



# **Requirements for Commercial Operation in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band**

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# Requirements for Commercial Operation in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band

## 1 Scope

This document specifies the requirements and technical considerations for commercial operations in the 3550-3700 MHz band in the United States. The requirements are based on Federal Communications Commission (FCC) rules adopted in the 2015 Report and Order in FCC docket GN 12-354, “Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band” [1]. The rules themselves are codified in Part 96 of Title 47 the U.S. Code of Federal Regulations [2]. The FCC rules will hereafter be referred to as “the FCC Rules,” “the Rules,” or “Part 96,” and reference to specific items in the rules will be given in the form of, for example, 96.15(a)(1).

The document defines the requirements on the Spectrum Access System (SAS), Citizens Broadband Radio Service Device (CBSD), End User Device (EUD), Priority Access License (PAL), and General Authorized Access (GAA) equipment in order to define the necessary operation and standards interfaces between such equipment to effect a properly functioning spectrum sharing environment in the 3550-3700 MHz band.

To assist the reader, we include below the SAS Functional Architecture with defined interfaces.

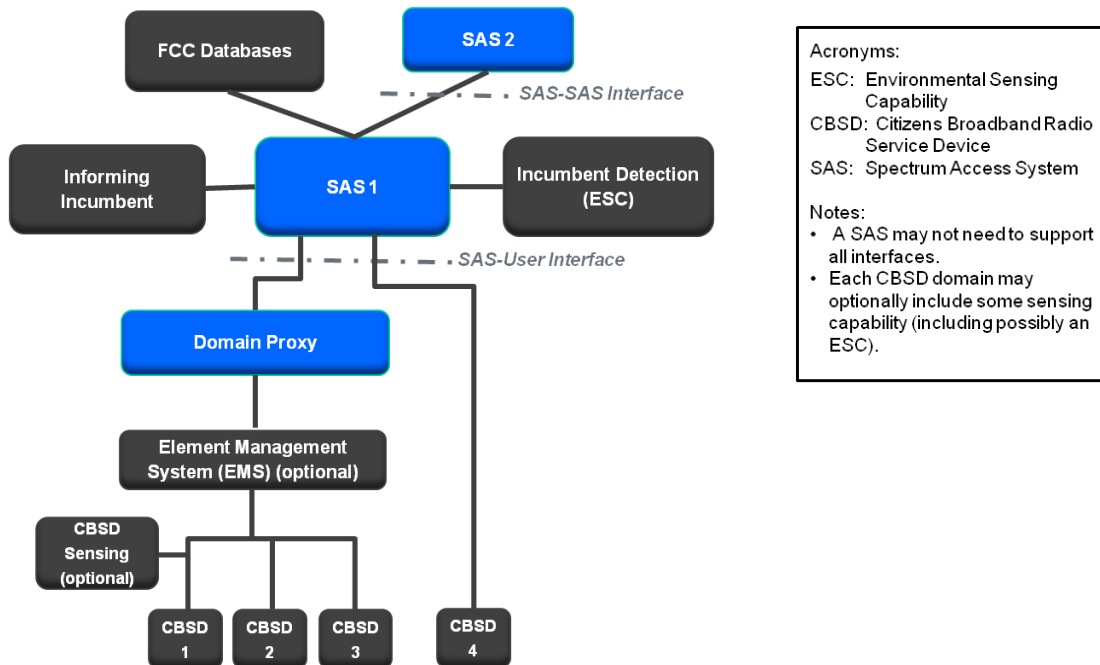


Figure 1: SAS Functional Architecture

## 2 Definitions and abbreviations

### 2.1 Other Definitions

The Wireless Innovation Forum Spectrum Sharing Committee (SSC) leverages the definitions provided by the FCC from their Title 47 Part 96 rules. These definitions are also available at reference. [3]

Additional definitions:

*Domain Proxy:* An entity engaging in communications with the SAS on behalf of multiple individual CBSDs or networks of CBSDs. The Domain Proxy can also provide a translational capability to interface legacy radio equipment in the 3650-3700 MHz band with a SAS to ensure compliance with Part 96 rules.

### 2.2 Abbreviations

3GPP	3rd Generation Partnership Project
CBSD	Citizens Broadband radio Service Device
DoD	U.S. Department of Defense
ESC	Environmental Sensing Capability
EUD	End User Device
FCC	Federal Communications Commission
FFS	For Further Study
FSS	Fixed-Satellite Service
GAA	General Authorized Access
MFCN	Mobile / Fixed Communication Networks
NTIA	National Telecommunications and Information Administration
OA&M	Operations, Administration and Maintenance
PA	Priority Access
PAL	Priority Access License
SAS	Spectrum Access System
WBS	Wireless Broadband Service (FCC Rules Part 90, Subpart Z)
WISP	Wireless Internet Service Provider (operated under WBS)

## 3 Requirement Organization

Requirements shall be uniquely identified by: R#-<CATEGORY>-<XX>. Where

- R0-: Requirements directly from FCC Rules
- R1-: Requirements derived from FCC Rules
- R2-: Requirements imposed by WINN Forum

- <CATEGORY>

Code	Category
SGN	SAS General
IPM	Incumbent Protection Management
IMZ	SAS Interference Management and Exclusion Zones
SAD	SAS Administration
SPU	SAS Requirements for PAL Users
SGU	SAS Requirements for GAA Users
ISC	Inter-SAS Communication
DEV	CBSD Requirements
DPX	Domain Proxy
SRR	System Registration Requirements (includes Owner, CBSD & Certified Professional Installer Registration)
ESC	Environmental Sensing Capability
EUD	End User Device

- <XX>: Unique number to identify the requirement

Requirements taken from the FCC Rules are included as “R0” and we attempted to use the FCC Rules without change. In some instances, the FCC uses “must” or “will” for rules, which we have included below as a requirement; however, we insert [shall] to indicate we consider this as a formal requirement.

The following terms are used within this document and should be interpreted as:

- SHALL is a mandatory requirement (negative is SHALL NOT)
- SHOULD is recommended requirement /best practice (negative is SHOULD NOT)
- MAY is an optional requirement, i.e. something that is allowed (negative is NEED NOT)

## 4 SAS Requirements

### 4.1 SAS General Requirements (SGN)

R0-SGN-01: The SAS shall support 3 tiers of service: Incumbent Access, Priority Access (PA) and General Authorized Access (GAA). [Ref-2, 96.1].

*Informative Note: The Incumbent Access tier includes authorized federal users, grandfathered FSS earth stations and for a finite period, grandfathered terrestrial wireless operations in the 3650-3700 MHz portion of the band. [Ref-2, para 4]*



R0-SGN-02: The SAS must [shall] support registration of CBSDs prior to CBSD initial service transmission. [Ref-2, 96.39] See CBSD section for what information is required for registration.

R0-SGN-03: The SAS assigns channels for PALs to use. [Ref-2, 96.11, 96.13 & 96.25]

- a. The SAS shall authorize 10 MHz channels in the 3550-3650 MHz frequency band to PA users. Note: 10 MHz channels shall be contiguous spectrum unless the PAL licensee agrees to subdivide the spectrum [Ref-2, para 74]
- b. The SAS shall not assign more than seven PALs in any given License Areas at any given time.
- c. The SAS must [should] assign multiple channels held by the same Priority Access Licensee to contiguous channels in the same License Area, to the extent feasible, and to the extent indicated by the PAL holder and consistent with the other requirements of the SAS.
- d. The SAS may temporarily reassign individual PALs to non-contiguous channels to the extent necessary to protect Incumbent Users or if necessary to perform its required functions under subpart F of Section 96 [2].
- e. Priority Access Licensees may request a particular channel or frequency range from the SAS but will not be guaranteed a particular assignment.
- f.

R0-SGN-04: The SAS shall make unused PAL channels available for assignment for General Authorized Access use. GAA users may operate in the 3550-3700 MHz frequency band. [Ref-2, 96.11 & 96.25]

R0-SGN-05: SAS interface security [Ref-2, 96.61 & 96.39]

- a. An SAS must [shall] 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 alter the SAS or the information it sends to a CBSD.
- b. Communications between CBSDs and an SAS, between an ESC and a SAS, between individual CBSDs, and between different SASs, must [shall] be secure to prevent corruption or unauthorized interception of data. An SAS must be protected from unauthorized data input or alteration of stored data.
- c. An SAS must [shall] verify that the FCC identification number supplied by a CBSD is for a certified device and must not provide service to an uncertified device.

R0-SGN-06: SAS The purposes and functionality of the SAS includes [Ref-2, 96.53].

- a. To enact and enforce all policies and procedures developed by the SAS Administrator pursuant to section 96.63.
- b. To determine and provide to CBSDs the permissible channels or frequencies at their location.
- c. To determine and provide to CBSDs the maximum permissible transmission power level at their location.

- d. To register and authenticate the identification information and location of CBSDs.
- e. To retain information on, and enforce, Exclusion Zones and Protection Zones in accordance with sections 96.15 and 96.17.
- f. To communicate with the ESC to obtain information about federal Incumbent User transmissions and instruct CBSDs to move to another frequency range or cease transmissions.
- g. To ensure that CBSDs operate in geographic areas and within the maximum power levels required to protect federal Incumbent Users from harmful interference, consistent with the requirements of sections 96.15 and 96.21.
- h. To ensure that CBSDs protect non-federal Incumbent Users from harmful interference, consistent with the requirements of section 96.17 and 96.21 [Ref R0-SGU-01:(b)].
- i. To protect Priority Access Licensees from interference caused by other PALs and from General Authorized Access Users consistent with section 96.25 [Ref R0-SGU-01:(b)].
- j. To facilitate coordination between GAA users operating Category B CBSDs, consistent with section 96.35.
- k. To resolve conflicting uses of the band while maintaining, as much as possible, a stable radio frequency environment.
- l. To ensure secure and reliable transmission of information between the SAS and CBSDs.
- m. To protect Grandfathered Wireless Broadband Licensees consistent with section 90.1307, 90.1338, and 96.21.
- n. To implement the terms of current and future international agreements as they relate to the Citizens Broadband Radio Service.

