

The future of cognitive radio

Stretching the spectrum

Cognitive radio (CR) is increasingly recognized as an emerging disruptive technology for alleviating today's spectrum scarcity problem. Zhi (Gerry) Tian is working to solve that scarcity problem with a new paradigm of cognitive radio networks.

"CR communications and networking hold great potential to dramatically enhance spectrum utilization efficiency," says Tian.

Radio frequency spectrum is an increasingly valuable resource tightly regulated by governments. The US and UK governments raised \$17 billion and \$22.5 billion respectively in their auctions of third-generation mobile phone licenses.

"On the other hand, radio access technologies are currently built on fixed spectrum allocation, which causes severe spectrum underutilization when a dedicated spectrum is idle."

Tian cites a recent study which showed the average spectrum occupancy of all bands from 30MHz to 3GHz measured in New York City was just 13 percent during a peak period. "The imbalance between spectrum scarcity and spectrum underutilization is especially undesirable today, when significant amount of radio spectrum is needed to provide the ubiquitous wireless high-speed connectivity that we have come to expect."

An emerging paradigm, dynamic spectrum allocation (DSA) ushers in new forms of spectrum-agile cognitive networks. Key to this paradigm are cognitive radios that are aware of the radio frequency environment and can dynamically program radio parameters to efficiently utilize vacant spectrum without causing harmful interference. Devices might include wireless sensors and radio frequency identification chipsets for monitoring and tracking applications, as well as wireless telemedicine radios for remote healthcare and emergency response. But CR research today is still at a conceptual stage. "While a key hindrance in programmable radio design has been the front-end circuit interface, the emerging open access paradigm brings up new technical challenges," notes Tian.

Tian is systematically investigating algorithms for efficient spectrum management in CR networks. She is also conducting fundamental research to cope with major hurdles in spectrum sensing, programmable radio platforms, and adaptive dynamic spectrum allocation. By exploring compressive sampling, she hopes to develop effective signal processing techniques that exploit various elements of sparsity inherent to CR networks.



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