



# **Opportunities of Cognitive Radio *Technologies for Advanced Regulatory Regimes***

**Eiman Mohyeldin, Max Riegel (Nokia Siemens Networks)**

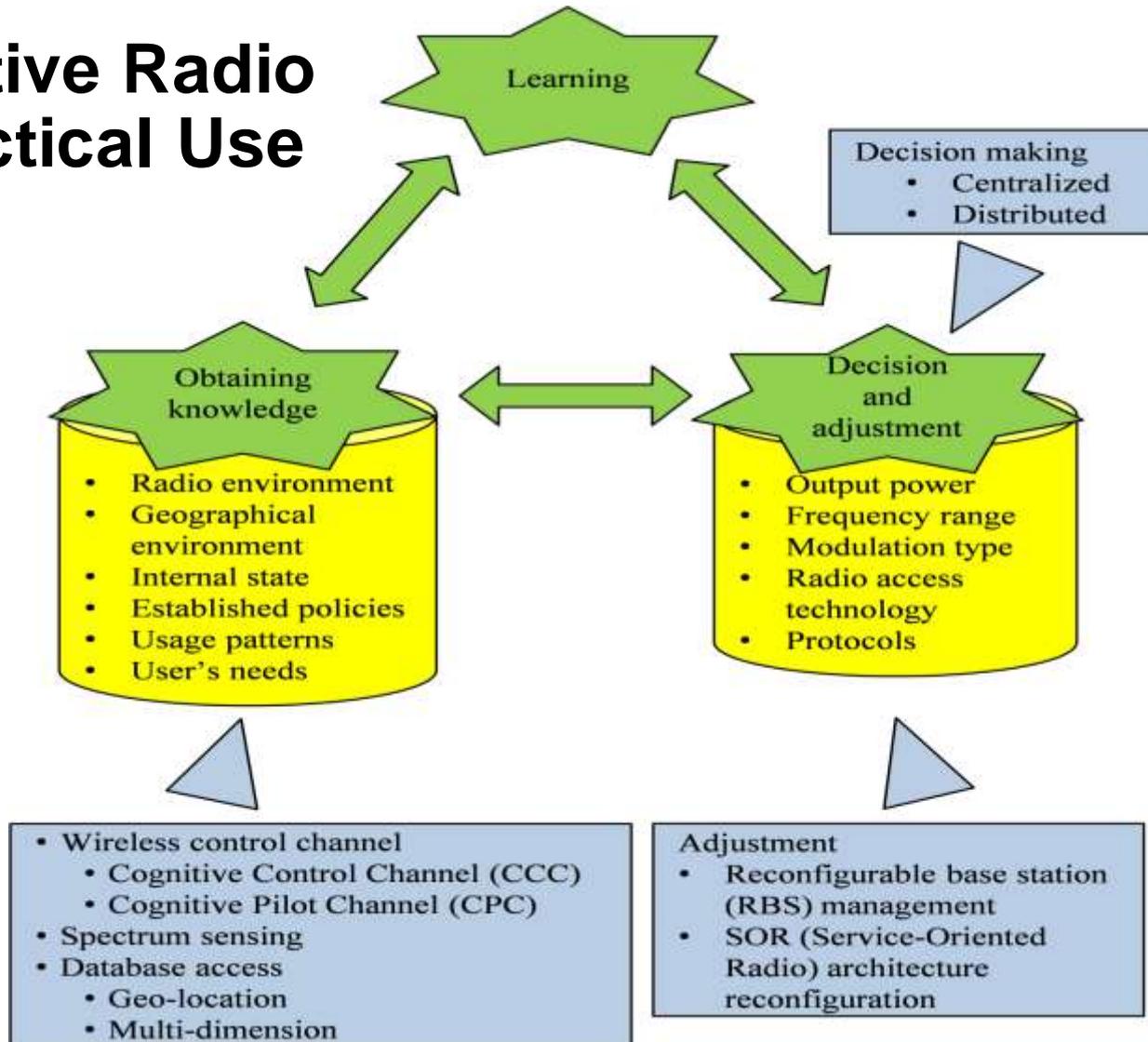
**SDR'12 – WinnComm – Europe  
2012-06-29**

# Outline

- **Introduction**
- **Regulatory Regimes**
- **What is Shared Spectrum Access**
- **Role of Cognitive Radio Technologies in Shared Spectrum Access**
- **Way Forward**
- **Conclusion**

