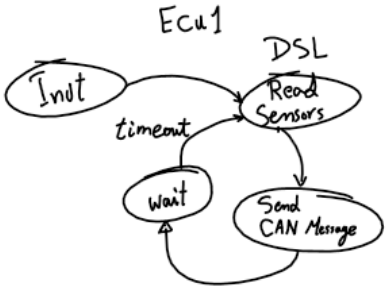
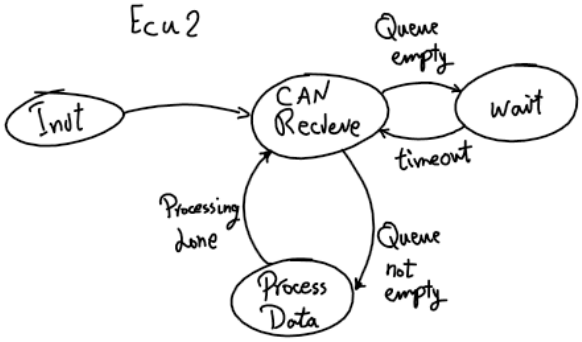
1. **State machine Diagram of ECU**
    1. **<u>ECU 1</u>**



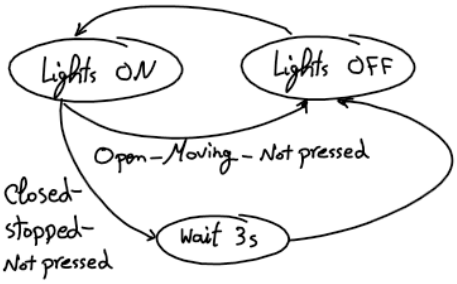
* CAN Tx : 5ms, 10ms, 20ms
* Counter: 1, 2, 4 {%4}
* Corresponding t : 5ms, 10ms, 20ms

    2. **<u>ECU 2</u>**

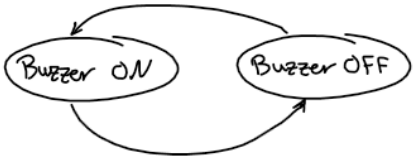


- **<u>Process Data</u> (State Machine Diagram for Actuators)**

Open – stopped – Not pressed,
Closed–Moving – Pressed,
Closed–stopped – Pressed,



Open – Moving – Not pressed,
Closed–stopped – Pressed



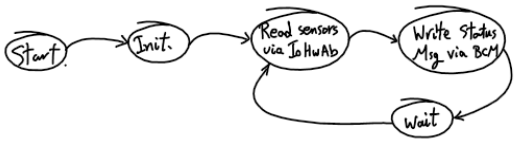
Open – stopped – Not pressed,
Closed– stopped – Not pressed,
Closed–Moving – Pressed

2. State Machine Diagram of ECU Components

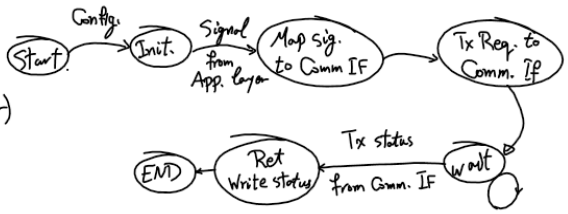
1. ECU 1

- ECU1 CAN Tx Path :

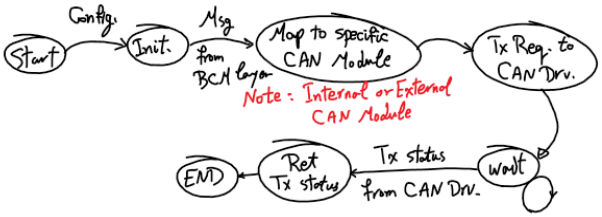
0] OS Task (utilizing Runnables from App. SWC)



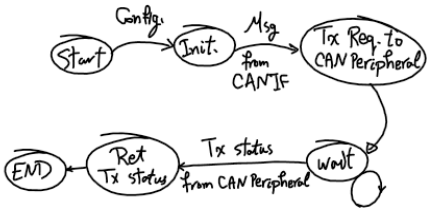
1] BCM Component (Comm. Manager)



