LINGI2143 - Concurrent systems : Assignment 1

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Introduction

In the zip archive, you should find :

assignment1_1.lts : the FSP model for NOMINALRING

assignment1_2.lts : the FSP model for NOMINALSERVICE

assignment1_3.lts : the FSP model for ELECTIONRING

assignment1_4.lts : the FSP model for ELECTIONSERVICE

As discussed by email, it will be simpler for you to have different files because you don't have to comment/uncomment anything from those files.

In this report (as in the files), you will never see a "not elligible" node, because an idle node has the exact same behavior ; the choice has been made to ignore it to be more concise.

1 Structural diagram

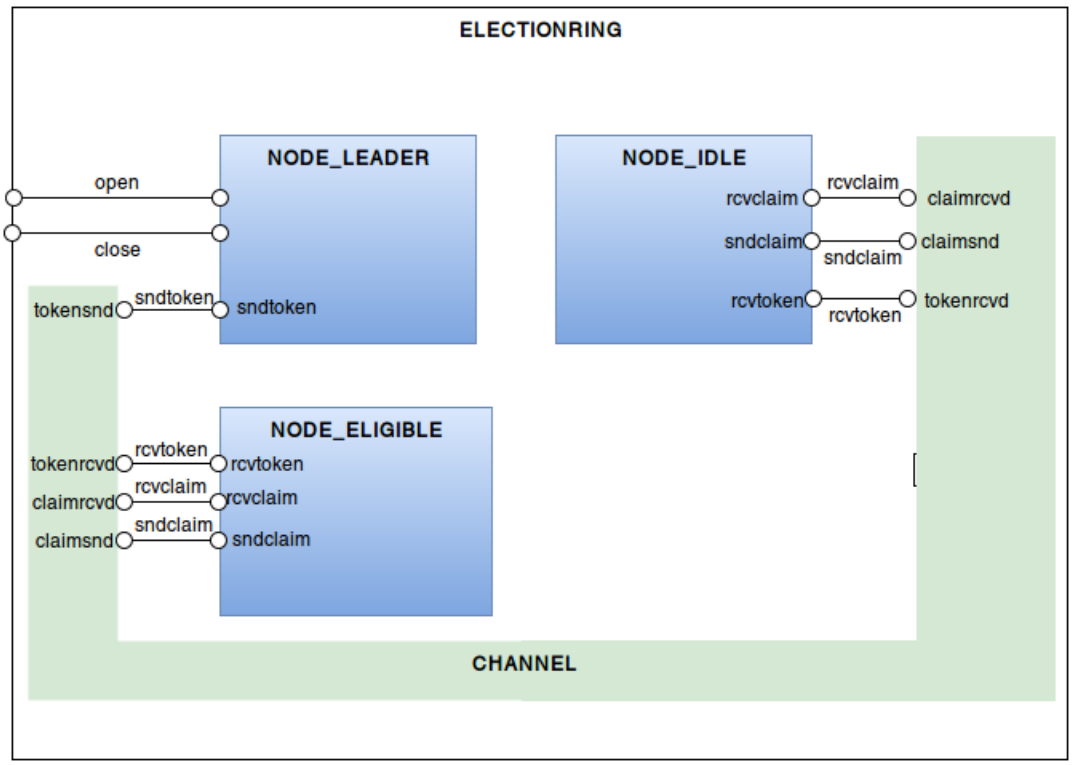

FIGURE 1 – Structure diagram of ELECTIONRING

2 Alphabet of ELECTIONRING

`[0..1].{{open, close}, rcvclaim[0..1], rcvtoken, sndclaim[0..1], sndtoken}`

Each operation has an index before its name that defines which node is performing the operation.

open, close : operations to allow a leader node to access the shared resources

rcvclaim : operation that happens when a claim is received by a node (the index after is the index of the claimer)

rcvtoken : operation that happens when a token is received by the node

sndclaim : operation that allows every node to start a leader election (after a timeout - not modeled here)

