# Wireless Communication and Mobile Network – Report of Project 2

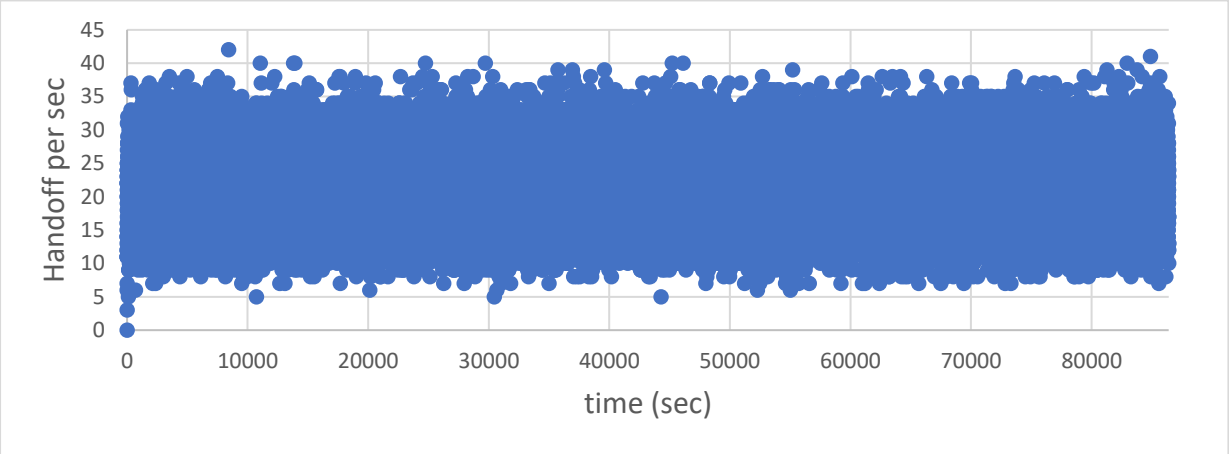
因為基地台位置是給定的，所以可以根據路徑損失的公式計算出在所有格點上所收到每個基地台的訊號。因此實作的部分便在於車子的抵達分布、移動以及交接策略。這裡的交接策略皆為根據接收訊號強度(Received Signal Strength, RSS)決定是否交接。主要有 Best 策略、Entropy(or hysteresis)策略和 Threshold 策略三種。其中 Entropy 策略和 Threshold 策略各有一個參數，這裡叫他們 E(Entropy)和 T(Threshold)。這兩個參數都有減少交接次數的功用，其中前者(Entropy)可以降低車子在兩基地台中點附近來回移動的不必要切換；而後者(Threshold)可以避免所謂乒乓效應——基地台訊號劇烈變化——造成的頻繁切換。但兩個策略亦有缺點，前者(Entropy)參數設置過大可能導致訊號接收強度過低、交接延遲，設置過小則會有較多不必要交接；後者(Threshold)設置過大會導致 Cell 邊界的交接頻繁，設置過小亦有訊號強度低的缺點。因此我的策略主要是結合 2 種策略——Entropy、Threshold，使用 Threshold 策略作為可接受訊號強度之下界，並以有機率性的 Entropy 策略來決定交接。利用車子位置與原基地台及所接收最大訊號強度之基地台的兩距離作為機率函式的參數(式(1))，當符合 Entropy 策略時根據此機率決定是否進行交接。

