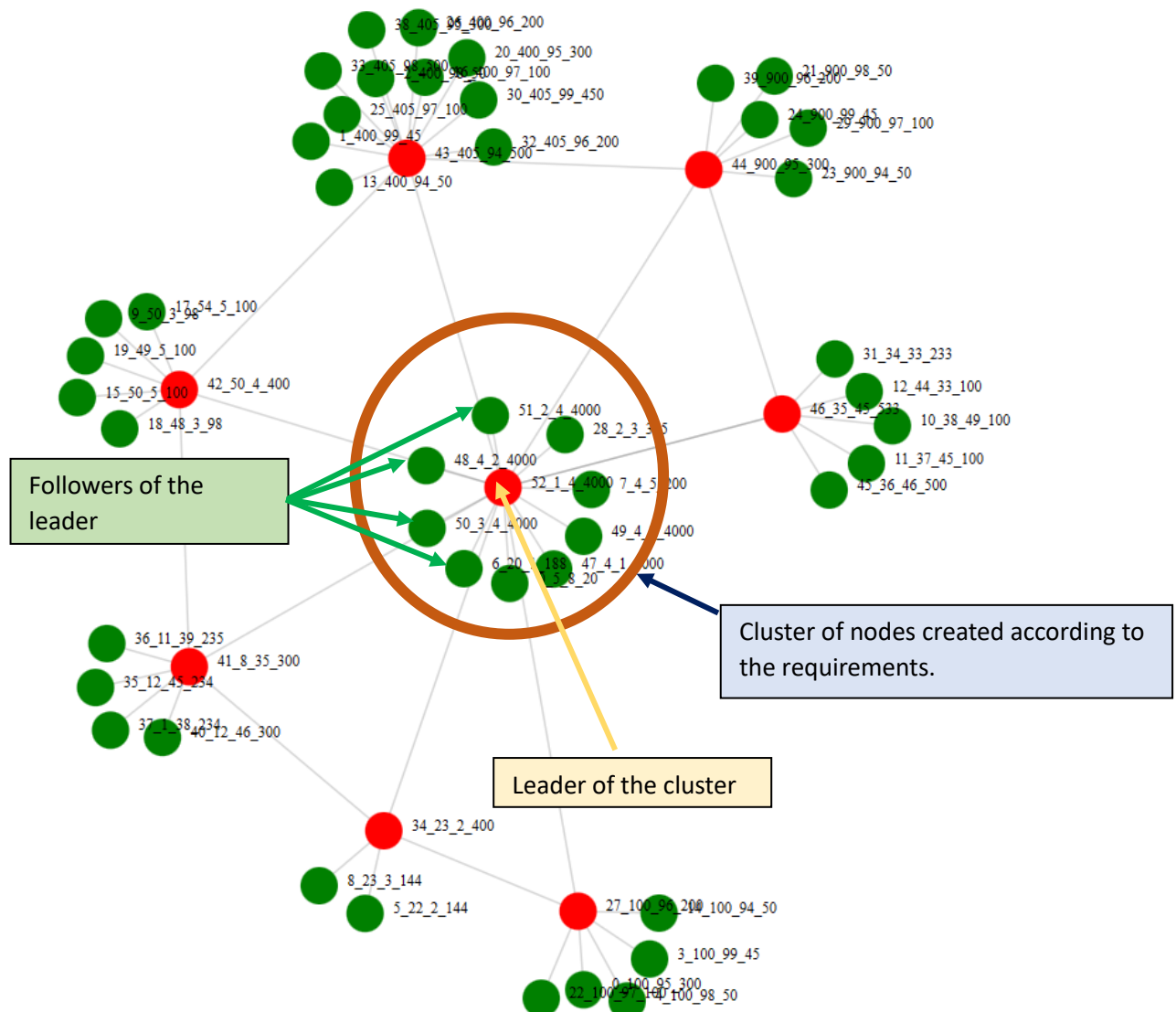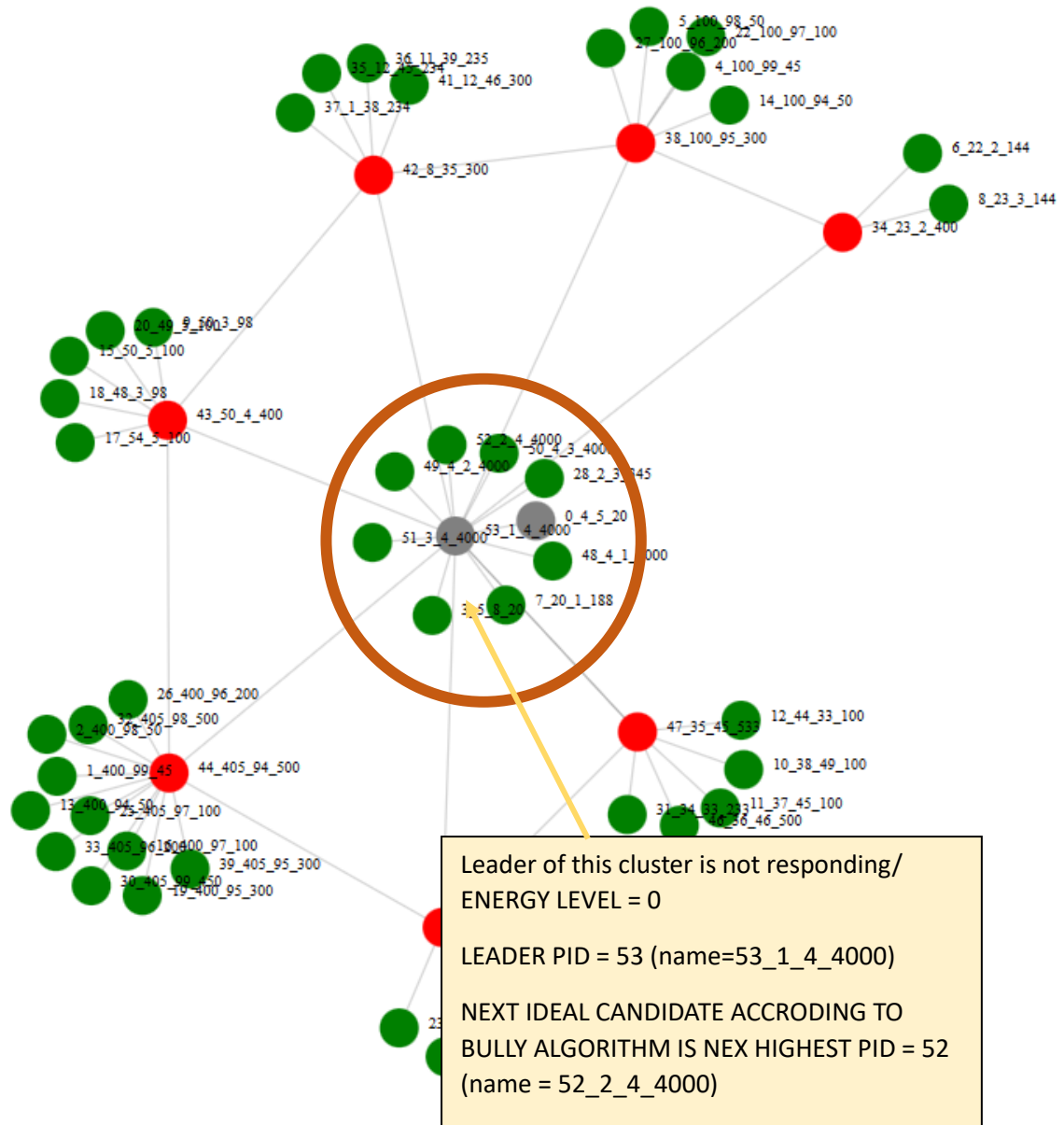- Extract/Copy the *Executables* folder into your local storage. Make sure you have installed java 11 on your pc.
- Move into the *Executables* folder and open a command line window on that folder.
- Run following command (1).
  - *java -jar Distributed_Systems_Project_18-2.8.9.jar --file="inputs/input1.txt"*
    - There are 4 inputs in the inputs folder.
    - *Input1.txt, input2.txt, input3.txt, original_input.txt*
    - Change the name according to the input file you want to run in the above command *- - file* tag.
- Then open the *frontend* folder.
- Double click on the "*frontend.html*" file. This will start the distributed system and you will be able to see log output on the console window that you run the command (1)
  - **Make sure port 8887 is free on your system.**
- On your browser window you will see visual representation of the distributed system.
- You should see a distributed system as a graph as in following figures. (<u>You can zoom in and out as necessary to see PIDs and NODE NAMES.</u>)

