



Collaborative GAA Coexistence Technical Specification

ONGO TS-2003
Version 5.0.0
December 5, 2023

LEGAL NOTICES AND DISCLOSURES

THIS SPECIFICATION IS PROVIDED "AS IS," WITHOUT ANY REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS, IMPLIED, OR STATUTORY; AND TO THE MAXIMUM EXTENT PERMITTED BY LAW, ONGO ALLIANCE, AS WELL AS ITS MEMBERS AND THEIR AFFILIATES, HEREBY DISCLAIM ANY AND ALL REPRESENTATIONS AND WARRANTIES, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, TITLE, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY, OR RELIABILITY, OR ARISING OUT OF ANY ALLEGED COURSE OF PERFORMANCE, DEALING OR TRADE USAGE. ANY PERMITTED USER OR IMPLEMENTER OF THIS SPECIFICATION ACCEPTS ALL RISKS ASSOCIATED WITH THE USE OR INABILITY TO USE THIS SPECIFICATION.

THE PROVISION OR OTHER PERMITTED AVAILABILITY OF OR ACCESS TO THIS SPECIFICATION DOES NOT GRANT ANY LICENSE UNDER ANY PATENT OR OTHER INTELLECTUAL PROPERTY RIGHTS ("IPR"). FOR MORE INFORMATION REGARDING IPR THAT MAY APPLY OR POTENTIAL AVAILABILITY OF LICENSES, PLEASE SEE THE [ONGO ALLIANCE IPR POLICY](#). ONGO ALLIANCE TAKES NO POSITION ON THE VALIDITY OR SCOPE OF ANY PARTY'S CLAIMED IPR AND IS NOT RESPONSIBLE FOR IDENTIFYING IPR.

TO THE MAXIMUM EXTENT PERMITTED BY LAW, UNDER NO CIRCUMSTANCES SHALL ONGO ALLIANCE, OR ANY OF ITS MEMBERS OR THEIR AFFILIATES, BE LIABLE FOR DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL, EXEMPLARY, PUNITIVE, OR OTHER FORM OF DAMAGES, EVEN IF SUCH DAMAGES ARE FORESEEABLE OR IT HAS BEEN ADVISED OR HAS CONSTRUCTIVE KNOWLEDGE OF THE POSSIBILITY OF SUCH DAMAGES, ARISING FROM THE USE OR INABILITY TO USE THIS SPECIFICATION, INCLUDING WITHOUT LIMITATION ANY LOSS OF REVENUE, ANTICIPATED PROFITS, OR BUSINESS, REGARDLESS OF WHETHER ANY CLAIM TO SUCH DAMAGES SOUNDS IN CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY), PRODUCT LIABILITY, OR OTHER FORM OF ACTION.

THIS DOCUMENT (INCLUDING THE INFORMATION CONTAINED HEREIN) IS PROVIDED AS A CONVENIENCE TO ITS READERS, DOES NOT CONSTITUTE LEGAL ADVICE, SHOULD NOT BE RELIED UPON FOR ANY LEGAL PURPOSE, AND IS SUBJECT TO REVISION OR REMOVAL AT ANY TIME WITHOUT NOTICE. THIS DOCUMENT IS PROVIDED ON AN "AS IS", "AS AVAILABLE" AND "WITH ALL FAULTS" BASIS. ONGO ALLIANCE MAKES NO REPRESENTATION, WARRANTY, CONDITION OR GUARANTEE AS TO THE USEFULNESS, QUALITY, SUITABILITY, TRUTH, ACCURACY, OR COMPLETENESS OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. ANY PERSON THAT USES OR OTHERWISE RELIES IN ANY MANNER ON THE INFORMATION SET FORTH HEREIN DOES SO AT HIS OR HER SOLE RISK.

IMPLEMENTATION OF A [NETWORK] AND/OR RELATED PRODUCTS OR SERVICES IS OFTEN COMPLEX AND HIGHLY REGULATED, REQUIRING COMPLIANCE WITH NUMEROUS LAWS, STATUTES, REGULATIONS AND OTHER LEGAL REQUIREMENTS ("LEGAL REQUIREMENTS"). AMONG OTHER THINGS, APPLICABLE LEGAL REQUIREMENTS MAY INCLUDE NETWORK OPERATOR REQUIREMENTS UNDER FEDERAL LAW, REQUIREMENTS RELATING TO E-911, ETC. A DISCUSSION OF SUCH LEGAL REQUIREMENTS IS BEYOND THE SCOPE OF THIS DOCUMENT. ACCORDINGLY, NETWORK OPERATORS AND OTHERS INTERESTED IN IMPLEMENTING NETWORKS OR RELATED SOLUTIONS ARE STRONGLY ENCOURAGED TO CONSULT WITH APPROPRIATE LEGAL, TECHNICAL AND BUSINESS ADVISORS PRIOR TO MAKING ANY IMPLEMENTATION DECISIONS.

