Module 6: Living on a decentralized network

1. Recap

2. Motivation: Smart Environments and IoT

3. Technologies of Smart Environments

4. LoRa Workshop

Recap

- Learned about mesh concepts
- Built WiFi mesh nodes
- Used IPFS to store and share files
- Talked about how to plan networks for a community
- Used tools to measure and evaluate network quality

Today

- Apply our knowledge of WiFi networks to other types of wireless devices

- Talk about the Internet of Things and Smart Environments

- Build a LoRa node through which we can send and receive packets over radio

Motivation

- When we think of the internet communication, we're often thinking of our experience with the World Wide Web

- However, most new connected devices are *embedded systems* with wireless capabilities

- An IEEE report estimates *30 billion devices* will be connected to the internet by 2020

Smart environments

- **Internet of Things**: Internet connected devices are becoming part of our daily lives for automation and sensing

- In some cities they are becoming a part of city infrastructure, some people call these ideas *Smart Cities*

Need for network literacy

Although these technologies can be immensely useful for sensing and automation there are concerns about:

Security

IoT device manufacturers have followed notoriously bad security hygiene. The 2016 Mirai Botnet DDoS attack exploited thousands of vulnerable internet connected CCTV cameras to take down DNS servers

Surveillance

Ubiquitous sensing in our environments raises concern about who has access to sensed data and what they may do with it

Resilience

As we become dependent on internet connected devices we need to ensure we have access to alternatives during failure

How do smart environments work?

Devices

- **Sensors** for collecting data from the environment

- **Transceivers** for sending and receiving wireless information

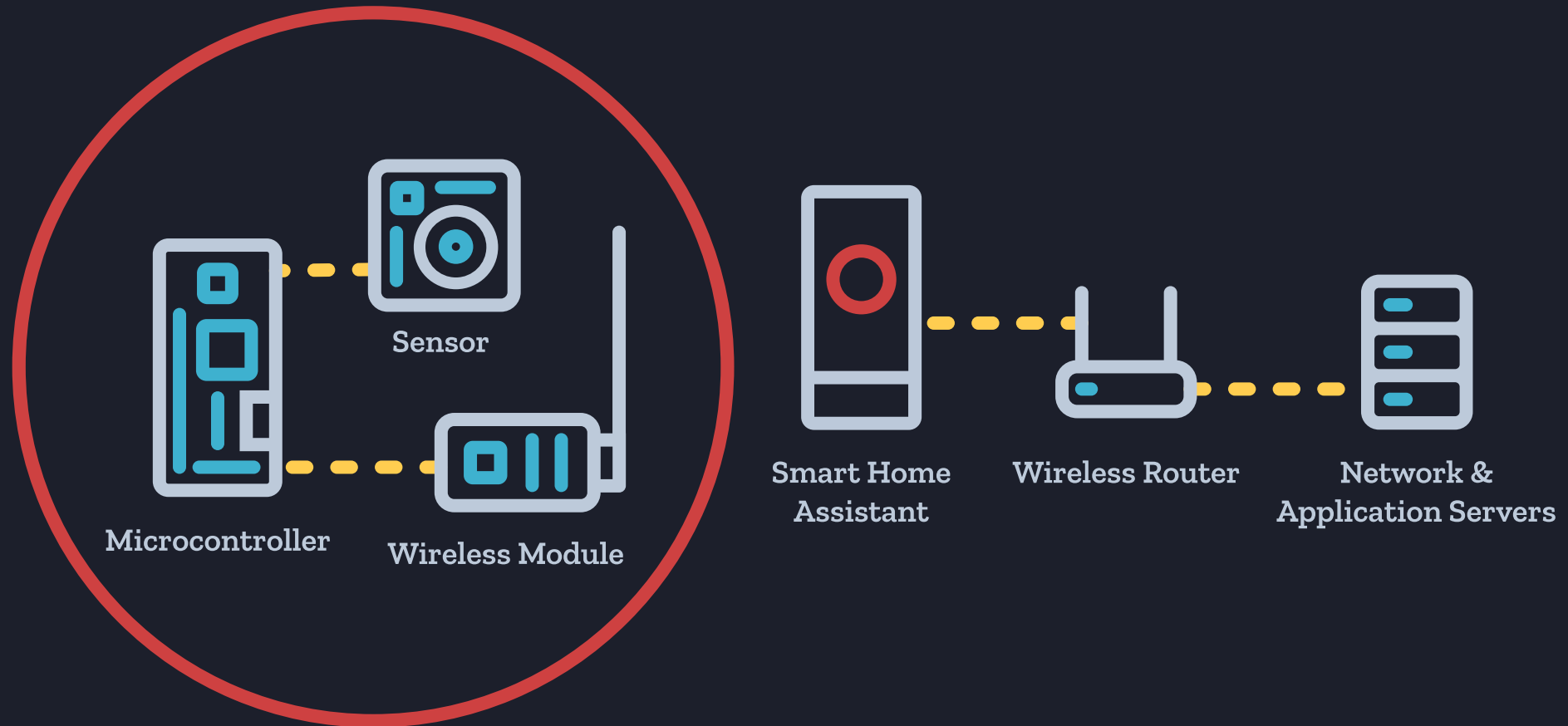- **Microcontrollers** are the brains of the device

