Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Promoting Expanded Opportunities for Radio Experimentation and Market Trials under Part 5 of the Commission's Rules and Streamlining Other Related Rules	)	ET Docket No. 10-236
	)	
2006 Biennial Review of Telecommunications Regulations – Part 2 Administered by the Office of Engineering and Technology (OET)	)	ET Docket No. 06-105

COMMENTS OF V-COMM, L.L.C.

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Table of Contents

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COMMENTS OF V-COMM, L.L.C

V-COMM, L.L.C. (V-COMM)[1] submits comments in response to the FCC's Notice of Proposed Rulemaking (NPRM) in the above-captioned proceeding.[2]

I. INTRODUCTION AND SUMMARY

The NPRM seeks comments on enhancing the development of innovative and new technologies by expanding the scope of its radio spectrum experimental licensing program pursuant to Part 5 of its rules. V-COMM herein comments on the use of Commercial Mobile Radio Service (CMRS) spectrum bands (i.e. Cellular, PCS, AWS, SMR, 700MHz bands, etc.)

[1] V-COMM, L.L.C. is a wireless telecommunications consulting company with principal members having over 29 years experience in the wireless industry. We have provided our expertise to wireless operators in RF engineering, system design, implementation, performance, optimization, and evaluation of new wireless technologies. We have extensive industry experience in all CMRS technologies. V-COMM's company information and experiences are highlighted in this report's Appendix A, along with biographies of senior members of its engineering team. Verizon Wireless retained V-COMM to evaluate the proposals in the NPRM and their potential impact on wireless networks.

[2] *Promoting Expanded Opportunities for Radio Experimentation and Market Trials under Part 5 of the Commission's Rules and Streamlining Other Related Rules*, Notice of Proposed Rulemaking, ET Docket No. 10-236 (released November 30, 2010) (*"NPRM*").

for radio experimentation and market trials pursuant the proposals outlined in the NPRM. V-COMM also provided comments in the FCC's Dynamic Spectrum Use Technologies Notice of Inquiry (NOI) proceeding,[3] as an attachment to comments submitted by Verizon Wireless on February 28, 2011. Therein, we provided reasons that opportunistic underlay spectrum sharing technologies are not compatible with and will cause harmful interference to existing licensed CMRS services.

V-COMM is an independent engineering firm with extensive experience in CMRS technologies and systems. We have significant experience in CMRS and Public Safety network design and deployments, engineering networks for high performance, optimizing spectrum efficiency, and evaluating new wireless technologies. V-COMM has conducted extensive interference and compatibility studies within CMRS networks,[4] performed noise and interference studies in CMRS spectrum bands,[5] and participated in numerous FCC proceedings with comprehensive engineering reports.[6]

For reasons provided herein, expanded opportunities as proposed in the NPRM for radio experimentation and market trials in licensed CMRS spectrum should not be authorized to third

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[3] *Promoting More Efficient Use of Spectrum Through Dynamic Spectrum Use Technologies*, Notice of Inquiry, ET Docket No. 10-237 (released November 30, 2010) (*"NOI"*).

[4] V-COMM has conducted extensive compatibility and interference studies within AT&T Wireless' and Verizon Wireless' networks including interference testing of spectrum-sharing technologies and trials within CMRS spectrum.

[5] V-COMM has conducted spectrum noise and interference measurements within Verizon Wireless and AT&T Wireless' CMRS networks. V-COMM submitted the "AMPS Noise Floor Study" within the FCC's AirCell spectrum-sharing proceeding (ET 02-86) on April 10, 2003, and the "PCS Noise Floor Study" within the FCC's Spectrum Policy Task Force Report proceeding (ET 02-135) on Sept. 16, 2003. These spectrum noise studies were also provided as Attachment B and Attachment C to Comments filed by V-COMM in the FCC's Interference Temperature (ET 03-237) comment proceeding on April 5, 2004.

[6] V-COMM has participated in numerous FCC proceedings with comprehensive engineering reports including experimental AirCell, Cellular Airborne, Spectrum Policy Task Force, Ultra-wide band, Interference Temperature, Cognitive Radio, PCS H-Block, AWS-III Block, and Low Power Auxiliary Stations, Wireless Microphones in 698-806 MHz band proceedings.

parties. Licensed CMRS spectrum is not suitable and not compatible with third party experimental uses. Further, universities, research organizations, and health care facilities should not utilize licensed CMRS spectrum to conduct unproven radio experiments or market trials. CMRS spectrum bands are intensely utilized, have highly mobile users, and are not suitable for radio experimentation and market trials which would result in harmful interference to existing CMRS services. In addition, CMRS bands provide critical Public Safety, E911 and other emergency services that must be fully protected from harmful interference.

Innovation Zone Experimental Licenses should only be authorized in non-auctioned and unlicensed spectrum that will not cause harmful interference to existing licensed services.[7] Coordination with adjacent market and adjacent band CMRS licensees should be required prior to authorizations. Harmful interference to CMRS services must be assessed and avoided in adjacent markets and adjacent bands.

CMRS licensees have limited engineering staff that are not capable of investigating and addressing third party experiments in their licensed bands. Such a distraction will diminish the quality of service of CMRS networks and slow the rate of innovation of new CMRS technologies including LTE.[8] The Commission should consider other bands more suitable for researching, testing, and developing new and unproven technologies, which will not interfere with existing licensed services.

