



**Reconfigurable Radio Systems (RRS);  
Information elements and protocols for the interface  
between LSA Controller (LC) and LSA Repository (LR)  
for operation of Licensed Shared Access (LSA)  
in the 2 300 MHz - 2 400 MHz band**

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# Contents

Intellectual Property Rights .....	5
Foreword.....	5
Modal verbs terminology.....	5
1 Scope .....	6
2 References .....	6
2.1 Normative references .....	6
2.2 Informative references.....	6
3 Definitions and abbreviations.....	7
3.1 Definitions.....	7
3.2 Abbreviations .....	7
4 LSA Spectrum Resource Availability Information: Description and Supported Functionality on LSA <sub>1</sub> .....	8
4.1 Introduction .....	8
4.2 LSRAI Scope.....	8
4.3 LSRAI Definition.....	8
4.4 LSRAI Handling Functionality .....	9
4.4.1 Introduction.....	9
4.4.2 LR Support.....	9
4.5 LSRAI Context.....	9
4.6 LSRAI Synchronization .....	10
4.7 LSRAI Confirmation.....	10
4.8 LC Handling of non-impacting Zones.....	11
5 LSA <sub>1</sub> Protocol Principles.....	11
5.1 Specification Notation.....	11
5.2 LSA <sub>1</sub> Protocol Procedures.....	11
5.3 Identification of procedures and messages.....	12
5.4 Procedure Outcome .....	12
5.5 Principles for Protocol Development and Version Interworking .....	12
5.6 Message Encoding and IE attributes .....	13
5.7 Overview of the protocol specification .....	13
6 LSA <sub>1</sub> Protocol: Procedures and Messages .....	13
6.1 Registration procedure .....	13
6.1.1 General.....	13
6.1.2 REGISTRATION REQUEST .....	14
6.1.3 REGISTRATION RESPONSE .....	14
6.2 Deregistration procedure .....	15
6.2.1 General.....	15
6.2.2 DEREGISTRATION REQUEST .....	16
6.2.3 DEREGISTRATION RESPONSE.....	16
6.3 Connectivity Check Notification procedure .....	16
6.3.1 General.....	16
6.3.2 CONNECTIVITY CHECK NOTIFICATION .....	17
6.3.3 CONNECTIVITY CHECK NOTIFICATION ACK.....	17
6.4 Connectivity Check Request procedure .....	17
6.4.1 General.....	17
6.4.2 CONNECTIVITY CHECK REQUEST .....	18
6.4.3 CONNECTIVITY CHECK RESPONSE .....	18
6.5 LSRAI Notification procedure .....	19
6.5.1 General.....	19
6.5.2 LSRAI NOTIFICATION.....	20
6.5.3 LSRAI NOTIFICATION ACK .....	20
6.6 LSRAI Request procedure.....	20
6.6.1 General.....	20

6.6.2	LSRAI REQUEST .....	21
6.6.3	LSRAI RESPONSE .....	22
6.7	LSRAI Confirmation procedure .....	22
6.7.1	General .....	22
6.7.2	LSRAI CONFIRMATION REQUEST .....	23
6.7.3	LSRAI CONFIRMATION RESPONSE .....	23
7	LSA <sub>1</sub> Protocol: Information Elements .....	23
7.1	LSRAI .....	23
7.2	Zone Description .....	24
7.3	Zone Type .....	24
7.4	Zone Action .....	25
7.5	Frequency .....	25
7.6	Radio Constraints .....	25
7.6.1	Introduction .....	25
7.6.2	Radio Constraints parameters .....	25
7.6.3	Radio Constraints profiles .....	26
7.7	Space .....	26
7.8	Time .....	27
7.9	Synchronization Information .....	27
7.10	Synchronization Ack Information .....	27
7.11	Circle .....	27
7.12	Polygon .....	28
7.13	Area Descriptor .....	28
7.14	Geographical coordinates .....	28
7.15	Frequency value .....	29
7.16	Periodic .....	29
7.17	Aperiodic .....	29
7.18	Time .....	30
7.19	Day Schedule .....	30
7.20	Week Schedule .....	30
7.21	Month Schedule .....	31
7.22	Year Schedule .....	31
7.23	Time of Day .....	31
7.24	Time of Week .....	32
7.25	Time of Month .....	32
7.26	Time of Year .....	32
7.27	Confirmed Zone List .....	32
7.28	Zone Confirmation .....	33
7.29	Zone Configuration Index .....	33
7.30	Message Type .....	33
7.31	Transaction ID .....	34
7.32	LR ID .....	34
7.33	LC ID .....	34
7.34	Licensee ID .....	34
7.35	Result .....	34
7.36	Sync ID .....	35
7.37	Sync Zone List .....	35
7.38	Synched Zone .....	35
7.39	Cause .....	36
7.40	Zone ID .....	37
7.41	Protocol Version List .....	38
7.42	Protocol Version .....	38
	<b>Annex A (informative): Change History .....</b>	<b>39</b>
	History .....	40

