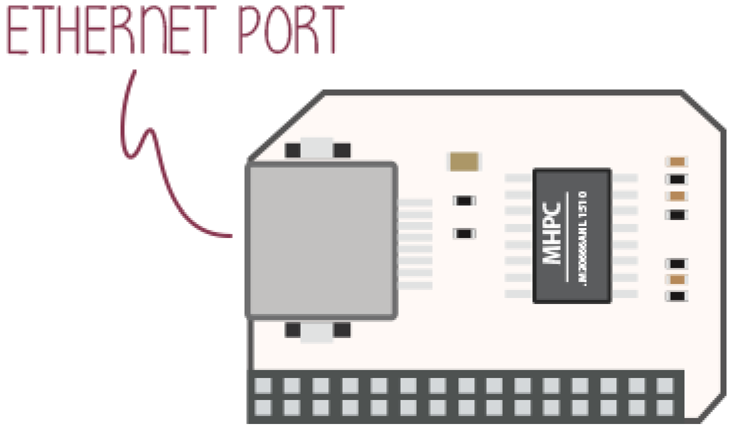
Ethernet Expansion

The Ethernet Expansion adds an Ethernet port to the Omega. With this expansion you can add reliable, wired network access to your Omega, without affecting its wireless capabilities. It also has the added bonus of being able to reflash an Omega whose software is corrupted (“bricked”).

