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## **Small Entity Compliance Guide**

### **Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band**

**FCC 15-47**

**GN Docket No. 12-354**

This Guide is prepared in accordance with the requirements of Section 212 of the Small Business Regulatory Enforcement Fairness Act of 1996. It is intended to help small entities—small businesses, small organizations (non-profits), and small governmental jurisdictions—comply with the new rules adopted in the above-referenced FCC rulemaking docket(s). This Guide is not intended to replace the rules and, therefore, final authority rests solely with the rules. Although we have attempted to cover all parts of the rules that might be especially important to small entities, the coverage may not be exhaustive. This Guide may, perhaps, not apply in a particular situation based upon the circumstances, and the FCC retains the discretion to adopt approaches on a case-by-case basis that may differ from this Guide, where appropriate. Any decisions regarding a particular small entity will be based on the statute and regulations.

In any civil or administrative action against a small entity for a violation of rules, the content of the Small Entity Compliance Guide may be considered as evidence of the reasonableness or appropriateness of proposed fines, penalties or damages. Interested parties are free to file comments regarding this Guide and the appropriateness of its application to a particular situation; the FCC will consider whether the recommendations or interpretations in the Guide are appropriate in that situation. The FCC may decide to revise this Guide without public notice to reflect changes in the FCC's approach to implementing a rule, or to clarify or update the text of the Guide. Direct your comments and recommendations, or calls for further assistance, to the FCC's Consumer Center:

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## I. INTRODUCTION

In the *Report and Order* the Commission adopted rules for commercial use of 150 megahertz in the 3550-3700 MHz band (3.5 GHz Band), to be codified in a new Part 96 of Title 47 of the Code of Federal Regulations. The 3.5 GHz Band is currently used for Department of Defense radar services, commercial Fixed Satellite Service (FSS) earth stations (space-to-earth) (in the 3600-3700 MHz portion of the band), non-federal radiolocation services (in the 3550-3650 MHz portion of the band), and Wireless Broadband Service licensees (in the 3650-3700 MHz portion of the band). The creation of a new Citizens Broadband Radio Service in this band will add much-needed capacity to meet the ever-increasing demands of wireless innovation. As such, it represents a major contribution toward the Commission's goal of making 500 megahertz newly available for broadband use and will help to unleash broadband opportunities for consumers throughout the country, particularly in areas with overburdened spectrum resources.

The *Report and Order* adopted a new approach to spectrum management, which makes use of advances in computing technology to facilitate more intensive spectrum sharing: between commercial and federal users and among multiple tiers of commercial users. This three-tiered sharing framework is enabled by a Spectrum Access System (SAS), to be implemented by one or more SAS Administrators to be selected by the Commission based on its review of applications. The SAS incorporates a dynamic spectrum database and interference mitigation techniques to manage all three tiers of authorized users (Incumbent Access, Priority Access, and General Authorized Access (GAA)). The SAS thus will serve as an advanced, highly automated frequency coordinator across the band – protecting higher tier users from those beneath and optimizing frequency use to allow maximum capacity and coexistence in the band. Incumbent users represent the highest tier in the new 3.5 GHz framework and receive interference protection from Citizens Broadband Radio Service users.

Protected incumbents include the federal operations as well as FSS and, for a finite period, grandfathered terrestrial wireless operations in the 3650-3700 MHz portion of the band. The Citizens Broadband Radio Service itself consists of two tiers—Priority Access and GAA—both authorized in any given location and frequency by an SAS. Both will be permitted to select whether they will provide service on a common carrier or non-common carrier basis.

As the name suggests, Priority Access operations receive protection from GAA operations. Priority Access Licenses (PALs), defined as an authorization to use 10 megahertz in a single census tract for three years, will be assigned in up to 70 megahertz of the lower 100 megahertz (3550-3650 MHz) portion of the band. The specific frequencies on which Priority Access Licensees (and GAA users) may operate will be determined by the SAS and may be subject to change from time to time through its dynamic interference management system, but the rules include provisions designed to ensure that PAL channel assignments remain as stable and consistent as feasible for licensees holding multiple channels within the same or contiguous census tracts.

GAA use will be allowed, by rule, throughout the 150 megahertz band. GAA users will potentially have access to all 150 megahertz in areas where there are no PALs issued or in use, and up to 80 megahertz where all PALs are in use. GAA users will receive no interference protection from other Citizens Broadband Radio Service users. In general, under this three-tiered licensing framework incumbent users would be able to operate on a fully protected basis, while the technical benefits of small cells are leveraged to facilitate innovative and efficient uses in the 3.5 GHz Band.

The Commission adopted its supplemental proposal to integrate the existing 3650-3700 MHz band within the Citizens Broadband Radio Service, thereby encompassing an additional 50 megahertz of contiguous spectrum. The Commission previously licensed the 3650-3700 MHz band on a non-exclusive nationwide basis, with protections for incumbent FSS operations. Smart grid, rural broadband, small cell backhaul, and other point-to-multipoint networks will enjoy three times more bandwidth than was available under the previous 3650-3700 MHz band rules. The adoption of the supplemental proposal will promote spectrum efficiency and availability, as well as economies of scale for equipment across the full 150 MHz band. Grandfathering rights for existing 3650-3700 MHz licenses are described below.

The Commission will continue to permit primary operations in the 3600-3650 MHz band for those FSS earth stations authorized prior to, or granted as a result of an application filed prior to, July 23, 2015, and constructed within 12 months of their initial authorization. However, the Commission will not accept applications for modifications to existing FSS earth station facilities after July 23, 2015, except for changes in polarization, antenna orientation, or ownership. The Commission will also allow modifications to increase the antenna size to mitigate interference from new services and it will consider reasonable waiver requests from existing FSS licensees to accommodate additional modifications, including facility relocation, on a case-by-case basis. Any new FSS earth stations in the 3600-3650 MHz band, applied for following July 23, 2015, will be authorized on a secondary basis to non-federal stations in the fixed and land mobile services. Citizens Broadband Radio Service Devices (CBSDs) are prohibited from causing harmful interference to any in-band FSS earth stations authorized prior to the effective date of this *Report and Order*, as those earth stations will retain primary status.

