ETSI TS 103 154 V1.1.1 (2014-10)

TECHNICAL SPECIFICATION

**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)**

Reference
DTS/RRS-0121

Keywords
BWA, radio, requirements

ETSI

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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**", "**may not**", "**need**", "**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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1 Scope

The present document defines system requirements for operation of mobile broadband service in the 2 300 - 2 400 MHz band under Licensed Shared Access (LSA). This band is allocated to the Mobile Service and identified for IMT globally in the ITU Radio Regulations. The objective of LSA is to enable access to this band for mobile/fixed communication networks (MFCNs) in those CEPT countries where access to the band is complex due to Incumbent usage, as documented in ETSI TR 103 113 [i.1] (for example, when it is not viable to "refarm" the band in a timely manner [i.2]).

An LSA system comprises one or more Incumbents, one or more MFCNs (LSA Licensees), and the means to enable coordination between Incumbents and LSA Licensees, such that the latter may deploy their networks without harmful interference. The requirements in the present document are intended as a first step towards the definition of LSA System architecture specifications.

2 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 reference document (including any amendments) applies.

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

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2.1 Normative references

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

Not applicable.

2.2 Informative references

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 103 113 (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.2] ECC Report 205: "Licensed Shared Access (LSA)", February 2014.
>
> [i.3] RSPG Opinion on Licensed Shared Access, RSPG13-538, November 2013.

3 Definitions and abbreviations

3.1 Definitions

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

exclusion zone: geographical area within which LSA Licensees are not allowed to have active radio transmitters

> NOTE: An exclusion zone is normally applicable for a defined frequency range and time period.

incumbent: current holder of spectrum rights of use

NOTE: This definition follows the RSPG opinion on LSA [i.3].

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 system: system that enables and/or facilitates the realization of LSA, and which comprises the LSA-specific technical features, architecture, protocols, and interfaces

LSA system administrator: entity responsible for system administration aspects (e.g. implementing security access rights or executing system management tasks)

protection zone: geographical area within which Incumbent receivers will not be subject to harmful interference caused by LSA Licensees' transmissions

NOTE: A protection zone is defined using specific measurement quantities and thresholds (e.g. a mean field strength that does not exceed a defined value in dBμV/m/MHz at a defined receiver antenna height above ground level). A protection zone is normally applicable for a defined frequency range and time period.

restriction zone: geographical area within which LSA Licensees are allowed to operate radio transmitters, under certain restrictive conditions (e.g. maximum EIRP limits and/or constraints on antenna parameters)

NOTE: A restriction zone is normally applicable for a defined frequency range and time period.

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

NOTE: This definition follows ECC Report 205 [i.2].

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:

3GPP	3rd Generation Partnership Project
CEPT	Conférence des administrations Européennes des Postes et Télécommunications
ECC	Electronic Communications Committee of the CEPT
ECS	Electronic Communications Services
EIRP	Effective Isotropic Radiated Power
EU	European Union
IMT	International Mobile Telecommunications (also IMT- Advanced)
ITU	International Telecommunications Union
LSA	Licensed Shared Access
LTE	Long Term Evolution
MFCN	Mobile/Fixed Communications Network
MS	Mobile (subscriber) Station
NRA	National Regulatory Authority
PMSE	Programme Making and Special Events
RSPG	Radio Spectrum Policy Group
TOC	Table of Contents
TS	Terminal Station

4   Requirement Organization and Methodology

This clause contains a description of how the requirements are organized and the format of the requirement.

4.1   Requirement Organization

As shown in Figure 4.1, the requirements described in the present document belong to two different categories: the functional requirements and the performance requirements. Each category, in turn, is organized into groups.
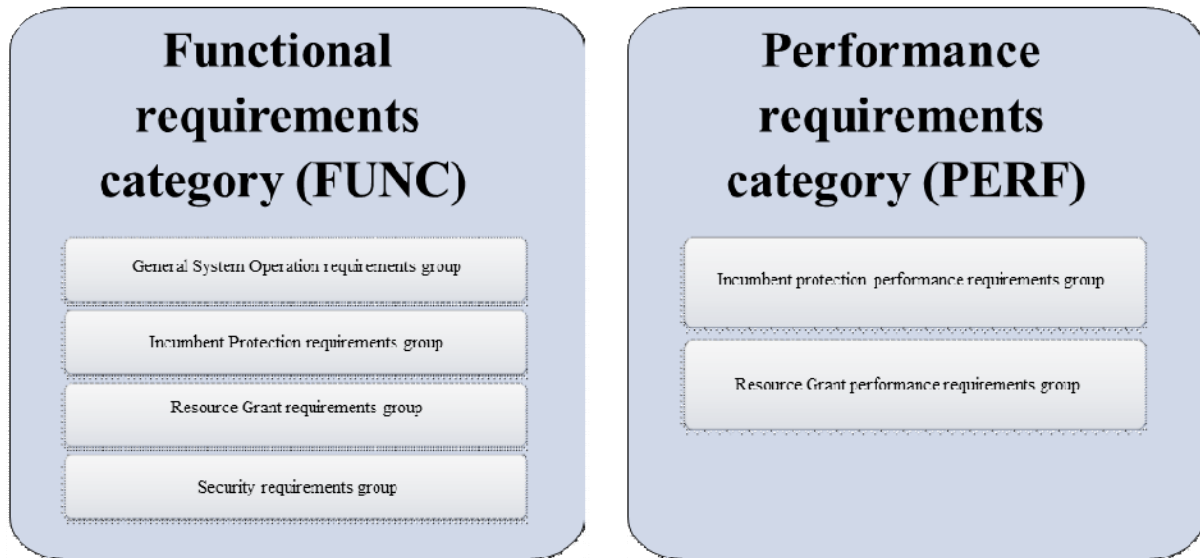
Figure 4.1: Requirements Organization

