EGYP**FWD** Initiative

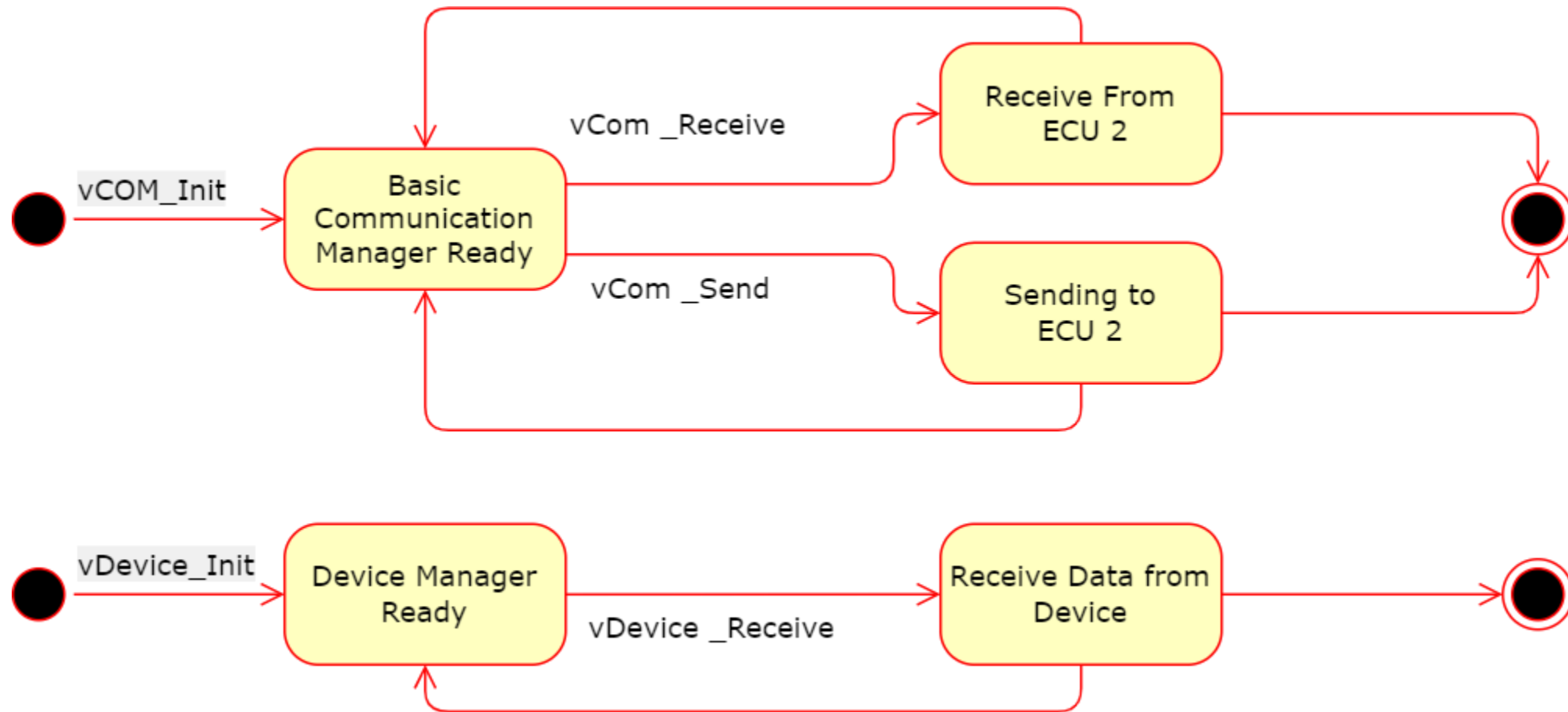**Advanced Embedded Systems Nanodegree,**

Embedded Software Design Masterclass by SPRINTS Egypt.

