Before the

Federal Communications Commission

Washington, D.C. 20554

In the matter of	)	
	)	
Public Notice Pursuant to the Spectrum Pipeline Act of 2015	)	GN Docket No. 14-177, 15-319, 17-183 and 17-258

COMMENTS OF THE WIRELESS INNOVATION FORUM ON THE FEDERAL COMMUNICATIONS COMMISSION PUBLIC NOTICE PURSUANT TO THE SPECTRUM PIPELINE ACT OF 2015

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

In 2014, the WInnForum created a Spectrum Sharing Committee focused on implementing the U.S. Federal Communications Commission's regulations for three-tiered spectrum sharing in the 3550-3700 MHz Citizens Broadband Radio Service (CBRS) band. The Committee presently has broad participation from over 60 organizational stakeholders in the new 3.5 GHz band, including wireless operators, Spectrum Access System developers, equipment manufacturers,

satellite operators, Wireless Internet Service Providers (WISPs), utilities, the U.S. government, and others.

The members of the Wireless Innovation Forum are pleased to provide the following response to the Commission's Public Notice seeking comment pursuant to the Spectrum Pipeline Act of 2015. Comments provided by WInnForum members are in two areas:

- Support for CBRS rule making and establishment of a multi-stakeholder group for the 3550 to 3650 MHz band
- Analysis of the results of the efforts of the multi-stakeholder group for the 3550 to 3650 MHz band

SUPPORT FOR RULE MAKING AND ESTABLISHMENT OF A MULTI-STAKEHOLDER GROUP

In February 2013, members of the WInnForum provided comments on the first NPRM (12-354) in areas of use of small cell technology, spectrum sharing, exclusion zones, tiered licensing model standards development, standards, management of the band, inclusion of 3650 to 3700 MHz, and promotion of service and technology neutrality[1]. Later in 2013, members of the WInnForum filed comments to the Public Notice on licensing models and technical comments in the 3650 to 3700 MHz band[2]. In those comments, the Forum first proposed criteria for a multi-stakeholder group supporting the CBRS band and committed to hosting such a group acting semi-autonomously within the Forum's structure. The criteria established were as follows:

- Open and transparent:
    - Membership open to all industry, government and academic institutions

[1] https://www.fcc.gov/ecfs/filing/6017164378
[2] https://www.fcc.gov/ecfs/filing/6017478939

    - Published research
- Membership supported:
    - Operations independent of specific industry or government funding
- Technology independent:
    - Support for a broad range of science and technology programs and projects
- Strong relationships with other multi stakeholder groups
    - History of corporative development with a broad range of government, industry and academic multi-stakeholder groups
- Strong support for multiuse spectrum
    - Central focus of the Forum Advocacy Agenda is open use of spectrum for benefit for all users.
- User focused:
    - Projects supporting innovation for improving wireless communications for users
- Experienced in military, tactical, public safety and commercial communications.
    - Understanding of communication systems ranging from military to commercial deployments
- International Membership:
    - Ability to support development of both United States and international standards

In 2014, the members of the WInnForum elaborated further on the criteria for establishing an industry-led multi-stakeholder organization in its comments and reply comments on the

FNPRM on Amendment of the Commissions Rules with Regard to Commercial Operation in the 3550-3650 MHz Band[3]. These criteria included:

- be incorporated and registered with the IRS as a 501(c)6 non-profit "business league", and;
- be organized under the National Cooperative Research and Production Act of 1993, as amended by the Standards Development Advancement Act of 2004 and registered with the US Government as a Standards Development Organization, and;
- have experience in working with the FCC, NTIA and other federal agencies with a history of acting as an honest broker in defining what is possible and where there are issues, and;
- have mature policies and procedures in place including:
    - an intellectual property rights property following industry best practices for establishing rules for managing contributed IP, and;
    - collaboration policies, including work group policies and procedures, project approval and balloting, and;
- have representation by small, medium and large commercial companies, along with government, non-profit and academic institutions each with the same rights and benefits and a single vote for each, and;
- have formal partnership agreements with standards bodies active in advancing wireless communications, including IEEE and ETSI.

The members of the WInnForum indicated that their organization fully met these criteria and proposed an initial structure for a new “Spectrum Sharing Committee” focused on supporting

[3] https://www.fcc.gov/ecfs/filing/6017879968

the needs of all stakeholders in the emerging CBRS Ecosystem. Additionally, the members of the WInnForum provided comments in this filing on the proposed three-tiered model, considerations for the reassessment of geographic exclusion zones, considerations for regulation of Spectrum Access Systems, and security.

Comments from industry through the Wireless Innovation Forum were largely accepted by the Commission in the Report and Order (R&O) issued in 2015. In addition, in the R&O the Commission made a number of "call-outs" to an industry multi-stakeholder organization to take action in the band. In response, in May of 2015, the members of the Forum filed a letter commending the Commission on the adoption of this model and introducing the structure of the newly-formed Spectrum Sharing Committee and assignment of each specific callout to industry within the R&O to a specific work group within this committee[4].

ANALYSIS OF THE RESULTS OF THE EFFORTS OF THE MULTI-STAKEHOLDER GROUP FOR THE 3550 TO 3650 MHZ BAND

The members of the WInnForum again commends the FCC on the multi-stakeholder process they adopted for this proceeding. The WInnForum believes this process has been very successful in supporting the 2015 rule changes, as evidenced through achievements in four key areas: stakeholder participation, standards development, certifications, and support for the evolution of technical regulations.

[4] https://www.fcc.gov/ecfs/filing/60001060365

Stakeholder Participation

Participation in the multi-stakeholder process has included some 69 organizations and 336 participants as shown in Table 1. Participation was supported both through member organizations and observers, who were defined in the charter[5] as "necessary for the full operations and support of the system … including, but are not limited to, the following:

- Government agencies that are engaged in the development of this system (i.e., FCC, NTIA)
- Current incumbent users of the spectrum
- Researchers and academics with special knowledge and contribution
- Operators, users, and equipment providers with no declared intent to use the system but with interest in the topic
- Other relevant industry associations"

Table 1: Participation in the WInnForum CBRS Multi-stakeholder Group

	Organizations	Participants
Incumbent and Government Stakeholder Organizations	23	86
Operators (MNO, MSO, Other)	7	46
Equipment Manufacturers	14	91
Prospective SAS Administrators	8	74
Other Ecosystem Participants	17	39
Total	69	336

5 https://winnf.memberclicks.net/assets/SSC/spectrum%20sharing%20committee%20scope%20and%20operations%20-%20v1.0.0.pdf

This level of participation shows that the objective to include all relevant stakeholders was achieved. In addition, in 2017 the WInnForum signed a collaboration agreement with the CBRS Alliance, an industry group focused on the advancement of LTE Technologies in the CBRS Band[6]. Per this agreement, the groups will extend mutual invitations to provide input contributions and comments, possibly hold joint workshop and meetings, share their roadmaps and planning schedules and nominate observers to sit on committees that are applicable to their shared interests. Through these opportunities, the groups aim to reduce any duplication of work, create better end products by introducing additional ideas and insight, and more robustly advocate for and promote commercialization of the Band.

