EGYPFWD 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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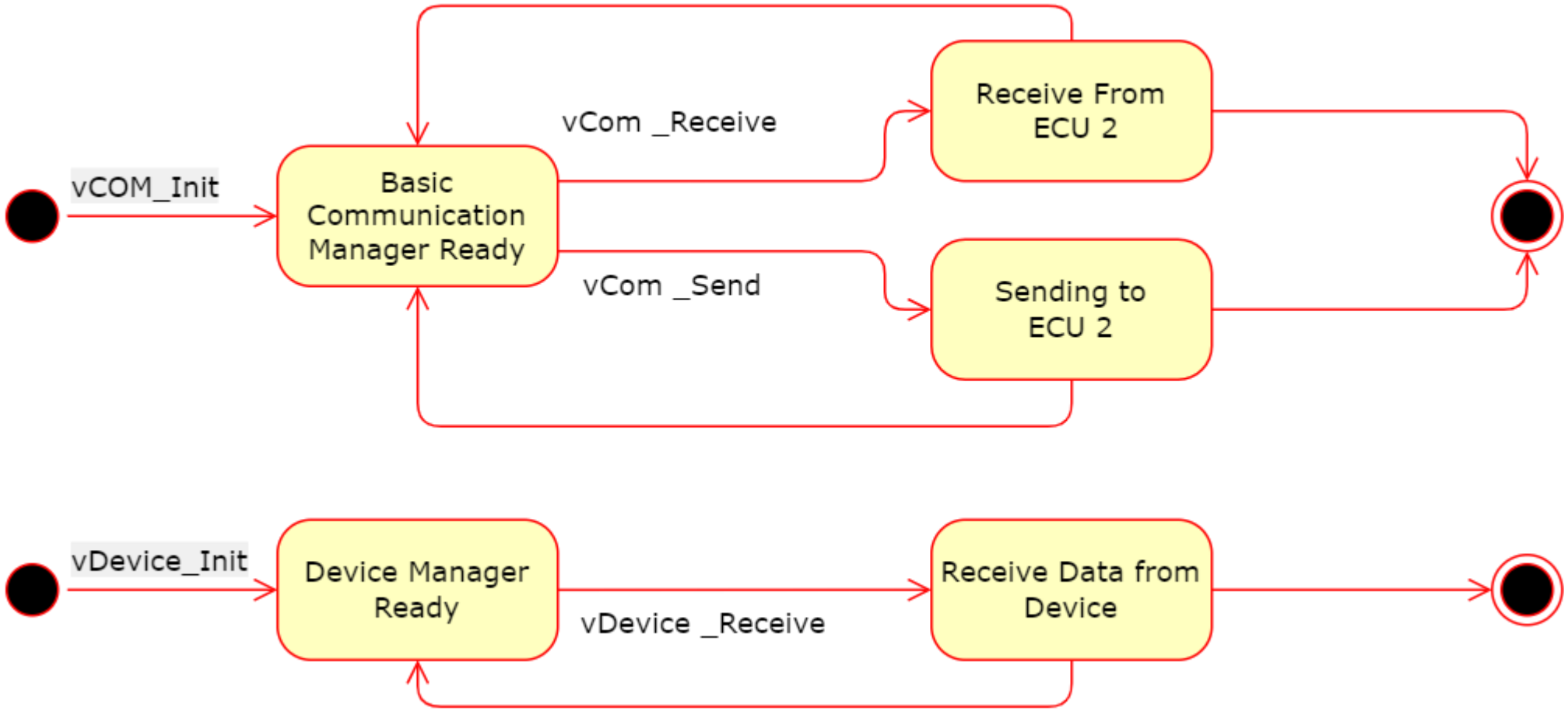
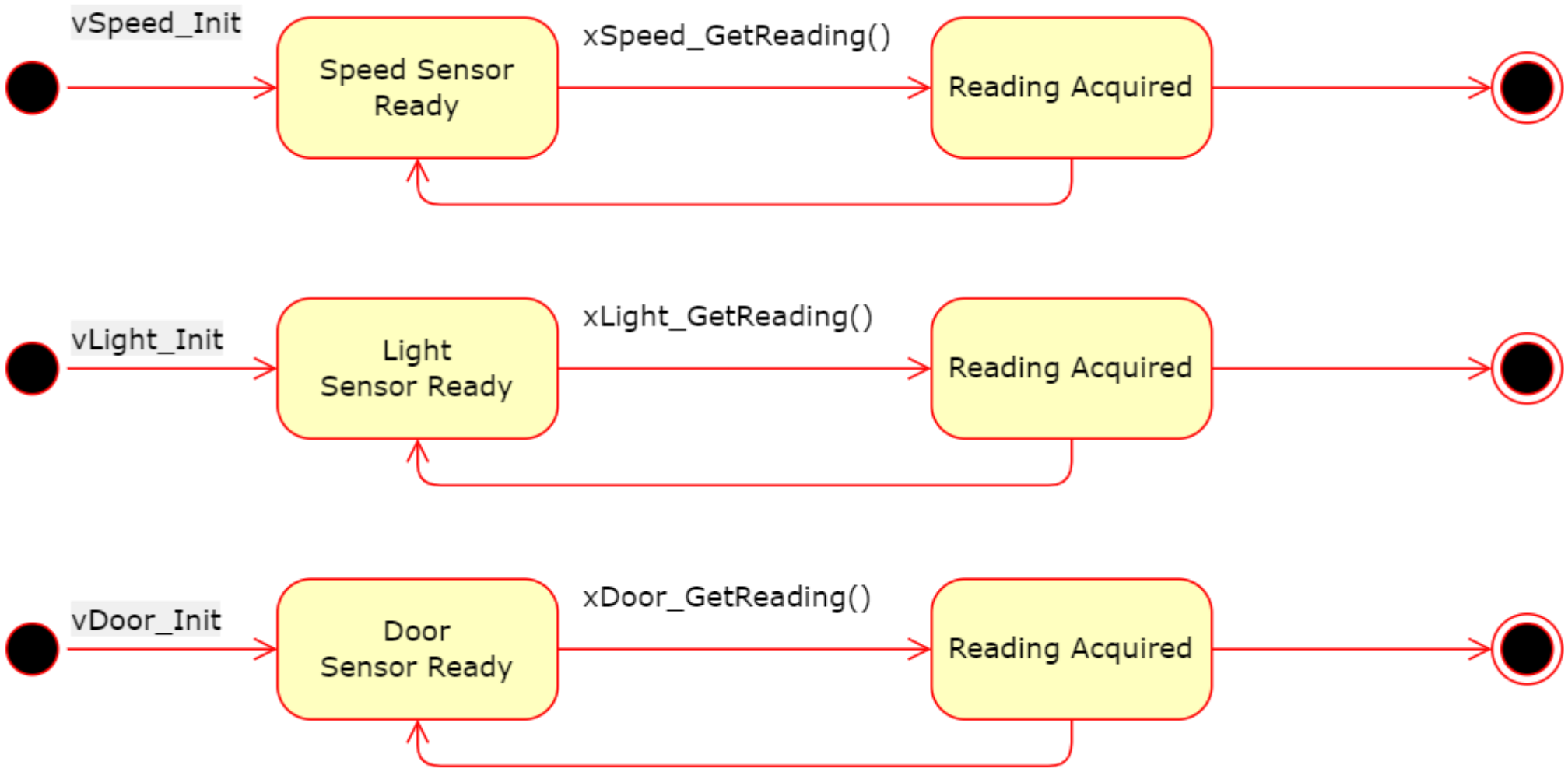
Github