The Commission eliminated the non-federal radiolocation allocation in the 3550-3650 MHz band. However, the Commission will continue to permit non-federal radiolocation stations that were licensed or had filed an application for authorization prior to July 23, 2015, to continue to operate on a secondary basis until the end of the equipment's useful lifetime.

## **A. Priority Access Tier**

### **1. Eligibility**

Any entity that is eligible to hold an FCC license is eligible to apply for, and hold, a PAL. All applicants for PALs must demonstrate their qualification to hold an authorization and demonstrate how a grant of authorization would serve the public interest. Qualifications include those under Section 310 of the Act regarding foreign ownership, as well as the bar on participation in spectrum auctions with respect to any person "who has been, for reasons of national security, barred by any agency of the Federal Government from bidding on a contract, participating in an auction, or receiving a grant."

### **2. PAL Configuration**

#### **a. Frequencies**

PALs will be authorized to operate over 10 megahertz unpaired channels, but only in the lower 100 megahertz (3550-3650 MHz) of the band. The Commission will require the SAS to assign multiple channels held by the same Priority Access Licensee to contiguous channels in the same or contiguous license areas, where feasible. However, while a Priority Access Licensee may initially request a particular channel or frequency range, any particular request will not be guaranteed.

**b. Area**

The Commission adopted census tracts, of which there are currently over 74,000 (each targeted to an optimum population of 4,000) as the appropriate geographic license size for PALs. Census tracts vary in size depending on the population density of the region, with tracts as small as one square mile or less in dense urban areas and up to 85,000 square miles in sparsely populated rural regions and generally nest into counties and other political subdivisions. In turn, they nest into the standardized license areas commonly used by the Commission (*e.g.*, CMAs, EAs, and Partial Economic Areas).

**c. Term**

The Commission adopted a three-year license term for PALs. At the end of its three-year license term, a PAL will automatically terminate and may not be renewed. However, solely during the first application window, the Commission will permit an applicant to apply for up to two consecutive three-year terms for any given PAL available during such first application window, for a total of six years. During subsequent regular application windows, only the next three-year license term will be made available for any given PAL. If sufficient interest is expressed by prospective Priority Access Licensees, the Commission will also open interim filing windows for unassigned PALs, in which case any newly auctioned PAL term will expire at the end of the three-year period associated with previously auctioned PALs, so that all PALs will be made available for bidding in the next regular window. This practice will avoid staggered PAL terms.

**3. Spectrum Aggregation Limits**

The Commission adopted an aggregation limit to allow licensees to hold no more than four PALs in one census tract at one time (*i.e.*, 40 megahertz out of 70 megahertz allocated to PALs in one census tract at any time). A spectrum aggregation limit of 40 megahertz will ensure availability of PAL spectrum to at least two users in those geographic areas where there is the greatest likelihood of high demand for such spectrum.

**4. Competitive Bidding Procedures**

The Commission adopted rules to govern the use of a competitive bidding process for assigning PALs in the 3550-3650 MHz band and it will conduct any auction of PALs in the 3550-3650 MHz band in conformity with the general competitive bidding rules set forth in Part 1, Subpart Q of the Commission's rules, and substantially consistent with the competitive bidding procedures that have been employed in previous auctions, except as otherwise provided in this *Report and Order*.

PALs will be assigned through competitive bidding only where Commission will receive multiple competing applications in a geographic area that seek PALs that exceed the available supply. If PAL applicants for a specific geographic area do not seek PALs that exceed the available supply, the Commission will not assign any PALs in that license area. Instead, the Commission will cancel the auction with respect to that license area and the spectrum will remain available for GAA use under the license-by-rule framework until the next application filing window for PALs in the 3.5 GHz Band is opened either for unassigned PALs or otherwise in advance of the expiration of the prior three-year license term.

Under this approach, when there are two or more applicants for PALs in a given census tract for a specific auction, the Commission will make available one less PAL than the total number of PALs in that tract for which all applicants have applied, up to a maximum of seven.

The determination of mutual exclusivity of PAL applications is not a one-time event for this band. Because PALs are licensed for three-year, non-renewable terms, the Commission will periodically open application windows for new PALs that take effect upon expiration of previously assigned PALs. Additionally, if sufficient interest is expressed by prospective PAL users, the Commission will open interim filing windows to accept applications for unassigned PALs, *i.e.*, PALs that could be made available for auction, before the expiration of an ongoing three-year PAL term. In the pre-auction public notice process by which the Commission first seeks comment on and subsequently announces the procedures for the first auction of PALs in the 3.5 GHz Band, the Commission will consider the process by which it will determine whether there is sufficient interest by prospective Priority Access Licensees in participating in an interim auction of PALs prior to expiration of an ongoing three-year PAL term.

The competitive bidding process will be initiated by the release of the *Auction Comment PN*, which will solicit public input on final auction procedures, and which will include specific proposals for auction components such as minimum opening bids. Thereafter, the *Auction Procedures PN* will specify final procedures, including dates, deadlines, and other final details of the applications and bidding processes. The Commission's practice of finalizing auction procedures in the pre-auction process will provide time for interested participants to both comment on the final procedures and to develop business plans in advance of the auction. Because the nature of the Citizens Broadband Radio Service already gives designated entities the opportunity to access 3.5 GHz spectrum, neither small business nor tribal land bidding credits will be offered in auctions of PALs.

## **B. General Authorized Access**

The Commission adopted a license-by-rule authorization framework under Section 307 of the Communications Act for GAA users. This framework will facilitate the rapid deployment of compliant small cell devices while minimizing administrative costs and burdens on the public, licensees, and the Commission.

Under the license-by-rule framework, GAA users may use only certified, Commission-approved CBSDs and must register with the SAS. Consistent with the new rules governing CBSDs, devices operating on a GAA basis must 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. GAA users must also comply with the instructions of the SAS and must avoid causing harmful interference to Priority Access Licensees and Incumbent Access tier users. Similar to unlicensed operations, GAA users will have no expectation of interference protection from Incumbent Users and other Citizens Broadband Radio Service users.

