# XC4394 LoRa Gateway

The LoRa Gateway is an ideal solution for connecting sensors and sensor networks to the internet.

The XC4394 LoRa Gateway incorporates a OpenWRT based router SoC offering WiFi, LAN, WAN and USB connectivity. Also connected to the SoC is an ATMega328 microcontroller offering functionality similar to an Arduino Uno. Many of the ATMega328's IO pins are broken out to a screw terminal header. The ATMega328 is also connected internally to a LoRa compatible module.
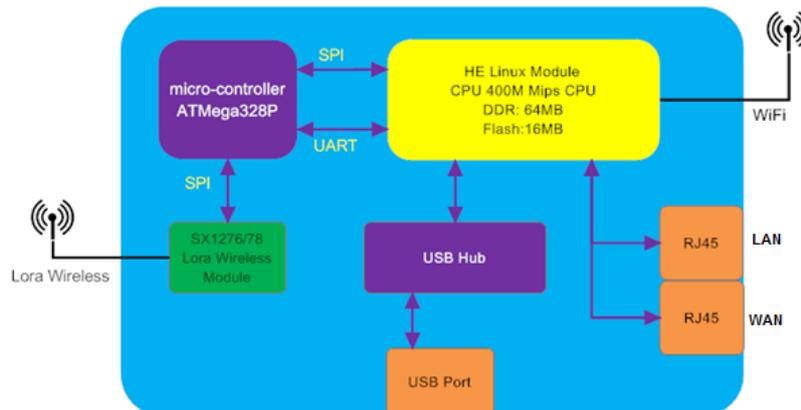
The following ATMega328 pins are broken out, as well as A2 being connected to the 'heartbeat' LED on top of the unit:
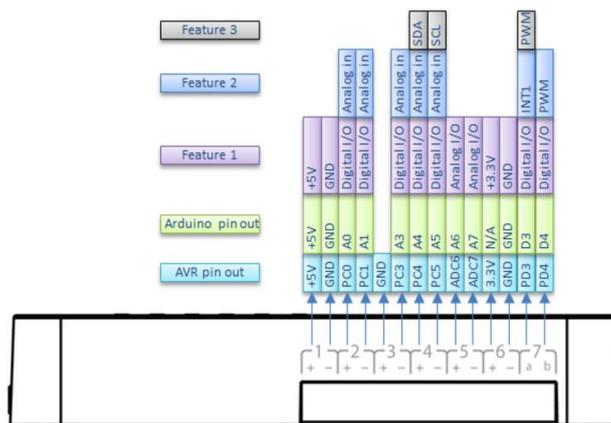
Setup:

Initial setup is similar to other routers- attach the external antenna if necessary (this is the LoRa antenna, the WiFi antenna is internal), and then connect the power supply to the Gateway and mains power. If you have a LAN connection to the internet, connect it now- you will be able to skip some of the wireless setup.

Once the Gateway has started, it will present an open WiFi network called 'duinotech-xxxxxx'. Connect to this WiFi network, and use a browser to go to http://10.130.1.1/. Use the username 'root' and the password 'duinotech' to log in. These credentials should be used for any activity that requires authentication, such as SSH.

Once logged in, click on System>System and set the Timezone to the correct setting for your location, then press 'Save' at the bottom of the page. Like other Linux-based devices, the Gateway can automatically set the time via NTP if it has an internet connection.

Click on Network>Internet Access and set the Internet connection method. Most users will be able to use 'WiFi Client' by setting the SSID, Encryption and Password to match their own WiFi network.

Click 'Save and Apply'. After this, the Gateway will not be accessible via http://10.130.1.1/, so you may have to find its new IP address via your WiFi router, and connect to this IP address. It may be a good idea to give the Gateway a reserved DHCP address so that the address doesn't keep changing. The instructions for this will vary between routers.

As the Gateway is effectively a Linux computer, you can also run commands via a console over an SSH connection. We have been using TeraTerm and PuTTY succesfully, but there are others out there. To connect a SSH client to the Gateway, you will need to know the IP address, username and password (the default username and password are as above). If you are having trouble with the SSH connection, check that SSH is enabled on the Gateway under the System>Administration menu.

Arduino Setup:

To be able to use the Gateway with the Arduino IDE, the Yun board profile needs to be installed. This also has a profile to allow programming over WiFi to occur. When programming the microcontroller, you can continue to use the Uno profile, but the Port is now a virtual port, not a physical COM port. It should appear as 'duinotech-xxxxxx at xxx.xxx.xxx.xxx' where the second set of x's is the IP address. If you are not seeing the virtual port, restart the Arduino IDE or the computer as necessary.