Gateways

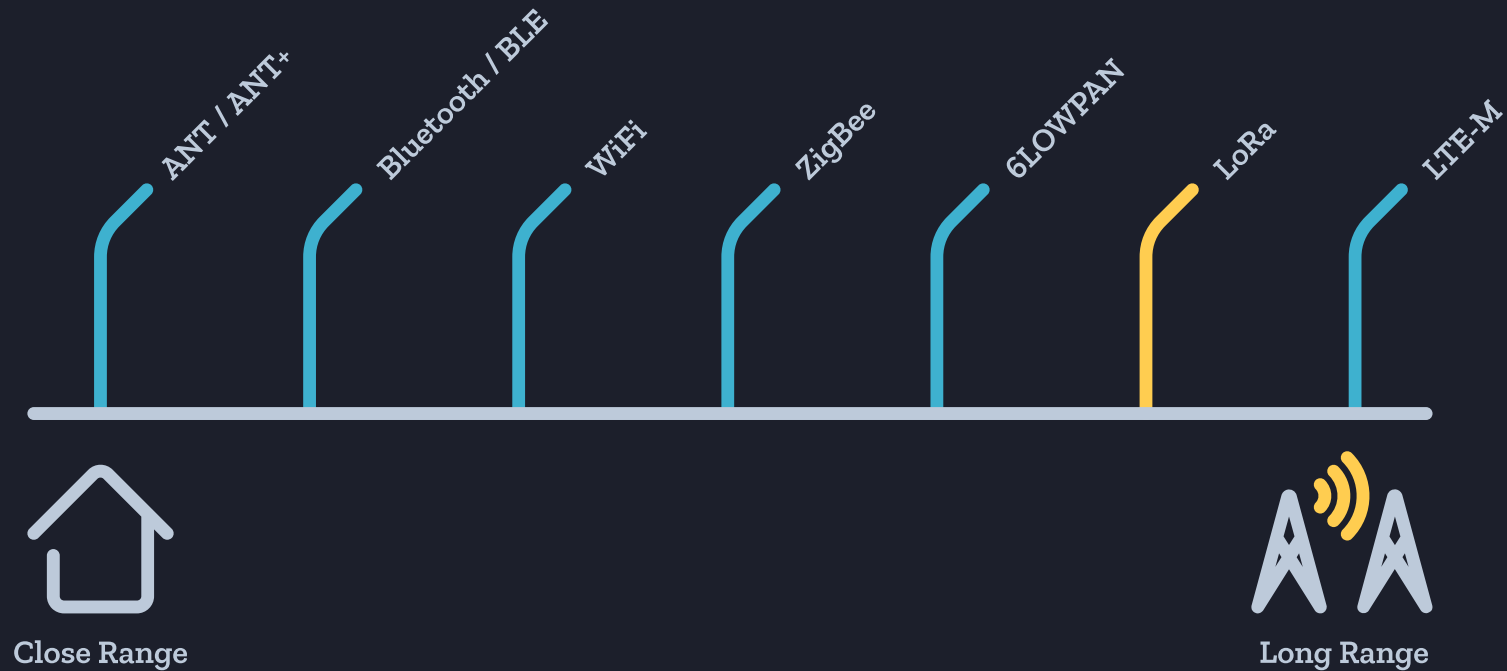Connect the device to the rest of the internet

How do smart environments work?