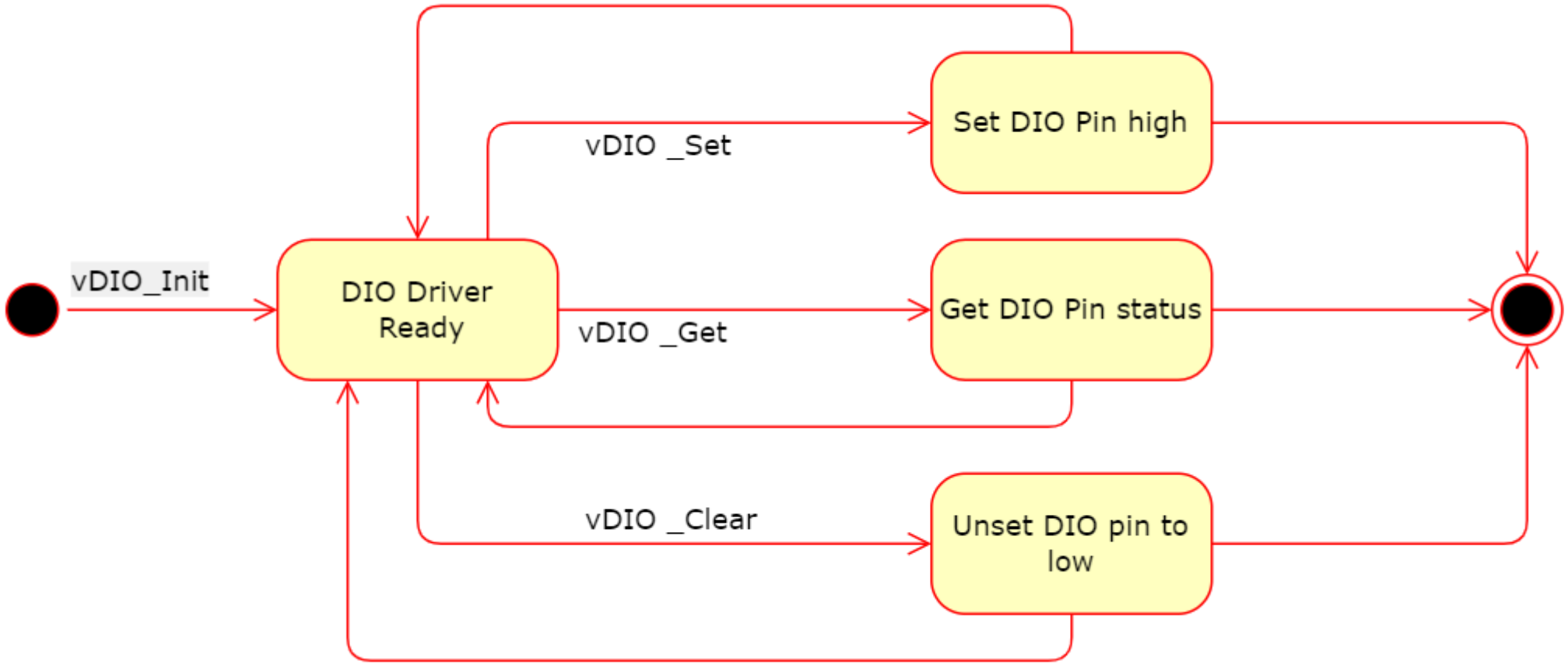
ECU 1 : Manager Modules State Diagrams



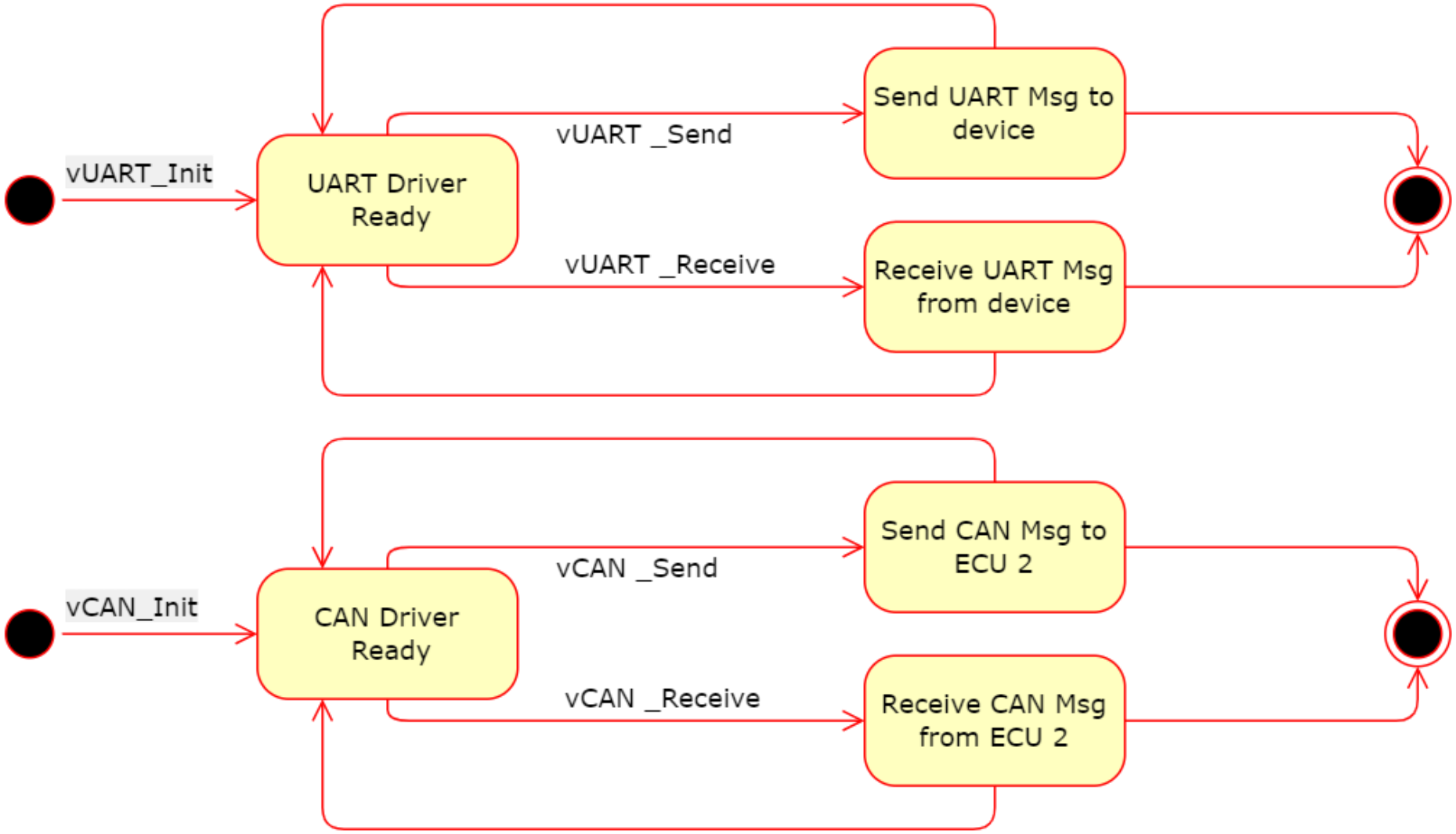
ECU 1 : Sensor Modules State Diagrams



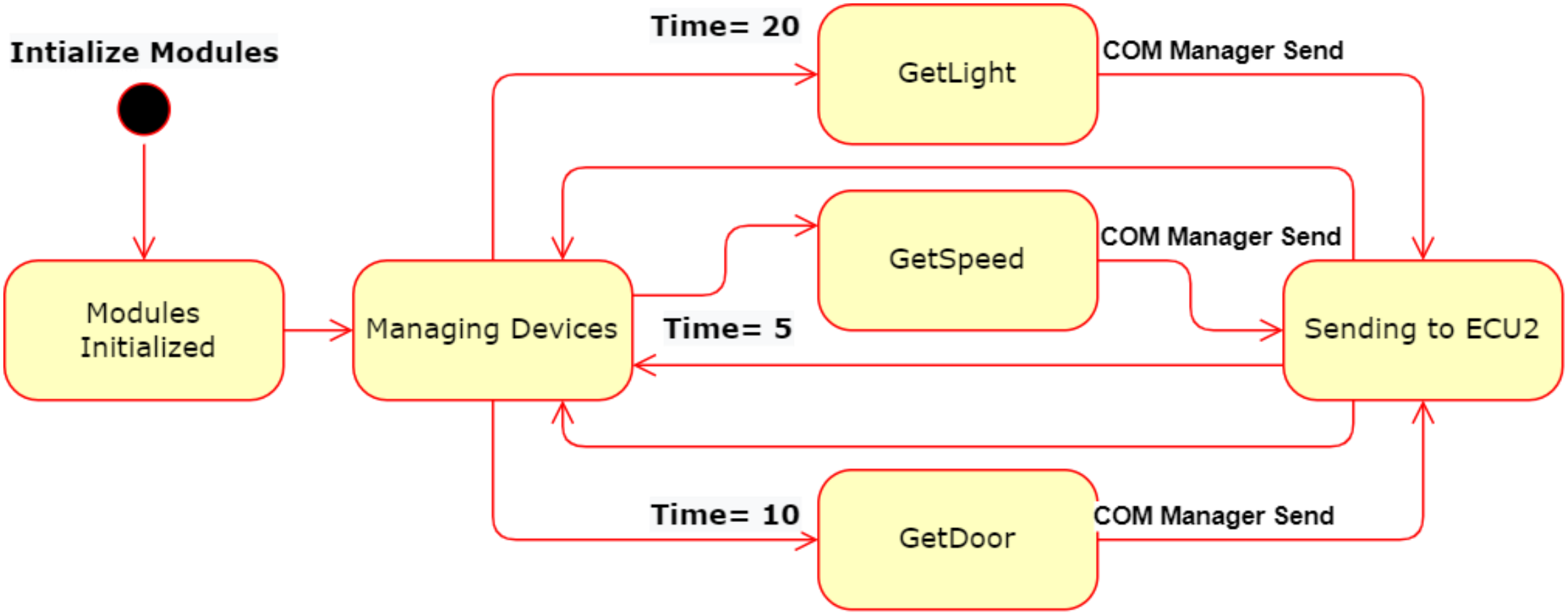
