



# Dynamic Spectrum Access - A Solution for the growing need for Spectrum

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# Overview



- Motivation for DSA
- DSA Methods
- The TV Whitespace Concept as an (good?) example
- International View: Who is already acting?
- Summary and Future Outlook

# Dynamic Spectrum Access: Motivation

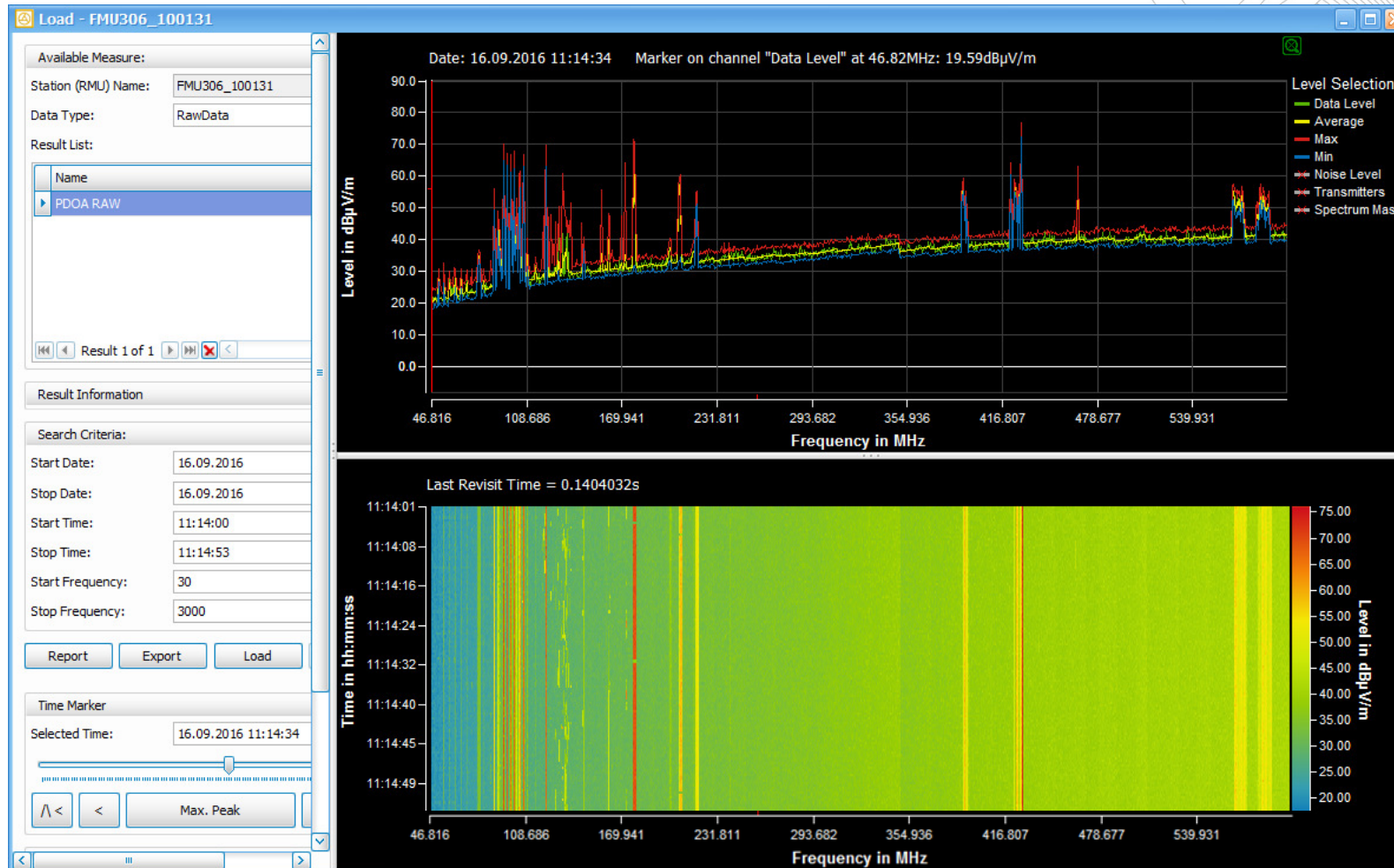


- Better usage of “residual” Spectrum
- Easy reclaim and re-farming of Spectrum
- Instant reaction possibility on emergency incidents
- Making Spectrum available which cannot be freed otherwise like military bands

