NRAs Approach to Spectrum Management

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BWA Regulation goals

- Defining the criteria for granting right of use of frequencies
- Ensuring the efficient use of the spectrum
- Promoting the competition in the provision of broadband services and fostering the innovation
- Encouraging the deployments and adoption of standards-based, interoperable, broadband wireless access (BWA) solutions (IEEE/ETSI e.g.)
- Supporting for a wide range of deployment scenarios

  - Rural, suburban, urban

  - Enterprise, small business, residential

Spectrum management trends (1)

- Increased allocation of **license-exempt** bands (individual licensing granted only when the risk of harmful interference is high)
- Adoption of **technology neutral** rules
  - A regulation that specifies which technologies an operator may deploy risks becoming quickly obsolete

But

- some market players argue that the allocation of license exempt frequency bands may not lead to ensuring an efficient use of the spectrum

Spectrum management trends (2)

- **Service neutrality**. Support of evolving & converging usage models (Fixed, Nomadic and Mobile services are converging)
- **Less restrictive individual rights**, when granted
- Adoption of **market-driven frameworks** to accelerate spectrum re-allocation – sub-licensing, trading –

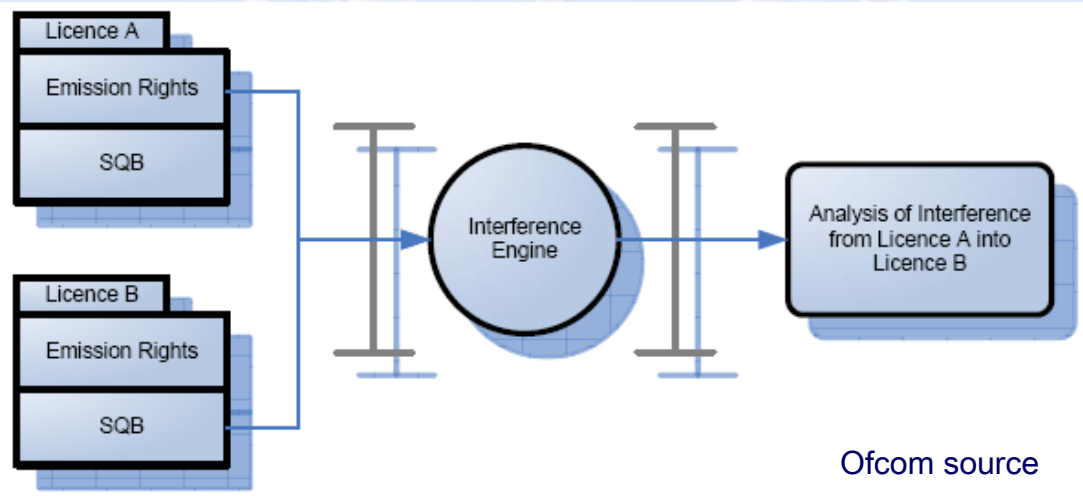
Spectrum management trends (3)

An example of NRA approach

- Ofcom's vision about spectrum management is expressed in the Spectrum Framework Review
- Licensees rights and obligations should be **technology-neutral**.
- Regulatory constraints should only be used where they are justified.
- It should be simple and transparent for license holders to change the ownership and use of spectrum.
- The process of spectrum management can be viewed as placing as few restrictions as possible whilst ensuring that spectrum usage rights granted to one user do not deteriorate the spectrum quality of another users.

