sea|me

software engineering in automotive
and mobility ecosystems

Team 4: Daekyung La, Jaehyeong Park, Minchan Jung

DES02: Instrument Cluster

Team4 Organization

DES02 repository

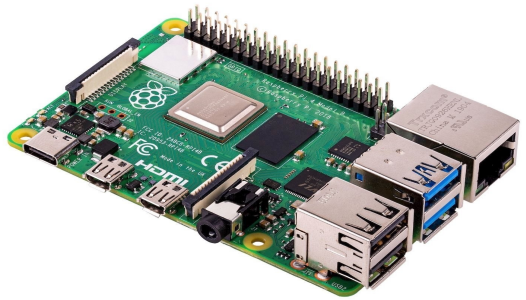
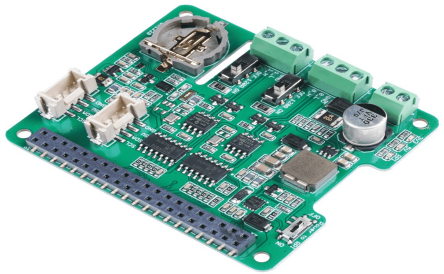
Kanban Board

INDEX

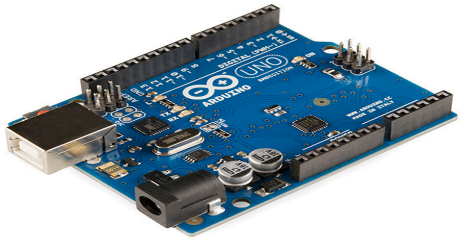
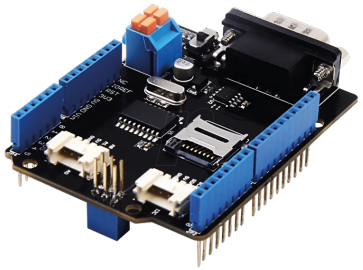
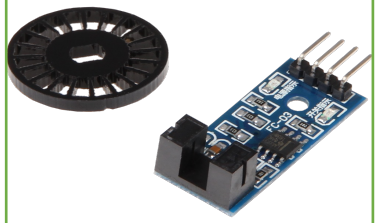
Specification: Hardware

sea:me
software engineering in automotive and mobility ecosystems

Raspberry Pi

Raspberry Pi 4B	CAN-BUS(FD) Shield(MCP2518FD)	7.9inch DSI LCD
		

Arduino UNO

Arduino UNO	CAN-BUS Shield V2.0 (MCP2515)	Speed Sensor (LM393)
		