		One Service	Multiple Services
Identical Hierarchy	One Operator	??	?
	More Operators	✓	✓✓
Multiple Hierarchy levels	One Operator	✓✓	✓✓✓
	More Operators	✓✓	✓✓✓

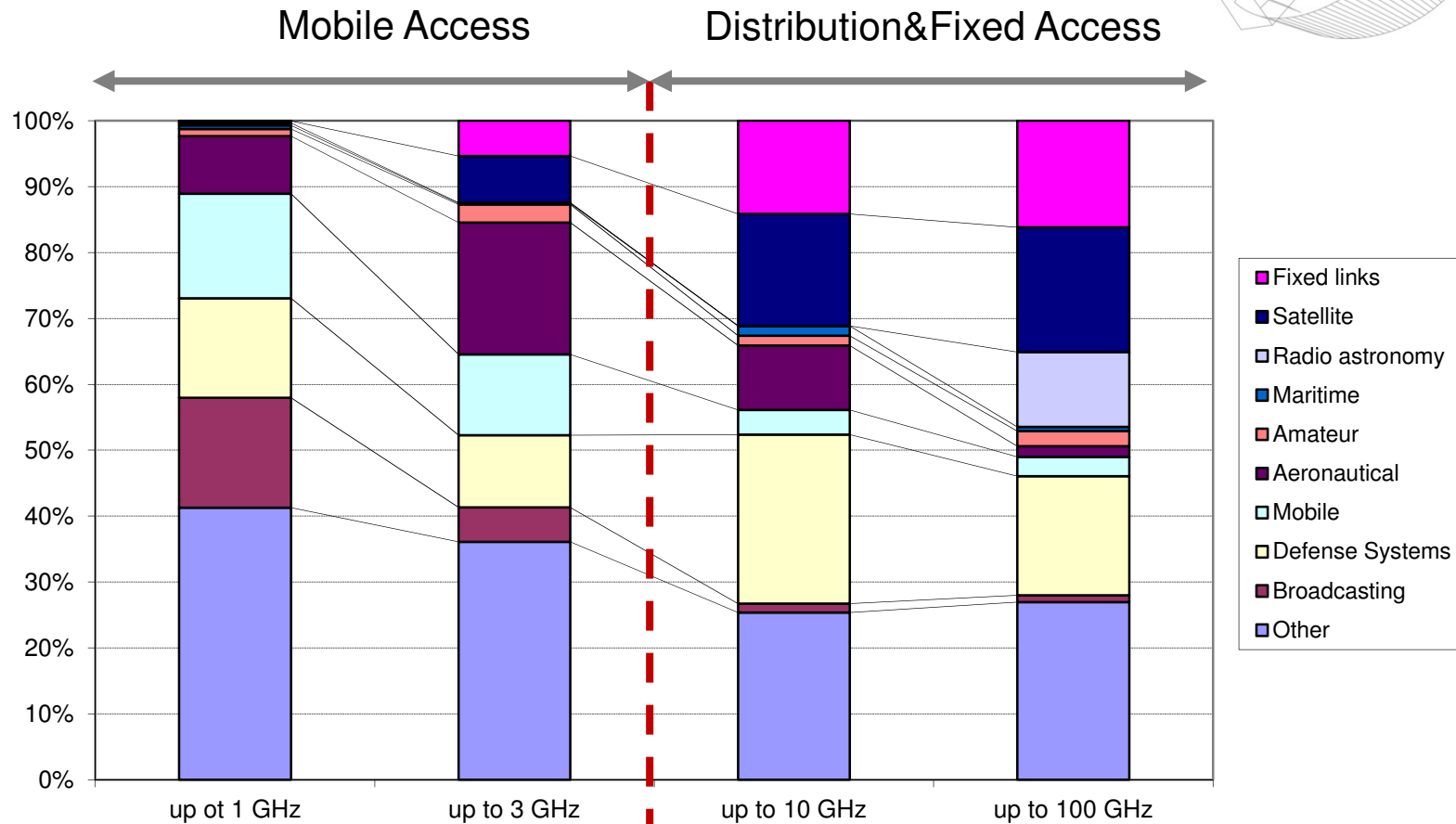
**Many entities would be open for band sharing if they could definitely reclaim their frequencies within one hour**