## **C. Technical Rules**

### **1. General Radio Requirements**

#### **a. Digital Modulation**

For both PAL and GAA use, the Commission adopted the requirement that CBSDs use digital modulation techniques.

**b. Emissions and Interference Limits**

The Commission adopted the following out of band emission limits:

- -13 dBm/MHz from 0 to 10 megahertz from the SAS assigned channel edge
- -25 dBm/MHz beyond 10 megahertz from the SAS assigned channel edge down to 3530 MHz and up to 3720 MHz
- -40 dBm/MHz below 3530 MHz and above 3720 MHz

**c. Received Signal Strength Limits**

The Commission established an aggregate -80 dBm per 10 megahertz signal threshold at the service boundaries. Licensees are permitted to agree to lower or higher acceptable maximum signal levels appropriate to their particular network configurations and communicate their agreement to an SAS. The measurement antenna must be placed at a height of 1.5 meters above ground level. These signal level requirements will not apply to adjacent license areas held by the same Priority Access Licensee. The Commission will apply the limit through measurements at the license area boundary at times of peak activity.

Priority Access Licensees must accept adjacent channel and in-band blocking from other Priority Access or GAA radios in the band, up to a power spectral density level not to exceed -40 dBm per 10 megahertz with greater than 99% probability.

**2. CBSD Requirements**

**a. CBSD Categories and Power Requirements**

The Commission defined two categories of CBSDs. Category A and Category B CBSDs will be defined mainly by their maximum conducted power and deployment conditions. Both CBSD categories will be available for GAA and Priority Access use (with certain caveats, described below). This commonality of technical rules throughout the Citizens Broadband Radio Service will ensure that equipment can switch between GAA and PA authorizations over time without changing network coverage footprint.

The table below summarizes the main technical and operational characteristics of Category A and Category B CBSDs:

<b>CBSD Category</b>	<b>Maximum Conducted Power (dBm/10 MHz)</b>	<b>Maximum EIRP (dBm/10 MHz)</b>	<b>Maximum Conducted PSD (dBm/MHz)</b>	<b>CBSD Installations</b>	<b>Operations in 3550-3650 MHz</b>	<b>Operations in 3650-3700 MHz</b>
Category A	24	30	14	- Indoor - Outdoor max 6m HAAT	Everywhere Outside Department of Defense (DoD) Protection Zone	Everywhere Outside FSS and DoD Protection Zone



Category B (Non-Rural)	24	40	14	- Outdoor only - Professional Installation	Outside DoD Protection Zone & requires Environmental Sensing Capability (ESC) approval	Everywhere Outside FSS Protection Zone and DoD Protection Zone
Category B (Rural)	30	47	20	- Outdoor only - Professional Installation	Outside DoD Protection Zone & requires ESC approval	Everywhere Outside FSS Protection Zone and DoD Protection Zone

**b. Geo-location and Reporting Capability**

The Commission adopted location accuracy requirements (+/- 50 meters horizontal and +/- 3 meters vertical), allowing location information to be captured and reported to SAS as part of a CBSD’s initial registration either via automated geolocation technologies or by a professional installer. Accurate CBSD location is essential for coordinating interactions between and among users in the band and for protecting Incumbent Users from harmful interference.

The Commission will permit professional installers to report accurate CBSD location information in lieu of automated reporting measures. Any subsequent CBSD movement must be reported by a professional installer as well. Since CBSDs will be fixed installations, the professional installation option should allow for network deployment in the near term while automatic geo-location technologies are tested and developed that meet the Commission’s accuracy requirements.

**c. Band-wide Operability**

All CBSDs must be capable of two-way transmissions on any frequency from 3550-3700 MHz as instructed by the SAS. Band-wide operability will help to establish a consistent certification process for the entire band, promote competitive access to the band, encourage innovation, foster the development of a diverse equipment ecosystem, and ensure that the band is made available for a wide variety of innovative uses by an array of potential users, including standalone private networks that do not have recourse to mobile networks in other bands for signaling and control. This capability requirement, however, does not mean that CBSDs and End User Devices are required to *operate* in a two-way mode.

The Commission exempted existing Part 90 equipment used by Grandfathered Wireless Broadband Licensees from the band-wide operability requirement and provided such licensees with a reasonable transition period during which their existing operations will be protected. After the transition period, such equipment will continue to be exempt from the band-wide operability requirement but must otherwise comply with the rules applicable to CBSDs, including SAS registration.



**d. Registration Requirements**

As part of registration, the CBSD must provide the SAS with a number of operational parameters, including geographic location, antenna height above ground level (meters), CBSD operational category (Category A/Category B), requested authorization status, unique FCC identification number, user contact information, air interface technology, unique serial number, and additional information on its deployment profile (e.g., indoor/outdoor operation). All information provided by the CBSD to the SAS must be true, complete, correct, and made in good faith, and failure to provide such information will void the user's authority to operate the CBSD.

Category B CBSDs must also register antenna gain, antenna beamwidth, antenna azimuth for sector site, and antenna height above ground level. These additional requirements could provide the SAS with information necessary to perform effective propagation and interference mitigation analyses on these higher power devices. This will help ensure the effective coexistence of all tiers of user operating in the band. If any of the required registration information changes, the CBSD must update the SAS within 60 seconds of such change.

**e. Interference Reporting**

The Commission will require that CBSDs be able to measure and report on their local interference levels and issues and will encourage industry to develop detailed metrics regarding issues like received signal strength, packet error rate, and technology specific parameters of signal and interference metrics. These metrics could be developed by an industry multi-stakeholder group. Such guidance could be incorporated in the SAS Approval process or incorporated independently by authorized SAS Administrators, subject to Commission review.

