
BEM VINDOS!
VENTURUS4TECH

Módulo IV
Internet das Coisas

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Agenda

- Internet das Coisas (IoT)
  - Introdução
  - Aplicações
  - Protocolos de comunicação
- Arduino
  - Introdução
  - Placa de desenvolvimento
  - Aplicativo House Control
- Android
  - Aplicativo House Control

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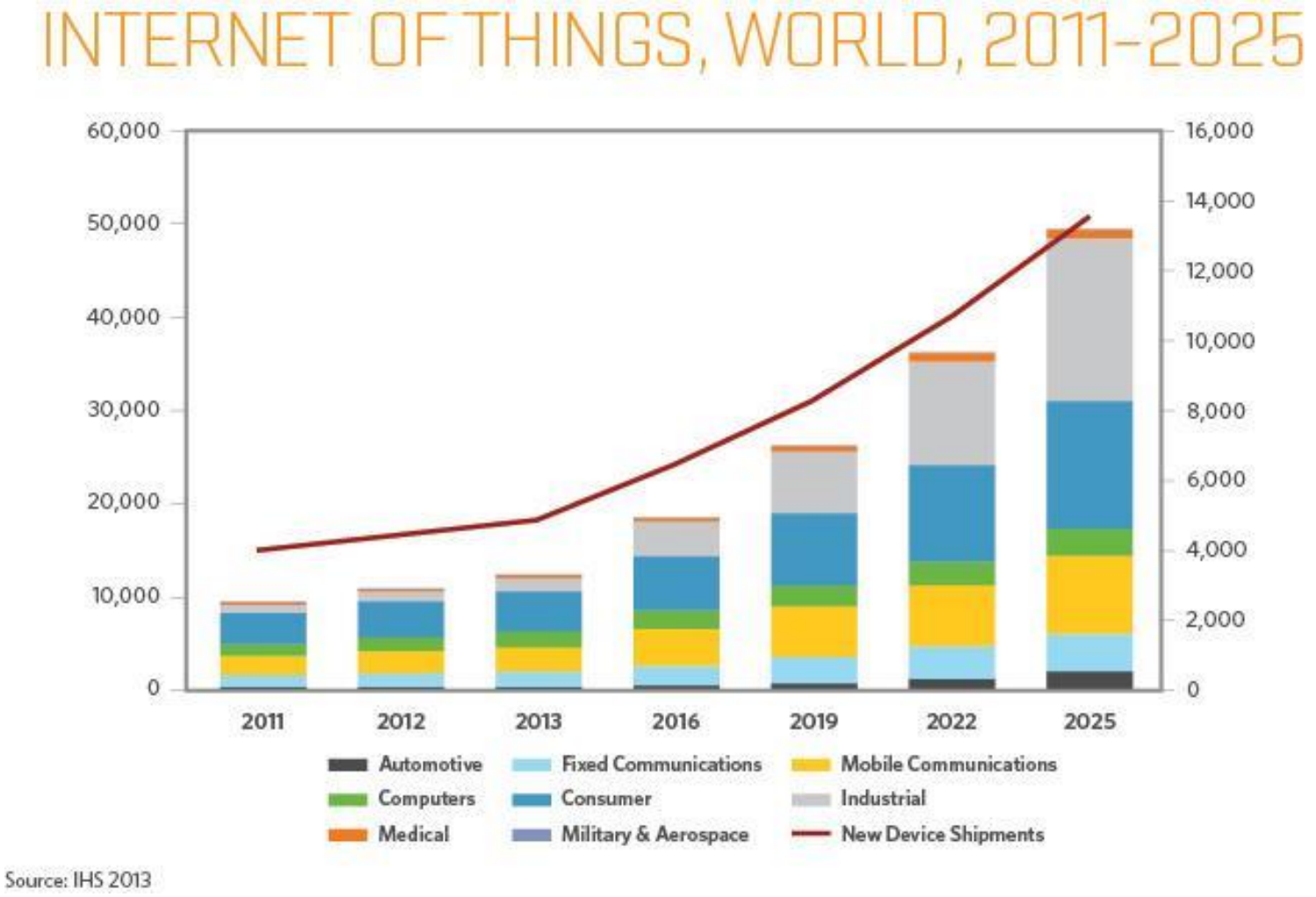
Introdução IoT

- Gerações:
  - Internet/Conectividade
  - E-commerce
  - Redes sociais
  - Internet das coisas

Introdução IoT

- O que é IoT?
  - É a rede de objetos físicos que possuem tecnologia embarcada para comunicar, captar sinais e interagir consigo mesmos ou com o ambiente externo. (Gartner)
- Termo IoT
  - Criado em 1999 pelo MIT durante necessidade de criar uma rede de devices global (RFID).