4.2   Requirement Format

A letter code system is defined which makes a unique identification of each requirement R-<CAT>-<GROUP>-<XX>. It should be constructed as follows:

- R-   : Standard requirement prefix

- <CAT>:

Code	Category
FUNC	Functional aspects
PERF	Performance aspects

- <GROUP>:Requirement group identifier. A three-letter code will be used for this identifier.

- <XX>   :   Requirement identifier within requirement group; range 01 => 99.

EXAMPLE: R-FUNC-GEN-01.

4.3   Requirement Formulation

A requirement is formulated in such a way that it is uniquely defined. It is built as follows:

Title: <Title Description>

Description: the description of a requirement will be formulated using one of the following terms:

- "shall" is used to express mandatory requirements (i.e. provisions that have to be followed)

- "should" is used to express recommendations (provisions that an implementation is expected to follow unless there is a strong reason for not doing so)

- "may" is used to express permissible actions (provisions that an implementation is able to follow or not follow)

4.3.1   LSA Roles

Requirements are formulated in regards of the "LSA System" and make use of generic "LSA roles", as shown in Figure 4.2.
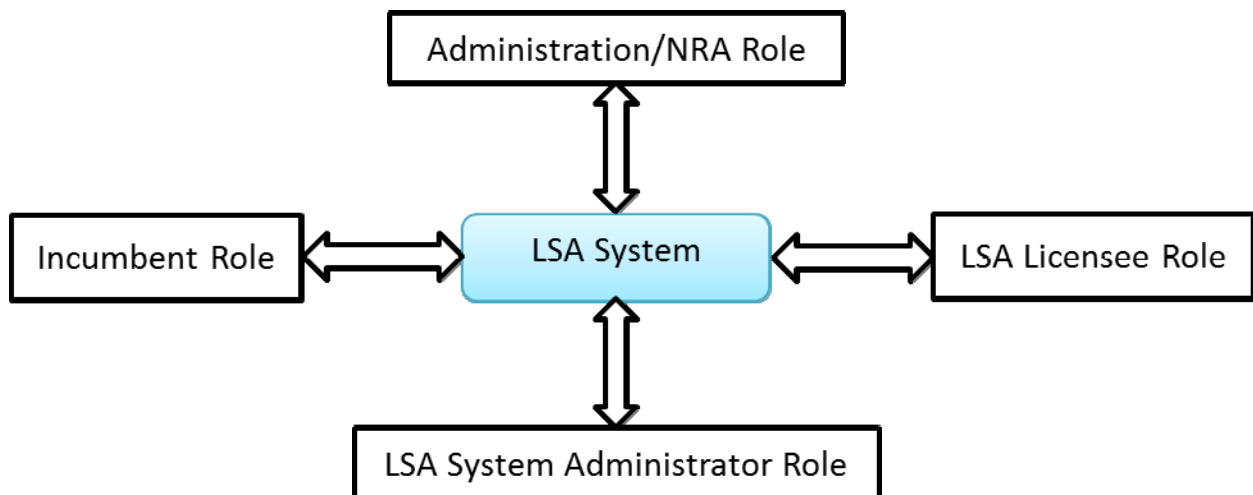
Figure 4.2: LSA Roles

Roles are abstracted concepts defined for requirement formulation; in specific deployments, roles will be performed by specific entities (e.g. the LSA Licensee role would be performed by a MFCN operator in the 2 300 - 2 400 MHz band). In addition, multiple roles may be performed by the same entity (e.g. the Administration/NRA may perform also the LSA System Administrator role).

Each of the roles may interact with the LSA System, and may also interact with each other via the LSA System.

There may be multiple instances of a given role in respect of a particular requirement.

5   Working Assumptions

The working assumptions described below are based on ETSI TR 103 113 [i.1], and particularly the use case "Bandwidth Expansion for Mobile Network Operator" in clause 7.1.2 of [i.1], as well as the ECC Report 205 [i.2] and the RSPG opinion on LSA [i.3].

5.1   Regulatory Background

It is assumed that, prior to implementation of LSA, the 2 300 - 2 400 MHz frequency band (or a sub-band) is used by one or more non-IMT services, provided by current holder(s) of spectrum rights of use. LSA provides for some administrations a solution to enable access to the 2 300 - 2 400 MHz frequency band for MFCN and impacts the national allocation of a frequency band.

