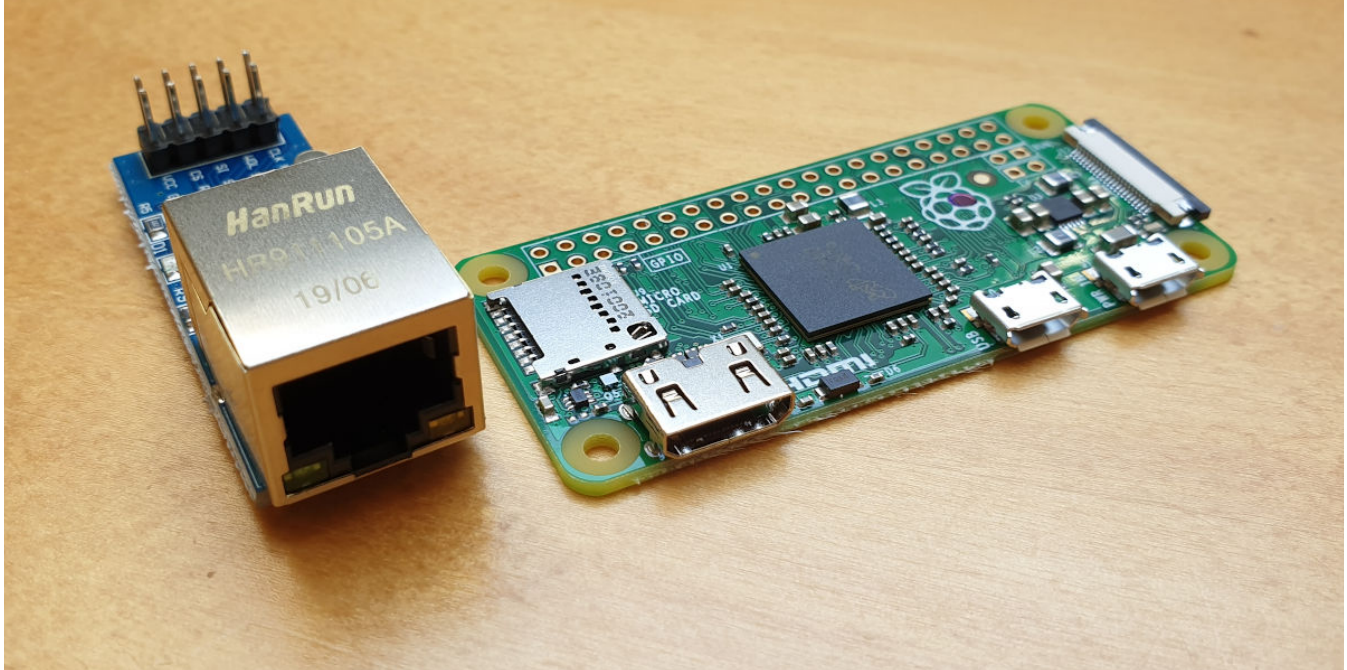




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Adding Ethernet to a Pi Zero

