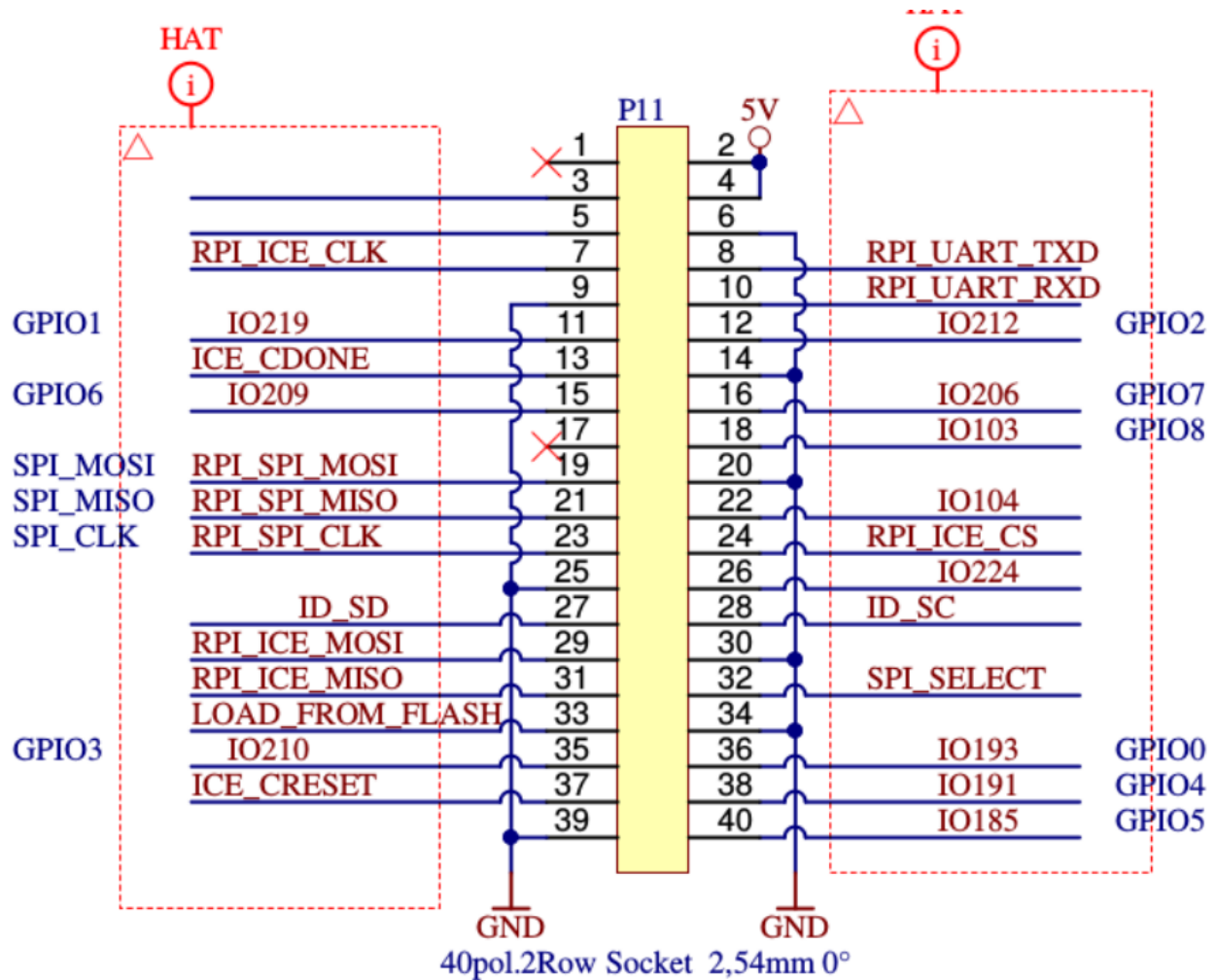


# **Testing Verilog on the CATBOARD on RPi Zero with CATBOARD 06/08/18**

A Pizero with CATBOARD FPGA. The CATBOARD provides 2 PMOD connector and a 20 pin with 3.3 v & Grd and 18 I/Os.

