BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matters of	
Fostering Innovation and Investment in the Wireless Communications Market	GN Docket No. 09-157
A National Broadband Plan for Our Future	GN Docket No. 09-51

REPLY COMMENTS OF LOCKHEED MARTIN CORPORATION

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TABLE OF CONTENTS

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I. INTRODUCTION AND SUMMARY.

Lockheed Martin is a global security company that employs approximately 140,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. Many of these systems and solutions depend on spectrum access. We therefore commend the Federal Communications Commission ("FCC" or "Commission") for initiating this Notice of Inquiry (the "NOI"). The FCC policies discussed in this proceeding have a direct impact on Lockheed Martin's ability to innovate and maximize the utility of these innovations for our customers.

In its initial comments Lockheed Martin recommended that the Commission: (1) recognize that any measure of spectrum efficiency must account for differences in bands and applications; (2) work with the National Telecommunications and Information Administration ("NTIA") to allow federal users more flexible access to commercial spectrum; and (3) improve the coordination process for experimental licenses.

The record in response to the NOI supports these recommendations. Unfortunately, however, some commenters undervalue the expanding demand for spectrum resources by federal users and existing incentives for these users to use spectrum efficiently. Lockheed Martin's reply comments therefore focus on three important points. First, the Commission should recognize that the record clearly supports spectrum efficiency analysis that varies by band and application. There is no record support for applying a simple intensity-of-use metric—or any single metric—to all spectrum bands and uses. Second, the Commission should recognize that demand for spectrum resources is growing for Federal as well as commercial entities. It is in the public interest to support the ever-increasing use of spectrum resources by federal agencies, and the FCC should not simply advocate repurposing federal spectrum. Third, the Commission should improve the experimental license process to encourage innovation. License holders should not be allowed to impede innovation and development of important new technologies by withholding coordination based on non-interference concerns.

II. SPECTRUM EFFICIENCY ANALYSIS SHOULD ACCOUNT FOR IMPORTANT DIFFERENCES BETWEEN BANDS AND USES.

The Commission has recognized that any measure of spectrum efficiency must reflect differences in spectrum bands.[1] Lockheed Martin's comments demonstrate that efficiency analysis must also account for differences in spectrum uses.[2] The Commission therefore should adopt the Department of Commerce Spectrum Management Advisory Committee ("CSMAC") model for categorizing spectrum dependent, or wireless, systems, and tailor efficiency and effectiveness analysis to each category. The CSMAC model establishes seven classes of

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1 *Fostering Innovation and Investment in the Wireless Communications Market, A National Broadband Plan for Our Future*, Notice of Inquiry, GN Docket Nos. 09-157, 09-51, ¶ 40 (Aug. 27, 2009) ("NOI").

2 Comments of Lockheed Martin Corporation ("Lockheed Comments") at 5 (filed Sept. 30, 2009).

wireless systems: broadcast systems, personal communications systems, point-to-point directional systems, non-communication transmitters and receivers, satellite systems, passive listeners, and short-range uses.[3] A simple intensity-of-use measure which does not differentiate between types of uses would improperly suggest that essential wireless applications that do not involve constant or intense transmission are somehow inefficient.[4]

The record supports Lockheed Martin's position.[5] For example, Boeing argues that it is impossible to make meaningful "quantitative comparisons of spectrum efficiency between dissimilar types of radio services and uses."[6] Therefore, Boeing explains "[t]he value of different spectrum uses should not be regulated via a single set of policies based upon commercial wireless efficiency criteria"[7] because overly simple measures of efficiency, like the rate of data transmission within a given bandwidth, "cannot . . . be used to provide a meaningful comparison of efficiency between different services."[8] Similarly, the Association for Maximum Service Television, Inc. and the National Association of Broadcasters ("MSTV/NAB") also agree that "a single objective

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3 CSMAC Working Group 1: Definitions of Efficiency in Spectrum Use at 3-4 (Oct. 1, 2008), *available at* http://www.ntia.doc.gov/advisory/spectrum/meeting_files/Spectral_Efficiency_Final.pdf ("CSMAC Report").

4 *See* CSMAC Report at 13-14.