**f. Security**

The Commission codified a requirement for secure communications between authorized SASs and CBSDs and also adopted comprehensive procedures to test and certify CBSDs and associated End User Devices for operation in this band. All CBSDs and End User Devices must contain security features sufficient to protect against modification of software and firmware by any unauthorized parties. Applications for certification of CBSDs and End User Devices must include an operational description of the technologies and measures that are incorporated in the device to comply with the security requirements. In addition, CBSDs and End User Devices should be able to protect the communication data that are exchanged between these elements. SAS Administrators and CBSD operators who, in good faith, implement duly approved/certified SAS or CBSD security capabilities will be presumed, for enforcement purposes, to be compliant with the rules pertaining to those capabilities. Any subsequently identified security vulnerabilities will need to be resolved on a going-forward basis. The Commission encouraged the industry to develop best practices for end-to-end security that can be validated in the equipment and SAS certification processes.

**3. End User Device Requirements**

End User Devices have a maximum EIRP of 23 dBm per 10 megahertz. They may only operate if they can receive and decode an authorization signal sent by a CBSD, including the frequencies and power limits for their operation. The End User Devices should operate under power control of an associated CBSD. This requirement is necessary to ensure that interference levels can be effectively

managed in the band to protect Incumbent Access and Priority Access Licensees from harmful interference. All End User Devices and CBSDs must also include necessary security features to protect against modification of software and firmware by any unauthorized parties. Applications for certification of CBSDs and End User Devices must include an operational description of the technologies and methods that are incorporated in the device to comply with the foregoing security requirements.

#### **4. Other Technical Issues**

Part 1 RF Safety and Part 2 Equipment Authorization rules apply to CBSDs.

#### **D. Incumbent Protections**

##### **1. Federal Incumbent Protection**

##### **a. Multi-Phase Approach**

The Commission adopted the phased approach to federal Incumbent User protection recommended by the National Telecommunications and Information Administration (NTIA). During phase one, a large portion of the country other than certain “Exclusion Zones” will be available for Citizens Broadband Radio Service use as soon as a commercial SAS is approved and made commercially available. During phase two, much of the rest of the country – including major coastal cities – will be made available for commercial use when no federal incumbent use is detected in a given area by the Environmental Sensing Capability (ESC).

Phase two will begin when an ESC is developed, approved, and deployed. The ESC will consist of a network of sensors – infrastructure-based, device-based, or a combination of both – that will detect federal radars operating in and around the 3.5 GHz Band and relay information regarding those transmissions to the SAS in order to protect incumbent federal users. Sensors must be deployed in or near Exclusion Zones and near federal ground-radar facilities to detect federal spectrum use. Approved SASs will process the information communicated by the ESC and instruct associated CBSDs to cease operations or move to unencumbered frequencies in geographic areas where federal use has been detected. The ESC will be managed and operated by one or more commercial entities and will not require day-to-day input or oversight from the Department of Defense (DoD) or NTIA.

As a consequence of ESC deployment in phase two, the Exclusion Zones will be converted to Protection Zones. Citizens Broadband Radio Service operations in the 3550-3650 MHz band will be permitted within Protection Zones, including major coastal cities, except when the ESC reports federal use in the area. Availability of an ESC will also allow use of Category B CBSDs in the 3550-3650 MHz band portion, provided that the relevant system parameters required to protect federal Incumbent User operations at these higher levels are determined and implemented through the ESC approval process. DoD may also add additional radar sites in the future through the usual NTIA spectrum assignment processes, and the Commission will provide appropriate notice of any such additions and make the necessary ministerial amendments to its Table of Allocations. Once assigned, these new sites will be accorded the same protections as other radar sites in the band.

This two-phase approach will also apply to the protection of the existing federal sites operating in the 3650-3700 MHz band. During phase one, these sites will be protected from commercial operations in the 3650-3700 MHz band consistent with the static protection contours set forth in 47 C.F.R § 2.106, US

109. During phase 2, these sites will be protected by the ESC in the same manner as federal sites in the 3550-3650 MHz band.

After the ESC and SAS are approved, spectrum availability will be determined and conveyed automatically, promoting efficient use of the band and ensuring that federal Incumbent Users are protected. This approach will rely on technology to automatically provide information on federal frequency use to an SAS for the benefit of all of its associated CBSDs, rather than requiring individual licensees and federal Incumbent Users to attempt to reach *ad hoc* coordination agreements and implement the terms of such agreements. It will avoid burdening military operators with significant new spectrum coordination obligations and will protect operational security.

The operators may skip phase one entirely if they develop an ESC simultaneously with the SAS. However, while the approval processes for these systems will be similar, they may be developed separately. If an SAS is approved and made commercially available before an ESC is available, the rules governing phase one deployments will apply until an ESC is approved and connected to an approved SAS.

There are several inland radar testing facilities that will require protection. The Commission will work with NTIA and DoD to determine appropriate phase one protection criteria for these sites based on the engineering methodology used to determine the revised coastal Exclusion Zones and taking into account any site-specific factors that may serve to minimize the impact of these Zones on Citizens Broadband Radio Service users. During phase two, these sites will be protected by the ESC. The Commission will release a Public Notice detailing these protection criteria.

The Commission will implement a coordination procedure to protect temporary federal naval radars – including visits to non-homeports – from interference. Under this procedure, federal Incumbent Users will provide the Commission with notice of the location and scope of temporary operations before such operations commence. This requirement will ensure that federal Incumbent Users may receive protection when they (infrequently) visit locations not covered by the coastal Exclusion Zones. The Commission will work with NTIA and DoD to develop appropriate coordination procedures.

The Commission also will require SAS Administrators to implement protocols to respond to directions from the President of the United States or another designated federal entity to manually discontinue operations of its associated CBSDs in a given area pursuant to 47 U.S.C. § 606. SAS Administrators must also implement protocols to manually discontinue operations of their associated CBSDs in response to enforcement actions taken by the Commission. These requirements are consistent with the Commission's enforcement responsibilities and its statutory obligation to comply with Presidential orders to suspend or amend the rules and regulations governing designated transmitters during times of war or national emergency.

**b. Protection of CBSDs from Radar Interference**

Citizens Broadband Radio Service users will be required to accept interference – including potentially harmful interference – from federal radar systems as a condition of their authorization. The Commission will require Citizens Broadband Radio Service users to acknowledge that they understand and accept the risk of interference from federal radar systems. This requirement will apply to all Citizens Broadband Radio Service users regardless of their area of operation or their status as a Priority Access

Licensee or GAA user. Such acknowledgements may be made through the SAS upon registering a CBSD. SAS Administrators must develop policies and procedures to ensure that such acknowledgements are properly recorded and maintained.