The Sharing Framework is the central piece for the implementation of LSA at national level. It will define for a given frequency band the spectrum, with corresponding technical and operational conditions, that can be made available for LSA. National administrations should decide which existing applications need to be considered as Incumbents within the Sharing Framework and maintained in the long term according to national policy objectives, and taking into account international obligations and community law in the case of EU Member States.

It is further assumed that one or more MFCN operators ("LSA Licensees") are subsequently granted individual rights to use distinct portions of the Incumbent's spectrum resource (authorizations) [i.2]. Sharing rules should be part of the corresponding licenses granted by the Administration/NRA, thus reinforcing the legal certainty to the parties, and in particular to the Incumbents. The LSA Licensees are allowed to use the spectrum resource in accordance with such rules included in their rights of use, thereby allowing all the authorized users, including Incumbents, to provide a certain QoS [i.3].

The Sharing Framework [i.2] would be established under the responsibility of the Administration/NRA (following consultations involving key stakeholders); the Administration/NRA is further expected to issue the individual authorizations to LSA Licensees, and may have a role in monitoring spectrum use, and validating that such use is compliant with the individual right of use, including the Sharing Framework.

5.2   Spectrum Sharing Arrangement

The set of practical details for a given LSA spectrum resource is referred to in the present document as a Sharing Arrangement. A Sharing Arrangement may be subject to change, but it should remain consistent with the Sharing Framework defined by the Administration/NRA and the obligations placed in the "Authorization" Directive for assigning spectrum resource for the delivery of Electronic Communication Services (ECS).

LSA spectrum resource sharing may in general be dynamic, i.e. the requirements of the Incumbent may be such that some portions of the spectrum are not permanently available to the LSA Licensee in any given location. However, a particular Spectrum Sharing Arrangement may include constraints on the potential variations of resource availability (e.g. to facilitate implementation or operability). Examples of such constraints are given below, noting that a particular Sharing Arrangement may include a combination of multiple constraints:

- Changes in the spectrum resource availability may only occur at pre-set times (e.g. periodic)

- There may be minimum allowed intervals between successive changes (in general or affecting a given area)

- Spectrum resource availability may be pre-configured (only a finite set of possible combinations in space/frequency is allowed)

- Changes may not be allowed if they violate certain statistical criteria (e.g. overall availability of a certain resource in a given time frame)

It is assumed that an LSA Licensee is granted individual rights of use by the relevant NRA. This implies that the LSA System will provide means to guarantee coexistence between Incumbents and LSA Licensees in general, but there is no special need to handle coexistence between LSA Licensees beyond normal deployment requirements (such as deployment of adjacent band users in same area, or same-band users in adjacent areas).

It is assumed that Incumbents and LSA Licensees not involved in a particular Sharing Arrangement will not get access permission to the respective LSA spectrum resource and will not receive information on the designated LSA spectrum resource.

5.3   LSA System Administration by Trusted 3rd Party Users

It is assumed that the LSA System or part(s) thereof may be administered by trusted 3rd party user(s) with defined access rights.

6   Functional System Requirements

6.1   General System Operation

This clause comprises functional requirements that relate to the general system operation.

6.1.1   R-FUNC-GEN-01 LSA Spectrum Resource Sharing

The LSA System shall support flexible spectrum resource sharing in the 2 300 - 2 400 MHz frequency band (or a sub-band thereof) between the Incumbent(s), and a limited number of LSA Licensees (MFCNs), according to the applicable LSA Sharing Framework.

Explanation: In general, spectrum assigned to Incumbent(s), may be used by MFCNs according to the applicable LSA Sharing Framework. The LSA System will allow an LSA spectrum resource unused by the Incumbent (considering time, space and frequency domains) to be made available in a flexible manner to the MFCN, on a non-interfering basis.

6.1.2   R-FUNC-GEN-02 Quality of Service

The LSA System shall facilitate the provision of a predictable Quality of Service (QoS) for both Incumbents and LSA Licensees, whenever operation by a particular service is allowed by the system.

Explanation: The LSA System supports sharing on a non-interfering basis, meaning that the sharing systems will operate without causing harmful interference. Predictable QoS in this context means that a system can perform in a similar way to a non-sharing case, at the radio level.

6.1.3   R-FUNC-GEN-03 Information Exchange between Incumbent and LSA Licensee

The LSA System shall provide means for the exchange of information between an Incumbent, and an LSA Licensee to enable the LSA Licensee to be made aware of the LSA spectrum resource that is available for its use and its possible changes over time.

Explanation: Legacy sharing arrangements are typically made in a static fashion (e.g. a secondary user may use a certain portion of spectrum in a given area until told otherwise). In order for LSA spectrum resource sharing to occur in an efficient manner, the LSA System will include efficient interfacing between Incumbent and LSA Licensee to enable changes in the available LSA spectrum resource to be communicated to the Licensee.

6.1.4   R-FUNC-GEN-04 Multiple MFCN Support

The LSA System shall allow the Incumbent to interact with one or more LSA Licensees for spectrum sharing purposes.