Experiments performed inside anechoic chambers and faraday cages should not require experimental licenses, however open area test sites should continue to require them. FCC rules

[7] Non-auctioned spectrum is spectrum that has not been auctioned to a licensed entity. Unlicensed spectrum is defined pursuant to FCC Part 15 rules.

[8] LTE (Long Term Evolution) is a 4th generation wireless technology that is being deployed by wireless operators and under continued development with new releases and enhanced functionality.

should require sufficient shielding and isolation to prevent signals leaking outside these facilities and causing harmful interference to existing services in licensed spectrum bands.

II. UNIVERSITY, RESEARCH & HEALTH CARE EXPERIMENTAL LICENSES

University, research and health care experimental licenses should be grouped together within FCC rules, and have the same regulations apply to each of them, as they represent the same issues that can impact incumbent spectrum licensees and users. Accordingly, we address them collectively as a group in this section.

Universities, research organizations, and health care facilities should not utilize licensed CMRS spectrum to conduct unproven radio experiments, which can result in harmful interference to incumbent CMRS services. CMRS spectrum is intensely utilized, has highly mobile users, ubiquitous coverage, and is very sensitive to external system interference. Thus, licensed CMRS spectrum bands are not suitable for conducting radio experiments. Rather, other bands that are more suitable should be considered for such radio experimentation as noted in Section III below.

Universities and health care facilities use and rely on CMRS services, which can receive interference from radio experiments in licensed CMRS spectrum. College dormitory residents use CMRS service as their only source of voice communications, and CMRS broadband data service as well, while standard landline telephones are rarely used by college dormitory residents. Health care providers rely on CMRS services for patient care -- including doctors, nurses, staff, visitors, and patients for emergencies. All of these users could be interfered with by radio experiments in licensed CMRS spectrum. Further, many universities and health care facilities are in urban areas and/or adjacent to major highways where there is additional concern

over harmful interference to CMRS users operating just outside these facilities. Therefore, licensed CMRS spectrum bands should not be used for radio experimentation that can result in harmful interference to these incumbent CMRS users.

In addition, such third party radio experiments in licensed CMRS spectrum can interfere with critical Public Safety, E911 and other emergency services provided within CMRS spectrum. Federal, state and local public safety agencies are able to use Priority Access Services (PAS) in CMRS spectrum pursuant to Part 64.402 rules to assist first responders during national emergencies. Public safety agencies use CMRS voice services to supplement their voice communications needs, critical broadband data communications for in-vehicle mobile data terminals, and CMRS smartphones to enhance efficiency and productivity for our nation's first responders.[9] The NPRM requests comments whether there can be alternate means to accomplish E911 and other emergency services during radio experiments in CMRS spectrum. V-COMM does not believe that there any alternate methods to accomplish and replace E911 and other emergency services in CMRS spectrum.

Further, CMRS networks and technologies are not compatible with third party uses operating in and sharing licensed CMRS spectrum, which will result in harmful interference and lower quality CMRS services. CMRS networks and technologies will be affected by third party radio experiments conducted within its licensed spectrum bands. CMRS networks can experience losses in system capacity, reduced data throughputs, disruptions, and poor quality of service when third party experiments increase noise and interference levels within licensed CMRS spectrum. For example, LTE networks dynamically manage use of resource blocks within spectrum, GSM networks use interference detection on call assignment and handoff, and

[9] Source: Public Safety IT, Jan/Feb 2011, Page 1.

CDMA networks use forward and reverse-link noise level thresholds for call assignment and loading balancing. This results in CMRS networks avoiding the use of these channels and resource blocks of spectrum for periods of time when the radio experiments are affecting the licensed CMRS spectrum bands.

For reasons provided above, third party radio experiments should not be authorized in licensed CMRS spectrum, which can result in harmful interference to incumbent licensed users. Such radio experiments should be conducted in either: i.) other spectrum bands that are more suitable for radio experimentation (i.e. unlicensed or lightly used fixed services bands); ii.) within established Innovation Zone Experimental License areas with non-auctioned or unlicensed spectrum; or iii.) inside anechoic chambers or shielded rooms (Faraday Cages). The use of these spectrum bands and locations can prevent harmful interference to existing CMRS services.

Further, experimental licenses should not be authorized in licensed CMRS spectrum bands because they would not be able to measure or monitor any interference caused to actual CMRS users within the testing area. For testing of opportunistic dynamic spectrum use technologies, all experiments should utilize simulated base stations and simulated users on other spectrum bands. In addition to preventing interference to actual licensed users, testing with simulated test users has the benefit of making tests more scientific and providing more information because the simulated users can be directly monitored during tests. This will provide valuable information and understanding of the experimental testing without impacting incumbent spectrum users.

Coordination and notification to CMRS licensees operating on adjacent bands and adjacent markets should be required for all radio experiments and testing activities by

universities, research organizations, and health care facilities. This is to address the potential interference from out-of-band emissions and propagation of interference beyond the experimental test facilities. Interference must be assessed and avoided to licensed CMRS services operating in adjacent markets and adjacent bands. These experimental licenses should be required to perform the following coordination and notification to adjacent band and adjacent market CMRS licensees.

1.) Coordination Requirements – Experimental licenses must coordinate with CMRS licensees operating on adjacent bands and adjacent markets for all testing experiments. Sufficient information must be provided to adjacent band and market licensees so they may understand the nature of the tests, radio equipment involved, requested timelines, detailed locations of transmitting antennas, indoor and outdoor operations, transmitting ERP levels, carrier frequencies & bandwidths, and how disruptions to the CMRS network will be avoided. Proofs of non-interference to adjacent markets and adjacent bands should be provided prior to and upon completion of testing experiments. The Experimental license must maintain a central point of contact (POC) to coordinate all test activities with the CMRS licensees, and be able to cease all transmissions in cases of interference to CMRS users.

