifically recognised in other forms of regulation or policy such as USO or more recently in the proposal in the Digital Britain Report to finance rural broadband coverage through a tax on telephone lines or as in the case of India the creation of a USO fund by levying a tax on operators' revenue.

The need to have access to mobile voice communication in rural areas has not diminished. The increased importance of having access to broadband services also applies to rural areas. Indeed, mobile broadband services could play a key role in bringing broadband access to rural populations. The UMTS licences have coverage roll-out requirements based on population coverage to ensure that not just people in urban areas have access to wide-band mobile data services.

Coverage requirements may conflict with other elements of best practice

Some current thinking appears to move away from coverage requirements. For example, the draft European Commission Recommendation on "WAPECS" (on the non-technical conditions attached to the rights of use for radio frequencies under the regulatory framework for electronic communications in the context of the Wireless Access Policy for Electronic Communications), in recital 8, states

"Coverage obligations to ensure effective and efficient use of radio spectrum tend to be difficult to enforce. Moreover, application of different coverage conditions to networks converging towards provision of similar end-user access services is increasingly questionable in the light of the principles of technological neutrality and ensuring effective competition."

India has used reverse auctions to encourage the extension of coverage in rural areas

In India for instance, competition among the operators has resulted in widespread availability of affordable mobile services with levels of coverage being a key means by which operators seek a competitive advantage over their rivals. Another approach taken in India was to change the underlying economics of extending coverage to rural

areas by holding a reverse auction for the amount of government cash support for each of several hundred sites identified by the government.

A rollout coverage condition offers a mechanism for ensuring that spectrum is utilised and prevents spectrum hoarding. Coverage requirements also provide a tool for achieving an important public policy objective. Any coverage conditions do not want to be too onerous such that they may reduce the attractiveness of the licence to new entrants. Any condition must also recognise the different investment profiles that incumbents and new entrants will face when contemplating network rollout.

Best practice recommendation:

- coverage requirements should be used in conjunction with other measures to promote the extension of coverage to rural areas

Spectrum caps

Spectrum caps are often used to promote or maintain levels of competition

Spectrum caps place limits on the maximum holdings that any one operator can hold of all or sub-sets of mobile spectrum. The main objective of spectrum caps is to avoid a potentially uncompetitive concentration of key spectrum bands amongst a limited number of mobile operators. If a cap is too large it will fail to encourage competition, if it is too small it may result in the inefficient use of the spectrum as operators cannot fully exploit the benefits of new technologies (i.e. LTE) which are spectrally most efficient when deployed in wide channels. Spectrum caps have also been used to create additional competition in an auction context through creating spectrum scarcity.

Sub 1GHz spectrum is particularly attractive due to superior propagation characteristics

Sub 1GHz spectrum offers significant advantages compared to higher frequencies in terms of coverage leading to lower capital expenditure and operating costs (less base stations and less maintenance of those base stations). This is particularly advantageous in rural areas as well as in relation to providing in-building coverage. Pakistan recognised this and while awarding new licences in 2004, in order to create a level playing field, initiated the re-farming of 900 MHz and had to claw back some of the already assigned spectrum from incumbents to ensure that all the players had the requisite sub 1 GHz spectrum.

In the UK 900MHz is held by only 2 out of 5 players. There are current proposals that would restrict 900MHz players from participating in the auction for 800MHz spectrum arising from the “Digital Dividend. This includes proposing safeguard caps on sub-1GHz and overall spectrum holdings in the auction. The stated intention is not to prevent bidders from acquiring efficient quantities of spectrum, but to prevent them acquiring more spectrum than likely to be needed in practice.

Different approaches have been adopted across Europe

In some of the European consultation documents on 900MHz, 1800MHz and 800Hz there is evidence of contingent caps, with caps being set with reference to operators’ spectrum holdings in other bands. In Italy a cap of 2x25MHz spans both 900MHz and 1800MHz. Although in current consultations they are considering lifting this cap. The justification for the contingent cap was to guard against spectrum hoarding.

Exhibit 27: Spectrum caps

Country	Sub 1GB	Above 1GB
Norway	n/a	90MHz 2.6GHz either FDD/TDD
New Zealand		40MHz 2.3GHz either FDD/TDD
Singapore	900MHz 2x15MHz	Total (900&1800MHz) 2x30MHz
Sweden		140MHz 2.6GHz either FDD/ TDD
Hong Kong		2x15MHz 2.6GHz FDD
Netherlands		Depending on existing holdings: TDD between 2x5MHz to 2x20MHz FDD between 15MHz and 50MHz
Denmark		2x20MHz 2.6GHz FDD

Country	Sub 1GB	Above 1GB
Germany	2x20MHz for sub 1GB including existing 900MHz	1800MHz 2x10MHz for operators with 900MHz and 2x15MHz for operators without 900MHz
Austria		2x30MHz 2.6GHz FDD
Finland		50MHz 2.6GHz either FDD or TDD
India		2x5MHz per region
Ireland	1GHz cap of 2x20MHz	Plus total cap multi-band cap (800,900,1800) of 2x50MHz
Switzerland	2x30MHz sub 1GHz	If an operator has 2x15MHz or more Sub 1GB, they cannot get more than 2x30MHz 1.8GHz 2x30MHz 2.1GHz

Source: Coleago research, regulator websites and consultations

In the German 800MHz consultation they recognised the importance of sub 1GHz spectrum and are proposed a cap of 2x20MHz which is applied across both existing 900MHz holdings and future 800MHz holdings i.e. An operator with 2x10MHz 900MHz will have a cap of 2x10MHz 800MHz spectrum.

