Modeling Cognitive Radio Networks with Multiple Channels for CBR and TCP Traffic

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ABSTRACT

Investigating and designing optimal models that take care of multiple channels and video traffic in lieu of equitable sharing of spectrum resources presents such a unique research direction. Available literature suggests that Constant Bit Rate (CBR) traffic have stringent service requirements; among which is the mechanism for providing differentiated services in terms of mean delay for Cognitive Radio (CR) users. This is most prevalent where data traffic is carried by Transmission Control Protocol (TCP) connections and CBR traffic. Interestingly, other researchers have observed that the performance of CBR traffic sharing a link with TCP connections is likely to degrade due to TCP connections that execute flow control to utilize as much available bandwidth as possible. The fixed spectrum allocation policy which assigns exclusive rights to the use of spectrum to a licensed user has led to spectrum scarcity. Cognitive radio has been suggested as the remedy to the above challenge. To overcome this challenge we proposed and designed a priority queuing scheme to allocate a channel to licensed (primary) and unlicensed (secondary) users. In this study, we set out to design a spectrum sharing scheme that ensures minimum guarantee for CBR traffic in the presence of TCP traffic. In order to achieve this objective, we analytically modeled the performance of the proposed scheme with regard to end-to-end delay and throughput. The proposed model described in this work looks at spectrum sharing scheme for multimedia applications over cognitive radio networks for TCP and CBR traffic with multiple channels; while hinging on the M/G/K queue technique. In our analysis, a primary user has preemptive priority over secondary user's video, voice and data (TCP) traffic. Secondary user's video traffic have preemptive priority over secondary user's voice and data (TCP) traffic. On the other hand, secondary user's voice traffic have preemptive priority over data (TCP) traffic. Our results show that end-to-end delay generally increases with increase in load and arrival rate of packets into the system. Primary user's traffic experiences a lower end-to-end delay compared to secondary user's video traffic which experiences a lower end-to-end delay than secondary user's voice traffic which in turn experiences a lower end-to-end delay than secondary user's data (TCP) traffic. We also observed that throughput decreases with increase in load and arrival rate. Furthermore, it is observed that as the number of connections increase throughput decreases. Throughput is also observed to increase with increase in the number of channels. This observation implies that if a spectrum is modeled in this fashion,

optimum sharing of resources amongst telecommunication providers can be attained. In this case, all available idle spectrum from the primary user is being utilized, hence more revenue can be generated by charging the secondary users.