

*Spectrum for Broadband
Wireless Access*

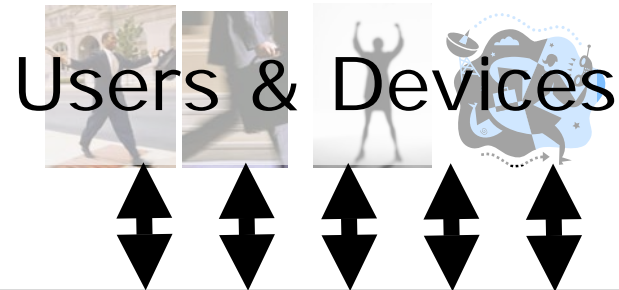
Prof. Simon Saunders
Chief Technology Officer

Agenda

- The importance of spectrum
- How spectrum is regulated
- The spectrum award programme
- But I want spectrum now...
- Spectrum for WiMax
- The 2.6 GHz frequency band
- Conclusions

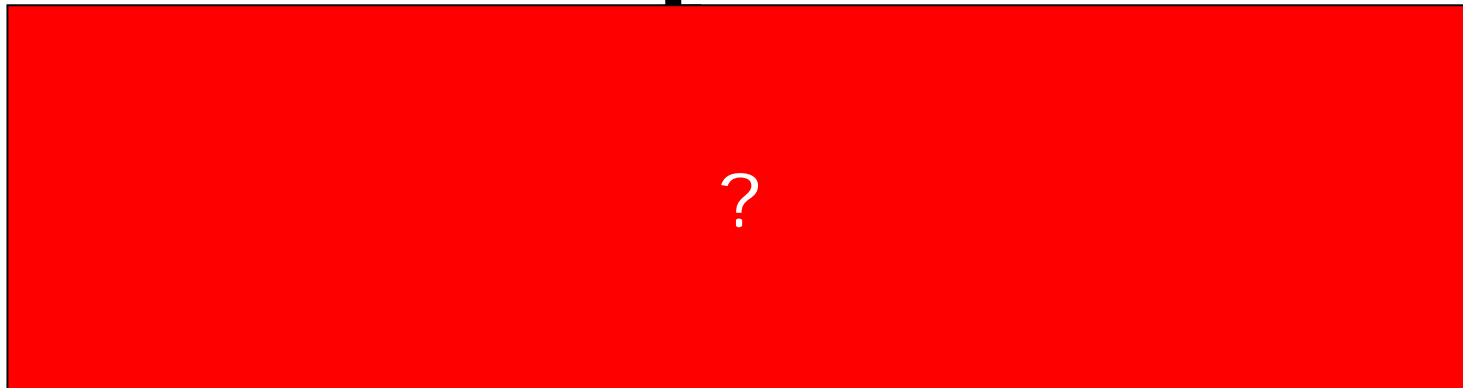
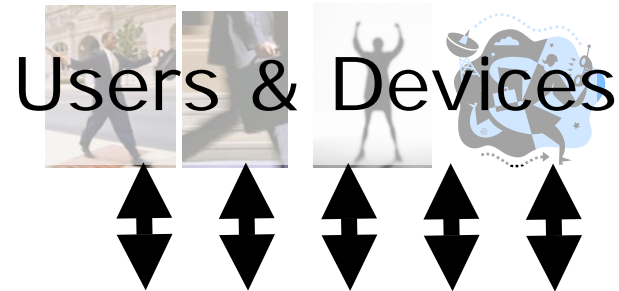


The Importance of Spectrum

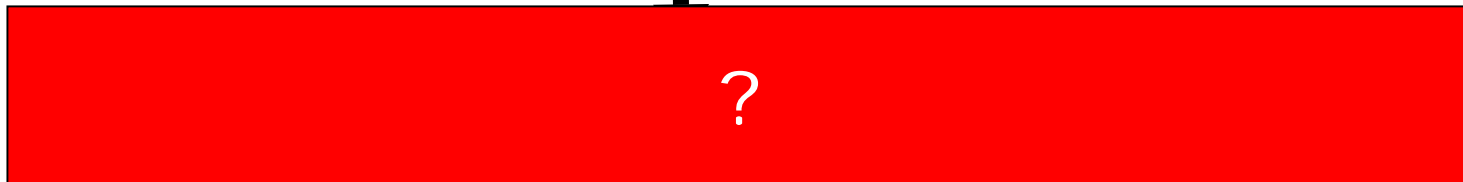
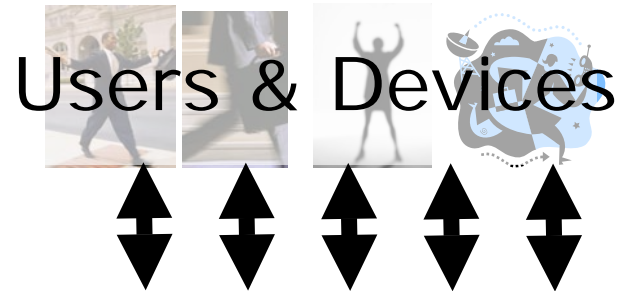


