

DIGITALEUROPE Position Paper on Licensed Shared Access (LSA) Common Understanding, Status and Next Steps

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1 Abstract

The mobile data explosion and the ensuing spectrum shortage for wireless services have spurred discussions on various spectrum sharing paradigms. Recently the concept of Licensed Shared Access (LSA) was put forth by the Radio Spectrum Policy Group which provides a means for incumbent spectrum holders to make available, subject to sharing and commercial agreement, their spectrum for wireless services. While spectrum sharing techniques have been discussed for decades, their implementation has met with practical limitations, regulatory obstacles, and probably more importantly reluctance by potential benefactors to consider spectrum sharing at this point in time. This document presents an overview of spectrum sharing and factors affecting it with a focus on LSA.

2 Background

2.1 Utilisation of Radio Spectrum

Radio spectrum is the lifeblood of all wireless communications. Since early 20th century when large-scale commercial use of radio spectrum started, utilisation of wireless is a significant factor in many economies around the world. Its contribution has been amplified with the advent of mobile communications in latter part of 20th century due to proliferation of mobile Internet and smart devices in the last few years.

New access technologies and increased device capabilities in recent years have resulted in an exponential surge in demand for wireless data communications. This explosive demand has in many cases led to network congestion and the wireless industry is developing means to mitigate the problem through implementation of new techniques supplementing any additional exclusive spectrum.

2.2 Spectrum Allocation and Use

Historically, spectrum has been a public resource that could be assigned to public or private entities for use for a limited time through a license. Regulations governing the licenses were designed to control harmful interference. There was also a need for reshuffling of spectrum assignments to make room for new applications through spectrum refarming or repurposing.

Majority of the spectrum being utilised today is assigned through exclusive licenses; i.e. in the geographical region of applicability of the license only the licensee(s) is allowed to use the identified spectrum. There are, however, spectrum bands identified as license-exempt, set aside for applications such as Industrial-Scientific-Medical (ISM) to facilitate the use of spectrum collectively by users, an example is Wi-Fi.

2.3 Mobile Spectrum

Spectrum below 6GHz is typically considered more suitable for implementation of wide-area cellular systems. However, only a fraction of this spectrum is currently being used by cellular systems with the remainder being allocated to a variety of other Services such as Satellite, Broadcasting, etc.. The ITU process for obtaining new Mobile allocation is a necessary step in repurposing of spectrum for cellular systems in domestic regulations of countries but the associated timescales can be considerable.

Problems are, however, mounting for the repurposing process and recently industry has been facing increased difficulties in making available additional spectrum even though identified for IMT at ITU level. Frequency bands below 6 GHz are generally quite crowded due to favourable propagation characteristics for many services, with even more favourable propagation characteristics found in frequency bands below 1 GHz which is seeing significant demand and interest in recent times.

On the one hand, explosive demand for Mobile services is pressing regulators to open more spectrum. On the other, finding spectrum that could be repurposed for exclusive use with reasonable cost is increasingly difficult, time consuming and costly.

3 Scope and Purpose of this Position Paper

3.1 Different Spectrum Sharing Opportunities¹

DIGITALEUROPE is aware of the ongoing dialogue between Industry, National Administrations, ETSI, CEPT and European Commission (EC) on various spectrum sharing proposal options including -

- **TV White Spaces.** In such a scheme, Smart Grid operators, Programme Making and Special Events (PMSE) and other White Space Device (WSD) users could share the TV White Spaces in UHF spectrum.
- **Licensed Shared Access (LSA).** In such a scheme operators could share spectrum with incumbent spectrum users as LSA licensees e.g. defence and wireless cameras in 2.3 GHz.
- **Licence-Exempt Sharing.** In such as scheme, RLAN devices can collectively share spectrum with incumbent users e.g. radars in the 5 GHz band or within an ISM band e.g. 2.4 GHz.

¹ Technicolor wishes to draw attention to the fact that usage of new services with invalidated parameters in a given frequency band can cause disturbances to the reception of existing services in adjacent bands but can also cause interference in bands more remote.