OnGo Alliance
3855 SW 153rd Drive, Beaverton, OR 97003
www.ongoalliance.org
info@ongoalliance.org
Copyright © 2021 OnGo Alliance, All Rights Reserved

Table of Contents

1	Introduction and Scope	4
2	References.....	5
3	Definition and Abbreviations.....	6
3.1	Definitions	6
3.2	Abbreviations.....	6
4	Collaborative GAA Coexistence Framework	7
4.1	General.....	7
4.2	Framework Flow.....	7
4.2.1	Interference Detection and Validation	7
4.2.2	Creation of GAA Coordination Area (GCA).....	8
4.2.3	Initial GAA Frequency Plan Proposal	8
4.2.4	GAA Frequency Plan Negotiation.....	9
4.2.5	Implementation of the GAA Frequency Plan	9
4.3	SAS CBSD Interaction.....	9
4.3.1	Frequency Guidance.....	9
4.3.2	Enforcement when all Parties are in Agreement	10
4.4	TDD Coordination	10
5	Collaborative GAA Coexistence Framework Requirements	12
5.1	Requirements for Participating SAS Administrators offering GAA Coordination Service.....	12
5.2	Participating SAS Requirements.....	13
5.3	Participating CBSD User Requirements	13
5.4	Participating CBSD Requirements.....	14
6	Protocol Specifications.....	15
6.1	Protocol between CBSD/DP and SAS.....	15
6.1.1	Registration Request Message.....	15
6.1.2	Spectrum Inquiry Request/Response Message.....	15
6.1.3	Grant Response Message.....	16
6.1.4	Heartbeat Response Message.....	16
	Appendices	17
	Appendix A: Recommended TDD Configurations	18
	Appendix B: Cell Phase Synchronization	19
	Appendix C: Spectrum Inquiry Request/Response Message Definition for GAA Coordination Area.....	20
	Appendix D: Change History	23

Table of Figures

Figure 1: NR-TDD 30 kHz SCS “S” Slot Pattern for CBSDs.....	18
---	----

Table of Tables

Table 1: Recommended E-UTRA TDD Configurations (with SSF 7) for E-UTRA CBSDs	18
Table 2: Recommended NR-TDD Configurations for CBSDs supporting 30 kHz SCS.....	18
Table 3: Spectrum Inquiry Request Message.....	20
Table 4: <i>SpectrumInquiryRequest</i> Object Definition.....	20
Table 5: Spectrum Inquiry Response Message	21
Table 6: <i>SpectrumInquiryResponse</i> Object Definition	21
Table 7: <i>AvailableChannel</i> Object Definition	22
Table 8: Change History.....	23

1 Introduction and Scope

To facilitate faster adoption¹ of GAA coexistence, a simplified Collaborative GAA Coexistence framework is proposed as an alternative. The collaborative framework focuses on the areas where a coexistence solution is needed while allowing maximum flexibility outside those areas.

These focused areas, called GAA Coordination Areas (GCA), are identified based on interference conditions that have been reported by one or more users of the GAA spectrum. The participating CBSD Users with CBSD deployments inside an identified GCA can participate in the process with SAS Administrators in identifying a GAA Frequency Plan to minimize interference.

The GAA Frequency Plan helps to avoid cochannel interference among participating CBSD Users. If interference conditions are still reported after the GAA Frequency Plan is in effect, then TDD coordination is undertaken to mitigate remaining interference.

The scope of this technical specification is to specify operational and functional requirements for SAS Administrators, SASs, GAA CBSD Users and CBSDs to establish a framework for Collaborative GAA Coexistence and specify protocol extensions.

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 [1].

¹ OnGo TS 2001 Coexistence Technical Specification has been available for several years, but it has seen slow adoption by OnGo Alliance member companies, and it has not been deployed in the field.

2 References

- [1] RFC-2119, “Key Words in RFCs to indicate Requirement Levels.”
- [2] 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”, Wireless Innovation Forum
- [3] WINNF-TS-0112, “Requirements for Commercial Operation in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band”, Wireless Innovation Forum
- [4] WINNF-SSC-0010, “Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS): WInnForum Recognized CBRS Grouping Information”, Wireless Innovation Forum

3 Definition and Abbreviations

3.1 Definitions

Term	Definition
Participant	CBSD User and/or SAS Administrator participating into Collaborative GAA Coexistence framework
Involved Party	CBSD User (e.g., operator or enterprise) that may or may not be willing to participate in the Collaborative GAA Coexistence framework, and may or may not wish to accept the GAA Frequency Plan as determined by the SAS
Connected Set	An undirected graph consisting of the vertices represented by registered CBSDs and the edges each of which is created between two vertices (registered CBSDs) having a potential for interference
CBSD User	The registered entity that has operational responsibility for the CBSD [WINNF-TS-0112, V1.9.1, section 2.1] (May be a network operator or an enterprise)
GAA Coordination Area	Geographic area where Involved Participants of Collaborative GAA Coexistence framework can collaborate to identify a GAA Frequency Plan
GAA Coordination Service	A service, offered by a SAS Administrator, to provide GAA coordination to improve interference scenario for GAA channels
GAA Frequency Plan	Within a defined GCA, the GAA Frequency Plan defines the set of Primary and Secondary GAA Channels where each CBSD is allowed to operate under the Collaborative GAA Coexistence framework
Primary GAA Channel	A frequency segment (part of the GAA Frequency Plan) allocated to a CBSD that is not allocated to any other CBSDs in the same GCA where it may cause interference
Secondary GAA Channel	A frequency segment other than Primary GAA Channel(s)

3.2 Abbreviations

Abbreviation	Explanation
GCA	GAA Coordination Area
GCS	GAA Coordination Service
SRG	Spectrum Reuse Group
SFG	Single Frequency Group

4 Collaborative GAA Coexistence Framework

4.1 General

To enable fast adoption and field deployment of a coexistence solution, a simplified Collaborative GAA Coexistence framework is described in this document. The framework details the steps required to identify and address coexistence issues.