To test out the connection, open the 'Blink' sketch, and change it to use pin 'A2' instead of '13'- this is the 'heartbeat' LED on the top of the case. If you can get the heartbeat LED blinking, then the virtual COM port upload is working.

LoRa Module

To make use of the LoRa Module on the Gateway, an Arduino library is needed, and we've been using one that can be installed via the Library Manager (Sketch>Include Library>Manage Libraries…). Search for 'lora', and install the library simply called 'lora'. Alternatively, it can be downloaded from https://github.com/sandeepmistry/arduino-LoRa, where there are guides describing the library features. A simple way to test the library is to use the 'LoRaReceiver' and 'LoRaSender' example sketches.

OpenWRT:

As mentioned above, OpenWRT is a version of Linux designed for small devices like routers. If you are familiar with Linux commands and file systems, you should find the Gateway has few surprises. One major difference worth remembering is that most of the file system is held on flash, which can wear out if used excessively. Files which are not required to be kept can be worked on in the /tmp folder, which exists as a ramdisk which is lost when power is lost. If you need large amounts of writeable storage, a USB stick or similar is recommended.

All the commands shown below are entered into the console, which will have to be accessed via an SSH client.

If you are unsure about how a command works, try the command name followed by '--help', eg:

```
ls --help
```

Although the Gateway has only one USB socket, a hub can be used to add extra devices. The Yun Shield has limited power ability, so a powered hub should be used if possible.

Connecting a 3G USB Wireless Broadband Stick

The Gateway version of the OpenWRT system should automatically detect a USB Modem if attached. Select 'USB Modem' under Network>Internet Access, and then see if the Modem is detected. Update the settings below to match your hardware and ISP's setting, then click Save & Apply to complete the setup.

If the Modem is not detected, you may need to find and install appropriate drivers.

USB Modem Setting

Field	Value	Note
USB Modem	Manufacturer:HUAWEI Technology, Vendor ID:12d1, Product ID:1436	Auto Detect USB Devices
Modem Status	inet addr:10.72.101.23 P-t-P:10.64.64.64 Mask:255.255.255.255	Connection Status
Available USB Port	/dev/ttyUSB1 /dev/ttyUSB2 /dev/ttyUSB3 /dev/ttyUSB4	A modem is always detected to have several USB port for different features
USB Modem Service	UMTS	3G WCDMA
VID	12d1	Vendor ID as shown in USB info section
PID	1436	Product ID as shown in USB info section
Service APN	3gnet	Service APN. 3gnet is for China Unicom
Dial String	*99#	Dial String, Default *99#
Username		Leave blank if no provided by your provider
Password		Leave blank if no provided by your provider
PIN		Leave blank if no provided by your provider
USB Serial Port	ttyUSB1	The USB port of your dongle used for Dial Up.

Webcam:

The following commands will install packages to allow a webcam to be used to take (jpg) photos.

Run:

```
opkg update

opkg install kmod-video-uvc fswebcam
```

We tested this following on our [QC3203 Webcam](), and also some cheap generic webcams, but your mileage may vary, and extra drivers may be needed.

Use the following command to capture an image to the /tmp folder:

```
fswebcam -S 10 /tmp/image.jpg
```

Image Manipulation:

Run the following:

```
opkg update

opkg install ffmpeg
```

After capturing a .jpg as above, run this command:

```
ffmpeg -i /tmp/image.jpg -vf scale=640:-1 /tmp/image.bmp
```

This will scale the file to 640 pixels wide and convert to bitmap format. This may be handy of you are using the Arduino to display or manipulate the image, as it is difficult to read .jpg files due to the compression, but .bmp files are uncompressed.

Audio:

Using our [XC4953 USB Soundcard](), we were able to play MP3's and stream audio from the internet:

```
opkg update

opkg install kmod-usb-audio kmod-sound-core madplay
```

To play sounds:

```
madplay test.mp3
```

To stream from an internet MP3 stream:

```
wget -O - http://live-radio01.mediahubaustralia.com/PBW/mp3/ | madplay –
```

USB Storage:

By default, drivers should be installed for USB flash drives, and should work as long as they have a FAT or FAT32 partition. Flash drives appear at:

```
/mnt/sda1
```

For example, enter the following to work in the root directory of the flash drive:

```
cd /mnt/sda1
```

Multiple drives may have names like /mnt/sdb1.