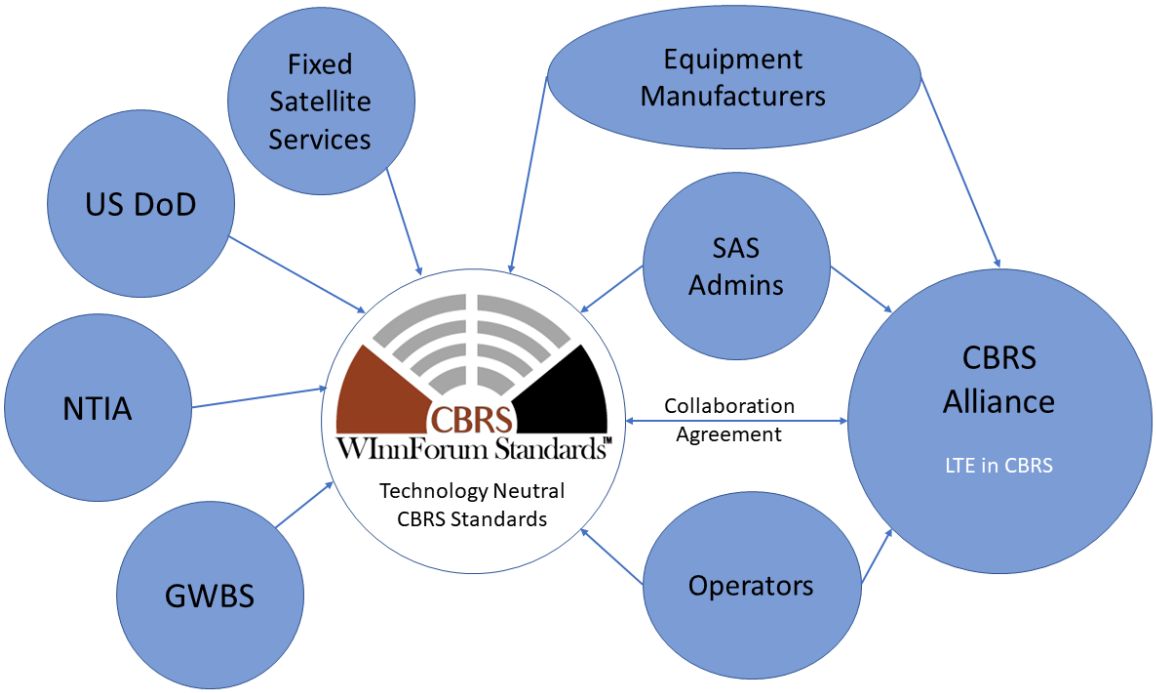

Figure 1: Participation in the WInnForum CBRS Multi-stakeholder Group

[6] https://www.wirelessinnovation.org/Partners

Baseline Standards Development

In February of 2018 the members of the WInnForum announced the completion of the ten standards comprising the baseline specifications for commercial operations within the CBRS band[7]. This watershed event allowed the finalization of CBRS products already in various levels of testing and set the stage for the rollout of commercial CBRS networks. Creation of the ten baseline standards included participation from stakeholder organizations in 1,345 hours of standards development meetings, accounting for more than 30,000 person-hours of investment in meetings alone from those organizations. Current revisions of these standards are as follows[8]:

- WINNF-TS-0112-V1.5.0 CBRS Operational and Functional Requirements
- WINNF-TS-0065-V1.1.0 CBRS Communications Security Technical Specification
- WINNF-TS-0071-V1.0.0 CBRS Operational Security Technical Specification
- WINNF-TS-0016-V1.2.1 SAS to CBSD Protocol Specification
- WINNF-TS-0096-V1.3.0 SAS to SAS Protocol Specification
- WINNF-TS-0061-V1.3.0 SAS Test and Certification Specification
- WINNF-TS-0245-V1.0.0 PAL Database Specification
- WINNF-TS-0022-V1.1.0 CBRS PKI Certificate Policy
- WINNF-TS-0122-V1.0.0 CBSD Test and Certification Specification
- WINNF-TS-0247-V1.0.0 CPI Accreditation Standard

[7] https://www.businesswire.com/news/home/20180130006409/en/Wireless-Innovation-Forum-Completes-Foundational-Standards-Enabling
[8] https://workspace.winnforum.org/higherlogic/ws/public/documents?view=