The framework is based on a voluntary collaborative approach, where the GAA CBSD Users and their SAS Administrators collaborate to:

- Identify areas with interference conditions that can not be solved by unilateral user network changes
- Agree on a GAA Frequency Plan, along with other measures (like for example aligning TDD configurations), that can be applied to the CBSDs in the affected areas
- Voluntarily agree to empower SASs to implement the agreed-upon GAA Frequency Plan

4.2 Framework Flow

The Collaborative GAA Coexistence framework is applied using the following steps:

1. Interference Detection and Validation
2. Creation of GAA Coordination Area
3. GAA Frequency Plan
4. GAA Frequency Plan Negotiation
5. Implementation of the GAA Frequency Plan

Although some of the framework stages are envisioned to involve human interaction between the impacted parties, this does not preclude future automation of any, or all, of the framework components.

4.2.1 Interference Detection and Validation

It is the responsibility of the CBSD Users to monitor their own network deployments and determine if the network is experiencing poor performance due to interference conditions. The CBSD User is encouraged to attempt to mitigate the interference by actions such as channel reselection and network reconfigurations before reporting the interference condition to the Managing SAS Administrator.

If the interference situation cannot be solved locally by the CBSD User, the CBSD User can report the interference condition to its Managing SAS Administrator using an off-line process. The interference report shall be accompanied by collected evidence of the interference condition. The evidence can include measurements conducted within the CBSD coverage area along with other relevant network information. OnGo Alliance does not specify which tools can be used to collect interference evidence; the CBSD User is encouraged to work with its SAS Administrator to determine the best way to collect the evidence.

After receiving the interference report, the SAS Administrator shall validate the evidence. Managing SAS Administrator reserves the right to not accept all interference reports or proceed with subsequent steps.

4.2.2 Creation of GAA Coordination Area (GCA)

After the interference report has been validated, the SAS Administrator will define a GAA Coordination Area (GCA) around the CBSDs that are impacted by interference conditions. The GCA will be represented as a polygon encompassing the CBSDs that may require frequency coordination.

SAS Administrators have several options available to define the GCA. One option would be to create a minimal Connected Set using the impacted CBSDs as seeds, and then create a contour as a union of coverage areas of the CBSDs that are part of the Connected Set. Another option is to use pre-defined geographical areas and define a GCA for those areas where interference is reported. The GCA is defined using all identified CBSDs, participating in coexistence or not. The details on how the SAS constructs the GCA are left out of the specification.

Once the GCA is identified, the list of Involved Parties is created by identifying CBSD Users with CBSD deployments inside the GCA as well as their serving SAS Administrators. The GCA polygon is shared by the respective Managing SAS Administrators with all Involved Parties. The GCA can be adjusted if approved by respective SAS Administrators.

4.2.3 GAA Frequency Plan

The SAS Administrators that manage CBSDs within a GCA will collaborate to determine a GAA Frequency Plan that will improve or solve the reported interference scenario. The allocated GAA Frequency plan for a CBSD (belonging to a GCA) contains frequency segments that are not allocated to any other CBSDs in the GCA that may cause interference. These frequency segments are termed as Primary GAA Channels.

Other frequency segments within the GAA Frequency Plan, if present, are allocated to the CBSD as long these allocations do not cause interference to the Primary GAA Channels of other CBSDs. These frequency segments are termed as Secondary GAA Channels.

Primary and Secondary GAA Channels are different frequency segments.

The SAS Administrators shall make best efforts to create channel plans that maximize bandwidth and coverage per Participant, while minimizing interference between Participants.

To create the GAA Frequency Plan, SAS Administrators will need supplementary information about the CBSDs that are located inside GCA. Managing SAS Administrators and CBSD Users may agree on the protocol and contents of the messages used to convey above information. Examples of such methods are WInnForum Release 1 grouping parameters [4], future WInnForum releases Enhanced CBSD Group Handling messages, or any other proprietary mechanism.

The required CBSD information includes:

- The list (groups) of CBSDs that require the same channel(s)
 - CBSDs belonging to such group receive the same channel(s) from the SAS Administrators
 - This group is equivalent to the Single Frequency Group (SFG) or Common Channel Group (CCG)
- The list (groups) of CBSDs that can reuse the same channel(s)
 - Usually these are CBSDs that are deployed by the same CBSD User and their mutual interference is managed so that they can reuse the same channel(s)
 - This group is equivalent to the Spectrum Reuse Group (SRG) or Interference Coordination Group (ICG)

For the CBSD Users that do not provide the information above, SAS Administrators are allowed to use other available information to predict CBSD behaviour. For example, the CBSDs that have the same *userID* are interpreted to belong to a group of CBSDs that could reuse the same channels since the interference between those CBSDs is controlled by the CBSD User.

