beeHouse-433

Smart **house** based on 433Mhz RF

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beeHouse-433: goal

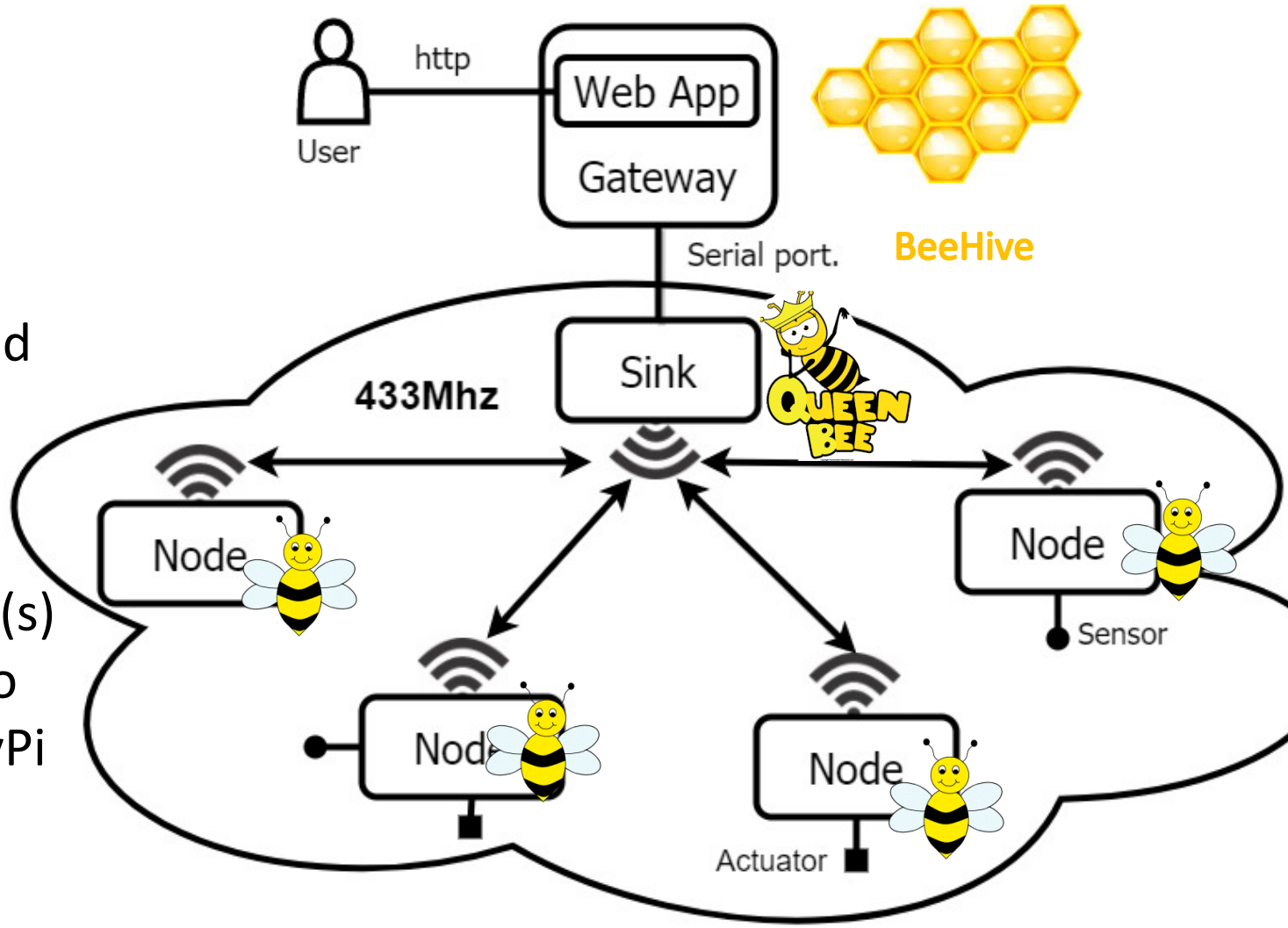
Monitor/Control/Automate your **house**.

Low cost wireless communication using **433Mhz** band

Organization likes **Bees** world…

System architecture

- Star topology (*sink* is the central node)
- Bidirectional communications based on 433Mhz RF.
- Components of architecture:
  - **Node(s)** (bees) – Arduino Nano(s)
  - **Sink** (beeQueen) – Arduino Uno
  - **Gateway** (BeeHive) - RaspberryPi



