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ELEC-E7230 Mobile Communications Systems (5 cr)

Presentation on Paper Titled “On the Scalability of Cognitive Radio: Assessing the Commercial Viability of Secondary Spectrum Access”

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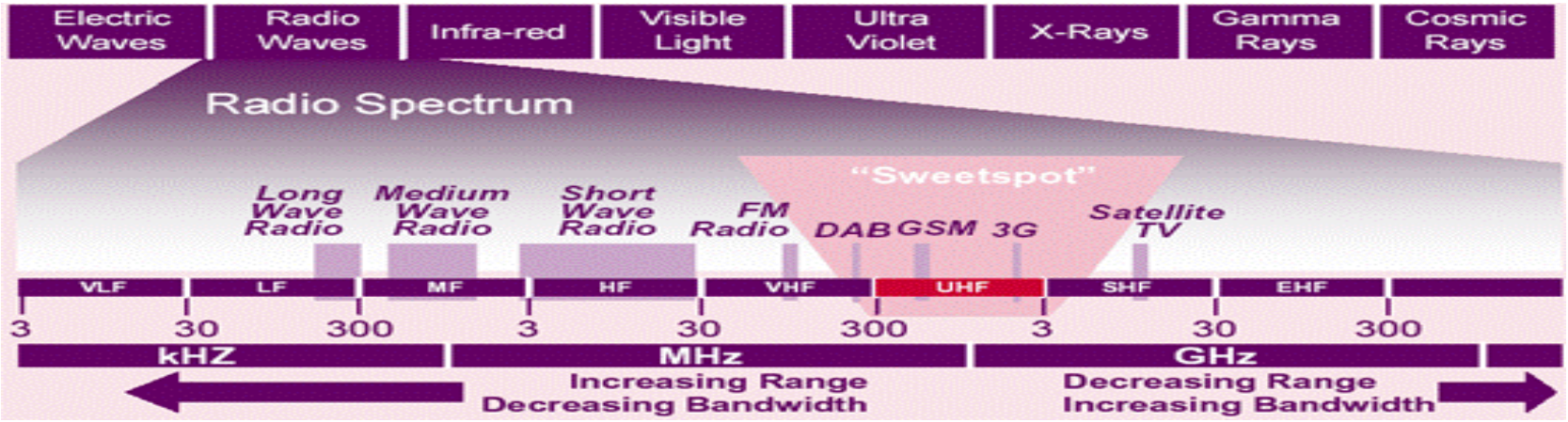
Image source:
http://wireless.kth.se/blog/projects/quasar/

Background

What is spectrum?



Why do we need more spectrum?

- Spectrum scarcity due to poor spectrum management.

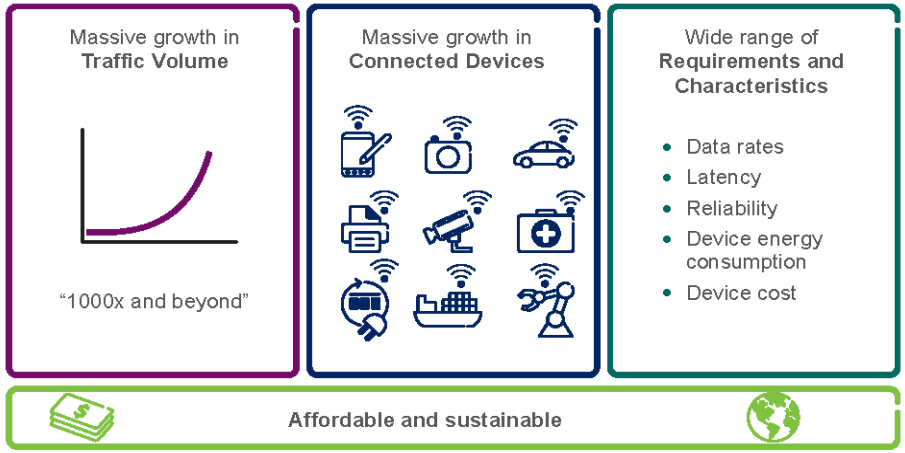


Image source:
Ericsson: 5G Radio Access, June 2013

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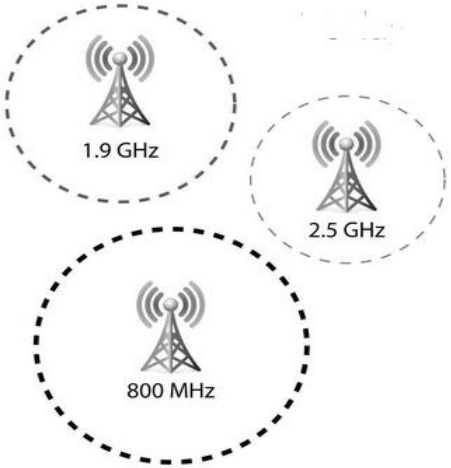
Background

