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System Requirements

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Contents

Intellectual Property Rights 4
Foreword 4
Modal verbs terminology 4
Introduction 4
1 Scope 6
2 References 6
2.1 Normative references 6
2.2 Informative references 6
3 Definition of terms, symbols, and abbreviations 7
3.1 Terms 7
3.2 Symbols 7
3.3 Abbreviations 7
4 Requirement organization 8
4.1 Requirement organization 8
5 System overview 9
5.1 System functional architecture 9
5.2 Spectrum Data Base (SDB) 9
5.3 Communication between SDB, DSAS, and S3D 11
5.4 Certified S3D-Installer Data Base (CDB) 12
5.5 Optional DSAS - NRA interface 13
6 Inter-system coordination (INC) 13
6.1 Functional requirements for inter-system coordination 13
6.1.1 Device registration and spectrum inquiry 13
6.1.2 Geolocation capability 14
6.1.3 Device power and emission limits 15
6.1.4 Security requirements 15
6.1.5 Primary user protection 15
6.1.6 Optional requirements for inter-system coordination 15
6.2 Technical requirements for inter-system coordination 16
7 Intra-system coordination (IRC) 16
7.1 Additional functional requirements for intra-system coordination 16
7.1.1 Non-primary user coordination 16
7.1.2 Optional requirements for intra-system coordination 17
7.2 Additional technical requirements for intra-system coordination 17
7.2.1 Introduction of NPU coordination requirements 17
Annex A (informative): Bibliography 19
History 20

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Reconfigurable Radio Systems (RRS).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

The Dynamic Spectrum Allocation Service (DSAS) manages spectrum access for non-primary users in frequency bands in which spectrum sharing is applied. DSAS guarantees interference-free operation for the primary users and offers dynamic spectrum access for non-primary users based on a situational assessment of the actual spectrum demand and on-site spectrum occupation. Furthermore, the following scheme can be used for co-primary allocation and coordination with the goal of effectively sharing band with guaranteed QoS.

In ETSI TR 103 885 [i.1], several use cases for temporary and flexible spectrum access are analysed and their requirements are compared with existing spectrum sharing frameworks. The results are used as the basis for the system requirements of the dynamic spectrum allocation service. The requirements are split into two categories:

- functional requirements that describe system behaviour under specific conditions and contain aspects of the end user expectations;

- technical requirements that describe the features and characteristics of the system that ensure pre-defined output performance and system's quality.

1 Scope

The present document specifies system requirements for the Dynamic Spectrum Allocation Service (DSAS) to support dynamic, temporary, and flexible spectrum sharing in an efficient, automated, and frequency and technology agnostic way based on the analysis introduced in ETSI TR 103 885 [i.1]. The report considers existing systems such as Automated Frequency Coordination (AFC), evolved License Shared Access (eLSA), or Citizens Broadband Radio Service Spectrum Access System (CBRS SAS), which could need to be adapted or simplified instead of developing a new system from scratch. It outlines which features of the previously mentioned systems can be removed, because they are unnecessary in the context of the intended use cases, and which features need to be added to fill identified gaps. In addition, the frequency ranges currently covered by AFC, eLSA, and CBRS SAS will be extended to other frequency ranges.

Functional and technical requirements of the DSAS are described and defined for two different coordination approaches:

- Inter-system coordination (INC): a sharing framework between different communication systems, in which Primary Users (PU) of the relevant frequency bands are protected against all users of lower tiers (i.e. Non-Primary Users (NPUs)).NPUs access is granted without any guaranteed level of Quality of Service (QoS). When only INC is enforced, NPUs may be requested to change their RF parameters and their overall system performance during their operation time.
  INC is comparable with the determination of available channels and its operational parameters on which a NPU device is allowed to operate at its geographic coordinates.

- Intra-system coordination (IRC): a sharing framework in which PUs of the relevant frequency bands get protected against all user of lower tiers (NPUs) and NPUs are getting coordinated to minimize interference between them and to guarantee a certain level of QoS. The level of QoS experienced by the NPUs depends on its prioritization, the current demand for spectrum, the neighboring situation, and maybe the price the user is willing to pay.
  IRC is comparable with a channel assignment/licensing including its operational parameters to NPU devices at its geographic coordinates.

The requirements captured in the present document are described in a technology neutral manner and are applicable for any wireless technology. DSAS enables dynamic spectrum sharing in any frequency band that is assigned for coordinated sharing.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

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

[i.1] ETSI TR 103 885 (V1.1.2): "Reconfigurable Radio Systems (RRS); Feasibility study on existing spectrum sharing frameworks for temporary and flexible spectrum access".

