

Renewable Energy based system

A wildlife monitoring device deployed in a forest, is equipped by both solar panels and a battery. To save energy, the system sleeps for a given amount of time, and then scans the environment. Scanning have an average duration of 2 minutes. The sleeping time, however, depends on the environment. During the night, the system sleeps for an average of 18 minutes. During the day, it sleeps for a different average duration, depending on whether solar power is available or not. If the solar panels produce enough energy, the sleeping time is reduced to 3 minutes. Otherwise, during cloudy periods, when solar panel cannot produce enough energy, the sleeping time is increased to 8 minutes. Assuming that days and nights have an average length of 12 hours, and that sunny period have an average length of 6 hours, while cloudy periods an average of 3 hours, and that the average power consumption when sleeping is 0.1 Watts, while when scanning the environment is 12 Watts, determine:

- The average power consumption of the device
- The utilization (fraction of time the system is scanning over the total time)
- The throughput, expressed in scans per day

To simplify the computation, assume that the all the durations can be expressed with exponential distributions. Analyze the system with a CTMC, and provide a representation of the:

- The graph showing the CTMC
- The infinitesimal generator matrix
- The reward vector for the average power consumption and for the utilization
- The reward matrix of the throughput