

**Before the
Federal Communications Commission
Washington, DC 20554**

In the Matter of:)
)
Amendment of Part 90 of the Commission's) WP Docket No. 07-100
Rules)
)
)

**COMMENTS OF
THE NATIONAL PUBLIC SAFETY TELECOMMUNICATIONS COUNCIL**

The National Public Safety Telecommunications Council (NPSTC) submits these comments in response to the Sixth Further Notice of Proposed Rulemaking (Sixth FNPRM) in the above captioned proceeding.¹ The Sixth FNPRM seeks comment on alternatives to stimulate expanded use of and investment in the 4.9 GHz band.

In these comments, NPSTC addresses the numerous policy and technical issues raised in the Sixth FNPRM. In addition, these NPSTC comments seek to set the record straight with a more accurate picture of current and potential usage in the 4.9 GHz band. The Commission's stated calculation that no more than 3.5% of the potential licensees use the band has apparently created the misimpression that very little of the band's capacity is in use. NPSTC examines the 3.5% calculation and presents more relevant statistics and sample use cases on existing public safety operations in the band. NPSTC also addresses emerging technologies used in public safety for which 4.9 GHz would be beneficial. NPSTC recommends managed sharing of the spectrum with CII entities and opposes auctioning the band for commercial use.

¹ *Sixth Further Notice of Proposed Rulemaking*, WP Docket No. 07-100, released March 23, 2018.

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The National Public Safety Telecommunications Council

The National Public Safety Telecommunications Council is a federation of public safety organizations whose mission is to improve public safety communications and interoperability through collaborative leadership. NPSTC pursues the role of resource and advocate for public safety organizations in the United States on matters relating to public safety telecommunications. NPSTC has promoted implementation of the Public Safety Wireless Advisory Committee (PSWAC) and the 700 MHz Public Safety National Coordination Committee (NCC) recommendations. NPSTC explores technologies and public policy involving public safety telecommunications, analyzes the ramifications of particular issues and submits comments to governmental bodies with the objective of furthering public safety telecommunications worldwide. NPSTC serves as a standing forum for the exchange of ideas and information for effective public safety telecommunications.

The following 16 organizations serve on NPSTC's Governing Board:²

- American Association of State Highway and Transportation Officials
- American Radio Relay League
- Association of Fish and Wildlife Agencies
- Association of Public-Safety Communications Officials-International
- Forestry Conservation Communications Association
- International Association of Chiefs of Police
- International Association of Emergency Managers
- International Association of Fire Chiefs
- International Municipal Signal Association
- National Association of State Chief Information Officers
- National Association of State Emergency Medical Services Officials
- National Association of State Foresters
- National Association of State Technology Directors
- National Council of Statewide Interoperability Coordinators
- National Emergency Number Association
- National Sheriffs' Association

² These comments represent the views of the NPSTC Governing Board member organizations.

Several federal agencies are liaison members of NPSTC. These include the Department of Homeland Security (the Federal Emergency Management Agency, the Office of Emergency Communications, the Office for Interoperability and Compatibility, and the SAFECOM Program); Department of Commerce (National Telecommunications and Information Administration); Department of the Interior; and the Department of Justice (National Institute of Justice, Communications Technology Program). Also, Public Safety Europe is a liaison member. NPSTC has relationships with associate members: The Canadian Interoperability Technology Interest Group (CITIG) and the Utilities Technology Council (UTC), and affiliate members: The Alliance for Telecommunications Industry Solutions (ATIS), Open Mobile Alliance (OMA), Telecommunications Industry Association (TIA), TETRA Critical Communications Association (TCCA), and Project 25 Technology Interest Group (PTIG).

NPSTC Comments

Given the importance of the 4.9 GHz band for public safety, NPSTC opposes auctioning the band for commercial use as some at the Commission proposed even prior to receiving any comments in this proceeding. As further addressed in these comments, auctioning the band would be detrimental to public safety agencies that rely on the 4.9 GHz spectrum. Also, reallocating the band for commercial use is unnecessary to stimulate expanded use. These NPSTC comments seek to set the record straight with a more accurate picture of current public safety usage of, and reliance on, the 4.9 GHz band. FirstNet's broadband LTE system will not be a substitute for these uses of the 4.9 GHz band which largely involve fixed point-to-point and secure WiFi type of

operations. We note that commercial carriers also use separate spectrum bands from that on which their networks operate to connect fixed sites and to provide for LTE-U.³

NPSTC also sets forth new public safety uses of the band that technology advances in robotics, the internet of things (IoT) and unmanned aerial systems will generate. In addition, NPSTC recommends steps to provide for shared critical infrastructure use of the band that can support infrastructure improvements and be beneficial to the public as well. Finally, as NPSTC and others in public safety have advocated previously and the Sixth FNPRM now addresses, these comments also recommend changes in the Commission's 4.9 GHz rules and policies that will provide more rigorous licensing and frequency coordination, enabling greater spectral efficiency and expanded usage, and will encourage more investment in the band.⁴

I. Current Public Safety Usage in the 4.9 GHz Band

The Commission's calculation that no more than 3.5% of the potential licensees use the band apparently has created the misimpression that very little of the band's capacity is in use. That is an inaccurate picture of the current public safety reliance on the band. First, the derivation of the 3.5% number is suspect, given the licensing policies and rules in the 4.9 GHz band. The Sixth FNPRM states the following:

Although nearly 90,000 public safety entities are eligible under our rules to obtain licenses in the band, there were only 2,442 licenses in use in 2012 and only 3,174 licenses in use nearly six years later in 2018. With no more than 3.5% of potential licensees using the band, we remain concerned that, as the Commission stated in 2012, the band has "fallen short of its potential." (footnotes omitted)⁵

³ In 2017, the Commission announced authorization of LTE-U devices for carriers in the 5 GHz unlicensed band.

⁴ NPSTC recommended improvements to the licensing and frequency coordination structure of the band almost six years ago in its 4.9 GHz National Plan Recommendation.

⁵ FNPRM at paragraph 1.

In making this statement, the Commission cites a U.S. Census Bureau statistic for the number of governmental units and Section 90.523(a) and 90.1203(a) regarding eligibility for licensing as the underpinning of the 3.5% calculation. Table 428 from the U.S. Census Bureau Statistical Abstract of the United States- 2012 the Commission cited shows that in 2007, the most recent year for which the stats are reported, there were a total of 89,527 “governmental units.” However, of these, 50,432 “governmental units” or 56% of the total are school districts and special districts which would overlap the municipalities and counties also reported.⁶ Where a county or municipality is licensed it would be unnecessary for an overlapping school district or special district also to be licensed to use the band for public safety purposes.

