



TECHNICAL SPECIFICATION

**Reconfigurable Radio Systems (RRS);
evolved Licensed Shared Access (eLSA);
Part 1: System requirements**

Reference

DTS/RRS-0150

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Contents

| | |
|---|----|
| Intellectual Property Rights | 5 |
| Foreword..... | 5 |
| Modal verbs terminology..... | 5 |
| Introduction | 5 |
| 1 Scope | 7 |
| 2 References | 7 |
| 2.1 Normative references | 7 |
| 2.2 Informative references..... | 7 |
| 3 Definition of terms, symbols and abbreviations..... | 8 |
| 3.1 Terms..... | 8 |
| 3.2 Symbols..... | 9 |
| 3.3 Abbreviations | 9 |
| 4 Requirement organization and methodology..... | 9 |
| 4.1 Requirement organization | 9 |
| 4.2 Requirement format..... | 10 |
| 4.3 Requirement formulation | 10 |
| 4.4 eLSA Roles | 10 |
| 5 Working Assumptions..... | 11 |
| 5.1 General Assumptions | 11 |
| 5.2 Operation of local high-quality wireless networks..... | 11 |
| 5.3 Regulatory background | 12 |
| 5.4 Sharing Framework | 12 |
| 5.5 Spectrum Sharing Arrangement | 12 |
| 5.6 eLSA functional enhancements..... | 13 |
| 5.7 eLSA system administration by trusted 3 rd parties | 13 |
| 6 Functional system requirements..... | 13 |
| 6.1 General system operation | 13 |
| 6.1.0 Introduction..... | 13 |
| 6.1.1 R-FUNC-GEN-01 eLSA spectrum resource sharing..... | 13 |
| 6.1.2 R-FUNC-GEN-02 Quality of service | 14 |
| 6.1.3 R-FUNC-GEN-03 Information exchange between eLSA roles..... | 14 |
| 6.1.4 R-FUNC-GEN-04 Multiple eLSA Licensee/Lessee support..... | 14 |
| 6.1.5 R-FUNC-GEN-05 Multiple Incumbent user support..... | 14 |
| 6.1.6 R-FUNC-GEN-06 Sharing framework support | 14 |
| 6.1.7 R-FUNC-GEN-07 Confidentiality of spectrum resource information..... | 15 |
| 6.1.8 R-FUNC-GEN-08 Provision of failure indication | 15 |
| 6.1.9 R-FUNC-GEN-09 eLSA system data storage function | 15 |
| 6.1.10 R-FUNC-GEN-10 eLSA system reporting function..... | 16 |
| 6.1.11 R-FUNC-GEN-11 Support of scheduled operation | 16 |
| 6.1.12 R-FUNC-GEN-12 Support of on-demand operation | 16 |
| 6.1.13 R-FUNC-GEN-13 Support of pre-configuration | 16 |
| 6.1.14 R-FUNC-GEN-14 Verification of inputs to the eLSA system | 17 |
| 6.1.15 R-FUNC-GEN-15 eLSA system availability to stakeholders..... | 17 |
| 6.1.16 R-FUNC-GEN-16 eLSA system operation in case of change of sharing arrangement or sharing framework..... | 17 |
| 6.1.17 R-FUNC-GEN-17 Support of allowance zones..... | 18 |
| 6.2 Incumbent protection requirements | 18 |
| 6.2.0 Introduction..... | 18 |
| 6.2.1 R-FUNC-INC-01 Protection of information of the Incumbent..... | 18 |
| 6.2.2 R-FUNC-INC-02 General protection of the incumbent..... | 18 |
| 6.2.3 R-FUNC-INC-03 Variation of incumbent's usage and protection requirements | 18 |
| 6.2.4 R-FUNC-INC-04 End-to-end acknowledgment of operational changes | 19 |

| | | |
|---------|---|----|
| 6.2.5 | R-FUNC-INC-05 Support of constraints on eLSA Licensee's transmissions..... | 19 |
| 6.2.6 | R-FUNC-INC-06 Support of constraints on received interference due to the eLSA Licensee's transmissions..... | 19 |
| 6.3 | Resource grant requirements | 19 |
| 6.3.0 | Introduction..... | 19 |
| 6.3.1 | R-FUNC-GRA-01 Protection of information of the eLSA Licensee..... | 20 |
| 6.3.2 | R-FUNC-GRA-02 Access grant to specific spectrum sharing arrangement information | 20 |
| 6.3.3 | R-FUNC-GRA-03 General protection of the eLSA Licensee | 20 |
| 6.3.4 | R-FUNC-GRA-04 Variation of eLSA Licensee's protection..... | 20 |
| 6.3.5 | R-FUNC-GRA-05 End-to-end acknowledgment for eLSA spectrum resource availability changes | 21 |
| 6.3.6 | R-FUNC-GRA-06 Support for Different eLSA Licensee response times | 21 |
| 6.4 | Security requirements..... | 21 |
| 6.4.0 | Introduction..... | 21 |
| 6.4.1 | R-FUNC-SEC-01 Data integrity..... | 21 |
| 6.4.2 | R-FUNC-SEC-02 Data authenticity..... | 22 |
| 6.4.3 | R-FUNC-SEC-03 Data confidentiality | 22 |
| 6.4.4 | R-FUNC-SEC-04 Identity management and authentication..... | 22 |
| 6.4.5 | R-FUNC-SEC-05 Support of authorization profiles..... | 22 |
| History | | 23 |

