

EGYPT 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.

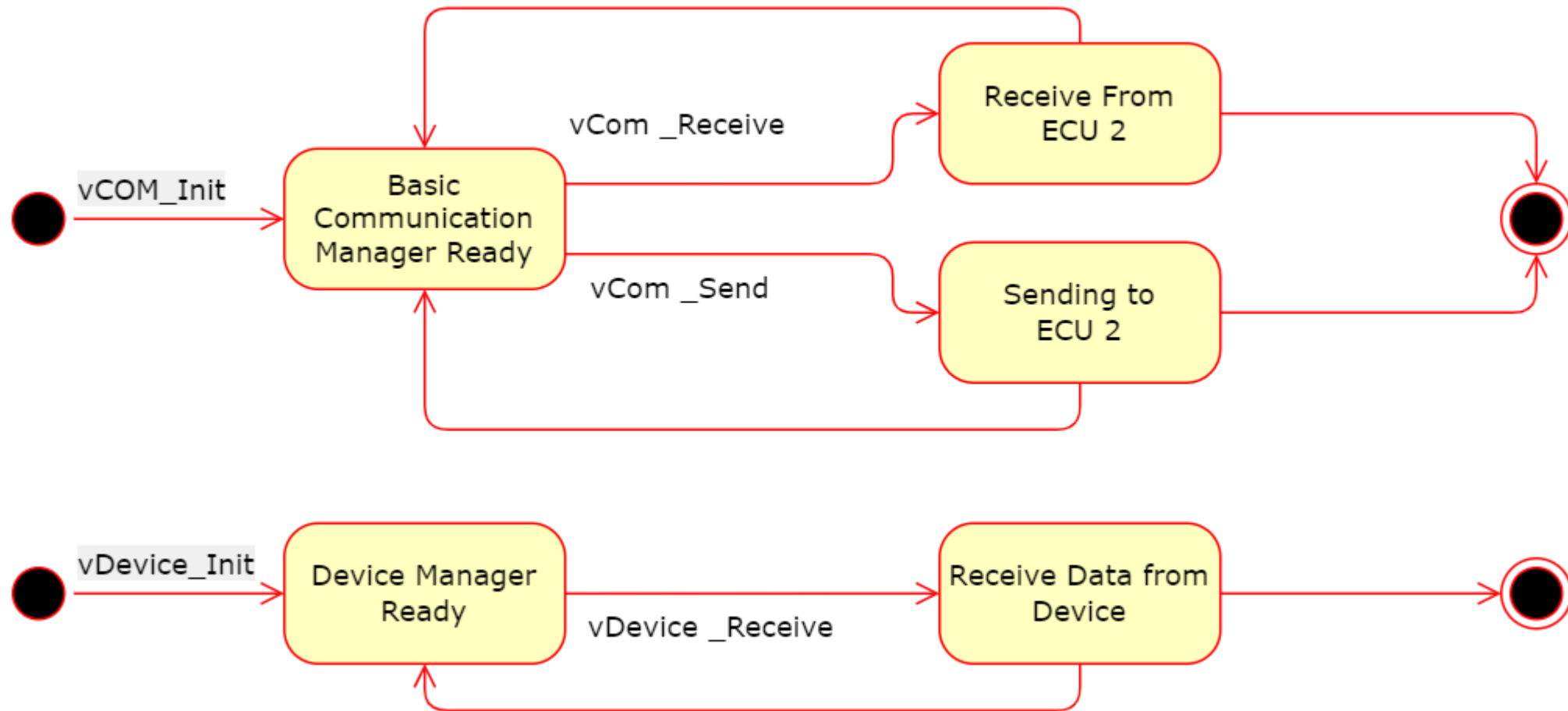
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