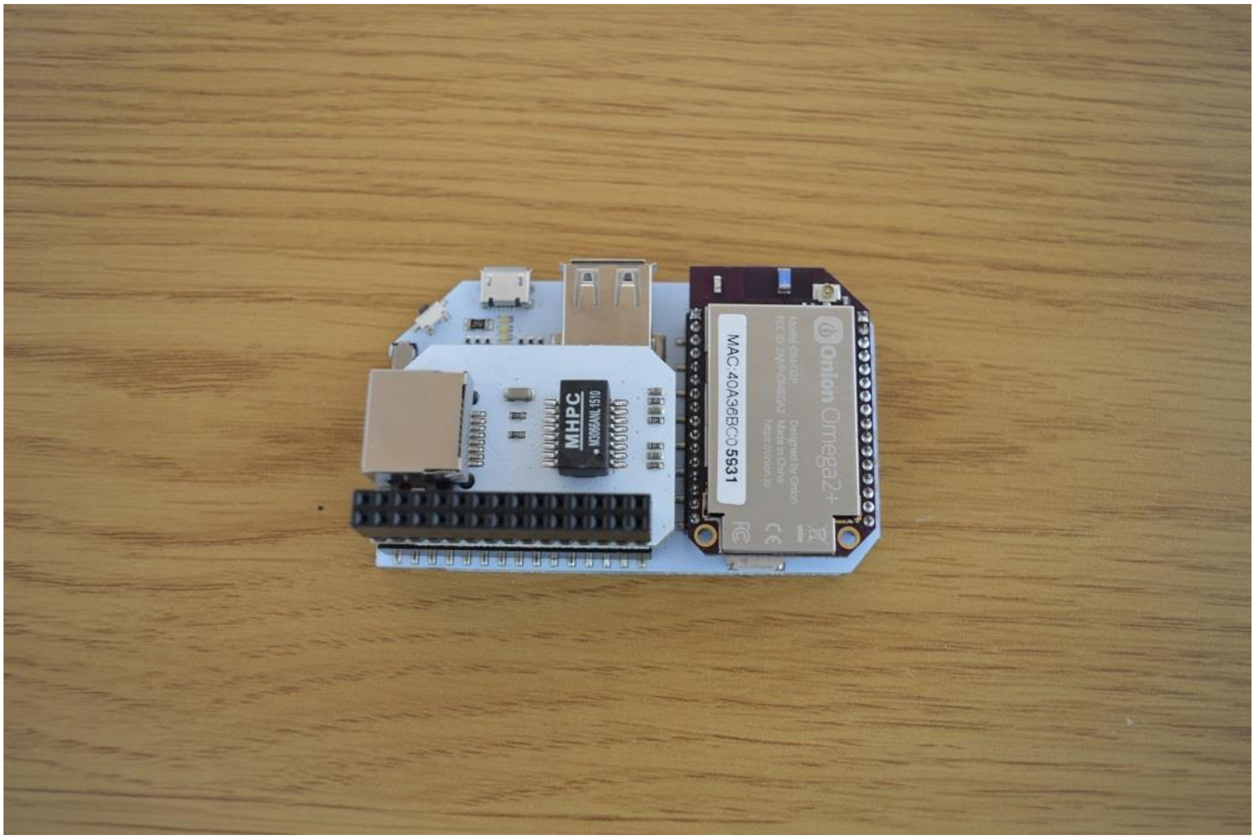
The Hardware

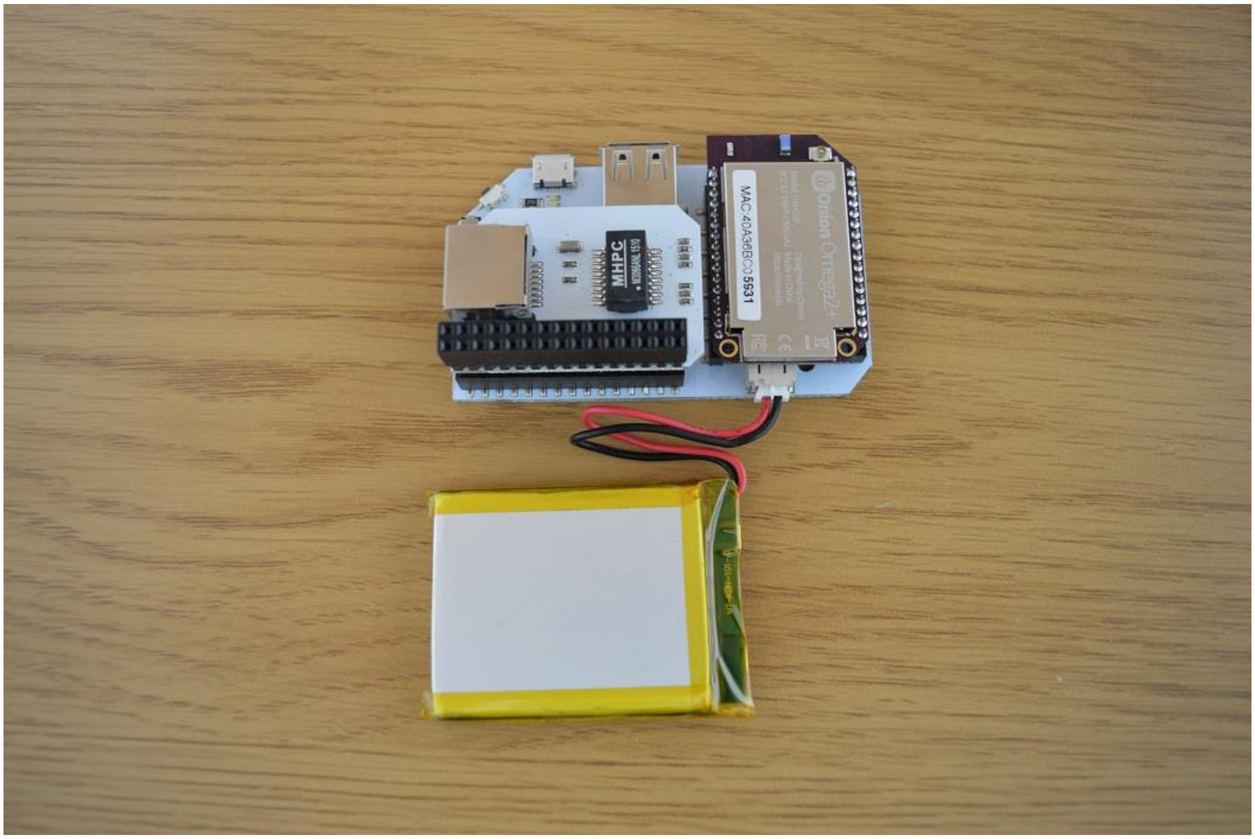
The Ethernet Expansion includes a single standard ethernet port. Simple, but effective.

