

**Wireless Innovation Forum's Comments to
the FCC regarding the Further Notice of
Proposed Rulemaking in the Matter of
Amendment of the Commission's Rules with
Regard to Commercial Operations in the
3550-3650 MHz Band**

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Before the
Federal Communications Commission
Washington, D.C. 20554

In the matter of)	
)	
Amendment of the)	
Commission's Rules with)	GN Docket No. 12-354
Regard to Commercial)	
Operations in the 3550 to)	
3650 MHz Band)	

COMMENTS OF THE WIRELESS INNOVATION FORUM ON THE FEDERAL COMMUNICATIONS COMMISSION FURTHER NOTICE OF PROPOSED RULEMAKING SEEKING COMMENT ON AMENDMENT OF THE COMMISSION'S RULES WITH REGARD TO COMMERCIAL OPERATION IN THE 3550-3650 MHZ BAND

The Wireless Innovation Forum (Forum) is a US based international non-profit organization driving technology innovation in commercial, civil, and defense communications around the world. Forum members bring a broad base of experience in Software Defined Radio (SDR), Cognitive Radio (CR) and Dynamic Spectrum Access (DSA) technologies in diverse markets and at all levels of the wireless value chain to address emerging wireless communications requirements through enhanced value, reduced total life cost of ownership, and accelerated deployment of standardized families of products, technologies, and services.

The members of the Forum commend the Commission on adopting the three-tier spectrum sharing framework envisioned in the PCAST report¹ and see no obstacles to the immediate implementation. The Forum applauds the Commission's plan to reassess the proposed Exclusion Zones and provides considerations for the Commission to aid their process. In this response, the Forum summarizes its qualifications for hosting the Multi-Stakeholder

¹“REALIZING THE FULL POTENTIAL OF GOVERNMENT-HELD SPECTRUM TO SPUR ECONOMIC GROWTH”
http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf

Group (MSG) and proposes the structure of the MSG as well as the charter for potential working groups. The Forum further offers summary comments on SAS and Security, with responses to the Commission's specific questions provided as an appendix.

1 Three-Tier Access Model

The Forum commends the FCC for proposing the three-tier structure and believes that a three-tier structure with priority access should be implemented as proposed in the PCAST report². The Forum further believes there are no technical obstacles to the immediate implementation of the three-tier structure.

The Forum supports the proposal to register GAA devices in the Spectrum Access System (SAS). Shared access to this band, and all other bands should be managed via networked databases as this would allow regulations and services to adapt over time and vary by band while protecting incumbent users. In doing so, the Forum believes that spectrum sensing technologies could also play a key role in augmenting these database systems to better enable cooperative, opportunistic access and as such the Forum recommends that advances in these technologies not be discounted in future planning. This could be an area of focus for a multi-stakeholder group for developing, evaluating and commercializing this technology.

2 Considerations for the Reassessment of Geographic Exclusion Zones

The proposed adoption of the NTIA Fast Track Exclusion Zones will limit market access to 40% of the US population. We praise the Commission's plans to reassess the proposed Exclusion Zones and believe that this process will be critical to the Citizen's Band success in

² <http://groups.winnforum.org/d/do/5895>

fostering economic growth and innovation. To aid in this process, we suggest that the Commission's account for the following considerations.

- Secondary devices should accept interference from primary and incumbent devices
- Existing small cell technologies can accept significantly more interference than considered in the NTIA analysis. Innovative wireless technologies will further increase this interference resilience
- SAS dynamic frequency management should protect incumbent and primary users
- Harm Interference thresholds should be favored over formal static exclusion zones

2.1 Secondary devices should accept interference from primary and incumbent devices

We strongly endorse Proposed Rule 96.15, which reflects a basic principle of spectrum sharing that new entrants should accommodate the existing transmissions of incumbent systems. However, the NTIA Fast Track Report Exclusion Zones related to shipborne radars flow from a premise that the small cells should be protected from high power U.S. Navy radar systems.³ Thus, if we incorporate the implications of Rule 96.15 into the reassessment, it is expected that the final Exclusion Zones will be much smaller and designed only to protect against possible interference to the incumbent systems, such as very close proximity to radars and those select grandfathered FSS earth stations.

³ See NTIA, An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, 4200-4220 MHz, and 4380-4400 MHz Bands (rel. October 2010) (Fast Track Report), available at http://www.ntia.doc.gov/files/ntia/publications/fasttrackevaluation_11152010.pdf. "As shown in Figures D-45 through D-55, the FCC would need to implement service rules based on license exclusion zones along the U.S. coastline to protect base stations from high power U.S. Navy radar systems." NTIA 1-7

2.2 Existing small cell technologies can accept significantly more interference than considered in the NTIA analysis. Innovative wireless technologies will further increase this interference resilience

In the event that the Commission revises rule 96.15 so that CBSDs do not have to accept any interference from federal primary users (a position we strongly disagree with), we note that existing technologies and that near-term envisioned wireless innovations enable a wireless system to operate in the presence of much stronger interference power from radar systems than the number used in the NTIA analysis of wireless broadband receivers (-6 dB I/N).⁴

Specifically, the combination of OFDM, FEC, and interleaving allows LTE, WiMAX, WiFi, and other similar systems to easily recover from the burst errors that result from pulses of radar energy that occupy only a short duration of the transmitted frame. Likewise, the small cells envisioned for use in the band will have much smaller cell radii than considered in the NTIA Fast Track analysis - 3.22 km (rural) or 0.64 km (urban)⁵. Several members of the Wireless Innovation Forum (e.g., Google, Virginia Tech, Federated Wireless) have planned filings that will provide data showing that such systems in typical configurations can successfully operate in the presence of interference that is several orders of magnitude stronger than the -6 dB I/N considered in the NTIA Fast Track Report.

Further, the possibility for gains in market share from mitigating possible interference from military radars to the new entrants strongly incentivizes software and equipment makers, like the members of the Wireless Innovation Forum, to develop, market, and deploy interference mitigation technologies. Such technologies include MIMO and null steering antenna arrays,

⁴ Table 4-7 in NTIA.

⁵ Table 4-7 in NTIA

interference cancellation, and a variety of other emerging innovative and cognitive radio technologies.⁶

Instead exclusion zones, when used, should be designed to protect primary systems from interference from secondary systems. In doing so, the FCC would promote technology innovation and gains in spectrum efficiency. Such a principle has been successfully employed in the TV Bands where the reception of the TV broadcasts are protected from interference from secondary transmissions, but secondary devices are given no assurances of protection from the TV broadcasts.

2.3 SAS dynamic frequency management should protect incumbent and primary users.

Even with stationary primary users, due to variations in local propagation conditions, DSA based on sensing working in tandem with a database more efficiently allocates spectrum among new users and existing incumbent systems than DSA where a database only enforces fixed geographic exclusion zones. These geographic exclusion zones will create an enormous area of underutilized spectrum. This principle is especially true when the primary users are dynamic, changing location and actively transmitting at irregular times, such as the case for shipborne or airborne radar systems. Further, this same principle that dynamic methods are more efficient than static methods for interference management of dynamic users is embodied in the Commission's proposed use of a dynamic SAS to manage interference and dynamically assign frequencies among PAL and GAA devices.⁷

Dynamic SAS management would then protect mobile radar systems by rapidly evacuating CBSDs from affected spectrum when mobile radars are present and transmitting. The

⁶ WinnF Quantification Document (however we cite it)

⁷ FNPRM p 12 (paragraph 33)

required information that mobile radar systems are present and transmitting can be accomplished with sensing at least two different ways.

- a) Deploying dedicated sensors in key locations (e.g., along the coast)
- b) Leveraging the proposed CBSD interference reporting requirements

The feasibility of sensing based approaches in combination with databases have previously been demonstrated by Shared Spectrum Company and other members of the Wireless Innovation Forum in other contexts. Similarly, several current Wireless Innovation Forum members (e.g., Federated Wireless, Shared Spectrum Company) have planned separate filings that will provide data showing that the use of sensing in conjunction with a dynamic SAS can successfully protect radar systems without the need for fixed geographic Exclusion Zones.

In sum, fixed geographic exclusion zones for mobile radar systems are very spectrally inefficient compared to only excluding use when and where radars are operational. But dynamic SAS spectrum management informed by sensing technologies can enable PAL and GAA devices to operate all the way to the coast without introducing interference to radar systems.

2.4 Harm Interference thresholds should be favored over static exclusion zones

Repeatedly, throughout the descriptive text and specifically in rule 96.15 FNPRM notes that CBSDs must not cause harmful interference to federal incumbent users. We strongly endorse this position, but note that harmful interference is not defined in the proposed rules in a technical, implementable, sense.

One such implementable technical definition of harmful interference is provided in the NTIA Fast Track Report, which defines -6 dB I/N as the point at which radar operation would be noticeably degraded. A dynamic SAS could ensure that interference at a particular location does not exceed this number or any other number that the Commission in conjunction with the NTIA

might establish by judicious assignment of frequencies and power levels based on CBSD locations and propagation models. Again, several members of the Wireless Innovation Forum (e.g., Federated Wireless, Shared Spectrum Company) have planned filings that will provide data showing that in such a scenario a dynamic SAS can reliably predict the individual and aggregated received interference power levels at a protected installation thereby establishing its feasibility.

In this way, formal exclusion zones are not necessary and greater spectrum efficiencies can be gained. This elimination of formal exclusion zones is also consistent with the principles espoused throughout the FNPRM and the proposed rules to permit different interference levels to higher priority users as long as the levels are mutually agreed upon by the parties and is enforceable by the SAS.⁸

To ensure consistent and predictable implementation of this approach, we propose the creation of a Multi-Stakeholder Group that includes representatives of protected federal users, SAS providers, equipment vendors, and service providers to formalize methods and procedures for implementing spectrum sharing via dynamic SAS management based on Harmful Interference Thresholds to incumbent Federal Users and among the secondary devices. As this approach is already consistent with rules embodied elsewhere in the proposal and will ultimately involve only software upgrades to the SAS with no changes to CBSD equipment or devices, the Commission should not delay the issuing of a Report and Order for this band.

⁸ See 96.17 (2) for mutual agreements between CBSD and FSS, 96.38 (c) for agreed alternate power levels at PAL boundaries, and 96.38 (e) (1) for agreed alternate power levels between PALs.

3 Considerations for the Regulation of Spectrum Access Systems

The following presents the Wireless Innovation Forum's high level comments on the descriptive text and rules of the FNPRM. Specific comments on data retention and accessing SAS data are provided in the Appendix.

3.1 We commend the Commission for adopting the principle of spectrum management via a dynamic SAS

The Wireless Innovation Forum commends the Commission for making the principle of utilizing dynamic Spectrum Access Systems functions central to the management of the interference among Citizen's Band devices and for optimizing spectral usage. This dynamism includes utilizing the SAS to manage ad-hoc interference agreements between GAA and PALs and between CBSDs and FSS systems as well as dynamic frequency and power assignment.

Logically, this principle should also extend to managing the interference that incumbent users experience from CBSD rather than using fixed exclusion zones. A more consistent SAS dynamic spectrum management framework could be realized by having the SAS target standardized Harm Interference Thresholds at the locations of primary users and wherever PAL or other higher priority users merit protection. Similarly, this also includes the ability of the SAS to reconfigure frequency plans of PAL devices as well as GAA devices as long as the bandwidth of the PAL holders is maintained.

This dynamic Harm Interference Threshold approach will result in significant gains in spectrum efficiency, spectrum efficiency, and wireless innovation when compared to using fixed geographic exclusion zones and other static parameters.

3.2 A multi-stakeholder group should finalize the SAS methods and procedures

While the FNPRM generally lays out a good set of principles by which a SAS should be implemented, defining the remaining technical details, protocols, and methods for the band will be best addressed by a technically focused multi-stakeholder group constituted of SAS Administrators, CBSD device manufacturers, network operators, federal users, and government agencies. This group should address the variety of outstanding technical issues such as inter-SAS communication, securing communications and database integrity, CBSD-communication, primary user protection, and GAA access to PAL spectrum.

Unlike in the TV White Space, which was a relatively simple management problem, proper spectrum management of the Citizen's Band is much more complex due to the multiple tiers of secondary users and the dynamic incumbents in this band. Accordingly, the wireless community should be given significant latitude to design the technical protocols and methods. By allowing the remaining standardization to proceed as a technically-focused process instead of a political process, devices will come to market more quickly, and greater innovation will be fostered.

The Commission should establish procedures for certifying that the SAS and CBSDs conform to the procedures and methods defined by the Multi-stakeholder group to ensure consistent and predictable device behavior in the Citizen's Bands.

3.3 The Commission should authorize multiple regional SAS rather than a single national SAS

Paragraph 100 of the FNPRM states that each SAS would provide nationwide service. While this requirement is not listed in the corresponding rule (96.43), we believe that this reflects the intention of the Commission to include nationwide operation as part of the SAS

Administrator authorization process. We request clarification on if nationwide service is a requirement for SAS Administration and further suggest that permitting multiple regional SAS administration will be better suited for fostering innovation, market competition, and spectrum efficiency in the Citizen's Band.

The technical specifications for how multiple regional SAS would synchronize to ensure consistent and reliable operation should be left to definition by a Multi-Stakeholder Group.

3.4 A SAS should accept and spectrum sensing data from CBSD and sensor networks

Spectrum sensing from CBSDs and sensor networks can be used to enable more efficient spectrum sharing, enhance interference management, to facilitate continuing innovation spectrum management and provision policies, and to provide forensic data to validate predictive algorithms. As such, the SAS should support exporting, importing, and retaining spectrum sensing data. The protocol and format for this spectrum sharing data should be developed and maintained through a multi-stakeholder group.

4 Security

The Forum reiterates its recommendation to the FCC focus on the development and application of security policies and standards that enable communication systems and platforms to protect all sensitive information and data⁹.

The Forum believes that systems operating in the band require security measures commensurate with meeting mission goals and deterring identified threats. International and domestic terrorist organizations, especially those supported by rogue nations, have access to resources that can enable damaging and potentially crippling attacks on PAL and GAA systems.

⁹ <http://groups.winnforum.org/d/do/6526>

Possible threats range from overt attacks on the physical components to insider attempts to subvert the operational software controlling the components of the systems. These threats may be present during the design and development, manufacturing or operational phases of a system.

The Wireless Innovation Forum has published a report outlining a process which identifies potential threats and vulnerabilities and leads to the development of security policies at the organizational, system and individual platform level¹⁰. These security policies specify the criteria and measures needed for protection and mitigation of designated threats throughout the entire lifetime of a system and its component elements.

The process includes identification of assets which require protection. These include but are not limited to information, security operating parameters and data, embedded software, hardware components and virtually all infrastructure component including dispatch centers, servers, routers relays, base stations and individual radio platforms. Threat and vulnerability analyses must be tailor for each asset in addition to risk assessments estimating the probability that any given threat/vulnerability may be realized. With this process completed, specific security measures and mitigation methods can be developed which can be applied to the design, manufacture and operation of the system and its various component elements. These security measures, methods and design requirements then form the basis of the various Organizational, System and Platform security policies which govern the lifecycle of design, manufacturing, operation and maintenance and decommissioning of the system and its components.

¹⁰ <http://groups.winnforum.org/d/do/3014>

5 Multi-stakeholder Groups

The Forum commends the Commission for recognizing and supporting the need for engagement with an unbiased industry lead Multi-Stakeholder Group (MSG). The Forum is a Multi-Stakeholder Organization (MSH) and has a long history of establishing and leading MSGs. We welcome an opportunity to support the Committee in this effort. Clearly, it is important that the association supporting these multi-stakeholder groups have an established base of members and partners familiar with spectrum sharing and dynamic spectrum access technologies. In addition, the association should:

- be incorporated and registered with the IRS as a 501(c)6 non-profit "business league", and;
- be organized under the [National Cooperative Research and Production Act of 1993, as amended by the Standards Development Advancement Act of 2004](#) and registered with the US Government as a Standards Development Organization, and;
- have experience in working with the FCC, NTIA and other federal agencies with a history of acting as an honest broker in defining what is possible and where there are issues, and;
- have mature policies and procedures in place including:
 - an intellectual property rights property following industry best practices for establishing rules for managing contributed IP, and;
 - collaboration policies, including work group policies and procedures, project approval and balloting, and;

- have representation by small, medium and large commercial companies, along with government, non-profit and academic institutions each with the same rights and benefits and a single vote for each, and;
- have formal partnership agreements with standards bodies active in advancing wireless communications, including IEEE and ETSI.