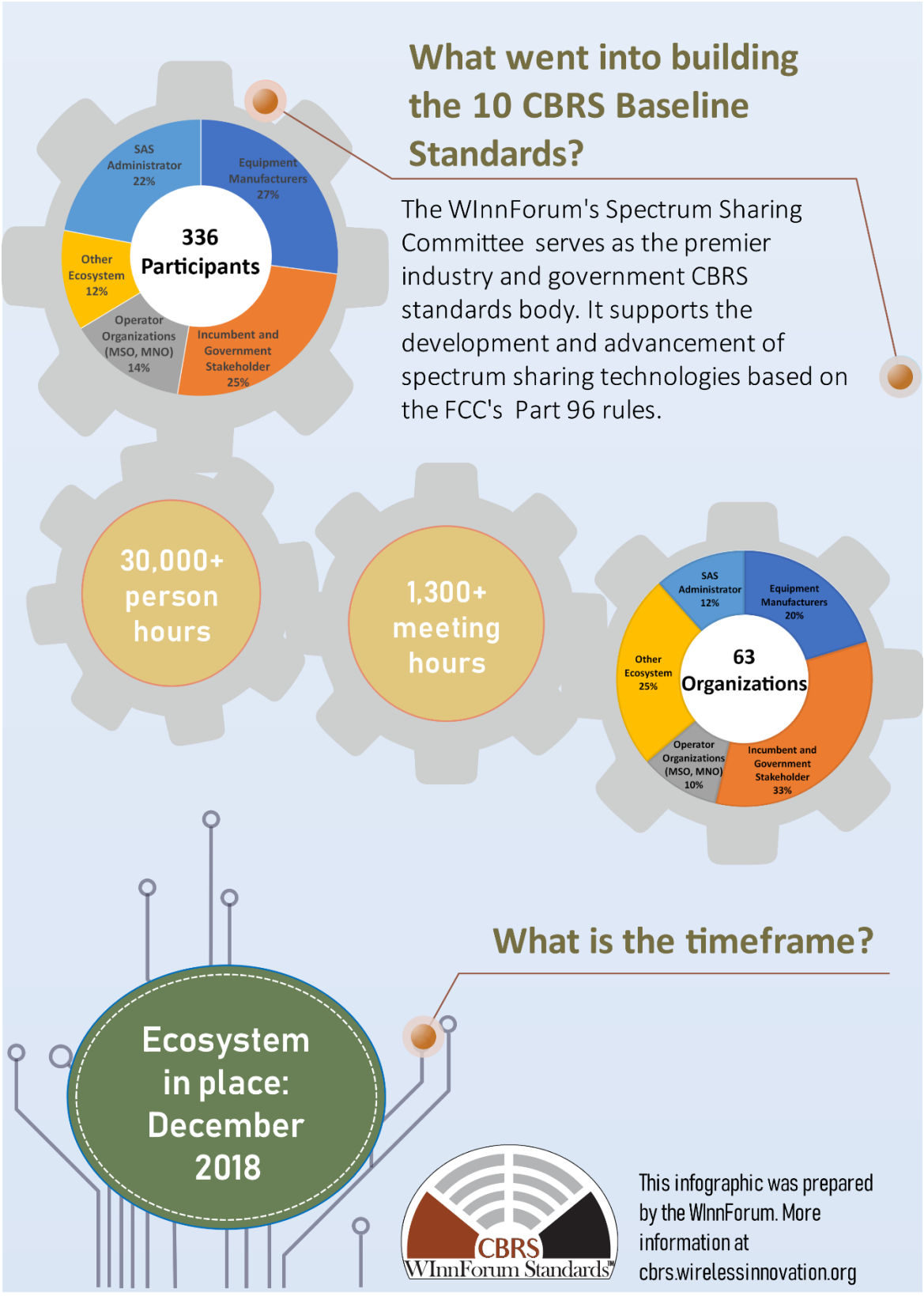

Figure 2: Diagram Summarizing Commitment of Stakeholders in Establishing the CBRS Ecosystem

In addition to these standards and in support of the ecosystem, the members of the WInnForum also established policies and procedures for registering air interfaces and measurement types to be used in CBRS[9].

Certifications

In further support of the ecosystem, the members of the WInnForum have established or are supporting certifications in four areas:

- **Approved CBRS Root Certificate Authority Operators.** In June of 2017, the members of the WInnForum issued a request for proposal for Root Certificate Authority operators supporting the associated CBRS standards[10]. To date, the members of the WInnForum have approved 3 such operators: Digicert, Insta and Kyrio.
- **Certified Professional Installer Training Program Administrators.** Later in 2017, the members of the WInnForum issued a request for proposal for Certified Professional Installer Training Program Administrators supporting the associated CBRS standards[11]. Multiple proposals were received, and approval of programs is imminent.
- **CBSD Certification.** In May of 2017, the members of the WInnForum filed comments with the Commission on the Office of Engineering and Technology's draft report entitled "Certification and Test Procedures for Citizen Broadband Radio Service Devices Authorized under Part 96 of the Rules."[12] The FCC acknowledged this input in the Knowledge Database (KDB) entry defining the approval procedures as follows[13]:

[9] https://www.cbrs.wirelessinnovation.org/cbrs-technology-registration
[10] https://www.cbrs.wirelessinnovation.org/cbrs-root-ca-operator
[11] https://www.cbrs.wirelessinnovation.org/cpi-program-administrator
[12] https://workspace.winnforum.org/higherlogic/ws/public/document?document_id=4263
[13] https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=229297&switch=P

"Devices may use the SAS emulator developed by Wireless Innovation Forum ("WInnForum") to demonstrate compliance, if the CBSD also uses the protocol developed by WInnForum. The protocol standard, test specifications, and other relevant standards can be found at http://www.cbrs.wirelessinnovation.org/. The WInnForum test software and test harness are publicly available at https://github.com/Wireless-InnovationForum/Citizens-Broadband-Radio-Service-Device. The test laboratory submitting data using the WInnForum test software must be recognized by WInnForum as an entity to perform such tests. Devices that do not use the WInnForum interface protocol, or have not been tested with the SAS emulator, must identify a specific SAS and demonstrate compliance using the indicated SAS."

In support of these procedures, the members of the WInnForum have an approval program for test labs[14]. To date nine test labs have been designated "WInnForum CBRS Approved." In May 2018, WInnForum notified the FCC that a CBSD software test harness in support of the recently-announced baseline standards has been formally released as version 1.0.0.2 and is available on the Web.[15] At this time, multiple CBSD's are in testing in anticipation of initial commercial deployment, and one vendor has received their Equipment Authorization[16].

- **SAS Certification.** In May 2018, WInnForum notified the FCC that the SAS software test harness in support of the baseline standards has been formally released as version

[14] https://www.cbrs.wirelessinnovation.org/cbsd-certification-program
[15] See WInnForum Letter Filing, 3.5 GHz SAS and ESC Applications, GN Docket No. 15-319, WInnForum *Ex Parte* filing, May 24, 2018.
[16] https://apps.fcc.gov/oetcf/eas/reports/GenericSearch.cfm

1.0.0 and is available on the Web.[17] At this time, the test harness is undergoing verification and validation review by the government, with full testing anticipated to initiate shortly.

Support for the Evolution of Regulations

Since the release of the first Report and Order, the members of the Forum have been active in supporting the FCC in evolving the regulations. Specific filings that were made include:

- Petition for Reconsideration proposing PAL Protection Areas, which was later adopted by the Commission[18]
- Comments on the Commission's Second Notice of Proposed Rulemaking related to the Fixed-Satellite Service[19]
- Comments on the Commission's Second Notice of Proposed Rulemaking related to spectrum use and secondary markets[20]
- Comments on the proposed methods for determining the protection contours for Grandfathered Wireless Broadband Licensees (GWBLs)[21]

Throughout these filings, the members of the WInnForum sought to act as an "honest broker" in providing a consensus view of all represented stakeholders in maximizing the value of the band. In addition to these filings, multiple *ex parte* filings have been made by the members of the WInnForum detailing the standards release schedule and related developments.

