WHAT'S NEXT FOR CBRS:

A Preview of the Release 2 WInnForum Standards

Wireless Innovation Forum Webinar
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Today's Speakers

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CBRS Part 96 WinnForum Standards Release 2

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Release 2 Rationale

- **Webinar will delve into the the details of Release 2**
  - But first want to provide the new philosophy of Release 2
- **Getting through Release 1 Design, Specifications, and Certification was a Major (and Lengthy) Process**
- **Improvements and Enhancement to the Release 1 Baseline were Considered Valuable, but "Redoing" the Process for CBSDs and SAS's Would Make Adoption Expensive and Slow**
- **Release 2 Structure Addresses that Concern -- Enables the CBRS Ecosystem to Evolve Incrementally; Driven by Need and Applications**

Release 1 Compared to Release 2 Process

Release 1

- Driven by the Mandatory Requirements of FCC Part 96

- All Requirements were Mandatory for Part 96 Certification

- SAS's Tested by Government Labs; CBSDs by Approved test Labs

Release I Compared to Release 2 Process

Release 1

- Driven by the Mandatory Requirements of FCC Part 96

- All Requirements were Mandatory for Part 96 Certification

- SAS's Tested by Government Labs; CBSDs by Approved test Labs

Release 2

- Driven by Industry, User, and Application Requests

- No Mandatory Requirements (beyond supporting Release 2 Framework)

- Testing level driven by potential interference impact of enhancement

- **Release 2 Has 3 Components:**
  - A Mandatory "Discovery Framework" for SAS's and CBSD's to Exchange which (if any) Release 2 Features they Support
  - A New Process to Develop, Document, and Define Testing for Optional Features
  - An Open-ended set of Optional Features that are Available for Implementation by SAS or CBSD vendors, based on market demand, applications, and cost
    - Each standalone and independent -- can select a mix
- **Existing SAS's and CBSD's inherently default to no support for Release 2 for backward compatibility**

- **Why Release 2 Is Important to You!**
  - Needed Features can be Rapidly Incorporated into the WinnForum Specifications and Implemented;
  - Individual Features can be Selected by vendors based on specific Application and Use Case Needs
  - Certification and Testing Complexity and Scope driven by the features impact on incumbent protection
  - Proprietary SAS or CBSD Features can be integrated into the feature discovery Framework

Release 2 Requirements

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Release 2 Functional and Operational Requirements

- **Release 1 requirements are in WInnForum Technical Specification <u>TS-0112</u>**
- **Spectrum Access Systems (SASs) were certified by FCC against Release 1 standards**
- **Release 2 requirements are contained in <u>TS-1001</u>**
- **Release 2 represents the innovation and evolution of SAS control of shared spectrum in CBRS**
- **The process for implementing/certifying Release 2 features is addressed by Virgil**
- **The Release 2 TS is designed to be easily extensible**
  - All Release 2 features (except for capability exchange) are implemented as separate Annexes to the document, and can therefore be added and balloted separately from the remainder of the contents
- **The following is a high-level overview of Release 2 features that have been approved by WInnForum, are in the process of being balloted, or are under development**
  - Disclaimer: any features in the last two categories may be modified or removed entirely depending on the results of WInnForum action; and other features not described here may be added

Capability Exchange (required)

- Capability exchange allows SASs and CBSDs to understand which (if any) Release 2 features are mutually supported
- Currently, capability exchange is the only required feature under Release 2
- If any Release 2 feature (including capability exchange itself) is not understood by either the SAS or the CBSD, then SAS management of the CBSD defaults to Release 1
- Note: In any geographic area with a mix of Release 1 and Release 2 SASs, the SAS operators shall cooperate as needed, with the default being Release 1
- "[A]ny Release 2 entity must support backward compatibility to Release 1 entities using SAS-CBSD and SAS-SAS protocols, and any feature requiring coordination among SASs."

