Recent Experiences with Spectrum Sharing, TV White Spaces: The Good, the Bad and the Opportunity

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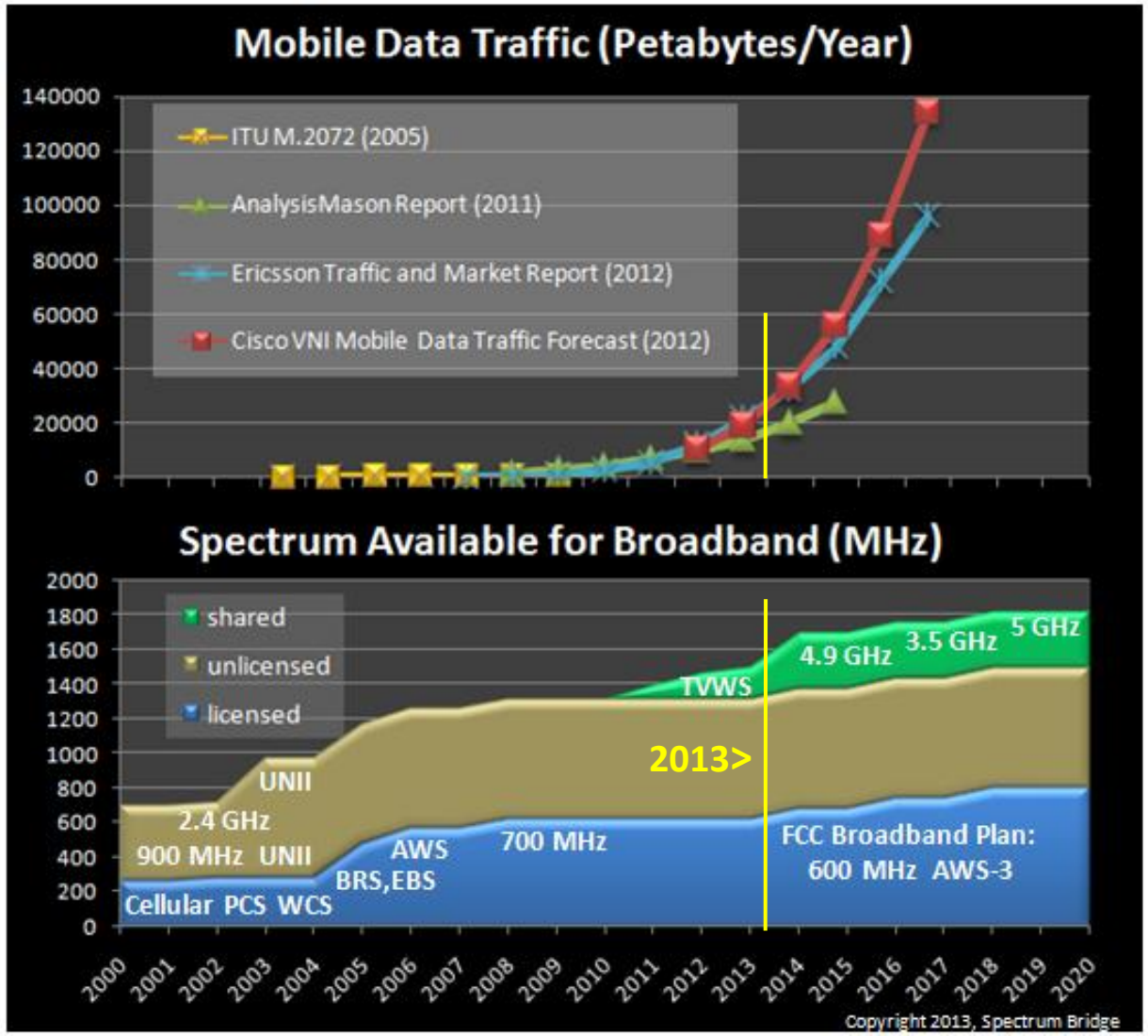
Wireless Spectrum Research and Development
Workshop IV
Promoting Economic Efficiency in Spectrum Use

Current Situation



….at the precipice of exponential growth in wireless bandwidth consumption.