Automotive Door Control System Dynamic Design

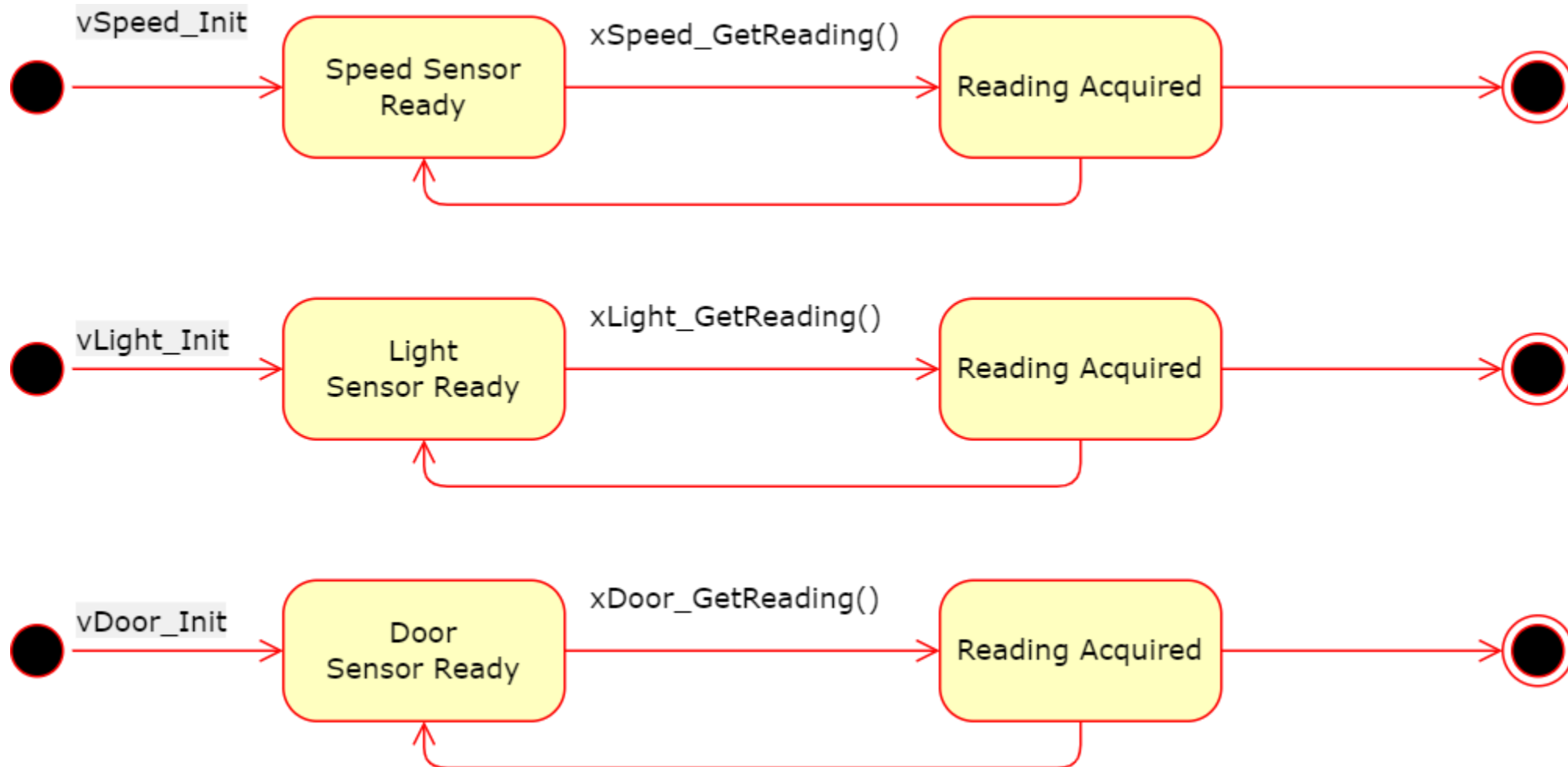**A Graduation Project submitted in partial Fulfillment of**

Embedded Software Design Masterclass.

Prepared by
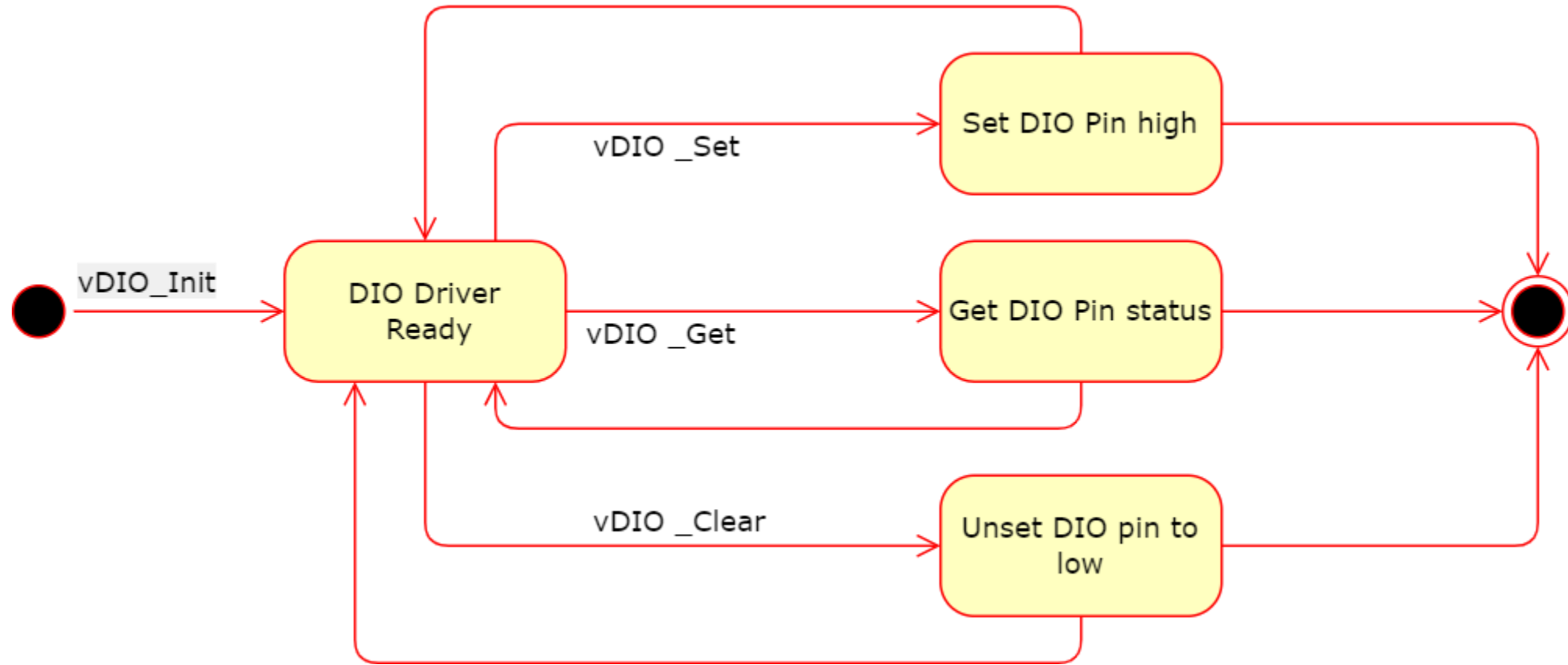**Muhammad Mokhtar Emara**
omriemara@gmai.com

