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NSF Spectrum Update

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A Snapshot of Current Issues

- Access Broadband over Power Line (Access BPL) update
- TV White Space
- Digital Television (DTV) Transition
- Aerostat (radar blimp) Coordination
- 14 GHz terrestrial mobile Very Small Aperture Terminal (VSAT) coordination

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Access Broadband over Power Line (Access BPL) Background

- Access BPL provides "broadband" internet access to customers using power lines as the distribution medium
  - Access BPL is distribution on medium- and low-voltage lines, up to the utility side of a service panel
  - In-home BPL is service within a building or residence, not maintained by the electric utility (not discussed here)
- Touted as a rural broadband solution, but now positioned as an urban/suburban competitor to DSL/cable
  - As with DSL/cable, repeater issue coupled with low population density makes rural business model more risky
- Interference Issue: RF leakage from power lines may pose threat to authorized spectrum users
  - Power lines and associated equipment (transformers, etc.) never intended to be used as RF transmission media

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Access BPL – Regulatory Activity

- October 2004, FCC releases Report & Order authorizing Access Broadband over Power Line using 1.705 – 80 MHz
  - Just above AM broadcast band to a little below the FM broadcast band
  - Includes the 13.36 – 13.41, 25.55 – 25.67, and 73 – 74.6 MHz exclusive passive bands, and the 37.5 – 38.25 MHz shared RA bands
- Emission limits for unintentional emissions from Access BPL systems were established based on a combination of Part 15 limits for intentional and unintentional radiators
- Different rules are applied to Access BPL on medium voltage (1,000 – 40,000 V) and low voltage (e.g. 240/120 V) lines

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Access BPL Emission Limits In RAS Terms

Frequency Range (MHz)	Medium Voltage Lines		Low Voltage Lines		Measurement Bandwidth (kHz)
	Field Strength (microvolt/m)	Measurement Distance (m)	Field Strength (microvolt/m)	Measurement Distance (m)	
1.705 - 30	30	30	30	30	9
30 - 80	90	10	100	3	120
	Equivalent Flux Densities at 1 km Assuming Free Space Loss				
1.705 - 30	23.9 MJy		23.9 MJy		
30 - 80	1.8 MJy		200 kJy		

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Protection for the RAS Afforded by the Report & Order

- **Emission Limits**
- **Notching:**
  - "Access BPL systems shall incorporate adaptive interference mitigation techniques to remotely reduce power and adjust operating frequencies, in order to avoid site-specific, local use of the same spectrum by licensed services. These techniques may include adaptive or "notch" filtering, or complete avoidance of frequencies, or bands of frequencies, locally used by licensed radio operations."
- **Exclusion Zones**
  - No Access BPL in the band 73 – 74.6 MHz on overhead medium voltage lines within 29 km of the VLBA sites
  - No Access BPL in the band 73 – 74.6 MHz on overhead low-voltage or on underground lines within 11 km of the VLBA sites
- **Consultation Areas**
  - Within consultation areas, BPL operator and affected users must consult in good faith to ensure no harmful interference occurs
  - Consultation areas were declared for Access BPL operations in the band 1.7 – 38.25 MHz within 4 km of the coordinates* of RAS facilities in footnote US311 (ATA, Goldstone, AO, VLA, VLBA, GB, OVRO)

*US 311 actually specifies boundaries, not observatory coordinate points

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Access BPL
Memorandum Opinion & Order

- Many parties filed petitions for reconsideration of the original Report & Order
- NTIA requested corrections and modifications on behalf of NSF due to errors and inconsistencies in original rules
- FCC issued a Memorandum Opinion and Order in August 2006 addressing the petitions
- Virtually all requests were denied except NTIA's. The MO&O:
  - Removed exclusion zones around the VLBA sites and replaced them with a 73 – 74.6 MHz exclusion zone around the VLA (65 km for overhead MV lines; 47 km for LV or underground lines, referenced to center of array)
  - Extended the frequency range for consultation zones surrounding US311 sites to 1.7 – 80 MHz

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Summary of Current Protections for the RAS from Access BPL

- **Exclusion zones:**
  - 73 – 74.6 MHz exclusion zone around the VLA (65 km for overhead MV lines; 47 km for LV or underground lines, referenced to center of array)
- **Consultation Areas:**
  - Within 4 km of coordinates specified for RA observatories in US311, for any Access BPL operations in the range 1.7 – 80 MHz
- **Notch Requirements (20 dB depth below 30 MHz; 10 dB above)**
- **General Radiated Emission Limits:**

Frequency Range	*1,000 – 40,000 V Lines*	*<1,000 V Lines*
1.705 – 30 MHz	30 microV/m measured at 30 m, in 9 kHz bandwidth	30 microV/m measured at 30 m, in 9 kHz bandwidth
30 – 80 MHz	90 microV/m measured at 10 m, in 120 kHz bandwidth	100 microV/m measured at 3 m, in 120 kHz bandwidth