5 Comments of the Association for Maximum Service Television, Inc. ("MSTV") and the National Association of Broadcasters ("NAB") at 2 (filed Sept. 30, 2009) ("MSTV/NAB Comments"); Comments of The Boeing Company at i (filed Sept. 30, 2009) ("Boeing Comments"); Comments of The Enterprise Wireless Alliance (filed Sept. 30, 2009) ("EWA Comments"); Comments of Sirius XM Radio Inc. (filed Sept. 30, 2009) ("Sirius Comments").

6 Boeing Comments at i. *See also* MSTV/NAB Comments at 2.

7 *Id*.

8 Boeing Comments at 13.

metric that could be used to compare efficiencies across different radio services is neither possible nor appropriate."[9]

Importantly, there is no support in the record for a simple intensity-of-use metric to measure efficiency across different classes of use. An intensity-of-use metric is not correlated with effectiveness or efficiency for many spectrum uses. A simple intensity-of-use efficiency metric is inappropriate for public safety communications systems, which require a guarantee of availability and reliability that often can only be achieved through dedicating spectrum resources even if these resources are not constantly in use.[10] Or, as MSTV/NAB states, "the benefits of any theoretical technological efficiency are likely outweighed by the harm that would be caused due to disruption of the communications infrastructure upon which the Nation's public safety services rely."[11] Additionally, as CSMAC has found, "passive listen[ing]" devices, such as the radio astronomy technologies employed by NASA and universities across the country to explore the universe, or for radar systems to protect national security or promote air safety, are not characterized by intense and constant transmissions.[12] Clearly this one characteristic should not lead the Commission to find that passive listening devices and non-communication transmitter/receivers such as radar systems do not deserve spectrum resources. Instead, the FCC should adopt a more sophisticated analysis based on the CSMAC categories discussed above.

The record also shows that measuring spectrum efficiency using as a proxy the price entities are willing to pay for a license is inappropriate. Many critical spectrum users deliver

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9 MSTV/NAB Comments at 2 (quoting Spectrum Policy Task Force Report, ET Docket No. 02-135, at 21 (Nov. 2002), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228542A1.pdf) ("SPTF Report").

10 Comments of Motorola, Inc. at 14, 16-17 (filed Sept. 30, 2009) ("Motorola Comments"); MSTV/NAB Comments at 3.

11 MSTV/NAB Comments at 3.

12 CSMAC Report at 13-14, 3-4.

tremendous value to our country – by contributing to job creation, innovation, homeland security, and national security – but do not directly generate revenue.[13] As MSTV/NAB explains, "[e]valuating the 'efficiency' of public safety communications based solely on maximizing spectrum use would yield diminishing returns, because the benefits of any theoretical technological efficiency are likely outweighed by the harm that would be caused due to disruption of the communications infrastructure upon which the Nation's public safety services rely."[14] Such a measure is even inappropriate for many commercial services. As the Enterprise Wireless Association notes, rules created for the "consumer marketplace where devices are calculated by the number of millions sold" cannot effectively address the needs of those spectrum bands "populated by the much smaller number of enterprise wireless users where innovation is found 'downstream' in internal business applications that do not generate revenue, but rather decrease production or distribution costs."[15]

III. THE COMMISSION SHOULD RECOGNIZE FEDERAL USERS' GROWING SPECTRUM NEEDS AND EXISTING INCENTIVES TO ACHIEVE EFFICIENCY AND EFFECTIVENESS.

The NOI recognizes that governments, businesses, and consumers have embraced advances in spectrum-intensive communications.[16] Federal spectrum users, like commercial entities, are under tremendous pressure to find ways to meet the expanding spectrum needs to enable deployment of these technologies – despite some commenters' failure to acknowledge that, similarly, a spectrum gap may well be facing the Federal Government, or individual agencies. Lockheed Martin urges the Commission to recognize the growth in federal spectrum

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13 MSTV/NAB Comments at 3; EWA Comments at 4-5; Motorola Comments at 3.

14 MSTV/NAB Comments at 3.

15 EWA Comments at 4-5.

16 *See* NOI ¶ 2.

demand, the existing incentives that have led to advances in federal spectrum efficiency, and the fact that federal spectrum users have been the source for some of our nation's most important wireless innovations.