R0-SGN-07: The SAS shall maintain current information on registered CBSDs, the geographic locations and configuration of protected FSS locations as set forth in section 96.17, and the federal Incumbent User Exclusion Zones and Protection Zones. [Ref-2, 96.55]

- a. For registered CBSDs, such information shall include all information required by section 96.39 and 96.45.
- b. SAS Administrators must [shall] make all information necessary to effectively coordinate operations between and among CBSDs available to other SAS Administrators.
- c. SAS Administrators must [shall] 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.
- d. For non-federal Incumbent Users, the SAS shall maintain a record of the location of protected earth stations as well as the all registration information required by section 96.17.

R0-SGN-08: The SAS shall maintain records not pertaining to federal Incumbent User transmissions for at least 60 months. [Ref-2, 96.55]

- R0-SGN-09: The SAS shall only retain records of information or instructions received regarding federal Incumbent User transmissions from the ESC in accordance with information retention policies established as part of the ESC approval process. [Ref-2, 96.55]
- R0-SGN-10: The SAS shall be technically capable of directly interfacing with any necessary FCC database containing information required for the proper operation of an SAS. [Ref-2, 96.55]
- R0-SGN-11: The SAS shall process and retain acknowledgements by all entities registering CBSDs that they understand the risk of possible interference from federal Incumbent User radar operations in the band. [Ref-2, 96.55]
- R0-SGN-12: SAS Registration, Authentication and Authorization of CBRS Devices [Ref-2, 96.57]
- a. An SAS must [shall] register, authenticate, and authorize operations of CBSDs consistent with this rule part.
  - b. CBSDs composed of a network of base and fixed stations may employ a subsystem for aggregating and communicating all required information exchanges between the SAS and CBSDs. [Note: Related to Domain Proxy Requirements & R2-SRR-13 & 14].
  - c. An SAS must [shall] also verify that the FCC identifier (FCC ID) of any CBSD seeking access to its services is valid prior to authorizing it to begin providing service. A list of devices with valid FCC IDs and the FCC IDs of those devices is to be obtained from the Commission's Equipment Authorization System. [Note: Related to R0-SRR-01 & -02]
  - d. An SAS must [shall] not authorize operation of CBSDs within Protection Zones except as set forth in section 96.15.
- R0-SGN-13: SAS Assignment of Frequencies [Ref-2, 96.13c, 96.59]
- a. An SAS must [shall] determine the available and appropriate channels/frequencies for CBSDs at any given location using the information supplied by CBSDs, including location, the authorization status and operating parameters of other CBSDs in the surrounding area, information communicated by the ESC, other SASs, and such other information necessary to ensure effective operations of CBSDs consistent with this part. All such determinations and assignments shall be made in a non-discriminatory manner, consistent with this part.
    - i. Upon request from the Commission or a CBSD, an SAS must [shall] confirm whether frequencies are available in a given geographic area.
    - ii. Upon request from the Commission, an SAS must [shall] confirm that CBSDs in a given geographic area and frequency band have been shut down or moved to another available frequency range in response to information received from the ESC.

- iii. If an SAS provides a range of available frequencies or channels to a CBSD, it may require that CBSD to confirm which channel or range of frequencies it will utilize.
- b. Consistent with the requirements of 96.25, an SAS shall assign geographically contiguous PALs held by the same Priority Access Licensee to the same channels in each geographic area, where feasible. The SAS shall also assign multiple channels held by the same Priority Access Licensee to contiguous frequencies within the same License Area, where feasible.
- c. An SAS may temporarily assign PALs to different channels (within the frequency range authorized for Priority Access use) to protect Incumbent Access Users or if necessary to perform its required functions.

R0-SGN-14: We require that the SAS and the ESC must [shall] not have any connectivity to any military or other sensitive federal database or system. Nor shall they store, retain, transmit, or disclose operational information on the movement or position of any federal systems. 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 [shall] include appropriate safeguards for classified and other sensitive data and will be developed by the Commission in coordination with NTIA and DoD. [Ref-2, 96.63n & para 330]

R1-SGN-01: The SAS must [shall] not collect, track, or store information on End User Devices or their users without user consent. [Ref-2, para 333]

## 4.2 Incumbent Protection Management (IPM)

R0-IPM-01: Protection of Existing FSS Earth Stations in the 3600-3650 MHz Band and 3700-4200 MHz Band [Ref-2, 96.17]

- a. CBSDs shall protect the FSS earth stations authorized to operate in the 3600-3650 MHz band listed at [fcc.gov/cbrs-protected-fss-sites](http://fcc.gov/cbrs-protected-fss-sites) in accordance with the Commission's rules.
- b. CBSDs shall protect the FSS earth stations authorized to operate in the 3700-4200 MHz band listed at [fcc.gov/cbrs-protected-fss-sites](http://fcc.gov/cbrs-protected-fss-sites) in accordance with the Commission's rules.
- c. These protection criteria will [shall] be enforced by the Spectrum Access System authorized consistent with section 96.53, et seq. below.
- d. FSS earth station licensees requesting protection under this Part must [shall] register with the Commission annually, no later than 30 days before the end of the preceding calendar year, or upon making changes to any of the operational parameters listed in this section. Registration information will [shall] be made available to all approved SASs.

- i. Annual registration for each earth station shall include, at a minimum: the earth station's geographic location (Using NAD83 coordinates); antenna gain; azimuth and elevation antenna gain pattern; antenna azimuth relative to true north; and antenna elevation angle.
- ii. Such information must [shall] be made available to SAS Administrators and maintained consistent with section 96.55.
- e. CBSDs may operate within areas that may cause interference to FSS earth stations provided that the licensee of the FSS earth station and the authorized user of the CBSD mutually agree on such operation and the terms of any such agreement are provided to an SAS Administrator that agrees to enforce them. The terms of any such agreement shall be communicated promptly to all other SAS Administrators.

R0-IPM-02: Protection of Existing Operators in the 3650-3700 MHz Band [Ref-2, 96.21]

- a. Grandfathered Wireless Broadband Licensees shall be granted Incumbent User status consistent with sections 90.1307 and 90.1338. Notwithstanding this status, Grandfathered Wireless Broadband Licensees shall not cause harmful interference to federal Incumbent Users and grandfathered FSS earth stations consistent with the rules governing Citizens Broadband Radio Service operators in this part.
  - i. Incumbent User protections for a Grandfathered Wireless Broadband Licensee shall only apply within its Grandfathered Wireless Protection Zone.
  - ii. Incumbent User protections for a Grandfathered Wireless Broadband Licensee shall only apply to Grandfathered Wireless Protection Zones around base or fixed stations that are registered in ULS on or before April 17, 2015 and constructed, in service, and fully compliant with the rules in Part 90, subpart Z as of April 17, 2016. Grandfathered Wireless Protection Zones will [shall] be reduced in geographic area and/or applicable frequency range if portions of the protected network fail to meet the above criteria after April 17, 2016. Grandfathered Wireless Protection Zones will [shall] not be defined for subscriber units operated by Grandfathered Wireless Broadband Licensees, regardless of whether they have been registered in ULS.
  - iii. Grandfathered Wireless Protection Zones must [shall] be registered in the SAS for these protections to apply.
- b. Grandfathered Wireless Broadband Licensees may operate within their Grandfathered Wireless Protection Zones and operational frequencies consistent with the technical rules in Part 90, subpart Z, consistent with the transition period set forth in sections 90.1307 and 90.1338.
- c. Grandfathered Wireless Broadband Licensees and Citizens Broadband Radio Service users must [shall] protect authorized grandfathered FSS

earth stations in the 3650-3700 MHz band, consistent with the existing protection criteria in part 90, subpart Z until the last Grandfathered Wireless Broadband Licensee's license expires within the protection area defined for a particular grandfathered FSS earth station. Thereafter, the protection criteria in section 96.17 applicable to similarly situated facilities shall apply.

R1-IPM-01: Protection of Federal Incumbent Users from CBSDs operating in the 3550-3650 band [Ref-2, 96.15]

- a. CBSDs and End User Devices must [shall] not cause harmful interference to and must accept interference from federal Incumbent Users authorized to operate in the 3550-3700 MHz band and below 3550 MHz. Note: the FCC Rules do not explicitly state how far below 3550 MHz that federal Incumbent Users must be protected. However, primary federal allocations extend to 3100 MHz.
- b. The SAS shall only authorize the use of CBSDs consistent with information on federal frequency use obtained from an approved ESC, except as provided in this section.
- c. For Category A CBSDs, Exclusion Zones shall be maintained along the Coastline, as shown at [ntia.doc.gov/category/3550-3650-mhz](http://ntia.doc.gov/category/3550-3650-mhz). Exclusion Zones shall also be maintained around federal radiolocation sites as set forth at [ntia.doc.gov/category/3550-3650-mhz](http://ntia.doc.gov/category/3550-3650-mhz). NTIA shall notify the Commission in writing if and when the list of protected federal radiolocation sites is updated. Exclusion Zones shall be maintained and enforced until one or more ESCs are approved and used by at least one SAS, in accordance with section 96.67. Thereafter, Exclusion Zones shall be converted to Protection Zones.
  - i. Category A CBSDs may be authorized by an approved SAS in geographic areas outside of Exclusion Zones before an ESC is approved.
  - ii. Once an ESC is approved and used by at least one SAS, Category A CBSDs may only be authorized consistent with information on federal frequency use provided to the SAS by an approved ESC.
  - iii. Category B CBSDs may only be authorized consistent with information on the presence of a signal from a federal system provided to the SAS by an approved ESC. [Ref-2, 96.45b]
- d. Within 60 seconds after the ESC communicates that it has detected a signal from a federal system in a given area, the SAS must [shall] either confirm suspension of the CBSD's operation or its relocation to another unoccupied frequency, if available. Note: the 60 second time period is expected to change with the second report and order.
- e. The Commission will, as necessary, add or modify Exclusion Zones or Protection Zones to protect current and future federal Incumbent Users.
- f. The Commission may temporarily extend or modify Exclusion Zones and Protection Zones to protect temporary operations by federal Incumbent



Users. Federal Incumbent Users will [shall] coordinate with the Commission prior to the beginning of any non-emergency operation requiring additional protection. Such modifications will [shall] be communicated to the SAS along with the expiration date and time of any modification.

