Automotive door control system design
Dynamic design Report

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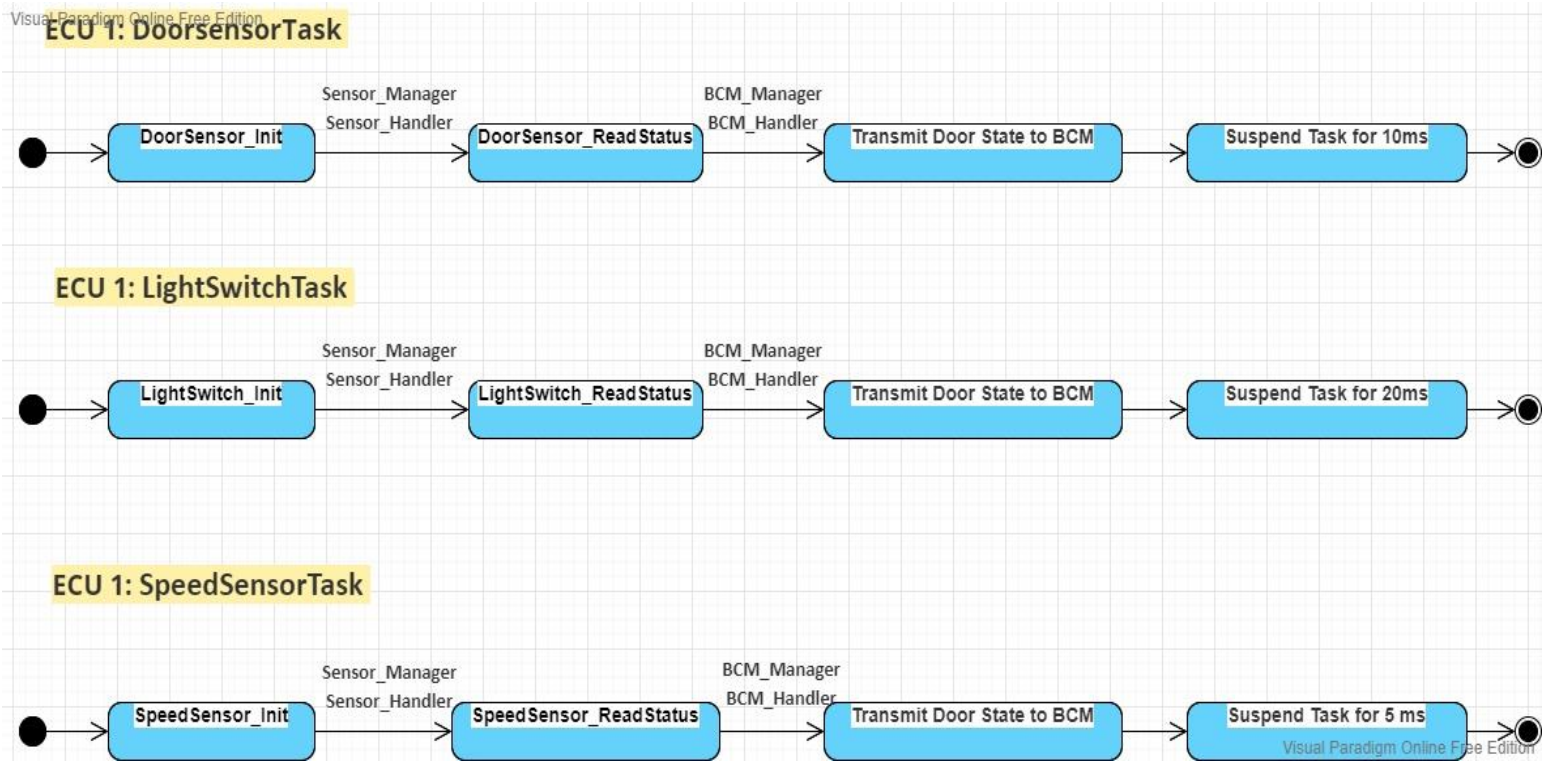
Dynamic Design:

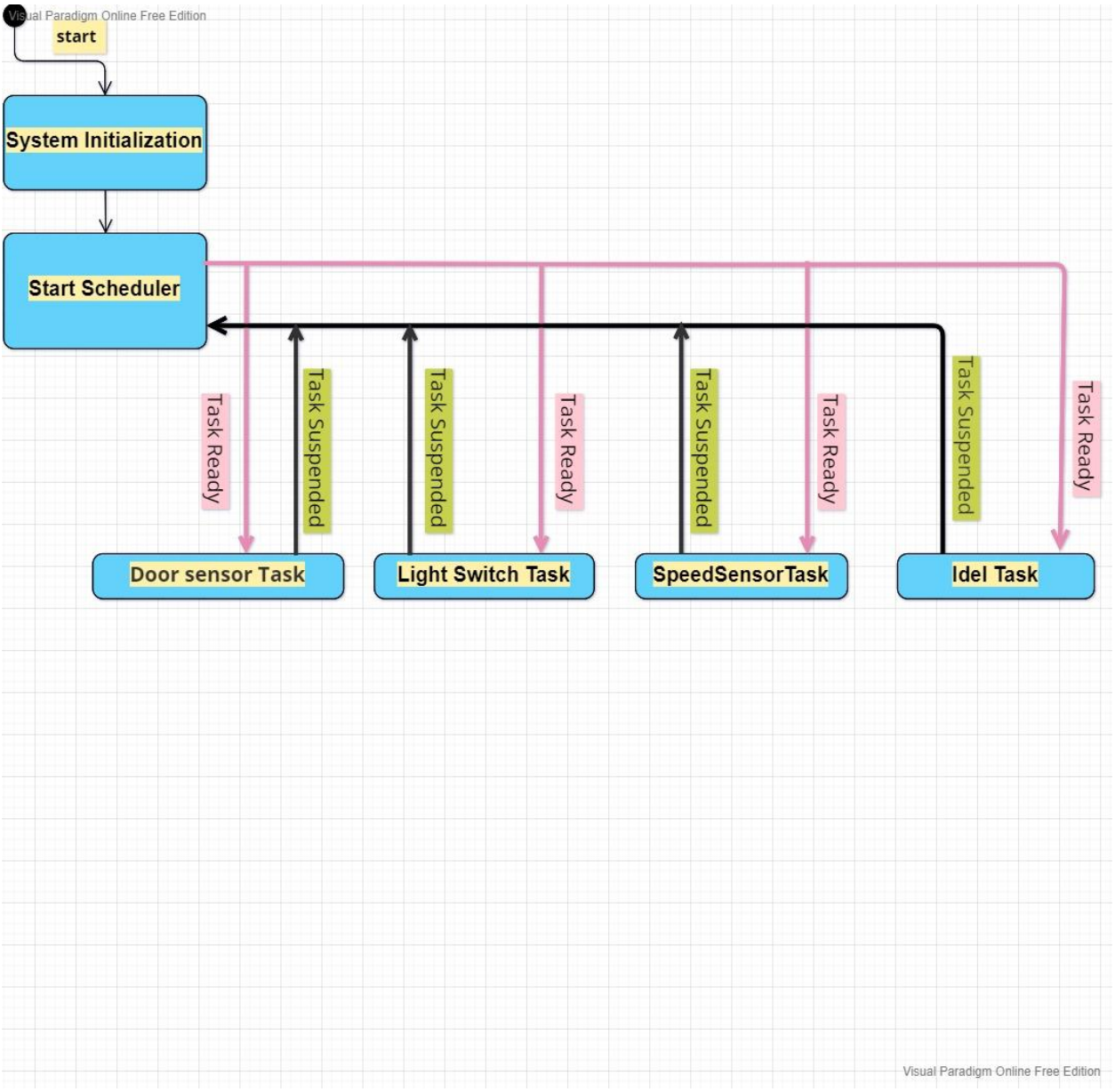
➢ For ECU 1:

1- State Machine diagram for ECU 1 component:

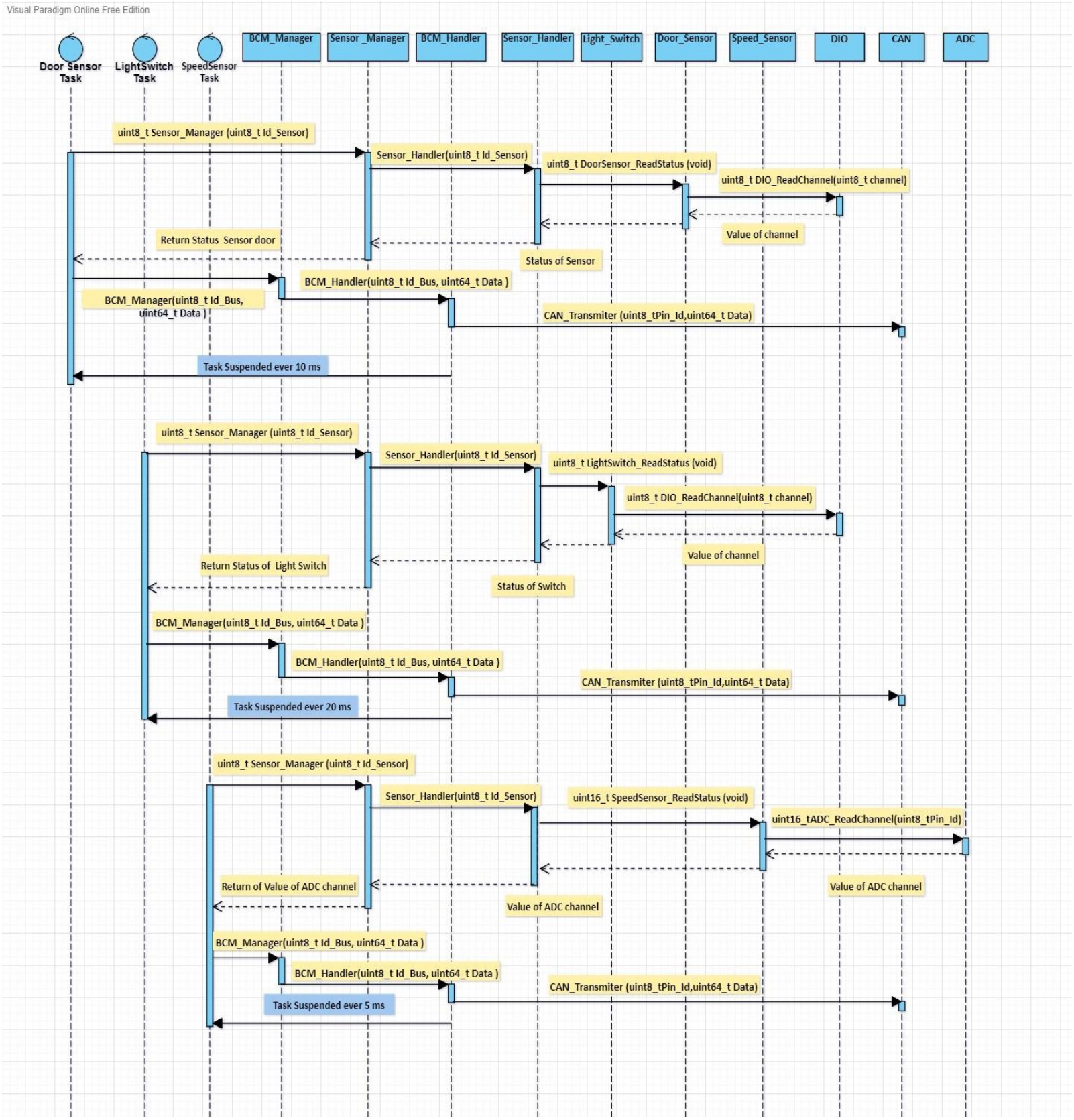


Notes: IDLE task exaction when the processor not exaction any task.