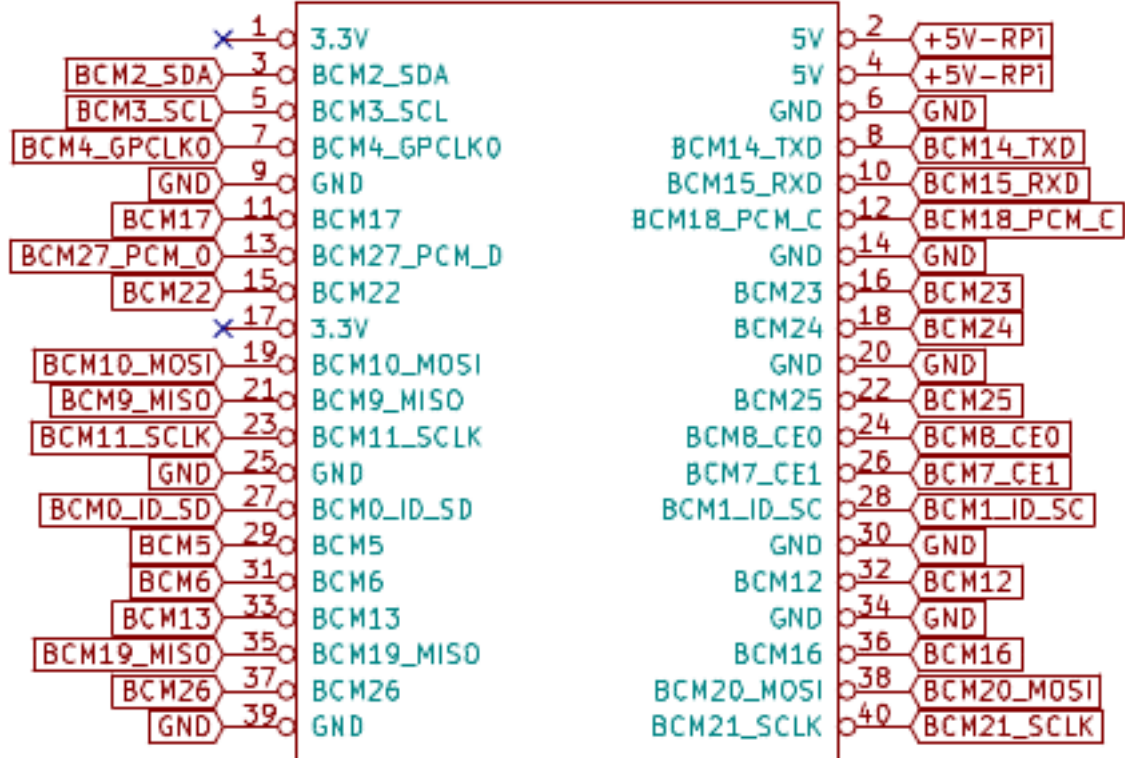
ICOBARD RPI

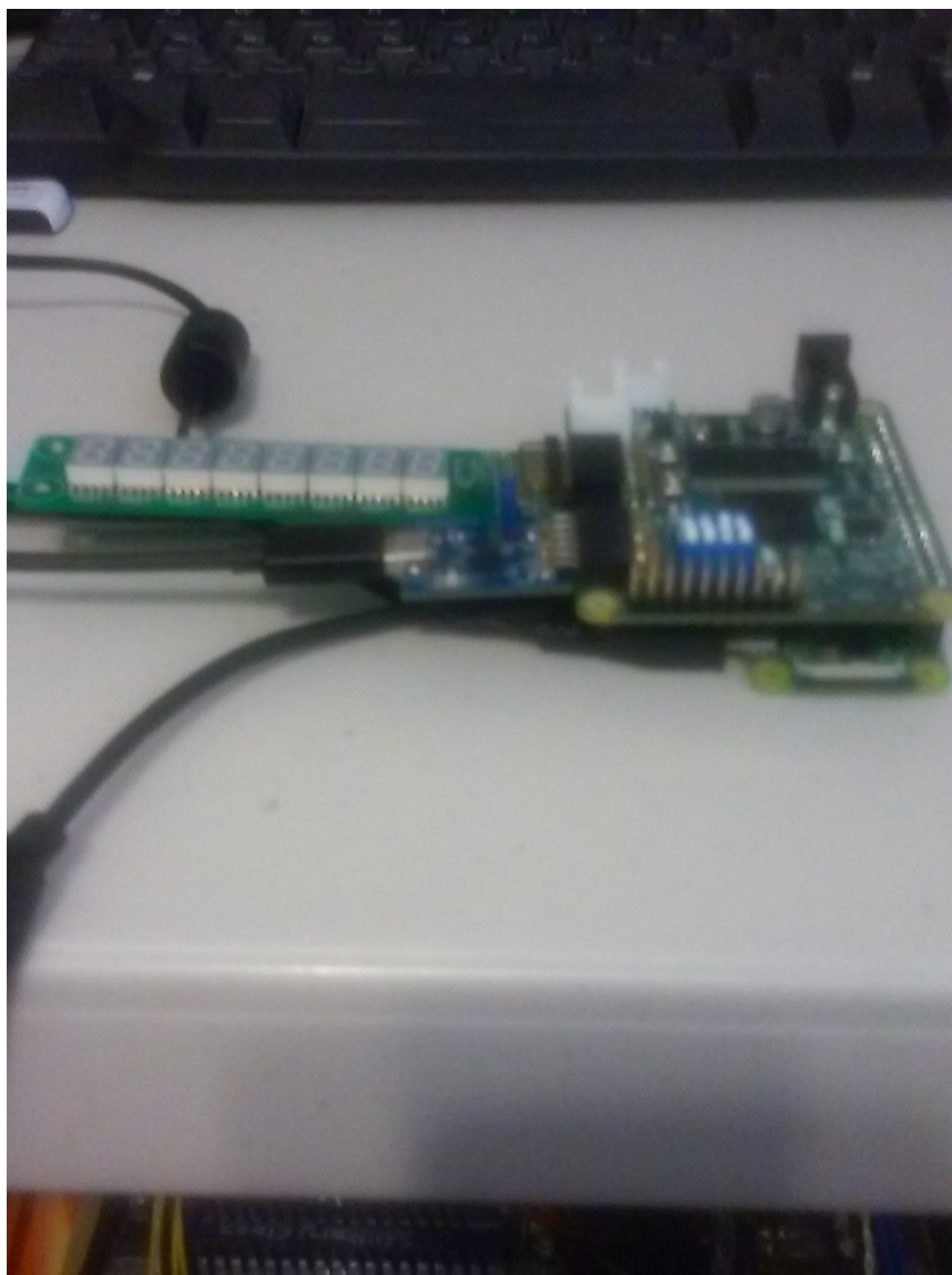


CATBOARD RPI

## GPIO

GPIO1  
RPI\_GPIO





Using a Pizero to program the FPGA.

Most of Verilog was written by Dan Gisselquist, Ph.D. from Gisselquist Technology, LLC. He is working with the ICOBARD which is a HX8K Lattice FPGA like the CATBOARD. The Verilog and C++ software is found at

**URL:** <https://github.com/develone/catzip.git>

```

File Edit Tabs Help
1
pi@pizero-1:~/catzip/rtl $ sudo config_cat pptest/speechpp.bin

OK: GPIO 25 exported
OK: GPIO 17 exported
OK: GPIO 22 exported

OK: SPI driver loaded

Setting GPIO directions
out
out
in
Setting output to low
0
Reseting FPGA
0
1
Checking DONE pin
0
Continuing with configuration procedure
263+1 records in
263+1 records out
135100 bytes (135 kB, 132 KiB) copied, 0.108344 s, 1.2 MB/s
Setting output to high
1
Checking DONE pin
1
pi@pizero-1:~/catzip/rtl $

```