$$P(d_{old}, d_{new}) = 1 - \frac{d_{new}}{d_{old}} \quad (1)$$

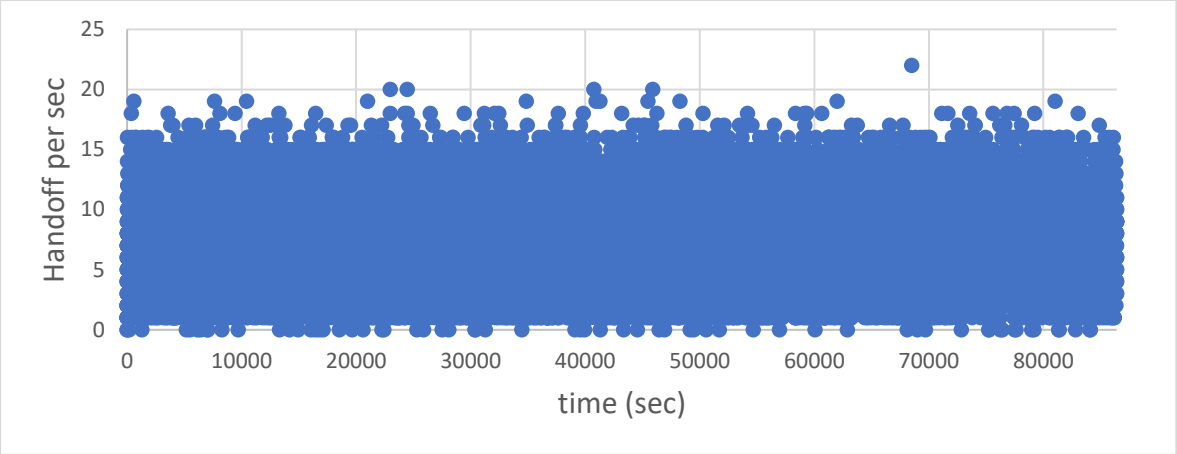
式(1)中$d_{old}$是車子與原基地台距離、$d_{new}$是車子與所接收最大訊號強度之基地台的距離，因為訊號強度(P)與距離(d)的關係為$P = A - B \times logd$，所以此機率函數的輸出值介於 0($d_{old} = d_{new}$原基地台即為最強訊號基地台)和 1($d_{new} = 0$車子與最強基地台位置重合或 $d_{old} \to \infty$車子與原基地台距離極遠)之間。利用 Threshold 和 Entropy 策略的結合可以獲得比 Threshold 策略更高的平均功率值，相較 Entropy 策略則可在付出一點功率損失下，使 Handoff 次數有較大幅的降低。與 Best 策略相比則能有大幅的 Handoff 次數下降。

表一 lambda = 0.5, E = 10.0, T = 10.0

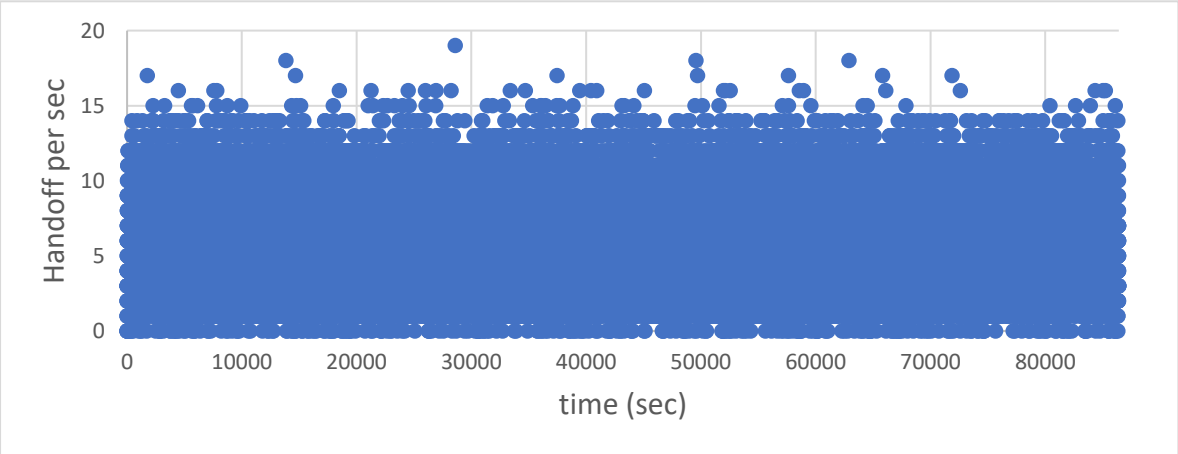
| **lambda = 0.5, arrProb = 0.0009995** | |
|---|---|
| total # of cars | 25827547 |
| Best policy | |
| total handoff | 1820604 |
| avg power | 17.8566 |
| Threshold policy with threshold 10 | |
| total handoff | 115689 |
| avg power | 15.4201 |
| Entropy policy with entropy 10 | |
| total handoff | 625684 |
| avg power | 16.594 |
| Threshold policy with threshold 12 | |
| total handoff | 497081 |
| avg power | 15.7429 |
| MyPolicy policy with entropy 10 threshold 10 | |
| total handoff | 610165 |
| avg power | 16.5234 |