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Foreword

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

The present document is part 1 of a multi-part deliverable covering evolved Licensed Shared Access (eLSA), as identified below:

Part 1: "System requirements";

Part 2: "System architecture and high-level procedures".

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 concept of *local high-quality wireless networks* has been identified in ETSI TR 103 588 [i.1] as a collective term to enclose a kind of use cases targeting local area services requiring predictable levels of QoS, e.g. in vertical industrial sectors such as industrial automation, PMSE, PPDR and e-Health. Their need for predictable levels of QoS mostly preclude operation in a license-exempt spectrum, due to coexistence issues, and target exclusively licensed spectrum. However, due to the current scarcity of suitable exclusive licensed spectrum resources, which can be directly accessible by vertical local area service providers, spectrum sharing has been proposed in [i.1] as the enabling spectrum technology for introducing QoS enabled local area services in licensed bands.

NOTE: In the present document, the term "local area service provider" used in [i.1] is substituted by the term "MFCN operator". An MFCN operator refers to e.g. a vertical sector operator.

Three possible spectrum sharing schemes have been identified in [i.1] for providing local area services focusing on QoS in licensed bands:

- 1) MNOs can offer dedicated local area services in their licensed frequencies.
- 2) MNOs can lease part out of their spectrum locally to local area service providers.
- 3) Spectrum can be nationally licensed to local area services providers.

Scheme 1 addresses the hosting of *local high-quality wireless networks* as service network areas by MNOs. Schemes 2 and 3 target the deployment of *local high-quality wireless networks* as standalone private networks.

The use of scheme 2 is not limited to MNO bands, but any licensed band can be used where leasing is regulatory allowed.

All three spectrum sharing schemes aim to facilitate licensed spectrum sharing between local vertical sector operators, with specified geographical and temporal limits, and incumbents both in IMT and non-IMT bands. In this context, the focus on IMT-bands facilitates wide availability of equipment since those bands are also used by Mobile Network Operators (MNOs).

For enabling each of the three functional use cases, clauses 6.1 and 6.2 in [i.1] provide examples of functional architectures in a general sense and within the current LSA framework [i.2], [i.3] and [i.4], respectively.

The main advantage of embracing the LSA framework is that it aims to ensure a predictable level of QoS at a defined location for all spectrum resource users, i.e. LSA licensees and incumbents. The current LSA framework was designed to share spectrum resources between Incumbents and LSA Licensees acting as MNOs. However, the support of vertical local area service providers as a new type of LSA licensees, which asks for both shorter or longer time of spectrum resource deployments with a predictable QoS level, and the expected higher number of these new type of LSA licensees make it necessary to evolve the current LSA framework on both system and CEPT/NRA levels.

At the regulatory level, for instance, the role concept in LSA needs to be evolved opening the LSA method to include local vertical sector operators as licensees.

At LSA system level, Table 6 in ETSI TR 103 588 [i.1] lists an overview of identified potential functional enhancements to the current LSA system and the corresponding affected LSA entities.

The present document leverages on the findings in ETSI TR 103 588 [i.1] to technically specify the requirements for providing spectrum access for *local high-quality wireless networks* within the LSA framework [i.5].

1 Scope

The objective of evolving the LSA framework towards an eLSA (evolved LSA) system is to support spectrum access to local high-quality wireless networks operated by vertical sector operators, as introduced in ETSI TR 103 588 [i.1]. The present document specifies system requirements for that purpose.

ETSI TC RRS work on eLSA is of technical nature aiming to provide an automatic tool to facilitate spectrum sharing coordination between incumbents, NRAs and eLSA Licensees (e.g. vertical sector operators).

To meet the spectrum access demand and needs of local high-quality wireless networks, eLSA aims to offer technical means to facilitate the spectrum allocation procedure, including automatic local area licensing and leasing agreements, and to manage the conditions of spectrum use. The work is based on the generic aspects of the current ETSI specifications [i.2], [i.3] and [i.4] for Licensed Shared Access (LSA) in the 2 300 - 2 400 MHz band and on the functional enhancements proposed in ETSI TR 103 588 [i.1].

The work targets operation of local high-quality wireless networks in licensed bands to guarantee predictable QoS levels. It is agnostic to the radio frequency bands.