Single Frequency Group (optional)

- **A Single Frequency Group ("SFG") is a set of CBSDs that require a common radio frequency assignment and reassignment when frequency reassignment is necessary**
- **Example use cases for SFG:**
  - CPE-CBSDs
  - Some DAS installations
- **Support for SFG has been balloted and approved in Release 2**
- **Draft (revised) version of TS-1001:**
  - Adopts "Enhanced Grouping Features" as a catch-all for all needed grouping functionalities
  - Splits out grouping into several explicit group types to support specific use cases (CPE-CBSD, DAS, etc.)
  - Revised definitions and extensions to support passive DAS are under development in the Working Group

2D Antenna Patterns (optional)

- **2D antenna patterns refers to the SAS using both azimuth and elevation in its determination of antenna gain for the purpose of co-existence, incumbent protection, etc.**
  - Note: Many entities incorrectly refer to such patterns as "3D antenna patterns." The proper term is 2D, since *two* dimensions are taken into account (azimuth and elevation).
  - In the draft revised TS-1001, the nomenclature is changed to "Enhanced Antenna Patterns"
- **Release 2 provides methods for estimating the antenna gain at an arbitrary azimuth and elevation when only the principal-plane horizontal and vertical antenna patterns are available**
  - The algorithm also provides for estimation when a nominal mechanical downtilt is used. Equations to support large mechanical downtilt scenarios are for future study.
- **Release 2 provides methods for interpolating antenna gain at an arbitrary azimuth and elevation when a gridded 2D pattern is available to the SAS, and the desired azimuth and elevation do not correspond to specific data points in the provided pattern**
- **2D antenna pattern functionality is balloted and approved for Release 2**

CPE-CBSD Indicator (optional)

- **The draft revised TS-1001 provides for a CBSD to identify itself to a SAS as a CPE-CBSD if it meets the definition of such as device**

WINNF SSC WG3 Protocols

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WInnForum SSC WG3 Protocols

- **Release 1 Technical Specifications**
  - WINNF-TS-0016 Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS): Spectrum Access System (SAS) - Citizens Broadband Radio Service Device (CBSD) Interface Technical Specification
  - WINNF-TS-0096 Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS): Spectrum Access System (SAS) - SAS Interface Technical Specification

- **Release 2 Technical Specifications**   Optional
  - WINNF-TS-3002 Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS):Extensions to Spectrum Access System (SAS) - Citizens Broadband Radio Service Device (CBSD) Interface Technical Specification (Release 2)
  - WINNF-TS-3003 Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS):Extensions to Spectrum Access System (SAS) – SAS Interface Technical Specification (Release 2)

- **Release 2 Policy**
  - WINNF-SSC-0010 Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS): WInnForum Recognized CBRS Grouping Information
  - WINNF-SSC-0012 WInnForum Registry of CBRS Vendor/Admin IDs for Third-Party Proprietary Feature Prefixes

Release 2 Compliance for SAS-CBSD Protocol:

- To support Feature Capability Exchange
- To support "RELEASE 2 ENHANCEMENT" parameters marked as "*Mandatory*"
- To support "RELEASE 2" parameters marked as "*Mandatory*"
- To support "RELEASE 2" response codes marked as "*Mandatory*".

SAS/CBSD operation mode:

- Determined based on Feature Capability Exchange and based on the Backward and Forward compatibility principle

SAS/CBSD Operation Mode

		CBSD Capability	
		Rel. 1	Rel. 2
SAS Capability	Rel. 1	Rel. 1	Rel. 1
	Rel. 2	Rel. 1	Rel. 2

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Feature Capability Exchange (FCE):

- Enables Exchange of Feature Capability List during Registration and upon change of Operationally Supported features

- Enables SAS and CBSD to operate on a common list of Operationally Supported Features

- Feature list may contain Features IDs(FID) defined in TS-3002 or third party proprietary features

- An empty Feature Capability List implies support of only Release 2 Mandatory parameter and response codes in addition to the FCE procedure

- Upon modification of Operationally Supported features, SAS/CBSD have to include all their current Operationally Supported features

- SAS can request the CBSD to initiate a FCE procedure via response messages to CBSD Spectrum Inquiry, Grant, Heartbeat and Relinquishment procedures
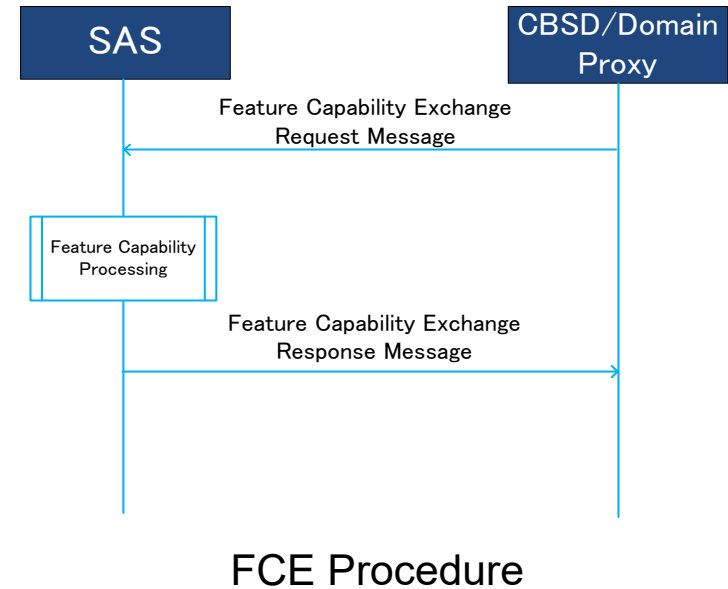

