

The Italian Pilot on the Licensed Shared Access in the 2.3-2.4 GHz band

The shared access to spectrum based on Licensed Shared Access.

LSA Workshop Rome 23rd September 2016

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Spectrum Management

- **Frequency management** is a set of technical and administrative procedures to ensure the exercise, without interference, to radio stations with the objective to ensure the optimal exploitation of the resource.

Peculiarities of the radio spectrum

- Radio spectrum is a **natural resource** at disposal of human kind .
- Radio spectrum **is not consumed with use**, on the contrary indeed, it is **wasted** if not used
- Spectrum is a **public resource**, to be managed by the NRA in accordance with agreed rules

Peculiarities of the radio spectrum

- **nternational**, because each country has at its disposal the whole radio spectrum
- Spectrum **cannot be confined** within national boundaries
- Radio spectrum is a **limited resource**. In theory, it is available to anyone, but the use of a frequency block imposes **constrains** to another user in the same area

The importance of harmonization

Harmonization is essential to:

- ✓ avoid **interferences**, at national and international level,
- ✓ put radio **equipments on the market**
- ✓ increase the **economies of scale**
- ✓ implement **International** communications systems

Therefore:

- Spectrum rules shall be **harmonised** at international level
- Spectrum has to be used in a **rational and efficient** way

The levels of spectrum Management

- **Global (ITU - International Telecommunications Union)**
 - **Radio Regulations** contains frequency allocation table, Rules on the use of radio frequencies, Coordination procedures,..
 - RR also establishes the need to leave maximum flexibility to each country
- **Regional (in Europe CEPT/ECC, EU)**
 - Exercise flexibility by regional harmonisation
- **Single National Administrations**
 - States are responsible to ensure proper balance of all spectrum needs in their country. **Adopt the National Frequency Allocation Table**, and other legally binding regulatory measures within the national boundaries.
- **Each level has its own purpose and merits.**

The demand of spectrum is increasing spectrum is becoming crowded

Spectrum is vital for all human activities:

- **Commercial uses**
 - Mobile
 - Radio, television
 - Wifi, radio tags, ...
- **Government uses**
 - Defence, interior, safety, emergency
 - Transportation (air, maritime, roads)
 - Scientific radio services (Meteorology, space, research..)
- **Economic, social & cultural life**
 - Societal (cultural, media pluralism)
 - Economic (industrial, commercial)
 - Strategic

Some examples of spectrum sharing in CEPT countries

- Today it is becoming more and more **necessary** to introduce **spectrum sharing mechanisms** to enable, new technologies and new applications, to entry into the market
- **Shared use** of spectrum is becoming **a necessity** for the future development of radio communications
- In CEPT countries, **Collective Use of spectrum** has been experienced, with success for many years, by many radio applications using different sharing techniques, such as Short Range Devices (SRD), R-LAN, PMSE,...
- These devices use the spectrum on non interference basis and without claiming protection

Cognitive Technology Concept

Cognitive Technology can increase efficiency in the use of the radio spectrum. It is based on the following observation:

Radio applications do not use their assigned spectrum continuously and in the whole operating area

A cognitive device:

- Consults a database to determine which radio channels can be used at its location (**geo location data base**)
- conducts measurements (**Spectrum sensing**) within the above candidate set of channels with aim to:
 - ✓ use temporarily and spatially the radio channel not in use
 - ✓ release it when requested by the primary user
 - ✓ move to another free channel

Licensed Shared Access (LSA)

- **LSA is an innovative sharing approach**, studied by CEPT that is going to be implemented in some frequency bands, such as 2.3-2.4 GHz band
- The innovation is that LSA approach consists of:
“an authorized use of a portion of spectrum already licensed to an incumbent operator”
- The incumbent remains the holder of right of use, but the spectrum may be used by **LSA operators**, under agreed technical conditions

