Spectrum Occupancy Monitoring and Analysis with the AMD RFSoC

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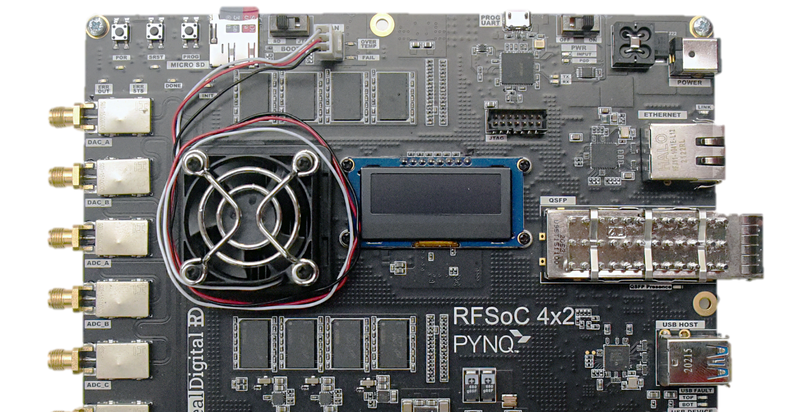
Background

The Radio Frequency (RF) spectrum is a finite resource that requires strict regulation to prevent illegitimate use and unauthorised transmissions. Spectrum monitoring (measurement and analysis) is key to supporting regulation by determining usage and occupancy in real-time as well as establishing temporal trends. Spectrum monitoring technology can also enable Dynamic Spectrum Access (DSA) solutions, which improve the efficiency of the radio spectrum by autonomously adjusting wireless communication networks in real-time. DSA techniques require knowledge of real-time spectrum occupancy and a historical database of past usage.

Radio Frequency System on Chip

The AMD RFSoC device features a Processing System (PS), FPGA Programmable Logic (PL), and specialist RF resources on the same chip. The ADCs and DACs operate at 5Gsps and 10Gsps, respectively.



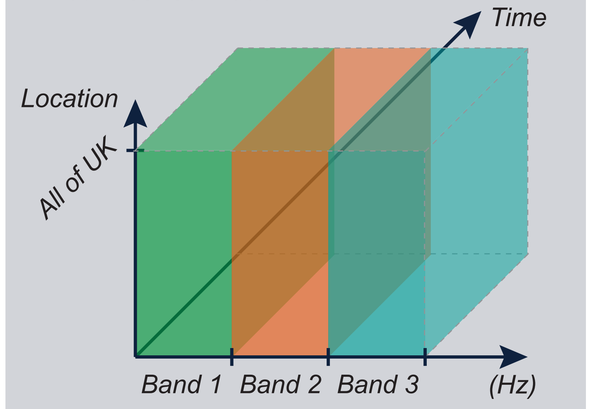
The RFSoC4x2 development platform (pictured below) includes 4 ADC channels that can be used to monitor the spectrum. Each channel is able to acquire 2.5GHz of bandwidth and can inspect between 0 - 5GHz using first and second order Nyquist Zones.

RFSoC-PYNQ is an open-source project from AMD that can make it easier to develop systems on RFSoC platforms. The StrathSDR team have developed an open-source spectrum analyser using RFSoC-PYNQ that can be deployed on the RFSoC4x2. The spectrum analyser can be accessed from a web browser. You can see a screenshot of the analyser to the right.

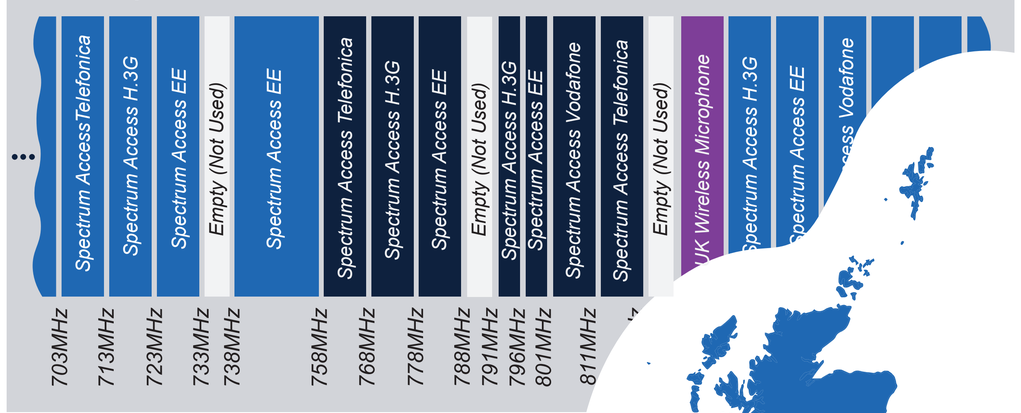
Radio Spectrum Allocation

The traditional method of managing the radio spectrum is to allocate bands of frequencies to particular usage types and licensed users. This is done by Ofcom (in the UK) and national regulators in other countries. In the UK, there are already shared spectrum approaches that allocate local licenses to users over long term periods (a year or more) via an application process. DSA and live spectrum monitoring can improve and optimise spectrum reuse by allowing users to get spectrum licences within milliseconds and obtain licences just a few hours for an event.