The work on eLSA is based on the LSA concept [i.5], i.e. same architecture, role assumptions and applicable functionality.

The requirements in the present document are intended to be used for the definition of an evolved LSA system architecture specification for providing spectrum access for local high-quality wireless networks.

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.

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

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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 TR 103 588 (V1.1.1): "Reconfigurable Radio Systems (RRS); Feasibility study on temporary spectrum access for local high-quality wireless networks".
- [i.2] ETSI TS 103 154 (V1.1.1): "Reconfigurable Radio Systems (RRS); System requirements for operation of Mobile Broadband Systems in the 2300 MHz - 2400 MHz band under Licensed Shared Access (LSA)".

- [i.3] ETSI TS 103 235 (V1.1.1): "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.4] ETSI TS 103 379 (V1.1.1): "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".
- [i.5] ECC Report 205: "Licensed Shared Access (LSA)", February 2014, CEPT WG FM PT53.
- [i.6] 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".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

allowance zone: geographical area within which an eLSA Licensee is allowed to operate radio transmitters on its assigned spectrum resource

NOTE 1: An allowance zone is defined using specific measurement quantities and thresholds, e.g. a maximum field strength level expressed in $\text{dB}\mu\text{ V/m/MHz}$, along the border of its geographical area.

NOTE 2: An allowance zone is normally applicable for a defined frequency range and time period.

eLSA licensee: entity operating a MFCN, which holds individual rights of use to an eLSA spectrum resource

NOTE: eLSA licensee role extends the scope of LSA licensees to include vertical sectors stakeholders (e.g. vertical local area communication service providers/operators).

eLSA spectrum resource: spectrum resource which is to be shared between an incumbent and an eLSA licensee on a static or dynamic basis according to the sharing framework defined by the administrations (NRAs)

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

incumbent: current holder of spectrum rights of use

lease: arrangement between the lessor and the lessee for using parts of the spectrum, a particular geographical area, or a combination of both, over a period of time

lessee: entity which holds right of use to a certain spectrum resource from a lessor under a lease

lessor: entity holding individual rights of use (license) to a certain spectrum resource, which leases out parts of his license to a lessee under a lease

protection zone: geographical area within which incumbent receivers will not be subject to harmful interference caused by eLSA/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 $\text{dB}\mu\text{ V/m/MHz}$ 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 an allowance zone where an eLSA Licensee has to operate under certain additional restrictive conditions (e.g. maximum EIRP limits and/or constraints on antenna parameters)

sharing arrangement: set of practical details for sharing an eLSA and/or 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 eLSA and/or LSA

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

vertical sector operator: operator of a local high-quality wireless network (MFCN) addressing a vertical sector specific local connectivity needs

NOTE: The concept of "vertical sector" is used to name business sectors that have a need to use MFCNs to maintain their operations, such as the transport, the culture and creative, the industrial automation or the healthcare sectors. Different vertical sectors have different connectivity requirements: e.g. capacity, network quality, latency, communication security and reliability.

3.2 Symbols

Void.

3.3 Abbreviations

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

| | |
|------|--|
| CEPT | Conférence Européenne des administrations des Postes et des Télécommunications |
| ECC | Electronic Communications Committee of the CEPT |
| EIRP | Effective Isotropic Radiated Power |
| eLSA | evolved LSA |
| IMT | International Mobile Telecommunications |
| LSA | Licensed Shared Access |
| MFCN | Mobile/Fixed Communication Network |

NOTE: MFCN is used in the present document to refer to a local high-quality wireless network.

| | |
|------|---------------------------------------|
| MNO | Mobile Network Operator |
| NRA | National Regulatory Administration |
| PMSE | Programme Making and Special Events |
| PPDR | Public Protection and Disaster Relief |
| QoS | Quality of Service |

4 Requirement organization and methodology

4.1 Requirement organization

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

As shown in Figure 1, the requirements described in the present document belong to the category of functional requirements. This category, in turn, is organized into groups.

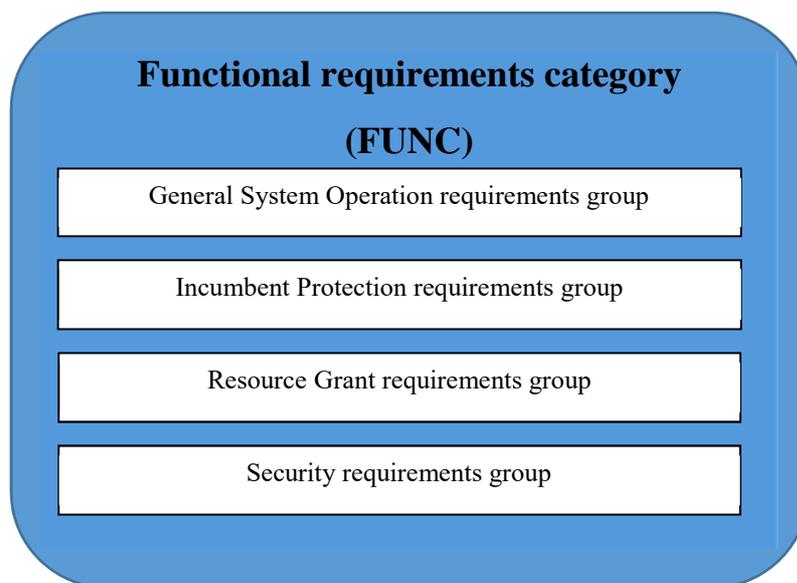


Figure 1: Organization of functional requirements

4.2 Requirement format

This clause describes the format of the requirements.