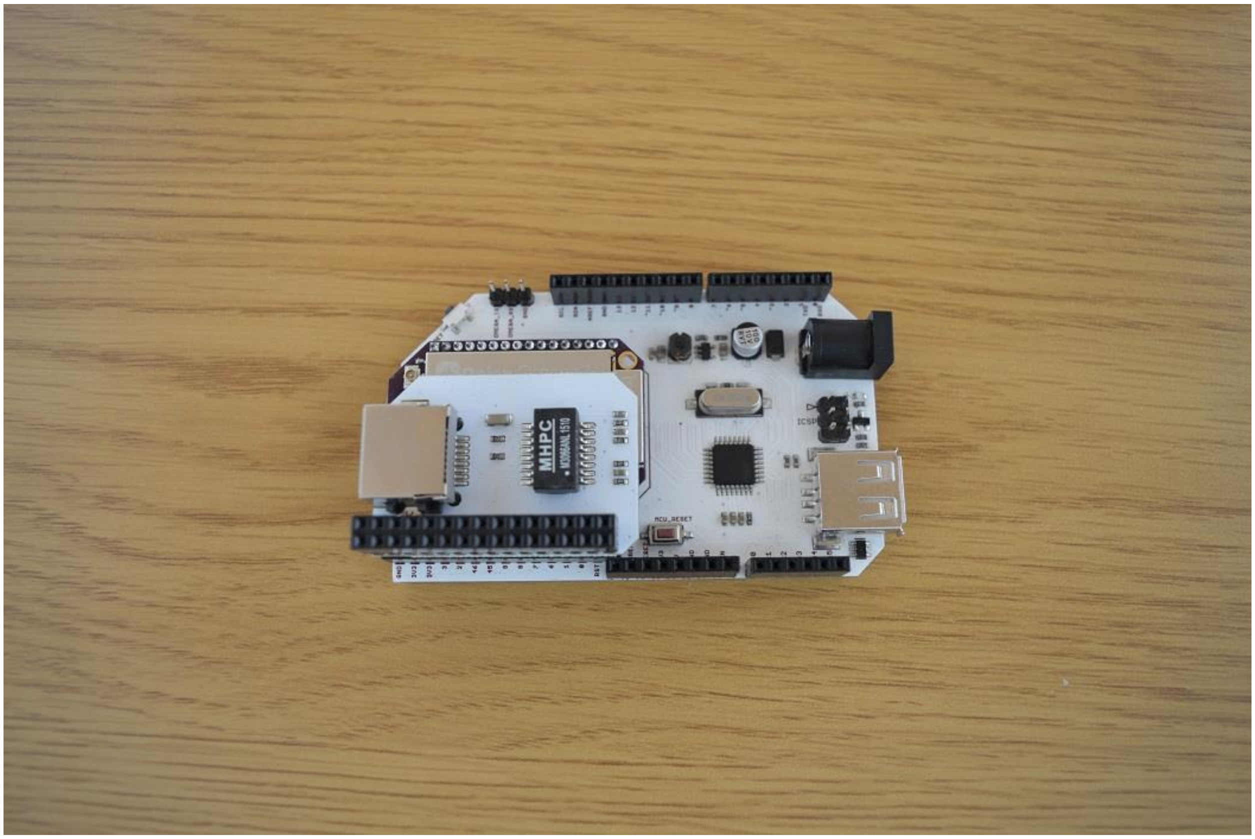


Connecting to a Dock

The Ethernet Expansion is to be plugged into an Expansion Header. These headers can be found on the Expansion Dock, Power Dock, and the Arduino Dock 2. In addition to that, the Ethernet Expansion can also be plugged into most other Expansions.







NOTE: The Ethernet Expansion does not plug in ALL THE WAY like the Omega does. The pin will be exposed at the top (refer to image above)

This Expansion features an Expansion Header, so other expansions can be safely stacked on top of it.

Connecting an Ethernet Cable

Your Omega will automatically discover when an Ethernet cord is connected to your Ethernet Expansion. If you're connected to the Omega's command line **through serial,** you'll see the following output when you plug in an Ethernet cord:

```
root@Omega-2757:/# [  473.834234] rt3050-esw 10110000.esw: link changed 0x01
```