While commercial broadband has been identified as a pillar of our future economy, the FCC should account for other spectrum applications that have contributed to the current explosion in innovation, technological improvements, job creation, productivity, and gains in national and homeland security – including industrial, satellite, aeronautical, defense and homeland security applications that often depend on federal spectrum, and the experimental uses of spectrum that brought about these advances. It is in the public interest to support and accommodate the growing spectrum needs of *all* users of spectrum, federal and commercial alike, for the full range of innovation and societal gains.

A. Demand for Federal Spectrum Resources is Growing.

In Lockheed Martin's experience, federal agencies are competing for limited spectrum resources and working hard to integrate spectrum-intensive new technologies and classes of users into their missions. Across the government, federal agencies continue to use spectrum resources for desired and critical missions, such as security and law enforcement, military equipment testing, training exercises, national defense and security, aeronautical mobile telemetry, scientific research, and meteorology. Increasingly, agencies are also called upon to devote spectrum resources to less expected missions, but nonetheless priorities of this Administration, such as electrical power grid management at federally operated electric utilities, continuity of government operations, interoperability with other agencies,[17] next generation

[17] *The Federal Strategic Spectrum Plan*, at B-4 (March 2008), *available at* http://www.ntia.doc.gov/reports/2008/FederalStrategicSpectrumPlan2008.pdf. For example, the Department of the Interior is currently implementing a plan to maximize radio spectrum efficiency and establish forward-looking policies enabling new uses and spectrum efficiencies.

aviation systems, highway safety, as well as the administration of federal buildings and maintenance of our national parks.[18] Spectrum allocated for federal use by the NTIA Office of Spectrum Management falls into four main categories: national defense, law enforcement and security, transportation, and resource management.[19] Each of these categories has experienced dramatic increases in spectrum demand.

National Defense. National defense applications account for the largest use of federal spectrum, with the Department of Defense ("DOD") and other agencies employing spectrum extensively for both strategic and tactical uses, both domestically and abroad.[20] DOD uses wireless communications to control, train, and deploy ground, sea, air, and space-based assets. Wireless systems have become so central to many of DOD's complex systems that without access to spectrum these systems cannot operate and missions cannot be executed. DOD uses radio signals to provide navigation and related services for manned and unmanned units, and numerous wireless systems to support surveillance and reconnaissance activities. In addition, critical military applications, such as unmanned aircraft systems,[21] have resulted in unprecedented increase in demand for spectrum resources. In addition to spectrum for control and command of the unmanned aircraft, data collected by sensors on the aircraft requires spectrum to ensure that the information is securely received on the ground. Military applications

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See http://www.ntia.doc.gov/osmhome/spectrumreform/Spectrum_Progress_Reports_FY2008/Interior_FY08_Progress_Report_Policy_Initiative.pdf.

18 *The Federal Strategic Spectrum Plan* at B-20.

19 *See* NTIA Office of Spectrum Management, *Basic Elements of Spectrum Management: How the Spectrum is Used, available at* http://www.ntia.doc.gov/osmhome/roosa2.html. ("OSM Spectrum Use Overview"). The federal government also uses spectrum for a number of unique applications ranging from time signal transmissions to Voice of America broadcasts. *See id.*

20 *See id.*

21 *The Federal Strategic Spectrum Plan* at B-10.

require that information safely cross wireless networks regardless of environment and arrive within identified timelines.[22] This often requires the use of omni-directional systems, access to very high bandwidth capability on contiguous spectrum for large numbers of forces over a dispersed area,[23] and other technologies or architectures that limit reuse and sharing.

Law Enforcement and Security. Federal law enforcement agencies in DHS and the Justice, Treasury, and Interior Departments use wireless applications to combat domestic terrorism, secure our borders, and fight crime. Federal law enforcement agencies, which include some of the nation's largest wireless users,[24] require spectrum for surveillance technologies, and for strategic and tactical communications. Unlike local police and fire departments, federal law enforcement must be able to operate anywhere in the country using the same technology and frequencies.[25] Essential applications include emergency radio networks to respond to natural and man-made disasters and ensure that lines of government communication remain available even if critical communications infrastructure is disabled or destroyed; radar, ground sensors, and wireless communications systems to help secure the border; airport and seaport security systems; and coordination of the activities of various entities to accomplish these goals.[26]

Transportation. NTIA has determined that national security considerations require standardized aeronautical and maritime navigation and communication systems.[27] Spectrum is

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22 *Id*. at B-20.

