OnGo Coexistence Technical Specifications / OnGo-TS-2001

OnGo Coexistence Technical Specifications TS-2001

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1 Introduction and Scope

An objective of the CBRS Alliance is to allow flexible use of the CBRS band while supporting coexistence of multiple deployments. This document is a Technical Specification (TS) for coexistence between and among multiple LTE and NR networks. In this release only GAA aspects are addressed. Coexistence between CBSDs belonging to the CBRS Alliance Coexistence Group is coordinated by one or multiple Coexistence Managers (CxMs). A Coexistence Manager (CxM) combined with a SAS forms a CBRS Alliance SAS Entity (CSAS). The specification addresses requirements on the CxM pertaining to coexistence. Additionally, the specification includes GAA coexistence requirements for CBSDs including cell phase synchronization, TDD Configuration for LTE-TDD and NR-TDD CBSDs, GAA channelization and SAS-CBSD protocol extensions. The current version of the document focuses on Band 48 [11] LTE-TDD using Frame Structure 2 (FS2) [4][16] and limited support for n48 [18][19] NR-TDD deployment. Coexistence between CBSDs belonging to the CBRS Alliance Coexistence Group is coordinated by one or multiple Coexistence Managers (CxMs).

The key words "required", "shall", "shall not", "should", "should not", "recommended", "may", and "optional" in this document are to be interpreted as described in RFC-2119 [12].

Note: LTE and E-UTRA are equivalent terms for the purposes of this TS. Furthermore, unless otherwise noted, references to CBSDs refer to CBRS Alliance CBSDs.

2 References

[1] J. Sanz Subirana et al, “Time References in GNSS”, at European Space Agency, 2011.

[2] 3GPP TS 36.133, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management (Release 14).”

[3] 3GPP TS 36.401, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Architecture description (Release 14).”

[4] 3GPP TS 36.211, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 14).”

[5] 3GPP TS 36.104, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception (Release 14).”

[6] 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)”, Version V1.x.x.

[7] Electronic Code of Federal Regulations, Title 47, Chapter I, Subchapter D, Part 96, http://www.ecfr.gov/cgi-

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[8] West, D. B. (2000), Introduction to Graph Theory, Pearson.

[9] 3GPP TS 36.214, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer: Measurements (Release 14).”

[10] 3GPP TS 32.425, “3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunications management, Performance Management (PM); Performance measurements Evolved Universal Terrestrial Radio Access (E-UTRAN) (Release 14).”

[11] 3GPP TS 36.101, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (Release 14).”

[12] RFC-2119, “Key Words in RFCs to indicate Requirement Levels.”

[13] RFC-3339, "Date and Time on the Internet: Timestamps", Klyne, Newman, July 2002.

[14] 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)”, Version 1.x.x**.**

[15] WINNF-SSC-0010, “Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS): WInnForum Recognized CBRS Grouping Parameters,” Version 2.0.0.

[16] 3GPP TS 38.211, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical channels and modulation (Release 15).”

[17] 3GPP TS 38.213, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical layer procedures for control (Release 15).”

[18] 3GPP TS 38.101-1, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone (Release 16).”

[19] 3GPP TS 38.101-3, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios (Release 16).”

[20] 3GPP TS 38.331, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Radio Resource Control (RRC) protocol specification (Release 15)”

[21] WINNF-SSC-0008, “Coordinated Periodic Activities Policy,” Version 1.3.0.

[22] WINNF-TR-5001 “CBRS Deployment Guidelines for Installers,” Version 1.0.0.

[23] CBRSA Indoor Deployment Guidelines (To be published by CBRSA Deployment and Operations Working Group)

[24] Electronic Code of Federal Regulations, Title 47, Chapter I, Subchapter A, Part 2, Subpart A https://www.ecfr.gov/cgi-bin/text-idx?SID=2a6a4daef214111e0c151e660d2b6bec&mc=true&node=se47.1.2_11&rgn=div8

[25] 3GPP TS 38.133, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Requirements for support of radio resource management," V15.7.0, Sept. 2019.

[26] 3GPP TS 38.401, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NG-RAN; Architecture description," v15.6.0, July 2019.

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3 Definitions and Abbreviations

3.1 Abbreviations

3GPP: 3rd Generation Partnership Project

BS: Base Station

CA: Carrier Aggregation

CBRS: Citizens Broadband Radio Service

CBRSA: CBRS Alliance

CBSD: Citizens Broadband Radio Service Device

CP: Cyclic Prefix

CPAS: Cooperative Periodic Activities among SASs

DL: Downlink

DP: Domain Proxy

E-UTRA: Evolved UTRA

FFS: For Further Study

FS2: Frame Structure 2 corresponding to LTE-TDD operation in 3GPP Band 48.

FSS: Fixed Satellite Service

GAA: General Authorized Access.

GNSS: Global Navigation Satellite System

GPS: Global Positioning System

ID: Identification

LTE: Long Term Evolution

NL: Network Listening

NR: New Radio

OOBE: Out Of Band Emission

OTA: Over the Air

PAL: Priority Access License

PTP: Precision Time Protocol

RAN: Radio Access Network

RF: Radio Frequency

SAS: Spectrum Access System

SCS: Sub-Carrier Spacing

SFN: System Frame Number

SSF: Special Subframe

TAI: Temps Atomique International

TDD: Time Division Duplex

TR: Technical Report

TS: Technical Specifications

UE: User Equipment

UL: Uplink

UTC: Coordinated Universal Time

3.2 Definitions

CCG (Common Channel Group): A group of CBSDs that are part of the same ICG, where all members of the CCG require the same channel assignment.

Connected Set: A set of CBSDs represented by the largest set of vertices of a graph, in which any two vertices of the set are connected to each other through at least one path in the graph.

CBRS Alliance SAS Entity (CSAS): A logical entity that comprises a WInnForum specified SAS [6] and a CBRS Alliance specified Coexistence Manager (CxM).

CxG (Coexistence Group): A group of CBSDs that abide by a common interference management policy which is used to coordinate their interference within the group.[1]

CxM (Coexistence Manager): A logical entity responsible for managing coexistence among CBSDs within a specific CxG.

GAA Channel Assignment: An operation performed by the CxM, where the CxM identifies the GAA frequency range that a particular CBSD may request from SAS and informs the CBSD and SAS of the assignment. The CBSD is expected to request grant(s) consistent with the GAA channel assignment and the SAS has the final discretion to accept or reject a CBSD's grant request to use a GAA channel.

ICG (Interference Coordination Group): A group of CBSDs belonging to the CBRSA CxG indicating that they can manage their own interference within the group, and do not require channel orthogonalization.

LTE-TDD: LTE-Time Division Duplex. In the CBRS Band, LTE-TDD corresponds to Band 48 as defined by 3GPP.

Equivalent TDD Configuration: A TDD frame configuration in which, regardless of the SCS (i.e., independently of symbol durations), all UL, DL and gap periods are strictly aligned from a timing point of view with those defined by a reference TDD Configuration.