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## Foreword

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

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## Modal verbs terminology

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# 1 Scope

The present document defines the application protocol on the LSA<sub>1</sub> interface, between LSA Controller (LC) and LSA Repository (LR) [i.2] (LSA<sub>1</sub> protocol), and the content of the LSA Spectrum Resource Availability Information (LSRAI) conveyed by this protocol. It is based on the System Requirements defined in ETSI TS 103 154 [i.1] and the System Architecture and High Level Procedures defined in ETSI TS 103 235 [i.2].

The present document supports the operation of mobile broadband service in the 2 300 MHz - 2 400 MHz band under Licensed Shared Access (LSA), aimed at enabling access for mobile/fixed communication networks (MFCNs) in those CEPT countries where access to the band is foreseen but cannot be provided without restrictions due to Incumbent usage, as documented in ETSI TR 103 113 [i.3]. Application to other bands is not precluded and depends on future regulatory decisions.

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## 2 References

### 2.1 Normative references

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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 TS 103 154: "Reconfigurable Radio Systems (RRS); System requirements for operation of Mobile Broadband Systems in the 2 300 MHz - 2 400 MHz band under Licensed Shared Access (LSA)".
- [i.2] ETSI TS 103 235: "Reconfigurable Radio Systems (RRS); System architecture and high level procedures for operation of Licensed Shared Access (LSA) in the 2 300 MHz - 2 400 MHz band".
- [i.3] ETSI TR 103 113 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference document (SRdoc); Mobile broadband services in the 2 300 MHz - 2 400 MHz frequency band under Licensed Shared Access regime".
- [i.4] ECC Report 205 (February 2014): "Licensed Shared Access (LSA)".
- [i.5] CEPT Report 58 (July 2015): "Technical sharing solutions for the shared use of the 2300-2400 MHz band for WBB and PMSE".

## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**idle zone:** zone which has been defined but which is not currently operational

**LSA Licensee:** entity operating a MFCN, which holds individual rights of use to an LSA spectrum resource

**LSA spectrum resource:** spectrum resource which is to be shared between an Incumbent and a LSA Licensee on a static or dynamic basis according to the Sharing Framework defined by the Administration/NRA

**LSA spectrum resource availability information:** information provided to a Licensee, which conveys the LSA spectrum resource that may be used by the Licensee, and the respective operational conditions or restrictions

**LSRAI context:** set of zones and their parameters that are to be maintained by the nodes (LC and LR) in an instance of the LSA<sub>1</sub> interface

**LSRAI synchronization process:** process to synchronize the LSRAI context between LC and LR

**operational zone:** zone to be taken into account by the Licensee, when making use of the LSA spectrum resource

**sharing arrangement:** set of practical details for sharing an LSA spectrum resource

**sharing framework:** set of sharing rules or sharing conditions that will materialize the change, if any, in the spectrum rights of the Incumbent(s) and define the spectrum, with corresponding technical and operational conditions, that can be made available for alternative usage under LSA

**spectrum resource:** resource or set of resources defined in time, space and frequency domains

### 3.2 Abbreviations

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

ACLR	Adjacent Channel Leakage power Ratio
ACS	Adjacent Channel Selectivity
ECC	Electronic Communications Committee of the CEPT
EIRP	Equivalent Isotropic Radiated Power
IE	Information Element
LC	LSA Controller
LR	LSA Repository
LSA	Licensed Shared Access
LSRAI	LSA Spectrum Resource Availability Information
MFCN	Mobile/Fixed Communications Network
NRA	National Regulatory Authority
PMSE	Program Making and Special Events
RF	Radio Frequency
UTC	Co-ordinated Universal Time

## 4 LSA Spectrum Resource Availability Information: Description and Supported Functionality on LSA<sub>1</sub>

### 4.1 Introduction

Clause 4 contains a high level description of the LSA Spectrum Resource Availability Information (LSRAI), and LSRAI-related functionality supported by the nodes (LC and LR), and the interface (LSA<sub>1</sub>). This clause expands the related material in the stage 2 specification of ETSI TS 103 235 [i.2], and describes detailed requirements for the LSA<sub>1</sub> protocol and its operation.