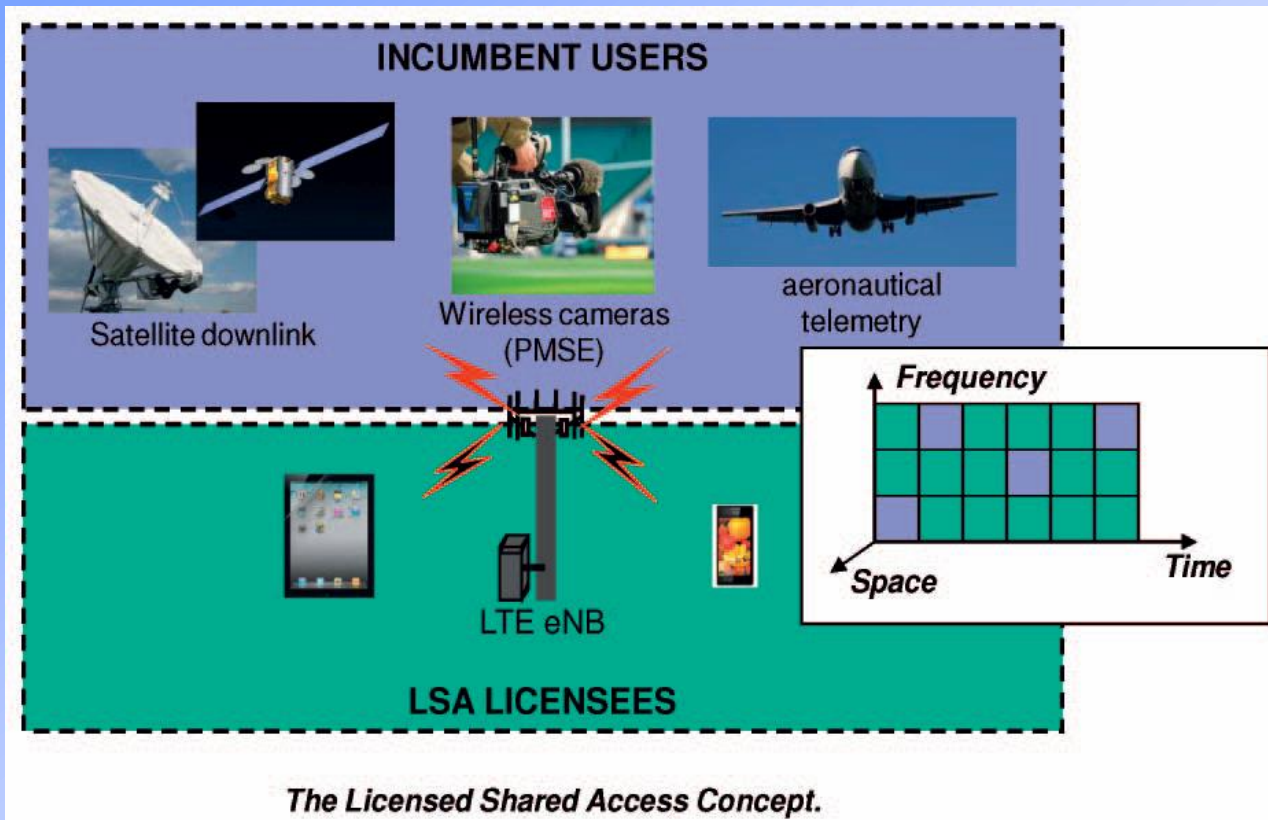
Licensed Shared Access Approach

- The **"incumbent"** permits, **temporarily** and in a given **geographical area**, the use of part of its assigned spectrum band, to a **new user**, with **agreed technical conditions** established to ensure the new user a certain **quality of service** without causing harmful interference to incumbent itself.

Everything is done under the **supervision** of the national spectrum authority

- **LSA approach** simplifies and allows **in a short time** the entry of new operators and new applications in a given frequency band, **avoiding the long procedures of refarming or of changing allocations in the Radio Regulations.**
- **LSA approach** significantly increases the **efficient use** of spectrum

LSA Concept



Regulatory framework in 2300-2400 MHz band

- The frequency band 2.3-2.4 MHz is **allocated** to the Mobile Service on a primary basis in all three ITU regions
- **WRC-07** identified the band 2.3-2.4 MHz for **IMT** (footnote RR 5.384A)
- **ECA Table** (ERC/REP 27 – May 2016) - In CEPT countries the band 2300-2400 MHz is used by the following systems/services:
 - Telemetry (both terrestrial and aeronautical telemetry)
 - Governmental use
 - Programme making and special events (PMSE) applications (SAP/SAB video links);
 - Amateur, as a secondary service.

Relevant deliverables on LSA in Europe

- **RSPG** approved in November 2013: **Opinion on Licensed Shared Access**, (RSPG13-538)
- **ECC Report 205** (Feb.2014) - Licensed Shared Access (LSA)
- **ECC/REC/(14)04** (May 2014) -Cross-border coordination between MFCN and other systems in the frequency band 2300-2400 MHz.
- **ECC/DEC/(14)02** (June 2014) - Harmonised technical and regulatory conditions for the use of the band 2300-2400 MHz for Mobile/Fixed Communications Networks (MFCN), containing LSA guidelines.
- **ECC/REC/(15)04** (July 2015) - Guidance for the implementation of a sharing framework between MFCN and PMSE within 2300-2400 MHz

Other deliverables on LSA

In response to the Mandates from the **European Commission** on 'Harmonised technical conditions for the 2300-2400 MHz frequency band, the following CEPT Reports were adopted:

- **CEPT Report 55** - Technical conditions for wireless broadband (WBB) usage of the 2300-2400 MHz frequency band (28.09.2014)
- **CEPT Report 56** - sharing between WBB applications and the relevant incumbent services/applications in the 2.3 GHz (06.03.2015)
- **CEPT Report 58** - Technical sharing solutions for the shared use of the 2300-2400 MHz band for WBB and PMSE (03.07.2015)

ECO website on National Activities

- ECO opened a window on CEPT/ECC website to **exchange information on LSA trials** with the objective to share experience among countries on LSA trials and testing (e.g. measurement results).

LSA trial in Rome in the band 2300-2400 MHz

- **In 2015**, the Italian Ministry for Economic Development decided to carry out a pilot project in collaboration with the Joint Research Centre of the European Commission to test this new spectrum sharing approach
- The pilot project was intended to be a **field test of LSA approach** for wireless broadband telecommunications in the 2.3-2.4 GHz band.
- It is being carried out **in Rome at the Ministry premises**, where a confined mobile LTE TDD network at 2.3-2.4 GHz has been deployed and a proper architecture enabling the LSA concept has been implemented.