In the catzip/rtl/pptest **make** creates **hellopp.bin**, **linepp.bin**, and **speechpp.bin** using yosys, arachne-pnr and icepack.

In the speechpp.pcf set\_io i\_clk R9. Pin R9 on the icoboard ICE\_CLK is connected to IOB\_81\_GBIN5 on the right side of the image below.



Trying to chg set\_io i\_clk R9 # 100 MHz clock  
 To C8 USER\_CLK was causing the following error  
 fatal error: bad constraint on 'i\_clk': no PLL at pin C8

Post on #yosys

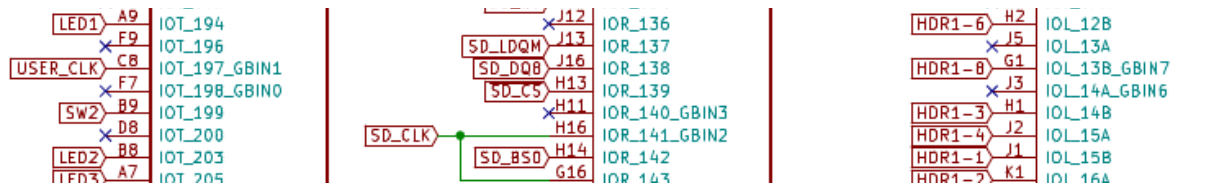
**Pin C8 is my USER\_CLK comes from a 100MHz osc. It is connected to IOT\_197\_GBIN1 on HX8K. When I try using it for as an input to PLL I get the fatal error: bad constraint on 'i\_clk': no PLL at pin C8.**

**Can only certain pins be used as inputs to PLL?**

**daveshah**

**develonepi3: use the SB\_PLL40\_CORE instead of SB\_PLL40\_PAD variant (and REFERENCECLK in instead of PACKAGEPIN)**

on the left side of the image below.