NR-TDD: NR-Time Division Duplex. In the CBRS Band, NR-TDD corresponds to Band n48 as defined by 3GPP.

TDD Configuration: A TDD configuration for an LTE-TDD deployment is defined as a combination of a UL/DL configuration and an associated SSF configuration. A TDD configuration for an NR-

[1] In the context of TS-2001 Release 2, support for only a single CBRSA CxG has been defined

TDD deployment is defined as a combination of an SCS and a TDD-UL-DL pattern for the NR frame.

4 CBRS Alliance CxM Information Exchange

Coordination of spectrum use between CBSDs within the CBRSA CxG is facilitated by exchanging information between CBSDs belonging to the CBRSA CxG and the CxM.

See Section 7 for protocol extensions to support this information exchange.

5 GAA Coexistence Requirements for CBSDs

5.1 Cell Phase Synchronization and TDD Configuration

A lack of frame synchronization or the use of incompatible uplink-downlink TDD Configurations between CBSDs can create interference from high power downlink signals from the network towards UE transmissions, potentially degrading throughput due to harmful interference. Therefore, cell phase synchronization and alignment of downlink and uplink resources are necessary within TDD Configuration Connected Sets (see details in Section 6.3.1) of CBSDs belonging to the CBRSA CxG, even when those CBSDs are operated by different operators.

5.1.1 Cell Phase Synchronization

Several methods are available to achieve phase synchronization of TDD networks, e.g. GPS or GNSS assistance [1], PTP, and NL. It is possible to achieve multi-operator frame synchronization based on existing parameters in 3GPP specifications in a manner that is independent of the actual source of timing information.

The definition of cell phase synchronization accuracy appears in 3GPP TS 36.133, Section 7.4 [2], for LTE cells and TS 38.133, Section 7.4.1 [25] for NR cells:

> *Cell phase synchronization accuracy is defined as the maximum absolute deviation in frame start timing between any pair of cells on the same frequency that have overlapping coverage areas.*

CBSDs shall conform with all the requirements of cell phase synchronization specified in the 3GPP TS 36.133 [2] for LTE cells and TS 38.133 [25] for NR cells, irrespective of the frequency assigned to them. In particular, the specification [2] establishes a requirement for accuracy at ≤ 3 μs for a wide area BS that has a cell radius ≤ 3 km and at ≤ 10 μs for a wide area BS that has a larger cell radius when measured against a common reference. In addition, the accuracy requirement for Home BS small cells at a propagation distance smaller than or equal to 500 m is ≤ 3 μs, while a large cell Home BS covering more than 500 m distance and operating in Network Listening (NL) mode will have to maintain Cell Phase Synchronization accuracy at a level ≤ 1.33 μs more than the time of propagation from the network synchronization source. The requirement for Home Base Stations without NL is equal to the small cell requirement. The 3GPP TS 36.133 and 3GPP TS 38.133 are the definitive references for all requirements pertaining to cell phase synchronization [2][25].

The parameters that establish synchronization are further detailed in 3GPP TS 36.401 and TS 38.401, Section 9.1 [3][26].

All LTE-TDD CBSDs and NR-TDD CBSDs belonging to the CBRSA CxG shall derive frame timing in accordance with the following requirements:

1. **Time reference:** A time reference traceable to a common time reference. This time reference shall not be leap second adjusted according to [3][26]. Temps Atomique International (TAI) shall be used.

2. **SFN init time:** Initialization time for the SFN timing formula shall be according to Section 9.1 of [3][26], expressed in the time reference above and shall follow the detailed SFN initialization time as specified by the GPS epoch 1980-01-06 at midnight UTC, which equals 00:00:19 expressed in TAI [4] or according to the definition of SFN and frame timing difference in Section 5.1.14 of [27]. The use of a common SFN initialization time serves to align the frame boundaries, and indeed the subframe boundaries, within the required timing accuracy.

CBSDs that use CA shall maintain a common frame reference for all the component carriers in any band combinations including the CBRS band, i.e. Band 48. When a CBSD belonging to a CBRSA CxG determines or predicts it is operating outside the allowable limits required for cell phase synchronization, the CBSD shall stop radio transmission. Once the CBSD determines or predicts it is able to operate within the allowable limits required for cell phase synchronization, the CBSD may start radio transmission using spectrum grants authorized by SAS.

5.1.2 TDD Configuration

It is well understood in the industry that a desirable condition for multiple overlapping outdoor LTE-TDD and NR-TDD deployments to coexist in the same band is that they align their frame boundaries and use the same TDD Configuration. Asynchronous operation in the same outdoor area can lead to detrimental interference conditions, and coexistence solutions without alignment of cell phases and TDD Configurations may not be practical and/or efficient.

For indoor deployments [22][23], where the CBSD power levels are comparable to UE power levels, the restriction on utilizing the same TDD Configuration can be relaxed.

All LTE-TDD CBSDs in a CBRSA CxG shall support the uplink-downlink configurations in Table 1 with SSF Configuration 7 [4].

Table 1: Mandatory E-UTRA TDD UL/DL Configurations for the CBRSA CxG.

Uplink-Downlink Configuration	UL:DL ratio	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
1	4:4	D	S	U	U	D	D	S	U	U	D
2	2:6	D	S	U	D	D	D	S	U	D	D

All NR-TDD CBSDs in a CBRSA CxG shall support NR SCS of 15 kHz or 30 kHz[2], as defined in Table 5.3.5-1 of TS 38.104.

NR CBSDs operating with 30 kHz SCS in a CBRSA CxG shall support the uplink-downlink configurations[2] that are shown in Table 2, which correspond to the mandatory LTE-TDD Configurations[3]. Slots shown with 'D' shall use 14 DL symbols, slots shown with 'U' shall use 14 UL symbols, and slots shown with 'S' shall have 14 symbols configured as 6 DL symbols followed by 4 Guard symbols followed by 4 UL symbols as shown in Figure 1 in order to match LTE-TDD SSF7 [17].

NR CBSDs operating 15 kHz SCS in the CBRSA CxG shall support TDD Configurations equivalent to the mandatory E-UTRA TDD Configurations shown in Table 1, where the symbols in the special slot shall be configured to match LTE-TDD SSF7 [17].

Table 2: Mandatory 30 kHz SCS NR-TDD UL/DL Configurations for the CBRSA CxG

UL:DL ratio	Slot Number																			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
4:5	D	D	D	S	U	U	U	U	D	D	D	D	D	S	U	U	U	U	D	D
2:7	D	D	D	S	U	U	D	D	D	D	D	D	D	S	U	U	D	D	D	D

Figure 1: NR-TDD 30 kHz SCS Slot 'S' Symbol Pattern for the CBRSA CxG

NR Slot	3, 13													
NR Symbol	0	1	2	3	4	5	6	7	8	9	10	11	12	13
UL-DL pattern	D	D	D	D	D	D	G	G	G	G	U	U	U	U

All LTE-TDD CBSDs and NR-TDD CBSDs that are part of the same TDD Configuration Connected Set shall use the same TDD Configuration or Equivalent TDD Configurations.