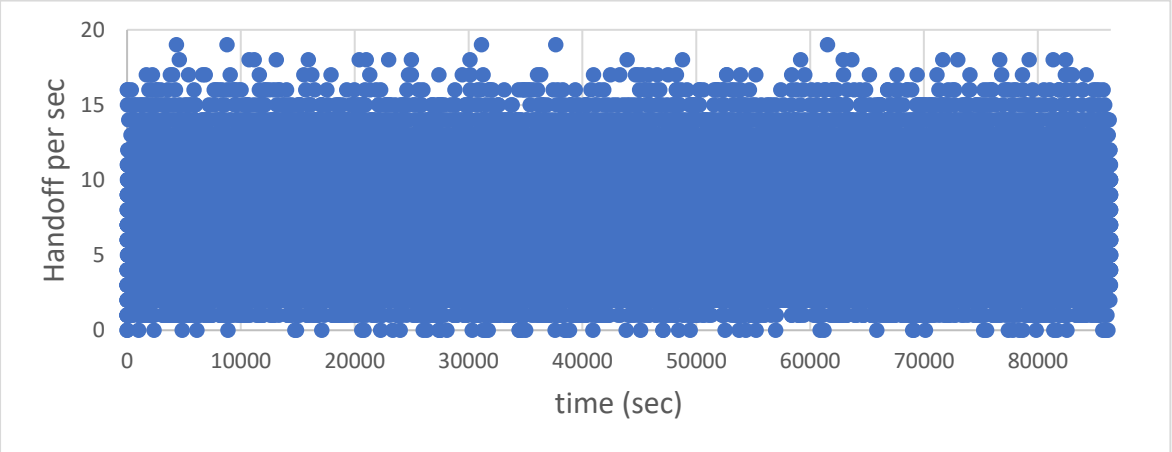

圖一 Best Policy with lambda = 0.5




圖二 Entropy Policy (E = 10) with lambda = 0.5



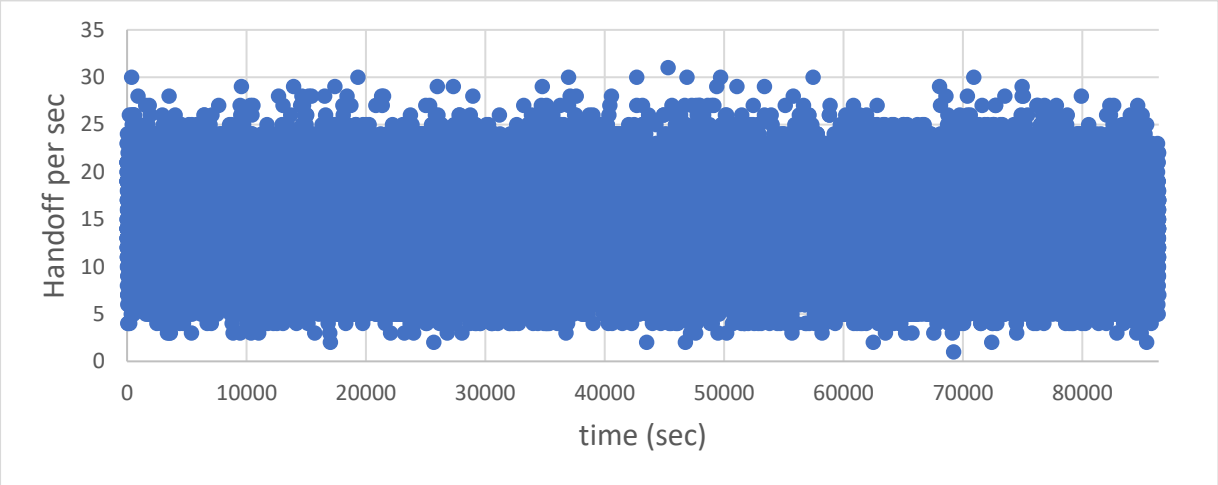

圖三 Threshold Policy (T = 12) with lambda = 0.5



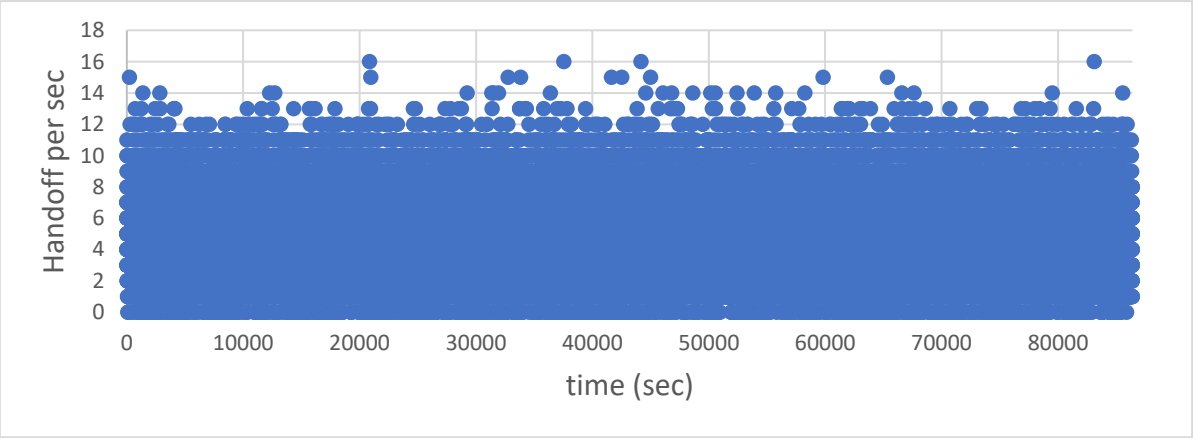

圖四 MyPolicy (T = 12, E = 10) with lambda = 0.5

表二 lambda = 0.33333, E = 10.0, T = 10.0

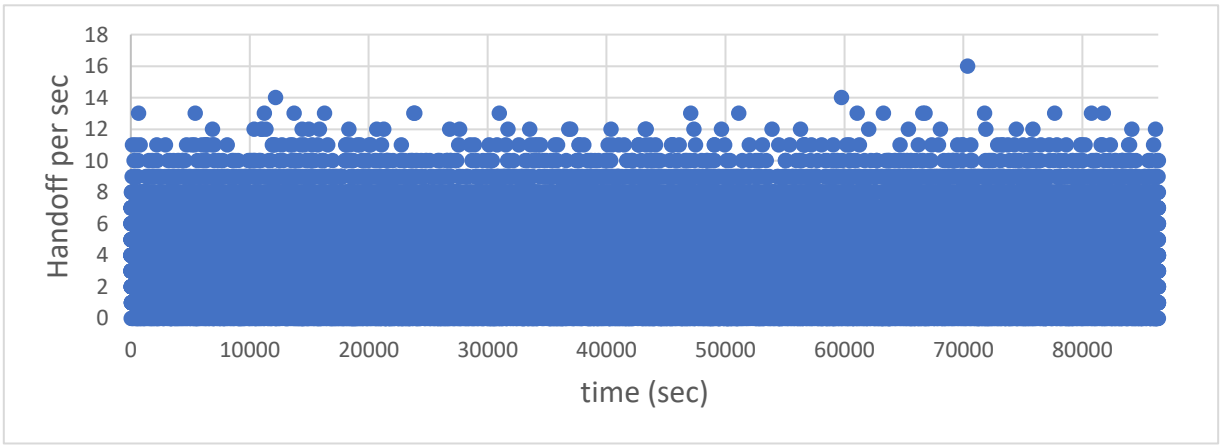
| lambda = 0.33333, arrProb = 0.000666444 | |
|---|---|
| **total # of cars** | 16885839 |
| **Best policy** | |
| **total handoff** | 1189883 |
| **avg power** | 17.8618 |
| **Threshold policy with threshold 10** | |
| **total handoff** | 75818 |
| **avg power** | 15.4241 |
| **Entropy policy with entropy 10** | |
| **total handoff** | 408388 |
| **avg power** | 16.5997 |
| **Threshold policy with threshold 12** | |
| **total handoff** | 324837 |
| **avg power** | 15.7467 |
| **MyPolicy policy with entropy 10 threshold 10** | |
| **total handoff** | 398404 |
| **avg power** | 16.5283 |



