Building an Ecosystem for the CBRS Brand

18 May 2017

President's Council of Advisors on Science and Technology (PCAST)

Presidential Memorandum
"Unleashing the Wireless Broadband Revolution"
June, 2010

NTIA "Fast Track Report"
October, 2010

PCAST Report
July, 2012

"*America's future competitiveness and global technology leadership depend, in part, upon the availability of additional spectrum.*"

Directed NTIA to collaborate with the FCC to make available 500 megahertz of spectrum available for commercial wireless services while ensuring no loss of critical government capabilities

"In order to ensure that this global [technology] leadership continues and that the Administration's goal of universal broadband is met, additional spectrum is needed for fixed and mobile wireless broadband systems."

NTIA identified 3550-3650 MHz as one of several federal bands that could be made available for commercial wireless broadband by 2015.

"In the coming years, access to spectrum will be an increasingly important foundation for America's economic growth and technological leadership."

Concluded that the best way to increase the availability of broadband spectrum is to promote spectrum sharing between federal and commercial users through the use of new technologies…

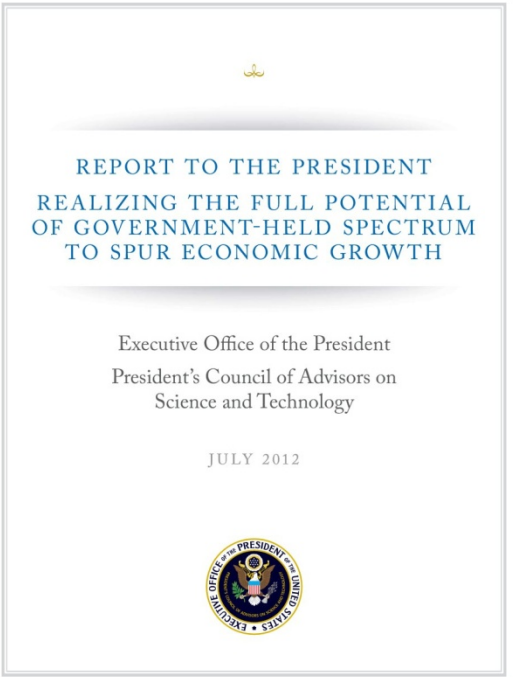
CBRS WInnForum Standards

WIRELESS INNOVATION FORUM

PCAST Spectrum Report

20 July 2012 Report from the US Presidents Council of Advisors on Science and Technology (PCAST) on "Realizing the Potential of Government-Held Spectrum to Spur Economic Growth."

- "The traditional practice of clearing and reallocating portions of the spectrum used by Federal agencies is not a sustainable model for spectrum policy"
- "The essential element of this new Federal spectrum architecture is that the norm for spectrum use should be sharing, not exclusivity"

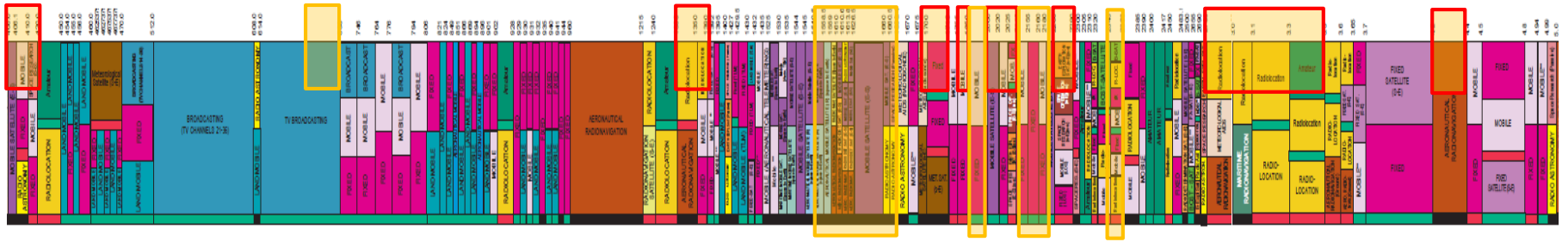

REPORT TO THE PRESIDENT

REALIZING THE FULL POTENTIAL OF GOVERNMENT-HELD SPECTRUM TO SPUR ECONOMIC GROWTH

Executive Office of the President

President's Council of Advisors on Science and Technology

JULY 2012

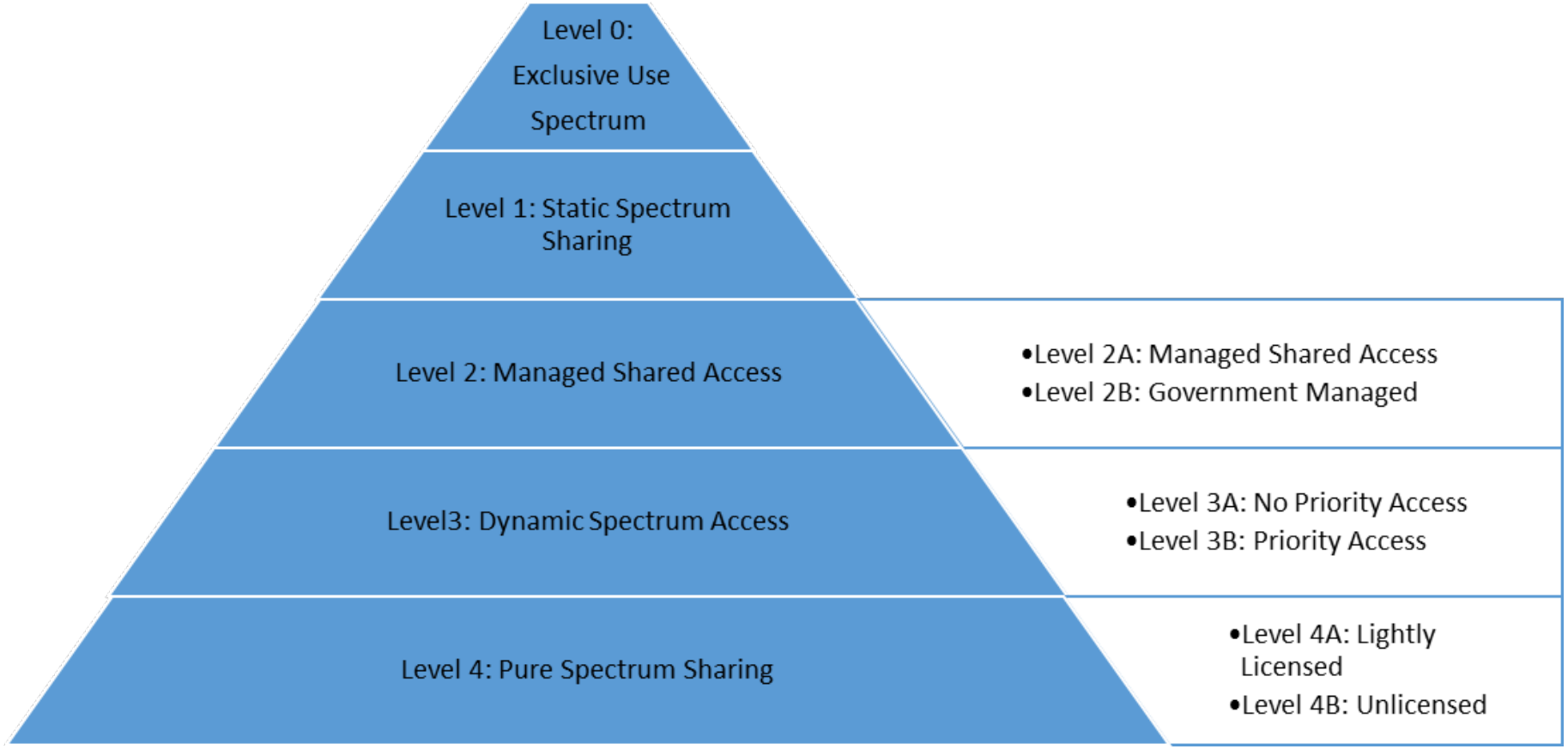


400MHz

5 GHz

Total spectrum Identified: 1473.9MHz

Where this falls in the levels of “Spectrum Sharing”



