Naïve 1-Steiner by Kahng/Robins

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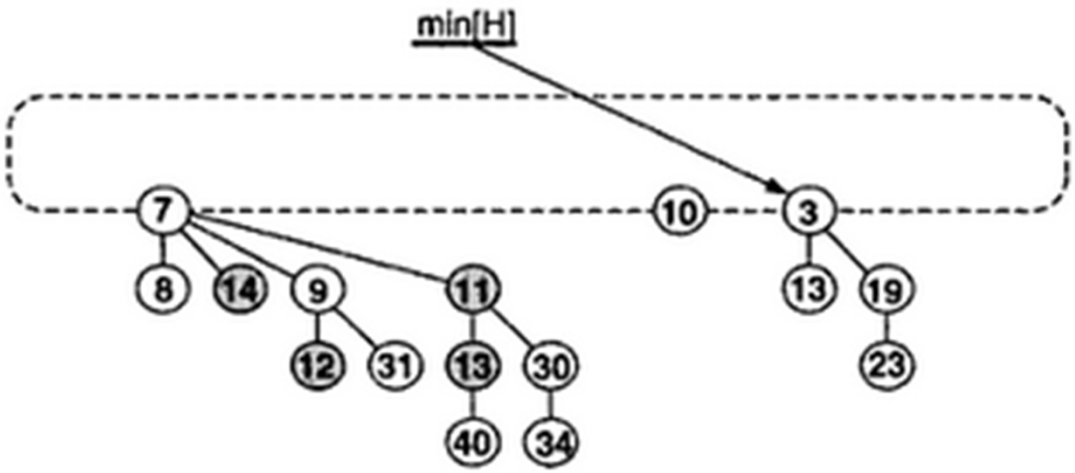
Implementation

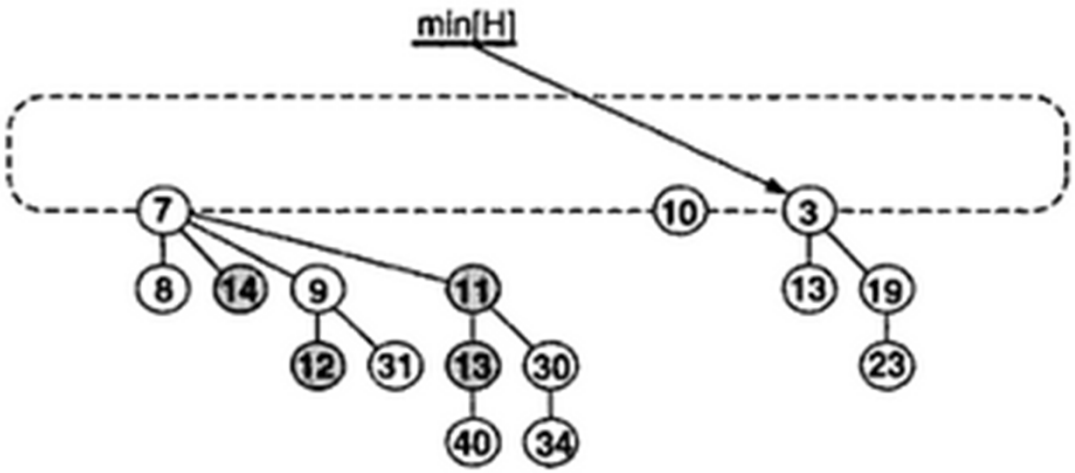
- Prim's MST Algorithm
- Runs MST Algorithm exhaustively on Steiner points
- Possibilities:
  - Adjacency Matrix
  - *Adjacency List*
  - *Use Heap to keep track of all connecting edges to MST*

What is a Fibonacci Heap?

- A heap is a ordered tree
- Fibonacci Heap is a collection of min-heap trees with a pointer to the minimum root node

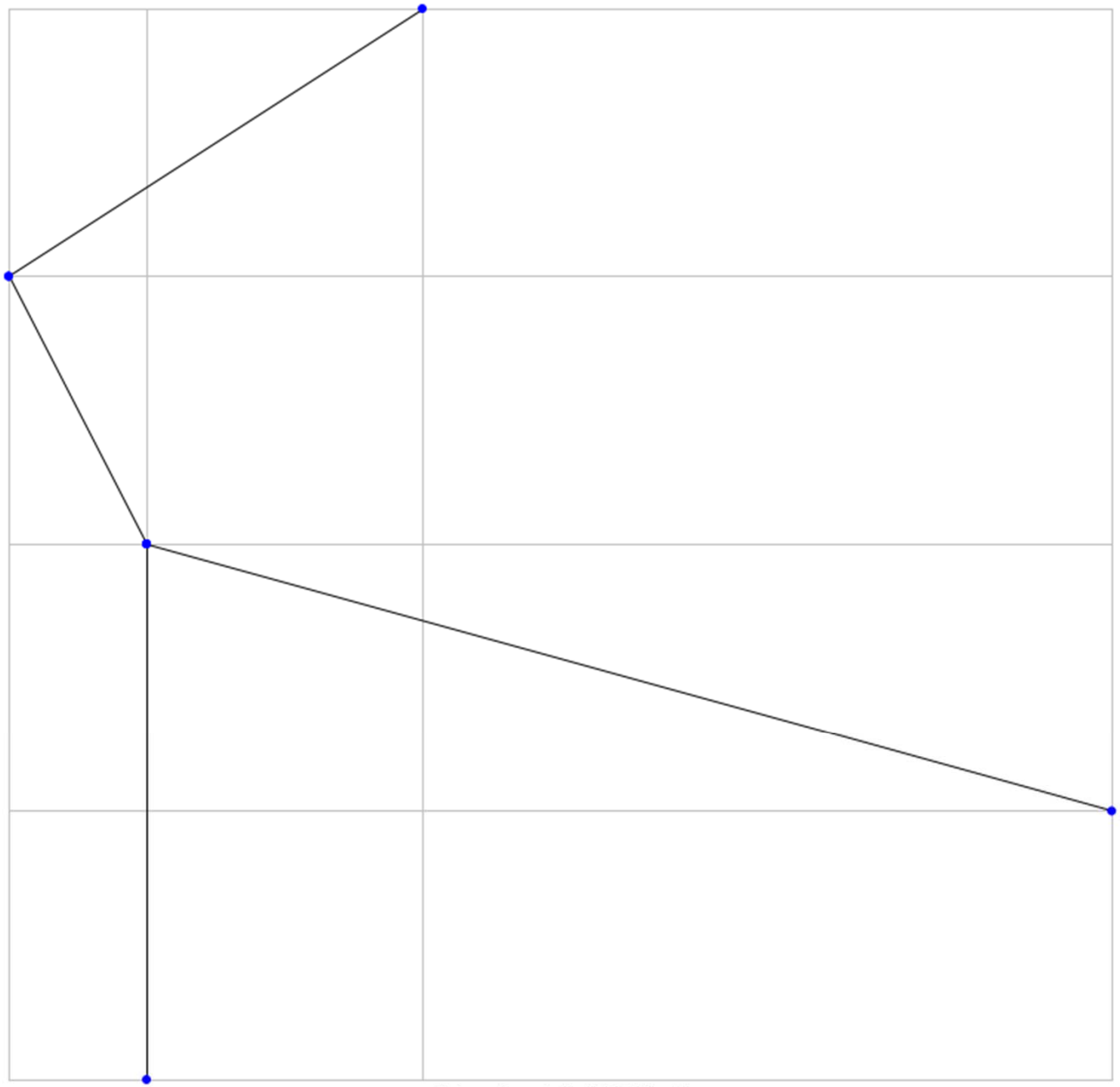


- Edges are kept as heap nodes in the tree
- We know what endpoints are closest to our current MST
- Amortized Runtime: O(E + V log V)