## **2. Protection of Incumbent FSS Earth Stations**

### **a. FSS Earth Stations in the 3.5 GHz Band**

For determining interference to C-Band downlink earth stations from in-band operations, the Commission concluded that CBSDs in the 3.5 GHz Band should be governed by an analytic framework similar to the Part 90 (Subpart Z) framework that applies to the Wireless Broadband service in the 3650-3700 MHz Band, and adopted rules that require CBSDs to protect specific incumbent in-band FSS earth stations from interference using power levels authorized and enforced by SAS.

FSS earth stations must register with the Commission annually, or upon making changes to any of the technical parameters specified in the annual registration. This registration information will be made available to all approved SASs and may be used to determine appropriate protection criteria for such earth stations. Annual registration for each earth station shall include, at a minimum, the earth station's geographic location, antenna gain, horizontal and vertical antenna gain pattern, antenna azimuth relative to true north, and antenna elevation angle. This information must be made available to SAS Administrators and maintained by them.

CBSDs may operate within areas that are predicted to potentially cause interference to FSS earth stations provided that the licensee of the FSS earth station, the authorized user of the CBSD, and an SAS Administrator mutually agree to such operation at specified CBSD location(s) and the terms of any such agreement are provided to, and can be enforced by, an SAS. The terms of any such agreement shall be communicated promptly to all SAS Administrators.

## **3. Operations near International Borders**

The Commission adopted the rule that it will commit to working with Canadian and Mexican authorities to determine how best to coordinate in-band and adjacent band frequency use in the 3.5 GHz Band near international borders. This approach is consistent with the usual practice for new services. SAS Administrators will be required to demonstrate that their systems can and will enforce agreements between the U.S., Canadian, and Mexican governments regarding commercial operations in the 3.5 GHz Band. The specific methods of enforcement will be determined and implemented by SAS Administrators, with appropriate Commission oversight, after the agreements are in place.

### **E. Spectrum Access System**

#### **1. High Level SAS Requirements**

The Commission concluded that the core functions that an SAS must perform are as follows:

- Determine the available frequencies at a given geographic location and assign them to CBSDs;
- Determine the maximum permissible transmission power level for CBSDs at a given location and communicate that information to the CBSDs;
- Register and authenticate the identification information and location of CBSDs;

- Enforce Exclusion and Protection Zones, including any future changes to such Zones, to ensure compatibility between Citizens Broadband Radio Service users and incumbent federal operations;
- Communicate with the ESC and ensure that CBSDs operate in a manner that does not interfere with federal users;
- Ensure that CBSDs protect non-federal incumbent users consistent with the rules;
- Protect Priority Access Licensees from impermissible interference from other Citizens Broadband Radio Service users;
- Facilitate coordination between GAA users to promote a stable spectral environment;
- Ensure secure and reliable transmission of information between the SAS, ESC, and CBSDs;
- Provide an approved ESC with any sensing information reported by CBSDs if available;
- Protect Grandfathered Wireless Broadband Licensees until the end of the grandfather period; and
- Facilitate coordination and information exchange between SASs.

**a. Information Gathering and Retention**

An SAS must be capable of gathering and retaining information submitted by registered CBSDs necessary to perform its essential tasks under Part 96. Information not pertaining to federal incumbent operations must be retained for a minimum of 60 months. SASs must also obtain essential licensing information from Commission databases, maintain accurate records of the parameters of Protection Zones, and enforce additional federal Incumbent User protections based on information received from the ESC.

SAS Administrators must make all information necessary to effectively coordinate operations between and among CBSDs available to other SAS Administrators and must make CBSD registration information available to the general public, but they must obfuscate the identities of the licensees providing the information for any public disclosures.

The Commission concluded that approved SAS will be capable of effectively coordinating operations between and among a wide variety of Citizens Broadband Radio Service Users and preventing disputes before they arise. However, the Commission will retain ultimate responsibility for enforcing its rules, overseeing and approving SASs and SAS Administrators, resolving disputes between licensees, and addressing consumer complaints.

With regard to information on federal Incumbent Users communicated from the ESC to the SAS and retention of that information, the Commission adopted several safeguards requiring that the SAS and the ESC must not have any connectivity to any military or other sensitive federal database or system or store, retain, transmit, or disclose operational information on the movement or position of any federal systems. The Commission will work with NTIA and DoD to establish the information the ESC would need to transmit to the SAS as necessary to manage connected CBSDs. The Commission will restrict the storage and retention of this data and any other operational information to ensure only the effective operation of the SAS and ESC, and for no other purposes. The SAS shall only retain records of information or instructions received from the ESC in accordance with information retention policies established as part of the ESC approval process. These policies will include appropriate safeguards for classified and other sensitive data and will be developed by the Commission in coordination with NTIA and DoD.

**b. Registration, Authentication, and Authorization of CBSDs**

The Commission determined that registering, authenticating, and authorizing CBSDs is an essential component of the SASs responsibilities. CBSDs must report information on their technical specifications, location, and the identity of their authorized operators or licensees to the SAS which in turn must verify this information to ensure that CBSDs are used only by authorized users in accordance with the Commission's rules. The SAS must also verify that the FCC ID of any CBSD seeking to provide Citizens Broadband Radio Services is valid prior to authorizing it to begin providing service. Individual CBSDs are not required to interface with the SAS so long as the required information is communicated by an aggregation point or network control device. These requirements do not apply to End User Devices. SASs must not collect, track, or store information on End User Devices or their users without user consent. The precise methods used to register, authenticate, and authorize CBSDs may be determined during the SAS approval process.

**c. Frequency Assignment**

In assigning frequencies for Priority Access and GAA use, the SAS must take appropriate steps to ensure that CBSDs operate only on authorized frequencies at all times. As one element of this process, when an SAS deauthorizes a CBSD or changes its permissible operational frequencies, it may require that CBSD to confirm that it has complied with the SAS's instructions. The Commission imposed end-to-end security requirements that will prevent tampering with devices to circumvent SAS control or otherwise defeating the purposes of the Commission's rules.