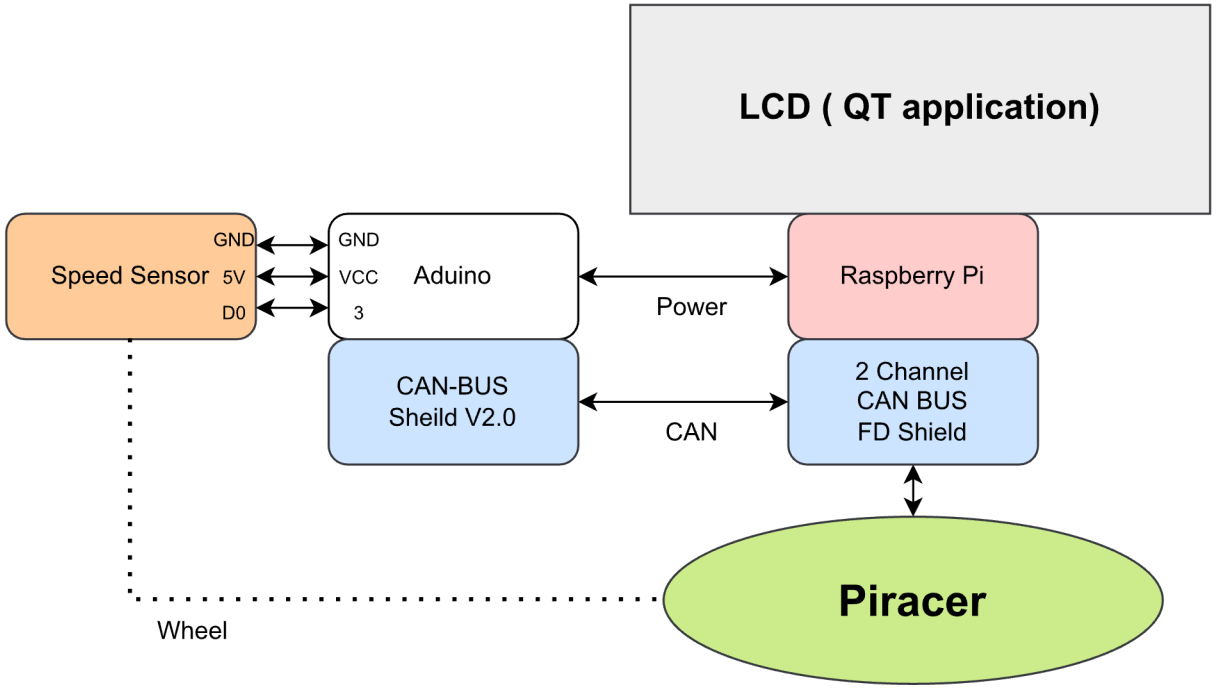
PiRacer AI Kit

Piracer Kit	Joystick
	

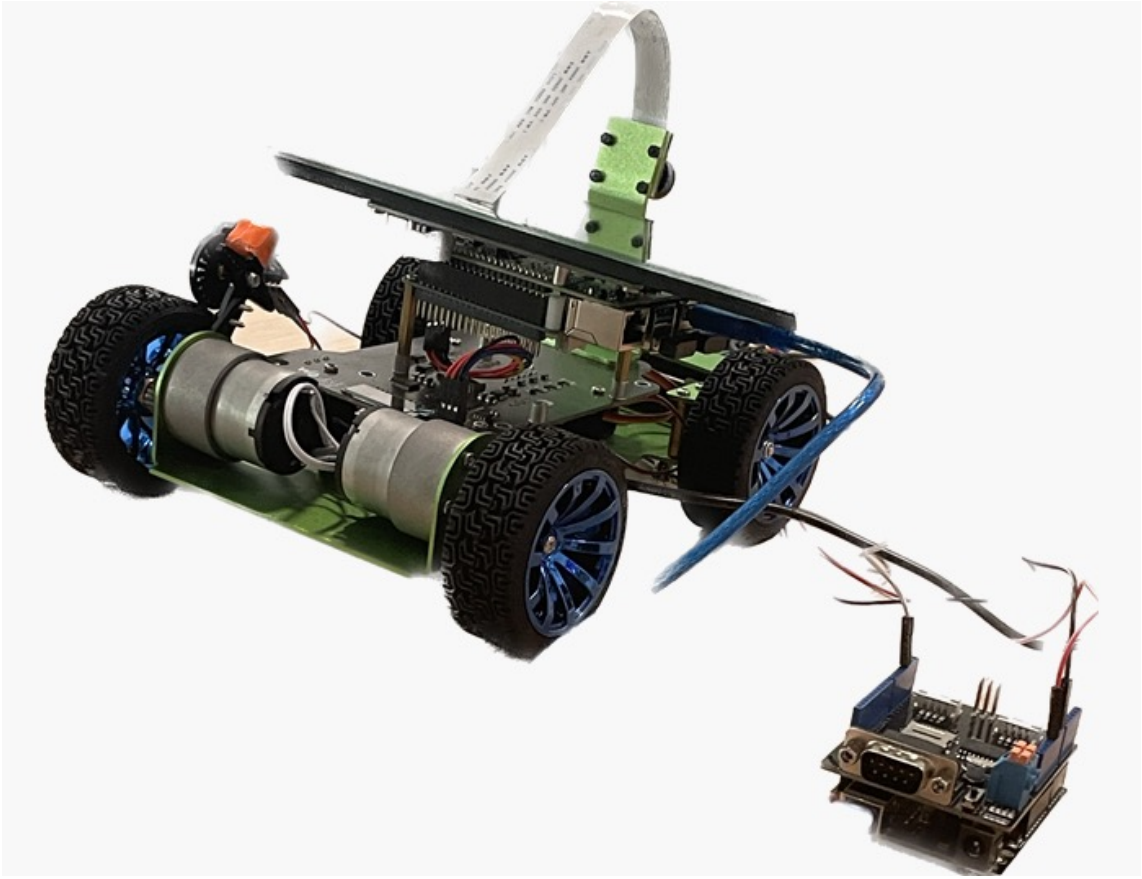
Specification: **Hardware connection**

sea:me
software engineering in automotive and mobility ecosystems

Circuit diagram



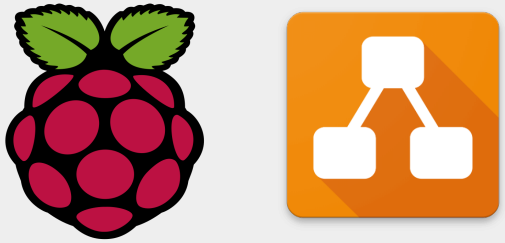
Physical hardware



Specification: Software

sea:me
software engineering in automotive and mobility ecosystems

Tool



Technology

SSH I2C

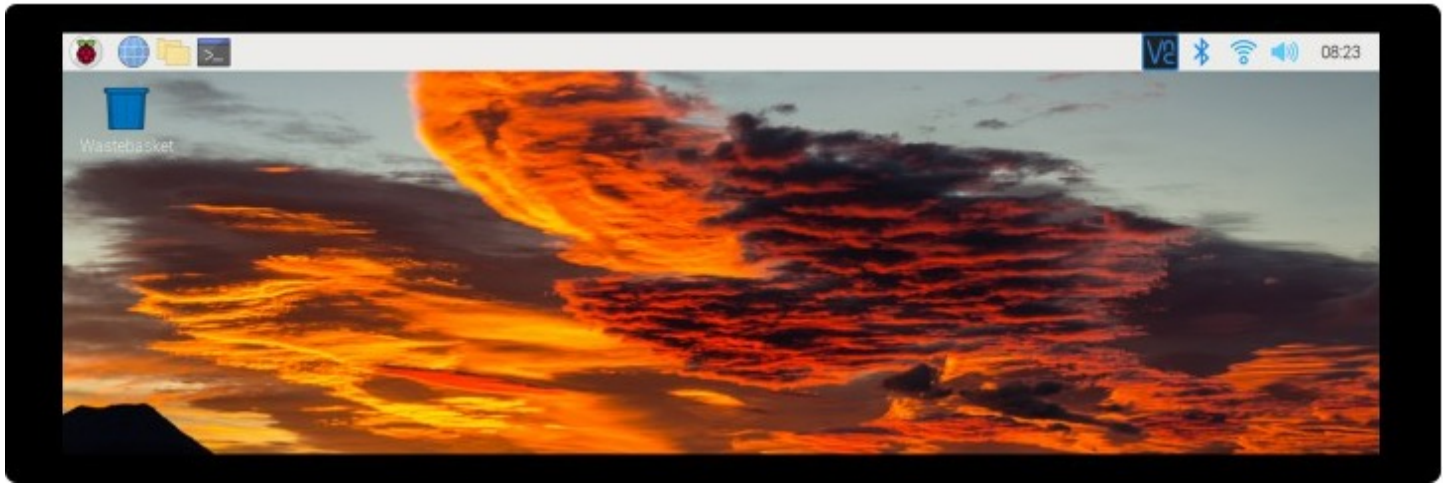
SPI

CAN D-Bus

Language

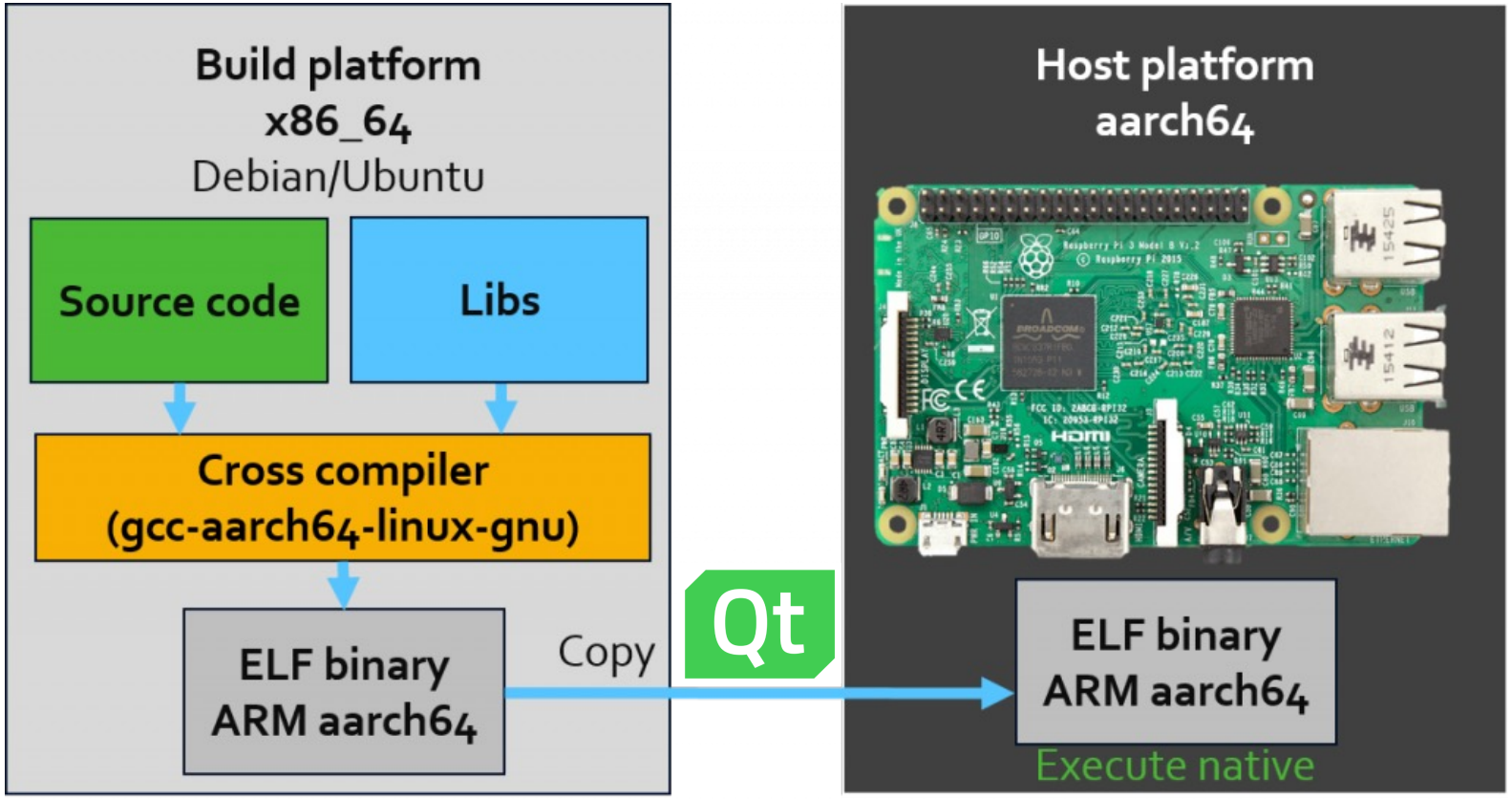
Display

sea:me
software engineering in automotive and mobility ecosystems



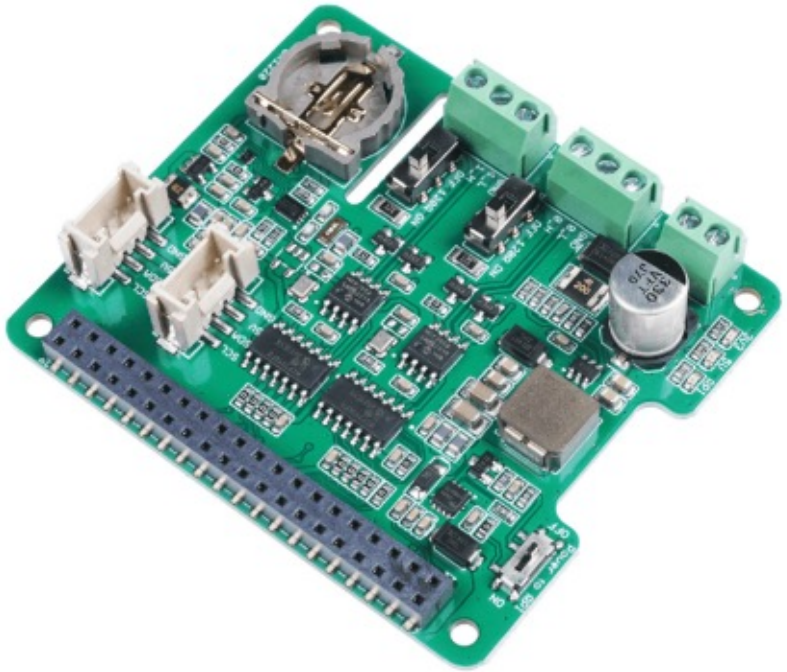
Cross Compile

sea:me
software engineering in automotive and mobility ecosystems

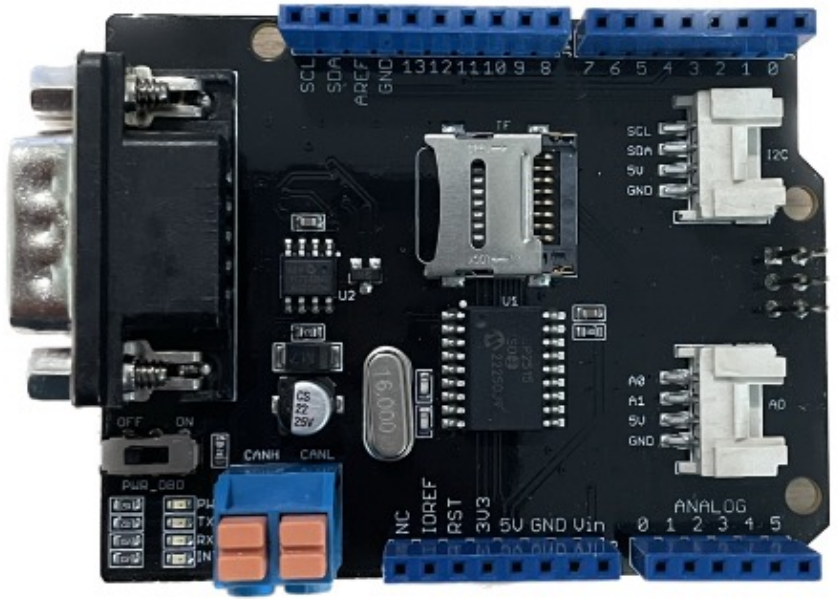


CAN Communication

2 Channel CAN BUS FD Shield



CAN-BUS Shield



CAN Communication

sender code

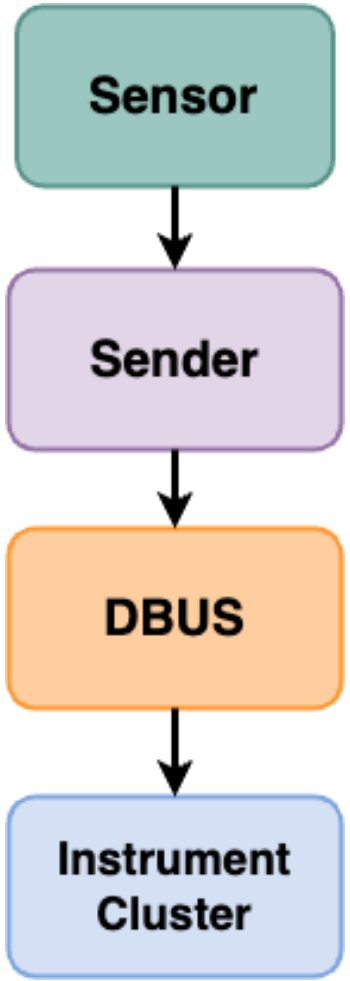
```
#include <SPI.h>
#include "mcp2515_can.h"

/*SAMD core*/
#ifdef ARDUINO_SAMD_VARIANT_COMPLIANCE
    #define SERIAL SerialUSB
#else
    #define SERIAL Serial
#endif

const int SPI_CS_PIN = 9;
mcp2515_can CAN(SPI_CS_PIN); // Set CS pin

void setup() {
    SERIAL.begin(115200);
    while(!Serial){};

    while (CAN_OK != CAN.begin(CAN_500KBPS)) {             // init can bus : baudrate = 500k
        SERIAL.println("CAN BUS Shield init fail");
        SERIAL.println(" Init CAN BUS Shield again");
        delay(100);
    }
    SERIAL.println("CAN BUS Shield init ok!");
}

unsigned char stmp[8] = {0, 0, 0, 0, 0, 0, 0, 0};
void loop() {
    // send data:  id = 0x00, standrad frame, data len = 8, stmp: data buf
    stmp[7] = stmp[7] + 1;
    if (stmp[7] == 100) {
        stmp[7] = 0;