# Motivation: The physical situation



 **The temptation: Even in Central Europe a widely empty band**

# Motivation ? The available band fractions



**The fact: Possible gain of 100-200% for a specific service, but not powers of 10!**



**Reducing the cell diameter has much higher impact on available capacity**



# Motivation: Still there is something to gain!


## Seattle

### Location Information

Place: 4735 East Marginal Way  
South, Seattle, WA 98134,  
USA  
Coordinate: 47.558179,-122.340289  
HAAT: -46.033m

### Available TV White Space Channels

2 **X** 3 **X** 4 **X** 5 **X** 6 **X** 7 **X** 8 **X** 9 **X** 10 **X** 11 **X**  
 12 **X** 13 **X** 14 **X** 15 **X** 16 **X** 17 **X** 18 **X** 19 **X** 20 **X** 21 **X**  
 22 **X** 23 **X** 24 **X** 25 **X** 26 **X** 27 **X** 28 **X** 29 **X** 30 **X** 31 **X**  
 32 **X** 33 **X** 34 **X** 35 **X** 36 **X** 37 **X** 38 **X** 39 **X** 40 **X** 41 **X**  
 42 **X** 43 **X** 44 **X** 45 **X** 46 **X** 47 **X** 48 **X** 49 **X** 50 **X** 51 **X**

**X** Available **X** Unavailable **X** Prohibition of use  
 Microphone  Reserved microphone

Device Type:

High dense urban  
1 channel



## Anchorage, Alaska

### Location Information

Place: Chester Creek Trail,  
Anchorage, AK 99508,  
USA  
Coordinate: 61.201638,-149.866534  
HAAT: -77.712m

### Available TV White Space Channels

2 **X** 3 **X** 4 **X** 5 **X** 6 **X** 7 **X** 8 **X** 9 **X** 10 **X** 11 **X**  
 12 **X** 13 **X** 14 **X** 15 **X** 16 **X** 17 **X** 18 **X** 19 **X** 20 **X** 21 **X**  
 22 **X** 23 **X** 24 **X** 25 **X** 26 **X** 27 **X** 28 **X** 29 **X** 30 **X** 31 **X**  
 32 **X** 33 **X** 34 **X** 35 **X** 36 **X** 37 **X** 38 **X** 39 **X** 40 **X** 41 **X**  
 42 **X** 43 **X** 44 **X** 45 **X** 46 **X** 47 **X** 48 **X** 49 **X** 50 **X** 51 **X**

**X** Available **X** Unavailable **X** Prohibition of use  
 Microphone  Reserved microphone

Device Type:

Dense urban  
10 channels



## Toccoa, Georgia

### Location Information

Place: 1480-1698 Georgia 145,  
Toccoa, GA 30577, USA  
Coordinate: 34.537622,-83.306843  
HAAT: -16.427m

### Available TV White Space Channels

2 **X** 3 **X** 4 **X** 5 **X** 6 **X** 7 **X** 8 **X** 9 **X** 10 **X** 11 **X**  
 12 **X** 13 **X** 14 **X** 15 **X** 16 **X** 17 **X** 18 **X** 19 **X** 20 **X** 21 **X**  
 22 **X** 23 **X** 24 **X** 25 **X** 26 **X** 27 **X** 28 **X** 29 **X** 30 **X** 31 **X**  
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 42 **X** 43 **X** 44 **X** 45 **X** 46 **X** 47 **X** 48 **X** 49 **X** 50 **X** 51 **X**