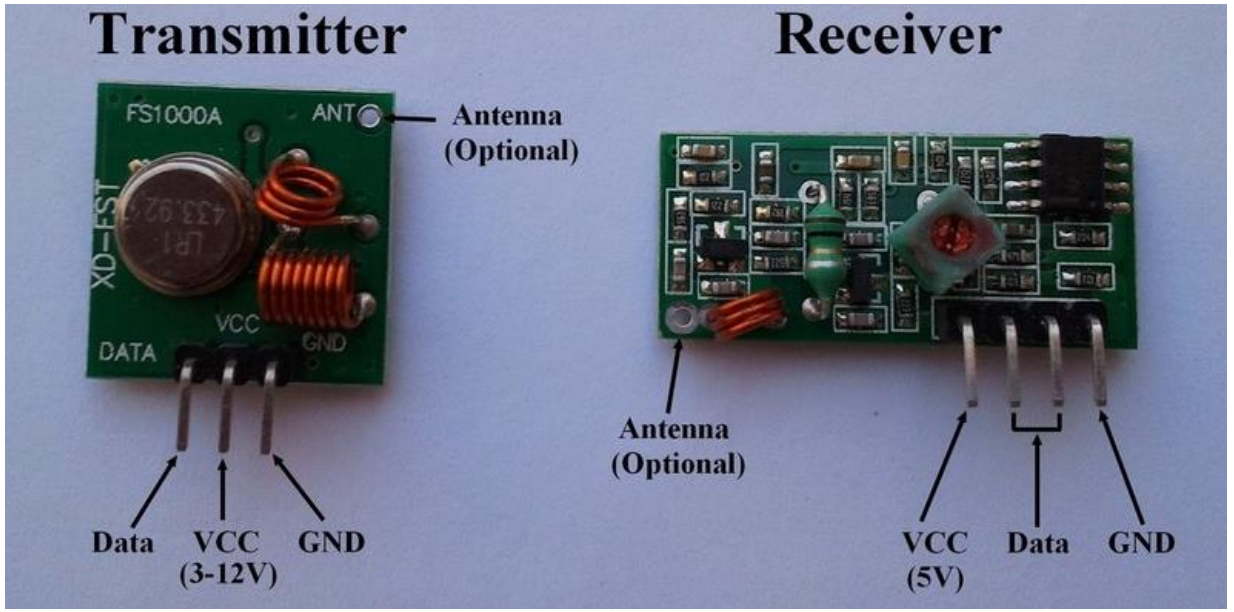
Wireless communication: 433Mhz transceivers

Specifications RF 433MHz ***Transmitter***

- Frequency Range: 433.92MHz
- Input Voltage: 3-12V
- Modulation: ASK
- Price: 1 – 2 euro

Specifications RF 433MHz ***Receiver***

- Frequency Range: 433.92 MHz
- Modulation: ASK
- Input Voltage: 5V
- Price: 1 – 2 euro



Range (with good antenna) up to hundred of meters.

Wireless Communication – 433 Mhz

Why choosing 433Mhz band instead of Wifi (2.4 GHz, 5Ghz) ?

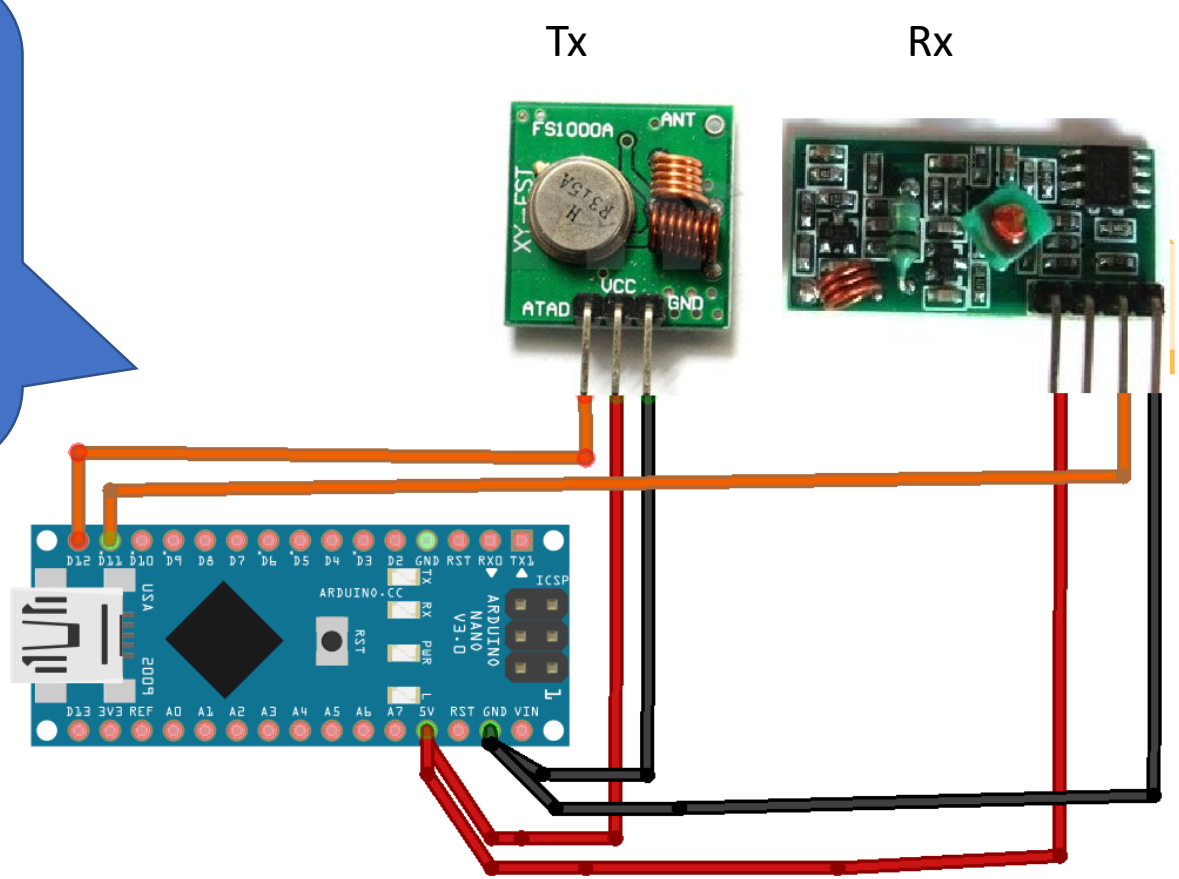
- **ISM** (industrial, scientific and medical) radio bands.
- Little interference with other networks (e.g., house wifi, mobiles phones)
- Cheap transceivers