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 |

- <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 the ETSI modal verbal terminology

4.4 eLSA Roles

Requirements are formulated in regards of the "eLSA System" and make use of generic "eLSA roles". "eLSA roles" are based on "LSA roles" as introduced in ECC Report 205 [i.5]. eLSA Licensee role includes the lease/sub-lease case and extends the scope to vertical sectors stakeholders.

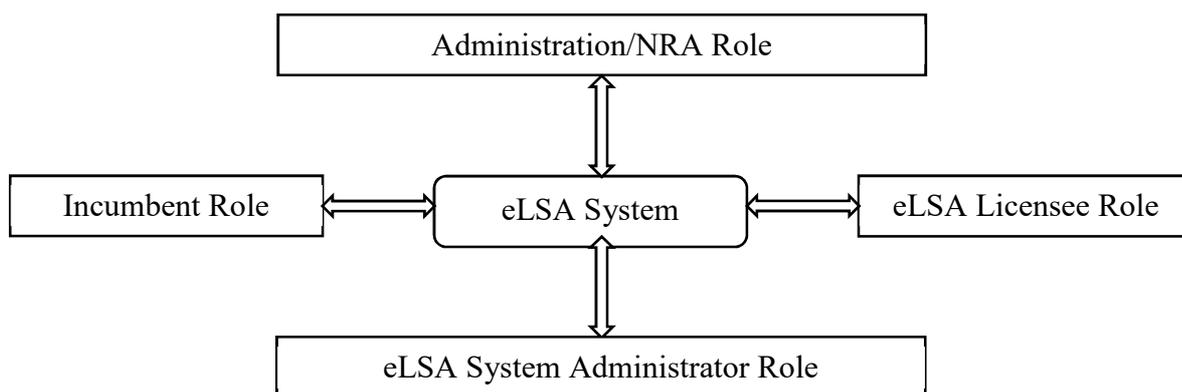


Figure 2: eLSA roles

5 Working Assumptions

5.1 General Assumptions

The working assumptions described below are based on ETSI TR 103 588 [i.1], and particularly on the three functional use cases described in clause 6.1 and summarized in Table 5 of ETSI TR 103 588 [i.1], as well as on the current ETSI LSA framework [i.2], [i.3], [i.4] and the ECC Report 205 [i.5].

For eLSA, the following general working assumptions apply:

- It operates in licensed bands and follows the concept defined for LSA [i.5] to allow for predictable QoS levels.
- It follows an agnostic approach in terms of targeted frequency bands and technology.
- It targets the role assumptions, the applicable functionality, and a system architecture as close as possible to the LSA system keeping simplicity to avoid a complex infrastructure adding cost.

NOTE: It is intended that an eLSA system under the general working assumptions stated in this clause could serve multiple use cases such as, e.g.:

- providing spectrum access for the operation of local high-quality wireless networks as described in ETSI TR 103 588 [i.1];
- "Bandwidth expansion for mobile network operator" in clause 7.1.2 of [i.6].

5.2 Operation of local high-quality wireless networks

Local high-quality wireless networks refer to MFCNs capable of supporting different use cases with following commons:

- their operation is confined in a local geographical area:
 - the definition of a local geographical area is assumed to be based on premises, real estate, address or similar notion. Having a precise area definition with right size that is non-geographically overlapping would help in licensing and leasing processes. Free polygon definitions as in LSA may still be useful, for instance for events where the area can cross several different real estate properties. What to use in a specific country would need to be determined nationally as regulation and needs may differ from country to country;
- have short-term to long-term deployments;

- need predictable levels of QoS, particularly in terms of deterministic communication behaviour, reliability and latency, etc.:
 - the allocation of a frequency block in a local geographical area is expected to be predictable to ensure the required QoS;
- network infrastructure and management with a suitable combination of private and public networks for implementing specific security standards or due to privacy reasons.

The present document aims at specifying system requirements for providing spectrum access for *local high-quality wireless networks* within the LSA framework [i.2], [i.3], [i.4]. Therefore, the current LSA specifications needs to be evolved on both LSA system and regulatory levels.