**X** Available **X** Unavailable **X** Prohibition of use  
 Microphone  Reserved microphone

Device Type:

Rural  
16 channels

 **But: There are many places, where more bandwidth would be welcomed!**

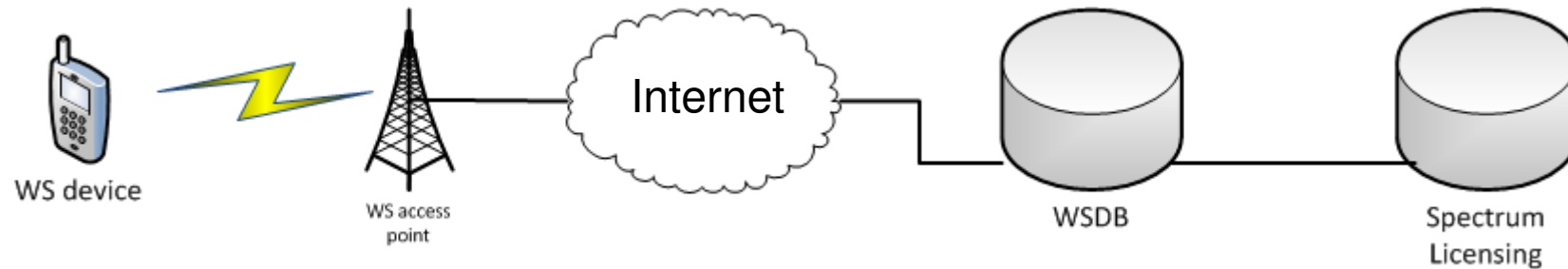


- **Self negotiating devices (listen before talk, negotiation channels...)**
  - ▶ Works fine in equally privileged scenarios of lesser importance like WiFi , Amateur Radio or CB
  - ▶ Problem of interference to others in systems with non equal link balance. Therefore not appropriate for systems with safety of live or high availability /high quality of service requirements
  
- **Locally controlled networks**
  - ▶ Typical example: GSM/3G: BSC assigns channel and timeslot or code for a mobile.
  