R1-IPM-02: Protection of Federal Incumbent Users from CBSDs operating in the 3650-3700 band [Ref-2, 96.15]

- a. CBSDs and End User Devices must [shall] not cause harmful interference to and must accept interference from federal Incumbent Users.
- b. Exclusion Zones shall be maintained for an 80 km radius around the federal radiolocation sites listed in 47 CFR 90.1331 [Ref 4] and 47 CFR 2.106 footnote US 109 [Ref 4]. These Exclusion Zones shall be maintained and enforced until one or more ESCs are approved and used by at least one SAS, in accordance with section 96.67. Thereafter, Exclusion Zones shall be converted to Protection Zones.
- c. CBSDs may only be authorized within these Protection Zones consistent with information on the presence of a signal from a federal system provided to the SAS by an approved ESC, in accordance with section 96.67.
- d. Within 60 seconds after the ESC communicates that it has detected a signal from a federal system in a given area, the SAS must [shall] either confirm suspension of the CBSD's operation or its relocation to another unoccupied frequency.

R2-IPM-01: Impacts from CBRS activity authorized by all SASs shall be managed to achieve an aggregate interference level at 3550-3650MHz for federal incumbent radars not to exceed an I/N of -6 dB at the incumbent radar system receiver [NTIA Report 15-517 section 4.3].

Note: there is a question in to NTIA regarding the noise level used in Report 15-517. A nominal noise figure of 3 dB was used in the derivation of the R2-ESC-02.

Note: how SAS's manage aggregate interference is left for future study.

#### 4.3 SAS Interference Management and Exclusion Zones (IMZ)

R0-IMZ-01: Citizens Broadband Radio Service operation in the 3550-3700 MHz band is [shall be] subject to current and future international agreements with Mexico and Canada. The terms of these agreements shall be implemented by the SAS. [Ref-2, 96.19]

#### 4.4 SAS Administrators (SAD)

R0-SAD-01: SAS Administrators are [shall be] designated by the FCC to provide nationwide service.

*Note: The Commission may, at its discretion, permit the functions of an SAS, such as a data repository, registration, and query services, to be divided among multiple entities; however, it shall designate one or more specific entities to be an SAS Administrator responsible for coordinating the overall functioning of an SAS and providing services to operators in the Citizens Broadband Radio Service. [Ref-2, 96.63]*

R0-SAD-02: Each SAS Administrator designated by the Commission must [shall]: [Ref-2, 96.63]

- a. Maintain a regularly updated database that contains the information described in section 96.55 [2].
- b. Establish a process for acquiring and storing in the database necessary and appropriate information from the Commission's databases, including PAL assignments, and synchronizing the database with the current Commission databases at least once a day to include newly licensed facilities or any changes to licensed facilities.
- c. Establish and follow protocols and procedures to ensure compliance with the rules set forth in this part, including the SAS functions set forth in section 96.53 [2], et seq.
- d. Establish and follow protocols and procedures sufficient to ensure that all communications and interactions between the SAS, ESC, and CBSDs are accurate and secure and that unauthorized parties cannot access or alter the SAS or the information transmitted from the SAS to CBSDs.
- e. Provide service for a five-year term. This term may be renewed at the Commission's discretion.
- f. Respond in a timely manner to verify, correct or remove, as appropriate, data in the event that the Commission or a party brings a claim of inaccuracies in the SAS to its attention. This requirement applies only to information that the Commission requires to be stored in the SAS.
- g. Securely transfer the information in the SAS, along with the IP addresses and URLs used to access the system, and a list of registered CBSDs, to another approved entity in the event it does not continue as the SAS Administrator at the end of its term. It may charge a reasonable price for such conveyance.
- h. Cooperate to develop a standardized process for coordinating operations with other SASs, avoiding any conflicting assignments, maximizing shared use of available frequencies, ensuring continuity of service to all registered CBSDs, and providing the data collected pursuant to section 96.55 [2].
- i. Coordinate with other SAS Administrators including, to the extent possible, sharing information, facilitating non-interfering use by CBSDs



connected to other SASs, maximizing available General Authorized Access frequencies by assigning PALs to similar channels in the same geographic regions, and other functions necessary to ensure that available spectrum is used efficiently consistent with this part.

- j. Provide a means to make non-federal non-proprietary information available to the public in a reasonably accessible fashion in conformity with these rules.
- k. Ensure that the SAS shall be available at all times to immediately respond to requests from authorized Commission personnel for any and all information stored or retained by the SAS.
- l. Establish and follow protocols to respond to instructions from the President of the United States, or another designated Federal government entity, issued pursuant to 47 U.S.C. 606.
- m. Establish and follow protocols to comply with enforcement instructions from the Commission.
- n. Ensure that the SAS operates without any connectivity to any military or other sensitive federal database or system, except as otherwise required
- o. Ensure that the SAS 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 by this part to effectively operate the SAS.

R0-SAD-03: An SAS Administrator may charge Citizens Broadband Radio Service users a reasonable fee for provision of the services [Ref-2, 96.65]

R1-SAD-01: We require SAS Administrators to [shall] 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 [shall] also implement protocols to manually discontinue operations of their associated CBSDs in response to enforcement actions taken by the Commission. [Ref-2, para 268]

R1-SAD-02: SAS Administrators must [shall] develop policies and procedures to ensure CBRS users accept & acknowledge that they may receive potentially harmful interference from federal radar systems as a condition of their authorization. [Ref-2, para 274]

R1-SAD-03: A SAS Administrator shall provide a capability for receiving reports of exceptional circumstances requiring the attention of the Administrator. Such reports shall be able to be received from these entities and/or their designated agents:

1. The Federal Government
2. Operators of incumbent Fixed Satellite Earth Stations
3. Operators of incumbent Wireless Broadband Service stations operating in the 3650-3700MHz band
4. Operators of networks protected by Priority Access licenses

5. Operators of network equipment licensed by GAA rules
6. Other SAS Administrators
7. ESC Administrators

Such reports shall support communication to the SAS Administrator of at least the following exceptional circumstances:

1. The report of erroneous data in the SAS database.
2. The report of harmful interference experienced by an incumbent station or Priority Access licensee which is prohibited by Part 96 rules.
3. The report of an alternative interference protection relationship between an incumbent station or group of stations) and CBSDs operating under Part 96.
4. The report of an alternative interference protection relationship between a network operator protected by a Priority Access license and other CBSDs operating under Part 96.
5. The report by the FCC of an enforcement action, including any action taken regarding a particular CBSD or group of CBSDs or regarding a particular CBRS user or group of users.
6. The report by the FCC of a waiver granted to provide an exception to Part 96 rules for CBSDs or other CBRS entities.
7. The report by the FCC of a waiver which has been granted to a non-CBRS entity which impacts CBRS operations.

When in receipt of such a report of exceptional circumstances, a SAS Administrator shall provide the full details of such a report to all other SAS Administrators to whom the report is relevant [Note: it is FFS to define who is “relevant”]:

1. Reports originated by the Federal Government shall always be provided to other SAS Administrators without delay.
2. Reports of alternative interference protection relationships between incumbents and CBSDs or between Priority Access and General Authorized Access users shall always be provided to other SAS Administrators without delay.
3. Reports leading to corrections in the SAS database shall be communicated to other SAS Administrators without delay insofar as the correction will impact previously-communicated information the SAS Administrator has corrected as a result of the report.
4. Reports of harmful interference may be communicated to other SAS Administrators in the process of responding to such a report.

The tools provided by a SAS Administrator for the reporting of harmful interference should provide sufficient information for the reporter of such harmful interference to follow standardized reporting procedures such as OpenSSRF formats and the JSIR process. Such tools shall also inform the user that reports may be acted upon by the FCC.

A SAS Administrator shall respond in a timely fashion corresponding to the nature of the report of exceptional circumstances, including those of harmful interference.

Note: FCC actions regarding an ad hoc exclusion zone or an emergency reclamation of spectrum are addressed in requirement R2-ISC-01.