Adopting the PCAST Model: Time Line for CBRS Regulations

2013	2014	2015	2016
Notice of Public Rule Making 3.5 GHz Workshop Public Notice on 3.5 GHz Licensing Framework	Further Notice of Proposed Rule Making	Report and Order and Second Further Notice of Proposed Rule Making Public Notice on Protection of Grandfathered 3650 to 3700 MHz Licensees First Wave Applications for SAS Administrators and ESC Operators	Order on Reconsideration and Second report and Order Methodology Adopted on Protection of Grandfathered 3650 to 3700 MHz Band Licensees Conditional Approval of SAS Administrators

Agenda for Today's Presentation

Overview of CBRS

History of the Wireless Innovation Forum in Defining the CBRS Standards

Standards Overview and Schedule

Building the Ecosystem Based on These Standards

What is the “Citizens Broadband Radio Service (CBRS)”

Citizen's Broadband Radio Service (CBRS)

3-Tier Concept

Authorized Federal and Grandfathered FSS

Grandfathered Wireless Broadband

"Use It Or Share It"

Reverts to GAA in 2020

Incumbent Primary Access

Priority Access License (PAL)

Licenses awarded by auction

Licensed by Census Tract

Ix-protected from GAA users, but must protect incumbents

Registers with and controlled by SAS

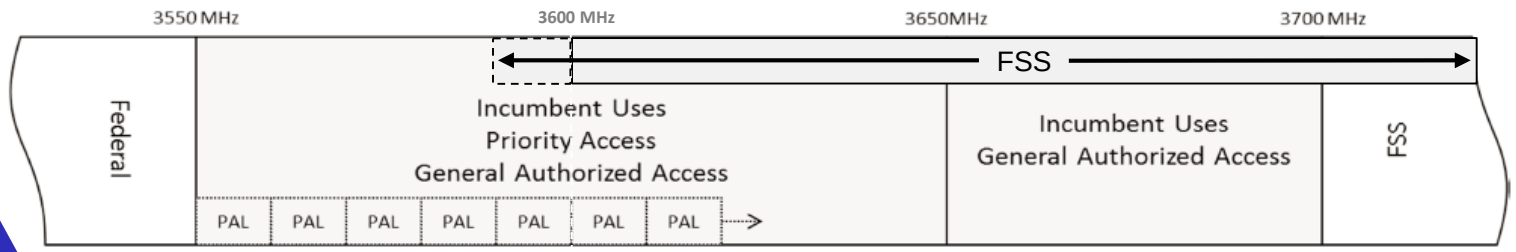
General Authorized Access (GAA)

Open eligibility

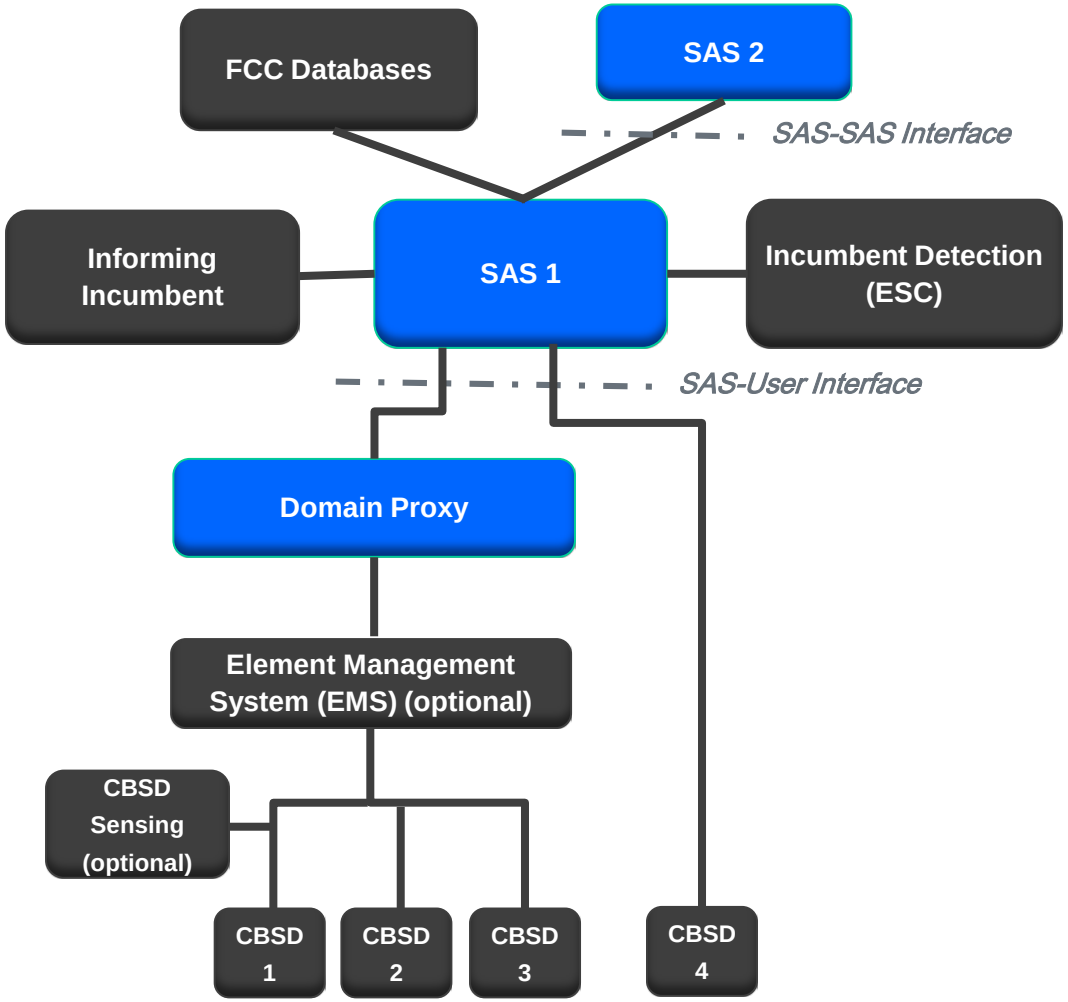
No interference protection

Registers and is controlled by SAS

Band Plan



Spectrum Access System (SAS) Functional Architecture



Acronyms:

ESC: Environmental Sensing Capability
CBSD: Citizens Broadband Radio Service Device
SAS: Spectrum Access System

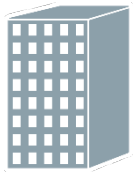
Notes:

- A SAS may not need to support all interfaces.
- Each CBSD domain may optionally include some sensing capability (including possibly an ESC).

Source: Wireless Innovation Forum, "SAS Functional Architecture", http://groups.winnforum.org/d/do/8512