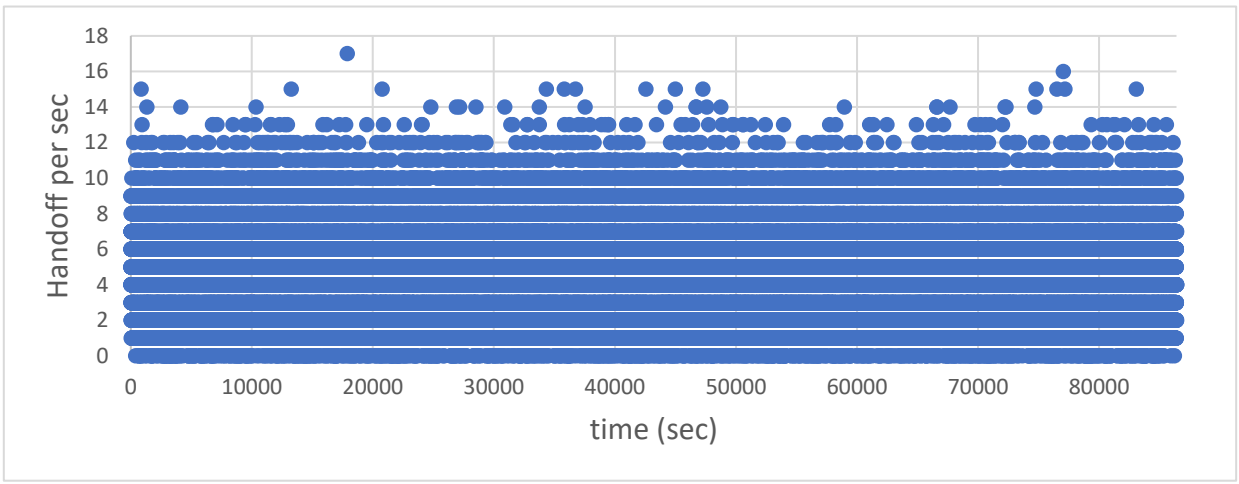

圖五 Best Policy with lambda = 0.33333




圖六 Entropy Policy (E = 10) with lambda = 0.33333



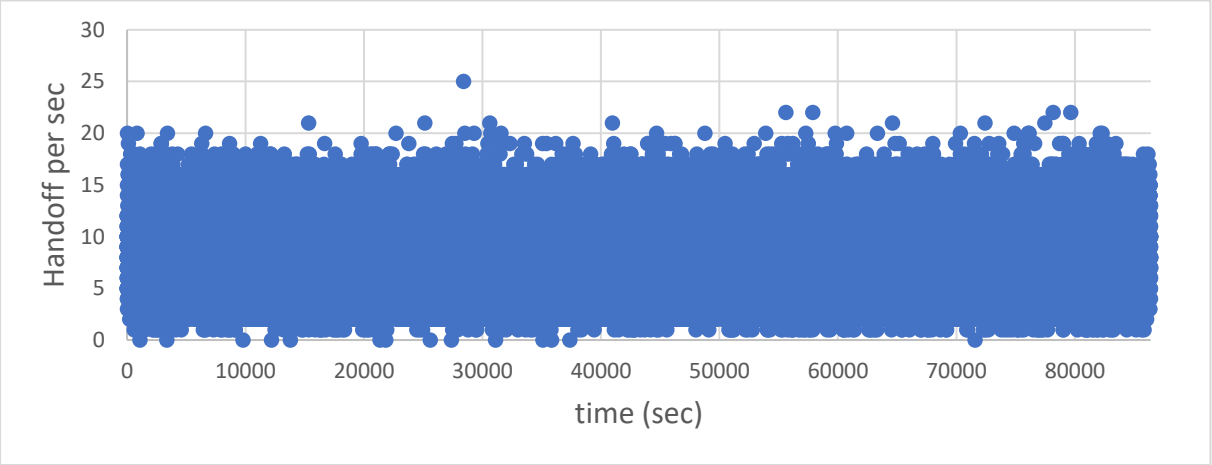

圖七 Threshold Policy (T = 10) with lambda = 0.33333



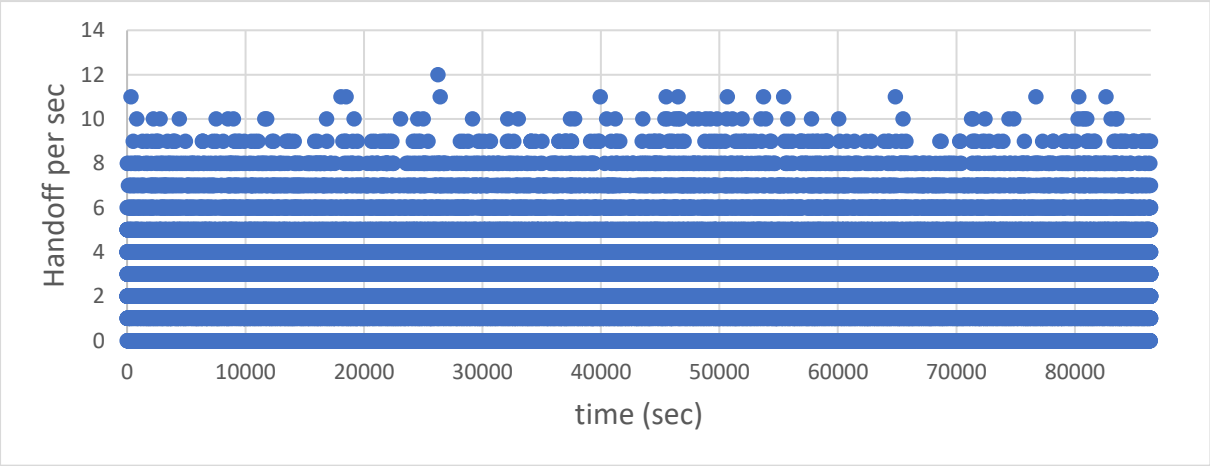

圖八 MyPolicy (T = 12, E = 10) with lambda = 0.33333

表三 lambda = 0.2, E = 10.0, T = 10.0

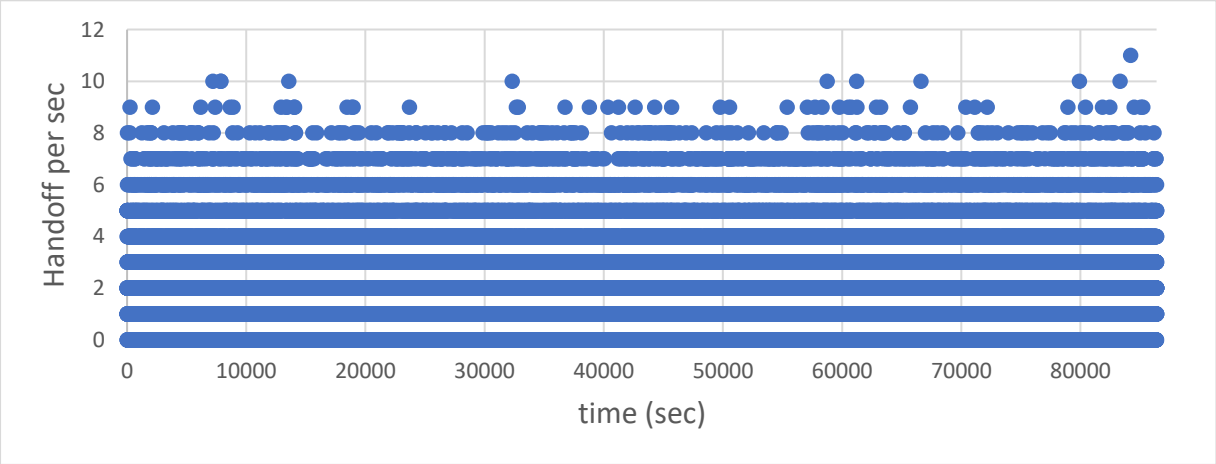