4.2.4 GAA Frequency Plan Negotiation

During the process of formulating the GAA Frequency Plan, CBSD Users may provide supplementary information to their managing SAS Administrators. For example, CBSD Users may provide channel preferences or field observations (e.g., unregistered carriers operating in the band) as supplementary information to their managing SAS Administrators. Managing SAS Administrators may collaborate with other participating SAS Administrators (with CBSDs within the GCA) to consider the supplementary information of their CBSD Users, if deemed reasonable.

4.2.5 Implementation of the GAA Frequency Plan

Once the GAA Frequency Plan is agreed, the SAS Administrators shall make the GAA Frequency Plan effective in their SAS which will then be granting GAA channels to participating CBSDs inside the GCA according to the GAA Frequency Plan. Where and when necessary, the SAS may terminate any existing grants that do not conform to the GAA Frequency Plan.

All participating CBSDs in the GCA are required to adhere to the SAS GAA Frequency Plan. SAS may approve or reject any channel grants outside the agreed GAA Frequency Plan. GAA Frequency Plan remains in place until a new interference event is reported and new coexistence steps identified in 4.2 commence.

4.3 SAS CBSD Interaction

4.3.1 Frequency Guidance

Once a GAA Frequency Plan is created for a GCA, a participating SAS Administrator may configure their SAS to provide GAA frequency guidance to all CBSDs inside GCA using the *Spectrum Inquiry* procedure. The frequency guidance is provided to Participants even if not all parties are in agreement. SAS may not provide frequency guidance to non-Participants. The guidance is provided in the form of a segregated list of all available channels, with Primary GAA Channels at the “top” of the list and Secondary GAA Channels subsequent.

Frequency Guidance is communicated to the CBSDs using:

- OnGo-specific enhancements of *Spectrum Inquiry Response* message (Appendix C)
- *Spectrum Inquiry Response* includes a list of Primary and Secondary GAA Channels (and PAL channels if applicable)
- All with 10 MHz granularity

ruleApplied parameter is used by the SAS to indicate Primary and Secondary GAA Channels using value set to either “GAA_COEX_PRIMARY” or “GAA_COEX_SECONDARY”

The Primary GAA Channels include all the channels that are assigned to the Participant in the agreed-upon channel plan.

The Secondary GAA Channels, where available, are those remaining channels that might be available for opportunistic use by a subset of CBSDs and may experience GAA interference.

Note: If approved Grants for the Secondary GAA Channels for a CBSD User occasionally cause unforeseen interference in Primary GAA Channel of any other CBSD User, then a new interference report may be submitted by CBSD Users to their Managing SAS Administrator.

4.3.2 Enforcement when all Parties are in Agreement

When all Involved Parties are in agreement on a GAA Frequency Plan, the participating SAS Administrators shall configure their SASs to reject Grant Requests outside of the Primary and Secondary GAA Channels with a specific error code/message for GAA Coexistence.

The CBSD need not perform a *Spectrum Inquiry* to receive enforcement, it can receive enforcement in the *Grant Response*. *Spectrum Inquiry Response* may not show channels as unavailable outside of Primary or Secondary GAA Channels, but SAS may issue rejection in Grant Response when Grant is requested outside of Primary and Secondary GAA Channels.

Where and when necessary, the SAS may terminate any existing grants that do not conform to the GAA Frequency Plan.

When the Managing SAS Administrator needs to communicate a change in GAA Frequency Plan, it shall communicate with CBSD Users offline and prepare an action plan (including but not limited to date/time) on executing the channel plan with all Involved Parties (i.e., CBSD Users and SAS Administrators).

4.4 TDD Coordination

The GAA Frequency Plan helps to avoid cochannel interference among participating CBSD Users. In order to also avoid TDD coordination-related interference (e.g., adjacent channel interference) inside a GCA, the participating CBSD Users are recommended to employ TDD frame synchronization and use one of the OnGo recommended TDD configurations. Recommended TDD configurations include LTE TDD Configurations 1 and 2, as well as the equivalent NR TDD Configurations (see Appendix A). Participating CBSD Users are recommended to inform their SAS Administrators whether they are using TDD frame synchronization and what they are using for TDD configuration. The method used to communicate this information between the participating CBSD Users and their Managing SAS Administrator is not defined and could include offline human or machine-to-machine interactions. Participating SAS Administrators may use this information in GAA Frequency Planning.

After the GAA Frequency Plan is in effect, if interference conditions are reported by a participating GAA CBSD User in one of its primary channels while using TDD frame synchronization and one of the recommended TDD configurations, and the interference is suspected to be arising from non-conforming CBSDs of a GAA CBSD User not using TDD frame synchronization or not using a recommended TDD configuration, then one or more of the following measures shall be taken for mitigating interference in the GCA.