[Ref-2, 96.35(e), 96.41(d)(1), 96.41(e)(4), 96.63(f), para. 37, 214, 399]

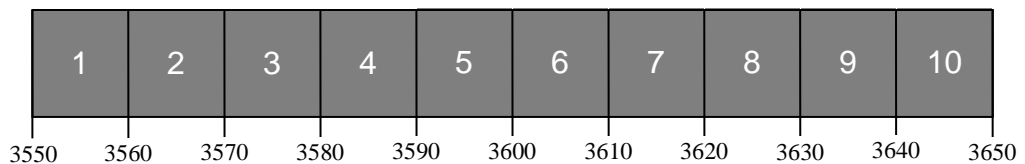
#### 4.5 SAS Requirements for PAL Users (SPU)

R0-SPU-01: Each PAL[shall] consists of a single License Area (Census Tract). [Ref-2, 96.25]

R0-SPU-02: PAL channels must [shall] be assigned by the SAS. Priority Access Licensees may request a particular channel or frequency range from the SAS but will not be guaranteed a particular assignment. Priority Access Users may operate in the 3550-3650 MHz frequency band with assigned 10 MHz channels. [Ref-2, 96.11, 96.12 & 96.25]

R0-SPU-03: Priority Access Licensees may [shall] not aggregate more than four PAL channels in any License Area at any given time. [Ref-2, 96.31]

R2-SPU-01: The following channels are defined for PAL assignments in the 3550-3650 MHz band:



[Reference: FCC 15-47 at paragraph 59]

*Informative Note: Future studies will examine the relative utility of each channel for single-carrier and aggregate emissions, in the context of out-of-band emissions limits, fixed-satellite and Part 90 incumbent protections, and other considerations.*

#### 4.6 SAS Requirements for GAA Users (SGU)

R0-SGU-01: General Authorized Access Users shall be permitted to use frequencies assigned to PALs when such frequencies are not in use, as determined by the SAS. Frequencies that are available for General Authorized Access Use shall be made available on a shared basis. [Ref-2, 96.35]

- a. General Authorized Access Users shall have no expectation of interference protection from other General Authorized Access Users operating in accordance with this part.
- b. General Authorized Access Users must [shall] not cause harmful interference to and must accept interference from Priority Access Licensees and Incumbent Users in accordance with this part. [Ref R0-SGN-06:(h) and R0-SGN-06:(i)]
- c. General Authorized Access Users operating Category B CBSDs must [shall] make every effort to cooperate in the selection and use of available frequencies provided by an SAS to minimize the potential for interference and make the most effective use of the authorized facilities. Such users shall coordinate with an SAS before seeking station authorization, and make every effort to ensure that their CBSDs operate at a location, and with technical parameters, that will minimize the potential to cause and receive interference among CBSDs.
- d. Operators of CBSDs suffering from or causing harmful interference are [shall be] expected to cooperate and resolve interference problems through technological solutions or by other mutually satisfactory arrangements.

R0-SGU-02: General Authorized Access Users may operate in the 3550-3700 MHz frequency band. [Ref-2, 96.11]

R0-SGU-03: General Authorized Access CBSDs must [shall] register with the SAS and comply with its instructions. [Ref-2, 96.33]

#### 4.7 Inter-SAS Communication (ISC)

R2-ISC-01: When a SAS Administrator receives instructions from the President of the United States or another designated Federal government entity issued pursuant to 47 U.S.C. 606, or instructions from the FCC pursuant to FCC enforcement actions, that SAS Administrator shall, without delay, inform all other designated SAS Administrators of those instructions.

[Ref-2, 96.63(l & m) & Para 268; Title 47 USC 606]

R2-ISC-02: When a SAS Administrator receives communication that the Commission has temporarily extended or modified an Exclusion Zone or Protection Zone to protect temporary operations by federal incumbent users, that SAS Administrator shall, without delay, inform all other designated SAS Administrators of such communication. This information shall include the nature of the extension or modification as well as any accompanying expiration date and time specified by the Commission. [Ref-2, 96.15(a)(6)]

R2-ISC-03: Sharing of ESC Information between SASs:

- a. Sharing of ESC information between SASs is prohibited if each of the SASs receive input from different ESCs.

- b. SASs shall exchange on a timely basis all CBSD data required for each SAS to correctly participate in aggregate federal incumbent radar protection relying on an ESC without reference to the behavior of any other SAS.

Note: an enumeration of CBSD data to be shared will be the subject of study in the information sharing WG1 Task Group.

- c. In addition, SAS administrators shall perform any necessary pre-arrangement of protection behavior needed to ensure the protection of federal incumbent radar activity in any exclusion zone within which CBSD operation is enabled due to the operation of an ESC system.

Note: The specifics of such pre-arranged responses is expected to be provided by SAS administrators at the time of their application for approval, including a description of how these responses are parameterized by the ESC. Such parameterization may be updated during periodic ESC reviews.

## 5 CBSD Requirements (DEV)

R0-DEV-01: The Citizens Broadband Radio Service is [shall be] authorized in the 3550-3700 MHz frequency band. General Authorized Access Users may operate in the 3550-3700 MHz frequency band. Priority Access Users may operate in the 3550-3650 MHz frequency band. Grandfathered Wireless Broadband Licensees may continue to use the 3650-3700 MHz band in accordance Ref-2. [Ref-2, 96-11]

R0-DEV-02: All CBSDs must [shall] be able to determine their geographic coordinates (referenced to the North American Datum of 1983 (NAD83)) to an accuracy of  $\pm 50$  meters horizontal and  $\pm 3$  meters of elevation. Such geographic coordinates shall be reported to an SAS at the time of first activation from a power-off condition. [Ref-2, 96.39]

- a. For professionally installed CBSDs, geographic coordinates to the same accuracy specified above may be determined and reported to the SAS as part of the installation and registration process. Geographic coordinates must [shall] be determined and reported each time the CBSD is moved to a new location.
- b. Non-professionally installed CBSD must [shall] check its location and report to the SAS any location changes exceeding 50 meters horizontal and  $\pm 3$  meters elevation from its last reported location within 60 seconds of such location change.

R0-DEV-03: A CBSD must [shall] register with and be authorized by an SAS prior to its initial service transmission. The CBSD must [shall] provide the SAS upon its registration with its geographic location, antenna height above ground level (in meters), CBSD class (Category A/Category B), requested authorization status (Priority Access or General Authorized Access), FCC identification number, call sign, user contact information, air interface technology, unique

manufacturer's serial number, sensing capabilities (if supported), and additional information (see below) [Ref-2, 96.39].

- a. CBSD Category-A devices must [shall] also indicate if they are operating indoors or outdoors. [Ref-2, 96.43b]
- b. CBSD Category-B devices must [shall] also provide: antenna gain, beamwidth, azimuth, downtilt angle, and antenna height above ground level. [Ref-2, 96.45d]
- c. If any of the registration information changes, the CBSD shall update the SAS within 60 seconds of such change, except as otherwise set forth in section 96.39 of Ref-2.
- d. All information provided by the CBSD to the SAS must [shall] be true, complete, correct, and made in good faith. [Ref-2, 96.39]

R0-DEV-04: CBSD technical operation [Ref-2, 96.39]

- a. All CBSDs must [shall] be capable of two-way operation on any authorized frequency assigned by an SAS. Equipment deployed by Grandfathered Wireless Broadband Licensees during their license term will be exempt from this requirement
- b. A CBSD must [shall] operate at or below the maximum power level authorized by an SAS, consistent with its FCC equipment authorization, and within geographic areas permitted by an SAS on the channels or frequencies authorized by an SAS.
- c. A CBSD must [shall] receive and comply with any incoming commands from its associated SAS about any changes to power limits and frequency assignments. A CBSD must [shall] cease transmission, move to another frequency range, or change its power level within 60 seconds as instructed by an SAS.
- d. A CBSD must [shall] report to an SAS regarding received signal strength in its occupied frequencies and adjacent frequencies, received packet error rates or other common standard metrics of interference for itself and associated End User Devices as directed by an SAS.
- e. If directed by the SAS, a CBSD that receives a range of available frequencies or channels from an SAS must [shall] promptly report to the SAS which of the available channels or frequencies it will utilize.
- f. CBSDs shall incorporate security measures sufficient to ensure that they are capable of communicating only with SASs operated by approved SAS Administrators, and that communications between CBSDs and SASs, between individual CBSDs, and between CBSDs and End User Devices are secure to prevent corruption or unauthorized interception of data.
- g. For purposes of obtaining operational limits and frequency availabilities and their updates, CBSDs shall only contact SASs operated by SAS Administrators approved by the Commission in accordance with subpart F.
- h. All communications between CBSDs and SASs must [shall] be transmitted using secure methods that protect the systems from corruption or unauthorized modification of the data.



- i. Communications between a CBSD and its associated End User Devices for purposes of obtaining operational power, location, and frequency assignments shall employ secure methods that protect the system from corruption or unauthorized modification of the data.
- j. All CBSDs and End User Devices must [shall] contain security features sufficient to protect against modification of software and firmware by unauthorized parties. Applications for certification of CBSDs and End User Devices must [shall] include an operational description of the technologies and measures that are incorporated in the device to comply with the security requirements of this section. In addition, applications for certification of CBSDs and End User Devices must [shall] identify at least one of the SAS databases operated by an approved SAS Administrator that the device will access for channel/frequency availability and affirm that the device will conform to the communications security methods used by such databases.
- k. Airborne operations by CBSDs and End User Devices are [shall be] prohibited.

R0-DEV-05: CBSD and End User Devices General Radio Requirements [Ref-2, 96.41]

- a. Systems operating in the CBRS must [shall] use digital modulation techniques
- b. Unless otherwise specified in this subsection, the maximum conducted output power, maximum transmit antenna gain, maximum EIRP, and maximum Power Spectral Density (PSD) of any CBSD and End User Device must [shall] comply with the limits shown in the table below:

Device	Geographic Area	Maximum Conducted Output Power (dBm/10 megahertz)**	Maximum EIRP (dBm/10 megahertz)	Maximum Conducted PSD (dBm/MHz)
End User Device	All	n/a	23	n/a
Category A CBSD	All	24	30	14
Category B CBSD*	Non-Rural	24	40	14
Category B CBSD*	Rural	30	47	20

\* Category B CBSDs will only be authorized for use after an ESC is approved and commercially deployed consistent with sections 96.15 and 96.67.