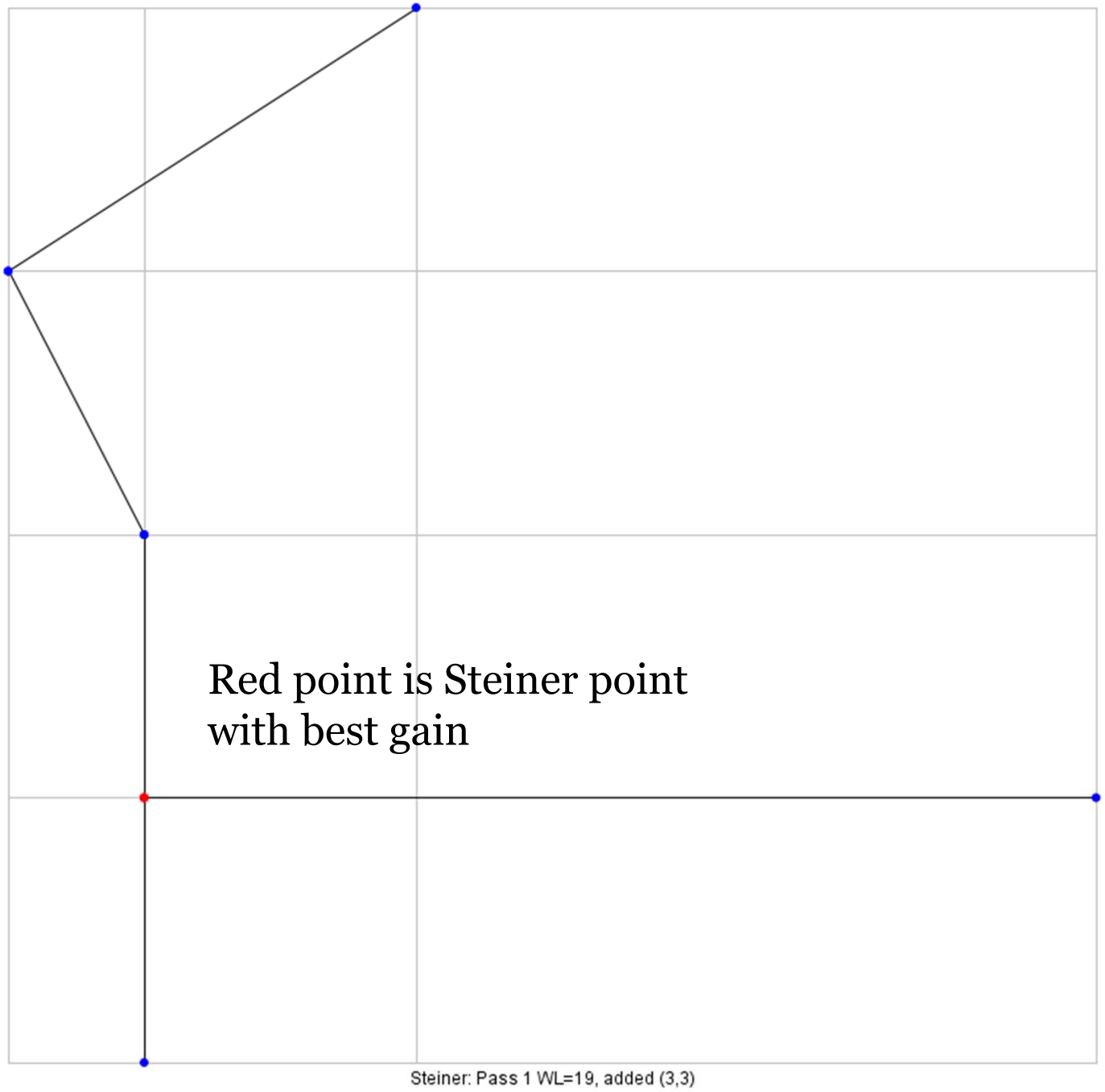
Test Results: 5 Demand Points

WL = 21

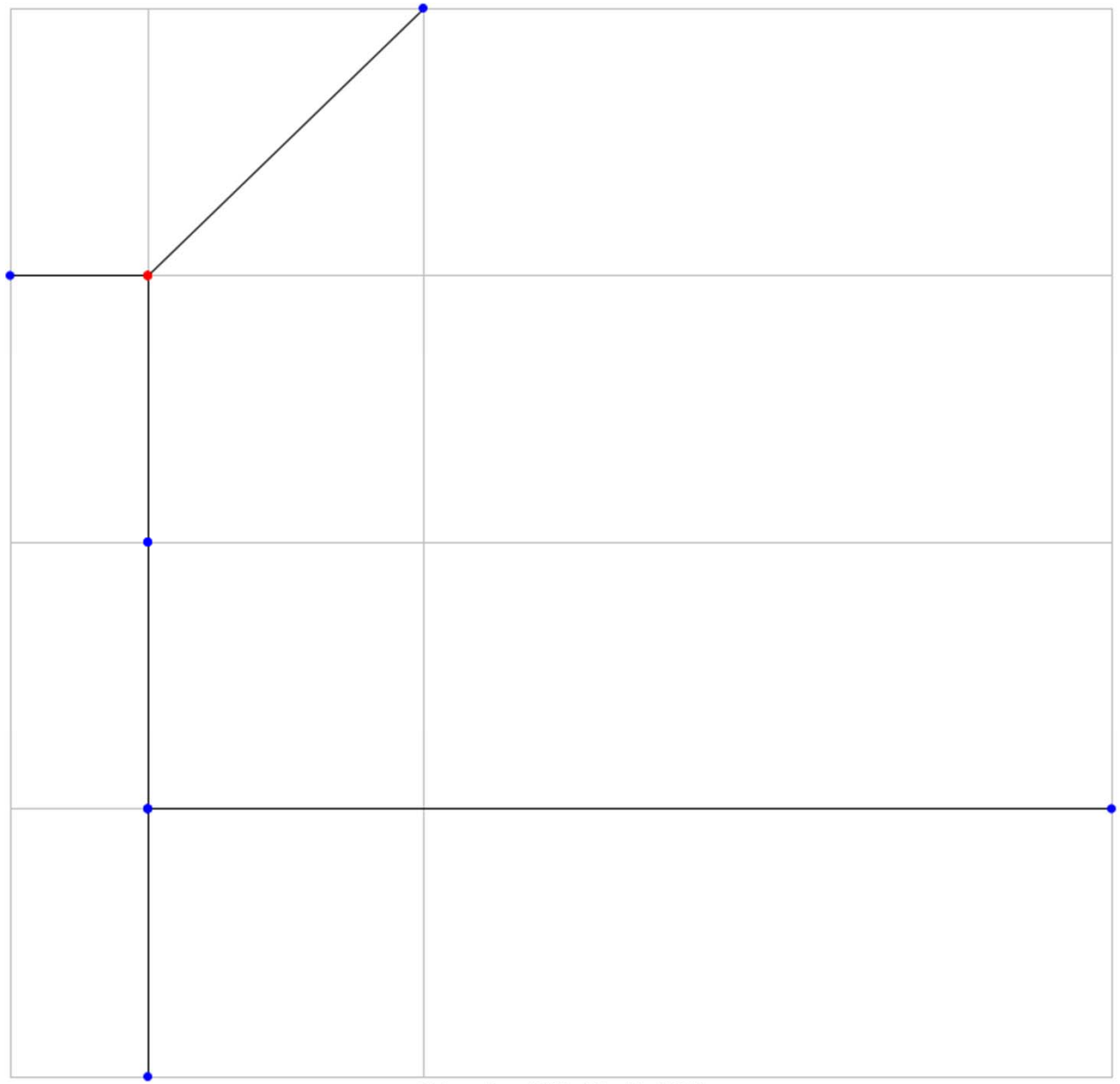


Steiner: Pass Initial MST WL=21

WL = 19