Under the Commission’s 4.9 GHz rules, a public safety entity may apply for and receive different types of licenses in the 4.9 GHz spectrum. Licenses authorizing permanent fixed point-to-point links are site-specific. However, a public safety entity may obtain a geographic license that authorizes use of the entire 50 MHz of the 4.9 GHz band for use within the licensee’s entire jurisdiction. A given geographic license can cover numerous unspecified hotspot sites and/or mobile or temporary fixed operations and can be used by multiple departments within the jurisdiction that holds the license. The geographic licensing approach has certainly proven not to be ideal, but nevertheless is embodied in the current rules and should have been taken into account when the Commission characterized the extent to which the band is being used.

When the Commission was considering geographic licensing for the 4.9 GHz back in the 2002 timeframe, NPSTC and other public safety organizations supported the approach as it would provide a jurisdiction greater flexibility to rapidly deploy temporary facilities at incidents or at pre-planned events. However, coupling the geographic approach with a lack of firm

⁶ Introductory text in Section 8 of this U.S. Census Bureau report notes that the “special districts” include independent public housing authorities and numerous local irrigation, power, and other types of districts.

requirements on regional planning or frequency coordination resulted in more downsides than benefits.

Based on the public safety community's experience, six years ago NPSTC expressed concerns about the geographic licensing approach at 4.9 GHz in which sites are not specified or recorded in the Universal Licensing System (ULS). Experience has shown the geographic license approach does not lend itself to a clear picture of operations that need to be protected and therefore is a challenge to frequency coordination. In the absence of any required regional planning or frequency coordination, the geographic licensing approach also does not help engender some public safety entities' confidence in the band as it is too close to an unlicensed structure. Although some metropolitan areas such as New York have voluntarily implemented regional planning for the 4.9 GHz band, such a voluntary initiative is not universal throughout the country. In NPSTC's view, if the Commission could have addressed the recommendations to modify the geographic licensing approach much sooner, additional use of the band would have materialized.

In reviewing the Commission's 3.5% calculation and the misinterpretation to which it leads, NPSTC reviewed the Commission's 4.9 GHz licensing records from the ULS and with only a minimal amount of additional analysis determined there are 18 states that hold licenses at 4.9 GHz, comprising a population of 138,140,526 people public safety is serving.⁷ In addition, there are also licensed localities outside of these states that would represent even more population served.

A NPSTC participant analyzed the ULS for both site-based 4.9 GHz licenses, and for 4.9 GHz geographic licenses. The results of this analysis are shown on two maps in Appendix B of

⁷ See list of states that hold their own 4.9 GHz licenses with their respective population counts in Appendix A of these comments.

these comments.⁸ The first map shows there are currently a total of 3918 fixed sites licensed that are distributed across the states and U.S. territories. The second map shows there are 2043 geographic licenses (denoted by the licensing codes FB and MO on the map) in the 4.9 GHz band distributed across the states and U.S. territories.

NPSTC also compared these recent totals with the number of fixed sites and geographic licenses, respectively, shown in the APCO International 4.9 GHz Task Force Report dated September 28, 2015, previously presented to the Commission in this docket. The APCO report showed a total of 2983 fixed sites and 2056 geographic licenses, as of August 15, 2015. With the recent analysis showing 3918 sites, ***there has been a 31% growth in fixed sites in fewer than three years***, a significantly different picture than the implication created by the Commission's 3.5% calculation.

In contrast to the significant growth in fixed sites, the growth in geographic licenses is essentially flat. However, as discussed below, that does not necessarily translate to a lack of growth in the facilities deployed under these licenses. The APCO report showed 2056 geographic licenses as of August 15, 2015, compared to the recent count of 2043 geographic licenses. Given that geographic licenses at 4.9 GHz authorize each licensee to use the entire 50 MHz of spectrum over its entire jurisdiction, a flattening of the number of licenses cannot be assumed to represent a lack of growth in public safety facilities. Under the geographic license, any number of additional facilities can be deployed with no modification to the license and no additional licenses.

⁸ NPSTC thanks Bette Rinehart with Rinehart Spectrum Solutions and more recently with the Enterprise Wireless Alliance (EWA) for this analysis.

NPSTC believes all these statistics provide a much more accurate picture of the usage of 4.9 GHz than the Commission's 3.5% calculation. However, perhaps more important than statistics, the following sample vignettes show how the public safety community is using the 4.9 GHz band spectrum to help protect and serve the public.⁹

- The City of Austin, TX:

The City of Austin has a permanent population of almost 1 million people as reported in 2016 and hosts over 25 million visitors per year.¹⁰ To help protect both its residents and its many visitors, the City of Austin has deployed its High Activity Location Observation (HALO) system. The system utilizes multiple clusters of surveillance cameras in its downtown area that are connected to monitoring facilities by 4.9 GHz links. The 4.9 GHz links carry multiple streams of video on a 24 hour/7 day a week basis. A crime center monitors the cameras in real time and allows the Austin Police Department (APD) to provide immediate support to officers and supply detailed information on monitored places where 9-1-1 calls have occurred. APD installed the first cameras for HALO in targeted locations around Rundberg Lane, a small yet crime-dense area in north Austin. The next phase of its HALO project involved setting up cameras around Sixth Street and the Warehouse District in downtown Austin. The HALO program has about 40 cameras deployed in high crime areas and is expanding the system for even greater coverage. The cameras include provisions for 360 degrees panning and high quality zoom. APD reports that since going live in 2011, the cameras have helped in hundreds of cases overall and have captured evidence on approximately 25 to 30 criminal cases every month.¹¹ Given the number and location of the cameras, the entire spectrum in the 4.9 GHz band is needed to support these operations and in some cases the entire 50 MHz is still not enough, so situations in which less

⁹ The Communications Act of 1934, as amended, still includes “promoting safety of life and property” as one of the purposes of the Commission. Communications Act of 1934, as amended Subchapter I – General Provisions; Section 151.

¹⁰ See <http://www.austinrelocationguide.com/Austin-Demographic-Information/> and <http://www.downtownaustin.com/business/tourism>

¹¹ <http://spectrumlocalnews.com/tx/austin/news/2017/03/21/austin-police-department-relies-on-specialized-cameras-to-catch-criminals>

security is tolerable, the HALO system is forced also to utilize some 5 GHz unlicensed spectrum.

