Py車達人

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Agenda

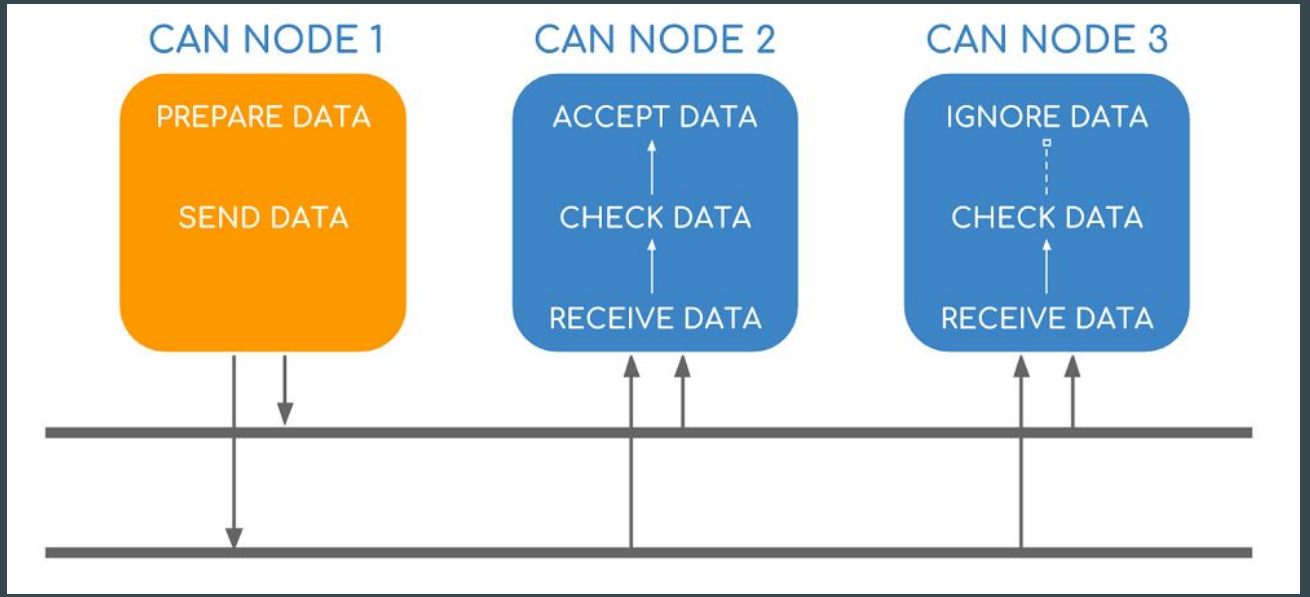
- 何謂CANBus
- 通訊協定介紹
- BeagleBone上的CANBus通訊
- 更方便的實作方式! ELM327
- Python-OBD
- 截取車子的訊息
- 上傳雲端

何謂CANBus

- Controller Area Network: CAN或稱CANBus, 最初被設計用於車輛上, 讓車上的電子設備之間通訊的協議。
- 相較於傳統工業用的RS-485通訊介面來說, 其容錯機制更佳
- 特點是允許網路上的多個微控制器或設備直接互相通訊
- CAN 2.0於1991年發布。該規範被分為兩部分;A部分適用於使用11位識別碼的標準格式, B部分適用於使用29位標誌符的拓展格式