Red point is Steiner point
with best gain
Steiner: Pass 1 WL=19, added (3,3)

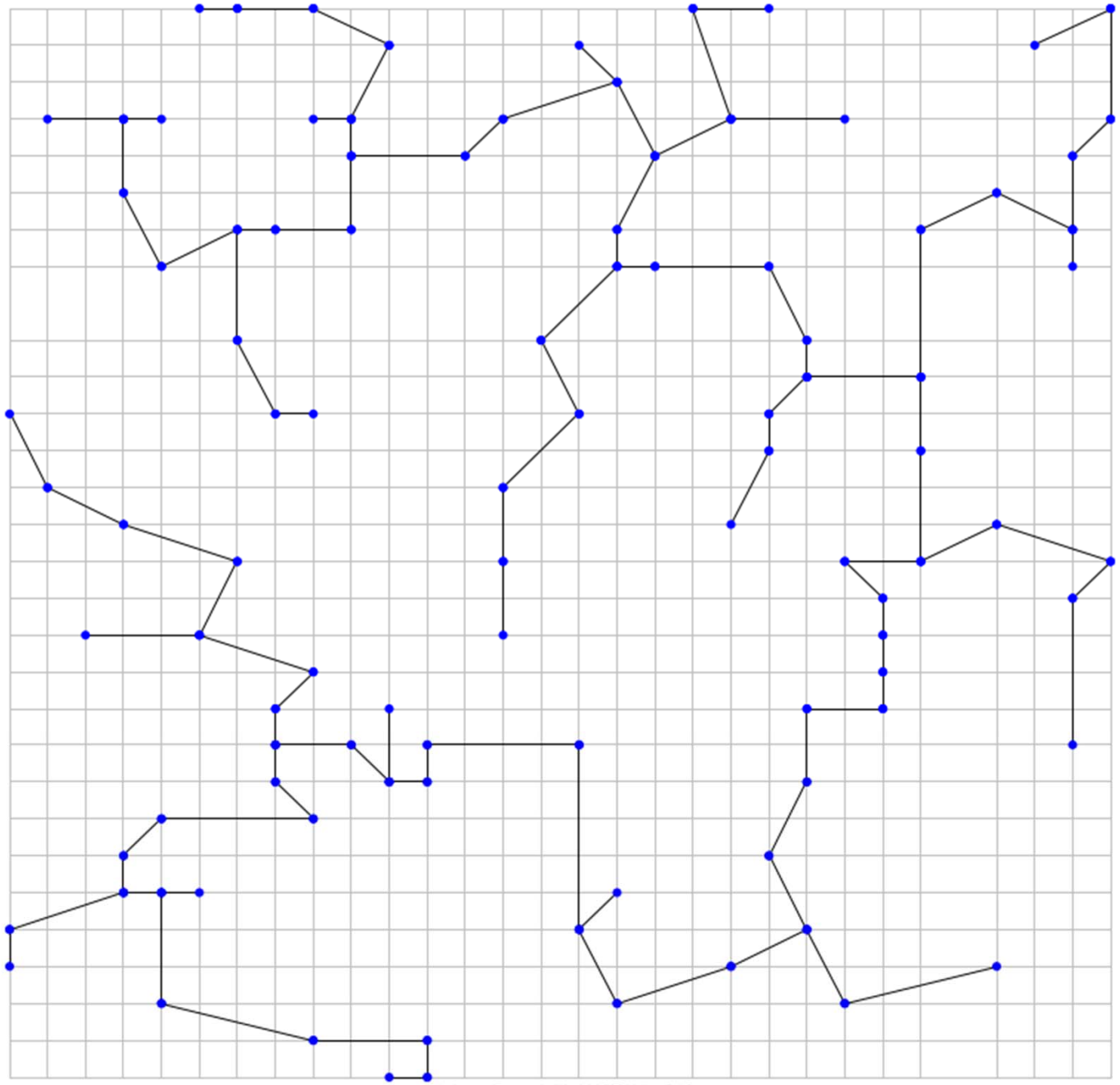
WL = 18



Steiner: Pass 2 WL=18, added (3,7)