2] CAN IF Component

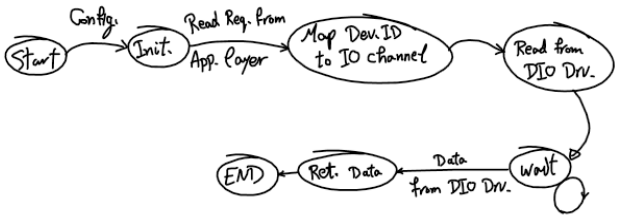


3] CAN Driver

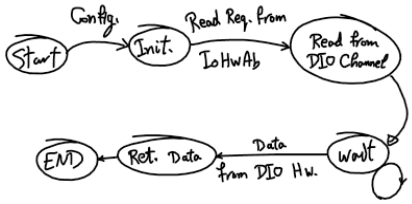


- ECU1 IoHwAb Path :

1] IoHwAb



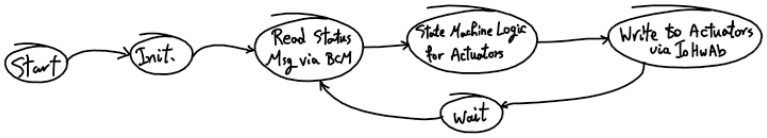
2] DIO Drv.



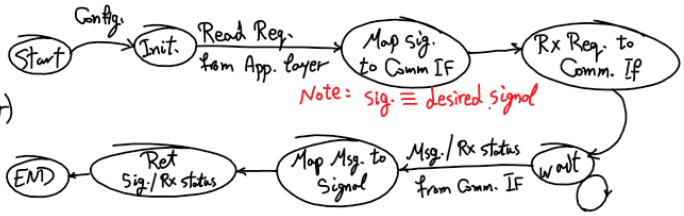
2. ECU 2

- ECU2 CAN Rx Path :

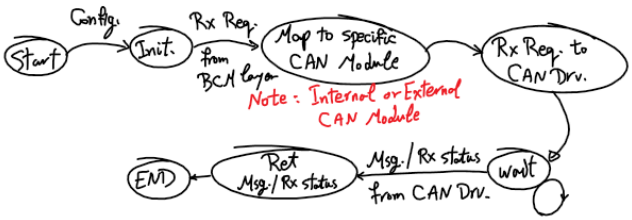
0] OS Task (utilizing Runnables from App. SWC)



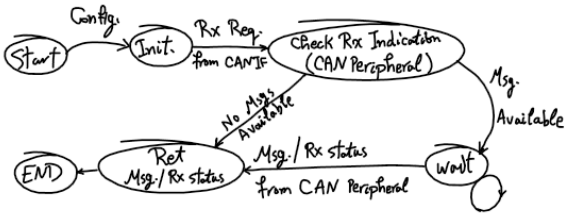
1] BCM Component (Comm. Manager)



2] CAN IF Component

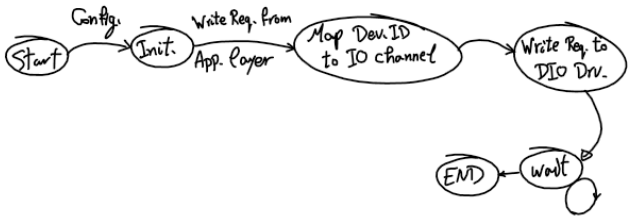


3] CAN Driver

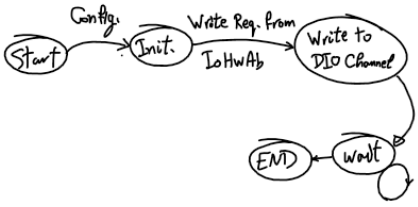


- ECU2 IoHwAb Path :