2- State Machine diagram for the ECU 1 operatin:



3- Sequence Diagram for the ECU 1:



4- Calculate CPU load for the ECU 1:

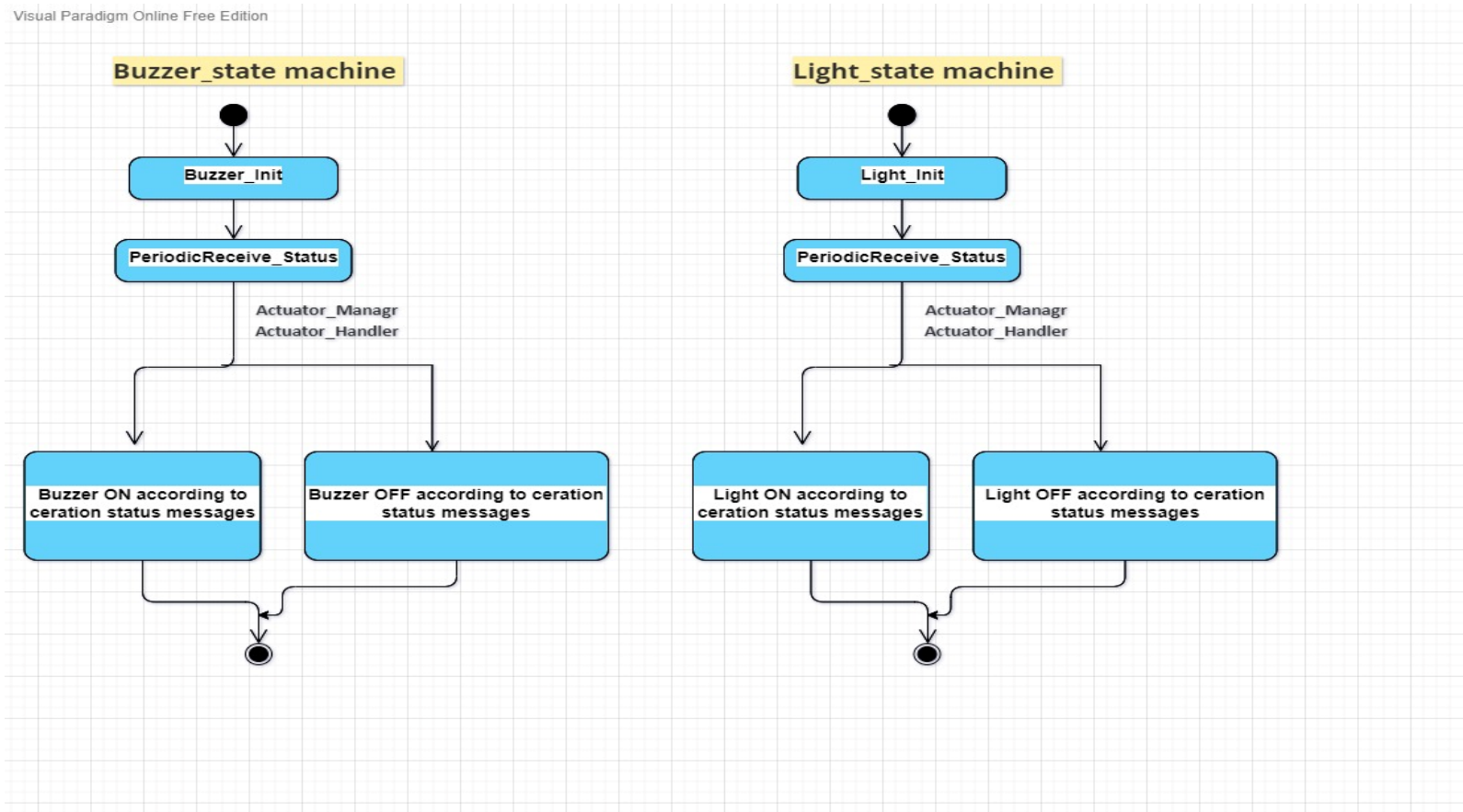
The system contains three tasks assuming worst case scenario that the execution time of task is **500 µs.**

