



On Improving the Efficiency of Limited Spectrum

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Spectrum Efficiency is Important Because:

- Telecom is a major infrastructure for *both* societies and economies in both developing and developed countries
- Spectrum is a key raw input to telecom
- While the growth of telecom firms is important, a larger factor macroeconomic is that efficient evolving telecom services at appropriate costs is key to economic growth throughout national economies
 - Telecom firms
 - Firms that use telecom to improve their own efficiency
 - Entrepreneurs whose business models are based on new telecom services, e.g. app makers, Amazon, Expedia



ICT also contributes macro-economically to productivity growth and increased competitiveness of the European economy as a whole, and thus is a factor in growth and job creation. -- COM(2006) 334



Longest Undefended Border in the World

8,891 kilometres (5,525 mi) long, including 2,475 kilometres (1,538 mi) shared with Alaska



The Peace Arch Surrey, BC, and Blaine, Washington



Haskell Free Library and Opera House Stanstead, Quebec and Derby Line, Vermont

US/Canada Spectrum Cooperation

- 7 present bilateral agreements going back to 1928
 - http://www.state.gov/documents/organization/202293.pdf
- FCC Rules for TV closed captioning include provision for all symbols used in French alphabet
 - To facilitate common receivers
- Major issue in pending incentive auction implementation needs bilateral discussion and agreement
- Regular FCC/IC coordination meetings

Agreement concerning the allotment and assignment of television broadcasting channels

and January 5, 1994.

TIAS 12530.

Entered into force January 5, 1994.

in areas adjacent to the border of the United

States and Canada, with working arrangement.

Exchange of notes at Washington November 3, 1993,

• NAFTA requirements

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TELECOMMUNICATION

Arrangement governing radio communications between private experimental stations.

Exchanges of notes at Washington October 2 and December 29, 1928, and January 12, 1929. Operative January 1, 1929. TS 767-A; 6 Bevans 26; 102 LNTS 143.

Extension

April 23 and May 2 and 4, 1934 (48 Stat. 1876; EAS 62; 147 LNTS 338).

Convention relating to the operation by citizens of either country of certain radio equipment or stations in the other country.

Signed at Ottawa February 8, 1951. Entered into force May 15, 1952. 3 UST 3787; TIAS 2508; 207 UNTS 17.

Agreement concerning the coordination and use of radio frequencies above thirty megacycles per second, with annex.

Exchange of notes at Ottawa October 24, 1962. Entered into force October 24, 1962. 13 UST 2418; TIAS 5205; 462 UNTS 68.

Amendments

June 16 and 24, 1965 (16 UST 923; TIAS 5833; 549 UNTS 300).

February 26 and April 7, 1982 (TIAS 10646). November 2, 1993, and January 4, 1994 (TIAS 12529). June 15 and 20, 2005 (TIAS 05-620).

Agreement for promotion of safety on the Great Lakes by means of radio, with technical regulations and exchange of notes of May 6, 1974. Signed at Ottawa February 26, 1973. Entered into force May 6, 1975. 25 UST 935; TIAS 7837.

Amendments

December 29, 1978 (30 UST 2523; TIAS 9352; 1170 UNTS 339). December 22, 1987, August 10 and October 24, 1988.

Agreement relating to the AM broadcasting service in the medium frequency band, with annexes.

Signed at Ottawa January 17, 1984. Entered into force January 17, 1984. TIAS 11263.

Agreement concerning the use of the 88 to 108 megahertz frequency band for frequency modulation broadcasting (FM), with attachment. Exchange of notes at Washington November 26, 1990 and February 25, 1991. Entered into force February 25, 1991. TIAS



Q1: Does the auctioning of exclusive licenses limit our ability to explore and develop future wireless technologies?

- Does private land ownership doom future more efficient land use?
 - Collective land ownership, as on US Indian reservations, *does* inhibit evolutionary use of land and investment in improvement
 - Maybe traditional spectrum license model does the same?



Q1: Does the auctioning of exclusive licenses limit our ability to explore and develop future wireless technologies?

- "Auctions" are not a magic long term solution <u>unless</u> coupled with
 - Technical flexibility
 - Allocation flexibility
 - Economic incentives for efficient spectrum use
- While not generally known, US spectrum auctions (and many other licenses) have such flexibility



Q2: Spectrum scarcity: fact or fiction?

- "Beauty is in the eye of the beholder"
 - so is spectrum scarcity
- While US' CTIA thinks there is a lot of idle ("never used") federal spectrum,
 - their further constraint that they only want nationwide 24/7 spectrum in international standard bands reduces "idle spectrum" to a near null set
- However, there <u>is</u> a shortage of fielded technology in US that can efficiently use all available spectrum
 - Is cellular industry addicted to the "crack cocaine" of cheap Chinese equipment?

