Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS):

WInnForum Recognized
CBRS Air Interfaces and Measurements

Document WINNF-SSC-0002

Version 4.0.0

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WInnForum Recognized CBRS Air Interfaces and Measurements

1   Introduction

This document lists information about the air interfaces (AI) and measurement types supported by the standards developed by the Wireless Innovation Forum for the Citizens Broadband Radio Service (CBRS) band.

2   Scope

This document consolidates information registered with the Wireless Innovation Forum following policy WINNF-17-SSC-0001 [n.4]. This document provides a list of the AIs, references for those AIs, and information about measurements that can be made by Citizens Broadband Radio Service Devices (CBSDs).

3   References

3.1   Normative references

The following referenced documents are necessary for the application of the present document.

[n.1]   "CBRS Communications Security Technical Report", WINNF-15-P-0065, Version V1.0.0, 2 August 2016.

[n.2]   RFC-2119, "Key words for use in RFCs to Indicate Requirement Levels", March 1997.

[n.3]   "Spectrum Access System (SAS) - Citizens Broadband Radio Service Device (CBSD) Interface Technical Specification", WINNF-TS-0016

[n.4] "Spectrum Sharing Committee Policy and Procedure: CBRS Air Interface and Measurement Registration", WINNF-SSC-0001

3.2   Informative references

The following referenced documents are not necessary for the application of the present document but they assist the reader with regard to a particular subject area.

[i.1]   Report and Order and Second Further Notice of Proposed Rulemaking, Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, Federal Communications Commission, 21 April 2015.

[i.2]   Order on Reconsideration and Second Report and Order, Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, Federal Communications Commission, 2 May 2016.

4   Definitions and abbreviations

AI: Air Interface

CBRS: Citizens Broadband Radio Service.

CBRS band: The 3550-3700 MHz Citizens Broadband Radio Service band.

Citizens Broadband Radio Service Device (CBSD): Fixed Stations, or networks of such stations, that operate on a Priority Access or General Authorized Access basis in the Citizens Broadband Radio Service.

E-UTRA: Evolved Universal Terrestrial Radio Access

Spectrum Access System (SAS): A system that authorizes and manages use of spectrum for the Citizens Broadband Radio Service in accordance with subpart F in [n.8].

5   Version Compatibility

Version 4 of this document is compatible with:

- V1.2.1 of [n.3].

6   Registered CBRS Air Interfaces

The following air interfaces (AIs) have been registered with the Wireless Innovation Forum for operation in the CBRS band:

6.1   E_UTRA
- o   Air Interface Reference: 3GPP TS 36.300

6.2   CAMBIUM_NETWORKS

6.3   4G_BBW_SAA_1
- o   Air Interface Reference: IEEE 802.16e

7   Measurement Report Types

The following measurement types have been registered with the Wireless Innovation Forum for operation in the CBRS band.

7.1   Received Power

Definition: Measurement of the radio frequency energy received over a set of frequency ranges during a measurement interval with results reported to a SAS for each of the frequency ranges in terms of effective received power for each frequency range.

The measurement capabilities associated with the Received Power measurement type are given in the following subsections.

7.1.1   RECEIVED_POWER_WITHOUT_GRANT

Semantics: Received Power can be measured and reported when the CBSD does not have a spectrum grant from the SAS. If this measurement report capability is indicated by the SAS to the CBSD, the CBSD performs and reports Received Power measurements over the entire CBRS

band in segments that do not exceed 10 MHz per measurement report. Those measurement reports are sent to the SAS in the first Spectrum Inquiry Request message and first Grant Request message.

A given CBSD can include unsolicited (i.e., even if SAS did not send *measReportConfig* to CBSD) *measReport* object in *spectrumInquiryRequest* object or *grantRequest* object, if the CBSD included *measCapability* parameter in *registrationRequest* object to SAS with a value of RECEIVED_POWER_WITHOUT_GRANT.

