DSA is the solution, what's the problem?

William Webb, June 2011

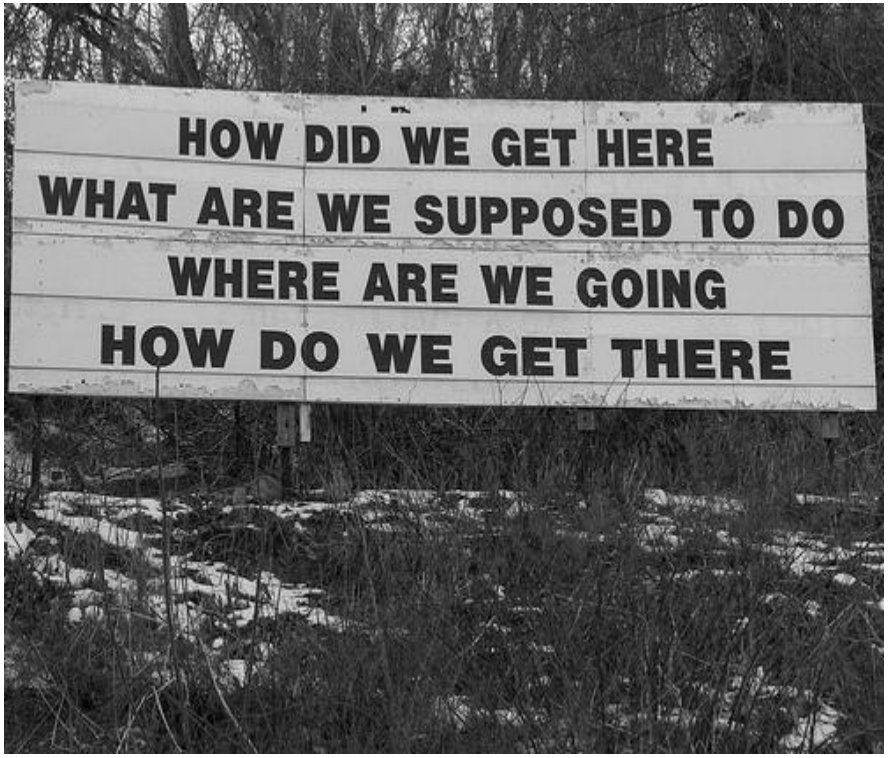
A solution looking for a problem

- DSA is a way to access more spectrum but do we know why we want that spectrum anyway?
- “Build it and they will come” is fine for a while but doesn’t hold for ever in the real world

- Do we have any clearer idea now what the problem that we are trying to solve actually is?

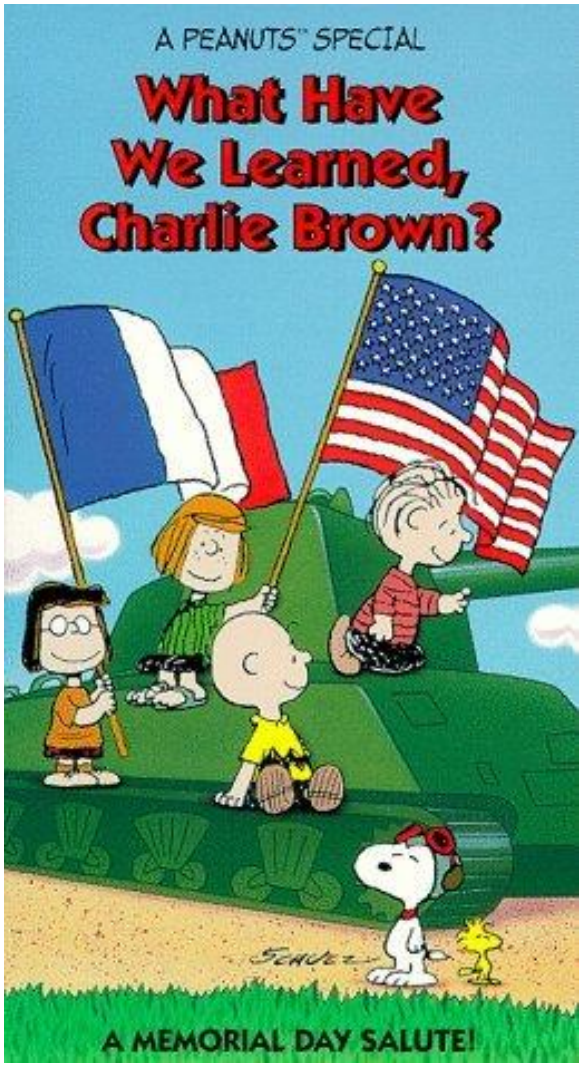
How did we get here?