1. The SAS Administrator communicates with the suspected non-conforming participating GAA CBSD User to start using TDD frame synchronization and one of the recommended TDD configurations (it is strongly recommended that the CBSD Users follow the guidance from their SAS Administrators), or
2. The SAS Administrator communicates with the suspected non-conforming participating GAA CBSD User to stop using its GAA channel that is causing TDD coordination-related interference to the affected GAA CBSD User's Primary GAA Channel in its CBSDs that are close to the affected user's CBSDs, or

3. The SAS Administrators may initiate a process to come up with a new GAA Frequency Plan to avoid TDD coordination-related interference to the affected GAA CBSD User².

² Note that Primary GAA Channel rearrangement (Option 3) should not reduce the number of Primary GAA Channels for GAA CBSDs compared to the original channel plan. Also note that, rearranging Primary GAA Channels alone may result in interference conditions being created for another participating GAA CBSD with Primary GAA Channels adjacent to the GAA CBSD not following TDD recommendations. If so, then Primary GAA Channels are rearranged again or one of the other options is used. Any interference remediation attempts that change the GAA channel assignments or availability must still have full agreement among the participating CBSD Users. The above measures may be repeated until interference concerns are fully resolved, or the remaining interference is accepted by participating GAA CBSD Users.

5 Collaborative GAA Coexistence Framework Requirements

5.1 Requirements for Participating SAS Administrators offering GAA Coordination Service

Note: The requirements in this section apply to Participating SAS Administrators offering GAA Coordination Service (GCS).

[SASA-R01] SAS Administrator shall provide instructions to its managed CBSD Users how to report interference scenarios.

[SASA-R02] Once an interference scenario has been reported, the Managing SAS Administrator shall evaluate and determine the validity of the reported interference scenario using its knowledge of all CBSDs in the area and propagation models.

[SASA-R02.1] Managing SAS Administrator may collaborate with other SAS Administrators as well as other CBSD Users to evaluate and determine the validity of the reported interference scenario.

[SASA-R03] Once the interference scenario has been deemed valid as per section 4.3, the Managing SAS Administrator shall determine the preliminary GAA Coexistence Area (GCA) around the CBSDs that are impacted by interference conditions.

[SASA-R03.1] GCA should be represented as a polygon encompassing the CBSDs that are impacted by interference conditions.

[SASA-R3.2] GCA should be defined using all identified CBSDs, participating or not, based on one of the following methods:

- To create a minimal Connected Set using the impacted CBSD as seeds, and then create a contour as a union of coverage areas of the CBSDs that are part of the Connected Set. (NOTE: details of how to define coverage area of the CBSD are outside the scope of this technical specification.)
- To use pre-defined geographical areas and define a GCA for those areas where interference is reported. (NOTE: details of pre-defined geographical areas are outside the scope of this technical specification.)

[SASA-R03.3] Managing SAS Administrator may collaborate with other SAS Administrators that are managing CBSDs inside GCA as well as other impacted CBSD Users, refining the CBSDs constituting the GCA.

[SASA-R04] Once GCA has been defined, the SAS Administrators shall collaborate to determine the GAA Frequency Plan to be applied inside GCA.

[SASA-R05] SAS Administrators shall ensure that the determined GAA Frequency Plan is communicated to all CBSD Users inside a GCA

[SASA-R06] SAS Administrators shall provide mechanism to the CBSD Users to communicate their frequency preferences. Acceptance of those frequency preferences as part of the GAA Frequency Plan is at the discretion of the SAS Administrators.

[SASA-R07] If all the CBSD Users inside GCA agree with the GAA Frequency Plan, SAS Administrators shall enforce the determined GAA Frequency Plan for their managed CBSDs inside GCA.

[SASA-R08] Managing SAS Administrator may facilitate sharing contact information upon written consent of CBSD User involved in determined GCA.

[SASA-R09] When the SAS Administrator needs to communicate a change in GAA Frequency Plan, it shall communicate with CBSD Users offline and prepare an action plan (including but not limited to date/time) on executing the channel plan with all Involved Parties.

[SASA-R10] After the GAA Frequency Plan is in effect, if interference conditions are reported by a GAA CBSD User in one of its Primary GAA Channels while using TDD frame synchronization and one of the OnGo recommended TDD configurations, and the interference is suspected to be arising from CBSDs of a GAA CBSD User not using TDD frame synchronization or not using a recommended TDD configuration, then one or more of the following measures should be taken for mitigating interference in the GCA:

1. SAS Administrator communicates with the suspected non-conforming GAA CBSD User to start using TDD frame synchronization and one of the recommended TDD configurations, or
2. SAS Administrator communicates with the suspected non-conforming GAA CBSD User to stop using its GAA channel that is causing TDD coordination-related interference to the affected GAA CBSD User's primary channel in its CBSDs that are close to the affected user's CBSDs, or
3. SAS Administrators may initiate a process to come up with a new GAA Frequency Plan to avoid TDD coordination-related interference to the affected GAA CBSD User

5.2 Participating SAS Requirements

[SAS-R01] SAS shall have a capability to be configured to inform the CBSDs inside GCA, during the Spectrum Inquiry procedure, of the recommended Primary GAA Channels and Secondary GAA Channels based on the agreed GAA Frequency Plan.