CBRS Use Cases



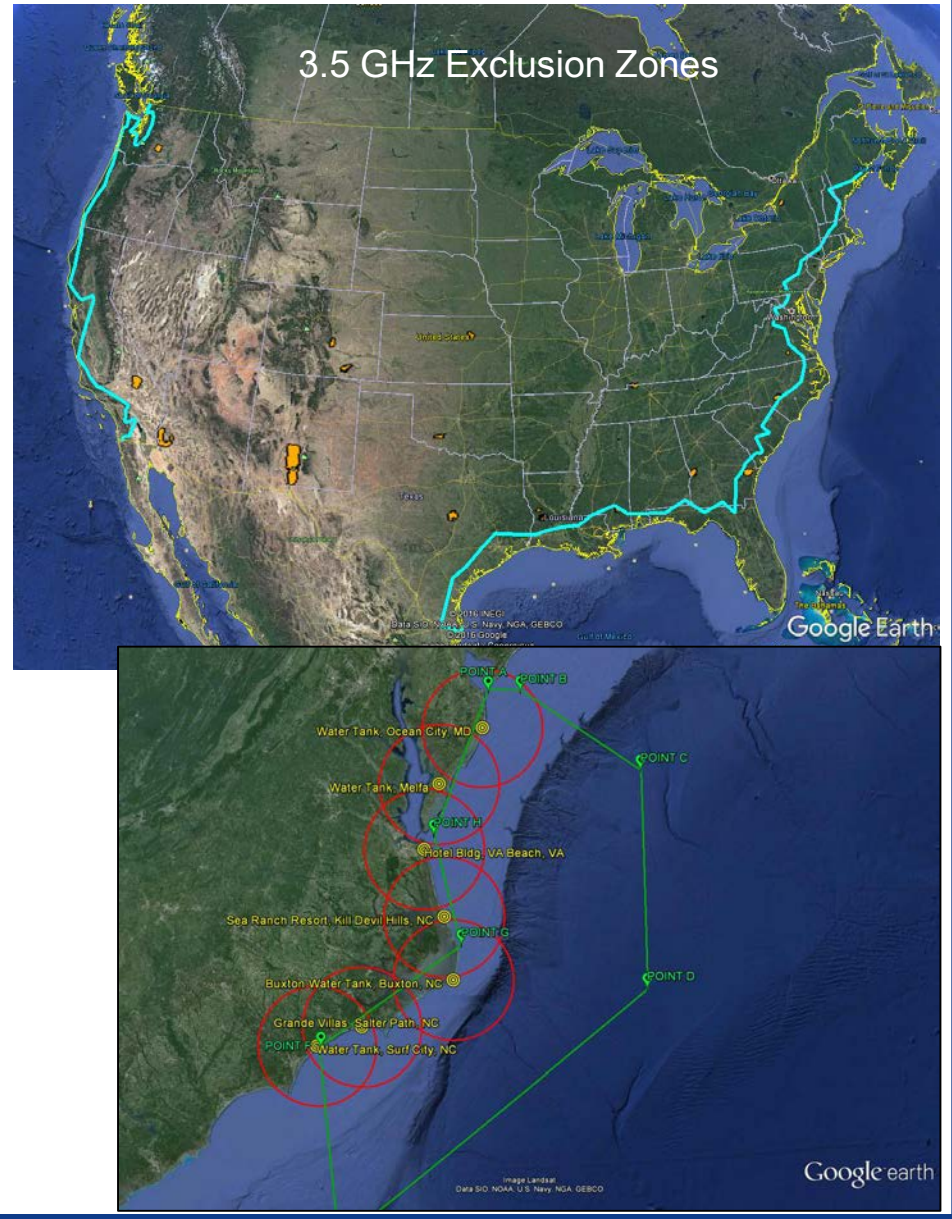



Use Cases	Embedded devices: FiOS, OnHub, Echo etc.	Neutral In-building wireless	Enterprise owned deployments	Smart Cities & Outdoor
Key Driver	Control of QoS; Assured delivery of content	Revenue expansion opportunity – Neutral Host	Piggyback on WiFi; Potential services via MVNO(?)	Infrastructure Buildout – Smart Cities initiatives, IoT etc.
Verticals	Homes, SOHO, SMBs	Public venues: Hotels, Hospitals, MDUs etc.	Enterprises	Outdoor: Street poles, Booths (LinkNYC), Manhole covers, Billboards etc.
ROM Market Size	Millions of units	Urban Buildings: 10s of thousands of buildings	100,000's of units	Millions of units

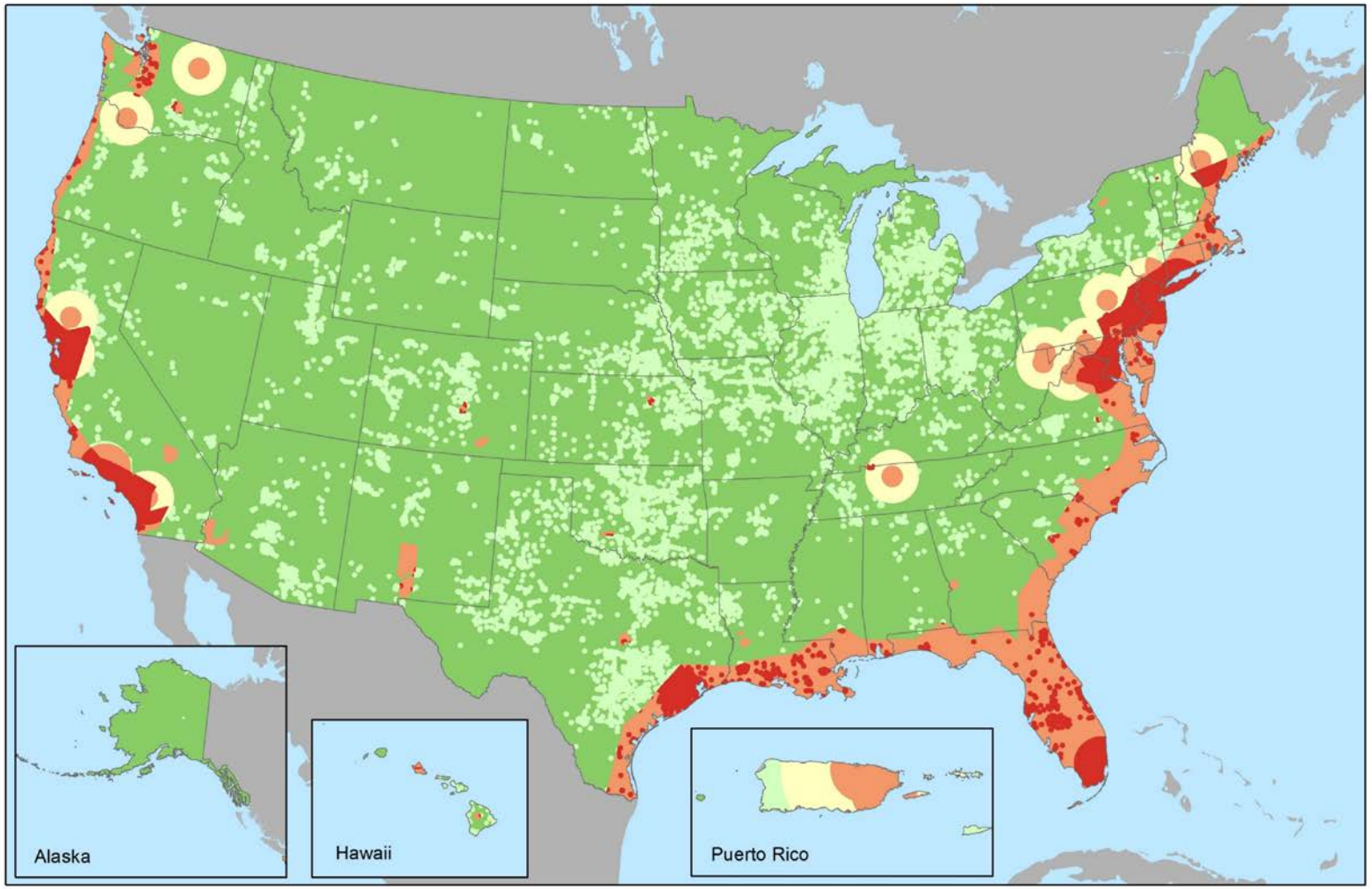
Environmental Sensing Capability (ESC)

The ESC must:

- 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.



CBRS Spectrum Availability



comsearch
A CommScope Company

CBRS Incumbent Assessment (3550-3700 MHz)

*Includes Federal Gov't, FSS, & Grandfathered Wireless

Amount of Spectrum Available

0 - 30 MHz
31 - 60 MHz
61 - 90 MHz
91 - 120 MHz
121 - 150 MHz

CBRS WInnForum Standards

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Devices

Device Type	Maximum EIRP (dBm/10 MHz)	Maximum PSD (dBm/MHz)	Limitations
End User Device (EUD)	23	n/a	• *Can operate only if they can positively receive and decode an authorization signal transmitted by a CBSD* • *Subject to Cat A/B classification if it operates at power higher than specified for EUD*
Category A CBSD*	30	20	• *Outdoor antenna height limited to 6m HAAT* • *If operation exceeds antenna height or max Cat A powers, it's subject to Cat B limitations*
Category B CBSD	47	37	• *Can only be authorized for use after an ESC is approved and commercially deployed* • *Limited to outdoor operation* • *Must be professionally installed*