- **Geo-location databases**
  - ▶ All systems report to one central node

# DSA Methods: The infrastructure



Use a Database to manage spectrum allocation

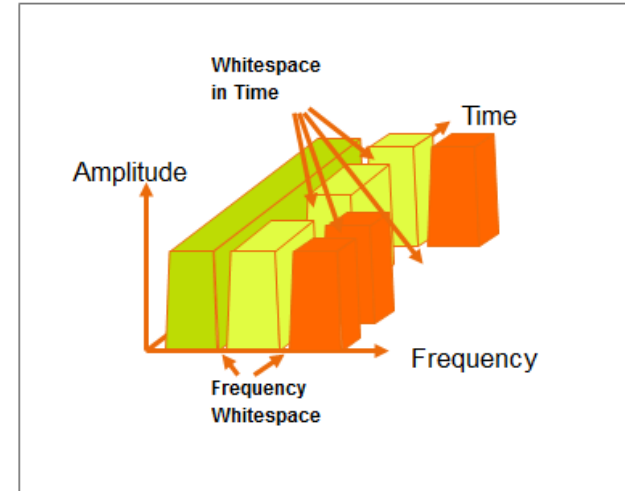
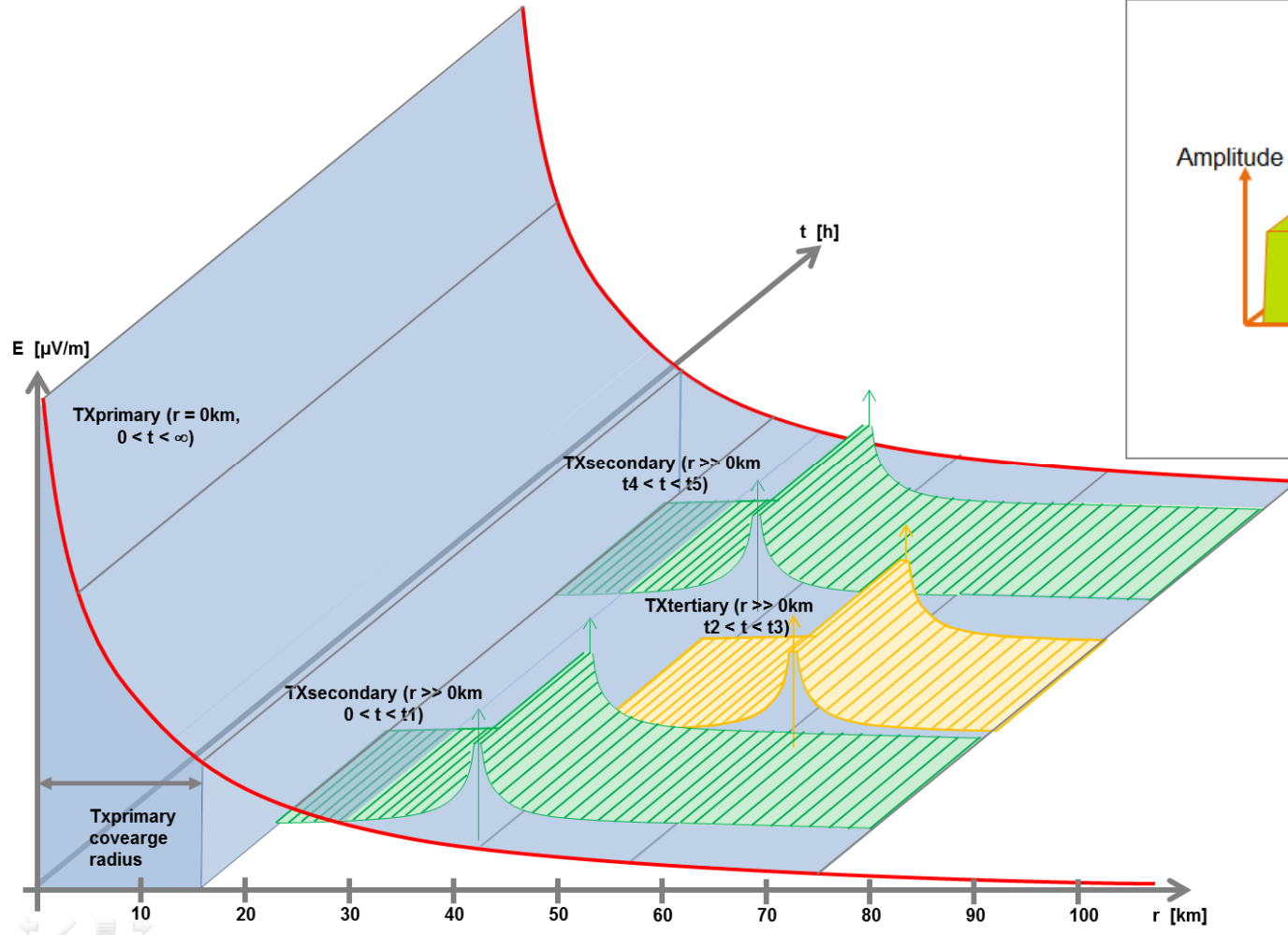


User access	Infrastructure	Interconnectivity	DSA database	Spectrum Licensing data
Consumer access device	Consumer access point Network provider infrastructure	Network transport mechanism probably internet based	Whitespaces spectrum assignment, registration, authorisation	Incumbent users, temporary protected users and regulatory controls
Large number of devices	Large number of access nodes	Multiple paths	One database OR multiple administrators	One source of prime data