Hardware Components – node(s)

Arduino Nano

- Atmel ATmega328
- 16 MHz
- 4,31 x 1,85 cm
- 22 Digital pins

433Mhz Trasmitter and Receiver



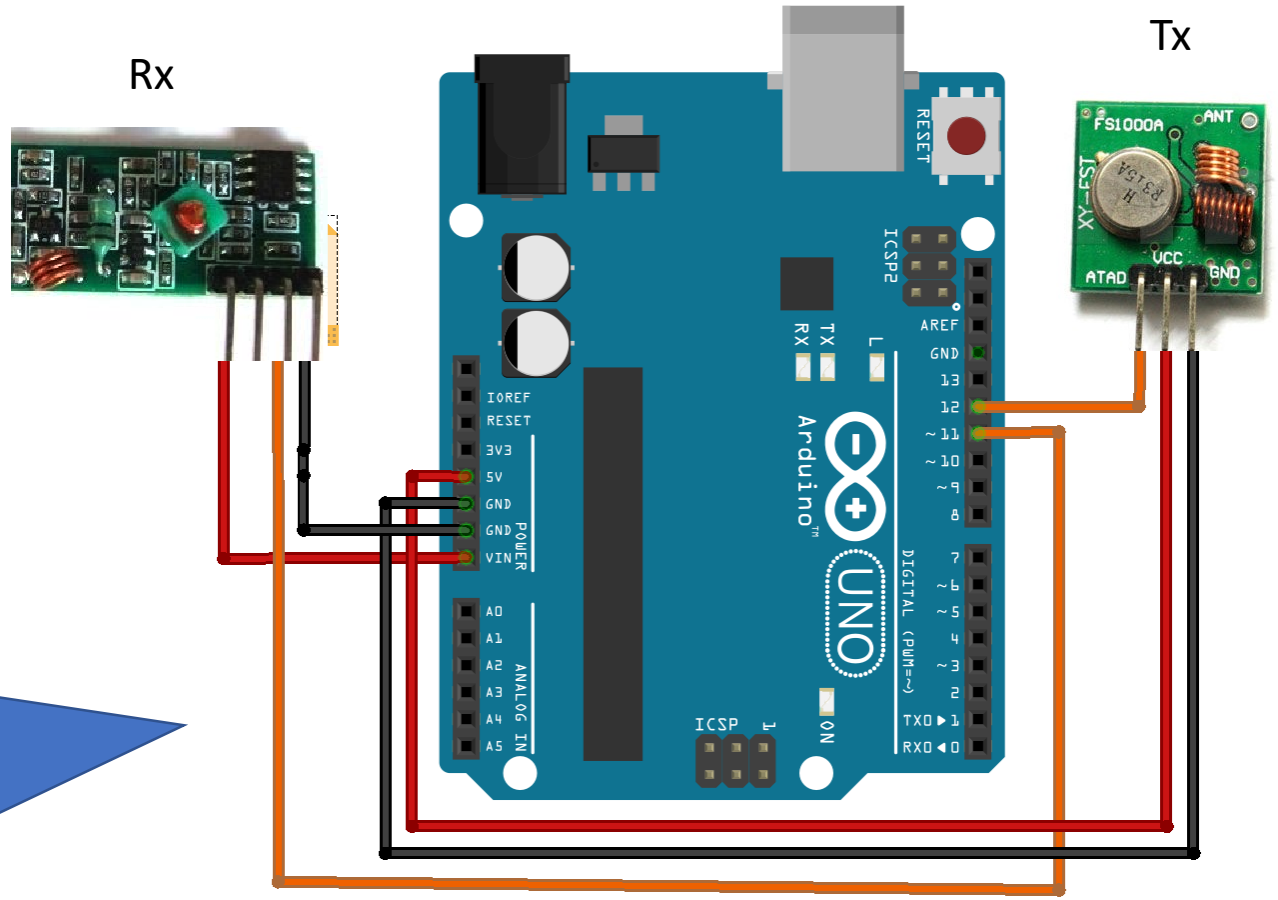
fritzing

Hardware components - sink

Arduino UNO

- Atmel ATmega328
- 16MHz
- 6.86 cm, 5.34 cm
- 14 Digital pins
- 6 Analog pins

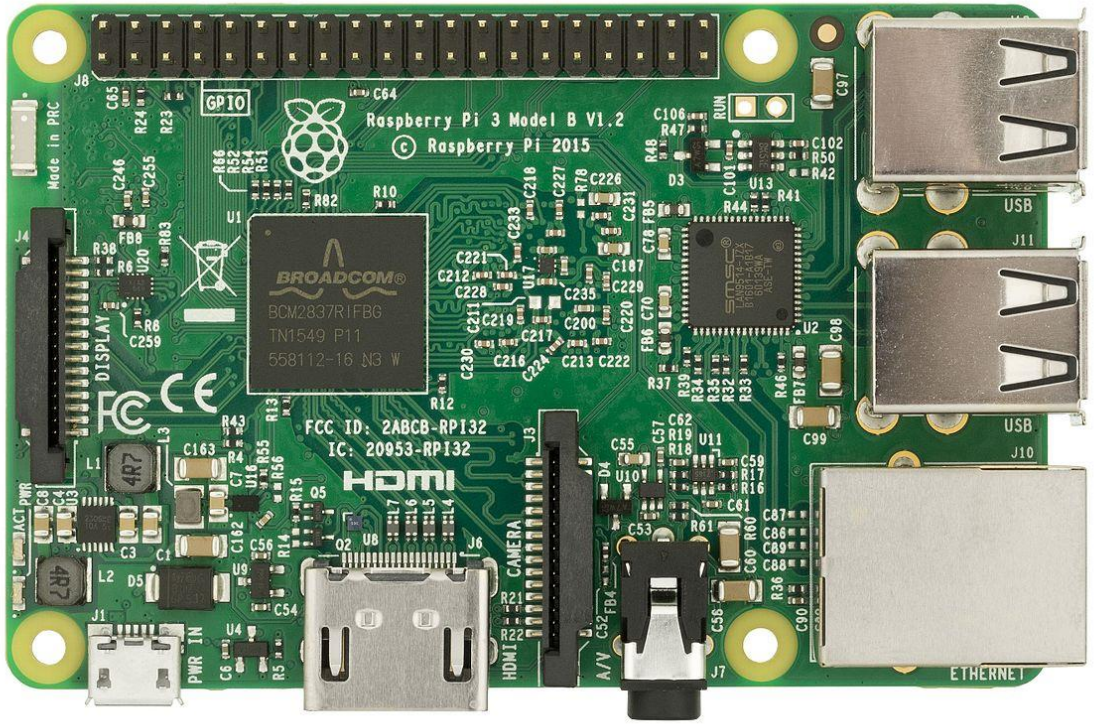
433Mhz Trasmitter and receiver



Hardware components - Gateway

Raspberry Pi (v2)

- ARM1176JZF-S
- 900 MHz
- RAM 512 MB
- 17 GPIO pins (out of 26)
- USB Port
- Ethernet port



Softwares - 433 Mhz communication

RadioHead [1] is a Object oriented radio library for embedded microprocessors

Platform supported (some):

- Arduino and the Arduino ID
- Adafruit Feather
- Linux and OSX Using the RHutil/HardwareSerial class
- …

BeeHouse-433 uses:
RF_ASK Driver
RHDatagram Manager:

Offers 2 main sets of classes:

- **Drivers**: low level access to a range of different packet radios and other packetized message transports (**RF22** , **RF69**, ASK,…)
- **Mangers:** provide high level message sending and receiving facilities:
  - **RHDatagram** Addressed, unreliable variable length messages, with optional broadcast facilities.
  - **RHReliableDatagram** : Addressed, reliable, retransmitted, acknowledged variable length messages.
  - **RHRouter:** Multi-hop delivery from source node to destination node via 0 or more intermediate nodes, with manual routing.
  - **RHMESH:** Multi-hop delivery with automatic route discovery and rediscovery.

Any Manager may be used with any Driver, A Driver can be used without a Manager.

Other libraries*: VirtualWire(deprecated)* [3], *RCSwitch* [4], *Other* [5]

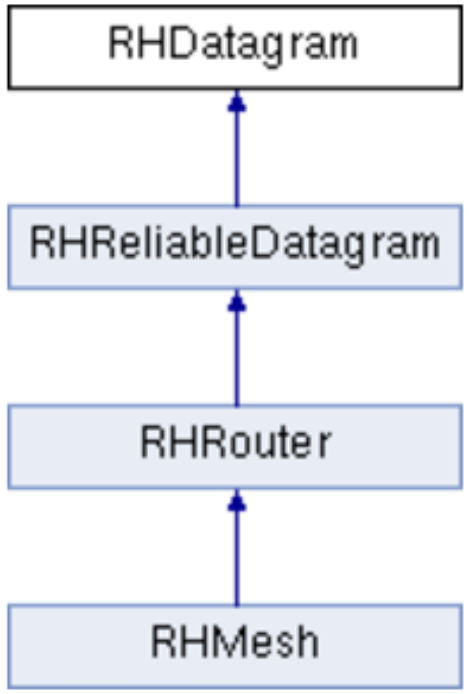
RadioHead library: RHDatagram manager

RHDatagram Addressed, unreliable variable length messages, with optional broadcast facilities.

