

Delivering spectrum for mobile broadband: the role of spectrum valuation

Phillipa Marks, Yi Shen Chan and Sarongrat Wongsaroj

There is a widespread consensus that more spectrum needs to be allocated for mobile broadband. The ITU has forecast a requirement for 1720 MHz by 2020 up from around 300-600MHz assigned today. Many countries in Europe, North America and the Asia Pacific have published targets to increase the amount of spectrum for mobile services by 2020. Much of this spectrum will have to come from other users. To ensure that spectrum release is efficient and generates the expected economic benefits, an assessment of the economic value of spectrum to mobile and the costs of moving incumbents will be necessary

Why value spectrum?

Spectrum is a scarce resource and ensuring its efficient allocation and assignment requires the assessment of its economic value. Spectrum is often valued in the following situations:

- Spectrum assignment – valuation is required to determine reserve prices in spectrum auctions or tender processes
- Spectrum fees – regulators need to estimate spectrum value in order to set spectrum usage fees that go beyond cost recovery (e.g. administered incentive pricing)
- Spectrum trading – in secondary markets, both buyers and sellers need to assess the value of spectrum in order to arrive at a mutually acceptable price point

Spectrum has value because it allows users to provide services that have market or social value, to enhance service quality and/or to reduce the costs of providing services. For mobile operators the value of an increase in spectrum holdings might include increased revenues and/or network cost savings. For non-commercial users the value of spectrum might comprise reduced operating costs and enhanced operating performance (e.g. enhanced policing or defence capability).

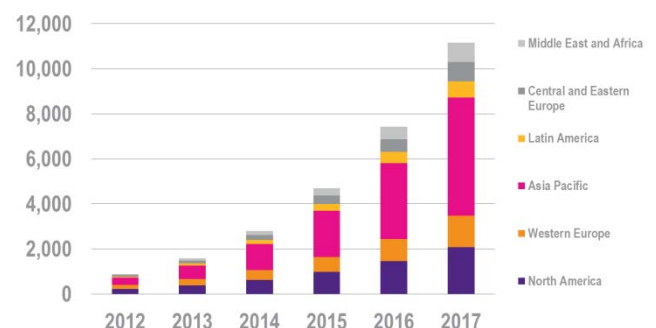
Spectrum valuation aims to quantify some or all of these benefits of spectrum use.

Spectrum valuation and reallocation decisions

A reallocation of spectrum is economically beneficial if the benefits to the new user exceed the costs to the incumbent user of moving. Robust spectrum valuation is therefore required if governments and regulators are to have confidence that they are making the right decisions.

The forecast of rapid growth of traffic on mobile networks (see figure below) means many governments and regulators are seeking to make more spectrum available for mobile services through reallocations. Additional spectrum, along with new technologies and more base stations, will enable mobile networks to cope with this traffic growth.

Mobile data traffic, PB/month

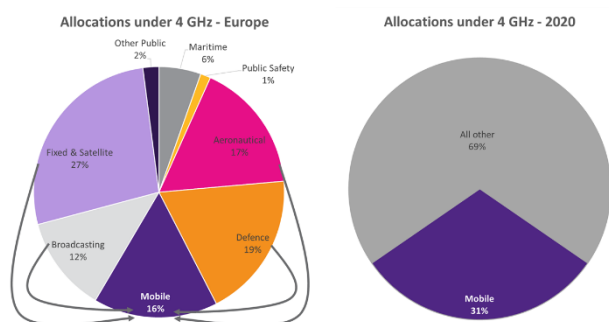


Source: Plum Consulting, Cisco

There are published targets in Europe, North America and Japan to double the amount of spectrum for mobile services by 2020. The next World Radio Conference in 2015 will debate the possible bands

may be allocated for mobile broadband applications over the next 10 to 15 years (Agenda item 1.1).

However, all of the potentially useful spectrum for mobile (i.e. 400 MHz – 4 GHz) has been allocated to different uses. Any increase in spectrum for mobile services means a reduction in spectrum allocated to one or more of the other major uses – defence, broadcasting, fixed services or possibly aeronautical. The figure below shows the allocations for a typical European country.



Source: Plum Consulting

Reductions or changes in allocations can involve significant costs for incumbent users who will be reluctant to move, even if offered alternative spectrum.