Explanation: A single Incumbent user may communicate with multiple MFCNs to provide information on the LSA spectrum resource available to each. For example, an Incumbent may have usage rights for a 20 MHz band, and two MFCNs are authorized to use 10 MHz each (non-overlapping bands) as LSA Licensees. The information sent to each MFCN reflects the degree of Incumbent usage only, since the LSA System does not support contention between MFCNs. Each LSA Licensee has an individual authorization to use a particular LSA spectrum resource, subject to a suitable grant provided by the LSA System.

6.1.5   R-FUNC-GEN-05 Multiple Incumbent User Support

The LSA System shall allow an MFCN to interact with one or more Incumbents for spectrum sharing purposes.

Explanation: A particular MFCN may be authorized as an LSA Licensee of different LSA spectrum resources, each shared with a particular Incumbent. For example, it may have usage rights to two different sub-bands, each shared with a particular Incumbent.

6.1.6 R-FUNC-GEN-06 Sharing Framework Support

The LSA System shall support the use of a Sharing Framework as defined on national level.

Explanation: The Sharing Framework is described in the working assumptions (clause 5.1).

6.1.7 R-FUNC-GEN-07 Confidentiality of Spectrum Resource Information

The LSA System shall support mechanisms to ensure that, for a particular Sharing Framework, the information on the associated available LSA spectrum resource may only be accessed by the concerned Incumbent and LSA Licensee.

Explanation: The LSA System contains information as to which entity (the Incumbent or the LSA Licensee) is allowed to use the spectrum at any given time and in any given location. In general, an LSA Licensee should not have visibility into such information concerning LSA spectrum resource that pertains to another LSA Licensee, and the Incumbent should not have visibility of such information concerning another LSA spectrum resource that the LSA Licensee may use (i.e. shared with a different Incumbent).

6.1.8 R-FUNC-GEN-08 Provision of Failure Indication

The LSA System shall have means to provide failure indications to both the LSA Licensee and the Incumbent, following the detection of any critical system failure that may result in harmful interference.

Explanation: Under some circumstances, failures may occur which prevent normal operation of the LSA System. A simple example of this would be the case where information provided by the Incumbent is no longer available to functions that process this information. Regardless of how such failures are detected (which may be implementation dependent), the LSA System is able to notify both the LSA Licensee and the Incumbent, so that appropriate action may be taken. Such action is expected to be defined within the sharing arrangement between Incumbent and LSA Licensee, and may consist of reverting to a default mode of operation by both parties if e.g. the failure is not cleared within an agreed time.

Possible examples of this default mode include:

    (i)   LSA Licensee exits the LSA spectrum resource;

    (ii)   LSA Licensee continues to use the last-known available LSA spectrum resource; or

    (iii) LSA Licensee operates on the basis that a certain pre-agreed LSA spectrum resource is available.

6.1.9 R-FUNC-GEN-09 LSA System Data Storage Function

The LSA System shall support the entry, storage and modification of information required for LSA operation.

Explanation: The LSA System supports receiving and maintaining information required for the operation of LSA, including LSA spectrum resource definitions, sharing rule definitions (from the Sharing Framework, the individual right of use, and the associated specific sharing arrangements), and information describing the LSA spectrum resource which is requested to be reserved for the Incumbent, and associated degree of protection. The stored information may be updated, e.g. to ensure that the LSA System is made aware of the LSA spectrum resource no longer required by the Incumbent.

6.1.10 R-FUNC-GEN-10 LSA System Reporting Function

The LSA System shall support the capability to generate reports on LSA operation, covering as a minimum the availability of LSA spectrum resource through LSA operation, and the occurrence of critical events such as LSA spectrum resource evacuation. Such reports may be provided on-demand, or according to a schedule.

Explanation: LSA operation is based on the reliable implementation of sharing rules. It is important that the various involved stakeholders (e.g. Incumbent, Licensee and Administration/NRA) have access to information that characterizes the operation of the LSA System in order to build confidence in the LSA spectrum resource sharing process. As an example, this function may report on statistics of LSA spectrum resource availability to the LSA Licensee, which may be compared to expectations in the Sharing Framework, the individual right of use or associated specific bilateral arrangements. The Sharing Framework may itself specify the provision (and the recipients) of such reports.

6.1.11   R-FUNC-GEN-11 Support of Scheduled Operation

The LSA System shall support a scheduled mode of operation for spectrum resource sharing.

Explanation: In this mode of operation, the LSA spectrum resource availability information changes at pre-set times according to a schedule. For example, the schedule may be part of the sharing rules, or it could be entered by the Incumbent as part of the provision of its LSA spectrum resource usage and protection requirements to the LSA System. This mode of operation is applicable in scenarios where the Incumbent has a long-term planned approach to LSA spectrum resource use.

6.1.12   R-FUNC-GEN-12 Support of On-Demand Operation

The LSA System shall support an on-demand mode of operation for spectrum resource sharing.