The version of speechpp.bin uses a PPL to reduce the 100MHz Oscillator down to 66MHz.

```

wire   clk_66mhz, pll_locked;
SB_PLL40_CORE #(
    .FEEDBACK_PATH("SIMPLE"),
    .DELAY_ADJUSTMENT_MODE_FEEDBACK("FIXED"),
    .DELAY_ADJUSTMENT_MODE_RELATIVE("FIXED"),
    .PLLOUT_SELECT("GENCLK"),
    .FDA_FEEDBACK(4'b1111),
    .FDA_RELATIVE(4'b1111),
    .DIVR(4'd8),           // Divide by (DIVR+1)
    .DIVQ(3'd4),          // Divide by 2^(DIVQ)
    .DIVF(7'd94),         // Multiply by (DIVF+1)
    .FILTER_RANGE(3'b001)
) pli (
    .REFERENCECLK (i_clk    ),
    .PLLOUTCORE   (clk_66mhz ),
    .LOCK          (pll_locked ),

```

```

        .BYPASS      (1'b0      ),
        .RESETB      (1'b1      )
    );
    assign s_clk = clk_66mhz;

```

The ICOBOARD used ***SB\_PLL40\_PAD*** since a different ***GBIN*** was used,

Running “***arm-netpport***” on pizero-1 which receives the data from the FPGA in parallel using 11 gpio pins

Maps pins on FPGA to Pins on Rpi. These pins were different on the ICOBOARD.

```
set_io i_clk    C8
```

```
set_io o_ledg[0] A9
```

```
set_io o_ledg[1] B8
```

```
set_io o_ledr   B7
```

```
set_io i_pp_dir  R3
```

```
set_io i_pp_clk  T8
```

```
set_io io_pp_data[0] R4
```

```
set_io io_pp_data[1] T3
```

```
set_io io_pp_data[2] T13
```

```
set_io io_pp_data[3] T6
```

```
set_io io_pp_data[4] T5
```

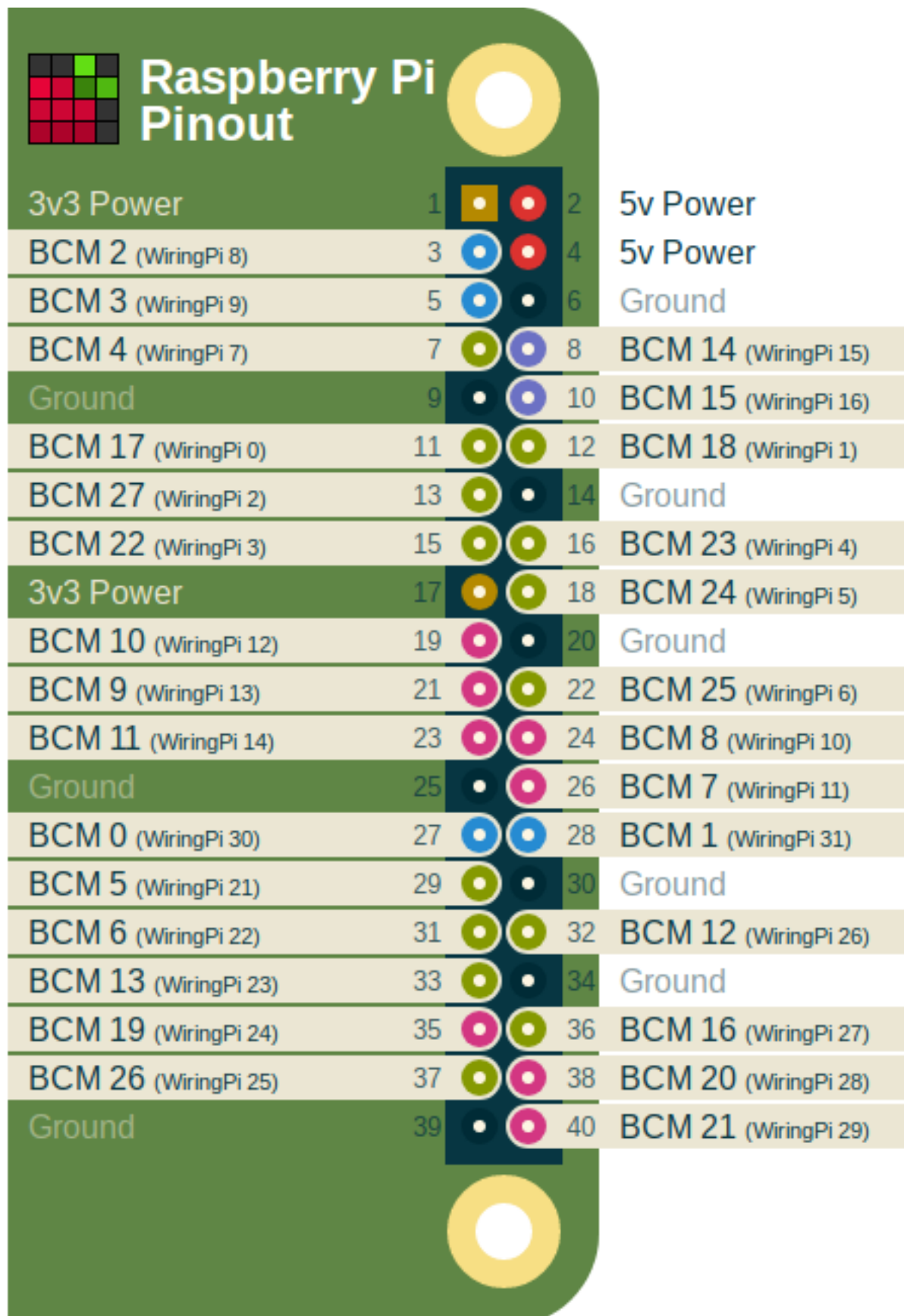
```
set_io io_pp_data[5] P9
```

```
set_io io_pp_data[6] T9
```

```
set_io io_pp_data[7] T11
```

```
set_io o_pp_clkfb T7
```