Spectrum caps seek to promote competition and the efficient use of spectrum by spreading the ownership of spectrum over a greater number of operators. If caps are too small it can lead to inefficiencies as operators are unable to fully exploit the benefits of some technologies. A hard cap that ensures that at least 4 players could acquire spectrum would promote competition and increase the likelihood of efficient spectrum use.

Best practice recommendation

- Regulators should consider setting cap on overall spectrum holdings while ensuring that the each of the players have sufficient sub 1G spectrum (safeguard cap) to ensure a competitive market.

Neutrality

Neutrality as a licence condition can take on different meanings. Neutrality is often discussed in terms of

- net neutrality;
- technology; and
- devices.

We discuss each dimension in turn below.

Net Neutrality

Net neutrality implies that licensees would not be able to treat different services differently on their networks

Net neutrality implies that licensees would not be able to treat different services differently on their networks. The subject of net neutrality is a major issue for all telecoms networks and regulators. Regulation in relation to net neutrality should be considered across all spectrum bands and all telecoms networks before developing licence conditions in relation to one specific element of the telecoms industry. To date no mobile licences we have reviewed included a clause in relation to net neutrality. However, we present some initial thoughts on net neutrality below.

Some operators are seeking to block certain types of traffic

Operators are expected to be neutral in relation to the applications and services delivered over their networks, in line with their role as publicly licensed operators. "Neutrality" in the sense that operators should not interfere with the traffic that their

customers wish to send is already a requirement of the standard licensing conditions. However, some operators are seeking to block certain services such as mobile VoIP (e.g. mobile Skype) although others, such as 3, are using the offering of Skype on a mobile phone as a source of differentiation.

Traffic discrimination may be essential for network management reasons

It is important that operators should be allowed to discriminate between different types of traffic on their networks for traffic management purposes. In principle, licensees should be able to operate their networks as they see fit, including being able to treat premium traffic with higher priority. The growth in internet video and internet TV services is placing increasing pressure on operator networks. Without the flexibility to discriminate different services at busy hour periods there may be serious implications for network quality. A distinction needs to be made between services blocked for network management purposes (i.e. during busy hour) and services blocked to protect operators revenue streams e.g. Skype, Twitter (both low bandwidth services) It is not in the public interest or in the interests of competition to allow operators to discriminate which services they carry and which they do not but it may be necessary to do so at the busy hour for traffic management purposes.

The FCC is proposing new neutrality rules disallowing data discrimination to address the growing practice i.e. Comcast discriminating against P2P applications, AT&T prohibiting the i-phone version of slingplayer (TV application) operating on its 3G network, T-Mobile blocking Twitter. The new guidelines will “prevent wireless companies from blocking internet applications and prevent them from discriminating (or acting as gatekeepers) to web content and services.

Julius Genachowski, the chairman of the FCC, recently made the following comments on net neutrality: “This is the power of the Internet: distributed innovation and ubiquitous entrepreneurship, the potential for jobs and opportunity everywhere there is broadband,” he said. “Saying nothing — and doing nothing — would impose its own form of unacceptable cost. It would deprive innovators and investors of confidence that the free and open Internet we depend on today will still be here tomorrow. It would deny the benefits of predictable rules of the road to all players in the Internet ecosystem.”

Initial recommendation on best practice:

- Best addressed by primary legislation in the country.

Technology Neutrality

Technology neutral licences do not prescribe technologies to deploy

An approach to granting of licences without specifying the technology to be deployed provided it does not cause unacceptable interference to other spectrum users.

Conditions on technology neutrality ensure that the licences are future proof with respect to technology evolutions. Technologies are evolving at increasing speeds and operators need the flexibility to deploy new technologies when required by the market. For example the demand for mobile data services is forecast to grow exponentially. To meet this anticipated growth in demand operators will need the flexibility to deploy the future technologies (i.e.LTE) to meet data capacity needs of their customers. Technology neutrality will support and promote the optimal and efficient use of spectrum. In addition technology neutrality will encourage innovation in new technologies.

There is some risk from a lack of harmonisation

There is a potential risk that technology neutrality could result in a lack of harmonisation across markets. The success of GSM has demonstrated the economic benefits of harmonisation. In future, devices are likely to be increasingly multi-band / multi-technology which will reduce the risks of a lack of incompatibility across markets.

In the short term however operators will continue to seek to serve GSM customers for as long as it is commercially optimal to do so. These customers may be domestic customers who have not yet migrated to a new device or GSM based in-bound roamers from other markets. The decision to deploy a new technology will be a

commercial decision for operators based on which technology will generate the greatest returns. This in turn will be determined by which technology provides the greatest utility or benefit to the market.

The 900MHz licence renewals in Australia, New Zealand, Hong Kong, Sweden and Norway have all been on a technology neutral basis. Technology neutrality increases the likelihood that spectrum is efficiently used; increase the attractiveness of licences to new entrants and future proofs the licences with respect to technology evolutions.

Best practice recommendation:

- Licences should be issued on the basis of technology neutrality in line with the practice in developed markets.