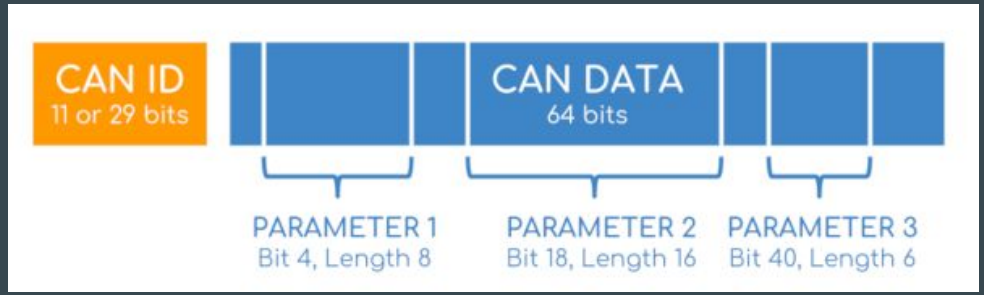
通訊協議介紹

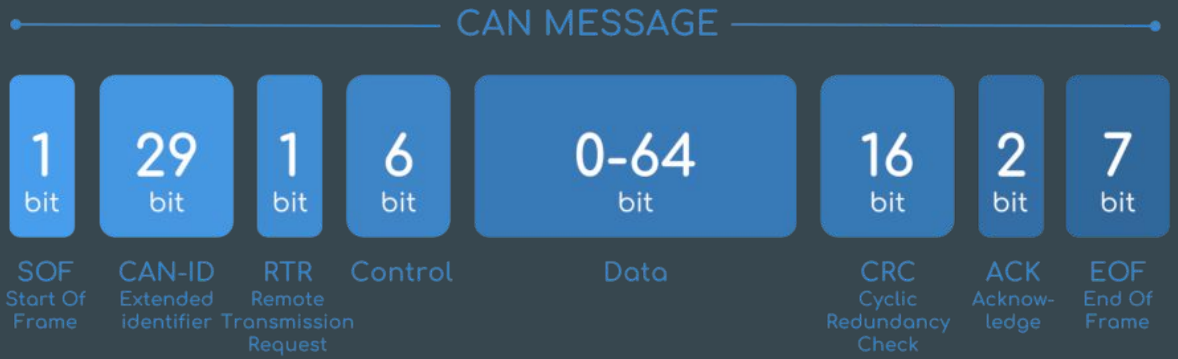
- 推薦一看的文章
- 成大的中文教學。



通訊協議介紹

- CAN Message

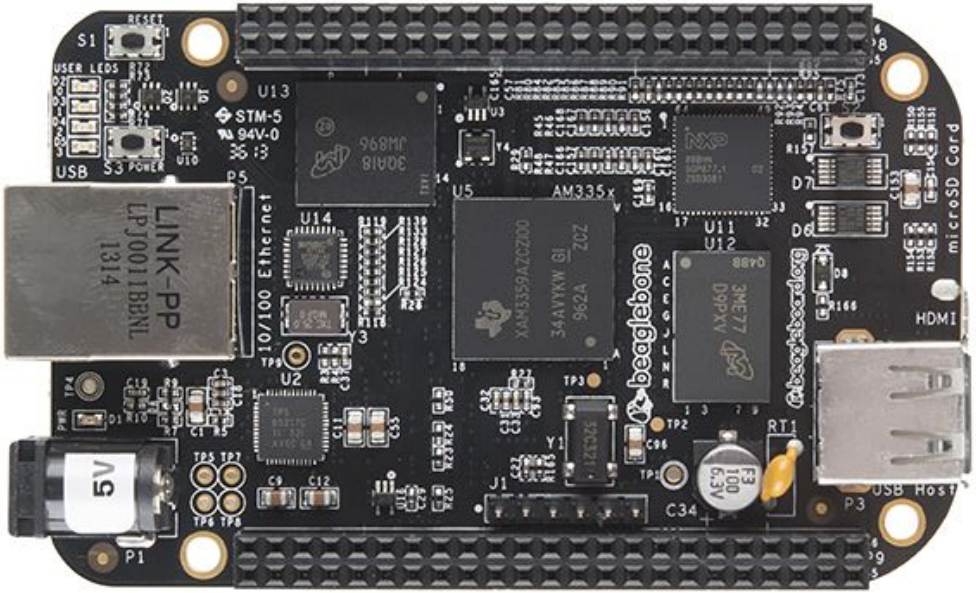


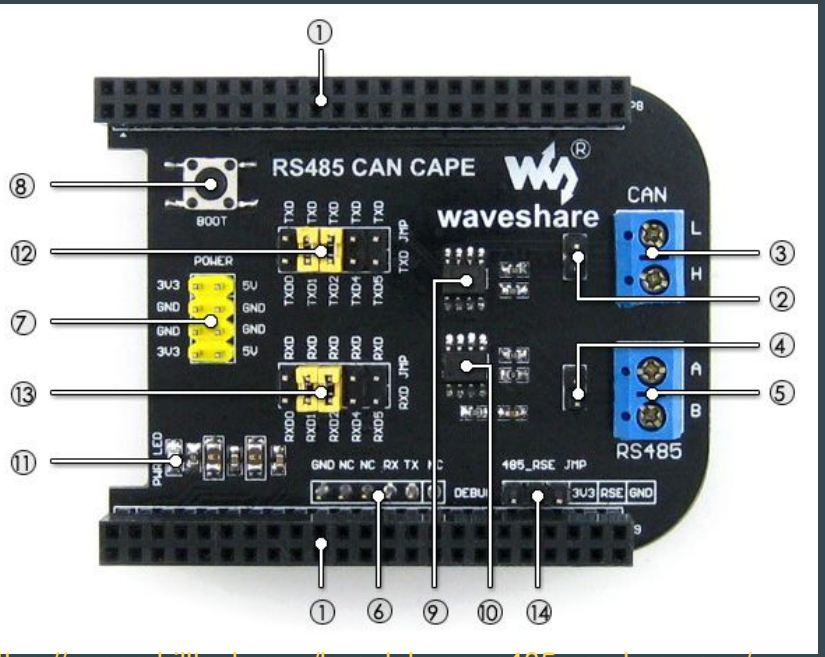


通訊協議介紹

- J1939、OBD2、CANOPEN、DeviceNet... ?
- 這些都是基於CANBus上的應用

BeagleBone上的CANBus通訊





ref: https://copperhilltech.com/beaglebone-rs485-can-bus-cape/

BeagleBone上的CANBus通訊

- CAN interface: 以socketCAN的方式通訊
- 1) 使用python-can: https://python-can.readthedocs.io/en/master/installation.html
  - 先決條件: linux kernel >= 2.6.25, python >= 3.3
- 2) 使用C包一層API (.so)
  - 使用Python 2.7或是更高版本, 都可採用此方式, 呼叫 API來和CANBus通訊

BeagleBone上的CANBus通訊

- canbus 速度: Max. 1000k, 由5k, 10k, 20k, 40k, 50k, 80k, 100k , 125k, 200k, 250k, 400k, 500k, 800k, 1000k
-

```
ip link set can0 type can bitrate 1000000 triple-sampling on
ip link set can0 up
```

```
root@BBB-CAN:~# ifconfig -a
can0      Link encap:UNSPEC  HWaddr 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00
          UP RUNNING NOARP  MTU:16  Metric:1
          RX packets:25 errors:0 dropped:0 overruns:0 frame:0
          TX packets:62 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:65535
          RX bytes:104 (104.0 B)  TX bytes:312 (312.0 B)
          Interrupt:71
.............
```

BeagleBone上的CANBus

- c的通訊範例。

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include <netinet/in.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <sys/ioctl.h>
#include <net/if.h>
#include <linux/can.h>
#include <linux/can/raw.h>

int main(int argc, char *argv[]) {
        int sock_can = 0, i;
        struct sockaddr_can addr;
        static struct can_frame can_frame;
        struct ifreq ifr;

        // 創造嗷爹子
        if ((sock_can = socket(PF_CAN, SOCK_RAW, CAN_RAW)) < 0) {
                perror("Create socket failed");
                exit(-1);
        }
```

BeagleBone上的CANBus通訊

- 進行介面的綁定。