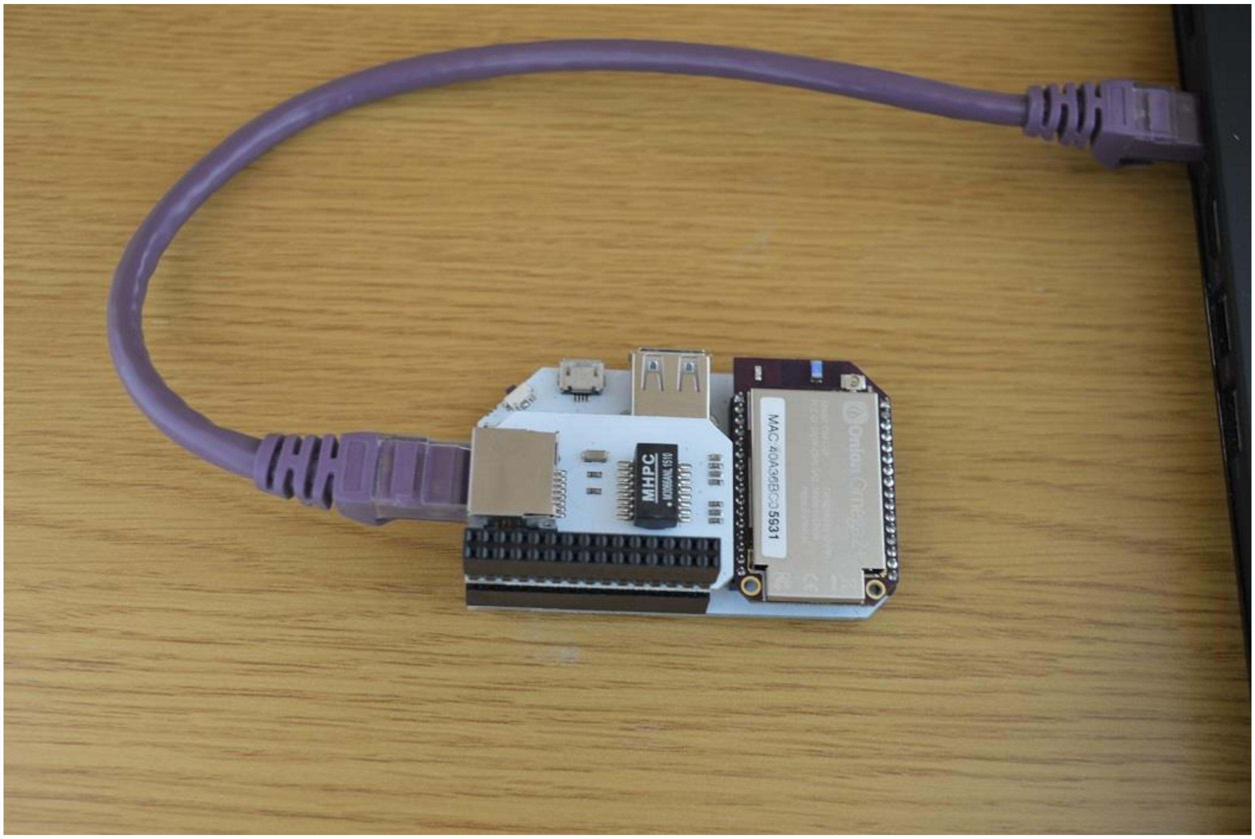
and when you unlpug the ethernet cord you'll see this:

```
[  491.625850] rt3050-esw 10110000.esw: link changed 0x00
```

If you're connected to the Omega's command line through SSH, you can run the `dmesg` command to print out all of the messages from the kernel.

To connect an Ethernet cord to your Ethernet Expansion, properly align the Ethernet plug with the jack, and insert. It will click in place.

In order to disconnect the Ethernet cable you'll need to press down on the cord in order to release the lock mechanism (the click sound was this mechanism)



Mechanical Drawings

We’ve made available a detailed diagram of the dimensions and geometry of the Ethernet Expansion.

Using the Ethernet Expansion

The Ethernet Expansion is a great tool to extend the networking capabilities of your Omega by providing another method of connecting to the internet.

To learn more about using the Ethernet Expansion check out our guide to using the Ethernet Expansion

Using the Ethernet Expansion

The Ethernet Expansion is a piece of hardware that adds a standard RJ45 ethernet port to your Omega, allowing for quick and easy Ethernet connections with other devices. With this Expansion, you can easily use your Omega as a router, an Ethernet bridge, and more.

You can learn more about the technical specifications of the Ethernet Expansion in our Ethernet Expansion hardware overview

Learn More about the Omega’s Ethernet Port

See the documentation article on the Omega’s ethernet port and its modes of operation to learn more.

