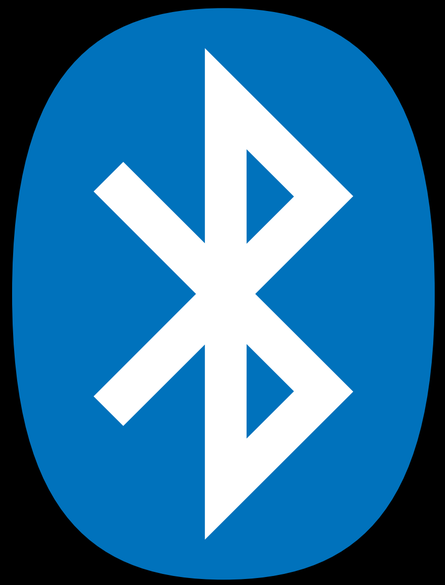
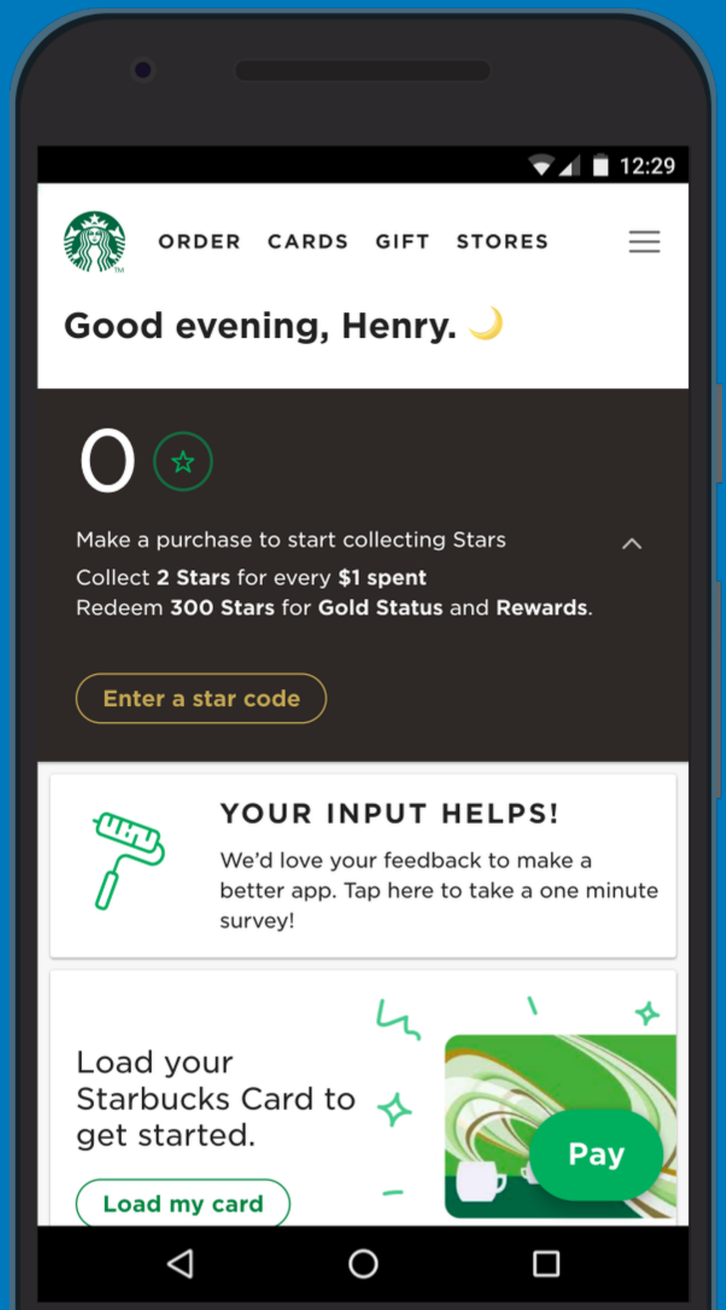
fun with bluetooth



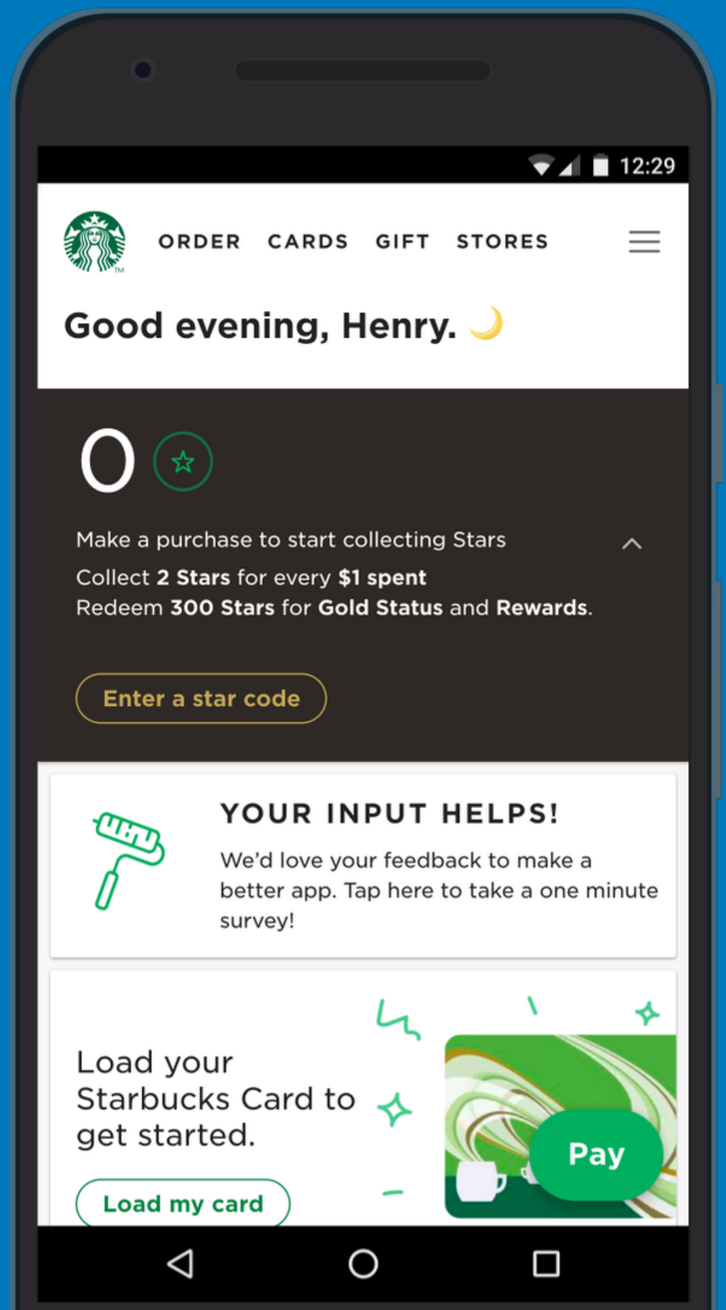
why?

progressive web apps

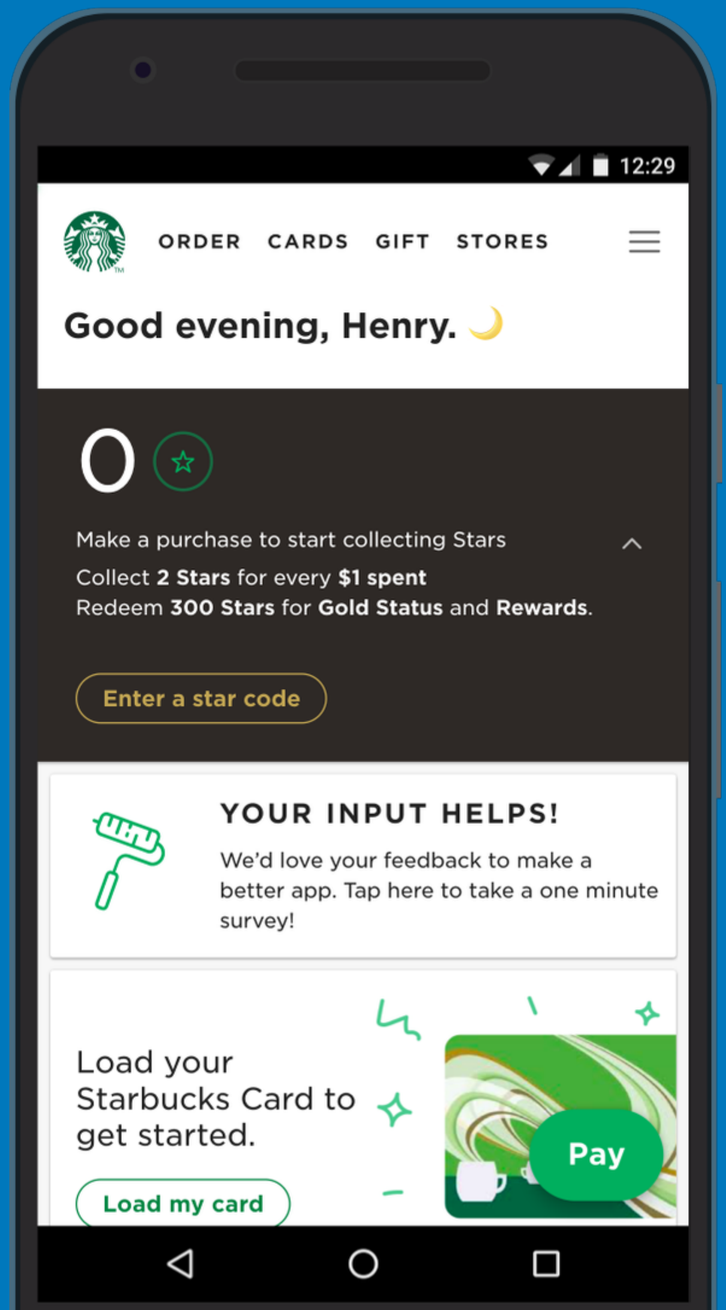
pwa's are great!



but...