1] IoHwAb

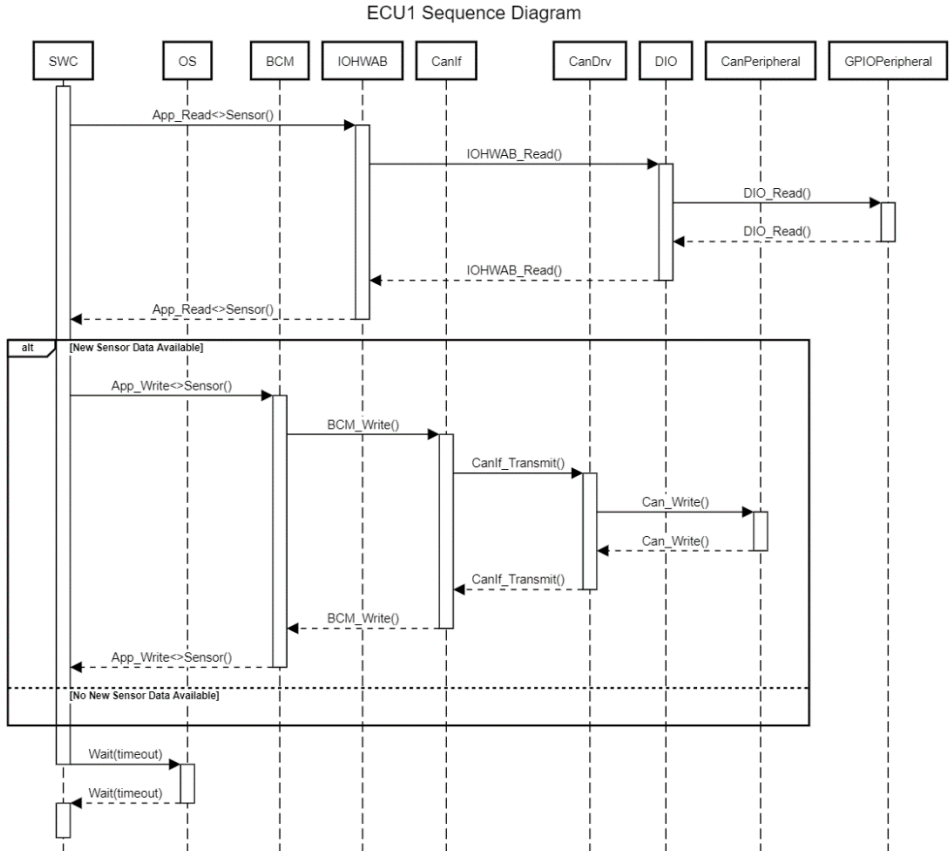


2] DIO Drv.