FCE Procedure

Enhanced CBSD Group Handling (FID: WF_ENHANCED_GROUP_HANDLING)

- Enhancement to Release 1 grouping information exchange:
  - Allows exchange outside of Registration procedure
  - Allows SAS to relay grouping configuration information to CBSD
- During Grouping information exchange the CBSD shall include:
  - All the Groups the CBSD is currently a member of and optionally updated information for any of these groups
  - All the new Groups the CBSD desires to be a member of and optionally additional information for any of these groups
- Based on the CBSD Grouping requests, SAS shall inform CBSD whether it supports the groups and may provide additional configuration information for the supported Groups

- If SAS or CBSD do not support this FID, Release 1 grouping can still be employed
- Release 2 Registered Group types and their information is documented in WINNF SSC-0010

Enhanced Antenna Pattern (FID: WF_ENHANCED_ANTENNA_PATTERN)

- Enables the use of enhanced antenna patterns targeting higher spectral efficiency in the CBRS band

- Release 2 Antenna Pattern Enhancements:
  - Support of vertical 3dB Beamwidth
  - Support for 1D horizontal and 1D vertical antenna pattern or 2D antenna pattern
    - These patterns are provided via and Antenna Pattern Identifier (ID). The SAS obtains the patterns associated with these identifiers via an Antenna Pattern Database (WIINF-TS-5006)
    - These patterns are employed together with the antenna azimuth and downtilt

2D antenna pattern

- A CBSD may provide antenna pattern information via several of the above options in addition to the Release 1 mandatory parameters.

- SAS shall perform the selection of the antenna pattern to be employed based on the information provided by CBSD following WINNF-TS-1001 REL2-R3-SGN-222.

- The parameters associated with this FID can only be exchanged during Registration procedure
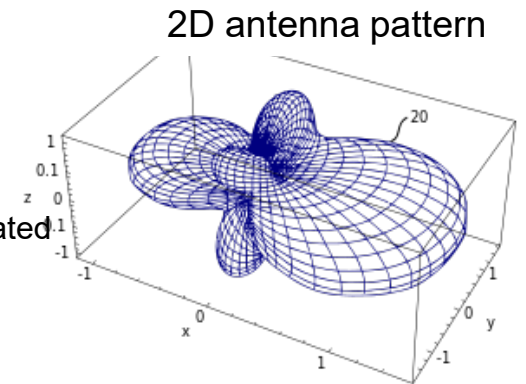
CPE-CBSD Indicator (FID: WF_CPE_CBSD_INDICATOR)

- Enables a CBSD-CPE to indicate to the SAS whether it's a CPE-CBSD.

- CPE-CBSD is defined as a fixed, stationary CBSD used as customer premise equipment. The served CBSD which is a client of the BTS-CBSD, may operate at a higher power level than an EUD and transmits during the same time slots as an EUD.

- CBSD can indicate it's a CPE-CBSD via:
  - A parameter during Registration procedure
  - Feature Capability Exchange Request message

WINNF-TS-3003 Overview

Feature Capability Exchange (FCE):

- Enables exchange of WInnForum and third party proprietary features between SASs
- Any SAS beyond Release 1 shall exchange Feature Capability List in the synchronization process
- If a SAS does not receive the Feature Capability List from a peer SAS, the peer SAS shall be treated as a Release 1 SAS.
- WInnForum FID permitted in the SAS-SAS FCE are defined in TS-3003

Enhanced CBSD Group Handling (FID: WF_ENHANCED_GROUP_HANDLING)

- Enables exchange of grouping information over the SAS-SAS interface
- SAS may optionally share CBSDs current grouping information with peer SASs

Release 2 Use and Deployment Cases

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CBRS Use Cases

CBRS provides a platform for the *high-performance deployments* of *diverse use-cases*.