A given CBSD must include *measReport* parameter in *spectrumInquiryRequest* object, if SAS included *measReportConfig* parameter in *registrationResponse* object to CBSD.

Table 7.1-1: *MeasReport* Object Definition

Parameter	Description
NAME: *rcvdPowerMeasReports* DATA TYPE: array of object: *RcvdPowerMeasReport*	An array of separate reports measured as Received Power.

Table 7.1-2: *RcvdPowerMeasReport* Object Definition

Parameter	R/O/C	Description
NAME: *measFrequency* DATA TYPE: number	Required	Frequency of the lowest end of the measured frequency range in Hz.
NAME: *measBandwidth* DATA TYPE: number	Required	Measurement bandwidth in Hz used by CBSD to perform the Received Power measurement. The range bounded by *measFrequency* as the lower bound and (*measFrequency* + *measBandwidth*) as the upper bound expresses the frequency range used in making the measurement.
NAME: *measRcvdPower* DATA TYPE: number	Required	Received Power measurement in units of dBm. The range of this parameter is -100 dBm .. -25dBm. The Received Power is measured over the frequency range from *measFrequency* as the lower bound to (*measFrequency* + *measBandwidth*) as the upper bound.

7.1.2   *RECEIVED_POWER_WITH_GRANT*

Semantics: Received Power can be measured and reported when the CBSD has a spectrum grant from the SAS. If this measurement report capability is indicated by the SAS to the CBSD, the CBSD performs and reports Received Power measurements over one or more frequency ranges that do not exceed 10 MHz per measurement report. The measurement report(s) are sent to the SAS in the subsequent Heartbeat Request message.

A given CBSD can include unsolicited (i.e., even if SAS did not send *measReportConfig* to CBSD) *measReport* object in *spectrumInquiryRequest* or *heartbeatRequest* object, if the CBSD included *measCapability* parameter in *registrationRequest* object to SAS with a value of RECEIVED_POWER_WITH_GRANT.

A given CBSD must include *measReport* parameter in the first *heartbeatRequest* object, if SAS included *measReportConfig* parameter in either *grantResponse* or *heartbeatResponse* objects to CBSD.

Table 7.1-3: *MeasReport* Object Definition

Parameter	Description
NAME: *rcvdPowerMeasReports* DATA TYPE: array of object: *RcvdPowerMeasReport*	An array of separate reports measured as Received Power.

Table 7.1-4: *RcvdPowerMeasReport* Object Definition

Parameter	R/O/C	Description
NAME: *measFrequency* DATA TYPE: number	Required	Frequency of the lowest end of the measured frequency range in Hz.
NAME: *measBandwidth* DATA TYPE: number	Required	Measurement bandwidth in Hz used by CBSD to perform the Received Power measurement. The range bounded by *measFrequency* as the lower bound and (*measFrequency* + *measBandwidth*) as the upper bound expresses the frequency range used in making the measurement.
NAME: *measRcvPower* DATA TYPE: number	Required	Received Power measurement in units of dBm. The range of this parameter is -100 dBm .. -25dBm. The Received Power is measured over the frequency range from *measFrequency* as the lower bound to (*measFrequency* + *measBandwidth*) as the upper bound.

7.2 Indoor Loss

Definition: Measurement of indoor loss at physical location of CBSD. This indoor attenuation data will be sent to a SAS to provide power and frequency management of the CBSD.

The measurement capabilities associated with the Indoor Loss measurement type are given in the following subsections.

7.2.1 INDOOR_LOSS_USING_GNSS

<u>Semantics</u>: A GNSS receiver along with its antenna, embedded inside a CBSD measures received power levels at 1575.42 MHz. GNSS power levels outdoors are well regulated and are maintained uniformly at -128.5 dBm into a 0 dBic antenna at ground level to 5 degrees elevation angle. By using an extremely sensitive GPS L1 C/A code receiver, this method can measure indoor losses up to 46.5 dB.