Explanation: In this mode of operation, the Incumbent's LSA spectrum resource usage and protection requirements are modified, and the resulting LSA spectrum resource availability information is communicated to the LSA Licensee. There is no prior knowledge of the time when the LSA System is to receive such modifications. This mode of operation is applicable in scenarios where the Incumbent has a previously unforeseen requirement to use the LSA spectrum resource (or part of it, e.g. requires an LSA spectrum resource evacuation), or, conversely, no longer needs a previously assigned LSA spectrum resource.

6.1.13   R-FUNC-GEN-13 Support for Pre-Configuration

The LSA System shall support the pre-configuration of the Incumbent's LSA spectrum resource usage and protection requirements (and associated LSA spectrum resource availability information), such that there will be a finite set of possible combinations of such requirements. Such pre-configuration may apply to the entire LSA spectrum resource, or to a defined sub-band and/or geographical area.

Explanation: In practical systems, it is useful to pre-configure the possible LSA spectrum resource sharing combinations, as these may be tested and validated in advance of normal system operation. Pre-configuration may be defined to ensure adequate protection for both Incumbent and LSA Licensee. Pre-configuration also simplifies processing within the LSA System, and contributes to minimize latency. Pre-configuration may be applied to both periodic and on-demand modes of operation, and may also include pre-definition of zones or zone characteristics.

6.1.14   R-FUNC-GEN-14 Verification of Inputs to the LSA System

The LSA System shall support the capability to verify the consistency and validity of its inputs, and in particular, it shall be able to:

- reject a requested change in the Incumbent's LSA spectrum resource usage and protection requirements, if it fails to meet a specific condition (e.g. within the Sharing Framework, the individual right of use, or associated specific sharing arrangements); and

- reject a new rule (e.g. agreed between Incumbent and LSA Licensee), if it conflicts with the applicable Sharing Framework or the individual right of use.

The LSA System shall also have means to provide a notification of the verification failure, which may include a cause descriptor.

Explanation: Inputs to the LSA System that violate some aspect of the sharing arrangement or are otherwise inconsistent with the particular sharing scenario should be rejected. Examples of such events include: (i) violation of a guaranteed minimum time between changes in LSA spectrum resource availability; (ii) violation of guaranteed minimum LSA spectrum resource availability for the LSA Licensee, and (iii) inconsistency between indicated LSA spectrum resource and that covered by the Sharing Framework or the individual right of use.

6.1.15   R-FUNC-GEN-15 LSA System Availability to Stakeholders

The LSA System shall incorporate mechanisms to maintain robustness against failures and malicious attacks such that the spectrum sharing arrangement between an Incumbent and an LSA Licensee can be fulfilled by the LSA system with a predictable level of certainty in its availability to stakeholders.

Explanation: The LSA System interfaces with geographically distributed stakeholders such as Incumbents, LSA Licensees and NRA/Administration. The components of the LSA System may also be deployed across geographic areas, i.e. employing a distributed approach. As such the LSA System is vulnerable to failures due to unforeseen causes that could be inside or outside its LSA System boundary. In addition to component or communication malfunctions, man made threats such as "denial of service" attacks are also real possibilities. Therefore, the LSA System will typically incorporate required safeguards for example in the form of fault tolerant design, communication and storage redundancy and quick fault recovery mechanisms. Through these safeguards, the LSA System is expected to offer a predictable level of certainty in its availability to stakeholders.

6.1.16   R-FUNC-GEN-16 LSA System Operation in case of Change of Sharing Arrangement or Sharing Framework

The LSA System shall support a change of the Sharing Arrangement or of the Sharing Framework. The change of the Sharing Arrangement or Sharing Framework will become operational after a specific lead time.

Explanation: The Sharing Arrangement or the Sharing Framework is expected to be defined with validity duration. Hence correct LSA System operation for the change of these prerequisites for LSA needs to be ensured. It is assumed that a change of the Sharing Framework will require a check of the existing Sharing Arrangement if compatible to the new Sharing Framework, and if not the corresponding adjustment.

6.2   Incumbent Protection Requirements

This clause contains functional requirements that relate to the protection of the Incumbent.

6.2.1   R-FUNC-INC-01 Protection of Information of the Incumbent

The LSA System shall allow the Incumbent to store a description of the LSA spectrum resource and its availability. This excludes any need to provide details on the network and actual usage of the LSA spectrum resource not available to the LSA Licensee.

Explanation: Neither network details of the Incumbent (e.g. deployment related data) nor the information about the actual usage of the LSA spectrum resource not available to the LSA Licensee (e.g. information on active carrier frequencies in a given geographical area) are needed for LSA. There might be also special use case scenarios (e.g. military) where the protection of such details is essential.

6.2.2   R-FUNC-INC-02 General Protection of the Incumbent

The LSA System shall support mechanisms to ensure that the Incumbent's LSA spectrum resource usage and protection requirements are met, and in particular it shall provide LSA spectrum resource availability information to the LSA Licensee that will be such as to meet these requirements.

