

Towards more flexible spectrum regulation:

**A study commissioned by the
German Federal Network Agency (BNetzA)**

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Towards more flexible spectrum regulation

- The German Federal Network Agency (BNetzA) commissioned the WIK to conduct a 2005 study: *Towards more flexible spectrum regulation*
- The team comprised: Dr. Ulrich Stumpf, Dr. Lorenz Nett, Mark Scanlan and Scott Marcus, supported by Prof. Martin Cave (University of Warwick) and Gérard Pogorel (ENST Paris).
- Comparative study of spectrum management in a number of countries with leading-edge practices.

Towards more flexible spectrum regulation

- Why is flexibility needed in spectrum regulation?
- Key elements of flexible spectrum management
 - Initial assignment mechanisms
 - Spectrum transfers, trades and leases
 - Liberalisation (flexibility of use)
- Related aspects
 - Interference
 - Competition issues
- Conclusions

Frequency Regulation

- Primary aim is to provide benefits to end users
 - Promote innovation
 - Increase the diversity of products
 - Ensure low end user prices
- Flexibility is not an objective in and of itself
- Ensure that spectrum is utilised as efficiently and effectively as possible
 - Technological efficiency
 - Highest value usage

Why regulate at all?

- Spectrum is limited.
- The most valuable spectrum – at frequencies below 6 GHz – tends to experience demand well in excess of supply.
- A system without rules is not possible – harmful and unacceptable interference would result.
- Decisions must be made.
 - On what basis should they be made?
 - What rules are appropriate?

Approaches to Spectrum Regulation

- Three primary models of spectrum management:
 - “Command and Control”
 - Market mechanisms / “property rights”
 - Commons model
- Correspond to three decision-making regimes:
 - Government officials decide
 - Market mechanisms “decide”
 - Technology “decides”
- Each model has its place!
 - Command and control to meet military, emergency services, radio astronomy, and other public needs.
 - Commons model to foster innovation.
 - Market mechanisms wherever otherwise possible.

Approaches to Spectrum Regulation

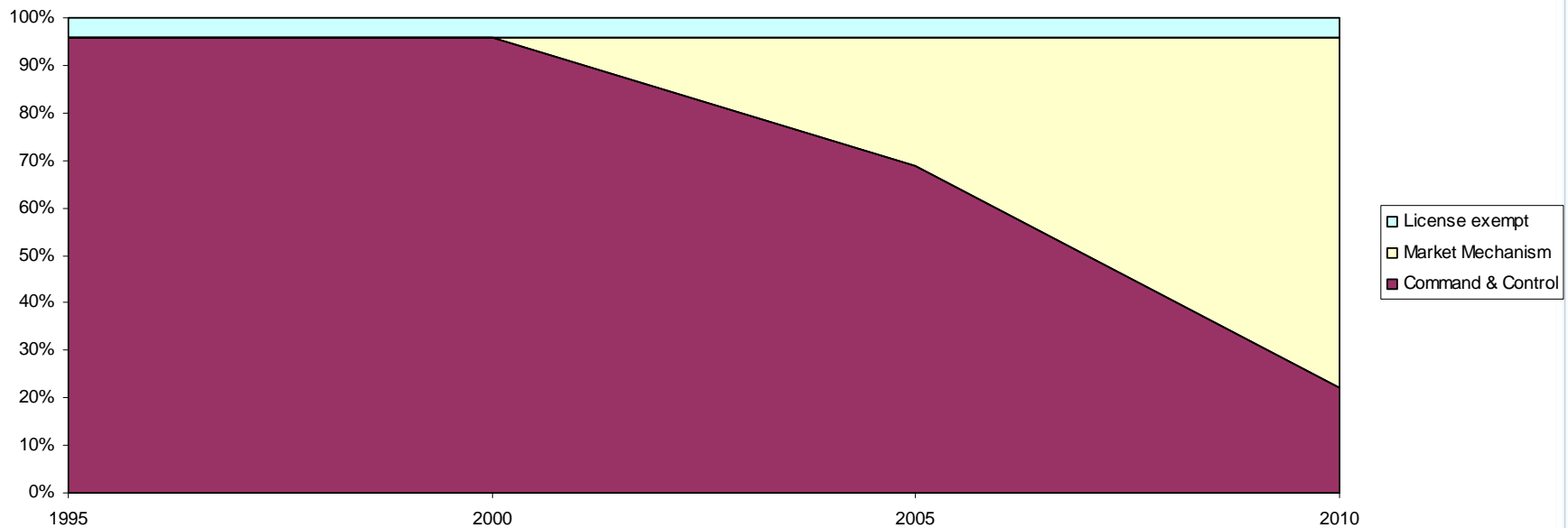
- Our study addressed these progressive countries:
 - United Kingdom (UK)
 - United States (US)
 - Canada
 - Australia
 - New Zealand
 - Guatemala
 - Germany
- Strong parallels among all of them.