5.3 Regulatory background

The current ETSI LSA framework [i.2], [i.3], [i.4] provides a solution to enable spectrum access to the 2 300 MHz - 2 400 MHz frequency band for MFCNs acting as MNOs. At this stage, eLSA does not target specific radio bands but aims to provide a general solution for providing spectrum access to *local high-quality wireless networks* in whatever suitable licensed frequency bands. It should be noted that the licensing and access to spectrum is a national decision and different radio bands may be suitable in different countries.

As a frequency agnostic, general, technical approach, eLSA has the potential to facilitate spectrum access for local high quality wireless networks under different national spectrum regulatory frameworks. The focus lies on the automation of the spectrum allocation procedure, including local area licensing and leasing agreements, and the management of the conditions of spectrum use.

5.4 Sharing Framework

The Sharing Framework remains the central piece for the implementation of eLSA at national level. It defines for a given frequency band the spectrum, with corresponding technical and operational conditions, that can be made available for eLSA.

For eLSA it is intended to provide technical solutions enabling at least following aspects:

- Using the LSA method to include vertical sectors players.
- Allowing additional spectrum sharing methods like leasing/subleasing of spectrum resources. For instance, an MNO may be allowed to lease/sublease out spectrum resources to a vertical sector operator operating a local MFCN or a 3rd party acting on behalf of a vertical sector operator operating a local MFCN.
- Facilitating use of appropriate licensed frequency bands for the eLSA spectrum sharing methods.
- Facilitating the handling of a high number of local MFCNs.
- Adaptation of the LSA role concept to allow a more flexible mapping of roles to the respective operation options of the evolved LSA system (i.e. evolved LSA Controller and evolved LSA repository) according to the needs of vertical sector operators. For example, a MNO may act as a 3rd party to provide a repository service of its spectrum resources to a MFCN operated by a vertical sector player.

5.5 Spectrum Sharing Arrangement

The spectrum sharing arrangement concept for eLSA is based on the spectrum sharing arrangement concept for LSA in ETSI TS 103 154 [i.2] and will contain additional features to deal with the new aspects for providing spectrum access to local high-quality wireless networks.

For example, if the Sharing Framework and the sharing conditions allow for that, it is assumed that operators of MFCNs may want to operate and control their local MFCNs in a detached mode, i.e. without a permanent connection to the eLSA System. Thus, the spectrum sharing arrangement may contain respective practical details for a given eLSA spectrum resource when used in detached mode.

5.6 eLSA functional enhancements

For providing spectrum access to *local high-quality wireless networks*, the current LSA framework needs to be evolve on system level. Table 6 in ETSI TR 103 588 [i.1] lists an overview of identified potential functional enhancements to the current LSA system and the corresponding affected LSA entities.

It is assumed that an eLSA system may need to handle a potentially large number of local MFCNs. It is assumed that each of these local MFCNs is granted individual rights of use by the relevant NRA. This implies that the eLSA system has to provide means to secure coexistence between incumbents and a potentially high number of eLSA licensees according to the agreed sharing conditions.

The number of neighbour relations is expected to be rather stable over time, i.e. dynamic behaviour due to dynamic neighbour relations is expected to be small and can be accounted for during the normal radio network planning. Thus, there is no need for an automatic/network-controlled interference coordination between neighbours.

It is assumed that eLSA spectrum resource sharing is based on geographical sharing, i.e. the individual right of use, the Sharing Framework, and/or a particular spectrum sharing arrangement defines an **allowance zone** within which the eLSA Licensee can operate a local high-quality wireless network on the assigned frequency block/range on a non-interfering basis and with predictable QoS. In this context, predictable QoS means that the network operated by the eLSA Licensee can perform at a radio level in a similar way to a non-sharing case.

An allowance zone is defined by specific measurement quantities and thresholds, e.g. a maximum allowed signal strength defined along the border of its geographical area. Based on that knowledge, the maximum allowed signal strength on the border of an allowance zone can help to predict the level of interference that may be experienced from a neighbour. That knowledge can be considered when planning the network deployment.

NOTE: Access to the public information in the NRA database/repository about licenses/leases is assumed.

5.7 eLSA system administration by trusted 3rd parties

It is assumed that the eLSA System or part(s) thereof may be administered by trusted 3rd party user(s) with defined access rights. The new aspect for eLSA is that a eLSA Controller may be operated by a 3rd party user, which acts on behalf of eLSA Licensees operating a local MFCN.

6 Functional system requirements

6.1 General system operation

6.1.0 Introduction

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

6.1.1 R-FUNC-GEN-01 eLSA spectrum resource sharing

The eLSA system shall support:

- spectrum resource sharing in suitable licensed bands between Incumbent(s) and eLSA, according to the applicable Sharing Framework automatic local area licensing of spectrum resources in suitable licensed bands to eLSA Licensees, even if no Incumbent is present in the band;
- leasing of spectrum resources between lessors and lessees, according to the applicable eLSA Sharing Framework and individual spectrum sharing arrangements.