The Software Defined Radio Forum Inc., doing business as the Wireless Innovation Forum ("The Forum") fully meets these requirements. The Forum was originally formed in 1996 at the request of the US Air Force Research Lab (AFRL) to act as a Multi-Stakeholder Organization responsible for advancing the market for SDR technologies. Since that time, the Forum's mission has expanded to include advocating for the innovative use of spectrum, and advancing radio technologies that support essential or critical communications worldwide¹¹. The Forum's members comprise government, industry and academic stakeholders from around the world, including five organizations that have already filed separately in these proceedings: Google, Federated Wireless, Motorola Solutions, Shared Spectrum and Spectrum Bridge. The Forum is registered with the Department of Justice Antitrust Division as a Standards Development Organization (SDO), and has proven processes for the consensus development, ballot and release of Reports, Recommendations and Specifications. Unlike similar organizations, these documents are made publicly available on The Forum's website. Downloads from the Forum's document library exceed 100,000 documents per year and these documents

¹¹ http://en.wikipedia.org/wiki/Wireless_Innovation_Forum

have been widely referenced by government organizations that include the FCC, NTIA, the Department of Defense and the Department of Homeland Security^{12 13}.

The Forum has a long history of successfully forming and operating international multi-stakeholder groups and organizations. An example of a multi-stakeholder group is the Forum's "Coordinating Committee on International Software Communications Architecture Standards (CC SCA)" formed in November of 2010. The CC SCA is a Technical Committee of the Wireless Innovation Forum created to oversee the evolution and adoption, at the international level, of SCA standards for the development of software defined radios. The multi-stakeholder working groups operating within the CC SCA committee have created and voted out 10 reports, recommendations and specifications since inception, with an additional 7 documents currently in ballot. This committee has been operating under a charter, with working policy and procedures¹⁴ developed by a Steering Group made up of Forum members that have a special interest in SCA and pay an enhanced membership fee. A best practice established by the CC SCA committee has been the use of a set of Advisors that advise the Steering Group on requirements and needs for SCA users. The Advisors represent a number of international government stakeholders and helps insure an open and productive exchange of concepts and ideas driving the work of the organization¹⁵.

¹² <http://www.gpo.gov/fdsys/pkg/FR-2004-11-22/pdf/FR-2004-11-22.pdf>

¹³ http://groups.winnforum.org/Forum_Work_Products

¹⁴ SCA Charter and Working Policies, <https://sdf.memberclicks.net/assets/documents/cc%20sca%20charter%20v3%200%200%20-%20%2023%20october%202012.pdf>

¹⁵ http://www.wirelessinnovation.org/CC_SCA_Steering_Group

The Forum proposes following a similar format to form a US Regional Committee¹⁶ to be the industry led multi-stakeholder group to develop recommendations for the 3.5 GHz Band and other band opportunities in the US. Members of the US Regional Committee will form the Steering Group that will develop the Committee charter and act as an architectural board, establishing the framework, structure, charter and roadmap of each work groups. Membership in the Steering Group shall be open to any Forum member organization that qualifies as a steering group member as directed by the Advisory group. The US Regional Committee operates within an international organization, the Wireless Innovation Forum, with focused US regional technology interests. An advantage of selecting a multi-stakeholder organization with international ties is the ability to insure national interest benefit from both emerging technology and regulatory approaches being developed by international partners.

The US Regional Committee would be composed of a number of Work Groups and managed by a Steering Group. The Committee will be member driven with general participation in the US Regional Committee open to any member organization as per existing policy.¹⁷ The Forum allows Associate members to participate but not vote or hold leadership position as per policy.¹⁸ As with all working committees of the Forum, the US Regional Committee will report to the Forum Chair.¹⁹ The Forum's Technical Director shall be an ex-officio member of the Committee's Steering Group, and shall represent the US Regional Committee on the Forum's Board of Directors.

¹⁶ The Forum created a Regional Committee Policy that leverages the successful structure of the CC SCA. <https://sdf.memberclicks.net/assets/documents/poli-winnf%20regional%20committee%20policy%20-%2010%20feb%202014.pdf>

¹⁷ Forum Policy 004

¹⁸ Ibid ?, page ?

¹⁹ Sections 8.3 and 7;.7.2 of the Forum's Bylaws as amended on 3 December 2009

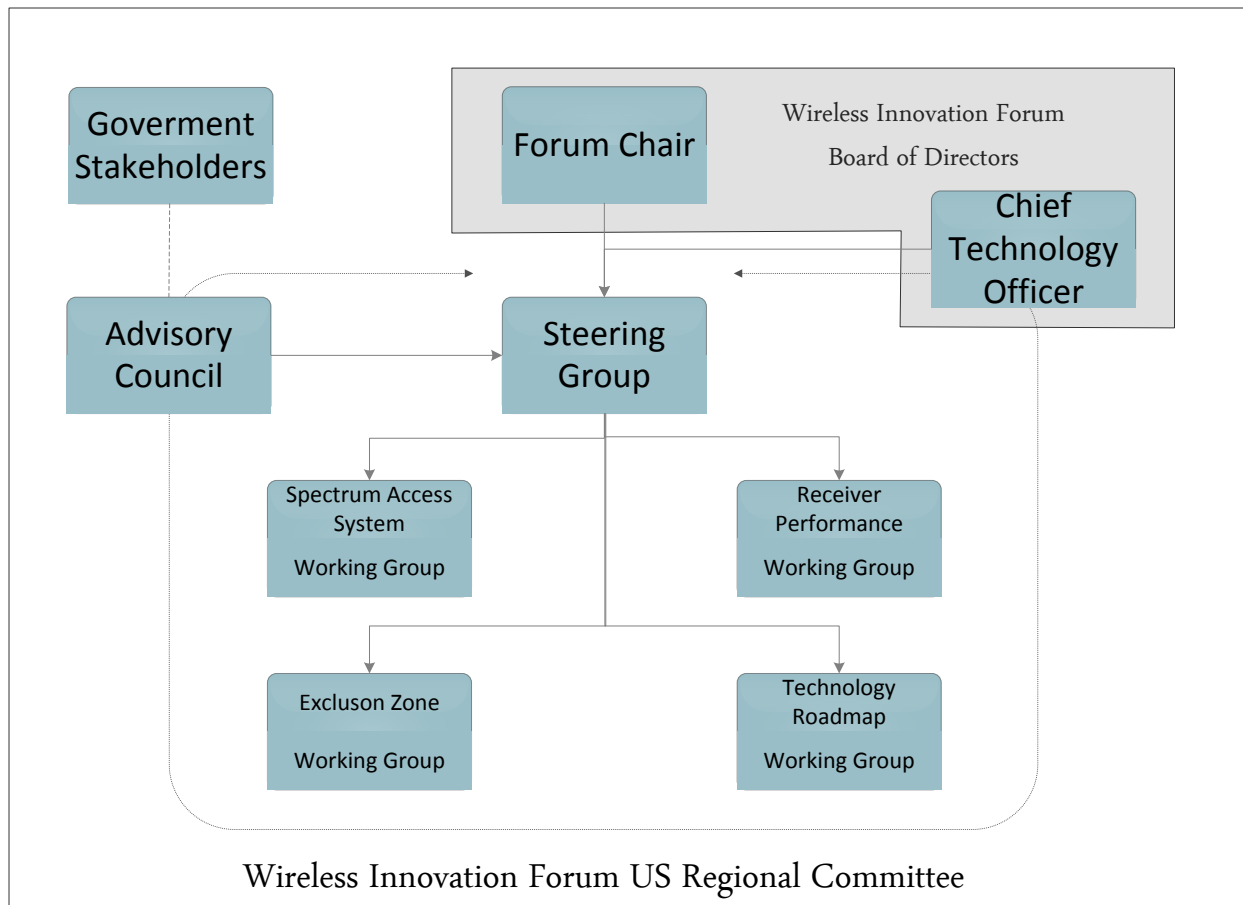


Figure 1: Proposed US Regional Committee Reporting Structure

The Forum recommends Government Stakeholders act as advisors to the US Regional Committee. Advisors will meet with representatives of the Steering Group in an advisory council to provide their expert opinion on committee direction and the activities of the various working groups^{20 21}. A number of important issues raised in the FNPRM, should be used to structure a set of industry multi-stakeholder groups, under the management of a multi-stakeholder organization (MSH).

²⁰ The Forum follows current best practices in working with advisors. Advisors participate in Forum’s advisory groups as individual “experts”, not as formal representatives of their employer or stakeholder affiliate. Interactions with Advisors occur without attribution to any individual Advisor wherever possible, and the appropriate confidentiality of the discussions will be preserved.

²¹ http://www.wirelessinnovation.org/assets/documents/poli-Regulatory_Advisory_Committee_Charter.pdf

The Wireless Innovation Forum is an ideal MSH to host MSGs of the US Regional Committee illustrated in Figure-1. The Forum is a technical organization that focuses on innovations based on hard science and technology, and therefore is an honest broker in providing innovation solutions for complex problems such as those addressed in the FNPRM. The Forum provides its members and the industry as a whole, an understanding of the technical foundations of advance communications architectures and seeks to identify opportunities for rapid innovation based on real science.

The Forum anticipates formation of four multi-stakeholder Working Groups (WGs) as shown in Figure one. These working groups directly address the science and technology that form the foundation of most of the difficult regulatory issues raised by the Commission in the FNPRM. These MSGs are listed below:

1. Receiver Performance Working Group (RP-WG)

In 2013, the Forum formed a Receiver Performance Working Group that is actively working on development of Harm Interference Thresholds (HITs) based on the physics of waveform propagation characteristics, receiver architectures, narrowband and wideband interference models (see Figure 2). There is an important distinction between harm interference thresholds and harm claim thresholds. Harm interface thresholds are base on actual physics and measurement of behaviour. Harm claim thresholds are based on regulatory decisions to provide guidance to the industry to avoid claim, and will often include regulatory margin to provide guidance to avoid clams in operational deployments. Harm interference thresholds are based on science and technology and harm claims are based on practical regulatory policy.

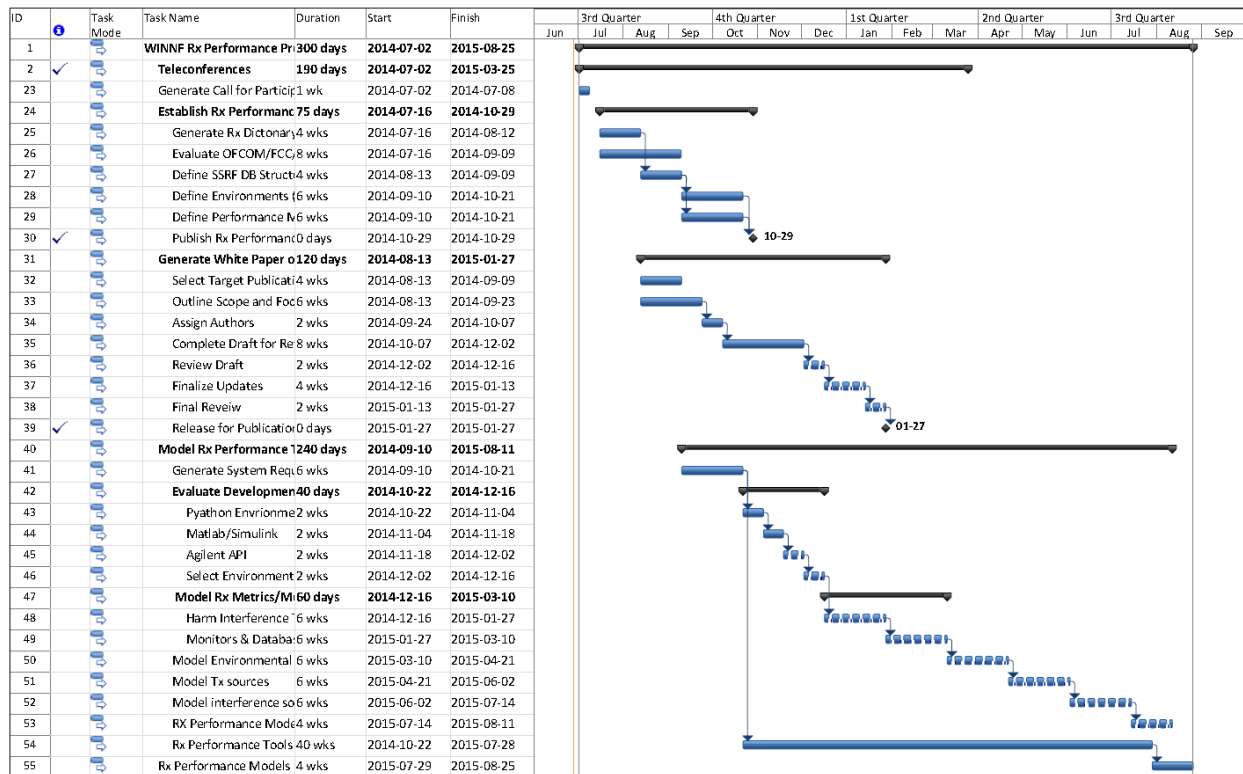


Figure 2: Project Plan for the Forum's Receiver Performance Guidelines Work Group

2. Spectrum Access System (SAS) Working Group (SAS-WG)

Development of an industry based SAS working group in the Forum will provide a venue for both industry and the academic intuitions to collaborate on the actual operational requirements for successful SAS operation. Similar in scope to the current CC-SCA, a SAS-WG will provide a venue for technical requirements development for SAS operation in real world environments. Many existing Forum members are providing detailed technical descriptions of proposed SAS operation (Federated Wireless, Google, Motorola Solutions, Shared Spectrum Company, Spectrum Bridge), which is an excellent foundation for a multi-stakeholder refine proposal for consideration by the Committee. In addition to database operation and control system design, security is a critical issue to be addressed by the SAS-WG.

3. Exclusion Zone (EZ) Working Group (EZ-WG)

Clearly the use of EZs is controversial, but the Forum believes the diverse issues raised by incumbent stakeholders in support of large EZs and prospective CBSD suppliers desiring elimination of EZs entirely should be evaluated on the merits of existing and near-term science and technology rather than historic market protections. An EZ Working Group will provide a venue for development and evaluation of models architectures to provide Government Stakeholders a solid foundation for regulator policy.

4. Technology Roadmap (TR) Working Group (TR-WG)

A clear goal of PCAST is establishment of an approach to spectrum sharing based on sound science and technology, as well as promote continued innovation in development of technology and to provide better spectrum utilization of all for the benefit of end user as a key driver in the economic future of the United States. The Commission has embraced this concept by designation of commercial operations of the 3550 - 3650 MHz band as an “innovation zone”. As technology evolves continued improvements in CBSDs design and new technology for incumbent user will allow tighten of regulatory policy over time. A Technology Roadmap Working Group will provide a venue to address innovations needed to support the PCAST vision for encouraging innovation and the Commissions vision for this band as an “Innovation Zone”.

In the same way a regulatory roadmap for development of efficient Corporate Average Fuel Economy (CAFÉ) standards for cars resulted in significant innovations that provide real tangible benefits to the public in many key aspects of our lives, similar standards for spectrum sharing will also provide real tangible benefits for the public. One of the most downloaded documents of the Forum is the “10 Most Wanted Wireless Innovations”. The TR-WG should develop the roadmap for the “10 Most Wanted Spectrum Sharing Innovations”, and provide the Commission a roadmap on when these innovations will available to support a Regulatory Policy Roadmap.

We reiterate our position that the eventual R&O should provide, as a minimum, a process for multi-stakeholder, industry formed groups to propose spectrum sharing standards and criteria to the Government, and that the Government be obligated to act on them in good faith within a stated, and limited time period, consistent with the principles of the Presidential Memorandum of June 14, 2013.

Such a process would entail:

1. Accepting and evaluating specific spectrum sharing criteria and engineering standards
2. Performing evaluations consistent with the transparency and spectrum sharing principles established by the Presidential Memorandum of June 14, 2013
3. Provide support to multi-stakeholder groups and other industry organizations in understanding the sharing constraints of incumbent Federal systems, in accordance with the principles of the Presidential Memorandum of June 14, 2013
4. Establishing a fixed timetable for these evaluations
5. Ensure that these evaluations are transparent (to the maximum extent possible consistent with National Security) and any adverse options are consistent with the principles of the Presidential Memorandum of June 14, 2013
6. Permit proposals beyond the initial spectrum opportunities provided in the eventual CBS R&O so that spectrum sharing can be established more broadly, consistent with the principles of the CBS R&O

With these principles in place, the Wireless Innovation Forum can commit to establishing such a multi-stakeholder process to develop these recommendations.