Public Member Functions

	RHDatagram (**RHGenericDriver** &driver, uint8_t **thisAddress**=0)
bool	**init** ()
void	**setThisAddress** (uint8_t **thisAddress**)
bool	**sendto** (uint8_t *buf, uint8_t len, uint8_t address)
bool	**recvfrom** (uint8_t *buf, uint8_t *len, uint8_t *from=NULL, uint8_t *to=NULL, uint8_t *id=NULL, uint8_t *flags=NULL)
bool	**available** ()
void	**waitAvailable** ()
bool	**waitPacketSent** ()
bool	**waitPacketSent** (uint16_t timeout)
bool	**waitAvailableTimeout** (uint16_t timeout)
void	**setHeaderTo** (uint8_t to)
void	**setHeaderFrom** (uint8_t from)
void	**setHeaderId** (uint8_t id)
void	**setHeaderFlags** (uint8_t set, uint8_t clear=RH_FLAGS_NONE)
uint8_t	**headerTo** ()
uint8_t	**headerFrom** ()
uint8_t	**headerId** ()
uint8_t	**headerFlags** ()
uint8_t	**thisAddress** ()

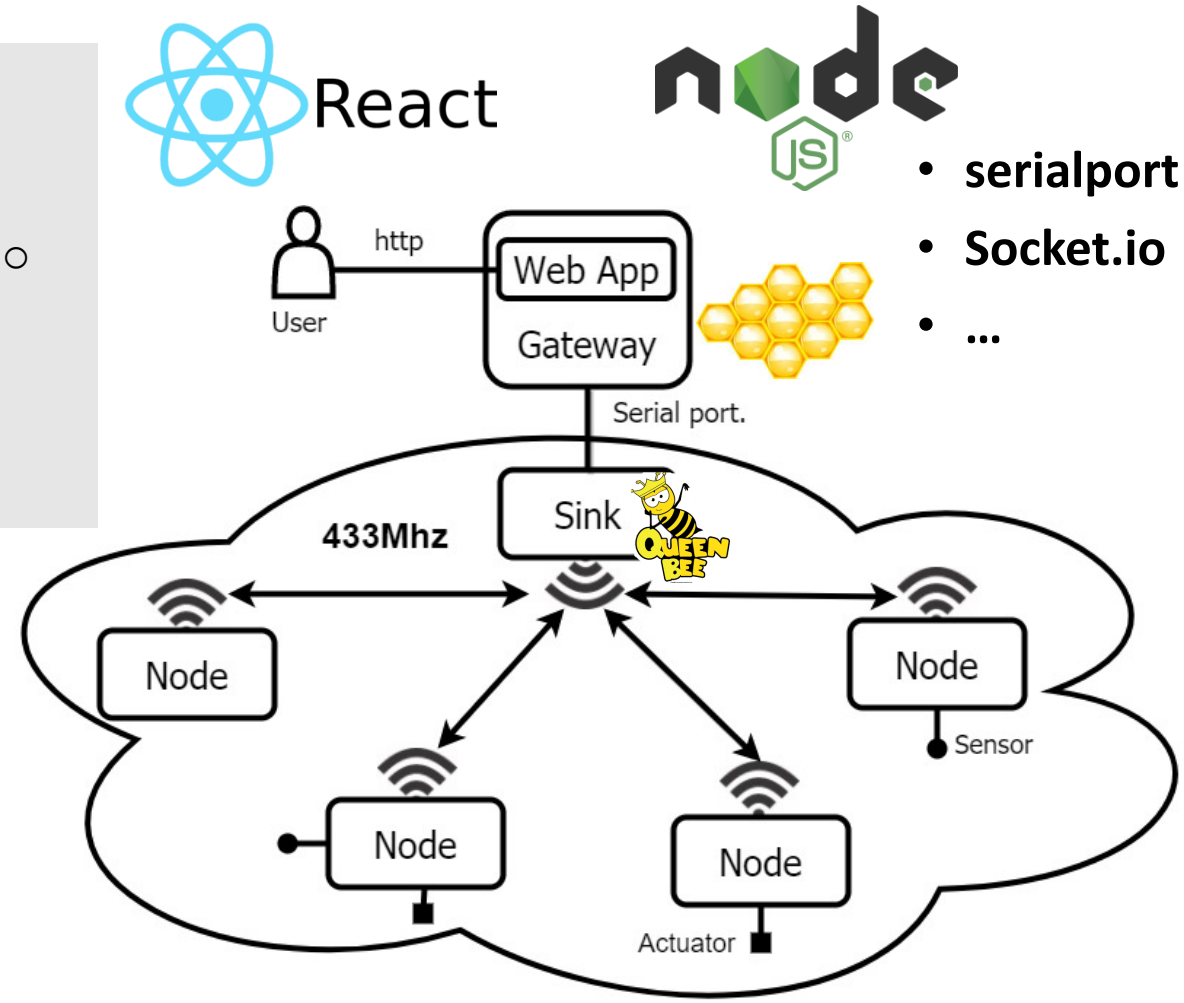
Broadcast message
address=RH_BROADCAST_ADDRESS



Softwares - gateway (Beehive-server)