### 4.2 LSRAI Scope

LSA Spectrum Resource Availability Information (LSRAI) is information provided to a LSA Licensee, which conveys information on the LSA spectrum resource that may be used by the LSA Licensee. As described in ETSI TS 103 235 [i.2], LSRAI is generated in the LR, and sent to the LC over the LSA<sub>1</sub> interface, using LSA<sub>1</sub> protocol messages.

Under LSA operation ECC Report 205 [i.4], it is assumed that the terms of a license will contain a description of the spectrum resource which is allocated to the respective LSA Licensee, and therefore such information is not required to be conveyed over LSA<sub>1</sub> as part of LSRAI. LSRAI therefore includes any additional operational conditions or restrictions that the Licensee shall apply, and which may be subject to change.

NOTE: It is a deployment choice whether permanent restrictions contained in the sharing framework or sharing arrangement, ETSI TS 103 154 [i.1], are conveyed to the LC as part of LSRAI.

The conditions or restrictions within LSRAI may apply to the licensed spectrum resource, or to a subset (described in frequency, space, time or a combination of these).

### 4.3 LSRAI Definition

LSRAI has the following characteristics:

- It contains one or more *Zones*. A *Zone* is an information object which describes a set of operational conditions or restrictions to be applied by the LSA Licensee.
- A *Zone* has a *Zone Type* associated to it (e.g. restriction, protection, exclusion).
- A *Zone* contains space, frequency, radio and time parameters:
  - Space parameters describing the geographical area to which the restriction applies.
  - Frequency parameters describing the frequency range to which the restriction applies.
  - Time parameters describing when the restriction applies.
  - Radio parameters describing the RF restrictions to be applied within the space/frequency/time combination defined by the above parameters.
- A *Zone* has a *Zone ID* and a *Zone Configuration Index* associated to it.

NOTE: When LSRAI is conveyed over the LSA<sub>1</sub> interface, each *Zone* is associated to a *Zone Action*.



## 4.4 LSRAI Handling Functionality

### 4.4.1 Introduction

As described in ETSI TS 103 235 [i.2], the LSA Information Exchange Function supports communication mechanisms to exchange LSRAI and related acknowledgement information between LR and LC. Clauses 4.4.2 and 4.4.3 further specify the related functional split between LR and LC in support of this high level function.

### 4.4.2 LR Support

The LR supports the LSA Information Exchange Function by:

- Constructing zone information including type and parameters for each Zone.
- Assigning a *Zone ID*, which uniquely identifies a Zone over all instances of the LSA<sub>1</sub> interface for a given LR.
- Assigning a *Zone Configuration Index*, which uniquely identifies the particular configuration (set of zone parameters).
- Conveying the zone information towards concerned LCs.
- Monitoring the status of LSRAI conveyed to the LC (e.g. per-zone acknowledgment and confirmation).
- Conveying a modification of Zone parameters towards the LC (with corresponding *Zone Configuration Index*).
- Conveying deletion of a Zone towards the LC.
- Synchronizing LSRAI with the LC.

### 4.4.3 LC Support

The LC supports the LSA Information Exchange Function by:

- Receiving and acknowledging LSRAI (including checking of parameters).
- Confirming LSRAI.
- Synchronizing LSRAI with the LR.

## 4.5 LSRAI Context

The LSRAI Context is the complete set of zones and their parameters that are to be maintained by the nodes (LC and LR) in an instance of the LSA<sub>1</sub> interface. The LR determines the LSRAI Context and informs the LC of any changes in the Context due to creation, modification or deletion of zones.

When receiving zone information, the LC shall consider that:

- a zone with a *Zone Action* set to "Create" is to be added to the LSRAI Context (including its parameters);
- a zone with a *Zone Action* set to "Modify" is to be kept in the LSRAI Context (including modified parameter set);
- a zone with a *Zone Action* set to "Delete" is to be removed from the LSRAI Context.

There is no relationship between the current status of a zone (idle/operational), and whether the zone is part of the LSRAI Context. The LSRAI Context may therefore include both idle and operational zones at any moment in time.