Device neutrality would prevent operators from signing exclusive device deals

Device Neutrality

Device neutrality would prevent operators from signing exclusive deals with device operators. No conditions on device exclusivity have been found in any of the licences reviewed in this research. However, the successful launch and the exclusive nature of Apple's deals for the iPhone have raised the issue of device exclusivity in some markets like Europe. The same issue has recently been raised in the US. Therefore, despite no previous licences containing such a condition we believe it is important to consider an issue which is gaining greater importance.

The French Conseil de la Concurrence (Competition Council) announced on 17 December 2008 its preliminary decision that availability of the iPhone should not be limited to Orange's customers. This was upheld by the Cour d'Appel (Appeal Court) in Paris on 4 February 2009.

This suggests that the competition law mechanism in France is well equipped to deal with alleged abuses of dominant position. A dominant fixed operator which secured an exclusive deal to supply certain types of CPE could not be dealt with by a spectrum licence condition but would be vulnerable to action under the competition law. It would be hard to specify a rule which did not prohibit exclusive deals by a dominant operator for insignificant items. The issue of device exclusivity is best addressed through competition legislation.

Best practice recommendation:

- No licence conditions relating to device neutrality

Service quality cannot be specified if accompanied by net neutrality conditions

Service quality

Service quality conditions would identify which services should be delivered by when and to what level of performance or quality. Any conditions relating to service quality, performance and other obligations relating to services would require the specification of the services to which these elements must apply. A specification of services however is contradictory to the recommendation on net neutrality. Therefore there are limited specific licence conditions which may be considered this area.

In relation to non-voice services, given the rapidly evolving mobile technology and the recommendation for a technology neutral licence, it would be impossible to prescribe technology dependent standards in the licence. However, there may be a future need to set minimum performance standards in the interest of users.

Typically GSM licences have standards on service and billing standards. With a provision that enables the authorities to change those service standards. These conditions seek to protect consumer interests.

Voice is such a critical service that some form of quality of service condition may be appropriate

In most markets, particularly in developing countries, voice services continue to provide the greatest source of revenue for operators and customers will always require a voice telephony service. We believe that providing a voice service will remain a commercially viable proposition for at least one operator in any market. A well functioning voice

telephony service is of great importance to Ireland and we believe that market forces will ensure that such a service continues to be offered. Where an operator chooses to provide a voice service certain conditions relating to the quality of that voice service should be specified.

Best practice recommendation:

- Conditions to ensure quality of voice services and those that seek to protect consumer interests should be maintained especially in countries where consumer protection institutions are not well developed.

“Use it or lose it”

A “use it or lose it” condition is designed to discourage inefficient spectrum hoarding

This condition is included to discourage spectrum hoarding. A “use it or lose it” condition potentially addresses any risks arising from spectrum hoarding resulting in inefficiency of spectrum use and a failure to fully promote competition. A licensee would have to use the spectrum to a certain extent by a certain date, or the licence would be revoked.

The scope for speculation in relation to spectrum is limited

Regulators have proposed including such a condition to deter speculators from acquiring the spectrum with the intention of reselling it for a profit. However, our analysis suggests that it is difficult to develop a condition that would effectively target speculators without potentially inflicting inefficiencies on operators who acquire with a view to delivering telephony services. In markets where spectrum trading is not possible the role for financial speculators is limited due to the absence of a secondary market. If speculators anticipated a change in the law to permit trading an efficient auction design will reduce the likelihood of financial speculators acquiring spectrum. To secure spectrum in the auction they would have to value the spectrum more highly than an operator. Speculators acquiring spectrum in an efficient auction will have paid more than the operators were prepared to pay and so a speculator would not be able to make a profit on the subsequent resale of the spectrum.

Operators pose the more likely threat in relation to hoarding of spectrum but hoarding by operators can be prevented through the use of an appropriate spectrum cap.

The drawbacks of such a condition are:

- it is difficult to define and detect when spectrum is being used or not used. For example, how little a use would constitute “no use” (whether considered in terms of bandwidth, location or time)? By what standard would inefficient spectrum use be judged? Implementing and monitoring the condition will be difficult;
- there is a need to distinguish between efficient episodic / temporary utilisation and genuine under utilisation;
- such a condition can be circumvented by a licensee finding temporary uses for the spectrum;
- there are circumstances where it may be efficient to keep spectrum idle e.g. waiting for a market uncertainty to reduce. In such circumstances forcing the use of spectrum may encourage investment to be made too early and hence inefficiently; and
- nationwide frequency assignment might make assessment difficult. There are examples in Germany where assignees with a nationwide frequency assignment have been using the spectrum only in a few big cities.

The International Benchmarks indicate opposing views on the “use it or lose it” condition. Ofcom, the UK regulators views on hoarding, speculation and “use it or lose it” conditions are of interest:

“We expect that as a market in spectrum becomes established we may see similar activities to those that occur in other markets, such as speculative acquisition. In general, we do not see this as a problem. For example, a speculator who conjectures

that a new technology will shortly emerge and who buys spectrum but then leaves it unused as technology develops may increase the value derived from the spectrum. This is because, were it immediately put into use, it might prove more difficult to re-farm to the new technology with resulting loss in value to consumers. Speculators may also play useful roles in consolidating fragmented spectrum holdings or otherwise adding value to the market. Given that this kind of activity can be very beneficial to consumers, we do not generally propose to employ “use it or lose it” clauses which would limit licensee’s flexibility about when and how to use spectrum.

