Efficient Dynamic Spectrum Sharing Through Rate Compensation and Spectrum Handoff
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Research Challenges

- Cognitive Radio improves the spectrum utilization.
- Allowing Secondary Users (SUs) temporarily occupying the unused spectrum bands.
- Sharing the available spectrum dynamically and efficiently in order to satisfy rate requirements.
- Controlling spectrum handoff to improve the quality of service and reduce the network contentions.

Dynamic Spectrum Sharing Model

- $r_j = \text{Rate Requirement of SU}$
- $w^i_j = \text{The allocated fraction of bandwidth for SU}_j$ over channel $i$, where $w^i_j \in \mathbb{R}; 0 \leq w^i_j \leq 1$

Preliminary Results

- Maximum achieved rate can be obtained by applying the global knowledge of channel states (GSH\textsuperscript{*}).
- Rate compensation strategy reduces significantly the number of channel handoffs.
- Number of channel handoffs and the ability of rate compensation can be controlled by $T_r$.

Rate Compensation and Spectrum Handoff

- Fixed allocation will be used during reservation period ($T_r$) without any handoff.
- Larger rate allocating bandwidth will compensate the unsatisfied rate requirement from previous $T_r$.

$$P_{\text{total}}(T_r) = \begin{cases} \sum_{i=1}^{h} \frac{T_{\text{on}}^i(T_r) \cdot \text{bw}^i}{P_{\text{size}}}, & i \in \text{CH}_j \\ \sum_{i=1}^{h} \frac{T_{\text{on}}^i(T_r) \cdot \text{bw}^i}{P_{\text{size}}}, & i \notin \text{CH}_j \end{cases}$$

$$P_{\text{send}_j}(T_r) = r_j \cdot T_r + q_j(t)$$

- $P_{\text{total}}(T_r)$ = The total number of packets to be sent in the next $T_r$.
- $P_{\text{send}_j}(T_r)$ = The total capacity of channel $i$, when it is selected by $\text{SU}_j$.
- Service satisfaction ($s_j$) can be measured as the ratio of achieved rate to the rate requirement.

Fair Channel Selection

- SU who has the lowest satisfaction ratio has the priority to select the channel.
- Selecting channel which has the largest $P_{\text{total}}^i(T_r)$
- Reserving the slots for transmitting packets for the next period as: $P_{\text{Res}_j}(T_r) = \min(P_{\text{send}_j}, P_{\text{total}}^i(T_r))$
- Then, the allocated fraction of bandwidth can be computed as follows:
  $$w^i_j = \frac{P_{\text{Res}_j}(T_r)}{P_{\text{total}}^i(T_r)}$$

Ongoing and Future Work

- Investigating the optimal value of $T_r$.
- Determining the number of wireless interfaces to improve the algorithm.
- Considering the Static spectrum sharing (SSH\textsuperscript{*}).