Wireless Sensor Network and PIP Tag

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What is RFID?

- Wireless ID and tracking
- Captures information on:
  - Identity
  - Location
  - Time
  - Various Sensor Readings
- Passive (no batteries)
- Unique identification

Slide Credit: Evan Welbourne, UW

Passive RFID

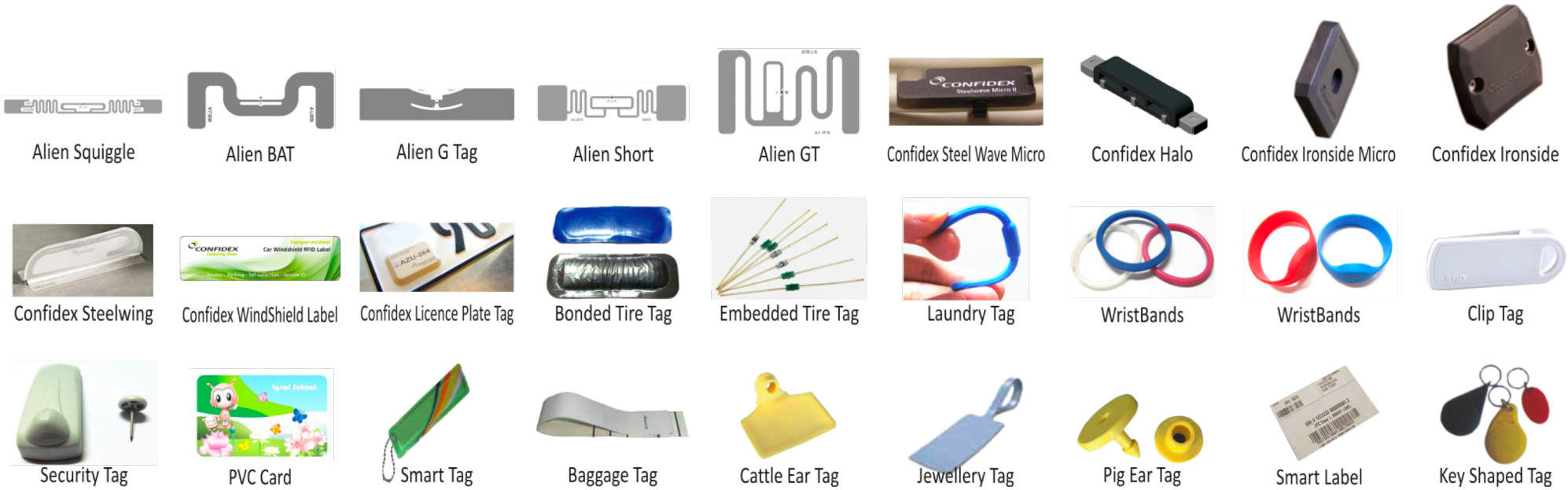
- Most basic: No computation. Tag echos back a pre-stored value.
- Some tags can be updated, some are hardcoded.
- Think of these as barcodes, QR codes

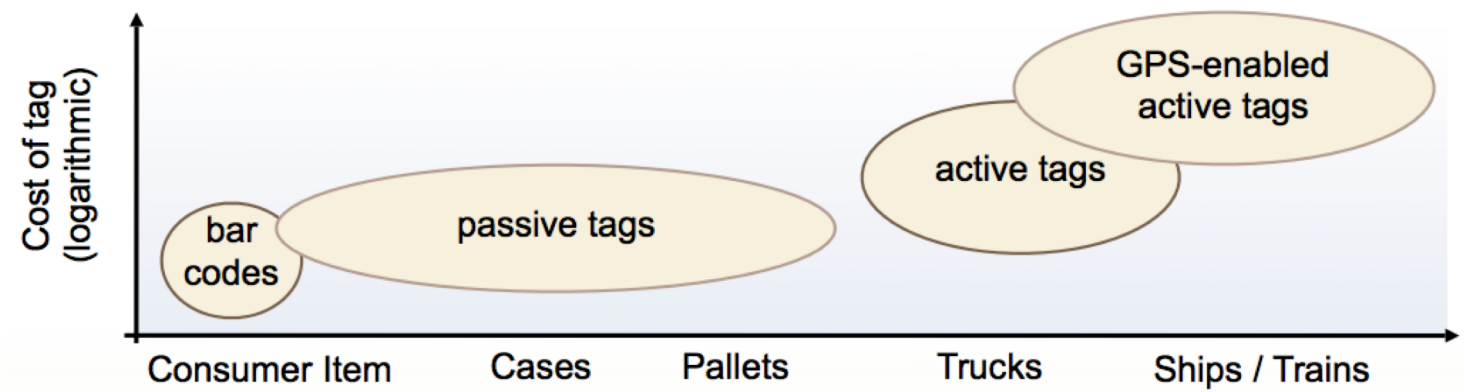
Active RFID

- Use battery-powered RFID tags
- Continuously broadcast their own signal containing various useful data

