# Broadcast Bully: A New Algorithm for Leader Election in Distributed Systems

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## Introduction

- A **distributed system** is a collection of 2+ computers on a shared network
- Work concurrently to complete tasks more efficiently as a broader system
- Tasks in a distributed system may be assigned and coordinated by a leader
- The **Bully algorithm** is a classic leader election algorithm[1]
- The Bully algorithm uses several “immediate procedures” that guarantee a response will be received within some interval
- Leads to several different types of messages sent and received
- We developed and implemented **Broadcast Bully** as an alternative to simplify and reduce the amount of messages needed
- Uses a broadcast communication protocol with periodic beacons
- Grants every node the ability to compare all process IDs with their own
- Eliminates the multi-stage election process described in the classic Bully algorithm

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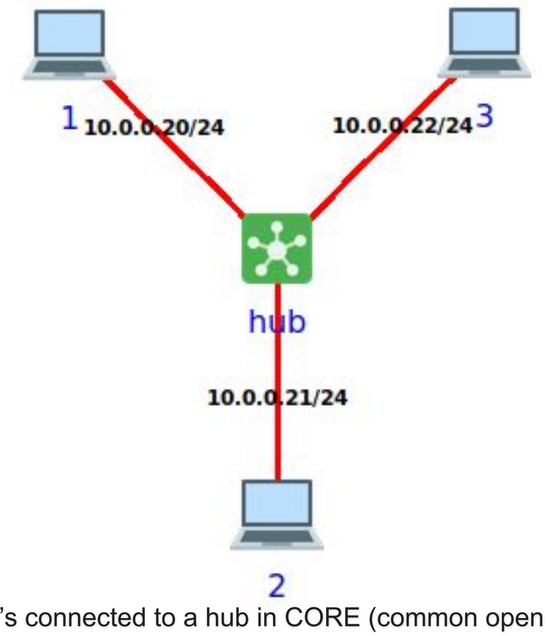
## Hypothesis

- By implementing a broadcast communication protocol and eliminating multi-step election process, the types of messages sent and received are reduced thus simplifying the original algorithm while maintaining correctness.

## Methods

- Implement Broadcast Bully as a distributed program in Python
- Incorporated the asyncio library to write concurrent code
- Used IP addresses for comparison as max process IDs
- Run algorithm on a network emulation tool, CORE (Common Open Research Emulator)




Three pc’s connected to a hub in CORE (common open research emulator) each with IP addresses.

**References:**
[1]Garcia-Molina, "Elections in a Distributed Computing System," in IEEE Transactions on Computers, vol. C-31, no. 1, pp. 48-59, Jan. 1982, doi: 10.1109/TC.1982.1675885.

## Outcome

```
root@n1:/tmp/pycore.1/n1.conf# runudp 70
Time period: 70

My IP is: 10.0.0.20          Status message

Received: Broadcast  10.0.0.20
My new coordinator is:  None
Received: Broadcast  10.0.0.21
My new coordinator is:  None
Received: Broadcast  10.0.0.22
My new coordinator is:  None
Broadcast state:  True
Received: Broadcast  10.0.0.20
My new coordinator is:  None
Received: Broadcast  Victory 10.0.0.22
My new coordinator is:  10.0.0.22
```

Terminal window of node 1 in CORE displaying messages received from other nodes in the shared network with new coordinator message

- Message types include:
  - Broadcast beacon message from all nodes on the same network
  - Broadcast Victory message from new coordinator
- Shown to be capable of electing a new coordinator under dynamic failures of nodes

## Future Work

- Implement classic Bully algorithm and evaluate on CORE
- Comparatively evaluate Bully and Broadcast bully algorithms under different network conditions
- Test link limitations, delays, and robustness with newly-added nodes and failure detection