# Introduction ( 1/2)

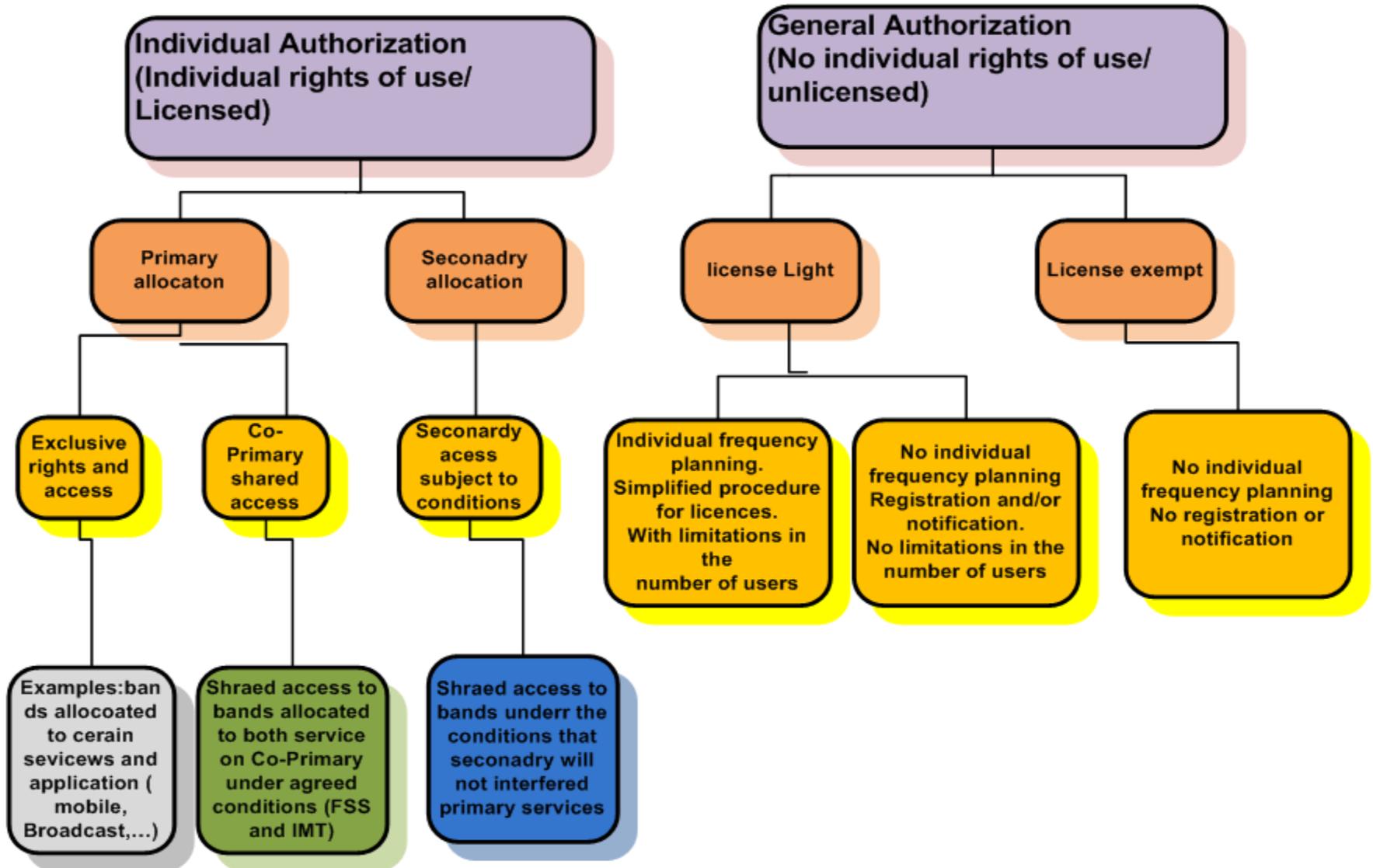
## Cognitive Radio in Practical Use



# Introduction (2/2)

- Potential Cognitive Radio Technologies:
  - Sensing
  - Geo-location and access to databases
  - Use of beacon or control channel such as CPC or CCC
- Possible deployment of Cognitive Radio System:
  - In frequency bands allocated exclusively to a single service; or
  - In frequency bands that have multiple radio communication service allocations ( shared and opportunistic access)
- Possible and potential applications of Cognitive Radio technologies:
  - TV white space application
  - To improve the management of spectrum resources
    - In single operator case
    - In multiple operators domain
  - In shared access of spectrum based on dynamic spectrum access.