- San Diego County, CA:

The County of San Diego uses the 4.9 GHz band for the San Diego County Fire Authority program called ASAPnet. It is a broadband system for County Fire to access the intranet for dispatch, reports and necessary training. The broadband network connects 73 fire stations to point and multipoint base stations at (currently) 13 locations county-wide. Appendix C of these comments shows a map of the extent of this network which depends on the 4.9 GHz spectrum. The County also uses 4.9 GHz point-to-point paths to provide data connectivity to remote Sheriff's Department and Regional Communications System facilities, for temporary paths as required to support remote and incident command posts. In addition, the County has a multi-agency Regional Explosive Ordinance Disposal team which operates multiple remotely-controlled robotic devices for use in extremely hazardous situations involving explosives or caches of compounds which, if mixed, would produce explosive or extremely hazardous chemical releases. These robotic devices use 4.9 GHz for video, audio, data and control of the device. In many situations, multiple robotic devices are deployed at an incident. As secure a link as possible is necessary for these essential public safety operations.

- The City of Los Angeles, CA:

The City of Los Angeles utilizes the 4.9 GHz band to support video aggregation points for surveillance systems at LAX, Jordan Downs, Mac Arthur Park and other locations, and for backhaul to/from the above areas. In addition, the City uses 4.9 GHz for on-scene mesh networks and for point-to-point links for T-1s at command posts. The City also uses 4.9 GHz for airborne public safety video operations under a waiver.

- The City of Long Beach, CA:

The City of Long Beach holds 10 licenses in the 4.9 GHz band that primarily support general police operations. Uses include fixed operations and robotic units. In addition, the City uses 4.9 GHz for airborne public safety video operations under a waiver. Secure public safety awareness of activity in this port city is critical for the protection of the public. As the second-busiest container sea port in the United States, the Port of Long Beach handles trade valued at more than \$180 billion annually and supports 1.4 million trade-related jobs across the nation, including 300,000 in Southern California. The Port serves 175 shipping lines with connections to 217 seaports around the world. Goods moving through the Port reach

every U.S. congressional district. In 2017, the Port handled more than 7.5 million container units, achieving the busiest year in its 107-year history.

- New York City, NY:

New York City holds multiple licenses in the 4.9 GHz band. Representatives participated in the NPSTC 4.9 GHz Working Group and provided some insight into the City's use of 4.9 GHz spectrum. The NYPD utilizes 4.9 GHz to support video monitoring operations at numerous locations throughout the City. The 4.9 GHz public safety spectrum is also used for backhaul. The Port Authority uses 4.9 GHz spectrum in support of security operations at its facilities within the city. The 4.9 GHz band is used by the Metropolitan Transportation Authority. NYC MTA is the largest underground mass transit system in the U.S. NYC MTA has implemented a dedicated 4.9 GHz public safety broadband network, as part of a project to enhance safety and connectivity in its subway system facilities. The City has successfully deployed 4.9 GHz nodes in close proximity by using vertical separation and has noted that additional isolation can be achieved by utilizing alternate polarizations when deploying 4.9 GHz nodes in close proximity to each other.

- The State of Oregon:

Oregon Department of Transportation's ITS section has an aggressive schedule of deploying 4.9 GHz point to point links throughout the state. These links provide communications for traffic signal control, variable speed limit signs and cameras for the state's Transportation Management Centers. The state has approximately 50 issued licenses and pending applications at the FCC, with more applications waiting for additional information from the state's IS section to be filed. The state's Wireless Communications Section has also submitted an application to the FCC for a point to point path for telemetering to the Pelican Butte site. This is a low-cost solution for the state to retrieve critical site data. The Oregon Department of Forestry is now using 4.9 GHz to link its fire lookout cameras and the Pacific Northwest Seismic Network is deploying equipment to monitor earthquake activity for early warnings.

- The State of Tennessee:

As shown on the maps in Appendix B, there are numerous authorizations for point-to-point links and geographic licenses held by the state and localities within Tennessee. The uses vary from point-to-point links for backhaul of public safety radio communications dispatch traffic and backhaul of the regional trunking system sites, to multi-location video systems that provide public safety video and data links used for university campus security and multiple needs in connection with state prisons.

- The Territory of Puerto Rico:

Puerto Rico has a significant amount of 4.9 GHz equipment used primarily to connect with surveillance cameras in different municipalities. These are used primarily for police video surveillance to protect life and property. Links in the 4.9 GHz band are also used to help manage traffic. The band is also used by some emergency agencies to provide access to the first responders when needed. There are 26 licenses in the 4.9 GHz band that support various public safety operations in the Territory of Puerto Rico and its various local jurisdictions.

These vignettes provide just a few samples of positive benefit of the 4.9 GHz public safety spectrum around the country, and the public safety operations which would suffer if the Commission reallocated the 4.9 GHz band. As the maps in Appendix B show, there are 4.9 GHz licenses held by localities and/or states in almost every state and U.S. territory. Accordingly, reallocation of the 4.9 GHz band to commercial carriers through an auction would be very detrimental to public safety and likely not very useful for commercial users.

II. Emerging Public Safety Uses for the 4.9 GHz Band:

In addition to existing applications, NPSTC believes there is a clear need to maintain the 4.9 GHz spectrum to support emerging technological advances that enable public safety operations. Three key categories of technological advances and applications are of particular interest to public safety at this time. They are a) airborne operations, using both manned aircraft and unmanned aerial systems (UAS); b) robotics; and c) the public safety safety things (PS IoT). All of these new technologies require spectrum support that the 4.9 GHz band can help provide. Following are NPSTC's recommendations regarding such use. Also, as part of addressing these uses, NPSTC sets forth its recommendations of a band plan to accommodate airborne and

robotics operations efficiently.