Examples of possible future reallocations to mobile services being considered at present include:

- Broadcasting allocations at 600/700 MHz in Asia, the Americas and Europe
- Defence, fixed and wireless camera links at 2.3 GHz in Europe and Asia
- Fixed links, satellite and radar applications at 3.4-3.8 GHz in Europe and the US
- In some cases novel geographic sharing arrangements are being considered, e.g. at 2.3 GHz in Europe¹ and at 3.5 GHz in the US.²

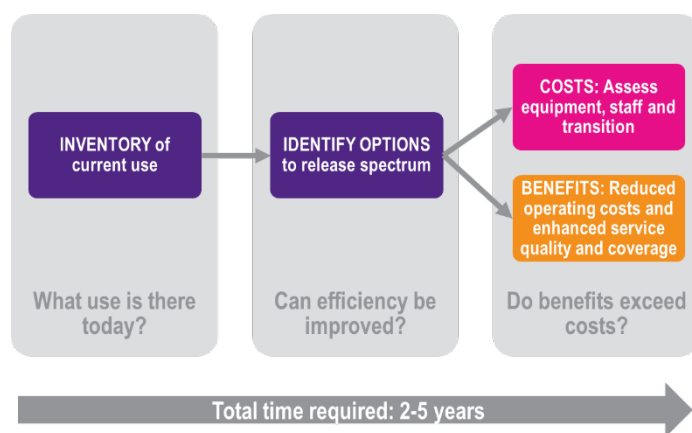
Using valuation to incentivise spectrum release/sharing

Policy makers may therefore seek to persuade incumbent users to move or put in place financial

incentives for change such as a “carrot” in the form of financial compensation or a “stick” such as spectrum pricing. All of these policies require spectrum to be valued.

Persuasion can be strengthened by evidence on the extent and nature of incumbent use, the costs of change and the economic and social benefits from the new use. It is not always the case that the benefits will exceed the costs, but if they do the case for change is much more powerful.

The steps involved are as follows:



The spectrum valuations required for making well supported and defensible reallocation decisions are: (a) the value of spectrum to the incumbent, and (b) the value of an increase in spectrum holdings to a mobile operator.

The value of an increase in spectrum holdings to a mobile operator will include increased revenues for (since additional spectrum allows service quality to be improved and/or more traffic to be supported, allowing additional revenues to be earned) and/or reduced costs (since additional spectrum allows operators to reduce costs because fewer base station sites are needed to provide traffic capacity/coverage).

The value of spectrum to the incumbent will include the costs of new equipment (transmitters and receivers), transition costs (e.g. if dual running of services is required as with digital TV switchover) and, for commercial services, any negative impact on profits as a result of moving.

¹ European Commission. RSPG Draft Opinion on Licensed Shared Access. 30 May 2013. Available at http://rspg-spectrum.eu/consultations/index_en.htm

² FCC. Enabling innovative small cell use in 3.5 GHz band NPRM & Order. 12 December 2012 <http://www.fcc.gov/document/enabling-innovative-small-cell-use-35-ghz-band-nprm-order>

Some examples of where these approaches have been taken include:

- France: A spectrum refarming fund is financed by licence fees. This was used, for example, to compensate defence for moving tactical links from the 2.6 GHz band³
- Ireland: Economic cost-benefit analysis to decide whether and when to move broadcast services away from the 2.6 GHz band⁴
- UK: Spectrum pricing is applied to most spectrum uses (including defence)⁵. The UK Ministry of Defence is planning to auction some of its spectrum at 2.3 GHz and 3.5 GHz in 2014.
- US: Auction proceeds are used to compensate defence for the costs of releasing AWS spectrum (\$1.082bn). These costs set the reserve price for the auction, which raised \$13.7bn.⁶

How to estimate the value of spectrum to mobile services?

Economic principles suggest that estimates of the value of spectrum should be based on its opportunity cost⁷. As markets reveal the opportunity cost of resources, it might be thought that the best approach is to use values revealed by market processes, such as the prices of other spectrum that has been auctioned and/or traded.

Simple benchmarking, using average values or ranges of prices from auctions/trades can work well if there are good “like for like” comparators.

Good comparators will be data points based on recent auctions/trades for same or similar bands from countries with similar market characteristics. When there are a large number of data points, econometric

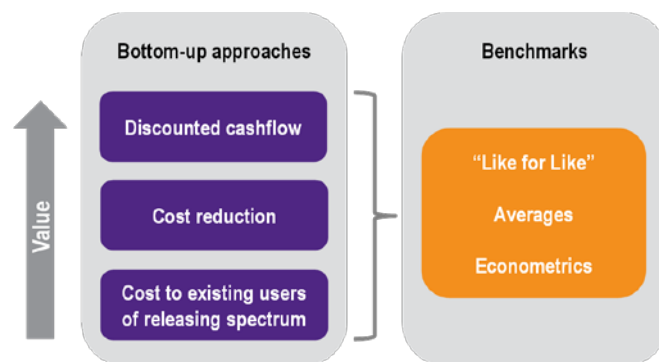
analysis can be used to control for the impact of market and economic factors on prices.