Explanation: The LSA System is able to ensure that the Incumbent's LSA spectrum resource usage and protection needs are met. The main mechanism for this purpose is the translation of the Incumbent's information and associated sharing rules into spectrum availability information communicated to the MFCN. This information should constrain the operation of the MFCN such that the Incumbent's usage requirements (protection of specific bands in specific areas at specific times, with specific protection criteria, etc.) are met.

6.2.3   R-FUNC-INC-03 Variation of Incumbent's Usage and Protection Requirements

The LSA System shall be able to update the LSA spectrum resource availability information provided to the LSA Licensee, following any modifications of the Incumbent's LSA spectrum resource usage and protection requirements during normal system operation, subject to any constraints set by the Sharing Framework or relevant sharing arrangements.

Explanation: The LSA System allows for changes in Incumbent's LSA spectrum resource usage and protection requirements during normal system operation, subject to any constraints set by the Sharing Framework, the individual right of use, or relevant sharing arrangement. When such changes occur, the LSA System should update the LSA spectrum resource availability information which is communicated to the MFCN.

6.2.4   R-FUNC-INC-04 End-to-end Acknowledgment of Operational Changes

The LSA System shall support the capability to provide a confirmation that the LSA Licensee has implemented operational changes in response to a change in the Incumbent's LSA spectrum resource usage and protection requirements. This confirmation shall be made available to the Incumbent.

Explanation: It is important that the Incumbent can have confidence that a change in the required LSA spectrum resource has been complied with, for example when a critical activity is to be initiated. In such circumstances, the Incumbent will naturally require an acknowledgement after the appropriate actions have been completed by the MFCN. Delivery of this acknowledgment may be supported e.g. by a change in an Incumbent-readable attribute.

6.2.5   R-FUNC-INC-05 Support of Constraints on LSA Licensee's Transmissions

The LSA System shall allow the Incumbent to provide a description of its LSA spectrum resource usage and protection requirements in the form of constraints on the LSA Licensee's radio transmissions.

Explanation: When the Incumbent provides its LSA spectrum resource usage and protection requirements to the LSA System, it may do so in the form of constraints to the LSA Licensee's transmissions. Exclusion zones and restriction zones are two examples of such constraints. Full definition of this type of constraint requires the geographical area boundaries, the transmission limitation such as maximum EIRP, frequency range, and a time period when the constraint is applicable. It is expected that the Sharing Framework will describe the method for providing Incumbent inputs (e.g. such as exclusion zones, or others). The sharing arrangement may also include provisions that predefine zone characteristics.

6.2.6   R-FUNC-INC-06 Support of Constraints on Received Interference due to the LSA Licensee's Transmissions

The LSA System shall allow the Incumbent to provide a description of its LSA spectrum resource usage and protection requirements in the form of constraints on the received interference due to the LSA Licensee's radio transmissions.

Explanation: When the Incumbent provides its LSA spectrum resource usage and protection requirements to the LSA System, it may do so in the form of constraints on the received interference due to the LSA Licensee's radio transmissions (for example, maximum field strength, or power spectral density).Typically these constraints would apply in a given geographical area (the protection zone). Full definition of this type of constraint requires the geographical area boundaries, the maximum field strength (or other suitable quantity) and conditions for its measurement, frequency range, and a time period when the constraint is applicable. It is expected that the Sharing Framework will describe the method for providing Incumbent inputs (e.g. such as protection zones, or others). The sharing arrangement may also include provisions that predefine zone characteristics.

6.3   Resource Grant Requirements

This clause contains functional requirements that relate to the process of granting the use of LSA spectrum resource to the LSA Licensee. Note that the term "grant" refers here to the process of providing information to the Licensee regarding the available LSA spectrum resource, and is different from usage in a regulatory context (e.g. "granting of a license").

6.3.1   R-FUNC-GRA-01 Protection of Information of the LSA Licensee

The LSA System shall be able to derive and communicate the LSA spectrum resource availability information to the appropriate LSA Licensee, without knowledge of the information related to its MFCN, or related to its usage of the LSA spectrum resource.

Explanation: Information related to the MFCN is confidential data of the LSA Licensee. LSA spectrum resource availability information is determined using the information available to the LSA System (see e.g. clause 6.1.9) and does not require MFCN details of the LSA Licensee (e.g. deployment related data) nor the information related to the actual usage of the LSA spectrum resource by the LSA Licensee (e.g. information on active carrier frequencies in a given geographical area).

6.3.2   R-FUNC-GRA-02 Access Grant to Specific Sharing Arrangement Information

The LSA System shall support functions to allow an Incumbent to grant the access to specific sharing arrangement information (e.g. practical details related to availability of a specific LSA spectrum resource), to an LSA Licensee.

Explanation: In accordance with the sharing arrangement, the LSA Licensee may need access to this information. For instance, the LSA System allows the LSA Licensee to access and verify information, or any modification thereof, such as protection criteria for a given LSA spectrum resource or potential variations of resource availability for a given LSA spectrum resource, input by the Incumbent (e.g. a PMSE operator), according to the defined sharing arrangement.

6.3.3   R-FUNC-GRA-03 General Protection of the LSA Licensee

The LSA System shall support mechanisms to ensure that the LSA Licensee's protection requirements related to the LSA spectrum resource are met, when the LSA spectrum resource is available to the LSA Licensee.

