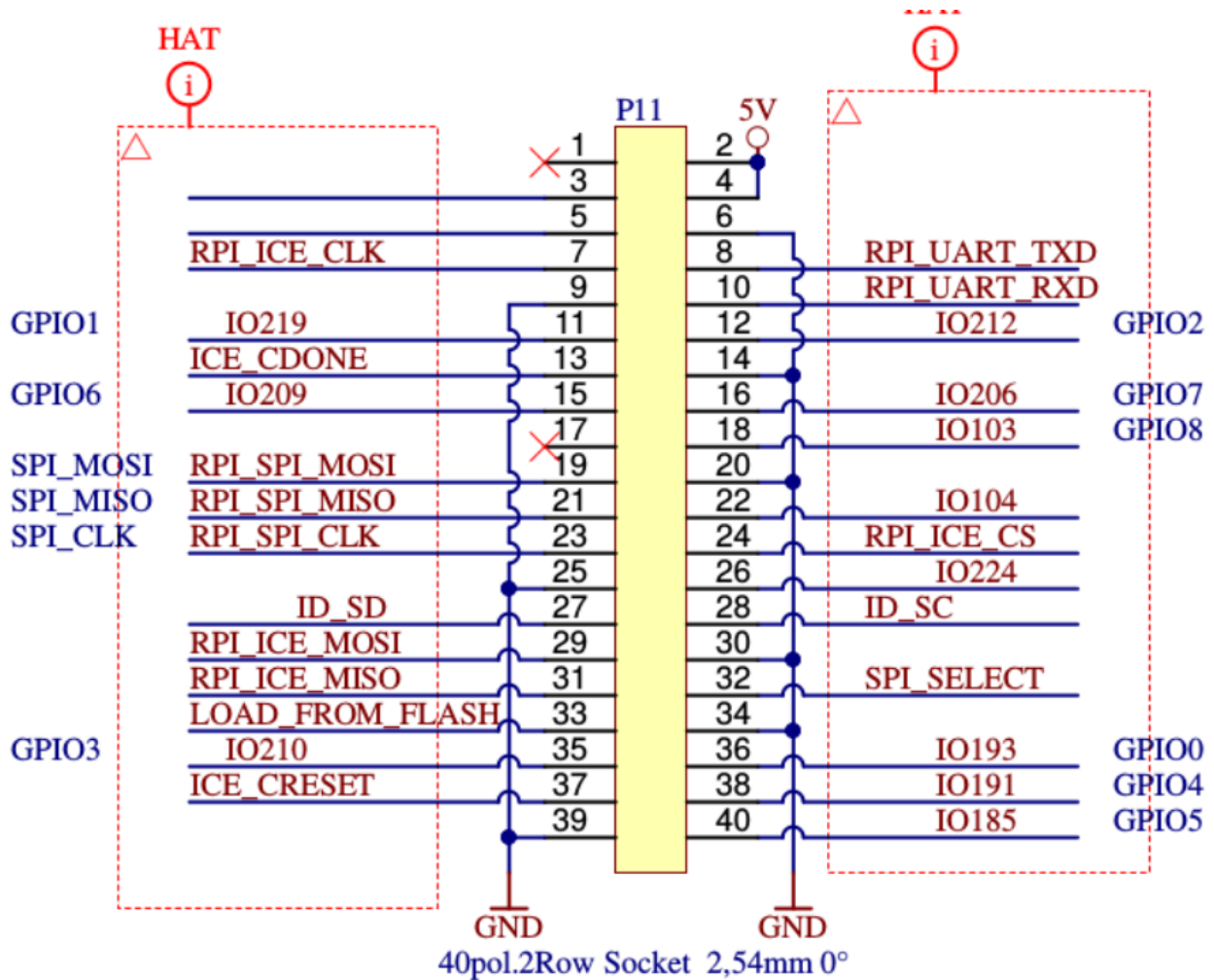# Testing Verilog on the CATBOARD
on RPi Zero with CATBOARD
05/18/18

