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Practical solutions for fault-tolerant networks

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Abstract

- Wireless communication is increasingly being employed to transfer highly sensitive information.
- the relational disposition of wireless nodes is constantly changing.
- The network's temporary physical topology depends on the distribution of wireless nodes and their transmission ranges.
- Limited energy supplies in wireless devices necessitate energy-efficient network design.
- Power optimization is crucial in wireless networks to ensure efficient and reliable communication.

Project's Goals

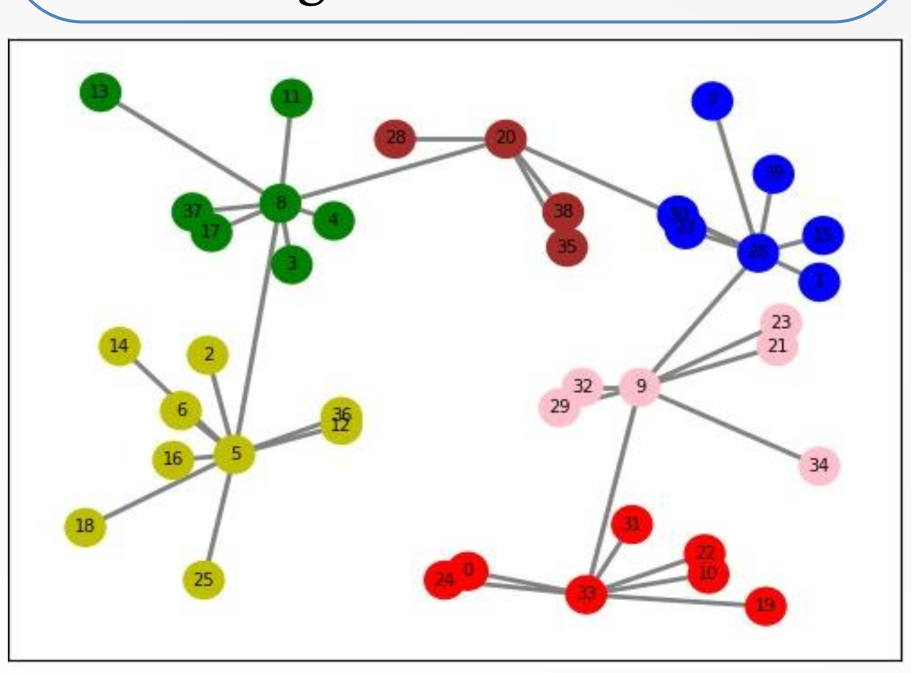
Our main goal is Design algorithms that assign power a_v to each node in order to satisfy the following objectives:

- Efficient Communication: Establish communication capability between all pairs of nodes within the network.
- Minimum Power Consumption: Minimize power usage to optimize energy efficiency.
- Battery Life Preservation: Maximize the battery life of wireless devices by effectively managing power allocation.
- Specific Objectives: Address desired requirements, such as network diameter, k-edge disjoint paths, or k-node disjoint paths between nodes.

Methods

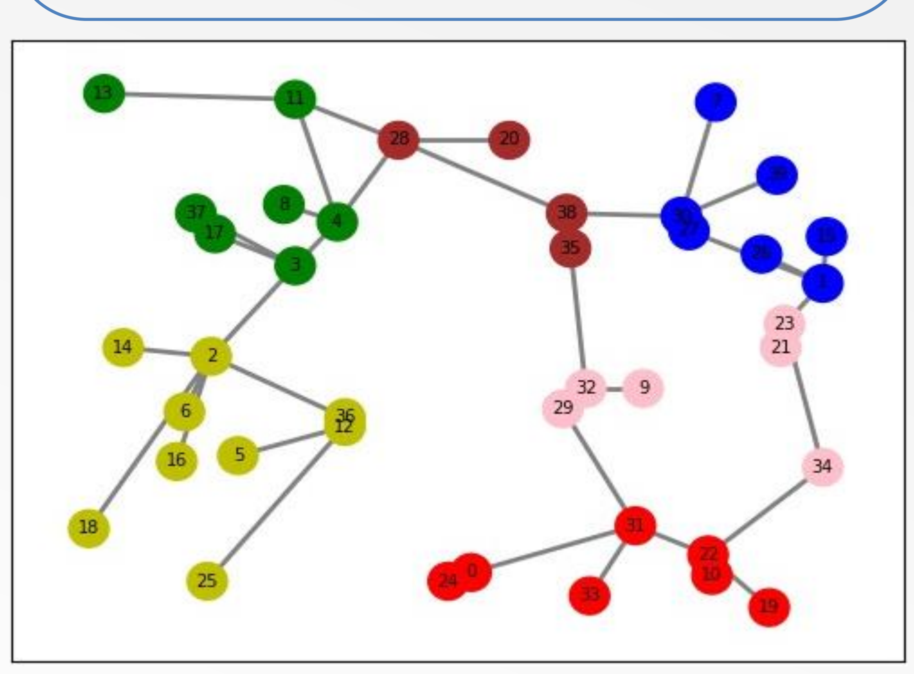
Method 1,2 (network diameter)