3.2 DIGITALEUROPE's Focus

This DIGITALEUROPE position paper will focus on Licensed Shared Access (LSA) and will consider "Common Understanding, Status and Next Steps on Licensed Shared Access" with the objective to -

- look at the definitions and agree common understanding
- consider various architectures / solutions
- capture the work ongoing within Europe
- provide a cohesive position to external organisations e.g. European Commission

4 Abbreviations

ASA	Authorised Shared Access
CSMA	Carrier Sense Multiple Access
CEPT	Conférence Européenne des Administrations des Postes et des Télécommunications
CRS	Cognitive Radio Systems
CUS	Collective Use of Spectrum
EC	European Commission
ECC	European Communications Committee
ESO	European Standards Organizations
ETSI	European Telecommunications Standards Institute
EU	European Union
GLDB	Geolocation Databases
IMT	International Mobile Telecommunications
LSA	Licensed Shared Access
NRA	National Regulatory Authority
RRS	Reconfigurable Radio Systems
RSPG	Radio Spectrum Policy Group
SDR	Software Defined Radio
TVWS	TV White Spaces
UWB	Ultra Wide Band

5 Definitions and Common Understanding

5.1 Collective Use of Spectrum (CUS)

Based on its work on Collective Use of Spectrum (CUS) and other spectrum sharing approaches² the EU RSPG analyses and recommends the way forward for "dynamic"³ approaches to spectrum sharing in the general sense and investigates how to implement or further improve the regulatory framework for innovative sharing arrangements in Europe.

In 2011, the RSPG set itself the task of -

- revisiting the Collective Use of Spectrum (CUS) model, in order to facilitate rapid access to spectrum, given that with the development of new technologies and the emergence of different regulatory models for ensuring the most efficient use of spectrum, the CUS model appears to be a subset of spectrum sharing in a broader sense, and
- providing the European Commission with analysis and further developments concerning Collective Use of Spectrum and other spectrum sharing approaches

5.2 Licensed Shared Access (LSA)

The EU RSPG defines the LSA concept as follows:

"An individual licensed regime of a limited number of licensees in a frequency band, already allocated to one or more incumbent users, for which the additional users are allowed to use the spectrum (or part of the spectrum) in accordance with sharing rules included in the rights of use of

² Reference to the RSPG report "Collective Use of Spectrum (CUS) and Other Spectrum Sharing Approaches (November 2011)

³ Any kind of sharing, other than exclusion zones, can be considered as dynamic i.e. as long as there is any kind of time based component (even if it is for a very long period)

spectrum granted to the licensees, thereby allowing all the licensees to provide a certain level of QoS.”