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[17] See WInnForum Letter Filing, 3.5 GHz SAS and ESC Applications, GN Docket No. 15-319, WInnForum *Ex Parte* filing, May 26, 2018.
[18] https://www.fcc.gov/ecfs/filing/60001094579
[19] https://www.fcc.gov/ecfs/filing/60001097525
[20] https://www.fcc.gov/ecfs/filing/60001097528
[21] https://www.fcc.gov/ecfs/filing/60001362611

SUMMARY

The members of the WInnForum believe the multi-stakeholder process encouraged by the Commission relating to standards for the multi-tiered use of frequencies between 3550 and 3650 MHz has been of high value for both government and industry organizations in developing the standardization framework necessary to support the introduction of new, shared-spectrum services. The WInnForum has a long history of establishing and leading successful multi-stakeholder groups composed of commercial and defense equipment vendors, database providers, network operators, academia and government agencies. Accordingly, WInnForum has been able to ensure full participation among all participants and establish a broad and inclusive framework for collaboration leading to the availability of the CBRS Standards.

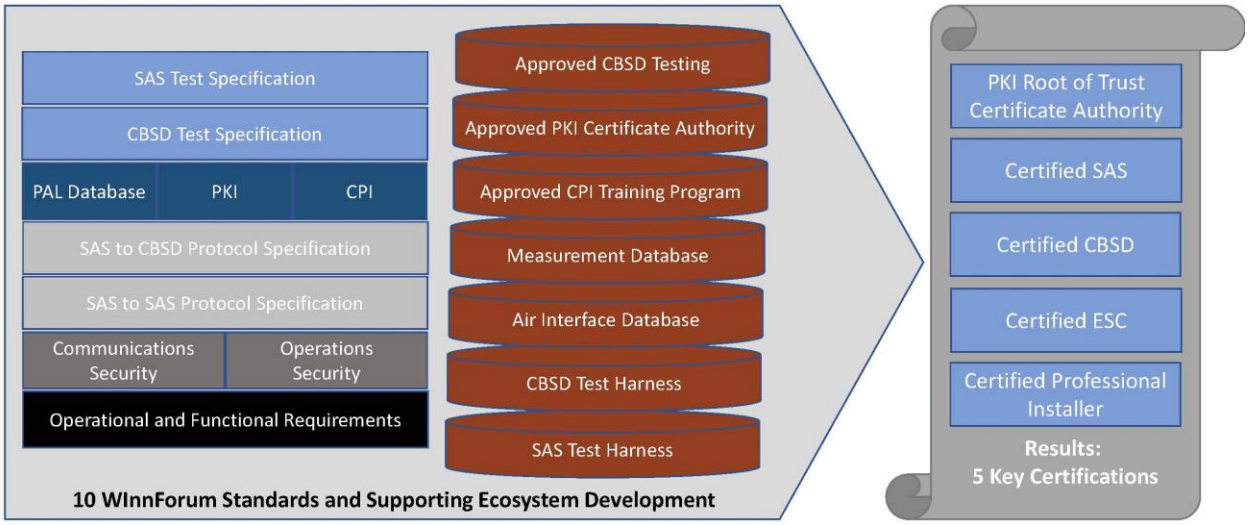

Figure 3: The CBRS Ecosystem is Ready to Deploy

Leveraging this multi-stakeholder community, the members of the WInnForum have invested heavily to developed 10 standards, 3 certification programs and two test harnesses in anticipation of commercial deployment in 2018. Industry, through these investments, has delivered on the commitments made in the May 2015 letter filing. As indicated by the record, members of the WInnForum are working diligently to make Spectrum Access Systems a reality for the CBRS band. Through many meetings and calls with the FCC, the members of the WInnForum have presented a schedule and road map that anticipate commercial launch of SASs by the end of 2018. We look forward to working with the FCC to make sharing a reality in CBRS and in other bands.

Respectfully submitted,

By /s/:
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Dated: 8 September 2018

ATTACHMENT 1

Wireless Innovation Forum Test and Certification Team Completes Major Milestone Toward Commercial Rollout of CBRS Band

Team delivers code for compliance of Spectrum Access Systems (SAS) in CBRS band, brings CBRS band one step closer to operation

For Immediate Release

Washington, DC, 29 May 2018 – The Wireless Innovation Forum (WInnForum) announced today delivery of the code for Software Access System software compliance for commercial operations within the 3.5 GHz Citizens Broadband Radio Service (CBRS) band to the FCC's Institute for Telecommunication Sciences. This milestone event brings commercial rollout of CBRS networks one step closer.

"The test code release marks another important milestone for the CBRS ecosystem and is the culmination of the WINNF Spectrum Sharing Committee's Release 1 work. NTIA-ITS can now conduct its preparations for formal lab testing of Spectrum Access Systems which we expect will commence this summer," said Kurt Schaubach, of Federated Wireless and chair of the SSC.

The code has been developed and tested by the Forum's Spectrum Sharing Committee (SSC) Test and Certification Works Group. The goal of this working group has been to define the test and certification standards for the SAS and across the various interfaces within the system. Their objective was to maximize the use of common industry testing processes as much as possible to allow for innovation and development of the subsystems in a healthy competitive environment while preserving the openness of the system.

The Forum's SSC serves as a common industry and government standards body to support the development and advancement of spectrum sharing technologies based on the three-tier architecture proposed for the 3.5 GHz (CBRS Band) rulemaking activities.

The main activities that conducted in the committee include:

- 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

The Forum recently announced the completion of the full set of specifications required for certification of CBRS equipment. This watershed event allows the finalization of CBRS products already in various levels of testing and sets the stage for the rollout of commercial CBRS networks. Specifications in the baseline standards package can be found here: https://www.cbrs.wirelessinnovation.org/cbrs-baseline-specifications

About the Wireless Innovation Forum

Established in 1996, The Wireless Innovation Forum (SDR Forum Version 2.0) is a non-profit mutual benefit corporation dedicated to advocating for spectrum innovation, and advancing radio technologies that support essential or critical communications worldwide. Members bring a broad base of experience in Software Defined Radio (SDR), Cognitive Radio(CR) and Dynamic Spectrum Access (DSA) technologies in diverse markets and at all levels of the wireless value chain to address emerging wireless communications requirements. To learn more about The Wireless Innovation Forum, its meetings and membership benefits, visit www.WirelessInnovation.org. Forum projects are supported by platinum sponsors Motorola Solutions, Leonardo and Thales.