A. Airborne Use of 4.9 GHz:

Currently, airborne operations at 4.9 GHz are not allowed under the rules and the only licensees authorized for airborne operation in the band are those that have obtained a waiver of the rules. The Sixth FNPRM proposes to designate Channels 1-5 (5 MHz total) as aeronautical mobile channels in the 4.9 GHz band. In its proposal, the Commission recognizes that many law enforcement agencies operate helicopters and planes using video cameras and could benefit from a change in the rules to lift the general restriction on airborne use in the 4.9 GHz band. NPSTC believes aeronautical operations can also benefit the fire service, as an “eye in the sky” is helpful in viewing the extent of wildland fires and certain details on structure fires. NPSTC recognizes that public safety has access to spectrum in the 2 GHz and 5 GHz bands for airborne use, however it is on a co-primary basis with Broadcast mobile ‘ENG’ operations, and in the larger urban areas the media uses this band extensively. Therefore, public safety users may not have access to spectrum for airborne operations during a major event. Accordingly, adding the provision for airborne use of spectrum in the 4.9 GHz band could be very beneficial.

The Commission proposes to allow manned airborne operation in the 4.9 GHz band at altitudes up to 1500 feet.¹² Previously, NPSTC had recommended a lower maximum altitude to protect radio astronomy, however, NPSTC concurs the 1500 feet limit FCC has proposed is more compatible with public safety operations for many manned aircraft operations in law enforcement and fire operations. However, we do note that when mapping wildland fire situations, public safety manned aircraft need to be above fire retardant drops that normally occur around altitudes of 3000

¹² Sixth FNPRM at para. 20.

feet. Therefore, this particular use case should be accommodated in the rules or be handled through expected applications for waiver. NPSTC believes the use of directional antennas coming off airborne platforms can help minimize exclusion zones around aircraft.

The Commission proposes to limit 4.9 GHz airborne use to manned aircraft. In NPSTC's view, this presents an unnecessary restriction on public safety use of the 4.9 GHz band. Public safety prevention and response operations increasingly benefit from the use of UAS. The use of UAS provide an extra set of eyes in the sky that can cover an area much faster than officers, firefighters or emergency medical personnel on the ground. UAS are being used to support public safety in searches for both missing persons and for suspects, in "seeing" the area covered by a localized fire and in delivering medical supplies quickly in an emergency. NPSTC believes allowing UAS to use the 4.9 GHz spectrum would be very beneficial to public safety.

Furthermore, it is not clear why a UAS operated under the rules established by the Federal Aviation Administration (FAA) should not be allowed.¹³ In addition, the Commission has expressed its view that use of the 4.9 GHz band is not living up to its full potential and that additional usage must be provided. Given the emerging importance of UAS operations for law enforcement, the fire service and the emergency medical services, imposing a restriction against UAS use of the 4.9 GHz spectrum simply creates an artificial limitation that is contrary to the Commission's stated goal of increased usage in the band.

After a yearlong study and involvement by numerous public safety and industry representatives, NPSTC recently completed the report "Using UAS for Communications Support – Spectrum and Technology Issues. As noted in the report:

UAS currently use unprotected radio frequency spectrum and remain vulnerable to unintentional (i.e., environmental or technological) or intentional (i.e., terrorist or hostile)

¹³ NPSTC understands that based on FAA rules, the maximum altitude for UAS operations is 400 feet above ground.

interference. This is of paramount security concern for public safety users as interruption of radio transmissions of the command and control signal can disengage the UAS control mechanism which may result in loss of a communications link or a “lost link” scenario.

In a “lost link” scenario, UAS generally have pre-programmed maneuvers that direct the aircraft to hover or circle in the airspace for a certain period of time to reestablish its radio link. If the link is not reestablished, then the UAS will return to its launch location or execute an intentional flight termination at its current location.¹⁴

As noted above, there are normally provisions for the lost link scenario to help prevent loss of the UAS aircraft. However, during such a situation, the benefit of a UAS in public safety operations may still be compromised. Therefore, use of protected spectrum allocated to public safety such as the 4.9 GHz band provides greater likelihood of a successful mission.

The NPSTC report advised that several categories of control, status, and data messages, along with payload video are normally required in order to ensure successful UAS missions. NPSTC recommends that all of these types of communications be allowed on the 4.9 GHz band. Control of the UAS normally is accomplished by the use of TDMA technology and does not require any additional bandwidth than that needed for the video transmission.

NPSTC recommends the Commission allow public safety manned and unmanned airborne operations in 4.9 GHz on the lower 10 MHz of the band. Channels 1-5 (1 MHz each) would likely need to be aggregated to provide one video-capable 5 MHz channel from 4940-4945 MHz. NPSTC recommends the Commission also allow public safety airborne operations on channel 6, i.e., 4945-4950 MHz. When airborne operations are used, they need to be authorized on these specific channels, without making the designated channels exclusive to airborne use. That way, any regions that do not have airborne use are still able to use the channels on a frequency-coordinated basis.

¹⁴ Using UAS for Communications Support – Spectrum and Technology Issues, May 30, 2018
http://www.npstc.org/download.jsp?tableId=37&column=217&id=4115&file=UAS_Comm_Spectrum_&Tech_Considerations_180530.pdf

B. Robotics:

The public safety community has an increasing need for the use of robotics. A robotic platform can serve different purposes based on the types of sensors and mechanics attached to the robotic platform. For example, the robotic platform can have the right mechanics, video and control to be used as a “bomb robot” to more safely disable explosive ordinances and devices. A robotic platform can be outfitted with chemical sensors to help determine the types of chemicals involved in a spill when human contact could place public safety personnel at risk. Robotics can be used across multiple public safety disciplines as different jurisdictions may assign responsibilities to law enforcement, fire, or specialized multi-hazard teams.

The 4.9 GHz band is needed as a secure resource to support necessary communications including both payload and control. The Sixth FNPRM, building off the NPSTC 4.9 GHz National Plan Recommendations Report from October 2013, has proposed to provide for robotics operations in the 4.9 GHz band. Specifically, the Commission has proposed that robotics use channels 1-5 (1 MHz each channels) from 4940-4945 MHz jointly for robotics and airborne uses.

NPSTC believes it is even more important now than it was back in 2013 to provide for public safety robotics uses in the 4.9 GHz band. A number of jurisdictions are already using robotics. These units are often purchased on a federal GSA contract, based on the Department of Homeland Security approved list for grant funding. Therefore, if the FCC removes the 4.9 GHz band or limits the public safety usage at 4.9, there will be impact nationally to Homeland Security operations.