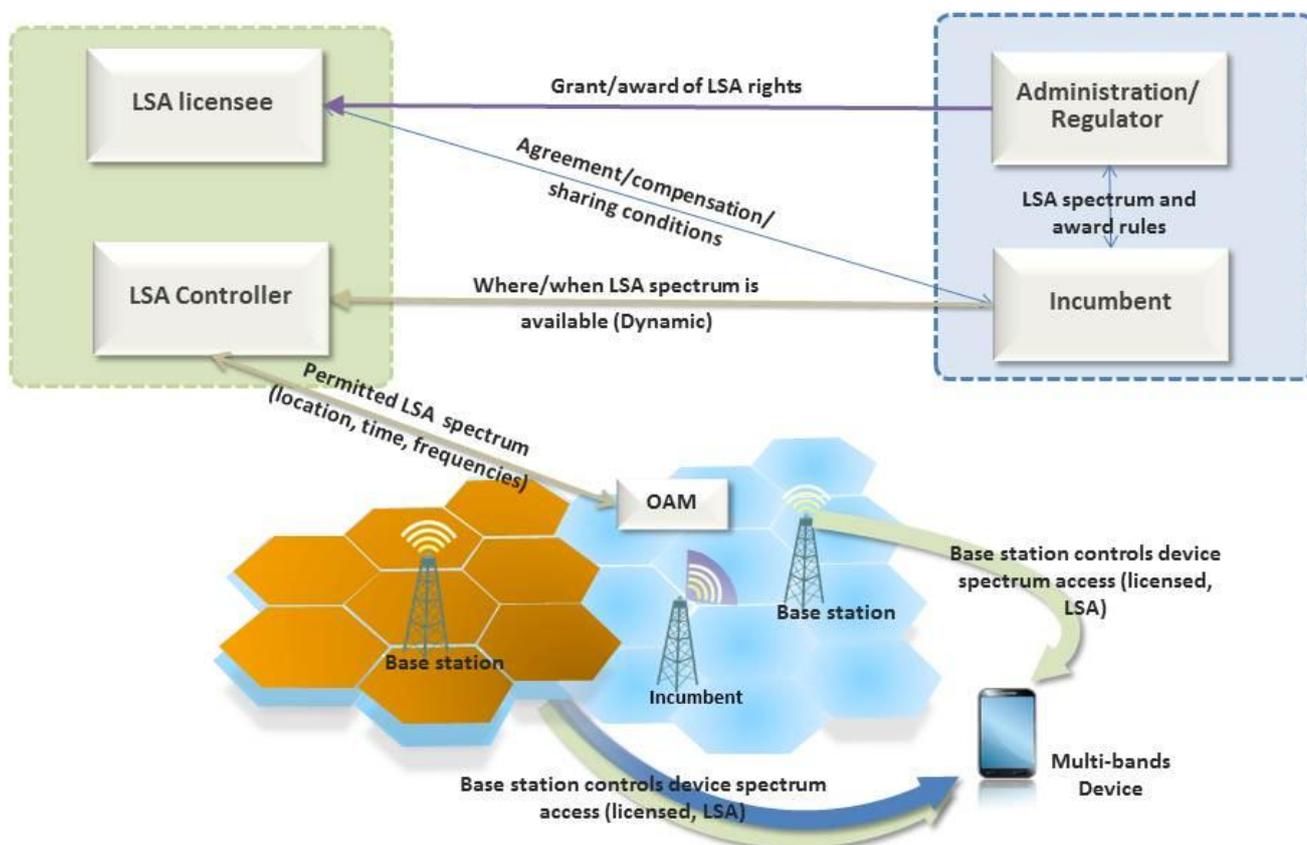
Implementation of LSA may take advantage of recent advances in cognitive technology, thus allowing sharing spectrum in a more innovative way, utilising frequency, location and time sharing bases. LSA does not impede predictability of operation given that a certain level of spectrum access shall be guaranteed (i.e., the incumbent user will have to allow access to a certain spectrum/time/location or will have to give sufficient time before significant restrictions to access are imposed). In other words, the “priority” given to the incumbent user is to be regulated. Any sharing arrangement would be part of the regulation and included in the authorisations delivered by the NRA.

DIGITALEUROPE believes –

- LSA should target bands allocated to incumbents, with “incumbent” being defined as a current holder of spectrum rights of use which have not been granted through an award procedure (first come, first served, beauty contest, auction) for commercial use. LSA does not target spectrum already awarded under the Authorization Directive (2002/21/EC)
- LSA addresses bands with clear potential for global harmonization and supported by the appropriate standardisation background
- LSA is a voluntary regulatory tool leveraging mutual commercial benefits of incumbents and LSA licensees
- LSA is compatible with the current EU Regulatory Framework. It provides an opportunity for the licensed shared use of spectrum based on the assignment of individual rights of use. The LSA licensee can enjoy exclusive spectrum rights of use where and when the spectrum is not used by the incumbent.
- Sharing under the LSA framework is binary by nature, as it admits spectrum use by either the incumbent or the LSA licensee. LSA should be based on contracts to ensure predictable QoS on LSA spectrum, leading to comparable quality as with traditional exclusive individual usage rights

6 Possible LSA Architecture

Possible system architecture for Licensed Shared Access (LSA) is depicted in the diagram below -



Spectrum bands are commonly shared by more than one Service. Considering that co-primary services in a band may not necessarily use the radio channel at the same time and in the same geographical area led to the proposal for LSA and associated techniques. Spectrum sharing schemes are classified into two categories based on priority to use the band – equal priority, or hierarchical. Examples of the first category are unlicensed spectrum or a spectrum pool where all users co-exist and manage interference. In Wi-Fi, this is achieved with through Carrier Sense Multiple Access (CSMA) where basic detect and avoid mechanisms suffice in these situations. However, QoS guarantees are not possible in un-licensed spectrum since the number of users in the system, and hence the interference, is not controlled or coordinated. Hierarchical spectrum sharing mechanisms can be broadly classified into:

Un-coordinated secondary usage (UWB, overlay-underlay, etc.): Primary user has no knowledge of Secondary user(s). However, Primary user is guaranteed to use the spectrum. The Secondary user(s) can only use the channel if it is not in use by the Primary. Mechanisms have been proposed to detect unused spectrum which involve sensing and information gathering. While these mechanisms have spurred the largest amounts of interesting research, harmful interference has been the biggest concern.