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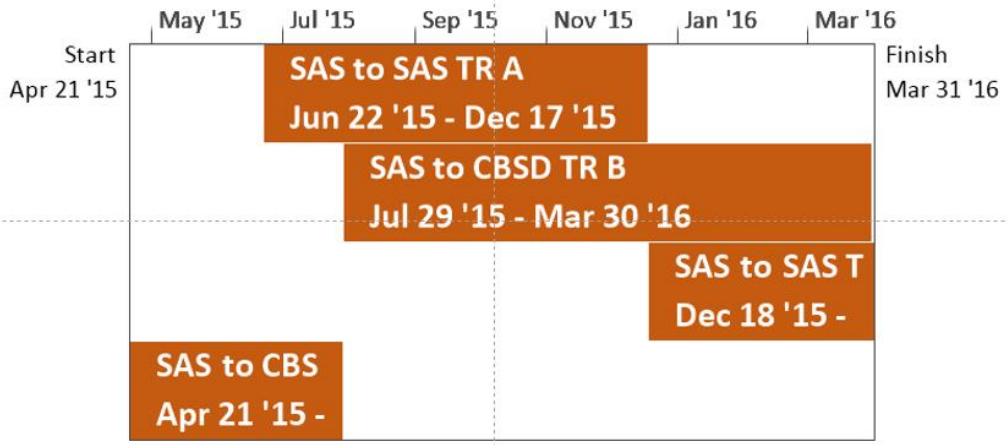
SPECTRUM SHARING COMMITTEE RELEASE SCHEDULE

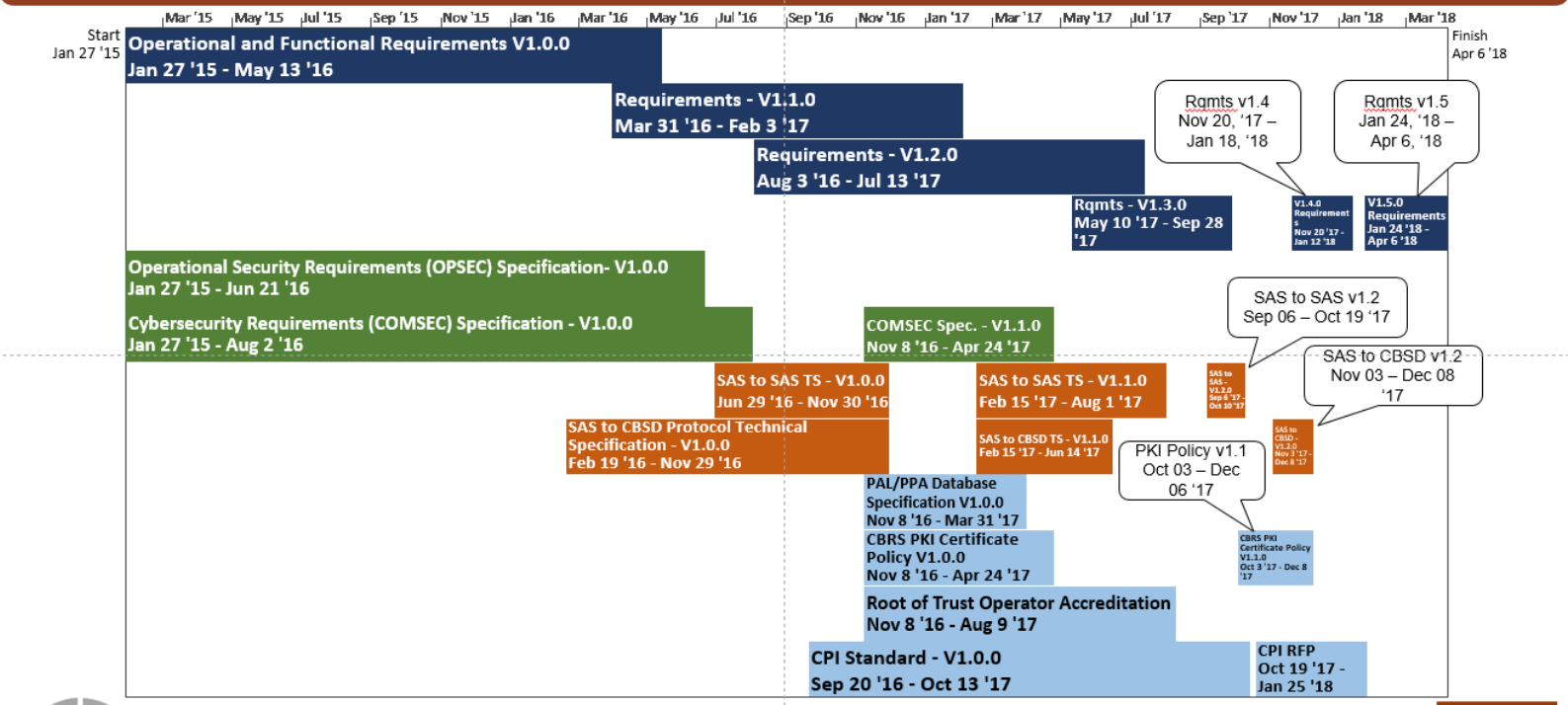
Approved by the Spectrum Sharing Committee Steering Group
28 February 2018

ATTACHMENT 2

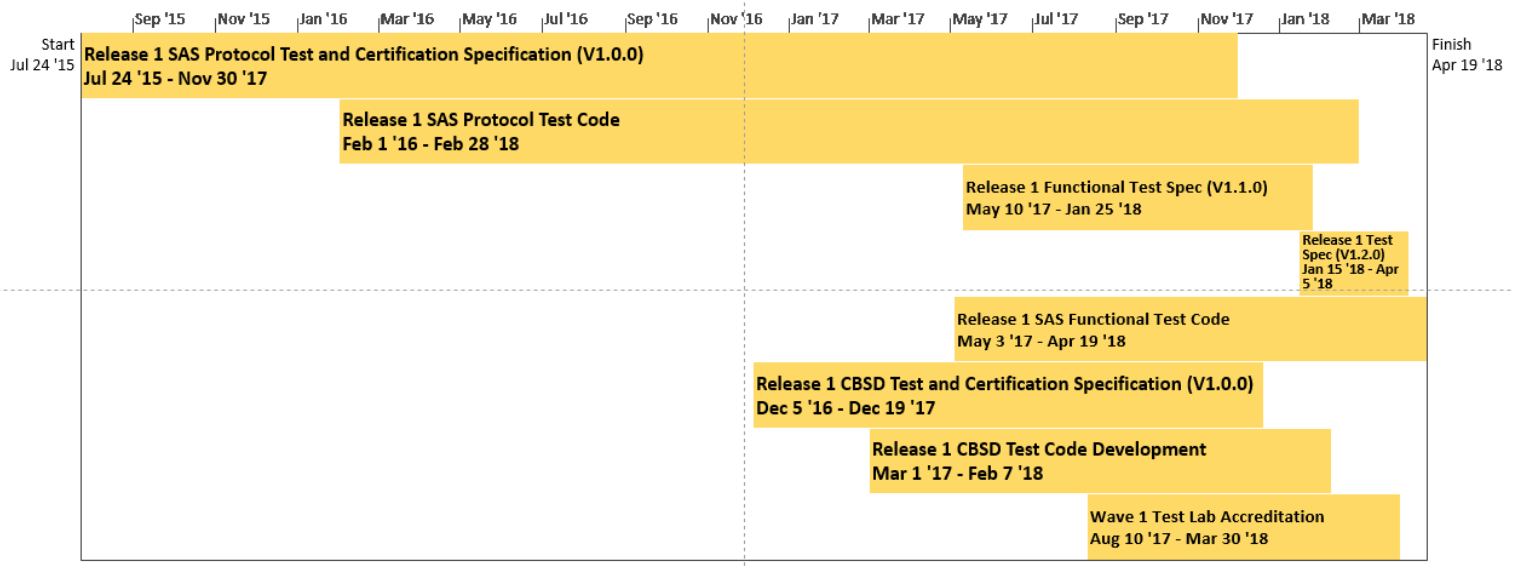
Early Release (Release 0) Publication Timeline



