Outline

- Connectivity
- Research Question
- Houston Highway System
- Conclusion
Connectivity

- Network Connectivity: The minimum number of elements (nodes or edges) that need to be removed in order to disconnect the remaining nodes from each other
  - Node Connectivity
  - Edge Connectivity

- Region Based Connectivity (RBC): The minimum number of regions that need to be removed in order to disconnect the remaining nodes from each other
a → b: 2 node disjoint

Blue nodes are in the ‘geometric’ region of node a
Blue nodes are in the ‘topological’ region of node b

The regular flow is 30
The region disjoint flow is 20

If the dashed edge is a wireless edge, the region disjoint flow is 30

c → d: 2 region disjoint

e → f: Not 2 region disjoint
Research Question

• Can I design and code an algorithm to test whether there exist \( k \)-region disjoint paths in any given network between two nodes?
  • If the network has \( k \)-region paths, which combinations of paths result in the minimum and maximum flow?

• Solution implemented in Java 8 and verified on various real-world scenarios
  • L3 Communication Networks
  • Houston Highway Network
  • AT&T Global IP Networks

• I have proved this problem to be NP-Complete.
Houston Highway System
Houston Highway System

- More than 19,000 paths from downtown to east Houston.
- Four mile radius can result in no two region disjoint paths from downtown to east Houston or from the Southeast to the Northwest.
- Radius problem of 0.5 miles will result in no three region disjoint paths.
- Analysis of flow (the number of cars per hour) of region disjoint paths can help city officials.
Conclusion

• Verification of network resiliency

• Network planning
  • Security
  • Transportation
  • Utilities Distribution
  • Ultra-reliable server networks

• Extensions to this work include incorporating 3D regions, using topological networks, etc.

• Relevant to CERN networks too!