Semi-coordinated secondary use (Database Access, Cognitive Pilot Channel): Primary user is aware of Secondary users' existence. A database contains spectrum that can be shared. The Secondary user queries the database, as in the case of TVWS, or obtains information about available channels from a cognitive pilot channel. The Primary user is not aware of how many Secondary users exist in a given location, however, they have the guarantee that none exist where the Primary is using the spectrum.

Fully coordinated hierarchical use (LSA): These are evolving schemes where the incumbent and the new users (LSA licensees) fully coordinate on the use of a given spectrum. The LSA licensee obtains rights and guarantees to the incumbent user's spectrum rights. This means that when the incumbent makes available the spectrum to the LSA licensee for a given period of time, depending on the license agreement, the incumbent cannot interfere with the LSA licensee for that duration (unlike the two sharing mechanisms above). In addition, unlike the previous two schemes, the incumbent user is likely to be financially compensated for sharing their spectrum.

LSA provides additional resources for wireless services plus economic incentives to incumbents even if only used for relatively static or long-term spectrum sharing. However, static spectrum sharing will simply be an incremental improvement to wireless services access to spectrum. A dynamic framework capable of operating across a larger range of sharing scenarios is needed when reasonable amounts of spectrum available for feasible durations are to be considered for sharing. LSA can deliver this vision; from static to fully dynamic.

7 LSA Spectrum Sharing Use Cases

There are likely three spectrum sharing use cases under LSA that generally fall within three categories.

7.1 Category 1: Supplementary Spectrum Sharing Solution

A supplementary solution to accelerated availability of a given spectrum band i.e. where a band suitable for example for IMT is planned to become available to mobile broadband services possibly through repurposing but on a stretched schedule. This is more relevant if the band is available in other regions and equipment is being developed or ready. In this case, LSA could be used to make the band at least partly available to wireless services until any repurposing is completed provided that incumbents are willing to engage.

7.2 Category 2: Long-Term Spectrum Sharing Solution

A long term solution to increase spectrum utilisation efficiency in cases where a) repurposing is difficult or improbable, and/or b) repurposing is not economically viable i.e. where some certain incumbents of a band suitable for IMT targeted for repurposing cannot vacate the band or timelines are unrealistically long. Refarming of some systems could also be prohibitively costly where auction proceeds may not justify repurposing. In this case, LSA could be used to make the band at least partly available to mobile broadband services.

7.3 Category 3: Dynamic Spectrum Sharing Solution

Dynamic spectrum sharing is a situation where multiple entities share available resources on a real-time basis. In dynamic cases more sophisticated LSA capabilities are used to full extent in a highly dynamic fashion, bringing multiple levels of optimization.

8 2.3 GHz LSA Operation Use Cases

2.3 GHz LSA enables availability of additional resources for mobile broadband services. The LSA framework should take into account competition issues and supports economic growth for broadband services. These could be offered by existing mobile operators or new entrants.

In the case of an existing operator, LSA spectrum will come as an additional resource to existing spectrum holdings. When 2.3 GHz spectrum is not available under LSA, users will hand-off to existing licensed spectrum.