- c. CBSDs and End User Devices shall limit their operating power to the minimum necessary for successful operations.
  - i. CBSDs must [shall] support transmit power control capability and the capability to limit their maximum EIRP and the maximum EIRP of associated End User Devices in response to instructions from an SAS.

- ii. End User Devices shall include transmit power control capability and the capability to limit their maximum EIRP in response to instructions from their associated CBSDs.
- d. Received Signal Strength Limits:
  - i. For both Priority Access and GAA users, CBSD transmissions must [shall] be managed such that the aggregate received signal strength, measured at any location on the Service Area boundary of any co-channel PAL, shall not exceed an average (rms) power level of -80 dBm in any direction when integrated over a 10 megahertz reference bandwidth, with the measurement antenna placed at a height of 1.5 meters above ground level, unless the affected PAL licensees agree to an alternative limit and communicate that to the SAS.
  - ii. These limits shall not apply for co-channel operations at the boundary between geographically adjacent PALs held by the same Priority Access Licensee.
- e. 3.5 GHz Emissions and Interference Limits:
  - i. General protection levels. Except as otherwise specified below, for channel and frequency assignments made by the SAS to CBSDs, the power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the power of any emission shall not exceed -25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.
  - ii. Additional protection levels. Notwithstanding paragraph (d)(i) of this section, the power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40dBm/MHz.
  - iii. Measurement procedure:
 

Compliance with this provision is [shall be] based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (i.e., 1 MHz or 1



percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

When measuring unwanted emissions to demonstrate compliance with the limits, the CBSD and End User Device nominal carrier frequency/channel shall be adjusted as close to the licensee's authorized frequency block edges, both upper and lower, as the design permits.

Emission power measurements shall be performed with the CBSD and End User Devices operating at their maximum EIRP levels.

Emission power measurements shall be performed with a peak detector in maximum hold.

- iv. When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.
- f. Reception Limits: Priority Access Licensees must [shall] accept adjacent channel and in-band blocking interference (emissions from other authorized Priority Access or GAA CBSDs transmitting between 3550 and 3700 MHz) up to a power spectral density level not to exceed -40 dBm in any direction with greater than 99% probability when integrated over a 10 megahertz reference bandwidth, with the measurement antenna placed at a height of 1.5 meters above ground level, unless the affected Priority Access Licensees agree to an alternative limit and communicates that to the SAS.

Note to paragraph (f): Citizens Broadband Radio Service users should be aware that there are Federal Government radar systems in the band and adjacent bands that could adversely affect their operations.

R0-DEV-06: Category A CBSDs shall not be deployed or operated outdoors with antennas exceeding 6 meters height above average terrain. CBSDs deployed or operated outdoors with antennas exceeding 6 meters height above average terrain will be classified as, and subject to, the operational requirements of Category B CBSDs. [Ref-2, 96.43a]

R0-DEV-07: Any CBSD operated at higher power than specified for Category A CBSDs in section 96.41 [R0-DEV-05:] will be classified as, and subject to, the operational requirements of a Category B CBSD. [96.43c]

R0-DEV-08: Category B CBSDs must [shall] be professionally installed. [Ref-2, 96.45a]

Note: See Ref-3 for the definition of a Category B CBSD.

R0-DEV-09: Category B CBSDs are [shall be] limited to outdoor operations. [Ref-2, 96.45c]

R0-DEV-10: Each transmitter used for operation under this part and each transmitter marketed as set forth in section 2.803 [Ref-4, Chapter I, Subchapter A, Part 2] must [shall] be of a type which has been certificated for use under this part.

Any manufacturer of radio transmitting equipment to be used in these services must [shall] request equipment authorization following the procedures set forth in Subpart J [Ref-4, Chapter I, Subchapter A, Part 2]. [Ref-2, 96.49]

Communication between individual CBSDs must [shall] be secure to prevent corruption or unauthorized interception of data. [Ref-2, 96.61]

## 6 Domain Proxy Requirements (DPX)

The following requirements related to the Domain Proxy

R1-DPX-01: Domain Proxy to CBSD operational requirements: A Domain Proxy must [shall] ensure that all of the CBSD requirements of 96.39 [Ref-2] are met by CBSDs for which the Domain Proxy is communicating to the SAS.

R1-DPX-02: Domain Proxy to SAS interface security [Ref-2, 96.61]

- a. A Domain Proxy must [shall] employ protocols and procedures to ensure that all communications and interactions between the Domain Proxy and SAS are accurate and secure and that unauthorized parties cannot access the Domain Proxy via this communication path or alter the information exchanged between the Domain Proxy and the SAS.
- b. Communications between a Domain Proxy and an SAS must [shall] be secure to prevent corruption or unauthorized modification of data
- c. A Domain Proxy must [shall] incorporate security measures sufficient to ensure that it is capable of communicating only with SASs operated by approved SAS Administrators.

R1-DPX-03: Domain Proxy to CBSD communications security [Ref-2 96.3, 96.61, 96.39(f), R0-SGN-05:]

- a. A Domain Proxy must [shall] employ protocols and procedures to ensure that all communications and interactions between the Domain Proxy and CBSDs are accurate and secure and that unauthorized parties cannot access the Domain Proxy via this communication path or alter the information exchanged between the Domain Proxy and the CBSD.
- b. Communications between a Domain Proxy and a CBSD must [shall] be secure to prevent corruption or unauthorized modification of data.

R2-DPX-01: Domain Proxy to CBSD communications security implementation: The protocols and procedures to fulfill and enforce Domain Proxy to CBSD security requirements are out of the scope of this document and are not specified.

## 7 System Registration Requirements

Registration is a rather complex process and we provide Informative Annex A.1 with information to help explain the process.

R2-SRR-01: Owner Registration Information: The Owner Registration and associated database requires the owner to provide the following information:

- a. Owner legal identity (corporate or individual),
- b. Owner mailing Address (contact address), or designated agent contact address,
- c. Owner's physical address (may or may not correspond to the Mailing Address),
- d. Owner's legal Address (may or may not correspond to the Mailing Address),
- e. Owner's Email contact address,
- f. Owner's Phone Number (contact, or of designated agent),
- g. Designated Agent (if applicable)

R2-SRR-02: During the Owner registration process, the system shall provide to the Owner in a secure manner the following:

- a. A system wide<sup>1</sup> unique Owner Registration Identity (OR-ID) to identify the Owner,
- b. A method to authenticate the Owner when accessing the Owner account (e.g, password)

R2-SRR-03: During the Owner registration process, the SAS shall record:

- a. Owner Registration date,
- b. Owner Registration expiration or term (tbd),
- c. Owner Registration state (valid, expired, pending enforcement, revoked),
- d. Registering Agent (FCC, SAS, or other agent),
- e. Optional Registration Fee Paid (true or false indication). Note: a credit card transaction for this may help to serve as an identity check and a mailing address check to prevent fraudulent or fictitious registrations and mailing addresses. This credit card transaction may be a separate transaction for the Owner License, or may be the purchase transaction for the CBSD itself.

R1-SRR-01: During registration, the owner shall provide and the SAS shall record:

- a. Acknowledgment of part 96 license rules, [Ref-2, 96.55(e) & para 274]
- b. Acknowledgement of federal operations risk [Ref-2, 96.55(e) & para 274]

R2-SRR-04: Owner Validation: The owner credentials (whether an individual or business) shall be validated by the SAS to ensure the owner is who they represent and has a valid contact information & address. [Informative note: For an individual, this can include using a credit card to validate name and contact address.]

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<sup>1</sup> The scope of System Wide is FFS.

- R2-SRR-05: Owner Maintenance of account: The Owner shall be able to update owner information and be able to register or deregister CBSDs associated with their account.
- R2-SRR-06: Association of CBSD with Owner: The SAS Administrator and the CBSD Owner shall exchange information that establishes a secure mechanism to identify the CBSD Owner identity and to establish the relationship between the CBSD and its owner. The owner information association shall be established per individual CBSD in such a way that legitimate owners may revoke the owner association.
- R2-SRR-07: CBSD ID: The CBSD Registration process shall establish a CBRS-wide unique CBSD ID.
- R2-SRR-08: The CBSD ID shall have a one-to-one correspondence with the combination FCC ID + CBSD S/N and may be identical to that combination.
- R2-SRR-09: SAS authentication of software & firmware is FFS (along with SAS handling and authentication of software & firmware updates).
- R0-SRR-01: Category A CBSD Parameter Set: Prior to the SAS enabling spectrum use by the CBSD, the following Category A CBSD information shall be provided to the SAS. The information shall be uploaded either via the CBSD communicating with the SAS or entered by a Certified Professional Installer via a mechanism provided by the SAS administrator.
- a. CBSD Vendor,
  - b. CBSD Serial number [required by 96.39(c)],
  - c. FCC Identification number [required by 96.39(c)],
  - d. Call Sign [required by 96.39(c)],
  - e. Secure information to associate CBSD with the Owner,
  - f. Informative Note: this will link a valid Owner with the CBSD [required by 96.39(c)]
  - g. CBSD Air Interface Technology [required by 96.39(c)],
  - h. Types include: EUTRA, other values to be defined as appropriate
  - i. CBSD Sensing capability [required by 96.39(c)],<sup>2</sup>
  - j. CBSD installation location (Indoor or Outdoor, required for Category A CBSDs) [Ref 2, 96.43(b)],
  - k. Location information: latitude, longitude, and antenna height above ground level (in meters) [Ref 2, 96.39(c) & para 219],
  - l. Certified Professional Installer Registration ID (if information provided to the CBSD was manually entered by a Certified Professional Installer)
  - m. Optional vendor specific information fields. The SAS shall allow CBSDs to provide optional vendor specific information which can be used by the SAS. Examples include: CBSD model number, CBSD HW version

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<sup>2</sup> To be defined by the Sensing & Measurement Task Group

number, CBSD SW and/or FW version number, hardware characteristics, etc.