Past growth supported by improvements in:

- ✓modulation techniques,
- ✓MIMO,
- ✓variable cell size,
- ✓MAC layer protocols,
- ✓brute force spectrum allocation.

Future growth will depend on spectrum sharing: more efficient spectrum use and smaller cells.

The Good…

- Proved the Dynamic Spectrum Sharing Model
  - ✓Incumbents are being protected
  - ✓Running changes to the rules had no impact
- Utility in UHF broadband spectrum
  - ✓12+ mile links + NLOS performance
  - ✓12+ Mbps data rates
- Two (2) spectrum management solutions approved by the FCC
- Three (3) radios have received FCC type approval
- Data shared on a real time basis between solutions providers
  - ✓accuracy is better than millimeters
- Killer apps in Industrial Telemetry and Precision Agriculture
  - ✓WS spectrum plentiful in rural areas
  - ✓broadband data rates
- Created a business model that includes value added services
- Database enables the opportunity to manage co-existence

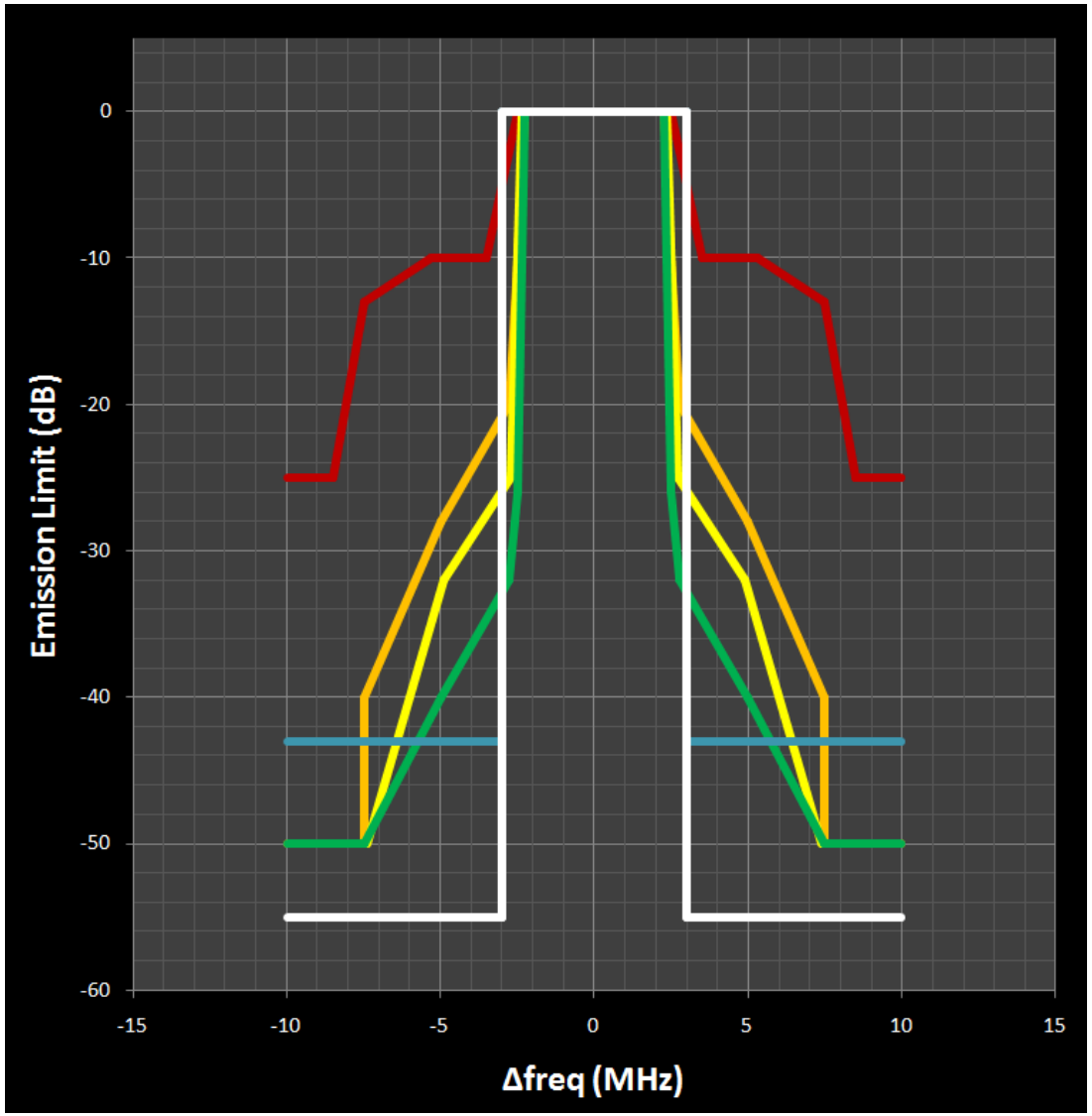
The Bad…

TVWS OOBE limits (-55 dB at band edge) not congruent with standards based technology

- LTE Uplink, E-UTRA UE, 5 MHz, SC-FDMA
- WiFi, 802.11, 5 MHz, 4.9 GHz Mask L
- WiMax, 802.16, 5 Mhz
- WiFi, 802.11, 5 MHz, 4.9 GHz Mask M
- FCC §27.53, mobile
- White Spaces Mask

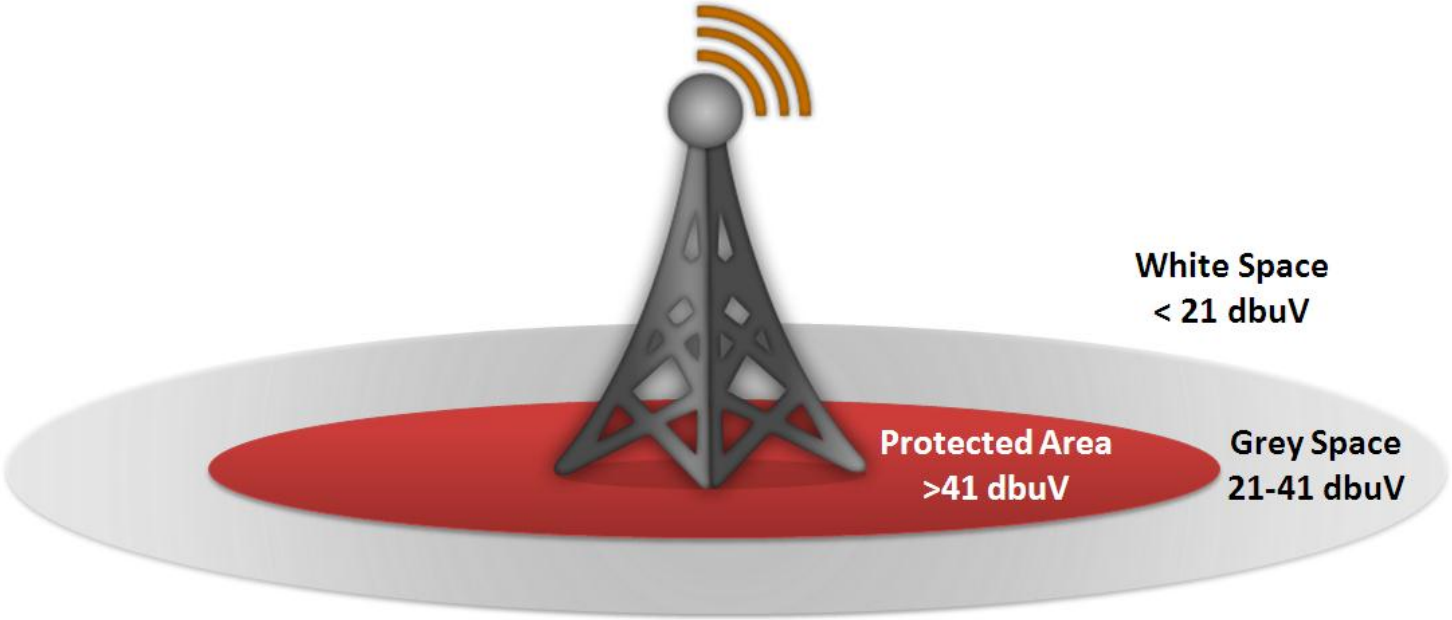
Proven, time-tested, well-engineered radio technologies are needed to:

- realize economies of scale
- enable low cost solutions
- provide robustness and efficiency



The Bad…

High power TV stations can be detrimental to low power device operation, even in white space…



USB connected

Available Channels

Channel availability at 28.74806, -81.36445

Height Above Average Terrain = 1.61m

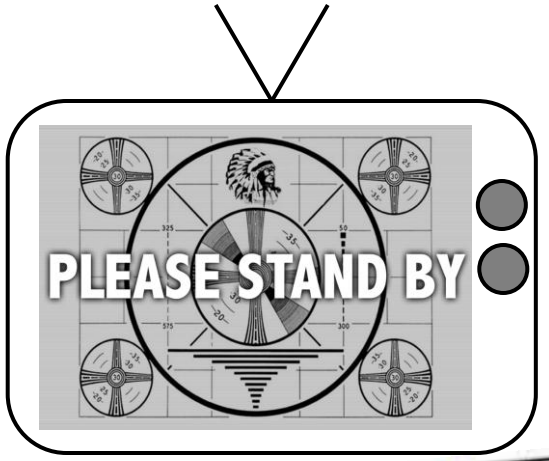
CH	Frequency (MHz)	Type	Noise Floor
29	560 - 566	Microphone, Available	-54
38	614 - 620	Microphone, Exclusive	-55
7	174 - 180	Fixed 3m	-67
15	476 - 482	Microphone, Available	-82
32	578 - 584	PP 40mW	-83
19	500 - 506	Fixed 30m	-84
34	590 - 596	PP 40mW	-86
44	650 - 656	PP 40mW	-86
13	210 - 216	Microphone, Available	-88
25	536 - 542	PP 40mW	-88
42	638 - 644	PP 40mW	-88
28	554 - 560	PP 40mW	-96
24	530 - 536	PP 40mW	-102
8	180 - 186	Fixed 30m	-108
45	656 - 662	PP 40mW	-108
18	494 - 500	Microphone, Available	-111
9	186 - 192	Microphone, Available	-113
20	506 - 512	Microphone, Available	-115
5	76 - 82	Fixed 30m	-117
35	596 - 602	Microphone, Exclusive	-119
14	470 - 476	Fixed 30m	-125
6	82 - 88	Fixed 30m	-162
2	54 - 60	Fixed 30m	-173