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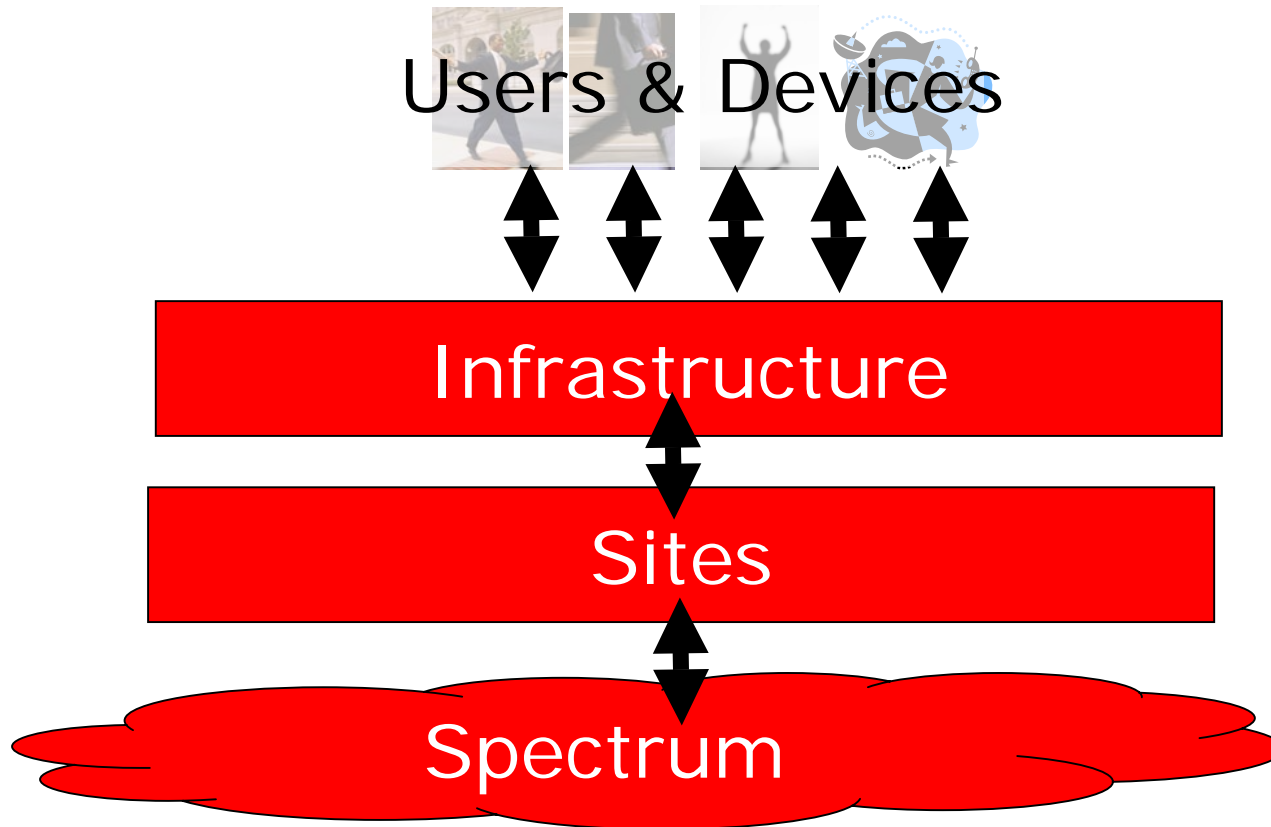
The Importance of Spectrum



The Importance of Spectrum



The Importance of Spectrum



- Every wireless network depends on spectrum – the 'layer zero' of wireless networks
- Spectrum is finite, crowded and varies in its qualities: hence it is valuable