| lambda = 0.2, arrProb = 0.00039992 | |
|---|---|
| **total # of cars** | 10310374 |
| **Best policy** | |
| **total handoff** | 726197 |
| **avg power** | 17.8553 |
| **Threshold policy with threshold 10** | |
| **total handoff** | 46459 |
| **avg power** | 15.4208 |
| **Entropy policy with entropy 10** | |
| **total handoff** | 250114 |
| **avg power** | 16.5944 |
| **Threshold policy with threshold 12** | |
| **total handoff** | 198453 |
| **avg power** | 15.7451 |
| **MyPolicy policy with entropy 10 threshold 10** | |
| **total handoff** | 244242 |
| **avg power** | 16.5243 |



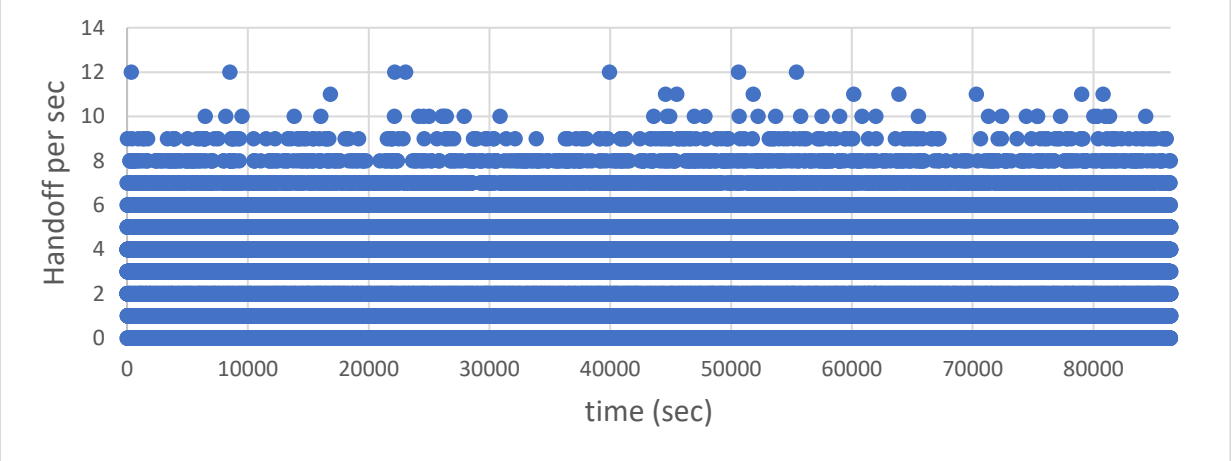

圖九 Best Policy with lambda = 0.2




圖十 Entropy Policy (E = 10) with lambda = 0.2




圖十一 Threshold Policy (T = 12) with lambda = 0.2




圖十二 MyPolicy (T = 12, E = 10) with lambda = 0.2