23 *Id*. at B-20.

24 The U.S. Coast Guard is one of the largest users of radio spectrum in the United States, supporting its primary missions of border security and drug interdiction in coastal areas and ports.

25 OSM Spectrum Use Overview.

26 Including the U.S. Coast Guard, Transportation Security Administration, U.S. Customs and Border Protection ("CBP"), and U.S. Immigration and Customs Enforcement.

27 NTIA Office of Spectrum Management, *Federal Long-Range Spectrum Plan: National Policy Regarding Use of the Spectrum by Federal Departments and Agencies, available at* http://www.ntia.doc.gov/osmhome/LRSP/LRSP1.htm.

an essential resource in meeting this goal for federal users like the Federal Aviation Administration, which uses spectrum for communications and surveillance. For example, the FAA, in collaboration with other agencies, is working on the NextGen initiative that will transform the national air transportation system to meet future needs. NextGen will move away from legacy ground based technologies to a new and more dynamic satellite based technology. In addition to reducing flight delays, enhancing safety, and improving environmental performance, NextGen will create jobs and stimulate the nation's economy.

Resource Management. A range of government agencies and departments use wireless applications to monitor and manage critical infrastructures and resources. Numerous agencies, including those in the Department of Energy ("DOE"), Department of the Interior, and the Department of Agriculture, use wireless systems to monitor seismic, geothermal, and other environmental conditions, and to coordinate responses where appropriate. For example, federal agencies use radio communications to help assess the spread of forest fires and control the deployment of firefighters. DOE uses numerous wireless systems to manage and control electrical energy transmission, including communicating power control information and issuing commands to electrical power grids and dams.[28] DOE uses spectrum to support monitoring of nuclear facilities, and to coordinate the operations of hazmat teams.[29] Furthermore, one of the line offices of the National Oceanic and Atmospheric Administration ("NOAA") is the National Weather Service which uses both polar-orbiting and geostationary environmental satellite systems operated by the another line office, the National Environmental Satellite Date and

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[28] *See* U.S. Department of Energy, *Spectrum Management Program, Program Overview, available at* http://www.cio.energy.gov/services/spectrum_program.htm.

[29] *See id.*

Information Service ("NESDIS"). These satellites are essential to a wide range of national security tasks, including protection of citizens and their property, military operations, and emergency preparedness. NOAA, NASA, the Departments of Defense, Commerce, State, Agriculture, and at least nine other federal agencies, among others at the federal, state, tribal, and local level, also use satellite and terrestrial facilities to monitor climate change, through programs such as the U.S. Global Change Research Program.

B. Federal Agencies Have Strong Incentives to Constantly Improve Efficiency and Effectiveness.

Federal agencies must respond to this flood of new users and technologies and the related demand for ever more spectrum resources without the near-term hope for new exclusive allocations. This drives federal users constantly to innovate and improve effectiveness and efficiency.[30] NTIA, in recognition of federal spectrum congestion, is currently conducting a review of the use of spectrum by federal agencies to evaluate current needs and future use.[31]

Even as this process proceeds, federal agencies are working to increase efficiency. For example, federal agencies are reducing channel size (narrowbanding), where appropriate, to achieve greater intensity of use.[32] Additionally, the Global Electromagnetic Spectrum Information System ("GEMSIS") is a major initiative by the Department of Defense to promote new spectrum management systems and, where possible, the adoption of significant spectrum reuse and spectrum-efficient technologies.[33] According to the Defense Information Systems Agency of DOD, "GEMSIS will deconflict spectrum use, integrate spectrum operations into net-

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30 *See The Federal Strategic Spectrum Plan.*

31 *Id*. at B-4.

32 *Id*. at B-6.