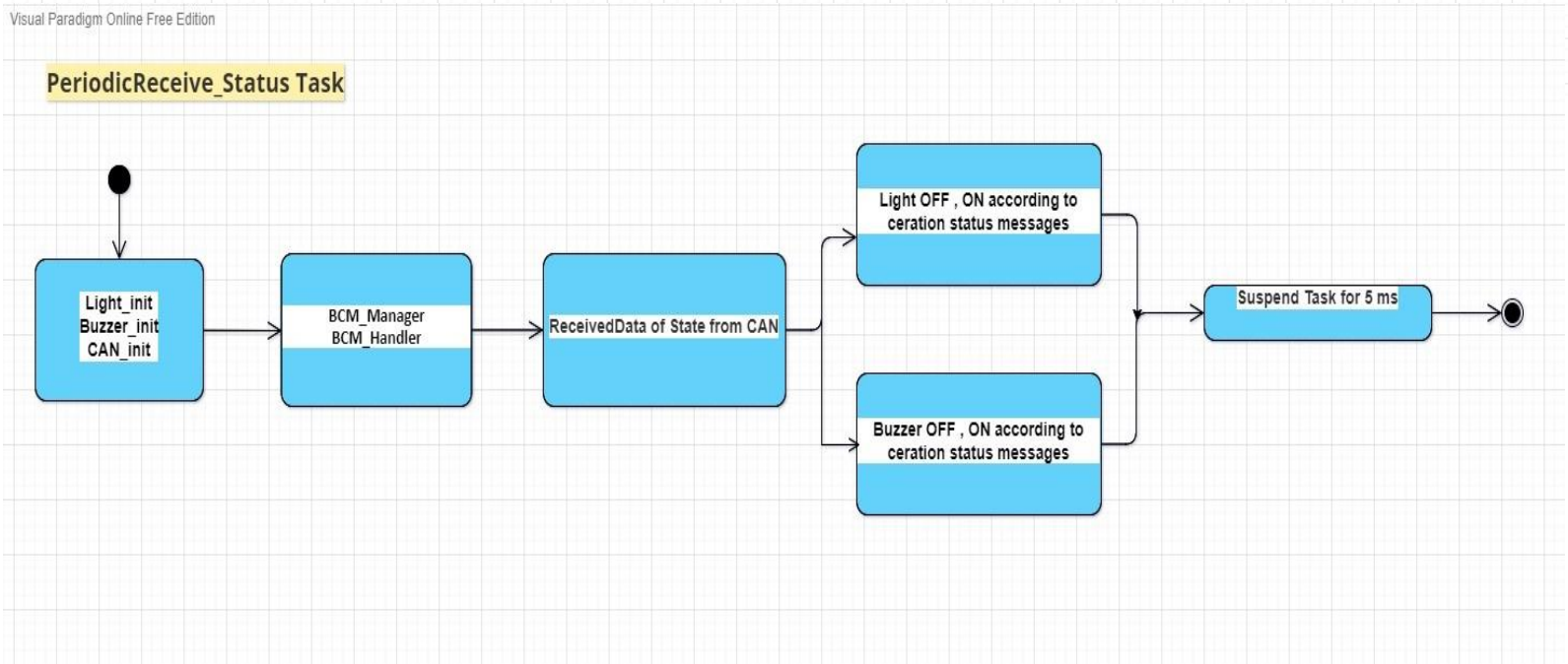
Name Task	Periodicity	Execution Time
Door Sensor Task	**10 ms**	**500 µs**
Light sensor Task	**20 ms**	**500 µs**
Speed Sensor Task	**5 ms**	**500 µs**

H (Hyper Period) = LCM(Pi) = 20 ms
CPU Load = $\sum$ E / H = (0.5*2 + 0.5*4 + 0.5*1) /20 * 100 = 17.5 %