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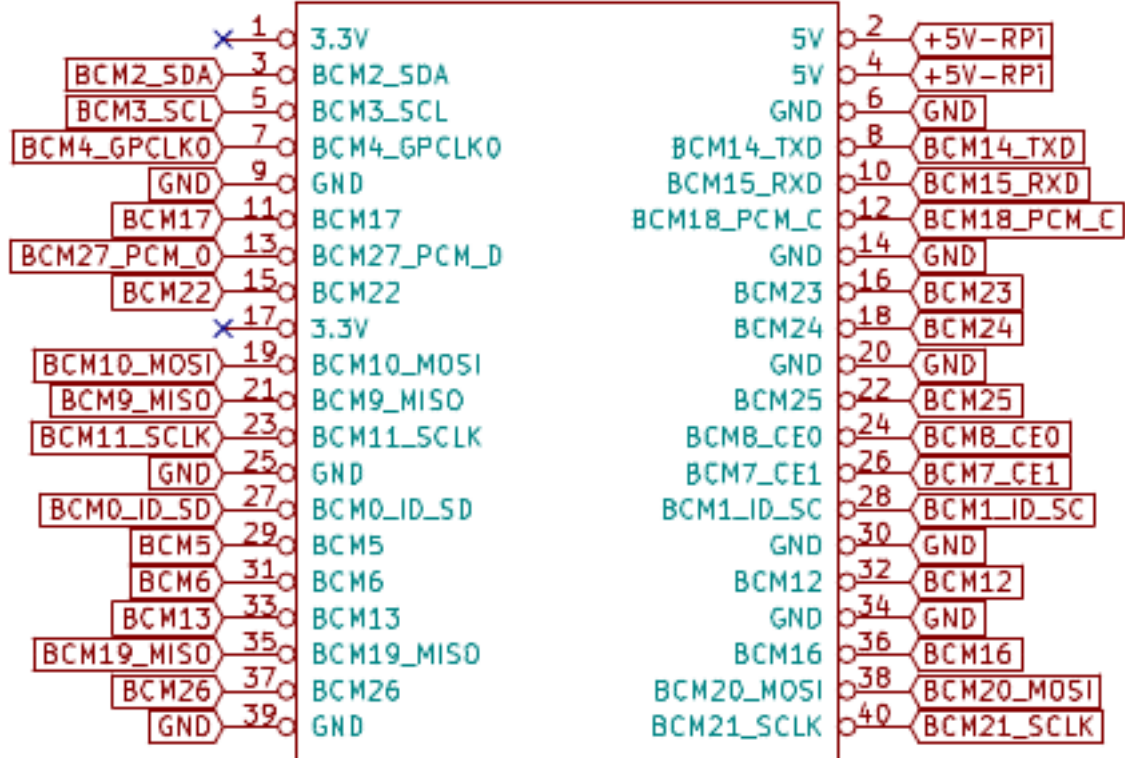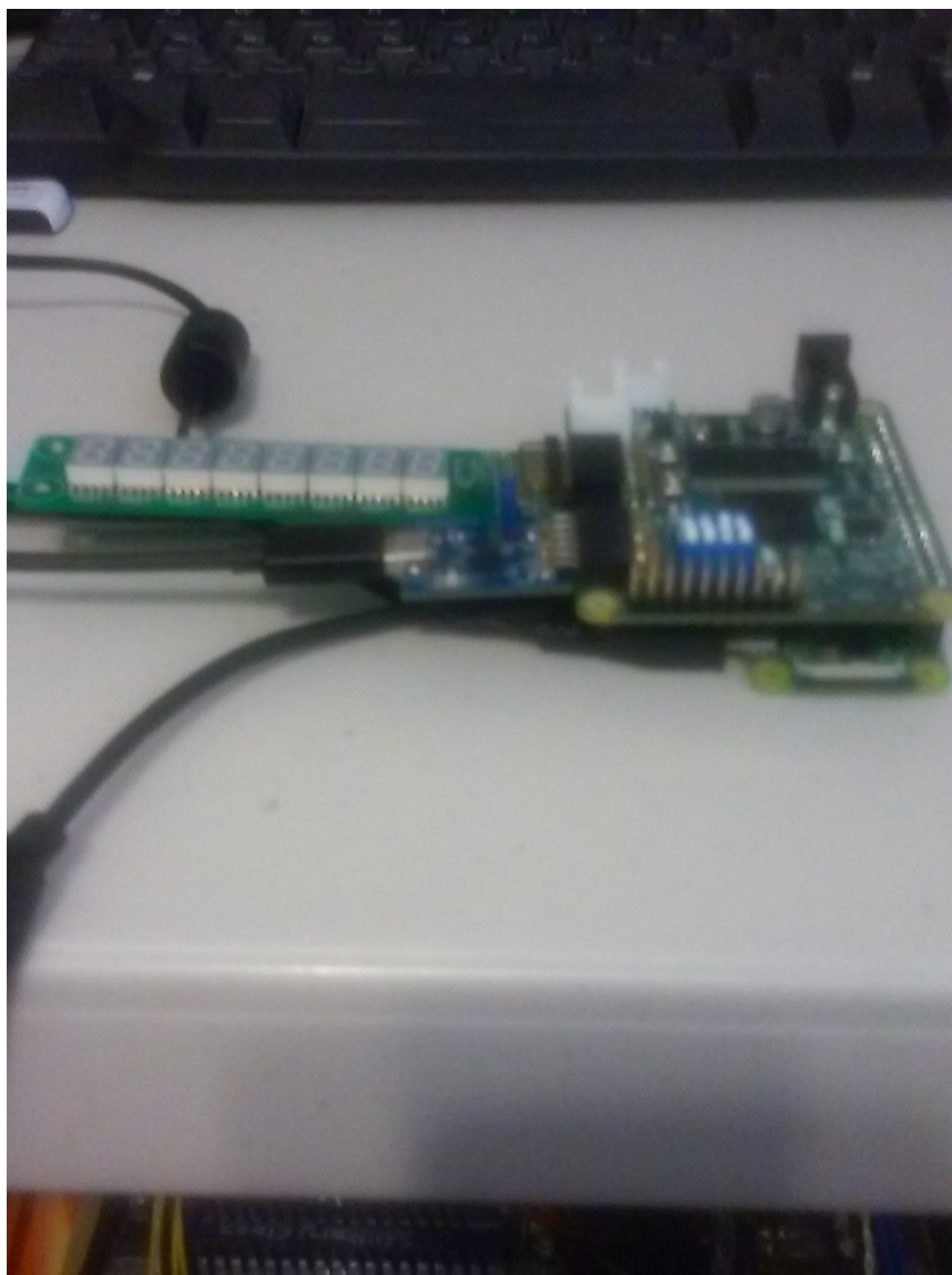
ICOBARD RPI