Motivation behind the Italian LSA Pilot

- Considering that in Italy there is no incumbent user but many private users of very small channels, there aren't the conditions to immediately apply in this band the LSA approach.
- Anyway, taking into account the designation of this band for IMT applications and the **initiatives of European Commission and CEPT**, Italy wanted to consider how to open this band for WBB systems while protecting the incumbent applications.

Motivation behind the Italian LSA Pilot

- **That's why Italy accepted** to carry out this **LSA trial** considering as incumbent fixed links, wireless cameras and governamental uses.
- **From this Trial Italy intended** to obtain useful technical information in order to apply it, in this and other frequency bands, such as **3.6-3.8 GHz**, even in view to use this band for 5G.

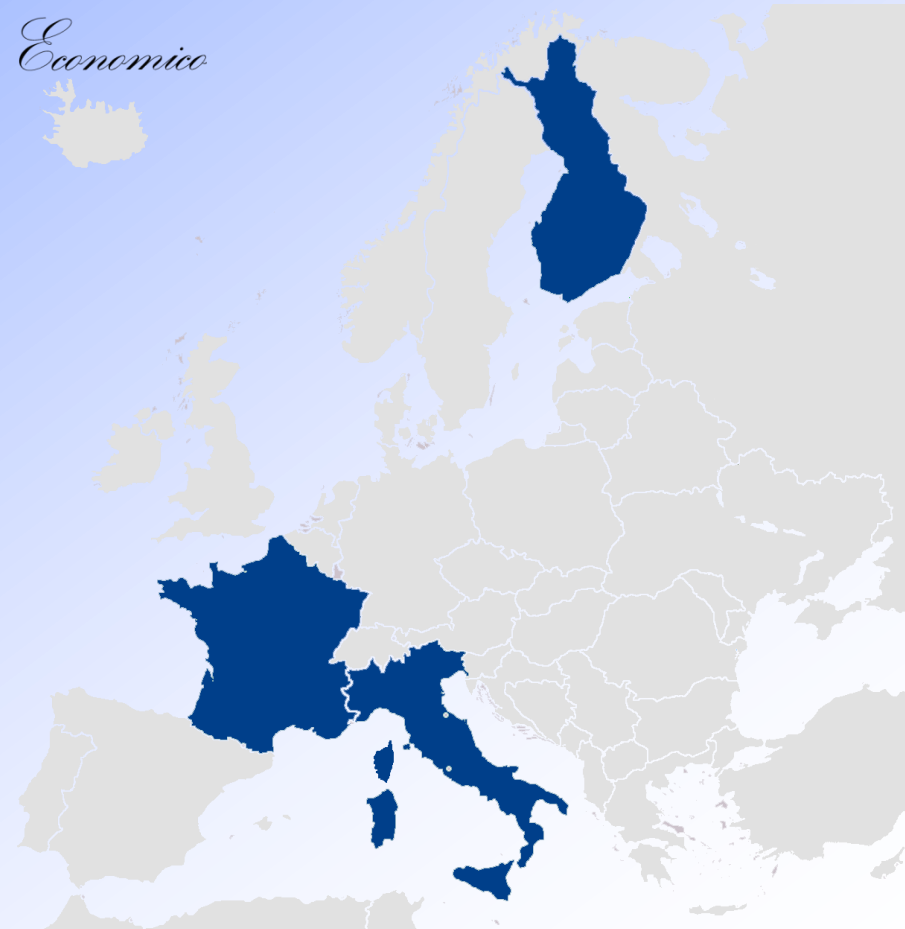
Pilot leaders and partners



Technical Coordinator:



Partners:



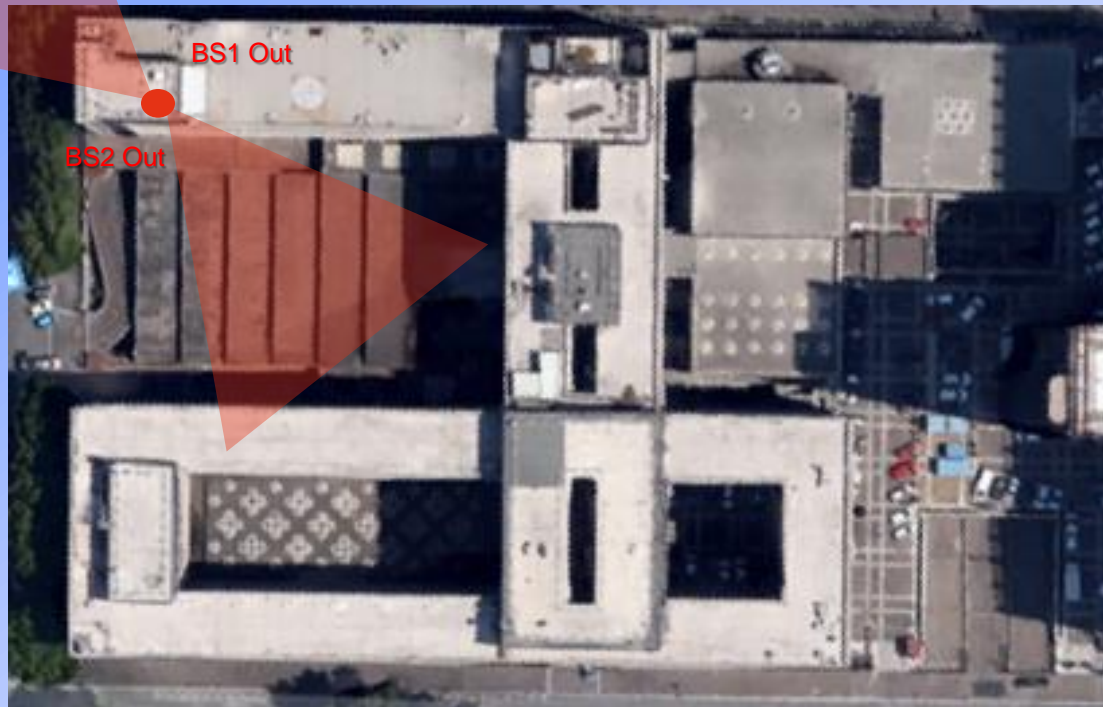
The site and frequency band for the LSA Pilot in Rome