ECU 1 MCAL : DIO State Diagram



ECU 1 MCAL : COM Drivers State Diagram



ECU 1 : State Diagram



ECU 1 : CPU LOAD

- **Calculation of HyperPeriod**

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

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

$$\boldsymbol{HyperPeriod} = 20$$

- **CPU Load Calculations**

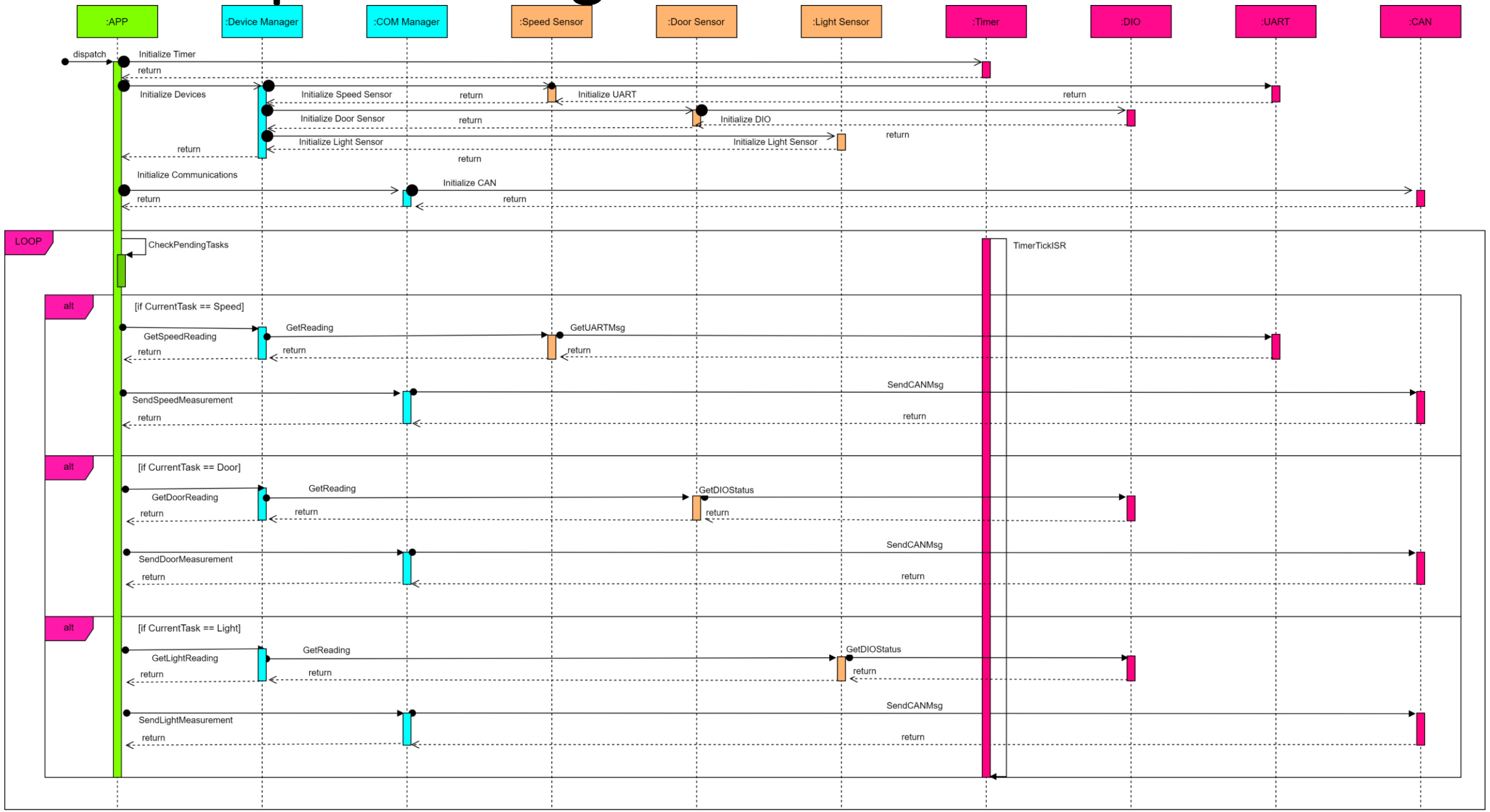
$$\textbf{CPU LOAD} = \frac{\text{Total Time}}{\text{HyperPeriod}} * \textbf{100}$$