How to read the front-end visualization
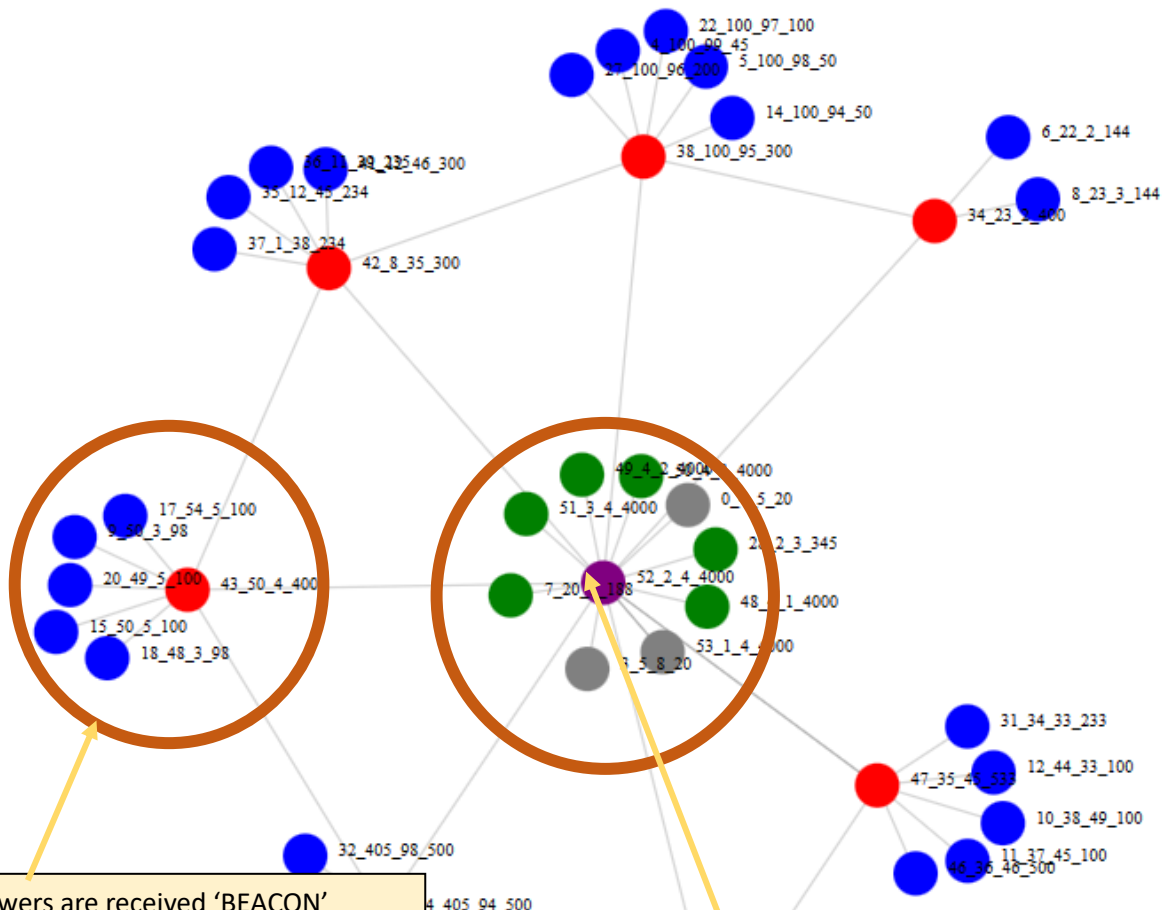
Leader Election Visualization