10

BY MATT ON MAY 20, 2020

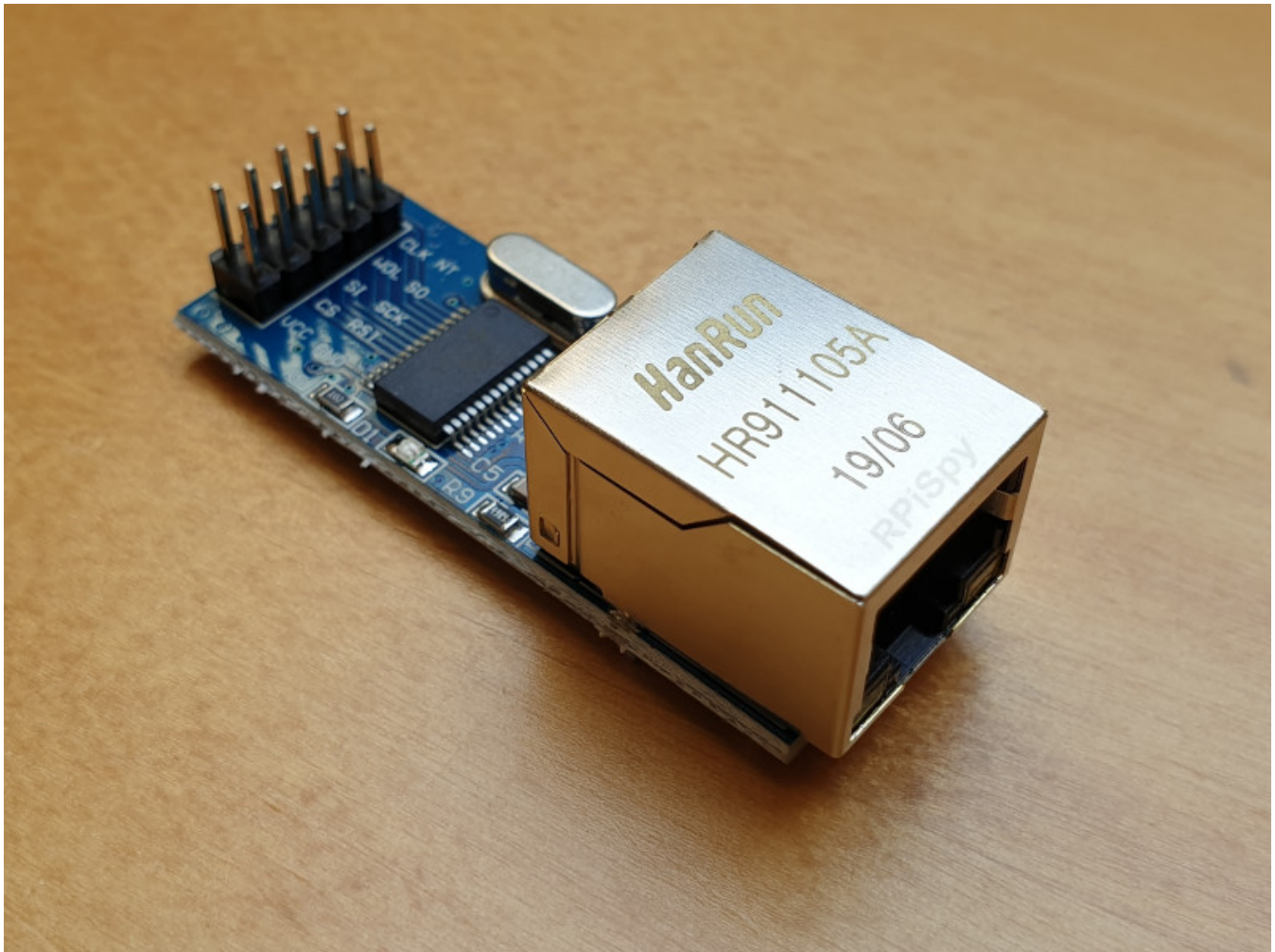
PI ZERO, TUTORIALS & HELP

The Pi Zero has no Ethernet port. If your project requires Ethernet you can add it using either an Ethernet module or a USB to Ethernet adapter.

At this point someone is going to question why you would want to add Ethernet to a Pi Zero. Why not just use a standard Pi which already includes the port? I guess the answer is that there are some projects where using a Pi Zero is desirable due to power consumption or size considerations but you also need the functionality of Ethernet devices. I've got a project in mind which I will blog about in the future (if it proves to be successful).

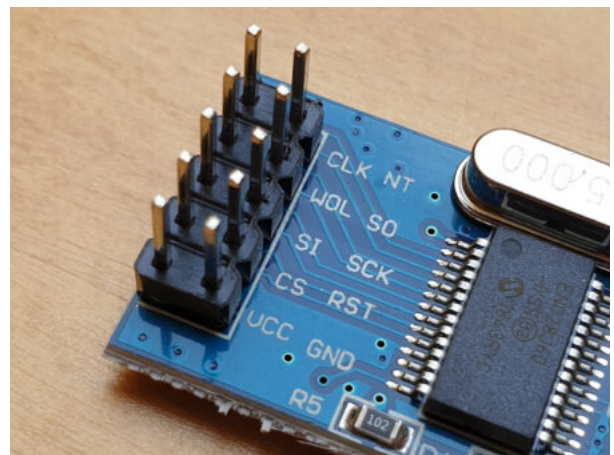
ENC28J60 Ethernet SPI Module

Microchip make the ENC28J60 which is a stand-Alone Ethernet Controller with SPI Interface. It is available as a cheap module which can be connected to the Pi's SPI interface.