The honne and tatemae of spectrum

In practice, at a given time and place there is lots of unused spectrum

- Results from:
 - Uneven population density
 - Uneven terrain
 - Allocations and assignments based on peak needs





<u>Today's</u> Demand for Wireless Capacity

- Voice communications has little or no growth
 - Required paired spectrum and low latency
 - Note that industry planned 3G as a paired service as if voice or 2-way video would be major content
- Growth is in Internet-related content and video
 - Data flows highly asymmetric
 - Data speed is more important than time latency
 - Content packetized so faster rerouting to use available spectrum is feasible
- Creative sharing options exist
 - Industry interest in the US doesn't -- More interested in hiring lawyers and lobbyists than paying for R&D

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Lack of Industry Interest in Load Management

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- Electric utilities know the difference between peak and base load and price accordingly
 - Peak electricity is more expensive to generate and is priced accordingly
- Mobile telecom often has flat pricing models that has no impact on peak loads
 - Even nonflat prices rarely address peak load issue
- "Interruptible spectrum" may be one way to increase overall spectrum utilization





Interruptible spectrum

From Wikipedia, the free encyclopedia

US Initiatives to Improve Spectrum Efficiency

- 2002 FCC Spectrum Policy Task Force identified low actual spectrum use and urge Dynamic Spectrum Access/Cognitive Radio to help fix it
 - Promise of DSA has not be reached due to pragmatic issues with incumbents
- Mobile broadband growth sparked US National Broadband Plan seeking to reallocation 500 MHz new spectrum to mobile broadband
 - Again practical problems get in the way
- 2012 PCAST Report tries new approach
 - Sharing of federal spectrum with active real time cooperation

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Q3: Are the days of over-the-air broadcasting numbered?

- In <u>most</u> countries broadcasting has disproportionate influence in spectrum management policies
 - Politicians and broadcasters tend to have strong ties
 - Broadcast media content is important in elections
 - In some cases, broadcast ownership was a license to "print money" and dispensed by regulators to political favorites
 - Timing of change of present FCC chairman turnover appears linked to pending Rupert Murdoch matter
- Hence in *most* countries broadcast spectrum issues involve a lot more than technocratic factors



US TV Channels Vs. Time



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The elephant in the room



 Universal broadband to at least urban residences is a national goal in many countries

- Isn't residential broadband crosselastic with over-the-air TV?
 - 1 HDTV channel < 18 Mb/s
 - A lot less than 100 Mb/s that is US goal
- If universal broadband is achieved in an area, why is TV broadcasting needed?



Broadcast Developments in US

- Network viewership falling to record lows
- Cable multichannel video households around 90%
 - Recent movements unclear
 - Some of these homes use antenna in some bedrooms



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AP / April 7, 2013, 8:59 PM

Broadcasters struggle to win back the "Zero TV" crowd



- 5% of households, mainly under 30s, have no video!
- Broadcasters pushing mobile DTV as the future

If it is, why does it need 6 MHz channels?
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Future of Broadcasting As viewed by a "techie"

- Why do we pump 100's of kW into the ether to it passes by most homes and is mainly received by cable headends?
 - Are TV transmitters mainly a precondition for "must carry" rather than being a communications media?
 - Such a charade is both using up scarce spectrum and using up a lot of electric power
- Pending FCC incentive auction proposal is a pragmatic approach to address this while respecting equities of
 - current broadcasters
 - small minority of public that uses "free" reception
 - economically disadvantaged who can't afford cable

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Possible Alternatives to Present TV Broadcasting

- Separate "must carry" rights from transmitter license and allow free transfer/sale of each
- European-style multiplexing of transmitters
- "Freemium" CATV pricing to assure universal service
 - Diversion of some incentive auction revenues to fund CATV freemium basic service
- Mobile DTV with multiplexed transmitters



DSA Attempts in USA

• 5 GHz U-NII

- Unlicensed sharing with military and nonmilitary federal radars
- Rule required passive sensing of radar signals

TV Whitespace

- Unlicensed sharing in TV spectrum
- Presence of anachronistic wireless microphones in band greatly complicated cognitive radio issues
- Rules required geolocation and database lookup based on naïve propagation model favorable to broadcast interests
 - Passive sensing allowed in theory but terms make implementation approval a herculean issue

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Whitespace in Canada: Pragmatic Issues

- US-compatible hardware may be necessary for Canadian implementation
- But why not base protection of TV stations on actual coverage of station usual modern terrain databases and contemporary propagation predictions?
 - Apparent approach pending in UK
 - As hypochondriacs go "doctor shopping", US broadcasters use "propagation model shopping" to get different models for different conflicts with other industries

PCAST 2012 Report: The Future of US Spectrum Management?



Executive Office of the President President's Council of Advisors on Science and Technology

JULY 2012



 Follows on 2010 **Presidential Memorandum** requiring that the Federal Government make available 500 MHz of Federal or non-federal spectrum for both mobile and fixed wireless broadband use by commercial users within 10 years.

http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf

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SPECTRUM LINKS

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International Telecommunications Union

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Surf over to web site for more information

Thanks for the invitation

Questions?



- 1) Does the auctioning of exclusive licenses limit our ability to explore and develop future wireless technologies?
 - 2) Spectrum scarcity: fact or fiction?
 - 3) Are the days of over-the-air broadcasting numbered?