Explanation: The LSA System needs to ensure that the LSA Licensee will not experience harmful interference when operating in the available LSA spectrum resource as indicated by the individual authorization (see clauses 5.4.1 and 5.4.2).

6.3.4   R-FUNC-GRA-04 Variation of LSA Licensee's Protection

The LSA System shall support a modification of the LSA Licensee's LSA spectrum resource usage and protection requirements following a change in the spectrum sharing arrangement.

Explanation: The sharing arrangement may contain an option to change practical details (e.g. this input is typically used to optimize the LSA spectrum resource usage in the MFCN). Optimizations related to the usage of LSA spectrum resource by Incumbent or LSA Licensee should be allowed, provided both parties agree to such re-definition.

6.3.5   R-FUNC-GRA-05 End-to-end Acknowledgment for LSA Spectrum Resource availability changes

The LSA System shall support the capability to provide an end-to-end acknowledgement for a change in LSA spectrum resource availability to the Incumbent to confirm that the LSA Licensee has finalized the execution of the change in LSA spectrum resource grant accordingly.

Explanation: There are many different options for the Incumbent to initiate and perform a change of availability information for the defined LSA spectrum resource. Common to all options is that the Incumbent sends a request to the LSA System, the LSA System forwards this request to the LSA Licensee, the LSA Licensee executes the request and sends an acknowledgement to the LSA System, and the LSA System informs the Incumbent about the successful performed request. This process may be asynchronous (e.g. the Incumbent requests LSA spectrum resource for an event in 2 months, i.e. the acknowledgement by the LSA Licensee will be received only after 2 months). It is important that the Incumbent can have confidence that the change in LSA spectrum resource grant is performed by the LSA Licensee.

6.3.6   R-FUNC-GRA-06 Support for Different LSA Licensee Response Times

The LSA System shall support different LSA Licensee response times following requests for evacuation of LSA spectrum resource.

Explanation: There are scenarios where the LSA Licensee may need to react to LSA spectrum resource evacuation requests with different levels of urgency. For example, there may be a normal response time for the LSA Licensee that allows a graceful exit from the band with minimum degradation of the service provided, whilst in certain situations a faster response time is required. The Sharing Framework, individual right of use, or associated specific sharing arrangements may include specific provisions regulating the expected response times.

6.4   Security Requirements

This clause contains functional requirements that relate specifically to security aspects of the LSA System.

6.4.1   R-FUNC-SEC-01 Data Integrity

The LSA System shall incorporate mechanisms to ensure the integrity of the data stored in the system and the data exchanged between any of: the LSA System, Incumbents, LSA Licensees and Administration/NRA. The LSA System shall ensure the availability of the information to the authorized recipients and shall support security functions to protect this information against security threats.

Explanation: If the information is compromised in the storage or in transport, this will be highly disruptive to the Incumbents and LSA Licensees. Therefore, the LSA System needs to make sure that such information as well as LSA related requests, queries or commands are protected against tampering or unauthorized modifications or deletions. In addition to prevent unauthorized modifications, the system should be able to detect and recover from such attempts.

6.4.2   R-FUNC-SEC-02 Data Authenticity

The LSA System shall incorporate mechanisms to ensure the authenticity of the information stored in the system and exchanged between any of: the LSA System, Incumbents, LSA Licensees and Administration/NRA.

Explanation: In contrast to integrity, which relates to the content of the information, the authenticity is concerned with the source of the information. To ensure authenticity, the LSA System is expected to implement mechanisms that will enable authorized entities and recipients of transmitted data to readily verify the identity of the source of the LSA related information, commands and requests. For instance strong authentication and cryptographic techniques, digital signatures and other algorithmic validation frameworks may be considered to meet these integrity and authenticity requirements.

6.4.3   R-FUNC-SEC-03 Data Confidentiality

The LSA System shall incorporate mechanisms to prevent unauthorized disclosure of confidential information that the system maintains and that is exchanged between any of: the LSA System, Incumbents, LSA Licensees and Administration/NRA.

Explanation: An LSA System may support many Incumbents and LSA Licensees and maintain their information in a common framework. This information may be related to the Incumbents, LSA Licensees and their spectrum usage. On the other hand, some sharing arrangement related information is only intended to be shared between concerned Incumbents and LSA Licensees. Therefore, the LSA System employs adequate confidentiality, access control, authentication and authorization methods to prevent unauthorized information disclosure and elevation of privilege.

6.4.4   R-FUNC-SEC-04 Identity management and authentication

The LSA System shall allow to manage identities and authentication of users. This includes configuration, reconfiguration and deletion of identities.

Explanation: In order to enforce the limitations of access rights and other security requirements, it is necessary to identify the users who access the system and to prove their identity by adequate authentication mechanisms.

6.4.5   R-FUNC-SEC-05 Support of Authorization Profiles

The LSA System shall distinguish between different authorization profiles assigned to user groups of the LSA System based on their identification, and shall allow the specification and enforcement of applicable access rights.