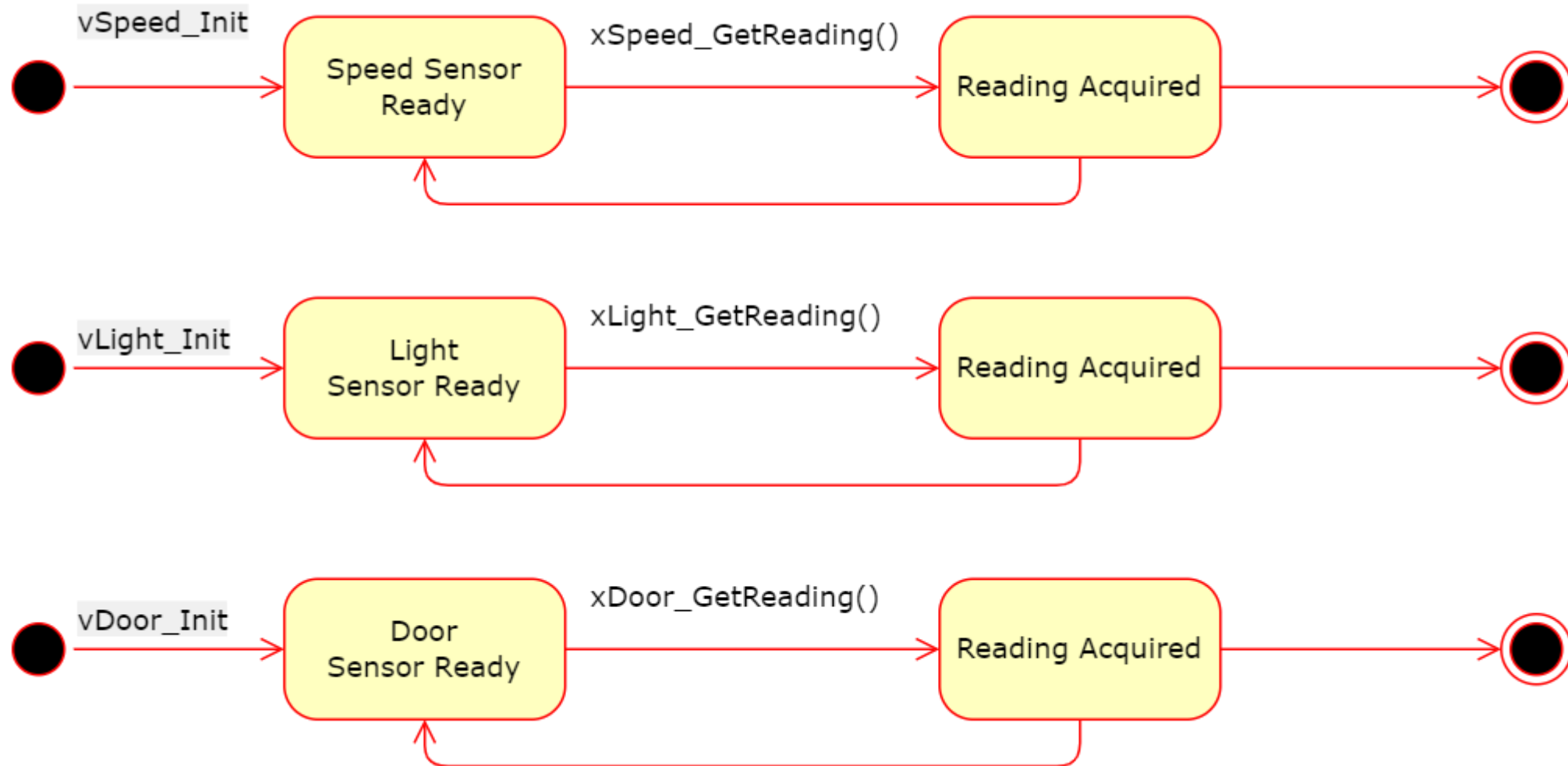
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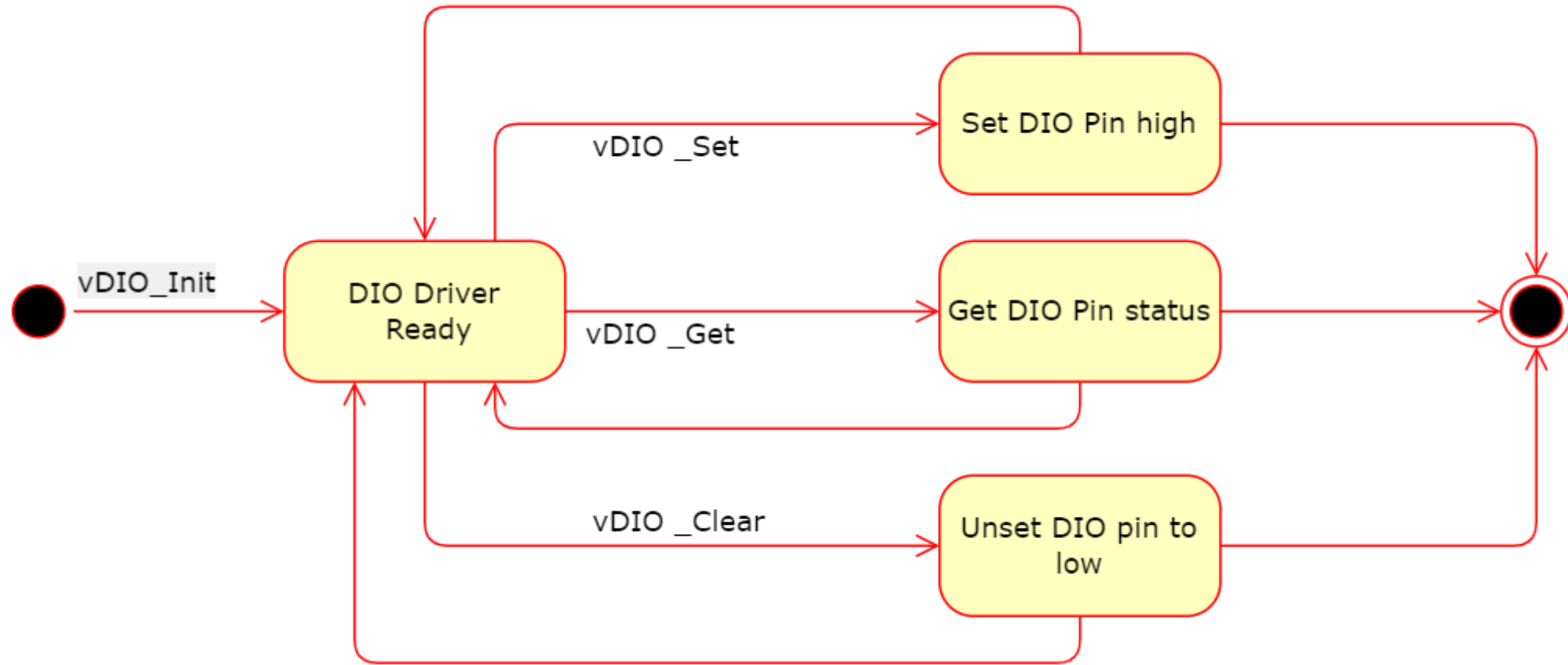
ECU 1 : Manager Modules State Diagrams