* CBSD – Citizen's Broadband Radio Service Device

Addressing the Needs for a Multi-stakeholder Group

Multi-stakeholder Group Callouts in FCC R&O

Paragraph	Call Out
59	We acknowledge that SAS Administrators, potential licensees, and other industry stakeholders will need to develop various implementation details to facilitate development of the Citizens Broadband Radio Service. As described elsewhere in this Report and Order, we believe that many of these issues can be addressed during the SAS Approval Process and through the efforts of a multistakeholder group.
195	We recognize that ensuring compliance with this limit at the boundary is likely challenging on a real-time basis and there are legitimate questions relative to how to develop appropriate predictive models. We also recognize that the use of an aggregate metric could be challenging in a multi-user environment. We encourage any multi-stakeholder group formed to address technical issues raised by this proceeding to consider how this limit should be applied.
214	For example, it might be possible that instead of the bright-line urban/rural distinction implemented in these initial rules, industry stakeholders (perhaps working through a multi-stakeholder forum) could agree on a "congestion metric" and associated methodology for SASs to reduce CBSD power levels in high-demand areas. We intend to continue an informal dialog with stakeholders on this topic and welcome the submission of additional technical analysis or reports of technological developments that can inform us going forward.
222	Given the importance of accurate reporting by professional installers, we strongly encourage the SAS and user community, through multi-stakeholder fora or industry associations, to develop programs for accrediting professional installers who receive training in the relevant Part 96 rules and associated technical best practices.
234	We encourage multi-stakeholder groups to consider the issues raised by the registration rules described in this section, including acceptable contact intervals between CBSDs and SASs, and to suggest appropriate operational parameters.
237	We 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 multistakeholder group. Such guidance could be incorporated in the SAS Approval process described in section IIIH)(3)(b) or incorporated independently by authorized SAS Administrators, subject to Commission review.
240	We encourage the industry to develop best practices for end-to-end security that can be validated in the equipment and SAS certification processes.
289	We agree with Federated Wireless, Google, Motorola Solutions, SIA, the Wireless Innovation Forum, and others, that a multi-stakeholder process could provide insight into the technical factors and interference limits between coexisting services in the 3.5 GHz Band.
319	We continue to believe that a "light touch" regulatory approach is appropriate for this band and that the rules should include only the high-level requirements necessary to ensure the effective development and operation of fully functional SASs. We agree with commenters that support collaborative, industry-wide efforts to create standards and best practices governing SAS operations. The Commission will assist these efforts through the SAS Administrator approval process, as set forth in III(H)(3)(b). We also believe that an active multi-stakeholder group could help develop industry consensus around the best methods of meeting the SAS requirements.
346	We require potential SAS Administrators to develop and demonstrate that their systems include robust communications and information security features during the SAS Approval process.745 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. We anticipate that given the immense value of industry-wide interoperability, groups – such as the types of multi-stakeholder groups discussed in section III(K) – will develop security models that SAS Administrators may consider, subject to Commission review.

Addressing the Need for a “Multi-stakeholder Group”

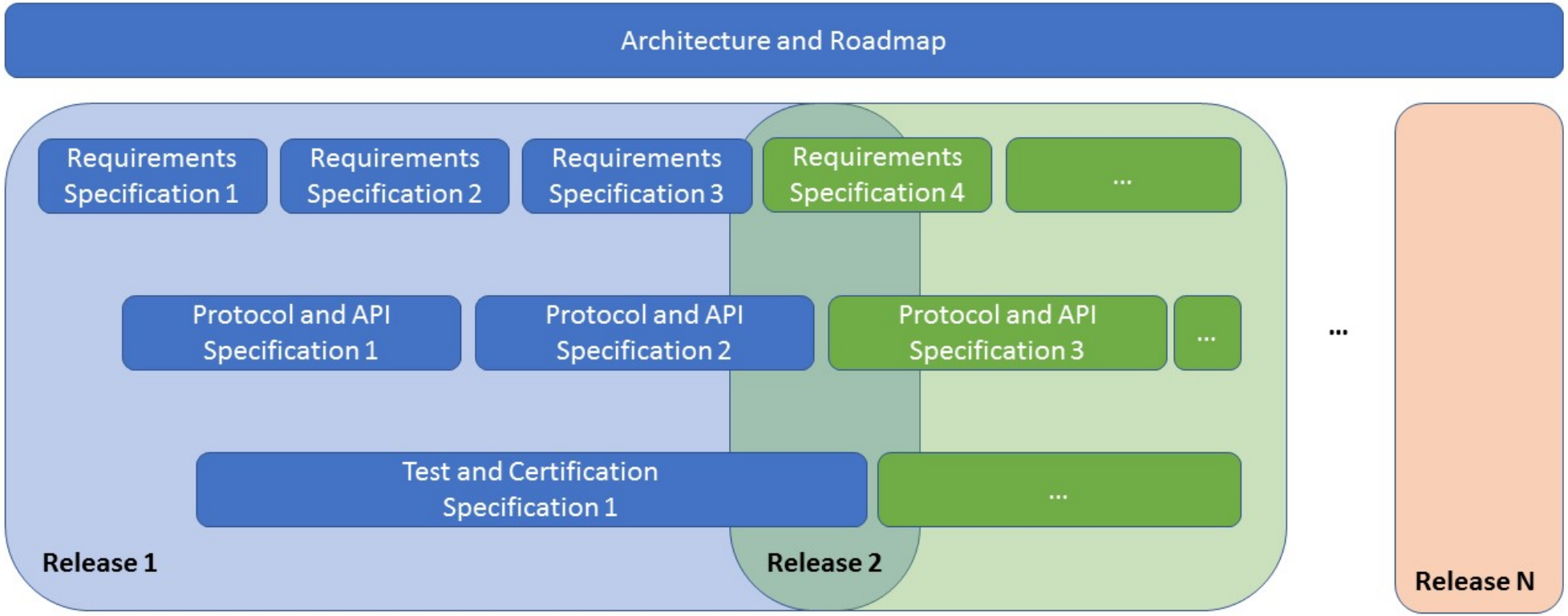
The Wireless Innovation Forum is a nonprofit “mutual benefit corporation” dedicated to:

“advancing technologies supporting the innovative utilization of spectrum and the development of wireless communications systems, including essential or critical communications systems”

CBRS WInnForum Standards

WIRELESS INNOVATION FORUM

The WInnForum "Lean Standards Development Model™"



Backlog items are assigned to a "sprint"
Continual Feedback from deployment against Interim Releases establishes new backlog items
Major release comprised of one or more interim releases
Results: Standards Based Products deployed in months, not years

History in forming this committee…

September 2012: Forum announces support for the PCAST Recommendations

March 2013: Hosted workshop on the DARPA Shared Spectrum Access for Radar and Communications (SSPARC) program

February 2013: Filed comments with the FCC regarding the NPRM on Enabling Innovative Small Cell use in the 3.5 GHz Band

December 2013: Filed comments with the FCC regarding Licensing Models and Technical Requirements in the 3550-3650 Band

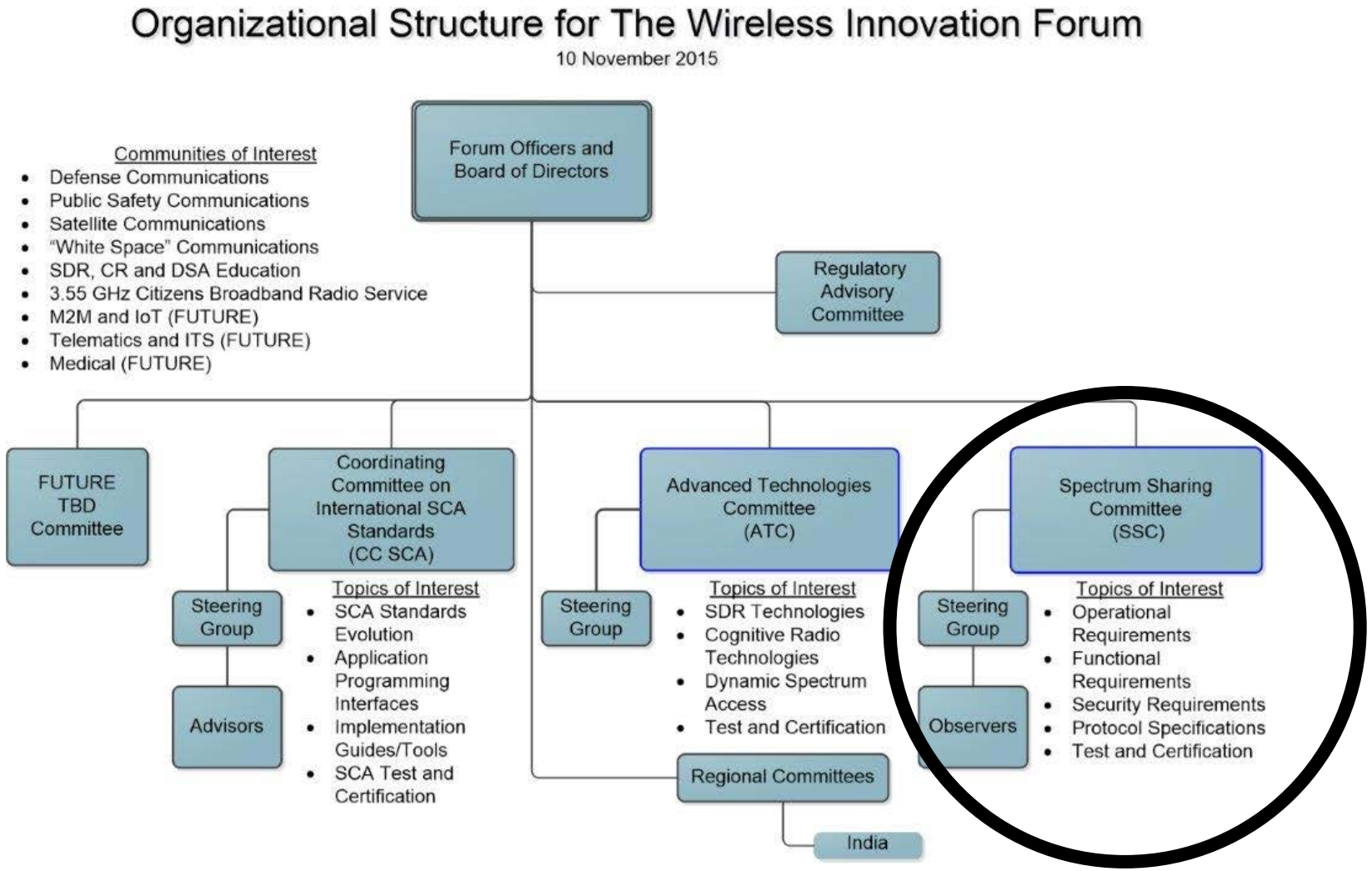
July 2014: Filed comments with the FCC regarding the FNPRM on Commercial Operation in the 3550 to 3650 Band