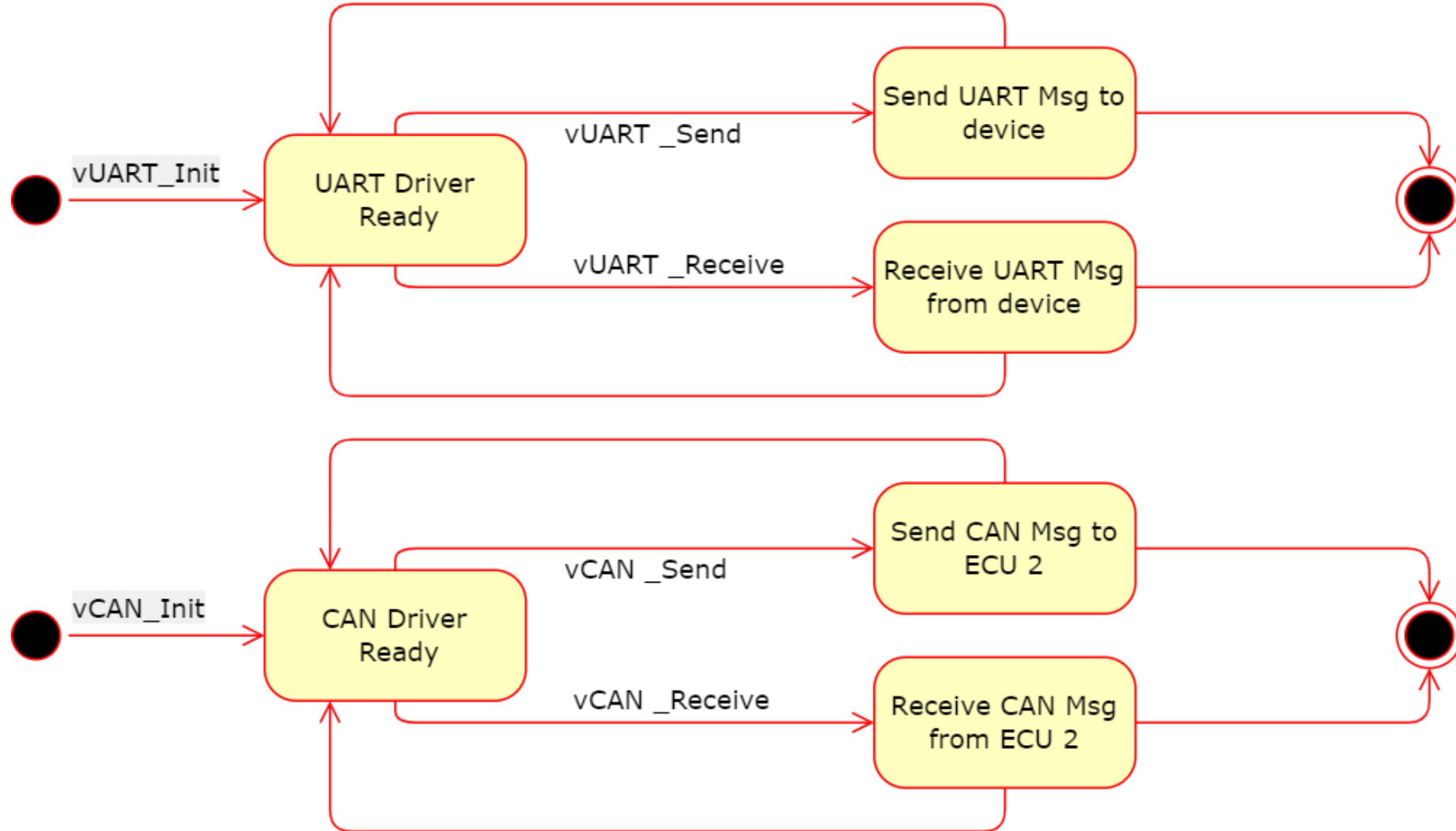# ECU 1 : Manager Modules State Diagrams

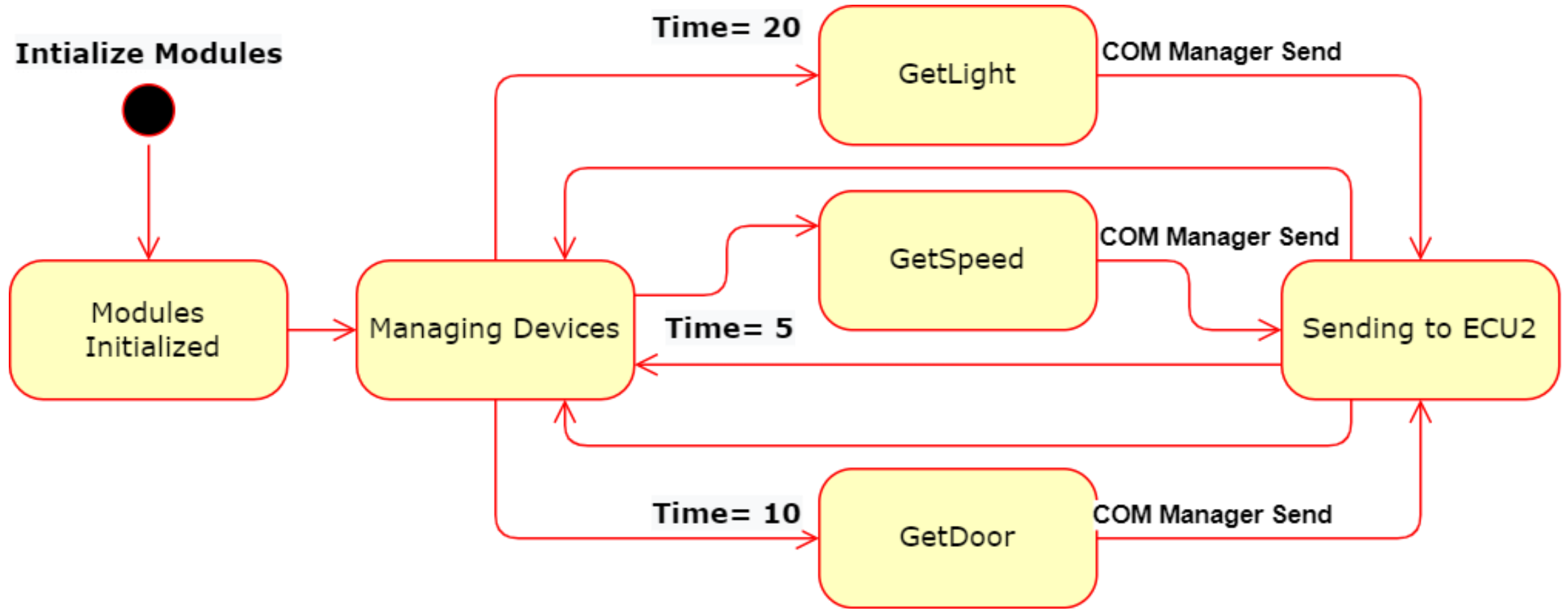# ECU 1 : Sensor Modules State Diagrams

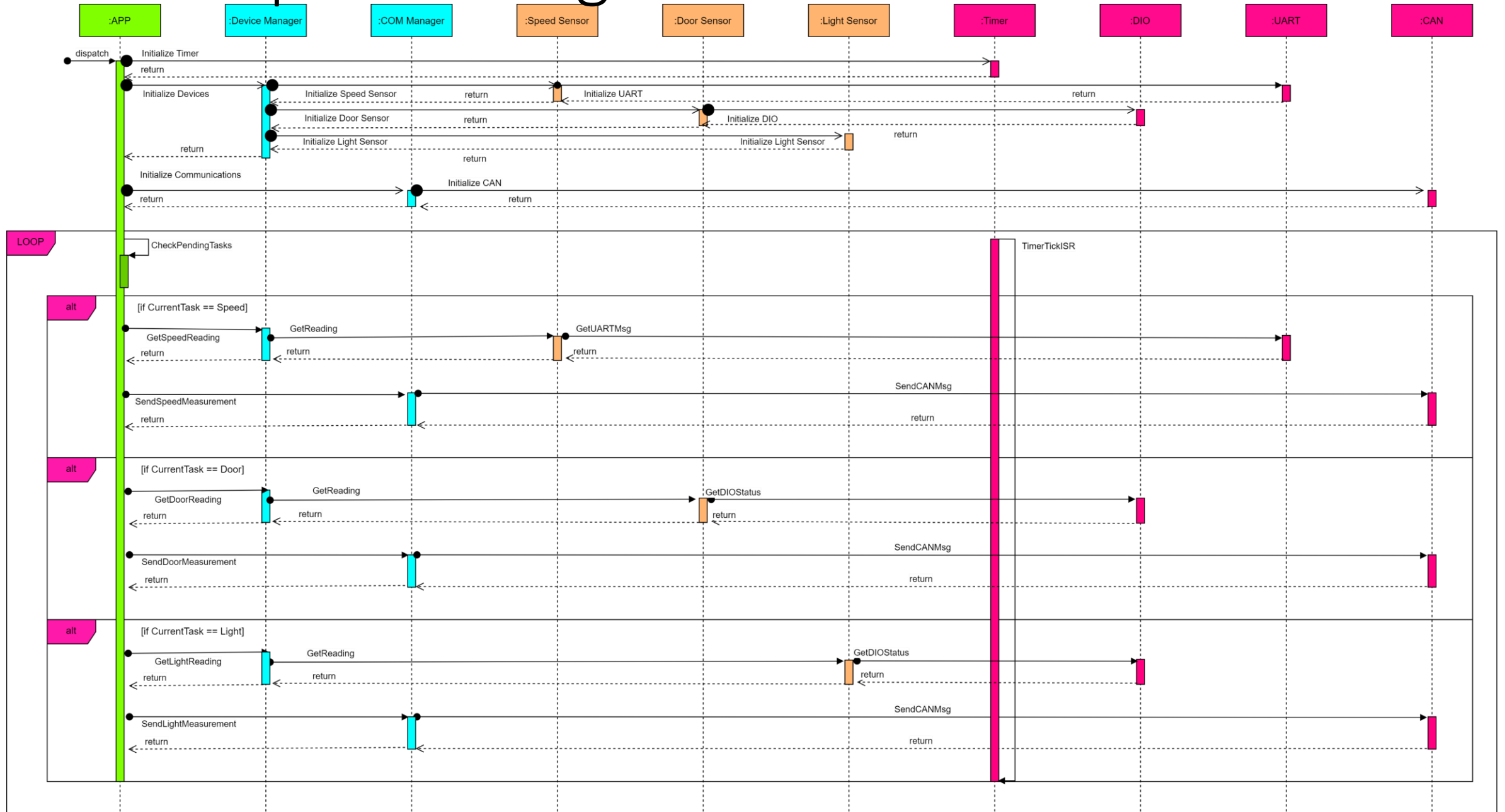# ECU 1 MCAL : DIO State Diagram

ECU 1 MCAL : COM Drivers State Diagram

ECU 1 : State Diagram

ECU 1 : Sequence Diagram

ECU 1 : CPU LOAD

- **Calculation of HyperPeriod**

Assumptions: **Tick time** = 1 ms ; **Task periodicities** : 5, 10 , 20 ms ;**Execution times** = 1,2,4 ms