Sensing is an additional option and not a solution to managing whitespaces

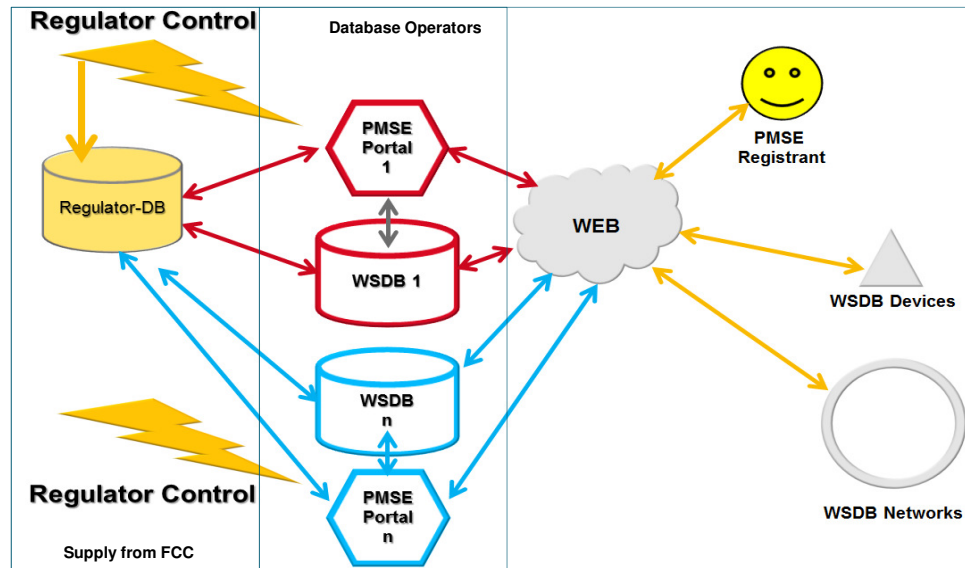


# TV Whitespace Concept



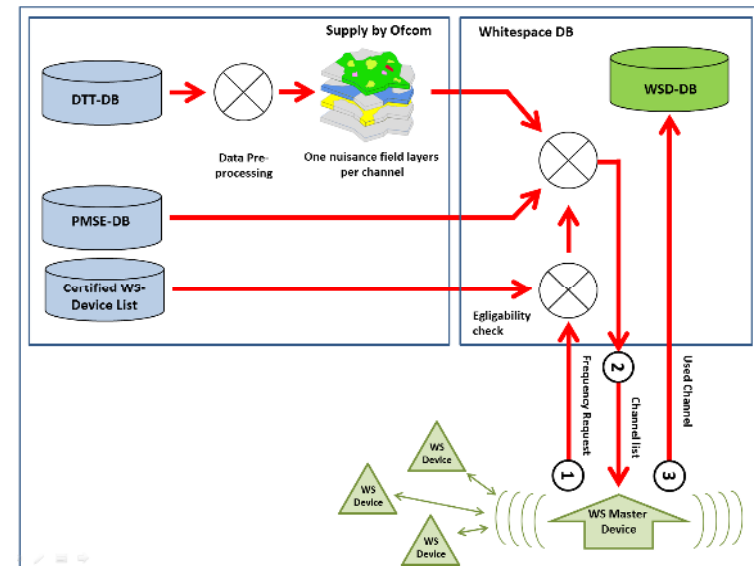
# DSA (Whitespace) Mechanics: FCC vs. Ofcom **LS telcom**

FCC: is easier to implement



- Multiple database operators
- More could join or leave at anytime
- Calculates available TVWS on the fly
- Must register protected LP-Aux
- Must share data between databases

