Confirmation Number: EL607057 File Number: 0320-EX-PL-2014

Date of Submission: April 14, 2014

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The table and verbiage below present a technical summary of what is being requested in the form of an experimental authorization from the FCC.

Form 442, Question 4: Government Project Description:

Engility Corporation will conduct demonstration and integration activities, undertaking these activities in support of the NIJ Communications Technology Center of Excellence, and NIJ Technology Research, funded via NIJ Grant Number 2010-IJ-CX-K023. This facility will be used to demonstrate the products (i.e., research deliverables) of NIJ funded research related to advanced communications technologies, developed using NIJ grant funds, for the benefit of the Law Enforcement and Public Safety community. The current period of performance for this grant ends on September 30, 2014, and we are in the process of working with NIJ to extending the period of performance through Q1 2015. Therefore we are requesting an experimental authorization period of 36 months to allow completion of this work.

Note: Engility activities associated with this NIJ cooperative agreement started in 2011, via tasking awarded to L-3 Communications. L-3 Communications spun off its L-3 Services business unit into a separate entity called Engility Communications. The NIJ cooperative agreement support moved with the new entity. ***Activities conducted under this authorization are a continuation of NIJ support activities conducted via WF2XTN, file #0180-EX-PL-2011. All technical tasks remain the same as what was filed for WF2XTN****.*

Form 442, Question 6: Description of Research Project:

Equipment used for SDR and Cognitive Radio technology demonstration, and integration activities will be operated under this authorization. Activities associated with this experimental authorization request will occur within office space located at the interior of the 7th floor, 80 M Street SW, Washington DC.

Location:
Engility Corporation
80 M Street SE, 7th Floor
Washington, DC 20003

Site coordinates: 38’ 52” 37.27N 77’0”22.9W

Three initial experiments will be demonstrated[1]

- SDR/CR prototype operating in the 2.4GHz/ 5.9GHz unlicensed and 4.9GHz licensed microwave bands for the purpose of demonstrating cognitive radio and smart antenna technology developed at the University of California at Irvine, with multiband smart Antenna Technology prototype developed at Utah State University.
- SCR/CR prototype operating in the 2.4GHz/ 5.9GHz unlicensed and 4.9GHz licensed microwave bands for the purpose of demonstrating cognitive channel bonding based on SpiderRadio technology.
- SDR/CR prototype operating in the VHF & 700MHz LMR bands, and the FRS UHF band for the purpose of demonstrating cognitive radio based interoperability gateway technology developed at Virginia Tech.

In addition to demonstration of delivered prototype equipment noted above, L-3 will undertake additional research related to the potential integration of technical features of each of these independently created prototypes into a single platform for further development and demonstration purposes, per obligations established by our NIJ cooperative research grant.

Background: University of California Irvine & Utah State University prototypes

Engility will demonstrate NIJ supported (wireless data centric) research using SDR and Cognitive radio based
OFDM, OFDMA technology, MIMO and reconfigurable MEMS antennas developed and delivered to NIJ from The University of California at Irvine, and Utah State University:

Authorization requested:

- Authorization to transmit via prototype in 5 GHz Wi-Fi band.
- Authorization to transmit via prototype in 4.9GHz PS band (if needed)

Demonstration overview:

- OFDM and OFDMA technology via reconfigurable SDR/CR waveforms on a development platform
- 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).
- Potential use of 4.9GHz Public Safety Band for an alternate RF & data path

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Each of these technology prototypes were previously demonstrated in Sterling Virginia (November 2010, STA WE9 XOX) and at the FCC office at 445 12th St SW (March 2011, STA WE9XSU). This experimental authorization will encompass the same demonstration activities, plus additional work related to integration of SDR/CR research prototypes.

- OFDM feed between two nodes (e.g., single user and base)
- Reconfiguration of same SDR platform to use OFDMA between many nodes (e.g., many users, one base)
- Inclusion of MIMO technology to enhance performance.
- Simulate how USU prototype MEMS antenna technology will be incorporated into the UCI radio prototype:
- Cognitive engine and hooks between the UCI SDR prototype and the USU
- MEMS antenna
- Demonstrate how beam steering will be incorporated
- 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.

Background: Stevens Institute prototypes

Engility will demonstrate NIJ supported (wireless data centric) research using SDR and Cognitive radio based OFDM, OFDMA technology developed and delivered to NIJ from Stevens Institute of Technology:

Authorization requested:

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

Demonstration overview:

- Cognitive channel management & network bonding via a development platform
- Spectrum in the 5 GHz Wi-Fi band for one RF & data path (analogous to the 4.9GHz Public Safety Band, but unlicensed) Commercial wireless (e.g., 3G) data service for a second, parallel, data path (if 3G/4G service is available)
- Potential use of 4.9GHz Public Safety Band for an alternate RF & data path

Stevens Spider CR/DSA technology

- Improved throughput via channel bonding (need not be contiguous spectrum to be bonded)
- Channel bonding within one band (in-band spectrum) is done at layer 2.5
- The process of adding new paths in a different band is done in layer 3.5
- Prototype ISO layer 3.5 protocol inserted between TCP and IP in the standard IP stack for multiband channel bonding
- 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

Background: Virginia Tech prototype

Engility will demonstrate NIJ supported (wireless voice centric) research using SDR and Cognitive radio based gateway interoperability technology developed and delivered to NIJ from Virginia Tech:

Authorization requested:

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

Demonstration overview:

- Land mobile radio channel waveform identification, configuration and interoperability via SDR & cognitive radio development platform
- Prototype covers all public safety (voice) bands between ~150MHz ~ 800MHz
- Over the air waveform recognition via RF sensing
- Prototype platform reconfiguration to proper/interoperable RF waveform
- Bridging of two incompatible/non-interoperable SDR based RF interfaces following CR sensing &SDR configuration

VT prototype is based upon:

- Android based control & operator interface
- TI “Beagle Board” for Digital Signal Processing (i.e., The NIJ Public Safety CR engine)
- USRP1 based SDR & RF boards
- Ettus Research WBX daughter RF boards (~ 50MHz ~ 2.2GHz) 50-100mW (17-20dBm)
- CR technology PSCR residing in the Beagle Board Is used for Waveform identification (via scan & classify functionality)
- SDR (USRP) control & configuration

Table 1. Summary: NIJ Demonstrations and University Principle Investigators

Demo/	RF Bands	RF Equipment	RF Power	RF Emission	Notes:
UCI/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	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	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 EIRP ~ 100mW.	700MHz Low power Itinerant paired channels 9 & 969* 12.5KHz Channel: 8K10F1E 700MHz Low power Itinerant paired channels 11 & 971* 12.5KHz channel: 11K0F3E	http://www.efjohnsontechnologies.com/products/portables/51SLes http://www.efjohnsontechnologies.com/products/portables/5100es
	UHF Part 95, FRS band (channels 8-14)	COTS FRS equipment	500mw Max for COTS FRS radios	Standard FRS frequencies: 2K40F3E	*Simulate UHF Public Safety channel*
	151.625MHz	COTS VHF	1W (+30dBm)	12.5KHz channel:	*Simulate VHF Public Safety*

	(red dot) 151.955MHz (purple dot) VHF GMRS Frequency	Itinerant Business radios (e.g.,, Motorola RDV2020)		8K10F1E	*channel*

- **§ 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.