R0-SRR-02: Category B CBSD Parameter Set: Prior to the SAS enabling spectrum use by the CBSD, the following Category B CBSD information shall be provided to the SAS. The information shall be uploaded either via the CBSD communicating with the SAS or entered by a Certified Professional Installer via a mechanism provided by the SAS administrator.

- a. CBSD Vendor,
- b. CBSD Serial number [required by 96.39(c)],
- c. FCC Identification number [required by 96.39(c)],
- d. Call Sign [required by 96.39(c)],
- e. Secure information to associate CBSD with the Owner,
- f. Informative Note: this will link a valid Owner with the CBSD [required by 96.39(c)]
- g. CBSD Air Interface Technology [required by 96.39(c)],
- h. Types include: EUTRA, other values to be defined as appropriate
- i. CBSD Sensing capability [required by 96.39(c)],<sup>3</sup>
- j. Location information: latitude, longitude, and antenna height above ground level (in meters) [Ref 2, 96.39(c) & para 219],
- k. Certified Professional Installer Registration ID (if information provided to the CBSD was manually entered by a Certified Professional Installer)
- l. Antenna Gain [Ref 2, 96.45(d)],
- m. Antenna beamwidth [Ref 2, 96.45(d)],
- n. Antenna azimuth pointing direction [Ref 2, 96.45(d)],
- o. Antenna downtilt angle [Ref 2, 96.45(d)],
- p. Optional vendor specific information fields. The SAS shall allow CBSDs to provide optional vendor specific information which can be used by the SAS. Examples include: CBSD model number, CBSD HW version number, CBSD SW and/or FW version number, hardware characteristics, etc.

R1-SRR-02: During the registration process, the SAS shall provide the following information to the registering CBSD:

- a. A system wide unique CBSD ID to identify the CBSD,
- b. All registration communication shall be done securely (as defined in the WG2 COMSEC standards). Informative note: the mutual authentication in the secure handshake is enough to identify the parties as mutually valid.
- c. An indication if the Registration was successful or what additional information is needed to complete the registration process.

This information is required to register the CBSD and to establish a CBSD Registration ID. This CBSD Registration ID shall be linked to a specific owner (an Owner ID), but one owner may register multiple CBSDs. A CBSD

<sup>3</sup> To be defined by the Sensing & Measurement Task Group

Registration ID corresponds to a single CBSD that can request a spectrum assignment from a SAS.

For a managed network with a Domain Proxy, the Domain Proxy can register on behalf of one or more CBSDs under its control. Each CBSD will still require its own CBSD Registration ID for its own parameters and location.

R2-SRR-10: A SAS shall be able to provide the following information on CBSD registration status to the CBSD Owner, Professional Installer of the CBSD, other SASs or the FCC:

- Whether the CBSD registration is revoked, pending or completed
- Whether the CBSD has been taken out of service (decommissioned)
- Whether the CBSD has any enforcement actions initiated against it or determined to be in effect

R2-SRR-11: Category A CBSDs unable to automatically determine their location to within the requirements set forth by the FCC R&O [include a reference to location accuracy] shall be installed by a Certified Professional Installer. [Ref-2, 96.39 & para 221]

R2-SRR-12: CBSD Group Identifier: While registering a CBSD, a CBSD Group identifier may be specified along with other required device information. If present, this identifier designates a CBSD as a member of a particular group (or network) of CBSDs.

Note: It is anticipated that a system-wide naming convention will be established such that CBSD Group identifiers can be easily selected by entities (such as Domain Proxies). Support for multiple group identifiers is left for further study.

R2-SRR-13: CBSD Group Assignment Indicator: While performing a spectrum inquiry or grant request, a Group Assignment Indicator may be included with the CBSD Group Identifier and other required device information. If present, this value indicates whether all CBSDs in the group prefer or require a common radio frequency assignment, and reassignment when frequency reassignment is necessary.

R2-SRR-14: Domain Proxy Relationship with SAS: The SAS shall ensure that owner information and the credentials for the Domain Proxy are known to, and verified by, the SAS administrator prior to providing service to any CBSD that is subordinate to that Domain Proxy.

R2-SRR-15: Professional Installer information provided to the CBSD: If a professional installer accesses the CBSD to provide additional information for Category A or Category B CBSDs, the professional installer shall provide to the CBSD their associated Certified Professional Installer Registration ID.



- R2-SRR-16: Professional Installer information provided to the SAS: When a professional installer provides additional information on Category A or Category B CBSDs via a mechanism provided by the SAS administrator, the professional installer shall provide:
- The CBSD serial number and FCC ID (to uniquely identify the CBSD),
  - The associated Certified Professional Installer Registration ID
- R2-SRR-17: Certified Professional Installer Registration Information: The Certified Professional Installer Registration (CPIR) process requires the Certified Professional Installer to provide the following information to a SAS accessible centralized database:
- Legal identity (name),
  - Mailing address,
  - Legal address,
  - Email contact,
  - Phone contact,
  - Accredited certification number from a training program,
  - License initiation date, termination date
- R2-SRR-18: During the Certified Professional Installer Registration process, the SAS accessible centralized database shall record and maintain the following information for the Certified Professional Installer:
- A system wide unique Certified Professional Installer Identify,
  - A method to authenticate the Installer when accessing the Certified Professional Installer account

## 8 Environmental Sensing Capability Requirements (ESC)

Additional background information is provided in Informative Annex A.2.

- R0-ESC-01: The following are ESC Requirements as identified in [Ref-2, 96.67]
- An ESC may only operate after receiving approval by the Commission.
  - An ESC must [shall] be managed and maintained by a non-governmental entity.
  - An ESC must [shall] accurately detect the presence of a signal from a federal system in the 3550-3700 MHz band and adjacent frequencies using approved methodologies that ensure that any CBSDs operating pursuant to ESC will [shall] not cause harmful interference to federal Incumbent Users.
  - An ESC must [shall] communicate information about the presence of a signal from a federal Incumbent User system to one or more approved SASs.
  - An ESC must [shall] maintain security of detected and communicated signal information.

- f. An ESC must [shall] comply with all Commission rules and guidelines governing the construction, operation, and approval of ESCs.
- g. An ESC shall be available at all times to immediately respond to requests from authorized Commission personnel for any information collected or communicated by the ESC.
- h. An ESC must [shall] operate without any connectivity to any military or other sensitive federal database or system and 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 by this part to effectively operate the ESC.

R1-ESC-01: The rules governing the ESC are technologically neutral and ESC developers may utilize different sensing techniques that yield the desired result. These sensors shall be deployed in the vicinity of the Exclusion Zones described in section III(G) to ensure that all federal radar use in and adjacent to the 3.5 GHz Band is accurately detected and reported to an SAS. [Ref-2, para 383]

R2-ESC-01: ESC Detection of RADAR Types: An ESC shall be capable of detecting in-band incumbent radar activity that has the following characteristics:

<u>Characteristic</u>	<u>Value</u>	<u>Reference</u>
Polarization	Horizontal or Circular	Ref [6], Table 1
Pulse repetition rate	1 kHz	Ref [6], Figure 6
Pulse width	0.9 us	Ref [6], Table 1 & Fig. 7
Pulse duty cycle:	0.1%	Ref [5], p. 4-57
Antenna rotation period	4 s	Ref [6], Table 1 & Fig. 5
Peak power:	90 dBm	Ref [5], p. 4-57
Average power:	60 dBm	Ref [5], p. 4-57
Antenna gain:	32 dBi	Ref [5], p. 4-57

Periodic review with the U.S. Department of Defense may produce additional radar signal types that must be added to ESC detection capability.

R2-ESC-02: ESC Detection Threshold: An ESC shall be capable of detecting an in-band incumbent radar over a maximum propagation loss from the radar of 184 dB on the coastline and given a sufficiently elevated sensor location (e.g. 25m) with a clear line-of-sight to the horizon.

ESC and SAS administrators shall include in their applications for approval the detection thresholds and corresponding protection mechanisms including an accounting for aggregate interference contributions from Category A and B CBSDs.



- R2-ESC-03: ESC Performance Monitoring: An ESC operator shall implement one or more methods to monitor ESC performance and detect ESC faults (including intrusion). Such methods shall be justified in the ESC certification process.
- R2-ESC-04: ESC Partial Failure: In the event of a partial failure of the ESC, resulting in an area or frequencies which the ESC is not providing positive incumbent activity monitoring satisfying R2-ESC-02 and R2-ESC-08 requirements, the ESC shall notify any dependent SASs of such an event in the same fashion as a notification of detection of incumbent activity within the area that was being monitored on the frequencies that were being monitored. [Note: this means ESC failures are treated as detections.]
- R2-ESC-05: Inland ESC: An ESC may detect the operation of inland in-band ground-based incumbent radars in the same manner as it detects shipborne radar operation in coastal areas.
- R2-ESC-06: Detection of out-of-band RADARs: Future periodic reviews with the U.S. Government may establish metrics to detect out-of-band radars operating in the NTIA-defined federal radiolocation sites.
- R2-ESC-07: ESC Interference Protection: An ESC operator of a dedicated sensor network may request interference protection of one or more of its sensors. A SAS shall manage CBRS (from CBSDs and EUDs) interference such that the aggregate interference at the antenna output terminal of the protected sensor in 3550-3650 MHz does not exceed 120 dBm/MHz – PL (Path Loss) or a higher level specified by the ESC operator. An ESC operator that requests protection shall provide the location and height of the protected sensor to a SAS. (PL defined as the detection threshold in ref R2-ESC-02). Such requests shall be shared between SASs.
- Note: WinnForum will develop appropriate protection definitions and exchange formats to accommodate such protections, as well as requirements on ESC providers to disclose protection requirements.
- R2-ESC-08: Figures of Merit: For a signal exceeding the threshold of detection, an ESC shall be capable of detecting in-band incumbent radar activity within 60 s with 99% probability. These time scales and performance characteristics may be adjusted as a consequence of future periodic ESC review.
- R2-ESC-09: ESC Data Retention: Full ESC detection records shall not be retained within the ESC system for a time past the cessation of incumbent activity longer than the detection time figure of merit plus any additional randomized deactivation period determined by the ESC. The time period may be subject to periodic review and adjustment. ESC administrators may propose keeping statistical records for the purposes of behavior analysis and reporting during the approval process, but any such record keeping will be subject to DoD review and may be declined.