12:29
ORDER CARDS GIFT STORES
Good evening, Henry.
0
Make a purchase to start collecting Stars
Collect 2 Stars for every $1 spent
Redeem 300 Stars for Gold Status and Rewards.
Enter a star code
YOUR INPUT HELPS!
We'd love your feedback to make a better app. Tap here to take a one minute survey!
Load your Starbucks Card to get started.
Load my card
Pay

but...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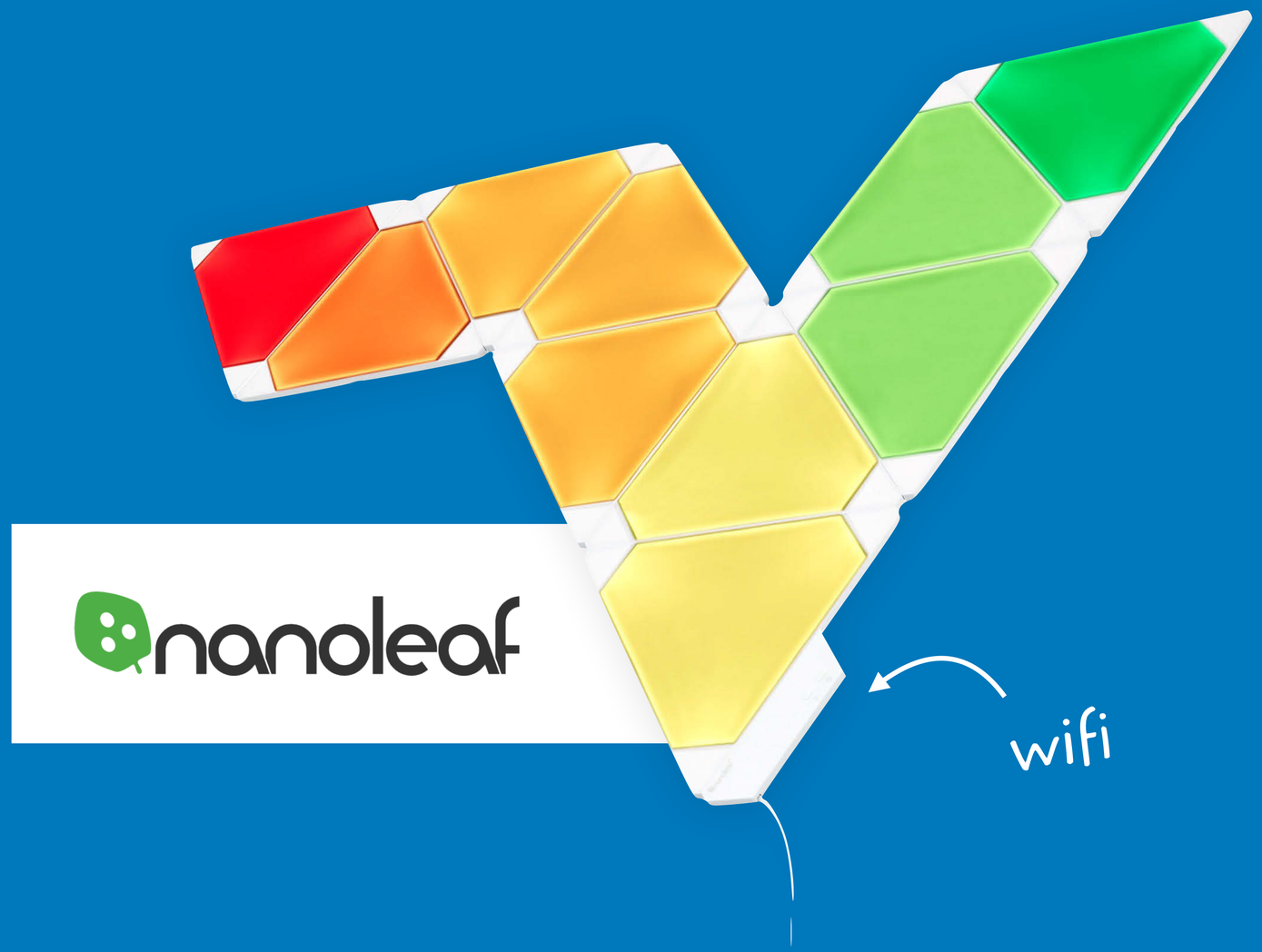
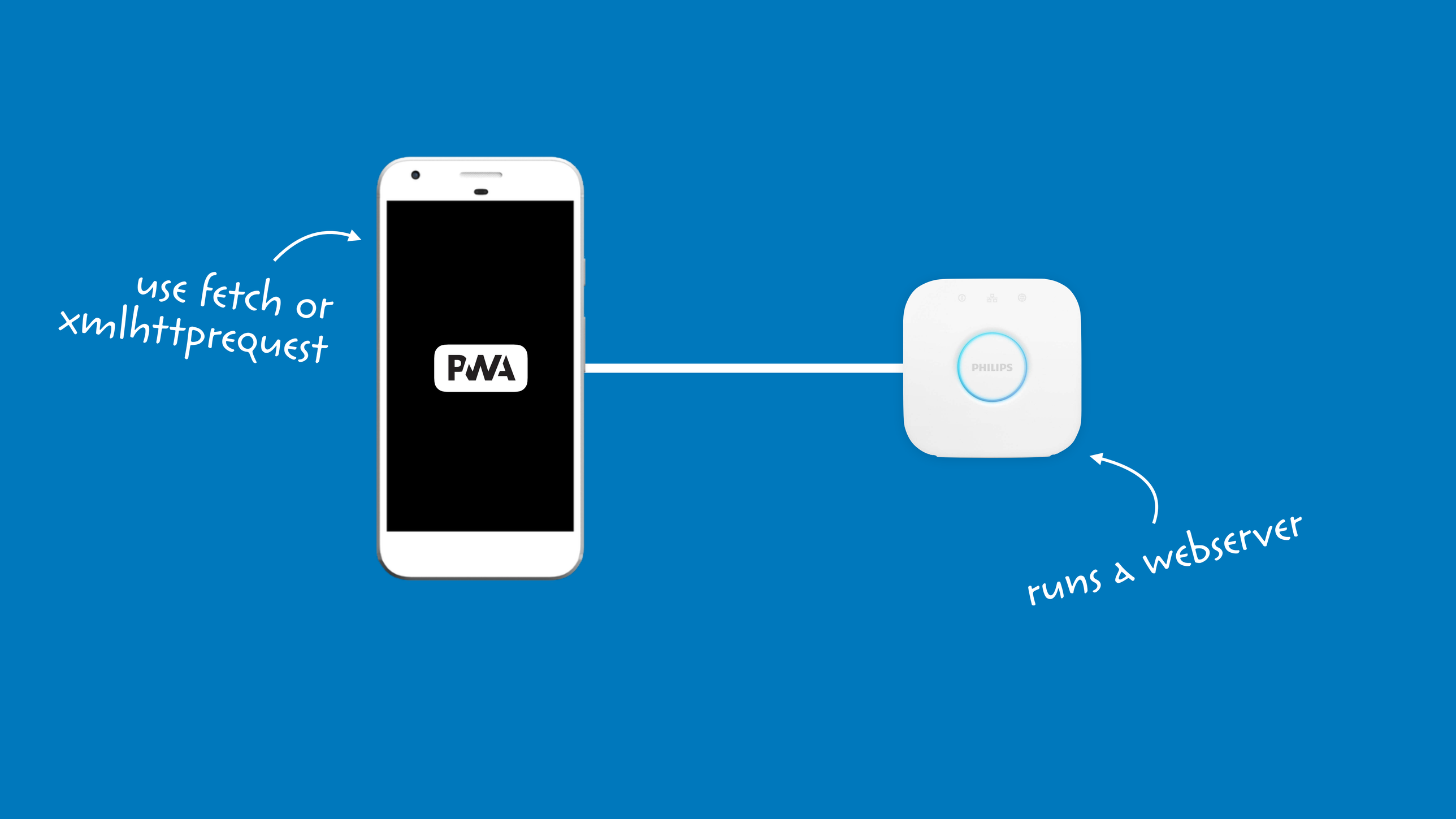
Load my card
Pay