```
34          // 设置CAN接口名称为can0
35          strcpy(ifr.ifr_name, "can0");
36          ioctl(sock_can, SIOCGIFINDEX, &ifr);
37          addr.can_family = AF_CAN;
38          addr.can_ifindex = ifr.ifr_ifindex;
39
40          // 绑定CAN总线
41          if (bind(sock_can, (struct sockaddr *) &addr, sizeof(addr)) < 0) {
42                  perror("Bind failded");
43                  close(sock_can);
44                  exit(-2);
45          }
```

BeagleBone上的CANBus通訊

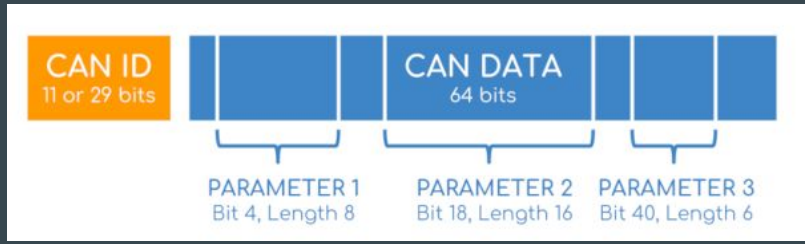
- Read / Write CAN封包
- 跟TCP網路封包的操作類似
- 只是改用can_frame structs

```
len = read(sock_can_listen, &can_frame, sizeof(struct can_frame));
```

```
46          can_frame.can_id = 0x123;       // 設置CANID
47          can_frame.can_dlc = 8;  // 数据长度为8
48
49          // 下面简单的设置数据为0到7
50          for(i=0; i<8; ++i){
51                  can_frame.data[i] = i;
52          }
53
54          // 发送 0 1 2 3 4 5 6 7,  CAN-ID 0x123
55          if(write(sock_can, &can_frame, sizeof(struct can_frame))<0){
56                  perror("Send failded");
57                  close(sock_can);
58                  exit(-3);
59          }
```

BeagleBone上的CANBus通訊

- 收到的封包格式(ref)




```
/**
 * struct can_frame - basic CAN frame structure
 * @can_id:  CAN ID of the frame and CAN_*_FLAG flags, see canid_t definition
 * @can_dlc: frame payload length in byte (0 .. 8) aka data length code
 *           N.B. the DLC field from ISO 11898-1 Chapter 8.4.2.3 has a 1:1
 *           mapping of the 'data length code' to the real payload length
 * @__pad:   padding
 * @__res0:  reserved / padding
 * @__res1:  reserved / padding
 * @data:    CAN frame payload (up to 8 byte)
 */
struct can_frame {
  canid_t can_id;  /* 32 bit CAN_ID + EFF/RTR/ERR flags */
  __u8    can_dlc; /* frame payload length in byte (0 .. CAN_MAX_DLEN) */
  __u8    __pad;   /* padding */
  __u8    __res0;  /* reserved / padding */
  __u8    __res1;  /* reserved / padding */
  __u8    data[CAN_MAX_DLEN] __attribute__((aligned(8)));
};
```

BeagleBone上的CANBus通訊

- 包成.so檔讓python用
- cansdk.h + cansdk.c → build it → libcansdk.so
- 指令:「"$CROSS_COMPILE"gcc -Wall -I../inc -fpic -shared cansdk.c -o libcansdk.so」
- cansdk.h如右
-

```c
#include <sys/socket.h>
#include <linux/can.h>
#include <linux/can/raw.h>

int can_init(void);

int can_read(struct can_frame *frame);

int can_write(struct can_frame *frame);
```

BeagleBone上的CANBus通訊

- cansdk.c 的初始化函式

```c
static int sock_can = -1;
int can_init(void)
{
  struct ifreq ifr;
  struct sockaddr_can addr;

  if ((sock_can = socket(PF_CAN, SOCK_RAW, CAN_RAW)) < 0) {
    exit(-1);
  }
  strcpy(ifr.ifr_name, "can0");
  ioctl(sock_can, SIOCGIFINDEX, &ifr);
  addr.can_family = AF_CAN;
  addr.can_ifindex = ifr.ifr_ifindex;
  fcntl(sock_can, F_SETFL, O_NONBLOCK);
  if (bind(sock_can, (struct sockaddr *) &addr, sizeof(addr)) < 0) {
    close(sock_can);
    exit(-2);
  }
  return 0;
}
```

BeagleBone上的CANBus通訊

- cansdk.c 的read/write