The code for netpport.cpp uses witingPi.



To create the executable



To create ***arm-netpport & arm-wbregs*** ~/catzip/sw/host or ~/icozip/sw/host and type ***make***.

```
# define RASPI_DIR 28 //BCM20 PIN 38, GPIO.28 IOB_59 R3
# define RASPI_CLK 10 //BCM8 PIN 24, GPIO.10, IOB_75 T8

# define RASPI_D0 27 //BCM16 PIN 36, GPIO.27, IOB_63 R4
# define RASPI_D1 24 //BCM19 PIN 35, GPIO.24, IOB_61 T3
# define RASPI_D2 0 //BCM17 PIN 11, GPIO.0, IOB_94 T13

# define RASPI_D3 21 //BCM5 PIN 29, GPIO.21, IOB_73 T6

# define RASPI_D4 22 //BCM6 PIN 31, GPIO.22, IOB_69 T5
# define RASPI_D5 4 //BCM23 PIN 16, GPIO.4, IOB_83 P9

# define RASPI_D6 5 //BCM24 PIN 18, GPIO.5, IOB_79 T9
# define RASPI_D7 1 //BCM18 pin 12, GPIO.1, IOB_89 T11
# define RASPI_D8 11 //BCM7 PIN 26, GPIO.11, IOB_75 T7

#define READ_FROM_ICO 0
```

**#define WRITE\_TO\_ICO 1**

The file “*speech.hex*” is read by the FPGA and sent to the pizero.

```
File Edit Tabs Help
pi@pizero-1:~/catzip/sw/host $ ./arm-netpport
Listening on port 8363
Listening on port 8364
. |=====|
. |
. | Four score and seven years ago our fathers brought forth on this
. | continent, a new nation, conceived in Liberty, and dedicated to
. | the proposition that all men are created equal.
. |
. | Now we are engaged in a great civil war, testing whether that
. | nation, or any nation so conceived and so dedicated, can long
. | endure. We are met on a great battle-field of that war. We have
. | come to dedicate a portion of that field, as a final resting
. | place for those who here gave their lives that that nation might
. | live. It is altogether fitting and proper that we should do this.
. |
. | But, in a larger sense, we can not dedicate-we can not consecrate-
. | we can not hallow-this ground. The brave men, living and dead,
. | who struggled here, have consecrated it, far above our poor power
. | to add or detract. The world will little note, nor long remember
. | what we say here, but it can never forget what they did here. It
. | is for us the living, rather, to be dedicated here to the
. | unfinished work which they who fought here have thus far so nobly
. | advanced. It is rather for us to be here dedicated to the great
. | task remaining before us-that from these honored dead we take
. | increased devotion to that cause for which they gave the last
. | full measure of devotion-that we here highly resolve that these
. | dead shall not have died in vain-that this nation, under God,
. | shall have a new birth of freedom-and that government of the
. | people, by the people, for the people, shall not perish from the
. | earth.
. |
. |
. |=====|
. |
```