NOTE: The LR may define a zone in such a way that it is idle (at the time that it is conveyed to the LC), and has no future idle-operational transition. During operation of the LSA<sub>1</sub> interface, the LR may modify the time parameters of the zone such that it will trigger an idle-operational transition at any desired point in time.

## 4.6 LSRAI Synchronization

As described in ETSI TS 103 235 [i.2], see e.g. clause 5.6.4, the LSA Information Exchange Function supports means for maintaining and restoring LSRAI Synchronization between LR and LC.

In the present document, LSRAI Synchronization is the process by which it is ensured that the LR provides the LSRAI context to the LC. An LSRAI Synchronization process may be triggered by either LC or LR. The provision of the LSRAI Context towards the LC uses the LR-initiated LSRAI Notification procedure (clause 6.5). The LSRAI Context may optionally be segmented over two or more instances of this procedure.

All procedures that are part of an LSRAI Synchronization process shall be identified by a specific synchronization process identity.

An LSRAI Synchronization process may be used to reset the LSRAI Context at the LC. In the case of LSRAI Synchronization with context reset, the LC shall immediately replace the LSRAI Context with the newly received context, and shall consider that all zones in the LSRAI Context require confirmation [i.2]. If no context reset is requested by the LR, the LC:

- shall use the information received to update the local LSRAI Context at the LC;
- shall consider that any existing zones not included in the received LSRAI Context are implicitly deleted;
- shall consider that confirmations are required for new or modified zones.

Once an LSRAI Synchronization process is initiated, any existing LSRAI-handling procedures shall be considered terminated. A node receiving an initiating message for a LSRAI-handling procedure while an LSRAI Synchronization process is ongoing shall fail such procedure with an appropriate cause e.g. "Synchronization ongoing", except if the new procedure indicates the initiation of a new LSRAI Synchronization process. In this case, the old LSRAI Synchronization process shall be considered to have been unsuccessfully terminated.

## 4.7 LSRAI Confirmation

As described in ETSI TS 103 235 [i.2], the LSA Information Exchange Function supports means for the LC to notify the LR once the necessary configuration changes in the MFCN have been applied according to the received LSRAI. This process is known as LSRAI Confirmation.

The LC shall explicitly provide confirmation for each zone within the LSRAI Context. Each zone shall be confirmed at least once. If the configuration of an existing zone is modified, the LC shall consider that a further confirmation is required for the zone (regardless of whether it had been previously confirmed, and regardless of the modification details). In order to identify the configuration that is confirmed, the LC shall include both the Zone ID and the Zone Configuration Index within the confirmation signalling.

If the LC receives a new or modified zone whose time configuration is such that the zone is operational at the time of reception, the LC shall consider that configurations changes shall be applied, if needed, and the corresponding confirmation shall be sent to the LR.

In the case of a zone whose time configuration includes multiple operational periods (i.e. scheduled or periodic zones), the LC shall provide confirmation at least once (in connection with its first operational period), and shall also provide confirmation after any modification (in connection with the first subsequent operational period after the modification is received by the LC). The LC is not required to provide confirmation for each idle-operational transition.

Confirmation may also be used by the LC to inform the LR that the configuration changes cannot be implemented ("negative confirmation").

**NOTE:** Confirmation messages may be sent by the LC more than once for a given combination of *Zone ID* and *Zone Configuration Index* (e.g. in the case of scheduled or periodic zones, an initial positive confirmation is sent by the LC; later the MFCN is not able to comply with a subsequent operational period, and a negative confirmation is sent). In all cases, the confirmation status of the last received message overwrites any previously received information.

For a particular zone, the time when the respective confirmation is sent depends on the timing of the required idle-operational transition for the zone, the timing of the change of configuration, and any associated requirements specific to the Sharing Framework or Sharing Arrangement.

Protocol confirmation messages support simultaneous confirmation of multiple zones. The multiplexing of zone confirmations is independent of the multiplexing of zones (and respective information) as previously sent by the LR towards the LC.

## 4.8 LC Handling of non-impacting Zones

The LC may receive a zone configuration such that the LC has identified that no MFCN resource is impacted by the zone. The LC shall however consider that the zone (and its information) forms part of the LSRAI Context.

The LC shall also act as if the necessary configuration changes have been applied, by sending an associated confirmation for any such zone towards the LR.

