Simulated Failure Model

- The simulation incorporates a permanent node failure mechanism to test the robustness of the gossip protocol.
- User-Defined Failure Count: The program accepts an input parameter specifying the number of nodes to fail.
- Random Selection: The specified number of nodes are randomly selected for failure.
- Permanent Failure: Once a node is selected for failure, it becomes permanently inactive. This means:
 - The failed node cannot receive or propagate messages.
  - It remains in the network topology but does not participate in the gossip protocol.
  - Failure Timing: Node failures are initiated at the start of the simulation, before the gossip/push-sum protocol begins.

## Recordings: (number of nodes= 100)

Gossip Failure Simulation:

Topology	Failure	Time(ms)
Full	0	17
Full	10	15
Full	30	16
Full	50	8
Line	0	Infinity
Line	10	Infinity
Line	30	Infinity
Line	50	Infinity
3D	0	5
3D	10	8
3D	30	2
3D	50	Infinity
imp3D	0	3
imp3D	10	2
imp3D	30	3

imp3D	50	Infinity

Convergence Time vs Failure Nodes for Different Topologies (Updated)
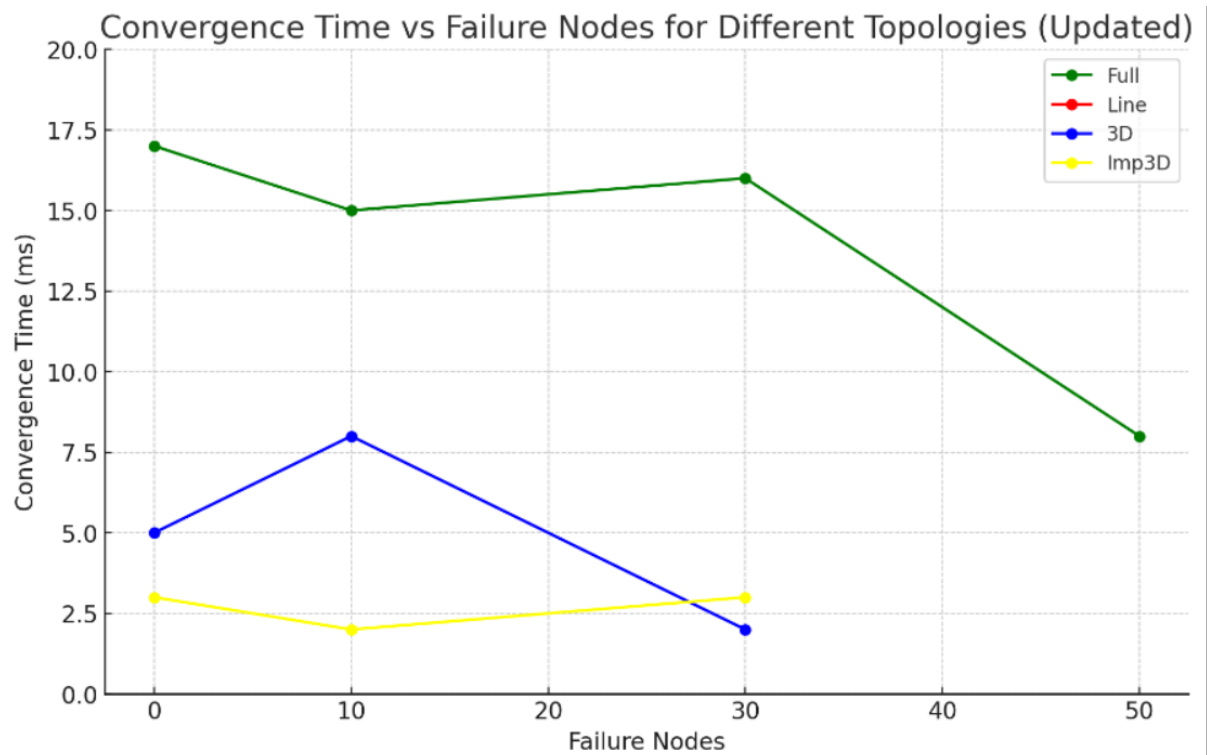
Push Sum Failure Simulation:

