Pseudocode:

The devices can be represented as nodes and traces can be represented as edges of a weighted undirected graph. The weights correspond to the time of the traces. There can be multiple edges between two nodes representing traces as different times.

Main steps:

1)Read the input file, obtain startNode, endNode, startTime and endTime of the message and construct weighted adjacency lists to represent the graph. --O(m+n)

2)Run a modified BFS. This BFS starts at the startNode and stops once you discover the endNode and it only looks at traces between startTime to endTime. For every node, this BFS looks at the edges adjacent to it and only adds edges whose timing is greater than time associated with the node. This makes sure any path down this BFS tree is a valid time path. It generates layers of nodes that are discovered along with the times when they were discovered. --O(m+n)

2.i)Also, this BFS adds nodes multiple times to the BFS tree if they are visited multiple times i.e If node 4 has a transaction at time 4 and is present in the second layer of the BFS tree. It can also be present again in layer 5 with a transaction time of say 7, if it doesn't violate the time validity of the paths in the BFS tree.This is necessary for sample in7.txt. --O((endTime-startTime)(n+m))

3)Find one valid path from startNode to endNode by using a recursive algorithm to traverse the BFS tree. --O(m+n)

Total Complexity Calculation:

For Critical step 2.i), we can see that if (endTime-startTime) is small compared to n and m (we can assume this as in a dense peer-2-peer network with low latencies, m+n >> (endTime - startTime)), the complexity of the overall algorithm is going to be O(m+n)

Correctness:

BFS algorithm starts at the startNode and stops once it finds the endNode. It will find a path from startNode to endNode, if there is one. We proved the correctness of BFS in class

BFS algorithm only adds edges if their timing is greater than the timing of the parent node. This makes sure all path down the BFS tree are consistent in the temporal sense.