```c
int can_read(struct can_frame *frame)
{
  if (read(sock_can, frame, sizeof(struct can_frame)) > 0) return 0;
  else return -1;
}

int can_write(struct can_frame *frame)
{
  int retval;

  retval = write(sock_can, frame, sizeof(struct can_frame));
  if (retval != sizeof(struct can_frame)) return -1;
  else return 0;
}
```

BeagleBone上的CANBus

- python引用方式

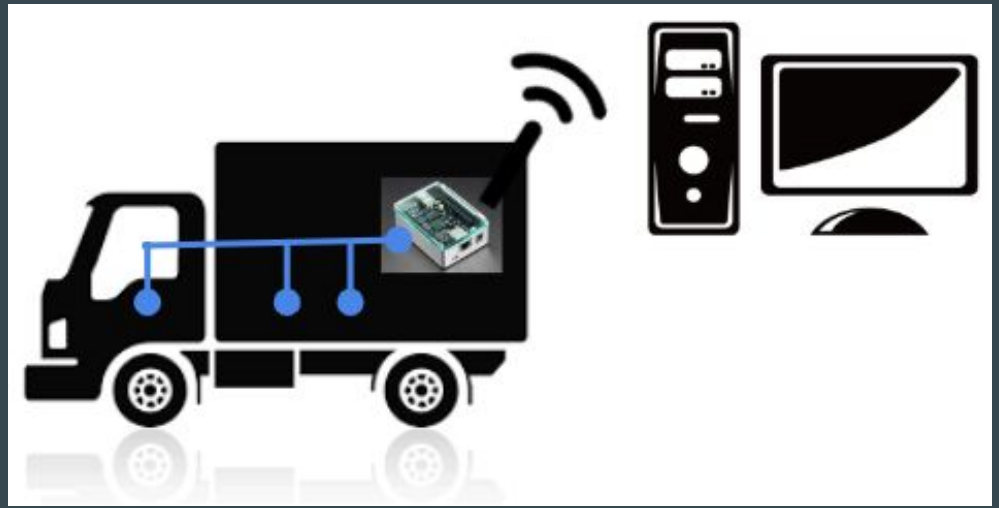
```
from ctypes import *
from struct import *
from ctypes import cdll
canlib = cdll.LoadLibrary("/libcansdk.so")
```

```
def can_read():
    try:
        buf_recv = create_string_buffer(16)#4+1*4+8
        res = canlib.can_read(buf_recv)
        [can_id, can_len, padding, data] = unpack('<LB3s8s', buf_recv)
        return [res, can_id, can_len, data]
    except Exception, e:
        raise e

def can_write(can_id, can_len, data):
    try:
        if type(data) is list:
            data = pack('<8B', data[0], data[1], data[2], data[3]
                        , data[4], data[5],data[6], data[7])
        can_frame = pack('<LBBBB8s', can_id, can_len, 0, 0, 0, data)
        return canlib.can_write(can_frame)
    except Exception, e:
        raise e
```

BeagleBone上的CANBus通訊

- 遇到的案例分享, 電動巴士、貨運車資訊收集
- 使用帶有CANBus、4G介面的資料收集器



BeagleBone上的CANBus通訊

- 使用帶有CANBus、4G介面的資料收集器
- Baudrate: 500kbps

ID (11bits)	第幾byte	名稱	數值
122	0	車速 km/hr	0~200
	1	水溫 (-50~150℃)	0~200

BeagleBone上的CANBus通訊

ID (11bits)	第幾byte	名稱	數值
130	2	b0: key on	0~1
	3	電瓶(12v)	0~150

ID (11bits)	第幾byte	名稱	數值
123	0~3	電池電壓 (0~600V)	0~60000
	4~7	電池電流 (-200A~200A)	0~60000

更方便的實作方式! ELM327

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參考連結：參考一、參考二、參考三、參考四。

Python-OBD

- Python-OBD
- install: https://python-obd.readthedocs.io/en/latest/
- connection: https://python-obd.readthedocs.io/en/latest/Connections/
- more ref: http://dthoughts.com/blog/2014/11/06/obd-scanner-using-elm327/

Jupyter上的實作分享: 收集資料上雲端

- jupyter-lab demo

The End

感謝聆聽