**d. Security**

The Commission adopted rules to require secure and reliable communications among and between CBSDs and SASs and it will require SASs to protect themselves from unauthorized data input or alteration of stored data.

The Commission will require potential SAS Administrators to develop and demonstrate that their systems include robust communications and information security features during the SAS Approval process. CBSDs shall demonstrate compliant security features during the equipment authorization process. These security protocols will be subject to the Commission's review and approval, with input from NTIA and DoD. The Commission anticipates that given the immense value of industry-wide interoperability, groups – such as multi-stakeholder groups – will develop security models that SAS Administrators may consider, subject to Commission review. It is also expected that security mechanisms will be updated on an ongoing basis to reflect state-of-the-art protection against ever-evolving security threats.

**e. Enforcement**

SAS Administrators must adopt procedures to immediately respond to requests from Commission personnel for information stored or maintained by the SAS and to discontinue CBSD operations as directed by the Commission. SAS Administrators must also establish and follow protocols to comply with enforcement instructions from the Commission, including discontinuance of CBSD operations in designated geographic areas.

The Commission expects many of the detailed enforcement mechanisms and procedures employed by SASs to be developed during the SAS Administrator approval process. However, the

Commission will retain the ultimate responsibility for and authority over licensees in the band. In the event that the SAS is unable to resolve disputes between licensees or identify and address the sources of harmful interference in the band, the Commission will address these issues, as well as any issues concerning unauthorized frequency use or unauthorized equipment.

## **2. SAS Administrators**

### **a. SAS Administrator Requirements**

The primary function of any SAS Administrator will be to develop protocols, procedures, and systems to enforce the Commission's rules governing SAS operations. Each SAS Administrator will be required to provide services for a five-year term, which, at the Commission's discretion, may be renewed. In the event that an SAS Administrator does not wish to continue at the end of its term, or if its term is not renewed, it will be required to transfer its database along with the information necessary to access the database to another designated SAS. The SAS administrator would be permitted to charge a reasonable fee for conveyance of that resource.

If the Commission approves multiple SAS Administrators, it must ensure that each SAS contains consistent, accurate information. Because a CBSD will only be required to contact a single SAS, there is a need for SASs to share accurate registration information so that each SAS has the same, current view of the radio environment. Therefore, SAS Administrators will be required to cooperate with one another to develop a standardized process for coordinating their operations, avoiding any conflicting assignments, maximizing shared use of available frequencies, ensuring continuity of service to all registered CBSDs, and sharing the data collected from registered CBSDs.

SAS Administrators will be required to coordinate with each other to facilitate non-interfering use by CBSDs connected to other SASs, maximize available GAA frequencies by assigning PALs to similar channels in the same geographic regions, and perform such other functions necessary to ensure that available spectrum is used efficiently. SAS Administrators must share information on the CBSDs and licensees managed by their SAS to the extent necessary to facilitate the effective coordination of all approved SASs.

SASs will obtain much of the information on licensed use of the 3.5 GHz Band from Commission databases. This information will include information on Priority Access Licensees and licensed in-band FSS users. This information may be stored in the Commission's Universal Licensing System database or another system. Each SAS will be required to synchronize itself with Commission databases at least once a day so that the information in the SAS remains current.

SAS Administrators must also establish protocols and procedures to protect Incumbent operations consistent with information received from an approved ESC. SAS Administrators will be responsible for ensuring that all information transmitted by the ESC is acted upon and protected consistent with any additional requirements imposed during the SAS and ESC approval processes. SAS Administrators may themselves provide an ESC (if approved) or work with another approved ESC provider.

SAS Administrators must respond quickly to verify and correct or remove data in the event that a party or the Commission brings claims of inaccuracies in the SAS to its attention. This obligation to remedy inaccuracies applies to information entered into or omitted from the SAS, whether willfully or through operator error. Further, SAS Administrators must ensure that the SAS is able, at all times, to



promptly respond to requests from Commission personnel for any information stored in the SAS. SAS Administrators must ensure that there is a capability in place to respond to emergency instances that require CBSDs to cease operation in a geographic area or during a specified time period.

SAS Administrators are permitted to hold PALs and act as GAA users. SAS Administrators are required to discharge their frequency assignment functions, whether involving their own users or those served by a different SAS Administrator, in a non-discriminatory manner, consistent with the priority accorded to PAL users vis-à-vis GAA users under the Commission's rules.

In reviewing applications to serve as SAS Administrators, the Commission will require a demonstration of intent and ability to comply with all of the rules, including this nondiscrimination requirement as well as the requirement that they cooperate with other SAS Administrators in coordinating and exchanging required information. Moreover, the Commission will monitor the behavior of SAS Administrators and will take enforcement action if necessary to ensure that SAS Administrators comply with all applicable rules. The Commission will also monitor the competitive balance in the 3.5 GHz Band and may take action to rectify any anti-competitive behavior that could be attributed to SAS Administrators holding or leasing PALs or GAA licenses or operating CBSDs (under PAL or GAA authorization) in the band.

**b. SAS and SAS Administrator Approval Process**

The Commission will designate one or more private sector administrators to create and operate an SAS, following a thorough approval and review process.

WTB and OET will issue a Public Notice requesting proposals from entities seeking to administer an SAS. Applicants will be required to, at a minimum, demonstrate how they plan to comply with the Commission's rules governing SAS operations, demonstrate their technical qualifications to operate an SAS, and provide any additional information requested by WTB and OET. Based on these applications, WTB and OET will determine whether to conditionally approve any of the applicants. If an application is not accepted, the applicant may file an Application for Review with the Commission.

Any applicants that receive conditional approval must demonstrate, to the satisfaction of WTB and OET, that their SASs meet all of the requirements according to the Commission's rules and any other conditions that these offices deem necessary. WTB and OET will provide detailed instructions to applicants throughout the process. At a minimum, applicants will be required to allow their systems to be tested and analyzed by FCC staff prior to making their systems available for a period of public testing prior to release. Applicants may also be required to attend workshops and meetings as directed by the offices. NTIA will provide input and guidance as needed to ensure that the concerns of federal incumbents are properly addressed during the approval process.