6 Summary

The Forum sees no obstacles to the immediate implementation of the three-tier spectrum sharing structure with priority access and applauds the Commission on adopting this framework envisioned in the PCAST report. The Forum believes the adoption of the NTIA Fast Track Exclusion Zones will limit market access of the Citizen's Band to 40% of the population. We commend the Commission's plan to reassess the proposed exclusion zones and offered four considerations to take into account in their assessment.

The Forum has a long history of establishing and leading successful Multi-Stakeholders groups composed of commercial and defense equipment vendors, database providers, network operators, academia and government agencies. In this response, we have proposed the creation of a US Regional Committee within the Wireless Innovation Forum to be the industry led multi-stakeholder group to develop recommendations for the 3.5GHz Band and other band opportunities in the US. We further proposed the organization structure which included a Steering Group and Advisory Committee, as well as charters for four potential working groups. We welcome the opportunity to work with the Commission on the creation of the multi-stakeholder group.

Respectfully submitted,

Bruce Oberlies
President and Chair
Wireless Innovation Forum

Dated: 10 July 2014

Appendix 1: Wireless Innovation Forum Responses to GN Docket 12-354

The following provides paragraph by paragraph responses to the Further NPRM and the proposed rules. On paragraphs not included in the table, the Forum has no comments.

¶	FNPRM Text	WinnForum Response
	I Introduction	
1	We are in the midst of a communications revolution that has connected us to each other as never before through an ever-increasing number of wireless devices. As a result of the continuing proliferation of connected devices, demand for wireless broadband capacity is growing rapidly. New, more efficient wireless network architectures and innovative approaches to spectrum management are tools that can help maximize the utility of existing spectrum resources and make new spectrum bands available for broadband access. As we previously discussed, our proposals for the 3550-3650 MHz band (3.5 GHz Band) focus on two components of the Commission’s ongoing efforts to address wireless coverage and capacity issues: small cells and spectrum sharing—both of which were addressed in a report issued by the President’s Council of Advisors on Science and Technology (PCAST).	The Wireless Innovation Forum agrees with the Commission and commends them on adopting the PCAST vision.
2	With this Further Notice of Proposed Rulemaking (FNPRM or Further Notice), we propose specific rules for a new Citizens Broadband Radio Service in the 3.5 GHz Band that would make the 3.5 GHz sharing regime originally described by PCAST a reality. The 3.5 GHz Band could be an “innovation band,” where we can explore new methods of spectrum sharing and promote a diverse array of network technologies, with a focus on relatively low-powered applications. If successful, the spectrum-sharing model proposed for this band could ultimately be expanded to other spectrum bands and “transform the availability of a precious national resource —spectrum—from scarcity to abundance.	The Wireless Innovation Forum commends the Commission on their vision for an Innovation Band.
3	The proposed rules set forth herein build upon the record developed in response to a series of prior proposals and workshops over the past sixteen months. These detailed proposals will allow for more focused comment prior to establishing rules governing the proposed Citizens Broadband Radio Service in a new Part 96 of the Commission’s rules.[1] Specifically, the proposed rules would implement an innovative and comprehensive framework to authorize a variety of small cell and other broadband uses of the 3.5 GHz Band on a shared basis with incumbent federal and non-federal users of the band, with oversight and enforcement through a Spectrum	The members of the Wireless Innovation Forum agree that spectrum sharing in this band should be managed through an SAS. The members of the Forum caution the commission on the use of the word “enforcement”. It has legal connotations that may not be intended here.

¶	FNPRM Text	WinnForum Response
	<p>Access System (SAS). The proposed rules reflect our belief that the 3.5 GHz Band could be an ideal “innovation band,” well suited to exploring the next generation of shared spectrum technologies, to drive greater productivity and efficiency in spectrum use.</p>	
5	<p>As set forth in more detail below, we propose to establish a three-tiered authorization framework – Incumbent Access, Priority Access, and General Authorized Access (GAA) tiers - based on the recommendations of PCAST and originally proposed in the NPRM. [1] Under this framework, existing primary operations – including authorized federal users and grandfathered Fixed Satellite Service (FSS) earth stations - would compose the Incumbent Access tier and would receive protection from harmful interference from Citizens Broadband Radio Service users. At this time, we propose to establish geographic Exclusion Zones based on the models suggested in the National Telecommunications and Information Administration’s (NTIA) Fast Track Report to protect federal Incumbent Access tier operations. We plan to work with NTIA in coming months to reassess these Exclusion Zones in light of new technologies envisioned in this FNPRM and new data from technical studies evaluating the coexistence of radars and wireless broadband services. If there are further developments that would enable a reduction in the size of the Exclusion Zones, we encourage participants to file in the record to ensure that there is sufficient opportunity for public comment prior to issuance of a Report and Order in this proceeding.</p>	<p>The members of the Forum respectfully disagree with the use of the exclusions zones defined by NTIA in the fast track report for protection of incumbent users. These zones were defined using WiMAX macrocells as a baseline. These macrocells operate at much higher power than the small cells envisioned for use in the innovation band and are therefore not relevant to these proceedings. A reassessment is therefore required before moving forward.</p> <p>The members of the Wireless Innovation Forum caution the commission on the use of exclusion zones for protecting secondary users. The use of such zones would be contrary to the PCAST vision, and instead the Forum’s members believe that management of such users should be delegated to the SAS.</p>
6	<p>Interference management with respect to the three-tiers of service, including adherence to designated Exclusion Zones, would be managed by a dynamic SAS, conceptually similar to, but more advanced than the databases used to manage Television White Spaces (TVWS) devices. Consistent with the Revised Framework, we propose to define each Priority Access License (PAL) as an authorization to use for one-year a 10-megahertz channel in a single census tract. PALs would be open to any prospective licensee that meets basic FCC qualifications and mutually exclusive applications for PALs would be subject to competitive bidding. PAL channels would be dynamically coordinated by the SAS and the exact spectral location of a given PAL authorization could shift from time to time as directed by the SAS during its license term.[1] The GAA tier would be licensed-by-rule to permit open, flexible access to the band to the widest possible group of potential users. We propose to reserve at all times for GAA use, a minimum of 50 percent of the band that is not encumbered by Incumbent Access tier users in any given location</p>	<p>The members of the Forum believe that defining such exclusion zones for secondary users as proposed eliminates the need for a SAS. Under the model presented, a single priority access user operating within a census tract would in essence capture the entire geographic region. The preferred model is to delegate management to the SAS without defining exclusion zones for secondary users.</p> <p>The members of the Forum concur with the Commission on assigning a large minimum percentage of the spectrum for GAA use. The Forum has no position on what the appropriate percentage should be.</p>

¶	FNPRM Text	WinnForum Response
7	<p>We propose baseline technical standards for the operation of Citizens Broadband Radio Service Devices (CBSDs) and End User Devices in the 3.5 GHz Band as well as general rules for the operation of the SAS and approval of SAS Administrators. Many of these concepts were originally raised in the <i>NPRM</i> and <i>Licensing PN</i>. We also seek further comment on other important issues raised in this proceeding, including: (1) protection criteria for Incumbent Users; (2) potential protection of FSS earth stations in the 3700-4200 MHz band (C-Band); (3) competitive bidding procedures for resolving mutually exclusive applications for PALs; and (4) the possible extension of the proposed rules to include the 3650-3700 MHz band. Some of these issues, particularly those dealing with protection criteria for Incumbent Access tier users, may require additional focused input from government and private industry stakeholders.</p>	<p>The members with the Forum concur the Commission’s vision to extend the band to include 3650 to 3700 MHz.</p>
	<p>II Background</p>	
9	<p>The Fast Track Report first identified the 3.5 GHz Band as potentially suitable for commercial broadband use.^[1] NTIA recommended that this band could be made available for commercial wireless broadband by 2015 based on the conditions outlined in the Fast Track Report.^[2] NTIA’s recommendation included significant geographic restrictions to protect existing Department of Defense (DoD) radar and FSS operations and to protect new commercial systems from co-channel interference from high-powered military in-band shipborne and adjacent band DoD ground-based radar systems.^[3] The radar systems that operate in the 3.5 GHz Band overcome the inherent propagation limitations of this frequency range by employing high transmitter power levels and high-gain antennas.^[4] These characteristics of the radar systems were a contributing factor to the size of the exclusion zones in the Fast Track evaluation.</p>	<p>The members of the Forum reiterate their concern on utilizing the exclusions zones defined by NTIA in the fast track report for protection of incumbent users. These zones were defined using WiMAX macrocells as a baseline. These macrocells operate at much higher power than the small cells envisioned for use in the innovation band and are therefore not relevant to these proceedings. A reassessment is therefore required before moving forward.</p>

¶	FNPRM Text	WinnForum Response
10	<p>In July 2012, PCAST recommended that the Federal Government identify 1,000 megahertz of federal spectrum for shared use to create “the first shared use spectrum superhighways.”^[1] PCAST recommends that shared spectrum be organized into three-tiers. To ensure interference protection, all users would be required to register in a database modeled on the TVWS database.^[2] The first tier would consist of incumbent federal users.^[3] These users would be entitled to full protection for their operations within their deployed areas, consistent with the terms of their assignments.^[4] The second tier would consist of users that would receive short-term priority authorizations to operate within designated geographic areas.^[5] Secondary users would receive protection from interference from third tier users but would be required to avoid interference with and accept interference from Federal Primary users.^[6] Third tier users (GAA) would be entitled to use the spectrum on an opportunistic basis and would not be entitled to interference protection. PCAST recommends that the Commission, in conjunction with NTIA, work expeditiously to implement its recommendations in the 3.5 GHz Band.</p>	<p>The members of the Wireless Innovation Forum concur with the Commission on the use of a three-tier model as defined in the PCAST report.</p>
11	<p>The Commission’s December 2012 <i>NPRM</i> proposed a three-tier, license-by-rule authorization framework, based on concepts described in the PCAST Report that are intended to facilitate rapid broadband deployment while protecting existing incumbent users of the 3.5 GHz Band.^[1] The <i>NPRM</i> solicited comment on all aspects of this proposal, including the appropriate licensing framework and the potential uses of each service tier. The Commission received extensive comment from a wide range of stakeholders in response.^[2] The <i>NPRM</i> also included a supplemental proposal to expand the proposed licensing and authorization model to an additional adjacent 50 megahertz of spectrum in the 3650-3700 MHz band, making up to 150 megahertz available for shared wireless broadband access</p>	<p>Again, the members of the Forum reaffirm their support for the three-tier model and believe that there are no technical obstacles to immediate implementation.</p>

¶	FNPRM Text	WinnForum Response
12	<p>As we noted in the <i>NPRM</i>, the technical characteristics of the 3.5 GHz Band and the existence of important incumbent operations in the band in many areas of the country contribute to make the band an ideal platform to explore innovative approaches to shared spectrum use and small cell technology.^[1] NTIA’s Fast Track Report recommended, based on technical assumptions typical of traditional macrocell deployments of commercial wireless broadband technology, that new commercial uses of the band occur outside of large “exclusion zones” to protect Federal government operations.^[2] Given that the exclusion zones would cover approximately 60 percent of the U.S. population^[3] and because of limited signal propagation in the band, the band did not appear to be well-suited for macrocell deployment. However, as noted in the <i>NPRM</i>, these very disadvantages could be turned into advantages if the band were used to explore spectrum sharing and small cell innovation.^[4] This proposal was based on recommendations put forth by the FCC’s Technology Advisory Council (TAC), which has advocated for the increased use of small cell devices in spectrum constrained areas and supported dedicating a spectrum band to small cell uses.^[5] The combination of small cells and spectrum sharing technologies could vastly increase the usability of the 3.5 GHz Band for wireless broadband and serve as a model for future coexistence among services in other spectrum bands.</p>	<p>The members of the Wireless Innovation Forum again reiterate our opposition to the use of exclusion zones for the protection of secondary users and again encourage the Commission to delegate management of such users to the SAS.</p>
13	<p>In November 2013, in response to record comments received up to that point, we released the <i>Licensing PN</i>, which described a Revised Framework that elaborated upon some of the licensing concepts and alternatives set forth in the <i>NPRM</i>.^[1] The Revised Framework retains the three-tier model proposed in the <i>NPRM</i> but expands eligibility to apply for PALs, and explores innovative means of assigning authorizations within that tier.^[2] Like the <i>NPRM</i>’s main proposal, the Revised Framework would leverage the unique capabilities of small cell and SAS technologies to enable sharing among users in the Priority Access and GAA tiers. Specifically, the Revised Framework contains the following core concepts</p>	<p>The members of the Wireless Innovation Forum commend the Commission on this approach and feel that it provides a proper framework for supporting continuing innovation. Expiration of PAL licenses as defined is a critical element of this framework, providing a mechanism for the introduction of new innovative uses of spectrum within recognized commercial time frames.</p>
	<p>An SAS to dynamically manage frequency assignments and automatically enforce access to the Priority Access and GAA tiers</p>	<p>The members of the Wireless Innovation Forum concur with this statement and believe that the SAS should be used in lieu of geographic exclusion. Again, the members of the Forum caution the commission on the use of the word “enforce”.</p>
	<p>Granular, but administratively-streamlined licensing of the Priority Access tier</p>	<p>The members of the Wireless Innovation Forum agree.</p>
	<p>Exclusive spectrum rights for Priority Access subject to licensing by auction in the event of mutually exclusive applications</p>	<p>The members of the Wireless Innovation Forum agree.</p>
	<p>A defined “floor” of GAA spectrum availability, to ensure that GAA access is available nationwide (subject</p>	<p>The members of the Wireless Innovation Forum agree.</p>

¶	FNPRM Text	WinnForum Response
	to Incumbent Access tier use);	
	Additional GAA access to unused Priority Access bandwidth, as identified and managed by the SAS, to maximize dynamic use of the unutilized portion of the band and ensure productive use of the spectrum	The members of the Wireless Innovation Forum agree.
	Opportunities for Contained Access Users to obtain targeted priority spectrum use within specific facilities (such as buildings) that meet certain requirements to mitigate the potential for interference to and from Incumbent Users and other Citizens Broadband Radio Service users; and	The members of the Wireless Innovation Forum Support the concept of contained access users.
	A set of baseline technical standards to prevent harmful interference and ensure productive use of the spectrum	The members of the Wireless Innovation Forum support the use of harm interference and prefer the use of harm interference thresholds as a technology too supporting spectrum management versus harm claim thresholds as the idea of “claim” has legal connotations which are not helpful in this proceeding.
	III Discussion	
17	With this FNPRM, we seek comment on proposed rules for the Citizens Broadband Radio Service.[1] These proposed rules build upon the concepts and proposals set forth in the NPRM and the Licensing PN, in light of the record created in this proceeding. Notably, the proposed rules would:	
	Implement the three-tier model proposed in the <i>NPRM</i> ;	The members of the Wireless Innovation Forum agree.
	Establish Exclusion Zones to ensure compatibility between incumbent federal operations and Citizens Broadband Radio Service users;	The members of the Wireless Innovation Forum agree.
	Establish granular, exclusive spectrum rights for the Priority Access tier, consistent with parameters discussed in the <i>Licensing PN</i> ;	The members of the Wireless Innovation Forum agree.
	Set a defined “floor” for GAA spectrum availability, to ensure that GAA access is available nationwide (subject to Incumbent Access tier use);	The members of the Wireless Innovation Forum agree.
	Set guidelines to allow Contained Access Users to request up to 20 megahertz of reserved frequencies from the GAA pool for use within their facilities;	The members of the Wireless Innovation Forum agree.
	Set guidelines for the operation and certification of SASs in the band	The members of the Wireless Innovation Forum find the language of the NPRM was acceptable. The belief of the Forum’s members is that further details should be defined by industry operating in cooperation through a multi-stakeholder group.
	A. Proposed Regulatory Framework	
	1. Proposed Paert 96 Rule Part	
	a. Subpart A - General Rules	
	i. Scope (_96.1)	