- Spectrum is valuable (eg auction revenue) ✓
- Monitoring spectrum shows lots is unused ✓
- Therefore, if we can access it we will generate value ?
- We can't get the licence holders to return it ✓
- Therefore we have to work around them ✓
- That will require clever radios ?
- Then the world will be a better place !



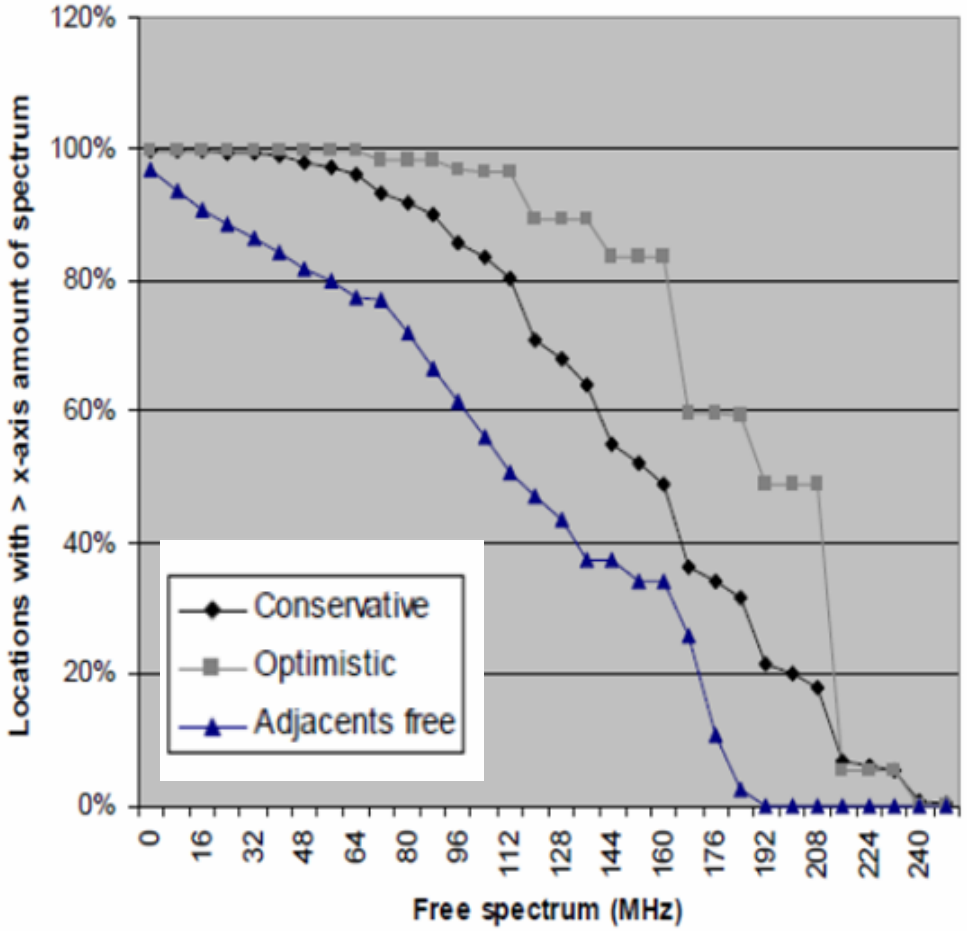
What have we learnt since?

- Sensing generally doesn't work in commercial environments
- Geolocation does but adds device complexity that impacts on applications
- White space is grey – polluted and less plentiful than initially assumed