SONOS
ethernet
et wifi
SONOS


nanoleaf
wifi


zigbee?
PHILIPS
Hue white
and color
hue


PHILIPS
PHILIPS
Hue white
and color
PHILIPS
Hue white
and color
PHILIPS
Hue white
and color
ethernet


use fetch or
xmlhttprequest
PWA
PHILIPS
runs a webserver

1

https://www.meethue.com/api/nupnp


```
[{
     "id":"001788fffe100491",
     "internalipaddress":"192.168.2.23",
     "macaddress":"00:17:88:10:04:91",
     "name":"Philips Hue"
},
{
     "id":"001788fffe09a168",
     "internalipaddress":"192.168.88.252"
},
```

2

http://192.168.2.23/description.xml

```
<root xmlns="urn:schemas-upnp-org:device-1-0">
   <specVersion>
      <major>1</major>
      <minor>0</minor>
   </specVersion>
   <URLBase>http://192.168.2.23:80/</URLBase>
   <device>
      <deviceType>urn:schemas-upnp-org:device:Basic:1</deviceT
      <friendlyName>Philips hue (192.168.2.23)</friendlyName>
      <manufacturer>Royal Philips Electronics</manufacturer>
```

3

http://192.168.2.23/api

```
{"devicetype": "hue_pwa#pixel_xl"}
```

↓

User presses physical button on the hub

click

↓

```
[{"success":{"username": "........"}}]
```

save to local storage

3

http://192.168.2.23/api

```
{"devicetype": "hue_pwa#pixel_xl"}
```

↓

User presses physical button on the hub

click

↓

```
[{"success":{"username": "........"}}]
```

save to local storage

4

http://192.168.2.23/api/...../lights


```
{
   "1": {
        "state": {
            "on": true,
            "bri": 144,
            "hue": 13088,
            "sat": 212,
            "xy": [0.5128,0.4147],
            "ct": 467,
            "alert": "none",
```

5

http://192.168.2.23/api/...../lights/1/state

```
{
  "hue": 50000,
  "on": true,
  "bri": 200
}
```

```
[
  {"success":{"/lights/1/state/bri":200}},
  {"success":{"/lights/1/state/on":true}},
  {"success":{"/lights/1/state/hue":50000}}
]
```

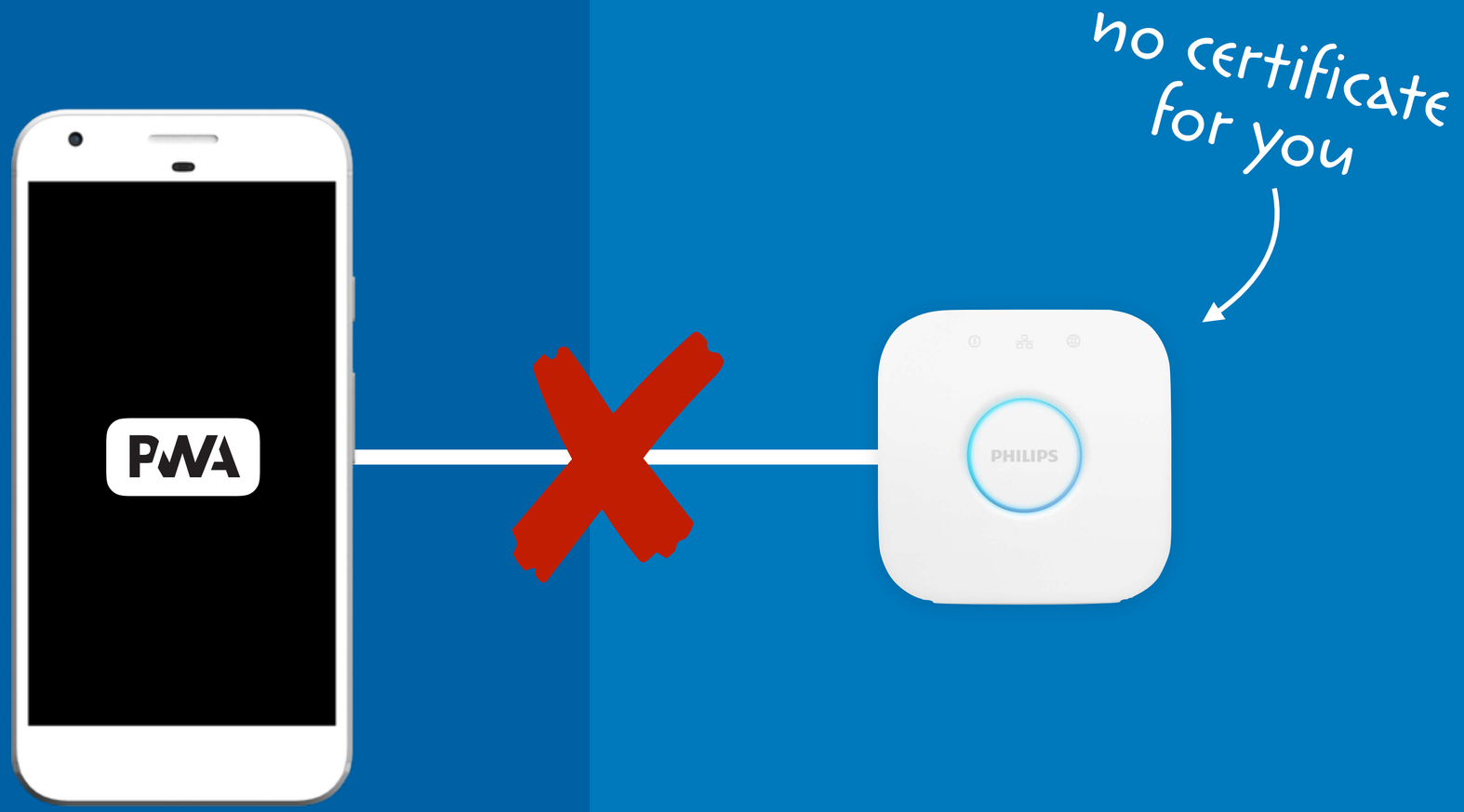
click

click

reload

click

this does not work!



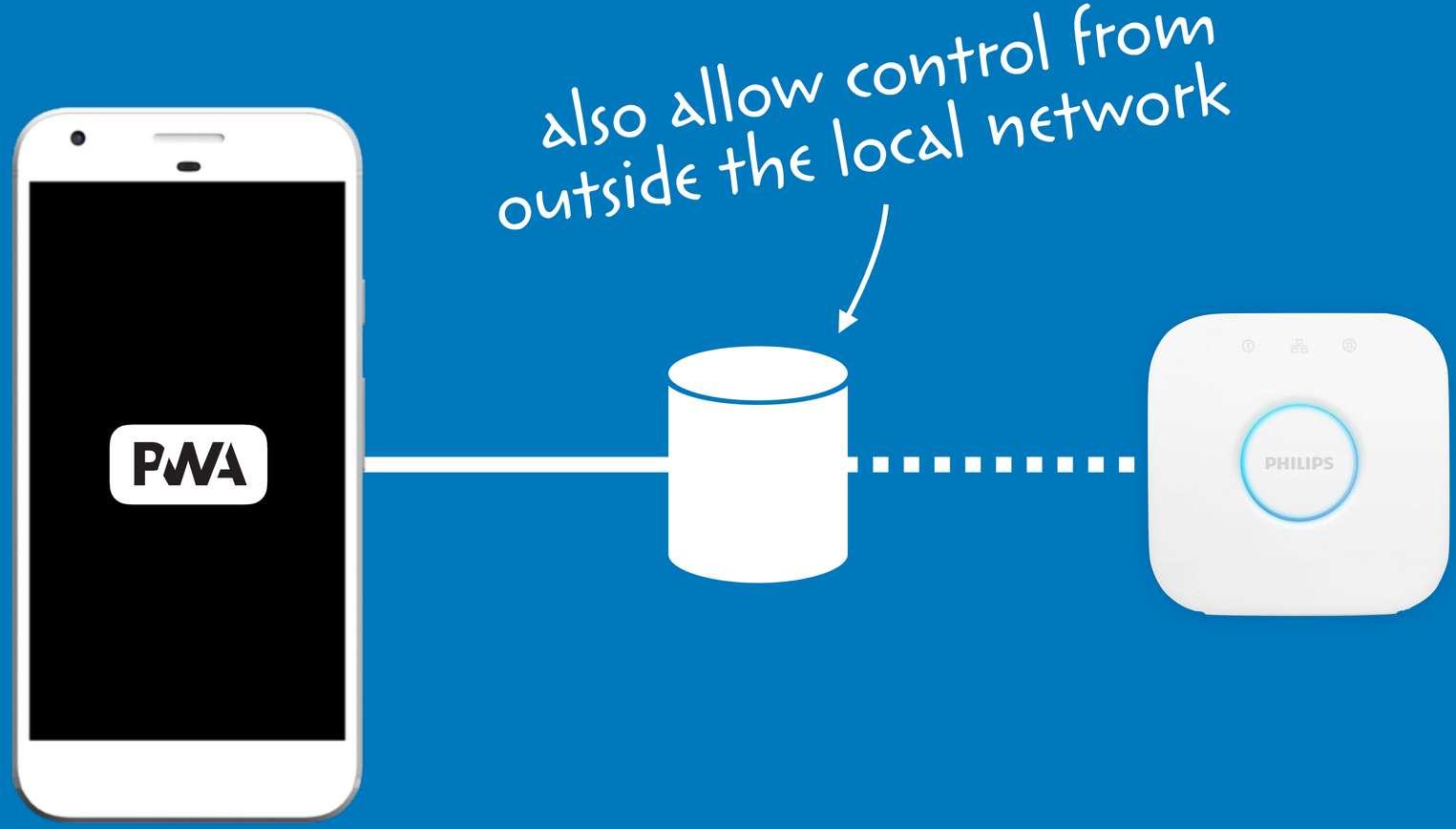
https only

http only

network

$=$ use remote api's

$\neq$ access to local devices



hue remote api

> *We are currently preparing for release of this remote API which will initially be available to a limited number of partners.*
>
> — Philips