$$HyperPeriod = LCM(Periodicities) = LCM(5,10,20)$$

$$HyperPeriod = 20$$

- **CPU Load Calculations**

$$CPU\ LOAD = \frac{Total\ Time}{HyperPeriod} * 100$$
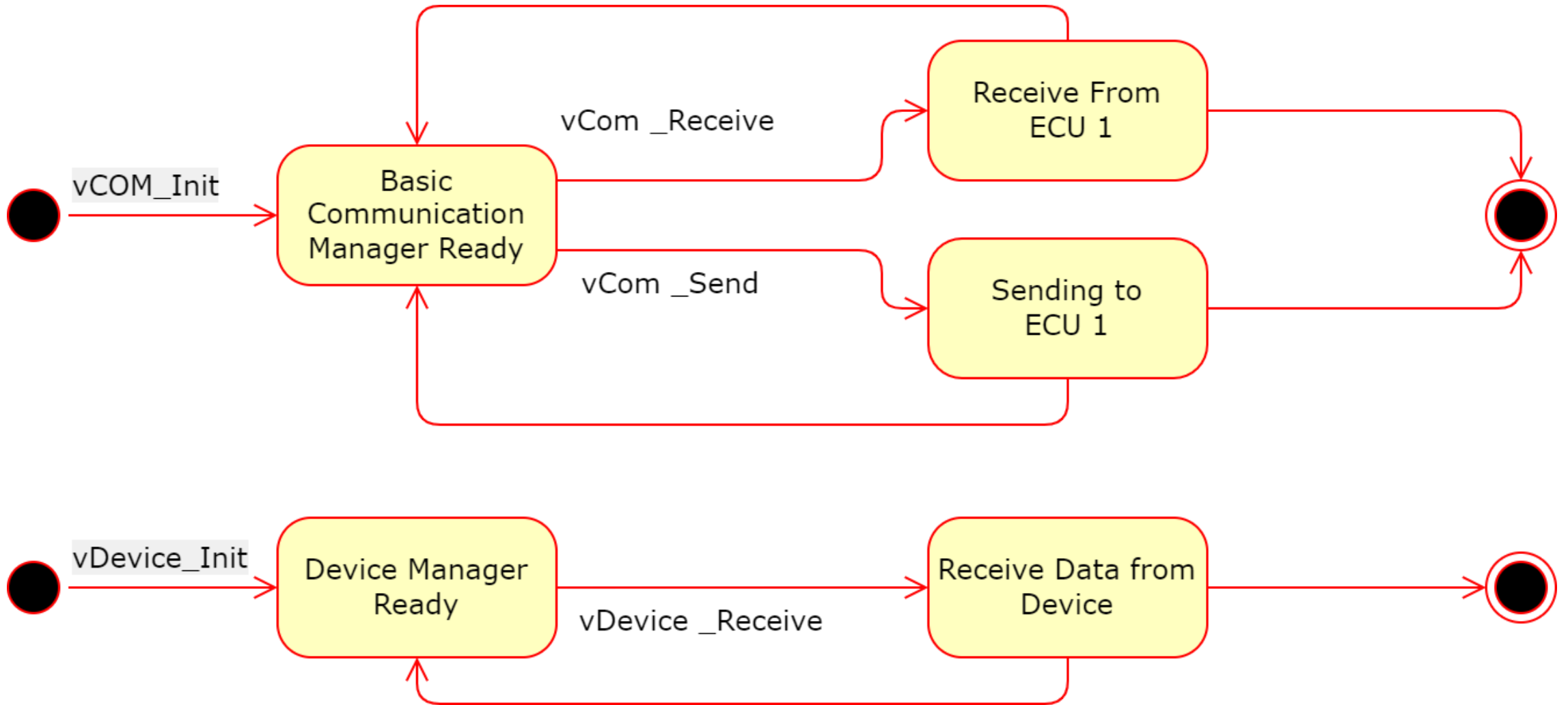
$$Total\ Time = \sum_{i=1}^{6} ExecutionTime_i * Num\ of\ Calls\ In\ HyperPeriod_i$$
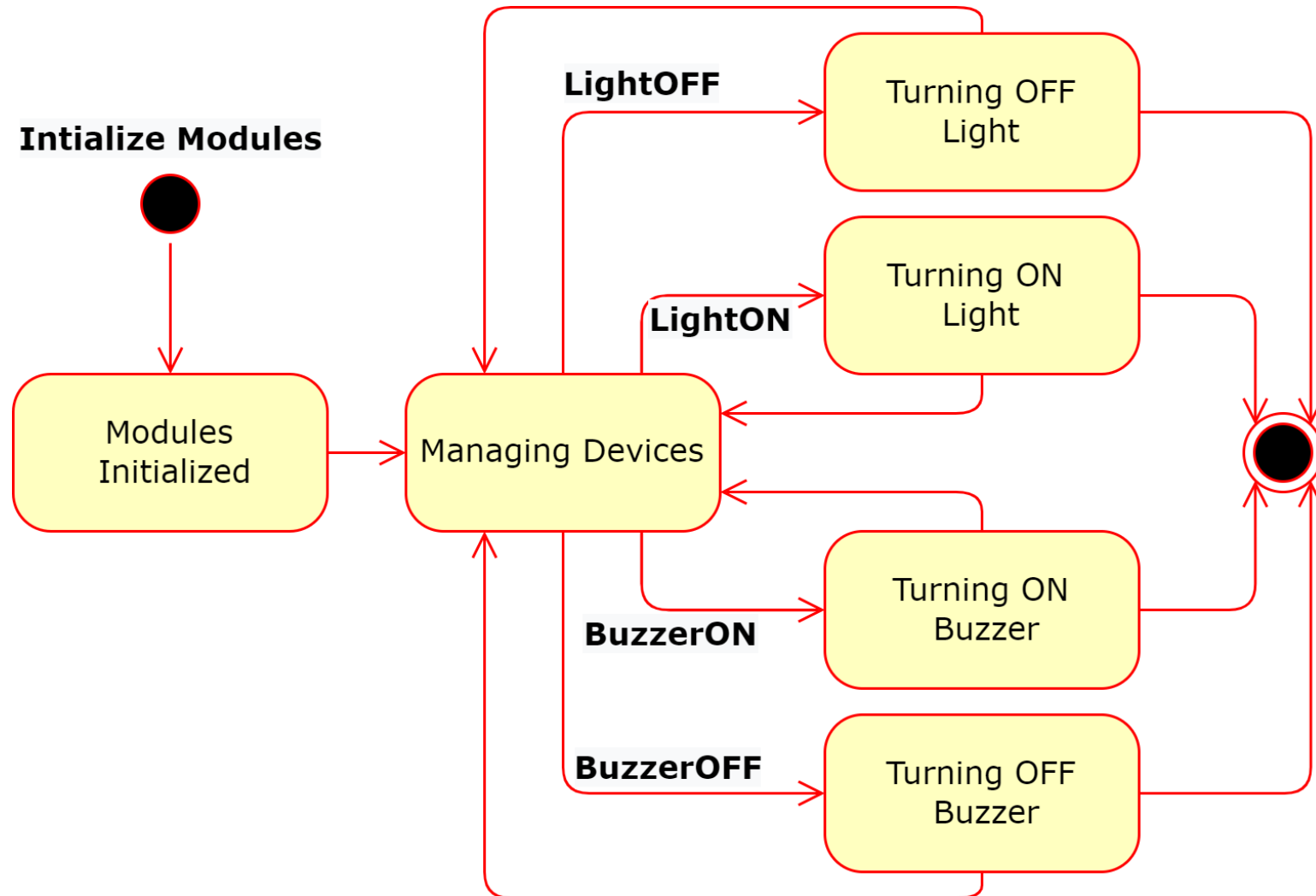
$$Total\ Time = 1 * 4 + 2 * 2 + 4 * 1 = 12ms$$