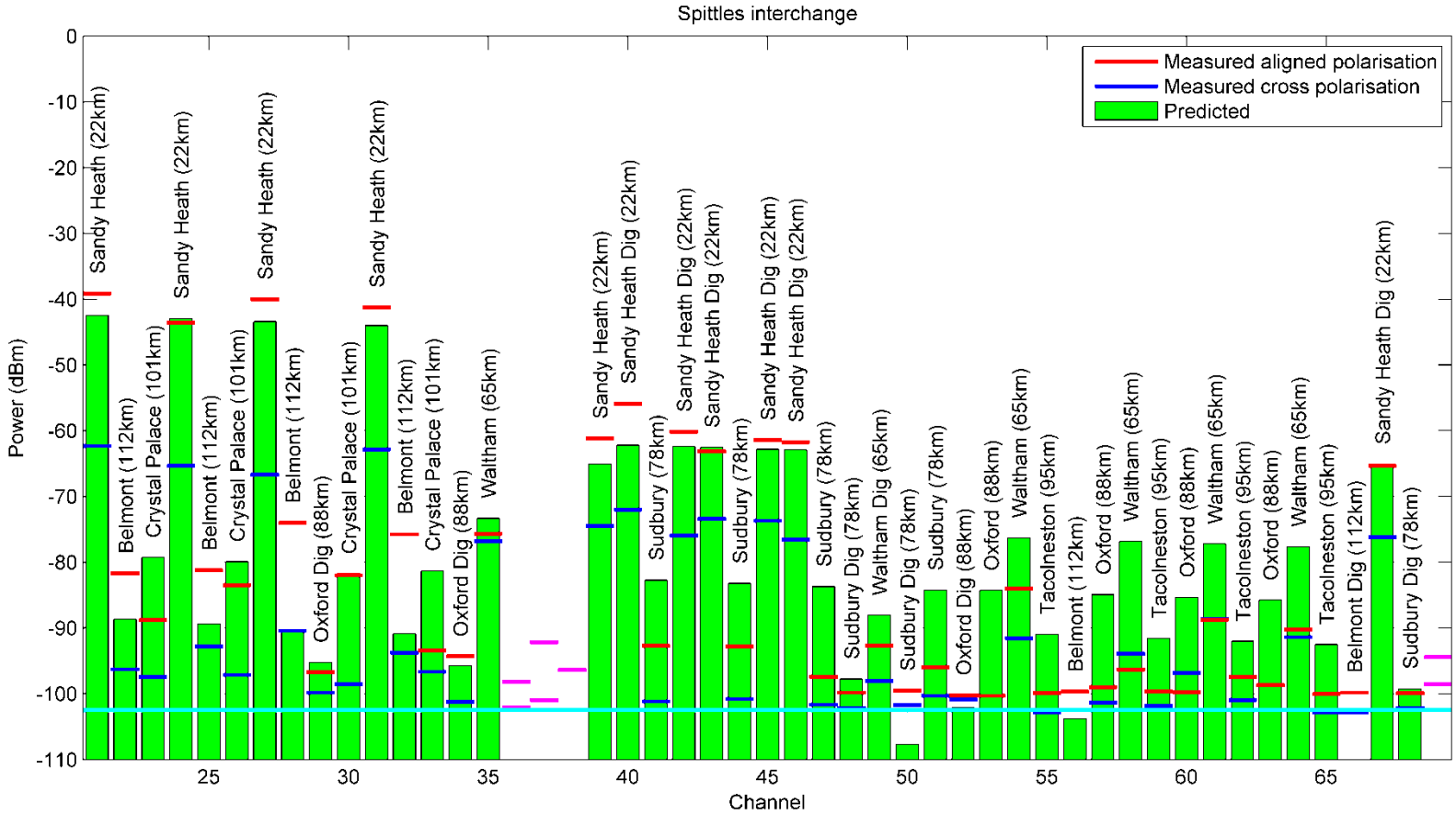


Whitespace spectrum – the good news

- Imminent freeing up of 150MHz of prime spectrum
- Excellent propagation properties allow 10km cell radius from low-power devices
- TV bands are harmonised world-wide so white space can be expected to be available globally
- More spectrum than the entire 3G band but at no cost