two years ago

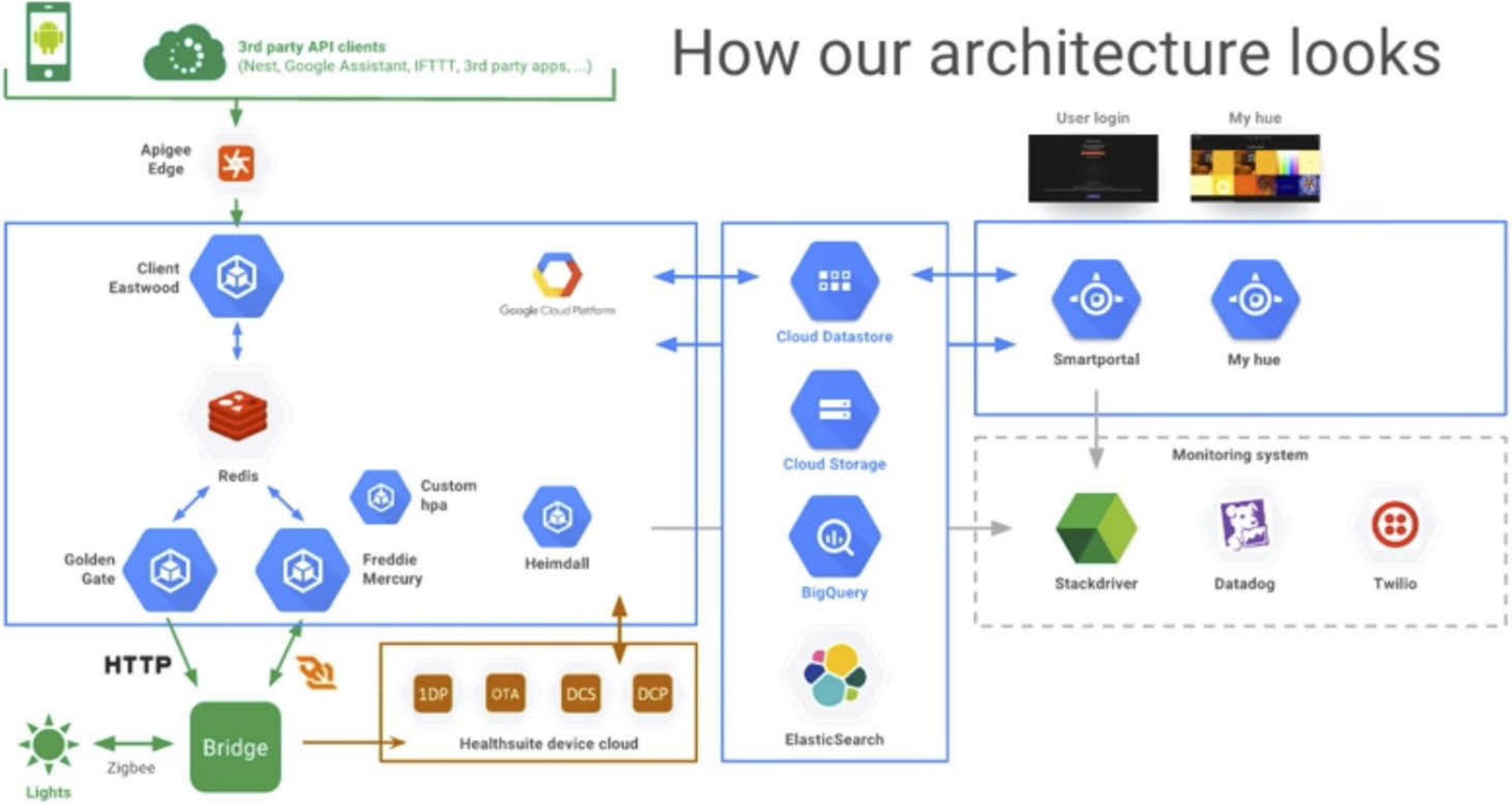
“

We are currently preparing for release of this remote API which will initially be available to a very *limited number of partners.*

— Philips

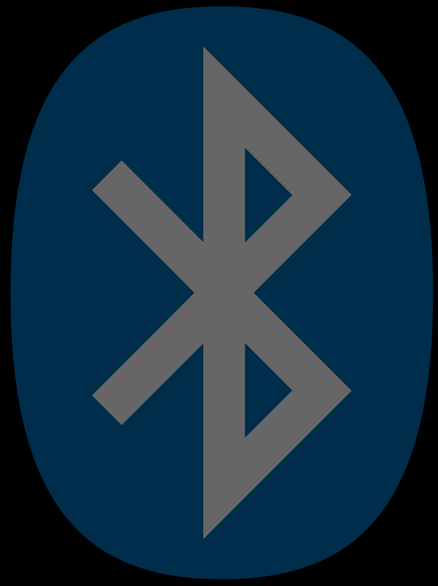
just nest, google assistant and ifttt

How our architecture looks



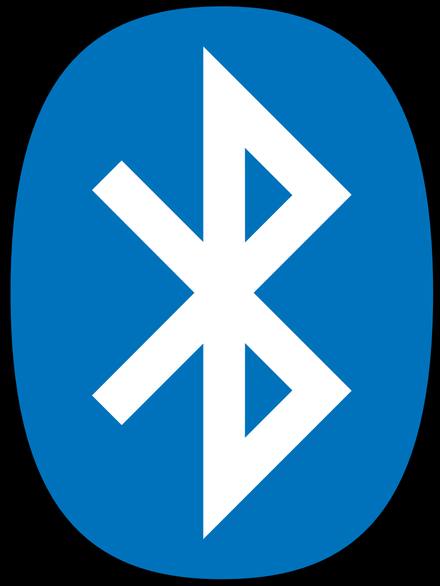
PWA

problems ~~fun~~ with

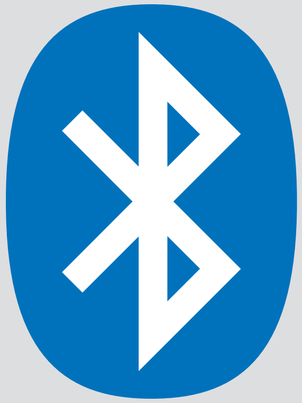


~~bluetooth~~ local networks

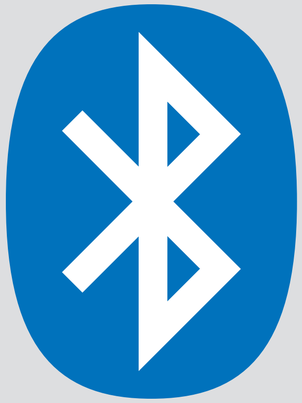
fun with



bluetooth



bluetooth



bluetooth sucks

classic bluetooth

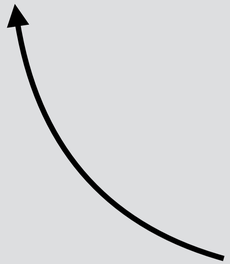
the reason everybody hates bluetooth

vs.