- R2-ESC-10: Operation in Exclusion Zone areas unmonitored by an ESC: A SAS shall not authorize operation of Category A CBSDs within the frequency ranges and exclusion zones established by NTIA if those areas are not monitored by an ESC network. ESC administrators supporting SASs which authorize CBSDs in the context of a partially-deployed ESC shall include in their applications for approval the method by which they determine the boundary between monitored and unmonitored areas and the resultant Exclusion Zones and Protection Zones around the boundary.
- R1-ESC-02: ESC System Failure: For protection of incumbent radar activity in the event of an ESC system failure, a SAS shall fail safely. A SAS which fails to receive expected messages from an ESC network shall behave in the same way as if no ESC was deployed over the relevant exclusion zone.
- R2-ESC-11: ESC Periodic Review: ESC network and system requirements are subject to periodic review and modification.
- R2-ESC-12: Federal Incumbent Detection Event: Notice from the ESC to the SAS resulting from a detection of federal incumbent activity in the band shall be made expeditiously subsequent to the detection of that activity by the ESC system. Information relevant to federal activity passed from an ESC to a SAS in an incumbent detection event record shall be limited to the following information:
- a. A geographical description (or reference) which defines the extent of the federal incumbent activity to be protected. This geographical description shall be limited to the constraints described by [ref: OpSec doc]
  - b. A frequency range which defines the extent of federal incumbent activity to be protected. This range shall be limited according to any constraints described by [ref: OpSec doc]
  - c. An activation time for this protection (which may be the current time).
  - d. A deactivation time for this protection (optional)
  - e. A retention time for this record within the SAS system, which shall be obeyed by the SAS following notification by the ESC system that the incumbent detection event has expired. This retention time shall be limited to the constraints described by [ref: OpSec doc]
  - f. A protection level specifier to be enforced by the SAS for this geographical description (if applicable).

Upon cessation of the incumbent detection event, the information passed from an ESC to a SAS relevant to the federal activity shall be limited to the amount necessary to identify which incumbent detection event record is no longer active.

Other information as needed for SAS and ESC operational concerns may also be passed by the ESC to the SAS as required. None of that information shall have any relationship to federal incumbent activity except insofar as it may be derived by either the ESC or the SAS from exactly that information listed in this requirement.

## 9 End User Device Requirements (EUD)

R0-EUD-01: End User Device Radios must [shall] also comply with CBSD General Radio Requirements stated above in R0-DEV-05: [Ref-2, 96.41]

R0-EUD-02: End User Devices may [shall] not be used as intermediate service links or provide service over frequencies listed in section 96.11 to other End User Devices or CBSDs. [Ref-2, 96.3]

R0-EUD-03: End User Devices may operate only if they can positively receive and decode an authorization signal transmitted by a CBSD, including the frequencies and power limits for their operation. An End User Device must [shall] discontinue operations, change frequencies, or change its operational power level within 10 seconds of receiving instructions from its associated CBSD.

Any device operated at higher power than specified for End User Devices in section 96.41 [R0-DEV-05:] will [shall] be classified as, and subject to, the operational requirements of a CBSD. [Ref-2, 96.47]

## 10 References

[1] Federal Communications Commission, “Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band,” GN Docket 12-354, FCC 15-47, Report and Order and Second Notice of Proposed Rulemaking, XX FCC Rcd #####, available at [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-15-47A1\\_Rcd.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-47A1_Rcd.pdf)

[2] Title 47, Code of Federal Regulations, Part 96 (2015), available at: [www.ecfr.gov](http://www.ecfr.gov).

[3] Wireless Innovation Forum, Spectrum Sharing Committee, “Definitions Related to Commercial Operations in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band” available at: <http://www.wirelessinnovation.org/fcc-definitions>

[4] Title 47, Code of Federal Regulations (various parts referenced), available at: [www.ecfr.gov](http://www.ecfr.gov).

[5] National Telecommunications and Information Administration, “An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands,” October 2010 (“Fast Track Report”).

[6] National Telecommunications and Information Administration, “Spectrum Occupancy Measurements of the 3550-3650 Megahertz Maritime Radar Band near San Diego, California,” Technical Report TR-14-500, January 2014.

## Appendix A.1: Registration Overview

Before a CBSD can begin automated channel allocation requests with the SAS, the CBSD must be registered with the SAS. This is a rather complex process where the following separate registrations or enrollments may be required:

- Owner Registration: CBSDs must be associated with an owner, we require the owner to pre-register (enroll) with the system. The owner may be a corporation or an individual.
- Certified Professional Installer Registration (CPIR): Some CBSDs will be installed by a Certified Professional Installer, we require the professional installer to be pre-registered with a Professional Installer certifying body database which the SAS must be able to access. *Note: Category B CBSDs must be setup by a Professional Installer.*
- CBSD Registration (CR): The CBSD must register with the SAS and also provide installation details.
  - Owner installed CBSDs: Category A CBSDs may be installed by an owner or an authorized associate of the owner. Such CBSDs will initiate registration with the SAS. An owner-installed CBSD must be capable of automatically calculating its location (as defined by the FCC Rules) and provide that information as part of the CBSD registration process.
  - Professionally installed CBSDs: All Category B CBSDs must be installed a certified professional installer, while certain Category A CBSDs may be installed by a certified professional installer. Category A CBSDs unable to automatically determine their location to within the FCC Rules must be installed by a certified professional installer, while other Category A CBSDs can be installed professionally (Ref-1 para 208). Category A CBSDs installed by a professional installer may not be capable of automatic determination of their location (either by design or due to disadvantaged placement); such CBSDs will be installed in a fixed location so as to be attached to a permanent structure (e.g. pole, ceiling, or wall), and the location of such a CBSD will be provided by the professional installer.
- PAL License Registration: For CBSDs using PAL spectrum, we require the PAL License and the specific protection area to be pre-registered (enrolled) with the system. This is currently FFS.

### Owner Registration / Enrollment with the SAS

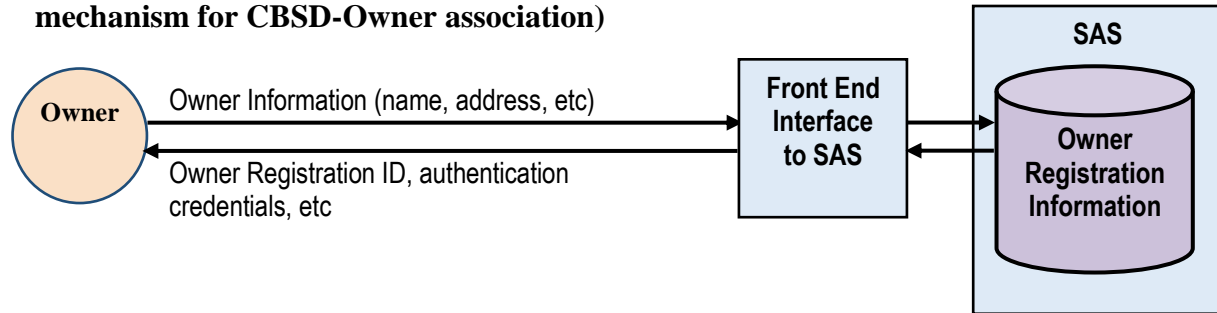
The Owner is a person or company who owns and is responsible for one or more CBSDs. Owner registration with a certified SAS is expected to be a manual process (likely via a Web Interface).

After the owner has provided necessary owner contact information, the system must provide the owner with:

- An Owner Registration Identity (OR-ID),
- A method to authenticate the Owner when accessing the Owner account (e.g, password),

Information is exchanged between the CBSD owner and the SAS Administrator to establish a secure mechanism to associate CBSD(s) and owner identity. This mechanism will be used to allow the SAS to properly associate a registering CBSD with its owner. This is to ensure the CBSD is linked to a valid owner and to ensure registration occurs with the Owner's permission. The mechanism would allow the owner to create sub-groupings of CBSDs which may be useful for large networks.