- MiSE premises in Rome in the EUR district
- Frequency band: 2330-2350 MHz



Two outdoor Base Stations installed on the building rooftop

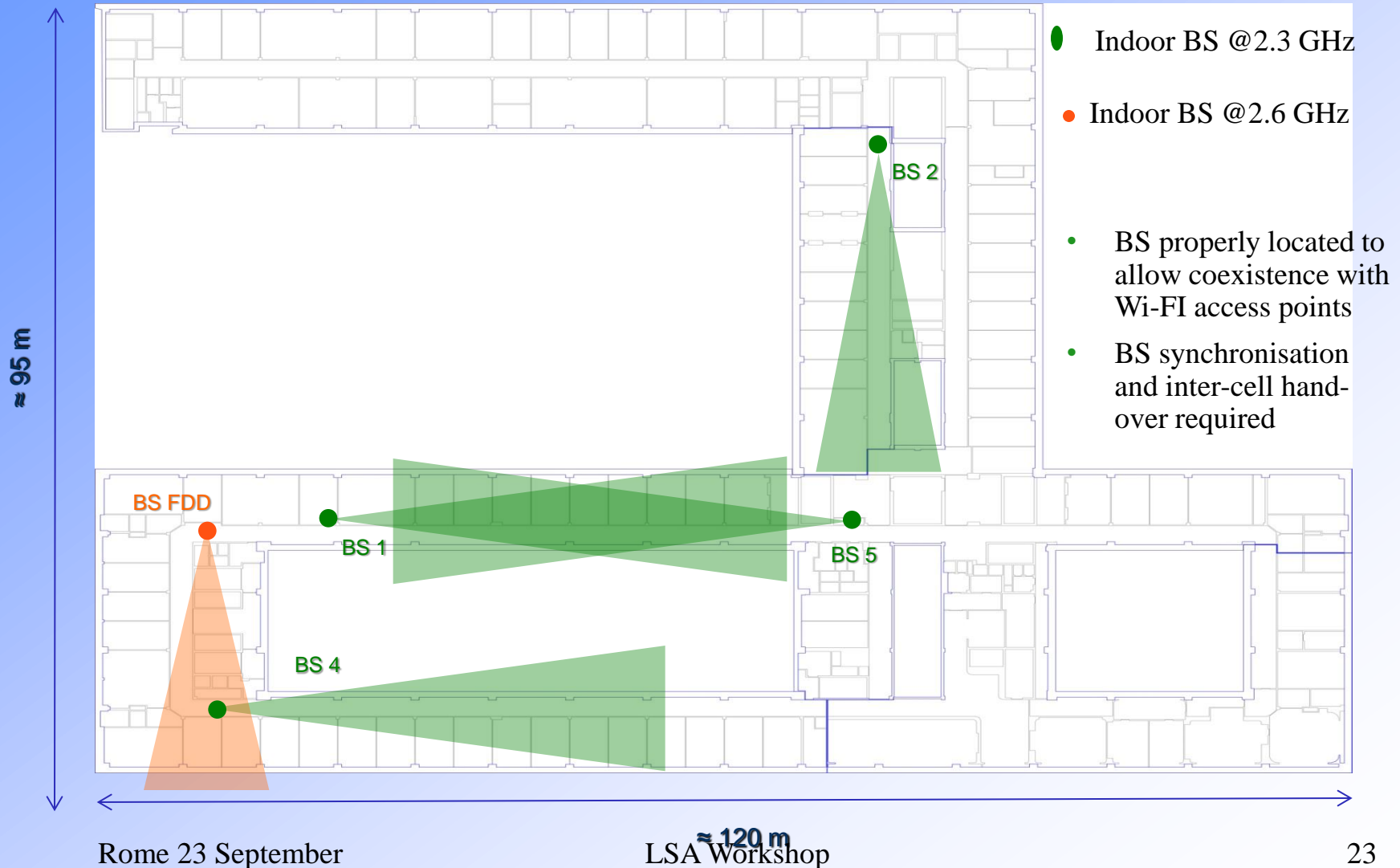


The MISE Premises in Rome (EUR area)

- Outdoor coverage is obtained through 2 outdoor BSs placed on the building rooftop.
- BS properly located to allow coexistence with equipment on the rooftop
- BS Synchronisation and inter-cell hand-over required