Approaches to Spectrum Regulation

- In each of these countries,
 - There was a tendency to move away from command and control.
 - There was a tendency to increasingly emphasize market mechanisms.
 - In most, there was also strong interest in the commons model.
- Collectively, these trends represent a Coasian, rather than a Pigovian, approach (away from central planning, and toward enabling private parties to work things out for themselves).
- Our focus was on market mechanisms.

Approaches to Spectrum Regulation

Ofcom Plans for Spectrum under 3 GHz

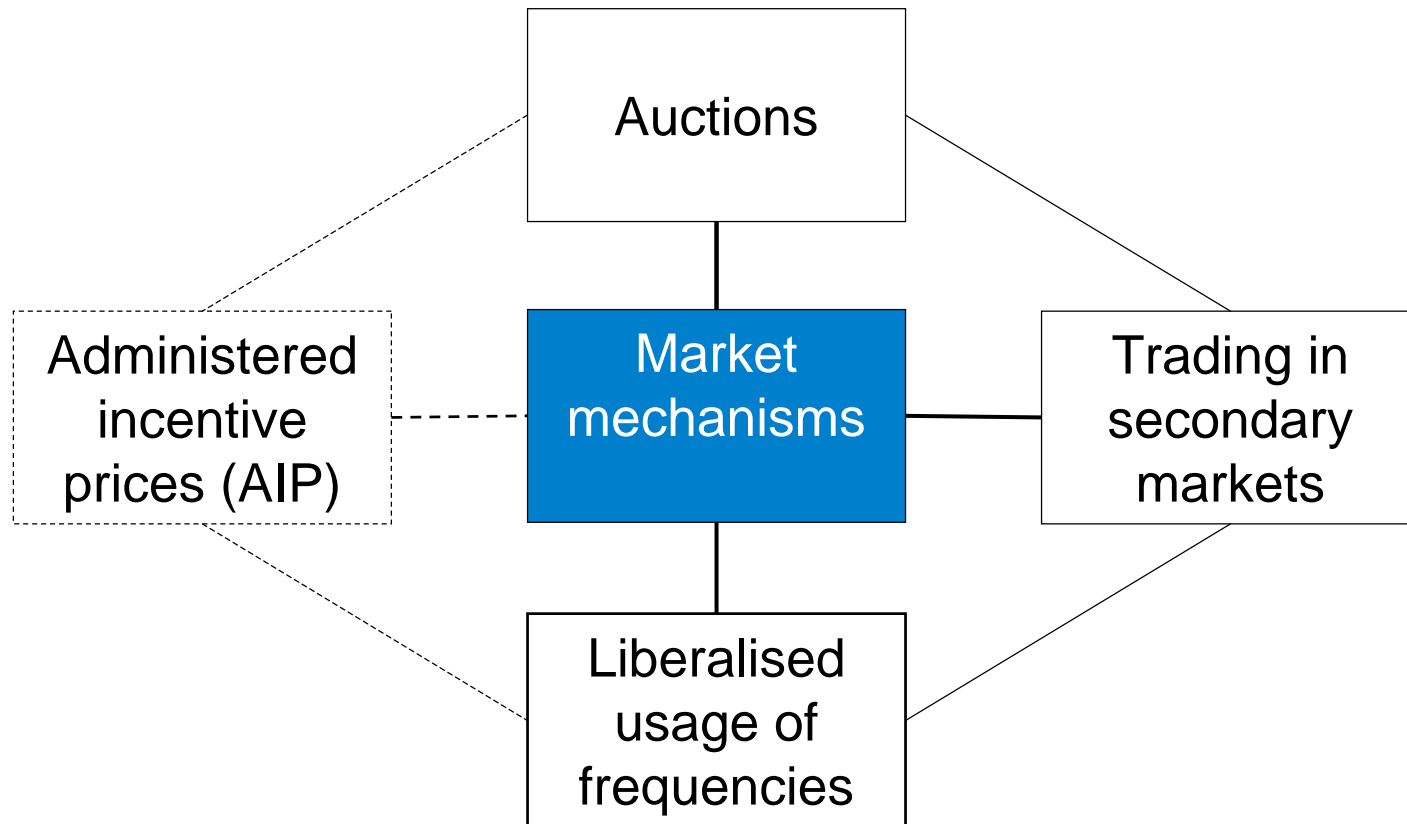


- A market mechanism system implies some specific right of use.
 - Exclusive use (generally licenced)
 - Collective use (typically shared based on geography and/or time)
- A commons mechanism need not depend on an explicit right of use – it is typically licence-exempt.

Key elements of flexible spectrum management

- Initial assignment mechanisms
 - Use market mechanisms wherever possible.
 - Allocate spectrum to highest valued use.
- Spectrum transfers, trades and leases
 - Secondary markets exist in practice in any case.
 - A secondary market helps correct for imperfect initial assignments.
 - A secondary market enables adjustments as changes in markets and technologies increase or decrease the value of different uses of spectrum.
- Flexibility of use
 - For market mechanisms to be fully effective, licensees should not be needlessly constrained in their use of spectrum.

Encouraging highest valued usage



Encouraging highest valued usage

- Auctions: the licensee confronts the opportunity cost of acquiring spectrum).
- Secondary markets: the licensee confronts the opportunity cost of retaining spectrum.
- Administrative Incentive Pricing (AIP): the licensee confronts the opportunity cost of retaining spectrum.