¶	FNPRM Text	WinnForum Response
19	<p>We propose to implement the three-tier authorization framework originally described in the <i>NPRM</i> and further discussed in the <i>Licensing PN</i>.^[1] This proposal is consistent with the framework for the 3.5 GHz Band originally described in the PCAST Report.^[2] Under this framework, existing primary operations – including authorized federal users and grandfathered FSS earth stations - would make up the Incumbent Access tier and would receive protection from harmful interference consistent with the proposed rules.^[3] The Citizens Broadband Radio Service would be divided into Priority Access and GAA tiers of service, each of which would be required to operate on a non-interference basis with the Incumbent Access tier.^[4] We also propose that any party that meets basic eligibility requirements under the Communications Act be eligible to hold a PAL or, when authorized, operate a CBSD on a GAA basis in the Citizens Broadband Radio Service</p>	<p>The members of the Wireless Innovation Forum concur with the Commission on all points as the propose model is consistent with the vision expressed in the PCAST report.</p>
20	<p>The proposed three-tier framework enjoys significant support from a diverse group of commenters, including AT&T, Google, Public Knowledge, and the Open Technology Institute at the New America Foundation.[1] Others, including CTIA – The Wireless Association (CTIA), NSN, and Qualcomm have argued that a two-tier framework that would prohibit or segregate GAA users would be a more efficient way to manage the 3.5 GHz Band</p>	<p>The members of the Wireless Innovation Forum support the three-tier model as defined in the PCAST report. Our members do not support a framework limited to two-tiers as the proposed GAA tier is a critical element in enabling continuing innovation. Our members believe that the most efficient use of the band, and the greatest economic value can be achieved by allowing GAA users to access all unutilized spectrum, and that such access should be managed by the SAS.</p>
21	<p>Some commenters, including some who have also expressed support for the three-tiered model, argue that the 3.5 GHz Band should be divided between two and three-tiered authorization schemes, at least on a transitional basis.^[1] Under this concept, as originally described by Verizon Communications Inc. and Verizon Wireless Inc. (Verizon), a portion of the band would be set aside for a “transitional framework” sub-band which would be licensed on a more traditional, exclusive-use basis and would not include GAA users.^[2] The remainder of the band could be split between GAA-only use and the proposed three-tiered sharing framework. The “transitional framework” sub-band could then be phased out after the three-tier framework is proven to be workable in practice</p>	<p>The members of the Wireless Innovation Forum support the three-tier model as defined in the PCAST report. Other models proposed will complicate management of the spectrum and limit investment and the potential for innovation. The members of the Forum do not see any reason not to move immediately to the three-tier model as proposed as there is no technological impediment to full implementation.</p>
22	<p>The specific Part 96 rules we propose today would apply the three-tier authorization model across the entire 3.5 GHz Band, based, at least in part, on concerns about the impact that Balkanization of this spectrum may have in terms of limiting the development of a robust and varied shared spectrum ecosystem in the band. We seek comment on the proposed section 96.1 and encourage commenters to consider the costs and benefits of any alternate proposals that they may put forward in light of</p>	<p>The members of the Wireless Innovation Forum believe that the rules should be technology neutral and should impose unnecessary restrictions on band utilization. Instead, the members of the Forum believe that this should be managed by the SAS.</p>

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	the recommendations of PCAST and the Commission's goals for this band.	
	(v) Regulatory Status (96.9)	
26	We propose to allow Citizens Broadband Radio Service users to select whether to provide service on a common carrier or non-common carrier basis, regardless of whether they operate in the Priority Access tier, GAA tier, or both. Users that choose to offer services on a common carrier basis would be required to comply with all of the Commission's rules applicable to common carriers. This is consistent with our approach in other licensed services.[1] We seek comment on this proposal. Specifically, should GAA users be permitted to provide common carrier services? Could the SAS effectively coordinate and enforce these individual service selections, subject to appropriate Commission oversight?	The members of the Wireless Innovation Forum support the use of the SAS as a more dynamic system of spectrum management than just relying on exclusion zones. The members of the Forum believe that if the commission is comfortable that the SAS can protect PAL users from other secondary users, then it should be able to use the SAS to protect incumbent users from these same secondary users, and so the use of exclusion zones is inconsistent.
	(vii) Frequency Assignments (96.13)	
28	Consistent with the concepts set forth in the <i>Licensing PN</i> , we propose to adopt rules governing frequency assignments that would balance the needs of Priority Access Licensees and GAA users. To foster a robust GAA ecosystem, a meaningful amount of the 3.5 GHz Band must be reserved for GAA use in any given geographic area. To that end, we propose to reserve for GAA use a minimum of 50 percent of the 3.5 GHz Band in any given census tract – after accounting for any frequencies reserved for Incumbent Access tier use in the area - with the remainder to be assigned as PALs. We do not propose to assign GAA users and Priority Access Licensees to fixed spectral locations (e.g., GAA from 3550-3600 MHz and Priority Access from 3600-3650 MHz). Rather, under our proposal, the SAS would dynamically assign PAL channels and GAA bandwidth in real time to promote efficient spectrum use.	The members of the Wireless Innovation Forum support establishing a large minimum percentage of the band for GAA, but have no comment on the specific percentage. The members of the Forum concur with not assigning fixed frequencies, and instead allowing the SAS to make the assignments dynamic to maximize use of band.
29	Under this proposal, PALs would be assigned in 10 megahertz channels, consistent with the processes described in section III(A)(1)(c) below, but we do not propose to establish a fixed channel size for GAA users. Rather, GAA users would be permitted to operate on a range of frequencies within the GAA pool, as determined by the SAS. In addition, in areas in which bandwidth has not yet been assigned to PALs or where assigned bandwidth is not in actual use by Priority Access Licensees, such bandwidth would be made available for additional GAA operations on an opportunistic basis. The SAS would coordinate Priority Access and GAA operations consistent with its responsibilities under the proposed rules.[1]	The members of the Wireless Innovation Forum respectfully disagree with this model. Logically, if you allocate PALs by census block AND you make the protection at the boundary of the block THEN you negate your model for GAA use as even a single PAL in a census block would take the entire block. This is inconsistent with the PCAST approach of protecting PAs as it establishes geographic exclusivity. The members of the Forum propose instead that this should be managed by the SAS.

¶	FNPRM Text	WinnForum Response
31	<p>We seek comment on whether the proposed rule appropriately balances public interest considerations raised by commenters on this matter. Does the proposed 50 percent floor for GAA bandwidth provide sufficient spectrum to foster a robust user ecosystem while ensuring that enough spectrum is made available for multiple Priority Access Licensees? We seek comment on the proposed rule, including any costs and benefits of the proposed approach. We also seek comment on alternative approaches to the apportioning of available spectrum between the PAL and GAA tiers</p>	<p>Certainty is important to developing a market, so having a well-defined floor is in everyone's best interest</p>
32	<p>Dynamic Frequency Assignment. Commenters differed as to whether frequency assignments should be fixed or dynamically assigned by the SAS. Notably, Google and WISPA supported dynamic assignment of Priority Access and GAA frequencies and argued that the SAS would be able to efficiently and dynamically assign frequencies to appropriate parties.[1] Commenters including AT&T, T-Mobile, CTIA, and Ericsson argued for designated, fixed channel assignments, claiming that dynamic frequency assignments would interfere with network planning and channel aggregation</p>	<p>The members of the Wireless Innovation Forum agree.</p>
33	<p>Under our proposal, in place of fixed channel assignments, the SAS would dynamically assign bandwidth within given geographic areas to Priority Access Licensees and GAA users in accordance with the procedures set forth in the proposed rules.[1] The SAS would ensure that Priority Access Licensees have access to allotted 10 megahertz channels and that GAA users are provided access to at least 50 percent of the band. However, the exact spectral location of any given authorization, whether Priority Access or GAA, would not be fixed. For example, a licensee might have Priority Access rights for a single PAL, but the specific channel location assigned to that user would be managed by the SAS and could be reassigned from time to time (e.g., from 3550-3560 MHz to 3630-3640 MHz). Individual GAA users would be assigned available bandwidth of a size and spectral location determined by the SAS (e.g., from 3550-3556 MHz or 3662-3673 MHz). The SAS would assign and maintain appropriate frequency assignments and ensure that lower tier users do not interfere with higher tier users. To the extent that some level of regional or national consistency of assignment facilitates the provision of service, SAS providers would be free to agree upon a common assignment convention. However, such a convention would not be specified in the rules, in order to allow the greatest degree of operational flexibility</p>	<p>The members of the Wireless Innovation Forum support moving from fixed frequencies to dynamic assignment, to be managed by the SAS.</p>

¶	FNPRM Text	WinnForum Response
34	We seek comment on the proposed rule, including the capabilities that the SAS would have to incorporate to manage operations in the band consistent with this proposal.[1] Alternately, should we adopt a more traditional model with static frequency assignments for GAA users and Priority Access Licensees? What advantages and disadvantages would a fixed channel assignment model provide as compared to the dynamic system set forth in the proposed rules?	The members of the Wireless Innovation Forum support moving from fixed frequencies to dynamic assignment, managed by the SAS.
35	We also seek comment on our proposal to allow the SAS to assign a flexible amount of bandwidth to individual GAA users. Should GAA users instead be assigned a consistent amount of bandwidth (e.g., 10 megahertz) like Priority Access Licensees? What would be the costs and benefits of such an approach?	The members of the Wireless Innovation Forum support allowing dynamic bandwidth assignments, managed by the SAS.
36	<i>GAA Access to Unused Priority Access Channels.</i> The Revised Framework discussed allowing GAA users to access unused Priority Access channels on an opportunistic basis. AT&T and T-Mobile supported the concept of allowing GAA users to make use of unused Priority Access tier channels so long as use was limited to unassigned and undeployed channels. Under their proposal, a channel would be unavailable for GAA once it is assigned to a Priority Access Licensee. ^[1] Public Knowledge, The New America Institute, Federated Wireless, and Google as well as a broad coalition of broadband service providers, manufacturers, trade associations, and technology companies (Coalition) argued for a more flexible model that would allow GAA use over Priority Access channels that are not in actual use. ^[2] The rule we propose here would allow GAA use on unused PAL channels to promote efficient and consistent use of spectrum	The members of the Wireless Innovation Forum believe that the benefit of this is reduced by forcing protection of the census district. The members of the Forum are not opposed to the auction concept but the relationship between census districts based on arbitrary physical boundaries and spectral boundaries are problematic and complicate this issue. The behaviour of GAA access to unused PAL channels should be an established requirement for consideration by the SAS-WG. Proper SAS control system design should allow best practice policies to be defined for specific localized behaviour.
37	We seek comment on the proposed rule, including any costs and benefits of the proposed approach. How should “use” be practically and consistently determined in this context? How should the determination be made in the context of our dynamic frequency assignment proposal? If an assigned but previously unused PAL channel is later determined to be “in use,” how long should a GAA user be given to vacate the Priority Access channel? What should be the triggering event that reserves assignment of a channel for PAL use? Should the event be based on action by a Priority Access Licensee (e.g., initiating service in a portion of the PAL) or by the SAS (e.g., assigning a channel to the PAL in response to a request from a Priority Access licensee)?	This is an excellent issue to be taken up by the multi-stakeholder SAS-WG. Behavioural models of these types of issues should be used to evaluate SAS implementations and establish system requirements for SAS deployment. While the stakeholder group is working on this issue, agreements can be negotiated by GAA and PAL users and managed by the SAS.
	b. Subpart B - INCUMBENT PROTECTIONS	
	(i) Protection of Federal Incumbents (96.15)	

¶	FNPRM Text	WinnForum Response
38	<p>Consistent with the three-tier construct, we propose in Section 96.15 to require that CBSDs^[1] may not cause harmful interference to and must accept interference from authorized federal users in the 3.5 GHz Band. As an initial matter, we also propose at this time that CBSDs comply with the geographic Exclusion Zones based on the parameters set forth in the Fast Track Report to ensure compatibility with federal operations, and that the SAS ensure that CBSDs do not operate within Exclusion Zones.^[2] We discuss issues related to these requirements in more detail, including the size of Exclusion Zones and our intention to revisit the appropriate incumbent protection criteria, in section III(B)(1) below. We seek comment on these proposed rules</p>	<p>The members of the Wireless Innovation Forum propose that interference protection, not exclusion zones, should be the defined model. If you trust the SAS for protecting secondary licensees, then the same mechanism should apply to protection of primary licensees.</p>
	<p>(ii) Protection of Existing Fixed Satellite Service Earth Stations in the 3550-3650 MHz Band (96.17)</p>	
39	<p>We also propose to protect existing FSS earth stations in the 3.5 GHz Band by requiring that CBSDs not cause harmful interference to these sites. We discuss broader issues related to these requirements in more detail in Section III(B)(3)(a) below and seek comment on the issue of protection for “out-of-band” FSS earth stations in section III(B)(3)(b). We seek comment on these proposed rules.</p>	<p>The Forum commends the Commission on focus on comprehensive interference analysis rather than static component elements of a system such as antenna angle, terrain, etc. The issue of FSS user protection should be addressed by the proposed Receiver Performance Multi-stakeholder Working Group and the Technology Roadmap Multi-stakeholder Working Group that identifies how and when to apply SAS control behaviour associated with FSS earth stations.</p>
	<p>(iii) Operation near Canadian and Mexican Borders (96.19)</p>	
40	<p>Our proposed rules note that Citizens Broadband Radio Service operations along the Canadian and Mexican borders would be subject to international agreements with Mexico and Canada. The SAS would be required to enforce these requirements. We seek comment on these proposed rules</p>	<p>Behaviour of the SAS as defined by the proposed SAS Multi-stakeholder Working Group will account for compliance with international agreements. The Forum is an international Multi-Stakeholder Organizations and well positioned to help define SAS behaviour in areas covered by international agreements.</p>
	<p>(i) Authorization (96.21)</p>	
42	<p>Under our proposed rules, any entity eligible to hold an FCC license would be eligible to apply for, and hold, a PAL.^[1] Commenters generally support expanding eligibility to the Priority Access tier to a broader class of users than we proposed in the <i>NPRM</i>.^[2] Expanded access to the Priority Access tier would promote more intensive use of the 3.5 GHz Band and would promote investment in new small cell technologies. We propose to require all applicants for PALs to demonstrate their qualification to hold an authorization and demonstrate how a grant of authorization would serve the public interest.^[3] Qualifications would include those under Section 310 of the Act regarding foreign ownership. The Commission has broad authority to prescribe “citizenship, character,</p>	<p>The Forum believes this is also an issue that should be vetted by the proposed SAS Multi-stakeholder Working Group to establish the scope of authority given to operational constraints on a SAS Administrator (static policy based) and behaviour of the SAS operations (dynamic policy based).</p>

¶	FNPRM Text	WinnForum Response
	<p>and financial, technical, and other qualifications” for its licensees.^[4] We seek comment on how to apply this authority with respect to the 3.5 GHz Band, and whether to adopt the same policies in this respect that the Commission has established for other services. We also propose that SAS Administrators may reasonably automate certain processes and requirements, in accordance with the Commission’s rules. We seek comment on these proposed rules, including on any limitations posed by our Title III obligations on the scope of authority that may be delegated to such SAS Administrators.</p>	
	<p>(ii) Priority Access Licenses (96.23)</p>	
44	<p><i>Geography.</i> We propose to authorize PALs at the census tract level and to permit geographic aggregation across license areas. As explained in the <i>Licensing PN</i>, census tracts offer a variety of benefits, including geographic sizes varying by population density, nesting into other political subdivisions including city lines, and aligning with other natural features that track population density. Under our proposal, PAL applicants could target specific geographic areas in which they need additional coverage and avoid applying for areas that they do not intend to serve. Our proposal reflects the unique technical characteristics of small cells to promote a high degree of spectral and spatial reuse while facilitating flexible, targeted deployment of CBSDs.</p>	<p>The members of the Wireless Innovation Forum caution the Commission to consider the difference between geo-location and spectrum-location as a guide for policy formulation. Based on spectrum band and spectral density each census track could be assigned a weighting factor for use by PAL holders to better encourage innovation and openness based on meaningful SAS dynamics.</p> <p>The members of the Wireless Innovation Forum are concerned that census tracks are not localized and not stable, in some cases non-contiguous, subject to change for political reasons, and as such may act as an impediment to investment.</p>
45	<p>We received a diverse record in response to our proposal to use census tracts as a licensing area. Some commenters agreed with our proposal.^[1] Others argued that census tracts were inappropriate geographic license areas because the borders of census tracts frequently divide streets and their relatively small size would make co-channel coordination between Priority Access Licensees more difficult.^[2] Other commenters suggest that even smaller geographic areas, such as census block groups would allow for granular and demand-focused assignments.^[3] Others proposed larger, more traditional license areas such as counties, EAs, or CMAs.^[4] Google suggests license boundaries be based on proposed network parameters and actual contours, as determined and enforced by the SAS</p>	<p>The members of the Wireless Innovation Forum strongly support the use of the SAS for optimizing spectrum sharing. SAS can implement and coordinate boundaries based on network parameters and contours.</p> <p>The members of the Forum again caution the commission on the use of the term “enforce”.</p>
47	<p><i>Channels.</i> As described in the Revised Framework and section III (A)(1)(a)(vii) above, we propose to authorize PALs to operate over 10 megahertz unpaired channels.^[1] While a few commenters argued for larger or smaller channels,^[2] the record generally supports our proposal to utilize 10 megahertz channels for PALs with the ability to aggregate multiple channels. Ten-megahertz channels provide a flexible, scalable, practically deployable bandwidth for high data rate technologies that would</p>	<p>Channels should be band specific. A 10MHz channel designation for a PAL is an arbitrary assignment and not based on any specific channel requirement. The commission should consider a range of channel specifications with narrow-band channels as low as 25KHz and wide-band channels as low as 1MHz. Channels are related to service and as information density improves with better technology, smaller</p>