[SAS-R02] SAS shall communicate the determined GAA Frequency Plan to its managed CBSDs inside a GCA. For GCA where all impacted CBSD Users have agreed to use the GAA Frequency Plan, only the GAA channels that are allocated to the CBSD will be communicated (this includes Primary GAA Channels and Secondary GAA Channels).

[SAS-R03] For the CBSDs inside a GCA where all impacted CBSD Users have agreed to use the GAA Frequency Plan, SAS shall approve only the grant requests for GAA channels that are in accordance with the GAA Frequency Plan. This will ensure that the GAA Frequency Plan is followed by all CBSDs.

[SAS-R04] Once the GCA collaboration is completed and a full consensus has been reached regarding GAA Frequency Plan inside a GCA, all participating SASs shall enforce the GAA Frequency Plan for the participating CBSDs inside the GCA at the agreed time. Enforcement includes directing CBSDs to relinquish previously used GAA grants that are no longer allocated to them.

5.3 Participating CBSD User Requirements

[CU-R01] CBSD User shall provide contact information to its Managing SAS Administrators for information exchange related to coexistence issues. This includes:

- receiving information about creation of GCAs,
- information about the GCA Frequency Plans,
- updates when the previous GCA information has changed.

[CU-R02] CBSD User may choose to actively participate in the Collaborative GAA Coexistence framework or instead delegate resolving of coexistence issues to its Managing SAS Administrator (this implies that the CBSD User will agree with the coexistence solution chosen by the SAS Administrator)

[CU-R03] CBSD User shall communicate, once the GCA is aggregated upon, whether they plan to opt-in or not with the outcome of the GAA Frequency Plan. Once CBSD User has agreed to move forward with the GAA Coordination framework, they can still opt-out after the GAA Frequency Plan is communicated, but CBSD Users should provide its managing SAS Administrator with an alternative plan and on why they will not participate.

[CU-R04] CBSD User shall communicate its final decision to comply with the GAA Frequency Plan for a GCA or opt out. The decision shall be communicated to the Managing SAS, and it will be shared with all impacted Participants (SAS Administrators and CBSD Users with CBSDs inside GCA)

[CU-R05] In lieu of CBSD supporting Spectrum Inquiry procedure, CBSD User should configure its CBSDs to send the Managing SAS a Grant Request following the recommended Primary GAA Channels and Secondary GAA Channels based on the agreed GAA Frequency Plan.

[CU-R06] CBSD Users shall inform their Managing SAS Administrator whether they are using TDD frame synchronization and what TDD configuration they are using.

5.4 Participating CBSD Requirements

[CBSD-R01] In lieu of CBSD supporting Spectrum Inquiry procedure, CBSD should have a capability to be configured to send its Managing SAS Grant Requests following the Primary GAA Channels and Secondary GAA Channels according to the GAA Frequency Plan.

[CBSD-R02] CBSD shall comply with the cell phase synchronization requirements (see Appendix B).

[CBSD-R03] An E-UTRA compatible CBSD shall supports operation with at least one of the recommended E-UTRA TDD configurations 1 or 2, with Special Subframe (SSF) Configuration 7 (see Appendix A).

[CBSD-R04] An NR compatible CBSD shall supports operation with at least one of the recommended NR TDD configurations (see Appendix A).

6 Protocol Specifications

This section captures the protocol used between CBSD/DP and SAS to exchange coexistence information.

The method of information exchange between SASs is not defined in this release of the specification.

The protocol for information exchange between SAS Administrator and CBSD User is not specified.

6.1 Protocol between CBSD/DP and SAS

In the event of any discrepancy between this section and §4.3, this section shall take precedence.

The WInnForum Release 1 protocol is used between CBSD/DP and SAS to exchange coexistence information. Only minor changes are done on top of the WInnForum protocol. In particular, the following messages are used to exchange coexistence related information:

- Registration Request Message
 - Could be used by CBSD/DP to provide more information about CBSDs to aid with GAA Frequency Planning
- Spectrum Inquiry Response Message
 - Used by SAS to communicate GAA frequency assignment to the CBSD
 - Minor changes are done to indicate GAA frequency assignment
- Grant Response Message
 - Used by the SAS to enforce proper use of GAA frequency assignment by the CBSD
- Heartbeat Response Message
 - Used by the SAS to enforce proper use of GAA frequency assignment by the CBSD

6.1.1 Registration Request Message

When instructed by their Managing SAS Administrator, the CBSD Users can configure their CBSDs to provide extra CBSD information to aid with GAA Frequency Planning. For example, CBSD/DP could use the Registration Request Message to declare its membership in different groups

If no grouping information has been provided by a CBSD that is located inside a GCA, the SAS Administrator could use the *userId* field of the Registration Request Message to virtually group together all the CBSDs belonging to the same CBSD User - this will be used for the purposes of determining GAA frequency assignments inside the GCA.