● Outdoor BS @ 2.3 GHz

Five indoor Base Stations installed at 7th floor

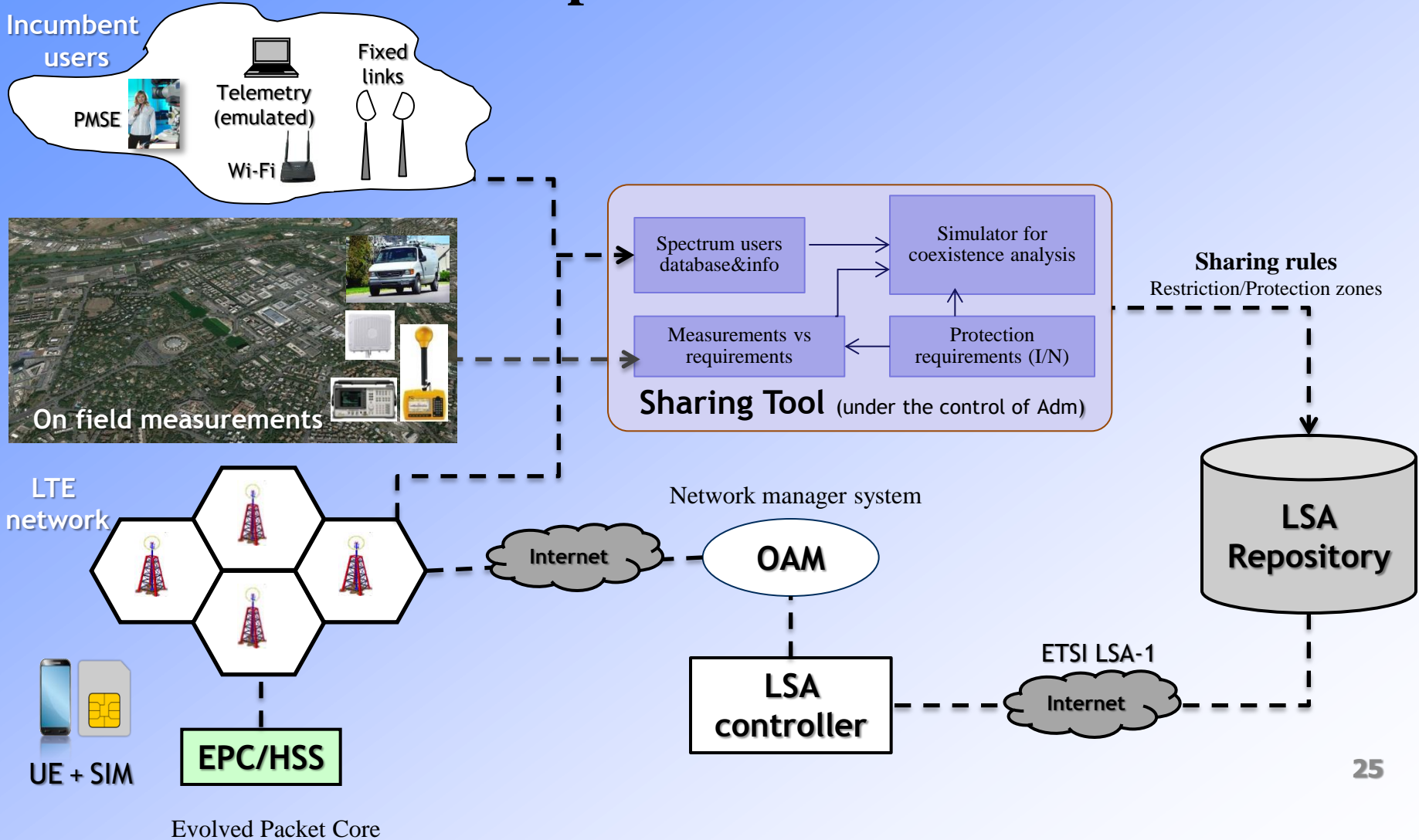


eNodeB Technical Details

	OUTDOOR	INDOOR
Model	NOKIA Flexi Zone Micro Integrated Directional Antenna	NOKIA Flexi Zone Pico Antennas
Number of nodes	2 in Band 40	5 in Band 40 1 in Band 7
Band supported	2300-2400 MHz – Band 40	2300-2400 MHz – Band 40 2500-2690 MHz – Band 7
Channel bandwidth	20 MHz	20 MHz
Carrier Power	5 W (37 dBm)*	≤ 250 mW (24 dBm)*
Supported configuration	2Tx/2Rx MIMO	2Tx/2Rx MIMO
Antenna gain	8 dBi	0 dBi
Beamwidth	70 degrees H-plane 60 degrees O-plane	Omnidirectional

- Ease compliance with the Italian EMF emission limits
- No need of authorization from the local Environment Agency for the BS installation