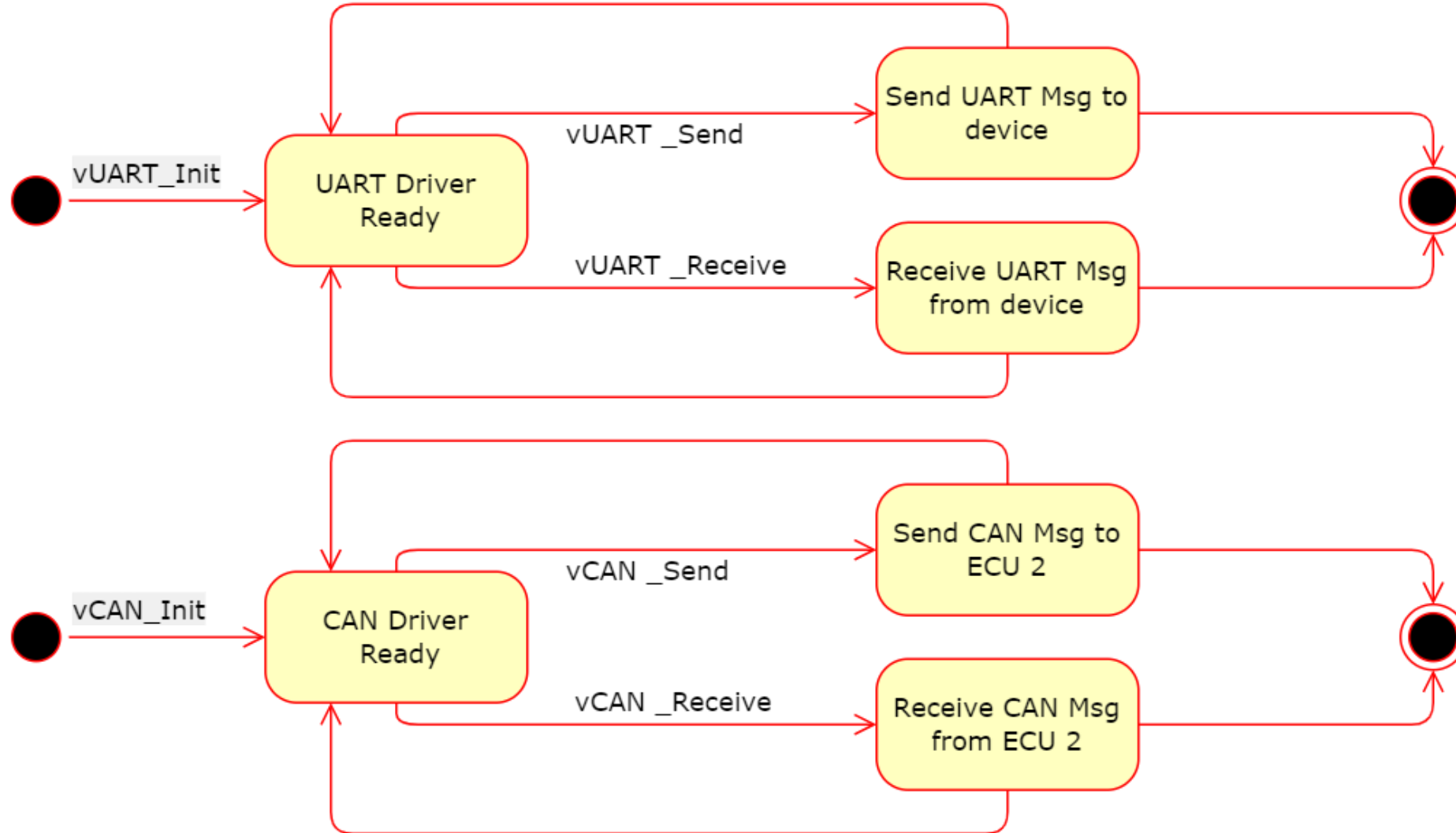
ECU 1 : Sensor Modules State Diagrams



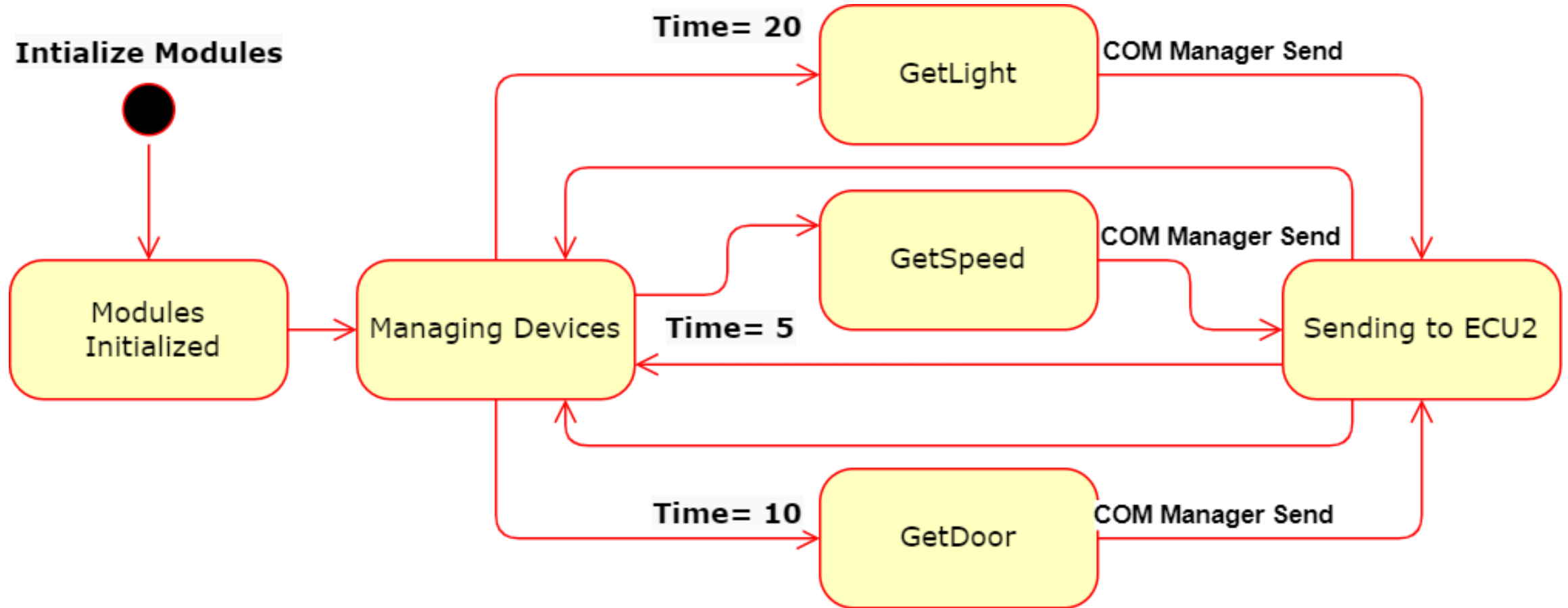
ECU 1 MCAL : DIO State Diagram



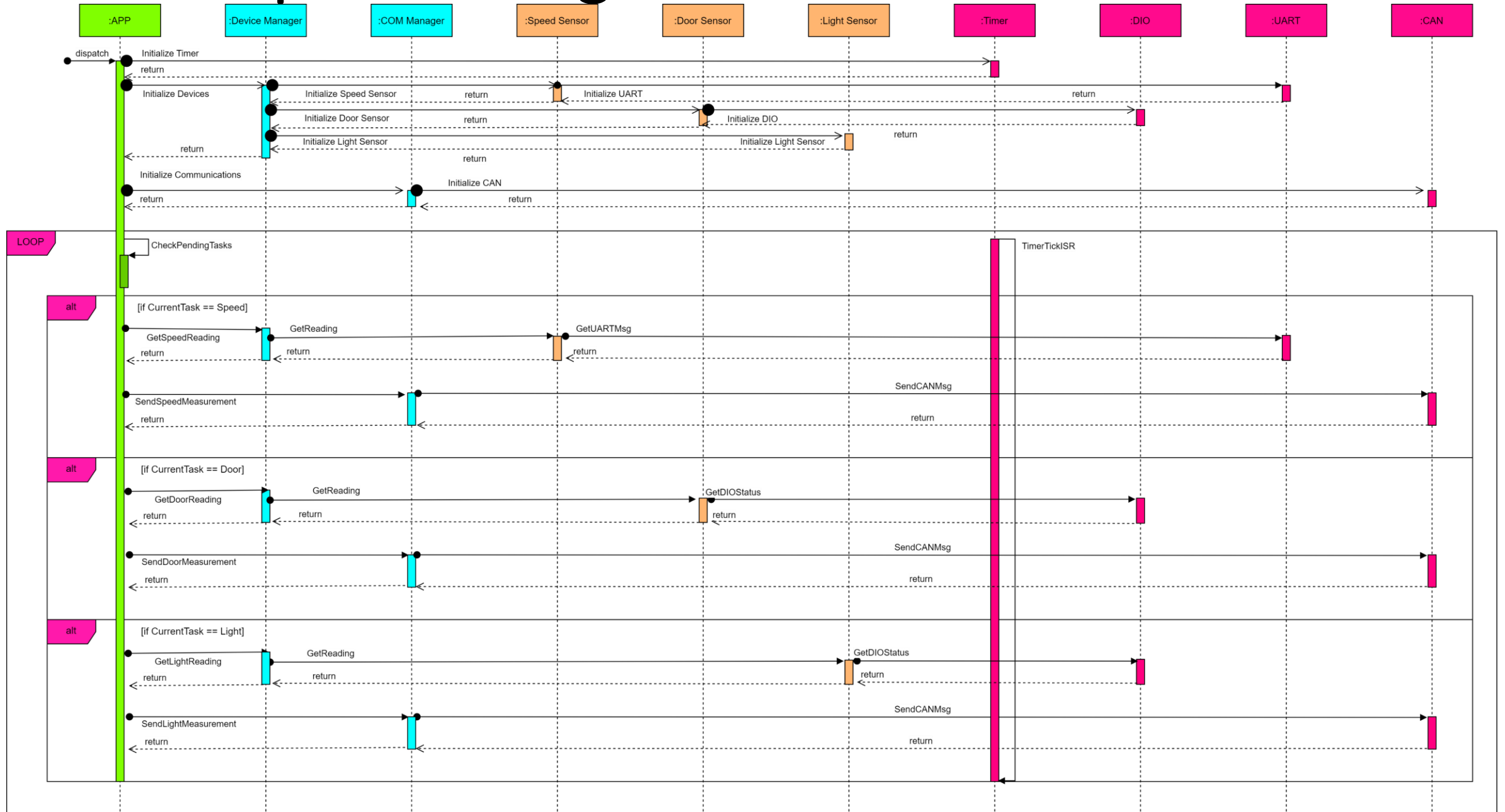