2.) Notification Requirements – Experiments conducted on adjacent bands and adjacent markets should provide advance notice to CMRS licensees of a minimum of 30 days. Longer notification periods may be required depending on the nature of the planned testing activities, to understand the testing activities and assess the impact to the CMRS network, to resolve any test activities that can cause interference to CMRS services, and in cases that require the CMRS equipment manufacturer to be consulted

for questions and compatibility issues. In some cases, non-disclosure agreements may be required to protect sensitive information and/or proprietary technology. The notification and coordination process must be open ended to allow the CMRS licensee time to address any issue they may have. Notifications should also be made in a FCC web-based reporting system, which supports electronic notification to CMRS licensees operating on adjacent bands and adjacent markets with respect to the testing experiments.

As stated above, adjacent channel, adjacent band, and out-of-band emissions can cause harmful interference to existing CMRS services in other CMRS bands. Some CMRS bands are adjacent to and/or intermixed with Public Safety spectrum bands, which can receive interference from radio experiments operating in adjacent bands and adjacent markets. In conjunction with adjacent band assessments, the near-far interference issue should be analyzed to ensure receiver overload and desensitization will not occur to existing services. This is required to protect CMRS device and base station receivers from experiments transmitting on adjacent bands that can overload and desensitize nearby CMRS receivers.

Proof of non-interference to adjacent bands and adjacent markets should be provided prior to and upon completion of testing experiments. Particular attention should be made regarding the uplink and downlink spectrum uses and FDD vs. TDD operations within intended and adjacent bands to confirm that harmful interference will not be caused to licensed CMRS services operating in these bands.[10]

[10] FDD and TDD terms are defined as Frequency Division Duplexing and Time Division Duplexing. FDD operation is where the transmitter and receiver operate at different carrier frequencies for uplink and downlink communications, and TDD operation is where the transmitter and receiver are operating on the same carrier frequency for uplink and downlink communications.

Minimum frequency offsets (i.e. guard bands) to avoid adjacent channel, adjacent band, and out-of-band emission interference should be studied on a case by case basis before authorizing experimental licenses.[11] Compliance to FCC limits for power, field strength and emissions will not be sufficient to fully protect incumbent CMRS services. CMRS licensees achieve protection through coordination with adjacent band operators and complying with industry standards to fully protect existing and future services from adjacent band and out-of-band emissions interference.

Although they are not subject to equipment type certification, all experimental radio equipment should comply with applicable FCC rules for the intended bands of operation. This includes power limits, emission limits, power flux density limits, field strength limits, and RF safety limits. Any non-compliant radio equipment should be required to obtain specific waivers for experimental operation. Proof of compliance documentation should be provided to potentially affected licensees upon request.

A central point of contact (POC) should be required for experimental licenses to coordinate and document all testing activities planned and completed, and to maintain positive control of all test transmitters used in experiments. Upon notification or identification of harmful interference to existing CMRS users, experiments must cease all transmissions immediately and not resume testing until such interference is resolved.

Experimental licenses should be required to submit reports prior to and upon completion of tests and experiments, in addition to annual progress and findings reports. Reports should be submitted in a FCC web-based reporting system, which supports electronic notification to CMRS licensees in adjacent bands and adjacent markets to the experimental licenses. Reports should

[11] The FCC requested comments on the minimum frequency offsets to prevent adjacent channel

contain sufficient detail to understand the nature and objectives of the experiment, the frequency bands utilized, radio equipment setup, operating characteristics, transmitted power levels, antenna information, detailed location of transmitters, indoor and outdoor operations, dates, times and duration of testing experiments planned and conducted. Proofs of non-interference to licensed CMRS services should be included in the report documentation.

In response to the NPRM's request for comments on setting power flux densities (PFD) to facilitate radio experiments,[12] V-COMM does not believe there is a threshold for additional noise and interference levels from third party experiments in CMRS spectrum that will not interfere with CMRS spectrum uses and services. Any increases in the noise and interference level will result in disruptions to CMRS services and E911 services. CMRS systems operate at very low signal and noise levels to optimize CMRS spectrum utilization and efficiency. CMRS features such as advanced dynamic power control algorithms adjusting links to the minimum power necessary a thousand times a second, advanced signal combining and processing techniques, advanced MIMO antenna systems using multiple signal path inputs and outputs, lower power base stations, and low noise receivers all contribute to very low operating signal and noise levels within CMRS spectrum. Given this, CMRS technologies are very sensitive to external system noise and interference and there are no additional noise and interference levels that are acceptable.

E911 signals also operate at very low signal levels, which require reception at multiple CMRS base stations for E911 caller location determination. GSM networks use TDOA network based triangulation methods receiving weak mobile signals from individual mobiles at multiple base stations to locate E911 callers. CDMA & UMTS networks use AGPS based handset and

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interference in the NOI at ¶ 21.

hybrid E911 location systems that transmit signals within CMRS uplink and downlink bands to locate E911 callers.

Body-worn medical devices transmitting in licensed CMRS spectrum bands should be tested and confined within locations inside the medical facility receiving the experimental license, while limiting use outside the medical facility to prevent interference to existing CMRS services.