The pin-out can vary but most modules will contain a block of 10 pins carrying the following signals :

- VCC & Gnd
- CLK
- INT
- WOL
- MISO & MOSI
- SCK
- CS
- RST



Some modules require 5V while others will work with 3.3V. Pay attention to the details when purchasing one so that you can connect it to the correct voltage. My module runs from 3.3V.

Connecting ENC28J60 to the Pi Header

The module can be connected to the Pi's GPIO header using female-female Dupont style jumper cables.

Pi Header	Module	Module	Pi Header
–	CLK	INT	Pin 22 (GPIO25)
–	WOL	MISO	Pin 21 (GPIO9)
Pin 19 (GPIO10)	MOSI	SCK	Pin 23 (GPIO11)
Pin 24 (GPIO8)	CS	RST	–
Pin 17 (3.3V) Pin 2 (5V)	VCC	GND	Pin 25 (Gnd)

As only 7 pins need to be connected you can connect the module to the Pi Zero using 7 cables.

Connect the ENC28J60 to your Network

Obviously you should connect the ENC28J60 module to your network using an Ethernet patch cable. I connect mine to a network switch but you could connect directly to a spare port on your router.

Given how light the Pi Zero and module are you may want to tape your cables to a surface to prevent them dragging your setup onto the floor.


```
#dtparam=spi=on
```

and delete the # character to leave :

```
dtparam=spi=on
```

Then add the following line :

```
dtoverlay=enc28j60
```

You should end up with a section in your config.txt looking like this:

```
# Uncomment some or all of these to enable the optional hardware interfaces
#dtparam=i2c_arm=on
#dtparam=i2s=on
dtparam=spi=on
dtoverlay=enc28j60
```

Save and exit using CTRL-X, Y and ENTER.

Power-up or Reboot

If you are working directly on the Pi you can now reboot :

```
sudo reboot
```

If you configured the SD card on a PC you can now insert it into the Pi and power-up.

Your Pi should connect to your network automatically.

Set MAC Address

Unlike most other network devices you might have used in the past the ENC28J60 has no preset MAC address. This means it is randomly generated every time the device is started. This may not bother you but could cause your router to keep allocating a different IP address. If you need a consistent MAC

address you have to set it in software.

In the following example I use "b8:27:eb:00:00:01". **If you have multiple devices using this technique you should make sure they are all unique and never clash with other devices on your network.**

Start by creating the following file:

```
sudo nano /lib/systemd/system/setmac.service
```

Add the following contents:

```
[Unit]
Description=Set MAC address for ENC28J60 module
Wants=network-pre.target
Before=network-pre.target
BindsTo=sys-subsystem-net-devices-eth0.device
After=sys-subsystem-net-devices-eth0.device
[Service]
Type=oneshot
ExecStart=/sbin/ip link set dev eth0 address b8:27:eb:00:00:01
ExecStart=/sbin/ip link set dev eth0 up
[Install]
WantedBy=multi-user.target
```

Save and exit using CTRL-X, Y and ENTER.

```
sudo chmod 644 /lib/systemd/system/setmac.service
sudo systemctl daemon-reload
sudo systemctl enable setmac.service
```

Reboot

With everything configured you can now reboot your Pi using:

```
sudo reboot
```

Once you are back at the command line you can check what IP and MAC addresses your Pi is using with :

```
ifconfig
```