# Characteristics of the different Regulatory Regimes



# Shared Spectrum Access

“Shared spectrum access” is where users or wireless applications are authorized to utilize the same range of frequencies on a non-exclusive basis in a defined sharing arrangement.

Key Features of Spectrum Shared Access:

- No limitation on **applications and /or technology** other than those required to avoid harmful interference and to reduce the risk of interference while **maintaining an acceptable quality of service** ;
- **Licensing or coordination** to avoid interference to non-collective use applications or to facilitate maintaining QoS for the future.

# Advanced regulatory Approach: Licensed Shared Access or Authorized Shared Access

Licensed Shared Access (LSA) or Authorized Shared Access (ASA) is a framework that enable sharing of spectrum between a number of licensed users.

The primary licensed user(s) or incumbent utilizing the spectrum for a specific application would share spectrum with one or several new users (ASA or LSA users) for the same or different applications in accordance with a set of conditions to be defined through regulation

## Key Features of ASA/ LSA:

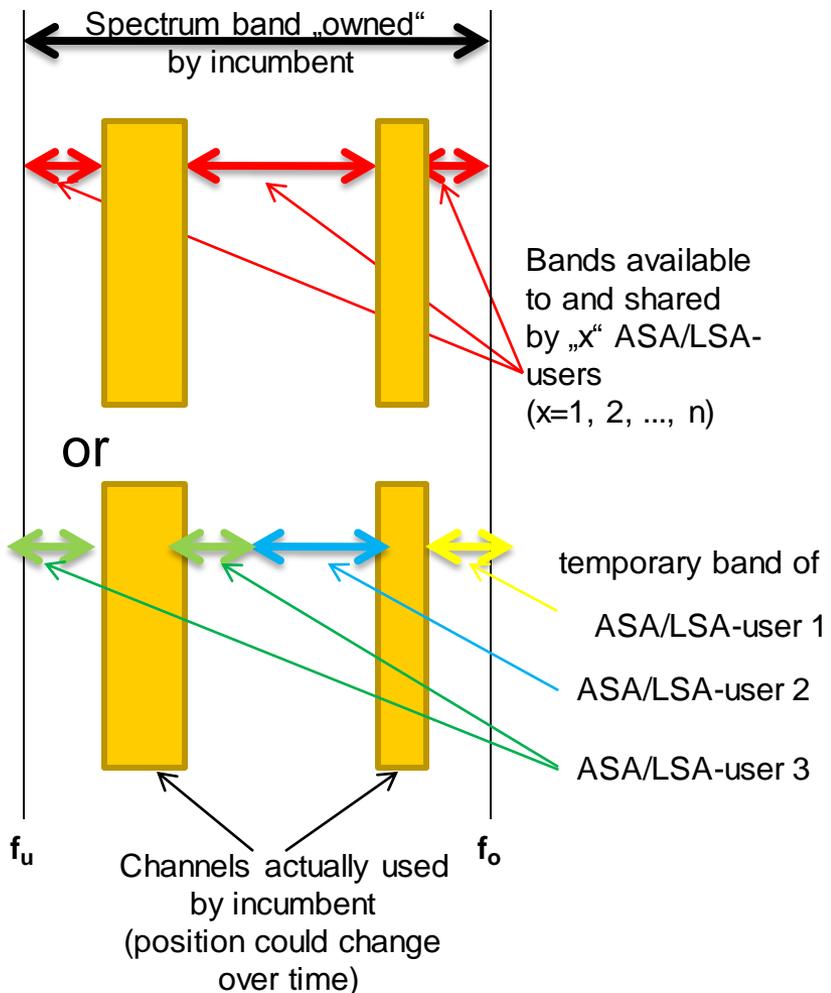
- Unlock the band used by incumbent ( primary user of the band) for new users
- ensure predictable quality of service for all right holders
- sharing agreements/ conditions among incumbent and the new users

LSA or ASA is not a **sharing technique** or a system, but ASA/LSA relies on **dynamic/cognitive radio** based sharing techniques (e.g. databases, sensing, ...)