III. SPECTRUM BANDS SUITABLE FOR RADIO EXPERIMENTATION

Spectrum bands that are suitable for radio experimentation, which will not result in harmful interference to existing licensed services, include the following bands. These bands are suitable for researching, testing, developing and market trials of new technologies, and they are particularly suitable for the development of new opportunistic dynamic spectrum use technologies.

- Unlicensed spectrum bands 2.4 GHz, 5.8 GHz and 900 MHz and the shared licensed 3.6 GHz band offer opportunities for radio spectrum experimentation. These unlicensed and shared licensed bands should provide good test beds for conducting radio experiments with new technologies.
- Certain locations with unlicensed or unused spectrum in microwave point-to-point bands that use fixed location stations.
- White space devices in certain markets using available channels in broadcast UHF TV spectrum on a low power basis with updated geolocation databases.

[12] NPRM at ¶ 22.

- Certain bands with very light usage above 38 GHz, which has the advantage of reduced interference ranges due to the higher frequency band operation.
- Potential experiments in spectrum bands that are used very infrequently, not used at certain times of the day, or not used in certain areas of the country. These can be considered for Innovation Zone experiments.

Licensed CMRS bands with high mobility, high spectrum utilization, and continuously changing network technologies are not suitable for radio experimentation or underlay spectrum sharing, which would result in harmful interference to existing and future CMRS services. In addition, CMRS bands are not suitable for unproven radio experimentation because they provide critical Public Safety, E911 and other emergency services.

IV. INNOVATION ZONE EXPERIMENTAL LICENSES

Innovation Zone Experimental Licenses should be designated for non-auctioned or unlicensed spectrum bands only, and must not cause harmful interference to existing licensed services in adjacent bands and adjacent markets. Innovation Zone Experimental Licenses should never be authorized to conduct radio experiments in active licensed CMRS spectrum bands, which can cause harmful interference to existing CMRS services including critical Public Safety, E911 and other emergency services. In addition to being restricted to non-auctioned and unlicensed spectrum, Innovation Zone Experimental Licenses should be located in remote areas and/or performed indoors to gain additional isolation and minimize the risk of interference to existing licensed services operating on adjacent bands and in adjacent markets.

The FCC's Office of Engineering and Technology (OET) should pre-establish and identify specific bands authorized for use within the Innovation Zone Experimental Licenses.

The FCC OET can confirm the availability of specific bands within the Innovation Zones including confirmation whether specific bands are either non-auctioned, licensed, operating pursuant to Special Temporary Authorities (STA) or other authorizations.

Existing Innovation Zone Experimental Licenses in spectrum bands that become auctioned to licensed entities should be subject to discontinuance. As licensees begin to utilize their spectrum for pre-market testing, customer trials, deployment of commercial service, or subleasing of spectrum for other uses, the Innovation Zone Experimental License must be immediately terminated (unless temporary authorization is provided by the licensee).

Coordination with the adjacent market and adjacent band CMRS licensees should be required prior to authorizations. Interference must be assessed and avoided to licensed CMRS services operating in adjacent markets and adjacent bands. Proofs of non-interference with adjacent market and adjacent band CMRS licensees should be analyzed and submitted with Applications for Innovation Zone Experimental Licenses.

Interference studies should consider the impact to incumbent licensed services and the compatibility with licensed operations on uplink and downlink spectrum bands and FDD vs. TDD operation in the intended and adjacent bands to confirm that harmful interference will not be caused to existing CMRS services. Interference studies should also consider the potential effects of long distance propagation (i.e. enhanced Tropospheric propagation, RF ducting, and propagation over water) particularly for outdoor transmitters at high elevations that can interfere with licensed services in distant markets within the U.S. and over international borders. In some cases, long distance propagation can extend the range of interference to licensed services operating in distant markets hundreds of kilometers away.

Coordination and notification to CMRS licensees operating on adjacent bands and adjacent markets should be required for all radio experiments and testing activities. Innovation Zone Experimental Licenses should be required to perform the same Coordination and Notification Requirements specified above in Section II.

Experimental licenses should also comply with FCC rules for frequency coordination to adjacent CMRS markets for the specific CMRS bands utilized in the experiments. For example, in cellular spectrum the FCC Rule § 22.907 requires "Licensees in the Cellular Radiotelephone Service must coordinate with the appropriate parties channel usage at each transmitter location within 121 kilometers (75 miles) of any transmitter locations authorized to other licensees or proposed by tentative selectees or other applicants, except those with mutually exclusive applications." Other CMRS spectrum bands have similar coordination requirements when operating base stations at high power levels in rural areas.

Innovation Zone Experimental Licenses must maintain a central point of contact and positive control of all radio devices and equipment operating within the Innovation Zone authorized areas. If harmful interference is identified to an incumbent licensed service during the radio experiments, the point of contact must control all experimental devices and cease all transmissions within the Innovation Zone areas until such interference is resolved.

Experimental licenses should be required to submit reports prior to and upon completion of testing experiments, in addition to annual progress and findings reports. Reports should be submitted in a FCC web-based reporting system, which supports electronic notification to CMRS licensees in adjacent bands and adjacent markets respect to the experimental licenses. Reports should contain sufficient detail to understand the nature and objectives of the experiment, the frequency bands utilized, radio equipment setup, operating characteristics, transmitted power

levels, antenna information, detailed location of transmitters, indoor and outdoor operations, dates, times and duration of testing experiments planned and conducted. Proofs of non-interference to licensed CMRS services should be included in the report documentation. The sharing of experimental licenses' report findings will benefit other researchers and enhance innovations of new technologies.