Going Further with the Ethernet Expansion

If you don’t have a router and need to supply a wireless network and internet connectivity to devices, the Ethernet Expansion can transform the Omega into a very effective router. For more on that you can read our tutorial on transforming your Omega into a router

You can use the Ethernet Expansion and the Omega to provide a wired connection to a laptop or a computer. This is known as an Ethernet Bridge, and you can learn more about it in our tutorial on creating an Ethernet Bridge using the Omega

he Ethernet Port

The Omega2 family devices feature a single 10/100M Ethernet integrated PHY. The addition of a transformer and a RJ45 port allow for quick and easy wired networking with ethernet cables.

The ethernet port can be configured to be a client or a DHCP host. It is set to client mode by default. Given the flexibility of the networking stack on the Omega2, there are a few overall modes of operation available:

- Ethernet client - Omega obtains network access through a wired connection
- Ethernet client + Router - Omega obtains network access through a wired connection and **shares** network access through its WiFi AP
- Ethernet host - Omega provides IP addresses to a device connected to the ethernet port
- Ethernet bridge - Omega obtains network access by connecting to a wireless network and **shares** network access to a device through ethernet

When using a through-hole Omega2 on a Dock with an Expansion Header, the Ethernet Expansion can be used to quickly add wired networking capabilities to the device. With custom hardware powered by the Omega2 or Omega2S, a transformer and an RJ45 port are required. See the Omega2S Reference Schematic for details.

Ethernet Client: Connecting to a Network through Ethernet

The Omega can join networks through a wired Ethernet connection, much like a desktop computer. By default, the Ethernet port on the Omega is configured to act as a network client, allowing users to simply plug in an ethernet cable and the Omega will do the rest: connecting to the network and attempting to obtain an IP address.

Note that by default, the Omega will have internet access. But it will not automatically share internet access to any devices connected to the Omega's WiFi AP.

Enabling Ethernet Client Mode

As mentioned, the ethernet port is configured for ethernet client operation by default. However, if the configuration on your Omega has changed and you would like to quickly return to ethernet client mode, run the following command:

```
onion ethernet client
```

This will:

- Configure the `wan` network interface to expect to obtain an IP address through DHCP
- Remove any `lan` network interfaces
- Remove any `lan` DHCP configurations

How Client Mode Works

For background, the Omega's Ethernet interface is called `eth0` by the system .

The default configuration in `/etc/config/network` defines a `wan` network interface that uses the physical `eth0` interface, and expects to be given an IP address through DHCP.
Opening the `/etc/config/network` file, you will find a block that looks something like the following:

```
config interface 'wan'
   option ifname 'eth0'
   option proto 'dhcp'
```

To learn more about OpenWRT's network configuration, see the related OpenWRT network documentation.

Packet Routing

By default, the Omega's firewall is **not** configured to share ethernet network access through the Omega's WiFi Access Point.

If the goal is to share ethernet network access through the Omega's WiFi Access Point, then the firewall configuration will need to be changed. Specifically, we will need to:

- Add our `wan` network interface (that uses the `eth0` ethernet interface) to the `wan` firewall rule
- Update the `wan` firewall rule to **allow packet forwarding**

To do this, open the `/etc/config/firewall` file, find the block that looks something like:

```
config zone
        option name 'wan'
        option output 'ACCEPT'
        option forward 'REJECT'
        option masq '1'
        option mtu_fix '1'
        option network 'wwan'
        option input 'ACCEPT'
```

and do the following:

- Change `option forward 'REJECT'` to `option forward 'ACCEPT'`
- Change `option network 'wwan'` to `list network 'wwan'`
- Add `list network 'wan'` after the `list network 'wwan'` line

```
config zone
        option name 'wan'
        option output 'ACCEPT'
        option forward 'ACCEPT'  # changed to ACCEPT
        option masq '1'
        option mtu_fix '1'
        list network 'wwan' # changed 'option' to 'list'
        list network 'wan'  # added wan network to list
        option input 'ACCEPT'
```

To learn more about OpenWRT's firewall, see the related OpenWRT firewall documentation.

Ethernet Host: Acting as the Host on a Wired Network

Alternatively, the ethernet port can act as a host. Any devices connected to the ethernet port will receive an IP address - similar to when a device is connected directly to the ethernet ports on the back of a router.