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	<p>permit multiple Priority Access Licensees to operate effectively in a given geographic area. We seek comment on the proposed rule.</p>	<p>channel slices encourage innovation in the area of bits/hertz solutions. This is particularly important in Small Cell deployment where significant spectrum reuse is possible.</p> <p>PCAST said don't vulcanize the BW and so that is the stance we are taking</p>
48	<p>In addition, consistent with the Revised Framework, we propose that once the Commission has assigned PAL rights to a user, the specific channels would be dynamically assigned to the PALs by the SAS.^[1] As discussed previously, some commenters argue for fixed channel assignments.^[2] Others, like Google and WISPA support the dynamic assignment model outlined in the Revised Framework.^[3] We should maximize flexibility in the band to allow the SAS to use channel assignments as a tool in maximizing efficiency and minimizing interference scenarios. However, we propose that the SAS be permitted to assign specific frequencies to Priority Access Licensees upon their request, when available and on a dynamic basis. To the extent a licensee has PALs in adjacent census tracts, we propose that the SAS should endeavor to assign contiguous frequencies across geographic boundaries. In addition, consistent with the dynamic nature of the proposed channel assignments, we encourage SAS Administrators to make reasonable efforts to assign adjacent frequencies to licensees with access rights to multiple channels in a single census tract. Dynamically assigning spectrum based upon the demand within a geographic area at a given time would promote efficient use of the band across wider geographic areas without compromising flexibility. We seek comment on this proposal. What effect would such assignment have on spectrum efficiency as opposed to the use of channel bonding techniques across non-contiguous spectrum? Would such a rule simplify or complicate the SAS's ability to manage the spectrum within any given census tract? What effect would such a rule have on the ability to predict and take measures to prevent harmful interference among users within the same census tract and users in nearby census tracts?</p>	<p>The members of the Wireless Innovation Forum believe that smaller channel granularity supports orthogonal use of codes and frequencies (colors) to reduce interference and improve frequency reuse. This is best managed by the SAS and should be a key requirement for SAS deployment. The members of the Forum strongly support dynamically assigned frequency plans to PAL and GAA user.</p>

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50	<p>The record related to these licensing concepts was also mixed. Some commenters agreed with our proposal of one-year terms with the option to aggregate multiple years.[1] Others argued for license terms shorter than one year while Microsoft agreed with the one-year proposal but argued for a prohibition on term aggregation. On the other hand, several commenters including Ericsson, NSN, and Qualcomm supported a more traditional licensing model with longer (e.g. 10-year) license terms.</p>	<p>The members of the Wireless Innovation Forum believe that, like Channel assignment, Term assignment should be based on planned services, spectrum bands and required investment infrastructure. A minimum term less than one year should be considered to support specialized events for PAL holders such as 1 to 3 months for disaster recover (supporting cell or SATCOM service when deployed infrastructure is seriously compromised). The members of the Forum believe that terms should be less than a wireless innovation cycle to allow for entry of new innovative technology.</p>
51	<p>Under this proposal, licensees would be able to hold up to five-years of PALs in a given geographic area at any given time. Licensees holding less than five-years of PALs in a geographic area may apply for additional PALs in the same geographic area, up to a total (including their existing PALs) of five-years. For example, a licensee awarded five-years of PALs through the annual application window in one year would be allowed to apply for a one year PAL through the annual application window in the subsequent year</p>	<p>Under the current proposal a single PAL holder is capped at a max of 50MHz of spectrum. The members of the Wireless Innovation Forum question whether the commission intends to cap licenses or spectrum? Also, many potential PAL services require significantly less than the 10MHz allocation proposed. As such, the members of the Forum feel that it may be reasonable to cap the percentage of available spectrum in a band, but not cap the number of PAL licenses within the specified spectrum limit.</p>
52	<p>We note that in response to the <i>Licensing PN</i>, several commenters argued for a shorter temporal aggregation limit than we propose here. For example, WISPA suggests a four-year aggregation cap, Public Knowledge and the New America Foundation suggest a three-year cap, Motorola Solutions suggests only two years, and Microsoft suggests we not permit term aggregation (effectively a one-year availability in the licensing window).[1] AT&T, by contrast, suggests that licensees be permitted to retain their authorizations indefinitely for areas in which they have deployed equipment and provided service within one year.[2] By combining short-term licenses with a multi-year application window, our proposal for one-year licenses with term aggregation balances the competing public interest concerns expressed in the record. We seek comment on the proposed one-year, non-renewable license terms and aggregation limit, including any costs and benefits.</p>	<p>The members of the Wireless Innovation Forum believe that a properly developed SAS can manage the details however the commission decides. The Forum takes no position on term aggregation other than to encourage the commission to choose a license period that encourages deployment of innovative technologies.</p>
	<p>(v) Aggregation of Priority Access Licenses (96.29)</p>	
	<p>b. Subpart D - GENERAL AUTHORIZED ACCESS</p>	
	<p>(i) Authorization and General Authorized Access Use (96.31 & 33)</p>	

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56	<p>As explained above, we propose to reserve a floor of at least 50 percent of available bandwidth in the 3.5 GHz Band in each census tract for GAA use, with additional frequencies to be made available on an opportunistic basis when not in use by Priority Access Licensees.^[1] As described in the <i>NPRM</i> and <i>Licensing PN</i>, GAA devices would be licensed-by-rule as under Section 307 of the Communications Act^[2] to promote rapid deployment by a wide range of users at low cost and with minimal barriers to entry.^[3] GAA users would be required to use only certified, Commission-approved CBSDs and register with the SAS.^[4] Consistent with the proposed rules governing CBSDs, devices operating on a GAA basis would be required to provide the SAS with all information required by the rules – including operator identification, device identification, and geo-location information – upon initial registration and as required by the SAS.^[5] GAA users would also be required to comply with the instructions of the SAS and avoid causing harmful interference to Priority Access Licensees and Incumbent Access tier users. Similar to unlicensed operations, GAA users would have no expectation of interference protection from other Citizens Broadband Radio Service users. Are there other licensing paradigms that the Commission should consider? If so, commenters are requested to provide a detailed analysis of the pros and cons of the approach</p>	<p>The members of the Wireless Innovation Forum support the commission’s vision.</p>
57	<p>As discussed previously, commenters took a variety of positions with regard to the portion of the band that should be used for GAA as well as our proposals to allow dynamic and opportunistic use of unused Priority Access channels.^[1] Some commenters also objected to our proposal to authorize the GAA tier on a license-by-rule basis.^[2] These positions are discussed in greater detail in sections III(A)(1)(a)(vii) and III(A)(2)(a). Our proposals would ensure widespread availability of GAA frequencies for the broadest possible class of users and applications. We seek comment on the proposed rules including potential costs and benefits</p>	<p>The members of the Wireless Innovation Forum support the SAS managing dynamic access and dynamic bandwidth assignment.</p>
	<p>(ii) Contained Access Facilities</p>	

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58	<p>As we noted in the <i>NPRM</i> and <i>Licensing PN</i>, a wide variety of critical services in the United States have current and future spectrum needs and there is currently insufficient spectrum to allocate exclusive bandwidth to all such services.^[1] While we believe that broad eligibility for use of the 3.5 GHz Band will produce significant public interest benefits, we continue to believe that “the high spatial reuse characteristics of low-power 3.5 GHz transmissions, combined with access management facilitated by the SAS, should allow the 3.5 GHz Band to be utilized on a shared, licensed basis by a variety of critical users to provide high quality services to localized facilities.”^[2] To that end, the <i>Licensing PN</i> sought comment on whether it would be in the public interest to allow critical users to receive interference protections, akin to Priority Access users, within a limited portion (<i>e.g.</i>, 20 megahertz) of the GAA pool inside the confines of their facilities.</p>	<p>The members of the Wireless Innovation Forum believe that within the confines of a facility where low power devices do not interfere with either incumbent services or PAL services, the commission should not limit GAA user’s bandwidth. SAS registration is appropriate to facilitate spectrum management but limiting use of spectrum in confined facilities discourages innovation and development of advanced spectrum reuse and sharing technologies.</p>
60	<p>We propose to allow Contained Access Users, such as hospitals, public safety organizations, and local governments to request up to 20 megahertz of reserved frequencies from the GAA pool for indoor use within their facilities in furtherance of the public interest. These frequencies may be used only for private internal radio services and may not be made available to the general public. Other GAA users would not be permitted to utilize the reserved frequencies within designated Contained Access Facilities (CAFs). Except for the ability to prohibit third-party use in CAFs, Contained Access Users availing themselves of the reserved channels would still operate on a GAA basis and would have no special rights with respect to interference from Incumbent Users and other Citizens Broadband Radio Service users. We also propose that Contained Access Users must undertake reasonable efforts to safeguard against harmful interference from GAA transmissions originating outside the CAF. The “reasonable efforts” requirement would therefore ensure that Contained Access Users take advantage of RF isolation intrinsic to the CAF, along with any other potential interference “self-help” measures, to protect the RF environment within the CAF. Potential Contained Access Users would be required to receive approval from the Commission to be eligible to utilize reserved frequencies. The public interest would be served by giving designated Contained Access Users the ability to utilize reserved frequencies indoors, within CAFs in this fashion. Moreover, the limited geographic and spectral impact of this proposal will allow for the effective coexistence of Contained Access Users, Incumbent Users, and other Citizens Broadband Radio Service operators.</p>	<p>GAA Contained Access Users by nature are noninterfering with PAL users and management of spectrum in a contained facility should be regulated by the facility and identified to the SAS.</p> <p>Technical issues related to managing contained access users should be addressed by the proposed SAS Multi-stakeholder Working Group.</p>

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61	<p>We seek comment on the proposed rule including any costs or benefits. Specifically, what types of entities should be considered qualified Contained Access Users? Does this proposal adequately address the spectrum needs of Contained Access Users? Would this proposal effectively address a demonstrated spectrum need for certain users that would not otherwise be addressed by the proposals in this FNPRM? Should this proposed framework be limited to Contained Access Users or expanded to include other types of facilities, including outdoor facilities? Would the SAS be able to effectively manage spectrum use by a large number of facilities? How would the SAS limit the operation of other GAA users within CAF premises? Would this plan unacceptably encumber GAA spectrum? We ask that commenters provide detailed technical and/or economic analysis to support their arguments</p>	<p>The members of the Wireless Innovation Forum believe that in an instance where possible harm from GAA users outside of the CAF exists, a PAL that covers an appropriate area should be used to insure critical communications are prioritized over GAA users. Creating a special category of GAA users is likely more disruptive to clean regulatory policy than localized PAL designation for CAF needs. This also simplifies monitoring, management and control operation of the SAS.</p>
	<p>b. Subpart E - TECHNICAL RULES</p>	
	<p>(i) Citizens Broadband Radio Service Devices General Requirements (96.36)</p>	
62	<p>To enable the SAS to authorize and effectively coordinate the use of shared spectrum in the 3.5 GHz Band, CBSDs must transmit certain operational and identification information to the SAS. In the <i>NPRM</i>, <i>Licensing PN</i>, and <i>SAS Papers PN</i> we sought comment on the types of information that CBSDs should be required to transmit.^[1] Commenters took a wide range of positions with regard to information transmission requirements for CBSDs.^[2] Elements of these proposals have been incorporated into proposed rule 96.36. Specifically, we propose that CBSDs must provide the SAS with the following information: (1) geographic location (within ±50 meters horizontal and ±3 meters vertical); (2) antenna height above ground level (meters); (3) requested authorization status (Priority Access or General Authorized Access); (4) unique FCC identification number; (5) user contact information; and (6) unique serial number. This information must be communicated when the CBSD initially registers at the SAS and at regular intervals thereafter. We also propose that CBSDs must follow directions and updates sent by SAS in a timely manner. For managed networks, while it is likely that information exchanges between CBSDs and the SAS would be aggregated through a proxy such as a network access manager, the proposed requirements would still be applicable to all CBSDs operating in the band.</p>	<p>The members of the Wireless Innovation Forum believe that Harm Interference Threshold (HIT) identification is also critical for SAS management. This is an area for the Receiver Performance Multi-stakeholder Working Group and SAS Multi-stakeholder Working Group to address.</p>

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64	<p><i>Interoperability.</i> To facilitate our proposed dynamic approach to frequency assignment,^[1] we propose to require CBSDs to be interoperable across all frequencies from 3550-3700 MHz. This would ensure that all CBSDs and End User Devices certified to operate in the band would be capable of sending and receiving information regardless of the frequencies assigned by the SAS. It also anticipates the possible inclusion of the 3650-3700 MHz band. Several commenters also supported band-wide device interoperability.^[2] We seek comment on this proposal including any potential costs and benefits. What effects would such a requirement have on equipment cost and design? What are the implications of equipment that may only work over a portion of the band and may not be able to tune to channels as assigned by the SAS? To what extent would an interoperability requirement promote consumer choice, given the characteristics of this service? To what extent should we seek to align the proposed interoperability requirement with existing international harmonization efforts for the 3.5 GHz Band (e.g., 3GPP Bands 42 and 43)? Similarly, how are current coexistence efforts among products conforming to multiple industry standards (e.g., 3GPP, IEEE 802.11 series) affected by the proposed interoperability requirement?</p>	<p>The members of the Wireless Innovation Forum point out that there are multiple layers of interoperability beyond the frequency capability of device, and as such the market place and manufacturers should figure out the technologies they will use in this band. The rules should be technology neutral to allow the greatest flexibility possible. This approach fosters innovation and advancement in communication architectures.</p>
66	<p><i>Interference Reporting.</i> Some commenters suggested that, to enable the SAS to tune or update its predictive models and also address real time interference issues, CBSDs should be required to provide the SAS with signal level measurements in their band or other adjacent frequency channels as requested by SAS.^[1] Many technologies already support this capability to allow radio resource management within a network.^[2] This capability could be a valuable tool for managing interference and promoting productive coexistence between multiple operators in the 3.5 GHz Band. We propose to require CBSDs to measure and report on their local signal level environment as set forth in the proposed rules.^[3] We seek comment on this proposal. What effect would the incorporation of such capability have on the cost of equipment? How should such a requirement be structured? Over what bandwidth or over how many channels should such measurements be reported? Does the Commission need to adopt measurement guidelines or procedures specifying how such measurements should be taken to ensure consistency in reporting among users?</p>	<p>The members of the Wireless Innovation Forum support this general principal, and believe that guidelines and standards in this area should be the responsibility of the multi-stakeholder working groups.</p>

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67	<p>Security. During the SAS Workshop many commenters also emphasized the importance of end-to-end security for communications among CBSDs, End User Devices, and the SAS. [1] We are mindful of the need to provide robust security for Federal information, personally identifiable information, and sensitive business information that may be transmitted between these devices and the SAS. To that end, we propose a security requirement for all communications between authorized SASs and CBSDs. We also propose to adopt comprehensive procedures to test and certify CBSDs and associated end user devices for operation in this band and to require the SAS to disconnect any device whose proper operation has been compromised. We seek comment on these proposed security measures. We ask commenters to suggest appropriate security protocols and discuss how these protocols would effectively safeguard sensitive information transmitted among the SAS, CBSDs, and End User Devices. If not, what additional measures should we adopt? Are there other enforcement mechanisms that can be put in place to ensure proper security of devices?</p>	<p>The members of the Wireless Innovation Forum believe that security must be considered throughout the design, development and deployment of systems used for essential and critical communications.</p> <p>These members have published a report outlining a process that identifies potential threats and vulnerabilities and leads to the development of security policies at the organizational, system and individual platform level²². These security policies specify the criteria and measures needed for protection and mitigation of designated threats throughout the entire lifetime of a system and its component elements.</p> <p>The process includes identification of assets that require protection. These include but are not limited to information, security operating parameters and data, embedded software, hardware components and virtually any infrastructure component including dispatch centers, servers, routers relays, base stations and individual radio platforms. Threat and vulnerability analyses must tailor for each asset in addition to risk assessments estimating the probability that any given threat/vulnerability may be realized. With this process completed, then specific security measures and mitigation methods can be developed which can be applied to the design, manufacture and operation of the system and its various component elements. These security measures, methods and design requirements then form the basis of the various Organizational, System and Platform security policies which govern the design, manufacturing, operation and maintenance and decommissioning of the system and its components.</p>
	(iii) General Radio Requirements (96.38)	
77	<p>We note that NTIA did not consider these proposed use cases or technical criteria in calculating the Fast Track Exclusion Zones. What effects would these additional use cases have on the size of the Exclusion Zones</p>	<p>The members of the Wireless Innovation Forum reiterate our support for Harm Interference Thresholds and not exclusion zones.</p>

