Measurement and Sensing in 5 GHz

Subcommittee Briefing
CSMAC Meeting
March 18, 2016

corrected copy Version 2

Measurement and Sensing in 5 GHz

Co-chairs:

- Paul Kolodzy
- Dennis Roberson

NTIA Liaison:

- Ed Drocella

Members:

- Mike Chartier
- Mark Gibson
- Dale Hatfield
- Mark McHenry
- Janice Obuchowski
- Rick Reaser
- Kurt Schaubach
- Steve Sharkey
- Mariam Sorond

Work Plan

Study Question:

What are the strengths and weaknesses of measurement-based and sensor-based spectrum sharing methods, and how can the weaknesses be overcome? How can this spectrum sensing and spectrum monitoring data be analyzed to identify and address environmental trends pointing towards potential interference situations before harmful interference occurs? Specific bands of interest are U-NII-2B (5350-5470 MHz) and U-NII-4 (5850-5925 MHz).

Work Plan:

Holding weekly telecoms since late December and have had excellent participation for each meeting.

Progress to Date

Three topic areas:

- Strengths/Weaknesses of Measurement Architectures
- Characterization of the systems and the measurements to be made
- Policy implications and work-arounds for measurement weaknesses from the regulator's perspective

Measurement tasks to be addressed:

- Prior to sharing (opportunity evaluation)
- Measurements to enable sharing,
- Measurements after sharing is allowed (trending)
- [Enforcement – not addressed by this subcommittee]

Status:

- List of systems and functions of 5 GHz Systems
- Characterization of key parameters (power, BW, duty cycles, etc)
- Addressing parallels with 3.5 GHz measurements

Systems Spreadsheet

Band (MHz)	Application	Current or Future Use	Characterization (Power/Bandwidth/Footprint/Elevation/Continuous or Intermittent/Fixed or Mobile	Attempt at finding real specifications:
4940 - 4990	DoD - tactical communications	Current	HP/WB/LF/EL/IN/MO - operating tactical systems that are used for line-of-sight and over-the-horizon communications. The Air Force uses the band to train aircrews in electronic combat, to send radar data over microwave links, and for such uses as missile testing and drone aircraft control. The Navy operates the Light Airborne Multipurpose System, a wideband data link between helicopters and ships in this band. Other military agencies operate tactical data links and drone command and control systems in this band.	May not be applicable example since at Ku Band - The LAMPS Hawklink is a high-speed, air-to-ground, digital data link that transmits reconnaissance and other data from MK III H-60 helicopters to their host surface ships, such as Arleigh Burke Class destroyers. The Hawklink will enable data, imagery, electronic support measures, communications, and radar information gathered by the helicopter's sensors to be multiplexed and transmitted in excess of >100nm, at a rate of 10.71 to 45 Mbps, to the host ship via the Ku-band link
4950 - 4990	NASA	Current	LP/WB/LF/LO/CO/FX - passive observations and measurements to advance many areas of environmental change research including water salinity and soil moisture content. This band is also used for radio astronomy research (at selected radio astronomy observatories) via continuum measurement to study the detailed brightness distributions of both galactic and extragalactic objects and to make radio maps of interstellar clouds and supernova remnants.	
4990 - 5000	Radio Astronomy Service	Current	LP/NB/LF/LO/CO/FX - used for radio astronomy research via continuum measurement to study the detailed brightness distributions of both galactic and extragalactic objects and to make radio maps of interstellar clouds and supernova remnants. Highly sensitive receivers used to detect weak signals from space	

SPECTRUM MEASUREMENT ARCHITECTURES - Strengths and Weaknesses vs. Applications

	HP/WB/LF/EL/CO/FX			HP/WB/LF/EL/CO/MO			HP/WB/LF/EL/IN/FX			HP/WB/LF/EL/IN/MO			HP/WB/LF/LO/CO/FX		
Examples =>				5470-5570, 5570-5650, 5650-5925 GHz - DoD UAS CMD & Control						5250-5255, 5255-5350, 5470-5570, 5570-5650, 5650-5925 GHz - military & special purpose radars					
	PRE	OPN	POST	PRE	OPN	POST	PRE	OPN	POST	PRE	OPN	POST	PRE	OPN	POST
Architecture															
Fixed Site (~30 meters)															
- Low Density (> 250 km2)															
- Narrowband (=> fast sweep)	Y	Y	Y	Y	Y	Y	Y	Y	Y	R	R	R	Y	Y	Y
- Wideband (=> slow sweep)	G	G	G	G	G	G	G	G	G	G	G	G	Y	Y	Y
- High Density (</= 250 km2)															
- Narrowband	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
- Wideband	G	G	G	Y	Y	Y	G	G	G	G	G	G	G	G	G
Nomadic Site (~6 meters)															
- Terrestrial															
- Narrowband	Y	Y	Y	Y	Y	Y	Y	Y	Y	R	R	R	Y	Y	Y
- Wideband	G	G	G	G	G	G	G	G	G	Y	Y	Y	G	G	G
- Aerostat															
- Narrowband	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	R	R	R
- Wideband	G	G	G	G	G	G	G	G	G	G	G	G	Y	Y	Y
Mobile (~2 meters)															
- Terrestrial															
- Narrowband	Y	Y	Y	Y	Y	Y	Y	Y	Y	R	R	R	Y	Y	Y
- Wideband	G	G	G	Y	Y	Y	Y	Y	Y	R	R	R	Y	Y	Y
- Aviation															
- Narrowband	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R	R	R
- Wideband	G	G	G	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
- Crowd Sourcing															
- Narrowband	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
- Wideband	G	G	G	Y	Y	Y	G	G	G	G	G	G	G	G	G

Path Forward

Developing Strawman Outline:

- Characterization of the systems and the measurements to be made
- Policy implications and work-arounds for measurement weaknesses from the regulator's perspective
- Strengths/Weaknesses of Measurement Architectures for the specific systems in the 5 GHz band
- Recommendations on (1) measurement techniques to use; (2) measurement technologies to develop; (3) possible policy impacts and workarounds

Early Draft Recommendations (1)

- Feedback between the federal spectrum user community under study and any occupancy measurements should be strengthened. Follow-up to disagreements should be quick and come, to a minimum, to an agreement of differences.
  - NTIA should develop a standard test process for occupancy measurements to include mechanisms for building consensus with stakeholders in the test plan, metrology, measurements, and findings
- Investigate the emitter beaconing technologies to assist in spectrum occupancy and/or interference measurements
  - NTIA (and FCC) study changes in technology, what is considered "protected/private" and the security issues for the federal users to the use of emission designators
- NTIA should complete the measurement architecture spreadsheet in order to map measurement needs to methodologies and architectures

Early Draft Recommendations (2)

- NTIA should investigate the use of proper monitoring architectures that match the types of emissions and sharing mechanisms. The focus should be to develop technical criteria so that the measurements have a high detection probability.
  - The goal is to insure that the lack of detecting a signal infers that the signal is not present (within the sensor to emitter distances) and not that the measurement approach is defective.
- NTIA (and FCC) investigate methodologies for either comprehensive measurement-based equipment certification or a combination of technical feature existence and partial equipment tests.
  - The issue is that there a large number of 'edge cases' making certification testing impractical for equipment for shared spectrum access.