        stmp[6] = stmp[6] + 1;

        if (stmp[6] == 100) {
            stmp[6] = 0;
            stmp[5] = stmp[6] + 1;
        }
    }

    CAN.sendMsgBuf(0x00, 0, 8, stmp);
    delay(100);                       // send data per 100ms
    SERIAL.println("CAN BUS sendMsgBuf ok!");
}
```

receiver code

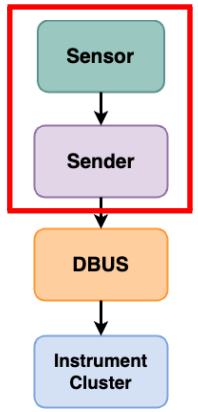
```
#include <SPI.h>
#include <mcp_can.h>

MCP_CAN CAN(9); //spi cs
void setup() {
  // put your setup code here, to run once:
  Serial.begin(115200);
  while(CAN_OK != CAN.begin(CAN_500KBPS, MCP_8MHz))
  {
      Serial.println("CAN BUS Init Failed");
      delay(100);
  }
  Serial.println("CAN BUS Init Success!");
}
void loop() {
  // put your main code here, to run repeatedly:
  unsigned char len =0;
  unsigned char buf[8];
  if(CAN_MSGAVAIL == CAN.checkReceive())
  {
      CAN.readMsgBuf(&len, buf);
      unsigned long canId = CAN.getCanId();
      Serial.print("\nData from ID: 0x");
      Serial.println(canId, HEX);
      for(int i=0; i<len; i++)
      {
        Serial.print(buf[i]);
        Serial.print("\t");
      }
  }
}
```

Code Flow

sea:me
software engineering in automotive and mobility ecosystems



Sender: Speed Sender



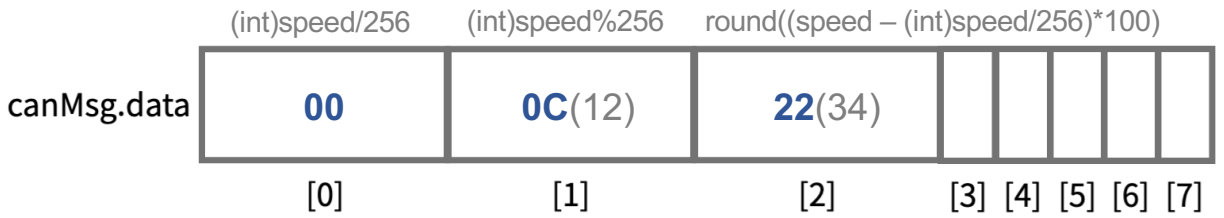
Arduino (speed_sender.ino)

- Calculate RPM, Speed
- Split Speed Data
- **Send** CAN Message
- Transmission Interval: **0.1s**

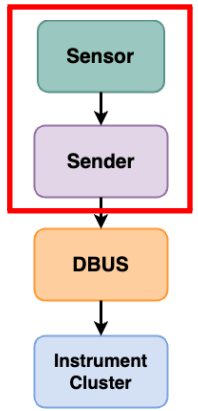
Raspberry Pi (speed_sender.py)

- **Check** CAN Connection
- **Receive** CAN Message
- Decode data to Decimal
- Data Processing(weighting)
- Send data to **D-Bus**

ex) **speed:** **12.34** cm/s

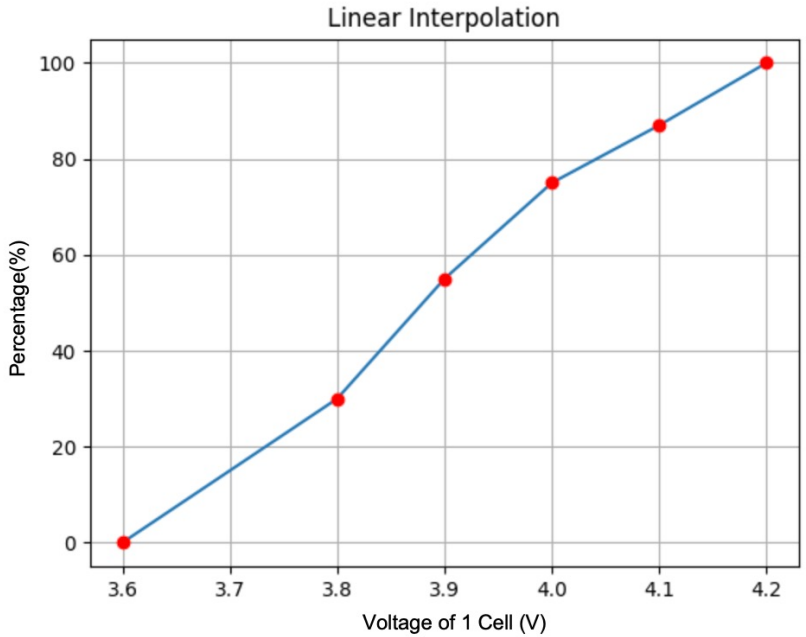


Sender: Battery Sender

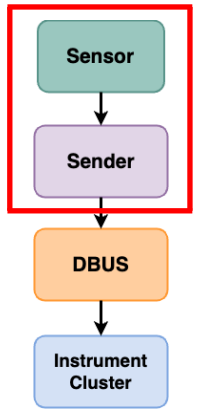


Raspberry Pi (battery_sender.py)

