

# 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

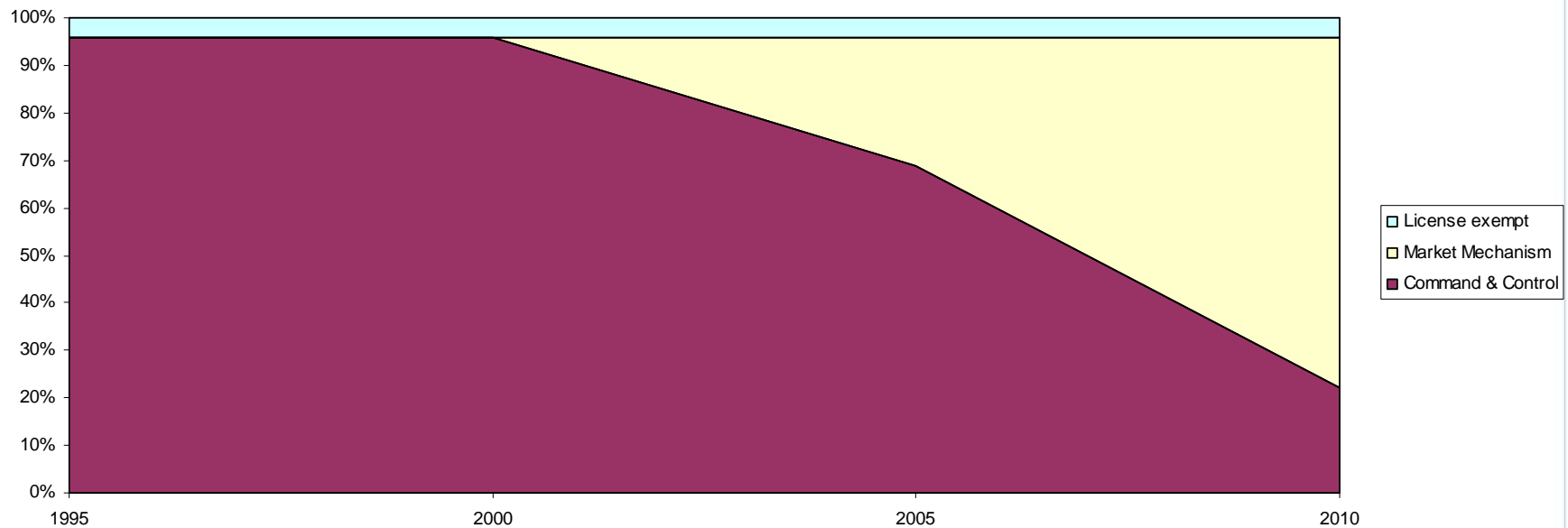
- Our study addressed these progressive countries:
  - United Kingdom (UK)
  - United States (US)
  - Canada
  - Australia
  - New Zealand
  - Guatemala
  - Germany
- Strong parallels among all of them.

# 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

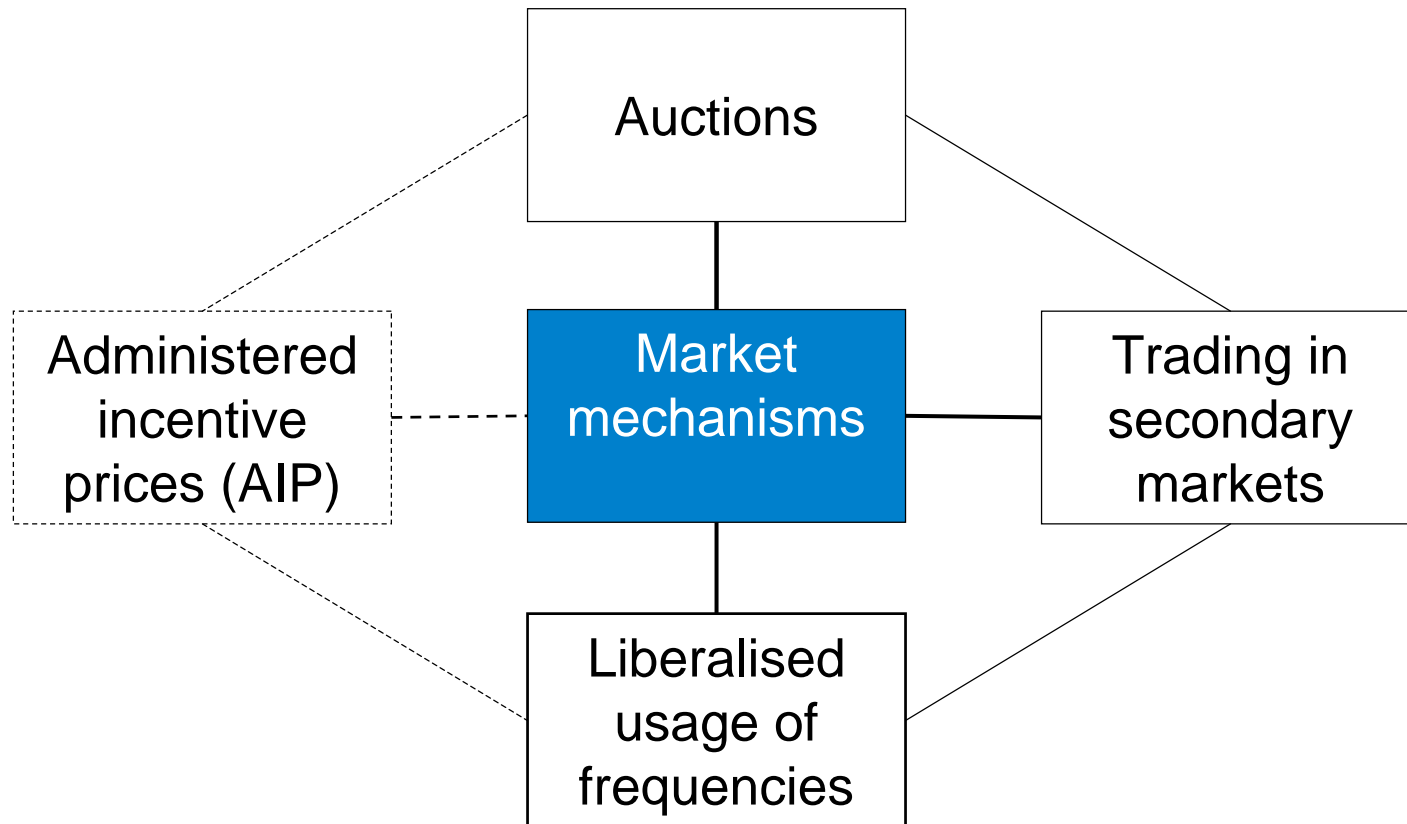


- A market mechanism system implies some specific right of use.
  - Exclusive use (generally licenced)
  - Collective use (typically shared based on geography and/or time)
- A commons mechanism need not depend on an explicit right of use – it is typically licence-exempt.

# 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:

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