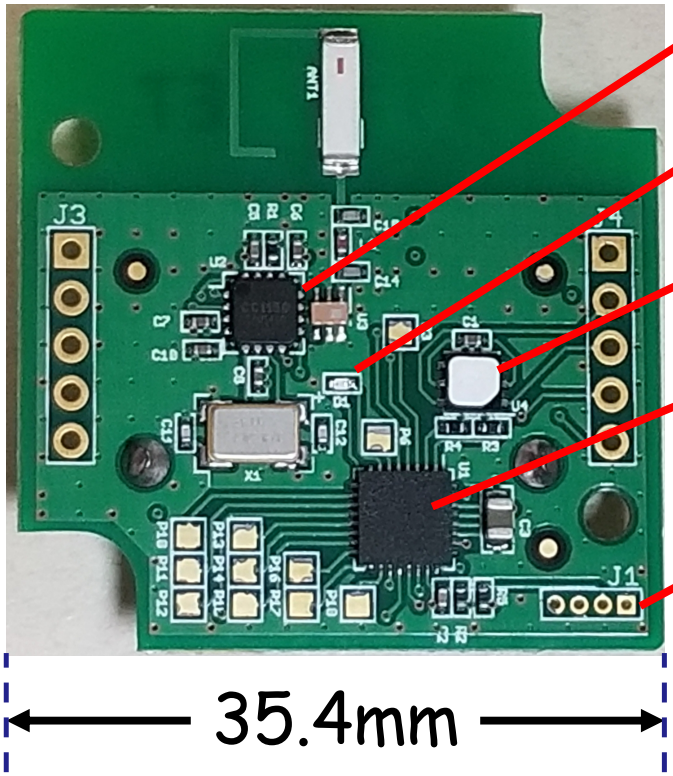
Active tags provide a much longer read range than **passive tags**, but they are also much more expensive.

RFID Tags - A Wide Variety





PIP Tag



- Radio Chip
- Light Sensor
- Temperature & Humidity Sensor
- Microprocessor
- Flash Port

PIP tag is a single-board passive sensing RF-tag which can collect various sensing readings and send them to a host receiver

PIP Tag Communication

- Microprocessor: MSP430
- Radio chip: CC1150
- Power: Lithium coin cell battery (~1 year)
- Protocol: Unidirectional heartbeat (Uni-HB)
  - Packet size: 10 bytes
  - Constant beacon interval

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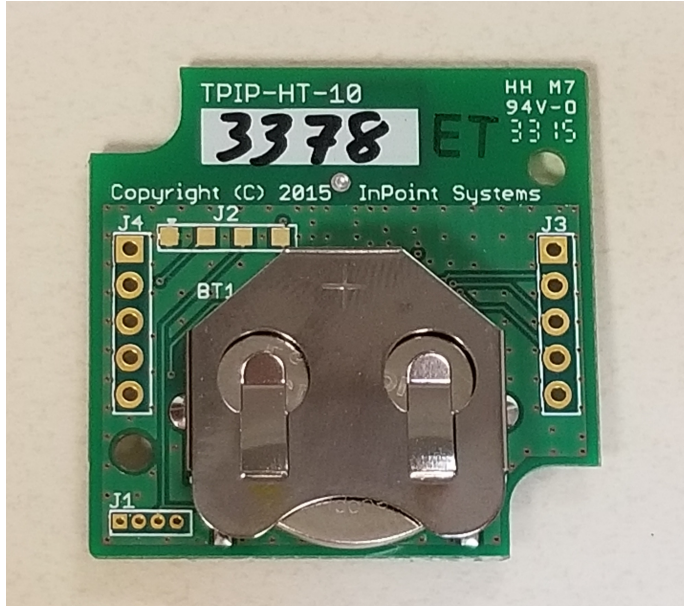