- **Get** Battery Voltage(i2c)
- **Check** Battery Percentage
- Data Processing (Maximum value)
- Send data to **D-Bus**
  (Transmission Interval: **0.01s**)



Sender: Brake Sender



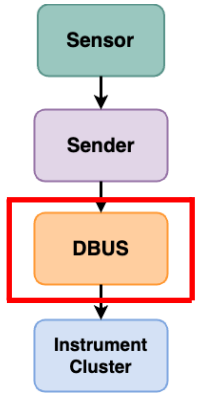
Raspberry Pi (brake_sender.py)

- **Get** Gamepad Input(left stick)
  (If input is backward, **True**
  else, **False**)

- Timeout Decorator

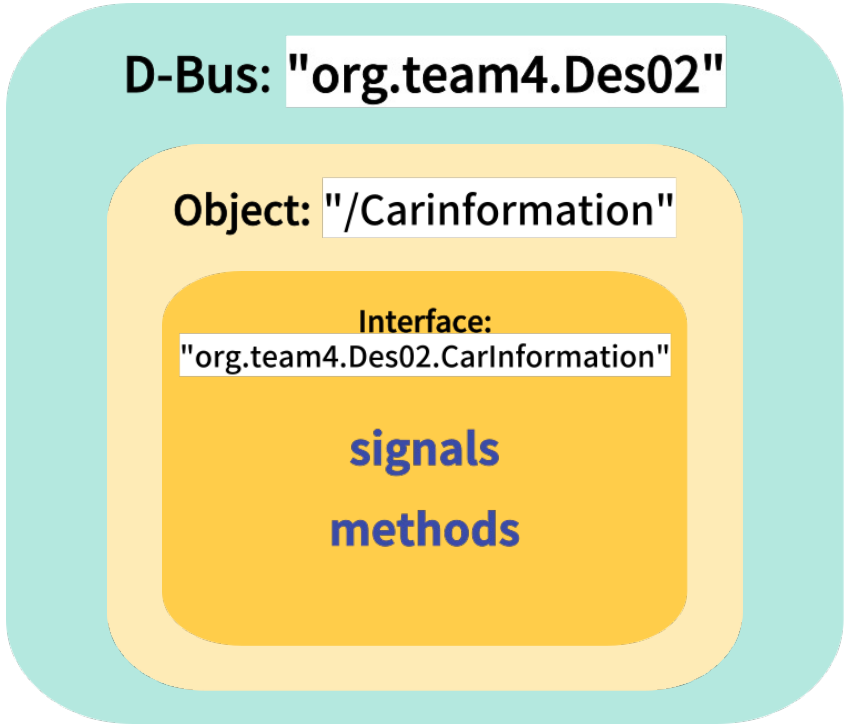
- Send data to **D-Bus**
  (Transmission Interval: **0.01s**)

D-Bus: Server Registration (in register_server)

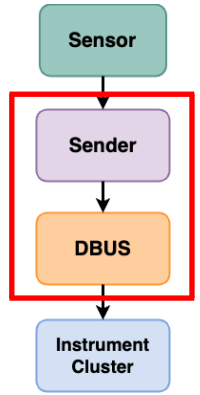


- Define D-Bus Object(carinformation.cpp, carinformation.h)
- Compile C++ to XML
- Add XML to Project
- **Register** Server and **Expose** Object to D-Bus

```
CarInformation *carinfo = new CarInformation();

new CarInformationAdaptor(carinfo);

QDBusConnection connection = QDBusConnection::sessionBus();
connection.registerObject("/CarInformation", carinfo);
connection.registerService("org.team4.Des02");
```

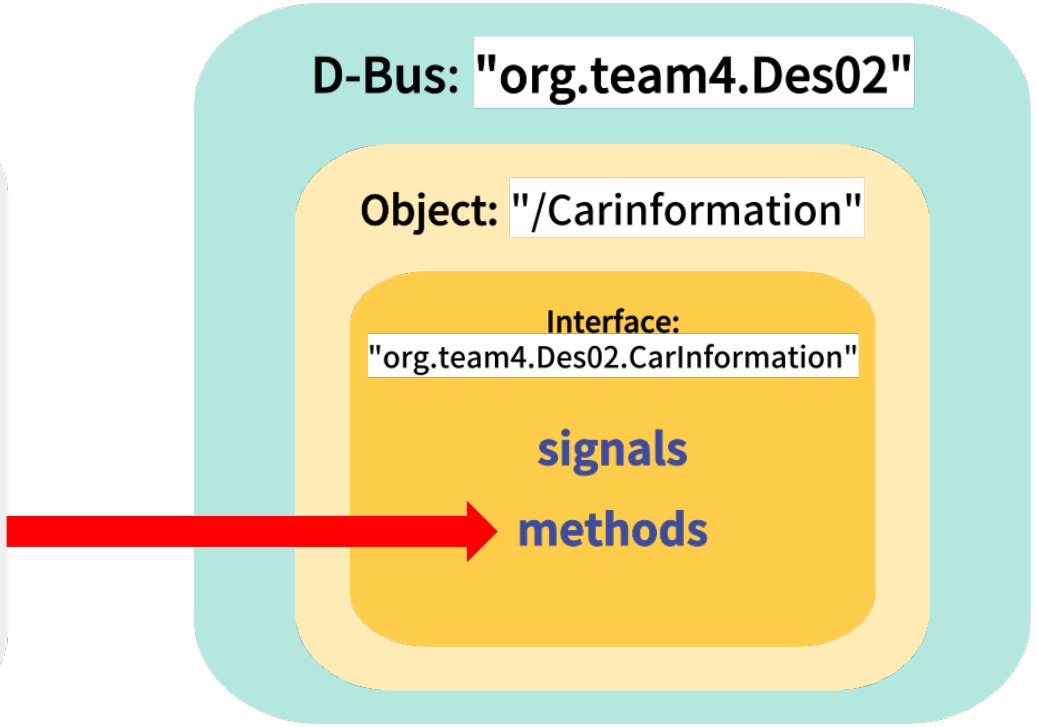


D-Bus: Send data to D-Bus



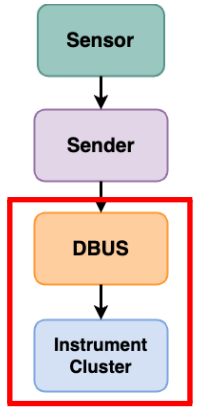
sender.py

- Connect with SessionBus
- Connect with Object
- Send data to D-Bus by calling **setVariable** method of Interface




```
bus = dbus.SessionBus()
service = bus.get_object("org.team4.Des02", "/CarInformation")
car_interface = dbus.Interface(service, "org.team4.Des02.CarInformation")

car_interface.setSpeed(speed_data)
```