ECU 1 MCAL : COM Drivers State Diagram



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

$$\text{HyperPeriod} = \text{LCM}(\text{Periodicities}) = \text{LCM}(5,10,20)$$

$$\text{HyperPeriod} = 20$$

- CPU Load Calculations

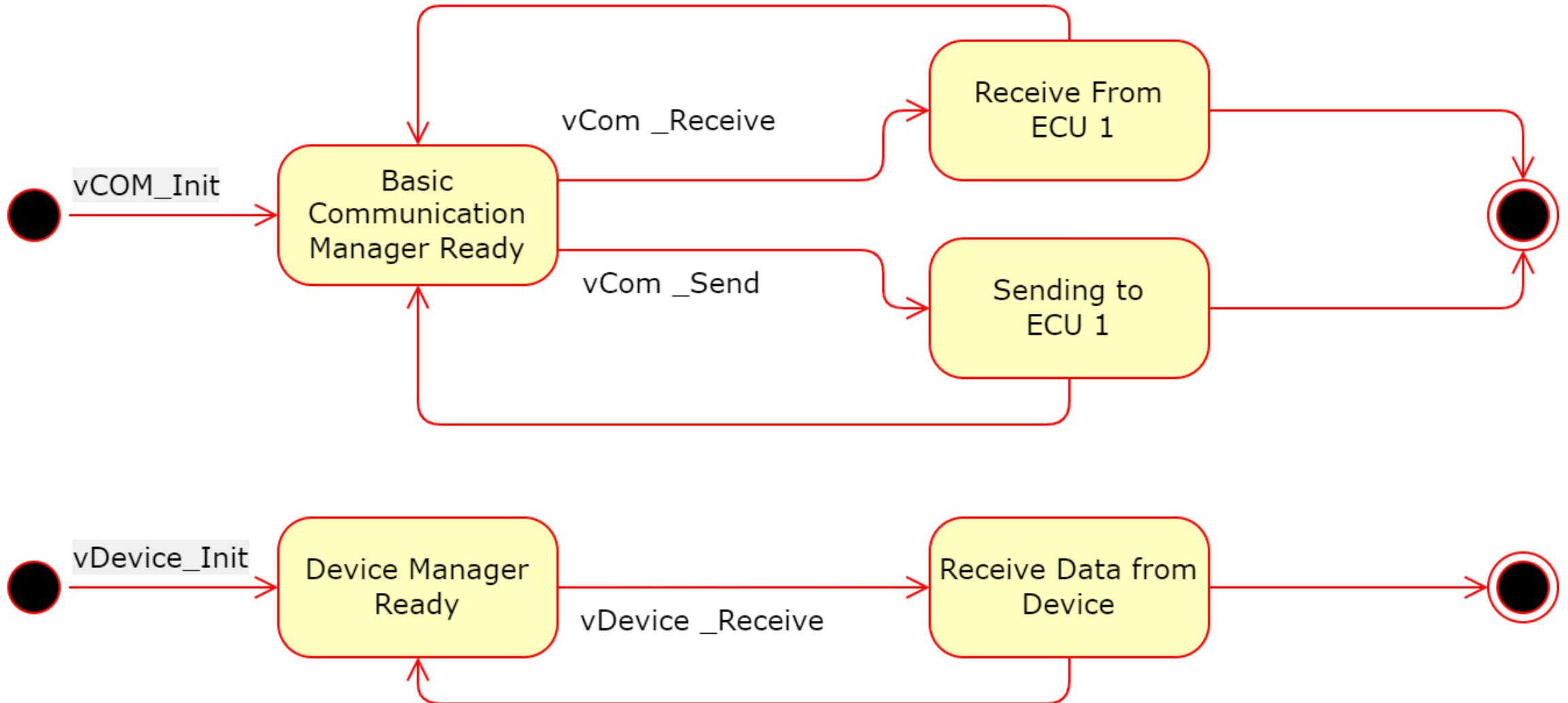
$$\text{CPU LOAD} = \frac{\text{Total Time}}{\text{HyperPeriod}} * 100$$

$$\text{Total Time} = \sum_{i=1}^6 \text{ExecutionTime}_i * \text{Num of Calls In HyperPeriod}_i$$