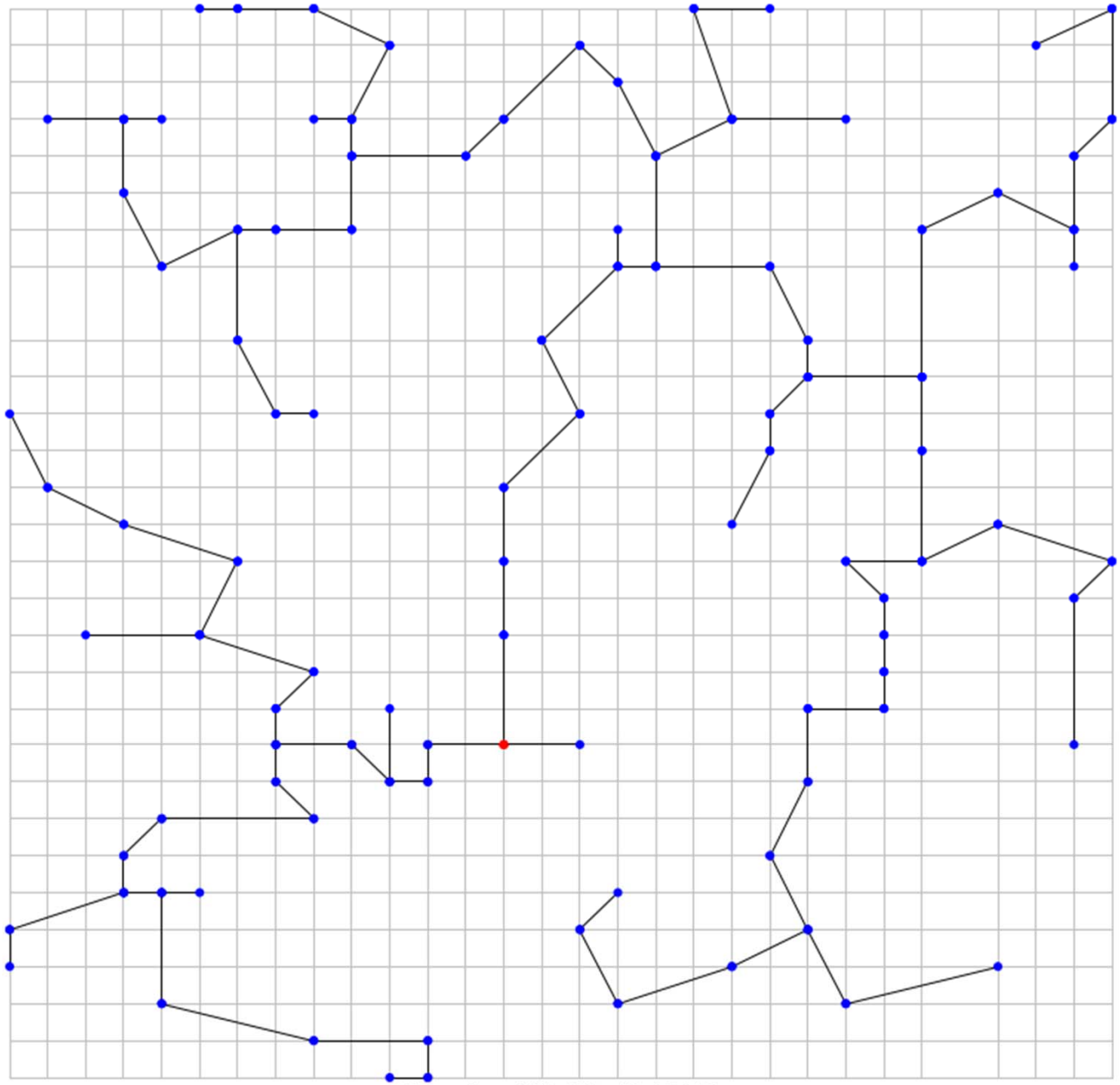
Test Results: 100 Demand Points

WL: 242

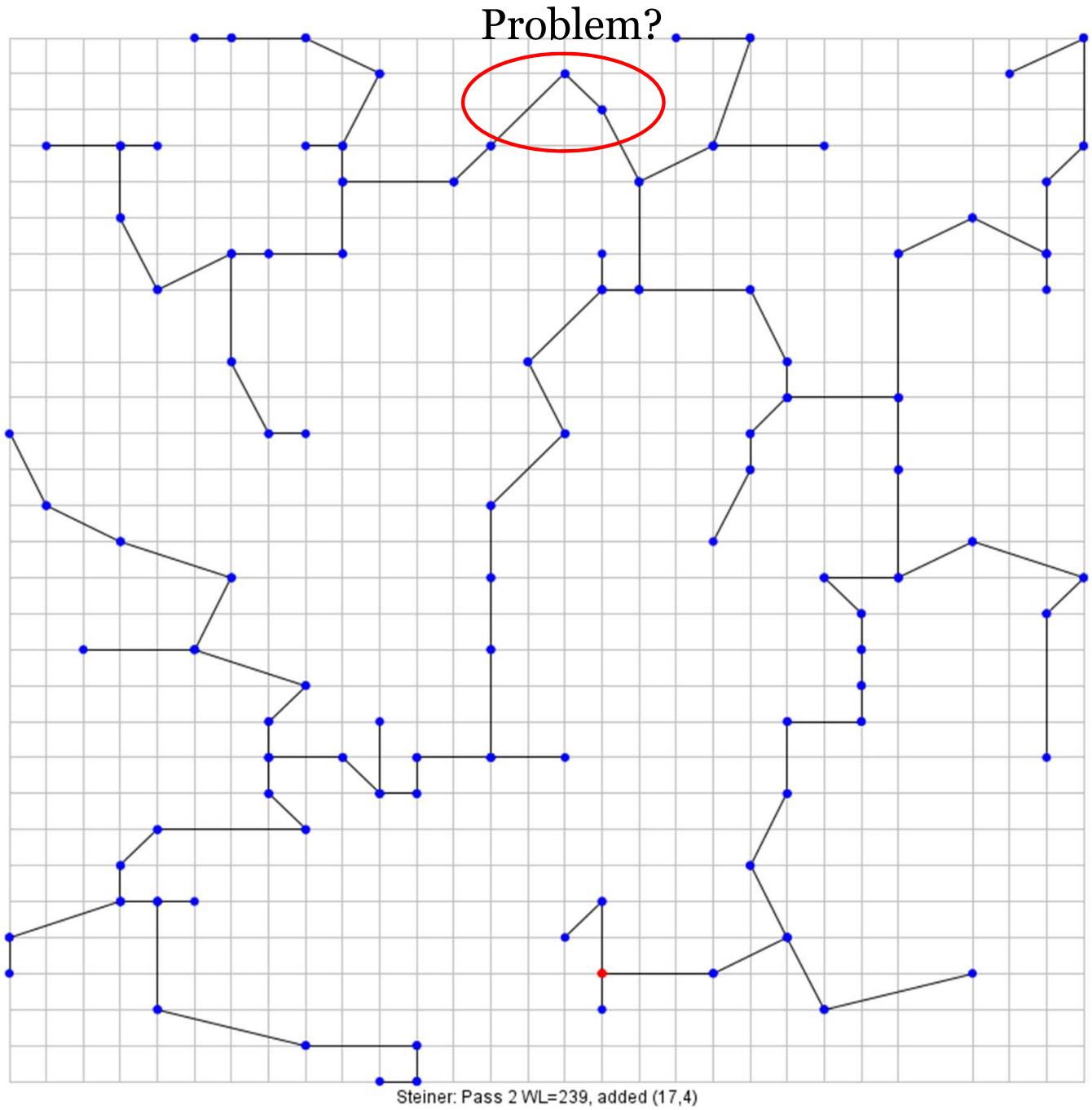