Low Frequency spectrum	High frequency spectrum
Below 6 GHz	Between 10-100 GHz
Less attenuation	High attenuation
Less cell sites	More cell sites
Low cost	High cost
2G, 3G and 4G	Expected 5G

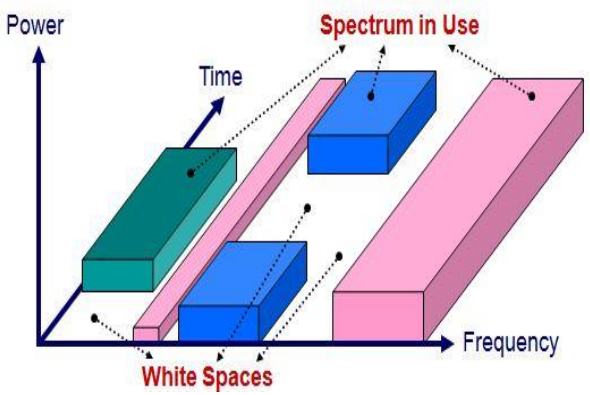


- Favorable use of lower frequencies leads to the proposal of reusing the white spaces or spectrum holes in these bands in an opportunistic way.

Image source:
http://www.googleimages.com

White Spaces

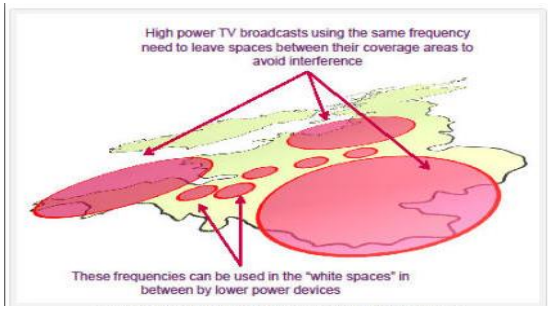
- Set of frequencies in the VHF and UHF band unused in the wireless spectrum.
- Frequencies left between TV channels for buffering purpose.



What is Cognitive Radio?

- Spectrum sharing technique where Secondary users opportunistically utilize the unused spectrum.

  (Finland-2009, 470-790 MHz)



Low spectrum occupancy can turn into opportunities?

Image source:
http://www.googleimages.com

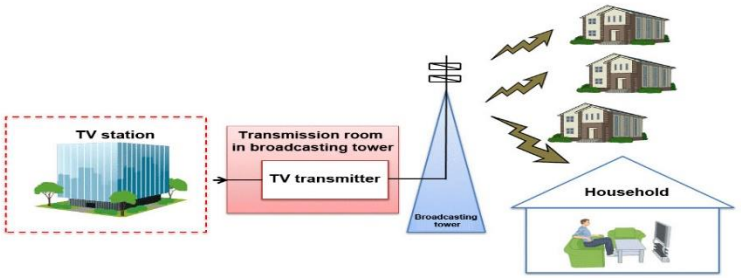
QUantitative Assessment of SecondARy spectrum access (QUASAR)

- Aims at Accessing and Quantifying the "Real world" benefits of Secondary spectrum.
- Quantitatively assesses the amount of spectrum available for secondary services for a number of commercially interesting scenarios.

Methods

Systems using secondary spectrum access

- TV Broadcasting
- Radar
- Aeronautical Navigation



Challenge to the systems

- Protect primary system performance from interference created by utilization of secondary spectrum.

Specifications to be known beforehand

Primary System	Secondary System
Interference Tolerance	Frequency allotment
Adjacent channel rejection	Location of users
Location of primary users	Traffic conditions

Spectrum sharing method

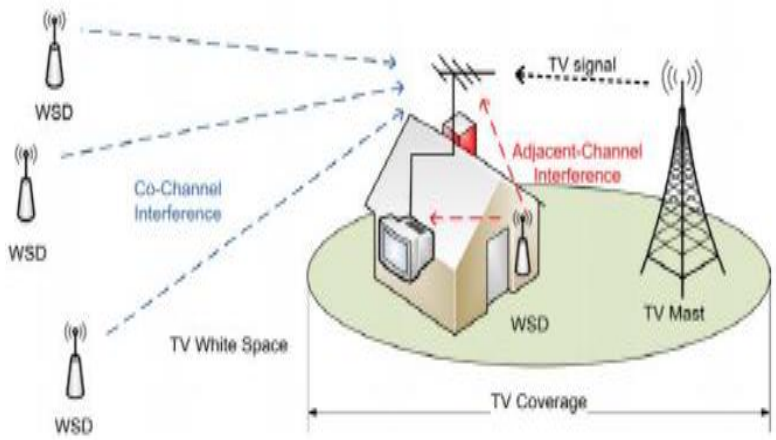
Image source:
http://www.googleimages.com