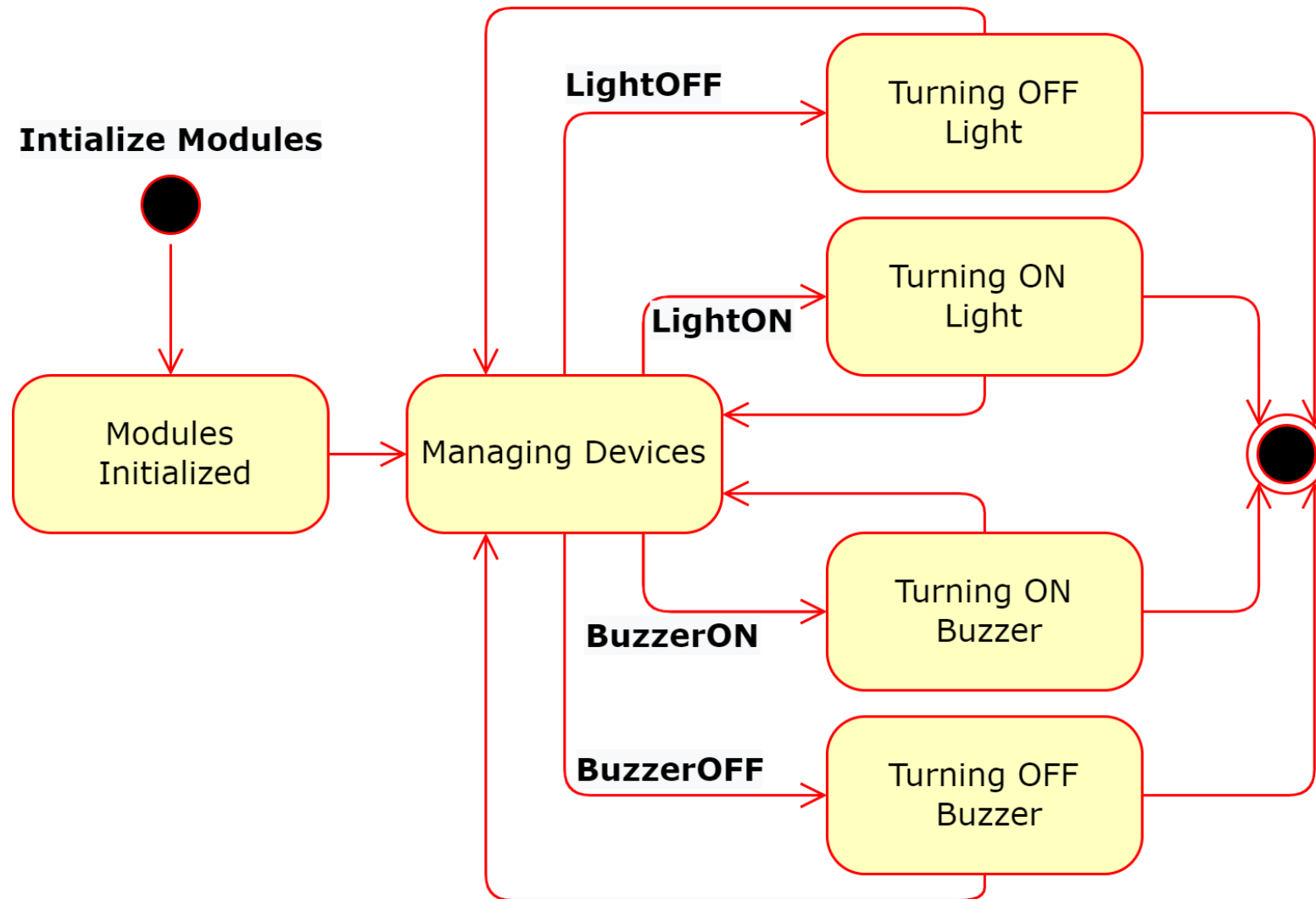
$$\text{Total Time} = 1 * 4 + 2 * 2 + 4 * 1 = 12\text{ms}$$