Enabling Ethernet Host Mode

The ethernet port can be configured for host mode by running the following:

```
onion -t ethernet host
/etc/init.d/ethernet-mode disable
reboot
```

This will:

- Remove the existing `wan` network interface that configures the ethernet port as a client
- Creates a `lan` network interface that statically sets the IP address of that interface to `192.168.100.1`
- Creates a DHCP `lan` configuration that uses the `lan` network interfaces, and assigns any connected devices an IP address in the range of `192.168.100.100` to `192.168.100.150`
- Disable the `ethernet-mode` service that runs at boot to make sure the ethernet port is set to client mode

After your Omega reboots, the ethernet port will act as a host, assigning IP addresses to any connected devices.

How Host Mode Works

For background, the Omega’s Ethernet interface is called `eth0` by the system .

After running the command above to enable ethernet host host mode, the configuration in `/etc/config/network` will define a `lan` network interface that uses the physical `eth0` interface, and statically sets the IP address of that interface to `192.168.100.1`
Opening the `/etc/config/network` file, you will find a block that looks something like the following:

```
config interface 'lan'
        option ifname 'eth0'
        option force_link '1'
        option macaddr '40:a3:6b:c0:27:84'
        option type 'bridge'
        option proto 'static'
        option ipaddr '192.168.100.1'
        option netmask '255.255.255.0'
        option ip6assign '60'
```

To learn more about OpenWRT’s network configuration, see the related OpenWRT network documentation.

DHCP

To be able to assign IP addresses to devices that connect to the ethernet port, there has to be a DHCP configuration. After running the command above to enable ethernet host host mode, the configuration in `/etc/config/dhcp` will define a `lan` DHCP configuration. It will be set up to assign IP address to connected devices in the range of `192.168.100.100` to `192.168.100.150` for 12 hour lease times.
About the assigned IP addresses: the base `192.168.100.*` part comes from the `lan` network interface’s static IP address and netmask (set in `/etc/config/network`), and the range of `100` to `150` is configured here in the DHCP configuration.

Opening the `/etc/config/dhcp` file, you will find a block that looks something like the following:

```
config dhcp 'lan'
        option interface 'lan'
        option start '100'
        option limit '150'
        option leasetime '12h'
        option dhcpv6 'server'
        option ra 'server'
```

To learn more about OpenWRT’s DHCP configuration, see the related OpenWRT DHCP documentation.

The Omega as a Router

This tutorial will show you how you can use the Omega as a WiFi router. A router is a device has a connection to the internet (or other networks) through Ethernet, and then provides access to this network wirelessly through a WiFi Access Point (AP).

The Omega is configured to host a WiFi Access point by default, by following this tutorial, you will learn how to change the configuration so that network access from the ethernet port is shared on the WiFi AP.

In this example, we will be using an Omega2, a Dock, and an Ethernet Expansion to turn our Omega into a low-cost yet effective router. These same configuration changes can be made for any custom hardware that uses the Omega2/Omega2S and has an ethernet port.