3 Definition of terms, symbols, and abbreviations

3.1 Terms

Void.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

dB	decibel
dBm	decibel-milliwatt
dBm/kHz	decibel-milliwatt per kilohertz
f_c	center frequency
GHz	gigahertz
h	hour
kHz	kilohertz
MHz	megahertz
m	meter
min	minute
mW	milliwatt

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AFC	Automated Frequency Coordination
B	channel Bandwidth
CBRS	Citizens Broadband Radio Service
CDB	Certified S3D-Installer Data Base
CR	Coordination Requirement
CSI	Certified S3D-Installer
CSI-ID	Certified S3D-Installer Identifier
DGR	shared spectrum service Device General Requirement
DL	Downlink
DSAS	Dynamic Spectrum Allocation Service
DSQ	shared spectrum service Device Security Requirement
EIRP	Effective Isotropic Radiated Power
eLSA	evolved Licensed Shared Access
FR	Functional Requirement
GB	Guard Band
I/N	Interference to Noise ratio
INC	Inter-system Coordination
IRC	Intra-system Coordination
NPU	Non-Primary User
NRA	National Regulatory Administration
OOB	Out-Of-Band
OP	Operational Parameter
PU	Primary User

QoS Quality of Service
RF Radio Frequency
S3D Spectrum Sharing Service Device
SAS Spectrum Access System
SDB Spectrum Data Base
SDB-L1 Spectrum Data Base Level 1
SDB-L2 Spectrum Data Base Level 2
SDB-L3 Spectrum Data Base Level 3SGR DSAS System General Requirement
SGR DSAS system general requirement
SNP DSAS System Non-primary user Protection
SPP DSAS System Primary user Protection
SSQ DSAS System Security Requirement
TR Technical Requirement
UL Uplink

4 Requirement organization

4.1 Requirement organization

Requirements shall be uniquely identified by: <TYPE>R-<COORDINATION>-<CATEGORY>-<XX>-<Y> with:

- <TYPE>: identifier of the requirement type.

Table 1: Requirements type

Code	Requirement type
F	Functional requirement
T	Technical requirement

- <COORDINATION>: identifier of the coordination approach.

Table 2: Coordination approach

Code	Coordination approach
INC	Inter-system coordination
IRC	Intra-system coordination

- <CATEGORY>: categorization of the requirement by using a three-digit code from Table 3.

Table 3: Requirements categorization

Code	Category
DGR	Shared spectrum service device general requirement
DSQ	Shared spectrum service device security requirement
SGR	DSAS system general requirement
SSQ	DSAS system security requirement
SPP	DSAS system primary user protection
SNP	DSAS System Non-primary user Protection

- <XX>: unique number to identify the requirement.
- <Y>: optional and used to identify subordinate requirements, typically captured in an alphabetical list.

5 System overview

5.1 System functional architecture

An overview of the functional architecture of a DSAS system is shown in Figure 1. It includes related interfaces that need to be specified, such as DSAS-SDB interface between DSAS and Spectrum Data Base (SDB), DSAS-S3D interface between DSAS and Shared Spectrum Service Device (S3D), DSAS-CDB interface between DSAS and the data base of Certified S3D-Installers (CDB), as well as an arbitrary interface that is not in scope of the present document. There may be cases where a link to multiple SDBs is required, e.g., in national border areas. This should also be supported.

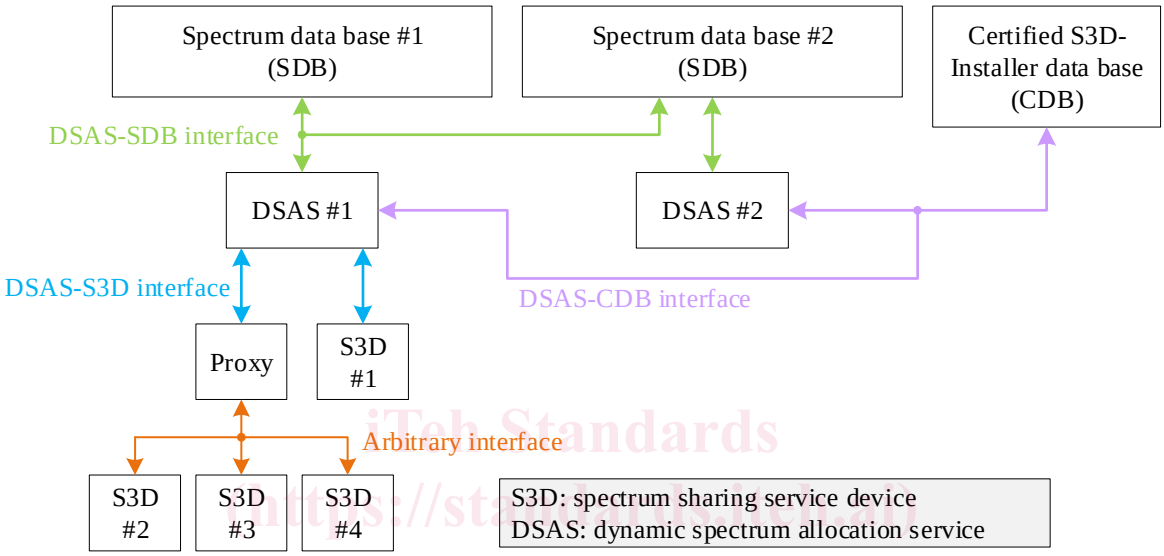

Figure 1: Functional architecture for spectrum sharing

The DSAS is located between the end user (here S3D) and the two data bases SDB and CDB and provides information on the available spectrum including its restrictions to the end user and determines the validity of the S3D license.