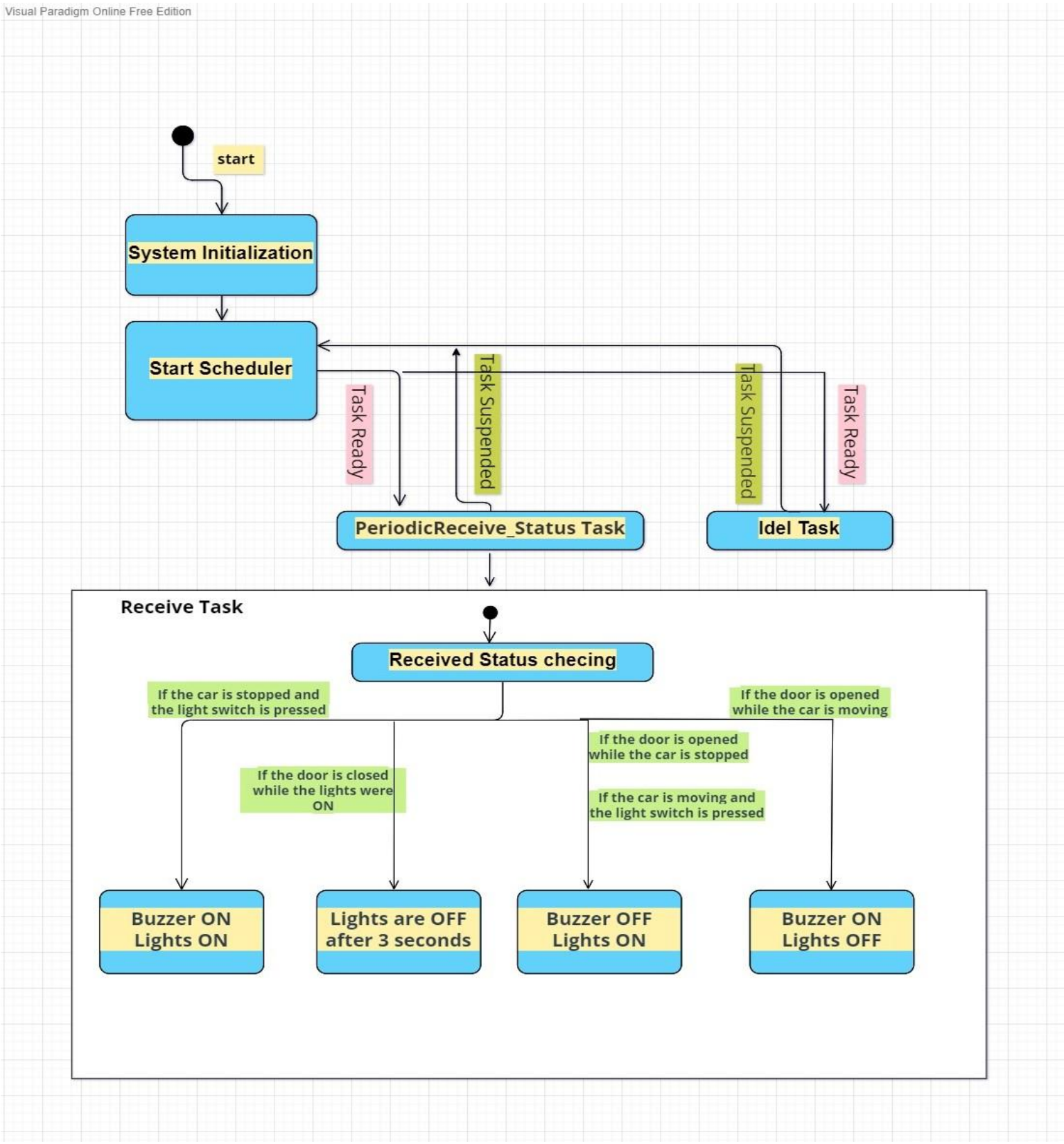
- **For ECU 2:**

1- State Machine diagram for ECU 2 component:

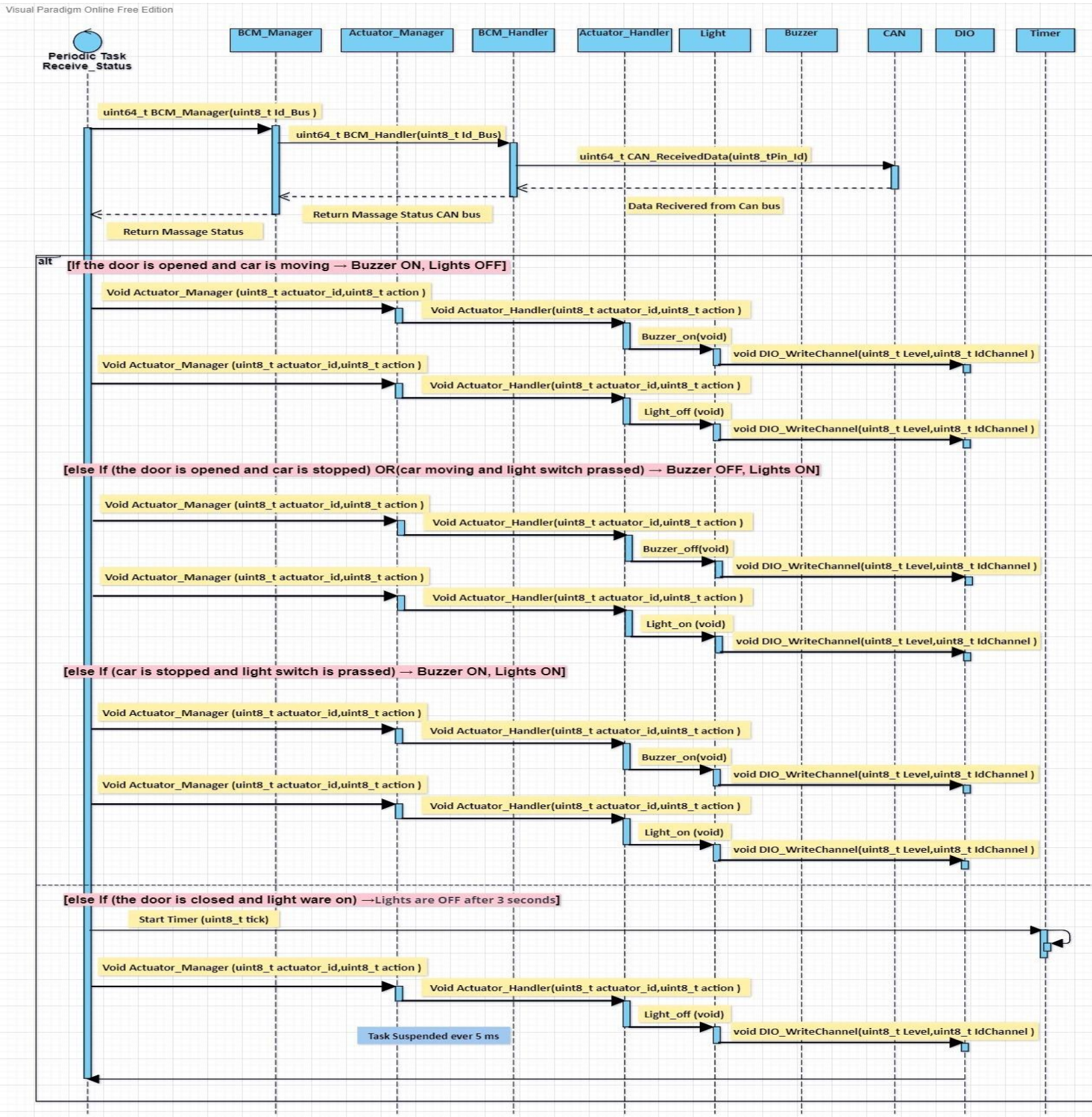




2- State Machine diagram for the ECU_2 operations:



3- Sequence Diagram for the ECU 2 :



4- Calculate CPU load for the ECU 2:

The system contains one tasks assuming worst case scenario that the execution time of task is 1 ms.

Name Task	Periodicity	Execution Time
Periodic Task Receive Status	**5 ms**	**1 ms**

H (Hyper Period) = LCM(Pi) = 5 ms
CPU Load = ∑ E / H = (1*1) /5 * 100 = 20%

- **Calculate bus load in your system:**

  Note: With what percentage of system bus was busy per 1 second

CAN Bus Load in System: time the CAN bus loaded with data
1 CAN frame contains approximately 125 bits.
assume we are using a 500 Kbit/s bit rate.
bit time = 1 / bit rate = 1 / (500 * 1000) s = 2 µs
Approximate time to transfer 1 frame = (2 µs/bit * 125 bit) = 250 µs.
We have multiple sending intervals on the bus:
1 frame every 5 ms → 200 frames every 1000 ms
1 frame every 10 ms → 100 frames every 1000 ms
1 frame every 20 ms → 50 frames every 1000 ms
This is in total = 350 frames every 1000 ms
Total time on bus = (total number of frames) * (time of 1 frame)
Total time on bus = 350 * 250 =87500 µs
Bus load = {((87500 µs *1000)\ 1000)* 100 %} = 8.75 %