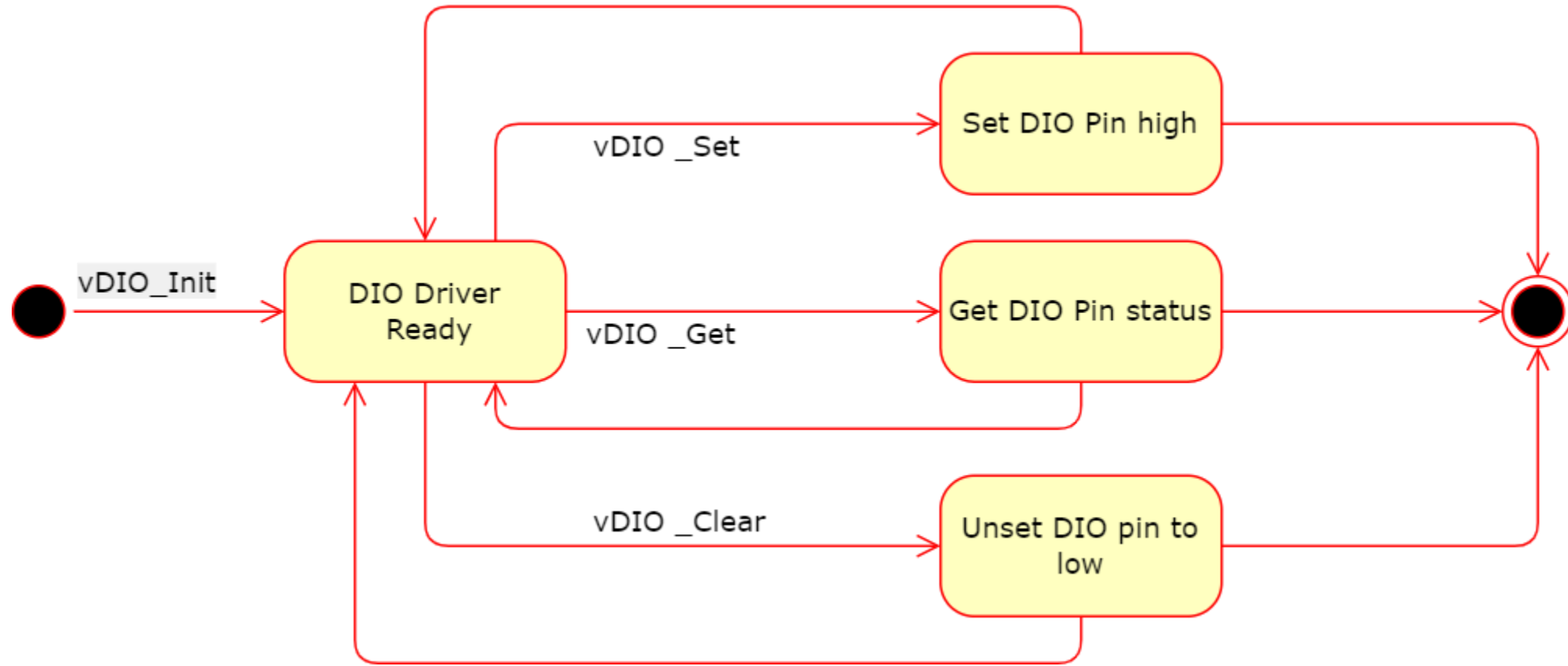$$Utilization = CPU\ LOAD = \frac{12}{20} * 100 = 60\%$$
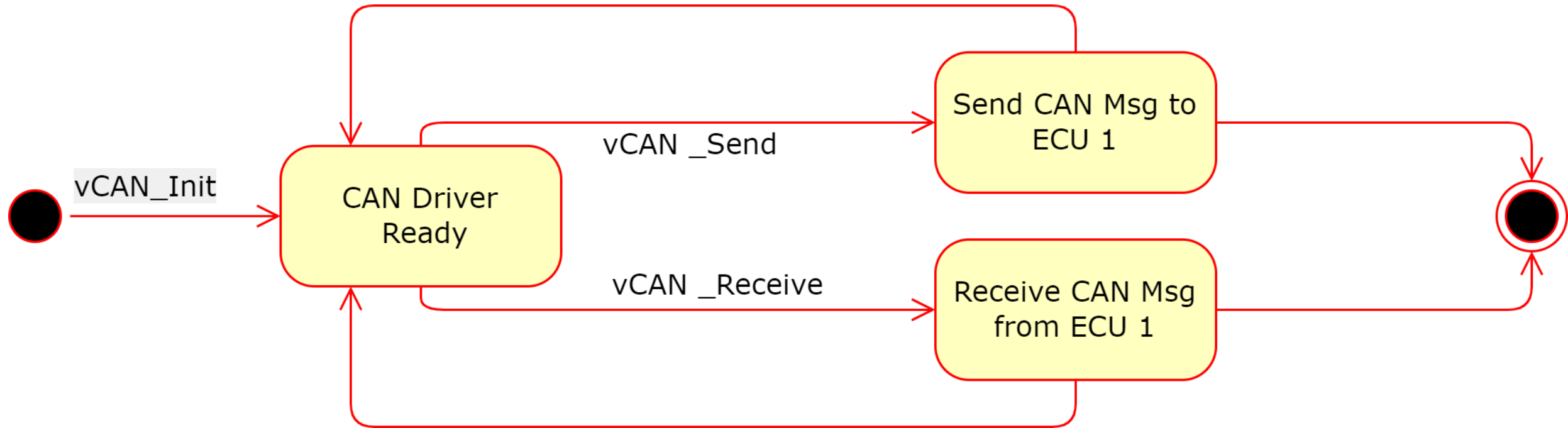
ECU 2 : Manager Modules State Diagrams