Explanation: In general, spectrum assigned to Incumbent(s), may be used by MFCNs according to the applicable eLSA Sharing Framework and individual spectrum sharing arrangements. The eLSA System will allow an eLSA 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 eLSA System shall facilitate the provision of a predictable Quality of Service (QoS) for both Incumbents and eLSA.

Licensees, whenever operation by a particular service is allowed by the system.

Explanation: The eLSA 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 eLSA roles

The eLSA System shall provide means for the exchange of information between different roles, e.g. between an Incumbent and/or NRA and an eLSA Licensee to enable the eLSA Licensee to be made aware of the eLSA spectrum resource that is available for its use and its possible changes over time.

If the Sharing Framework and the sharing conditions allow for that, there is no requirement for a permanent connection, i.e. no need for continuous information exchange, between an eLSA Licensee and the eLSA system.

Explanation: Legacy spectrum 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 eLSA spectrum resource sharing to occur in an efficient manner, the eLSA System will include efficient interfacing between eLSA roles to enable changes in the available eLSA spectrum resource to be communicated to the Licensee/Lessee. Operators of MFCNs may prefer spectrum sharing arrangements, which allow to operate and control their networks in a detached mode, i.e. without a permanent connection to the eLSA System.

6.1.4 R-FUNC-GEN-04 Multiple eLSA Licensee/Lessee support

The eLSA System shall allow an Incumbent, NRA or lessor to interact with one or more eLSA Licensees/Lessees for spectrum sharing purposes.

Explanation: A single Incumbent user may communicate with multiple MFCNs to provide information on the eLSA 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 eLSA Licensees. The information sent to each MFCN reflects the degree of Incumbent usage only, since the eLSA System does not support contention between MFCNs. Each eLSA Licensee has an individual authorization to use a particular eLSA spectrum resource, subject to a suitable grant provided by the eLSA System.

6.1.5 R-FUNC-GEN-05 Multiple Incumbent user support

The eLSA System shall allow an MFCN to interact with one or more Incumbents, lessors and/or one NRA for spectrum sharing purposes.

NOTE: An MFCN should be able to interact directly with the NRA in frequency bands where there is no incumbent.

Explanation: A particular MFCN may be authorized as an eLSA Licensee of different eLSA 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 eLSA 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 5.4).

6.1.7 R-FUNC-GEN-07 Confidentiality of spectrum resource information

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

Information about the frequency allocations of neighbour licenses could be useful in fulfilling the required radio conditions. This information could be used as available.

Explanation: The eLSA System contains information as to which entity (the Incumbent or the eLSA Licensee) is allowed to use the spectrum at any given time and in any given location. In general, and unless otherwise agreed, an eLSA Licensee or Incumbent may have the possibility to access information concerning eLSA spectrum resources that pertain to another eLSA Licensee or that are shared with different Incumbents.

6.1.8 R-FUNC-GEN-08 Provision of failure indication

The eLSA System shall have means to provide failure indications to both the eLSA 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 eLSA 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 eLSA System is able to notify both the eLSA 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 eLSA 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.

Under detached operation, failure notification may not be possible immediately after failure detection. It is expected that either the individual right of use, the Sharing Framework and/or the spectrum sharing arrangement contain details on the procedure for failure indication under detached operation. For instance, the MFCN operating in detached mode has to connect periodically to the eLSA System in order to check for possible failure notifications.

Possible examples of this default mode include:

- (i) eLSA Licensee exits the eLSA spectrum resource;
- (ii) eLSA Licensee continues to use the last-known available eLSA spectrum resource; or
- (iii) eLSA Licensee operates on the basis that a certain pre-agreed eLSA spectrum resource is available.

6.1.9 R-FUNC-GEN-09 eLSA system data storage function

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

Explanation: The eLSA System supports receiving and maintaining information required for the operation of eLSA, including eLSA spectrum resource definitions, sharing rule definitions (from the Sharing Framework, the individual right of use, and the associated specific spectrum sharing arrangements), and information describing the eLSA 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 eLSA System is made aware of the eLSA spectrum resource no longer required by the Incumbent.

6.1.10 R-FUNC-GEN-10 eLSA system reporting function

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

Explanation: eLSA 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 eLSA System in order to build confidence in the eLSA spectrum resource sharing process. As an example, this function may report on statistics of eLSA spectrum resource availability to the eLSA 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 eLSA System shall support a scheduled mode of operation for spectrum resource sharing.

Explanation: In this mode of operation, the eLSA 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 eLSA spectrum resource usage and protection requirements to the eLSA System. This mode of operation is applicable in scenarios where the Incumbent has a long-term planned approach to eLSA spectrum resource use. The detached operation option may use the scheduled mode of operation as well. Due to the fact that a MFCN performs scheduled actions related to an eLSA spectrum resource without having a permanent connection to the eLSA System there may be a need to adapt the LSA procedures, e.g. LSRAI Confirmation Procedure defined in ETSI TS 103 154 [i.2] accordingly.

