

SPECTRUM SURVEYING FOR POLICY BASED COGNITIVE RADIO

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ABSTRACT

Rapid growth in wireless communication technologies and services creates high demands for radio spectrum. Current spectrum management and regulations are unable to cater these demands despite claims that radio spectrum is underutilised. Cognitive Radio (CR) aims to resolve these conflicts by enabling opportunistic spectrum access to licensed spectrum. Understanding the spectrum occupancy patterns of licensed spectrum users is important for large scale deployment of CR. This thesis aims to evaluate the 24-hour spectrum occupancy in the 30-3000 MHz frequency band of a suburban outdoor radio environment in Johor Bahru, Malaysia and its applications in the policy development for Policy Based Cognitive Radio (PBCR) concept. A spectrum survey was carried out whereby spectrum measurement was performed, and spectrum data was classified and analysed using energy detection and duty cycle based method. Findings revealed that the spectrum occupancy was 11.29% and several potential spectrum bands for future deployment of CR were identified. Distributions of the duty cycle variable were modelled using continuous probability distributions and their entropy was investigated for different occupancy levels. Results indicated that the beta and Kumaraswamy distributions were an accurate fit and investigations on the entropy distributions proposed characterisations for high, moderate and low spectrum occupancy level. The information gained was applied to demonstrate the development and testing of PBCR policies using Cognitive Radio Language. The demonstration proved the practicability of using the information from spectrum survey in the policy development of PBCR.

ABSTRAK

Perkembangan yang pesat dalam teknologi dan servis komunikasi tanpa wayar mewujudkan permintaan yang tinggi terhadap spektrum radio. Pengurusan dan peraturan spektrum yang sedia ada tidak dapat memenuhi permintaan ini walaupun terdapat pihak yang mendakwa bahawa spektrum radio masih tidak digunakan sepenuhnya. Radio Kognitif (CR) bertujuan untuk menyelesaikan konflik ini dengan membolehkan penggunaan spektrum berlesen secara oportunistik. Memahami corak penggunaan spektrum oleh pengguna spektrum berlesen adalah penting bagi penggunaan CR pada skala yang besar. Tesis ini bertujuan untuk menilai penggunaan spektrum 24 jam pada jalur frekuensi 30-3000 MHz bagi persekitaran radio luar di kawasan pinggir bandar di Johor Bahru, Malaysia dan aplikasinya dalam pembangunan polisi untuk kegunaan Radio Kognitif Berasaskan Polisi (PBCR). Kajian spektrum telah dijalankan dimana pengukuran spektrum telah dilakukan dan data spektrum telah diklasifikasikan dan dianalisis menggunakan kaedah berasaskan pengesanan tenaga dan kitar tugas. Keputusan telah menunjukkan bahawa penggunaan spektrum adalah sebanyak 11.39% dan beberapa jalur spektrum yang berpotensi untuk penggunaan CR telah dikenalpasti. Taburan kitar tugas yang berubah-ubah telah dimodelkan menggunakan taburan kebarangkalian selanjur dan entropinya dikaji bagi tahap penggunaan spektrum yang berbeza. Hasil kajian menunjukkan bahawa taburan beta dan Kumaraswamy adalah paling sesuai dan kajian terhadap taburan entropi pula mencadangkan pencirian bagi tahap penggunaan spektrum yang tinggi, sederhana dan rendah. Maklumat yang diperolehi telah digunakan untuk mendemonstrasikan pembangunan dan pengujian polisi bagi PBCR menggunakan "Cognitive Radio Language". Demonstrasi ini telah membuktikan bahawa maklumat yang diperolehi melalui kajian spektrum dapat memainkan peranan dalam pembangunan polisi untuk kegunaan PBCR.