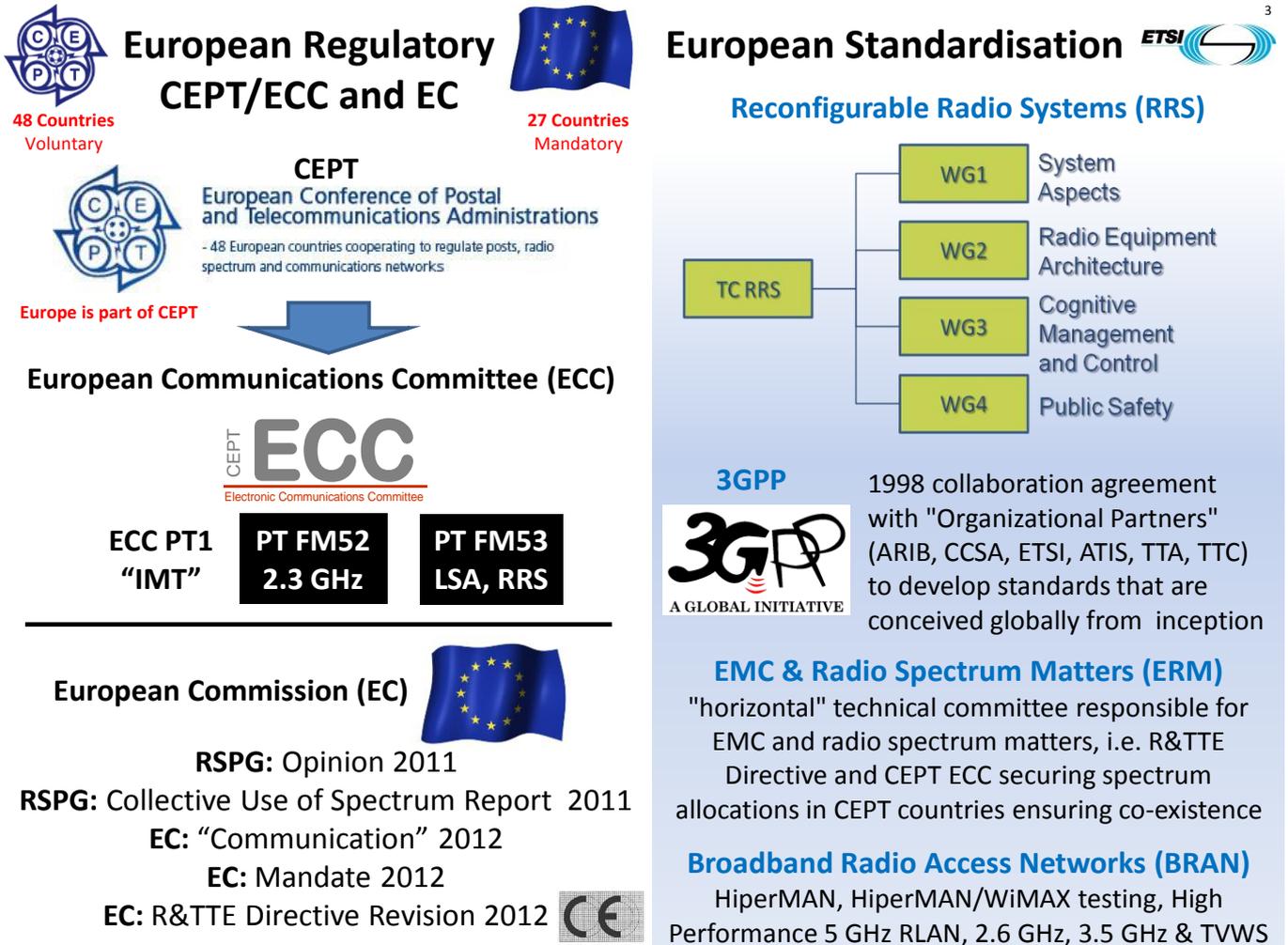
Alternatively, a new mobile operator or wireless service provider not operating a radio access network in a licensed band could enter into an agreement with a 2.3 GHz incumbent to use part of this band under the LSA framework. Depending upon the terms of the LSA license with regard to frequency range, times, geographies it applies to, a new mobile operator or wireless service provider may be able to build a business model solely on that LSA licence. In cases where service continuity cannot be provided on the LSA licence alone, the new mobile operator can–

- use national and/or regional roaming with other mobile operators who operate in a licensed band
- use Mobile Virtual Network Operator (MVNO) under other mobile operator

- or enter a network sharing agreement with another mobile operator

9 Current Regulation and Standardization Activities within Europe

It is also important to understand the regulatory and standards environment in which LSA is being discussed in Europe. The diagram below captures the regulatory work ongoing within CEPT/EC and the standardisation work ongoing within ETSI.