In addition, a remote host, using telnet can receive the data being sent from the FPGA. The command “*telnet pizero-1 8364*”

```
File Edit Tabs Help

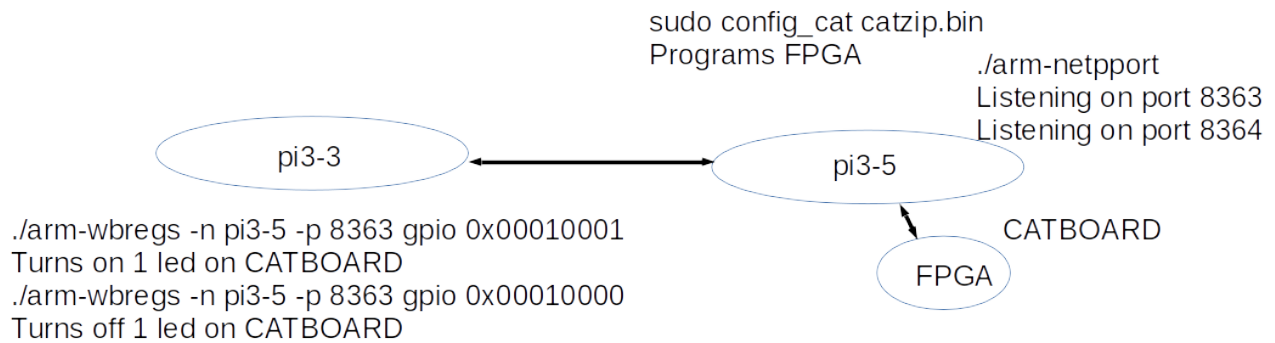
pi@pi3-2:~/uart_rxtx/wbuart32/ppptest $ telnet pizero-1 8364
Trying 2600:1700:bc40:b480::38...
Trying 2600:1700:bc40:b480:d428:7a81:e997:5433...
Trying 192.168.1.100...
Connected to pizero-1.
Escape character is '^]'.

=====
|
| Four score and seven years ago our fathers brought forth on this
| continent, a new nation, conceived in Liberty, and dedicated to
| the proposition that all men are created equal.
|
| Now we are engaged in a great civil war, testing whether that
| nation, or any nation so conceived and so dedicated, can long
| endure. We are met on a great battle-field of that war. We have
| come to dedicate a portion of that field, as a final resting
| place for those who here gave their lives that that nation might
| live. It is altogether fitting and proper that we should do this.
|
| But, in a larger sense, we can not dedicate-we can not consecrate-
| we can not hallow-this ground. The brave men, living and dead,
| who struggled here, have consecrated it, far above our poor power
| to add or detract. The world will little note, nor long remember
| what we say here, but it can never forget what they did here. It
| is for us the living, rather, to be dedicated here to the
| unfinished work which they who fought here have thus far so nobly
| advanced. It is rather for us to be here dedicated to the great
| task remaining before us-that from these honored dead we take
| increased devotion to that cause for which they gave the last
| full measure of devotion-that we here highly resolve that these
| dead shall not have died in vain-that this nation, under God,
| shall have a new birth of freedom-and that government of the
| people, by the people, for the people, shall not perish from the
| earth.
|
| =====
```