$$\text{Utilization} = \text{CPU LOAD} = \frac{12}{20} * 100 = 60\%$$

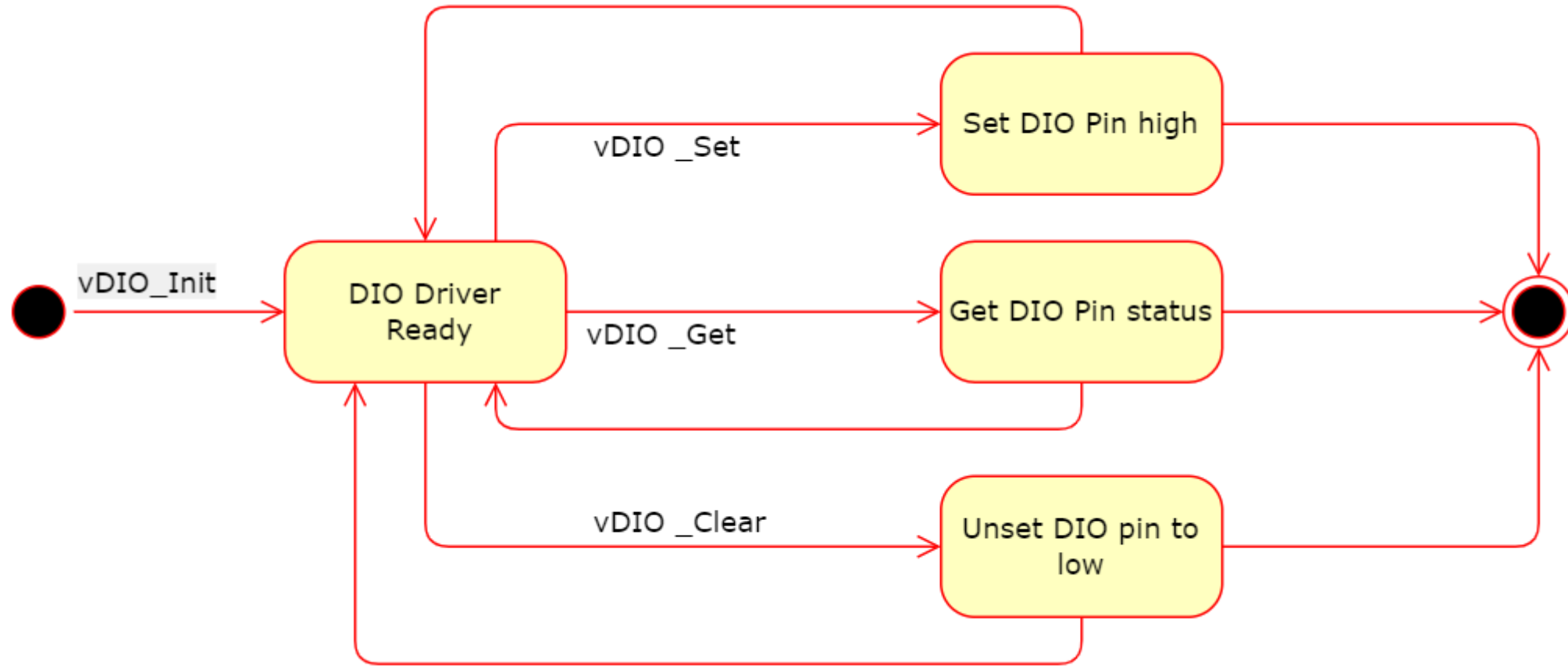
ECU 2 : Manager Modules State Diagrams



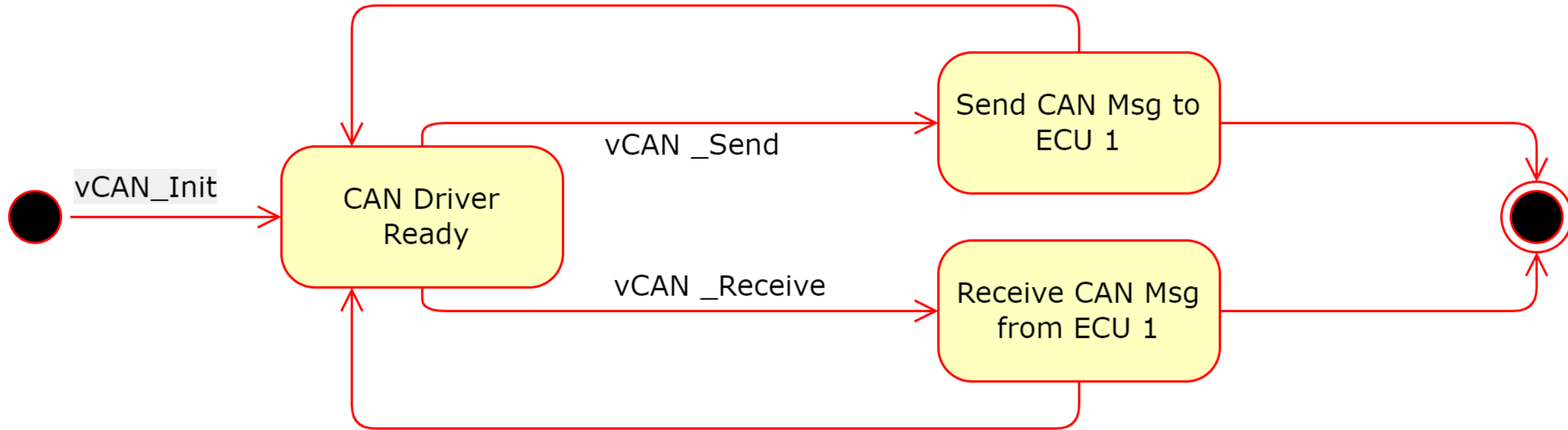
ECU 2 : Actuator Modules State Diagrams



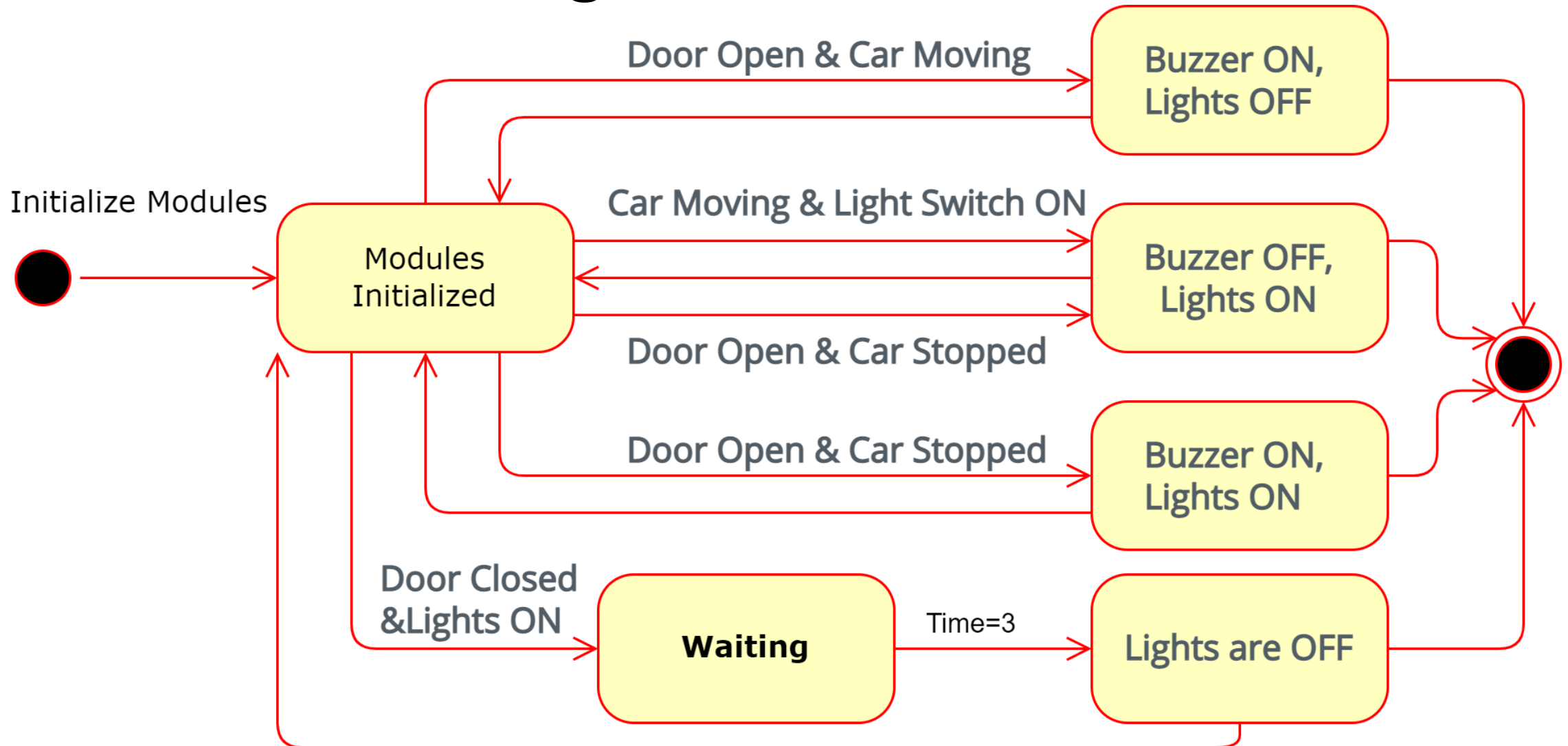
ECU 2 MCAL : DIO State Diagram



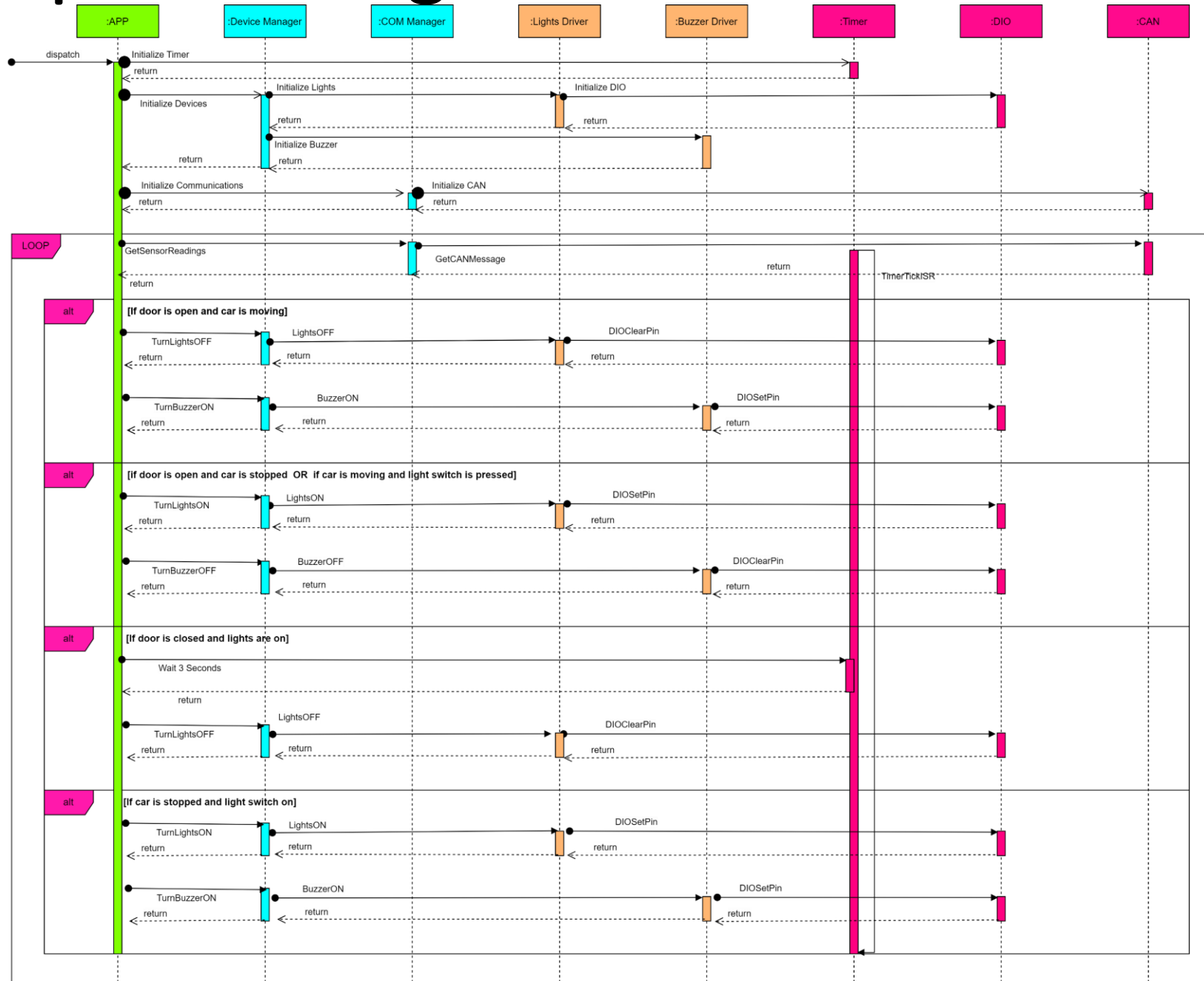
ECU 2 MCAL : COM Drivers State Diagram



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

$$\text{HyperPeriod} = LCM(\text{Periodicities}) = LCM(5,10)$$

$$\text{HyperPeriod} = 10$$

- CPU Load Calculations

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

$$\text{Total Time} = \sum_{i=1}^6 \text{ExecutionTime}_i * \text{Num of Calls In HyperPeriod}_i$$

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

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