

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

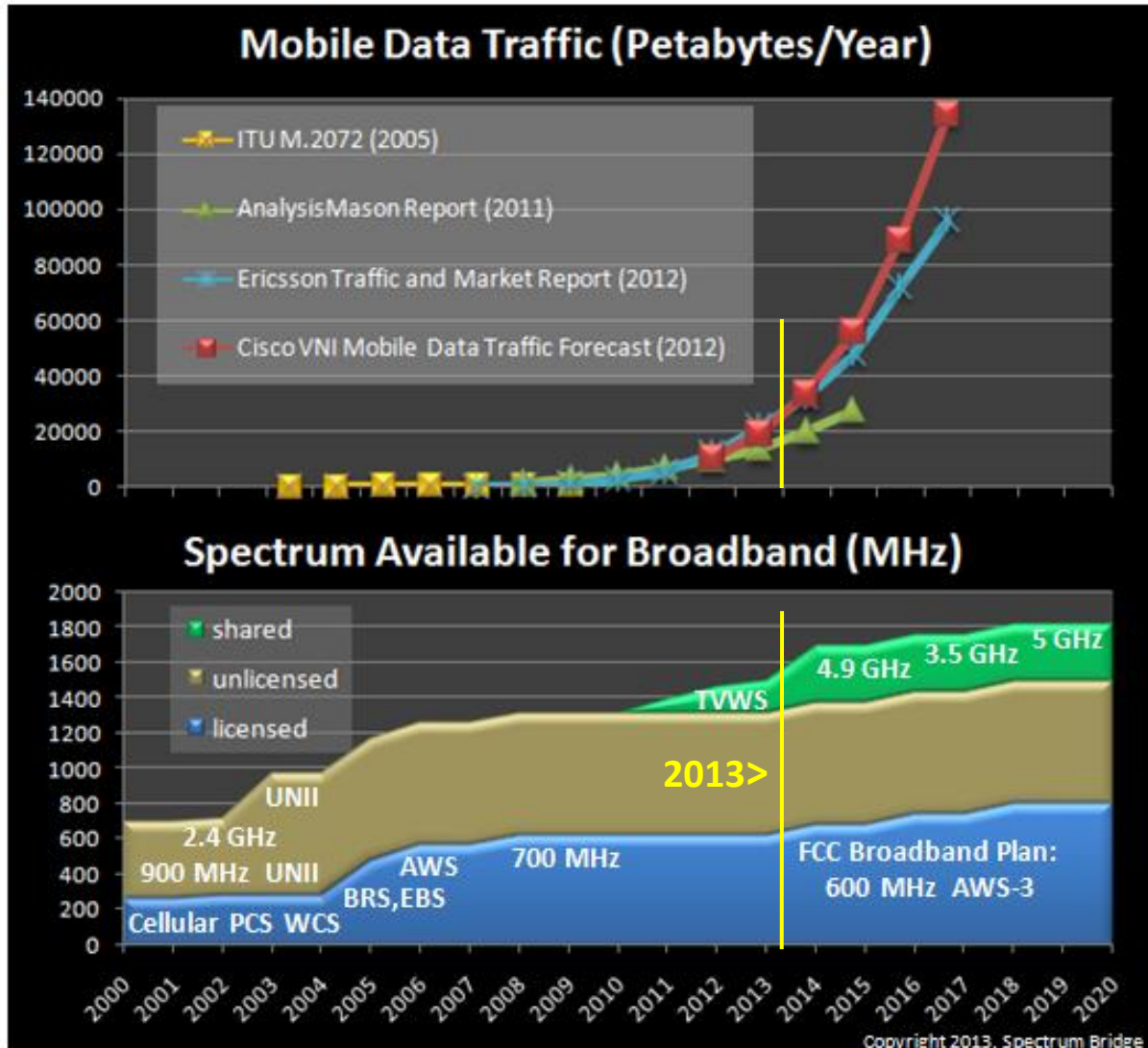
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Wireless Spectrum Research and Development  
Workshop IV  
Promoting Economic Efficiency in Spectrum Use





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

Past growth supported by improvements in:

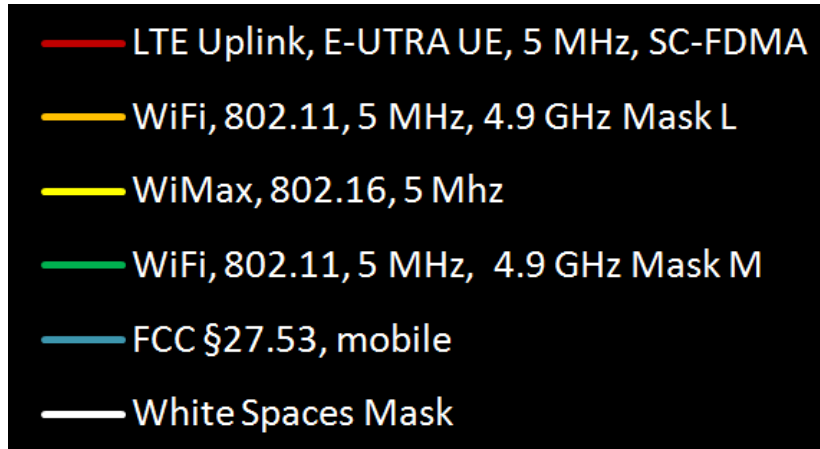
- ✓ modulation techniques,
- ✓ MIMO,
- ✓ variable cell size,
- ✓ MAC layer protocols,
- ✓ brute force spectrum allocation.