Any LTE-TDD Configuration defined in [4] or the NR Equivalent TDD Configuration [17] may be used, provided all the LTE-TDD and NR-TDD CBSDs in the TDD Configuration Connected Set use the same TDD Configuration or Equivalent TDD Configurations.

[2] Note: SCS employed for the TDD Frame configuration does not restrict k the SCS that can be employed for the PRACH preamble format.

[3] Note: Initial NR CBSD deployments may not support both mandatory configurations, provided the CBSD stops NR operation if the CxM directs the CBSD to use a mandatory configuration that the CBSD does not yet support.

If LTE-TDD and NR-TDD CBSDs belonging to the same TDD Configuration Connected Set select different TDD Configurations, the CxM shall designate the use of one of the mandatory TDD Configurations.

In a TDD Configuration Connected Set containing only NR-TDD CBSDs, an NR-TDD Configuration not compatible with LTE-TDD may be used, provided that all NR-TDD CBSDs in the TDD Configuration Connected Set use the same SCS and NRTDD Configuration.

5.2 Coexistence Measurement Report

Coexistence measurement reports are conveyed by CBSD/DPs to the CxM using the SAS-CBSD protocol. The measurements reports are carried in the *CoexMeasInfo* object described in Section 7, and can be sent by the CBSD in any SAS-CBSD message that allows a *GroupInfo* object, including the *RegistrationRequest*, *SpectrumInquiryRequest*, *GrantRequest*, and *HearbeatRequest* [6].

The coexistence measurement reports are intended to provide the CxM with measurement information regarding the radio environment in the vicinity of the CBSD(s) that are performing or collecting the measurement, and thereby assist the CxM in its CBSD channel assignment function.

Coexistence reports may provide identification information, measurements, usability and tolerability indications. The information can pertain to the channels currently in use by the CBSD, or to other channels.

Along with a coexistence measurement report, CBSDs shall also provide the CxM with identification information about their transmitted CBRS E-UTRA/NR signals. This information is carried in *cellInfo* parameter of the *CbrsAllianceInfo* object described in Section 7. *cellInfo* parameter, which is an array of *SignalInfo* objects, shall be included in a heartbeat request when a CBSD starts to transmit a new CBRS E-UTRA/NR signal or whenever the identification information related to a CBRS E-UTRA/NR signal is modified.

The channels for which measurement information is being reported could pertain to a cell with an E-UTRA/NR TDD signal detected at the CBSD, signals corresponding to non-E-UTRA/NR TDD interferers detected at the CBSD, or E-UTRA/NR TDD signals detected by UEs connected to the CBSD.

For all reported channels, the report shall provide the frequency range for the measurements. Additionally, if the measured channel contains an E-UTRA/NR TDD signal, the report may include additional E-UTRA/NR TDD specific identification information regarding the signal, such as PCI, ECGI, etc.

For all reported channels, the CBSD may provide a ternary usability indication for the channel and may report its RSSI. Additionally, if the measured channel contains an E-UTRA/NR TDD signal, the report can contain EUTRA/NR TDD specific measurements such as RSRP and RSRQ.

If the CBSD is reporting UE-based measurement results, such reports shall contain statistical information based on UE measurement reports received by one or more CBSDs sharing the same E-UTRA/NR Cell Global Identifier. The messages will have to be duplicated for each CBSD that is part of the E-UTRA/NR Cell Global Identifier.

5.3 Coexistence Reporting Assistance from CxM

Coexistence Reporting Assistance Information is guidance that can be provided by the CxM to the CBSDs/DPs as input to coexistence measurement reporting. The guidance information may include a list of channels for which the CxM is interested in receiving measurement information, along with additional identifiers regarding specific E-UTRA/NR TDD cells that may exist in those channels.

5.4 GAA channelization

For CBSDs that are members of the CBRSA CxG, only combinations of 5 MHz channel units can be used for spectrum inquiry and grant request for GAA. Thirty channel units of 5 MHz width are defined with the following frequency ranges (in MHz)

$$[3550 + (k-1) * 5, 3550 + k * 5], k = 1, 2, \dots, 30.$$

CBSDs shall request a spectrum grant in multiples of these 5 MHz channel units. The CxM shall follow the above GAA channelization for all frequency guidance and guard band assignments in multiples of 5 MHz. NR requires a minimum of 10 MHz contiguous bandwidth. For connected sets which include NR and LTE CBSDs the CxM shall attempt to employ the same minimum contiguous bandwidth (10MHz) for the GAA Channel Assignment process.

5.5 CBSD Grouping

When a CBRSA CxG CBSD indicates membership in the CBRSA CxG, it may indicate membership in at most one Interference Coordination Group (ICG) to the CxM in a *cbrsaGroupingParam* parameter. ICG members are capable of managing interference among themselves, so even members with overlapping downlink coverage areas do not require non-overlapping spectrum assignments from the CxM.

A CBSD may further indicate membership in at most one Common Channel Group (CCG). A CCG shall consist of a subset of the CBSDs in a given ICG and shall indicate its CCG membership in the same *cbrsaGroupingParam* parameter that indicates membership in the corresponding ICG. All members of a given CCG require the same channel assignment from the CxM.

Figure 2 illustrates the relationship between CBSDs in the CBRSA CxG, ICGs, and CCGs. Note that the ICG and CCG formation are declared by the CBSD Users. The CBSD Users can form the CBSD Groups independently of the TDD Configuration which is determined by the CxM.