Bottom-up approaches to estimating opportunity costs may also be used. These involve considering how operators themselves value spectrum based on:

- (a) the value arising from using spectrum to reduce network deployment costs (cost reduction value), and
- (b) the value based on the discount cash flows earned from the spectrum.

The cost reduction value will be less than the discounted cashflow value unless some spectrum use is unprofitable.

The costs of moving incumbents can be considered as a lower bound on spectrum value in bands where reallocation to mobile is shown to be beneficial.



Using benchmarks is advantageous in that they reflect actual prices paid whereas discounted cashflow and cost reduction estimates rely on forecasts over the licence period (often 15-20 years) and so are subject to considerable uncertainty. The costs of moving incumbents have the advantage of certainty but may be low relative to the value of spectrum to a mobile operator.

When determining spectrum values regulators⁸ have tended to use a mix of approaches which allows sense checking of the results. One question that often arises is where in a range should the value be set? It is important that values used to set spectrum licence fees or reserve prices are not too high, as this

³ The process is described in ANFR annual reports. See http://www.anfr.fr/fileadmin/mediatheque/documents/organisation/RA_2007VA.pdf

⁴ <http://www.comreg.ie/fileupload/publications/ComReq1180a.pdf>

⁵ Ofcom has evaluated the impact of spectrum pricing on spectrum release by different users including defence, radio astronomy, commercial users and the police. “Policy evaluation report: AIP.” Ofcom. July 2009.

⁶ http://wireless.fcc.gov/auctions/default.htm?job=auction_factsheet&id=66

⁷ “That is the value in the next best alternative use – the opportunity forgone. Essentials of Modern Spectrum Management”, Cave, Doyle and Webb, Cambridge University Press, 2007; “An Economic Study to Review Spectrum Pricing”, Indepen, Aegis Systems and Warwick Business School, for Ofcom, February 2004

⁸ Synopsis of 15 year license valuation methodology, Plum for the Department of Broadband, Communications and the Digital economy, Australia, 2012 http://www.dbcde.gov.au/radio/radiofrequency_spectrum/spectrumlicences

increases the risk that the spectrum will be left idle which means the economic and social benefits from its use will be lost.⁹ Also overly high values may encourage potentially costly reallocation. It is therefore good practice to choose values conservatively.

On the other hand, if spectrum licence fees or reserve prices are set too low, governments may consider that they are not getting a fair return for use of a public asset and may not support spectrum release plans that involve displacing major other users (such as defence or broadcasting).

Conclusion

Whatever the policy goals (be it securing fair return for spectrum, facilitating market entry or ensuring efficient spectrum use), it will be crucial for governments and regulators to have a clear idea of the value of spectrum in order to understand the trade-offs involved and to achieve their policy objectives.

To make efficient and sustainable decisions about spectrum release for mobile broadband, it is necessary to understand the costs of releasing the

spectrum and its value to mobile services. If this analysis is not undertaken, plans to release large amounts of spectrum required to support future mobile broadband traffic will not be realised. Incumbent users will simply refuse to move.

The net benefits of releasing spectrum for mobile need to be demonstrated and incumbents may need to be given financial incentives to move (e.g. compensation or spectrum pricing) so that spectrum can be released in a timely manner. Once the spectrum has been released, valuation is again required to set reserve prices and/or spectrum fees.

None of the methods used to derive spectrum value is perfect but the growing body of auction results plus the use of bottom up estimates as cross checks provides a practical way forward. As a general rule it is better to set values conservatively, so that spectrum is not left idle and the potential economic and social benefits from its use foregone.

What we do

Plum is a global leader in the providing policy and regulatory advice on radio spectrum, telecommunications and online issues.

We provide consultancy services on all aspects of spectrum policy and regulation, including release of spectrum, spectrum pricing, award design, auction support, licensing and licence exemption, liberalisation and trading.

We work for regulators, governments and private clients in Europe, Asia-Pacific and the Middle East and Africa. Our clients include: Axiata, ACMA (Australia), Huawei, MDA (Singapore), NCC (Taiwan), PCCW, Qualcomm, Telstra and Vodafone.

Our spectrum team is led by Phillipa Marks, an international expert in spectrum management policy and economics. She is a member of the Ofcom Spectrum Advisory Board and the Irish Electronics Communications Expert Advisory Panel.



Phillipa Marks



Yi Shen Chan



Sarongrat Wongsaroj

⁹ In India the government's attempts to auction off 850 MHz and 1800 MHz licences were hampered by high reserve prices. Two auctions have already been held (in November 2012 and March 2013) and each time only a significant number of licences remain unsold. In Australia the 700 MHz auction in May 2013 ended with 30 MHz of the 90 MHz available unsold.