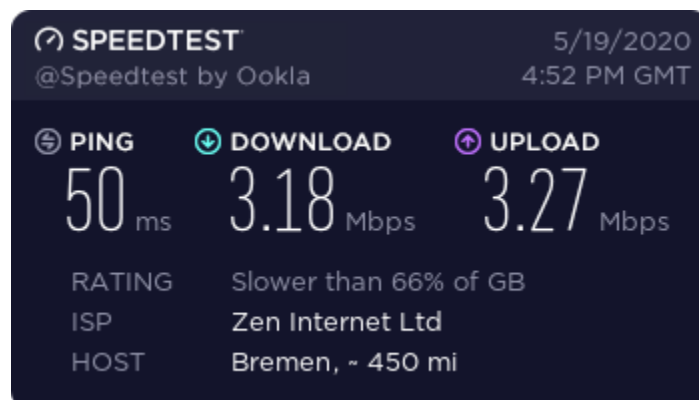
Which should give you an output looking something like :

```
pi@raspberrypi:~ $ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 192.168.001.131  netmask 255.255.255.0  broadcast 192.168.178.255
    inet6 fe80::4cc6:91e:1573:2417  prefixlen 64  scopeid 0x20<link>
    ether b8:27:eb:00:00:01  txqueuelen 1000  (Ethernet)
    RX packets 1188  bytes 192527 (188.0 KiB)
    RX errors 0  dropped 1  overruns 0  frame 0
    TX packets 98  bytes 12457 (12.1 KiB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
    device interrupt 160
```

Here we can see the Pi is using the MAC address we set and has been given an IP address of 192.168.001.131 by my router.

Performance

Using the [speedtest-cli](#) utility I measured the speed of the network link to be between 3.15 and 3.7 Mb/s. Whether this is adequate will depend entirely on the project you are building.



Power & Current Requirements

Lots of people are happy using these devices powered directly from the Pi's 3.3V pin. However the datasheet for the ENC28J60 states it can require 180mA of current when transmitting which is beyond the 50mA limit of the Pi's onboard 3.3V regulator.

For this reason I decided to ensure my ENC28J60 was never starved of current and added a small 5V to 3.3V regulator (HK1117). This small 3-pin module is easy to connect and provided the Ethernet device with all the current it might ever need.

Pi Header	HK1117	ENC28J60
Pin 2 (5V)	Vin	-
Pin 6 (Gnd)	Gnd	-
-	Vout	Vcc (3.3V)

Pi Zero Ethernet Troubleshooting

While setting up my module and writing this article I came across a few issues. These were solved by taking note of the following points :

- Double check all your connections
- Check for loose connections
- Be careful not to confuse CLK and SCK
- Be careful not to confuse MISO (SO) and MOSI (SI)
- Consider using a separate 3.3V regulator to provide adequate current

Buy an Ethernet Module

The ENC28J60 is available from lots of retailers including :

- [ENC28J60 on eBay](#)

My device was described as a “Mini ENC28J60” and cost £4.



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10 COMMENTS



Henry on May 20, 2020 6:21 pm

Brilliant! The only negative I can see to this is that neither unit has a case to enclose them. Someone who's into 3D printing should perhaps try to design a case that will hold a Raspberry Pi Zero [and](#) [reply](#) >

ENC28J60 module side by side or end to end or even one on top of the other, just anything that will keep them from moving around in relation to each other and possibly shorting out!



Matt on May 20, 2020 6:47 pm

The project I have in mind will definitely require the components to be secured in an enclosure. The cables weigh more than the Zero and the module so I taped them to my desk to avoid the whole setup getting dragged onto the floor. Once I know exactly what items I need for my project I'll have to decide what enclosure to use and how best to fit everything inside.

[REPLY >](#)



Steve on May 27, 2020 1:21 am

Interesting post — welcome back! I had about given the website up for dead. Quick question for you: on the face of it, this seems like overkill; is there any reason why you couldn't just use a Ethernet->USB port? These are readily available on the market and work well. It seems to me like this would be a much simpler approach.