CATBOARD RPI

GPIO

GPIO1
RPi_GPIO

1	3.3V	5V	2 +5V-RPi
BCM2_SDA 3	BCM2_SDA	5V	4 +5V-RPi
BCM3_SCL 5	BCM3_SCL	GND	6 GND
BCM4_GPCLK0 7	BCM4_GPCLK0	BCM14_TXD	8 BCM14_TXD
GND 9	GND	BCM15_RXD	10 BCM15_RXD
BCM17 11	BCM17	BCM18_PCM_C	12 BCM18_PCM_C
BCM27_PCM_0 13	BCM27_PCM_D	GND	14 GND
BCM22 15	BCM22	BCM23	16 BCM23
17	3.3V	BCM24	18 BCM24
BCM10_MOSI 19	BCM10_MOSI	GND	20 GND
BCM9_MISO 21	BCM9_MISO	BCM25	22 BCM25
BCM11_SCLK 23	BCM11_SCLK	BCM8_CE0	24 BCM8_CE0
GND 25	GND	BCM7_CE1	26 BCM7_CE1
BCM0_ID_SD 27	BCM0_ID_SD	BCM1_ID_SC	28 BCM1_ID_SC
BCM5 29	BCM5	GND	30 GND
BCM6 31	BCM6	BCM12	32 BCM12
BCM13 33	BCM13	GND	34 GND
BCM19_MISO 35	BCM19_MISO	BCM16	36 BCM16
BCM26 37	BCM26	BCM20_MOSI	38 BCM20_MOSI
GND 39	GND	BCM21_SCLK	40 BCM21_SCLK

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

In the catzip/rtl/pptest *make c*reates **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
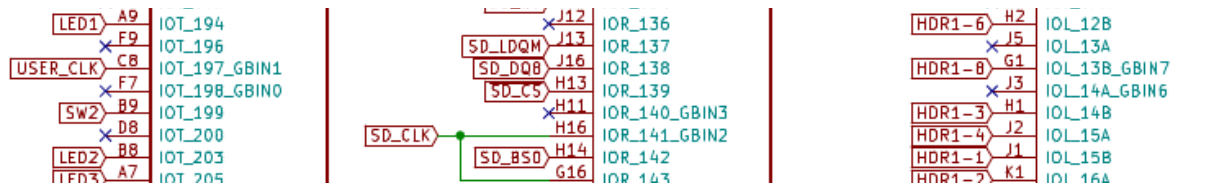fatal error: bad constraint on 'i_clk': no PLL at pin C8

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.

LED1 A9 IOT_194
F9 IOT_196
USER_CLK C8 IOT_197_GBIN1
F7 IOT_198_GBIN0
SW2 B9 IOT_199
D8 IOT_200
LED2 B8 IOT_203
LED3 A7 IOT_205

J12 IOR_136
SD_LDQM J13 IOR_137
SD_DQ8 J16 IOR_138
SD_CS H13 IOR_139
H11 IOR_140_GBIN3
H16 IOR_141_GBIN2
SD_CLK
SD_BS0 H14 IOR_142
G16 IOR_143

HDR1-6 H2 IOL_12B
J5 IOL_13A
HDR1-8 G1 IOL_13B_GBIN7
J3 IOL_14A_GBIN6
HDR1-3 H1 IOL_14B
HDR1-4 J2 IOL_15A
HDR1-1 J1 IOL_15B
HDR1-2 K1 IOL_16A

