The interference profile to the 8 PU sub-bands on execution of the aforementioned bit allocation schemes is depicted in Figure 12. While the proposed algorithms, Algorithm 2-4, are successful in mitigating the interference to each of the PU sub-bands, the cap-limited scheme only does so for the spectrally closest PU sub-band. The subcarrier-nulling scheme, however, generates the lowest interference profile, since it nulls sub-carrers till interference to each band is mitigated.

Sub-carrier bandwidth sizing

The simulation parameters are the same as those described for the power allocation and bit loading problems. However, the 5 MHz SU bandwidth is not divided into 32 sub-carriers anymore. Instead, the problem entails searching for that sub-carrier bandwidth which will maximize the SU throughput, while mitigating the coherence to the PU band. The coherence bandwidth is $\Delta f_c = 200$KHz ($\Delta f_c = 1/5\sigma_T$ [46], where $\sigma_T$ is the rms delay spread, and assumed to be 1$\mu$s). The power budget at the SU Tx is $P_t = 1$ W.

In Figure 13, we analyze the SU throughput, while increasing the sub-carrier bandwidth unto the coherence bandwidth $\Delta f_c$. Although not plotted, it is expected that the SNR will increase with an increase in the sub-carrier bandwidth, however, the same cannot be said about the throughput. It is observed (Figure 13) that unto a certain point, an increase in bandwidth results in a corresponding increase in throughput; after which, any further increase results in the symbol duration becoming relatively smaller than the guard interval, and the throughput reduces. Initially a crude search was conducted by varying $N_s$ in a step size of 10, as indicated by the markers in Figure 13. Then a fine search was conducted to look for the global optima. The execution of Algorithm 5 yielded $N_{s_{opt}}$ as 101 and the corresponding $B_{opt}$ as 99.01 KHz.

The optimum SU sub-carrier bandwidth should also maintain the interference to the PU band below the specified threshold. To understand the effect of varying sub-carrier bandwidth on the PU interference, we have plotted Figures 14 and 15, by dividing the PU band into 4 and 8 sub-bands, respectively, and allocating the power uniformly. In both cases, the following observations are made: (i) As the SU sub-carrier bandwidth decreases, the interference to the PU sub-bands scheme from literature which is based on sub-carrier nulling [14] gives the lowest throughput.