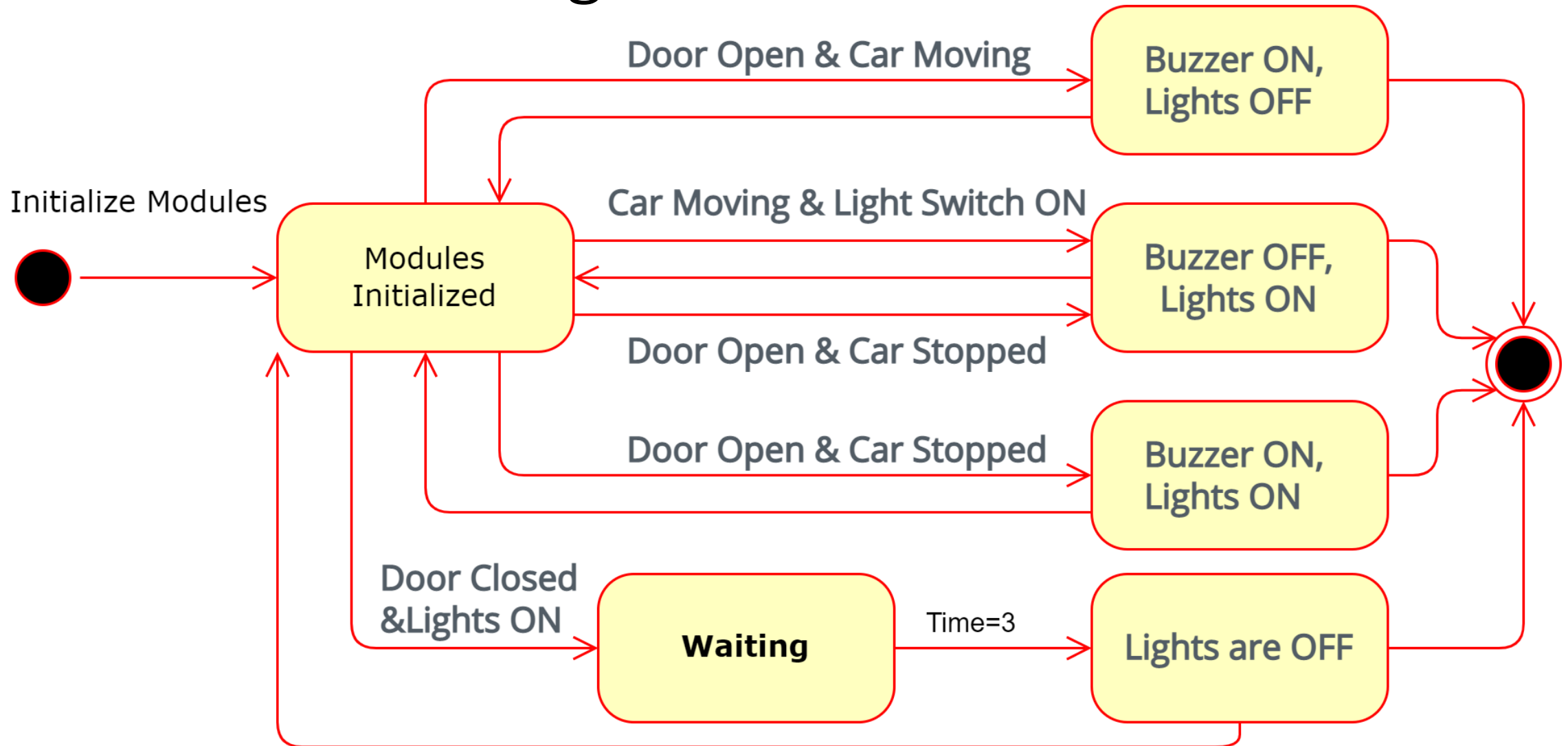# ECU 2 : Actuator Modules State Diagrams