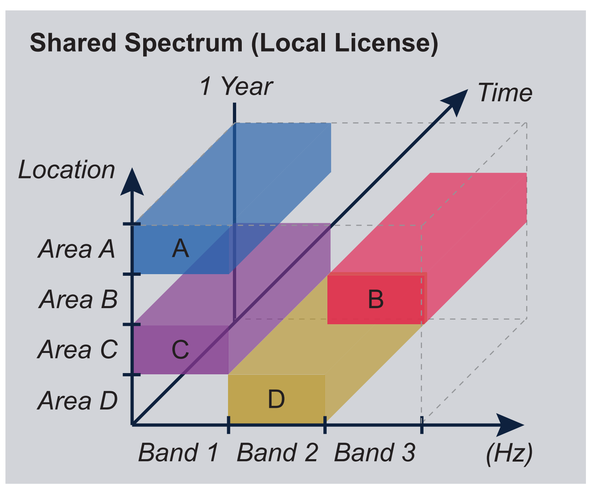
Fixed License Model



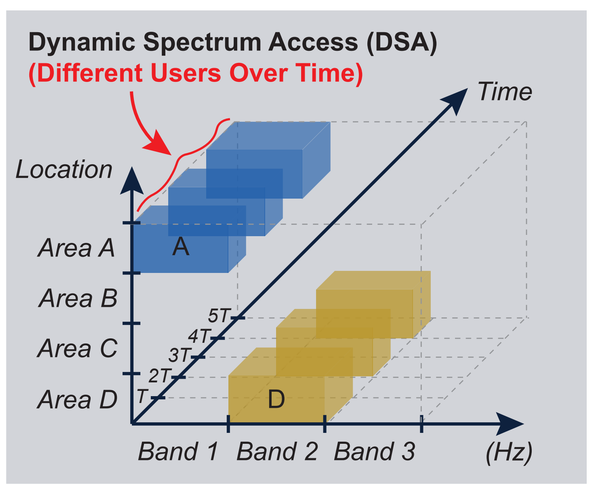
Ofcom Spectrum Allocation Table

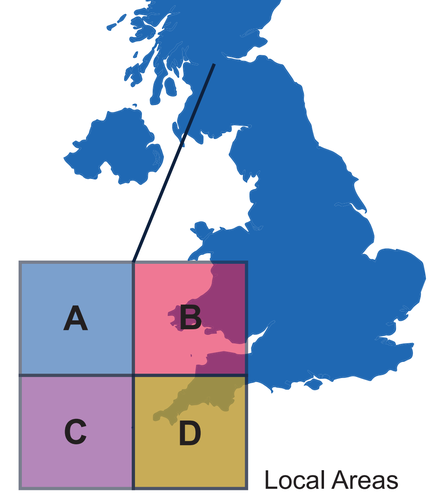


Shared Spectrum (Local License)



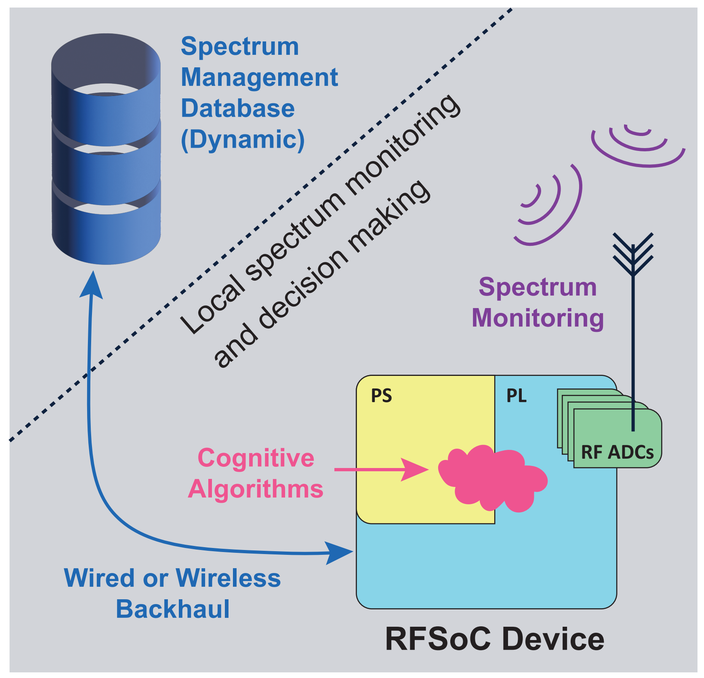
Dynamic Spectrum Access (DSA)
(Different Users Over Time)





Spectrum Monitoring for Sharing

Autonomous vehicles, media and broadcast technologies, and smart manufacturing environments increasingly require DSA to overcome wireless communication congestion. Autonomous DSA mangement requires a “smart” radio that can make decisions based on spectrum database information and spectral observations. Engineers from StrathSDR and AMD have developed an innovative specturm monitoring solution that aims to improve spectrum regulaton and enable real-time DSA techniques. The solution is implemented entirely on the AMD RFSoC and features an open-source stack and hardware design to measure the power of ambient radio signals over time. The system also combines spectrum measurements alongside a local database of frequency band allocations published by Ofcom. The monitoring solution can identify in-use frequency bands and the organisations that can legitimately use them.



Sponsor & Special Thanks

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Contact and Video Demonstration

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Video Demo

Conclusions and Further Work

We have established a prototype design of a spectrum monitoring system on the AMD RFSoC. Further work on improving the spectrum monitoring features, cognitive capabilities, and database integration is underway.