[REPLY >](#)



Matt on May 27, 2020 8:14 am

I've got an Ethernet-USB adaptor and plan to give that a try as well. I think the reason the ENC module might be useful is that you could pack it into a smaller space and it wouldn't require a USB plug to stick out the side of the Pi. Although the USB plug could be cut off and the wire soldered directly to the back of the Pi PCB. The ENC modules are also marginally cheaper so if you needed a lot of them it might bring the total cost down.

[REPLY >](#)



steve on May 28, 2020 8:37 am

Fair enough...although there are 90-degree USB connectors that could considerably lower the profile of the connection. In my experience, the Eth-USB adaptors are completely plug-and-play — no configuration, nothing to troubleshoot, so that would be a big win in my book.

Looking forward to future posts!

[REPLY >](#)



Colin on June 20, 2020 1:09 pm



You can get those SPI to Ethernet modules with a 5v regulator included on the module, the couple I have which I got on ebay as well have the AMS1117 3.3 regulator on the bottom of the board and on the header there is one for a 3.3v supply and one for a 5v supply which feeds the regulator which then supplies the module.

[REPLY >](#)



Adam Insanoff on August 8, 2020 3:21 pm

Many thanks for the instruction. Worked from first try.

[REPLY >](#)



Daniel on June 3, 2021 10:21 am

Does this prevent anything else working e.g. the camera? I'd love to try and implement this for CCTV...

Thanks

[REPLY >](#)



Matt on June 18, 2021 10:45 pm

Creating a CCTV camera was the reason I started playing with these devices. I didn't get around to trying it but there is no reason it shouldn't work.

[REPLY >](#)



Viragored on September 14, 2022 7:28 am

Great instructions, thanks. I hooked up one of these adapters to an old, old Pi Zero and everything worked first time!

One of your first commenters suggested an enclosure. I think they're right, so that's on my list of "do one day" projects. If I succeed, the result will be on Printables.

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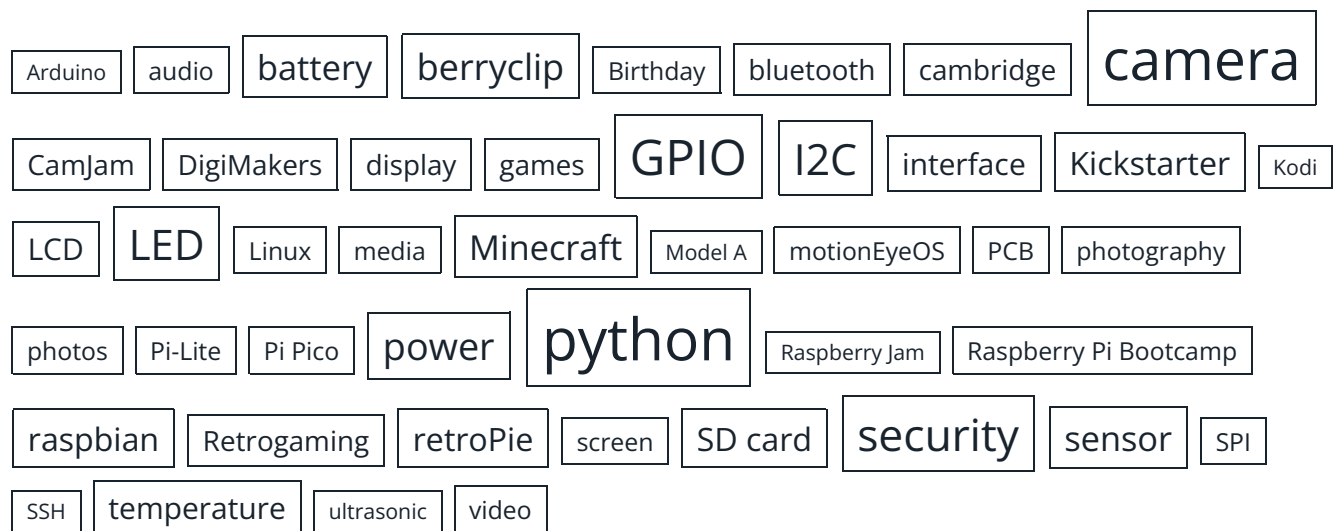
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