Steiner: Pass Initial MST WL=242

WL: 240

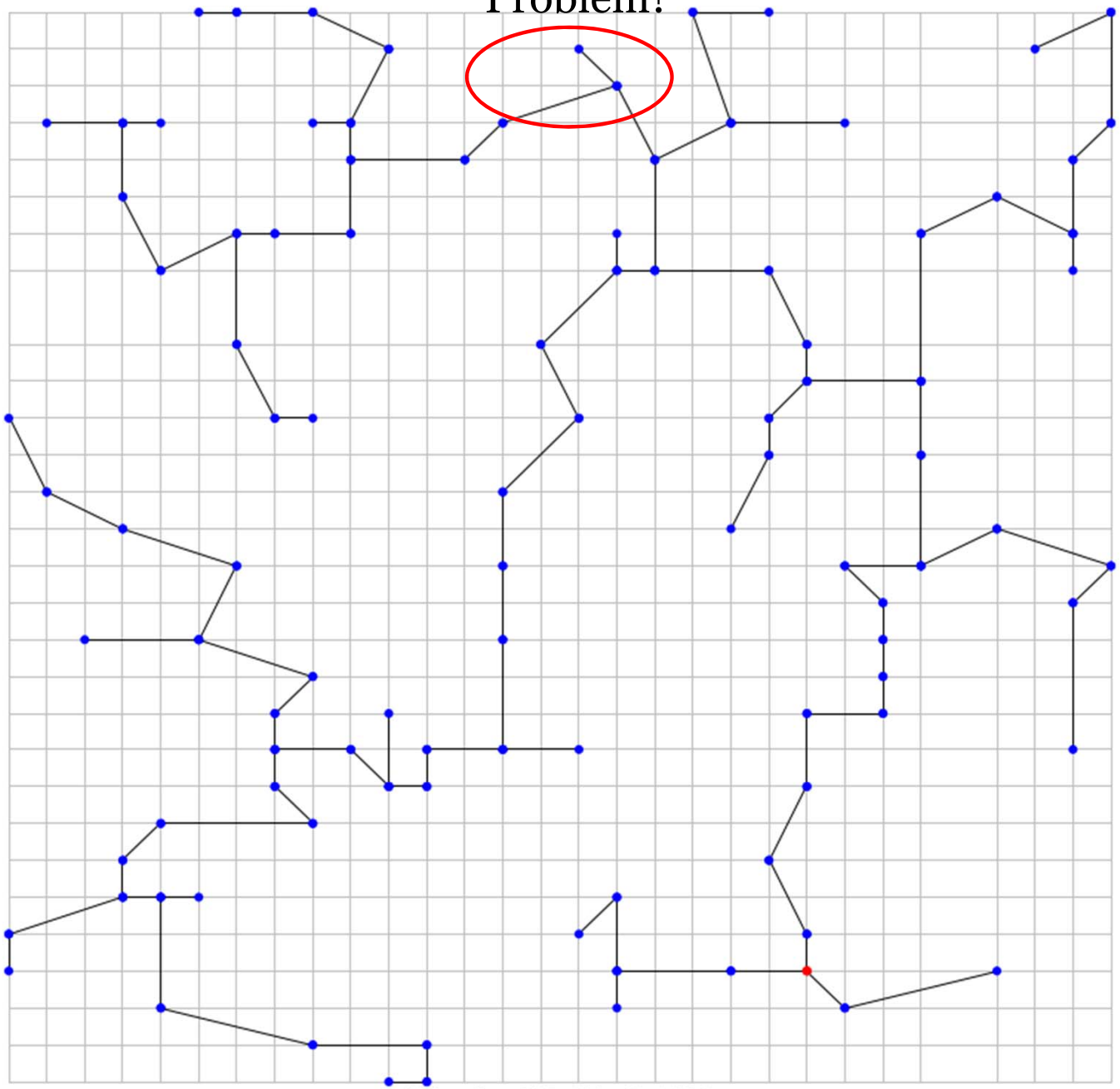


WL: 239



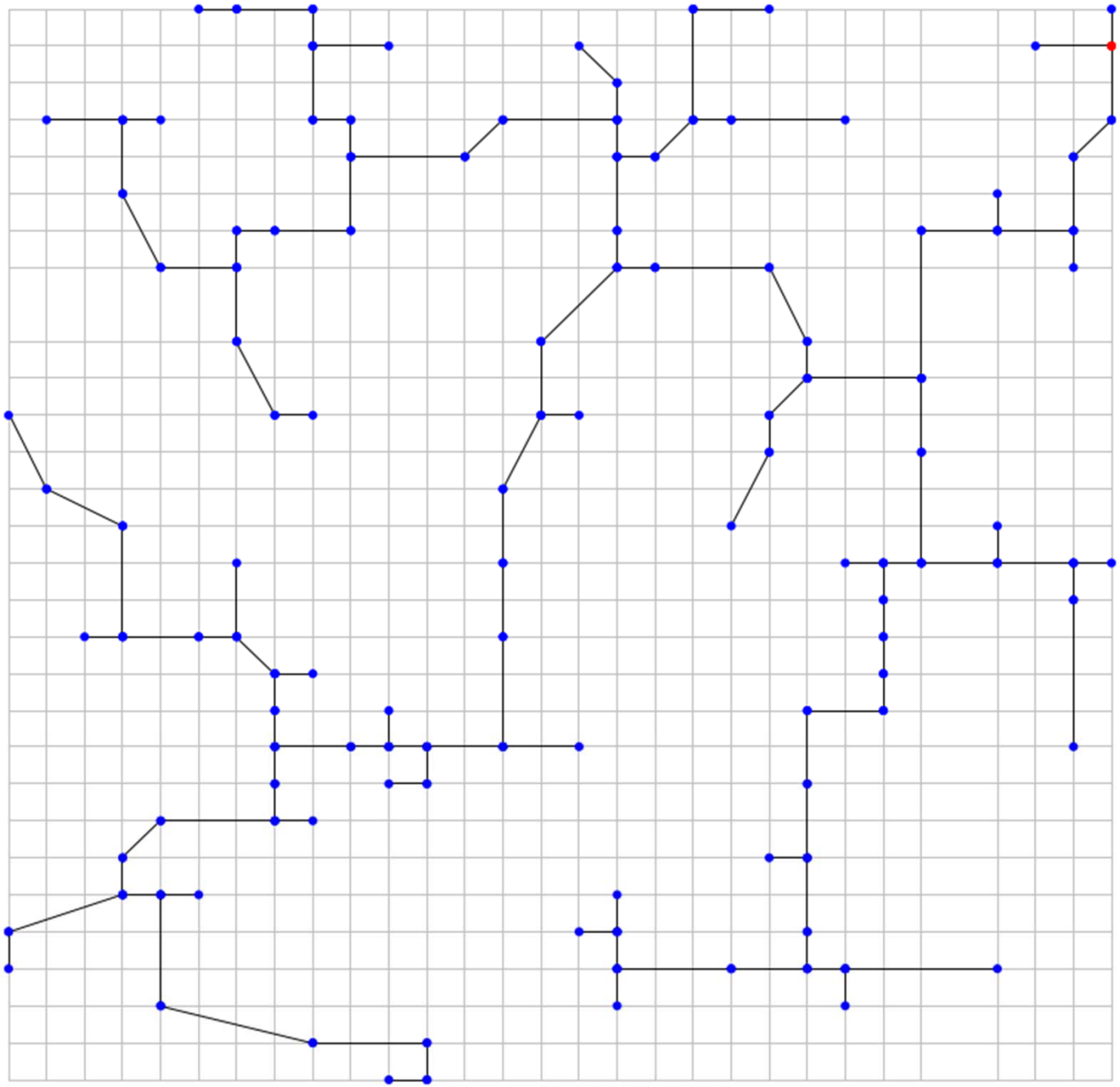
Problem?

