Cognitive Wireless Communications--A Solution for Efficient Multiple Networks Coexistence

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With the rapid development of wireless communications, more and more wireless networks are in use nowadays. As a result, the radio resource, spectrum, becomes a valuable and scare resource. How to allocate the scare spectrum to all the wireless networks so that the end users can enjoy different types of service is a difficult problem for policy makers, engineers, and researchers.

In this talk, I will discuss a potential solution for the multiple network coexistence problem—cognitive wireless communication. A recent spectrum usage study shows that for fixed spectrum allocation scenarios, the allocated spectrum is often underutilized. Therefore, with cognitive wireless communication, a secondary network is able to utilize the spectrum that is assigned to a given network (primary network) when the spectrum is unused. In other words, with the introduction of a cognitive wireless network, we could potentially support multiple types of networks with the spectrum that was only able to support one network service without using this technique.

The key concept of cognitive wireless communication is that the secondary network can use the spectrum without interfering with the primary network. The secondary network needs to reliably identify the primary network's spectrum usage. The process of knowing the spectrum usage is often termed "spectrum sensing." In this talk the requirements and challenges posed to spectrum sensing are discussed. Then spectrum sensing techniques, including single node sensing and multi-node cooperative sensing, are overviewed.

For the secondary network to utilize the unused spectrum, the system designer shall carefully consider the tradeoff between the transmission rate and possible interference to the primary network. In this talk we discuss the cross layer design methodology that does the intelligent scheduling to maximize the transmission of the secondary network without interfering with the primary network in an energy efficient manner.

Finally, the developing project DysNet, a cognitive network test bed, is introduced. This project is sponsored by the National High Technology Research and Development Program (863 Program) of China. The goal of this project is to develop a demo system that uses TV white space for data transmission. The technologies we are planning to research and demonstrate with this test system include spectrum sensing algorithms, both centralized and decentralized transmission control schemes, user mobility management.