Methods

QUASAR investigate the effect of using Cognitive Radio in the following steps:

Step 1

- Quantifies co-channel and adjacent channel interference generated by secondary system and estimate effect on primary system receivers.



Step 2

- Regulatory authorities provided constraints based on primary system requirements protection decide the economic feasibility of secondary system.

Image source:
Reference Paper

Methods

- Method and tool developed for assessment of secondary reuse feasibility

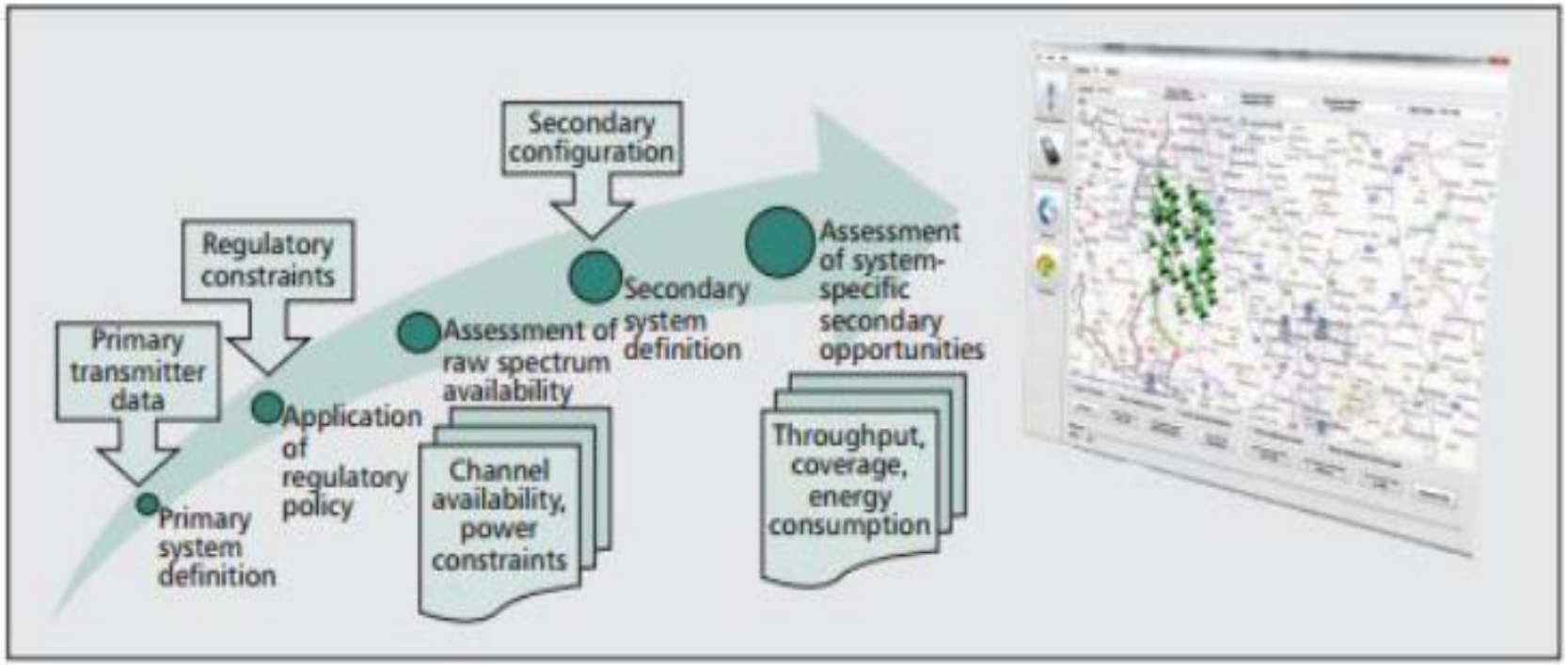


Image source:
Reference paper

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Results

From commercial perspective what actually matters is:

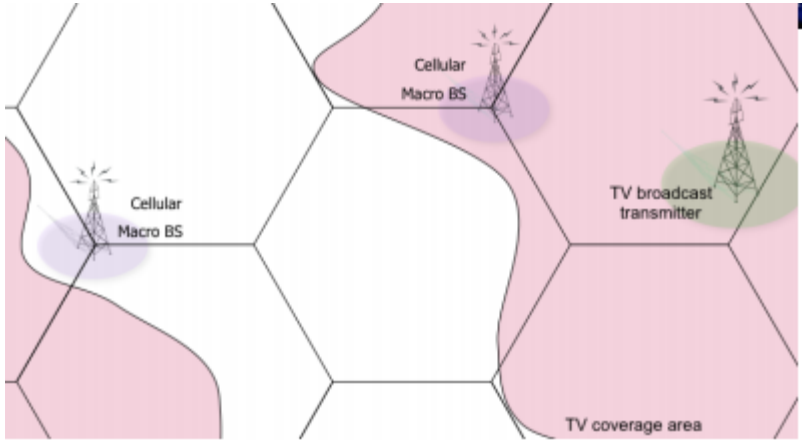
”Spectrum demand of application matches the availability”

Case studies:

- Macro-cellular use of TVWS

  Contiguous coverage difficult to achieve in high demand urban areas.

  Secondary use can serve as capacity booster. (470-790 MHz)



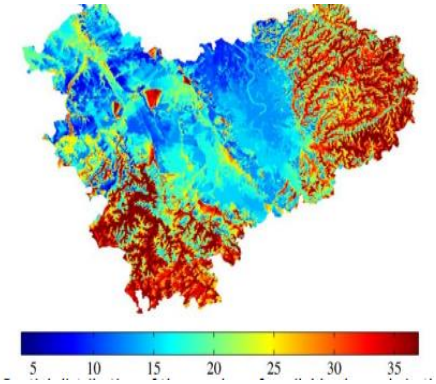


Image source:
QUASAR Deliverable D5.2

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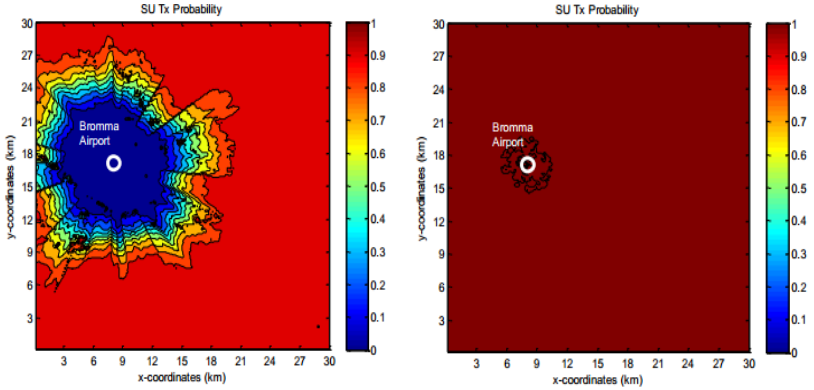
Results

- Indoor Broadband in Radar

  Air-traffic control radar-primary and LTE home BS-secondary system. (2.7-2.9 GHz)



- Indoor Broadband in Aeronautical spectrum

  Distance measuring equipment (DME) as primary and indoor broadband as secondary system.
  (960-1215 MHz)

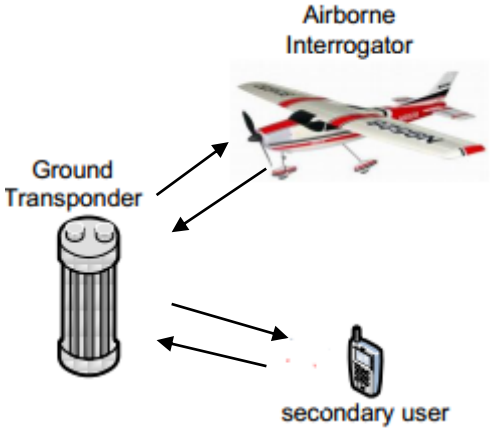


Image source:
QUASAR Deliverable D5.2

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Conclusions

- Aggregate interference from multiple users limits the potential of secondary spectrum access.

- In wide-area cellular network, demand is higher while secondary spectrum availability is poor.
- Short range or indoor communication are commercial sweet-spots.

- Capacity provided by TVWS is low.
- Low capacity systems not competent to drive the costs invested.

- High risk of investment in installing new infrastructure compared to already existing network.
- Secondary system cost efficient only when licensed spectrum more expensive for certain application.

Thank you for attention!