sndtoken : operation that allows a node to pass the token to its next neighbor

3 LTS of NOMINALRING (N=2)

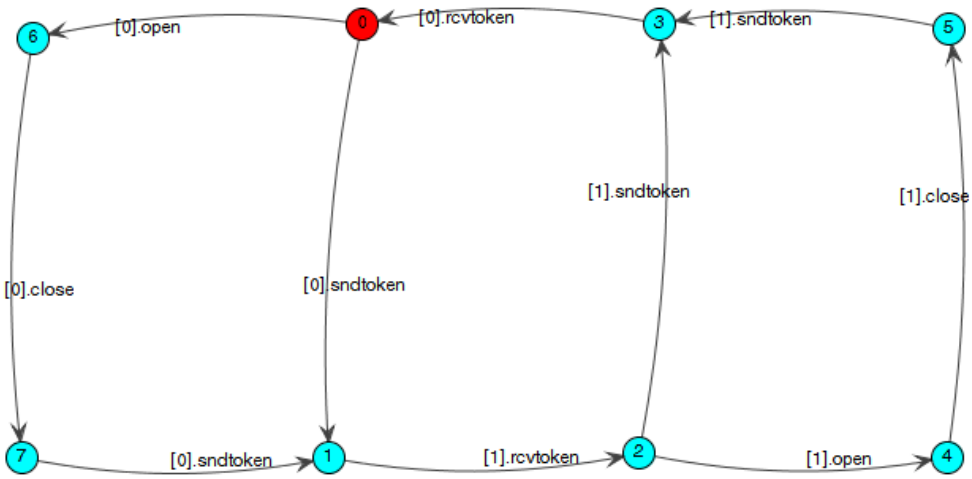

FIGURE 2 – LTS of the NOMINALRING (N=2)

4 Number of states, transitions and time for NOMINALRING

Here is a table with the N changing for the NOMINALRING.

	#States	#Transitions	Time
N=1	4	5	79ms
N=2	8	10	46ms
N=3	12	15	73ms
N=4	16	20	70ms
N=5	20	25	35ms
N=10	40	50	30ms
N=20	80	100	71ms

5 LTS of the NOMINALSERVICE (N=2)

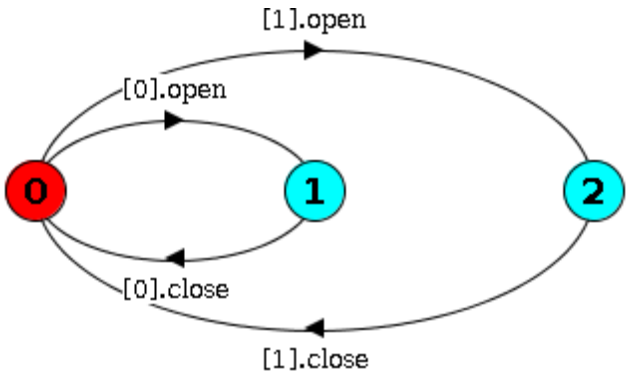

FIGURE 3 – NOMINALSERVICE LTS (N=2)

The main part of this protocol is to ensure that only one node can access the shared resources, and this LTS shows that it is how it works. However, with this representation we lose one very important part of the protocol which is the fairness (one node in the ring is a leader, and each node has been the leader the same number of times (or minus 1)). Here it looks like 0 can open the resources forever and 1 will never do anything.

6 One node of ELECTIONRING (N=2)

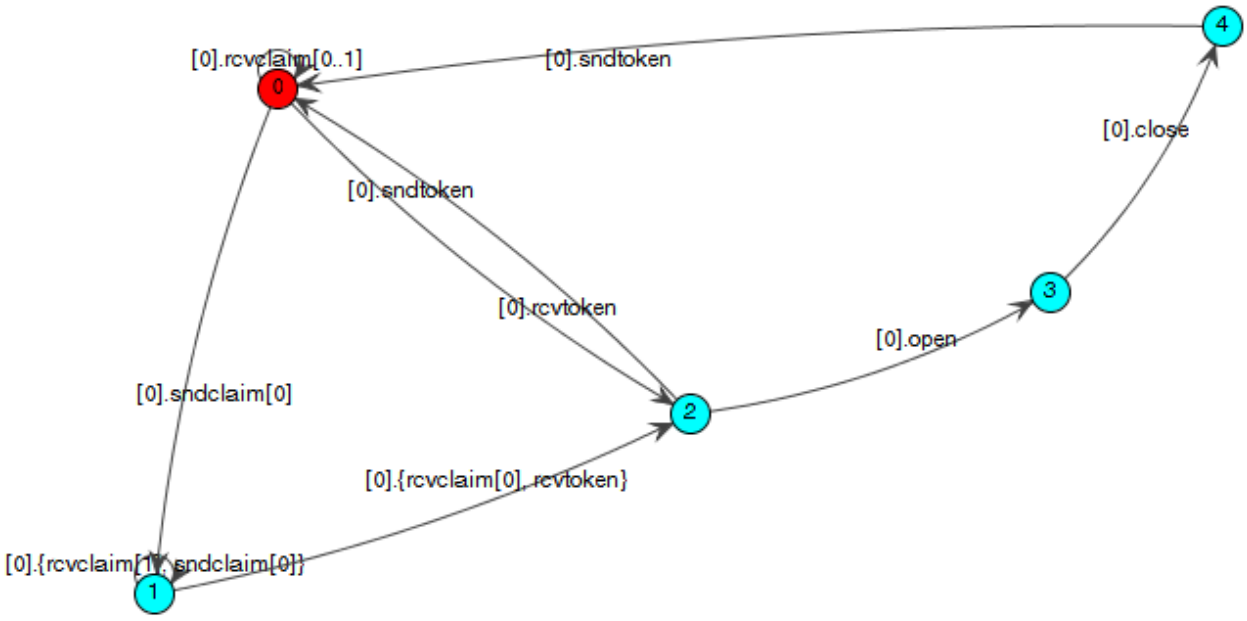

FIGURE 4 – LTS of node 0 ELECTIONRING (N=2)