5.2 Spectrum Data Base (SDB)

Each DSAS shall be connected to at least one SDB, connections to multiple SDBs can be required in case of e.g. cross-national operation.

In general, the SDB supports the following different levels:

- a first level containing information on the relevant primary users (SDB-L1):
  - required for protecting the PUs (INC).
- a second level containing information on the temporarily active non-primary users (SDB-L2):
  - required only in case of coordinating the NPUs (IRC) otherwise optional;
  - possible implementation of SDB-L2 could be a logical function within the DSAS (hence enabling a DSAS to DSAS interface).
- a third level containing additional information on the PUs and/or NPUs, e.g. antenna patterns, operating time (SDB-L3):
  - optional;
  - possible implementation of SDB-L3 could be a logical function within the DSAS.

Figure 2 depicts this approach. Each of these levels can have several instances, e.g. there could be a second level SDB for each region.

Every second level SDB needs to be registered at the corresponding NRA who stores this information in the first level SDB. The sequence of steps (step 1 to step 5) in the communication flow between SDB and DSAS is shown in Figure 3. Depending on the number of existing first and second level SDBs step 1 to step 5 has to be repeated accordingly. Like the three levels of SDB the interface between DSAS and SDB is divided into three parts:

- level 1 interface: read-only access to SDB-L1;
- level 2 interface: read-write access to SDB-L2;
- level 3 interface: read-only access to SDB-L3.

The first level of SDB is always mandatory, the second level is mandatory only if IRC is supported to enable coordination of NPUs and to calculate aggregate interference, the third level is optional.

National Regulatory Administrations (NRA) may be responsible to manage and update the first level SDB using a centralized data base. The second level SDB as well as the third level SDB could be also implemented in a centralized data base managed by NRA or a third party, or could be realized as a decentralized approach, i.e. it contains only information on the locally active NPUs e.g. as part of the local DSAS, or as local stand-alone data base managed by a service provider.

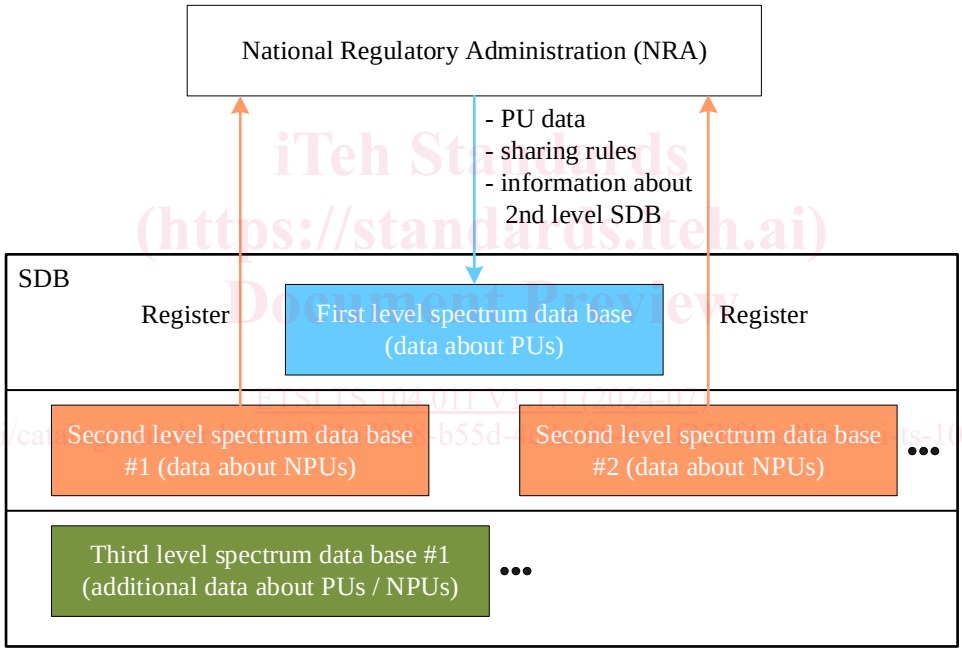

Figure 2: 3-level architecture of the SDB