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

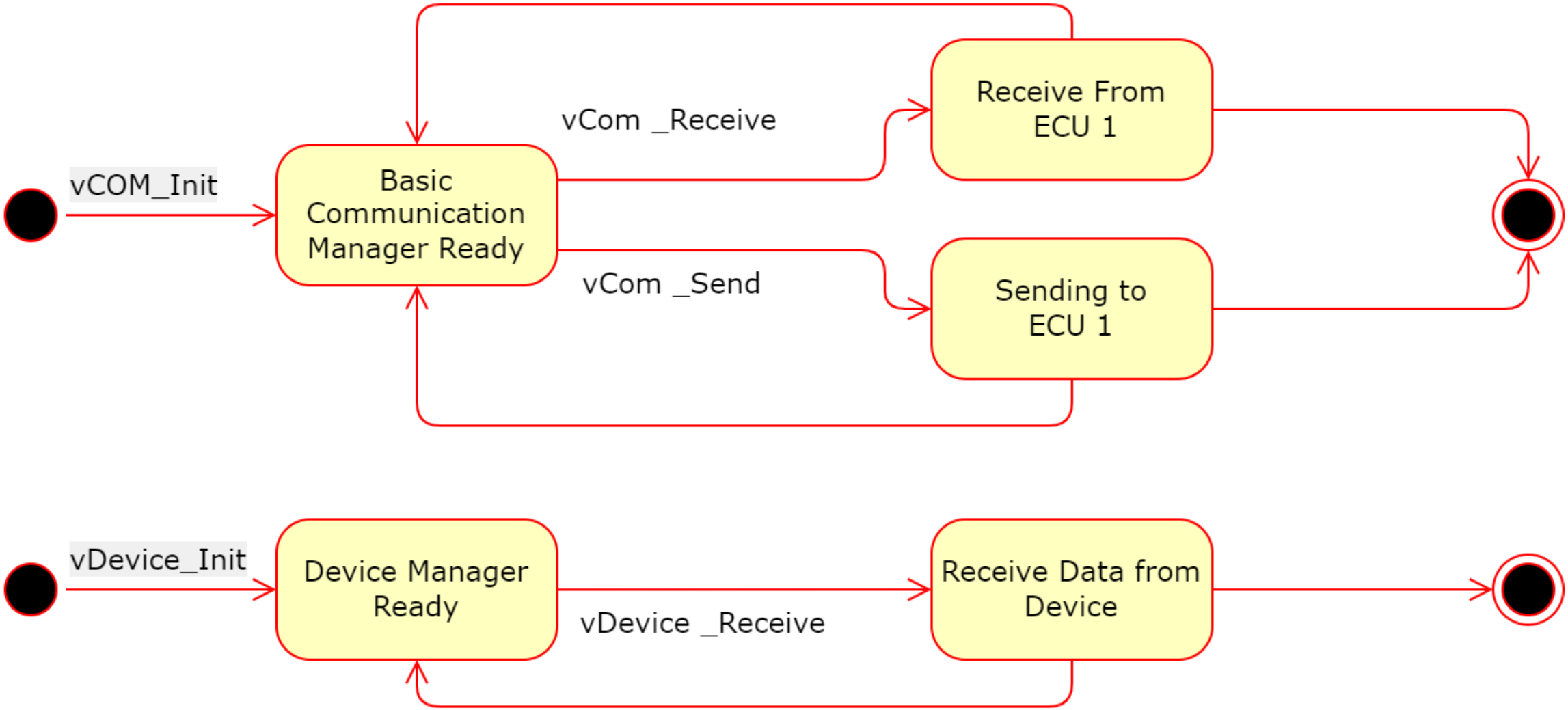
$$\boldsymbol{Total\ Time} = \mathbf{1} * \mathbf{5} + \mathbf{2} * \mathbf{2} + \mathbf{4} * \mathbf{1} = \mathbf{13}\boldsymbol{ms}$$

$$\boldsymbol{Utilization} = \textbf{CPU LOAD} = \frac{\mathbf{13}}{\mathbf{20}} * \mathbf{100} = \mathbf{65}\%$$