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# 5 LSA<sub>1</sub> Protocol Principles

## 5.1 Specification Notation

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

Procedure	When referring to an elementary procedure in the specification the Procedure Name is written with the first letters in each word in upper case characters followed by the word "procedure", e.g. LSRAI Notification procedure.
Message	When referring to a message in the specification the MESSAGE NAME is written with all letters in upper case characters followed by the word "message", e.g. LSRAI NOTIFICATION ACK message.
IE	When referring to an information element (IE) in the specification the Information Element Name is written with the first letters in each word in upper case characters and all letters in Italic font followed by the abbreviation "IE", e.g. <i>Space</i> IE.
Value of an IE	When referring to the value of an information element (IE) in the specification, the value is written enclosed by quotation marks, e.g. "Value".

## 5.2 LSA<sub>1</sub> Protocol Procedures

The LSA<sub>1</sub> protocol procedures are classified in the following categories:

- 1) LSRAI handling Procedures
- 2) Interface management procedures

The LSRAI handling procedures are those procedures whose primary function is to convey LSRAI, or to exchange information directly related to the provision of LSRAI (e.g. confirmations).

The interface management procedures are those procedures whose primary function is to set up, maintain or discontinue an LSA<sub>1</sub> interface instance.

Tables 5.2-1 and 5.2-2 show the procedures and messages for each category:

**Table 5.2-1: LSRAI Handling Procedures**

LSA <sub>1</sub> Protocol Procedure	Initiating Message	Response Message
LSRAI Notification	LSRAI NOTIFICATION	LSRAI NOTIFICATION ACK
LSRAI Request	LSRAI REQUEST	LSRAI RESPONSE
LSRAI Confirmation	LSRAI CONFIRMATION REQUEST	LSRAI CONFIRMATION RESPONSE

**Table 5.2-2: Interface Management Procedures**

LSA <sub>1</sub> Protocol Procedure	Initiating Message	Response Message
Registration	REGISTRATION REQUEST	REGISTRATION RESPONSE
Deregistration	DEREGISTRATION REQUEST	DEREGISTRATION RESPONSE
Connectivity Check Notification	CONNECTIVITY CHECK NOTIFICATION	CONNECTIVITY CHECK NOTIFICATION ACK
Connectivity Check Request	CONNECTIVITY CHECK REQUEST	CONNECTIVITY CHECK RESPONSE

### 5.3 Identification of procedures and messages

Each message defined in the LSA<sub>1</sub> protocol (as listed in the tables of clause 5.2) includes a specific *Message Type IE*, allowing the receiver to identify the general procedure and message.

Each procedure instance is identified by a *Transaction ID IE*, which is mandatory in all messages of the LSA<sub>1</sub> protocol. The value of this IE is set by the node that initiates the procedure, and the same value shall be used by the responding node in the response message. The initiating node shall not assign this value to a new procedure during the period of execution of the original procedure.

### 5.4 Procedure Outcome

The node that receives the initiating message shall process the message and its IEs according to the requirements in clauses 6 and 7, and shall include in the response message an indication of whether it considers the procedure to be successful or unsuccessful.

The node that initiates the procedure shall also consider the procedure to be unsuccessful if it receives an unsuccessful indication from the receiver node, and in addition it may consider the procedure to be unsuccessful according to criteria such as:

- lack of response message after an implementation-dependent timer;
- response message indicates success, but IEs in the response message contain errors or are inconsistent with successful processing.

Subsequent to a procedure failure, the action from the initiating node is generally implementation dependent, except where specified in the present document or in ETSI TS 103 235 [i.2].

### 5.5 Principles for Protocol Development and Version Interworking

The LSA<sub>1</sub> protocol may be further developed in future specifications. Each new version will be distinguished by a version number. Protocol versions shall be sequentially numbered starting with V1 defined in the present document.

Table 5.5-1 provides the relationship between versions and specifications.

**Table 5.5-1: Relationship between LSA<sub>1</sub> protocol versions and respective ETSI specifications**

Version Number	ETSI Specification
Version 1	ETSI TS 103 379 (V1.1.1)

Backward compatibility between protocol versions shall not be guaranteed. A protocol peer supporting Version N of the protocol may (but is not mandated to) support lower numbered versions of the protocol (N-1, N-2, etc.). Interworking between protocol peers is based on explicitly negotiating the protocol version to be used in the specific LSA<sub>1</sub> instance. This negotiation takes place during the Registration procedure. During this procedure:

- The LC provides a list of supported versions in the initial REGISTRATION REQUEST message.