

Attachment for STA application.

Philip Harris 315 525 3368

Confirmation Number: EL406484 STA File Number: 0534-EX-ST-2010

Date of Submission: November 3, 2010

The table and verbiage below is a technical summary of what is being requested from the FCC in support of the NIJ demonstration. Authorization to operate in support of demonstration is requested for November 13- November 18, inclusive.

Changes of note since our initial discussion:

- On-site observations indicated poor or non-existent 3G signal levels (Verizon) in the demonstration room. As a result, we need to treat commercial service availability as a "plan B" item. Therefore I have included a request for authorization to use both the 2.4 GHz Wi-Fi & 4.9GHz PS bands.
- Also, after discussion with the PI from Virginia Tech, I've included two common VHF itinerant business band frequencies. These frequencies will be analogous to VHF PS frequencies for the purposes of this demonstration.
- The USU Principle Investigator is fabricating new antennas with a center frequency in the middle of the lower 5.15 <> 5.25GHz Wi-Fi band, with an expected completion date by 11/13.10. They already have antennas on hand for the upper 5GHz UNII band at 5.6GHz, but we are trying to avoid use the upper band because of DFS issues. Our plan is to use the lower band with the new antennas, unless they experience difficulties in the fabrication process, so the upper 5GHz band is entered as a contingency.

The demonstration site will be limited to an interior conference room, located at the Dulles Holiday Inn:

Holiday Inn Washington Dulles International Airport
45425 Holiday Drive (Route 28N, Exit 9B from Route 267)
Sterling, Virginia 20166
Phone: (703) 471-7411 Fax: (703) 834-7558
Site coordinates: 38°59'4.02"N 77°25'42.81"W (derived from Google Earth)

Table 1. Summary: NIJ PI Demonstrations

Demo/ PI's	RF Bands	RF Equipment	RF Power	RF Emission	Notes:
UCI/USU Drs. Ahmed Eltawil (UCI) & Bedri Cetiner (USU)	5.15-5.25GHz (U-NII-1)	WARP SDR Develop. Board, all bands	18dBm, adjustable USU antenna gain of 8dBi nets ~ 26dBm maximum	(See Table 27909, below)	PI website: http://newport.eecs.uci.edu/~aeltawil/Publications.html Equipment specific information: http://warp.rice.edu/ http://mangocomm.com/products/boards/warp-radio-board-v1
Stevens Dr. R. Chandramouli (Mouli)	2.4GHz GHz, Wi-Fi bands	Ettus Research xcvr2450 (USRP daughter board)	100mW (20dBm), adjustable	OFDM, per 802.11a,b,g specifications	PI website: http://www.ece.stevens-tech.edu/~mouli 2.4GHz daughterboard specific information: http://www.ettus.com/downloads/ettus_ds_USRP_TXRX_v5b.pdf
	5 GHz, Wi-Fi band	COTS Wi-Fi RF boards (unmodified, Part 15 Certified)	Per Mfg. type acceptance	OFDM, per 802.11a,b,g specifications	COTS Wi-Fi RF boards (unmodified, Part 15 Certified)
	4.9GHz, Part 90	Ubiquiti SR4C COTS 4.9GHz PCI card	Per Mfg. type acceptance	Proprietary 4.9GHz based on OFDM 802.11a with QPSK/16QAM/ 64QAM	Equipment specific information: http://www.ubnt.com/sr4c
VA Tech Dr Charles Bostian	700 & 800MHz LMR band UHF FRS frequencies (channels 8-14) VHF Itinerant & business Frequencies	Ettus Research WRX (USRP daughter boards)	WRX development boards All frequencies : 100mW (20dBm) max, adjustable by 25dB	700MHz Low power Itinerant paired channels 9 & 969* 12.5KHz Channel: 8K10F1E 700MHz Low power Itinerant paired channels 11 & 971* 12.5KHz channel: 11K0F3E Standard FRS frequencies: 2K40F3E 151.625MHz 151.955MHz 12.5KHz channel: 8K10F1E	PI website: http://www.cognitiveradio.wireless.vt.edu/dokuwiki/doku.php?id=home http://www.wireless.vt.edu/ Equipment specific information: http://www.ettus.com/WBX
	700 & 800MHz LMR band	COTS EF Johnson 51SL ES & 5100 ES portable radios	EFJ 51SL & 5100 ES radios: 1W (+30dBm) w/10 dB atten. Inline net	700MHz Low power Itinerant paired channels 9 & 969* 12.5KHz Channel:	http://www.efjohnsontechnologies.com/products/portables/51SLes http://www.efjohnsontechnologies.com/products/portables/5100es

			EIRP ~ 100mW.	8K10F1E 700MHz Low power Itinerant paired channels 11 & 971* 12.5KHz channel: 11K0F3E	
	UHF Part 95, FRS band (channels 8- 14)	COTS FRS equipment	500mw Max for COTS FRS radios	Standard FRS requencies: K40F3E	<i>Simulate UHF Public Safety channel</i>
	151.625MHz (red dot) 151.955MHz (purple dot) VHF GMRS Frequency	COTS VHF Itinerant Business radios (e.g., Motorola RDV2020)	1W (+30dBm)	12.5KHz channel: 8K10F1E	<i>Simulate VHF Public Safety channel</i>

- **§ 90.531 (4) Narrowband low power itinerant channels.** The following narrowband channels are designated for low power use for on-scene incident response purposes using mobiles and portables. These channels are licensed nationwide for itinerant operation. Transmitter power must not exceed 2 watts (ERP): Channels 9–12 paired with Channels 969– 972 and Channels 959–960 paired with Channels 1919–1920.