Servers

Servers operated by your device provider or other third-parties manage your smart device's data

Sensor

Microcontroller

Wireless Module

Smart Home Assistant

Wireless Router

Network & Application Servers

Wireless technologies

Smart devices today can use many different wireless technologies

ANT / ANT+

Bluetooth / BLE

WiFi

ZigBee

6LOWPAN

LoRa

LTE-M

Close Range

Long Range

Choice of technologies depends on...

- Cost
- Range
- Power Requirements
- Data Rate
- Licensing
- Coverage
- Ease of Installation

Why LoRa is a promising choice

- **Cost**: Low Cost; $2 RF transceivers

- **Range**: Long Range; Advertised up to 25 km; World record: 702 km

- **Power Requirements**: Very Low Power; Sensor applications ~10 Year life from 2 AA batteries

- **Data Rate**: Low Data Rate; ~150 bps

- **Licensing** (900 MHz in Canada): ISM Band; No license requirement!

- **Coverage**: No LoRa providers; need set up our own gateways

- **Ease of Installation**: Community is developing and supported hardware is becoming available

LoRa workshop

LoRa decoded

LoRa can achieve such great distances with such low power because it is not very susceptible to noise. LoRa works remarkably well with low signal strength.

LoRa uses *Chirp Spread Spectrum Modulation*, ie. the information is encoded in the shifts of increasing or decreasing frequency.
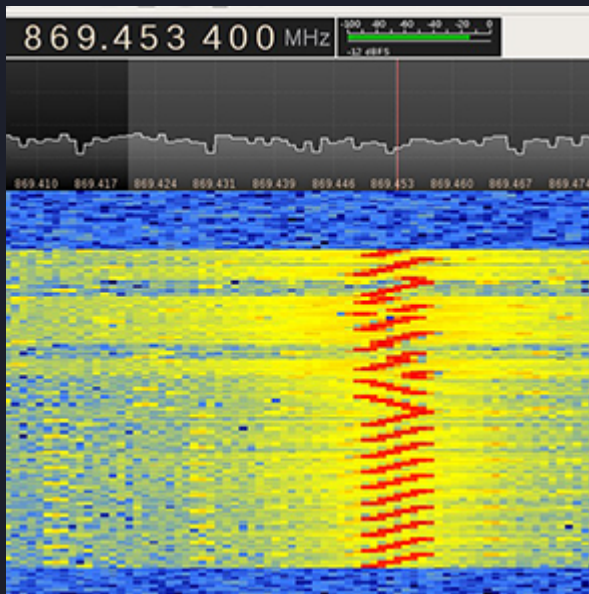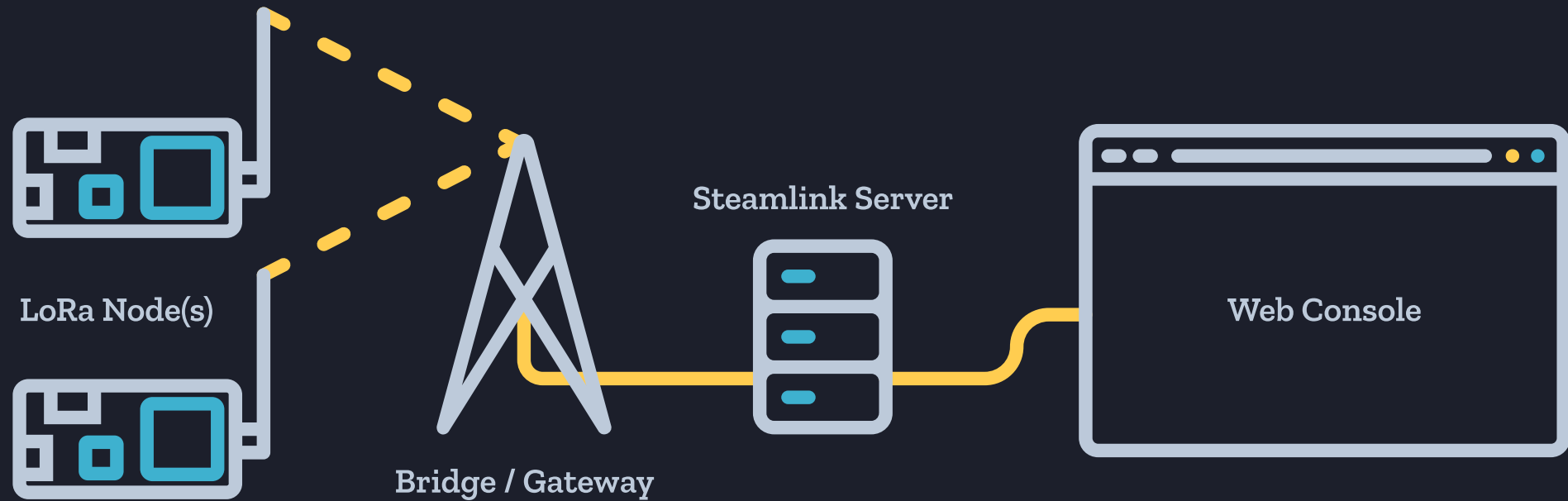