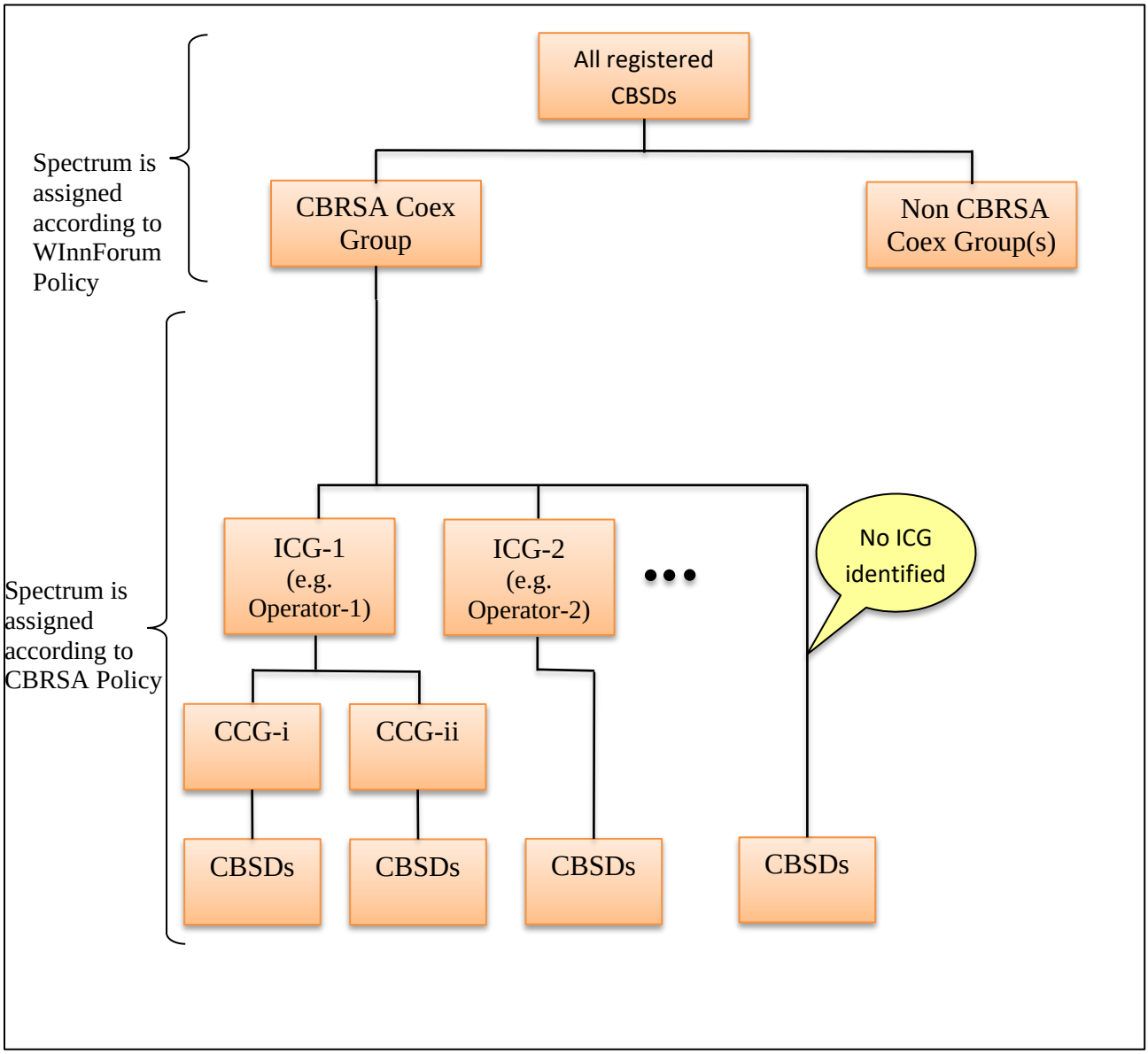

Figure 2: Relationship between CBSDs in the CBRSA CxG, ICGs, and CCGs.

6 GAA Coexistence Requirements for CxM

6.1 CBRS Alliance CxG Coexistence Principles

This section describes intra-CxG GAA Channel Assignment (defined in Section 3.2) to be used by CBRSA CxG CBSDs in the Grant Requests assuming LTE-TDD (FS2) or NR-TDD as the underlying technologies. Incumbent and PAL protection is handled by the SAS per Part-96

requirements [7] and the CxM procedures are subordinate to any decisions imposed by the SAS for this purpose.

The CxM is responsible for assigning a pool of available spectrum assigned by the CSAS for the CBRSA CxG among all CBSDs claiming membership in the CBRSA CxG.

As per Section 5, all the LTE/NR CBSDs in each TDD Configuration Connected Set use the same TDD Configuration or Equivalent TDD Configurations and are time synchronous to eliminate CBSD to CBSD or UE to UE interference between different LTE/NR-TDD systems. Indoor CBSDs which seek to opt out of TDD Configuration Connected Sets, shall also be time synchronous (per Section 5).

In this section, “coverage” refers to the CBSD downlink coverage. Considerations for coverage adjustment based on uplink performance are FFS.

6.1.1 Primary Channel Assignment

The CSAS is responsible for providing the CxG with a spectrum assignment that is meant to be distributed among CBSDs within that CxG. In particular, the CSAS identifies one or more sets of CBSDs within the CBRSA CxG and provides the CxM with a spectrum assignment for each set. The CxM shall perform primary channel assignment consistent with the operation as described in this section below. The CxM is responsible for informing the serving CSAS regarding the GAA Channel Assignment.

For each set of CBRSA CBSDs identified, the CSAS provides the CxM with a list of the CBSDs in the set, information about those CBSDs, and a pool of spectrum assigned for that set. The information provided includes CBSD registration information such as the location of each CBSD, maximum EIRP or requested EIRP (if available), height above average terrain (HAAT) of the antenna placement, antenna characteristics and grouping information [15] (e.g., the contents of *InstallationParam*, *grouping parameters*, etc.).

For each set of CBSDs identified by the CSAS, using information provided by the CSAS, the CxM creates an “coverage overlap graph”, which represents interference relationships between CBSDs, as follows:

- The CxM creates vertices of the graph.
  - The CxM creates one vertex for all CBSDs belonging to a CCG.
  - The CxM treats a CBSD as one vertex if the CBSD does not indicate any CCG membership.
- The CxM creates edges of the graph. The edge can be created between two vertices as follows:
  - An Edge can be created based on the coverage overlap between the corresponding CBSDs. NOTE: The definition of coverage overlap is FFS.
  - There is an edge between co-situated CBSDs belonging to different ICGs. Refer to Section 6.3.3 for the definition of co-situated CBSDs.

- No edge should be created between the two vertices if all CBSDs corresponding to two vertices belong to the same ICG.
- The edge can also be created based on internal modeling of the propagation environment, RF measurements, network performance, interference condition, and so on.

After the CxM creates the coverage overlap graph, it finds different connected components of the graph, and each connected component becomes a “Channel Assignment Connected Set”. At this point, the CxM considers each Channel Assignment Connected Set separately and performs the primary channel assignment independently for each Channel Assignment Connected Set:

- The CxM colors each vertex of a Channel Assignment Connected Set with minimum number of colors in the entire graph such that any two vertices with an edge between them have different colors. This minimum number is called the chromatic number [8].
- The spectrum available to the Channel Assignment Connected Set is divided into orthogonal and equal primary channels, and each vertex is assigned one of these channels corresponding to the color of the vertex in the graph.

The CxM should ensure stability over time (e.g. days) of channel assignment within the CxG as long as there is no instruction from the SAS on the change of channel availability due to the higher-tiers’ activity.

Given that a significant CBSD EIRP power reduction (e.g. more than 10 dB in a typical use case) could completely invalidate the CBSD deployment goals, the CxM should recommend channel assignments to CBSDs that will not require more than an indicated EIRP power reduction from the requested EIRP level when higher tiers protection is applied. Channel assignment should also consider other aspects such as contiguous and stable channel assignments. In case the CxM is not able to assign any channel that will meet the specified CBSD maximum power reduction, this is conveyed to the CBSD.

The CxM shall convey to the CBSD the set of channels assigned. The CBSD can request one or more Grants with the appropriate requested operational parameters using these channels. Following a successful Grant Request / Response, the SAS entity within the CSAS should notify the CxM of the spectrum grant. For CBSDs relinquishing a spectrum grant during the day, the SAS entity within the CSAS may notify the CxM.