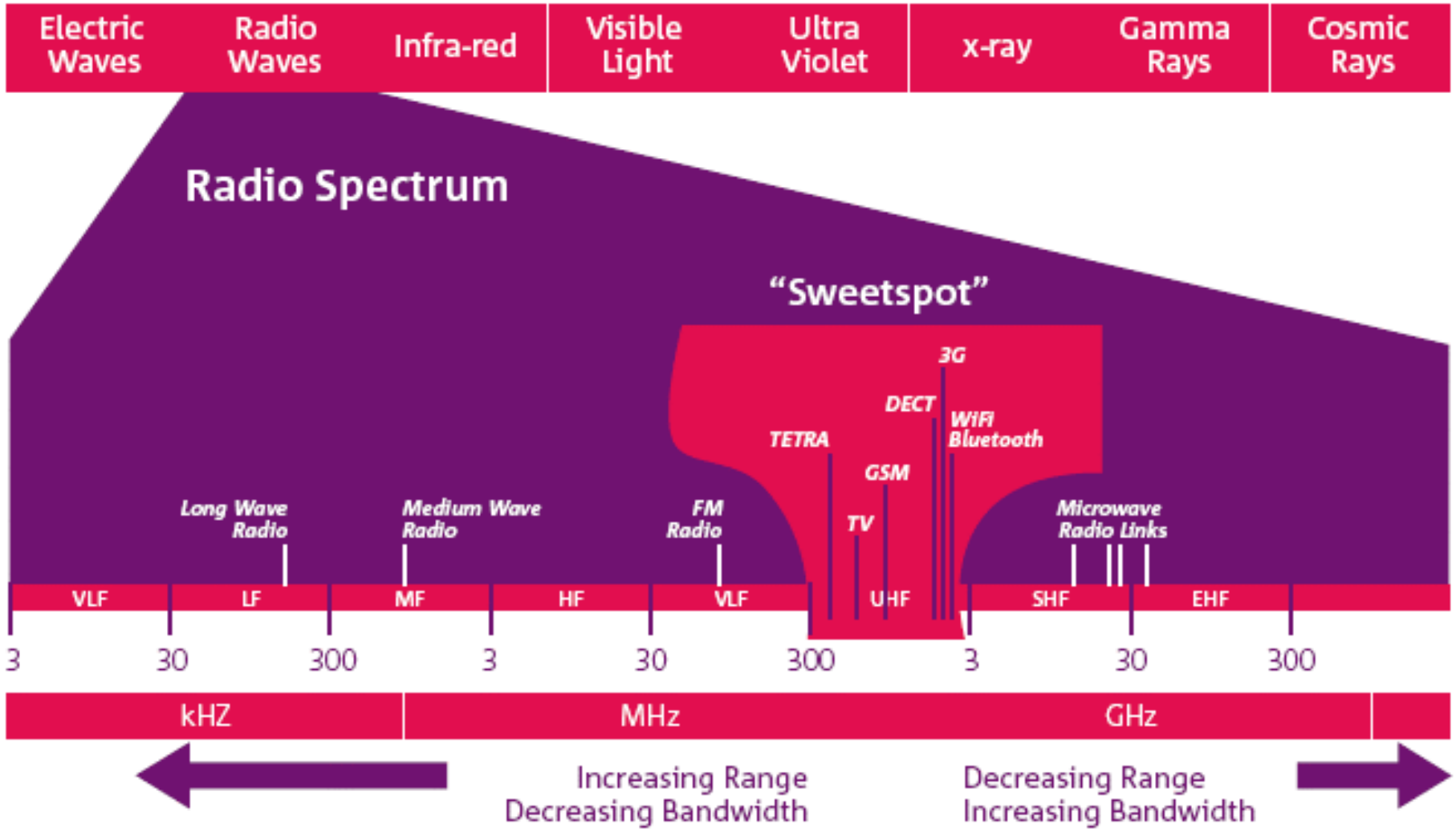
Spectrum Value



- Consumer benefits of UK 3G auction estimated at £40 billion (2004)
- Spectrum estimated to contribute at least £24 billion pa to GDP (2002)
- FCC spectrum management costs US consumers \$77 billion pa (lack of spectrum for mobile, raising prices and reducing competition)
- Delay in innovation in US in 1980s reduced consumer welfare by \$34 billion (2002)