control drones and other cool shit

bluetooth low energy

bluetooth low energy



also known as

Bluetooth Smart

Bluetooth LE

BLE

Bluetooth 4

bluetooth low energy

also known as

Bluetooth Smart

Bluetooth LE

BLE

Bluetooth 4 and 5

10 million

bluetooth devices
shipping every day

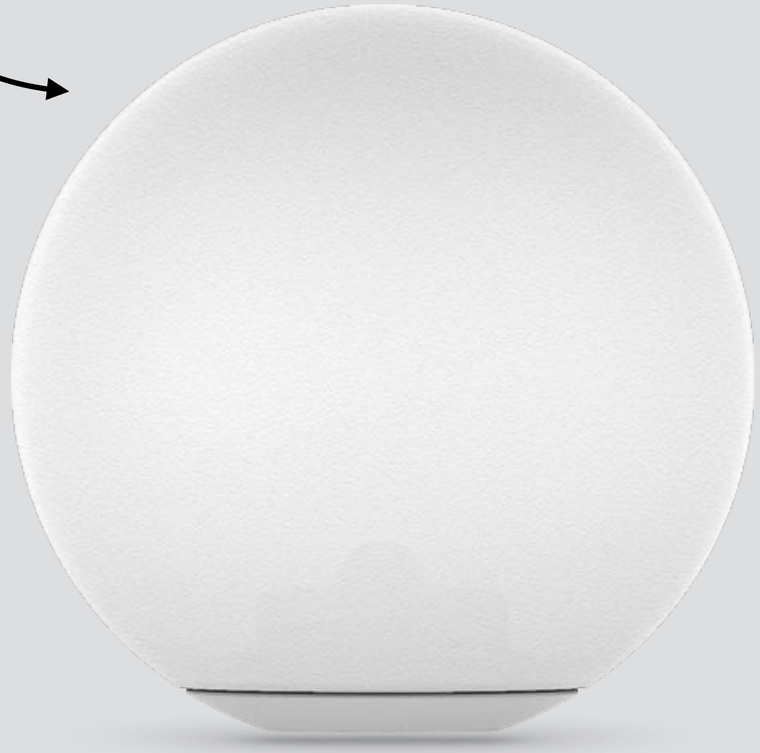
mobile phone

computer


glucose monitor
MEM
5.8
mmol/L
308 2015
8:00 AM
GLU
CHOL
MEMORY
somebody's hand

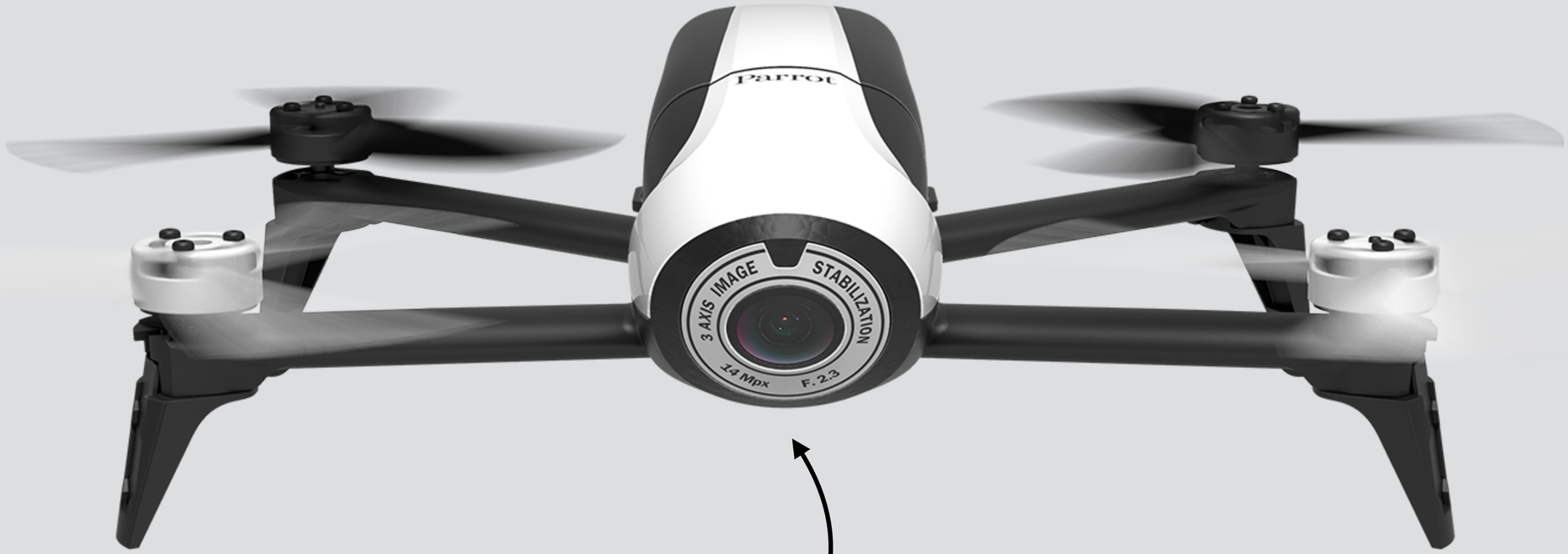

activity tracker

playbulb sphere



playbulb

spherio bb-8



parrot mini drone

fidget spinner

the boring theoretical stuff

central

peripheral

central

generic attribute profile

generic attribute profile ?

generic attribute profile

gatt, because gap was already taken

~~central~~

client

~~peripheral~~

server

device information

light

multiple services per device

device information

battery

flight control

device information

battery

steering control

- device information
- battery
- heart rate

dev inf on

b y

heart rate

device information

battery

heart rate

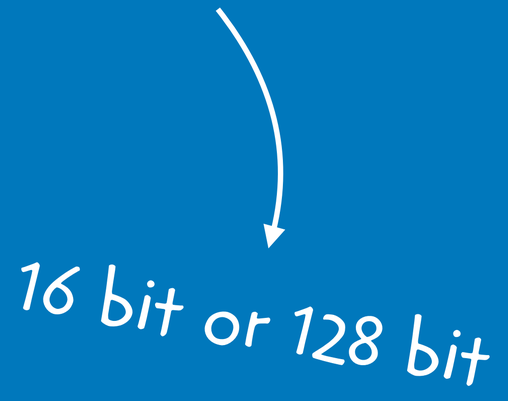
device information

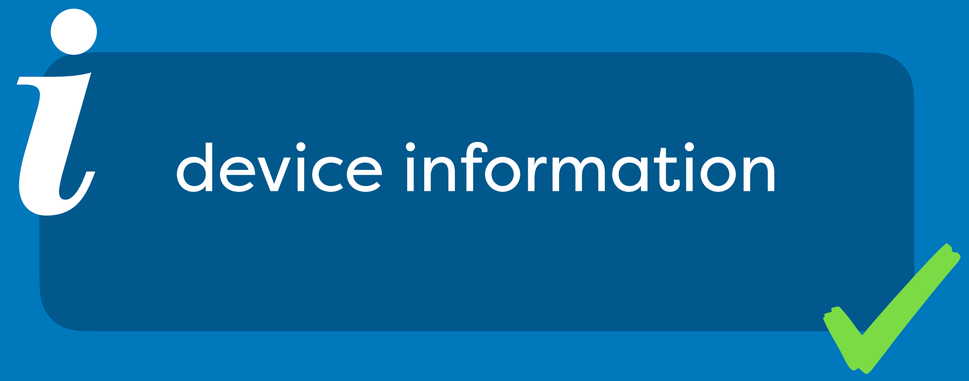
manufacturer
model number
serial number
hardware revision
firmware revision
software revision
...

multiple characteristics per service

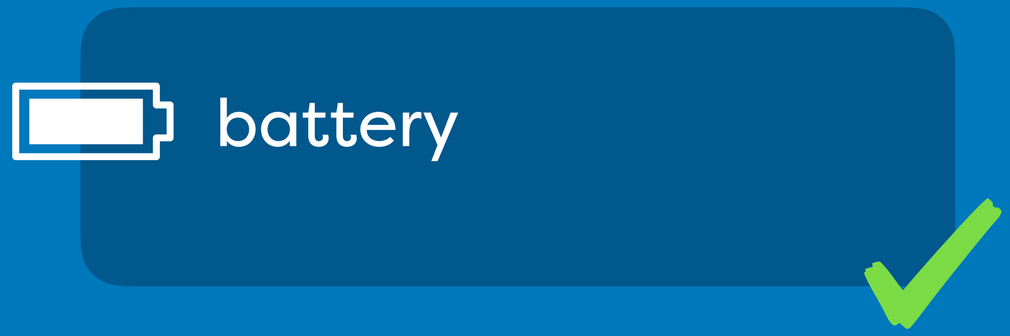
server	array of objects
service	object
characteristic	property
value	value

services and characteristics are identified by uuid's





16 bit	0x180A
128 bit	0000180A-0000-1000-8000-00805F9B34FB



16 bit `0x180F`

128 bit `0000180F-0000-1000-8000-00805F9B34FB`

light

steering control

flight c

still, everybody does this

16 bit `not recommended`

128 bit `any UUID outside of the range`

`xxxxxxxx-0000-1000-8000-00805F9B34FB`

device information

manufacturer
model number
serial number
hardware revision
firmware revision
software revision
...