This includes simple deployments in point-to-point for small networks to larger more complex and expansive networks that can be nationwide. Because CBRS is technology agnostic, it invites innovation and a wide-array of use and deployment possibilities. These span fixed uses, mobility, and even advanced interconnected networks and stand-alone networks alike.

CBRS allows for generalized and incorporated networks, but also private networks.

Use cases are governed by the FCC Part 96 rules but allow for extensive diversity.

Use case may be an alternative or choice away from present Wi-Fi or may incorporate Wi-Fi as a parallel or vital component of an integrated network. *Its not either or.*

Example Use Case Types in CBRS Deployments

Fixed Wireless Networks (Indoor and Outdoors)
WISP (Wireless Internet Service Providers)
Indoor Networks (e.g. Private LAN)
Extensions of Cable Networks/Operators (MSOs)
Utilities and Energy

Internet of Things (IoT) and Industrial Internet of Things (IIoT)
Security and Surveillance
Industrial, commercial and residential monitoring
Agricultural (such as moisture sensors) and dairy sensors
Parking and building functions

Private Networks (Single or many locations/geographies)
Industrial or Business
Multiple Unit Dwellings (MDUs) or Multi-Tenant Enterprises (MTEs)

Neutral Host Networks (Networks which can accommodate more than one host)
Venues, Stadiums, Accommodations
Workplace

Mobile Networks and 5G LTE and NR/NRU
Mobile Network Operations (MNOs)
Private mobile networks

Market Vertical Deployment of CBRS

- **Medical/Dental Office and Hospitals and Centers & Telemedicine**
- **Education (K-12 and Higher Ed) & Remote Education**
- **Industry and Commercial**
- **Security and Surveillance**
- **Hospitality and Accommodations**
- **Venues, Stadiums, Public Places**
- **Retail Business and Offices**
- **Multi-Family Residential**
- **Multi-Tenant Enterprise (MTEs)**
- **Airports and Campuses**
- **Oil and Gas**
- **Energy**
- **Healthcare, Doctors Offices/Clinics and Telemedicine**
- **Power and Utilities Systems**
- **Telecommunications**
- **Transportation**
- **IoT and IIoT as well as use with AI**
- **Entertainment …. and More.**

Applications for CBRS Networks may include (indoor and outdoor):

Delivery of a Private Network limited to a specific group of credentialed users or interconnected with differing rights allowing roaming into other networks.

Delivery of Video Content: This might be in high-intensity security and surveillance uses where cameras are used with CBRS networks, or it might be for the delivery of entertainment and video/audio services and more.

Mobile Communication Networks: CBRS is used today in back-office deployments for networks designated for company employees; or, for use in much wider applications such as stadiums and large public forums.   Mobile networks and extensions of fixed networks to mobile (e.g. nomatic).

Internet of Things (IoT/IIoT) and Sensor Based Controllers or Reporting: CBRS may be used in industrial applications for continuous or time-base measurement, device control, geofencing and a wide-array of industrial, research, and other applications.

Release 2 –New Specific Use Cases

WInnForum Release 2 Standards provides new and incremental options for creating new features that add to use choices and function in CBRS.

While Release 2 is just beginning, examples of uses/features which can be added are virtually endless. For example, a group can be created to define a specific need.

Example: Groups and Grouping: Single or Common Frequency Group/Use

If a network depends on operating on a common frequency, they may designate that need by defining a group which fits that need. In the case of common frequency group, for example, an operator may seek to have multiple client devices (CPE) on the same frequency as the base station (or eNodeB) or base stations. This permits the SAS to understand that such grouping is important, and if there is any move or transition needed, the SAS will consider the common frequency requirement in its grants or changes.

Specific Examples of CBRS Use Cases

Precision Agriculture, Agricultural Advancement, Dairy: Agricultural vendor using lots of continuous data to surveil and track country farming fields. Building out an LTE CBRS system for continuous monitoring and provision of connectivity in the fields. Use of CBRS in farming buildings and with farming equipment. Utilizing a back-up to the cloud. Utilizing IoT sensors in the fields as controllers of things like watering and other field activities and sensing (such as moisture, etc.). Geography: Central United States.