USB Receiver

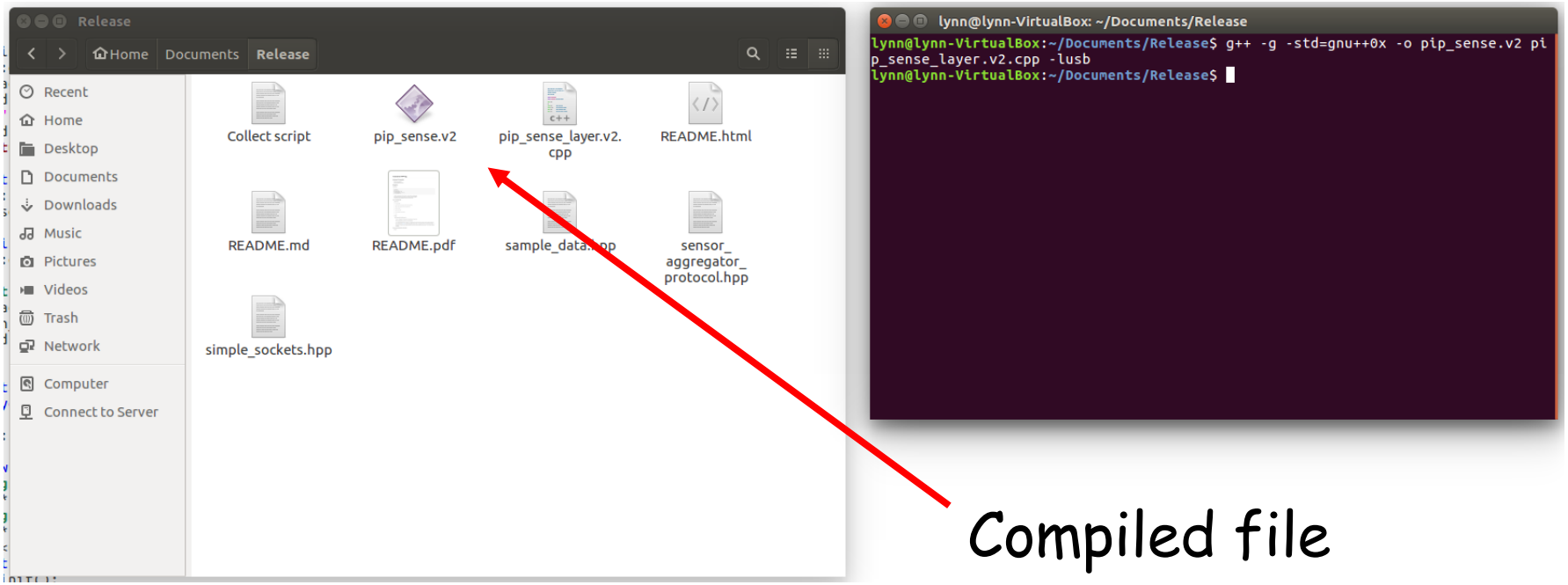
Receive signal data from specific one or many PIP tags

The Basic Steps to Start

- Setup the PIP tag (install the battery)
- Plug the USB receiver in a computer with Linux operating system
- Compile & run the receiver code

Compile Code

1. Install compiler (g++):
   $ sudo apt-get update
   $ sudo apt-get install g++
2. Install some libraries (essential and usblib):
   $ sudo apt-get install build-essential
   $ sudo apt-get install libusb-dev
3. Compile:
   $ g++ -g -std=gnu++0x -o pip_sense.v2 pip_sense_layer.v2.cpp -lusb



Compiled file

Run Code

Run the pip_sense.v2 with the following command in a terminal

$ sudo stdbuf -o0 ./pip_sense.v2 l l | stdbuf -o0 grep TX:03378

It would receive message from PIP tag NO.03378

```
lynn@lynn-VirtualBox: ~/Documents/Release
lynn@lynn-VirtualBox:~/Documents/Release$ sudo stdbuf -o0 ./pip_sense.v2 l l | stdbuf -o0 grep TX:03378
[sudo] password for lynn:
parameters are ac:3
server ipl port 0
Connected to USB Tag Reader.
Connected to the GRAIL aggregation server.
TS:1531162525897        Drop:0  RX:656  TX:03378        RSSI:-34.50        CRC Data: 0c 32 01 6b 03 11  | light: 50 temp: 36.30 humidity: 785
TS:1531162526248        Drop:0  RX:656  TX:03378        RSSI:-32.50        CRC Data: 0c 1e 01 4f 03 5f  | light: 30 temp: 33.50 humidity: 863
TS:1531162527240        Drop:0  RX:656  TX:03378        RSSI:-32.00        CRC Data: 0c 1e 01 4f 03 5f  | light: 30 temp: 33.50 humidity: 863
TS:1531162528247        Drop:0  RX:656  TX:03378        RSSI:-33.00        CRC Data: 0c 1e 01 4f 03 5f  | light: 30 temp: 33.50 humidity: 863
```

Timestamp RX ID TX ID Received Signal Strength Indicator Light strength Temperature Humidity

You could design your applications based on the code.

PIP Tag Projects

PIP Tag Project 1

- **Dynamic Data Monitor**
  - Fetch data from a PIP tag using a PIP tag receiver and send the data to a self-build server.
  - Build the server that can handle HTTP requests.
  - Display the data with a real-time line chart on a webpage.

PIP Tag Project 2

- **Alarm Clock Controller**
  - Use light sensor on PIP tag to control an alarm clock.
  - Design your mode. For example, covering the light sensor several times could stop the alarm clock from ringing.
  - Display the raw sensor data.

PIP Tag Project 3

- **IoT Warning System**
  - Use sensors on PIP tag to design a security-conscious IoT framework for home appliances (e.g., coffee machine, humidifier).
  - If the sensor data is higher than a pre-defined threshold, a user notification will be sent through email.