bad for readability,
good for saving bandwidth

each characteristic supports one or more of these

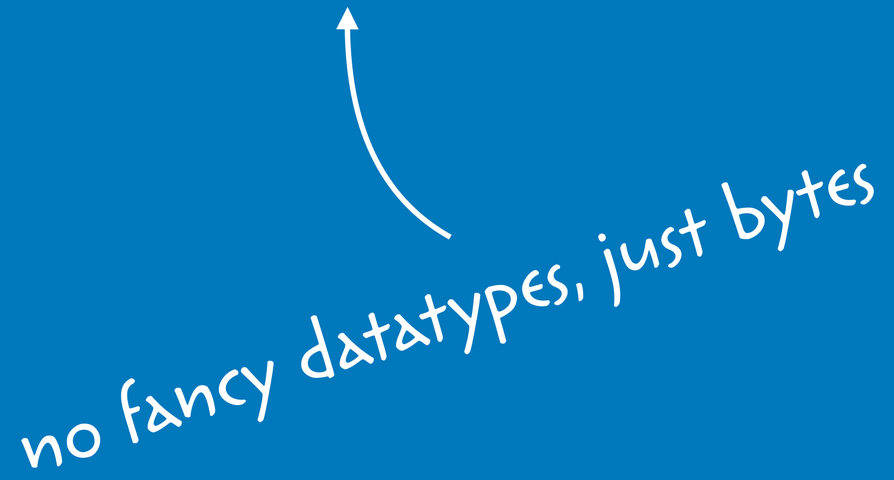
read

write

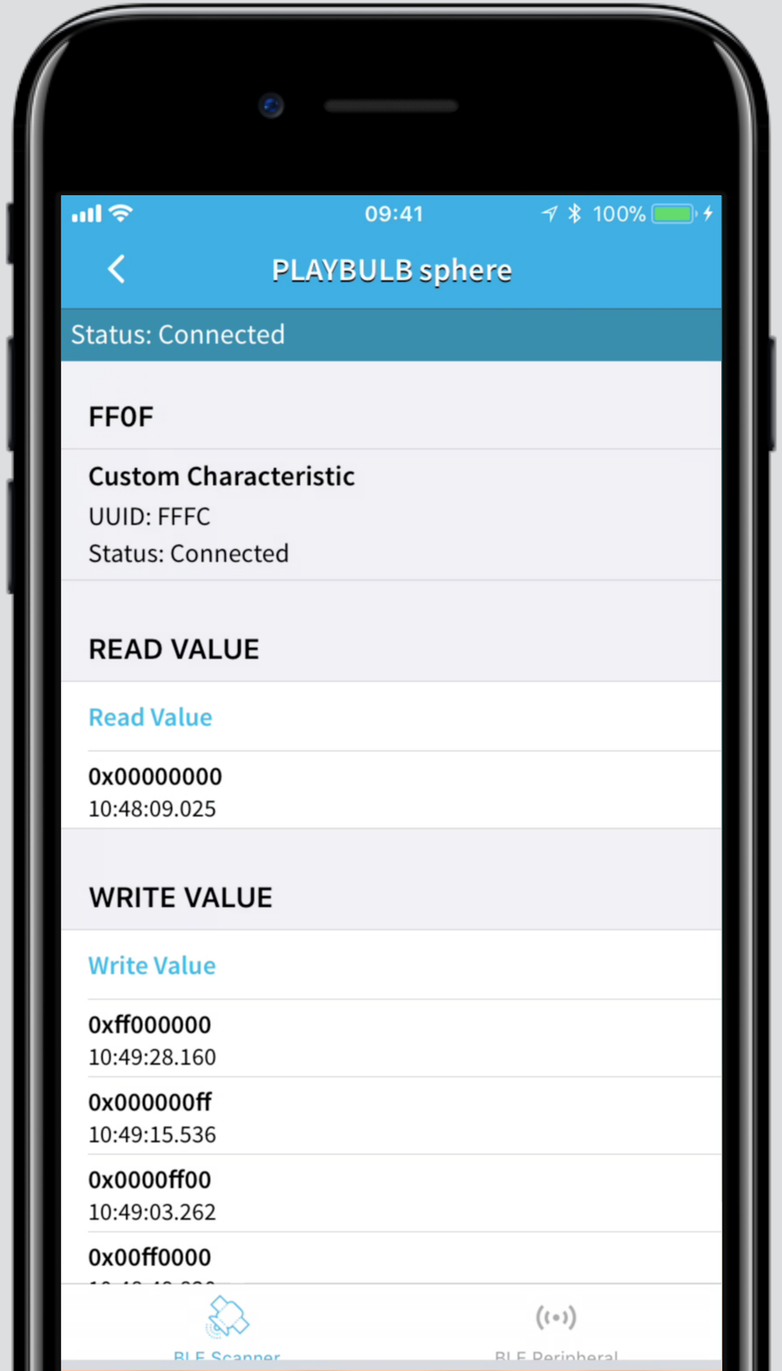
write without response

notify

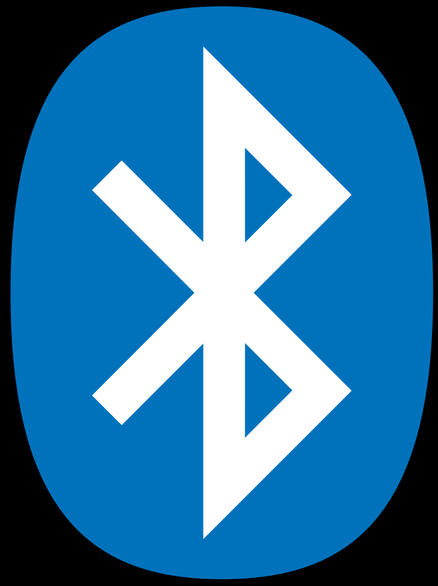
every value is an array of bytes



pfew...

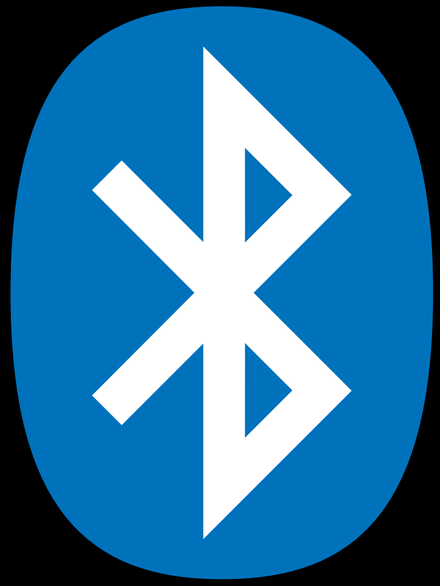

09:41
100%
PLAYBULB sphere
Status: Connected
FF0F
Custom Characteristic
UUID: FFFC
Status: Connected
READ VALUE
Read Value
0x00000000
10:48:09.025
WRITE VALUE
Write Value
0xff000000
10:49:28.160
0x000000ff
10:49:15.536
0x0000ff00
10:49:03.262
0x00ff0000

boring facts about ~~fun with~~



bluetooth

fun with



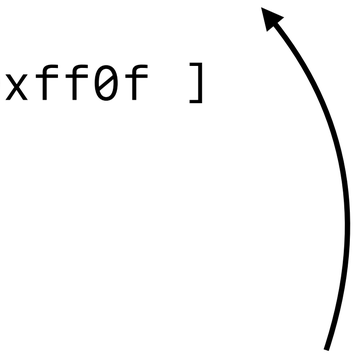
bluetooth

web bluetooth api

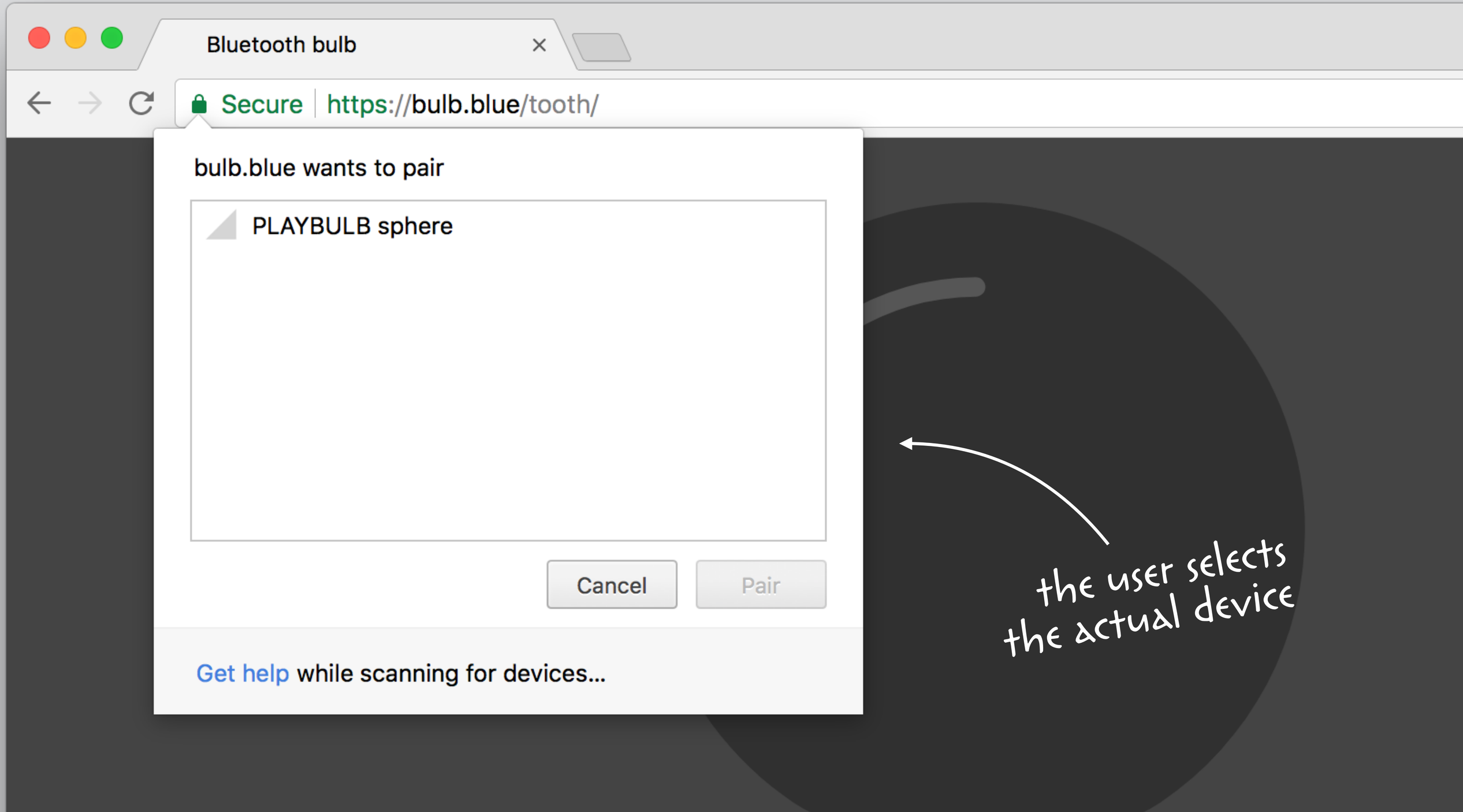
connecting to a device

1

```
navigator.bluetooth.requestDevice({
    filters: [
        { namePrefix: 'PLAYBULB' }
    ],
    optionalServices: [ 0xff0f ]
})
```