6.1.2 Spectrum Inquiry Request/Response Message

Appendix C of this technical specification provides OnGo-specific enhancements of Spectrum Inquiry Request/Response Message. For the purpose of GAA Collaborative Coexistence framework, a participating SAS will respond to a Spectrum Inquiry Request message from a CBSD located inside a GCA, with a Spectrum Inquiry Response message that contains the GAA frequency assignment information according to Appendix C of this technical specification.

NOTE: Only the Spectrum Inquiry Response Message is enhanced to include new values for the *ruleApplied* parameter. There is no change to the Spectrum Inquiry Request Message from WINNF-TS-0016, but it is shown in the Appendix C of this technical specification for completeness. By defining a pair of Request/Response messages, this technical specification will not impact any specification for WInnForum Release 1 test and certification.

6.1.3 Grant Response Message

Grant Response Message will be used by the SAS to enforce compliance with the GAA frequency assignments for the CBSDs located inside a GCA where all parties are in agreement (as per section 4.3.3).

The method of enforcement is left to each SAS Administrator.

NOTE: Example of the enforcement methods when a CBSD located inside a GCA request a grant on a frequency range (channel) that conflicts with the GAA frequency assignment, the SAS will either:

- Return non-zero response code 400 (INTERFERENCE) as preferred method; or
- Return response code 0 (SUCCESS) and the *responseMessage* parameter is included to indicate that the Grant will not be allowed to transmit. In this case, the SAS will automatically delete the Grant immediately after approval of the Grant so that it can return non-zero response code such as 103 (INVALID_VALUE) in the subsequent Heartbeat Response Message (see section 6.1.4).

6.1.4 Heartbeat Response Message

Heartbeat Response Message will be used by the SAS to enforce compliance with the GAA frequency assignments for the CBSDs located inside a GCA where all parties are in agreement (as per section 4.3.3).

When a CBSD located in such GCA holds a grant on a frequency range (channel) that conflicts with the GAA frequency assignment, the SAS will either:

- Terminate the grant and will return an error code of 500 (TERMINATED_GRANT); or
- Suspend the grant by returning error code 501 (SUSPENDED_GRANT) or any other non-zero value (e.g. 103)

Appendices

Appendix A: Recommended TDD Configurations

Table 1: Recommended E-UTRA TDD Configurations (with SSF 7) for E-UTRA CBSDs

Uplink-Downlink Configuration	UL:DL subframe 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

Table 2: Recommended NR-TDD Configurations for CBSDs supporting 30 kHz SCS

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

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

Figure 1: NR-TDD 30 kHz SCS "S" Slot Pattern for CBSDs

Appendix B: Cell Phase Synchronization

Several methods are available to achieve cell-phase synchronization of TDD networks, e.g. GPS or GNSS assistance, 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, for LTE cells and TS 38.133, Section 7.4.1 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 for LTE cells and TS 38.133 for NR cells, irrespective of the frequency assigned to them. In particular, the 3GPP specification establishes a requirement for accuracy at $\leq 3 \mu\text{s}$ for a wide area BS that has a cell radius $\leq 3 \text{ km}$ and at $\leq 10 \mu\text{s}$ 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 $\leq 3 \mu\text{s}$, 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 $\leq 1.33 \mu\text{s}$ 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.

All LTE-TDD CBSDs and NR-TDD CBSDs 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 3GPP TS 36.401 and 3GPP TS 38.401, 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 or according to the definition of SFN and frame timing difference in Section 5.1.14 of 3GPP TS 38.215. 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 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.

Appendix C: Spectrum Inquiry Request/Response Message Definition for GAA Coordination Area

This Appendix provides OnGo-specific enhancements of Spectrum Inquiry Request/Response Message for GAA Coordination Area. For the purpose of GAA Collaborative Coexistence framework, a participating SAS will respond to a Spectrum Inquiry Request message from a CBSD located inside a GCA, with a Spectrum Inquiry Response message that contains the GAA frequency assignment information as described below.

NOTE: Only the Spectrum Inquiry Response Message is enhanced to include new values for the *ruleApplied* parameter (no other changes are done to the message format or content). There is no change to the Spectrum Inquiry Request Message from WINNF-TS-0016 [2], but it is shown in this Appendix for completeness. The only changes as compared to WINNF-TS-0016 are highlighted in **special font format** below.

Definition of Spectrum Inquiry Request Message

Table 3: Spectrum Inquiry Request Message

Parameter	R/O/C	Description
NAME: <i>spectrumInquiryRequest</i> DATA TYPE: array of object: <i>SpectrumInquiryRequest</i>	Required	Array of <i>SpectrumInquiryRequest</i> objects. Each <i>SpectrumInquiryRequest</i> object represents a Spectrum Inquiry Request of a CBSD.