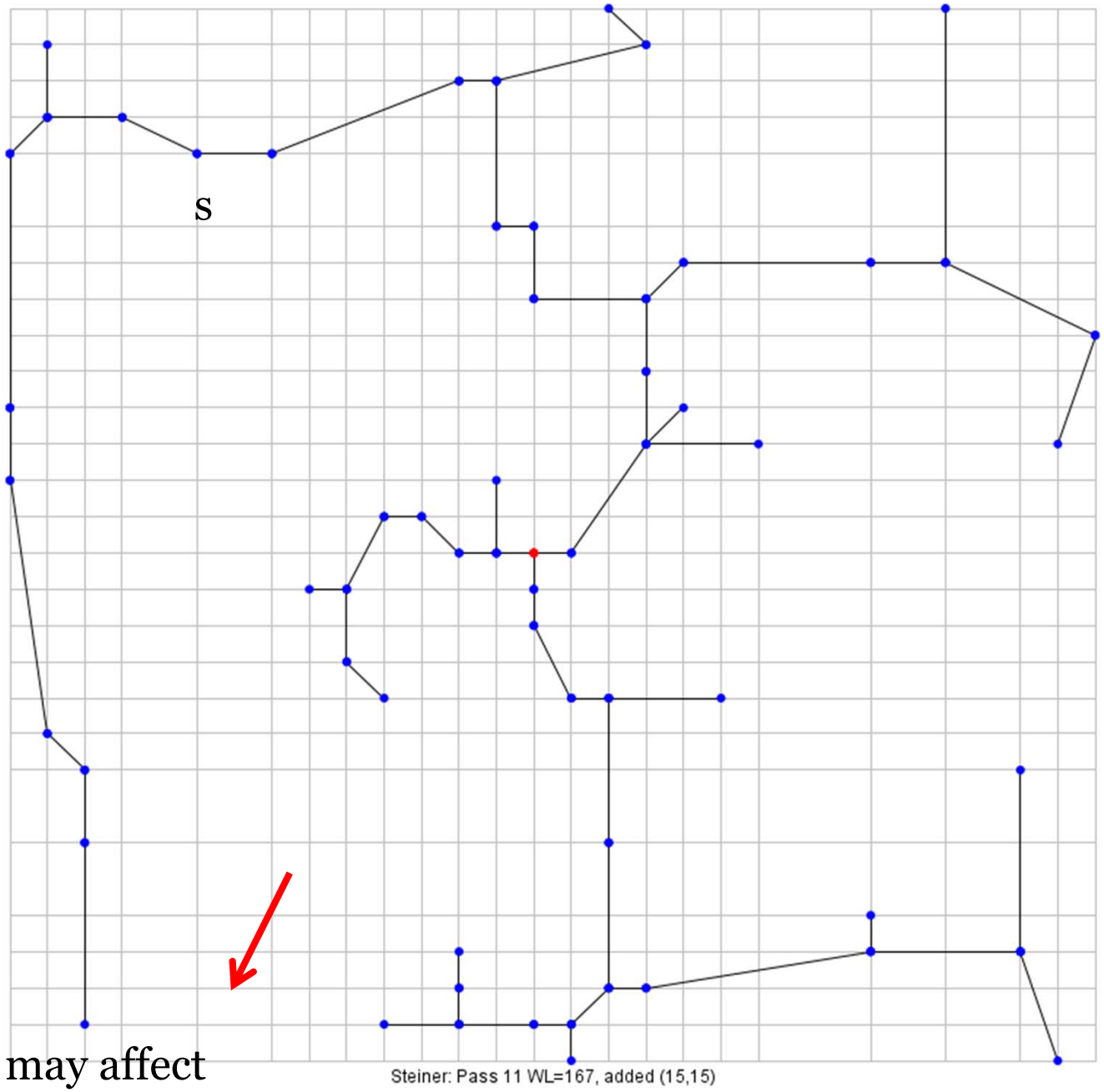
WL: 238



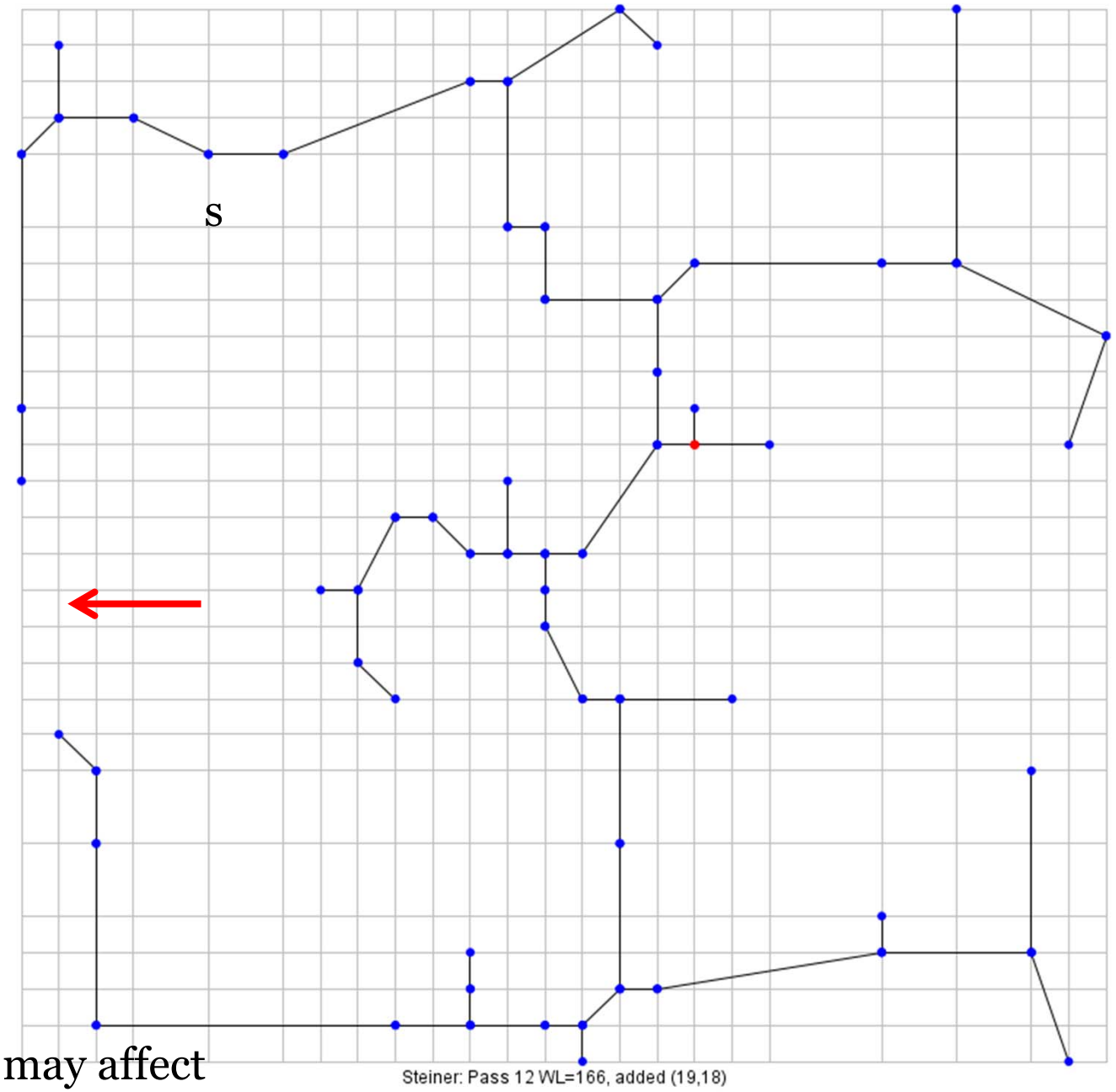
Steiner: Pass 3 WL=238, added (22,4)