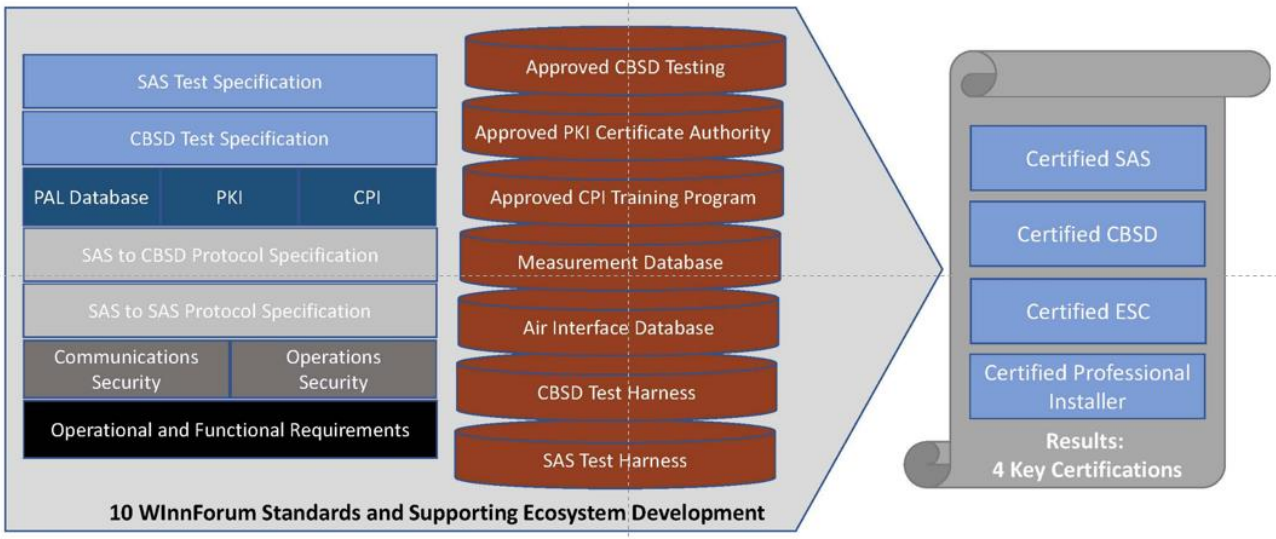
Release 1 Standards Publication Timeline



Release 1 Test and Certification Timeline



Commercializing CBRS: Standards and Ecosystem Support



Standards That Comprise Release 1

WINNF-TS-0112-V1.5.0 Operational and Functional Requirements
WINNF-TS-0065-V1.1.0 CBRS Communications Security Technical Specification
WINNF-TS-0071-V1.0.0 CBRS Operational Security Technical Specification
WINNF-TS-0016-V1.2.1 SAS to CBSD Protocol Specification
WINNF-TS-0096-V1.2.0 SAS to SAS Protocol Specification
WINNF-TS-0061-V1.2.0 SAS Test and Certification Specification
WINNF-TS-0122-V1.0.0 CBSD Test and Certification Specification
WINNF-TS-0245-V1.0.0 PAL Database Specification
WINNF-TS-0022-V1.1.2 CBRS PKI Certificate Policy
WINNF-TS-0247-V1.0.0 CPI Training Program Accreditation Standard

What is addressed in the Release 1 (1 of 3)

Border Area Management

- Requirements on Implementing international agreements to protect Canada and Mexico

CBSD Measurement Reporting

- Initial requirements for CBSD measurements of their local interference environment, and reporting those data back to the SAS.

CBSD Registration Processing

- The requirements for how a CBSD registers with a SAS, including owner registration, professional installer registration and CBSD registration.

Communications Security

- The communications security policies governing SAS and CBSD communications interfaces.

Certificate Authority Accreditation Standard

Certified Professional Installer Training Program Accreditation Standard

- Guidelines for adoption of uniform industry working standards and curriculum required to be consistent with the protection of spectrum, both licensed and GAA, for sharing in the 3550-3700 MHz band.

Note: Detailed feature list associated with each release is captured in the SSC CBRS Requirements Traceability Matrix (WINNF-17-SSC-0003)

What is addressed in the Release 1 (2 of 3)

Domain Proxy

- The baseline Operational and Functional Requirements of the CBRS Domain Proxy for initial testing and trials.

Dynamic Protection Zones

Environmental Sensing Capability (ESC)

- The requirements for implementation of an Environment Sensing Capability, and protecting federal incumbents.

Exception Management

- The requirements for how trouble tickets or exceptions are managed, including from FCC input, reports from incumbents, and reports from PAL.

FSS Protection

Grandfathered Wireless Device Protection

Operations Security

- The overall system operational security requirements to include handling of incumbent data, obfuscation of spectrum data, and processes associated with auditing and governance of the SAS infrastructure.

What is addressed in the Release 1 (3 of 3)

PAL Protection Area Definition

- Requirements on how PALs reports their coverage area to the SAS for end-to-end use of the licenses. This includes how PAL licensees define PAL Protection Areas (PPAs), request to operate in a particular geographic area within their license boundary (PPA), how PPA credentials and IDs are defined, conveyed and managed, and how the SAS accomplishes such protections.

Protocol Support for Priority Access Licensing

Propagation Modeling

- Identify appropriate 3.5 GHz propagation models for Incumbent and PAL protection and PPA definition, determine relative benefits and limitations, develop agreement on baseline needs such as underlying data, and define standardized interference aggregation methodologies.

SAS to SAS Information Sharing

- Initial support for SAS-SAS Synchronization and Information exchange.

Spectrum Grant Request Processing

- The requirements for how a CBSD requests and relinquish grants, and how grants are reassigned or terminated.