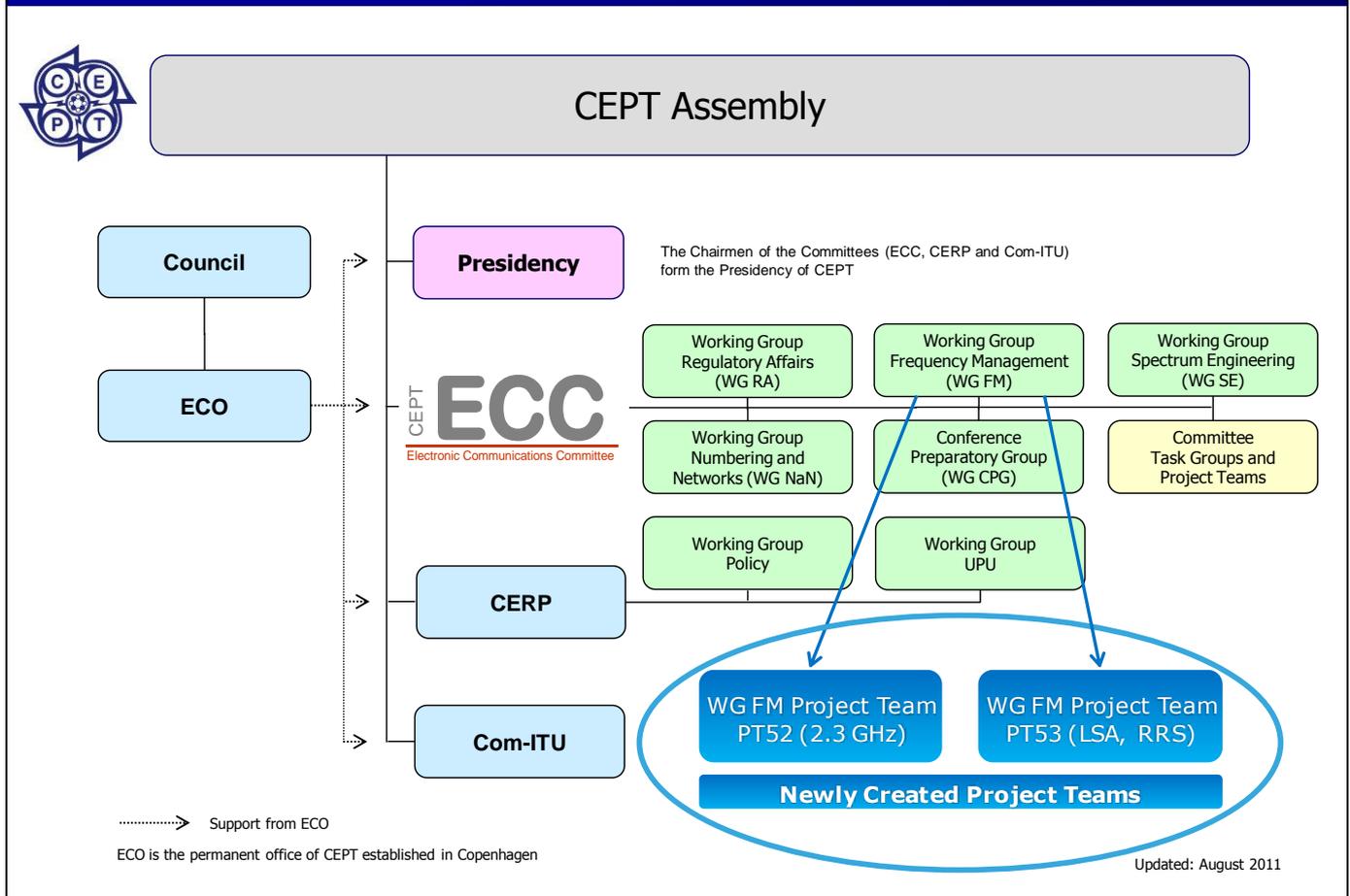
9.1 CEPT

CEPT studied Authorized Shared Access (ASA) concept since 2011. Under this concept, the incumbent user(s) share spectrum with one or several licensed ASA users. A key feature of ASA is to ensure a predictable quality of service for all spectrum rights of use holders, network operators, wireless services providers and for consumers. The more stable the incumbent's spectrum use, the better predictability there is for the QoS of the ASA licensees. The inherently guaranteed QoS is indeed a key argument for major stakeholders, in particular for cellular operators. As an inherent limitation, ASA will operate on shared and non-interference basis, subject to individual authorization (i.e. licenses), in bands allocated to the Mobile Service and identified for IMT by ITU-R.

October 2012, CEPT Working Group Frequency Management (CEPT WG FM) decided to further develop the required regulation framework in order to enable the usage of LSA. For this purpose, two Project Teams have been set-up.