33 *Id*. at B-20. *See also*, Defense Information Systems Agency, Department of Defense, http://www.disa.mil/dso/gemsis.html.

centric operations . . . [and] increase efficiency of the DOD spectrum use by eliminating inefficient preplanned and static frequency assignment."[34] GEMSIS will also supply "automated tools that reflect spectrum operations in support of operational mission planning and rehearsal, simulation-based acquisitions, and national-level spectrum management."[35]

In an effort to meet this growing demand for spectrum, DOD is working on techniques to address spectrum access challenges by allowing more dynamic, flexible, and autonomous spectrum access. These capabilities will enable wireless devices to dynamically adapt their spectrum access according to criteria such as policy constraints, spectrum availability, propagation environment, and application performance requirements. Assuming success in this innovation, this can result in increased access to spectrum in near-real time between and among federal users, thus improving the utilization of spectrum, including perhaps commercial spectrum. For example, Lockheed Martin is the prime contractor on a DOD satellite system, Mobile User Objective System ("MUOS"), that will implement this type of technology in the UHF band by using radios capable of detecting the presence of other users, and consequently transmitting in a manner that mitigates interference with other uses as well as suppresses the impact of interference from those users.

C. Federal Spectrum Use Leads to the Wireless Innovations that Make Commercial Advances Possible.

As the Commission seeks to spur wireless innovation, Lockheed Martin also suggests that the FCC recognize that federal spectrum use has produced a series of the most important wireless innovations in our nation's history. Federal agencies' investment in spectrum research and application development pioneered many of the innovations that now serve as the foundation

34 *Id.*

35 *Id.*

of the commercial wireless industry, including spread spectrum communications, satellite video and data, RFIDs, and the GPS applications industry.

It is well understood that without access to adequate spectrum resources the federal government will be unable to fulfill critical missions related to safety, security, science, and a range of other government responsibilities. But the Commission should not overlook the fact that reducing federal access to spectrum will also undermine the government's ability to develop next generation technologies, which are the harbingers of innovations that can power the wireless industry of tomorrow. As many commercial entities tighten their belts and reduce research and development budgets, the R&D role of the federal government is becoming even more important.[36]

IV. ACCESS TO SPECTRUM FOR EXPERIMENTAL LICENSEES IS CRITICAL TO INNOVATION.

The Commission should recognize that improving the experimental license process and clarifying coordination regulations for experimental licenses will enhance innovation. Specifically, Lockheed Martin recommends that the Commission improve the experimental license regime by finding that incumbent spectrum holders may only refuse coordination where there is a risk of harmful interference. Furthermore, the Commission should reject the incorrect

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[36] The Commission has noted the challenge of diminishing R&D budgets to the goal of maintaining US innovation leadership. *See, e.g.*, Remarks of Commissioner Michael J. Copps, Practicing Law Institute/Federal Communications Bar Association (Dec. 15, 2006), *available at* http://fjallfoss.fcc.gov/edocs_public/attachmatch/DOC-269009A1.pdf ("[W]ithout innovation and research, there's not much hope that our country can maintain the technology edge that made us the world's greatest power." While it is certainly true that science and technology investment is critical, and Lockheed Martin devotes substantial resources to R&D, we encourage the Commission also to recognize that government innovations have consistently provided the basic research, applied research, and deployment funding that has supported US innovation leadership.

presumption—suggested by one commenter—that harmful interference is inevitable where testing is to be performed in commercial spectrum.[37]

As numerous parties have confirmed, experimental licenses are essential to wireless innovation. Experiments allow companies like Lockheed Martin to develop and test new technologies prior to commercialization. The Commission's experimental licenses and special temporary authority grants ("STAs") have paved the way for significant wireless advances developed by Lockheed Martin, including Satellite on the Move ("SOTM") antenna technologies that facilitate connection from terminals in moving vehicles, encrypted wireless communications using WiMAX technology, and a range of radar technologies.[38] Nor is Lockheed Martin alone in recognizing the importance of experimental licenses to innovation. For example, CTIA notes that "STAs have been successful in facilitating the development of new wireless devices and technologies" and therefore "should be recognized as one of the Commission's primary tools for promoting innovation and investment."[39]

The record reflects broad-based recognition of the value of experimental licensing, forming the basis for support for streamlining the experimental license process. For example, the Telecommunications Industry Association ("TIA") notes that removing license restrictions "to enable experimentation and development with respect to innovative wireless technologies and services," will encourage innovation.[40] Motorola also advocates that the Commission "facilitate innovation by improving its equipment authorization process and its experimental licensing

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37 Comments of AT&T Inc. at 91 (filed Sept. 30, 2009) ("AT&T Comments").