As robotics technologies advance, NPSTC believes additional departments and jurisdictions will take advantage of the benefits of robotics and therefore, the need for secure public safety spectrum at 4.9 GHz to support robotic operations will increase. Furthermore, robotics communications are normally conducted in a relatively confined area compared to that of many

point-to-point links or airborne communications, and multiple robotic devices may be deployed simultaneously. Therefore, NPSTC believes that robotics should be allowed on other channels in the 4.9 GHz band as well and not be limited to channels 1-5. Of course, frequency coordination of all operations will be needed to help minimize interference among the various types of operations and to help ensure efficient spectrum use.

The Commission requested comment on whether it should place any restrictions on the types of communications, i.e., payload or command and control associated with robotic communications. NPSTC believes any such restrictions would be counterproductive, as both payload and command and control signals can be integrated on the same spectrum. For example, San Diego County is deploying robotic units that use coded orthogonal frequency-division multiplexing (COFDM) to carry payload and control on the same spectrum link.

C. Public Safety Internet of Things (PS IoT)

NPSTC has a Public Safety Internet of Things (PS IoT) Working Group in its Technology and Broadband Committee that has been examining use cases and deployment issues surrounding public safety IoT. To date, the working group has focused on four use cases that could occur in day-to-day public safety operation. These are IoT in connection with 1) a law enforcement traffic stop; 2) a house fire; 3) a basic emergency medical service (EMS) use case; and 4) a vehicle crash with injuries and hazmat, each described further below. Of course, there could be IoT use cases involving hurricanes or tropical storms, or other catastrophic events as well. However, the working group decided first to tackle use cases that occur more routinely in safety operations.

As the Working Group analyzed each Use Case, it identified not only potential benefits of IoT, but also key barriers to adoption of IoT solutions by public safety. Specifically, the Working

Group identified concerns about data validity (authenticity, integrity and real-time access to time sensitive data), device and data interoperability (does the IoT solution interoperate with other devices, systems, databases), and security/cybersecurity (design, access controls, upgrading/patching, protection from spoofing, denial of service, hacking/theft of data, etc.). The Department of Homeland Security (DHS) and the National Institute of Standards and Technology (NIST) have identified many of these same concerns.

Public safety entities are also concerned with data ownership and control, i.e., who owns the data (e.g., government or third-party commercial), who stores the data, who is authorized to share and use the data, and who controls the release of data. Agencies are wary of delegating control of confidential and sensitive data to commercial entities. Moreover, they are concerned that commercial solutions, often originally designed for non-public safety markets, will not provide “public safety grade” standards for accuracy, reliability and security of mission critical data.

For these reasons, some public safety agencies will elect to forego commercial solutions and build and operate their own wireless IoT systems. This decision, though perhaps more costly, is attractive to some agencies who wish to ensure data availability and integrity, and to maintain control of the data that will be generated by these systems. These agencies will need spectrum to connect IoT devices to the communications hub, which may be worn by the first responder, activated at the incident, or operated in a remote location, such as the PASP or data center. Currently, most commercial solutions rely on Bluetooth or unlicensed Wi-Fi for wireless connectivity of IoT devices, but in general, these networks would not meet security and reliability standards required by public a number of safety agencies. LTE solutions such as those offered by FirstNet may serve as the transmission network for some IoT applications, but applications requiring high-bandwidth and

extended timelines such as streaming video, may use larger amounts of bandwidth than that envisioned for incidental video. For these reasons, some agencies are considering 4.9 GHz as backhaul for devices such as video cameras and for other high-bandwidth IoT solutions. If the Commission were to open the 4.9 GHz band up to commercial use, public safety could lose these critically important security, reliability and availability features that currently make it highly attractive for use by public safety as a high-bandwidth IoT network solution.

All the use cases involve numerous sensors. For each, the sensors need to communicate with a common data aggregation point, which would also likely serve as a communications hub where the collected sensor data would be sent to the cloud using for example a commercial LTE network. However, a significant issue uncovered is the problem of what spectrum is used to move this IoT data from the individual sensors to the communications hub, especially given the requirements about data validity, security, control and ownership. At an incident scene, there could be dozens and dozens of IOT devices that need to communicate with each other and with first responders. Using 4.9 GHz to move sensor data to an aggregation communications hub would be enormously beneficial, even if the aggregated data were then distributed further by a network such as FirstNet. Having dedicated spectrum feed into the aggregation hub would be critical to the successful transmission of this data and video traffic.

Following is additional information on the four use cases the working group has explored to date.

1) Law Enforcement Traffic Stop:

While on routine patrol, an officer sees a vehicle run a red light near a school zone. The officer pulls in behind the vehicle and follows his/her agency's traffic stop protocol. The officer approaches the vehicle and makes contact with the driver. Sensors on the officer's uniform capture voice, data and imagery and would detect threats which may be out of the officer's visual range. An example of such a threat could be a person rapidly approaching

from behind the officer, a vehicle driving by that has drifted out of its lane, etc. A variety of other safety-oriented IOT devices would also be enabled (e.g., sensors that detect removal of the officer's firearm from the holster, sensors that detect a gunshot [either from the officer's firearm or from any firearm], sensors that detect motion to indicate the officer is in a struggle or that the officer is motionless, sensors that detect that the officer is prone on the ground, sensors that detect biometric signatures including heart rate). Sensors need to be redundant – if they cannot reach the officers radio they need to reach out to another path to get the signal out. Especially if the data is being passed through a single device. Some sensors may be important enough to need their own connection to the network connection while other sensors could use a HUB to relay their data.

2) House Fire:

This use case involves the response to a single family residential house fire. IOT devices and applications monitor the health and safety status of the firefighters who are inside the burning home. Biometric data sensors embedded in the firefighters clothing are monitoring their heart rate, respiratory rate, body temperature, ambient room temperature, and checking for the presence of any toxic gases or chemicals. This data is transmitted in real time to a device used by the incident Commander. Additional biometric and safety sensors monitor firefighter movement to detect a fall down stairs or through a floor, detect a firefighter who has collapsed, or detect other significant events including when the firefighter is motionless. Alarm data from the sensors is transmitted to all nearby firefighters as well as to the Incident Commander. Video or infrared imagery data from the firefighter's helmet camera may transmit continuously to the incident Commander allowing visualization of interior conditions.