Topology	Failure Nodes	Convergence Time
Full	0	80ms
Full	10	45ms
Full	30	42ms
Full	50	20ms
Line	0	4598ms
Line	10	No Convergence
Line	30	No Convergence
Line	50	No Convergence
3D	0	50ms
3D	10	84ms
3D	30	84ms
3D	50	No Convergence
Imp3D	0	34ms
Imp3D	10	34ms
Imp3D	30	50ms
Imp3D	50	No Convergence

Convergence Time vs Failure Nodes (Reduced Scale)
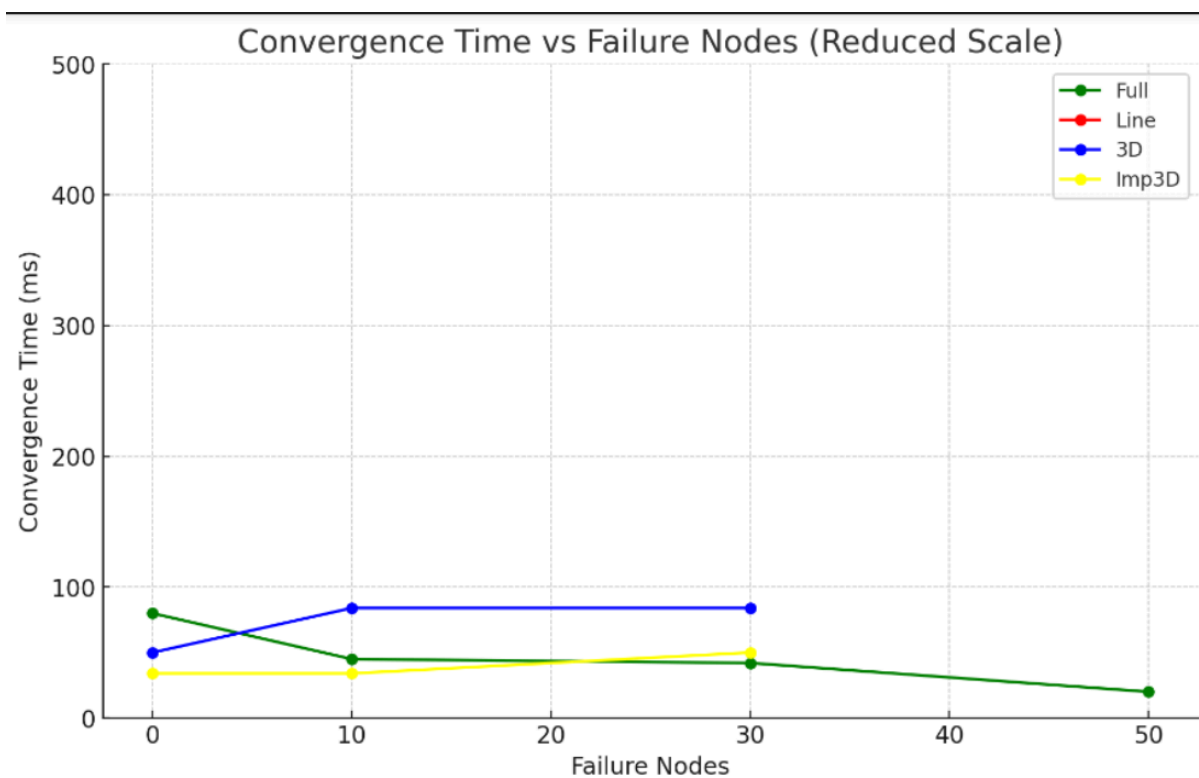
Interesting observation

- We observe that in the Line protocol, convergence fails to occur as expected even when 1 node fails

- The full network topology does not slow down convergence in our implementation. In fact, it accelerates the process. This is because, when a node fails, it sends a callback to the node that initially contacted it, requesting to be removed from its neighbour list. This mechanism contributes to a noticeable speedup in the network.

 - We notice when almost half of the nodes in the network fail, even for 3D and imperfect 3D, there is no convergence