Fig. 6. RAP-MAC spectrum access decisions lead to fewer blocked transmission attempts.

CRN Fairness. RAP-MAC does not have an explicit mechanism for inter-flow coordination. However, it adopts a probabilistic non-greedy transmission approach that prevents a single CRN flow from exclusively capturing an available spectral opportunity. This results in RAP-MAC significantly outperforming OPT-MAC in terms of the fairness characteristics as shown in Figure 7. Figure 7(a) depicts Jain’s Fairness Index $JFI = \left( \frac{\sum_i T(i)^2}{(\sum_i T(i))^2} \right)$, where $T(i)$ is the goodput of the $i$th flow and $L$ is the number of CRN flows [26]. At low CRN demands, JFI of RAP-MAC approaches its optimal value of unity implying that all flows are getting approximately equal goodput shares. As the traffic demands increase, JFI of RAP-MAC decreases but it is always much higher than JFI of OPT-MAC. The poor fairness performance of OPT-MAC is attributed to its greedy transmission strategy that can allow some flows to exclusively capture spectral opportunities and thereby starving other flows in ad-hoc networks. Figure 7(b) illustrates the percentage of flows receiving less than 10% of the average CRN goodput. It can be seen that OPT-MAC allows only 53% of the flows to capture the spectral opportunities starving the remaining 47% of the flows. Meanwhile, less than 1% and 2% of the flows are underserved using RAP-MAC depending on the value of $\beta$.

Channel Utilization. OPT-MAC assumes CRN nodes with wide-band spectrum sensing capability aiming at closely tracking spectral opportunities. Meanwhile, RAP-MAC has the CRN flows randomly picking their channel. Despite the difference in the spectrum sensing scheme, Figure 8 shows that both RAP-AMC and OPT-MAC tend to utilize the channels licensed to PRNs with the lowest activity factors of 0.1 for most of the time, namely, channels 1, 4 and 7 illustrated by the dark blue, light blue and orange bars, respectively. At low CRN traffic demands, both RAP-MAC and OPT-MAC do not frequently utilize the rest of the channels with activity factors of 0.5 and 0.9 as illustrated in Figure 8(a). However, as the CRN traffic demand increases (Figure 8(b)), RAP-MAC probabilistic access scheme allows the CRN flows to explore the heavily utilized channels more than OPT-MAC rather than having the excess demand utilizing channels 1, 4 and 7. However, RAP-MAC does not degrade the outage performance of highly active PRNs because of RAP-MAC