- (1) Centers Clique based on clustering.
- (2) Centers MST based on clustering.



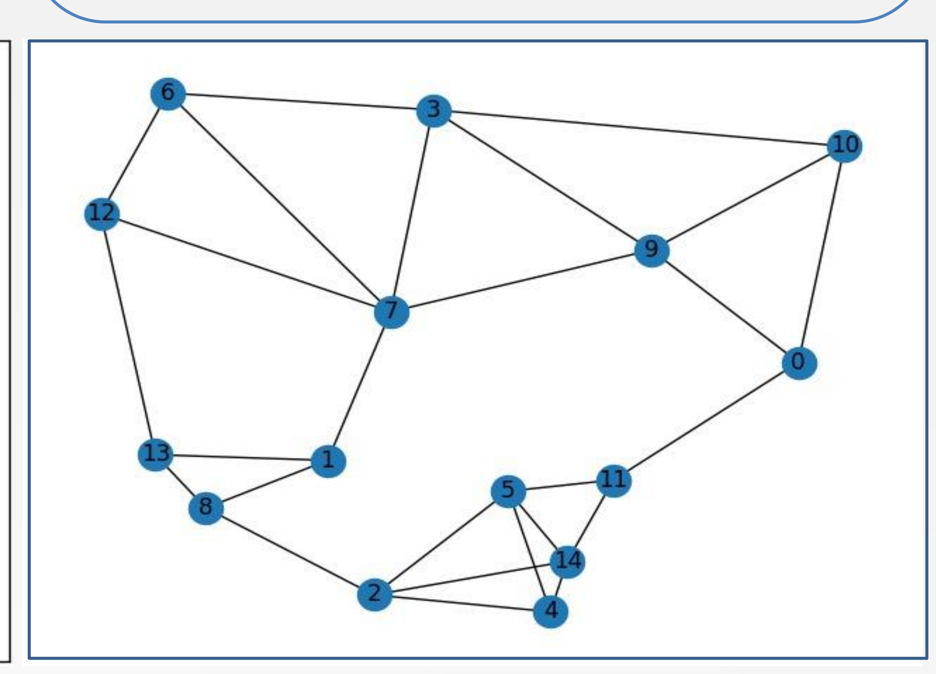
Method 3 (network diameter)

- Clustering with MST of border nodes.