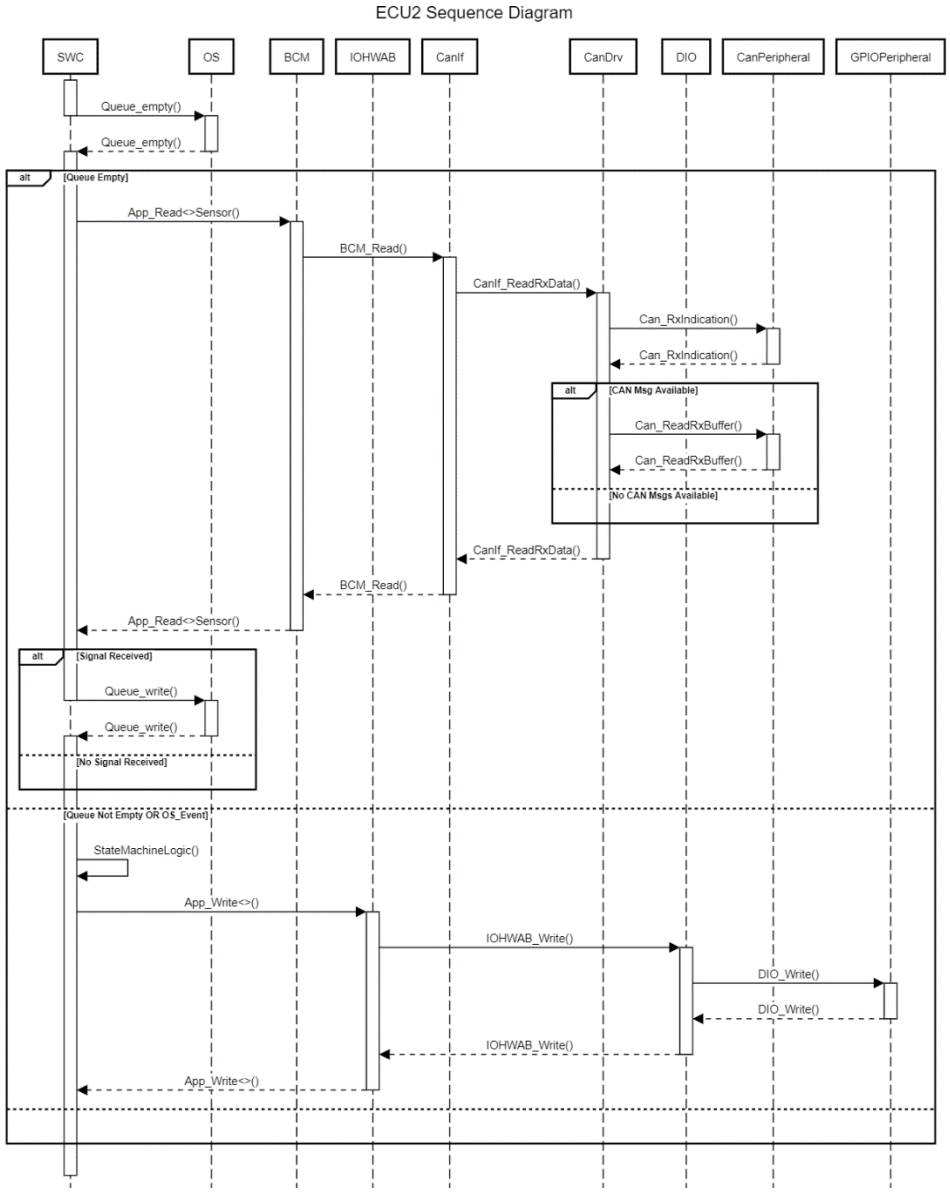


1. Sequence Diagram for ECU

1. <u>ECU 1</u>



2. ECU 2


ECU2 Sequence Diagram
SWC
OS
BCM
IOHWAB
CanIf
CanDrv
DIO
CanPeripheral
GPIOPeripheral
Queue_empty()
Queue_empty()
alt
[Queue Empty]
App_Read<>Sensor()
BCM_Read()
CanIf_ReadRxData()
Can_RxIndication()
Can_RxIndication()
alt
[CAN Msg Available]
Can_ReadRxBuffer()
Can_ReadRxBuffer()
[No CAN Msgs Available]
CanIf_ReadRxData()
BCM_Read()
App_Read<>Sensor()
alt
[Signal Received]
Queue_write()
Queue_write()
[No Signal Received]
[Queue Not Empty OR OS_Event]
StateMachineLogic()
App_Write<>()
IOHWAB_Write()
DIO_Write()
DIO_Write()
IOHWAB_Write()
App_Write<>()

4. CPU Load for the ECU

1. ECU1

Single OS Task with period of 5ms

Assume the worst case execution time of this task $T_1 \leq 5\text{ms}$

$$\text{CPU Load of ECU1 \%} = \frac{T_1}{5\text{ms}} \times 100\ \%$$

2. ECU2

Single OS Task with period of 1ms

Assume the worst case execution time of this task $T_2 \leq 1\text{ms}$

$$\text{CPU Load of ECU2 \%} = \frac{T_2}{1\text{ms}} \times 100\ \%$$

5. BUS Load in the system

Periodic Messages					**# Frames / 20ms**
	5ms	10ms	15ms	20ms	
Speed State: 5ms	x	x	x	x	4 Frames
Door State: 10ms		x		x	2 Frames
Light Sw. State: 20ms				x	1 Frame
Total					7 Frames

Data Bytes per Msg: 1Byte = 8bits

bits per CAN Frame without data: 47bits

total bits per CAN Frame: 47+8 = 55bits

bits transmitted over CAN in 20ms = 55bits * 7 Frames = 385 bits

bits transmitted over CAN in 1s = 385bits/20ms = 19,250 bits/s

max bits that can be transmitted over CAN in 1s = 125,000 bits/s

$$BUS\ Load = \frac{BUS\ Utilization}{BUS\ Max\ Capacity} = \frac{19{,}250}{125{,}000} = 15.4\%$$