Explanation: Different authorization profiles may be used to differentiate authorizations of individual users or user group. For instance a user group may consist of the set (or a subset) of LSA users that perform the same LSA Role. A user group (associated with a certain LSA Licensee) may have read access to a specific area of the LSA System data storage function and another user group of the same LSA Licensee may have additional write access to this area of the LSA System data storage function, whilst an individual (associated with the same LSA Licensee) may be granted further extended read / write access rights. Another example for specific user capabilities is the access to data delivered by the reporting function of the LSA System. In case the LSA System is administered by a trusted 3rd party user, specific access rights should be defined, since a 3rd party LSA System Administrator should not need access to most of the information shared between Incumbent and LSA Licensee.

7   Performance Requirements

7.1   Incumbent Protection Performance Requirements

Not applicable.

7.2   Resource Grant Performance Requirements

7.2.1   R-PERF-GRA-01 Lead Time for Modification of LSA Spectrum Resource

The LSA System shall allow modification of the definition of LSA spectrum resource and of respective sharing arrangement provisions to become operational after a lead time.

Explanation: The definition of the LSA spectrum resource and respective sharing arrangement provisions are typically used in advance to plan and prepare the MFCN before the LSA spectrum resource can be used. A request for change should be allowed, especially when the involved parties agree to such re-definition. Typically changes of the LSA spectrum resource or respective sharing arrangement provisions have technical and commercial impacts, which may require a longer lead time for re-planning of the MFCN. Different lead times may be agreed depending on the reason for the modification.

7.2.2   R-PERF-GRA-02 Latency Time for Transferring of LSA Spectrum Resource Availability Information

The LSA System shall allow transferring of the LSA spectrum resource availability information to the LSA Licensee within a predefined latency time, which is defined by Incumbent and LSA Licensee in the spectrum sharing arrangement. To support synchronous and asynchronous control scenarios the LSA System shall minimize the processing and transmission time for all methods that are used to transfer the LSA spectrum resource availability information from Incumbent to LSA Licensee.

Explanation: Whenever the Incumbent and the LSA Licensee have agreed to share LSA spectrum resource, it is necessary to forward the LSA spectrum resource availability information as fast as possible to avoid negative impact on the agreed lead time(s). The support of a synchronous control scenario is required for example in case the Incumbent requires for emergency situations an evacuation of the LSA spectrum resource on a very short time frame, yielding a corresponding short lead time. The support of an asynchronous control scenario by means of a typically longer lead time is required for instance in case of pre-known or known periodic changes of the LSA spectrum resource availability or in case of availability declaration by the Incumbent well before (e.g. weeks/months before) the adoption of the change takes place. In both scenarios, the LSA System is expected to forward the LSA spectrum resource availability information within a predefined latency time, corresponding to the transfer delay between reception of the Incumbent's information at the LSA System data storage function and reception of this information at the LSA Licensee.

Annex A (informative):
Change History

date	Version	Information about changes
July 2013	v0.0.1	Initial template
August 2013	v0.0.2	Implemented the following: RRSWG1(13)100092r2 RRSWG1(13)100093r2
September 2013	v0.0.3	Implemented the following after RRS1#24: RRSWG1(13)100111 RRSWG1(13)100116r2 RRSWG1(13)100117r1 RRSWG1(13)100122r1
October 2013	v0.0.4	Implemented the following: RRSWG1(13)100110r2 RRSWG1(13)100126 RRSWG1(13)100127r1 RRSWG1(13)100129r1
4 November 2013	v0.0.5	Updated TOC and implemented RRSWG1(13)100113r4
15 November 2013	v0.0.6	Implemented RRSWG1(13)100114r3
20 December 2013	v0.0.7	Implemented the following: RRSWG1(13)100141r4 RRSWG1(13)100157r2 RRSWG1(13)001006r2 RRSWG1(13)001009r2 RRSWG1(13)001010r1 RRSWG1(13)001013r1 RRSWG1(13)001014r1 RRSWG1(13)001018r3 Added missing figure captions
24 December 2013	v0.0.8	Correction to the implementation of RRSWG1(13)100157r2 due to one missing requirement ("Support for Different LSA Licensee Response Times") Minor editorials
6 February 2014	v0.0.9	Implemented RRSWG1(14)100004r1 and update of TOC
24 February 2014	v0.0.10	Implemented RRSWG1(14)100005r3
6 May 2014	v0.0.11	Implemented RRSWG1(14)100040r4
29 May 2014	v0.0.12	Implemented RRSWG1(14)100073r1
2 July 2014	v0.0.13	Implemented RRSWG1(14)027015r2 and RRSWG1(14)027016r1, update of TOC
6 August 2014	v0.0.14	Implemented RRSWG1(14)100079r1 plus a missing formal paragraph in clause 4.2, included in RRSWG1(14)100079r2 for reference, update of TOC
24 September 2014	v0.0.15	Implemented RRSWG1(14)028028, RRSWG1(14)028021r2
25 September 2014	v0.0.16	Editorial changes

History

Document history		
V1.1.1	October 2014	Publication