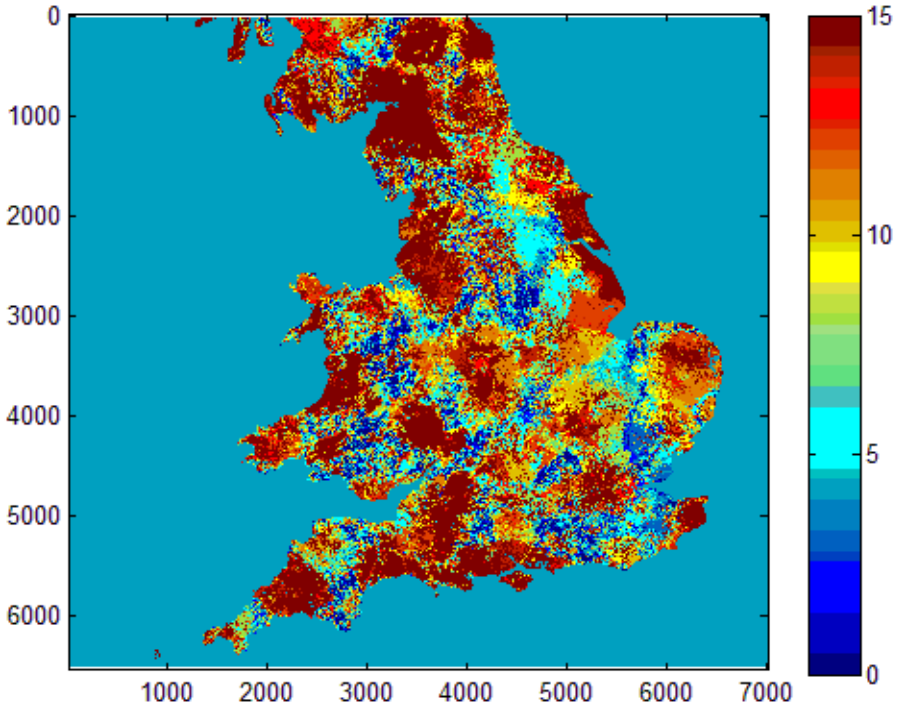


Whitespace is actually grey – TV interference widespread

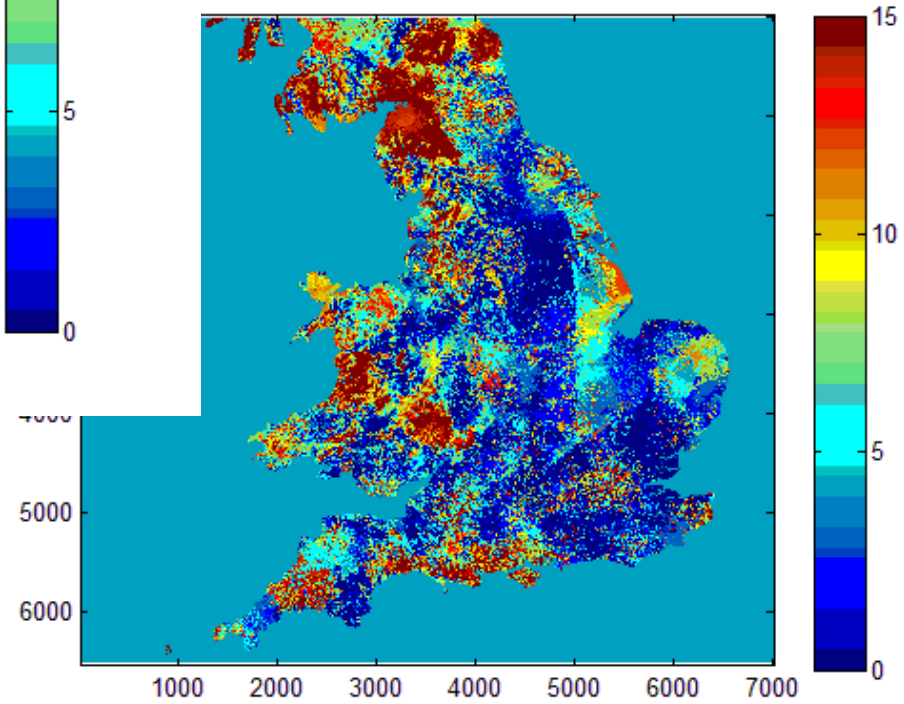


- This has major implications for the receiver design – needs to work in the presence of strong out-of-band signals
- The receiver has to tune over an octave; there will be very powerful TV transmitters in-band

This can be overcome – but only with the right design



Number of TV channels available (each=8MHz) taking all factors into account



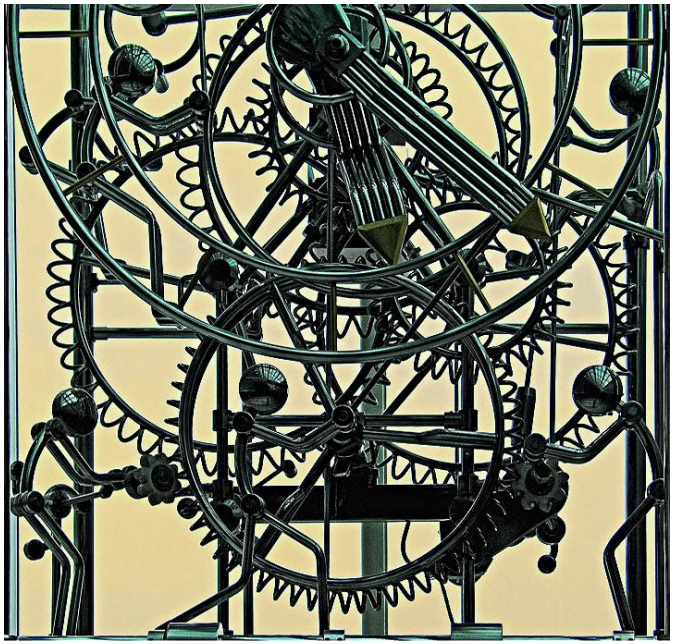
Weightless M2M (above) has much better spectrum availability than WiMax/WiFi (right)