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

Future Releases

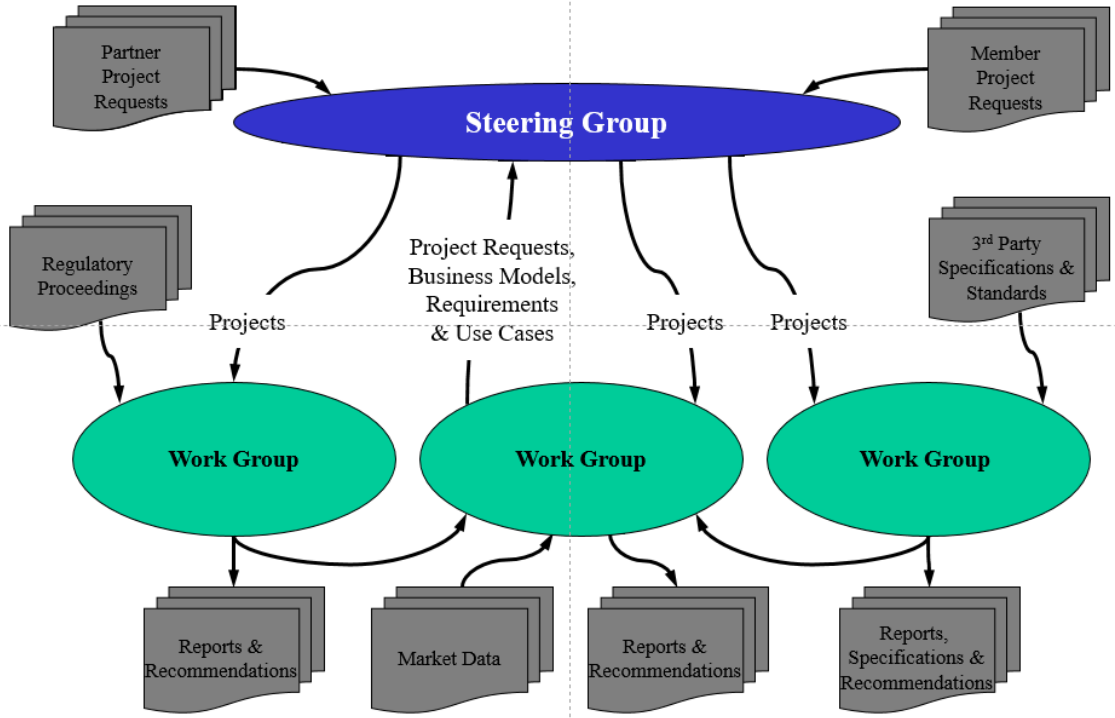
One year cycle for future Major Releases, inclusive of both technical and test and certification specification development

- Adherence to timeline determines what's "in" or "out" of the specification
- Project approval and prioritization of new feature development will be managed by the Steering Group (see next slide)

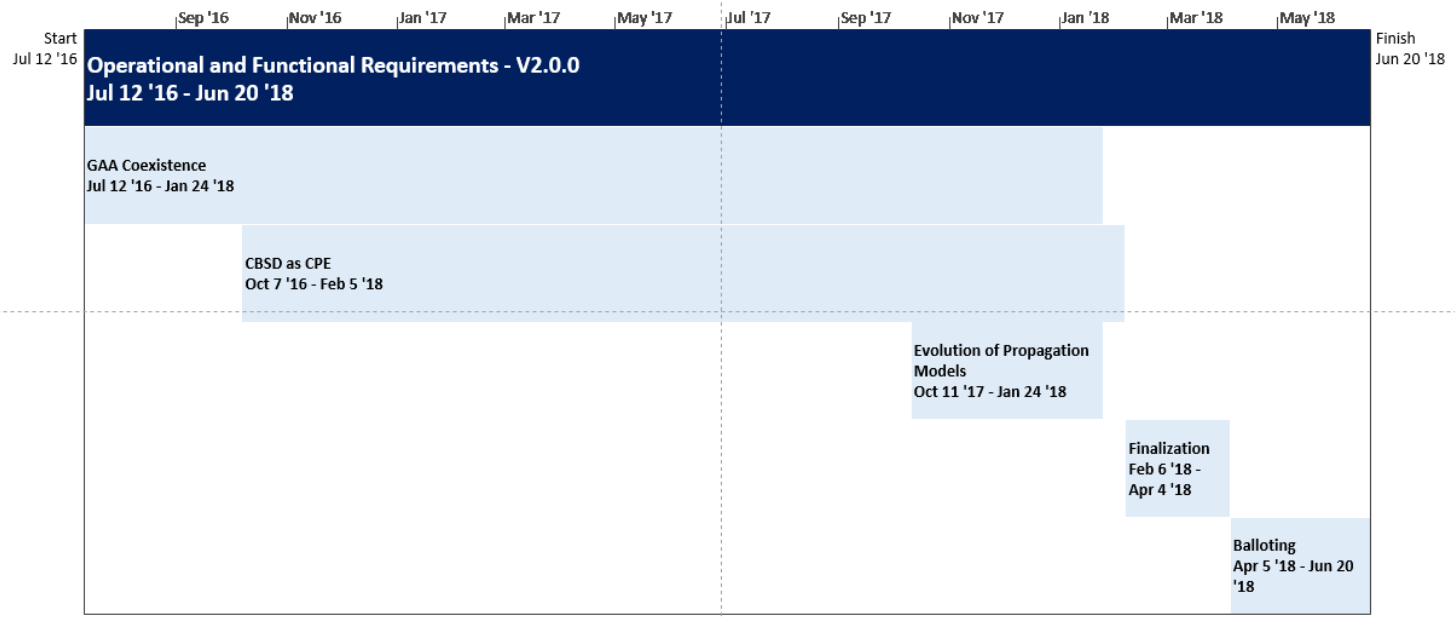
Standards maintenance will be managed through technical updates to existing version

- E.g., 1.1, 1.2, 1.3, etc.