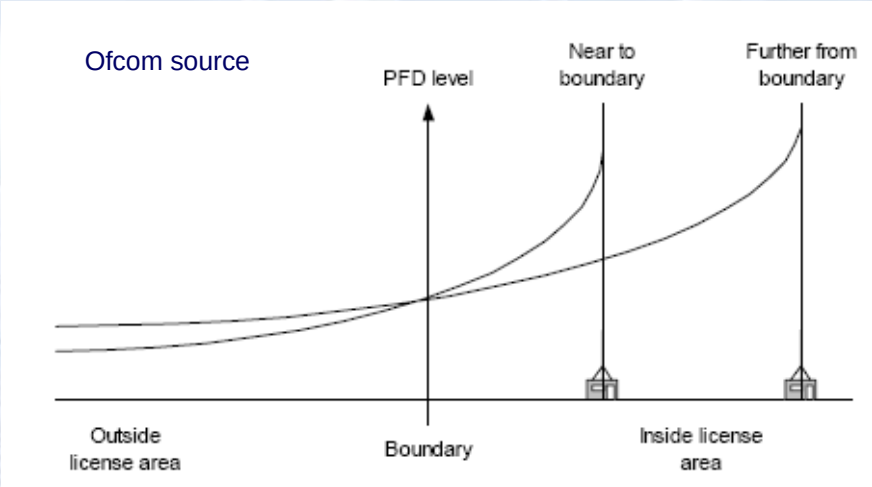
Spectrum management trends (4)

- Allow change of use (or a new assignment) as long as Spectrum Quality Benchmark (SQB) are fulfilled
- A SQB example: Interference at the receiver should not exceed X dBW for more than Y % of the time [at more than Z % of locations] (Ofcom)
- What tools can be used to assess this?



Spectrum management trends (5)

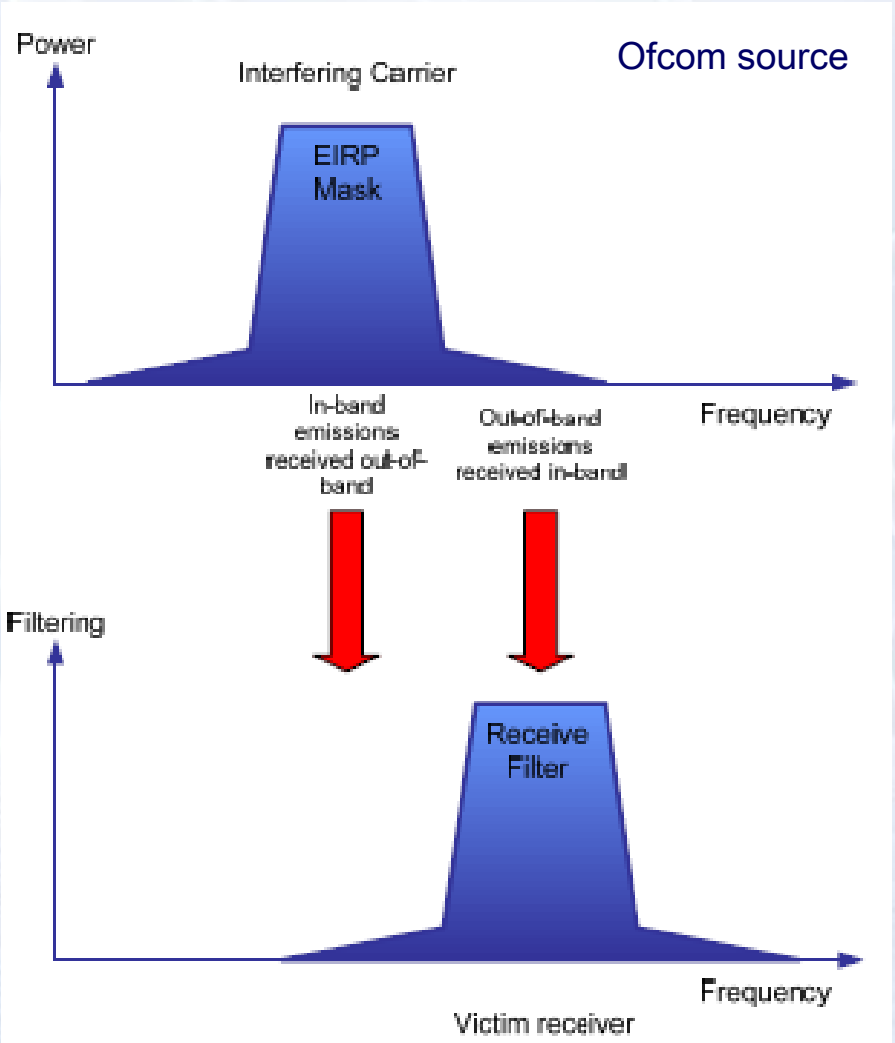
- Frequency rights of use in a specific service area are granted fixing thresholds on some parameters that limit the interference to adjacent service areas.
- **Power Flux Density (PFD)** on the boundary is a possible parameter. The aggregate transmitted PFD at or beyond the service area boundary should not exceed *X dBW/m^2/kHz* at any height up to *H m* for more than P % of the time.