6.1.2 Bandwidth Expansion

Within the spectrum assigned to the CxG by the SAS, the CxM may increase the bandwidth available to a CBSD beyond its primary channel assignment (which is an equal division of available GAA spectrum between the identified colors of a Channel Assignment Connected Set) by assigning any spectrum or part thereof that does not overlap with another CBSD’s primary channel assignment, for all pairs of CBSDs where the vertices representing the two CBSDs are connected with an edge.

6.2 GAA Spectrum Inquiry Response to Newly Registered CBSDs

For CBSDs registering and requesting spectrum during the day (prior to the daily activity schedule), in a Spectrum Inquiry Request, the CSAS may provide the following possible channels for consideration, listed in no priority order. (*Note: The SAS has the final authority on what spectrum to grant CBSDs that it manages.*) For initial deployment, the CxM may not be operational for spectrum inquiry objects during the day.

a. Channels unassigned to CBSDs that would have edges to the new CBSD.

b. Channels which require protection. (Note: To use these channels, power reduction might be required by SAS).

c. Channels already assigned to the same Interference Coordination Group (ICG), provided:

   1. the channel assignment does not violate protection of a higher tier user, and

   2. the channel assignment does not interfere with that of CBSDs in a different Channel Assignment Connected Set, where the channel is already in use by a different CxG (Note 1).

d. Expansion channels currently assigned to other CBRS-Alliance CBSDs in the Channel Assignment Connected Set (provided compliance with higher tier users and no edge to a different CxG).

e. Channels which have additional interference headroom after protecting higher tier users (Note 1).

Note 1: These are included in the list for completeness; however, most likely the CxM is not aware of other CxGs (non CBRS-Alliance CxGs) or incumbents (which would be higher tier users), thus the CxM would not know if these channels are available. The CSAS would need to decide if these channels are available.

6.3 TDD Configuration and Guard Band

6.3.1 Selection of TDD Configuration

Section 5.1.2 requires all LTE-TDD and NR-TDD CBSDs that are part of the same TDD Configuration Connected Set to use the same the same TDD Configuration or Equivalent TDD Configurations. The TDD Configuration Connected Set shall be similar to the Channel Assignment Connected Sets built by forming edges between CBSDs that have overlap of their respective -96dBm/10 MHz contours. Note that the TDD Configuration Connected Set that the CxM constructs can be different from the Channel Assignment Connected Sets discussed in Section 6.1, which the CxM constructs for a different purpose. For example, these Connected Sets can be different in the case where indoor CBSDs opt out of the TDD Configuration Connected Set. Unless all the CBSDs in the TDD Configuration Connected Set have specified the same desired TDD Configuration, the

choice of a particular mandatory TDD configuration in the corresponding TDD Configuration Connected Set shall be based on the designation of a single fallback choice for TDD Configuration that is chosen from Table 1 (which corresponds to an NR Equivalent TDD Configuration from Table 2 for SCS=30 kHz). The TDD Configuration shall be chosen by majority voting among the fallback TDD Configurations specified by CBSDs within the constructed baseline TDD Configuration Connected Set, where ties are resolved by a pseudorandom draw. The desired TDD Configuration and the fallback configuration, as well as the desired NR-TDD Configuration, are specified by the CBSD as attributes in the grouping parameter associated with CBRSA CxG.

Indoor CBSDs deployed as per the CBRSA Indoor deployment guidelines [23], shall have the option of informing the CxM of its desire to opt out of TDD Configuration Connected Sets used for TDD Configuration determination. An Indoor CBSD shall inform the CxM of its request to opt out via the attributes in the grouping parameters. Indoor CBSDs which select to opt out are not exempt from applying any mandatory TDD Configuration if requested by the CxM. The CxM shall request Indoor CBSDs to employ the mandatory TDD Configurations only when harmful interference [24] scenarios originated by the Indoor CBSDs are reported. The CxM shall consider fallback TDD preferences of Indoor CBSDs which have requested to opt out, if these CBSDs are going to be mandated a TDD Configuration.

An NR CBSD, capable of supporting NR-TDD Configurations that are not compatible with LTE-TDD Configurations, may specify the desired NR-TDD Configuration to the CxM. If, and only if, all the CBSDs in a TDD Configuration Connected Set specify the same NR-TDD Configuration, then the CxM shall allow that NR-TDD Configuration to be used by the members of the TDD Configuration Connected Set. If, at a later time, a new CBSD joins the TDD Configuration Connected Set, and the new CBSD does not desire to use a NR-TDD Configuration or desires to use a different NR-TDD Configuration, then the CxM shall change the TDD Configuration used in the TDD Configuration Connected Set to one of the mandatory TDD Configurations.

6.3.2 Change of TDD Configuration

After determination of the TDD Configuration by the CxM for a given TDD Configuration Connected Set according to Section 6.3.1, the CxM shall recognize one of the following:

1. Registration of new CBSDs that desire a different TDD Configuration than what is used in the TDD Configuration Connected Set, or
2. Introduction or removal of new CBSDs that tip the majority class of the *desiredTddConfig* or *fallbackTddConfig* objects to a new alternative.

The CxM shall determine the new TDD Configuration to impose on the CBSDs that are part of the TDD Configuration Connected Set, either a desired TDD Configuration, or the fallback TDD Configuration. When CBSDs are being removed, the CxM will select the planned activation of a fallback TDD Configuration.

When adding a new CBSD to a TDD Configuration Connected Set, the CBSD shall be assigned initially to a single TDD Configuration Connected Set that has the greatest affinity to the CBSD; this is indicated by the edge corresponding to the highest estimated interference connection to the CBSD.

After the initial assignment, the CxM shall over time determine whether two or more TDD Configuration Connected Sets bear merging due to the introduction of the CBSD, for example during occurrences of the Cooperative Periodic Activities among SASs (CPAS) [21] process for the CxG. The decision of whether and when to reconcile will consider additional factors such as a possible change of TDD Configuration for one or more TDD Configuration Connected Sets. The exact schedule of such reconfigurations is an operational matter that is left to the discretion of the CxM.

When the CxM has identified the need for a change in TDD Configuration in a TDD Configuration Connected Set, it shall inform the SAS entity in the CSAS, and the CSAS shall terminate the grant(s) as part of the daily CPAS schedule for the CxG. The CBSD should modify its grant request(s) to reflect the new TDD Configuration as informed by the CxM. A Grant request in violation of the agreements for the CxG or the TDD Configuration Connected Set should be rejected according to the coexistence decision made by the CxM.

6.3.3 Guard Band considerations for TDD Configurations

Synchronized CBSDs that use the same TDD Configuration do not need guard bands between co-situated CBSDs using different channels. Co-situated CBSDs are CBSDs sharing the same physical site and potentially the same antenna, i.e. sharing infrastructure or in close physical proximity.

Co-situated CBSDs that do not belong to the same ICG shall not be assigned the same frequency.

CxM should maximize the frequency separation between different ICGs as necessary.

Identified cases of harmful interference [24] may be handled by the CxM (e.g. channel re-assignment, increased frequency separation, revoking opt out privileges, facilitating exchange of data) in collaboration with affected operators.