Although they are not subject to equipment type certification, all experimental radio equipment should comply with applicable FCC rules for the intended bands of operation. This includes power limits, emission limits, power flux density limits, field strength limits, and RF safety limits. Any non-compliant radio equipment should be required to obtain specific waivers for experimental operation. Proof of compliance documentation should be provided upon request.

V. MARKET TRIALS OF EXPERIMENTAL EQUIPMENT

The comments and proposed rules outlined in the above section for University, Research & Health Care Experimental Licenses equally apply to Market Trials experimental authorizations. Market trials in licensed CMRS spectrum should not be authorized to third parties absent an agreement from the CMRS licensee due to the additional complexity and potential interference from thousands of devices used in market trials. Market trials in licensed CMRS spectrum should be managed by CMRS licensees, which are able to manage the use of their spectrum and prevent harmful interference to incumbent CMRS users. In addition, due to the extent and enforcement of potentially thousands of experimental market trial devices operating in licensed spectrum we recommend the following additional requirements for third party market trials of experimental equipment to protect existing CMRS services operating in adjacent bands and adjacent markets.

The authorized party must have the ability to retrieve and remove all experimental radio devices operating during and upon completion of the marketing trials. They must have the ability to maintain positive control and enforcement of all devices participating in Market Trials. This is a requirement to resolve any incidences of harmful interference occurring to existing licensed users during the marketing trial, and upon completion of the marketing trial to remove the trial devices from the market to clear the spectrum.

All of the experimental equipment and devices operating in Market Trials should be capable of control functions such as "remote kill", periodic "keep alive", and other capabilities to manage and render experimental devices inoperable as required during and upon completion of the market trials. Further, the radio portion of the trial devices should be designed to be tamper resistant, and not capable of being hacked or modified in ways that can cause interference to existing CMRS services during or after the market trials.

Market trials of experimental equipment should consist of participants that are signed up for the specific objectives of the trial, and generally not offer experimental radio equipment for sale off-the-shelf to consumers. This will facilitate the appropriate controls and safeguards of maintaining the participating experimental devices. Also, the experimental authorizations for Market Trials should be limited in operational use to specific areas, to manage the collection of trial devices at the completion of the market trial.

All market trials must maintain a central point of contact and positive control of all radio equipment and devices operating pursuant to the authorized market trial to be able to immediately cease any transmissions causing harmful interference to existing licensed services.

Enforcement and removal of Market Trial devices can be difficult particularly for devices with peer to peer capabilities. Therefore, appropriate safeguards as noted above are required to

ensure all experimental trial devices are removed upon completion of the experimental market trial.

VI. THIRD PARTY EXPERIMENTS IN CMRS SPECTRUM WILL DIMINISH CMRS QUALITY OF SERVICE AND INNOVATIONS OF NEW TECHNOLOGIES

Experimental licenses should not be authorized to third parties in active CMRS spectrum, because it would divert the engineering staff of CMRS network operators and manufacturers in their efforts to provide high quality CMRS service, optimize networks and spectrum efficiency, and advance new technologies like LTE.

CMRS engineering staff are required to support the daily operation, maintenance, and optimization of the CMRS network to provide high quality services to its customers. Diverting their attention to other causes can result in delays in network optimization, reduced spectrum efficiency, and lower quality of service for its customers. Therefore, the Commission should not divert the limited engineering resources of CMRS network providers to investigating and addressing unproven radio experiments in licensed CMRS spectrum. In addition to causing harmful interference to CMRS service, investigating and addressing such third party spectrum uses will slow the rate of innovation and advancement of new CMRS technologies.

CMRS licensees have been successful in advancing new technologies in CMRS spectrum for the past 30 years, which include the evolution of the following wireless technologies into CMRS networks for the benefit of CMRS consumers representing 93% of the nation.[13]

- 1st Generation (1G) - analog voice AMPS technology.

[13] Reference of U.S. wireless penetration is www.ctia.org/consumer_info/service/index.cfm /AID/10323.

- 2nd Generation (2G) - digital voice and data technologies CDMA, GSM, TDMA, ESMR, NAMPS, GPRS and EDGE technologies.
- 3rd Generation (3G) - improved voice and data technologies including EVDO Rev. 0, EVDO Rev. A, UMTS and HSPA technologies.
- 4th Generation (4G) - enhanced broadband data technologies including LTE and WiMAX technologies.
- Ongoing network technology enhancements and incremental improvements in CMRS spectrum efficiency are continuously made with minor upgrades and incremental enhancements to CMRS networks and consumer devices.

Further, the continued development of advanced 4G technology standards are currently in process with final stages of standards work and initial stages of research and development, which include the IMT-Advanced 4G standards LTE Advanced and WiMAX 2.[14] The objectives of IMT-Advanced standards are the criteria of 1 Gbit/s for stationary and low mobility reception, and 100 Mbit/s for mobile reception according to ITU requirements. This will achieve peak spectral efficiencies of 15 bit/s/Hz in the downlink, and 6.75 bit/s/Hz in the uplink.

To maintain this high level of innovation and advancement of CMRS technologies, high quality of service of CMRS networks, and high level of efficiency and utilization of CMRS spectrum, the Commission should not authorize third party experimental licenses or market trials in licensed CMRS spectrum bands.