WL: 219
After 22
Passes
(Iterations)



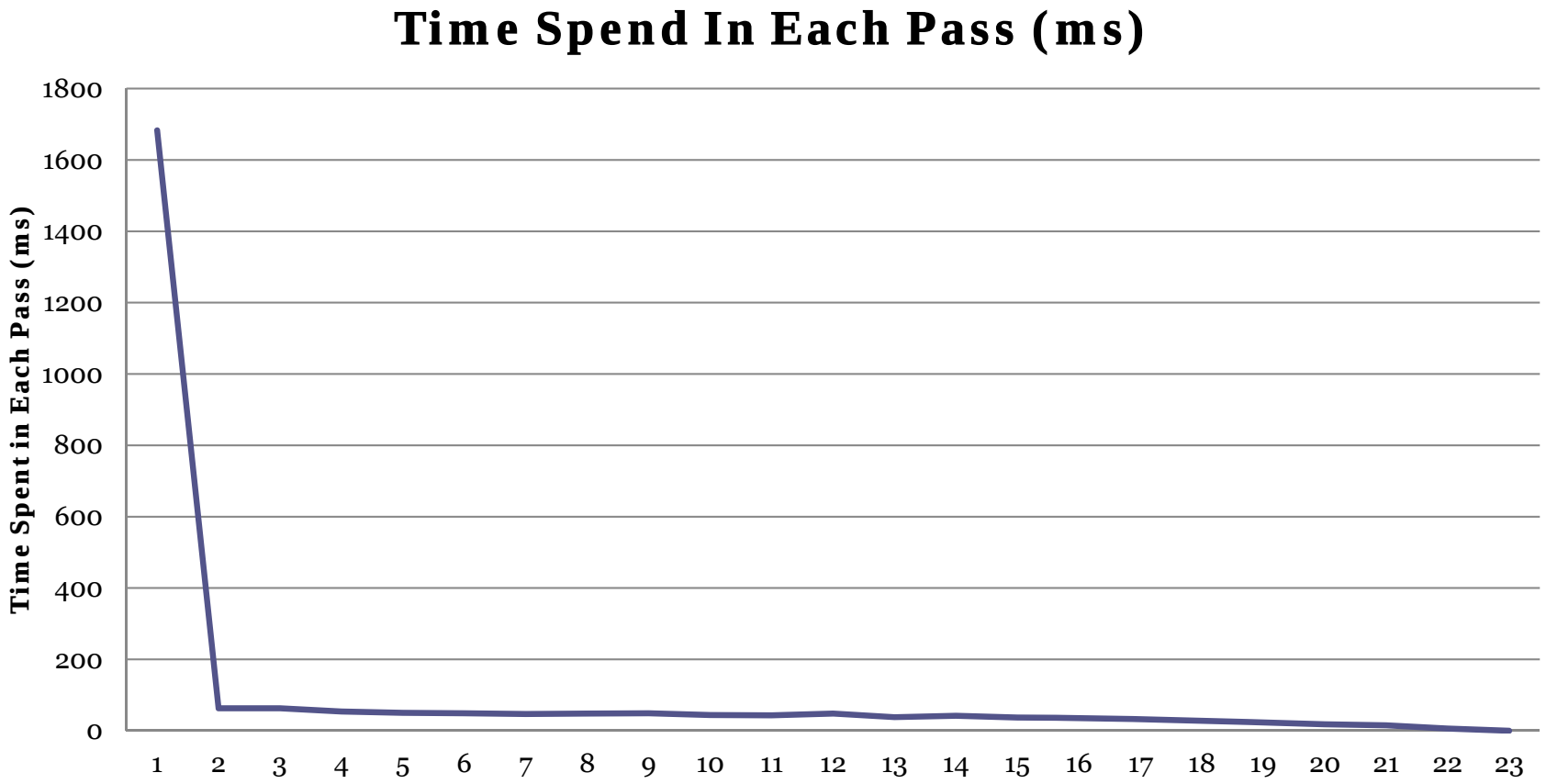


This problem may affect Radius drastically



This problem may affect Radius drastically

Total Run Time – 2516 ms
First pass - 1683 ms (~67% of run time)
Lowest Wirelength - 219