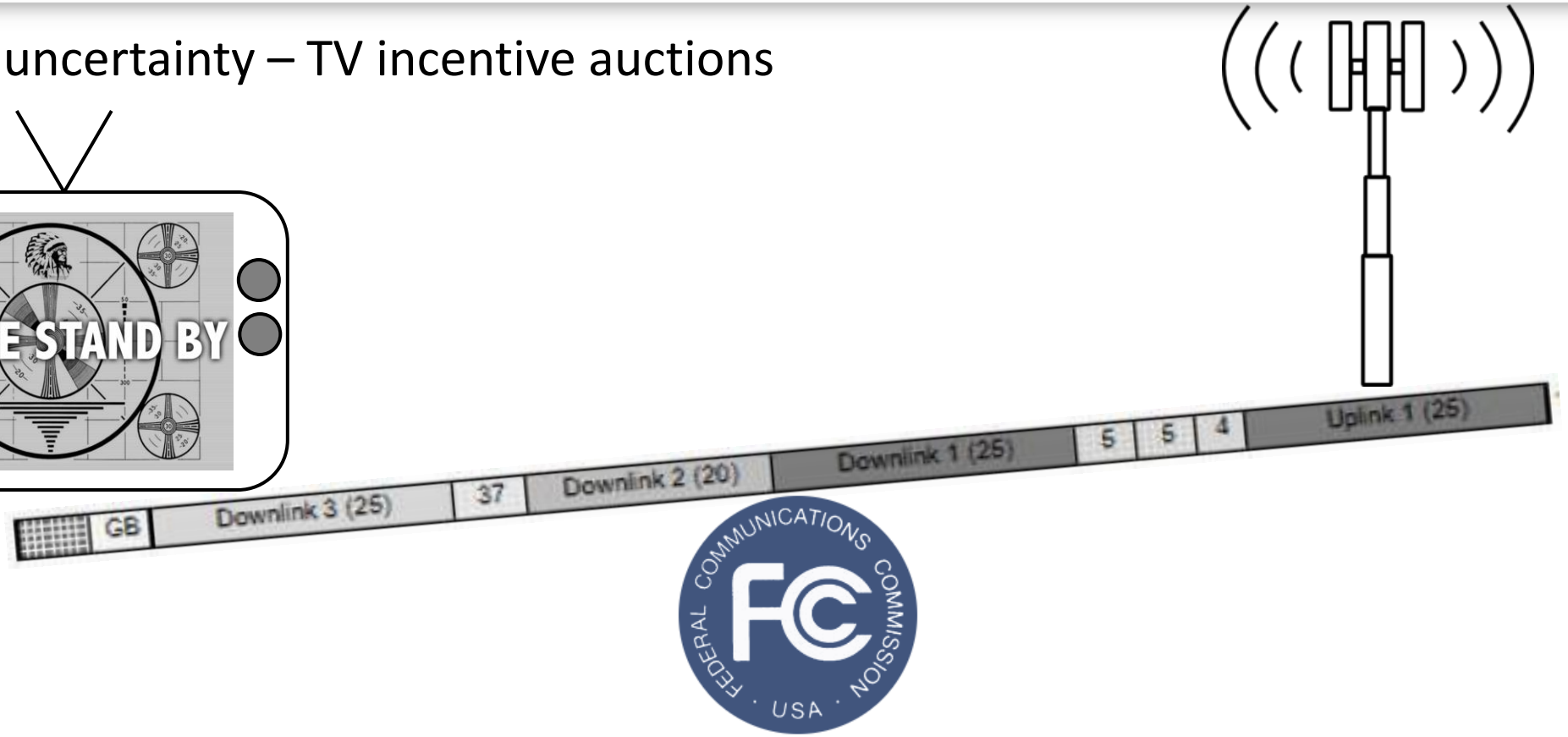
Exclusively Available to Microphone Users
Available to Microphone Users
Available to Microphone Users and TVBDs

…but we can estimate channel quality and enable co-existence

The Bad…

Looming uncertainty – TV incentive auctions



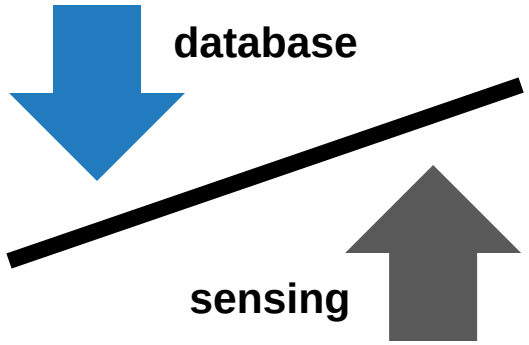


"In the white space … we propose measures that…would make a substantial amount of spectrum available for unlicensed uses, including a significant portion that would be ***available on a uniform nationwide basis*** *… Television white spaces will continue to be available for unlicensed use in the repacked television band." Ref: FCC* NPRM 12-268

The Opportunity, beyond TVWS…

Dynamic Spectrum sharing has the potential to address exponentially increasing wireless demand -

- Protects incumbents,
- Compliments sensing technology,
- Enables co-existence,
- Policies can be adapted over time,



But

- Allocate a critical mass of spectrum….ebbs and flows are ok,
- Facilitate the use of commercially available standards based technologies,
- Maintain a healthy regulatory landscape… uncertainty and unnecessarily complex rules result in stagnation,
- Shift from the mindset of incumbent protection to a sharable landscape.

Thank You

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