We do, however, need to be wary of the risk that the acquisition of spectrum could be anti-competitive. For example, an operator might acquire spectrum purely in order to prevent the entry of a new competitor. Given the already competitive nature of most wireless services and the increasing amount of spectrum available in a wide range of bands we do not expect to see this happening, but it is an important issue that we will consider carefully. If we believe that the risk is large enough then there are powers available to take appropriate action.”

The trend is away from “use it or lose it” conditions

In several European countries, “use it or lose it” conditions have been attached to spectrum usage rights. In the German UMTS auction of 2000, interested parties had to deliver a frequency usage concept explaining how they would use the spectrum. In more recent licences for 2.6GHz, 900MHz and 800MHz (German consultation) no “use it or lose it” conditions have been attached to the licence.

The New Zealand 2.6GHz licence has a specific use it or lose it clause. Hong Kong manages through the mechanism of a performance bond.

There are a number of drawbacks of a “use it or lose it” condition such as that it is difficult to detect and monitor under utilisation, any conditions can be easily circumvented and there are difficulties in identifying genuine temporary under utilisation. Given the many drawbacks, obligation to ensure the efficient use of spectrum and prevention of hoarding may be better addressed through spectrum caps, efficient auction design or spectrum usage fees to reduce the likelihood of spectrum hoarding.

Best practice recommendation:

- Licence conditions should not include a “use it or lost it” condition

Infrastructure sharing

Market dynamics have promoted infrastructure sharing

This is an obligation on licence holders to share masts, ducts and other facilities, and or to co-locate on commercial terms. In the US, Australia and Europe restrictions placed by various local bodies on installation of mobile towers, passive infrastructure sharing viz., building, tower, dark fibre etc. amongst service providers has become a norm rather than exception. Market forces rather than an explicit licence provision drove this change.

In India, the regulator does not mandate but permits a holder of an operating licence to share both passive and active infrastructure limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system only. Market conditions brought about by the entry of a large number of new entrants and reduction in the overall tariffs from fierce competition encouraged the operators to share infrastructure.

Best practice recommendation:

- No licence condition required.

National roaming

Mandating national roaming can facilitate new market entry

This obligation to provide national roaming is introduced to encourage entry of a competitor so that the entrant can provide national coverage from the outset even if it

does not have national infrastructure. Regulators have to strike a balance between promoting competition and encouraging infrastructure investment from the new entrant.

Existing operators with national coverage would have a distinct competitive advantage over a new entrant without an existing nationwide network. Without a national roaming agreement any new entrant would struggle to compete with existing operators with nationwide networks. In UK the existing operators were required to offer the new entrant 3UK, national roaming on terms that were fair, reasonable and not unduly discriminatory when 3 UK had rollout its network to 20% of the population. 3UK continues to rely on its national roaming agreement to remain competitive despite having network coverage of 90% of the population. It is not cost effective for 3UK to rollout its network for the last 10% of population yet to remain competitive in the UK market 3 has to offer a nationwide service. 3 struck similar agreements in Austria, Italy and Ireland.

Roaming is combined with minimum roll-out requirements for new entrants

In Ireland national roaming on the incumbents' existing GSM networks was mandated for the new entrant 3 in 2002, but only after it had deployed its 3G network to 20% of the population, and the roaming would be effective for only 5 years after the license award to 3.

For national roaming to be of value to a new entrant the price needs to be "fair, reasonable and not unduly discriminatory". The regulator in New Zealand believes that prices of national roaming in New Zealand are discriminatory and bear no reflection to the costs; as a result, it is currently considering enhancing the regulation to include the pricing of national roaming. Many of the territories in our benchmarking allowed national roaming but none had regulated the price of national roaming.

Licence conditions on coverage rollout and conditions allowing national roaming only after a new entrant has met some roll out conditions (i.e. 20% population) would encourage the new entrant to invest in infrastructure.

Mandating a national roaming obligation may result in additional administration costs although these are likely to be small when compared to the benefits of additional competition.

Of countries surveyed only the UK, Hong Kong and Canada have licence conditions pertaining to national roaming. In Canada national roaming has been mandated on both AWS and PCS spectrum. In Hong Kong national roaming is not permitted.

A condition on national roaming would make the licence more attractive to new entrants. National roaming enables new entrants to offer a nationwide service whilst it is rolling out its network. Roll-out conditions should mitigate the potential risk that new entrants relies on national roaming and fails to invest in infrastructure.

Best practice recommendation:

- Mandate national roaming once the new entrant has rolled out its network to a specified percentage of the population while ensuring that the price of national roaming is fair, reasonable and not unduly discriminatory.

Conclusions and recommendations

The Cave Review, December 2005, of spectrum management in the UK recommendation with which we agree states:

"The [regulator] should aim minimising the licence conditions to those necessary for efficient spectrum use. Existing licences should be amended to remove restrictions which are not needed for reasons of international co-ordination or interference management, and new licences should be issued with the minimum number of restrictions possible."

We have carefully considered a list of possible licence conditions. In many of these cases, we recommend that there should be no licence condition or the least onerous of licence conditions. In summary we believe the following constitutes best practice:

- granted for a minimum duration of between 10 to 15 years; and
- all new licences should be co-terminus in relation to the expiry date.
- Licences should be awarded nationally unless the country is large geographically, in terms of population and exhibits significant variations between regions.
- Regulators should consider setting cap on overall spectrum holdings while ensuring that the each of the players have sufficient sub 1G spectrum (safeguard cap) to ensure a competitive market.
- Best addressed by primary legislation in the country.
- Licences should be issued on the basis of technology neutrality in line with the practice in developed markets.
- No licence conditions relating to device neutrality
- Conditions to ensure quality of voice services and those that seek to protect consumer interests should be maintained especially in countries where consumer protection institutions are not well developed.
- Licence conditions should not include a “use it or lost it” condition
- Sharing No licence condition required.
- Mandate national roaming once the new entrant has rolled out its network to a specified percentage of the population while ensuring that the price of national roaming is fair, reasonable and not unduly discriminatory.