October 2014: First formation meeting of the propose Spectrum Sharing Multi-stakeholder Committee

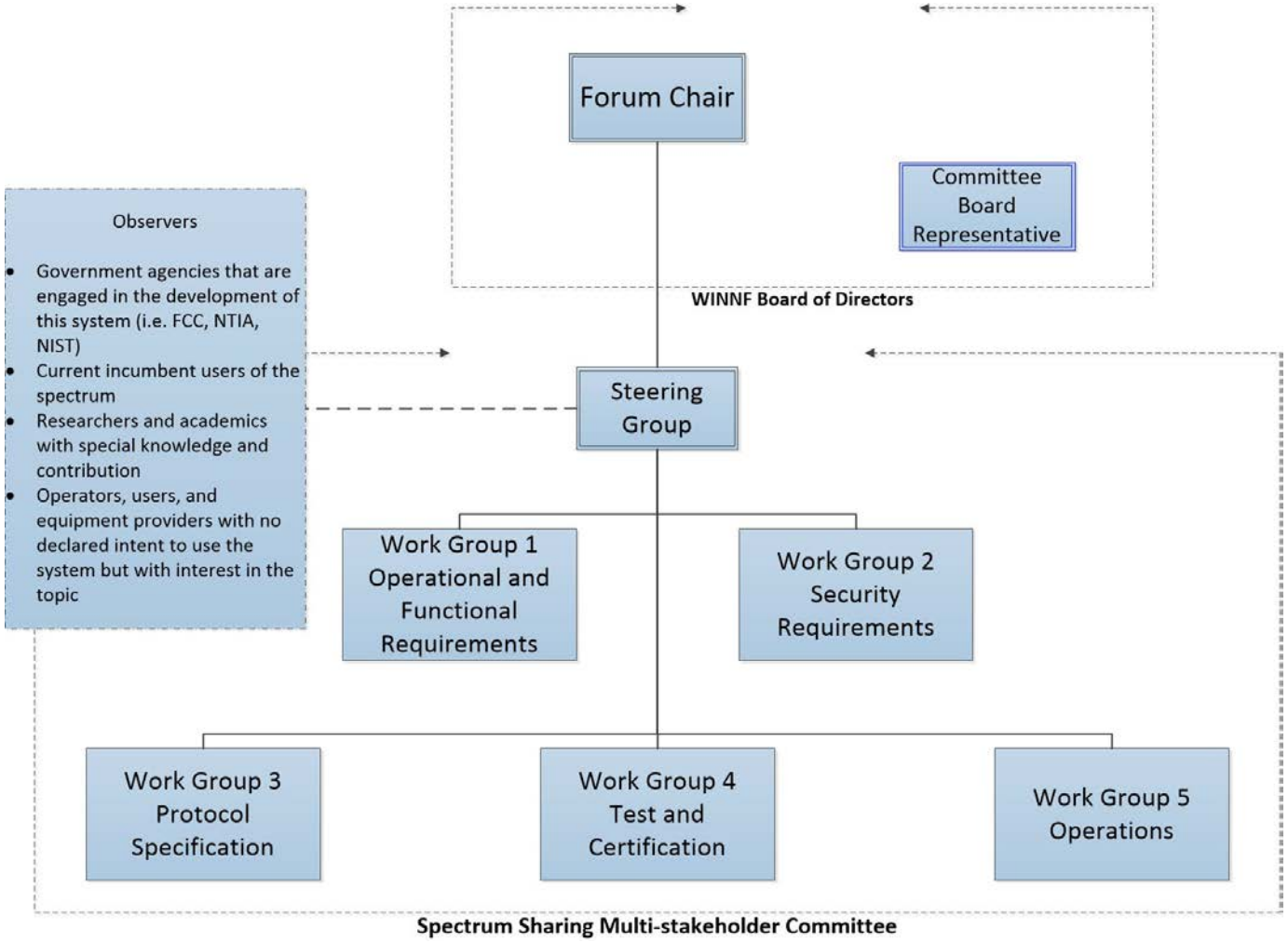
November 2014: Interim Steering Group for the committee formed

December 2014: Second formation meeting of the propose Spectrum Sharing Multi-stakeholder Committee

Forum Structure



Spectrum Sharing Committee Structure



CBRS Standards Development Within the Forum: 250+ Participants, 60+ Organizations