38 Lockheed Comments at 3; *see also* Comments of the Satellite Industry Association at 9-10 (filed Sept. 30, 2009) ("SIA Comments") (describing satellite operators' development of innovative technologies).

39 Comments of CTIA-The Wireless Association at 91 (filed Sept. 30, 2009) ("CTIA Comments").

40 Comments of Telecommunications Industry Association at 5 (filed Sept. 30, 2009) ("TIA Comments").

process."[41] Boeing highlights the precautions taken by experimental licensees, which "often agree to provide contact information, such as a toll free telephone number, that is staffed throughout the testing process," and "use emergency 'cease buzzer' procedures to ensure that any complaints of suspected harmful interference are immediately addressed by stopping testing."[42] Furthermore, Google notes that "interference standards and processes should value any and all spectrum usage unless it is demonstrated to cause a licensee a '*significant* risk of harmful interference.'"[43] While Lockheed Martin notes that "significant" risk of harmful interference is neither a recognized standard of protection nor an appropriate concept for experimental licensing, Google's general argument that harmful interference is key for FCC spectrum policy is apt with regard to experimental licensing.

Yet despite the numerous benefits of experimentation, AT&T has proposed *additional* restrictions on experimental licensing. Specifically, AT&T maintains that "testing should be done only within spectrum that is far from commercial spectrum to avoid harmful interference or in severe circumstances when it is in the public interest."[44] Accordingly, AT&T asks the Commission to forbid experiments using commercial spectrum except in "severe" or "critical" circumstances.[45] This is manifestly not in the public interest.

First, AT&T's suggestion that experiments necessarily cause harmful interference is simply wrong. Indeed, Lockheed Martin itself has operated under experimental licenses and STAs, in many bands using many different technologies over many years. This testing has been

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41 Motorola Comments at 3.

42 Boeing Comments at 10.

43 Google Comments at 20 (emphasis in original).

44 AT&T Comments at 91.

45 *See id.* Note also that AT&T fails to identify who would determine what testing is indeed "severe" or "critical" enough to merit permission to conduct testing in commercial spectrum.

done entirely without harmful interference, in accordance with FCC rules requiring protection for incumbent license holders.[46] Adopting AT&T's recommendation to disallow experimental licenses in commercial spectrum would stifle opportunities for the very innovation that the Commission hopes to further promote.

In addition, the record shows that allowing licensees to withhold consent for coordination based on reasons unrelated to harmful interference has stood in the way of innovation. For example, Boeing was prevented by carriers in some areas from performing necessary High Intensity Radiated Field ("HIRF") testing of new aircraft. Such testing is required before an aircraft is permitted to fly in the National Airspace.[47] In this case, incredibly, licensees refused consent for testing *even though they had not yet built out their wireless networks* where the proposed HIRF testing was to take place. Without a network in place clearly there is no risk of harmful, or any other level of, interference.[48]

Because of the importance of access to spectrum through experimental licenses, Lockheed Martin urges the Commission to state clearly that so long as experimental license holders take necessary precautions to ensure operations do not cause harmful interference, they should be permitted to perform testing and experimentation.

V. CONCLUSION

Lockheed Martin thanks the Commission for its efforts to promote wireless innovation. To achieve this goal, we recommend that the FCC craft a nuanced manner of analyzing spectrum efficiency that follows the CSMAC categorization system and supports the growing needs of federal spectrum users, and clarify its rules to establish that while experiments and testing must

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46 47 C.F.R. § 5.85(c).

47 Boeing Comments at 11.

48 Boeing Comments at 10-11.

not cause harmful interference to incumbent users, incumbents may not refuse to coordinate with experimental licensees, except where there is actual risk of harmful interference.

Respectfully submitted,

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