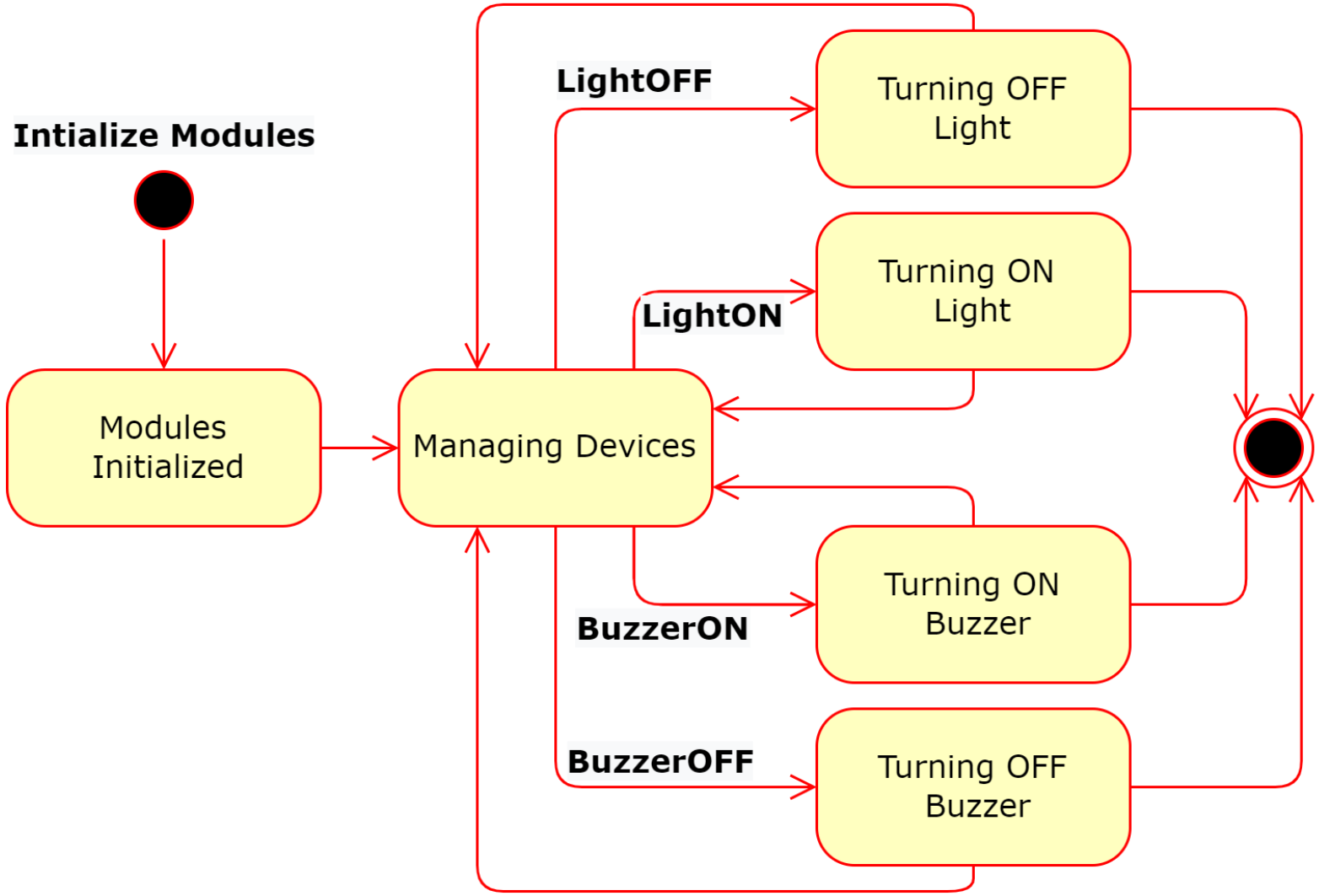
ECU 1 : Sequence Diagram



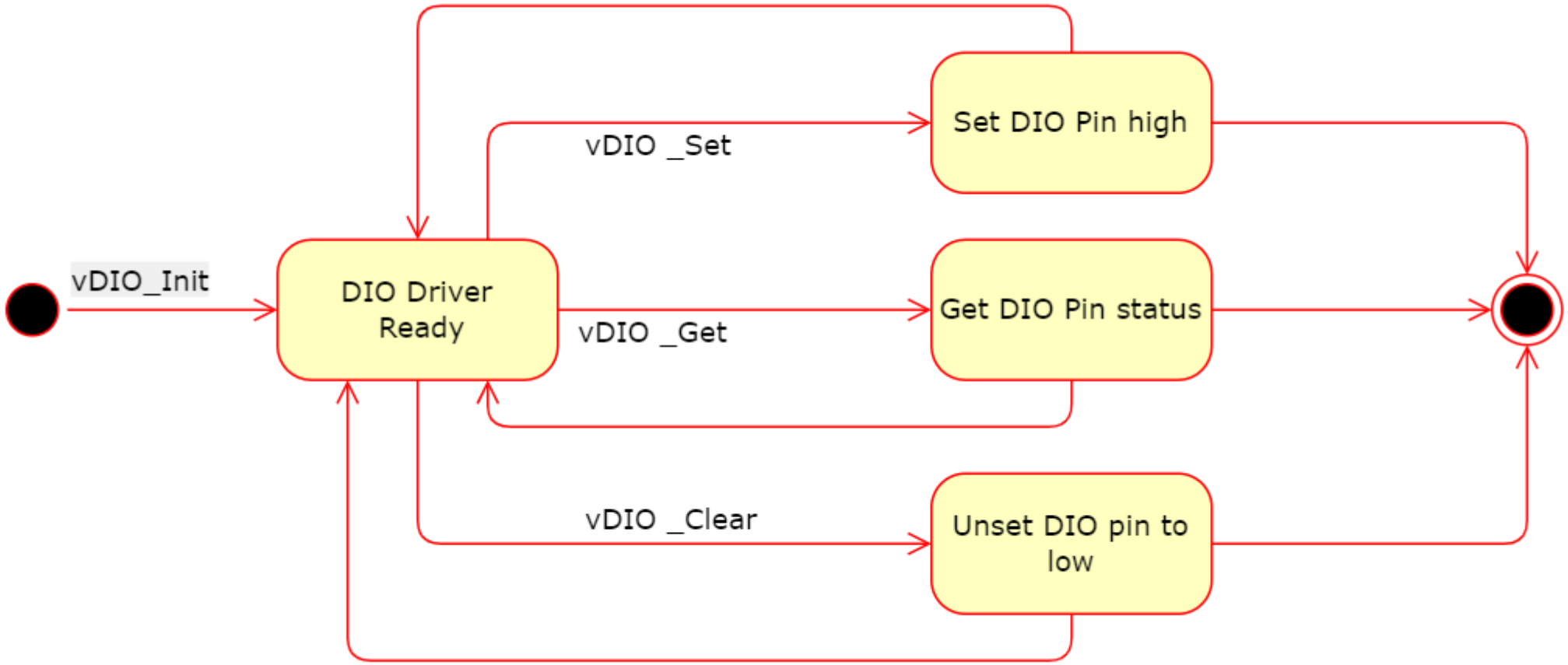
ECU 2 : Manager Modules State Diagrams



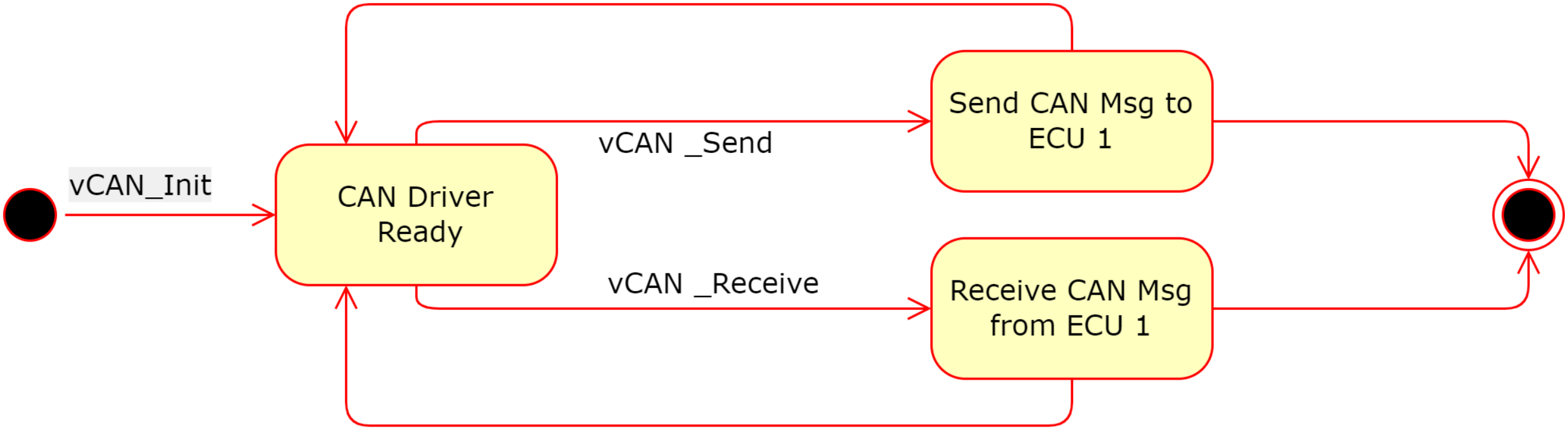
ECU 2 : Actuator Modules State Diagrams



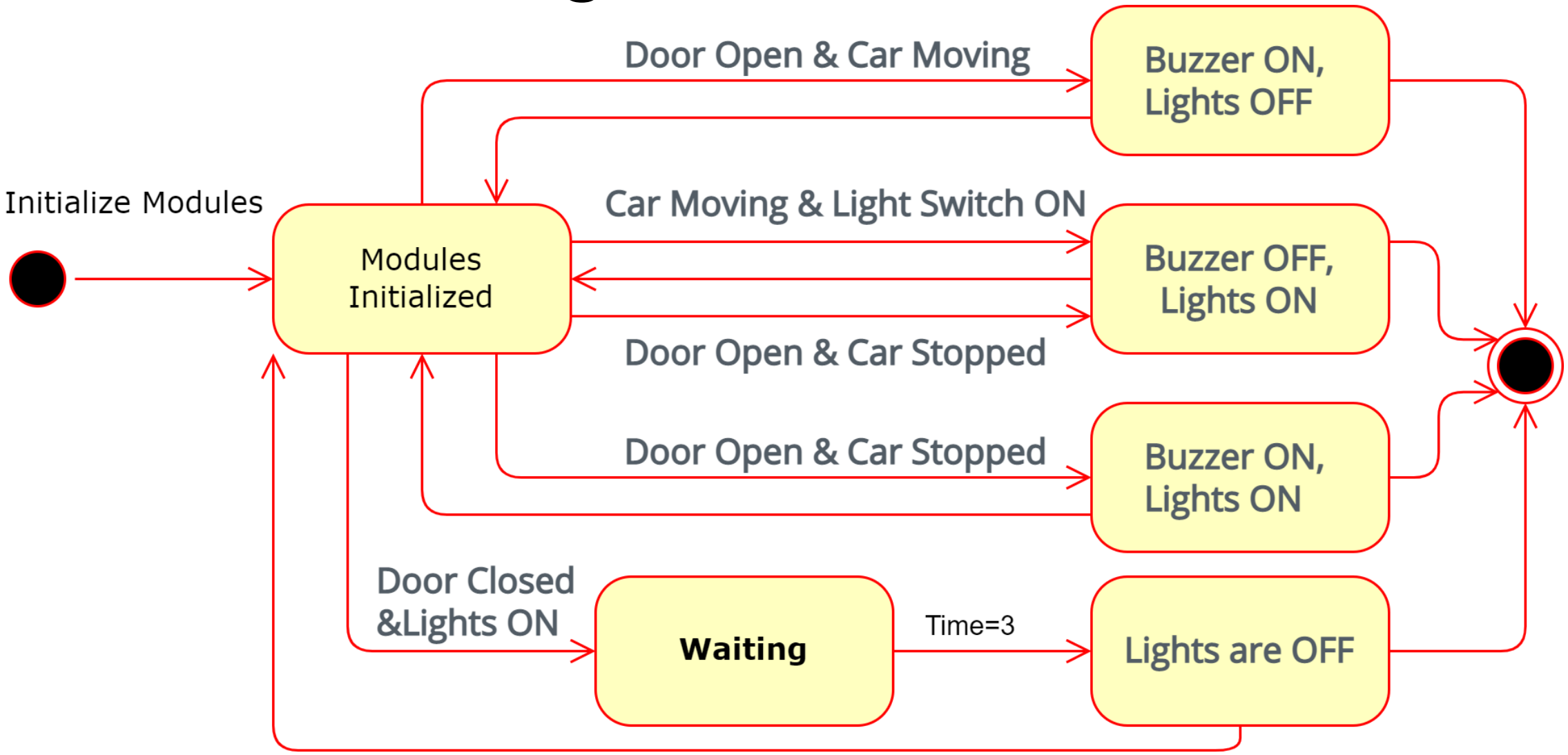
ECU 2 MCAL : DIO State Diagram