we tell the browser what kind of device we want

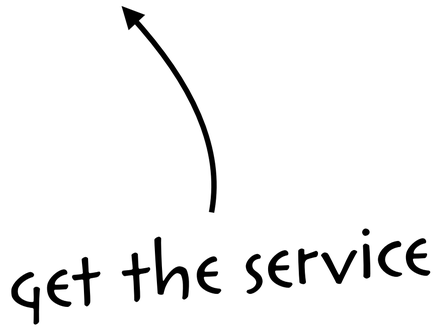

Bluetooth bulb
Secure
https://bulb.blue/tooth/
bulb.blue wants to pair
PLAYBULB sphere
Cancel
Pair
Get help while scanning for devices...
the user selects
the actual device

2

```
navigator.bluetooth.requestDevice({
    filters: [
        { namePrefix: 'PLAYBULB' }
    ],
    optionalServices: [ 0xff0f ]
})

.then(device => device.gatt.connect())
```

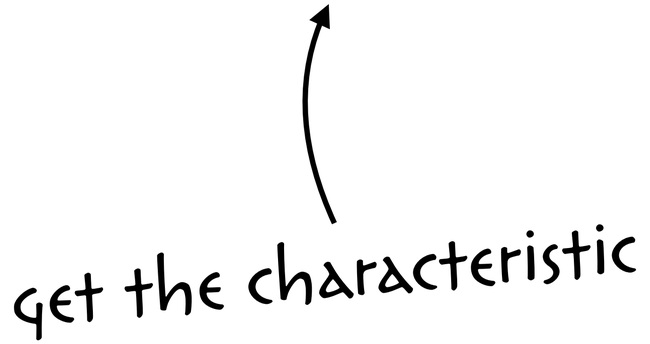
3

```
navigator.bluetooth.requestDevice({
    filters: [
        { namePrefix: 'PLAYBULB' }
    ],
    optionalServices: [ 0xff0f ]
})

.then(device => device.gatt.connect())
.then(server => server.getPrimaryService(0xff0f))
```

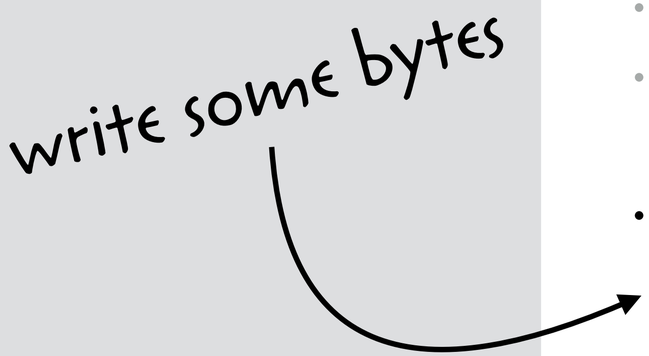


4

```
navigator.bluetooth.requestDevice({
    filters: [
        { namePrefix: 'PLAYBULB' }
    ],
    optionalServices: [ 0xff0f ]
})

.then(device => device.gatt.connect())
.then(server => server.getPrimaryService(0xff0f))
.then(service => service.getCharacteristic(0xfffc))
```

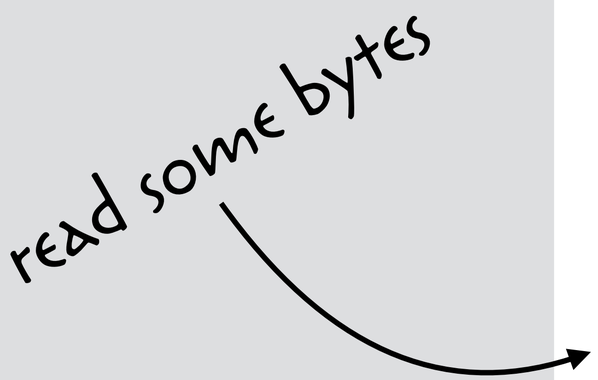


writing data




```
navigator.bluetooth.requestDevice({ ... })
.then(device => device.gatt.connect())
.then(server => server.getPrimaryService(0xff0f))
.then(service => service.getCharacteristic(0xfffc))

.then(c => {
    return c.writeValue(
        new Uint8Array([ 0x00, r, g, b  ])
    );
})
```

reading data




```
navigator.bluetooth.requestDevice({ ... })
.then(device => device.gatt.connect())
.then(server => server.getPrimaryService(0xff0f))
.then(service => service.getCharacteristic(0xfffc))

.then(c => c.readValue())
.then(value => {
    let r = value.getUint8(1);
    let g = value.getUint8(2);
    let b = value.getUint8(3);
})
```

get notified of changes

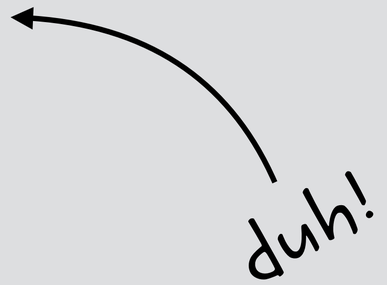
add event listener

```
navigator.bluetooth.requestDevice({ ... })
.then(device => device.gatt.connect())
.then(server => server.getPrimaryService(0xff0f))
.then(service => service.getCharacteristic(0xfffc))

.then(c => {
    c.addEventListener('characteristicvaluechanged', e => {
        let r = e.target.value.getUint8(1);
        let g = e.target.value.getUint8(2);
        let b = e.target.value.getUint8(3);
    });

    c.startNotifications();
})
```

don't forget to start listening

things you need to know:

- the webbluetooth api
- promises
- typed arrays

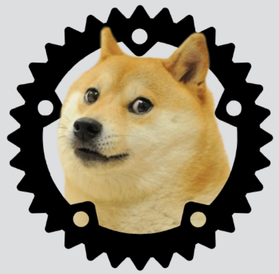


browser support

Chrome

Opera

Samsung



Servo

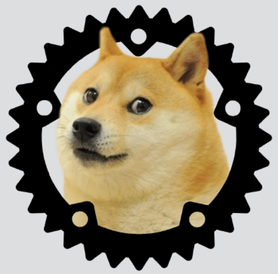
(soon)

browser support

Chrome

Opera

Samsung



Servo

(soon)

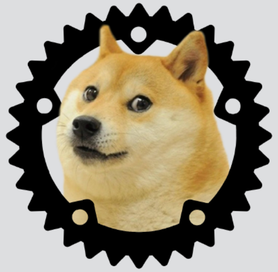
Safari

browser support

Chrome

Opera

Samsung



Servo

(soon)

Safari

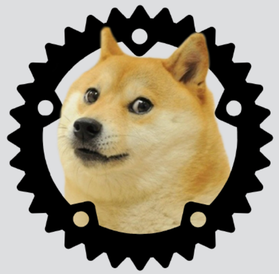
browser support

kinda works

Chrome

Opera

Samsung



Servo

(soon)

WebBLE

for iOS

custom characteristics *wtf!*

writing a value:

```
function(r, g, b) {
    return new Uint8Array([ 0x00, r, g, b  ]);
}
```

reading a value:

```
function(buffer) {
    return {
        r: buffer.getUint8(1),
        g: buffer.getUint8(2),
        b: buffer.getUint8(3)
    }
}
```

writing to and reading
from the same characteristic

writing a value:

```
function(r, g, b) {
    return new Uint8Array([
        0x01, g, 0x01, 0x00, 0x01,
        b, 0x01, r, 0x01, 0x00
    ]);
}
```

reading the current color is not possible

writing a value:

```
function(r, g, b) {
    var buffer = new Uint8Array([
        0xaa, 0x0a, 0xfc, 0x3a, 0x86, 0x01, 0x0d,
        0x06, 0x01, r, g, b, 0x00, 0x00,
        (Math.random() * 1000) & 0xff, 0x55, 0x0d
    ]);

    for (var i = 1; i < buffer.length - 2; i++) {
        buffer[15] += buffer[i];
    }

    return buffer;
}
```