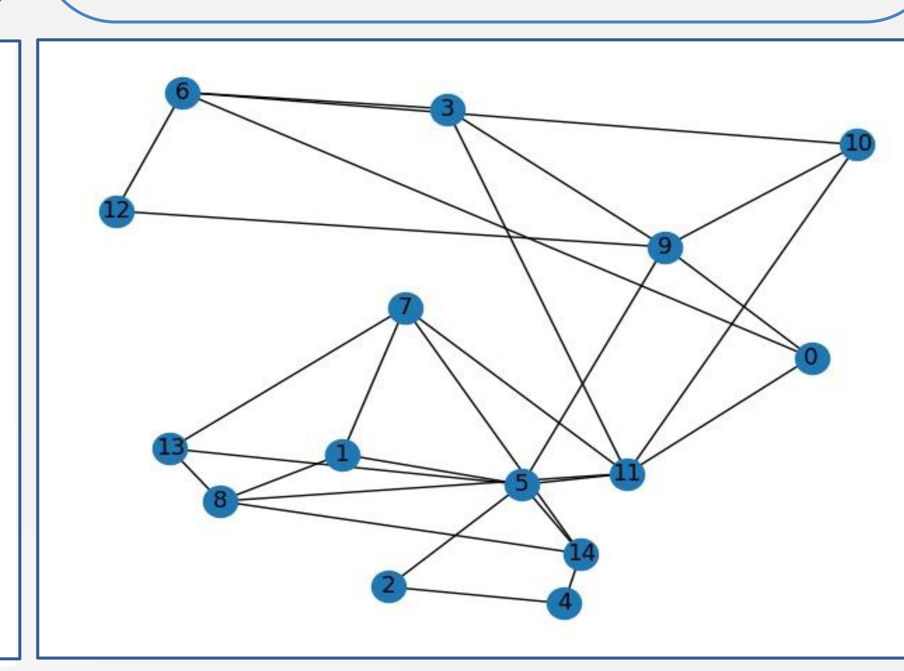
Method 4

- K-edge disjoint paths

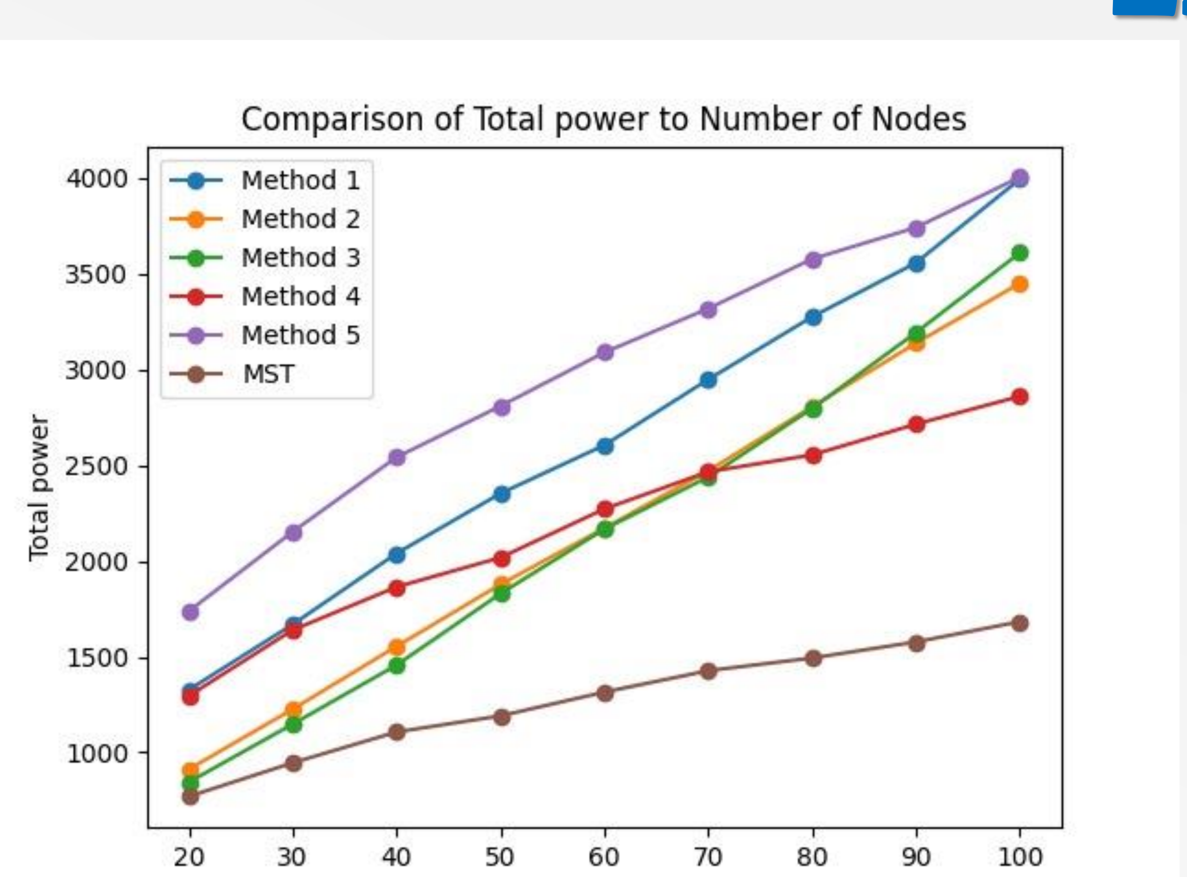


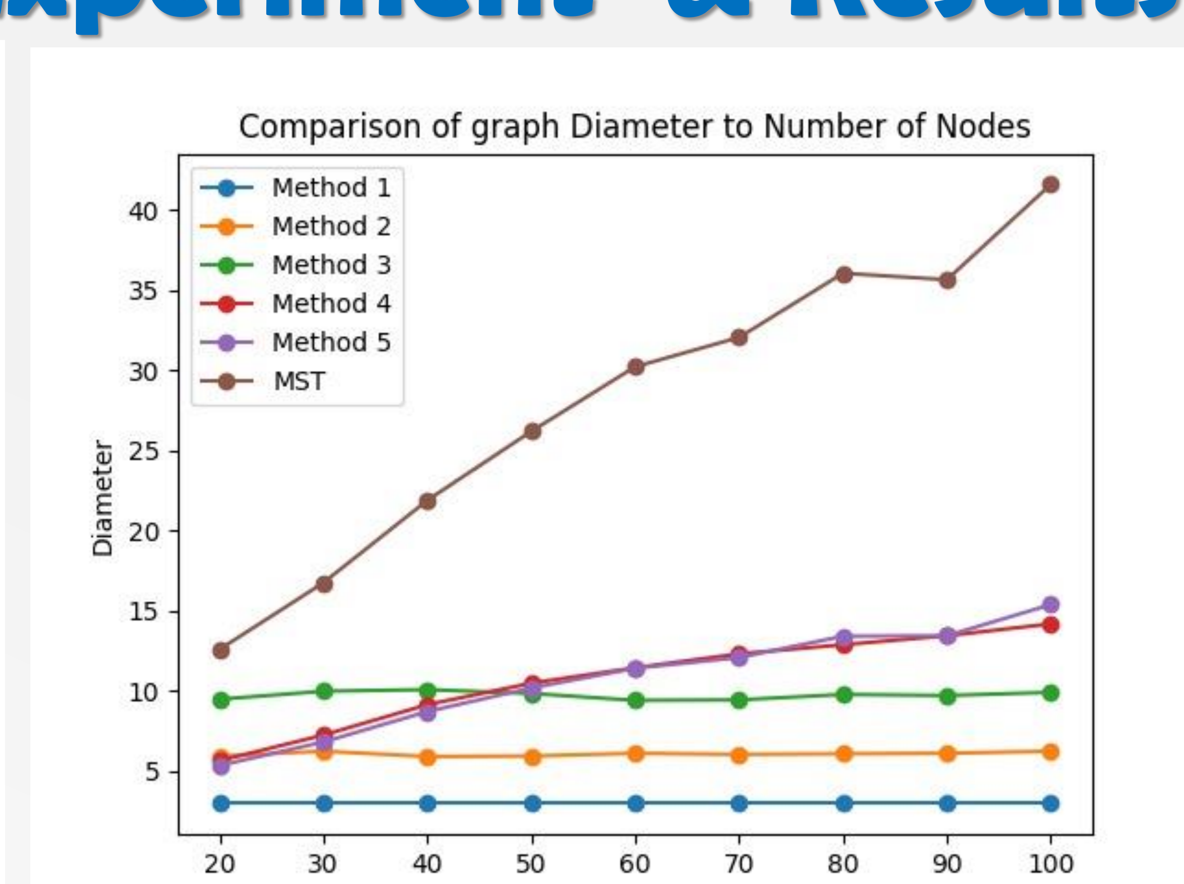
Method 5

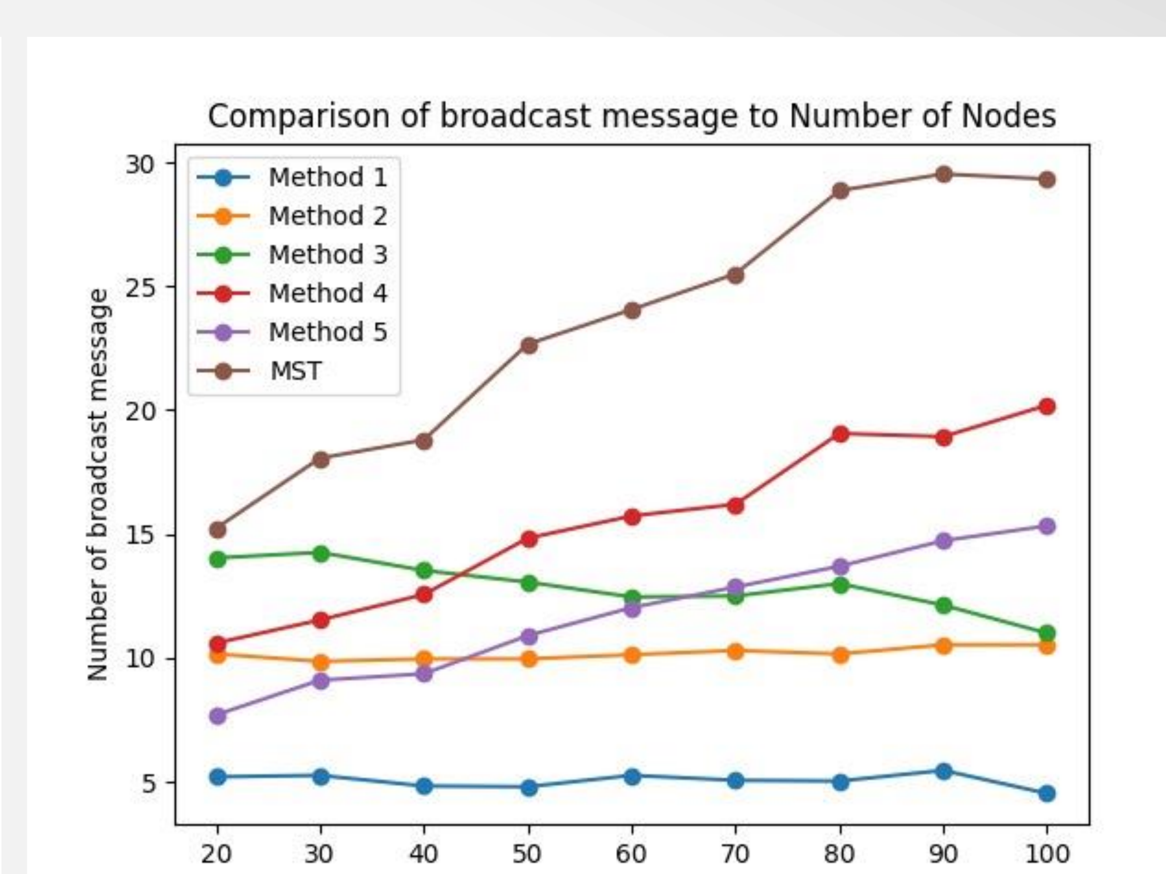
- K-node disjoint paths



Experiment & Results







- In small networks, Method 1 and Method 2 perform closest to the optimal solution.
- In large networks, Method 4 achieves the closest approximation to the optimal solution.
- Method 5 trades higher power consumption for increased network durability.

- In Methods 1, 2, and 3, the diameter of the graph is determined solely by the number of clusters and remains independent of the network size.
- In Methods 4 and 5, the diameter of the graph increases slowly with the network size, indicating a gradual expansion compared to the network size.

- The number of broadcast messages that can pass through the network represents the lifespan of the network.
- In methods 1, 2, and 3, the number of broadcast messages is mainly determined by the number of clusters and remains independent of the network size.
- In methods 4 and 5, the number of broadcast messages increases gradually as the network size grows.