

# TV White Spaces: The Next Wi-Fi?

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# Who am I ? 30 second intro

- Contributor to Mobile Radio Technology ([www.mrtmag.com](http://www.mrtmag.com)) since January 2003.
- Hearing policy wonks talk about 700 MHz, unlicensed spectrum in D.C. for years.
- Day job: Editor-in-Chief, VON Magazine
  - Feb 2007 Interview, Phil Zimmermann
    - <http://vonmag.com/editorial/pioneer/philip-zimmermann-creator-of-pretty-good-privacy-interview>

# Unlicensed TV White Spaces

- What is “White Spaces”?
- How did the concept get created?
- Technical proposals - History
- Tech Specifics as of July 31, 2006
- Final Word in October

# What is White Spaces?

- “Analog”/NTSC TV uses VHF and UHF
  - Today we have TV channels 2-69
  - As of Feb 18, 2009, channels 2-51 will be for TV, and all digital
    - (Assuming no last minute political panic)
- In any given geographic area, one can receive only a handful of stations due to geography, careful licensing
- 51 channels -handful = LOTS of open unused, “white spaces” channels
- Each DTV channel = 6 MHz, 27 Mbps broadcast bandwidth using existing DTV spec

# Why is the 700 MHz RF band loved and coveted by all?

- Propagation characteristics
  - Go through walls, obstacles
  - In a licensed use mode, one can cover a city with 1 or 2 base stations vs. lots of cells/transmitters in Wi-Fi and higher frequencies.
- There's a lot of white spaces space available, the farther away from cities you go.
  - Policy wonks see this as a savior for the “Digital Divide” in Rural America

# FYI: There's a lot of lurking LICENSED 700 MHz space

- First auction
  - Lot of speculators sitting on it
    - Largest Aloha Networks, Vulcan Ventures
- Second auction coming up
  - Speculation cable, Google, others may raise money
  - Lot of political in-fighting on how it should be conducted
    - Google pushing for liberalized auction rules
    - CTIA (the cell guys) like current model

# How did White Spaces created?

- Review of spectrum policy by wonks
  - Hey, there's all this bandwidth...
    - New America Foundation ([www.newamerica.net](http://www.newamerica.net))
- Success of Wi-Fi
- Demand for more unlicensed bandwidth
  - FCC, Congress both recognize needs
- Cognitive/smart radio
  - Enabling technology to “look”
  - DARPA has done work on cognitive radio

# The Recent History of White Spaces Maneuvers

- FCC Notice – May 04
- It won't be Part 15 (WiFi)
- First round of comments
  - “White Spaces” Alliance
  - Motorola
  - Association for Maximum Service Television
- FCC addresses comments July 2007
  - (Not before DEFCON materials deadline ☹)

# FCC Notice of Proposed Rulemaking

- Released on May 13, 2004.
  - Written in part by Ed Thomas, FCC, Office of Engineering and Technology
- Statement to open up white spaces channels, solicited comments
- Suggested approaches to avoid interference
  - “Guard signal” to indicate open freqs
  - Geolocation (Where am I? Look at database)
  - Spectrum sensing (Sense before send)

# NAB (of course) not happy

- Response by Association for Maximum Television
- Generated worst-case scenarios for white space
  - 154 pages in initial response
- Tried to convince FCC that it would Never Work.

# White Spaces Devices won't be Part 15 (Wi-Fi)

- Part 15
  - Up to 1 watt power
  - Must take interference
  - Not cause interference
- Comments from White Spaces Alliance, Moto indicate Part 15 not workable.
- Typical White Spaces Device
  - Under 1 watt (To avoid interference)
  - Need a cognitive/smart radio
    - “Look before broadcast” and/or geolocation