7 Number of states, transitions and time for ELECTIONRING

	#States	#Transitions	Time
N=1	6	7	43ms
N=2	150	281	41ms
N=3	5850	14550	84ms
N=4	266622	804241	1214ms

I can't generate a LTS larger than the one for 4 nodes because of the limit of 1Go of RAM.

8 Simulation trace for ELECTIONRING

```
0.sndclaim.0
1.sndclaim.1
1.rcvclaim.0
0.rcvclaim.1
1.sndclaim.0
0.rcvclaim.0
0.sndtoken
1.rcvtoken
1.open
1.close
1.sndtoken
0.rcvtoken
```

Each node sends a claim ; each node receives the claims of the other ; node1 sends the claims with index 0 ; node0 receives it so it can become the leader node ; it sends the token ; node1 receives it and access the resources then send the token ; node0 get the token back.

9 Minimization results for ELECTIONSERVICE

	#States	Time
N=1	2	0ms
N=2	14	43ms

The time explodes to more than 10 minutes for N=3, so I didn't get the results for the minimization of a LTS larger than N=2.

10 Minimized LTS of ELECTIONSERVICE (N=2)

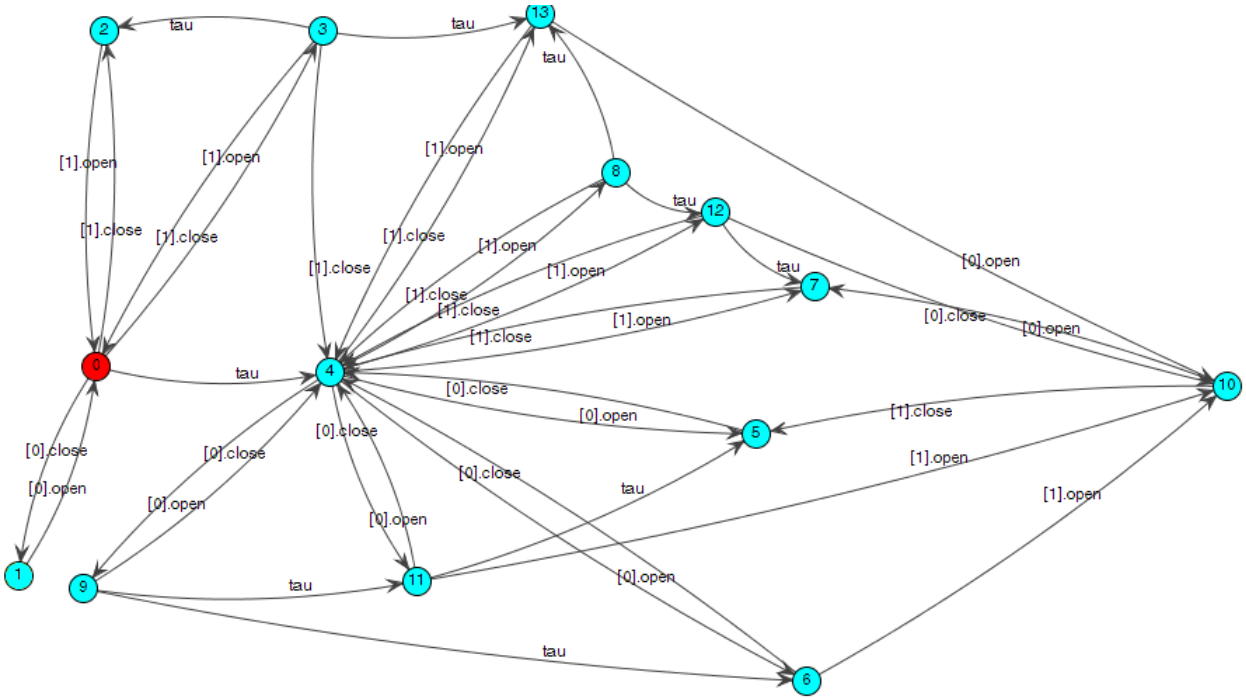

FIGURE 5 – Minimized LTS of ELECTIONSERVICE (N=2)