Spectrum management trends (6)

Out-of-band issues

- Regulation of OoB emissions is an important issue;
- An example: Interference at the receiver should not exceed X dBW for more than Y % of the time [at more than Z % of locations] (ofcom)



Granting the right of use of spectrum: Auctions (1)

- There is no single auction design that can be used in all cases of spectrum allocation because the overall bandwidth, the number of potential bidders, the geographic coverage (regional or national) and policy objectives are all likely to differ.

- The main types of auctions are:
- Ascending-price
- Sealed-bid
- Anglo-Dutch

Granting the right of use of spectrum: Auctions (2)

- Supporters of auctions argue that spectrum is assigned to those operators that value the spectrum most highly and that, thus, are expected to make an economically efficient use of the spectrum.
- Auctions are also based on the assumption that operators market information allow them to provide a realistic estimate of the spectrum value.
- There is the risk that operators bid artificially high prices just to prevent competition, thus, appropriate auction design is required.
- A well-designed auction should achieve a realistic market price for the spectrum and encourage efficient use of the spectrum.

Granting the right of use of spectrum: Auctions (3)

Simultaneous ascending price :

- **effective** where a certain number of licenses are to be awarded for many different geographic areas.
- Based on **sequential rounds** of bidding. Each bidder should increase the previous standing bid on a “lot” by more than a pre-set amount. **When there is no more bidding the auction ends** and the bidders with the highest bids on each “lot” wins.
- The fact that bidders can see how their opponents are bidding should ensure a more efficient spectrum allocation than with a sealed bid.

Granting the right of use of spectrum: Auctions (4)

Sealed-bid:

- each bidder makes one single offer.
- more attractive to new entrants than the ascending auction thanks to the possibility that they might outbid an incumbent who has under-estimated the value of the spectrum.

Granting the right of use of spectrum: Auctions (5)

Anglo-Dutch:

- is a mixture of the two auction types above.
- Initially there is an ascending price auction. When the number of bidders has been reduced to one more than the number of licenses available there is a sealed-bid.
- The sealed-bid has to be the same or greater than the final price reached through the ascending auction.

Granting the right of use of spectrum: Comparative selection (Beauty contest) (6)

- The government invites applications that are rated according to some pre-set criteria.
- Licenses are assigned to those whom the government believes best meet the stated requirements.
- Beauty contest is sometimes seen to present several disadvantages in terms of transparency of the process and efficiency

Hybrid Approach

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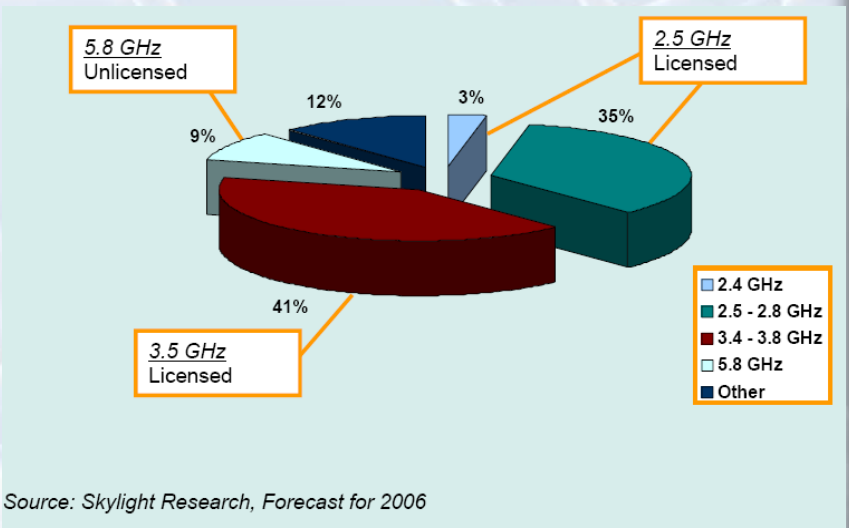
Spectrum for Broadband Wireless Access below 10 GHz (1)