- Under these mechanisms, spectrum will tend to gravitate toward those who value it most.

Initial assignment mechanisms

- First-come, first-served
 - Economically efficient only if there is no scarcity
- “Beauty contests”
 - Impossible to avoid subjective judgments
 - Not economically efficient
- Lotteries
 - Nondiscriminatory
 - Not economically efficient
- Auctions
 - Can be nondiscriminatory
 - Economically efficient
- Combinations/hybrids are possible (e.g. Canada)

- Various forms of auction are possible
 - Single-lot: English, sealed-bid, Vickrey, Dutch
 - Multiple-lot: sequential English auctions, simultaneous sealed first price auction, one price, simultaneous multiple
- They differ in many dimensions:
 - Closeness of approximation to market price
 - Possibility for pooling
 - Risk of winner's curse
 - Transparency / comprehensibility
- Careful auction design is important.

Spectrum transfers, trades and leases

- In the interest of moving spectrum to highest valued use, transfers, trades and leases should be permitted wherever possible.
- Transaction costs should be minimized:
 - Increase regulatory certainty by identifying in advance categories of trades that will automatically be approved.
 - Create a predictable time frame for approval.
 - Simplify regulatory procedures so as to avoid unnecessary “red tape”.
 - Administrative charges should be nominal.
- How many different kinds of transfer and lease transactions should be supported?

Central Register of Spectrum Use

- An electronic central register of spectrum use might facilitate trades.
- The amount of information provided should be tailored to the intended use.
 - The intent is to make it easy for prospective buyers and sellers to find one another.
 - Licensees should not be obliged to reveal possibly sensitive data.
 - Update obligations should not be inappropriately burdensome.