Appendix E: Glossary of auction related terms

In order to facilitate the use of this report, we have provided a simplified set of definitions of the key auction related terms below.

1st price rule: In a Dutch auction the auctioneer announces a high opening price and reduces the price until a buyer is prepared to buy the lot at the announced price – this is an example of a 1st price auction rule. In a 1st price sealed bid auction bidders place their bids in an envelope and the highest bidder wins and pays the amount of their highest bid. This is another example of a 1st price rule. Under certain assumptions these auction formats are equivalent.

2nd price rule: In a classic English ascending auction, bidders continually raise their bids until there are no further bids at which point the auction ends. The bidder with the standing highest bid is the winner and pays the amount of that bid. The price in such an auction is effectively determined by the price of the 2nd highest bidder as the winning bidder need only bid a small increment above the 2nd highest price in order to end the auction and secure the lot. This is an example of a 2nd price rule. In a 2nd price sealed bid auction bidders place their bids in envelopes and the highest bidder wins but he pays the amount of the 2nd highest bidder. This is another example of a 2nd price rule. Under certain assumptions these auction formats are equivalent.

Activity rules: Rules that govern the way bidders may behave when placing their bids from round to round during an auction. There are many different types of activity rule and they are used to influence the behaviour of bidders.

Affiliated information: A situation where if the value that one bidder places on a lot is high then there is an increased likelihood that other bidders also place a high value on the lot.

ARPU: Average Revenue per User

Bidder credits: A device used by the Federal Communications Commission of the US to place weaker on a more equal footing with larger bidders.

Budget constraint: A financial limit placed on a bid team which represents a ceiling above which their total expenditure in an auction cannot exceed.

CCA: Combinatorial Clock Auction is an auction format which allows bidders to express demand for combinations of lots at a given set of prices which tick up during each round of a clock phase.

Collusion: Bidding strategies designed to coordinate a specific auction outcome amongst a number of bidders.

Common value: Where the value of an auction lot is the same for all bidders.

Common value uncertainty: The situation where there is uncertainty over the common value of an auction lot.

Complements: Auction lots are said to be complements if the value of the lots together is greater than the sum of the individual parts.

Continuity risk: Arises when existing spectrum holdings are to be renewed through auction and represents the risk that the current holder of the spectrum fails to secure the spectrum in the auction putting at risk the continuation of their business.

Discounted Cash Flow analysis: A financial analysis technique which adjusts future cash flows for risk and the time value of money (an AUS\$ is worth more today than an AUS\$ in a year's time) and expresses their value in a single, equivalent amount in today's terms.

Economic efficiency: The allocation of resources to bidders who are able to generate and therefore place the greatest social value on the resource.

Eligibility: Usually expressed in terms of points and determined by activity rules and set out the number or value of lots on which a bidder is allowed to bid at each stage of the auction.

Exposure risk: The risk of bidding for a group of complementary lots at prices which reflect the synergies of the lots but then being outbid on some elements of the group leaving the bidder paying a price which exceeds the value of the remaining lots. Exposure risk is present if the bidder cannot avoid paying for the remaining lots at the prices which reflect the value of the synergies which are now no longer available.

Fragmentation risk: A form of exposure risk where the bidder bids on the basis of being awarded contiguous spectrum lots which it values more highly than non-contiguous spectrum and then faces the risk of being outbid on a lot and then not being able to avoid paying for the remaining lots at the prices which reflected contiguous spectrum.

Free riding: Benefiting from the actions of another without contributing to the generation of the benefit.

Generic lots: Bidders when placing a bid for a generic lot do not know the specific position of the lot in the frequency range.

Lots: Individual items available for auction

LTE: Long Term Evolution is a 4th generation mobile broadband technology

Monotonicity: A monotonic function is one that preserves the order of the items subject to the function. In an auction context an activity rule may require monotonicity in demand which means that demand can only ever stay the same or decline round on round.

Net Present Value: The result of applying discounted cash flow analysis. In a mobile valuation context it is the adjusted value of future cash flows generated by the business which gives an equivalent, single amount in today's terms which is equal to the future cash flows from the business.

Package bidding: The ability to place a bid for a combination of lots where the bidder will either win all the lots in the combination or package or none at all. Package bidding is often cited as a potential solution for mitigating exposure risk.

Parking: Bidding on lots in an auction which the bidder does not want and on which he expects to be overbid but does so in order to preserve eligibility.

Predation: A bidding strategy aimed at weakening or intimidating other bidders.

Price increment: The amount by which the price of a lot increases in a multi-round auction

Private value: Where valuations for lots are idiosyncratic to individual bidders.

Reserve prices: The minimum price at which a lot may be sold.

SMRA: Simultaneous Multi Round Ascending auction – an auction where multiple lots are auction simultaneously in an auction comprising a number of rounds and where the prices of the lots increase in each round.

SMRA-AS: Simultaneous Multi Round Ascending auction with Augmented Switching – an auction similar to an SMRA but bidders are able to switch their bids across lots. The ability to switch can help alleviate exposure risk.