Step - 01

Leader of this cluster is not responding/
ENERGY LEVEL = 0

LEADER PID = 53 (name=53_1_4_4000)

NEXT IDEAL CANDIDATE ACCRODING TO
BULLY ALGORITHM IS NEX HIGHEST PID = 52
(name = 52_2_4_4000)

Step - 02

22_100_97_100
4_100_99_45
5_100_98_50
27_100_96_200
14_100_94_50
38_100_95_300
6_22_2_144
8_23_3_144
34_23_3_400
36_11_39_23546_300
35_12_45_234
37_1_38_234
42_8_35_300

49_4_2_4004_4000
51_3_4_4000
0_5_20
2_2_3_345
7_20_188
52_2_4_4000
48_1_4000
53_1_4_400
5_8_20

17_54_5_100
9_50_3_98
20_49_5_100
43_50_4_400
15_50_5_100
18_48_3_98

31_34_33_233
12_44_33_100
47_35_4_533
10_38_49_100
11_37_45_100
46_36_48_500

32_405_98_500
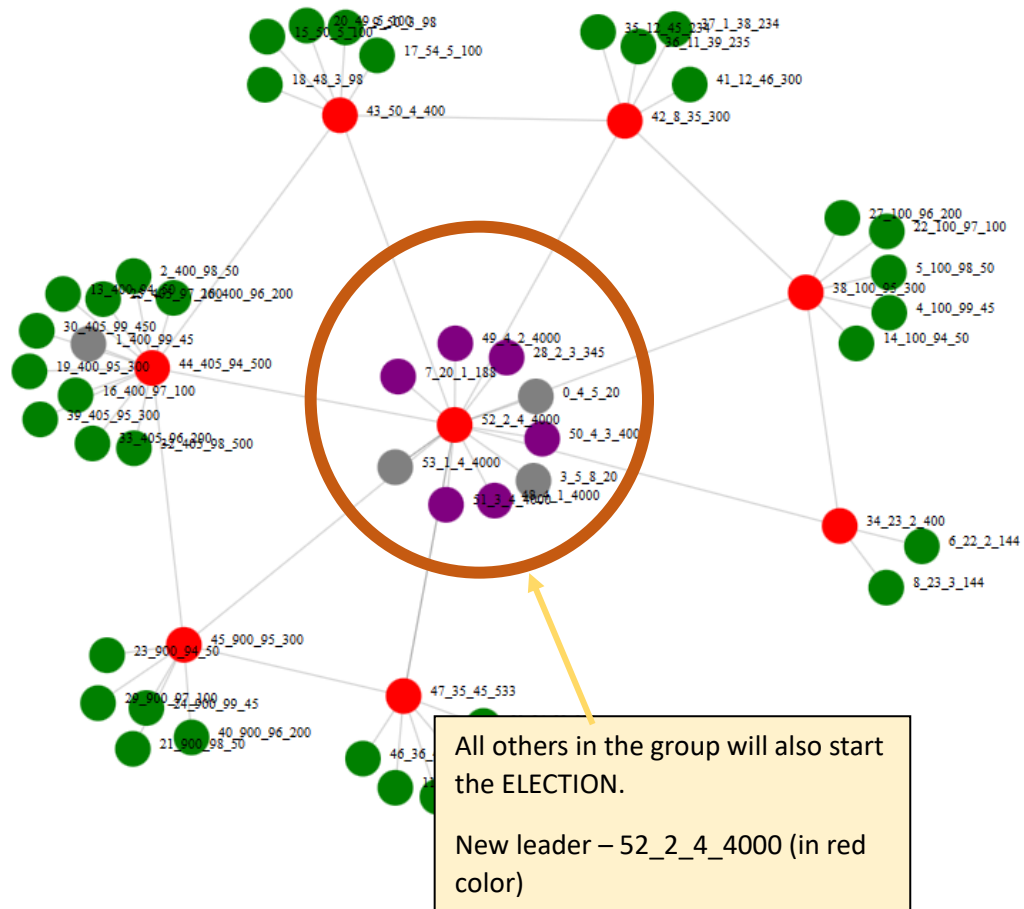
4_405_94_500
5
26_400_9
16_400_97_100
50
5_400095_300

Blue means followers are received 'BEACON' message and they know leader is responding by receiving 'BEACON' message. Leader will send the beacon message to all the followers in interval of 15 seconds. Followers will assume leader is not responding if 'BEACON' message is not received for 20 seconds or not responding to a direct message to a leader within 5 seconds. If they know leader is not responding then who ever first realize that leader is not responding will start an election (will turn in to purple)

Next ideal candidate (52_2_4_4000) realize leader (53_1_4_4000) is not responding since 'BEACON' message not received from the leader (53_1_4_4000)

So, it starts an election (hence purple color) and realize that no process has PID greater than his ID in his group (every node knows who is in their group and assigned PIDs) and he make himself as the leader (hence center of the group – in the next step it will be red color)

Step - 03

All others in the group will also start the ELECTION.

New leader – 52_2_4_4000 (in red color)

Step - 04

22_100_97_100
27_100_98_000_45
5_100_98_50
14_100_94_50
38_100_95_300
6_22_2_144
8_23_3_144
34_23_2_400
16_11_39_33246_300
35_12_45_234
37_1_38_234
42_8_35_300

49_4_2_50_4_3_4000
0_4_5_20
51_3_4_4000
28_2_3_145
52_2_4_4000
48_4_1_4000
7_20_1_188
53_1_4_4000
3_5_8_20

17_54_5_100
9_50_3_98
20_49_5_100
43_50_4_400
15_50_5_100
18_48_3_98

31_34_33_233
12_44_33_100
47_35_45_333
10_38_49_100
11_37_45_100
46_36_46_500

32_405_98_500
25_405_97_100
44_405_94_500
1_400_99_45
13_400_94_50
33_405_96_200
30_405_99_450
2_400_98_50
26_400_96_
16_400_97_100
19_400_96_300
39_405_95_300

Then new leader will send OK to others and all other followers who have received ELECTION messages from lower PID processes will send the OK messages to those processes.

When process receive an OK message, it will turn into yellow color and withdraw from the ELECTION (will turn into green back again).

p.s - Processes will withdraw from ELECTION even when they received a 'BEACON' message from new leader.