Fixed Wireless WISP: WISP (Wireless Internet Service Provider) providing rural Internet services to under-served and rural environments where there is currently no or little connectivity. Using low power small cells and keeping costs down but able to deliver to a broad area. Geography: California.

CBRS Takes the Place of Another Band: Focus on SAS providing a model for WISPs utilizing towers for green field deployments and applications. Replacing 2.5 GHz (licensed) deployments with CBRS. Providing service for IoT/IIoT hosted core solutions with advanced CBRS equipment. Providing full end-to-end support in CBRS. Geography: Unstated.

Passive DAS: Deploying in-building Passive DAS system with CBRS. Geography: Unstated Geography.

Smart City: Deploying a Smart City application for interactive use with utilities. Geography: Ohio

Specific Examples of CBRS Use Cases

Transition from FCC Part 90z: Deploying CBRS (Proprietary Air Interface) for thousands of CPE and APs in transition from Part 90 sub-part Z, NN licensees (3.65-3.70 GHz). Many WISP redeployment's/transition to Part 96 CBRS.

Rural and Suburban Deployments – Low Density: Considering advanced CBRS spectrum deployments for expansion in their network to Fixed Wireless Access use.   Using CBRS with Cat A and Cat B CBSDs to help deploy in rural areas in America. Operators sees CBRS as a budget friendly approach in rural and under-served regions. Geography: Along their deployments nationwide.

Managed Services Deployments across CBRS: Working with Macro's for deployment of CBRS via small cells and DAS. Fully exploring deployment in Fixed Wireless Access in areas where users have limited access to Internet. Operator sees CBRS as a strong case for managed deployment and combination with Wi-Fi (indoors).

Internet of Things – Industrial IoT: They are focused on Systems Integration and solution-oriented deployments in fixed wireless access of CBRS. They want to/and are working with IoT/IIoT for deployments using small cells.

More Examples of Use Cases

Oil and Gas and Energy Sector: A hardware vendor in the fixed wireless access space. They deliver "large scale solutions". They operate in oil and gas and energy solutions and see CBRS OnGo in both fixed and mobile solutions for oil/gas/mining deployments. And, in IIoT and large-scale industrial uses. Geography: Nationwide.

Cable Options: Large provider is examining fixed wireless access solutions compatible with their cable deployments. They will get back with FWA about a range of solutions they see possible along their strands and in combination with cable deployments.

Mobility: Large providers of networked MSO services provides nationwide coverage using a diversity of spectrum bands. CBRS qualifies as a 5G midband. It can utilize the spectrum to deliver services on a primary or secondary basis adding access to more spectrum for consistent service.

Other examples are in transportation systems: University/college dormitories and classrooms, advanced building to building (MTE/MDU) deployments, and more.

Conclusion: CBRS Provides New Options in a Diverse Band

CBRS utilizes standards from the Wireless Innovation Forum (WInnForum) to create a green field for development of networks which provide uses only defined by need.

Where a specific target is needed, Release 2 of the WInnForum Standards now allow for permitted customization of the Band for even greater deployment possibilities.

Release 2 is incremental and can be added to as demand is created in the CBRS ecosystem. This permits new uses or expanded uses to be created that fit many needs.

As evidenced during the Pandemic, providing more accessible broadband solutions equals more services, even at a distance including the promotion of commerce even in an emergency.

We want to hear about your use, technology integration, and how CBRS deployments are making a difference.

Release 2 Test and Certification

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- Example of high level test configurations for BTS-CBSD and DP/BTS-CBSD:

- FCC has agreed to allow the use of the **WINNF-TS-0061** and **WINNF-TS-0122** Test Specifications, along with their associated Test Harnesses, for certifying CBSDs and SASs to operate in CBRS band