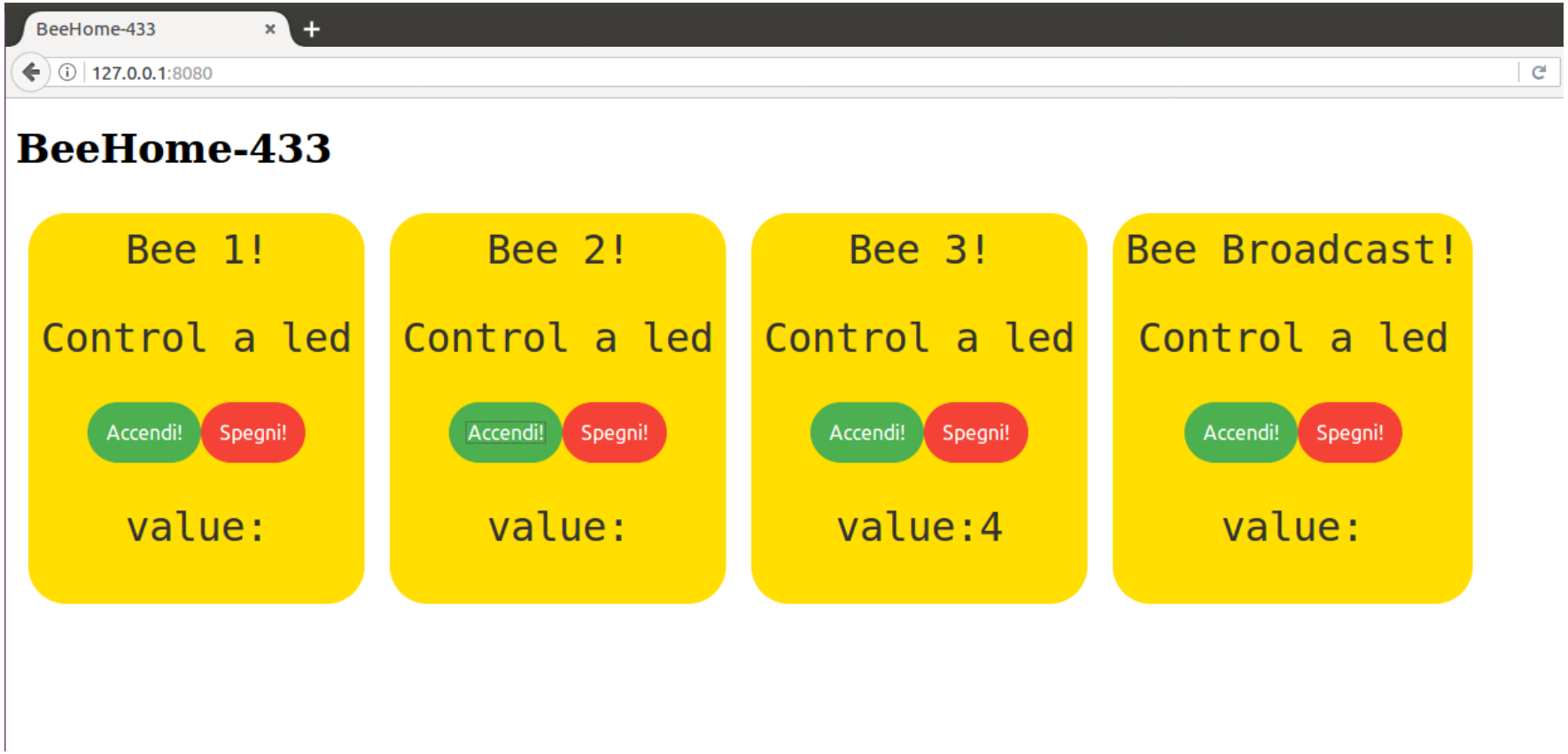
```
# code gateway (beehive-server)

m = Receive(msg) via serial port from sink
Send event("name", m ) to users via socket.io

m = receive event("name", msg) from user
Send(m) via serialport to sink
```

```
msg {
    src: Number,
    dst: Number,
    op: Number,
    data: Number
}
```