This does not fulfill the requirement of Part 96.39(d) but can provide supplemental information to the SAS.

The indoor loss measurements are sent to the SAS upon request.

Table 7.2-1: *MeasReport* Object Definition

Parameter	Description
NAME: *indoorLossGNSSMeasReport* DATA TYPE: array of object: IndoorLossGNSSMeasReport	An array of reports of indoor loss associated with direction (Azimuth and Elevation)

Table 7.2-2: *IndoorLossGNSSMeasReport* Object Definition

Parameter	R/O/C	Description
NAME: *indoorLoss* DATA TYPE: number	Required	A number representing indoor loss measurement in units of dB. This number is a float ranging from 0 dB to 70 dB
NAME: *azimuthAngleWithGNSS* DATA TYPE: number	Required	A number representing azimuth angle associating the direction of each indoor loss measurement in degrees. This number is an integer ranging from 0 to 359 degrees (0 degrees is true north, 90 degrees is East)
NAME: *elevationAngleWithGNSS* DATA TYPE: number	Required	A number representing elevation angle associating the direction of each indoor loss measurement in degrees. This number is an integer ranging from 0 to 90 degrees, (0 degrees at horizon, 90 degrees at zenith)
NAME: *technologyType* DATA TYPE: string	Required	A string representing what technology type is being used to measure indoor loss. Allowed values are GPS_L1, GPS_L2, GPS_L5, GLONASS_G1, GLONASS_G2, GLONASS_G3, GALILEO_E1, GALILEO_E5A,

		GALILEO_E5B, GALILEO_E6, BEIDOU_B1, BEIDOU_B2, BEIDOU_B3

8 Measurement Report Configuration

SAS can request CBSD to send *measReport* by including *measReportConfig* in *registrationResponse* object or *heartbeatResponse* object according to CBSD *measCapability*.

The *measReportConfig* enumeration is detailed in Table 8.1-1.

Table 7.2-1: *MeasReportConfig* Parameter Definition

Parameter	Description
NAME: *measReportConfig* DATA TYPE: array of string	The SAS uses this parameter to configure CBSD measurement reporting. The measurement report requested by the SAS shall be consistent with the CBSD measurement capabilities reported during the registration request. The CBSD shall report the measurement listed in this array. The permitted enumerations can be one or ~~both of the following values:~~ ~~RECEIVED_POWER_WITHOUT_GRANT,~~ ~~RECEIVED_POWER_WITH_GRANT.~~ multiple of the values defined in section 7, Measurement Report Types, of this document.

9 CBSD Measurement Capability

The *measCapability* enumeration is detailed in Table 9.1-1.

Table 7.2-1: *MeasCapability* Parameter Definition

Parameter	Description
NAME: *measCapability* DATA TYPE: array of string	The array of string lists measurement reporting capabilities of the CBSD. The permitted enumerations can be one or ~~both of the following values;~~ ~~RECEIVED_POWER_WITHOUT_GRANT,~~ ~~RECEIVED_POWER_WITH_GRANT.~~ multiple of the values defined in section 7, Measurement Report Types, of this document.

10 Document History

		Document history
V1.0.0	19 April 2017	Initial version
V2.0.0	22 June 2017	Added air interface from Cambium Networks. Corrected E_UTRA to reflect modified rules.
V2.0.1	22 June 2017	Editorial changes
V2.0.2	30 August 2017	Updated the version number of the SAS-CBSD TS according to the new numbering method.
V3.0.0	15 August 2018	Added 4G_BBW_SAA_1 air interface submitted by Siemens
V3.0.1	1 October 2018	Corrected copyright date and updated this table to include V3.0.0
V4.0.0	28 November 2018	Added indoor loss measurement type. Updated to allow received power to be sent unsolicited. Addition of Measurement Report Configuration and CBSD Measurement Capability sections. Other editorial changes.