And many more…

CBRS WInnForum Standards

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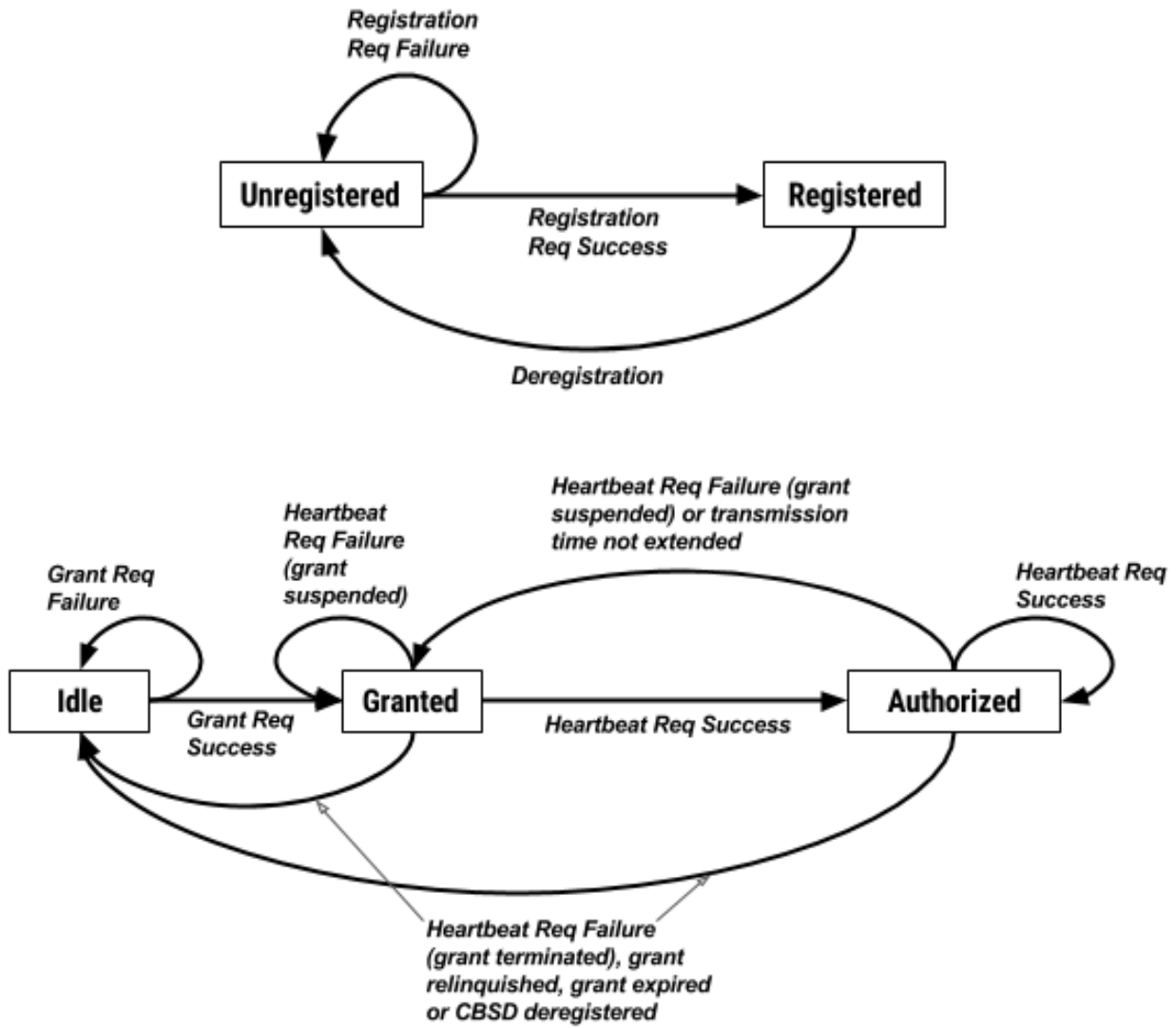
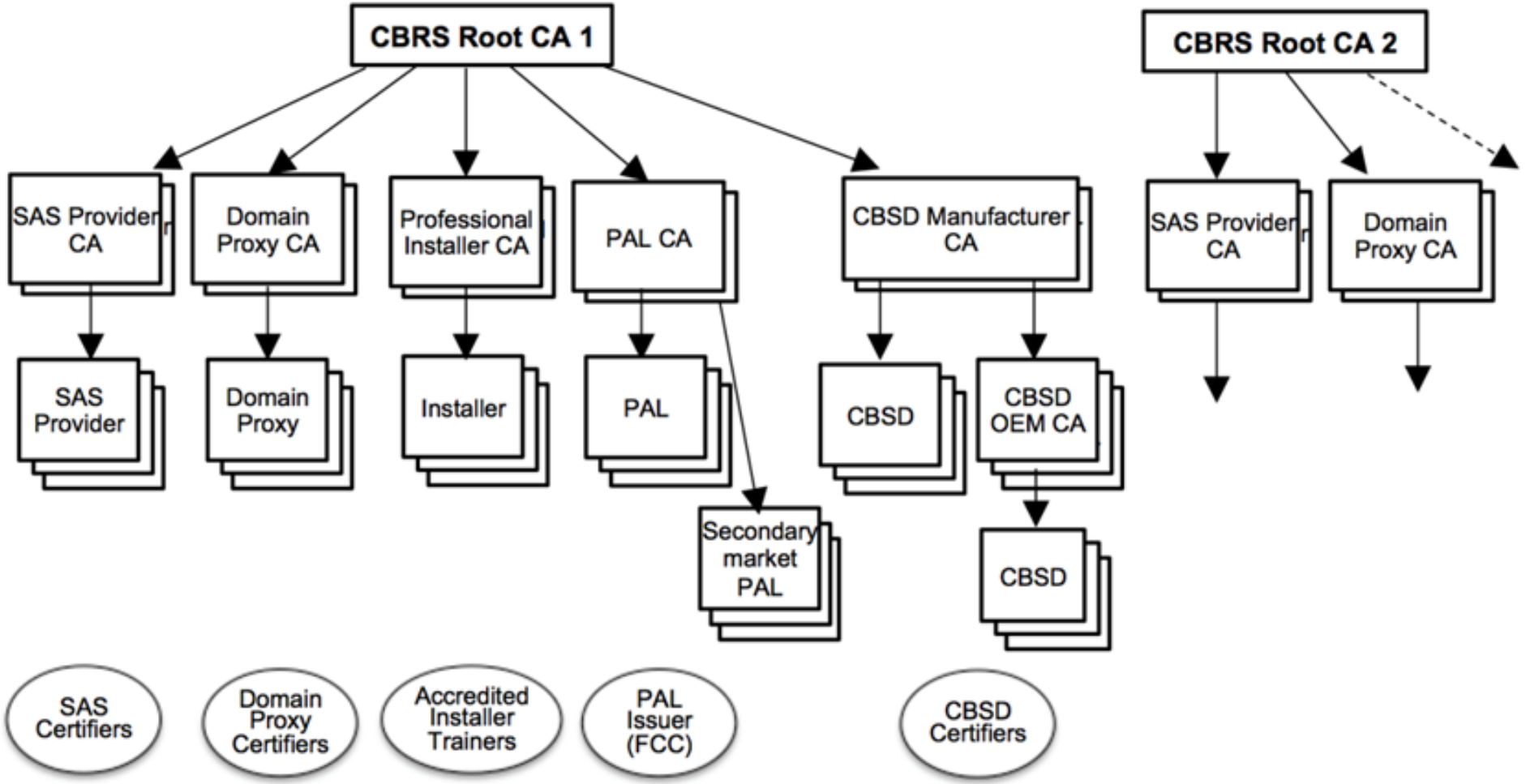
Conditionally Approved SAS Providers