- **serialport**
- **Socket.io**
- **…**

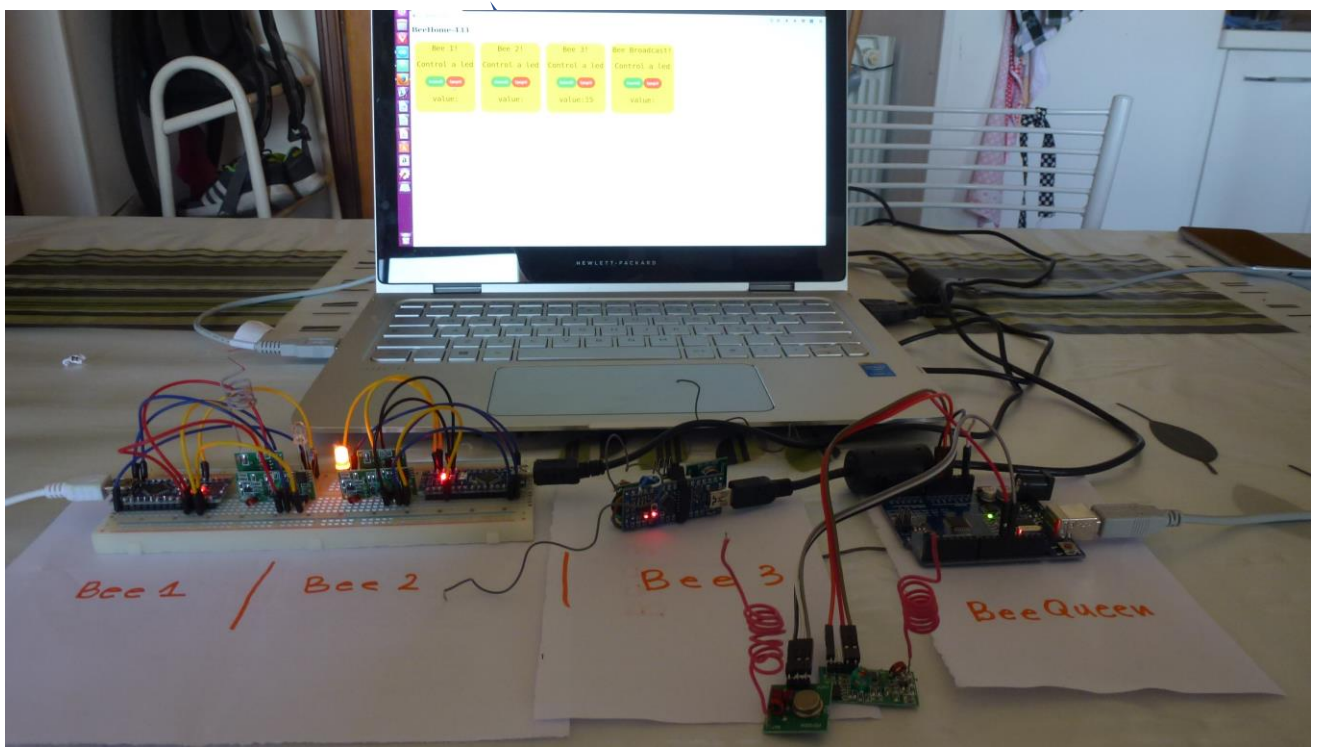
WebApp interface

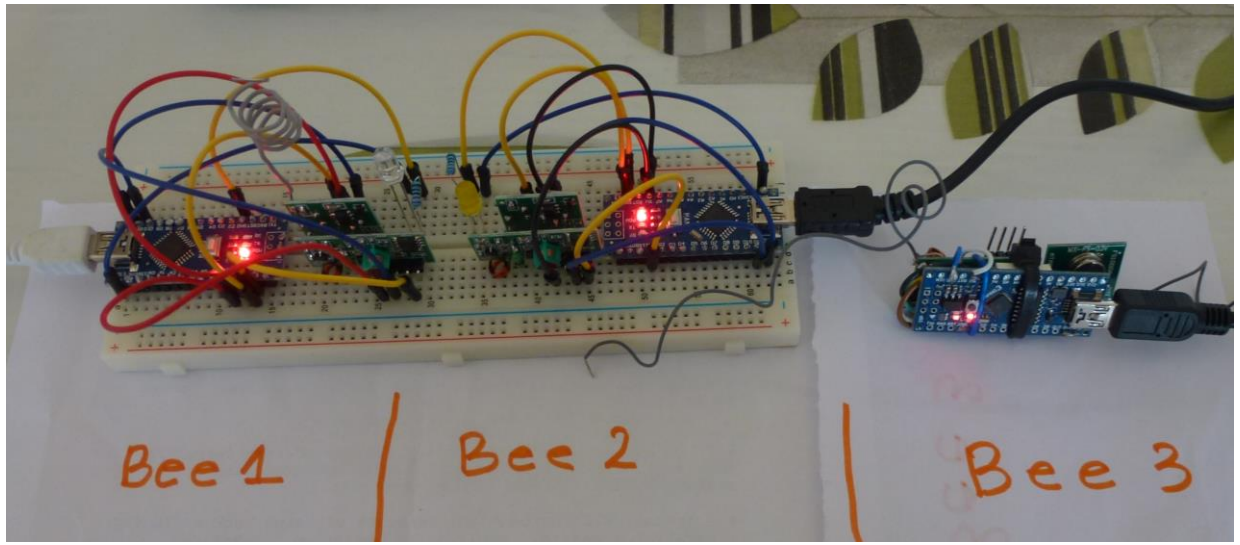


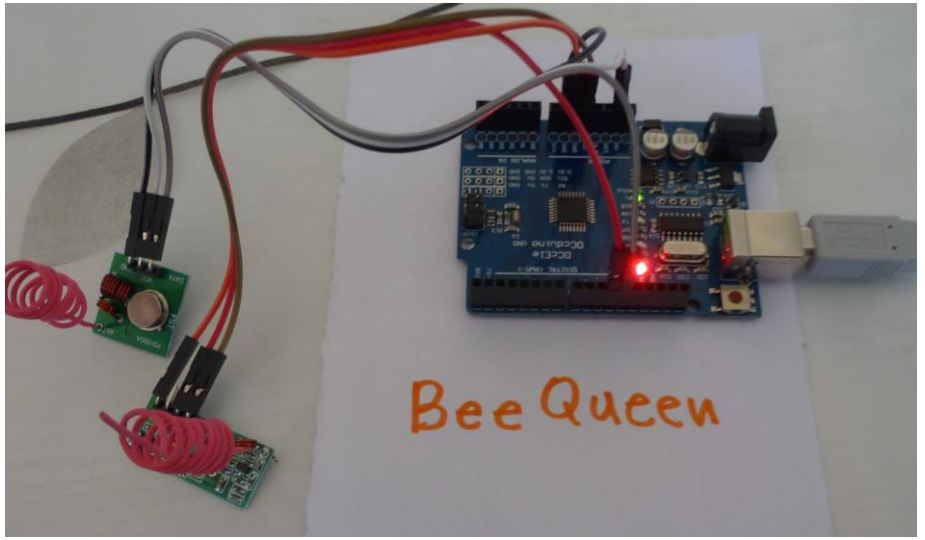
Demo: video on You Tube

https://youtu.be/yvfxI-R9Ju4v

Bee1 Bee 2 control a led
Bee 3 send integer values







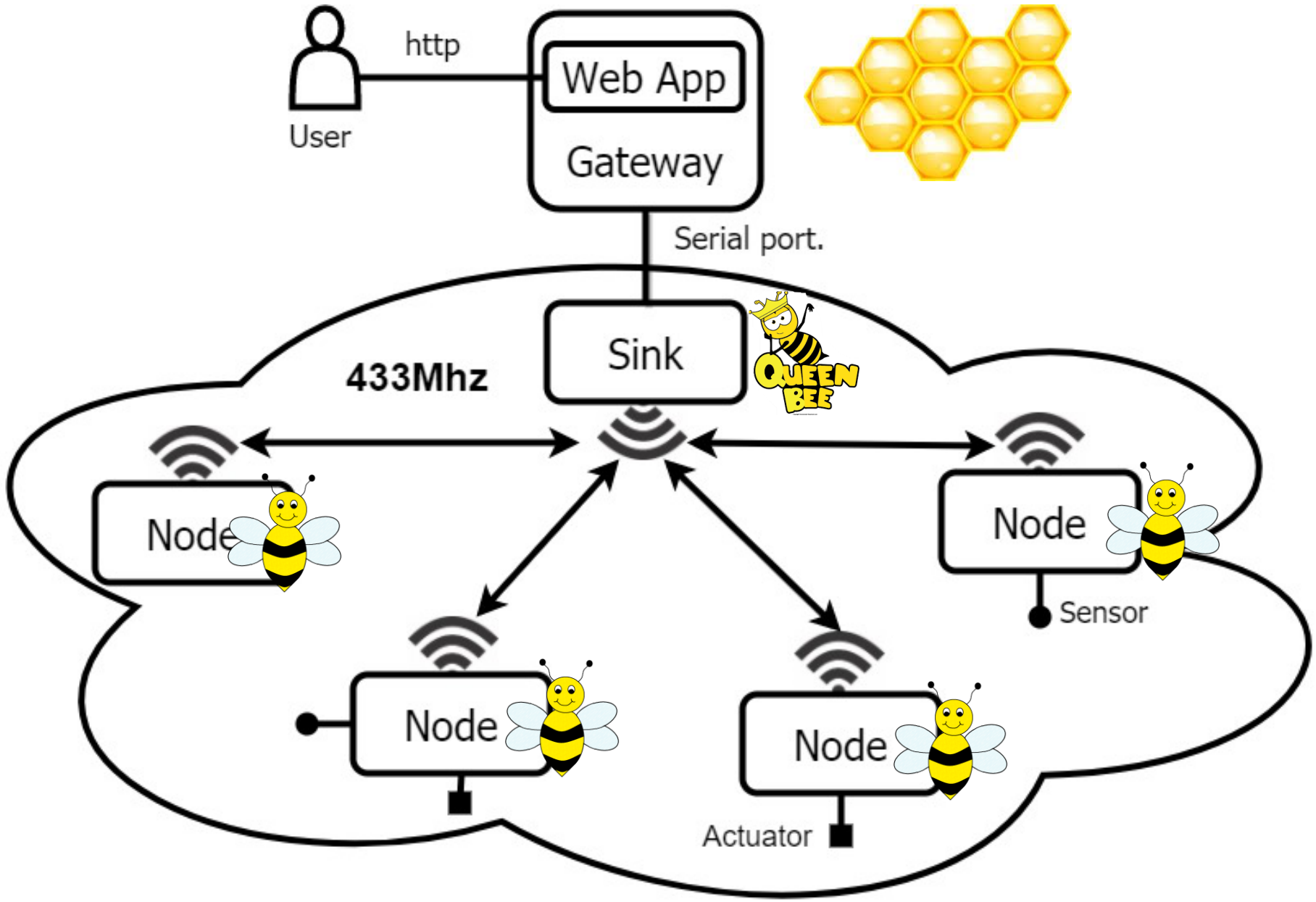
References

GitHub: https://github.com/dido18/beehouse-433

- [1] RadioHead library, http://www.airspayce.com/mikem/arduino/RadioHead/
- [2] 433Mhz antenna, http://www.wirelesscommunicationmodule.com/sale-7593127-long-range-433mhz-antenna-wireless-communication-pcb-antenna-spring-antenna-small-size.html
- [3] VirtulaWire(deprecated), http://www.airspayce.com/mikem/arduino/VirtualWire/
- [4] RcSwitch, https://github.com/sui77/rc-switch
- [5] https://andreasrohner.at/posts/Electronics/New-Arduino-library-for-433-Mhz-AM-Radio-Modules/

Tutorials

- http://randomnerdtutorials.com/rf-433mhz-transmitter-receiver-module-with-arduino/
- https://www.liwen.id.au/arduino-rf-codes/


User
http
Web App
Gateway
Serial port.
Sink
433Mhz
Node
Node
Sensor
Node
Node
Actuator