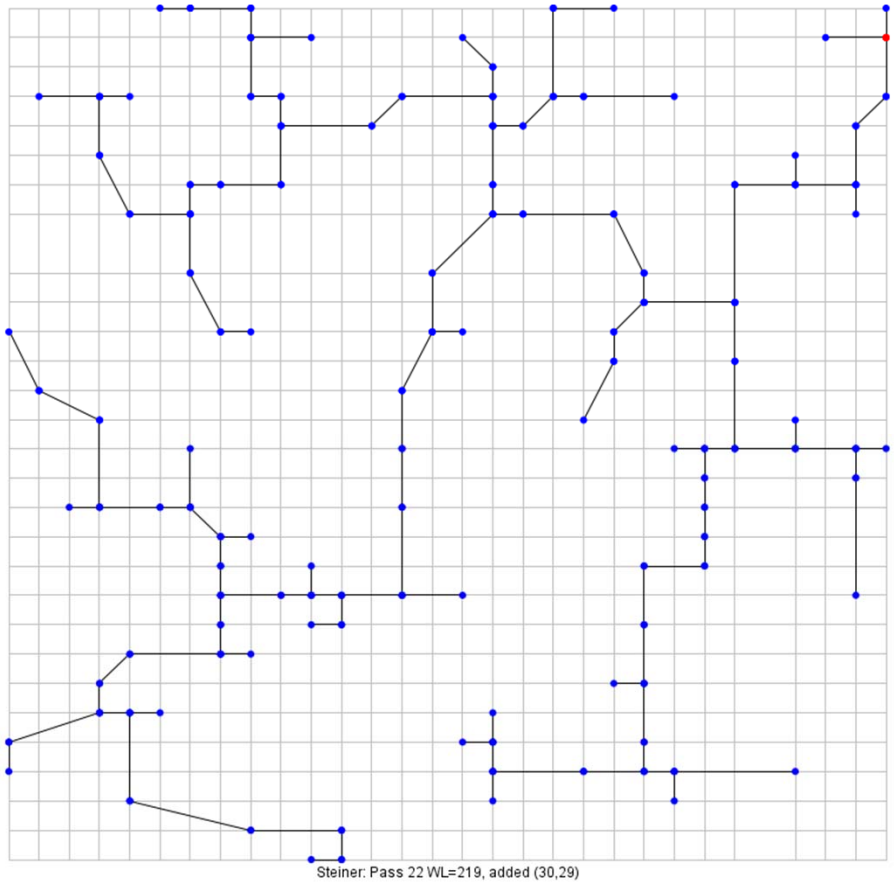


Slight Modification

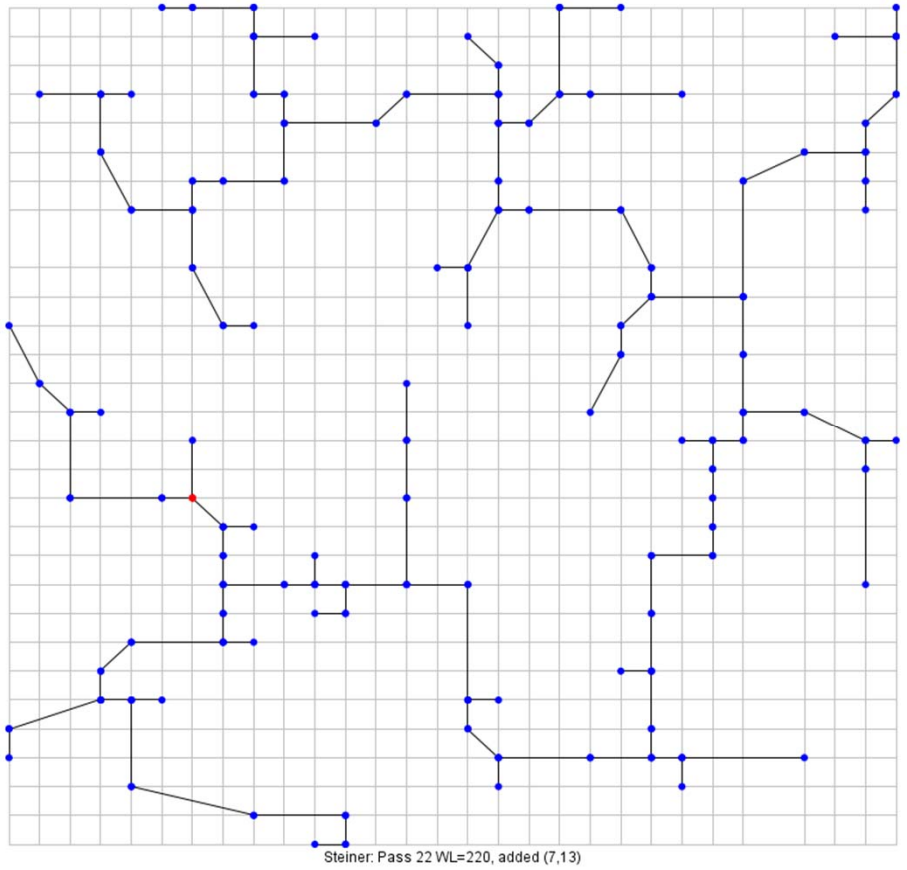
- Observation: gain is small per iteration (~1,2)
- Shuffle the Steiner set and break loop immediately after finding positive gain
- No need to compute MST for every Steiner point
- Disadvantage:
  - May lead to inconsistent results

Comparisons

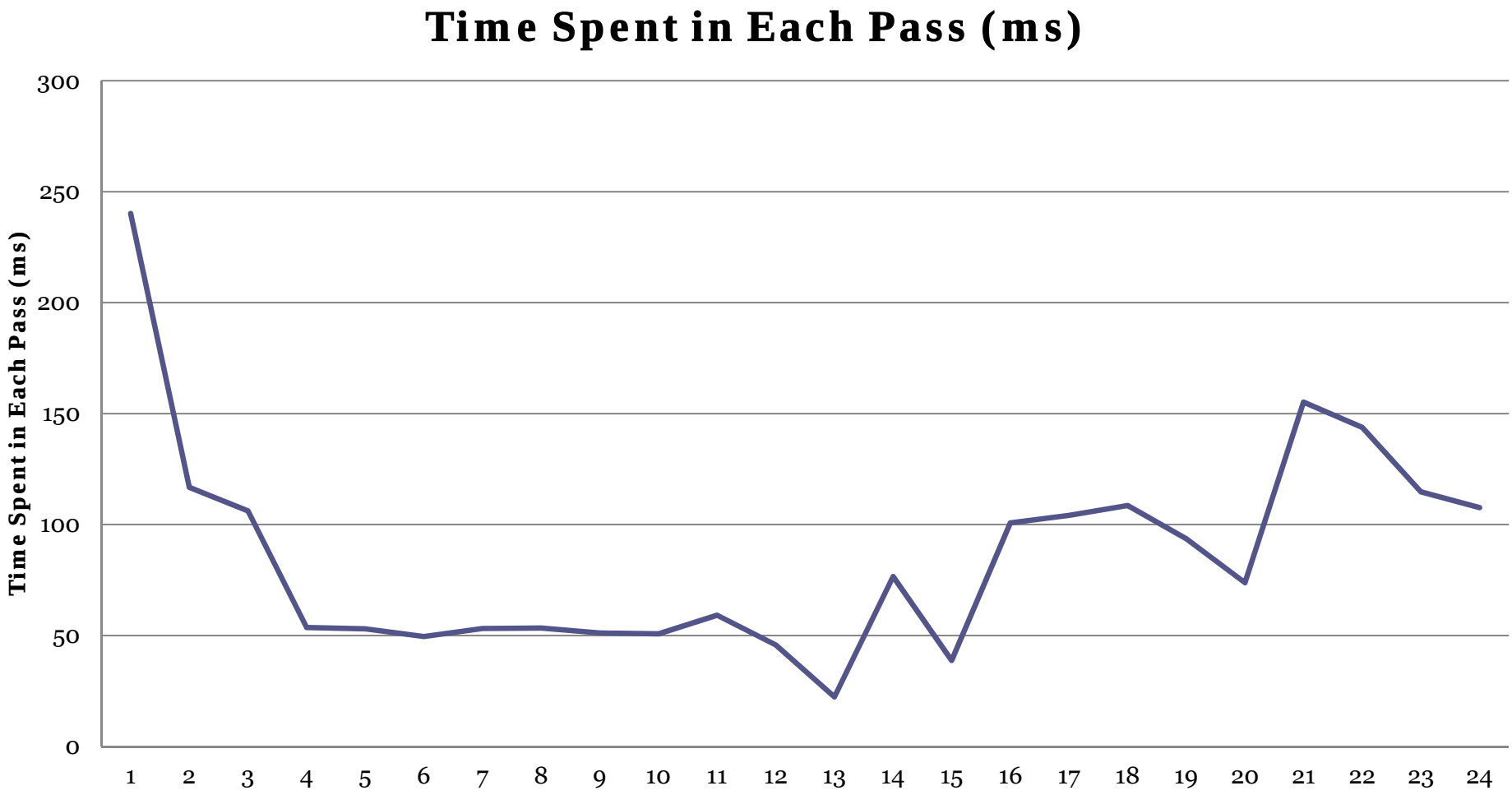
Original (WL = *219*, *2516* ms)



Modified (WL = *220*, *2030* ms)



Total Run Time (Avg/5 Runs)– **2030** ms
Ranged from **1764** ms to **2228** ms
Lowest Wirelength (Avg) – **219.4**



Improvements

- Make 1-Steiner radius-sensitive