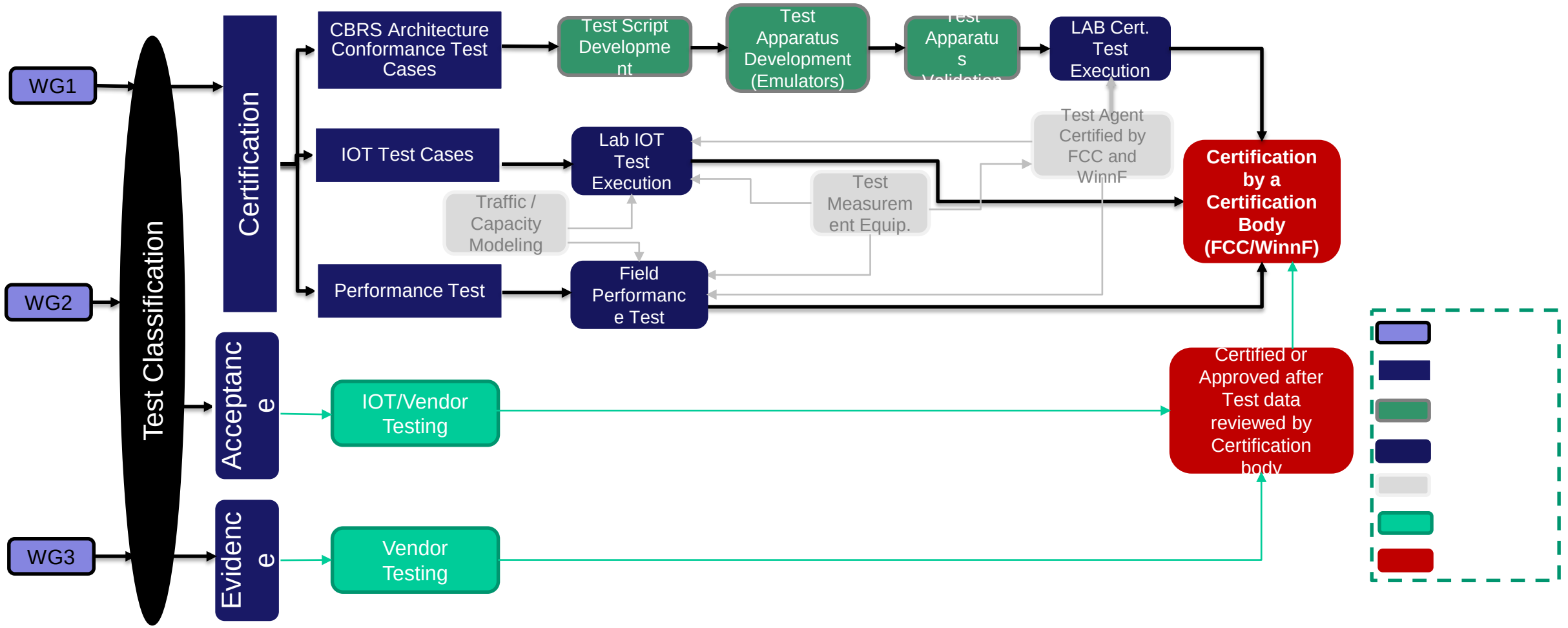
Protocol Development



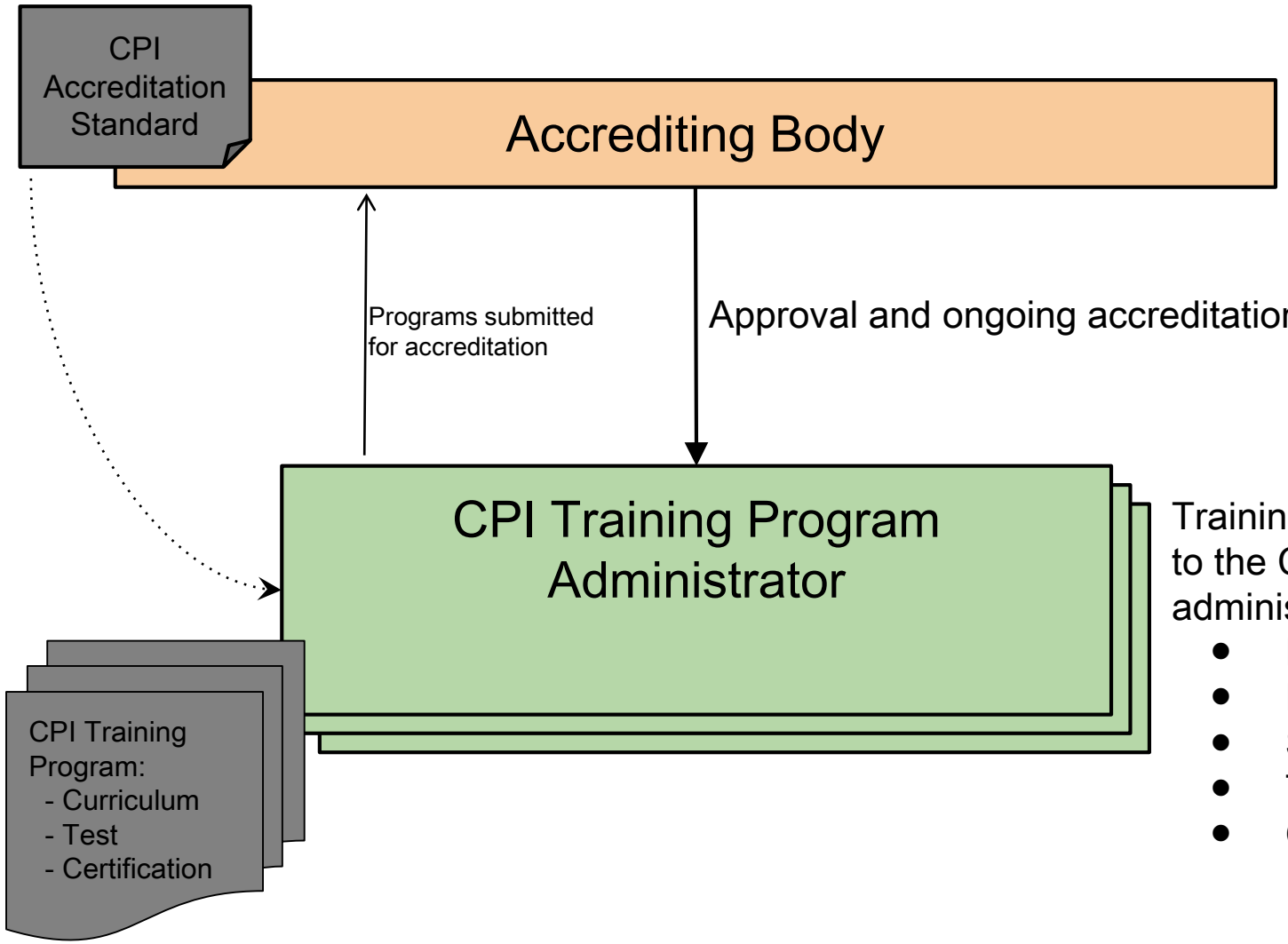
PKI Root of Trust Accreditation



WINN Forum Certification Flow (Approved)



CPI Training Program Accreditation Process

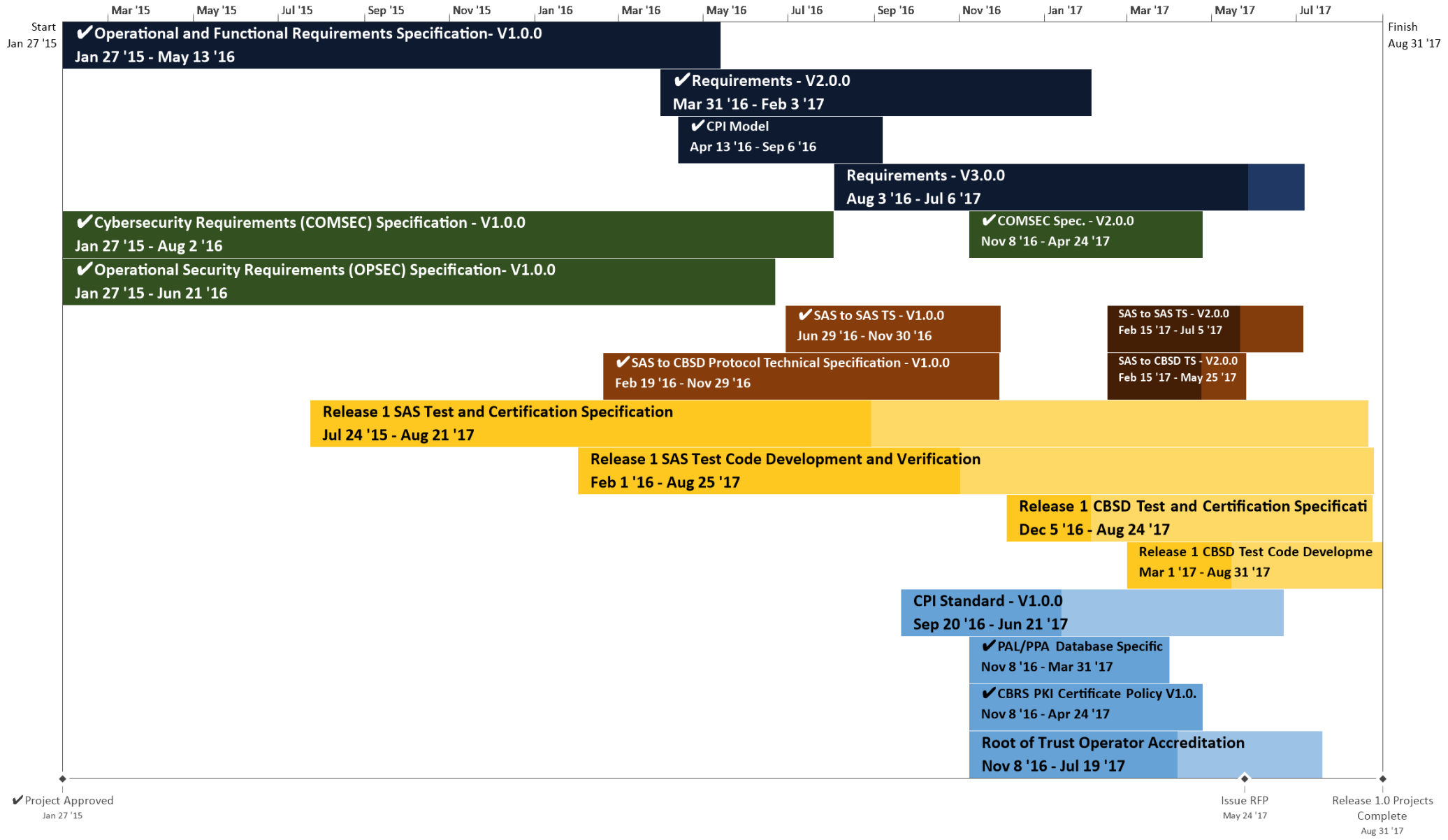


- Records on participating programs
- Common portable credentialing process
- Maintains global database of current professional installers

Training programs may be developed (subject to the CPI accreditation standard) and administered by

- Network operators
- Equipment vendors
- SAS Administrators
- Third-party training organizations
- Others

Release 1 Publication Timeline (Revised)



Complete List of Standards That Comprise Release 1

WINNF-15-S-0112-V3.0.0 Operational and Functional Requirements
WINNF-15-S-0065-V2.0.0 CBRS Communications Security Technical Specification
WINNF-15-S-0071-V1.0.0 CBRS Operational Security Technical Specification
WINNF-16-S-0016-V2.0.0 SAS to CBSD Protocol Specification
WINNF-16-S-0096-V2.0.0 SAS to SAS Protocol Specification
WINNF-16-S-0061-V1.0.0 SAS Test and Certification Specification
WINNF-17-S-0122-V1.0.0 CBSD Test and Certification Specification
WINNF-16-S-0245-V1.0.0 PAL Database Specification
WINNF-17-S-0022-V1.0.0 CBRS PKI Certificate Policy
WINNF-16-S-0247-V1.0.0 CPI Standard

Issue Management and Change Requests

Following the release of revision 1 specifications, change requests will be collected from the Forum's public issues management portal

Wireless Innovation Forum Issue Specification Issue Reporting Form

This form enables submission of issues identified in Specifications developed under policy WINNF Policy 001 (http://www.wirelessinnovation.org/policies_and_procedures). It supports the Forums members and other stakeholders in providing continuous improvement in the Specifications issued.