²² Wireless Innovation Forum, “Securing Software Reconfigurable Communications Devices”, <http://groups.winnforum.org/d/do/3014>

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78	<p>We seek comment on these proposed rules. Are the proposals in this section appropriate for the variety of use cases possible in the 3.5 GHz Band? Would these proposals further the public interest by promoting efficient and innovative use of spectrum resources? Should the proposed definition of “rural environments” be altered due to the use of small cells and in light of the fact that these systems are proposed to be deployed in areas smaller than counties? In light of the flexible approach to EIRP limits proposed herein, should we consider allowing higher power operations in the 3.5 GHz Band? We encourage commenters to support their positions with detailed technical and cost benefit analyses taking into account the various interference scenarios that may exist in this band among different CBSDs and among CBSDs and Incumbent Users</p>	<p>The members of the Wireless Innovation Forum reiterate our support for Harm Interference Thresholds and not exclusion zones.</p>
79	<p><i>Received Signal Strength Limits.</i> To perform proper frequency assignments and interference management, it is important for the SAS to have a baseline threshold for the maximum signal level from CBSDs at the border of their service area. Therefore, Citizens Broadband Radio Service users should ensure that the aggregate signal level from their CBSDs as well as transmissions from their associated End User Devices at the edge of their authorized service areas remain at levels that would not harm other CBSDs in the same or higher tiers. For small cell networks, the industry standards and studies have shown 20 dB and 55 dB of interference rise over noise to be acceptable for picocells and femtocells respectively.^[1] Based on these industry standards, and taking into account reasonable distance between authorized use operations, we propose a signal level threshold of - 80 dBm measured by a 0 dBi isotropic antenna in a 10 megahertz bandwidth anywhere along PAL service area boundaries between different Citizens Broadband Radio Service users.^[2] We also propose to allow neighboring users to coordinate a higher signal level threshold. We seek comment on this proposed rule. How should this signal level be determined? Over what bandwidth should the signal threshold be measured? The proposal implies that this signal level would need to be met at all points along the PAL service boundary at ground level and all heights above ground level. Is such a requirement feasible? Should there be a single point at which this signal level should be enforced? What is the effect of this proposal on operation of CBSDs and on the interference potential within the band? How feasible would it be for the SAS to calculate and enforce such a limit?</p>	<p>The members of the Wireless Innovation Forum believe that this is likely network dependent and a general "Receive" Signal Strength Limit should be determined by the PAL and GAA service providers. Using Harm Interference Threshold models, the SAS can provide dynamic management of the spectrum. This encourages innovation in development of better receiver technology. The members of the Forum believe that multi-stakeholder working groups can best establish these details.</p>

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80	<p><i>Emission Limits.</i> In the <i>NPRM</i> we sought comment on whether to adopt out-of-band emission (OOBE) limits or other requirements to protect services in adjacent bands from harmful interference. We also asked for comment on the appropriate OOBE limits for small cells in the 3.5 GHz Band and the interference protection threshold limits of relevant services.^[1] Several commenters highlighted the importance of protecting incumbent and adjacent band services but differed as to the specific protection criteria.^[2] Some commenters presented co-existence analysis and protection distances based on long-standing $43 + 10 \log (P)$ dB OOBE limits. Issues specifically related to OOBE that could affect the operations of earth stations in the C-Band are addressed in detail in section III(B)(3)(b). We also seek comment on whether to specify particular OOBE limits</p>	<p>The members of the Wireless Innovation Forum believe that this would be addressed in the Harm Interference Threshold models. These members propose that a roadmap of tighter specifications can be achieved over time. These issues should be addressed by both the Receiver Performance Multi-stakeholder Working Group and the Technology Roadmap Multi-stakeholder Working Group.</p>
81	<p>The Commission’s rules generally limit the amount of radio frequency (RF) power that may be emitted outside of, or in a range of frequencies outside of, the assigned frequencies/channel(s) of an RF transmission. Moreover, the Commission has previously concluded that in certain circumstances, attenuating transmitter OOBes to at least $43 + 10 \log (P)$ dB is appropriate to minimize harmful electromagnetic interference between operators.[1] This limit has served well as a basis for development of industry standards which may impose tighter limits in certain cases. For Priority Access and GAA operations in the 3.5 GHz Band, we propose to apply the limit of $43 + 10 \log (P)$, which is equivalent to -13 dBm / MHz, to all emissions outside of channel assignments and frequency authorizations by SAS in the 3.5 GHz Band. We seek comment on this limit and whether it should be more stringent (i.e., at a lower power spectral density) given the state-of-the art of modern radio technologies, and the potential gains in spectral efficiency and minimizing interference coupling distance between neighboring radios operating in the 3.5 GHz Band</p>	<p>Again, the members of the Forum believe that this should be managed through Harm Interference Thresholds.</p>
82	<p>Notwithstanding the foregoing paragraph, we recognize the need for Citizens Broadband Radio Service operations to protect incumbent and dissimilar radio services with sensitive weak signal receivers such as in-band and out-of-band FSS earth stations and DoD radar systems.^[1] These incumbent radio service operations may be within and adjacent to the 3.5 GHz Band. Protection thresholds for weak signal receivers and minimizing the interference coupling distance to these receivers from new 3.5 GHz Band transmitters may require greater out-of-band attenuation (lower than -13 dBm / MHz) than can be achieved within the RF filter pass-band of 3.5 GHz Band radios. Striking the proper balance between the emission limits of CBSDs and End User Devices, along with the protection thresholds of incumbent receivers, may require more stringent OOBE</p>	<p>The members of the Wireless Innovation Forum believe that this can best be addressed through a Harm Interference threshold Roadmap. Essentially, as technology advances, Harm Interference thresholds will advance with it. The members of the Forum concede that an initial threshold is required now, but prefer that rules establish a framework for setting these limits, versus setting hard limits, to allow adapting these limits over time.</p>

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	<p>limits in certain circumstances.^[2] We also recognize that there has been considerable technological advancement in transmitter and receiver device technologies deployed in the mobile broadband industry over recent years, such that more stringent OOBE limits may be practical without undue burden to manufacturers and operators</p>	
83	<p>For example, the current LTE standards for the use in PCS requires mobiles in 1850 – 1915 MHz to meet a limit of -50 dBm/MHz in 1930-1995 MHz.[1] The current capabilities for mobile broadband manufacturers will support this level of tolerance for interference. Given that other mobile broadband service operations may already be imposing OOBE at the -40 dBm/MHz level, we propose this limit specifically for CBSD emissions above 3680 MHz and below 3520 MHz. We recognize that a more stringent limit would enable closer proximity of neighboring service operations. We seek comment as to whether this limit should be more stringent at -50 dBm/MHz.</p>	<p>This would be managed through the Harm Interference Threshold Roadmap.</p>
84	<p>In general, while OOBE limits to -40 dBm/MHz are reasonable and not burdensome, a spectral transition gap immediately above and below the edges of the 3.5 GHz Band may be necessary given the limitations of RF/radio filter technology, in stepping down from an in-band limit of -13 dBm/MHz to an out-of-band emission limit of -40 dBm/MHz. Some current research indicates that a transition gap of approximately 1 percent of the band edge frequency may be within the state-of-the-art of existing radio/filter technologies.[1] Therefore, we propose a transition gap of 30 MHz above 3650 MHz and 30 MHz below 3550 MHz, for setting the OOBE attenuation levels to -40 dBm/MHz. We seek comment on the size of this transition gap, whether it is in the range of existing RF filter technology, and whether the gap could be smaller through the use of more narrow RF filters in CBSD and user devices (e.g., two RF filters over 3550 – 3650 MHz, one covering the lower 50 MHz and the other covering the upper 50 MHz)</p>	<p>This would be managed through the Harm Interference Threshold Roadmap.</p>

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85	<p>Reception Limits. Priority Access Licensees may be authorized for operation in the same geographic area, with other Priority Access Licensees authorized to operate in adjacent or near-adjacent channels. The potential for interference between two or more Priority Access Licensees depends on both the transmitter and receiver performance of the respective radio systems, because unwanted RF energy received by a CBSD can be caused by both the emissions from an adjacent licensee spilling into the desired frequencies of operation, as well as the imperfections of radio receivers. Establishing an RF field strength/power spectral density that PAL receivers would need to accept from nearby licensed transmitters, would effectively define the spectrum rights between PALs,[1] and enable the SAS to assign these rights with clear obligations between respective licensees. We seek comment on this approach</p>	<p>The members of the Wireless Innovation Forum support reliance on a Harm Interference Threshold roadmap to manage innovation in this area.</p>
86	<p>While the Commission’s rules in this regard are technology neutral, we note the signal strength levels of undesired interfering signals in widely adopted industry standards for receiver performance (e.g., 3GPP LTE).^[1] We recognize the in-band and out-of-band blocking characteristics and adjacent channel selectivity of modern radio receivers that must perform over a high dynamic range of RF power levels. We note that the interfering signal mean power, for acceptable Home Base Station (HeNB; Femtocell) adjacent channel selectivity and blocking, ranges in the relevant 3GPP standards between -28 dBm^[2] and -15 dBm^[3] (in all LTE channel bandwidths) with moderately high wanted signal power. The 3GPP interfering signal power for acceptable LTE User Equipment adjacent channel selectivity and blocking performance, in many cases is -30 dBm or above.^[4] Therefore, we propose a power spectral density limit of -30 dBm / 10 megahertz as the interference limit that CBSDs operating on a Priority Access basis must accept, not to be exceeded with greater than 99 percent probability, unless the affected user agrees to a higher or lower limit and communicates such agreement to the SAS. Establishing a probability threshold is important because worst-case conditions for highly transient and unlikely RF interference events would otherwise establish an excessive constraint on neighbouring radio service operations. Would such a scheme be feasible for the SAS to administer? That is, how difficult would it be for the SAS to track, manage and enforce agreements between different users? What mechanism would be used to communicate such agreements to the SAS? How would an SAS be assured that all affected users are in agreement</p>	<p>The members of the Wireless Innovation Forum believe that if the SAS has knowledge of Harm Interference threshold profiles for all incumbent, PAL and GAA devices it can properly frequency plan networks dynamically.</p>

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88	We seek comment on these proposed rules. We also seek comment on methods and procedures that may be employed by Priority Access Licensees or the SAS to enforce these thresholds. We encourage commenters to provide detailed technical and cost benefit analyses to support their proposals.	
89	In addition, as we noted in the <i>Licensing PN</i> , the TAC has been studying spectrum interference policy and receiver standards in general, and it recommends that the Commission consider forming one or more multi-stakeholder groups to study such standards and interference limits policy at suitable service boundaries, such as those related to the 3.5 GHz Band. ^[1] The Wireless Innovation Forum, in its comments to the <i>Licensing PN</i> , recommended that the FCC encourage the formation of industry led multi-stakeholder groups, proposed key characteristics of such a process, and committed to establishing such a multi-stakeholder process to develop recommendations for the 3.5 GHz Band and other band opportunities. ^[2] Consistent with the recommendations of the TAC, we encourage and suggest industry action to charter a technical group of stakeholders to develop industry coordination agreements and protocols, including technical options and methods for managing spectrum access that would improve access to and make efficient use of the 3.5 GHz Band. What should the scope and charter be of such a multi-stakeholder group? What should be the governance structure of such a group?	<p>The Wireless Innovation Forum already exists as a Multi-Stakeholder Organization (MSH) and is heavily experienced in development of Multi-Stakeholder Groups (MSG) bringing together commercial and defense equipment vendors, database providers, network operators, government agencies and academic institutions. The Forum reiterates its commitment to support the community in fulfilling the requirements established in this proceeding.</p> <p>See section 5 of this filing for additional details.</p>
	f. Subpart F - SPECTRUM ACCESS SYSTEM	
91	Our proposed rules also assume that multiple SAS Administrators and, consequently, multiple SASs would be authorized to operate in the 3.5 GHz Band, much as multiple databases have been authorized in the TVWS context, to ensure that consumers are provided with a robust set of choices in the marketplace. We seek comment on what techniques could be used to effectively coordinate multiple SASs in the band. What other implementation challenges arise from the possibility of multiple SAS providers? Are they solvable? We seek comment on the proposal to authorize multiple SAS providers. In responding to the questions and proposed rules in this section, we ask commenters to consider the implications of multiple authorized SASs and to address these issues in their filings	<p>The members of the Wireless Innovation Forum feel that SAS administration should be automatous to allow dynamic reconfiguration of spectral resources and the rule set used to control spectrum should be layered. How the SAS is structured is an excellent topic of focus for a SAS-WG multi-stakeholder group.</p> <p>The members of the Forum believe that the market is best served through multiple, competing SAS administrators.</p> <p>The members of the Forum further feel that given the small number of incumbents in this band, straightforward mechanisms can be found for incumbent protection.</p>

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92	<p>We also intend to institute a comprehensive approval process for SASs and SAS Administrators that closely follows the multi-step process used to test, certify, and approve TVWS databases and administrators. In the TVWS context, prospective database administrators were invited to submit proposals outlining how their systems would meet the Commission’s requirements for database operators and provide information sufficient to show that they have the technical expertise to administer a database and a viable business plan for operating a database for a five-year term.^[1] OET then reviewed these proposals and approved the proposals of those operators that met the requirements.^[2] Approved operators were then required to attend mandatory workshops to ensure compliance with the rules, meet milestone dates set by OET for reporting and compliance, and submit to rigorous real-world testing of all database elements prior to making their services available to the public.^[3] By following the precedent set in the TVWS proceeding, we can ensure that the technical solutions and developed by prospective SAS Administrators are consistent with the letter and spirit of our high-level rules, especially with regard to the protection of Incumbent Access tier users</p>	<p>The members of the Wireless Innovation Forum commend the Commission on their success in certifying TVBD database administrators.</p> <p>Moving forward, the members of the Forum feel that establishing requirements for SAS should be done in coordination with a Multi-Stakeholder group.</p>
	<p>(i) Spectrum Access System Purpose and Functionality (96.43)</p>	
94	<p>While commenters and workshop presenters submitted a diverse set of positions regarding the necessary features of the SAS, most agreed that an effective SAS would need to be more dynamic and responsive than the current TVWS database. Moreover, many commenters agreed that the FCC should set only baseline parameters and guidelines for the SAS and should allow industry stakeholders to develop detailed policies and standards to facilitate operation consistent with the Commission’s rules. Some commenters that supported a two-tiered licensing model also advocated a simplified, “binary” SAS that would only inform Priority Access Licensees whether or not they could operate in a given area or frequency range without causing harmful interference to incumbents. Other commenters opposed giving the SAS the ability to dynamically assign channels or modify the maximum allowable transmit power for CBSDs</p>	<p>The members of the Wireless Innovation Forum believe that the SAS will be able to dynamically reconfigure CBSCs frequency plans to optimize spectrum utilization.</p>
95	<p>After thorough review of the record and using the TVWS rules as a guide, we propose that authorized SASs would perform the following core functions</p>	
	<p>Determine the available frequencies at a given geographic location and assign them to CBSDs;</p>	<p>The members of the Wireless Innovation Forum agree.</p>
	<p>Determine the maximum permissible radiated transmission power level for CBSDs at a given location and communicate that information to the CBSDs;</p>	<p>The members of the Wireless Innovation Forum Agree.</p>
	<p>Register and authenticate the identification information and location of CBSDs;</p>	<p>The members of the Wireless Innovation Forum believe that this should apply for fixed only. For</p>

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		mobile our members propose the use a back off power figure to insure non-interference.
	Enforce Exclusion Zones to ensure compatibility between Citizens Broadband Radio Service users and incumbent federal operations;	The members of the Wireless Innovation Forum protection of incumbent users should be based on protection criteria not Exclusion Zones.
	Protect Priority Access Licensees from harmful interference from General Authorized Access Users;	The members of the Wireless Innovation Forum believe the SAS can protect priority access users from harmful interference. The SAS will preclude operation by GAA users in areas where they can cause interference with priority access users.
	Reserve the use of GAA channels for use in a CAF;	The members of the Wireless Innovation Forum support this.
	Ensure secure transmission of information between the SAS and CBSDs.[1]	The members of the Wireless Innovation Forum support this and urge protection of SAS metadata.
96	Under our proposal, each SAS would provide nationwide service. Each SAS would also collect and retain all information provided by CBSDs and Incumbent Users according to the proposed rules and enforce robust security protocols to protect such information.[1] If multiple SASs are authorized, each SAS would be responsible for sharing this information with other authorized SASs to ensure effective coordination of operations within the band. The proposed rules outline the essential requirements for a successful SAS and would promote innovation and productive use of the 3.5 GHz Band. Further, these rules represent the lightest regulatory approach possible to accomplish the core objectives of the SAS.	The members of the Wireless Innovation Forum feel that the relationships/ interactions between SAS providers should be modeled/developed by the multi-stakeholder group.
97	We seek comment on these proposed rules. Specifically, do the proposed rules accurately describe the necessary functions of an SAS? What additional elements, if any, should be included in the SAS? What responsibilities should SASs (and SAS Administrators) have to maximize use by and minimize interference among GAA users, notwithstanding any absence of interference protection rights that may be extended to such users under our rules? How should the Commission most appropriately discharge its Title III responsibilities in supervising these and other functions that may be delegated to the SASs and SAS Administrators? Are the proposed rules unduly burdensome for potential SAS Administrators? Could a compliant SAS be built and operated using existing or “in development” technology?	The members of the Wireless Innovation Forum feel that this is an excellent subject for a multi-stakeholder group. The members of the Forum caution the Commission that the SAS is more complex than the TVBD rule making, and so flexibility so additional flexibility in the Rules will be required to ensure success.