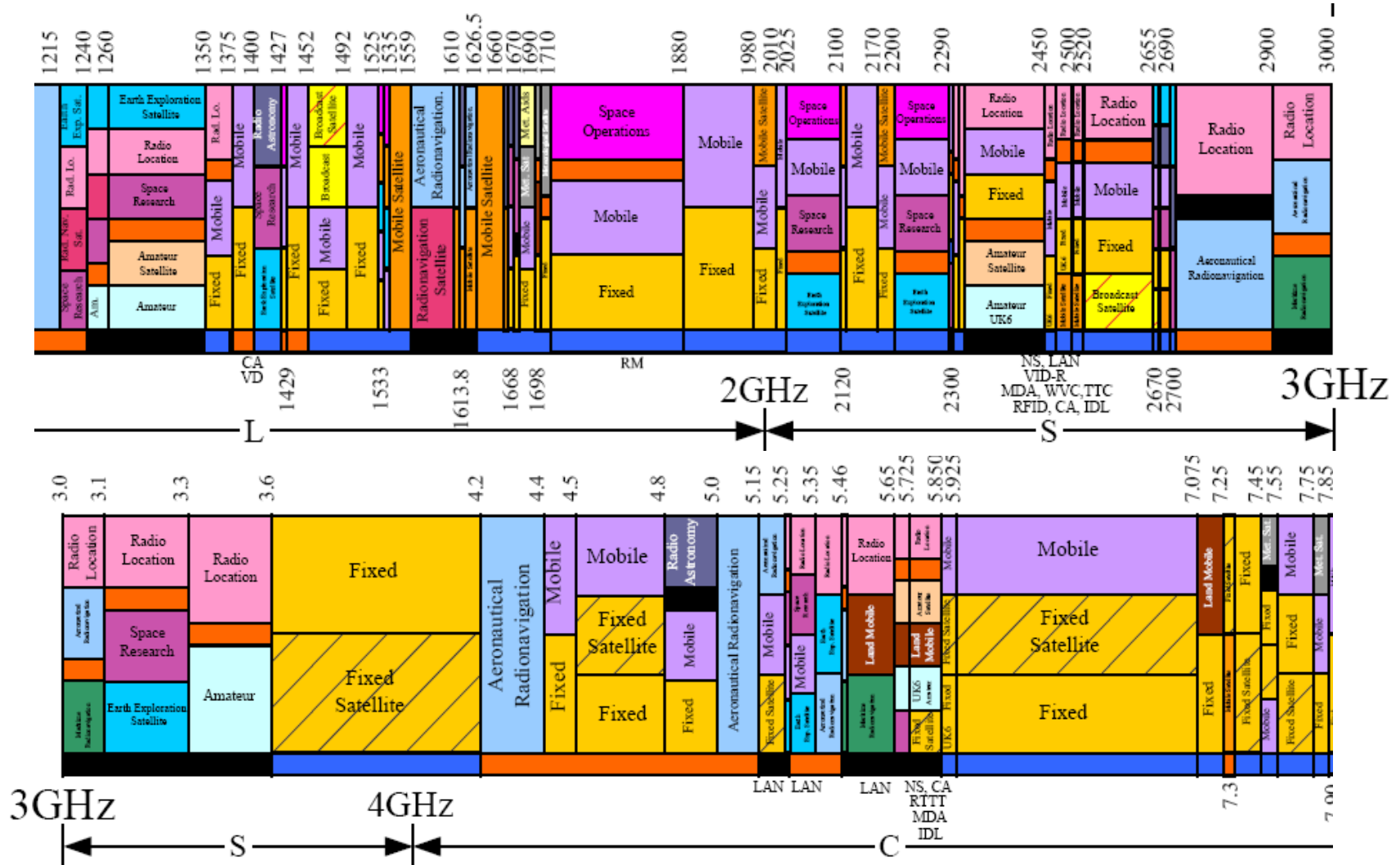
Which Spectrum?



Source: Ofcom



Sweet-spot Spectrum is Crowded and Finite



How is Spectrum Managed?