Sniping: A bidding strategy of placing a bid in a time bound auction at the final stages of the auction to prevent other bidders from having the opportunity to place another bid.

Specific lots: When placing a bid the bidder knows exactly where in the frequency range the lot is placed.

Spectrum caps: A limit to the amount of spectrum a bidder can bid on or hold at the end of the auction.

Strategic bidding: Not bidding sincerely based on the true value the bidder places on the spectrum.

Strategic demand reduction: A tactic of reducing the demand for a desired lot in the hope of limiting the increase in price for other desired lots.

Substitutes: Two lots are substitutes if the demand for one lot will increase if the price of the other lot rises as the bidder will substitute the cheaper lot for the more expensive lot.

Substitution risk: The risk that a bidder cannot swap their demand from a high priced lot in favour of a substitute lot which could be acquired at a lower price.

Threshold problem: The challenge for regional bidders in coordinating their individual bids in order to over bid a national bidder.

Transparency: The degree to which information is provided to bidders at the start of an auction and during each round of an auction.

Vickrey pricing: Another term for a 2nd price rule.

Winners curse: An outcome where a bidder secures a lot in an auction and then subsequently discovers that they paid more than the value they placed on the lot

Appendix F: Auction descriptions

The three alternative simultaneous auction format that have been used in countries around the world are:

- Simultaneous multi-round ascending auction (SMRA) based on the format developed by the Federal Communications Commission (FCC) of the US;
- SMRA with augmented switching proposed by Professor Nils-Henrik M von der Fehr, and developed and implemented in collaboration with the Norwegian Post and Telecommunications Authority (NPT) and the consulting firm Dot Econ.
- The Ausubel, Cramton and Milgrom “standard” combinatorial clock auction implemented using the Dot Econ design (CCA)

SMRA

The description⁹⁸ of a Simultaneous Multi-Round Ascending auction is based on the format used by the FCC in the US prior to the 700MHz auction in 2008.

Distinct as opposed to generic spectrum lots are made available simultaneously through auction. Bidders are required to make an upfront payment in the form of a refundable deposit which determines the bidder’s maximum eligibility in any round. The size of the deposit and the bidder’s maximum eligibility reflects their objectives prior to the auction. The greater the amount of spectrum the bidder seeks the greater the eligibility they require and the larger the deposit. In addition to determining eligibility the requirement of a deposit also deters frivolous participants.

A bidder is able to bid on any combination of licences in any round subject to an activity rule that determines the bidder’s eligibility to bid in that round. The FCC specifies minimum bid increments between rounds which are set at the greater of a percentage increment and an absolute increment. The FCC is able to adjust the size of the bid increment to manage the speed of the auction and to reflect the behaviour of the bidders. During the early stages of the auction when activity levels are high the bid increment is large but as the auction proceeds and activity levels fall the bid increment is reduced. The bid increment is typically in the range of between 5 and 10%.

Activity in the auction is governed by the activity rule proposed by Milgrom and Wilson and provides another mechanism for managing the speed of the auction as well as promoting price discovery. The activity rule requires a bidder to maintain a certain level of activity in order to preserve its current level of eligibility. As the auction develops the activity requirement increases in stages such as initially 60%, then 80% and ultimately 100% in the final stages. If the activity level is set at say, 60%, then the bidder must be active on a set of licences which collectively represent at least 60% of the bidder’s current eligibility. If the bidder’s activity falls below 60% then the bidder’s eligibility in the following round falls to its current level of activity divided by 60%. This calculation recalibrates the bidder’s maximum eligibility such that his current level of activity is now 60% of his revised maximum. When the activity level have reached 100% then any drop in activity below its full eligibility results in a drop to its current level of activity in the next round.

Bidders are able to deploy waivers to prevent a drop in eligibility although the number of waivers is limited. In the FCC auctions the number of allowable waivers is usually five.

A high level of information is provided prior to the start of the auction and at the end of each new round. Each bidder is fully identified and information is provided on their upfront payments and maximum eligibility. High bids and the standing highest bidder are identified after each round as well as all other bidders’ eligibility and any waivers.

⁹⁸ The description is based on the narrative of Peter Cramton (2001) in the Handbook of Telecommunications Economics

A standing high bidder can withdraw their bids subject to a penalty. If a bid is withdrawn the FCC becomes the highest standing bidder at a price equal to the previous highest bid on that lot although the bidder who actually made that bid is no longer responsible for it. This price becomes the minimum bid. If no further bids are made on the lot then the FCC can reduce the minimum bid but it will only reduce the minimum bid, if it chooses to do so, once. The penalty for withdrawing a bid is equal to the cost imposed on the FCC from the withdrawn bid. A cost is imposed on the FCC only if the final sales price is less than the withdrawn bid. The inclusion of withdrawals was designed to allow bidders to manage exposure risk. If an aggregation strategy failed the bidder could withdraw in order to avoid being stranded with an unwanted licence.

A simultaneous stopping rule is used to ensure that all bidders have a full opportunity to implement their bidding strategies. The auction ends when a round passes without any bidding. The absence of any new bids implies that no bidder is willing to raise the price on any licence.