7 Protocol Extensions

To facilitate management of the CBRSA CxG by the CxM, all CBSDs that declare themselves to be part of the CBRSA CxG exchange information with the CxM. This is accomplished by including this information in JSON objects known as CBRS Alliance Coexistence Objects transported by using various existing messages of the SAS-CBSD protocol [6] and SAS-SAS protocol [14] as needed.

The CBSD and the CSAS shall support:

- WInnForum Release 2 (or higher) Specifications [6], [14]
- The “WF_ENHANCED_GROUP_HANDLING” optional feature ([6], [14])
- The *groupType* “COEXISTENCE_GROUP” ([15]).

The CBRS Alliance Coexistence Objects are:

- *CbrsAllianceInfo* object from CBSD/DP to CxM
- *CbrsAllianceConfig* object from CxM to CBSD/DP.

In the CBSD/DP to CxM direction, the *CbrsAllianceInfo* object is contained in the *groupInfo* parameter of the *GroupParam* data object [6].

In the CxM to CBSD/DP direction, the *CbrsAllianceConfig* object is contained in the *groupConfigInfo* parameter of the *GroupConfig* data object [6]. The details are in the following subsections.

7.1 Information Transfer from CBSD/DP to CxM

A CBSD may send grouping information to a CxM by including the *groupingParam* parameter in the *RegistrationRequest*, the *SpectrumInquiryRequest*, the *GrantRequest* or the *HeartbeatRequest* object [6]. The *groupingParam* parameter and its content are defined in [6].

An LTE-TDD or NR-TDD CBSD shall indicate membership in the CBRSA CxG by use of a single instance of the *GroupParam* object. In particular, it shall set *groupType* to "COEXISTENCE_GROUP" and *groupId* to "CBRS_ALLIANCE" in the *GroupParam* object.

GroupInfo is a data object that enables CBSD/DP to share its group information in addition to *groupType* and *groupId* as specified in [6] and [15]. The *GroupInfo* object and its content are specified in Table 3 to Table 14.

Table 3: *GroupInfo* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *cbrsAllianceInfo* DATA TYPE: object: *CbrsAllianceInfo*	Required	This parameter includes additional group information of the CBRSA CxG.

Table 4: *CbrsAllianceInfo* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *cbrsaVersion* DATA TYPE: string	Required	This parameter indicates the version of the CBRSA Coexistence Objects(s) implemented by the CBSD/DP. The version of CBRSA Coexistence Objects sent to the CBSD/DP shall be the same as the version of the *CbrsAllianceInfo* object from the CBSD/DP. In this version of this specification, this parameter shall be set to the value "v3.2".
NAME: *desiredTddConfig* DATA TYPE: object: *EutraTddConfig*	Optional	This parameter indicates the desired E-UTRA TDD Configuration or its NR Equivalent TDD Configuration.
NAME: *desiredNrTddConfig* DATA TYPE: object: *NrTddConfig*	Optional	This parameter indicates the desired NR-TDD Configuration. It is used only by CBSDs that desire to use an NR-TDD Configuration not compatible with LTE-TDD (otherwise, for NR Equivalent TDD Configurations, the *desiredTddConfig* parameter shall be used). If all CBSDs in a TDD Configuration Connected Set specify the *desiredNrTddConfig* with the same NR TDD Configuration value, then the CxM shall allow this NR TDD Configuration to be used in the TDD Configuration Connected Set.
NAME: *usedTddConfig* DATA TYPE: object: *EutraTddConfig*	Conditional	This parameter shall be included in the *GrantRequest* object, indicating the E-UTRA TDD Configuration or its NR Equivalent TDD Configuration to be used for the grant. This parameter shall not be included when *usedNrTddConfig* is included in this object.

Parameter	R/O/C	Parameter Information
NAME: *usedNrTddConfig* DATA TYPE: object: *NrTddConfig*	Conditional	This parameter shall be included in the *GrantRequest* object, indicating the NR-TDD Configuration to be used for the grant. This parameter shall be specified only if the CBSD has previously received permission from CxM, in the *CbrsAllianceConfig* object, to use an NR-TDD Configuration that is not compatible with the LTE-TDD. This parameter shall not be included when *usedTddConfig* is included in this object.
NAME: *fallbackTddConfig* DATA TYPE: object: *EutraTddConfig*	Optional	This parameter indicates the fallback E-UTRA TDD Configuration or its NR Equivalent TDD Configuration from the allowed mandatory choices in Table 1. If *fallbackTddConfig* is not provided by a CBSD, the CxM shall assume Configuration 2 in Table 1 or its NR Equivalent TDD Configuration as the *fallbackTddConfig* for that CBSD.
NAME: *cbrsaGroupingParam* DATA TYPE: array of object: *CbrsaGroupParam*	Optional	The CBSD can optionally indicate its membership of group types defined by the CBRSA.
NAME: *cellInfo* DATA TYPE: array of object: *SignalInfo*	Conditional	This parameter includes information about the signals transmitted by the CBSD. This parameter is included in a heartbeat request as described in Section 5.2.
NAME: c*oexMeasInfo* DATA TYPE: object: *CoexMeasInfo*	Optional	This parameter includes coexistence related measurement information.
NAME: *indoorCbsdOptOut* DATA TYPE: Boolean	Optional	Indoor CBSDs may use this parameter to indicate if they request to opt out of TDD Configuration Connected Sets. True: Indoor CBSD selects to opt out False: Indoor CBSD selects not to opt out The default value of this parameter is False.

Table 5: *EutraTddConfig* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *ulDLConfig* DATA TYPE: number	Required	Permitted values are 0, 1, 2, 3, 4, 5, and 6. This parameter represents either E-UTRA TDD UL/DL configuration [4] or the corresponding NR TDD Equivalent Configurations. In the case of the *fallbackTddConfig*, permitted values are restricted as per Table 1 (see section 5.1.2 for more details)[4].
NAME: *ssfConfig* DATA TYPE: number	Required	Permitted values are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. This parameter represents E-UTRA TDD special subframe configuration [4] and can also be adapted by NR TDD CBSDs to ensure an NR TDD Equivalent Configuration. In the case of the *fallbackTddConfig*, permitted value is 7 (see section 5.1.2 for more details)[4].

Table 6: *NrTddConfig* Definition

Parameter	R/O/C	Parameter Information
NAME: *subcarrierSpacing* DATA TYPE: string	Required	NR subcarrier spacing in kHz. The permitted values are “kHz15” and “kHz30”, representing 15 kHz and 30 kHz subcarrier spacing, respectively.
NAME: *nrTddUlDlPattern1* DATA TYPE: *NrTddUlDlPattern*	Required	NR TDD UL-DL Pattern, similar to the one defined in [20] (section describing *TDD-UL-DL-Config* information element)
NAME: *nrTddUlDlPattern2* DATA TYPE: *NrTddUlDlPattern*	Optional	NR TDD UL-DL Pattern, similar to the one defined in [20] (section describing *TDD-UL-DL-Config* information element)

[4] Note: Table 2 describes the NR TDD Configurations for NR SCS=30 kHz that are equivalent to the mandatory E-UTRA TDD Configurations specified in Table 1. Likewise, Figure 1 only specifies the special slot configuration for NR SCS=30 kHz which is equivalent to the LTE SSF7.