CEPT Organisation



- **CEPT ECC WGFM Project Team 52 (FM52)** on 2.3-2.4 GHz band: Objective to develop draft ECC Decision, aimed at 2.3-2.4 GHz frequency band including regulatory provisions based on LSA.
- **CEPT ECC WGFM Project Team 53 (FM53)** on Reconfigurable Radio Systems (RRS) and Licensed Shared Access (LSA): Objective is enable introduction of LSA by analysing the procedures for the assignment of LSA individual rights of use, in conformity with the EU Framework, developing an ECC Report on general conditions and band-specific conditions for the implementation of the LSA, establishing relevant interaction with ETSI and studying “level of guarantee” in spectrum access required by an operator for network investment.

The 2.3-2.4 GHz band has been identified as the band for the first LSA implementation. Additional bands are expected to follow.

9.2 European Commission (EC)

The EU regulatory framework for electronic communications seeks to facilitate access to spectrum based on the least onerous authorisation system possible and favours use of general authorisations, except where individual licences are clearly necessary, e.g. to ensure protection against harmful interference. It establishes principles of efficient use and effective management of spectrum, as well as technology and service neutrality. The RSPB extends these principles to all relevant EU policy areas. To enhance efficiency and flexibility, it requires Member States, in cooperation with the EC, to foster, where appropriate, the collective use and shared use of spectrum.

Corresponding to EC policy objective of allocating sufficient and appropriate spectrum in a timely manner and to best meet the increasing demand for wireless broadband, the RSPB aims to identify at least 1200

MHz by 2015. Spectrum sharing approaches small cell base stations and mesh networks are explicitly referred to. The RSPG also requires the EC, in cooperation with Member States, to assess the possibility of extending the allocation of unlicensed spectrum for wireless access systems in the 5 GHz range. Meeting these objectives requires solutions adapted to the different authorisation situations. In addition to licence-exempt bands and exclusively licensed cleared bands, there are also bands where sharing can happen between incumbent users and a number of users which will have licenses. The RSPG has established a spectrum inventory to identify spectrum-sharing opportunities.

The shared use of spectrum refers to situations in which a number of independent users and/or devices are allowed to access the same range of frequencies under certain conditions. Stakeholders are increasingly turning to emerging sharing possibilities to meet growing demands for wireless connectivity. To maximise the benefits of efficient spectrum use, it is necessary to support this trend, while ensuring that there is no deterioration in the quality of services provided.

EC has also considered ASA and has been further developed within the EC's Radio Spectrum Policy Group (RSPG) after considering the regulatory aspects of an ASA approach, using this as the basis to foster potential to share spectrum, which is not limited to only bands identified for IMT bands, in a harmonised manner within a license regime. EC now refers to this as "Licensed Shared Access" (LSA).

Beyond activities on the regulation level as indicated above, the EC issued a standardisation mandate to cover at least the following three directions

- **Objective A (deadline earliest end 2014)**
In the area of commercial applications, to enable the deployment and operation of cognitive radio systems (CRSs) including white space devices (WSD) and devices under Licensed Shared Access regime, dependent for their use of radio spectrum on information obtained from geolocation databases (GLDB).
- **Objective B (deadline earliest mid-2016)**
In the area of civil security and military applications, to ensure the standardization of suitable SDR architecture(s) (SCA-based for the military domain).
- **Objective C (deadline earliest mid-2016)**
To explore potential areas of synergy among commercial, civil security and military applications.

The corresponding activities started after the publication of the mandate, in particular in the ETSI Reconfigurable Radio Systems (RRS) Technical Body.

9.3 ETSI

ETSI RRS Technical Body is expected to be the centre of competence within ETSI for future Spectrum Sharing related standards. Currently, ETSI RRS is developing a System Reference Document (SRdoc) which serves as a means for communicating officially with CEPT. Industry players are detailing the requirements on the set-up of an LSA framework from their perspective and CEPT is subsequently chartered to consider corresponding regulation changes in order to make possible the entering to the market of such systems.

In the framework of the above-mentioned mandate, ETSI RRS is expected to furthermore develop Harmonized Standards (HS) which are a regulatory tool in Europe. The European Standards Organizations (ESOs), including ETSI, support European legislation in helping the implementation of the EC directives. European Standards developed in response to a mandate are called 'Harmonized Standards'. Those Harmonized Standards are supporting EU Directives and Regulations and are essential for device certification.