SMRA-AS

The SMRA with augmented switching (SMRA-AS) was first introduced in the 2004 Norwegian 3.5GHz FWA auction and subsequently used in the awards of 2.6GHz band in Norway and Sweden. The design is similar to the SMRA but with a number of significant differences. The switching element was introduced to address exposure risk. Bidders can withdraw standing high bids from lots but they must then submit a corresponding bid or bids on other lots. The withdrawals can only be used to switch demand and not to reduce demand. No penalties are imposed from withdrawing and switching bids. The introduction of augmented switching makes it much easier to shift demand compared to the standard SMRA.

In the first round of the auction the bidders make their initial bids and these bids determine their maximum eligibility for future auction rounds. A key difference from the standard SMRA is that all bids are committing throughout the entire auction unless they are specifically withdrawn and switched to a different lot.

In subsequent rounds, subject to their maximum eligibility, bidders have the choice between:

- Increasing some or all bids;
- Leave some or all bids unchanged; and
- Switch some or all of their bids to lots where it does not currently have a bid.

A bidder can only switch a bid where it is the standing highest bidder. When a bidder switches it must switch to a lot or lots on which it has never previously bid. The switch must adhere to the rule that the total eligibility of all withdrawn bids must be equal to the total eligibility of all new bids.

When a bid has been switched or withdrawn from a lot the next highest bid which has not been withdrawn is reactivated and once again becomes the standing highest bid. The bidder who placed that bid is once again liable for that lot at the standing highest price unless he is subsequently over bid.

The same eligibility rules as the standard SMRA are applied with adjustments made for net bid where standing bids and new bids contribute positively towards eligibility and withdrawals count negatively. Eligibility rules are complicated however by the fact that adjustments may be required when a previously superseded bid is reactivated by the withdrawal of another bidder's bid.

The auction ends when there are no new bids and there are no withdrawals.

Combinatorial clock auction

The auction mechanism presented in this paper is based upon Dot Econ's implementation of an auction design which leans heavily on the clock-proxy auction proposed by Ausubel, Cramton and Milgrom. The design features three stages; a primary or clock stage, a supplementary bids round and finally an assignment stage. Generic lots are used in the primary and supplementary stages to reduce complexity and the assignment stage is used to allocate specific frequencies.

The primary rounds follow a clock auction format. In the first round the auctioneer sets a price for each category of generic lots. The bidders then indicate the number of lots of each category they would wish to acquire at the stated prices subject to any bidding constraints such as spectrum caps.

If demand exceeds the number of available lots in any category then another round takes place and the price for lots with excess demand is increased in line with a pre-determined bid increment. The price of lots where there was no excess demand will typically remain unchanged from round to round. The clock stage continues with increasing prices until there is no more excess demand. All bids made during the primary stage are potentially binding.

The supplementary bids round is effectively a one-off sealed bid where the bidders can submit potentially binding bids that:

- Reflect the full value of the package they were bidding on at the end of the clock phase; and
- To bid for any packages of lots that they were eligible to bid for during the primary round but they did not bid for.

Bidders can make as many supplementary bids as they like subject to caps which are based on their bids during the primary stage and the specific rules of the auction which are designed to provide incentives for sincere bidding throughout the auction process.

At the end of the supplementary stage the winner determination algorithm (which identifies the combination of bids which maximises revenues) is applied to all submitted bids from all rounds and stages of the auction. A further algorithm is then applied to determine the prices to be paid based on a generalised 2nd price rule which ensures that individual bidders and the winning group of bidders all pay at least their opportunity cost. Where the opportunity cost can be viewed as the loss inflicted on the losing bidders as a result of the winning bidders participating in the auction. The pricing algorithm seeks to identify the lowest possible set of prices that the winning bidders could have paid and still received the same allocation of spectrum. Bidders can only be awarded all of the lots within a bid or none at all and, at most, one bid can be accepted from each bidder.

At the end of the supplementary stage winning bidders are guaranteed to win their generic lots. The assignment stage affords the bidders to make another one-off sealed bid in which they can express their preferences for specific lots within the spectrum category. Once again the winning allocation of specific frequencies is based on the maximisation of revenue and the prices are determined with a generalised 2nd price rule.

Appendix G: International approaches to spectrum pricing

As illustrated below, a number of approaches are applied to spectrum pricing.

Although the terminology varies considerable, many of these approaches are consistent with AIP. As such we believe that ODV and BAU are both credible alternative methodologies.

However, we note that ODV is much more widely, and explicitly, used as a basis for calculating spectrum prices.

Exhibit 28: Overview of international approaches to spectrum allocation^{99, 100}

Approach		Commentary
Belgium	Entrance fees	<ul style="list-style-type: none"> One-time fee to reflect market value of spectrum
France	Spectrum usage fees	<ul style="list-style-type: none"> Reflects economic value, encourages efficient use Fee based on bandwidth, authorisation surface and an index of the value of each band
United Kingdom	Administered Incentive Pricing (AIP)	<ul style="list-style-type: none"> Annual fee designed to provide price signal and discovery Also aims to promote spectrum efficiency, innovation and competition Based on ODV approach
Hungary	Reservation fees	<ul style="list-style-type: none"> One-off fee at the time of assignment which is waived in the case of a beauty contest or auction
Ireland	Spectrum access fees	<ul style="list-style-type: none"> One-off fee paid at auction to reflect scarcity value of spectrum
	Spectrum fees	<ul style="list-style-type: none"> Extracts fair value for the use of a scarce national resource Designed as a type of 'congestion charge' to encourage take-up of alternative bands for both new and existing licences
Italy	Usage fees	<ul style="list-style-type: none"> Fee is similar to AIP in that it is designed to ensure spectrum is used efficiently However the fee is not calculated based on opportunity cost
Luxembourg	Spectrum assignment fees	<ul style="list-style-type: none"> Recurrent fee that applies whether spectrum is used or not Designed to incentivise licence holders to quickly put spectrum to use
	Spectrum usage fees	<ul style="list-style-type: none"> A recurrent fee based on actual usage by the operator