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

- 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

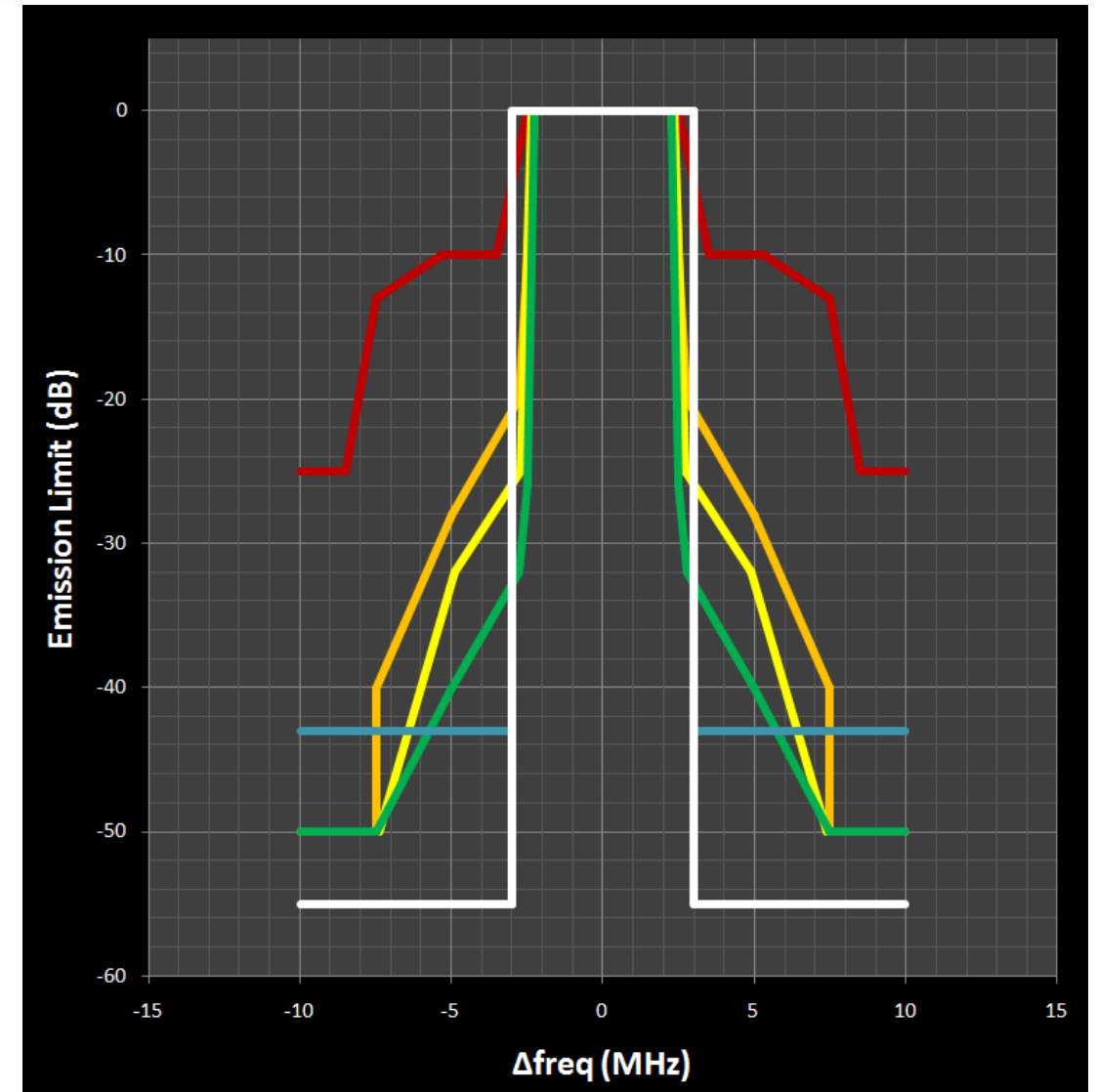


TVWS OOBE limits (-55 dB at band edge) not congruent with standards based technology



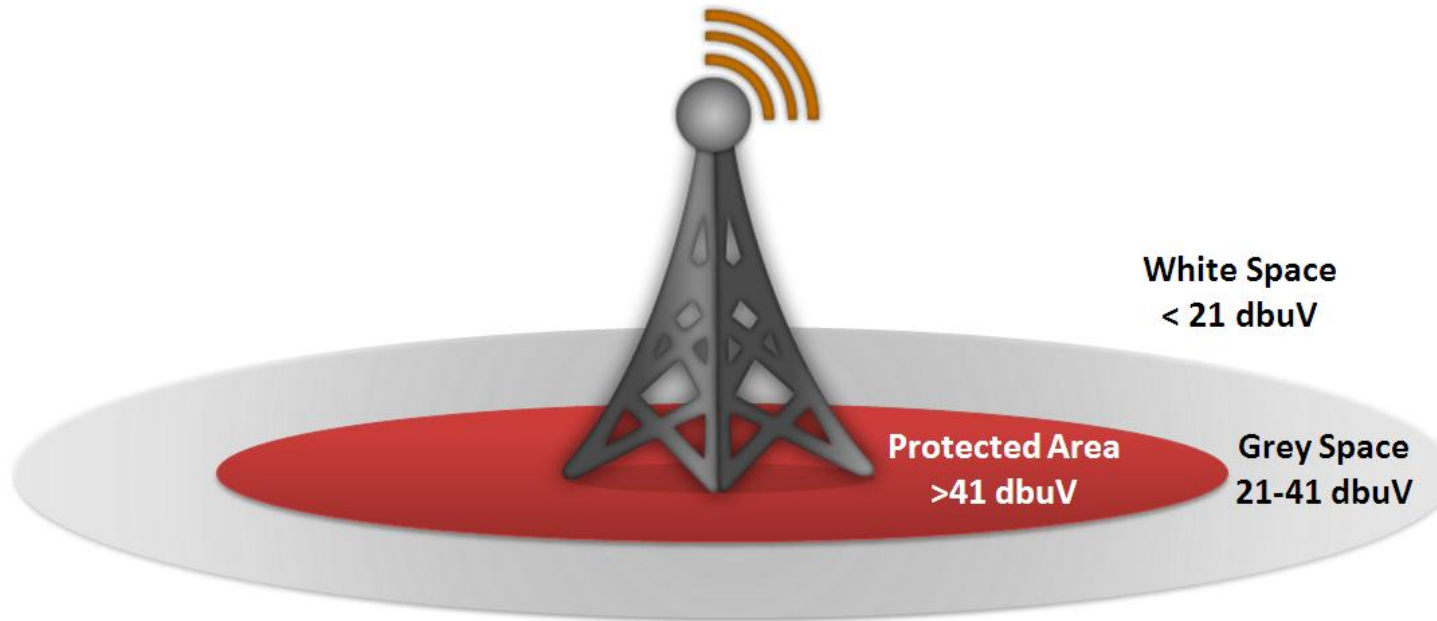
Proven, time-tested, well-engineered radio technologies are needed to:

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





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



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

USB connected

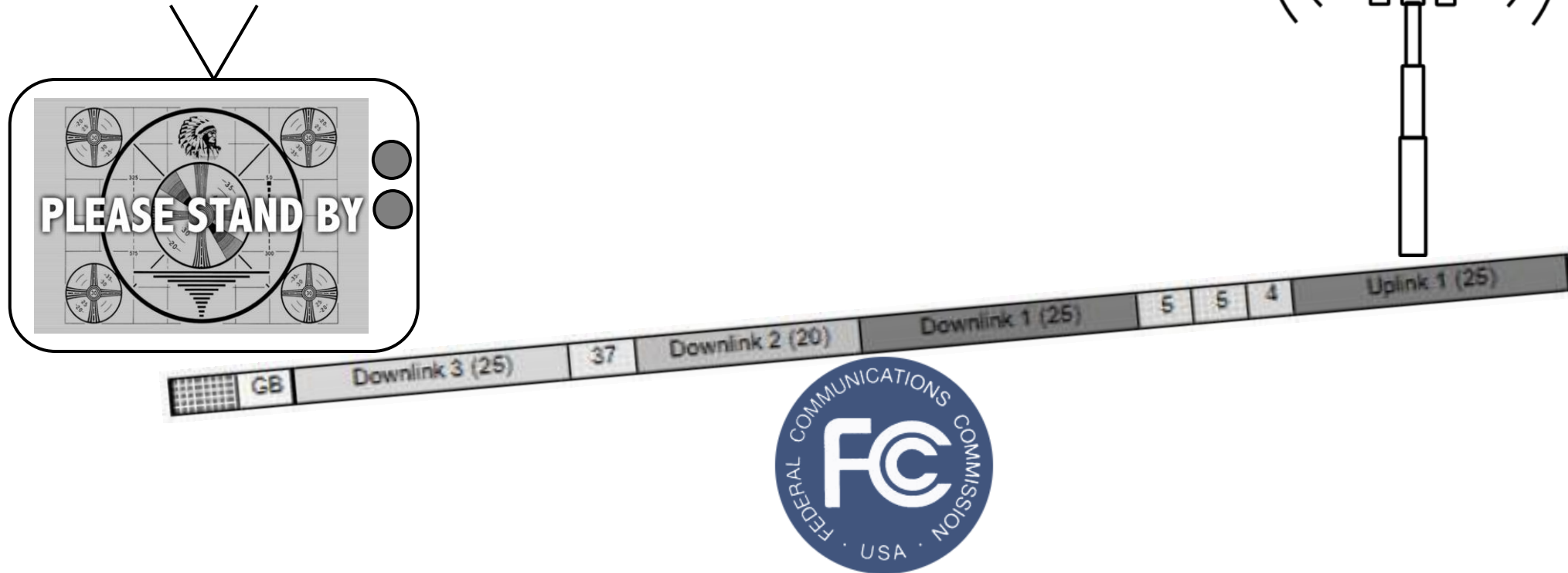
### Available Channels

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

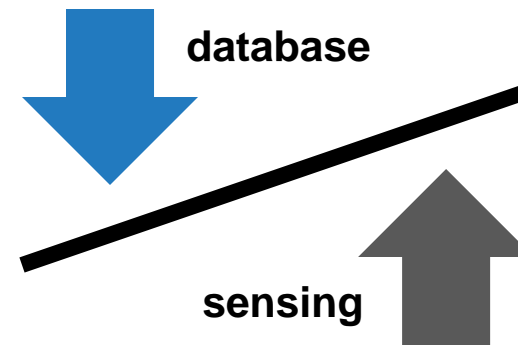
Looming uncertainty – TV incentive auctions



*“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*

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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