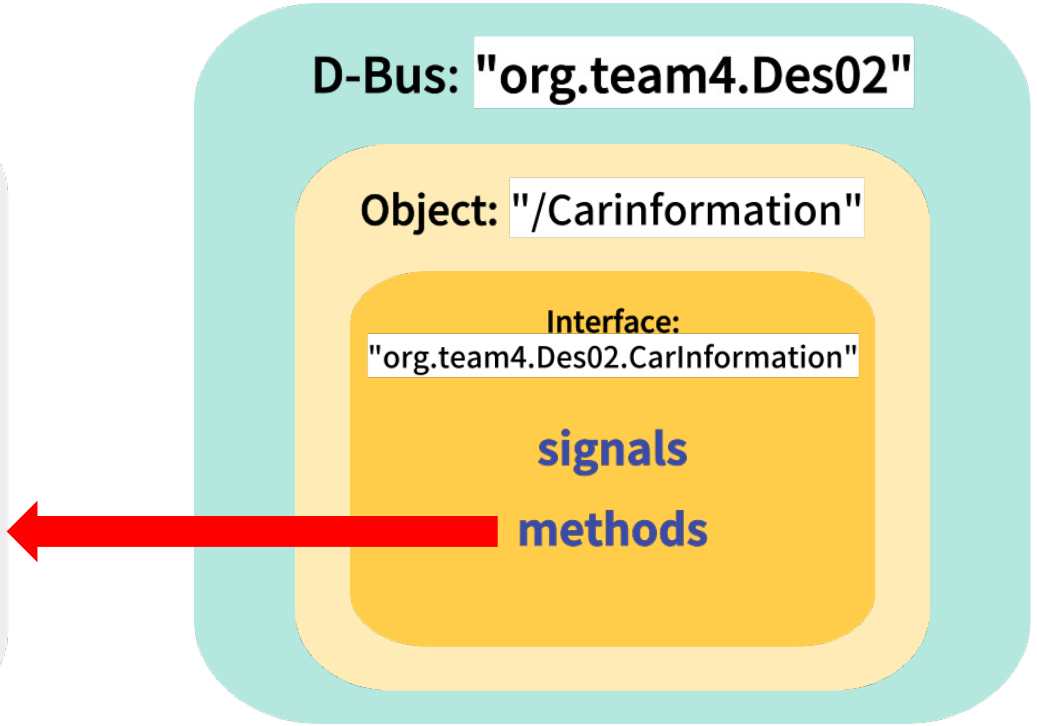
D-Bus: Get data from D-Bus (in instrument_cluster)



instrument_cluster

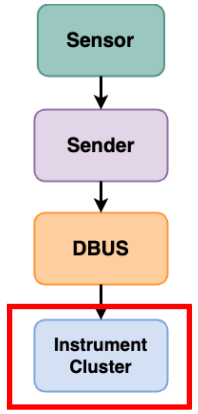
- Add XML to Project
- Set interface
- Get data by calling **getVariable** of interface

```
speed = interface->call("getSpeed");
```




```
// car2qml.h
org::team4::Des02::CarInformation *interface;

// car2qml.cpp
interface = new org::team4::Des02::CarInformation("org.team4.Des02", "/CarInformation", QDBusConnection::sessionBus());
```

Connect C++ to QML (in instrument_cluster)



car2qml.h

```
Q_PROPERTY(qreal speed READ getSpeed)
```

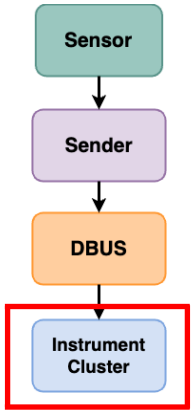
car2qml.cpp

```
void Car2Qml::setSpeed()
{
    speed = interface->call("getSpeed");
    emit speedChanged()
}

qreal Car2Qml::getSpeed()
{
    return speed;
}
```

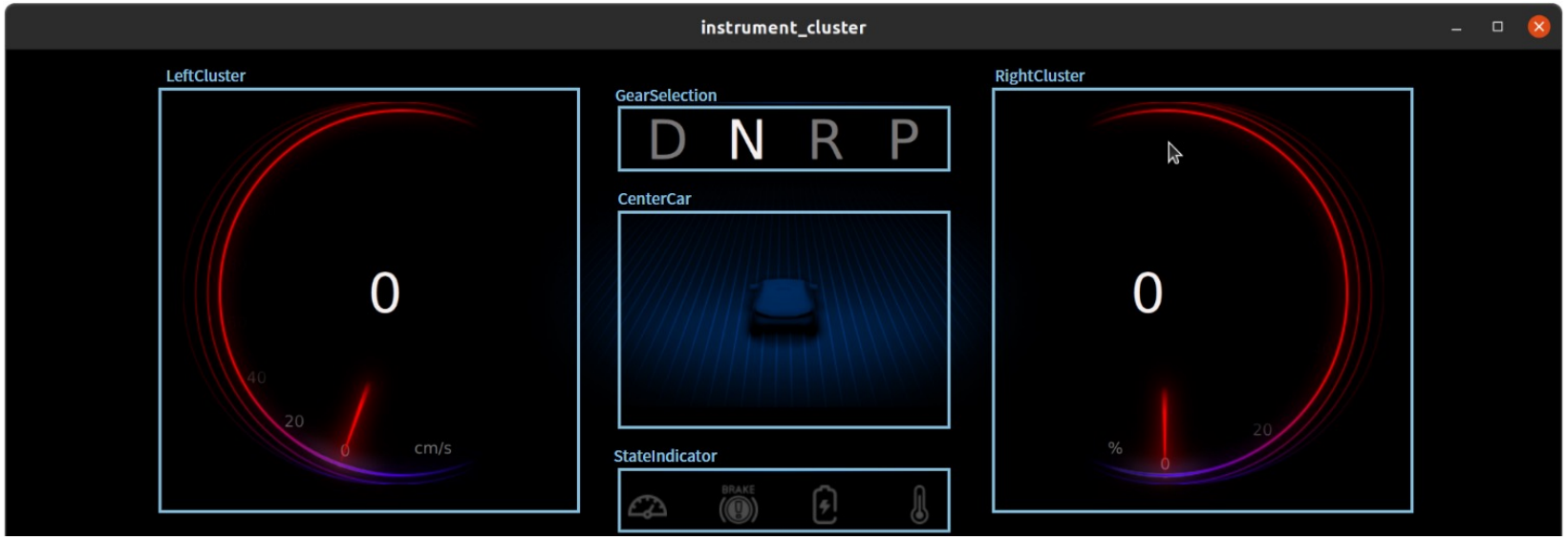
instrumentCluster.qml

```
Car2Qml{
        id: carinfo

    onSpeedChanged: {instrumentcluster.speed = carinfo.speed}
}
```

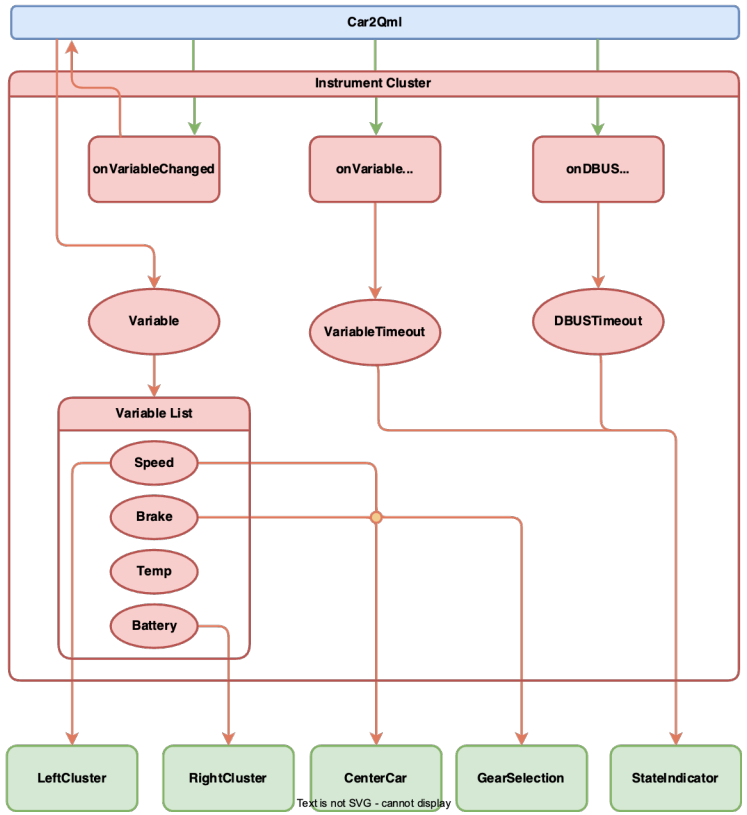
GUI(QML)



instrument_cluster



GUI(QML)