- Liberalisation (flexibility of use) greatly enhances the ability of market mechanisms to move spectrum to highest valued use.
- There is, however, a tension between liberalisation and harmonisation, which may be needed for:
 - Manufacturing and operational economies of scale.
 - Portability of equipment across national borders (including mass market license-exempt devices).
 - Compliance with treaty obligations.
- Coordination may also be required in border areas.

Ofcom has identified many challenges to liberalisation:

Services	Challenges to liberalisation
Satellite	Inherently transnational nature of the service.
EU harmonized bands	EU regulation.
Maritime and aviation	International nature and associated treaties.
Services operating below 20 MHz	Propagation characteristics imply a need for international coordination.
Broadcasting	National broadcasting regulation, international agreements.
Radio astronomy	Need for protection and for international coordination.
Radio amateurs	Operational need for harmonization on an international basis.

- Insofar as possible, allocations should be technology neutral and should permit flexible use.
- This must, however, be balanced against the need to mitigate the risk of harmful interference.

- The flexible U.S. model of use in the mobile telephony bands may be of particular interest.
 - No restrictions at all on 2G / 3G / nG usage.
 - No restrictions on fixed versus mobile usage.
 - Broad consensus that this is the preferred approach going forward.
- Simple, minimal interference mitigation rules.
- Avoids creating false scarcity of spectrum, and thus inflating auction prices.
- Simplifies migration from 2G to 3G (and beyond).

Administrative Incentive Pricing

- Administrative Incentive Pricing (AIP) can be a useful complement to other market-based mechanisms.
- Under AIP, spectrum fees are levied periodically at rates that reflect the opportunity cost associated with the spectrum.
- AIP could be particularly useful in avoiding hoarding of spectrum previously assigned through command and control mechanisms.
- AIP reduces the likelihood of spectrum licensees earning windfall profits.

Interference Management

- Increasingly, the tendency is to manage interference in a technology-neutral fashion.
- Where harmful interference occurs, the parties may be in a better position to resolve it than is the regulator.
- The regulator must, however, be prepared to intervene where necessary to resolve disputes.
- An effective monitoring system can serve as an effective tool for the regulator. At a minimum, it is likely to be necessary to monitor when harmful interference has been alleged.

Interference Management

- The flexible U.S. model of use in the mobile telephony bands may be of particular interest.
 - No restrictions at all on 2G / 3G / nG usage.
 - No restrictions on fixed versus mobile usage.
 - Broad consensus that this is the preferred approach going forward.
- Just three specific interference mitigation rules:
 - Power radiated into adjacent frequency bands in the same geographic area (out-of-band emissions);
 - Power radiated into adjacent geographic areas in the same frequency band; and
 - Power radiated inside the assigned band.

Interference Management

- The risk of interference cannot be totally eliminated; however, evolving technology may change our approach to interference over time.
- In the U.S., there has been interest in a balanced approach to interference, considering not only the transmitter but also the receiver. Certain inexpensive improvements in receiver quality could provide significant public benefits.
- With cognitive radio and Software Defined Radio, we may place increasing emphasis on technology in lieu of regulation.

Flexible spectrum management

- There is an emerging consensus among leading edge spectrum management authorities:
 - Reduce emphasis on command and control.
 - Increase emphasis on market-based mechanisms.
- Market-based mechanisms depend primarily on:
 - Initial assignment mechanisms
 - Spectrum transfers, trades and leases
 - Liberalisation (flexibility of use)
- It will be necessary to strike a suitable balance:
 - Mitigation of the risk of harmful interference.
 - Retaining the benefits of harmonisation.
 - Recognition of legitimate interests of current licensees.

- The ITU has prepared an excellent summary, available at:
[http://www.itu.int/osg/spu/ni/multimobile/papers/MMS_flexibl
espectrumstudy_060606.pdf](http://www.itu.int/osg/spu/ni/multimobile/papers/MMS_flexibl
espectrumstudy_060606.pdf).
- The German Federal Network Agency (BNetzA) has made the full English language document available at:
<http://www.bundesnetzagentur.de/media/archive/4745.pdf>.
- The full document is also available in German.



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