Command & control

All decisions made by the regulator

Historically adopted for > 90% of spectrum

Market Mechanisms

Decisions made in the market

Approach advocated by Cave Review and UK government

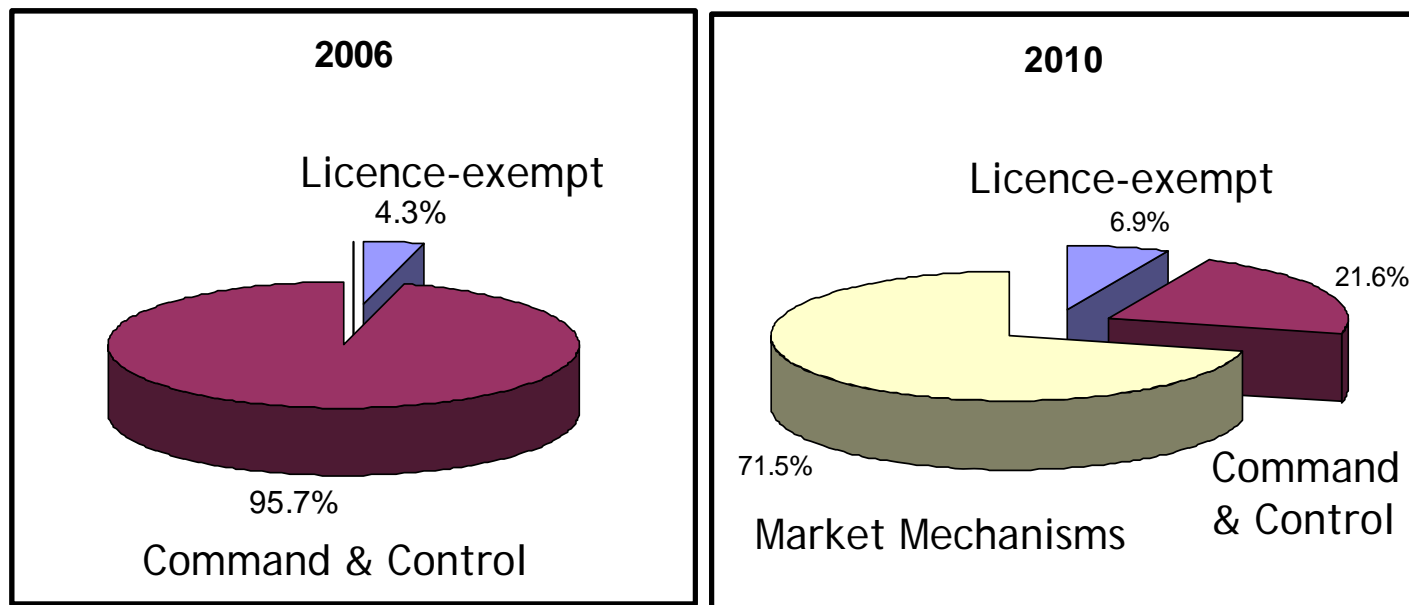
Licence-exemption

Regulator sets some rules, but no licensing

Approach adopted for < 10% of spectrum

Revolution in UK Spectrum

- Triggered by Communications Act 2003
- Most spectrum turning to market mechanisms and licence-exemption
- Most licences will be tradeable & technology neutral
- Will often be service-neutral (e.g. fixed/mobile)



Source: Ofcom Spectrum Framework Review

Ofcom's Spectrum Vision

- Spectrum should be free of technology, policy and usage constraints as far as possible
- It should be simple and transparent for licence holders to change the ownership and use of spectrum
- Rights of spectrum users should be clearly defined and users should feel comfortable that they will not be changed without good cause

Liberalisation

Awards

Trading

Some of the New Spectrum Awards **Red-M**

Common Name	Frequency Band	Likely Date	Example Uses
Low Power GSM	1781 – 1880 MHz	April 06	7 - 12 new short-range mobile operators
Dolphin	412 - 414 MHz 422 – 424 MHz	Autumn 06	1-4 new operators of TETRA – digital private mobile. 1: Arqiva CDMA – alternative cellular system
TETRA 2	872 - 876 MHz 917 - 921 MHz	Late 06 / Early 07	Further TETRA operators & capacity
Digital Dividend	470 - 854 MHz	Details in June 07	Mobile TV (DVB-H), home broadband etc.
3G TDD	2010 – 2025 MHz	Late 07 (?)	New 3G operators (special mode for flexible high speed services)
	2290 – 2302 MHz	Late 07 (?)	WiMax / 3G
“3G Expansion Band”	2500 – 2690 MHz	Late 07 (?)	New 3G operators and/or additional capacity for existing operators WiMax (wireless broadband – fixed and mobile)
L Band	1452 -1492 MHz	Late 07	Mobile TV (DVB-H)
3.6 GHz	3695 - 3875 MHz 4015 – 4195 MHz	Late 07	WiMax etc.