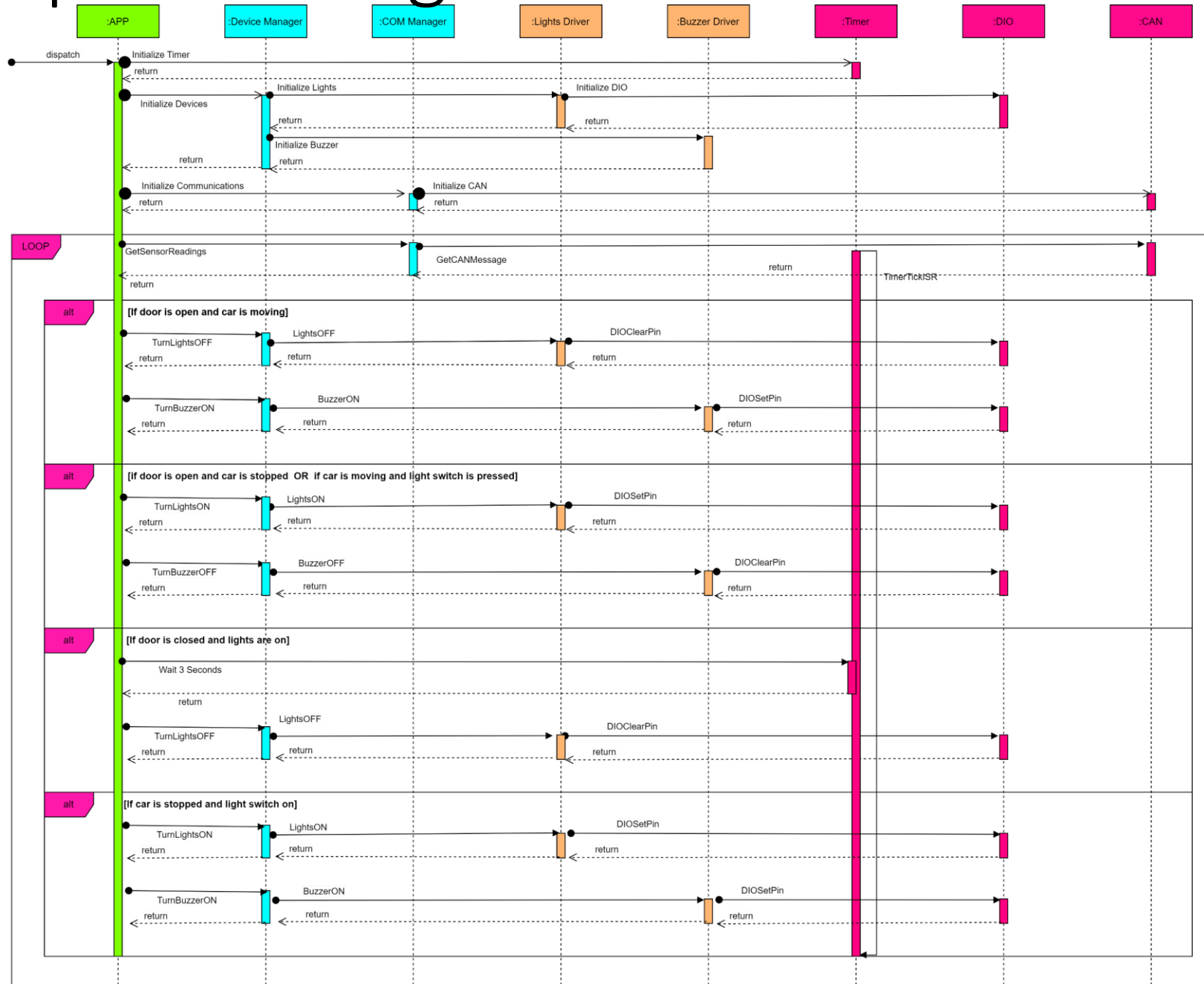# ECU 2 MCAL : DIO State Diagram

ECU 2 MCAL : COM Drivers State Diagram

ECU 2 : State Diagram

ECU 2 : Sequence Diagram

ECU 2 : CPU LOAD

- **Calculation of HyperPeriod**

Assumptions: **Tick time** = 1 ms ; **Task periodicities** : 5 , 10 ms ;**Execution times** = 2 , 3 ms

$$HyperPeriod = LCM(Periodicities) = LCM(5,10)$$

$$HyperPeriod = 10$$

- **CPU Load Calculations**

$$CPU\ LOAD = \frac{Total\ Time}{HyperPeriod} * 100$$

$$Total\ Time = \sum_{i=1}^{6} ExecutionTime_i * Num\ of\ Calls\ In\ HyperPeriod_i$$

$$Total\ Time = 2 * 2 + 3 * 1 = 7ms$$

$$Utilization = CPU\ LOAD = \frac{7}{10} * 100 = 70\%$$