- Currently, WInnForum Release 1 Test Specifications are used for FCC certification purposes for both SAS and CBSD
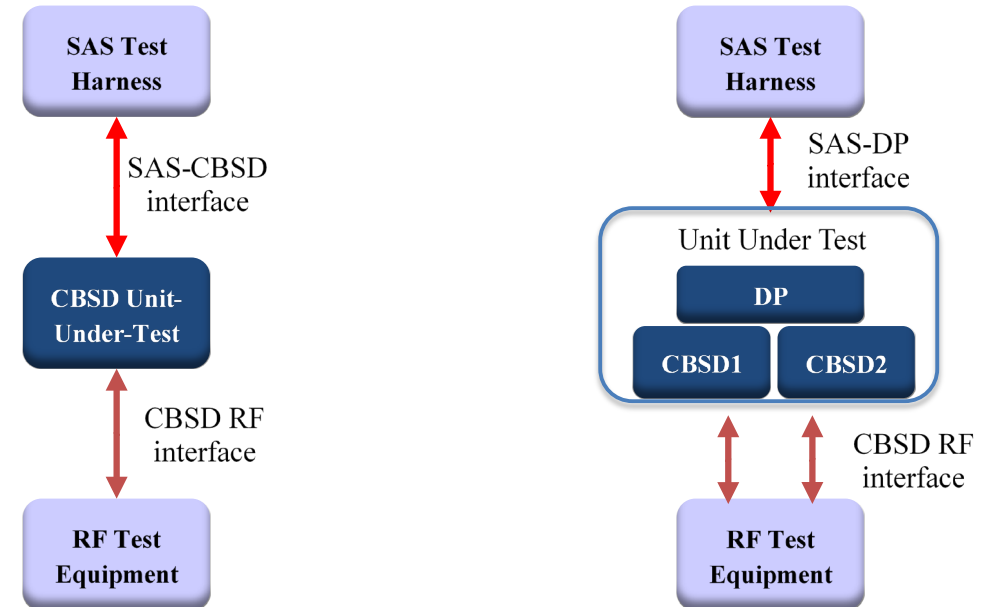
Types of Release 2 Features

1. **"Non-Regulatory Impacting" Features: Do not impact Part 96**
   - Examples:
     - Feature Capability Exchange (mandatory WInnForum Release 2 feature)
     - Enhanced CBSD Group Handling
     - CPE-CBSD Indicator
     - Single Frequency Group
     - Enhanced Antenna Pattern used for GAA coexistence

2. **Features that may impact Part 96 certification**
   - Example:
     - Enhanced Antenna Pattern used for PAL and incumbent protection
   - Impact of these features will be different for SAS and CBSD

These two types of features need to be treated separately with respect to "certification"

Release 2 Testing
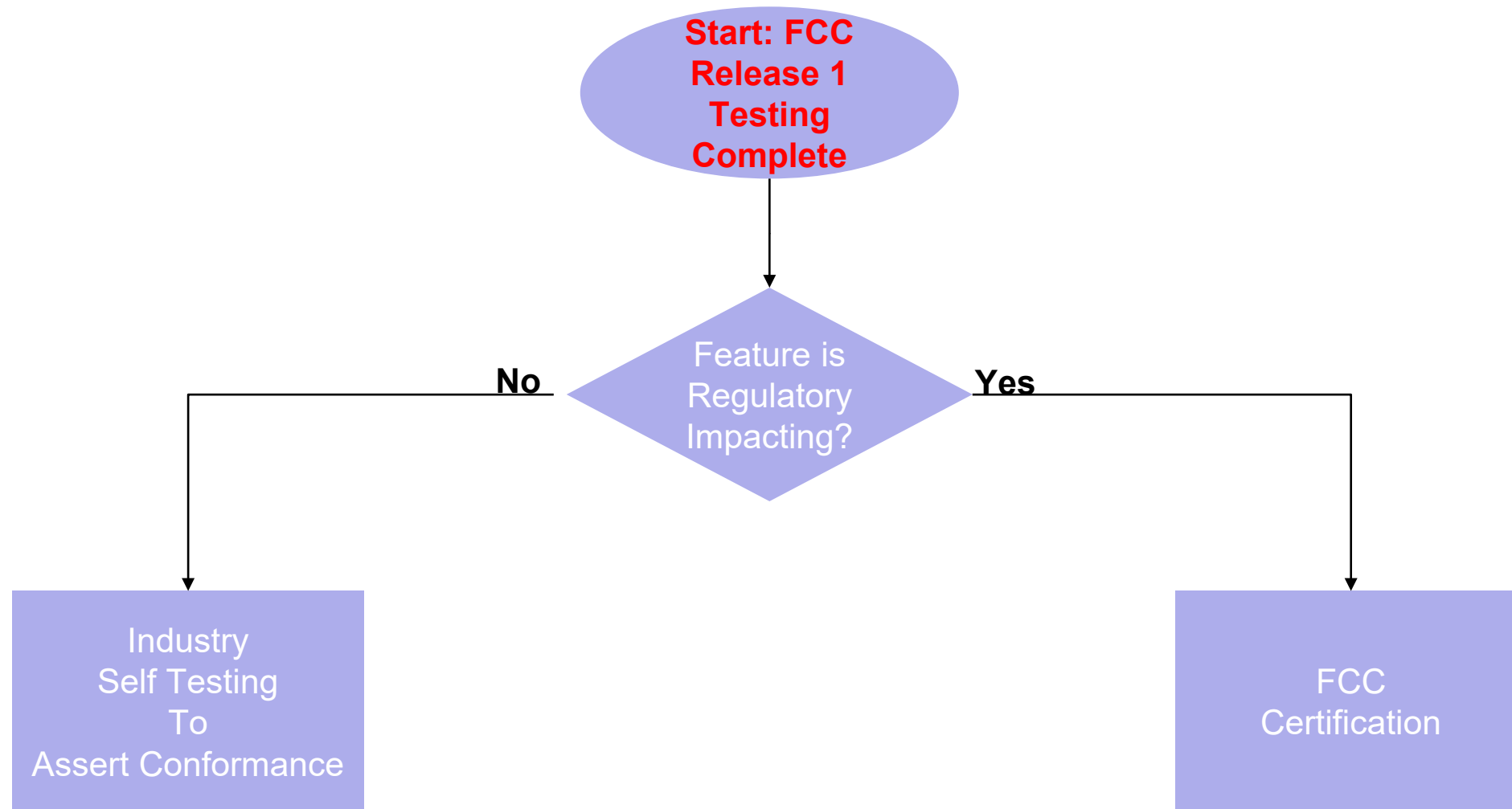
Self Testing for Features Not Impacting Part 96