### ***Steps to run on Bare Metal***

```
Demo UDP Server ready
setting IOB_108_SS low
IOB_108_SS 0
Resetting FPGA
Setting Reset low
Reset 0
Setting Reset high
Reset 1
CDONE 0
Sending to SPI catboard.bin
In SPISendFile2 135100
In SPISendFile2 131004
In SPISendFile2 126908
In SPISendFile2 122812
In SPISendFile2 118716
In SPISendFile2 114620
In SPISendFile2 110524
In SPISendFile2 106428
In SPISendFile2 102332
In SPISendFile2 98236
In SPISendFile2 94140
In SPISendFile2 90044
In SPISendFile2 85948
In SPISendFile2 81852
In SPISendFile2 77756
In SPISendFile2 73660
In SPISendFile2 69564
In SPISendFile2 65468
In SPISendFile2 61372
In SPISendFile2 57276
In SPISendFile2 53180
In SPISendFile2 49084
In SPISendFile2 44988
In SPISendFile2 40892
In SPISendFile2 36796
In SPISendFile2 32700
In SPISendFile2 28604
In SPISendFile2 24508
In SPISendFile2 20412
In SPISendFile2 16316
In SPISendFile2 12220
In SPISendFile2 8124
In SPISendFile2 4028
Setting True in SPISendFile2
True returned from SPI wr catboard.bin
In SPISendFile2 6
Setting True in SPISendFile2
True returned from SPI wr sixzeros.bin
CDONE 1
setting IOB_108_SS high
IOB_108_SS 1
CDONE 1
```

## Remote Control FPGA



06/06/18

The initial socket code was found at

***“<https://forum.lazarus.freepascal.org/index.php?topic=21024.0>”***

***“cd Ultibo\_Projects/socket\_tests/raspbian”***

***“export PATH=/home/pi/ultibo/core/fpc/bin:\$PATH”***

***“fpc -B -Tlinux -Parm @/home/pi/ultibo/core/fpc/bin/fpc.cfg -O2 server.pas”***

***pi@pi3-2:~/Ultibo\_Projects/socket\_tests/raspbian \$ ./server***

Listener has been created

Socket successfully initialized

Bind on 5050

We have 1 client threads!

Accepted connection from 192.168.1.214:47914

***pi@pi3-3:~/Ultibo\_Projects/socket\_tests/raspbian \$ telnet pi3-2 5050***

Trying 2600:1700:bc40:b480::49...

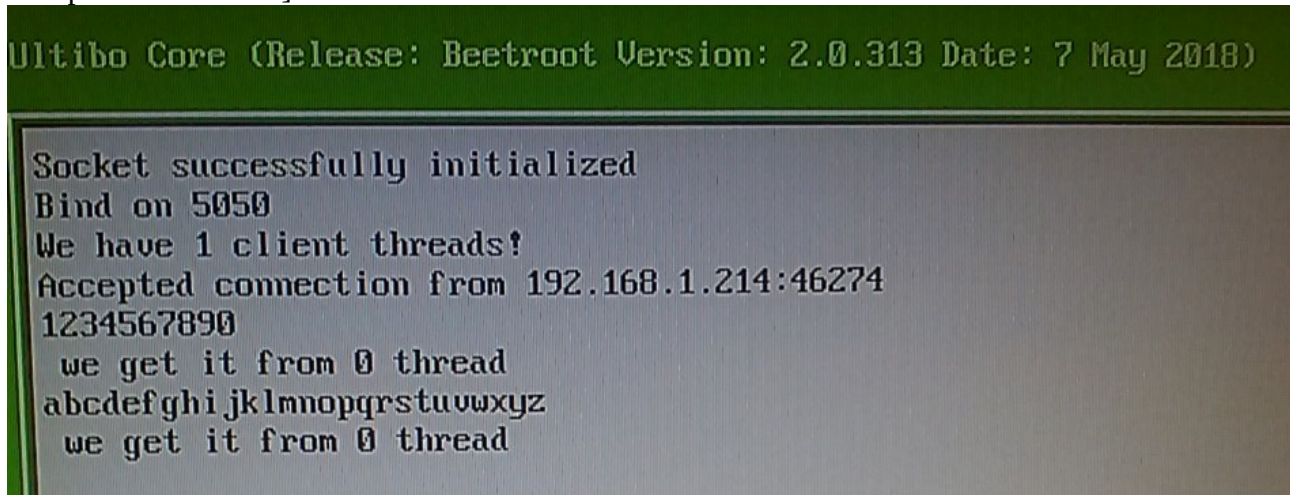
Trying 2600:1700:bc40:b480:4077:e4cb:6d18:81df...

Trying 192.168.1.181...

Connected to pi3-2.