The pilot architecture



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The pilot elements

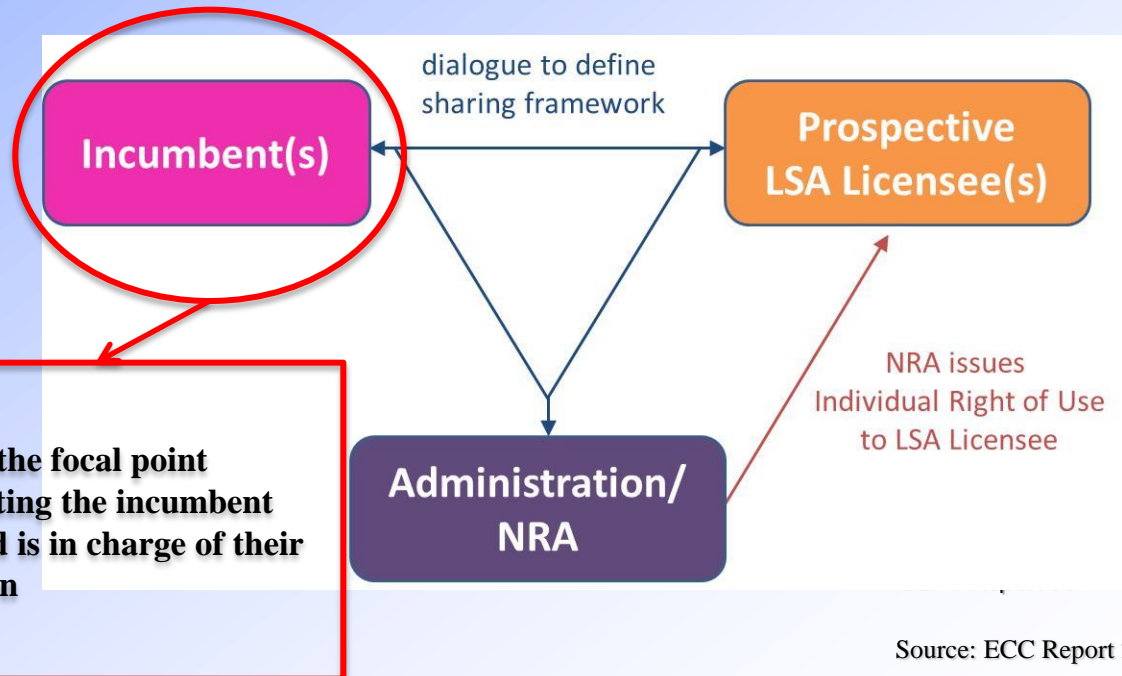
- The pilot consists of:
 - 2 outdoor TD-LTE BS in Band 40
 - 5 indoor TD-LTE BS in Band 40
 - 1 indoor FD-LTE BS in Band 7
- An **international test platform** and distributed architecture:
 - eNodeB deployment and EPC in **Italy**
 - The Network manager (OAM) and the **LSA controller** are in **Finland**.
 - The LSA **repository** is in **France**
- Integration of technologies, solutions and devices from various companies:
 - The indoor and outdoor BSs employed for the LSA Pilot are connected to the **Evolved Packet Core** (EPC), which allows the communication toward the devices.
 - The **network management system** (OAM) communicates with the LSA controller and is capable of managing the mobile network in order to cope with the requirements imposed by the **sharing rules** stored in the LSA repository.
- A set of User Equipment: off-the-shelf smartphones provided with test SIMs.

LSA Regulatory Process

The regulatory process required before the introduction of WBB under LSA

- **dialogue** involving Administration / NRA, Incumbent(s) and prospective LSA Licensees, in order to define the sharing framework;
- the **Administration** / NRA issuing an individual right of use to the LSA Licensee, following a procedure that is compliant with the Authorisation Directive.

The exact implementation of LSA is likely to differ from country to country, in order to adapt to national circumstances.