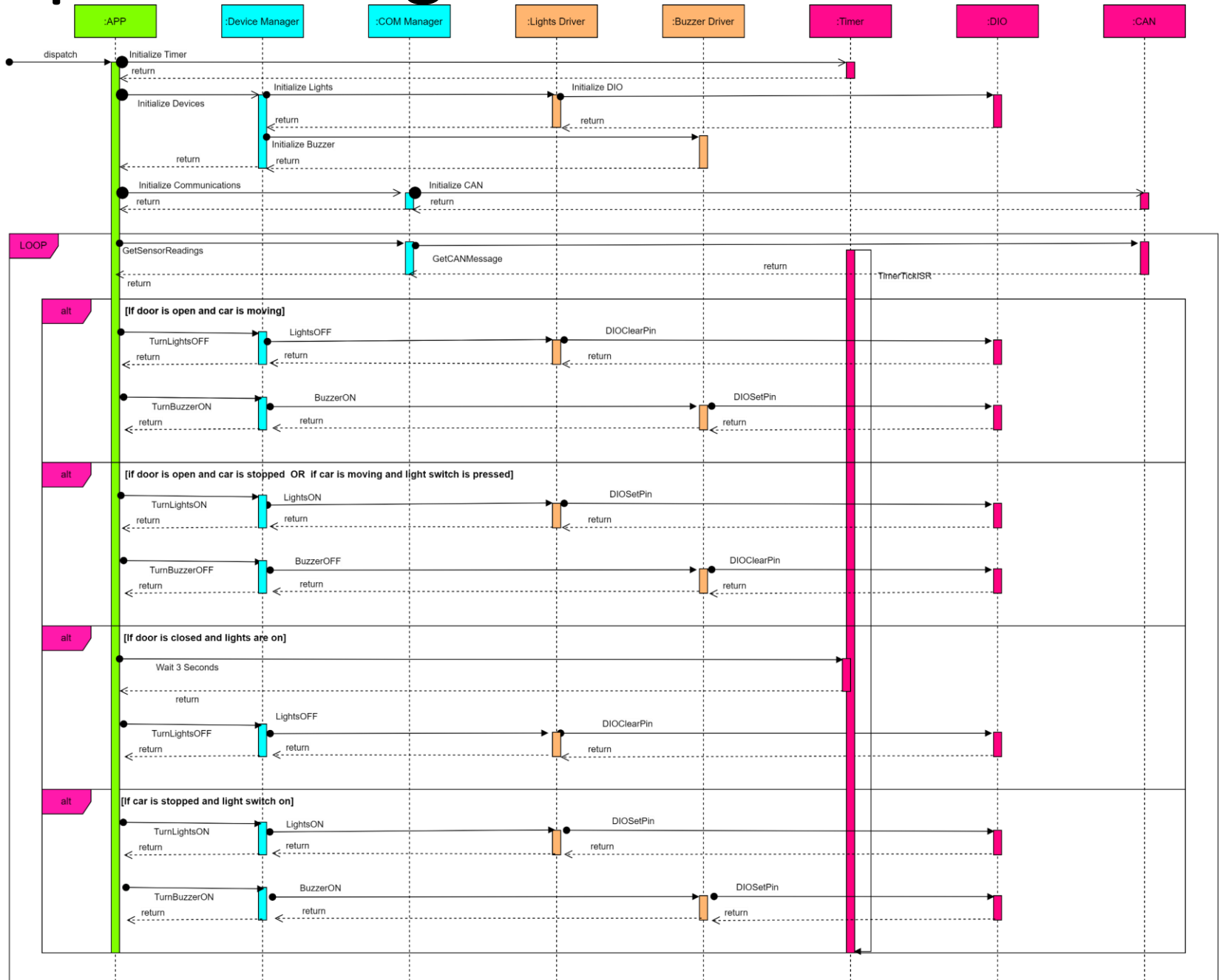
ECU 2 MCAL : COM Drivers State Diagram



ECU 2 : State Diagram



ECU 1 : Sequence Diagram



ECU 2 : CPU LOAD

- **Calculation of HyperPeriod**

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

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

$$\boldsymbol{HyperPeriod} = 10$$

- **CPU Load Calculations**

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

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

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

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