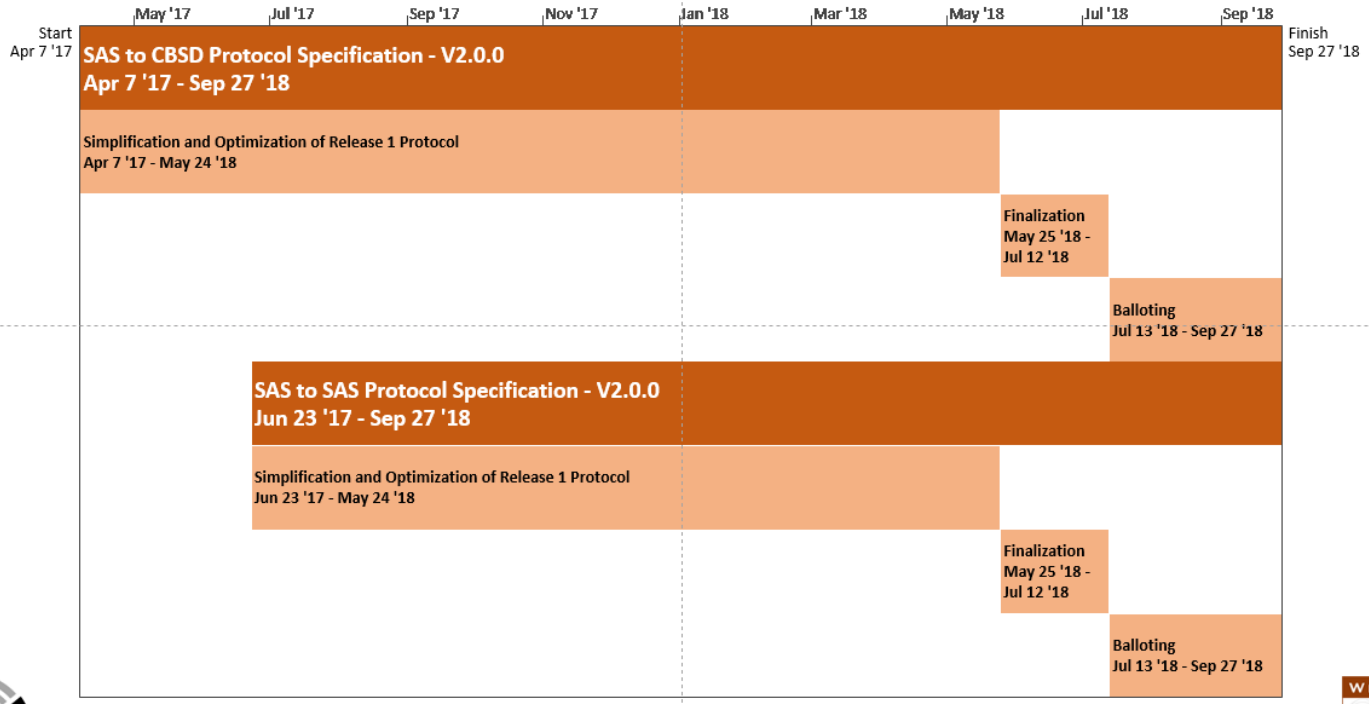
“Projects” are Initiated through the Committee Steering Group (SG)



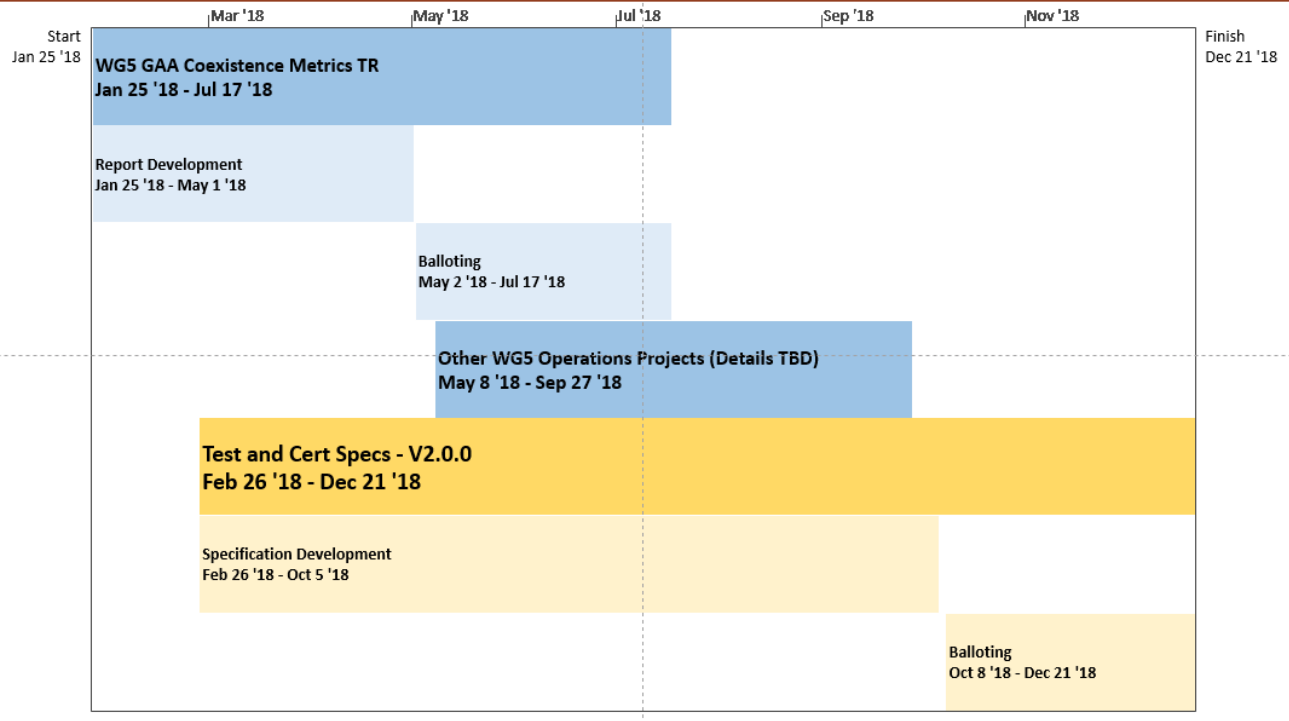
Release 2 Requirements Publication Timeline



Release 2 Protocols Publication Timeline



Release 2 Protocols Publication Timeline



Backlog/Future Release Features

Backlog (Target WG)

- Leasing (WG1)
- Simplification and Optimization of Requirements from Release 1 (WG1)
- Support for Revised Rules as Required (WG1)
- Automated Exception Handling (WG1)
- Enhanced PAL Support (WG3)
- Registration Update (WG3)
- Enhanced Measurement Reporting (WG3)
- PAL Channel Assignment (WG5)
- PAL Coexistence (WG1)

In Progress

- Propagation Model for Release 1 (WG1)
- International Border Update for Release 1 (WG1)
- Test Case Updates to Release 1 (WG4)
- Simplification and Optimization of Release 1 SAS to CBSD Protocol for Release 2 (WG3)
- Simplification and Optimization of Release 1 SAS to SAS Protocol for Release 2 (WG3)
- GAA Coexistence TR (WG5)

Complete

- CBSD as CPE for Release 2 (WG1)
- GAA Coexistence for Release 2 (WG1)
- Evolution of Propagation Models for Release 2 (WG1)

CBRS WInnForum Standards

WIRELESS INNOVATION FORUM