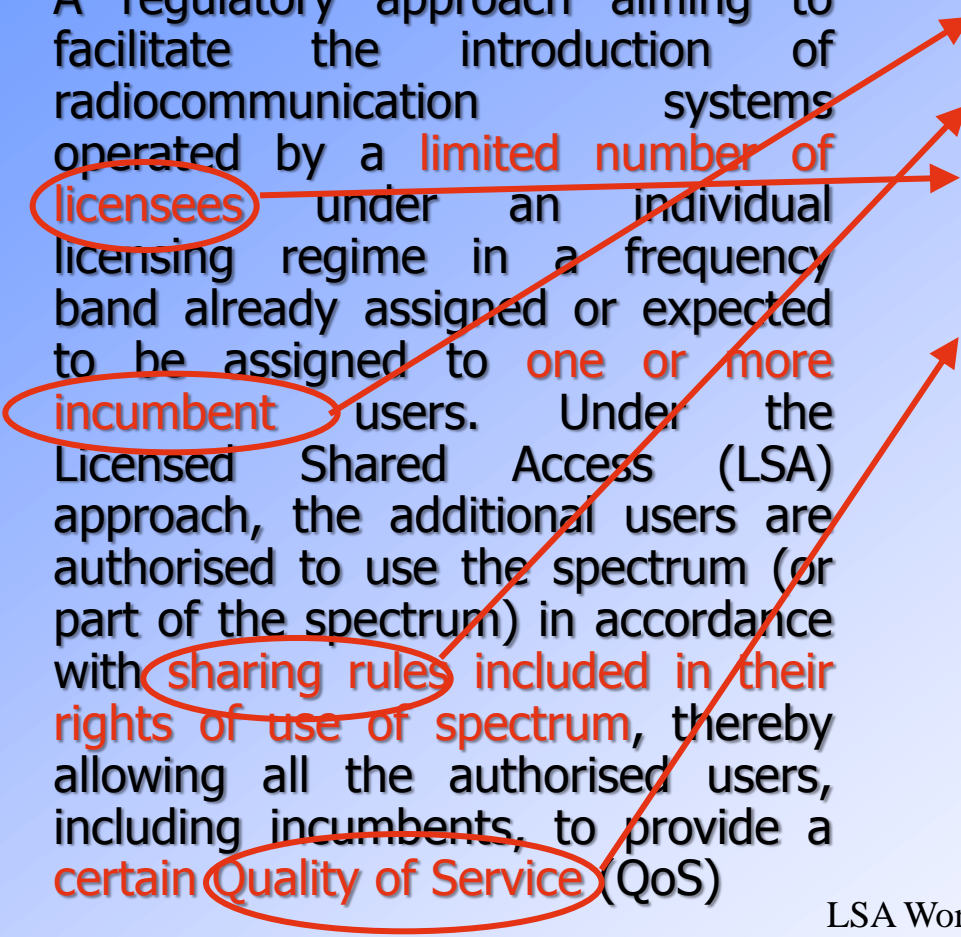


Source: ECC Report 205

The LSA process for the pilot

RSPG Definition of LSA

A regulatory approach aiming to facilitate the introduction of radiocommunication systems operated by a **limited number of licensees** under an individual licensing regime in a frequency band already assigned or expected to be assigned to **one or more incumbent** users. Under the Licensed Shared Access (LSA) approach, the additional users are authorised to use the spectrum (or part of the spectrum) in accordance with **sharing rules included in their rights of use of spectrum**, thereby allowing all the authorised users, including incumbents, to provide a **certain Quality of Service** (QoS)