3) Basic EMS Use Case:

This use case involves the response of an EMS crew to the scene of a medical emergency. ENGINE 1 arrives at the home first and takes over care of the patient from the daughter. Responders attach additional patient care sensors to the mother that will monitor her vital signs, including her blood oxygenation, percentage of exhaled carbon dioxide, blood pressure, pulse rate, breathing rate and EKG rhythm. An Automated External Defibrillator (AED) is attached and a shock is performed which restores her heart rhythm and pulse. She begins to breathe on her own and regains consciousness. MEDIC 2 arrives and takes over management of the medical emergency and switches on an EMS Analytics Hub. The various patient care sensors automatically connect to the hub and aggregate patient status data. Partially due to privacy requirements, the data would need to be encrypted on all hops of the connection. The paramedic uses a two-factor authentication system to open a secure container that holds

injectable narcotics. Data alerts are sent to the on-duty EMS field supervisor and the agency's medical supply center noting that a specific syringe has been removed from the container.

4) A Vehicle Crash with Injuries and Hazmat:

This use case involves the response of law enforcement, fire and EMS personnel to the scene of a multi-vehicle crash on an interstate highway that includes injuries and leaking chemicals from an overturned tanker truck. Multiple public safety agencies are needed to manage the incident scene and specialized units are needed for the hazmat response. This use case highlights only three groups of Public Safety IOT solutions that may be used at this incident scene and does not duplicate IOT solutions discussed in prior use cases above, except to the extent necessary to demonstrate the need for data sharing. IOT devices and applications may monitor the air quality and conduct analysis of unseen threats, including rapid identification of vapors and other chemicals. The helmet camera on one of the firefighters identifies a hazard placard on the back of the tanker and translates the color codes and digits on the sign. The firefighter is immediately alerted that molten sulfur is being carried in the tanker. The helmet camera also has an infrared mode which detects that the tanker is nearly full of this chemical. This chemical is flammable and presents an explosion risk due its low ignition temperature. Hydrogen sulfide gas may also be present in the container. It is a toxic gas which can produce immediate unconsciousness and suffocation. This placard alert is also transmitted to the incident commander, all other firefighters on scene. An environmental sensor on the robot detects that the air quality within 10 feet of the tanker's edge contains dangerous gases. This alert is also transmitted to the incident commander and all first responders on scene. A situational awareness application is also used by all of the firefighters on scene and allows them to receive instructions, assignments and other incident information; while also viewing the incident map. County fire personnel pull eight sensor packs from a cache in the Incident Commander's vehicle and attach one to each of the county's firefighters. This allows data on the hazmat personnel to flow to the incident commander and to the Baker County hazmat officer. The IC can now see the location and movement of all public safety personnel on scene. The driver of the semi is injured but cannot safely be removed from the wreckage of the truck until the vehicle is stabilized and some extrication completed. Because the cab of the truck is in the hot zone, EMS personnel may not access the patient. A firefighter, wearing Personal Protective Equipment (PPE), attaches a biomedical sensor pack to the driver and tapes a cube shaped video camera to the hood of the semi. This allows streaming of vital signs information from the patient to the EMS personnel who will eventually be responsible for his care.

A review of these sample use cases shows that first responders would benefit from having a

variety of biometric and safety sensors attached to their clothing. Data from these sensors would detect a medical emergency, a first responder falling through the floor of a house that is on fire, or when a firefighter becomes motionless while operating on an emergency scene. Other sensors would trigger an alert when they detected that a police officer was in a struggle. Data from these sensors needs to be transmitted to other first responders (so they will receive the alerts directly) as well as to a communications hub, which could perform additional analytics on the data, detect patterns, make recommendations, and move the data to the cloud – for distribution to the PSAP or other automatic intelligence platforms. Although the working group focus so far has been primarily on the use cases, these discussions have identified that this data does need to move around the emergency scene. While additional work needs to be done, NPSTC believes the 4.9 GHz spectrum could provide a credible solution by providing the secure spectrum for a hotspot aggregation hub.

III. Eligibility and Spectrum Sharing

In its National Plan Recommendation submitted in 2013, NPSTC recommended that the 4.9 GHz band be opened to Critical Infrastructure Industry (CII) users on a frequency-coordinated and phased-in basis. NPSTC recommended that two of the 5 MHz channels be made available for CII immediately upon a Commission decision on modifying the rules and that three years later, the entire 4.9 GHz band be opened to CII. NPSTC stands by that recommendation.¹⁵ As the Commission recognized in the Sixth FNPRM “Extending eligibility to CII could encourage collaborative investment by public safety and CII users of the 4.9 GHz band to improve response to emergencies that affect both public safety and critical

¹⁵ Note that NPSTC Governing Board member APCO does not support opening any portion of the 4.9 GHz band to CII on a co-primary status with public safety users. NPSTC recognizes it has been five years since its recommendations were developed and looks forward to the comments of APCO and other public safety entities concerning such band sharing.

infrastructure.”¹⁶

The Commission also seeks comment on various approaches that would open the band further for commercial use, such as auctioning the band for commercial operations, borrowing some approaches from the Citizens’ Broadband Radio Service (CBRS) at 3.5 GHz and establishing a two-tier approach with dynamic spectrum sharing, etc. NPSTC believes the foregoing information in these comments provide a clear picture of current and prospective public safety operations that are realizing the significant potential of the band and will expand that use in the future. That, together with NPSTC’s recommendation in its National Plan to open the band to CII on a frequency-coordinated and phased basis should allay any Commission concerns about use of the band.

Further, we note that the history at the former 2 GHz microwave band does not paint a positive picture of sharing spectrum between public safety and new incumbent commercial operators. In reallocating the 2 GHz band microwave spectrum for emerging technologies in 1992, the Commission initially exempted public safety licensees from involuntarily relocating their fixed microwave networks out of the band and indicated that public safety licenses would maintain a co-primary status with new emerging technology entrants. Negotiating relocation out of the band was encouraged but not required. By late 1994, just two years after the initial allocation decision, the Commission changed the provisions for continued public safety use of the 2 GHz band for essential fixed microwave links, in favor of allowing new PCS licensees into the spectrum. The erosion in protection for public safety is specifically summarized in the Commission’s Second Memorandum Opinion and Order in the emerging technology proceeding:

¹⁶ Sixth FNPRM at paragraph 70.