# Difference between ASA/LSA and other licensing methods

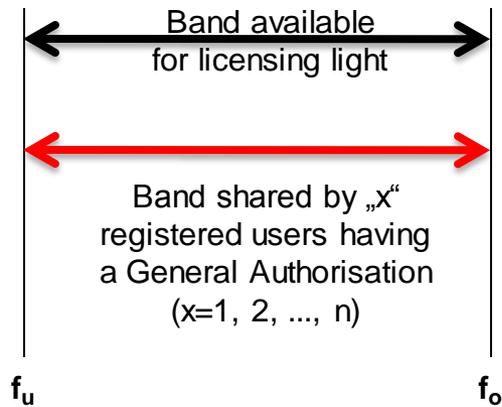
## ASA/LSA

(i.e. incumbent exists)

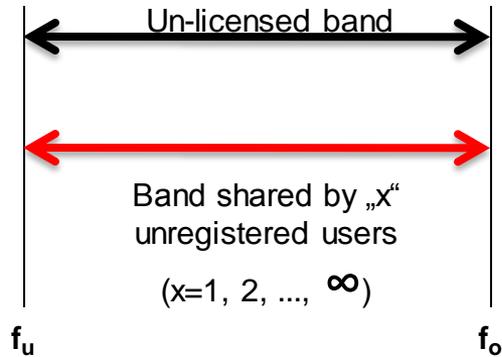


## Licensing light

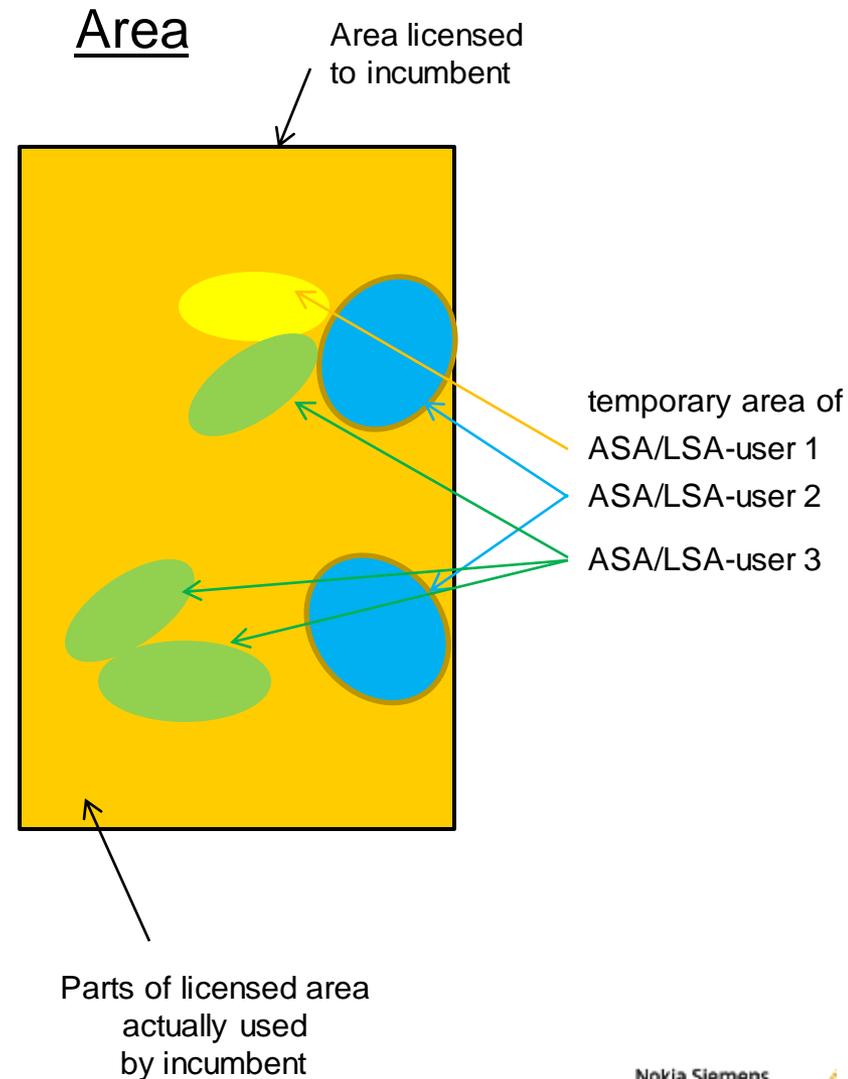
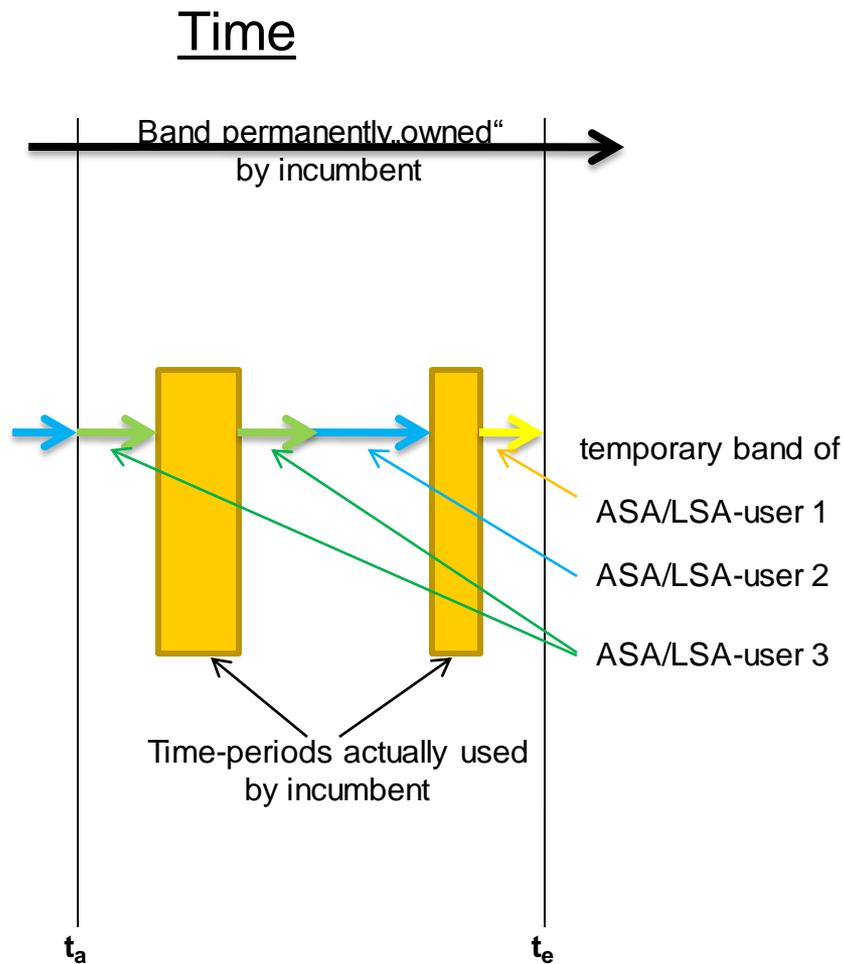
(no incumbent)