**c. SAS Administrator Fees**

SAS Administrators may charge any Citizens Broadband Radio Service user a reasonable fee for provision of their services. If SAS Administrators engage in anti-competitive or collusive practices resulting in excessive fees, or if a competitive market for SAS services otherwise fails to materialize, the Commission may take steps to address such issues.

## **F. Environmental Sensing Capability**

The Commission will allow the use of one or more ESCs to detect federal frequency use in and adjacent to the 3.5 GHz Band. Spectrum sensing technologies – in conjunction with management of CBSDs by an approved SAS - would allow Citizens Broadband Radio Service users to operate near the coastline on a channel or frequency not being used by federal radar systems.

The ESC will be developed, managed, and maintained by a non-governmental entity and should not require oversight or day-to-day input from NTIA or DoD. The rules governing the ESC are technologically neutral and, as such, ESC developers may utilize different sensing techniques that yield the desired result. The sensors comprising an authorized ESC may be infrastructure-based, device-based, or a combination of the two, as long as the ESC complies with the rules and guidelines set by the Commission. These sensors shall be deployed in the vicinity of the Exclusion Zones to ensure that all federal radar use in and adjacent to the 3.5 GHz Band is accurately detected and reported to an SAS.

The Commission's rules protect the security and confidentiality of federal operations by ensuring that the ESC does not store, retain, transmit, or disclose any information on the locations or movements of any federal systems. The ESC will not provide any insights into the operations, locations, parameters, or features of federal radar and other systems that could potentially affect their security posture. Prospective ESC operators must have their systems reviewed, certified, and approved through the approval process used to approve SASs and SAS Administrators. While the processes are the same, ESCs and SASs shall be evaluated, tested, and approved separately. However, these processes may be concurrent and the ability to communicate with an SAS will be a key component of ESC approval. The approval process will be overseen by the Commission in close consultation with NTIA and DoD. To be approved, an ESC must meet the following requirements:

- be managed and maintained by a non-governmental entity;
- accurately detect federal frequency use in the 3550-3700 MHz band and adjacent frequencies;
- communicate information about detected frequency use to an approved SAS;
- maintain security of detected and communicated signal information;
- comply with all Commission rules and guidelines governing the construction, operation, and approval of ESCs;
- be available at all times to immediately respond to requests from authorized Commission personnel for any information collected or communicated by the ESC;
- ensure that the ESC operates without any connectivity to any military or other sensitive federal database or system;
- ensure that the ESC does not store, retain, transmit, or disclose operational information on the movement or position of any federal system or any information that reveals other operational information of any federal system that is not required to effectively operate the ESC by Part 96.

Following ESC approval, approved SAS Administrators making use of an approved ESC may dynamically authorize CBSDs nationwide.

### G. 3650-3700 MHz Band

In light of the significant investment many incumbent 3650-3700 MHz licensees have made in the band, the Commission provided protections for these incumbent operations during a reasonable transition period. These include exclusion of PAL use in this upper portion of the band, technical rules in Part 96 that will accommodate existing 3650-3700 MHz band deployments, exemption from interoperability requirements for equipment, and allowing legacy network equipment to interact with the SAS at relatively low cost. In addition, the Commission will protect incumbent 3650-3700 MHz nationwide licensees (whose licenses were granted prior to April 17, 2015) (Grandfathered Wireless Broadband Providers) until April 17, 2020 or for the remainder of their license term, whichever is longer – with one exception. Incumbents licensed after January 8, 2013 will be granted a transition period extending only to April 17, 2020, regardless of the end date of their license term.

At the end of the transition period, these licensees may continue to operate their networks consistent with the Part 96 rules governing GAA operations, but without the priority accorded them during the transition.

During the transition period, grandfathered licensees will receive interference protection from other 3.5 GHz Band users operating in the 3650-3700 MHz band segment (*i.e.*, only GAA and not PAL users) for network operations and frequencies that are in use at registered sites as of April 17, 2016.

The Grandfathered Wireless Protection Zone extends only to *registered* networks that are *constructed*, *in service*, and in *compliance* with the prior existing rules for the 3650-3700 MHz band. These concepts are defined as follows:

- *Registered* means that any fixed or base stations defining the extent of the network have been properly registered with ULS.
- *Constructed* means that all of the requisite infrastructure elements are in-place and operational. These include siting, FCC-certified radio equipment, backhaul, power, etc.
- *In service* means that the network provides ongoing service to unaffiliated, paying subscribers (*e.g.*, broadband service from a WISP) or for *bona fide* private uses (*e.g.*, utility networks, network backhaul).
- *Compliance* means that to receive protection, licensees must be in compliance with all other applicable FCC rules (or operating pursuant to a waiver of those rules).

For any assignments or transfers of control of Grandfathered Wireless Broadband licenses or registered sites that occur following the effective date of this *Report and Order*, the applicable transition period will run with the original license date, on a site-by-site basis.

The Grandfathered Wireless Protection Zone will be reduced should any portions of the protected network fail to meet the above criteria after April 17, 2016. Any registrations filed after April 17, 2015 will only be afforded protection from harmful interference under the rules within the licensee's Grandfathered Wireless Protection Zone, *i.e.*, a Grandfathered Wireless Broadband Provider may not expand its protected contour using sites registered after April 17, 2015. Modifications to ULS site

registrations after April 17, 2015, will not have the effect of increasing the Grandfathered Wireless Protection Zone.

In order to be afforded Grandfathered Wireless Broadband Provider protections, the Commission will require incumbent operators to register their frequency usage with approved SAS Administrators. Existing licensees must register their fixed and base stations as well as their service contours with the SAS. In addition, existing licensees must indicate the specific frequencies and channel bandwidth in use at each site. Subsequently, any Grandfathered Wireless Broadband Provider protections will only apply in the frequency range registered by the incumbent.