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TV White Space

- Sen. Ted Stevens is a proponent of the white space concept
- Notice of Proposed Rulemaking released in May 2004
- Geared toward the use of “locally-vacant” TV spectrum for the provision of unlicensed broadband data services, among other things
- TV spectrum considerations:
  - RAS and low-power medical telemetry devices presently have exclusive access to TV channel 37 spectrum (608-614 MHz)
  - Channels 2 – 4 commonly used for video output
  - Channels 14 – 20 used in some major markets for Private Land Mobile Radio and Commercial Mobile Radio Service
  - Channels 52-69 being re-allocated post-DTV transition

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TV White Space

- Fixed devices could be allowed 1 W transmit power and up to 6 dBi antenna gain = 4 W Effective Isotropic Radiated Power
- FCC clearly envisions broadband applications such as wireless networks, with bandwidths of 6 MHz and more
- Channels 37, 2 – 4, 14 – 20, and 52 – 69 likely ruled out, but out-of-band emissions from 4 W broadband signals should be of concern
- Commission approved a First Report & Order and Further NPRM on this topic on Thursday (10/12/06)
  - Full text not yet available
  - NPRM requests comments on (among other things):
    - Technical rules
    - Should portable devices be allowed?
    - Should licenses be required?
  - CORF should consider filing comments to insure full protection of Channel 37 from eventual mass-market unlicensed devices. May wish to use NSF comments to NTIA as a basis.
- FCC Schedule: Second R&O in October 2007; marketing of products begins on February 18, 2009

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DTV Transition

- TV stations are vacating channels 52 – 69 and moving all operations to the "core" TV channels of 2 – 51
- Channels 52 – 69 (698 – 806 MHz) are being re-allocated to Public Safety, CMRS, broadcasting (lower-power than regular TV), and other applications
- After Tuesday, February 17, 2009, regular analog TV broadcasts will cease to exist, and all TV broadcasts will be digital
  - Date specifically chosen to be after the Super Bowl and before the NCAA basketball tournament
- Better interference rejection of DTV receivers will allow greater efficiency of TV allotments, meaning more stations will be packed into fewer channels with less distance between co-channel allotments
- Recent EOR experience at the VLA has shown that interference from digital TV signals is more problematic, at greater distances, than that from analog TV signals
- → RA observing in Channels 2 – 51 will be more challenging after the transition

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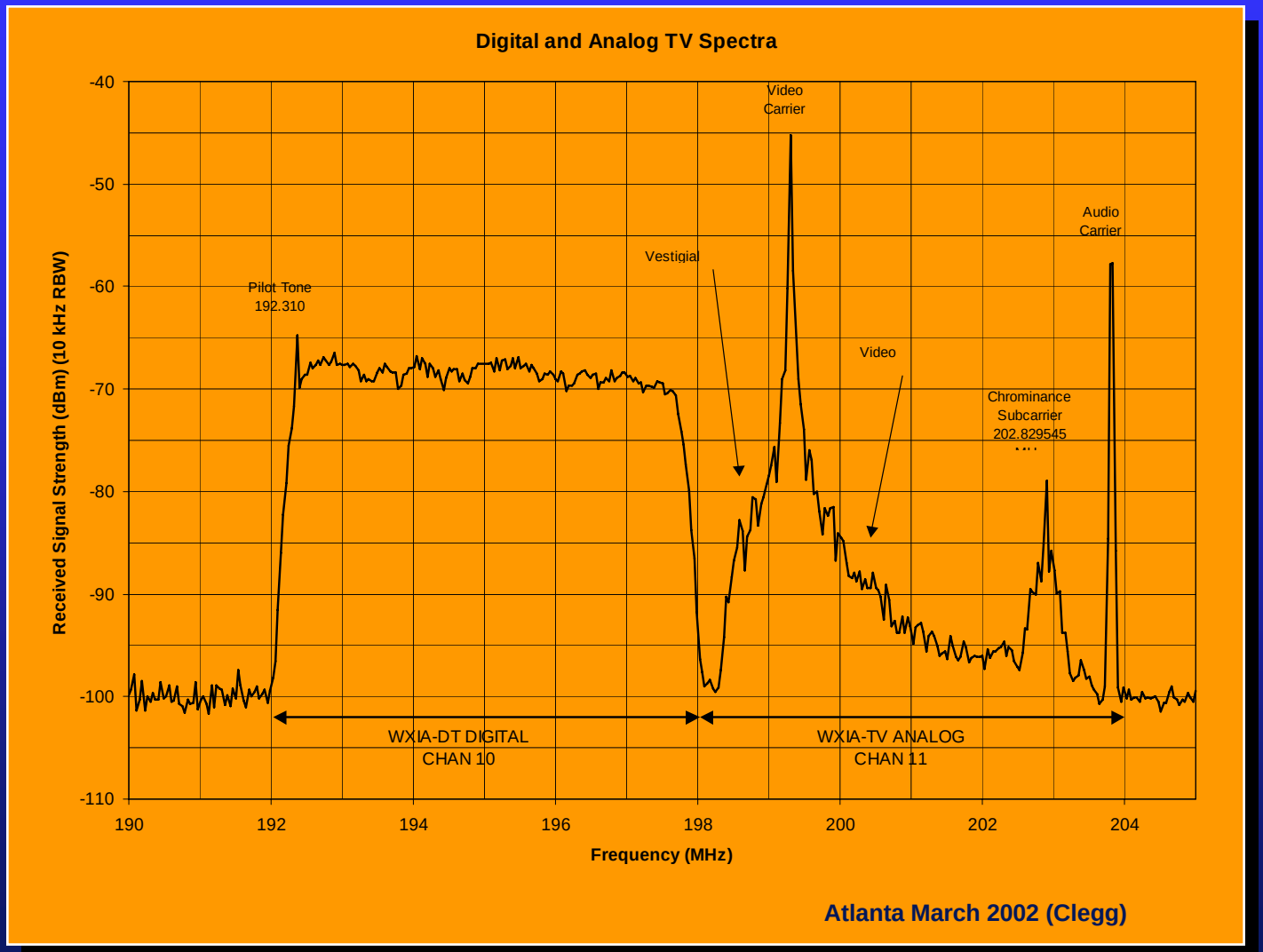
DTV vs Analog TV Spectrum