In the First R&O, we exempted licensees of incumbent public safety facilities from involuntary relocation, but encouraged them to relocate on a voluntary basis when the spectrum is needed by an emerging technology provider. At that time we believed that adequate spectrum could be made available for services using emerging technologies through the voluntary relocation of incumbent public safety facilities. In the Third R&O, we maintained the public safety exemption, but clarified the definition of public safety. In the MO&O on our own motion, we concluded that PCS may be precluded or severely limited in some areas unless public safety licensees relocate; that in previous decisions we underestimated the difficulty that PCS will have in sharing spectrum with incumbent public safety licensees; and that allowing all public safety facilities to remain in the band indefinitely would defeat our primary goal in this proceeding of providing usable spectrum for the implementation of emerging technologies. Consequently, we decided that it would be in the public interest to subject all incumbent facilities, including those used for public safety, to mandatory relocation if an emerging technology provider requires the spectrum used by the incumbent.¹⁷

This decision documents that in a previous proceeding involving public safety microwave links, the Commission underestimated the difficulty in sharing spectrum and ultimately took steps to force public safety out of the band to benefit new entrants. NPSTC is concerned that the same result would occur if the Commission mandated sharing of the public safety 4.9 GHz band with commercial carriers. The 4.9 GHz band includes fixed point-to-point microwave links under site-based licenses plus geographic licenses that support multiple types of temporary-fixed and mobile operations. Opening the band to commercial carriers would negatively impact public safety entities and CII users that NPSTC has recommended for sharing in the band.

NPSTC has also considered the potential of dynamic spectrum sharing similar to the spectrum access system (SAS) in which the Commission has planted its hopes for the CBRS spectrum. NPSTC has several concerns with a SAS or similar dynamic sharing approach for 4.9 GHz. First and foremost, such dynamic sharing approaches are still being designed and tested and the rules are still

¹⁷ Second Memorandum Opinion and Order, ET Docket No. 92-9, released December 2, 1994, at paragraph 3.

being adjusted, after multiple years of promotion. Therefore, dynamic spectrum sharing still appears to be experimental in nature from a public safety perspective. NPSTC does not believe the Commission should experiment in public safety bands with sharing technologies still under development and testing. The potential consequences of any interference that may occur if the experimental sharing approaches do not perform flawlessly is too great.

Second, in bands where sharing is being implemented, it appears that incumbent users may have existing operations protected, but it is not at all clear they would still have the same rights and opportunities to expand their operations if needed. If that is the case, the sharing is actually more of a de-facto reallocation with protection for the existing deployments of current users. Third, it is not clear how an SAS-type system would be funded in public safety spectrum.¹⁸

In summary, NPSTC continues to believe the best option for sharing the spectrum is to open the spectrum to CII eligibles on a shared, frequency coordinated basis as set forth previously in the NPSTC National Plan Recommendation, and looks forward to recommendations from other public safety entities regarding such sharing.

IV. Technical Rules and Licensing Improvements

Grandfathered Systems: NPSTC supports the Commission's proposals with regard to "grandfathered" systems that may not match any new technical rules adopted. As recognized by the Commission in its Sixth FNPRM and as addressed above in these comments, a key challenge with the current geographic licensing approach is that it is impossible to tell what is actually deployed under a geographic license by examining the information in the ULS. Accordingly, NPSTC supports the proposal to require existing licensees to provide more specific information

¹⁸ NPSTC has heard estimates that an SAS can cost approximately \$20 million to establish and implement.

about its operations that the Commission would incorporate into the license information in the ULS. Although NPSTC would encourage existing licensees to provide this information as expeditiously as possible, NPSTC supports the Commission's proposal to allow up to one year to provide this information. For jurisdictions that have complex systems, it could take considerable time to document all aspects of the system.

Frequency Coordination: The Commission proposes that public safety frequency coordinators be eligible to coordinate 4.9 GHz and seeks comments whether to allow additional coordinators outside of public safety for the band. NPSTC believes that proper frequency coordination is essential for the 4.9 GHz band. NPSTC recommends that both public safety and CII applications use public safety frequency coordinators. Public safety coordinators best understand how public safety operations work and the interference thresholds that need to be maintained to protect public safety operations. Given the wide range and vastly different technical nature of the applications used in this band, the coordinators need both technical expertise and a deep understanding of public safety operations.

Regional Planning – NPSTC supports additional involvement by the regional planning committees (RPCs). NPSTC has coordinated with the NRPC and supports the Commission's proposal re regional planning.

Bandwidth- The Commission has proposed to allow channel aggregation up to 40 MHz as the default rule, however RPCs could include lower aggregation limits in regional plans. NPSTC discussed the proposed bandwidth aggregation limit and recommends instead that the full 50 MHz be the maximum aggregation, while maintaining a RPCs ability to set a lesser limit as part of its regional plan. Regardless of the bandwidth limit, NPSTC believes frequency coordination will be a key requirement to provide a balance of flexibility and efficiency. Frequency Coordinators will need to

assess requests for various bandwidths based on the type of operation and the systems that need to be protected.

Power levels/antenna requirements: For point-to-point links, applicants and system designers need to consider the benefits of cross polarization and narrower beamwidth antennas. NPSTC continues to support the antenna recommendations as stated in the National Plan recommendations. Vertical spacing and cross polarizations between paths are also important factors in frequency re-use for point-to-point links. NPSTC recommends that the maximum EIRP be based on Part 101.113 rules and be consistent with the limits for the 3.7-4.2 GHz and 5.9-6.4 GHz bands. Those bands have a maximum EIRP of +55 dBW.

Database: The Commission proposes using ULS as the official database. NPSTC concurs.

Technical protocol: The Commission proposes no mandatory technical protocol standards in the rules: NPSTC concurs. From practical standpoint, much of the equipment is based on 802.11. It is important that different versions of 802.11 be backward compatible, as is normally the case.

Fixed and Mobile Use: Agree with FNPRM to allow both fixed and mobile use.

Conclusion

NPSTC appreciates the opportunity to provide input to the Commission's proposals in the 4.9 GHz Band Sixth Further Notice of Proposed Rulemaking. NPSTC supports managed sharing of the band with Critical Industries Infrastructure (CII) entities and opposes reallocation and auction of the band for commercial use. Reallocation of the band would be very detrimental to public safety and likely would not be very productive for commercial carriers. The Commission's calculation that no more than 3.5% of the potential licensees use the band apparently has created the misimpression that very little of the band's capacity is in use, an

inaccurate picture of the current public safety reliance on the band.