Table 2. UCI System parameters

Name	Value
No. of subcarriers	128
Cyclic prefix length	16
No. of sub-channels	3
Modulation	QPSK, 16-64 QAM
Coding	Conv. encoding
Viterbi decoder TB length	42
Maximum MS supported	3
Subcarrier allocation scheme	PUSC
No. antennas	2x2
MIMO encoding	OSTBC
Carrier frequency	2.4GHz/5.1GHz
Bandwidth	10MHz

UCI & USU:

Demonstration of NIJ supported (wireless data centric) research using SDR and Cognitive radio based OFDM, OFDMA technology, MIMO and reconfigurable MEMS antennas.

Authorization requested:

- o UCI/USU needs authorization to transmit via prototype in 5 GHz Wi-Fi band.
- o UCI/USU needs authorization to transmit via prototype in 4.9GHz PS band (if needed)

Demonstration overview:

- o OFDM and OFDMA technology via reconfigurable SDR/CR waveforms on a development platform
- o Spectrum in the 5.15-5.25 GHz (U-NII-1) band for the combined demonstration (considered analogous to the 4.9GHz Public Safety Band, but unlicensed). (Upper 5GHz frequencies requested as a contingency, see note above).
- o Potential use of 4.9GHz Public Safety Band for an alternate RF & data path
- o OFDM feed between two nodes (e.g., single user and base)
- o Reconfiguration of same SDR platform to use OFDMA between many nodes (e.g., many users, one base)
- o Inclusion of MIMO technology to enhance performance.
- Simulate how USU prototype MEMS antenna technology will be incorporated into the UCI radio prototype
 - o Cognitive engine and hooks between the UCI SDR prototype and the USU MEMS antenna
 - o Demonstrate how beam steering *will* be incorporated
 - o Demonstrate using four discrete antennas how beam steering, via *forthcoming* USU MEMS based prototype, is expected to enhance performance with a single electronically steered, MEMS based antenna.

Stevens:

Stevens Institute will demonstrate NIJ supported (wireless data centric) research prototype

Authorization requested:

- o Stevens Institute needs authorization to transmit via prototype in 2.4 GHz Wi-Fi band.
- o Stevens Institute needs authorization to operate COTS 4.9GHz radios
- o Wi-Fi radios operate in unlicensed Part-15 spectrum. COTS end user radios do not require a license

Demonstration overview:

- o Cognitive channel management & network bonding via a development platform
- o Spectrum in the 5 GHz Wi-Fi band for one RF & data path (analogous to the 4.9GHz Public Safety Band, but unlicensed)
- o Commercial wireless (e.g., 3G) data service for a second, parallel, data path (if 3G/4G service is available)
- o Potential use of 4.9GHz Public Safety Band for an alternate RF & data path
- Stevens Spider CR/DSA technology
 - o Improved throughput via channel bonding (need not be contiguous spectrum to be bonded)

- o Channel bonding within one band (in-band spectrum) is done at layer 2.5
- o The process of adding new paths in a different band is done in layer 3.5
- o Prototype ISO layer 3.5 protocol inserted between TCP and IP in the standard IP stack for multiband channel bonding
- o CR technology to find/use spectrum
 - Improved/surge capacity
 - Maintain capacity during changing band/path/propagation conditions
 - Multi-network diversity
 - Security enabled via path/route diversity, on a per IP packet basis

Virginia Tech:

Charles plans on demonstrating NIJ supported (voice interoperability centric) research

Authorization requested:

- o VA Tech needs authorization to transmit, via prototype, using noted frequencies.
- o FRS radios operate in unlicensed UHF spectrum. COTS end user radios do not require a license.
- o VA Tech needs authorization to operate 700MHz UHF radios using noted frequencies.
- o VA Tech needs authorization to operate 150MHz business band radios using noted frequencies.

Demonstration overview:

- o Land mobile radio channel waveform identification, configuration and interoperability via SDR & cognitive radio development platform
- o Prototype covers all public safety (voice) bands between ~150MHz ~ 800MHz
- o Over the air waveform recognition via RF sensing
- o Prototype platform reconfiguration to proper/interoperable RF waveform
- o Bridging of two incompatible/non-interoperable SDR based RF interfaces following CR sensing & SDR configuration
- VT prototype is based on:
 - o Android based control & operator interface
 - o TI "Beagle Board" for Digital Signal Processing (i.e., The NIJ Public Safety CR engine)
 - o USRP1 based SDR & RF boards
 - Ettus Research WBX daughter RF boards (~ 50MHz ~ 2.2GHz)
 - 50-100mW (17-20dBm)
 - o CR technology PSCR residing in the Beagle Board is used for
 - Waveform identification (via scan & classify functionality)
 - SDR (USRP) control & configuration