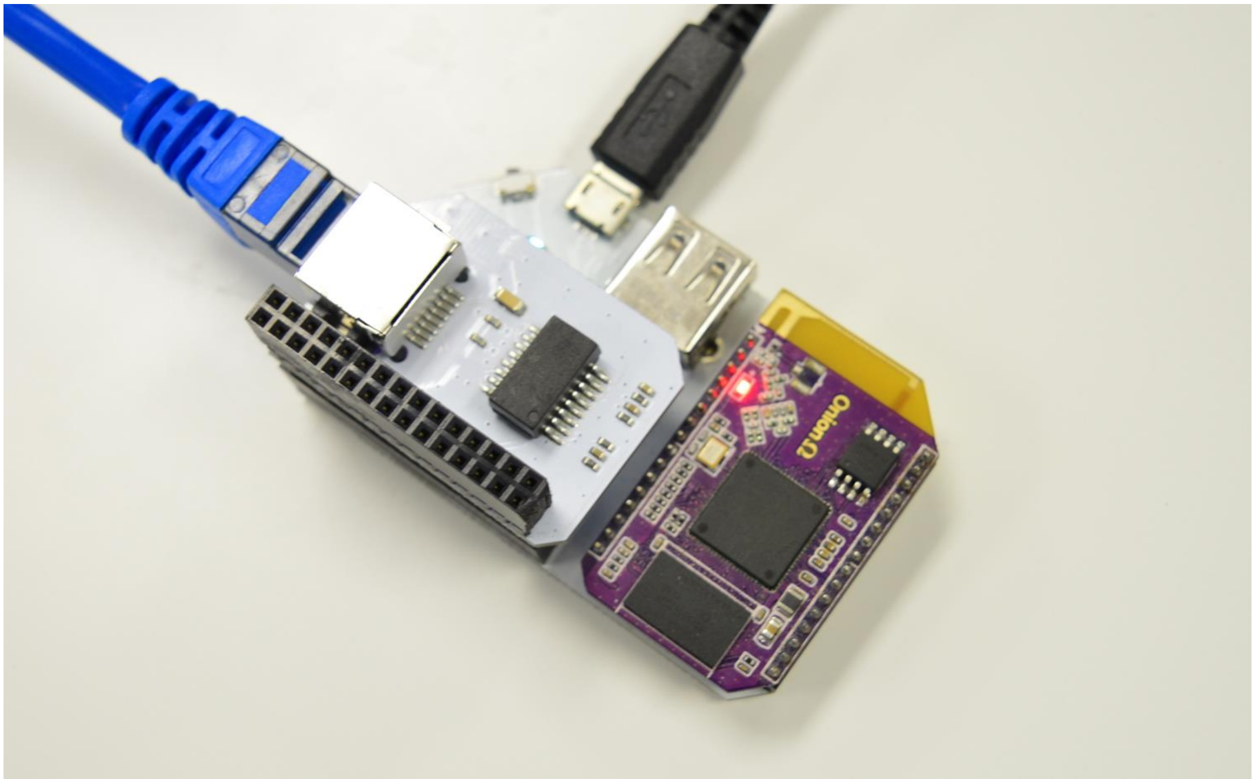
Overview

Tutorial Difficulty	**Intermediate**
Time Required	**10 mins**
Required Materials	Omega2 or Omega2+ Expansion Dock Ethernet Expansion

We're going to first setup the hardware, then we'll change some Omega config files that will enable the Omega to forward our connection properly.

Step 1: Setup the Hardware

Connect your Ethernet Expansion to the Expansion dock, and plug in the Ethernet cable, as shown below:



After you have connected everything, power on the Omega.

Step 2: Setup the Omega

The next step is to disable the WiFi client connection on the Omega. We want our Omega to connect to the internet via the ethernet connection and so we're going to turn off the WiFi on our Omega

We're going to be disabling the WiFi on the Omega so you'll need to make sure that you've established a serial connection with your Omega. For more information, please refer to this guide on connecting to your Omega.

To do this, you will use the `uci` command to change the wireless of your Omega. Enter the following command to disable the WiFi client interface, also known as STA:

```
uci set wireless.sta.disabled=1
```

If your Omega is running a firmware older than v0.2.0, the command will instead be `uci set wireless.@wifi-iface[0].ApCliEnable=0`. We strongly recommend upgrading to the latest firmware!

Then run the following command to save your changes:

```
uci commit wireless
```

This will disable the WiFi client interface that is used to wirelessly connect to a router.

Step 3: Changing the Settings of the Omega’s WiFi Access Point

Since you probably don’t want uninvited guests on your new router, it is recommended that you change your Omega’s settings from the default setup, especially the password.

To do so, enter the following commands, substituting `OmegaRouter` and `RouterPassword`:

```
uci set wireless.ap.ssid=OmegaRouter
uci set wireless.ap.key=RouterPassword
uci commit wireless
```

Restart the WiFi network to apply your saved changes:

```
wifi
```

Changing the Encryption Type

The default encryption of the Omega’s WiFi AP is set to WPA2. We recommend sticking with WPA2 as it is the most secure.

To confirm the encryption type, you can run:

```
uci get wireless.ap.encryption
```

And you will see `psk2` as the output.
If you wish to keep the default encryption type, you can continue to the next step below.

However, if you wish to change the encryption type, find the type you want in the UCI wireless encryption list, then substitute it into `YourEncryptionType` and run:

```
uci set wireless.ap.encryption=YourEncryptionType
uci commit wireless
```

The options are:

- `psk2` for WPA2
- `psk` for WPA1
- `wep` for WEP
- `none` for no encryption

Note: If you don’t know what encryption type to use, just keep the default.