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graph LR
    A1([limited number of licensees]) --> S1[1. Identify incumbents]
    A2([one or more incumbent]) --> S2[2. Determine rules for sharing]
    A3([sharing rules included in their rights of use of spectrum]) --> S3[3. Open spectrum to additional users based on LSA]
    A4([certain Quality of Service]) --> S4[4. Verify compliance of sharing conditions and QoS of both incumbent and MFCN uses.]
```

0. Determine the portion of frequency band for LSA
1. Identify incumbents
2. Determine rules for sharing
3. Open spectrum to additional users based on LSA
4. Verify compliance of sharing conditions and QoS of both incumbent and MFCN uses.

1) Identify incumbents

- The 2.3-2.4 GHz band is used in Italy for:
 - **Fixed Service:** numerous incumbent users operate their low capacity fixed links (1, 2, 4 MHz Ch.) under an individual licensing regime
 - **PMSE wireless cameras**, according to ERC/REC 25-10, authorisation for temporary usage granted for video links
 - **Governmental use**, which affects only a very small portion of the band 2334-2336. Telemetry systems are software emulated, considering the interest across Europe on this kind of usage

2) Determine rules for sharing

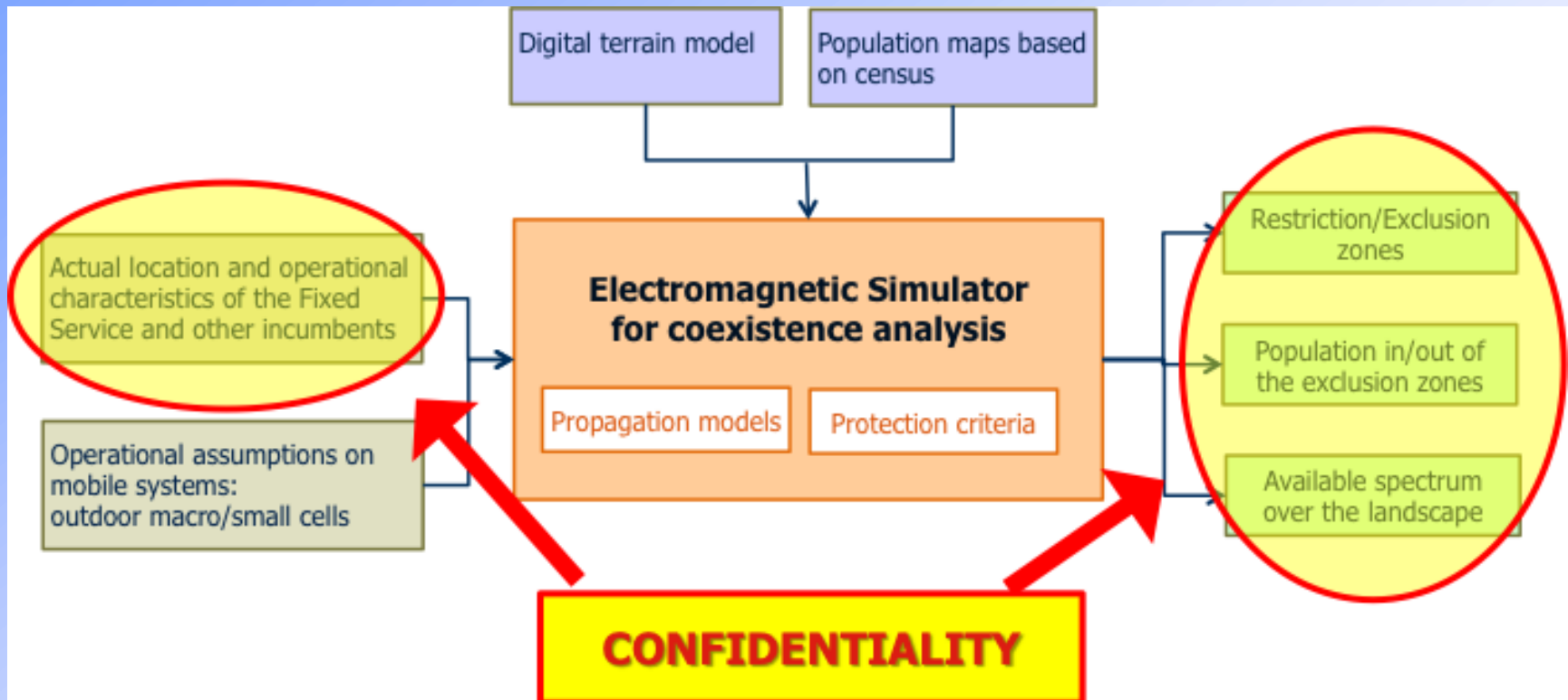
- **The Ministry decided to adopt different approaches to protect the incumbents:**

Incumbent use	Protection approach
Fixed Links	Restriction/Exclusion Zones
PMSE (videolinks)	Protection Zones
Telemetry (emulated)	Protection Zones

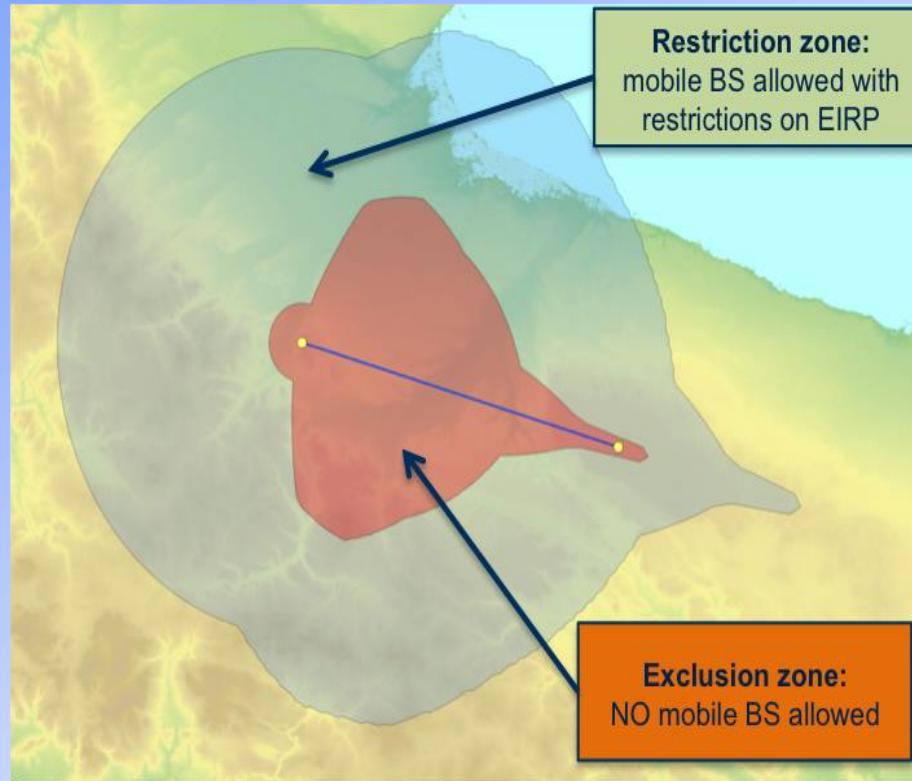
- **Protection may be based on different protection criteria:**
 - **“I/N” criterion.** The value of the maximum permitted interference is defined in relation to the thermal noise floor. For example, for a target rise of 1 dB in the noise floor, the value of interference would need to be 6 dB below the thermal noise floor.
 - **“C/(I+N)” criterion.** The value of the maximum permitted interference is defined in relation to a target reduction in the receiver’s signal-to-interference-plus-noise ratio. This criterion might be appropriate where the receiver operates at some margin above its minimum sensitivity.

2) Coexistence analysis to determine the sharing rules

- The definition of the sharing rules relies on the analysis of coexistence between the incumbent users and the mobile service, performed through a Sharing Tool developed by FUB (as a third party) and operated under the control of the Italian Ministry of Economic Development.



2) Fixed Service: Restriction/Exclusion Zones



Fixed Links

2) PMSE and Telemetry: Protection Zones

PMSE (videolinks)



The mean field strength, within the protection zone, shall not exceed a defined value in $\text{dB}\mu\text{V}/\text{m}/\text{MHz}$ at a defined receiver antenna height above ground level



Telemetry (emulated)



4) Verify compliance

Various tests have been executed within the LSA Pilot

Scope	Tests
Functional tests	Coverage (EIRP pattern, outdoor drive tests and indoor walk tests) Hand-over Speed tests Channel preemption (evacuation time) Carrier power reduction
Regulatory compliance	Compliance with the sharing rules EMF exposure Propagation model

Thank you for your attention

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Grazie