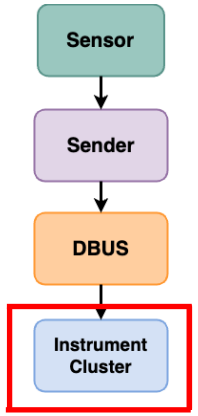


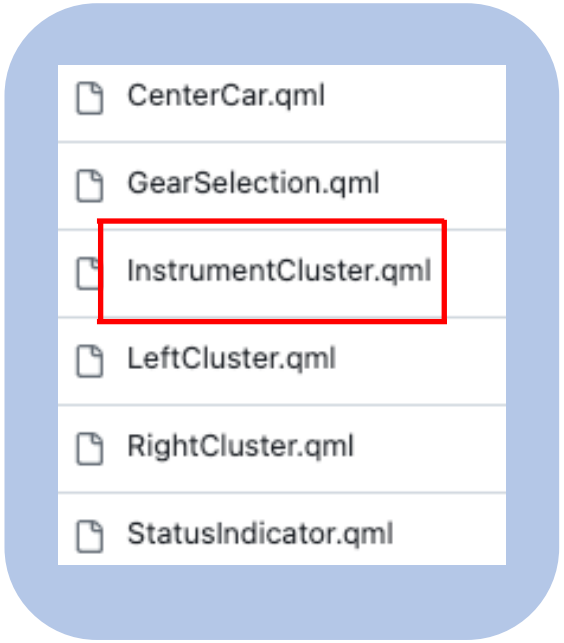
instrumentCluster.qml

```
Car2Qml{
        id: carinfo

        onSpeedChanged: {instrumentcluster.speed = carinfo.speed}
}
```

LeftCluster.qml

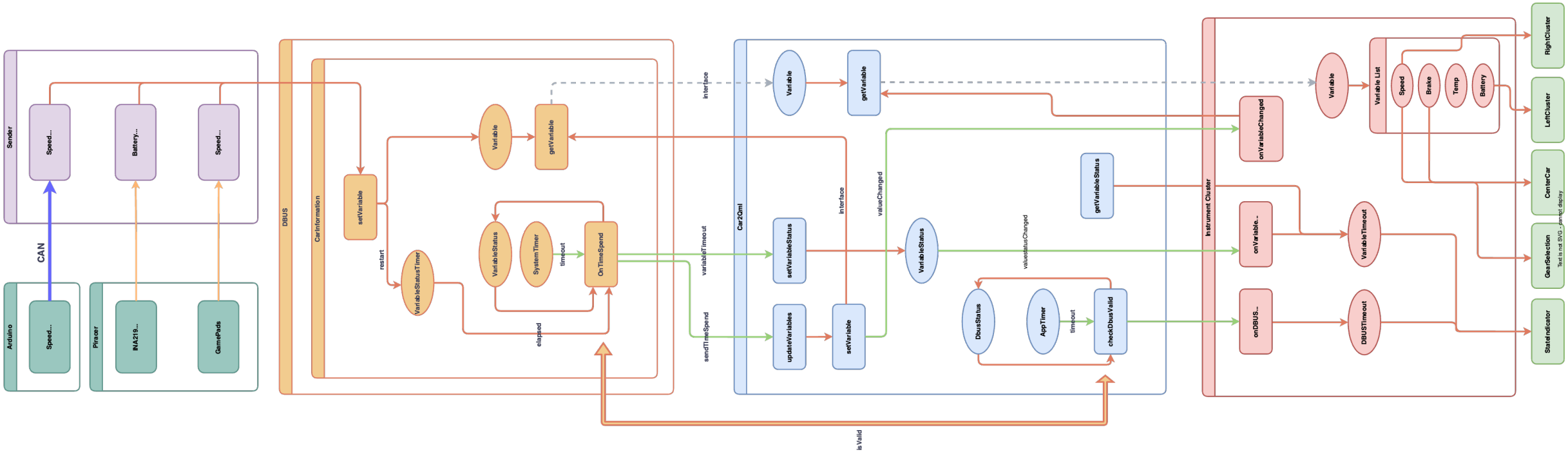
```
Text {
        x: 166
        y: 131
        color: leftcluster.textcolor
        text: Math.abs(parent.parent.speed)
        font.pixelSize: 45
        font.family: "Sarabun"
        font.bold: false
        width: leftcluster.width
        horizontalAlignment: Text.AlignHCenter
        verticalAlignment: Text.AlignVCenter
    }
```





Exception Handling

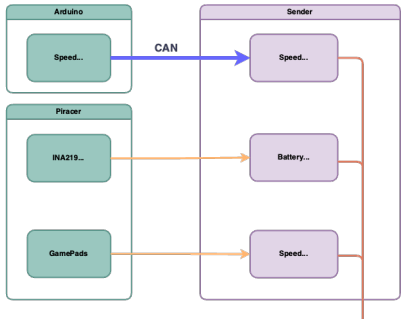
sea:me
software engineering in automotive and mobility ecosystems