Table 4: *SpectrumInquiryRequest* Object Definition

Parameter	R/O/C	Description
NAME: <i>cbid</i> DATA TYPE: string	Required	The CBSD shall set this parameter to the value of its CBSD identity.
NAME: <i>inquiredSpectrum</i> DATA TYPE: array of object: <i>FrequencyRange</i>	Required	This field describes the spectrum for which the CBSD seeks information on spectrum availability. Refer to the format of the <i>FrequencyRange</i> object in [2].
NAME: <i>measReport</i> DATA TYPE: object: <i>MeasReport</i>	Conditional	The CBSD uses this parameter to report measurements to the SAS. Refer to the format of the <i>MeasReport</i> object in [2].

Definition of Spectrum Inquiry Response Message

If the requesting CBSD is located within a GCA with an agreed-upon GAA Frequency Plan, the SAS will return Spectrum Inquiry Response Message according to the definition below.

Table 5: Spectrum Inquiry Response Message

Parameter	R/O/C	Description
NAME: <i>spectrumInquiryResponse</i> DATA TYPE: array of object: <i>SpectrumInquiryResponse</i>	Required	Array of <i>SpectrumInquiryResponse</i> objects. Each <i>SpectrumInquiryResponse</i> object represents a Spectrum Inquiry Response to a spectrum inquiry request of a CBSD located within a GCA.

Table 6: *SpectrumInquiryResponse* Object Definition

Parameter	R/O/C	Description
NAME: <i>cbsdId</i> DATA TYPE: string	Conditional	This parameter is included if and only if the <i>cbsdId</i> parameter in the <i>SpectrumInquiryRequest</i> object contains a valid CBSD identity. If included, the SAS shall set this parameter to the value of the <i>cbsdId</i> parameter in the corresponding <i>SpectrumInquiryRequest</i> object.
NAME: <i>availableChannel</i> DATA TYPE: array of object: <i>AvailableChannel</i>	Conditional	This parameter is an array of zero or more data objects, <i>AvailableChannel</i> , which describe a channel that is available to the CBSD either as PAL or as GAA according to the GAA Frequency Plan. Included: If and only if the Spectrum Inquiry is successful.
NAME: <i>response</i> DATA TYPE: object: <i>Response</i>	Required	This parameter includes information on whether the corresponding CBSD request is approved or disapproved for a reason. Refer to the format of the <i>Response</i> object in [2].

Table 7: *AvailableChannel* Object Definition

Parameter	R/O/C	Description
NAME: <i>frequencyRange</i> DATA TYPE: object: <i>FrequencyRange</i>	Required	This parameter is the frequency range of the available channel For GAA channels, the size of the channel frequency range shall be 10 MHz and it should match the GAA Frequency Plan. Refer to the format of the <i>FrequencyRange</i> object in [2].
NAME: <i>channelType</i> DATA TYPE: string	Required	“PAL”: the frequency range is a PAL channel. “GAA”: the frequency range is for GAA use.
NAME: <i>ruleApplied</i> DATA TYPE: string	Required	The regulatory rule used to generate this response or, for GAA channels within a GCA, this field is used as a “marker” to indicate to the CBSD within GCA whether this <i>AvailableChannel</i> object represents a Primary GAA Channel or a Secondary GAA channel. <ul style="list-style-type: none"> • The value of this parameter is set to “GAA_COEX_PRIMARY” if the requesting CBSD is within the GCA and this <i>AvailableChannel</i> object represents a Primary GAA Channel • The value of this parameter is set to “GAA_COEX_SECONDARY” if the requesting CBSD is within the GCA and this <i>AvailableChannel</i> object represents a Secondary GAA Channel
NAME: <i>maxEirp</i> DATA TYPE: number	Optional	Maximum EIRP likely to be permitted for a Grant on this <i>frequencyRange</i> , given the CBSD registration parameters, including location, antenna orientation and antenna pattern. The maximum EIRP is in the units of dBm/MHz and is an integer or a floating point value between -137 and +37 (dBm/MHz) inclusive.

Appendix D: Change History

Table 8: Change History

Version	Date	Description
V0.0.0	2022-10-27	Initial official draft from contribution
V0.0.1	2022-12-05	Implemented C-TG-22-788_2022.10.06_Celona_Technical.CR Requirements Comments and Updates for TS-2003
V0.0.2	2023-02-17	Implemented C-TG-22-827_2023.02.02_Google_Technical.Frequency Plan Definition and C-TG-23-826_2023.02.02_Ericsson_Technical.TS-2003 CR for Protocol Specification
V0.0.3	2023-03-09	Implemented C-TG-23-834_2023.02.24_Charter_Technical.TS-2003 CR for TDD Coordination
V0.0.4	2023-03-16	Implemented C-TG-23-840_2023.03.16_Ericsson_Technical.TS-2003 CR for CBSD requirements
V0.0.5	2023-03-23	Implemented C-TG-23-845_2023.03.23_FW_Technical.Some Modifications to TS-2003
V0.0.6	2023-03-30	Implemented latest revision of C-TG-23-834_2023.02.24_Charter_Technical.TS-2003 CR for TDD Coordination
V0.0.7	2023-03-31	Prepared document for ballot
V0.0.8	2023-08-03	Updates after ballot comments resolution
V0.0.9	2023-09-14	Updates after second ballot comments resolution
V5.0.0	2023-12-05	Published