- The prevailing wind is entirely for market mechanisms:
 - Cave Review 2002: “Meet new public sector requirements through the spectrum market – exceptions subject to strict criteria”
- There are few exceptions:
 - Large populations of existing users
 - Outstanding public benefit: e.g. public service broadcasting and public safety
 - Choice of spectrum packaging to facilitate new entrants and innovation

But I want spectrum *now*...



Indoor & outdoor

Microwave ovens

Bluetooth

Wi-Fi
802.11b,g,n

Radiated Power
< 100mW

2.4 GHz

2400 2483.5

Indoor
only

Wi-Fi
802.11a,g,n

Radiated Power
< 200mW

5 GHz Band A

5150 5350

Indoor & Outdoor

Radiated Power
< 1 W

5 GHz Band B

5470 5725

Line-of-sight,
outdoor, *fixed only*

Proprietary Systems
Pre-WiMax

Radiated Power
< 2 W

5.8 GHz Band C

5725 5850



- In principle, IEEE802.16 standard can operate in any frequency band
- In practice, the WiMax Forum is defining 'profiles' which constrain likely equipment manufacture and inter-operability
- 3.5 GHz
 - UK Broadband
 - Pipex
- 2.6 GHz
 - Good trade-off between range, in-building penetration and bandwidth
 - But higher than 3G (2.1 GHz and maybe lower): needs advanced technology to overcome the differences



The 2.6 GHz Licence Award

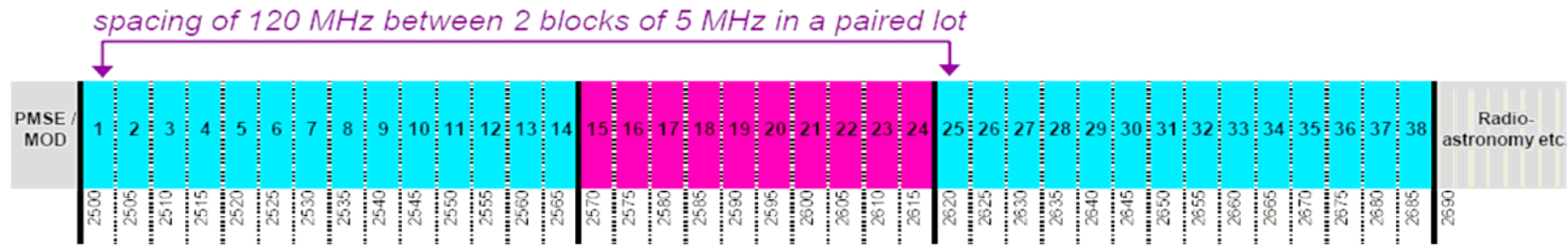


- Three bands:
 - 2010 – 2025 MHz:
 - Originally for self-coordinated 3G: no take-up
 - Potentially paired with parts of 2570 – 2620 MHz (requires ECC approval)
 - Currently reserved for IMT-2000 (i.e. 3G)
 - 2290 – 2302 MHz:
 - Released by MoD under 'Administrative Incentive Pricing'
 - Could be paired with 2010 – 2025
 - 2500 – 2690 MHz:
 - Intended for IMT2000, but not adopted by UK
 - Previously occupied by TV OB, but freed from 1/1/07
- Compare with recent US Advanced Wireless Services auction: \$13.9 bn



The 2.6 GHz Consultation

- Responses due by 9th March!!
- Technology neutral
- 20 year term
- Tradable – partial or total
- 2010-2025 and 2500-2690 simultaneously award
- May be paired or unpaired, suitable for frequency or time division duplex
- 38 blocks of 5 MHz: may be paired (max 14 lots) or unpaired (max 38 lots)



- Possibility of a binding decision by European Radio Strategy Committee which would restrict options
- Potential auction in 'late 2007'
- Auction process: *Clock* then *BAFO*

Summary

- Spectrum is a vital ingredient for all wireless systems
- It has value and is increasingly managed according to market principles
- Value and price are not the same thing: there is plenty of 'free' spectrum with value
- The right choice depends on many factors:
 - Applications
 - Coverage
 - Capacity
 - Resilience
 - Interworking...
- *Caveat emptor!*