The Commission's 3.5% calculation suffers from the inclusion of over 50,000 school districts and special districts that would overlap the almost 40,000 local and state entities also counted. In reality, the 4.9 GHz spectrum is licensed by state and/or local entities in almost every state in the U.S. Just the states alone that hold licenses in the band cover a total population 138 million, and there is additional population served by public safety in localities outside of the states that also hold licenses. In addition, as addressed in these comments, there are two types of licensing, site-specific licenses for permanent point-to-point operations and geographic licenses that cover a licensee's entire jurisdiction for the entire band. Fixed point-to-point sites have experienced a 31% increase over the past three years. As geographic licenses do not include site information, increases in the facilities used under those licenses could have increased as well, but it is impossible to determine that from the ULS database.

More importantly than statistics, the 4.9 GHz band supports a number of types of public safety operations as addressed in sample vignettes of usage by several states, localities and U.S. territories included in these comments. In addition to current uses of 4.9 GHz, NPSTC also set forth how this spectrum can be instrumental in supporting emerging technologies beneficial to public safety, including aeronautical, both manned and unmanned (UAS), robotics and the public safety Internet of Things (PS IoT). NPSTC has provided additional information on each of these types of emerging uses and the additional need for the 4.9 GHz spectrum they bring.

NPSTC has also addressed many of the technical and licensing improvement issues raised in the Sixth FNPRM. These include the need for more specific information in the data base related to geographic licenses, as well as increased frequency coordination and provisions for regional planning committee involvement. NPSTC appreciates the attention the Commission

paid to its previous comments and supports the resulting Commission proposals in many of these areas as addressed herein.

Ralph A. Haller, Chairman

A handwritten signature in black ink, appearing to read "Ralph A. Haller", with a long horizontal flourish extending to the right.

National Public Safety Telecommunications Council
8191 Southpark Lane, Suite 205
Littleton, Colorado 80120-4641
866-807-4755

July 6, 2018

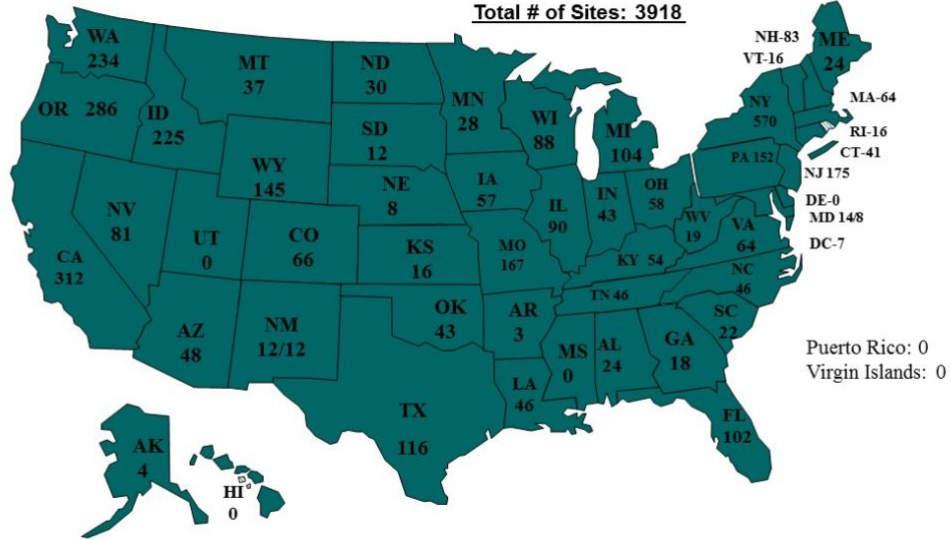
Appendix A: 4.9 GHz Licenses issued to States and Population Served

<u>State:</u>	<u>Population:</u>
State of Alaska	739,795
State of California	39,536,653
State of Colorado	5,607,154
State of Connecticut	3,588,184
State Of Idaho	1,716,943
State of Maryland - Department of Information Technology	6,052,177
State of Montana - Dept. of Administration	1,050,493
State of Nebraska Department of Roads	1,920,076
State of Nevada, Colorado River Commission	2,998,039
State Of New Hampshire Homeland Security & Emergency Management	1,342,795
State of New Jersey	9,005,644
STATE OF NEW YORK DIVISION OF STATE POLICE	19,849,399
STATE OF OKLAHOMA DEPT OF PUBLIC SAFETY	3,930,864
State of Oregon, Department of Administrative Services	4,142,776
State of Rhode Island	1,059,639
State of Tennessee, Department of Correction	6,715,984
State of Wyoming	579,315
STATE OF; TEXAS DEPT. OF TRANSPORTATION	28,304,596
Total Population served by 4.9 GHz for State Licenses	138,140,526

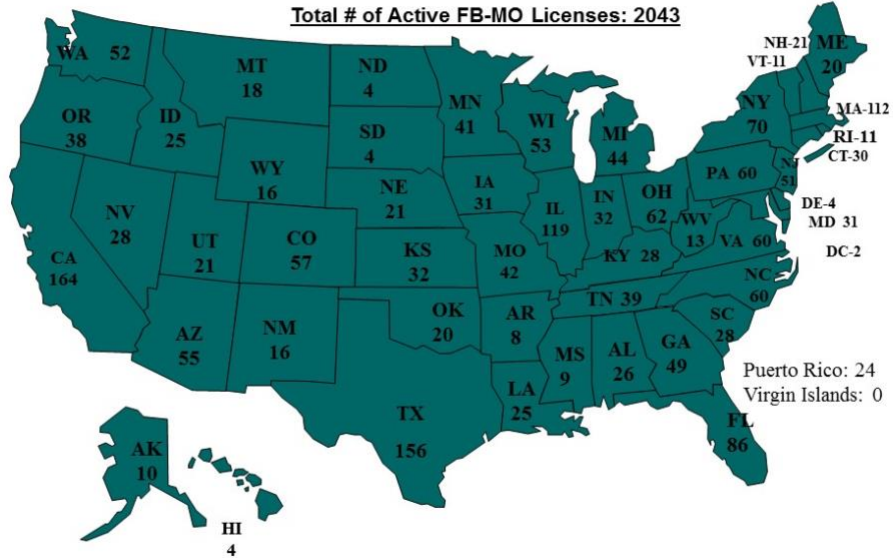
The 4.9 GHz band also helps public safety serve and protect additional population beyond these 138.1 million in localities not located in the above states.

Appendix B: Analysis of 4.9 GHz License Information from the ULS

4.9 GHz Point-to-Point Licensing By U.S. State



4.9 GHz FB-MO Licensing By U.S. State



Appendix C: Map of San Diego County, CA ASAPNet Using 4.9 GHz Spectrum