## Unlicensed band



# Other/additional dimensions of ASA/LSA: Time- and area based sharing

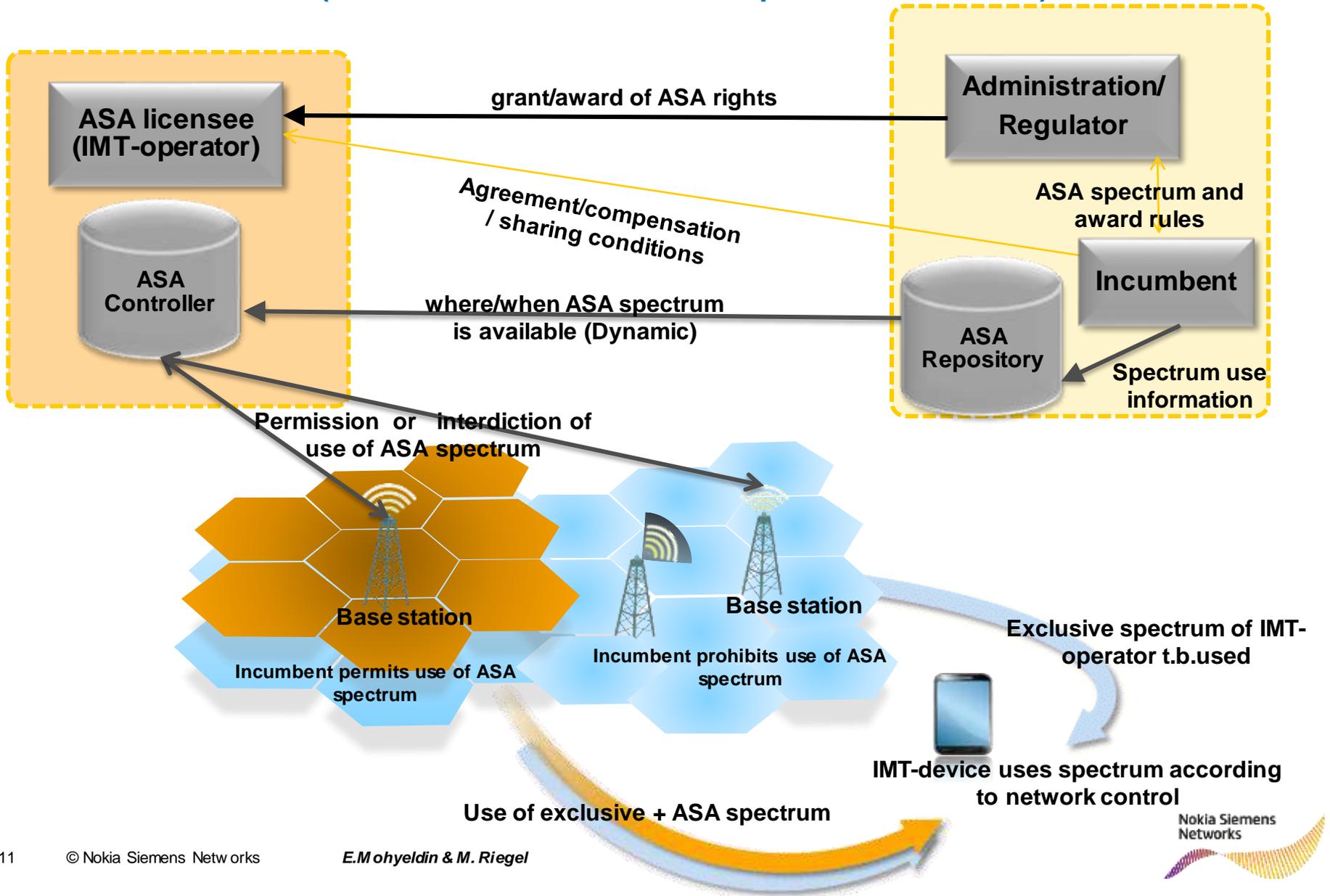


# Drivers for Licensed/Authorized Shared Access

- **Demand of spectrum is continuously increasing**
- **Many services use their spectrum**
  - not everywhere
  - not all the time
  - not in the entire allocated (licensed) band
- **Spectrum is scarce**
  - increase of “overall spectrum efficiency” is a “must”!
- **Technical means (databases) exist to enable access to spectrum that is unused or under-utilised by the incumbent in**
  - Spatial (geographical) domain
  - Time domain
  - Frequency domain
  - or any combination of the above three
- **There seems to be no appropriate licensing method to permit co-usage of unused spectrum of incumbent for a restricted number of co-users in a controlled manner guaranteeing not harmful interference to incumbent**

# Example of an ASA-Implementation using Database

( Source: Annex 2 of CRCG report to ECC WGFM)



# Way Forward

- To foster actions on LSA/AS different action in **Regulation** as well as in **Standardization** are required
- In Europe some actions have been started in the Regulation domain, need to be **followed and crystallized**
- The standardization path should allow the way to define **requirements, functional architecture, protocols**

# Conclusion

- Cognitive technologies enable new ways to share spectrum more efficiently
- Dynamic spectrum access schemes are essential enabler for accessing additional spectrum
- Advanced regulatory approaches for spectrum authorization are needed to allow more flexibly shared use of spectrum
- The big advantage of ASA/LSA: Enabling Timely Availability and Licensed Use of Harmonized Spectrum for mobile services with predictable QoS
- With Cognitive Radio technologies such as geo-location databases ASA/ LSA would be applicable to spectrum sharing in all bands and for all kinds of applications