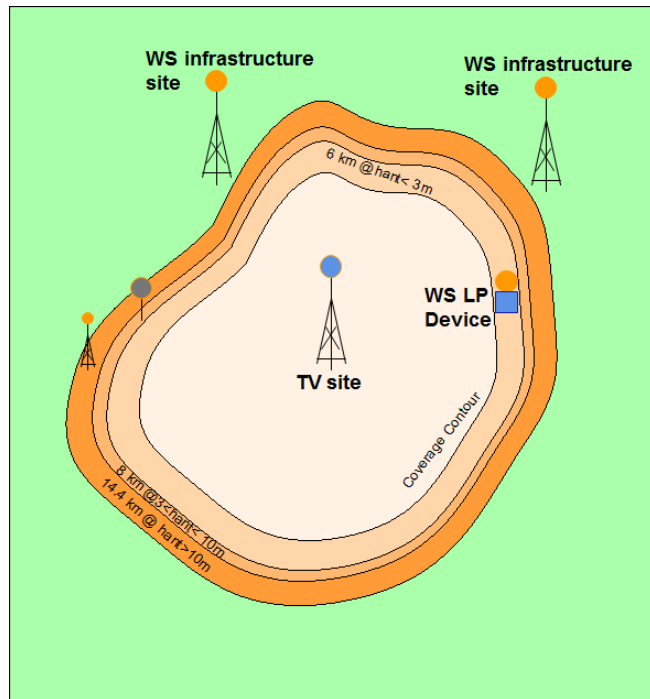
OFCOM: more controlled and risk averse



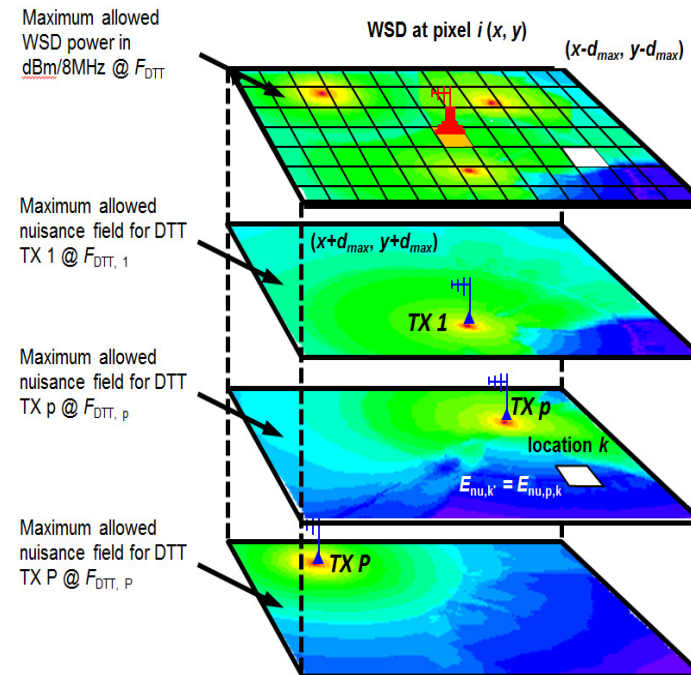
- Multiple database operators
- Can only join at specific approved times
- Calculation is a logic engine of data
- Must provide a specific enforcement portal

# DSA (Whitespace) Physics: FCC vs. Ofcom

FCC: is easier to implement



OFCOM: more controlled and risk averse



# Whitespace Databases: An example



LS-Internet - SRVLSWEBTS - Remote Desktop Connection

Home  
Channel Availability  
Protected Entity Registration  
Service

Tomorrow's Communication  
Designed Today.

Channel Availability

**Search Location**  
Enter one of the following search criteria:  
 • Latitude Longitude (at least one behind the decimal)  
 • Street Address (google format)  
 • ZIP Code (10016)

Or select the location on the map

Select Channel  
 Select all  
 2 3 4 5 6 7 8 9 10 11  
 12 13 14 15 16 17 18 19 20 21  
 22 23 24 25 26 27 28 29 30 31  
 32 33 34 35 36 37 38 39 40 41  
 42 43 44 45 46 47 48 49 50 51

Protected Area  
 Select all  
 TV Channel  Waiver PLMRS/CMRS  
 BAS Link  Border Areas  
 Translator  Astronomy  
 Temp BAS  TV Receive Site  
 MVPD  Lower Power Aux  
 Metropolitan  Offshore Radio  
 PLMRS/MRS Telephone  
 STA  FCC Area

Show Contours Clear Contours  
 Get Contours in view  
 Call Sign: Search Next

**Check TV White Space Channels**

Location Information  
 Place: 2-18 Sherrod Boulevard,  
 Belen, NM 87002, USA  
 Coordinate: 34.864841,-106.732178  
 HAAT: -40.443m  
 (-37.543m antenna HAAT)