Table 7: *NrTddUlDlPattern* Definition

Parameter	R/O/C	Parameter Information
NAME: *dlUlTransmissionPeriodicity* DATA TYPE: string	Required	Periodicity of the DL-UL pattern in milliseconds. Permitted values are “ms0p5”, “ms1”, “ms2”, “ms2p5”, “ms3”, “ms4”, “ms5”, “ms10”.
NAME: *nrofDownlinkSlots* DATA TYPE: number	Required	Number of consecutive full DL slots at the beginning of each DL-UL pattern. Maximum value is 20. This parameter is an integer number.
NAME: *nrofDownlinkSymbols* DATA TYPE: number	Required	Number of consecutive DL symbols in the beginning of the slot following the last full DL slot (as derived from *nrofDownlinkSlots*). The value 0 indicates that there is no partial-downlink slot. The symbols after the last DL symbol and before the first UL symbol, are considered to be guard symbols with no UL or DL signal being transmitted. The maximum number of symbols in a slot is 14. This parameter is an integer number.
NAME: *nrofUplinkSlots* DATA TYPE: number	Required	Number of consecutive full UL slots at the end of each DL-UL pattern. Maximum value is 20. This parameter is an integer number.
NAME: *nrofUplinkSymbols* DATA TYPE: number	Required	Number of consecutive UL symbols in the end of the slot preceding the first full UL slot (as derived from *nrofUplinkSlots*). The value 0 indicates that there is no partial-uplink slot. The maximum number of symbols in a slot is 14. The symbols after the last DL symbol and before the first UL symbol, are considered to be guard symbols with no UL or DL signal being transmitted. This parameter is an integer number.

Table 8: *CbrsaGroupParam* Definition

Parameter	R/O/C	Parameter Information
NAME: *cbrsaGroupType* DATA TYPE: string	Required	Allowed values are "CBRSA_ICG" or "CBRSA_CCG". If *cbrsaGroupType* is set to "CBRSA_ICG", the CBSD belongs to an Interference Coordination Group (ICG) defined by the CBRSA. If *cbrsaGroupType* is set to "CBRSA_CCG", the CBSD belongs to a Common Channel Group (CCG). A CBSD shall belong to at most one ICG and at most one CCG.
NAME: *cbrsaGroupId* DATA TYPE: string	Required	This field specifies the identifier for this group of CBSDs. *cbrsaGroupId* shall be the concatenation of CBSD *userId* (as defined in [6]) and a string chosen by the user to uniquely identify the group among CBSDs with the same *userId*.

Table 9: *SignalInfo* Object Defintion

Parameter	R/O/C	Parameter Information
NAME: *eutraInfo* DATA TYPE: object: *EutraInfo*	Required	Indicates information on an E-UTRA signal or E-UTRA compatible NR signal.

Table 10: *EutraInfo* Object Definition

Parameter	R/O/C	Parameter Information
NAME: s*ignalEarfcn* DATA TYPE: number	Required	Indicates the EARFCN of the LTE signal or NR-ARFCN of the NR signal. For *signalRat* = LTE, permitted values are integers between 55240 and 56739 inclusive. For *signalRat* = NR, permitted values are even integers between 636668 and 646666.

Parameter	R/O/C	Parameter Information
NAME: *signalRat* DATA TYPE: string	Conditional	Indicates the RAT associated with the signal. When used in the *cellInfo* parameter of the *CbrsAllianceInfo* object, the allowed values are “LTE” and “NR”. Otherwise, allowed values are “LTE”, “NR”, and “UNKNOWN”. This parameter shall be included if used in the *cellInfo* parameter of the *CbrsAllianceInfo* object.
NAME: *signalPci* DATA TYPE: number	Conditional	Indicates the PCI associated with the signal. For *signalRat* = LTE, permitted values are integers between 0 and 503 inclusive. For *signalRat* = NR, permitted values are integers between 0 and 1007 inclusive. This parameter shall be included if the *EutraInfo* object carries information of the transmitted signal. This parameter shall be included if used in the *cellInfo* parameter of the *CbrsAllianceInfo* object.
NAME: *signalEcgi* DATA TYPE: string	Conditional	For *signalRat* = LTE, indicates the ECGI associated with the signal. It is a string of length 52, containing 0’s and 1’s. For *signalRat* = NR, indicates the NCGI associated with the signal. It is a string length 60, containing 0’s and 1’s. This parameter shall be included if the *EutraInfo* object carries information of the transmitted signal. This parameter shall be included if used in the *cellInfo* parameter of the *CbrsAllianceInfo* object.
NAME: *signalBandwidth* DATA TYPE: number	Required	Indicates the bandwidth of the signal. Bandwidth of the signal is in 100’s of kHz (E.g. number 200 indicates bandwidth of 20MHz).

Table 11: *CoexMeasInfo* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *channelReport* DATA TYPE: array of object: *ChannelReport*	Optional	Provides CxM reports about a set of channels
NAME: *signalReport* DATA TYPE: array of object: *SignalReport*	Optional	Provides CxM reports about a set of detected signals

Table 12: *ChannelReport* Object Definition

Parameter	R/O/C	Parameter Information
NAME: c*hannelFrequencyRange* DATA TYPE: object: *FrequencyRange*	Required	Indicates the frequency range of the reported channel.
NAME: *channelUsability* DATA TYPE: string	Optional	Permitted values are “USABLE”, UNUSABLE” and “UNKNOWN”. Indicated values should only be interpreted as relative comparison between channel usabilities reported by CBSDs belonging to the same CCG and ICG.
NAME: *channelRssi* DATA TYPE: number	Optional	Indicates the estimated RSSI of the channel in dBm. Permitted values are integers between -110 and -19 (including -110 and -19). Indicated values should only be interpreted as relative comparison between channel RSSIs reported by CBSDs belonging to the same CCG and ICG.
NAME: *measurementInterval* DATA TYPE: object: *TimeInterval*	Optional	This parameter indicates the time interval when the measurement included in the *ChannelReport* object is performed.

Table 13: *TimeInterval* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *startTime* DATA TYPE: string	Required	Indicates the beginning of a time interval. This parameter is UTC time expressed in the format, YYYY-MM-DDThh:mm:ssZ as defined by [13].
NAME: *endTime* DATA TYPE: string	Required	Indicates the end of a time interval. This parameter is UTC time expressed in the format, YYYY-MM-DDThh:mm:ssZ as defined by [13].

Table 14: *SignalReport* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *detectedSignalInfo* DATA TYPE: object: *SignalInfo*	Required	Provides information about the detected signal
NAME: *signalTolerability* DATA TYPE: string	Optional	Indicates the tolerance to interference from the reported signal. Permitted values are “TOLERABLE”, INTOLERABLE” and “UNKNOWN”.
NAME: *cbsdSignalRsrp* DATA TYPE: number	Optional	Indicates the estimated RSRP of the detected downlink LTE waveform or estimated SS-RSRP of the detected downlink NR waveform. Permitted values are integers between -17 and 97 (including -17 and 97). The value is based on measurement at the CBSD.
NAME: *cbsdSignalRsrq* DATA TYPE: number	Optional	Indicates the estimated RSRQ of the detected downlink LTE waveform or estimated SS-RSRQ of the detected downlink NR waveform. Permitted values are integers between -30 and +46 (including -30 and +46). The value is based on measurement at the CBSD.

