

Open Spectrum: Economic and Policy Research

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Open Spectrum: Economic & Policy

- ❑ Future is shared spectrum
- ❑ Business/Policy Models for sharing spectrum
- ❑ Current trajectory of policy reform
- ❑ Research questions/issues
- ❑ “Managing shared access to a spectrum commons”

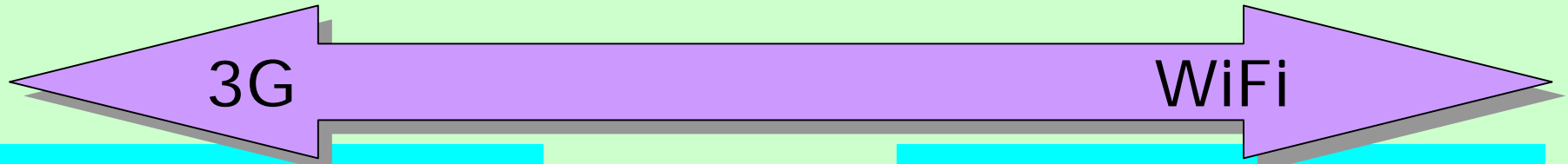
Future is shared spectrum: decoupling of spectrum frequencies from infrastructure investment & applications

Technology (Capabilities) → frequency agility, expanded capacity for sharing	Smart radio systems, spread spectrum, transition to broadband platform architectures
Revenue (Customer experience) → 24/7 availability, simplicity of use, seamless mobility	Heterogeneous networks (3G/WiFi, wireless/wired, global roaming)
Costs (Network provisioning) → lower costs, take advantage intermodal competition	Bursty traffic, multimedia services, fat-tailed usage profiles
Policy (Spectrum reform) → reduced <i>artificial scarcity</i> due to legacy regulations	Transition to expanded flexible market-based licensing and unlicensed spectrum mgmt regimes

Broadband Wireless Policy & Business Models

LICENSED

UNLICENSED



Service Provider Model
Network-centric
(Traditional Telecoms)

End-user Equipment Model
Edge-centric
(Internet vision)

Key Features

- ❑ Top Down
- ❑ Vertically Integrated
- ❑ Centralized Control

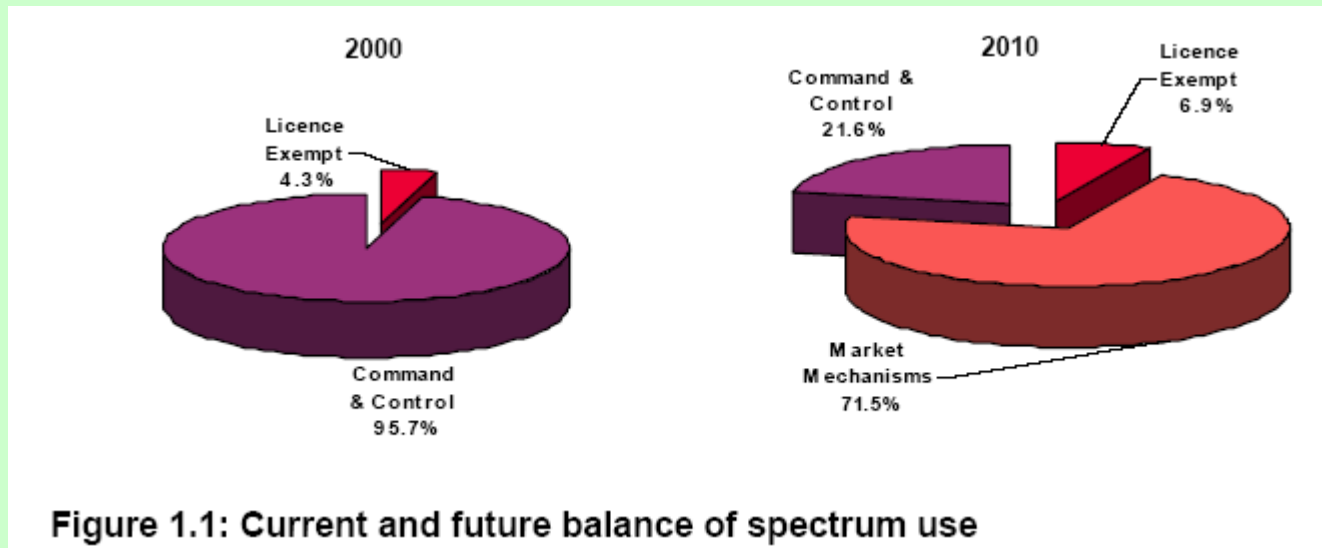
- ❑ Bottom Up
- ❑ Less Vertically Integrated
- ❑ Distributed Control

Shared Use

- ❑ Mux users into min spectrum
(spectrum scarce)
- ❑ Roaming, MVNOs
- ❑ Secondary markets??

- ❑ Open access: viral adoption and rapid diffusion
(spectrum not scarce)
- ❑ “Commons” shared use rights
- ❑ Etiquettes/Rules

Trajectory of reform: from regulation → markets



Source: Ofcom Spectrum Framework Review, June 28, 2005

- ❑ From Command & Control => Liberalized, tradable, exclusive licenses
- ❑ Unlicensed for low-power, low-range uses (<100m)
 - Limited allocation below 3Ghz
 - Underlays and Overlays (??), Dedicated @ 5GHz

#1: Need exclusive licenses (and secondary markets) to manage when scarce (if not scarce, then unlicensed best...)

#2: Unlicensed (decentralized, commons) suitable only for managing short distance, low cost of congestion

Research Questions: Is this right policy?

- ❑ Allocation of spectrum between “licensed” & “unlicensed”
 - *Future* “opportunity” cost of spectrum?
 - Architectures of (wireless) BB access networks?
 - International harmonization for scale/scope economies means delay costly
- ❑ Efficient design of secondary markets
 - Dynamic spectrum allocation markets (who controls?)
- ❑ Transition issues: spectrum clearing and allocation (auctions?)
- ❑ Unlicensed secondary use rights
 - *Underlays*: power limits and UWB development? Impact of underlays on licensed spectrum innovation?
 - *Overlays*: cognitive radio? Interruptible services
- ❑ Etiquettes/protocols for managing open spectrum

All issues require mix of technical, business, and policy analysis.

- Complex stakeholder interests (NIMBY, windfall profits, etc.)
- Uncertain technology & “future proof” policy

“Managing Shared Access to a Spectrum Commons”

- “Open” does not mean *no* regulation
 - But hopefully, minimal Free? Maybe not, but certainly low cost. Avoid usage fees.
 - Any user? No, only those that conform to “rules.” Could be private commons (e.g., mobile providers share 3G spectrum cooperatively).
- Criteria to evaluate:
 - Technical: avoid unnecessary interference when congestion rare.
 - Economic: promote innovation, invest, competitive → strive for technical neutrality while avoiding “Tragedy of Commons”:
 - Political: How future-proof? (Reversibility)
Enforcement? (Liability)
- Key technical rules
 - (1) Power restrictions (probably higher than consistent with underlay)
 - (2) Signaling capability (common channel signaling for identity, use, power, location)
 - (3) Contention/allocation mechanism (ERC, preemption)
 - (4) Enforcement (reliably verifiable conformance testing)
 - (5) Reversibility (term limits)

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