6.1.12 R-FUNC-GEN-12 Support of on-demand operation

The eLSA System shall support an on-demand mode of operation for spectrum resource sharing only if the frequency allocation of the license requires such an operation due to incumbent use. In general, an on-demand operation mode is not desired for providing spectrum access to MFCNs as described in ETSI TR 103 588 [i.1].

Explanation: In the on-demand mode of operation, the Incumbent's eLSA spectrum resource usage and protection requirements can be modified on-demand, and the resulting eLSA spectrum resource availability information is communicated to the eLSA Licensee. There is no prior knowledge of the time when the eLSA 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 eLSA spectrum resource (or part of it, e.g. requires an eLSA spectrum resource evacuation), or, conversely, no longer needs a previously assigned eLSA spectrum resource.

6.1.13 R-FUNC-GEN-13 Support of pre-configuration

The eLSA System shall support the pre-configuration of the Incumbent's eLSA spectrum resource usage and protection requirements (and associated eLSA 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 eLSA spectrum resource, or to a defined sub-band and/or geographical area.

Explanation: In practical systems, it is useful to pre-configure the possible eLSA 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 eLSA Licensee. Pre-configuration also simplifies processing within the eLSA System and contributes to minimize latency. Pre-configuration may be applied to both scheduled 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 eLSA system

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

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

- Explanation: Inputs to the eLSA System that violate some aspect of the spectrum 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 eLSA spectrum resource availability;
 - (ii) violation of guaranteed minimum eLSA spectrum resource availability for the eLSA Licensee; and
 - (iii) inconsistency between indicated eLSA spectrum resource and that covered by the Sharing Framework or the individual right of use.

6.1.15 R-FUNC-GEN-15 eLSA system availability to stakeholders

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

- Explanation: The eLSA System interfaces with geographically distributed stakeholders such as Incumbents, eLSA Licensees and NRA/Administration. The components of the eLSA System may also be deployed across geographic areas, i.e. employing a distributed approach. As such the eLSA System is vulnerable to failures due to unforeseen causes that could be inside or outside its eLSA System boundary. In addition to component or communication malfunctions, man made threats such as "denial of service" attacks are also real possibilities. Therefore, the eLSA 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 eLSA System is expected to offer a predictable level of certainty in its availability to stakeholders.

6.1.16 R-FUNC-GEN-16 eLSA system operation in case of change of sharing arrangement or sharing framework

The eLSA System shall support a change of the Spectrum Sharing Arrangement or of the Sharing Framework. The change of the Spectrum 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 eLSA System operation for the change of these prerequisites for eLSA needs to be ensured. It is assumed that a change of the Sharing Framework will require a check of the existing Spectrum Sharing Arrangement if compatible to the new Sharing Framework, and if not the corresponding adjustment.

6.1.17 R-FUNC-GEN-17 Support of allowance zones

The eLSA System shall support allowance zones as described in clause 5.6.

Explanation: It is assumed that eLSA spectrum resource sharing for vertical sector players is based on geographical sharing, i.e. the individual right of use, the Sharing Framework, and/or a particular spectrum sharing arrangement defines an allowance zone within which the eLSA Licensee can operate a local high-quality wireless network on the assigned frequency block/range on a non-interfering basis and with predictable QoS. In this context, predictable QoS means that the network operated by the eLSA Licensee can perform at a radio level in a similar way to a non-sharing case.

6.2 Incumbent protection requirements

6.2.0 Introduction

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

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

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

Explanation: Neither network details of the Incumbent (e.g. deployment related data) nor the information about the actual usage of the eLSA spectrum resource not available to the eLSA Licensee (e.g. information on active carrier frequencies in a given geographical area) are needed for eLSA. 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 eLSA System shall support mechanisms to ensure that the Incumbent's eLSA spectrum resource usage and protection requirements are met, and in particular it shall provide eLSA spectrum resource availability information to the eLSA Licensee that will be such as to meet these requirements.

Explanation: The eLSA System is able to ensure that the Incumbent's eLSA 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 eLSA System expects no changes in Incumbent's eLSA spectrum resource usage and protection requirements during normal system operation. If, however, such changes occur, the eLSA System shall be able to update the eLSA spectrum resource availability information which is communicated to the MFCN.

Any expected changes shall be subject to constraints set by the Sharing Framework or relevant spectrum sharing arrangements.

6.2.4 R-FUNC-INC-04 End-to-end acknowledgment of operational changes

The eLSA shall support the capability to provide a confirmation that the eLSA Licensee has implemented operational changes in response to a change in the Incumbent's eLSA 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 eLSA 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 acknowledgment 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. During normal eLSA system operation and in order to guarantee the QoS requirements of MFCNs this kind of operational changes are not desired. End-to-end acknowledgment of operational changes needs to be adapted for eLSA to allow also detached operation of the MFCN.

