

Cognitive Radio Network (CRN) Technology

Supervisor: Dr Tazeen Syed (t.s.syed@herts.ac.uk)

The advent of technologies such as Internet of things and 5G is creating a huge demand for spectrum. RF spectrum is a valuable resource, and it is underutilised due to the strict and rigid policies of spectrum management. Dynamic Spectrum Access (DSA) based on CR technology offers significant increase in spectrum efficiency. Cognitive radios (CRs) are smart wireless sensor devices that have the capability to sense, learn and adapt to the environment in real time. CR technology is an advancement of software defined radios. The key characteristics of these intelligent devices are cognitive capability and reconfigurability.

The major challenge in the functioning of the wireless networks is the efficient utilization of radio resources and energy efficiency. It is essential, to ensure the longevity of CR devices which are mobile, and battery operated.

Spectrum sensing is the fundamental process of CR technology and is one of the most challenging issues in CRN. Efficient utilisation of the available spectrum is possible when CRs have knowledge regarding spectrum holes. At the same time, spectrum sensing should be energy efficient.

In [1] & [2], an energy efficient spectrum sensing scheme was developed using the history of the sensed data. An analytical engine database (AED) was employed which produced a rich history data set which was utilised by the CRs to make efficient spectrum sensing decision. In [3], an energy efficient MAC protocol was designed for efficient transmission of data between CRs and base station (BS).

Research can be done on the following topics:

- CR technology in 5G wireless communication systems.
- AED generate the rich analytical history data set. Further work can be done on the algorithm in [1] to generate effective analytical data set from the sensed data received from CR, based on machine learning (ML).
- Develop an energy efficient MAC protocol based on IEEE 802.11ac standard for high throughput.
- CR networks are vulnerable to security threats because of its unique features and this may lead to interruption of normal functioning of the system. Research on mitigating security issues at transport and data link layer in CRN communication.
- Event streaming (e.g. MQTT, KAFKA etc) is a cutting-edge technology used in M2M communication. It can enhance the network performance of CRN by providing high throughput and low latency.

Applicants should have strong background in computer networking, wireless communication and networking. Programming skills (for e.g., Python, MATLAB) is essential.

References

1. T. S. Syed and G. A. Safdar, "On the Usage of History for Energy Efficient Spectrum Sensing," in *IEEE Communications Letters*, vol. 19, no. 3, pp. 407-410, March 2015.
2. T. S. Syed and G. A. Safdar, "History-Assisted Energy-Efficient Spectrum Sensing for Infrastructure-Based Cognitive Radio Networks," in *IEEE Transactions on Vehicular Technology*, vol. 66, no. 3, pp. 2462-2473, March 2017.
3. T. S. Syed and G. A. Safdar, "Energy-Efficient GCSA Medium Access Protocol for Infrastructure-Based Cognitive Radio Networks," in *IEEE Systems Journal*, vol. 14, no. 1, pp. 288-297, March 2020