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Channels 2 – 51 Frequency Bands

- Channels 2 – 6: 54 – 88 MHz
- Channels 7 – 13: 174 – 216 MHz (z_{HI} ~ 5 – 7)
- Channels 14 – 51: 470 – 698 MHz (z_{HI} ~ 1 – 2)
- General TV technical constraints:
  - Each channel (analog or digital) is 6 MHz wide
  - Analog TV EIRP limit: 8 MW
  - Digital TV EIRP limit: 2 MW

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Aerostat Coordination

- U.S. Air Force uses aerostats for border protection
  - Aerostats are radars installed on tethered balloons, operating ~10,000 ft altitude
- The radars use the 1200 – 1300 MHz band, and are within line of sight or near line-of-sight to some radio and optical observatories (AO, VLA, Pie Town, Kitt Peak, Lemmon, Hopkins, Apache Pt)
- Ten-year old MOU with AF provides for blanking the radar signal when the radars sweep toward an observatory
  - Blanking interval depends on calculated and/or measured levels of interference
- AF has asked that we re-negotiate the coordination agreement since they have installed updated radars with better performance specifications
- So far, they have not made any case for improved performance. We (NSF and interested observatory representatives) are presently working with them to make in-situ out-of-band emissions measurements on the new radars

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Mobile VSAT Coordination

- NSF has negotiated a Coordination Agreement with another 14 GHz VSAT operator, but this time it is a terrestrial mobile operator rather than an aeronautical terminal
- The operator (RaySat) plans to use VSAT terminals mounted on up to 4000 vehicles to provide mobile broadband data access to first responders, emergency services, and other users on a nationwide basis in the contiguous U.S.
- The VSATs use the 14.0 – 14.5 GHz band for uplinks, which includes the 14.47 – 14.5 GHz footnote consideration for RA observations of the formaldehyde line

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Mobile VSAT

- Coordination agreement calls for excluding RaySat emissions within the sub-band 14.47 – 14.5 GHz when a terminal is within:
  - 160 km of Green Bank or the VLA
  - 50 km of seven out of eight VLBA stations in the contiguous U.S.
  - 25 km of the Hancock NH VLBA station
- Distances based on Rec 769 and propagation modeling, except for Hancock, whose coordination distance is reduced due to its proximity to Boston
- Terminals are not centrally controlled and therefore cannot coordinate based upon observing schedules

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Lastly… some *useful* (but not necessarily relevant) telecom news from Washington

- Get a bigger tax refund this year!
- Several companies took the IRS to court over a 100-year-old law that taxes long distance telephone service based on a definition of long distance as a service that is charged based on time and distance
  - Current long distance charges are generally not distance-dependent, therefore should not be subject to the tax
- Companies won in court more than a year ago, but it has taken until now for the IRS to relent
- Be sure to claim a credit on your 2006 income taxes for excise taxes improperly levied by the IRS on your domestic long-distance telephone service dating from February 28, 2003 to July 31, 2006
  - A "standard refund" amount will be determined by the IRS for most of us who did not keep long distance phone bills for the last three years. Individuals with accurate records can itemize.
- See *FHH Telecom Law* newsletter, July 2006