[14] International Mobile Telecommunications (IMT) Advanced 4G standards are the 3GPP Long Term Evolution Advanced (LTE Advanced) standard, and the Worldwide Interoperability for Microwave Access II (WiMAX 2) standard, according to International Telecommunication Union (ITU) requirements. WiMAX 2 is also known as IEEE 802.16m and WirelessMAN-Advanced standards.

VII. ANECHOIC CHAMBERS, FARADAY CAGES, AND OPEN AREA TEST SITES

Radio experiments performed inside anechoic chambers and faraday cages should not require experimental licenses, however radio experiments performed at open area test sites should require experimental licenses to operate in licensed spectrum bands for reasons provided below. For all cases, FCC rules should require sufficient shielding to prevent signals from leaking outside such facilities and causing harmful interference to existing services in licensed spectrum bands.

Anechoic Chambers and Faraday Cages. Experiments performed inside anechoic chambers and faraday cages should not require experimental licenses due to the RF isolation and shielding provided by these types of facilities. However, FCC rules should require sufficient isolation and shielding effectiveness to prevent signals from leaking outside such facilities and causing harmful interference to existing services in licensed spectrum bands. Shielding effectiveness and signal leakage measurements should be performed on all frequency bands and power levels utilized in tests to confirm non-interference to existing services operating in licensed spectrum bands outside the facilities. Proof of compliance documentation should be provided upon request. In addition, anechoic chambers and faraday cages should be properly designed, installed and operated in compliance with manufacturer specifications.

Open Area Test Sites (OATS). Radio experiments performed at OATS should continue to require experimental licenses to operate in licensed spectrum bands, and should be required to show substantial justifications for operation in licensed bands and proofs of non-interference to existing licensed services. Signal leakage measurements should be performed on all frequency bands and power levels utilized in tests to confirm non-interference to existing services operating in licensed spectrum bands outside the facilities.

Applications for OATS experimental licenses should include a detailed description of the test site facility, the power and frequency bands utilized in tests, the types of antenna used in tests, radio frequency techniques used to minimize signal reflections and leakage from the facility, proof of non-interference to existing licensed services, and justifications for not using anechoic chambers for such experiments. Construction of such facilities require sufficiently open areas free of reflections, an advanced competence in radio frequency engineering, and should meet qualifications described in ANSI C63 standards for open area test sites.[15]

[15] ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio - Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. ANSI C63.7-2005, American National Standard Guide for Construction of Open-Area Test Sites for Performing Radiated Emission Measurements.

VIII. CONCLUSION

For reasons provided above, the Commission should not authorize Experimental Licenses or Market Trials to third parties in licensed CMRS spectrum. CMRS spectrum bands are not suitable and not compatible with third party radio experiments by universities, research organizations, and health care facilities. CMRS spectrum bands are intensely utilized and have high mobility users that are not suitable for radio experimentation or underlay spectrum sharing, which would result in harmful interference to existing CMRS services including Public Safety, E911 and other emergency services. Further, CMRS licensees have limited engineering staff that are not capable of investigating and addressing third party experiments in their licensed bands. Such a distraction will diminish the quality of service of CMRS networks and slow the rate of innovation of new CMRS technologies including LTE. The Commission should consider other bands more suitable for researching, testing, and developing new and unproven technologies, which will not interfere with existing licensed services.

Respectfully Submitted,

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APPENDIX A – COMPANY INFORMATION & BIOGRAPHIES

V-COMM is a leading provider of quality engineering and engineering consulting services to the worldwide wireless telecommunications industry with offices in Cranbury, NJ and Blue Bell, PA. V-COMM's engineering staff is experienced in Cellular, Personal Communications Services, 700 MHz Spectrum, Wireless Broadband Data, Enhanced Specialized Mobile Radio, Paging, Public Safety, 2-Way radio, Microwave, and Broadcast Mobile TV. We have provided our expertise to wireless operators in engineering, system design, implementation, performance, optimization, and evaluation of new wireless technologies. We have extensive experience in studying interference in various spectrum bands including Cellular, SMR, PCS, AWS, Air-to-ground, Public Safety, and 700 MHz spectrum. We have engineering experience in all commercial wireless technologies, including LTE, HSPA, UMTS, EVDO, CDMA, GSM, EDGE, WiMAX, MediaFLO, DVB-H, and Public Safety wireless technologies including analog and digital Project 25, EDACS, Opensky, and other trunking and conventional radio networks. Further, V-COMM was selected by the FCC & Department of Justice to provide expert analysis and testimony in the Nextwave and Pocket Communications Bankruptcy cases. For additional information, visit V-COMM's web site at www.vcomm-eng.com.

BIOGRAPHIES OF SENIOR MEMBERS OF ENGINEERING STAFF

Dominic C. Villecco
President and Founder, V-COMM, L.L.C.

Dominic Villecco, President and founder of V-COMM, is a pioneer in wireless telecommunications engineering, with over 29 years of executive-level experience and various engineering management positions previously held. Under his leadership, V-COMM has grown from a start-up venture in 1995 to a highly respected full-service wireless telecommunications engineering firm.

In managing V-COMM's growth, Mr. Villecco has overseen expansion of the company's portfolio of consulting services, which today include a full range of RF and Network support, network design tools, measurement hardware, and database services as well as time-critical engineering-related services such as business planning, zoning hearing expert witness testimony, regulatory advisory assistance, and project management.

Before forming V-COMM, Mr. Villecco spent 10 years with Comcast Corporation, where he held management positions of increasing responsibility, his last being Vice President of Wireless

Engineering for Comcast International Holdings, Inc. Focusing on the international marketplace, Mr. Villecco helped develop various technical and business requirements for directing Comcast's worldwide wireless venture utilizing current and emerging technologies.