Please feel free to consolidate issues if appropriate, but do not combine issues that are unrelated. Instead, please submit a separate form for each.

Upon completing this form, you will be issued a unique Issue Number. Please reference that number in all future correspondence.

Submitted issues may be made public, however contact information on the submitted issue will not be disclosed.

Contact Information

Contact Name | Organization Name | Email

Issue/Suggestion Details

Please select the specification from the following categories (select 1)

SDR Specifications: Click drop down to select from this category

Other Specifications: Click drop down to select from this category

Page | Section and Paragraph

Issue One Line Description

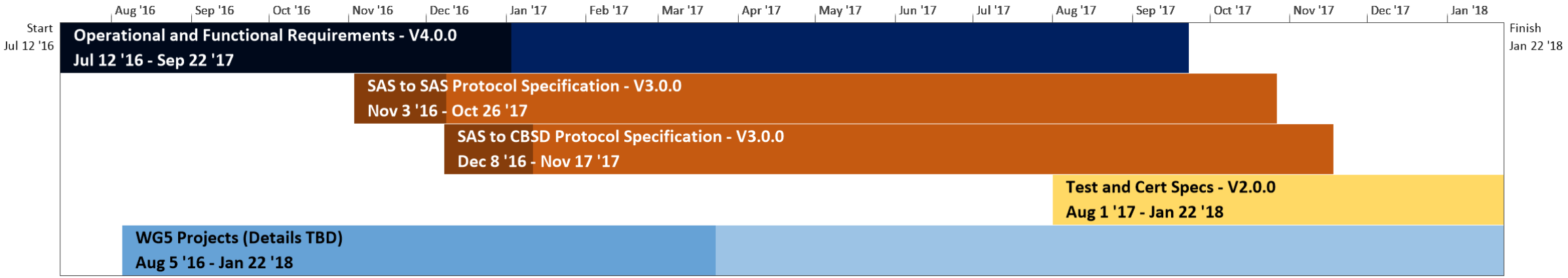
Issue Full Description (1000 Chars Max)

Issue Severity: Critical, Major, Minor

Proposed Resolution (Optional, 1000 Chars Max)

If you need more space or wish to provide an attachment, please send to SCA-Standards@wirelessinnovation.org. Only attachments in PDF format will be accepted.

Release 2 Publication Timeline



Building the Ecosystem Based on These Standards

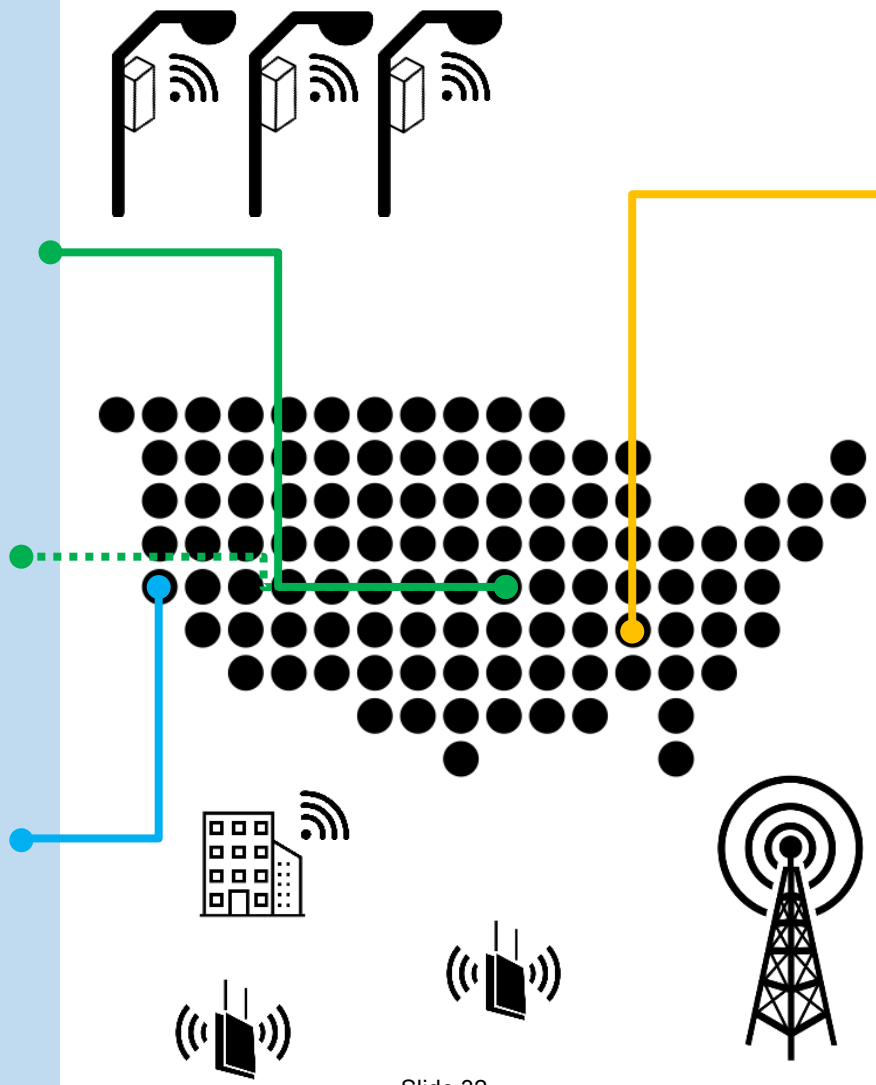
Multiple U.S. Trials and Applications Underway

1. **May, 2016: Alphabet and Federated** working on SAS systems to manage CBRS priority lanes.

2. **April, 2016: Kansas City, MO approved Google** to test 3.5 GHz capabilities using antennas on light poles and other structures in over 8 locations for a period of 18 months.

3. **May, 2016: Ruckus i**n talks to join Google in the KC trials. Ruckus seeks to provide connectivity in-building solutions to improve cellular connections.

4. **May, 2016: Qualcomm** seeking FCC approval for tests in California over a period of 12 months. The company seeks to test small cell base stations connected to mobile devices.



5. **July, 2016: Federated Wireless** announced that it filed their SAS application for **CINQ XQ**, their SAS platform.

6. **August, 2016: AT&T** Labs filled permission with FCC to test a 3.5 GHz non-line of sight 5G antenna system in Atlanta, GA.

7. **February 8, 2017:** Nokia, Alphabet and Qualcomm demonstrate the first live demo of a private LTE network over CBRS at the Las Vegas Motor Speedway.

8. **February 2017** New experimental applications filed in the 3.5 and 3.6 GHz band by Speedwavz, Digis, and Extenet.

Multi-stakeholder Groups: WinnForum & CBRS Alliance

Detailing common industry and government functionality and architecture for Spectrum Access Systems (SAS), sensors, and devices

Interoperability requirements and protocol definition to allow for open competitive and well-functioning systems

Common framework for testing and integration of components of spectrum sharing technologies to allow for rapid certification and deployment and predictability, thus expanding the ecosystem and increasing utility of the spectrum

Details of requirements, processes, and methods for protection of incumbent users as required by the spectrum rules

Operational procedures definition for the well -functioning of the system as it pertains to spectrum assignment, managements, and interoperability

Evangelize LTE-based CBRS technology, use cases and business opportunities

Drive technology developments necessary to fulfill the mission, including multi-operator LTE capabilities

Establish an effective product certification program for LTE equipment in the US 3.5 GHz band ensuring multi-vendor interoperability

CBRS WInnForum Standards

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