ENTROPIC ANALYSIS OF SPECTRUM SENSING FOR COGNITIVE RADIO

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The rapid proliferation of wireless communications has brought many exciting new technologies that require ever more spectrum. As the use of wireless technology has increased, spectrum allocation has become increasingly expensive [1]. A recent FCC study [2] noted that spectrum utilization exhibits large spatial-temporal variances. These variances can be exploited by allowing secondary users unobtrusive access to any channel experiencing negligible primary user (PU) activity; thus enabling even more wireless devices to use the crowded spectrum.

For example, cellular bands might exhibit different use between the business day and the weekend, just as they might vary from Salt Lake City to Green River. Hence a secondary user might utilize these less active bands, provided a tolerant level of PU interference could be ensured. Essentially just a radio and spectrum analyzer defined in software and driven by a decision algorithm, cognitive radio is expected to be the key enabling technology for this method of intelligent spectrum access [3].

As primary user activity is not spatially localized, a collaborative measure amongst multiple cognitive radio nodes has been suggested as a more accurate metric of activity [4]. The only caveat here being the loss of bandwidth due to the required control channel. As PU activity is non-deterministic in nature, the entropy of the control channel is a valid model of this lost bandwidth. If this loss is higher than the available bandwidth, the feasibility of this approach would be put to question.

The widely held hypothesis that PU activity is Markovian in nature appeared to be the first obvious model to scrutinize. That is, if PU activity is indeed Markovian, the lost bandwidth could easily be measured. An ISM band spectrum analyzer was created in GNU Radio and a large sample set of PU activity recorded to challenge this hypothesis. Upon further statistical analysis, we plan to present our findings at the forthcoming UROP Symposium.

[1] Committee on Energy and Commerce, House of Representatives, ”Commercial Spectrum Enhancement Act”, Report to Congress on Agency Plans for Spectrum Relocation Funds, Feb., 2007.

[2] FCC, ET Docket No 03-222 Notice of proposed rule making and order, Dec. 2003.

[3] S. Haykin, ”Cognitive Radio: Brain-Empowered Wireless Communications”, Selected Areas in Communications, Vol. 23, No.2, Feb. 2002

[4] A. Ghasemi, E. S. Sousa,”Collaborative Spectrum Sensing for Opportunistic Access in Fading Environments,” Proc. Symposium on Dynamic Spectrum Access Networks, Nov. 2005.