“Old thinking” of applications

- Military was the original concept – arrival in new location requires self-configuration
- Peer-to-peer connected everything
- Rural broadband
- Urban broadband
- Campus network
- “Wi-Fi on steroids”
- Emergency service overflow
- Home Wi-Fi with extended range
- Home entertainment system
- ……

Perhaps it is better for networks

- The move from sensing to geolocation makes peer-to-peer much less attractive due to increased complexity
- Indoor applications struggle with location
- The poorer quality of the spectrum makes high bandwidth applications more difficult
- Severe spectrum masks make re-banding technology very hard
- Applications with connected base stations have no problem with location and database access
- Spectrum problems easier to resolve with a clever base station
- Perhaps ideal for a low bandwidth network – M2M for instance



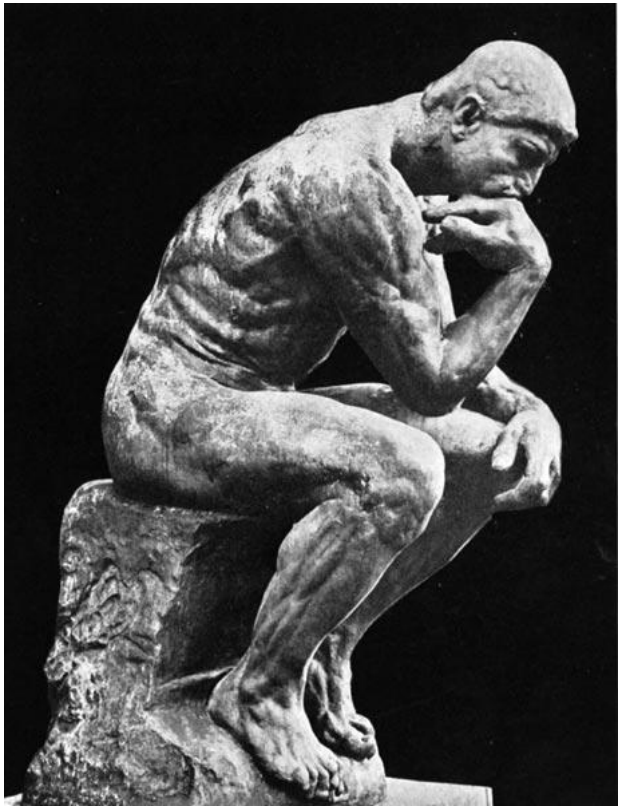
Why M2M works with DSA / white space

- M2M applications are different – 10x more devices sending generally short messages and needing 5 year battery life
- But the data rates are generally low and the tolerance to lost bursts due to interference quite high
- White space is free spectrum with great propagation characteristics allowing low-cost network deployment
- This can only work with a custom-designed technology
- For example, Neul's technology provides flexibility from variable TDD, variable allocation, variable spreading factor, variable burst sizes, careful scheduling and more
- A custom-designed technology and network for M2M in white space able to deliver near-100% coverage, handle 1bn+ devices at costs of a few $ per year per device

Which suggest unlicensed access may not be ideal

- Networks generally do not like unlicensed spectrum because of the risk that the investment will become useless
  - But some exceptions eg at 2.4GHz
- But DSA does not need to be unlicensed – could be controlled access into eg military spectrum with varying QoS guarantees

But are the devices cognitive any more?



- A device that accesses a database / network and does what it is told is not particularly clever
- For example, M2M in white space would seek to make the terminals as simple as possible
- Could still be some intelligence at the end but not clear whether this is needed
- So DSA and cognitive and probably not synonymous
- And if it is simple it probably is not software defined either

So what is the problem?

- DSA for networks like M2M, rural broadband, perhaps campus
- CR excellent for military applications, unclear where it must not interfere
- SDR as a design tool useful for many areas (eg base stations) but not really needed for DSA

- All the terms are rather vague though…DECT could be a cognitive device using DSA….