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98	<p>In addition, under this proposal multiple SASs could be authorized, much as multiple databases have been authorized in the TVWS context,[1] to ensure that consumers are provided with a robust set of choices in the marketplace. We seek comment on what techniques could be used to effectively coordinate multiple SASs in the band? What other implementation challenges could arise from the possibility of multiple SAS providers? Are they solvable? We seek general comment on the proposal to authorize multiple SAS providers.</p>	<p>The members of the Wireless Innovation Forum believe that this is a solvable problem with existing technology and avoids contention between SAS providers. The members of the Forum propose that this can best be addressed by a multi-stakeholder group.</p>
	<p>(ii) Information Gathering and Retention (96.44)</p>	
99	<p>To protect Incumbent Users and effectively coordinate Citizens Broadband Radio Service users, we propose that the SAS retain information on all operations within the 3.5 GHz Band. For CBSDs, such information would include all data that they are required to transmit to the SAS pursuant to the proposed section 96.36.^[1] For incumbent FSS operators, the SAS would maintain a record of the location of protected earth stations as well as the direction and look angle of all earth station receivers and any other information needed to perform its functions. For incumbent federal users, the SAS would include only the geographic coordinates of the Exclusion Zones.^[2] We seek comment on these proposed rules and alternative approaches</p>	<p>The members of the Wireless Innovation Forum feel that the SAS should only need to retain user information that relates to the scope of the SAS.</p>
100	<p>With regard to federal operations, if Exclusion Zones are altered or other incumbent protection criteria implemented in future phases of this proceeding, the SAS may eventually need to gather and manage a significant amount of data on federal operations. Much of this information is likely to be sensitive or classified and would require additional safeguards that may not be necessary to protect non-federal information. Some commenters raised the possibility of establishing a separate database to store sensitive federal information and instruct registered SASs on the required protection contours for federal operations.[1] We seek comment on whether a separate database should be established for federal information. Would such a database be more efficient and secure than entrusting federal information to each registered SAS? What additional security measures should be required for a database holding sensitive federal information? Who should maintain such a database? We will continue to work with NTIA and incumbent federal users to develop this aspect of the SAS requirements.</p>	<p>The members of the Wireless Innovation Forum observe that NTIA has only authorized 1 system in this band, and there are 23 instances of this incumbent system in this band, so operation can be readily managed via sensing or technology.</p>

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101	<p>Some commenters have argued that the SAS should be required to incorporate spectrum sensing information from CBSDs or other remote beaconing and sensing sites to accurately detect incumbent usage models and respond to the interference environment.[1] We seek comment on whether such capabilities would be helpful for the operation of the SAS</p>	<p>The members of the Wireless Innovation Forum believe that this should be allowed but not required at device side. This allows the market to decide.</p> <p>The members of the Forum feel that the SAS should have a protocol defined that allows requesting and receiving this data. An example of this type of protocol is IEEE P1900.6. The specific protocol should be developed and maintained through a multi-stakeholder group.</p> <p>The members of the Forum believe that Spectrum Sensing from both CBSDs and other sensor networks should be importable to the SAS for analysis and refinement of spectrum provisioning policies. Also independent support for monitoring of spectrum should be permitted to validate predictive algorithms with forensic data.</p>
	<p>(iii) Registration and Authorization of Citizens Broadband Radio Service Devices (96.45)</p>	
102	<p>In addition to gathering required information from CBSDs, the SAS would confirm and verify the identity of any CBSD seeking to use the 3.5 GHz Band prior to authorizing its operation. The SAS would also prevent CBSDs from operating within any Exclusion Zones. We seek comment on these proposed rules.</p>	<p>The members of the Wireless Innovation Forum believe that dynamic SAS operational characteristics make exclusion zones unnecessary through the use of interference protection criteria.</p>
	<p>(iv) Frequency Assignment (96.46)</p>	
103	<p>As discussed in section III(A)(1)(a)(7) above, under our proposal, assignment of PAL channels and GAA frequencies in the 3.5 GHz Band would be a dynamic process. The SAS would be responsible for determining the available and appropriate frequencies at a location using the location information supplied by CBSDs, compliance with Exclusion Zones, the authorization status and operating parameters of CBSDs in the surrounding area, and such other information necessary to ensure effective operations of CBSDs. The SAS would also take into consideration any channel requests submitted by CBSDs as well as geographic and spectral efficiency considerations. We also propose that the SAS be able to provide a list of available frequencies in a given area and confirm that any CBSDs causing harmful interference to an Incumbent User have been deactivated or reassigned upon request. We seek comment on these proposed rules</p>	<p>The members of the Wireless Innovation Forum agree, and propose that this would include appropriate data logging of frequency assignments under rule 96.44.</p>
	<p>(v) Security (96.48)</p>	
104	<p>We propose to require that the SAS employ protocols and procedures to ensure that all communications and interactions between the SAS and CBSDs are accurate and secure and that unauthorized parties cannot access or</p>	<p>The members of the Wireless Innovation Forum commend the Commission on identifying security as a key issue. The Forum has previously developed multiple work products in</p>

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	alter the SAS or the list of frequencies sent to a CBSD. These protocols and procedures would be reviewed and approved by the Commission before the SAS Administrator could be certified.[1] We seek comment on these proposed rules and on any additional safeguards needed to protect sensitive federal information.	this area, and we refer the Commission to see section 4 of this response.
	(vi) Spectrum Access System Administrators (96.48)	
106	To this end, we propose that SAS Administrators be required to:	The members of the Wireless Innovation Forum feel that the detailed role of SAS Administrators and the scope of their authority should be a key focus of the proposed SAS Multi-stakeholder Working Group.
	maintain a regularly updated database that contains the information described in the proposed rules;	The members of the Wireless Innovation Forum feel that these are standard back office functions for the SAS supported by existing technology.
	establish a process for acquiring and storing in the database necessary and appropriate information from the Commission's databases;	The members of the Wireless Innovation Forum feel that these elements can be established in the operational framework for the SAS and are supported by existing technology
	establish and follow a process for ensuring compatibility between Citizens Broadband Radio Service users and Incumbent Users, including enforcement of Exclusion Zones;	The members of the Wireless Innovation Forum reiterate that exclusion zones are unnecessary if Harm Interference Thresholds are established and SAS controls dynamic spectrum allocation.
	establish and follow processes for registering and coordinating Priority Access Licensees and GAA users;	The members of the Wireless Innovation Forum agree
	establish and follow protocols and procedures to ensure that Incumbent Users are protected from harmful interference from Citizens Broadband Radio Service operators;	The members of the Wireless Innovation Forum agree
	establish and follow protocols and procedures to ensure that Priority Access Licensees are protected from harmful interference from Priority Access and GAA users;	The members of the Wireless Innovation Forum agree
	establish and follow protocols and procedures to ensure that all communications and interactions between the SAS and CBSDs are accurate and secure;	The members of the Wireless Innovation Forum agree
	make its services available on a non-discriminatory basis;	The members of the Wireless Innovation Forum agree, and reiterate their view that spectrum allocations should be technology and bandwidth neutral.
	respond in a timely manner to verify, correct or remove, as appropriate, data in the event that the Commission or a party brings claim of inaccuracies in the SAS to its attention;	The members of the Wireless Innovation Forum agree
	securely transfer the information in the SAS to another designated entity in the event it does not continue as the SAS administrator at the end of its term;	The members of the Wireless Innovation Forum agree
	cooperate with other SAS Administrators to develop a standardized process for coordinating and exchanging required information;	The members of the Wireless Innovation Forum agree
	provide a means to make public information available to	The members of the Wireless Innovation Forum

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	the public in an accessible manner;	agree
	establish protocols to maintain appropriate security clearances and other security measures as may be determined by the Commission for access to and storage of required federal incumbent information if required in future phases of this proceeding	The members of the Wireless Innovation Forum agree
107	Under our proposed rules, SAS Administrators would be authorized to provide service for a five-year term, which could be renewed at the Commission’s discretion. We further propose that the Bureau review applications for certification and establish procedures for reviewing the qualifications of prospective SAS Administrators. What conflict of interest requirements, competitive or other selection process, technical qualifications, or other standards should govern this process? Do other models involving Commission selection of third-party assistance provide useful insights into these questions?	The members of the Wireless Innovation Forum agree
108	We seek comment on this proposal. Do the proposed rules establish appropriate qualifications for SAS Administrators? What procedures should the Bureau adopt to select SAS Administrators, ensure that they are qualified to perform their duties, and ensure that SASs are able to perform the functions required by the proposed rules. What steps should the Commission take to ensure that SAS Administrators are properly supervised and operating within the bounds of the law? Commenters should provide a detailed analysis, including economic costs and benefits, of any alternate or supplemental approach they propose	The members of the Wireless Innovation Forum agree. These rules are sufficiently proscriptive to allow the market to form, and remaining issues should be delegated to a multi-stakeholder group.
	B. Other Issues	
	Interference protection for federal incumbents;	The members of the Wireless Innovation Forum believe that such interference protection should be based on harm interference thresholds and dynamic policy provisions.
	Interference protection for CBSDs from federal radar transmissions;	The members of the Wireless Innovation Forum respectfully disagree and believe that CBSDs should have no expectation of protection from incumbents. The members of the Forum believe that geographic regions and frequencies available for operation of CBSDs could be improved in the future through the development of a roadmap of tighter harm-interference threshold constraints and should be considered by a multi stakeholder group.
	The potential integration of the 3650-3700 MHz band into the Citizens Broadband Radio Service	The members of the Wireless Innovation Forum agree
	1. Protection for Federal Incumbent Access Tier Users	

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138	<p>In its Fast Track Report, NTIA concluded that geographic separation and frequency offsets could be used to minimize interference between commercial networks and ground-based, airborne, and shipborne radar systems currently operating in the 3.5 GHz Band. However, NTIA’s analysis indicated that it would be necessary to put in place extensive exclusion zones to prevent incumbent operations and broadband wireless systems from causing interference to each other. NTIA concluded that effective exclusion zone distances around ground-based and airborne radar systems would extend approximately one to 60 kilometers, coupled with frequency offsets of 40 or 50 megahertz,^[1] while exclusion zones around certain high-power shipborne Naval radars would require over-land separation distances of several hundred kilometers.^[2] NTIA acknowledged, however, that its analysis assumed deployment of high power, macrocell networks, and stated that its conclusions would require revision to the extent the Commission proposes to implement systems with different technical characteristics.</p>	<p>The members of the Wireless Innovation Forum feel that exclusion zones are problematic in that they don't accurately account for specific geography of the region and topology of spectrum consumption models. Small cell deployment can be effective and managed by a SAS without interference in most of what would be predefined exclusion zones. A better approach is to establish a dynamic SAS control plane that permits frequency reuse on a non-interference basis to promote innovation in regions, which would otherwise remain barren in an exclusion zone. This should be an issue addressed by the Exclusion Zone Multi-stakeholder Working Group.</p>
139	<p>In the NPRM, the Commission noted that the large exclusion zones and limited signal propagation in the 3.5 GHz Band weighed against the use of macrocell deployment in the band. Instead, the Commission stated that the use of the 3.5 GHz Band could be significantly increased through spectrum sharing and application of small cell technology. The Commission therefore proposed the creation of the Citizens Broadband Radio Service premised on 1) technical rules that focused on the use of low-powered small cells, and 2) the use of a dynamic SAS to manage users of the band. In light of the small cell deployment model, the Commission noted that some of the assumptions made in the Fast Track Report’s analysis regarding the requisite exclusion zone distances would not apply and would need to be revisited.[1] The Commission indicated that it may be possible to reduce any exclusion zones through technical and operational parameters for small cells in combination with an effective SAS and other interference mitigation techniques. The Notice therefore requested technical analysis as to how application of small cell and access management technologies may impact interference to and from incumbent 3.5 GHz Band users as well as the size of exclusion zones necessary to ensure compatibility with incumbent and prospective users of the band</p>	<p>The members of the Wireless Innovation Forum agree and believe spectrum can be managed by the SAS without predefined exclusion zones. The members of the Forum believe that establishing this management framework is a good subject for a multi stakeholder group.</p>

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140	<p>Many of the comments filed in response to the Notice supported the tentative conclusion that the size of Exclusion Zones as estimated by NTIA should be re-evaluated given the proposal to apply the small cell model.[1] We note that the Exclusion Zones were a condition for the Executive Branch agreeing to provide access to this spectrum for non-federal use. As a starting point for continued analysis and discussion, we propose to implement the geographic Exclusion Zones proposed in the Fast Track Report. Nevertheless, preliminary studies have been performed on the potential effects of small cells on radar operations, with additional studies planned that could lead to a reduction in Exclusion Zones in the near future. We also note that the rules proposed in this FNPRM contemplate additional uses other than small cells, with varying maximum transmit power levels and antenna gains, which must factor into the consideration of Exclusion Zones.</p>	<p>The members of the Wireless Innovation Forum believe that in a dynamic SAS model, exclusion zones are simply a fully occupied spectral assignment of an incumbent user.</p>
141	<p>We are continuing our dialogue with NTIA and the federal agencies on this matter and, if possible, plan to reduce the Exclusion Zone distances from the instant proposal based on the Fast Track Report, which distances, we emphasize, we propose as a starting point for further analysis. We intend to work collaboratively and expeditiously with NTIA and other relevant federal agencies on this project. We emphasize that important technical studies involving federal agencies, industry, and academia are underway and will likely provide data that will be informative in determining whether and to what extent the size of the Exclusion Zones can be reduced. If there are further developments that would enable a reduction in the size of the Exclusion Zones, we encourage participants to file them in the record to ensure that there is sufficient opportunity for public comment prior to issuance of a <i>Report & Order</i> in this proceeding. We will also consider any data and studies submitted in this proceeding in our ongoing discussions with NTIA and other federal agencies on this topic</p>	<p>The members of the Wireless Innovation Forum believe that in a dynamic SAS model, exclusion zones are simply a fully occupied spectral assignment of an incumbent user.</p>
142	<p>Additionally, in the <i>NPRM</i>, the Commission stated that GAA use could be allowed in areas where small cell operations would not cause harmful interference to Incumbent Access tier users but where signals from incumbent users could possibly interfere with GAA uses.^[1] However, the <i>NPRM</i> noted that Priority Access users, which have quality-of-service expectations, would only be permitted where CBSD operations would not interfere with incumbent operations, and where harmful interference would not be reasonably expected from Incumbent Access tier operations.^[2] It may eventually be practicable to authorize coordinated operations for GAA – and possibly Priority Access - tier users inside the proposed Exclusion Zones. We anticipate such use would involve a level of dynamic access to the spectrum</p>	<p>The members of the Wireless Innovation Forum believe that support for dynamic SAS control of spectrum avoids excessive exclusion zones.</p>

