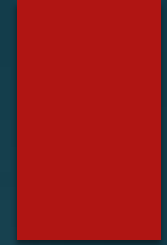


Discovering the Topology in an Unknown Network



Author: Silviu Mării (s.c.marii@student.tudelft.nl)
Supervisors: Dr. Jérémie Decouchant & Bart Cox

I) Background

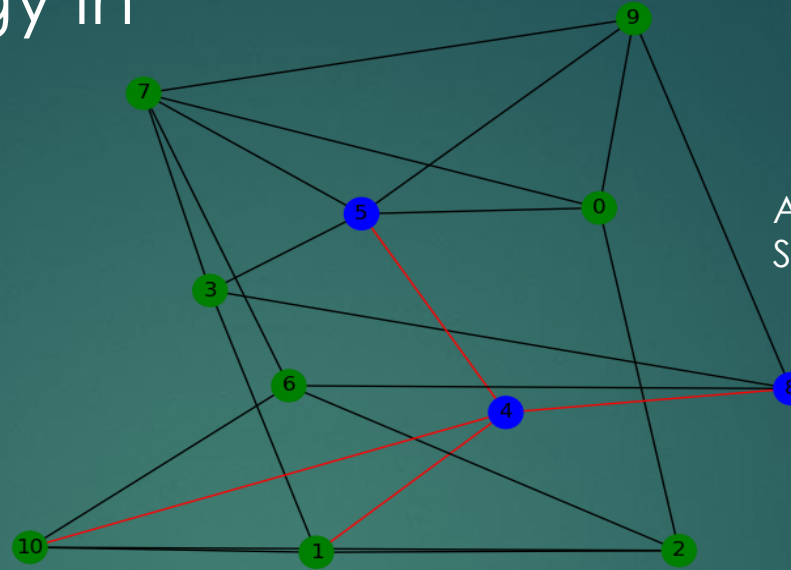
- Reliable Communication is an essential requirement in distributed systems, but it requires assumptions that are hard to achieve in practice and has a factorial complexity for the worst-case [1].
- In order to overcome these problems, each node in a network needs to be able to discover the topology of a network.
- Explorer2 is a protocol recently designed with a complexity of $O(n^2)$ RC instances, but still it's not clear whether it can be improved [2]. Each node broadcasts a message containing its neighborhood.

II) Research question

In Explorer2, can the number of nodes that broadcast be reduced while still achieving RC? Based on the topology found, can the RC layer be optimised?

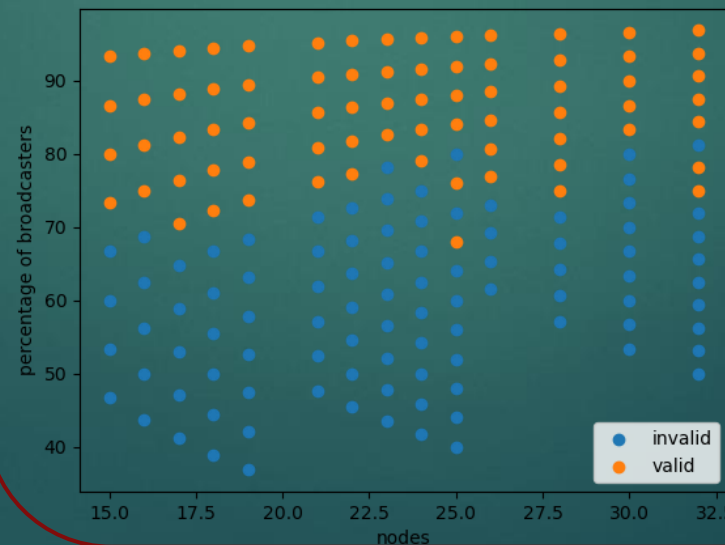
III) Method

We implemented Explorer2 and we analysed its behaviour when the number of broadcasters is reduced. We used the number of messages exchanged, network throughput and latency as metrics for measuring the performance.



IV) Results

We observed that the minimum number of broadcasters required is 81.25% out of the total number of nodes.



V) Conclusion

We achieved a reduction of 18.38% in the number of messages exchanged and proposed a modification meant to safeguard the RC properties. We implemented a generator for disjoint paths based on max-flow with a time complexity of $O(N^*E)$.

VI) Limitations

The number of broadcasters cannot be further reduced without making new changes. The modification we proposed might be able to reduce the number of broadcasters required, but after some point it will become counterproductive.

VII) References

- [1] Dolev, D., 1981, October. Unanimity in an unknown and unreliable environment. In 22nd Annual Symposium on Foundations of Computer Science (sfcs 1981) (pp. 159-168). IEEE.
- [2] Bonomi, Silvia and Decouchant, Jeremie and Farina, Giovanni and Rahli, Vincent and Tixeuil, Sebastien: Practical Byzantine Reliable Broadcast on Partially-Connected Networks. ICDCS 2021.
- [3] Maximum flow problem. https://en.wikipedia.org/wiki/Maximum_flow_problem