# Assignment 4

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## 1. Program Graph

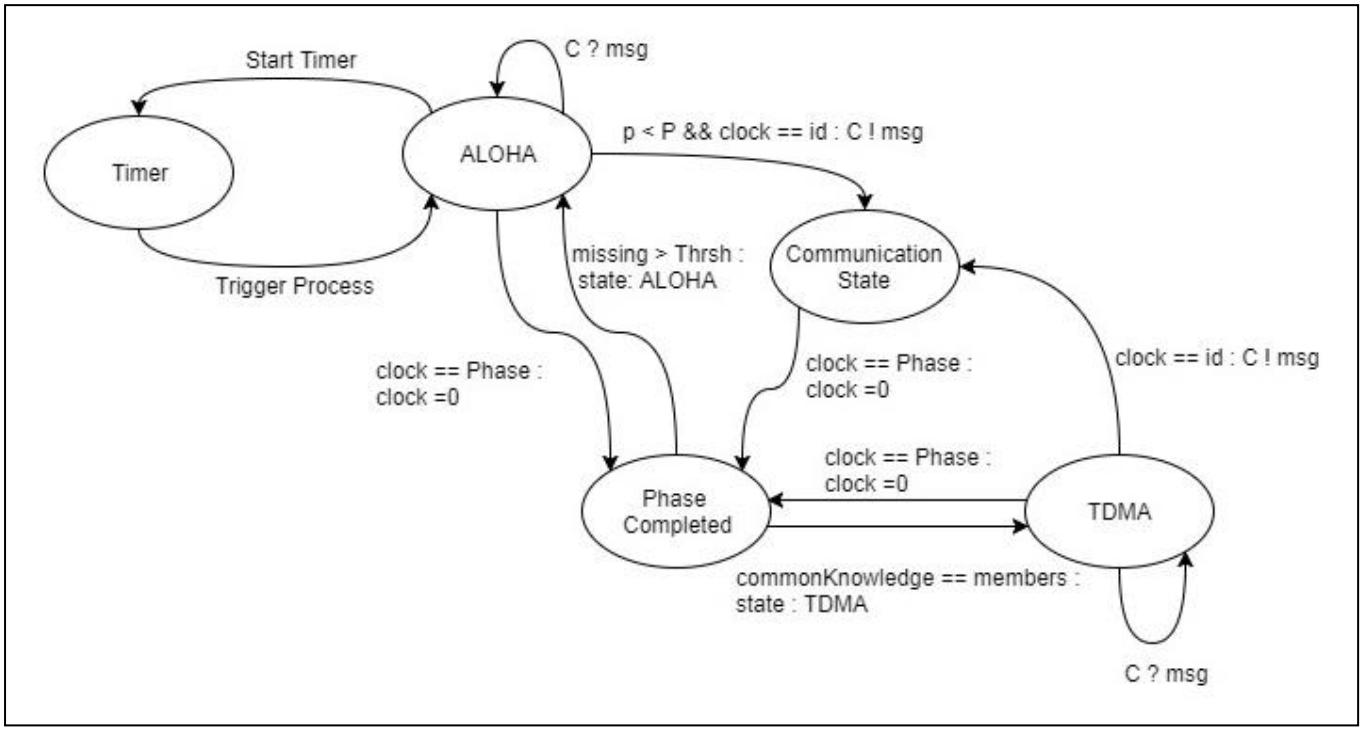


Figure 1: Program graph consisting of all the states of the system.

## 2. Linear Time Properties

1. **Liveness Property :**
   Explanation : Infinitely often all three processes will be in TDAM state.
   Condition : ([]<>(tdma))
   Macro : #define tdma (tioa_tdma_state == 1)

2. **Invariance Property :**
   Explanation : Always all three processes will be transmitting.
   Condition : ([](transmission))
   Macro : #define transmission (transmission_state == 1)

3. **Liveness Property :**
   Explanation : Every process eventually enters into TDMA state.
   Condition : []<>state0 /\ []<>state1 /\ []<>state2 /\ []<>state3

Macro :
#define state0 (controlPacket[0].msg.state==1)
#define state1 (controlPacket[1].msg.state==1)
#define state2 (controlPacket[2].msg.state==1)
#define state3 (controlPacket[3].msg.state==1)

4. **Safety Property :**
   Explanation : No two processes transmitting at the same time.
   Condition : (!send0 \/ !send1 \/ !send2 \/ !send3)
   Macro :
   #define send0 (nempty(P0P1) && nempty(P0P2) && nempty(P0P3))
   #define send1 (nempty(P1P0) && nempty(P1P2) && nempty(P1P3))
   #define send2 (nempty(P2P0) && nempty(P2P1) && nempty(P2P3))
   #define send3 (nempty(P3P0) && nempty(P3P1) && nempty(P3P2))

5. **Fairness Property :**
   Explanation: If state is TDMA, then only one process should be sending.
   Condition : (!slot0 \/ !slot1 \/ !slot2 \/ !slot3) /\ (tdma)
   Macro :
   #define tdma (tioa_tdma_state == 1)
   #define slot0 (currentSlot == 0)
   #define slot1 (currentSlot == 1)
   #define slot2 (currentSlot == 2)
   #define slot3 (currentSlot == 3)

## 3. Output

```
#processes: 96
                ck[0].member[0] = 4
                ck[0].member[1] = 4
                ck[0].member[2] = 4
                ck[0].member[3] = 4
                ck[1].member[0] = 4
                ck[1].member[1] = 4
                ck[1].member[2] = 4
                ck[1].member[3] = 4
                ck[2].member[0] = 4
                ck[2].member[1] = 4
                ck[2].member[2] = 4
                ck[2].member[3] = 4
                ck[3].member[0] = 4
                ck[3].member[1] = 4
                ck[3].member[2] = 4
                ck[3].member[3] = 4
                counter = 0
                commonKnowledgeState[0] = 1
                commonKnowledgeState[1] = 1
                commonKnowledgeState[2] = 1
                commonKnowledgeState[3] = 1
                currentSlot = 29
                tioa_tdma_state = 1
                missingMessages[0] = 0
                missingMessages[1] = 4
                missingMessages[2] = 4
                missingMessages[3] = 0
                timer_tick = 7
                numberOfNodes = 4
                members = 0
                tranmission_state = 1
                controlPacket[0].processId = 0
                controlPacket[0].msg.id = 1
                controlPacket[0].msg.state = 0
                controlPacket[0].msg.members = 4
                controlPacket[0].msg.time = 28
                controlPacket[1].processId = 0
                controlPacket[1].msg.id = 1
                controlPacket[1].msg.state = 0
                controlPacket[1].msg.members = 4
                controlPacket[1].msg.time = 27
                controlPacket[2].processId = 0
                controlPacket[2].msg.id = 1
                controlPacket[2].msg.state = 1
                controlPacket[2].msg.members = 4
                controlPacket[2].msg.time = 26
                controlPacket[3].processId = 0
                controlPacket[3].msg.id = 1
                controlPacket[3].msg.state = 0
                controlPacket[3].msg.members = 4
                controlPacket[3].msg.time = 25
```

Figure 2: Output of the Spin Model checker