**Owner Registration Process (includes a secure mechanism for CBSD-Owner association)**



**CBSD Registration**

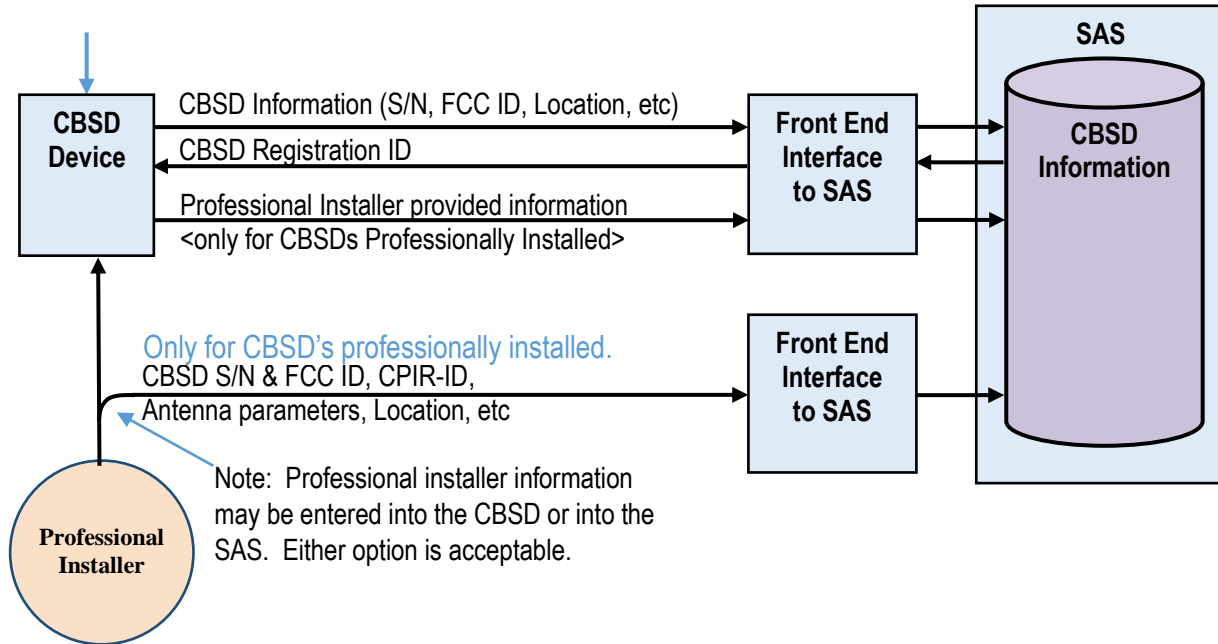
Category B CBSDs are required to be setup by a professional installer and require the professional installer to provide additional information about the CBSD. The information may be entered into the CBSD (to be relayed to the SAS) or entered by a Certified Professional Installer via a mechanism provided by the SAS administrator.

Category A CBSDs which are unable to automatically calculate their location within the FCC requirements need to have their location validated by a certified professional installer.

The information provided by the certified professional installer is site specific.

### CBSD Registration Process

User Entered Data

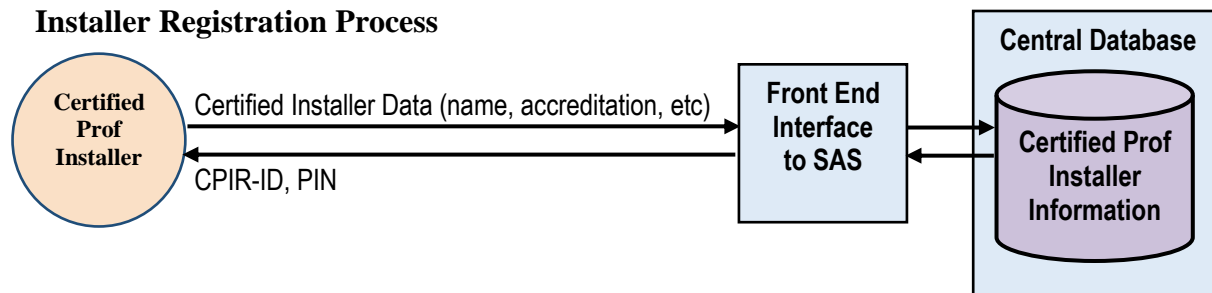


### Certified Professional Installer Registration (enrollment)

The FCC Rules require Category B CBSDs must be installed by a certified professional installer, while Category A CBSDs may be installed by a professional installer [Ref-2 96.45 (b)]. The rules also “encourage” an accreditation program for professional installers (para 222).

The Certified Professional Installer must be pre-registered in a centralized database, which is accessible by all SASs, which will provide the installer with a system wide unique Certified Professional Installer Identify and a method to authenticate the Installer when accessing the Certified Professional Installer account. This information will be used by the installer when they enter the Device Installation Record into the CBSD or provide it to the SAS Administrator.

### Installer Registration Process





## Appendix A.2: Additional Information about ESC Requirements

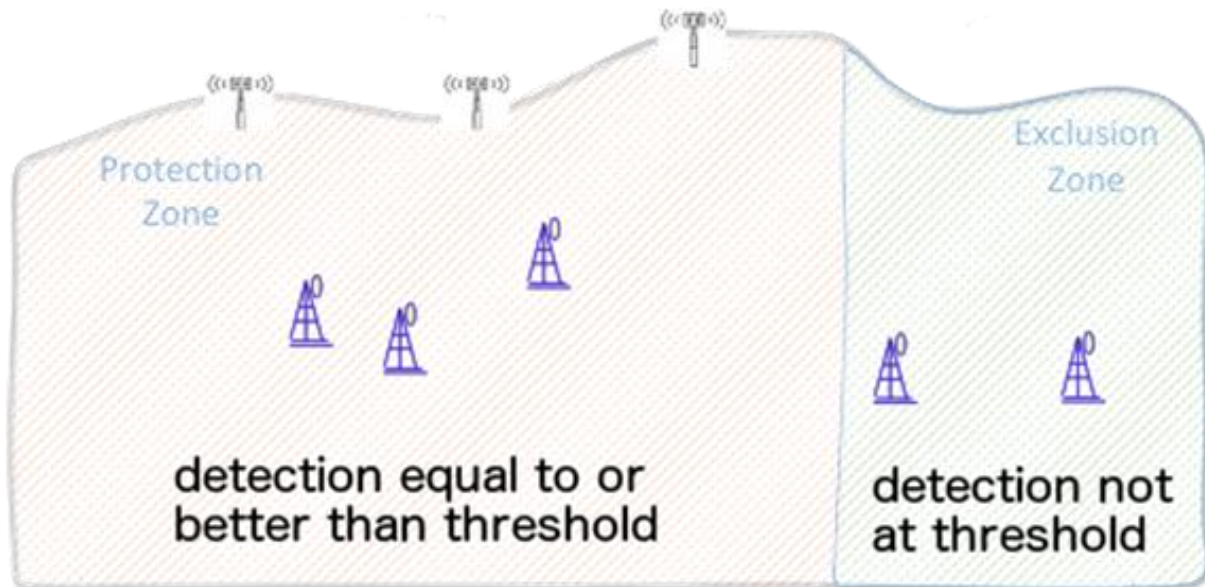
The ESC requirements establish the maximum propagation loss over which an incumbent radar must be detected by an ESC on the coastline. Effectively specifying the required sensitivity of the ESC without multiple complicating factors such as peak vs average detection, integration time, reference bandwidth, maximum distance to radar, etc. Also allowing maximum flexibility in system design.

For reference, the specified maximum propagation loss (184 dB) corresponds to the minimum path loss allowed between an equivalent total emission power of a single Category B rural CBSD on the coastline and the radar receiver such that the interference-to-noise ratio (I/N) in the receiver does not exceed -6 dB. (The calculated loss assumes a radar receiver noise figure of 3 dB, an equivalent noise bandwidth of 1 MHz, and an insertion loss of 2 dB).

In practice, ongoing investigations into the effects of aggregate interference from multiple CBSDs and their locations may need to be taken into account to better establish this figure.

The implementer may choose to interpret this requirement as a received power requirement using a link budget for conversion and the radar antenna gain, transmit power, maximum propagation loss, and appropriate assumptions on the receiver (e.g., antenna gain).

If the ESC is not capable of detecting the equivalent incumbent radar at a particular location on the coastline, a SAS relying on this ESC for incumbent radar detection would need to make use of the static NTIA defined Exclusion Zones.



Note: This figure may be adjusted as a result of future periodic ESC review.

The ESC provides the only mechanism within CBRS to determine the presence of federal Incumbent Users and ESC designs are limited in their ability to detect federal Incumbent Users due to the presence of interference such as that caused by CBRS device transmissions. CBSDs and EUDs within very close proximity of ESC sensors will prevent ESC from accurate federal Incumbent User detection. Therefore, given that federal Incumbent User protection is one of SAS’s highest priorities, SAS must prevent excessive CBRS device interference at ESC sensors. In particular, SAS must prevent CBRS transmissions in close proximity to ESC sensors.

Given the R2-ESC-01 parameters and the path loss defined in R2-ESC-02, the peak radar power received at an ESC sensor antenna is:

$$P_{ESC} = 120 - PL \text{ dBm/MHz}$$

Assume an ESC radar signal-to-CBSD interference plus noise power ratio (SINR) of 5 dB is required to satisfy ESC performance requirements and that the ESC antenna gain in the direction of the radar is 5 dB greater than the ESC antenna gain in the direction of each CBSD. Then assuming the CSBD interference greatly exceeds the noise, to achieve SINR = 5 dB implies that the aggregate CBSD power, PCBSD, incident on the ESC antenna is given by

$$\begin{aligned} PCBSD &= P_{ESC} + \text{antenna discrimination} - \text{SINR} \\ &= 120 - PL + 5 - 5 \\ &= 120 - PL \text{ dBm/MHz} \end{aligned}$$

Thus, the SAS needs to ensure that the aggregate CBSD interference does not exceed 120-PL dBm/MHz so that SINR >= 5 dB.

Note: this analysis does not imply any additional sensitivity requirement on ESC sensors.

Note: SASs will need to coordinate to achieve the protection requirement.



## Appendix B: Revision History

Document History		
V1.0.0	May 2016	Forum approval