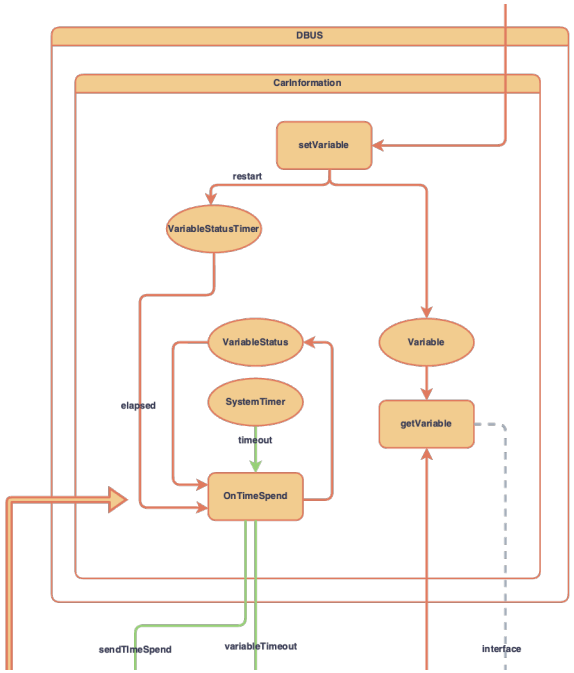


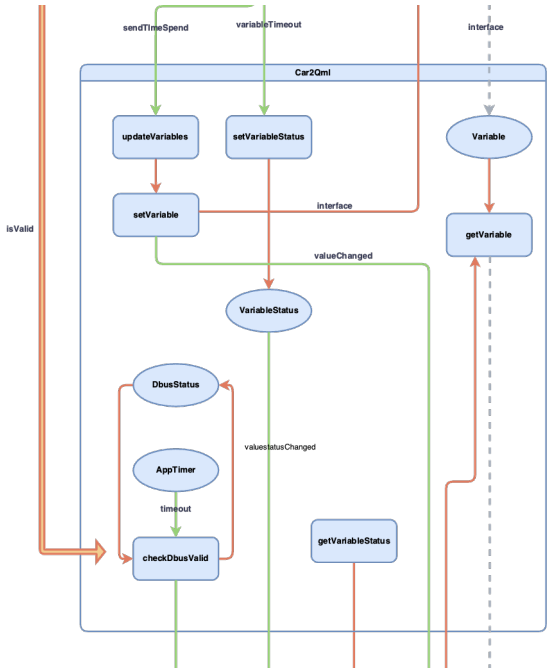
Sender D-Bus Car2Qml QML

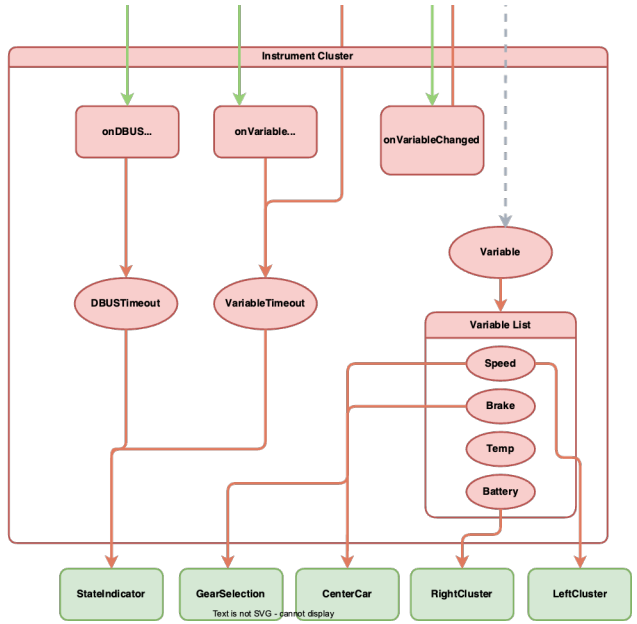
Exception Handling

sea:me
software engineering in automotive and mobility ecosystems









Sender

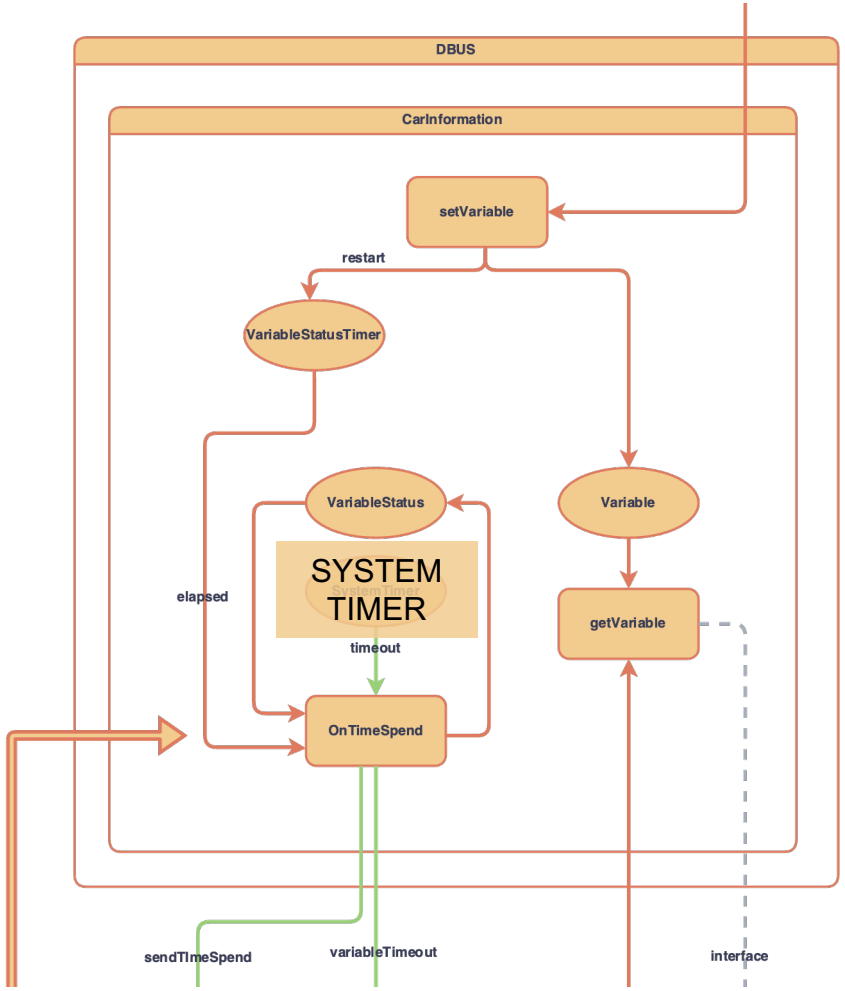
D-Bus

Car2Qml

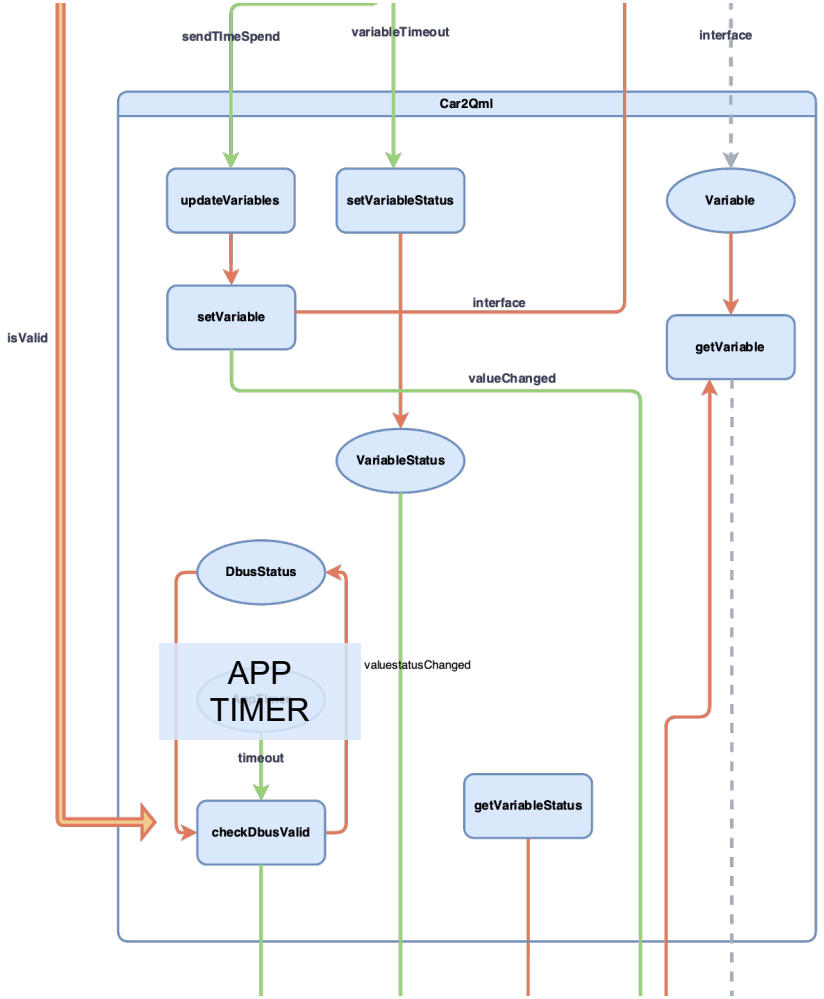
QML

Exception Handling

sea:me
software engineering in automotive and mobility ecosystems

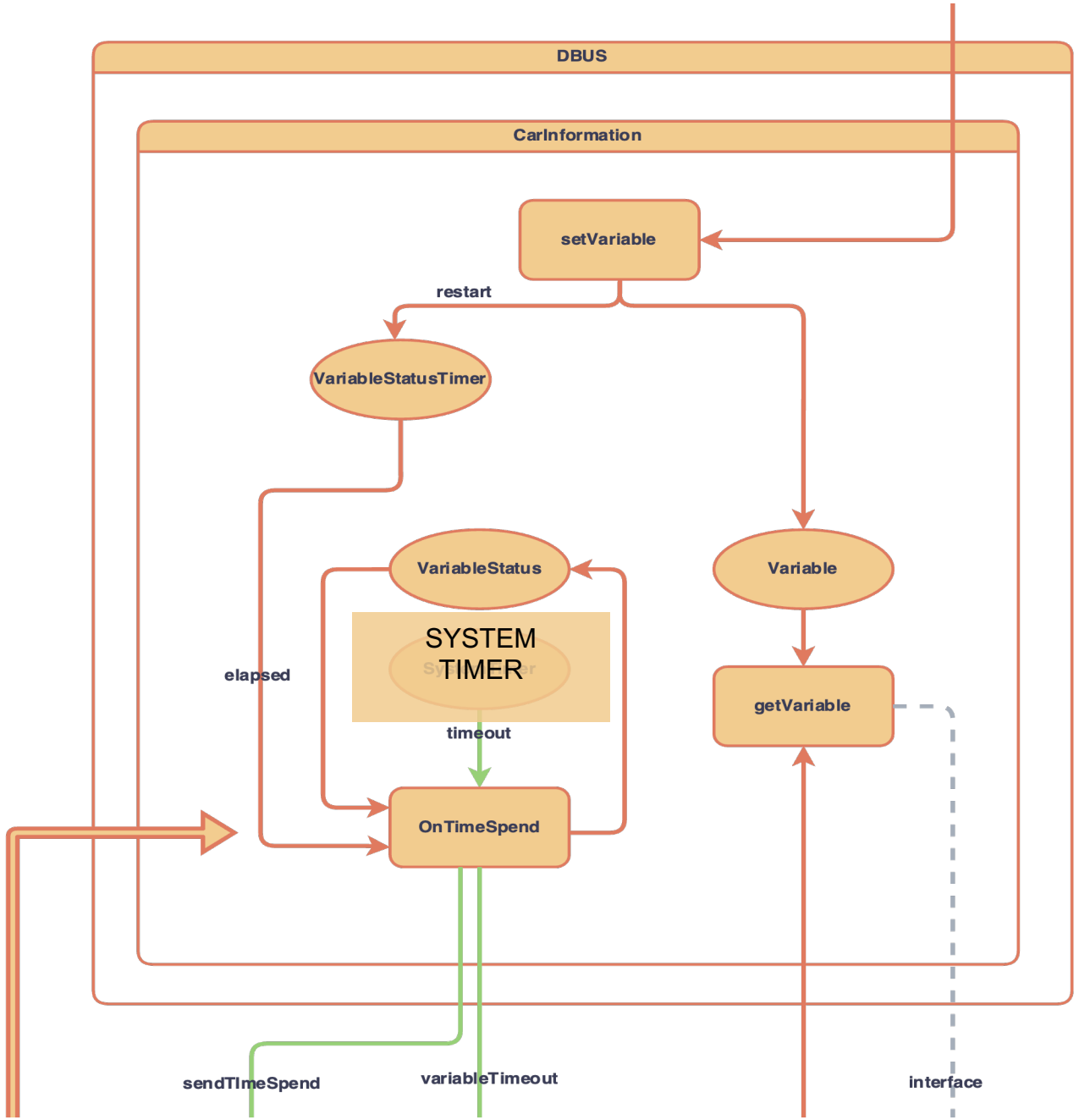


D-Bus



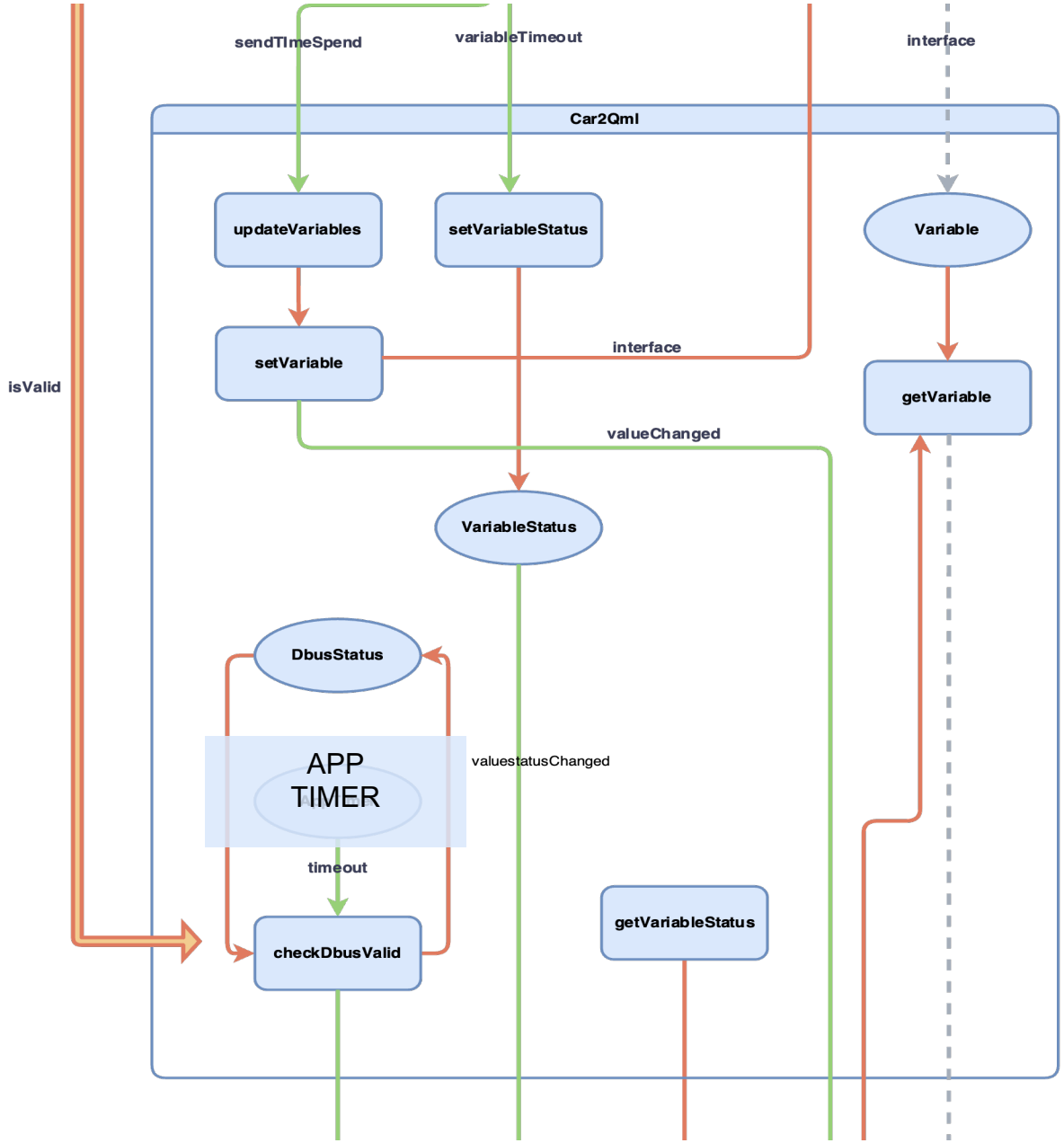