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	<p>and would be authorized through the SAS. However, adding this kind of dynamic element to the SAS raises many technical and operational questions that are not ripe for resolution at this time. Accordingly, we will explore the topic of dynamic coordinated access within the Exclusion Zones (<i>i.e.</i>, converting Exclusion Zones to protection zones) in future phases of this proceeding.^[3] We seek comment on allowing Citizens Broadband Radio Service operations within currently designated Exclusion Zones and encourage commenters to submit technical analyses to support their positions</p>	
	<p>2. Protection for Citizens Broadband Radio Service Devices from Federal Radar Systems</p>	
143	<p>While the proposed Exclusion Zones will prevent interference from radar systems into CBSDs, the possibility of future CBSD operations in close proximity to high power federal radar systems may require that Priority Access Licensees and GAA users take reasonable measures to protect their CBSDs from these high powered operations. Radar systems operating at the power levels described in the NTIA Fast Track Report^[1] could lead to peak field strengths in excess of 180 dBuV/m (~33 dBm) at line of sight distances of approximately 1 km.^[2] We also recognize that modern receiver technologies incorporate Surface Acoustic Wave / Bulk Acoustic Wave filters that may have peak input power limits in the range of 10 dBm to 33 dBm. To ensure that end users are not adversely affected by the hard failure of receiver components due to interference from such radars, we propose that CBSDs must be capable accept interference in authorized areas of operation up to a peak field strength level of 180 dBuV/m. We seek comment on these proposals and ask that commenters support their proposals with detailed technical analyses. How would such a requirement impact the design and cost of equipment for this band? Alternatively, are there measures that licensees can take to minimize the potential of receiving interference from federal incumbent operations?</p>	<p>The members of the Wireless Innovation Forum respectfully disagree. The commission should not specify technology or receiver limits. GAA users are responsible for their own receiver designs and assume the performance risk. The SAS can support PAL devices on a QoS basis and by not specifying a specific technological solution; the Commission is actively fostering innovation in receiver design.</p>
144	<p>In addition to the high-power interference effects discussed in the previous paragraph, pulsed radar signals can also cause degradation of CBSD receiver performance. NTIA recently performed measurements to examine the impact of pulsed radar signals on digital receiver performance.[1] Three receiver parameters were examined: (1) data throughput rates; (2) block error rates; and (3) internal noise level. These performance parameters were measured as a function of radar pulse parameters and the incident power level of radar pulses. We seek comments on how the NTIA report can be used to develop thresholds for CBSD receivers to be used in assessing potential interference from federal incumbent operations.</p>	<p>The members of the Wireless Innovation Forum believe that commercial PAL and GAA equipment manufacturers should be responsible for their own receiver performance design and harm interference threshold. The market will support commercial deployment of systems that work in these areas.</p>

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	3. Protection for Fixed Satellite Service Earth Stations	
	a. Earth Station in the 3.5 GHz Band	
147	Notably, SIA filed several comments and letters arguing that the Commission should allow small cell operations in the 3.5 GHz Band only if it can show that in-band and C-Band satellite services will be protected from interference and asking the Commission to lift the freeze on earth station applications in the band.[1] SIA also submitted a technical analysis that indicated that in-band FSS earth stations would require protection distances of up to 107.4 km to mitigate long-term interference and 487 km to mitigate short-term interference	The members of the Wireless Innovation Forum respectfully disagree with the use of fixed geographic exclusion zones for FSS spectrum. A roadmap for better receivers is appropriate for FSS earth stations, as it will be for all user deployments. This should be addressed by the Technology Roadmap Multi-stakeholder Working Group.
148	On September 3, 2013, Google made an <i>ex parte</i> submission addressing potential interference from proposed Citizens Broadband operations into existing in-band and out-of-band satellite earth stations. ^[1] With regard to grandfathered FSS earth stations in the 3.5 GHz Band, Google asserts that these earth stations can be protected by the SAS through a combination of coordination, spectral separation, and protection zones. ^[2] Google also asserts that SIA’s submission overstates the potential for interference from CBSDs into in-band FSS earth stations. ^[3] According to Google, these overstatements are largely due to inappropriate assumptions about terrain, small cell emissions output, and typical small cell power levels as well as a reliance on an ITU interference protection standard that was not intended to apply in this context	The members of the Wireless Innovation Forum agree.
151	We also seek comment on protection approaches other than protection areas. For example, we are interested in whether field strength, power-flux density, or some other technical metric, measured in relation to the earth station’s technical configuration (antenna characteristics, etc.) might provide FSS earth stations with adequate protections while maximizing the available geographic area and bandwidth for Citizens Broadband Radio Service Users. To the extent such an approach is dependent upon operation of the SAS, we seek comment on what functionalities would need to be required by rule and what functionalities could be specified through other means (<i>e.g.</i> , industry standards, multi-stakeholder groups, etc.). Again, we request that parties provide specific and actionable suggestions in providing comments on this issue, including the potential costs and benefits of these approaches	The members of the Wireless Innovation Forum feel that this should be based on harm interference thresholds and managed by a SAS to avoid interference in all areas and regions.
	b. Earth Stations in the C-Band	

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153	<p>Notably, a coalition of media companies and trade organizations, including Fox Entertainment Group, Inc., Time Warner Inc., Viacom Inc., the Walt Disney Company, CBS Corporation, and the National Association of Broadcasters (NAB) (jointly, Content Interests) filed jointly to encourage the Commission to study the potential for interference into C-Band satellite operations before considering commercial operations in the 3.5 GHz Band.[1] Their filings included technical reports from Comsearch and Alion Science and Technology (Alion) that concluded that C-Band earth stations would require significant geographic protection from CBSDs. Alion asserts that separation distances ranging from 600 meters to 9 Km would be required to protect C-Band earth station locations with appropriate filters installed while unfiltered sites would require 19 to 33 Km separation distances. The separation distances would increase to 14 to 28 Km for filtered sites if the full 3550-3700 MHz band is utilized.</p>	<p>The members of the Wireless Innovation Forum support SAS control.</p>
154	<p>The Comsearch Report largely comports with Alion’s findings. Comsearch noted that the 43+10 log (P) dB OOB limit proposed in the <i>NPRM</i> is equivalent to OOB of -13 dBm/MHz (-43 dBW/MHz), the same as the International Telecommunication Union (ITU) and LTE-Advanced (LTE-A) baseline “Category A” limits.[1] Comsearch suggests that adopting the ITU’s more stringent “Category B” limit for OOB would significantly reduce required protection zones around C-Band earth stations.[2] According to Comsearch, interference could occur at a range of up to 47.6 km from C-Band receivers with typical separation distances of 5.1 km if Category A devices are authorized by the Commission.[3] The typical separation distance would be reduced to 0.7 km if devices are limited to Category B emission limits.[4]</p>	<p>The members of the Wireless Innovation Forum support SAS control.</p>
155	<p>SIA’s comments also addressed protection criteria for C-Band earth stations.[1] SIA’s technical analysis indicated that C-Band earth stations would require protection zones of up to 36.4 km to protect them from OOB in the 3.5 GHz Band.[2] SIA also asserts that simply determining the size of these protection zones is insufficient to ensure protection of existing FSS operations and that the Commission must ensure that these protection zones are effectively enforced.</p>	<p>The members of the Wireless Innovation Forum support SAS control.</p>

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156	<p>Google also made multiple submissions, including a detailed technical analysis, addressing potential interference from proposed Citizens Broadband operations into C-Band earth stations.^[1] Google asserts that emissions from small cells in the 3.5 GHz Band would cause minimal interference issues to C-Band receivers and that any potential interference would come from operations in close spatial and spectral proximity to those earth stations.^[2] Moreover, Google claims that the look angle of C-Band earth stations can have a significant effect on potential interference from OOB and that protection zones can be significantly reduced by including the positions of these receivers in the SAS. While SIA disagrees with many of Google’s conclusions, they agree that relevant data related to CBSDs and earth stations could be programmed into the SAS to allow for real-time calculation of required protection distances.</p>	<p>The members of the Wireless Innovation Forum support SAS control.</p>
157	<p>According to Google’s studies, accounting for the elevation angle of C-Band dishes coupled with appropriate placement of Citizens Broadband devices can further reduce the required separation distances and areas around C-Band earth stations.^[1] Using Google’s assumptions,^[2] the maximum required protection distance for any C-Band earth station would be 1.67 km (with an excluded area of only .55 km) for an earth station with a 5 degree elevation.^[3] The average protection area for a typical earth station would be approximately 0.285 km.^[4] Google asserts that these shaped exclusion zones could be managed and enforced by the SAS and that the same techniques could be applied to grandfathered earth stations in the 3600-3650 MHz band</p>	<p>The members of the Wireless Innovation Forum support SAS control.</p>
158	<p>Google also asserts that, due to differences in international C-Band allocations, many C-Band earth stations in the U.S. “listen” to transmissions well outside of their authorized spectrum allocations.^[1] Indeed, Google claims that many such earth stations “listen” for transmissions as low as 3400 MHz, a full 300 megahertz below their authorized allocation.^[2] The ITU studies cited by SIA consider these equipment specifications in reaching their conclusions about harmful interference from commercial operations in the 3.5 GHz Band.^[3] Google asserts that existing C-Band operators should not be afforded special protections for equipment that listens well beyond their licensed allocation.^[4] Moreover, according to Google, many C-Band earth stations can effectively mitigate interference from commercial operations in the 3.5 GHz Band by utilizing readily available, low-cost filters.^[5] Indeed, Google asserts that C-Band operators already utilize similar filters to protect themselves from Federal radar operations on the 3500-3700 MHz band.</p>	<p>The members of the Wireless Innovation Forum support SAS control.</p>

¶	FNPRM Text	WinnForum Response
159	<p>While the proposed Part 96 rules do not necessarily address all concerns about potential interference into C-Band earth stations raised in the record, they do include stricter-than-normal out of band emission limits for CBSDs/user devices, and a spectrum access framework utilizing a dynamic SAS. The SAS can calculate the expected aggregate power flux density at in-band station locations attributable to authorized CBSDs and End User Devices, and authorize operations to ensure that interference protection criteria are not exceeded. We propose an equivalent power flux density (EPFD), which would be the sum of the power flux densities produced at a geostationary satellite system receive Earth station, by CBSD and End User Devices in the area of that earth station. The EPFD would be calculated to take into account the off-axis discrimination of the Earth station receiving antenna assumed to be pointing in its nominal direction. We seek comment as to whether CBSD and End User Device emission limits based on EPFD and SAS authorization controls would adequately address concerns over potential interference with C-Band earth stations, or whether additional protections are necessary.</p>	<p>The members of the Wireless Innovation Forum feel that antenna characteristics modeling should be included in defining the harm interference threshold.</p>
160	<p>The “look angle” of FSS earth stations would have a significant impact on the potential for interference from CBSDs, particularly those located at moderate angles (<i>e.g.</i>, > 15°) from the axis of the FSS earth station main lobe. We seek comment on the effect of the “look angles” of FSS earth stations for potential interference from CBSDs, including any potential costs and benefits. Would the SAS be able to effectively monitor and manage information on FSS earth station “look angles” to calculate EPFD interference limits, and dynamically adjust any potential protection areas around these earth stations accordingly?</p>	<p>The members of the Wireless Innovation Forum feel that antenna characteristics modeling should be included in defining the harm interference threshold.</p>
161	<p>We also seek comment on additional mitigation strategies that could be employed to prevent harmful interference to earth stations and reduce or eliminate the need for geographic separation between CBSDs and C-Band earth stations. Specifically, to what degree could filters be utilized to reduce or eliminate harmful interference? Are current commercially available filters sufficient? What would be the likely cost of installing filters in C-Band and 3.5 GHz Band FSS earth stations?</p>	<p>The members of the Wireless Innovation Forum feel that antenna characteristics modeling should be included in defining the harm interference threshold.</p>
	<p>4. Enforcement Issues</p>	
	<p>5. Extension of Part 96 Rules to 3650-3700 MHz Band</p>	

¶	FNPRM Text	WinnForum Response
163	<p>In the NPRM, the Commission sought comment on a supplemental proposal to include the adjacent 3650-3700 MHz band in the proposed regulatory regime.[1] As noted in the NPRM, incorporating this additional 50 megahertz would create a 150 megahertz contiguous block of spectrum that could be used by existing licensees in the 3650-3700 MHz band – as well as new licensees – to expand the services that they are already providing. Subsequently in the Licensing PN the Commission sought comment on extending the Revised Framework to the 3650-3700 MHz band, and asked what provisions would need to be made for existing operators and how much transition time would be required.</p>	<p>The members of the Wireless Innovation Forum support including 3650 to 3700 MHz.</p>
164	<p>Commenters generally support the proposal to create a 150 megahertz contiguous block of spectrum,[1] while a few commenters oppose changing the existing framework for the 3650-3700 MHz band. In addition, WISPA believes that existing 3650–3700 MHz users should get priority access protection and have five years to transition to the new framework.</p>	<p>The members of the Wireless Innovation Forum support including 3650 to 3700 MHz.</p>
165	<p>There could be long-term gains and significant public interest benefits to extending the rules proposed here to the 3650-3700 MHz band, both in terms of terms of spectrum efficiency and availability, and economies of scale for equipment across the full 150 megahertz. However, we recognize the significant investment that incumbent 3650-3700 MHz licensees have made. Should we incorporate 3650-3700 MHz into the regulatory scheme proposed in this <i>FNPRM</i>, we would seek to do so in a way that would maximize the benefits to all potential licensees, while minimizing the costs to incumbent licensees. Below we set forth proposed rules in the event that we opt to incorporate the 3650-3700 MHz band into our proposed regulatory framework.</p>	<p>The members of the Wireless Innovation Forum support including 3650 to 3700 MHz.</p>

¶	FNPRM Text	WinnForum Response
166	<p>If we extend these proposed rules, we propose to grandfather existing 3650-3700 MHz operations for a period of five years after the effective date of the proposed rules. More specifically, we would treat each incumbent 3650-3700 MHz nationwide licensee (Grandfathered Wireless Broadband Provider) as an Incumbent User within the service contours of its registered base stations or fixed access points during the transition period. During the transition period, existing licensees would be permitted to operate stations in accordance with the technical rules in Part 90, Subpart Z, if any have been authorized, and would have priority over GAA and Priority Access users in the 3650-3700 MHz band. During this period, Grandfathered Wireless Broadband Providers would be required to avoid causing harmful interference to federal users and grandfathered FSS earth stations, in accordance with existing Part 90 rules.[1] After the transition period, Grandfathered Wireless Broadband Providers would be required to protect incumbent operations in the 3650-3700 MHz band consistent with any applicable protection criteria the Commission develops in conjunction with NTIA, DoD, and other stakeholders. Because the Grandfathered Wireless Broadband Provider would continue to operate under Part 90 rules and would not operate equipment that is authorized by the SAS, GAA use would not be permitted to interfere with the service contour of Grandfathered Wireless Broadband Providers during the transition period.</p>	<p>The members of the Wireless Innovation Forum support including 3650 to 3700 MHz.</p>
167	<p>At the end of the transition period Grandfathered Wireless Broadband Providers would have the option, available to all eligible 3.5 GHz Band users, to apply for PALs or to operate on a GAA basis consistent with Part 96 rules. During the transition period, Grandfathered Wireless Broadband Provider with overlapping service contours would be required to coordinate with one another as currently required by Part 90, Subpart Z.</p>	<p>The members of the Wireless Innovation Forum support including 3650 to 3700 MHz.</p>
168	<p>We seek comment on this proposed approach to incorporating the 3650-3700 MHz band into the regulatory scheme described in this <i>FNPRM</i>. In particular, we seek comment on whether the five year transition period proposed is appropriate. What are current equipment upgrade cycles for fixed and mobile equipment in the 3650-3700 MHz band? Given upgrade cycles, what is the incremental cost of upgrading a 3650-3700 MHz system to one that can operate consistent with the proposed Part 96 rules over a five-year period? How do these costs weigh against the possibility of upgrading to equipment that could access a full 150-megahertz on a PAL or GAA basis? We seek comment on our proposal to protect the service contour of existing licensees. More specifically what criteria should be used to define the existing service contour? What criteria should be used to</p>	<p>The members of the Wireless Innovation Forum support including 3650 to 3700 MHz.</p>

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	define interference to the existing contour from GAA users? We also seek comment on whether there are other grandfathering and transition mechanisms that we should consider.	
169	We also seek comment on how the band should be assigned to GAA and Priority Access tier users after the transition period. Under the proposed rules, a minimum of 50 percent of available bandwidth would be made available for GAA use at any given time in any given geographic area. Would this formulation still be in the public interest if the supplemental proposal is adopted? Notably, Microsoft suggested that a minimum of 50 megahertz of spectrum should be reserved for GAA uses at all times.[1] If we adopt the supplemental proposal, should we guarantee a fixed spectrum floor for GAA (i.e., 50 megahertz) and make the remainder of the spectrum available as PALs? We encourage commenters to consider the costs and benefits of any proposals they put forth	The members of the Wireless Innovation Forum support including 3650 to 3700 MHz.