Available TV White Space Channels  
 2 3 4 5 6 7 8 9 10 11  
 12 13 14 15 16 17 18 19 20 21  
 22 23 24 25 26 27 28 29 30 31  
 32 33 34 35 36 37 38 39 40 41  
 42 43 44 45 46 47 48 49 50 51

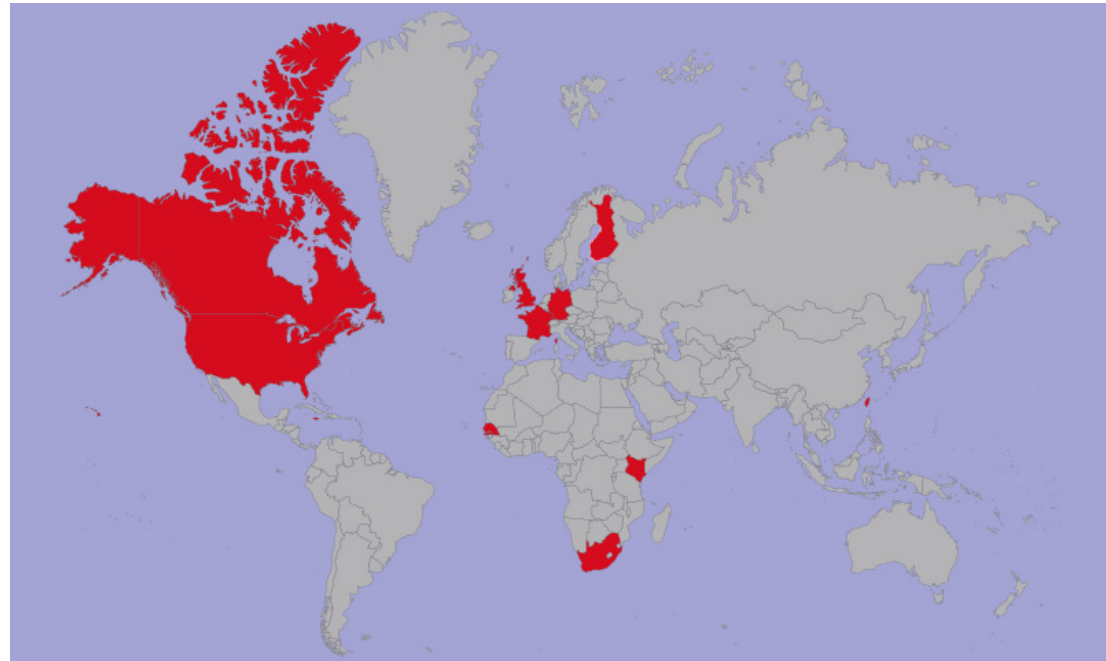
Available Unavailable Prohibition of use  
 Microphone Reserved microphone  
 Device Type: Fixed<3m

www.whitespaceforum.com

# International footprint



- Operational DSA policy and operations (trial or commercial)
  - USA, Canada, Jamaica
  - UK, Finland, Germany, France
  - Singapore, Taiwan
  - Malawi, South Africa, Senegal,
  - Kenya



- Mainly TVWS although several countries are now moving to release of other bands (primarily Military spectrum)
  - Netherlands, France, USA



# DSA Outlook



- No “killer” application has yet been found.....
- Applications to date are mainly about rural and similar internet access
  - Limited hardware supplier base
  - Limited application benefit
- USA has about 400 TVWS nodes mainly for rural access or trial technologies like mobile TV for sport events, or TV extension inside shopping Malls.
- UK applications are; rural internet access, flood warning, IoT type applications.

Commercial viability is doubtful

BUT.....

# DSA Outlook



- The release of spectrum adjacent to used, or densely demanded spectrum opens up more opportunity... especially if this is co-ordinated worldwide.
- Trials of LTE in DSA allocations have taken place
- Chipset manufacturers get interested if there are viably large demands of co-ordinated releases
- The next wave will involve mobile broadband, probably using a version of LTE or in the roll out of 5G type capabilities.
- Huawei demonstrated this two years ago. Other commercial operators are frequently involved in discussions.



**Thank you for your attention!**



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