Grandfathered Wireless Broadband Licensees will be deemed incumbent users within their registered service contours for the duration of the transition period. During this transition period, Grandfathered Wireless Broadband Providers must avoid causing harmful interference to authorized federal users and grandfathered FSS earth stations, in accordance with the rules. Thus, existing FSS sites will be protected under Part 90, Subpart Z until the last Grandfathered Wireless Broadband Licensee within a given protected area is transitioned to the new Part 96 regime. After the transition period, such facilities shall be protected from harmful interference consistent with the protections afforded similarly situated facilities as set forth in sections 96.15 and 96.17. Consistent with current practice, during the transition period, Grandfathered Wireless Broadband Providers with overlapping service contours must coordinate with one another as currently required by Part 90, Subpart Z.

Grandfathered Wireless Broadband Licensees may register sites outside of their Grandfathered Wireless Protection Zones, but these sites will not be entitled to any interference protection from Citizens Broadband Radio Service users. The Commission strongly encouraged Grandfathered Wireless Broadband Licensees to procure equipment with an eye toward complying with the Part 96 technical rules once the transition period is completed. All Grandfathered Wireless Broadband Licensees must comply with the Part 96 rules once their transitions are complete. At that point, use of legacy equipment that does not operate across the entire 150 megahertz band could hinder a former Part 90 licensee's flexibility with respect to other GAA operations in the band. On the other hand, the use of technology that is capable of, or can be upgraded to, operation throughout the band will provide for the possibility of much greater spectrum access. Grandfathered Wireless Broadband Licensees, and their vendors, should plan accordingly.

## **II. RECORDKEEPING AND OTHER COMPLIANCE REQUIREMENTS**

As a result of the Commission's actions in this *Report and Order*, small businesses will have access to spectrum that is currently unavailable to them. For example, wireless carriers can deploy small cells on a GAA basis where they need additional capacity. Real estate owners can deploy neutral host systems in high-traffic venues, allowing for cost-effective network sharing among multiple wireless providers and their customers. Manufacturers, utilities, and others can construct private wireless broadband networks to automate industrial processes that require some measure of interference protection and yet are not appropriately outsourced to a commercial cellular network. All of these applications can potentially share common wireless technologies, providing economies of scale and facilitating intensive use of the spectrum.

Under the new rules, Citizens Broadband Radio Services Devices (CBSDs) must comply with technical and operational requirements aimed at preventing interference to Incumbent Access and Priority

Access users, including: complying with technical parameters (e.g., power and unwanted emissions limits) and specific deployment conditions; reporting location information to an SAS as part of initial registration by a professional installer; having the ability to operate across all frequencies from 3550-3700 MHz; having the ability to measure and report on their local interference levels; and incorporating security features to protect against modification of software and firmware by unauthorized parties, and to protect communication data that are exchanged between CBSDs and End User Devices. Under the new rules, End User Devices must operate under the power and control of an SAS-authorized CBSD and contain security features to protect against modification of software and firmware by unauthorized parties. The new rules require Citizens Broadband Radio Service users to meet certain qualification requirements, designate whether they will provide service on a common carrier or non-common carrier basis, and register their devices with an SAS.

In the *Report and Order*, the Commission adopted a number of measures to protect Incumbent operators. To protect incumbent federal users, the Commission established Exclusion Zones and Protection Zones to ensure compatibility between Federal Incumbent Users and Citizens Broadband Radio Service users. In addition, Fixed Satellite Service Earth Stations in the 3600-3650 MHz Band and the 3700-4200 MHz Band will be afforded protection from harmful interference from CBSDs under the new rules if they register with the Commission annually. Likewise, Grandfathered Wireless Broadband Providers in the 3650-3700 MHz Band must register their frequency usage with an SAS in order to receive protection from harmful interference during their grandfathered period.

Small businesses operating in the upper portion of this band (3650-3700 MHz) must transition from the current non-exclusive nationwide licensing approach to the Citizens Broadband Radio Service licensing framework. Recognizing that this transition would likely entail additional costs and administrative burdens, the Commission adopted enhanced protections for Grandfathered Wireless Broadband Providers in the 3650-3700 MHz Band:

The Commission believes that it has made necessary and appropriate rule accommodations to allow prior existing 3650-3700 MHz licensees to continue operations in the band under a framework that provides access to greater spectrum that may better meet their needs in the long run. To the extent that the Commission may have overlooked any technical obstacles to achieving this goal, Part 90 incumbents may avail themselves of the Commission's waiver process on a case-by-case basis.

While Commission's proposals require small businesses to register with an SAS and comply with the rules established for the Citizens Broadband Radio Service, they will receive the ability to access spectrum that is currently unavailable to them. On balance, this would constitute a significant benefit for small business.

The reporting, recordkeeping, and other compliance requirements resulting from *the Report and Order* will apply to all entities in the same manner. The Commission believes that applying the same rules equally to all entities in this context promotes fairness. The Commission does not believe that the costs and/or administrative burdens associated with the rules will unduly burden small entities. The rules the Commission adopted should benefit small entities by giving them more information, more flexibility, and more options for gaining access to valuable wireless spectrum. By licensing GAA use on a license by rule basis, the Commission has avoided the need for filing individual license applications. The hybrid framework adopted in the *Report and Order* leverages advances in computing technology and economics

to select, automatically, the best approach based on local conditions. Where competitive rivalry for spectrum access is low, the General Authorized Access tier provides a low-cost mode of access, similar to unlicensed uses. Where rivalry is high, an auction resolves mutually exclusive applications in specific geographic areas for Priority Access Licenses. Finite-term licensing facilitates evolution of the band and an ever-changing mix of General Authorized Access and Priority Access bandwidth over time.

### **III. WEBLINK**

The *Report and Order and Second Further Notice of Proposed Rulemaking*, FCC 15-47, was adopted April 17, 2015 and released April 21, 2015

The new rules became effective July 23, 2015, except for those rules and requirements that require approval by the Office of Management and Budget (OMB) under the Paperwork Reduction Act, which shall become effective after the Commission publishes a notice in the Federal Register announcing such approval and the relevant effective date.

[http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FCC-15-47A1.docx](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-15-47A1.docx)

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