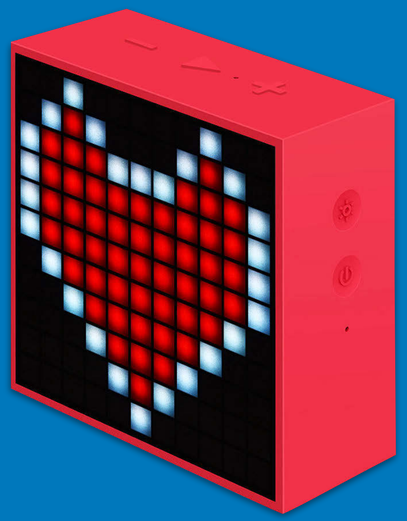
reading the current color is not possible

writing a value:

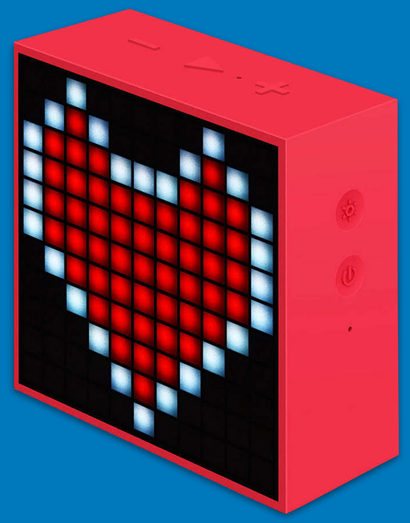
```
function(r, g, b, position) {
    let buffer = new Uint8Array([
        0x07, 0x02, position + 1, r, g, b
    ]);

    return buffer;
}
```

writing a value:

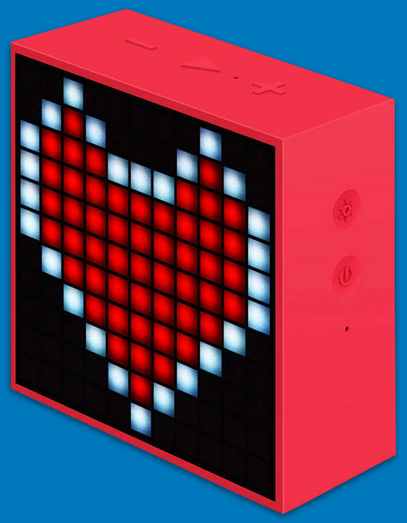
```
function(r, g, b, position) {
    let buffer = new Uint8Array([
        0x58, r, g, b, 0x01, position
    ]);

    ...
```



writing a value:



```
function(r, g, b, position) {
    let buffer = new Uint8Array([
        0x58, r, g, b, 0x01, position
    ]);

    let payload = new Uint8Array(buffer.length + 4);
    payload[0] = payload.length - 2;
    payload[1] = payload.length - 2 >>> 8;
    payload.set(buffer, 2);

    let checksum = payload.reduce((a, b) => a + b, 0);
    payload[payload.length - 2] = checksum;
    payload[payload.length - 1] = checksum >>> 8;

    let extra = payload.filter(value => {
```



```
                message[m + 1] = 0x05;
                m += 2;
            }
            else if (payload[i] === 0x03) {
                message[m] = 0x03;
                message[m + 1] = 0x06;
                m += 2;
            }
            else {
                message[m] = payload[i];
                m++;
            }
        }

        message[0] = 0x01;
        message[message.length - 1] = 0x02;

        return message;
    }
```

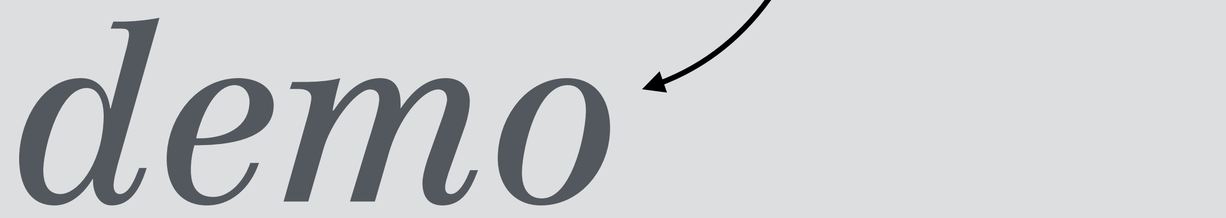
adafruit bluetooth sniffer

decompiling

the apk

don't tell anyone!

finally the fun part



warning

experimental technology

setting low expectations

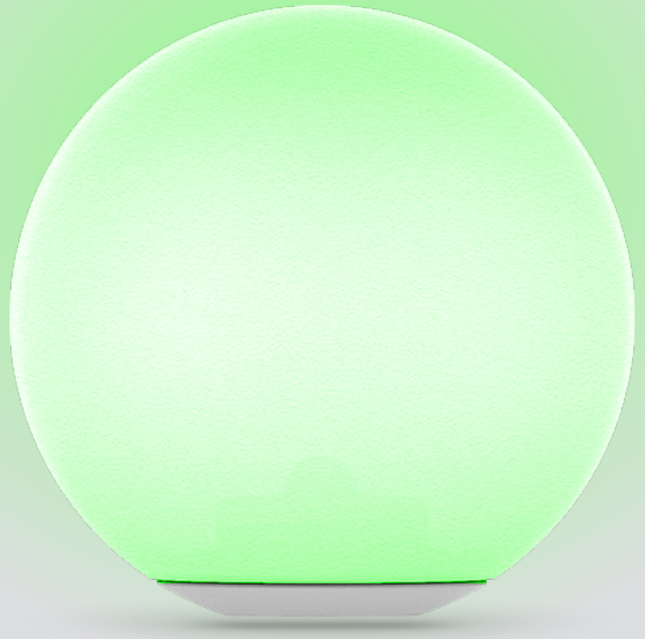
warning

wifi interference

lowering them even further

#devdaysvilnius

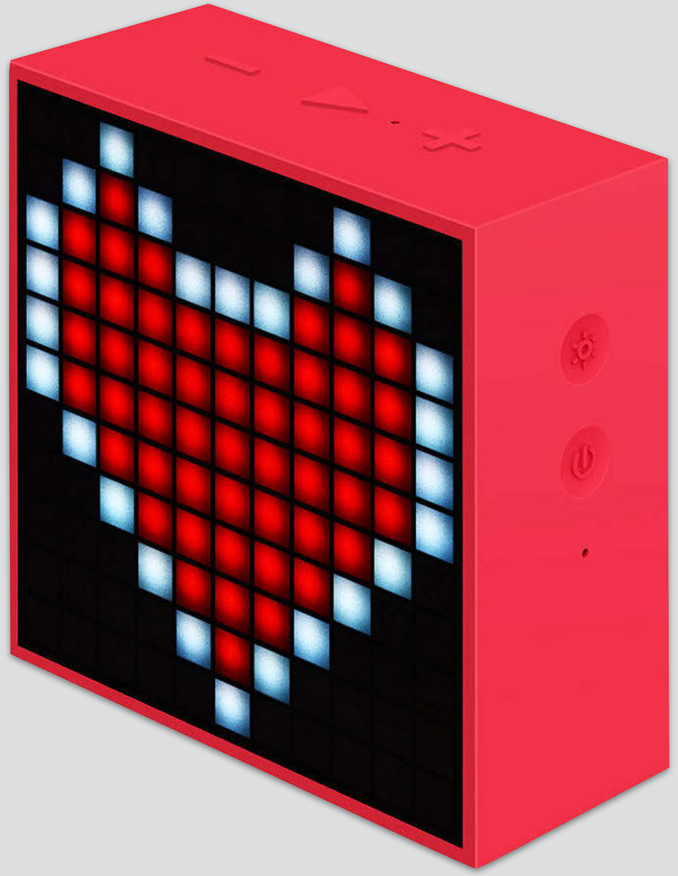
change the colour
of a lightbulb



https://bluetooth.rocks/lightbulb

https://github.com/BluetoothRocks/Lightbulb

draw pixel art on a led matrix display



https://bluetooth.rocks/pixel

https://github.com/BluetoothRocks/Matrix

control a lego racer
using a gamepad

use css animations to
define a path

https://bluetooth.rocks/racer

https://github.com/BluetoothRocks/Racer

control a drone
from your browser

https://bluetooth.rocks/drone

https://github.com/BluetoothRocks/Drone

print on a receipt printer

https://bluetooth.rocks/printer

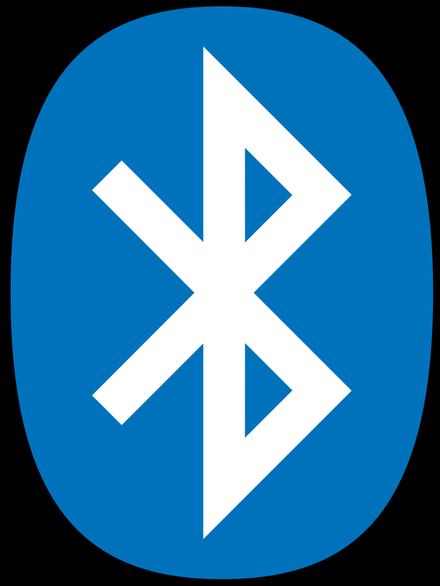
https://github.com/BluetoothRocks/TweetPrinter

find out your
current heartbeat

https://bluetooth.rocks/pulse

https://github.com/BluetoothRocks/Pulse

fun with



bluetooth!

questions?