Escape character is '^['.



```
./arm-wbregs -n 192.168.1.185 -p 5050 version  
A1011R Read from Addr A1011R
```

```
./arm-wbregs -n 192.168.1.185 -p 5050 gpio 0x00010001  
A1009W10001 This means write to Addr 1009 data 10001
```

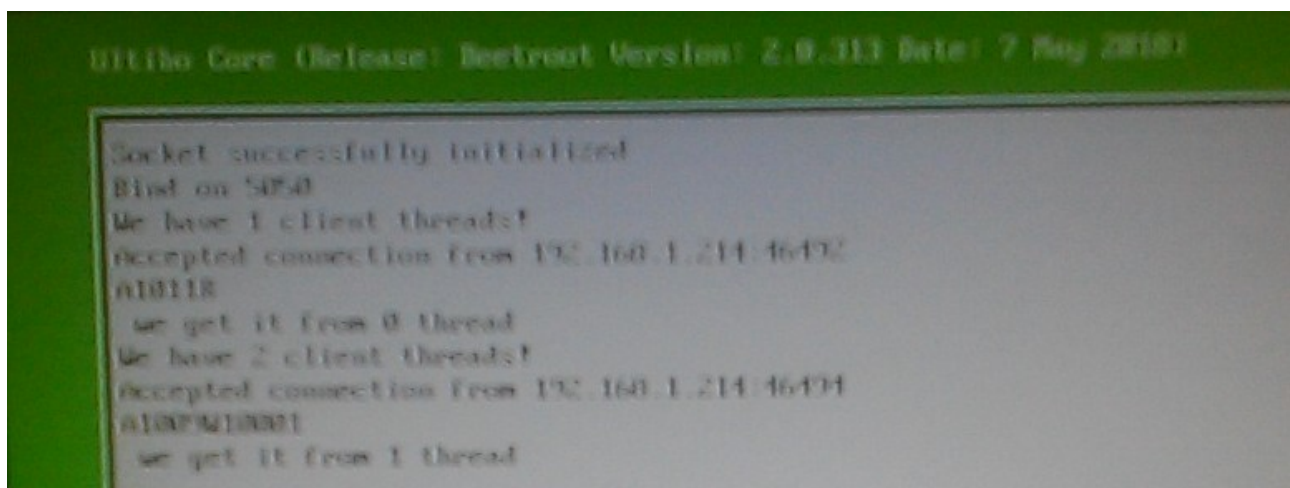
ufpga

function initfpgagpio(): Boolean;

function SPISendFile2(const Filename: String; BlockSize: LongWord; Window: TWindowHandle): Boolean;

function ProgFpga(const Filename: String; ProgWindow: TWindowHandle): Boolean;  
function ReadFpga(ProgWindow: TWindowHandle): integer;

wishbone



Now can program do the following:

program the fpga

read the parallel port of the fpga

connect remote to socket 5050

receive data over the socket.

```
In SPISendFile2 36796
In SPISendFile2 32700
In SPISendFile2 28604
In SPISendFile2 24508
In SPISendFile2 20412
In SPISendFile2 16316
In SPISendFile2 12220
In SPISendFile2 8124
In SPISendFile2 4028
Setting True in SPISendFile2
True returned from SPI wr speechpp.bin
In SPISendFile2 6
Setting True in SPISendFile2
True returned from SPI wr sixzeros.bin
CDONE 0
setting IOB_100_SS high
IOB_100_SS 1
CDONE 0
```

```
=====
|
| Four score and seven years ago our fathers brought forth on this |
| continent, a new nation, conceived in Liberty, and dedicated to |
| the proposition that all men are created equal. |
|
| Now we are engaged in a great civil war, testing whether that |
| nation, or any nation so conceived and so dedicated, can long |
| endure. We are met on a great battle-field of that war. We have |
| come to dedicate a portion of that field, as a final resting |
| place for those who here gave their lives that that nation might |
| live. It is altogether fitting and proper that we should do this. |
|
| But, in a larger sense, we can not dedicate—we can not consecrate— |
| we can not hallow—this ground. The brave men, living and dead, |
| who struggled here, have consecrated it, far above our poor power |
| to add or detract. The world will little note, nor long remember |
| what we say here, but it can never forget what they did here. It |
| is for us the living, rather, to be dedicated here to the |
| unfinished work which they who fought here have thus far so nobly |
| advanced. It is rather for us to be here dedicated to the great |
| task remaining before us—that from these honored dead we take |
| increased devotion to that cause for which they gave the last |
| full measure of devotion—that we here highly resolve that these |
| dead shall not have died in vain—that this nation, under God, |
| shall have a new birth of freedom—and that government of the |
| people, by the people, for the people, shall not perish from the |
| earth. |
|
|
|=====
```

```
FFG0 was program
Socket successfully initialized
Bind on 5050 .
We have 1 client threads!
Accepted connection from 192.168.1.214:57904
1234567890
we get it from 0 thread
abcdefghijklmnopqrstuvwxyz
we get it from 0 thread
```