- **WInnForum CBRS Release 2 Self-Testing Policy is defined in document WINNF-TS-4005**
- **Companies (members and non-members) must agree to Policies and Procedures for Self Testing to claim "conformance" with WInnForum Standards for that feature, including:**
  - Agreeing to follow the test specifications defined by the WInnForum CBRS Test and Certification work group for the mandatory Release 2 capability exchange and for supported Release 2 optional features
  - Agreeing to use the WInnForum test harness developed by the WInnForum CBRS Test and Certification work group for supported features
  - Agree to submit, on company letter head, a signed letter to the WInnForum summarizing the testing for each feature, including the output of the test harness, if applicable, and indicating that all tests were passed
- **WInnForum will maintain a public website detailing which products are compliant with which feature**
- **Release 2 testing will start with Feature-by-Feature case, but may later use feature bundle profiles**
- **Interoperability testing "in addition to" the self testing**
  - Not required as part of WinnForum Self Testing Policy
  - Entities might require that as part of their business agreement

Self-Testing Agreement

Companies wishing to self-test a SAS or CBSD/DP product for CBRS Release 2 features shall:

(i) sign an agreement;

(ii) successfully test appropriate Licensee products in conformance with WInnForum Policy demonstrating compliance of such products with the Specification as defined by the WInnForum CBRS Test and Certification work group for the mandatory Release 2 procedures and for supported Release 2 optional features;

(iii) if applicable, use of the WInnForum test harness developed by the WInnForum SSC WG4 (CBRS Test and Certification) for supported Release 2 features;

(iv) include a declaration on the packaging and in any materials relating to any self-tested product of the optional Release 2 features supported by the product as to which compliance is asserted;

(v) submit a statement to WInnForum on company letter head signed by an authorized representative of Licensee summarizing the testing for each feature and attesting to the passage by such products with all required tests in compliance with the Policy accompanied by the test report produced in the conduct of such testing demonstrating compliance.

Example of Self-Testing Signed Letter

CBSD Declaration of Compliance to WInnForum Release 2

Company _____ hereby declares that the CBSD named _____ with FCC-ID _____ has passed the WinnForum Release 2 test cases, for the following release 2 features:

_____
_____
_____
_____
_____
_____

Signature   _____
Name   _____
Position   _____
Address   _____
                   _____
                   _____

SAS Declaration of Compliance to WInnForum Release 2

Company _____ hereby declares that the SAS named _____ with FRN _____ has passed the WinnForum Release 2 test cases for the following release 2 features:

_____
_____
_____
_____
_____

Signature   _____
Name   _____
Position   _____
Address   _____
                   _____
                   _____

Questions?

Slide 40

Next Online Event

https://www.wirelessinnovation.org/spectrum-sharing-deep-dive