Previously he was Vice President of Engineering and Operations for Comcast Cellular Communications, Inc. His responsibilities included overall system design, construction and operation, capital and operating budget preparation and execution, interconnection negotiations, vendor contract negotiations, major account interface, new product implementation, and cellular market acquisition. Following Comcast's acquisition, Mr. Villecco successfully merged the two departments and managed the combined department of 140 engineers and support personnel.

Mr. Villecco served as Director of Engineering for American Cellular Network Corporation (AMCELL), where he managed all system implementation and engineering design issues. He was responsible for activating the first cellular system in the world utilizing proprietary automatic call delivery software between independent carriers in Wilmington, Delaware. He also had responsibility for filing all FCC and FAA applications for AMCELL.

Prior to joining AMCELL, Mr. Villecco worked as a staff engineer at Sherman and Beverage (S&B), a broadcast consulting firm. He designed FM radio station broadcasting systems and studio-transmitter link systems, performed AM field studies and interference analysis, and TV interference analysis, and helped build a sophisticated six-tower arrangement for a AM antenna phasing system. He also designed software for FM allocations pursuant to FCC Rules Part 73.

Mr. Villecco started his career in telecommunications engineering as a wireless engineering consultant at Jubon Engineering, where he was responsible for the design of cellular systems, both domestic and international, radio paging systems, microwave radio systems, two-way radio systems, microwave multipoint distribution systems, and simulcast radio link systems, including the drafting of all FCC and FAA applications for these systems.

Mr. Villecco has testified as an expert witness in federal court on behalf of the Department of Justice and the Federal Communications Commission on two separate high profile cases involving wireless system design, implementation and operation.

Mr. Villecco has a BSEE from Drexel University, in Philadelphia. He is also a member of the Drexel ECE (Electrical and Computer Engineering) Department advisory board. In February 2001, Mr. Villecco received the "2001 Distinguished Alumnus Award" from the Drexel ECE Department for his continued contributions to the engineering profession. Since 1983, Mr. Villecco has been an active member of IEEE.

<u>Relevant Expert Witness Testimony Experience:</u>
Over the past fifteen years, Mr. Villecco had been previously qualified and provided expert witness testimony in the states of New Jersey, Pennsylvania, Delaware and Michigan. Mr. Villecco has also provided expert witness testimony in the following cases:

- United States Bankruptcy Court
- NextWave Personal Communications, Inc. vs. Federal Communications Commission **
- Pocket Communications, Inc. vs. Federal Communications Commission **

** In these cases, Mr. Villecco was retained by the FCC and the Department of Justice as a technical expert on their behalf, pertaining to matters of wireless network design, optimization and operation.

David K. Stern
Vice President, V-COMM, L.L.C.

David Stern, Vice President and co-founder of V-COMM, has over 27 years of hands-on operational and business experience in telecommunications engineering. He began his career with Motorola, where he developed an in-depth knowledge of the wireless engineering technologies CDMA, TDMA, and GSM, as well as AMPS and Nextel's iDEN.

While at V-COMM, Mr. Stern oversaw the design and implementation of several major Wireless markets in the Northeast United States, including Omnipoint - New York, Verizon Wireless, Unitel Cellular, Alabama Wireless, PCS One and Conestoga Wireless. He has testified at a number of Zoning and Planning Boards in Pennsylvania, New Jersey and Michigan.

Prior to joining V-COMM, Mr. Stern spent seven years with Comcast Cellular Communications, Inc., where he held several engineering management positions. As Director of Strategic Projects, he was responsible for all technical aspects of Comcast's wireless data business, including implementation of the CDPD Cellular Packet Data network. He also was responsible for bringing into commercial service the Cellular Data Gateway, a circuit switched data solution.

Also, Mr. Stern was the Director of Wireless System Engineering, charged with evaluating new digital technologies, including TDMA and CDMA, for possible adoption. He represented Comcast on several industry committees pertaining to CDMA digital cellular technology and served on the Technology Committee of a wireless company on behalf of Comcast. He helped to direct Comcast's participation in the A- and B-block PCS auctions and won high praise for his recommendations regarding the company's technology deployment in the PCS markets.

At the beginning of his tenure with Comcast, Mr. Stern was Director of Engineering at Comcast, managing a staff of 40 technical personnel. He had overall responsibility for a network that included 250 cell sites, three MTSOs, four Motorola EMX-2500 switches, IS-41 connections, SS-7 interconnection, and a fiber optic and microwave "disaster-resistant" interconnect network.

Mr. Stern began his career at Motorola as a Cellular Systems Engineer, where he developed his skills in RF engineering, frequency planning, and site acquisition activities. His promotion to Program Manager-Northeast for the rapidly growing New York, New Jersey, and Philadelphia markets gave him the responsibility for coordinating all activities and communications with Motorola's cellular infrastructure customers. He directed contract preparations, equipment orders and deliveries, project implementation schedules, and engineering support services.

Mr. Stern earned a BSEE from the University of Illinois, in Urbana, and is a member of IEEE.

Sean Haynberg
Director of RF Technologies, V-COMM, L.L.C.