Frequency	Comments
700-800 MHz	Being considered for future allocations, especially in USA and Philippines
2.3-2.4 GHz	Being used in USA, Korea, Malaysia, Singapore for wireless mobile services, including broadband
2.5-2.69 GHz	Recommended for expansion of IMT-2000 services by ITU. Being considered by some countries for technology neutral allocation-USA, Brazil, Maxico, Canada,Australia, New Zealand, Hong Kong, Singapore
3.4-3.6 GHz	Strong support to shift satellite and other users from this band to allow for mixed TDD and FDD allocations for WiMAX and other 4G platforms-US, UK, France, Malaysia, China,Germany, Hongkong, Australia, New Zealand, Africa and some parts of Latin America
5.15-5.35, 5.725-5.85 GHz	Being considered for unlicensed usage by broadband wireless technologies including WiMAX



Source: Skylight Research, Forecast for 2006

Spectrum for Broadband Wireless Access below 10 GHz (2)

a) **IEEE 802.16d - Fixed WiMAX**

Approved Certification Profiles		
FREQUENCY BAND (MHz)	**DUPLEXING**	**CHANNELIZATION (MHz)**
3400 to 3600	TDD	3.5
		7.0
	FDD	3.5
		7.0
5725 to 5825	TDD	10.0

b) **IEEE 802.16e - Mobile WiMAX**

Proposed Certification Profiles		
FREQUENCY BAND (MHz)	**DUPLEXING**	**CHANNELIZATION (MHz)**
2300 to 2400	TDD	5.0
		8.75
		10.0
2469 to 2690	TDD	5.0
		10.0
3300 to 3400	TDD	5.0
		7.0
3400 to 3800	TDD	5.0
		7.0
		10.0

Spectrum for Broadband Wireless Access below 10 GHz (3)

State of the art of regulation

- Frequency band used: mostly 3.5 GHz
- Duplexing: FDD or TDD chosen by the operator
- Type of the licenses: mostly regional (e few cases: national or released on single cities)
- Right of use duration: 5-20 years
- Overall allocated Bandwidth: 15-100 MHz
- Technology: neutral
- Definition of channel raster and filter masks according to CEPT/ECC recommendations.

Spectrum for Broadband Wireless Access below 10 GHz (4)

The German (BNETZA) example

- 4 regional licenses, at 3.4-3.6 GHz**,** auctioned for 28 regions.
- Licenses granted for BWA**,** do not specify the technology.
- The starting price for a region depends on the population density and prices vary from 300.000 euros to about 1.8 million euros per region. Total price of the licences reached 56 million euros.
- Licensees are required to cover at least 15% of the towns in each region by the end of 2009 and 25% of the towns by the end of 2011.
- Each license covers a paired 21 MHz channel; FDD duplex distance is 100 MHz; duplexing: TDD or FDD chosen by the operator.
- Definition of channel spacing (multiple of 0,25MHz) and block edge masks according to CEPT/ECC rec 14-03 and CEPT/ECC rec (04) 05-2006
- PDF limit = -122W/MHz/m^2 at 7,5 km beyond the region boundary

Conclusions

- A BWA regulation based on a “light touch”, technology-neutral and service-neutral approach is seen as appropriate to fostering an effective competition for the provision of BB services and to exploiting innovative technologies.
- The approach, proposed by some regulators, based on the concept of spectrum usage rights (when required) and the assurance of spectrum quality benchmarks appears to be promising.
- A critical issue is represented by the adoption of a well designed, transparent and non discriminatory spectrum awarding procedure, that should achieve a realistic market price for the spectrum and encourage its efficient use.