⁹⁹ Radio Spectrum Policy Group, "Radio Spectrum Policy Group Report on Assignment and Pricing Methods", 2009

¹⁰⁰ Note: all countries in the table also have an additional yearly fee designed to cover the administrative costs of spectrum management

Approach		Commentary
		<ul style="list-style-type: none"> • May increase or decrease based on actual usage by operator
Netherlands	Bid	<ul style="list-style-type: none"> • Auction or beauty contest bid
	Financial fees	<ul style="list-style-type: none"> • Stimulate efficient use of the spectrum by charging the 'real market value' of the licence • Reflects opportunity cost or the alternative costs that a licence holder would need to make if denied access to the spectrum • Based on ODV approach
New Zealand	Optimal deprival value (ODV)	<ul style="list-style-type: none"> • Reflects the cost that the licence holder would need to incur to provide the same service should the licence be removed
Norway	Spectrum fees	<ul style="list-style-type: none"> • For incentivizing more efficient spectrum use
Portugal	Spectrum fees	<ul style="list-style-type: none"> • Recurrent fee designed to reflect economic value of the spectrum and to encourage efficient usage • Depends on several factors including frequency band, bandwidth, link length, number of radio stations etc
Slovakia	Spectrum fees	<ul style="list-style-type: none"> • Fees calculated from the estimated profits of the provision of the service
Switzerland	Licence fees	<ul style="list-style-type: none"> • Tax to reflect exclusive use of a public good • Depends on the assignment procedure and can take the form of a one-off fee (auctions) or recurrent fee (beauty contest or first come first served)

Source: Radio spectrum policy group

Appendix H: International benchmarks

Comparing recent versus historic spectrum auctions within individual markets provides insight into the general spectrum pricing trends since the turn of the millennium. We were able to source data from nine countries in which auctions were used both recently and historically for spectrum of comparable value.

As illustrated in the table below, the overall trend has been towards declining spectrum prices over the past decade.

Table 26: Recent versus historical auction prices (US\$/MHz/pop)

Country	Historic auctions			Recent auctions			% Price delta
	Year	Band	Price ¹	Year	Band	Price ¹	
Austria	2000	2.1GHz	0.79	2010	2.6GHz	0.03	-96%
Denmark	2000	2.1GHz	0.82	2010	2.6GHz	0.16	-80%
France	2001	2.1GHz	0.35	2009	2.1GHz	0.52	+46%
				2010	2.1GHz	0.62	+75%
				<i>Average:</i>		0.57	0.57
Germany	2000	2.1GHz	5.25	2010	2.1GHz	0.14	-97%
				2010	2.6GHz	0.03	-99%
				<i>Average:</i>		0.09	0.09
Italy	2000	2.1GHz	1.58	2009	2.1GHz	0.19	-88%
Netherlands	2000	2.1GHz	1.65	2010	2.6GHz	0.00	-99%
Norway	2001	1.8GHz	0.32	2007	2.6GHz	0.03	-88%
Singapore ²	2001	2.1GHz	0.62	2008	0.9GHz	0.01	-99%
<i>Average</i>			1.43			0.14	-90%

¹ Note: Prices all quoted in US\$ per MHz per pop at June 2010 exchange rates (eliminates the impact of foreign exchange fluctuations on price trends)

² Note: Although low-bands are not directly comparable with higher bands, the Singapore benchmark of the recent 900MHz sale versus historic 2.1GHz is interesting as 900MHz typically attracts higher valuations

Source: Regulator websites, analyst research, Coleago analysis

With the exception of France, all markets in the above sample have shown declines in average auction prices per MHz of between 80% and 99.9%. On average, recent auction prices per MHz stand at circa 10% of the prices realized in 2000-2001.

The exceptionally high spectrum values obtained in 2000/2001 may be explained by the following factors:

- 2000/2001 auction prices were inflated by prospective new entrants, with ready access to capital during the technology bubble
- Mobile operator valuations were at their peak (for example, shares in the Vodafone Group in early 2000 were ~225% higher than today)
- At the height of dotcom era, 3G spectrum was regarded as a prerequisite for the long-term survival for mobile operators (mobile revenues were already stagnating or in decline, and 3G services were perceived as the key growth area)
- Harmonized mobile spectrum was scarce, and 3G frequencies represented the only spectrum suitable for high-speed data

- No mitigating strategies for spectrum insufficiency were perceived by operators at the time of the 3G auctions

Contrasting circumstances since 2007 account for the declining trend in spectrum prices:

- Traditional new mobile entrants are discounted in most markets
- Significantly more 3G+ enabled spectrum is available across a variety of bands
- Consolidation in many markets has further alleviated competition for spectrum resources
- Pressure on operator margins and substantially reduced access to capital has led to budget constraints
- Unprecedented rates of price erosion for mobile data put pressure on spectrum valuations (for example, prices today are roughly a 1/1000th relative to 5 years ago)
- Significant mitigating strategies currently exist for spectrum insufficiency including WiFi offloading and network sharing (to increase network capacity)

Appendix I: References for spectrum pricing

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