The verison of speechpp.bin uses a PPL to reduce the 100MHz Oscilator 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)
) plli (
    .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
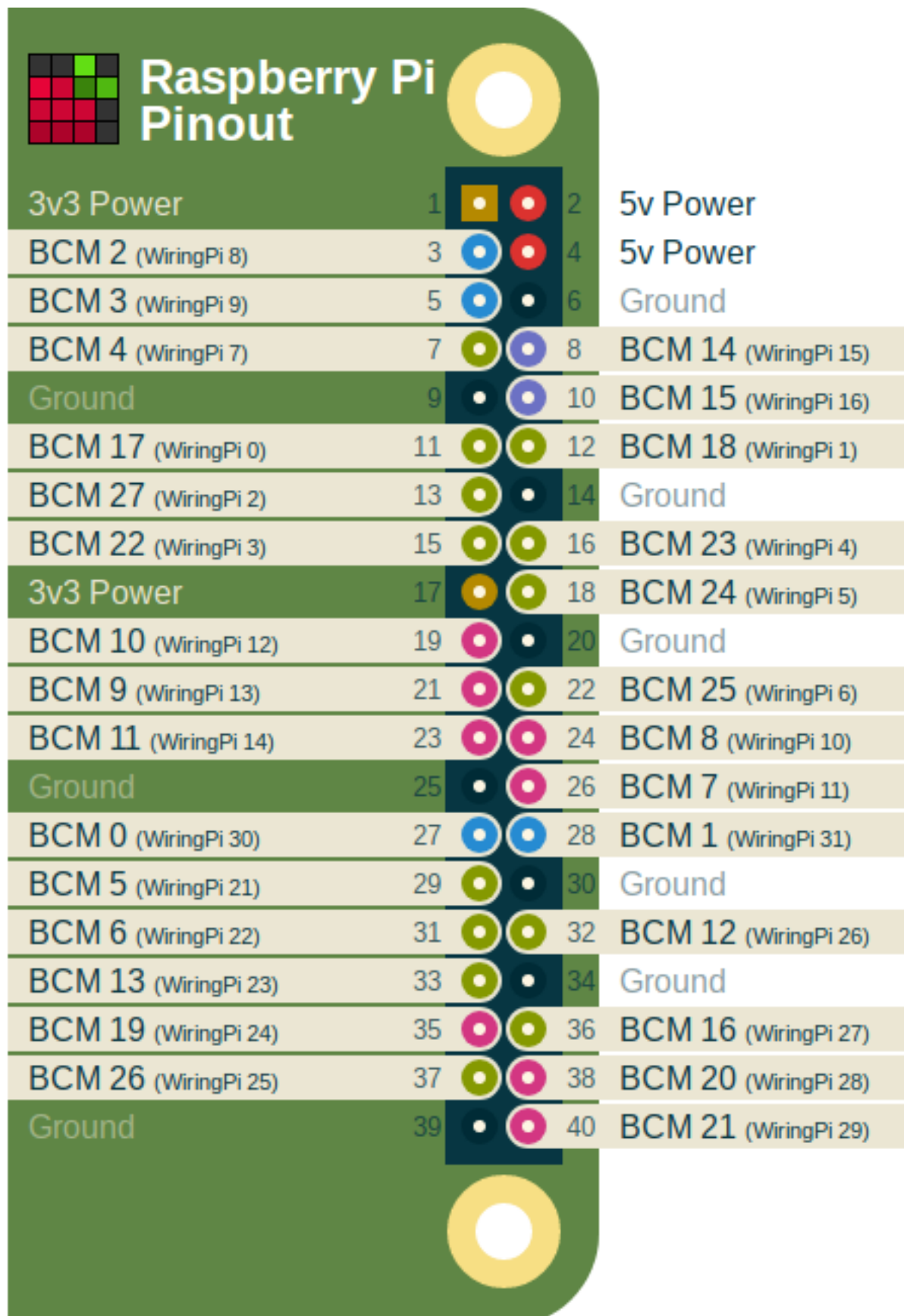*set_io io_pp_data[2] T13*
set_io io_pp_data[3] T6
set_io io_pp_data[4] T5
set_io io_pp_data[5] P9
set_io io_pp_data[6] T9
set_io io_pp_data[7] T11

set_io o_pp_clkfb   T7
The code for netpport.cpp uses witingPi.

To create the executeable

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**

```
pi@pi3-2:~/uart_rxtx/wbuart32/pptest $ 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.                                                             |
|                                                                    |
|                                                                    |
|====================================================================|
```