Car2Qml

Exception Handling



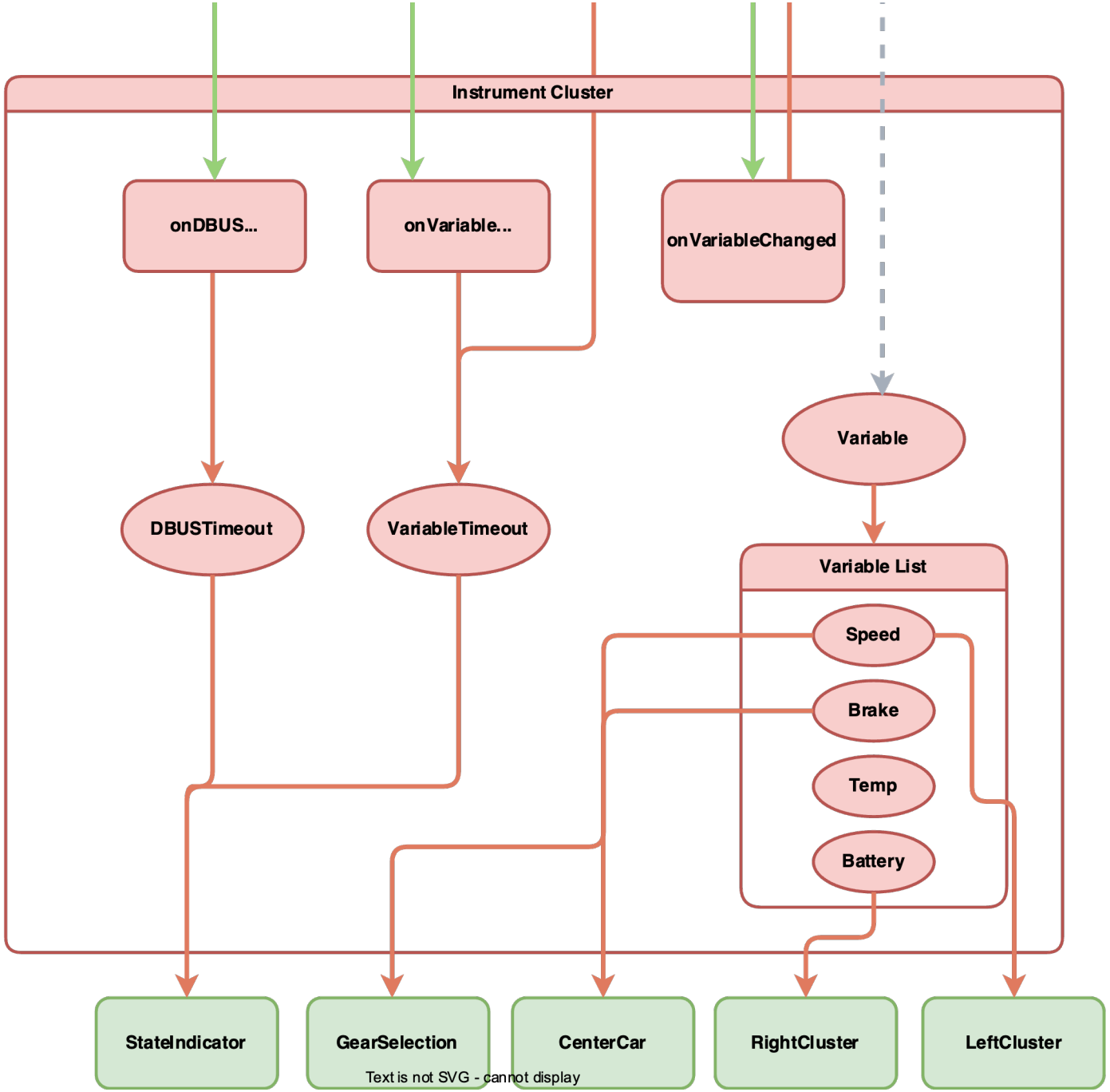
sea:me
software engineering in automotive and mobility ecosystems

Exception Handling



sea:me
software engineering in automotive and mobility ecosystems

Exception Handling



sea:me
software engineering in automotive and mobility ecosystems

Let’s See How It Works!

sea:me
software engineering in automotive and mobility ecosystems

sea|me

software engineering in automotive
and mobility ecosystems

DES02 Repository

Thank you!

Q&A

Team 4's Evaluation