Image source: https://revspace.nl/images/d/d2/DecodingLora_Project.jpg

Steamlink

We're using an open source community platform for building, deploying, and managing low-cost low-powered long-range networks.

LoRa Node(s)

Bridge / Gateway

Steamlink Server

Web Console

Build a node!

Let's build a circuit to connect to the network. You can send a message by pressing the button. Received messages should light up the LED.
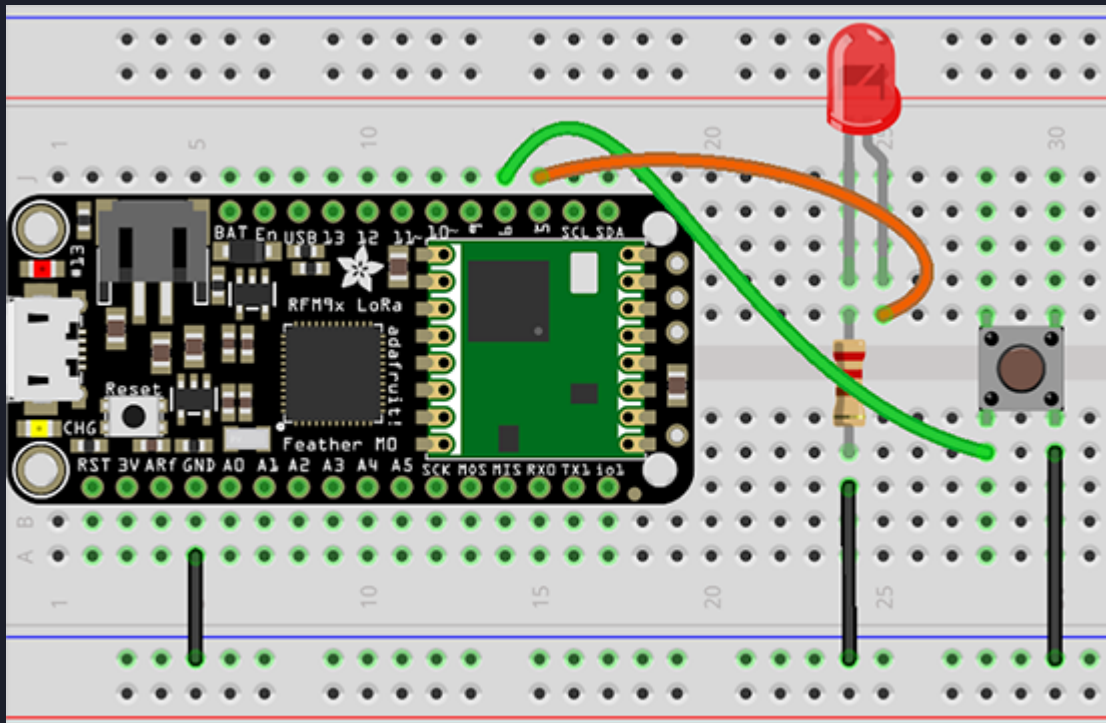
In your browser, open `steamlink.local` to see your node!