6.2.5 R-FUNC-INC-05 Support of constraints on eLSA Licensee's transmissions

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

Explanation: When the Incumbent provides its eLSA spectrum resource usage and protection requirements to the eLSA System, it may do so in the form of constraints to the eLSA Licensee's transmissions. Allowance zones, exclusion zones and restriction zones are three 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 allowances zones, or others). The spectrum 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 eLSA Licensee's transmissions

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

Explanation: When the Incumbent provides its eLSA spectrum resource usage and protection requirements to the eLSA System, it may do so in the form of constraints on the received interference due to the eLSA 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

6.3.0 Introduction

This clause contains functional requirements that relate to the process of granting the use of eLSA spectrum resource to the eLSA Licensee. Note that the term "grant" refers here to the process of providing information to the Licensee regarding the available eLSA 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 eLSA Licensee

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

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

6.3.2 R-FUNC-GRA-02 Access grant to specific spectrum sharing arrangement information

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

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

6.3.3 R-FUNC-GRA-03 General protection of the eLSA Licensee

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

Explanation: The eLSA System needs to ensure that the eLSA Licensee will not experience harmful interference when operating in the available eLSA spectrum resource as indicated by the individual authorization.

6.3.4 R-FUNC-GRA-04 Variation of eLSA Licensee's protection

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

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

6.3.5 R-FUNC-GRA-05 End-to-end acknowledgment for eLSA spectrum resource availability changes

The eLSA System shall support the capability to provide an end-to-end acknowledgement for a change in eLSA spectrum resource availability to the Incumbent to confirm that the eLSA Licensee has finalized the execution of the change in eLSA 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 eLSA spectrum resource. Common to all options is that the Incumbent sends a request to the eLSA System, the eLSA System forwards this request to the eLSA Licensee, the eLSA Licensee executes the request and sends an acknowledgement to the eLSA System, and the eLSA System informs the Incumbent about the successful performed request. This process may be asynchronous (e.g. the Incumbent requests eLSA spectrum resource for an event in 2 months, i.e. the acknowledgement by the eLSA Licensee will be received only after 2 months). It is important that the Incumbent can have confidence that the change in eLSA spectrum resource grant is performed by the eLSA Licensee. End-to-end acknowledgment for eLSA spectrum resource availability changes needs to be adapted for eLSA to allow also detached operation of the MFCN.

6.3.6 R-FUNC-GRA-06 Support for Different eLSA Licensee response times

The eLSA System shall support different eLSA Licensee response times following requests for eLSA Spectrum Resource availability changes (e.g. evacuation of an eLSA spectrum resource).

Explanation: There are scenarios where the eLSA Licensee may need to react to eLSA spectrum resource evacuation requests with different levels of urgency. For example, there may be a normal response time for the eLSA Licensee that allows a graceful exit from the band with minimum or no 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 spectrum sharing arrangements may include specific provisions regulating the expected response times. The response times may also consider the new option for detached operation.

6.4 Security requirements

6.4.0 Introduction

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

6.4.1 R-FUNC-SEC-01 Data integrity

The eLSA System shall incorporate mechanisms to ensure the integrity of the data stored in the system and the data exchanged between any of the eLSA System, Incumbents, eLSA Licensees and Administration/NRA. The eLSA 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 eLSA Licensees. Therefore, the eLSA System needs to make sure that such information as well as eLSA 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 eLSA System shall incorporate mechanisms to ensure the authenticity of the information stored in the system and exchanged between any of the eLSA System, Incumbents, eLSA 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 eLSA 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 eLSA 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 eLSA System shall incorporate mechanisms to prevent unauthorized disclosure of confidential information that the system maintains and that is exchanged between any of the eLSA System, Incumbents, eLSA Licensees and Administration/NRA.

Explanation: An eLSA System may support many Incumbents and eLSA Licensees and maintain their information in a common framework. This information may be related to the Incumbents, eLSA Licensees and their spectrum usage. On the other hand, some spectrum sharing arrangement related information is only intended to be shared between concerned Incumbents and eLSA Licensees. Therefore, the eLSA 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 eLSA 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 eLSA System shall distinguish between different authorization profiles assigned to user groups of the eLSA 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 groups. For instance, a user group may consist of the set (or a subset) of eLSA users that perform the same eLSA Role. A user group (associated with a certain eLSA Licensee) may have read access to a specific area of the eLSA System data storage function and another user group of the same eLSA Licensee may have additional write access to this area of the eLSA System data storage function, whilst an individual (associated with the same eLSA 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 eLSA System. In case the eLSA System is administered by a trusted 3rd party user, specific access rights should be defined, since a 3rd party eLSA System Administrator should not need access to most of the information shared between Incumbent and eLSA Licensee.

History

| Document history | | |
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