Please keep in mind that 1st generation WPA is not secure.

Restarting the Wifi Radio

Once you have finished customizing the WiFi network settings, run the following command to restart the WiFi radio and apply your settings:

```
wifi
```

Enabling the Ethernet Port

Only needed on firmware v0.1.10 or lower, safely skip to the next step if running a later firmware.

In firmware v0.1.10 and earlier, the ethernet interface was not enabled by default. Enable the ethernet port by running:

```
uci set network.wan.ifname='eth0'
uci set network.wan.hostname='OnionOmega'
uci commit
```

Then restart the Omega's network interfaces:

```
/etc/init.d/network restart
```

We strongly recommend upgrading to the latest firmware

Step 4: Enabling Packet Routing

The Omega's ethernet port is configured to act as a network client by default. So we will just need to configure the Omega to route packets from the ethernet networ interface (`wan`) to your WiFi AP interface (`wlan`). To do this, you will be editing the `/etc/config/firewall` file:
Find the block that looks something like the following:

```
config zone
        option name 'wan'
        option output 'ACCEPT'
        option forward 'REJECT'
        option masq '1'
        option mtu_fix '1'
        option network 'wwan'
        option input 'ACCEPT'
```

and do the following:

- Change `option forward 'REJECT'` to `option forward 'ACCEPT'`
- Change `option network 'wwan'` to `list network 'wwan'`
- Add `list network 'wan'` after the `list network 'wwan'` line

What you will end up with is something like the following:

```
config zone
        option name 'wan'
        option output 'ACCEPT'
        option forward 'ACCEPT'
        option masq '1'
        option mtu_fix '1'
        list network 'wwan'
        list network 'wan'
        option input 'ACCEPT'
```

This configuration adds the `wan` network (which is defined in `/etc/config/network`) to a firewall zone called `wan`. This zone has already been setup to route packets to another firewall zone called `lan`, which contains the `wlan0` interface.

Once you have saved and closed the file, run the following command to restart the firewall with the updated configuration:

```
/etc/init.d/firewall restart
```

Step 5: Using the Omega Router

And we are ready! To use the Omega Router, you simply need to connect your computer or your smartphone/tablet to the Omega's WiFi network, and your devices will be able to access the Internet!

Happy hacking!

Ethernet Bridge

In this tutorial, we are going to create an Ethernet Bridge using the Omega. An Ethernet Bridge is a device that shares its WiFi internet access through an Ethernet connection, similar to a WiFi dongle.

Our Omega's WiFi and the Ethernet Expansion will allow this to be accomplished.

As an example, this type of setup can be used to bring internet access to a desktop computer that does not have a network adapter.

Overview

Tutorial Difficulty	**Intermediate**
Time Required	**10 mins**
Required Materials	Omega2 or Omega2+ Expansion Dock Ethernet Expansion

The Expansion dock can be substituted with a Power Dock, Mini Dock, or Arduino Dock 2.

This tutorial will cover connecting to a WiFi network, configuring the Ethernet port to act as a host, and then bridge the wireless internet connection with an Ethernet connection.

Step 1: Connect Omega WiFi to the Internet

To begin, you'll need to establish a wireless connection to the Internet on your Omega. Follow this guide to learn more on how to set up your Omega.

Step 2: Configure the Omega's Ethernet Port

Connect your Ethernet Expansion to your Expansion Dock, and then plug in an Ethernet cord to set up the hardware.

What we need to do next is change the following code block located in `/etc/config/network`:

```
config interface 'wlan'
        option type 'bridge'
        option ifname 'eth0.1'
        option proto 'static'
        option ipaddr '192.168.3.1'
        option netmask '255.255.255.0'
        option ip6assign '60'
```

Change `option ifname 'eth0.1'` to `option ifname 'eth0'`
Restart the network service by running the follow command:

```
/etc/init.d/network restart
```

Step 3: Configure your Device to use Ethernet

Now that the Omega is configured, we should be able to connect with other devices via Ethernet.

Make sure that your connection is set to `Obtain IP address and DNS address Automatically`. It should be set so by default.

Windows

To do this on Windows, follow this guide

Mac OSX

To do this on Mac OSX, follow this guide