10 DIGITALEUROPE's Position

10.1 Terminology

DIGITALEUROPE will use the term "Licensed Shared Access (LSA)" to -

- avoid any confusion between other acronyms
- be aligned the scope of CEPT ECC WGMF Project Team 53 (FM53) and Project Team 52 (FM52)

- be aligned with terminology used within the RSPG
- be aligned with terminology used in ETSI System Reference Document TR 103 113

10.2 DIGITALEUROPE Position on Shared Spectrum for Mobile Broadband Services

DIGITALEUROPE supports the following policies (in priority order)

- **#1 Clear Spectrum for use on an Exclusive Licensed Basis**

Wherever possible, European Administrations should release or re-purpose spectrum for uses that bring greater social and economic benefits to Europe on an exclusive licensed basis. Presumptively, cleared spectrum should be assigned on an exclusive licensed basis to enable efficient long range, wide area network (WAN) uses.

- **#2 Share Spectrum on a LSA Basis**

Where clearing is not possible in a reasonable timeframe or is too costly, European Administrations should look for sharing opportunities between incumbent users and new commercial users on a LSA basis.

Enabling sharing on a well defined LSA basis will foster efficient market incentives for high quality of service as well as infrastructure and technology investment, and encourage voluntary, market-driven negotiations between the incumbent user and the new licensee to increase the value of the spectrum (e.g. mitigation mechanisms that permit operation in specific geographic areas, at specified frequencies, or during specified times).

- **#3 Share Spectrum on an License Exempt Basis**

Where network service use of spectrum is not possible on a LSA basis Administration's should look for sharing opportunities on a licence exempt basis.

10.3 Evolution of Position on Shared Spectrum

DIGITALEUROPE will regularly review this position paper based on current status of discussions and direction taken within Europe through decisions and deliverables produced by EC, CEPT, and ETSI.

11 Summary

Spectrum allocation and utilization has come a long way from the early twentieth century. Wireless communications is now ubiquitous with high speed connectivity anywhere, anytime and to devices that have been evolving to unimaginable levels. In addition to putting a heavy burden on spectrum, they have also spurred new models for spectrum use. We have described the evolution of spectrum sharing leading to Licensed Shared Access (LSA) providing a symbiotic sharing relationship between incumbents and mobile operators. We outlined categories of LSA usage which if defined properly provide a robust and scalable means for implementing secure and reliable spectrum sharing arrangements. The flexible structure of LSA allows multiple use cases and variations in implementation in accordance with mobile broadband services' needs over the short and the long run.

11.1 Possible Architectural / Solutions

LSA can provide additional resources for wireless services and economic incentives to incumbent users even if it is used for relatively static and long term spectrum sharing. However, static spectrum sharing will simply be an incremental improvement to wireless services access to spectrum. A more dynamic framework capable of operating across a larger range of sharing scenarios will only be needed when reasonable amounts of spectrum are to be considered for sharing.

11.2 Regulatory Framework

Within the complex European Regulatory framework DIGITALEUROPE must maintain a proactive influencing strategy to influence, where appropriate / possible, while remaining vigilant to ensure regulatory and standardisation activities maximise LSA opportunities for the future.

DIGITALEUROPE believes that what is ultimately desirable is a harmonised, technology neutral, framework within Europe for shared use of spectrum.

DIGITALEUROPE will need to consider contributing to the recently issued EC Mandate.

DIGITALEUROPE considers that the LSA implementation should allow an equal opportunity for existing mobile operators as well as new entrants taking into account competition and economic growth for the mobile broadband services.

11.3 DIGITALEUROPE Shared Spectrum for Mobile Broadband Services

In priority order, DIGITALEUROPE supports the availability of spectrum for wireless broadband services in the following order 1) Clear Spectrum for use on an Exclusive Licensed Basis, 2) Share Spectrum on a LSA basis, 3) Share Spectrum on a License Exempt basis.

ABOUT DIGITALEUROPE

DIGITALEUROPE represents the digital technology industry in Europe. Our members include some of the world's largest IT, telecoms and consumer electronics companies and national associations from every part of Europe. DIGITALEUROPE wants European businesses and citizens to benefit from digital technologies and for Europe to grow, attract and sustain the world's best digital technology companies.

DIGITALEUROPE ensures industry participation in the development and implementation of EU policies. DIGITALEUROPE's members include 60 global corporations and 33 national trade associations from across Europe. In total, 10,000 companies employing two million citizens and generating €1 trillion in revenues. Our website provides further information on our recent news and activities: <http://www.digitaleurope.org>

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