Parameter	R/O/C	Parameter Information
NAME: *ueSignalRsrpHistogram* DATA TYPE: array of number	Optional	A length-48 array, where each element indicates number of occurrences of UE-reported RSRP for this LTE signal or SS-RSRP for this NR signal that fall within each bin *i*, *i =0,…,47*. The RSRP range for each bin is as specified in [10], Section 6.1.
NAME: *ueSignalRsrqHistogram* DATA TYPE: array of number	Optional	A length-18 array, where each element indicates number of occurrences N_i of UE-reported RSRQ for this LTE signal or SS-RSRQ for this NR signal that fall within each bin *i*, *i =0,…,17*. The RSRQ range for each bin is as specified in [10], Section 6.2.
NAME: *measurementInterval* DATA TYPE: object: *TimeInterval*	Optional	This parameter indicates the time interval when the measurement(s) included in the *SignalReport* object is performed.

7.2 Information Transfer from CxM to CBSD/DP

Based on the CBRSA Coexistence policies, described in Section 6.3, a CxM may suggest coexistence parameters for a CBSD by using the *GroupConfigInfo* object in the *groupingConfig* parameter in the *RegistrationResponse*, the *SpectrumInquiryResponse*, the *GrantResponse*, or the *HeartbeatResponse* object [6]. The *GroupConfigInfo* object and its content are defined in Table 15 to Table 18.

Table 15: *GroupConfigInfo* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *cbrsAllianceConfig* DATA TYPE: object: *CbrsAllianceConfig*	Optional	This parameter is included if the CxM intends to configure the CBSD with specified coexistence parameter values.

Table 16: *CbrsAllianceConfig* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *cbrsaVersion* DATA TYPE: string	Required	This parameter indicates the version of the CBRSA Coexistence Objects(s) sent to the CBSD/DP. The version of CBRSA Coexistence Objects sent to the CBSD/DP shall be the same as the version of the *CbrsAllianceInfo* object from the CBSD/DP.
NAME: *eutraTddConfig* DATA TYPE: object: *EutraTddConfig*	Optional	If included, this parameter specifies the E-UTRA TDD Configuration or its NR Equivalent TDD Configuration that the CBSD shall use for all its grants.
NAME: *nrTddConfig* DATA TYPE: object: *NrTddConfig*	Optional	If included, this parameter specifies the NR-TDD Configuration that the CBSD shall use for all its grants. This parameter may be included by the CxM if the *eutraTddConfig* parameter is not present.
NAME: *coexMeasAssist* DATA TYPE: object: *CoexMeasAssist*	Optional	The CxM uses this parameter to send assistance information for coexistence measurements to the CBSD
NAME: *cbsdFrequencyGuidance* DATA TYPE: array of object: *FrequencyRange*	Optional	CxM uses this parameter to provide guidance on the frequency range(s) the CBRSA CxG CBSD is instructed to request and use going forward. Upon receiving this information, the CBRSA CxG CBSD is expected to only request and hold spectrum grants that are within the received *cbsdFrequencyGuidance*. In the scenario where the guidance last received from the *SpectrumInquiryResponse -> availableChannel* object is in conflict with the last received *cbsdFrequencyGuidance*, the CBSD should follow the latter for determining the frequencies on which to request spectrum grants.

Inclusion of a parameter to indicate primary or expansion channels is FFS.

Table 17: *CoexMeasAssist* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *channelAssistance* DATA TYPE: *FrequencyRange*	Optional	Indicates the frequency range of the reported channel.
NAME: *signalAssistance* DATA TYPE: array of object: *SignalInfo*	Optional	The CxM uses this parameter to inform CBSD the list of signals the CxM is interested about.

Table 18: *FrequencyRange* Object Definition

Parameter	R/O/C	Parameter Information
NAME: *lowFrequency* DATA TYPE: number	Required	The lowest frequency of the frequency range in Hz.
NAME: *highFrequency* DATA TYPE: number	Required	The highest frequency of the frequency range in Hz.

Appendices (Informative)

Appendix A: Document History

Table 19: Change History

Version	Date	Description
r1 (towards V3.0.0)	July 19, 2019	Incorporate approved contributions for NR Coex WI: C-TG-19-431_2019.06.27_Nokia_Technical.Rel 3 NR Config Signaling (approved) C-TG-19-410_2019.04.11_Nokia_Technical.NR Config for GAA r2 (approved for Rel 3).
R2 (towards V3.0.0)	Aug 28, 2019	Incorporate approved contributions for NR Coex WI: C-TG-19-436_2019.07.11_Ericsson_CR.NR TDD Configuration_r3 C-TG-19-450_2019.08.07_Nokia_Technical.NR RACH SCS and DCI Format 2_0 (approved).docx
r3 (towards V3.0.0)	September 18, 2019	Incorporate approved contribution for V2.1.0: C-TG-19-415_2019.04.25_Nokia_CR.Connected Set for TDD Config Part 2 (Approved for Rel 2.x) C-TG-19-393_2019.02.21_Nokia_CR.TDD Config for New CBSD (approved) C-TG-19-394_2019.02.22_Nokia_CR.Fallback ssfConfig Value (approved) C-TG-19-397_2019.02.28_Nokia_CR.Connected Set for TDD Config (approved) C-TG-19-398_2019.02.28_CommScope-FW-Google_CR.Connected Set for TDD Config (approved) C-TG-19-387_2019.02.08_Ericsson_CR.CBSD Identification Information_r1 C-TG-19-388_2019.02.13_Commscope_CR.CXM-002-Channel Assignment_r0
r4 (towards V3.0.0)	October 16, 2019	Use the new OnGo spec template. Incorporate approved contribution C-TG-19-475_2019.10.03_Nokia_Technical.TP_Indoor_Coex(approved).docx
r5 (towards V3.0.0)	December 12, 2019	Implement agreements of resolved ballot comments on CBRSA-TS-2001-V2.0.0-r4 (towards V3.0.0).
V3.0.0	February 18, 2020	Version approved for publication
r1 (towards V3.1.0)	March 23, 2020	Incorporate approved contribution to allow use of 15 kHz SSC for NR: C-TG-20-506_2020.02.06_Nokia_Technical.5G NR SCS-limited TDD patterns_r4(approved).docx

Version	Date	Description
r2 (towards V3.1.0)	March 30, 2020	Incorporate the following approved contributions: C-TG-20-516_2020.03.20_Ericsson_CR.Align with WinnF Rel 2.docx C-TG-20-517_2020.03.26_Nokia_Technical.GAA Channelization Considerations for NR.pptx
r3 (towards V3.1.0)	May 4, 2020	Implement all resolutions for ballot comments on the version towards V3.1.0.