Sean Haynberg, Director of RF Technologies at V-COMM, has over 21 years of experience in wireless engineering. Mr. Haynberg has extensive experience in wireless system design, implementation, testing and optimization for wireless broadband data and voice systems utilizing UMTS, HSPA, LTE, EVDO, CDMA, GSM, EDGE, ESMR and Analog wireless technologies. In his career, he has conducted numerous new technology deployments, compatibility & interference studies, and evaluations to assess, develop and integrate new technologies that meet industry and FCC guidelines. His career began with Bell Atlantic Mobile, where he developed an in-depth knowledge of wireless engineering.

While at V-COMM, Mr. Haynberg was responsible for the performance of RF engineering team supplying total RF services to a diverse client group. His projects included managing a team of RF Engineers to perform interference testing & analysis, FCC reporting and presentations, studying new wireless technology compatibility and integration with existing CMRS network technologies, conducting technology interference studies at CMRS base stations and customer provided equipment, design, deploy and optimize numerous CMRS wireless networks in various markets, wireless system design & expansion of international markets in Brazil and Bermuda, and development and procurement of hardware and software engineering tools. He has also developed tools and procedures to assist carriers in compliance to FCC rules & regulations for RF Safety, international TV band interference studies, and other FCC regulatory issues. In addition, Mr. Haynberg was instrumental in providing leadership, technical analysis, engineering expertise, and management of a team of RF Engineers to deliver expert engineering support and reporting on behalf of the FCC & Department of Justice, in the NextWave and Pocket Communications Bankruptcy proceedings.

Prior to joining V-COMM, Mr. Haynberg held various management and engineering positions at Bell Atlantic NYNEX Mobile (BANM). He was responsible for evaluating new technologies and providing support for the development, integration and implementation of first office applications (FOA), including CDMA, CDPD, and RF Fingerprinting Technology. Beyond this, Haynberg provided RF engineering guidelines and recommendations to the company's regional network operations, supported the evaluation and integration of new wireless equipment and technologies, including indoor wireless PBX/office systems, phased/narrow-array smart antenna systems, interference and inter-modulation analysis and measurements, and cell site co-location and acceptance procedures. He was responsible for the procurement, development and support of engineering tools for RF and system performance engineers to enhance the performance, design and optimization of the regional cellular networks. He began his career as an RF Engineer responsible for the system design and expansion of cellular markets in New Jersey, Philadelphia, PA; Pittsburgh, PA; Washington, DC; and Baltimore, MD markets.

Mr. Haynberg earned a Bachelor of Science degree in Electrical Engineering with high honors, and attended post-graduate work, at Rutgers University in Piscataway, New Jersey. While at Rutgers, Mr. Haynberg received numerous honors including membership in the National Engineering Honor Societies. In addition, Mr. Haynberg has qualified and provided expert witness testimony in the subject matter of RF engineering and the operation of wireless network systems for many municipalities in the State of New Jersey.

David Hunt
Senior Staff RF Engineer, V-COMM, L.L.C.

Mr. Hunt has over 27 years of experience in RF engineering including extensive experience in wireless planning, RF design, optimization, and performance of wireless systems utilizing OFDM, CDMA, EVDO, GSM/GPRS/EDGE, UMTS/HSPA, LTE, SMR/IDEN and other wireless technologies. In his career, he was responsible for the specification, design, proof-of-performance tests, implementation, and optimization of numerous wireless communications systems, detection and measurement systems including advanced military systems. His career began in the specification, design, and implementation of underwater acoustic warfare systems and continued with commercial wireless communications systems while at V-COMM.

While at V-COMM, Mr. Hunt has been responsible for the performance of a RF engineering team supplying a variety of RF services to a diverse client group. Projects include: system performance monitoring, frequency planning, adjacent market coordination, inter-modulation analysis, RF propagation prediction, system technology evaluation. Mr. Hunt designed, tested, optimized, and maintained new and existing cellular, PCS, MMDS, SMR, 700 MHz and other wireless voice and/or data systems throughout the United States and the Caribbean. In addition, Mr. Hunt has been involved in special technology evaluations and the development and procurement of hardware and software engineering tools to enhance both V-COMM and its client's capabilities. Mr. Hunt has lead the development of tools and procedures to assist clients and carriers in meeting compliance with FCC Rules & Regulations for RF Safety, emission standards and other FCC regulatory issues including FCC, FAA and AM tower studies and filings. David's activities included the development and submission of comprehensive engineering studies for consideration in numerous FCC proceedings.

While at the Naval Air Warfare Center (NAWC), Mr. Hunt designed and wrote computer programs to generate and display antenna beam pattern for various conditions of a linear array of hydrophones for display of receiver gain calculations. He documented this work in Technical Memorandum 5032 TM-887-IBP-08. Mr. Hunt was involved in all aspects of the SSQ-101 Air Deployable Active Receiver (ADAR) sonobuoy development including: signal processing software, hardware design and development, test planning, setup and testing. Mr. Hunt designed, developed and implemented an All-Threat In-Buoy Signal Processing (IBSP) Program used to detect, classify and localize enemy targets on the SUN workstation using standard signal to noise ratio measurements and advanced detection methods. This involved analyzing signal to noise ratio performance requirements and the design/implementation of specific portions of the preprocessor including modulation, filter decimation, windowing with redundancy, frequency analysis, magnitude/phase detection and a short term integration process.

While at NAWC, he received seven Performance Awards, a Quality Step Increase, three Letters of Appreciation, and one Special Act Award.

Mr. Hunt has a Bachelor of Science Degree in Electrical Engineering from Temple University emphasizing Signal Processing, Digital Signal Processing and Communications. In addition, Mr. Hunt has earned a Masters of Science Degree in Electrical Engineering from Drexel University in Philadelphia.