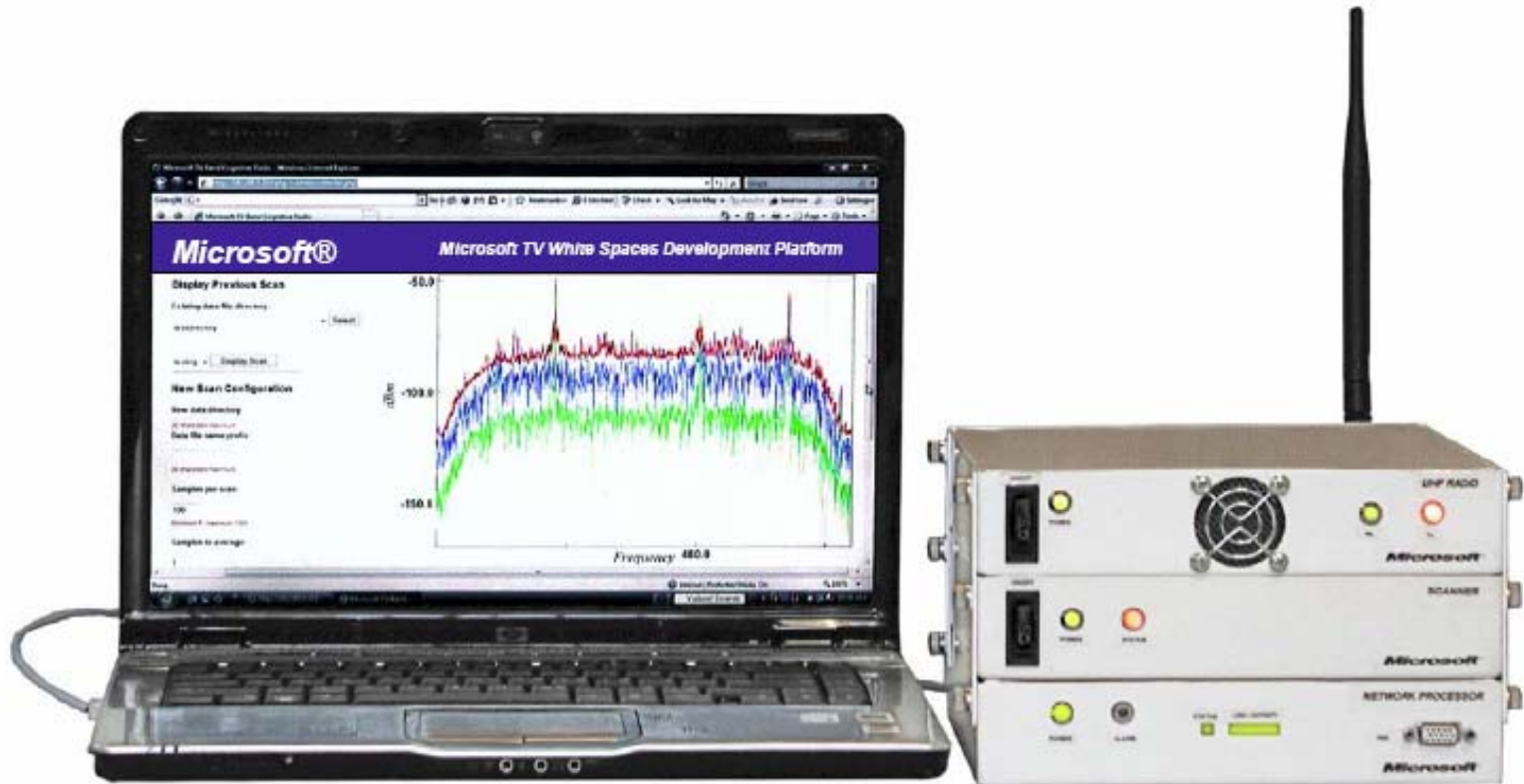
# Cognitive/smart radio

- Smart radio should be able to:
  - Sense environment
  - Avoid broadcasting on channels in use
    - TV most obvious, also some first responders, and licensed wireless microphones.
  - Find the unused bandwidth
  - Adjust power accordingly
  - Sounds like Electronic Warfare, without the War...
  - Can be used for TV white spaces (700 MHz), other bands

# “White Spaces” Alliance comments

- Dell, Google, HP, Intel, Microsoft, Philips
  - Contributor – Edmond J. Thomas
- Block off channels 2-20 (and 37)
  - Avoid interference with existing licensed users (LMR)
  - Reserve lower end for potential public safety white spaces use
- Geolocation too cumbersome
- Doesn't even talk about “guard” channel
- Spectrum sensing “smart” radio only way to go.
- “And here's a toy Microsoft built...”

# The Toy That Microsoft Built



# The Toy That Microsoft Built

- “Microsoft TV White Spaces Development Platform Version 1”
- (Ignorant) Press made it sound like a finished consumer device
- Prototyping platform to “explore, develop and evaluate technologies required to create a commercially viable cognitive radio-based communications network product”

# Why White Spaces gave FCC the Device

- Enable FCC test division to work with spectrum scanning, gain confidence
  - Test sensitivity of process
  - Turn knobs up (more power) and down (less power)
  - Test interference with existing devices
  - Test waveforms to ID DTV, NTSC, wireless mics

# Functions of MS-TV-WS-DP-V1

- Enable developers to:
  - Create spectrum scanning and signal recognition software & hardware used to co-exist and avoid interfering with incumbent (TV) operators
  - Develop & refine transmit power control algorithms
  - Explore & test waveforms & modulation techniques
  - Perform on-air propagation & coverage measurements
    - VERY important in FCC test lab environment

# Under the hood of MS...DP-V1

- Two system assemblies
  - Windows-based PC using IE browser as interface
  - Three boxes containing wide-band spectrum scanner and network processor and a tunable UHF half-duplex transceiver controlled by the network processor

# MS...DP-V1 : How it works

- Spectrum scanner goes through UHF 21-51, does 2048 FFT
- Signature feature templates for DTV and NTSC applied to FFT
- Non-occupied channels are declared potential white space, scanned for narrow-band incumbents such as wireless mics.
- Display scanner control and discovery info using (whatelse?) MS IE.

# Motorola comments

- Much more conservative approach
  - Block off 2-21, also throw in two other channels for public safety use
- Geolocation initially used, with spectrum sensing maybe later
- Spectrum sensing deemed too “immature”
  - Hmm, compared to...?
- No discussion on guard band
- In interview, reluctant to talk about potential demo device/prototype lurking about

# New America Comments

- Want all TV white spaces, no technical excuse not to grab 'em
- Whitespaces Coalition
  - Picked block of 2-20 because they didn't want big antennas (Mobile device use)
- Motorola
  - Business model geared to fixed broadband, so geolocation works better; i.e. dealer installed Canopy-type devices

# FCC addresses comments in July 2007

- Not announced as of July 6, 2007
- This slide to be updated for DEFCON presentation

# What is expected to be finalized

- Technical specifications
- Final Report and Order Issued in October 2007

# Real World Implementation by ???

- Consumer electronics vendors hot to go
- Intel, Philips always needs to sell more chips, devices
- Google wants Yet Another Way Around The Man (In this case, Telcos & Cable)
- Software is relatively straight-forward
  - After all, Microsoft did it with one engineer and IE...
  - Maybe by late 2008 or early 2008, if we don't get into "standards"
    - 802.11n still isn't finalized