Introdução IoT



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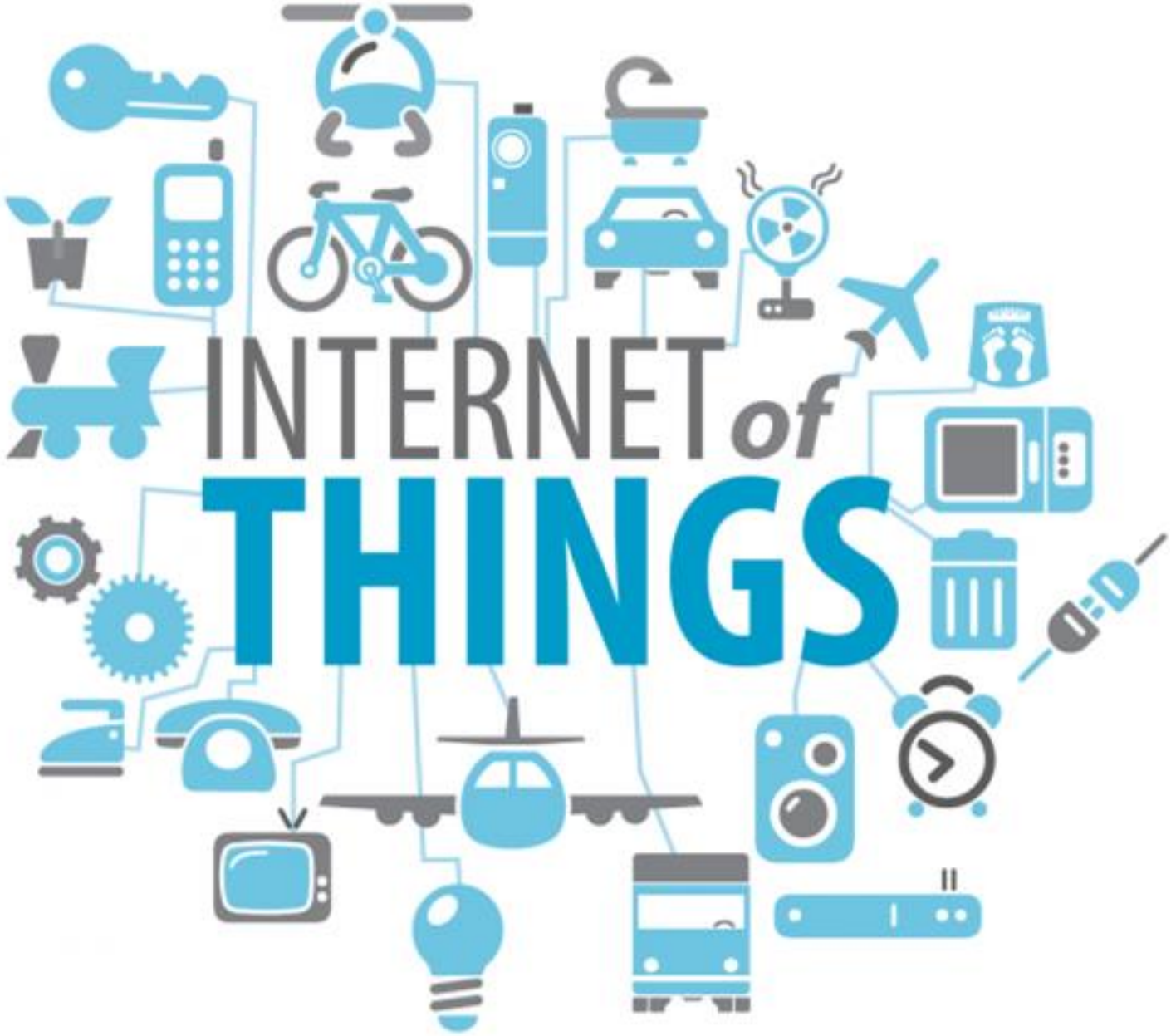

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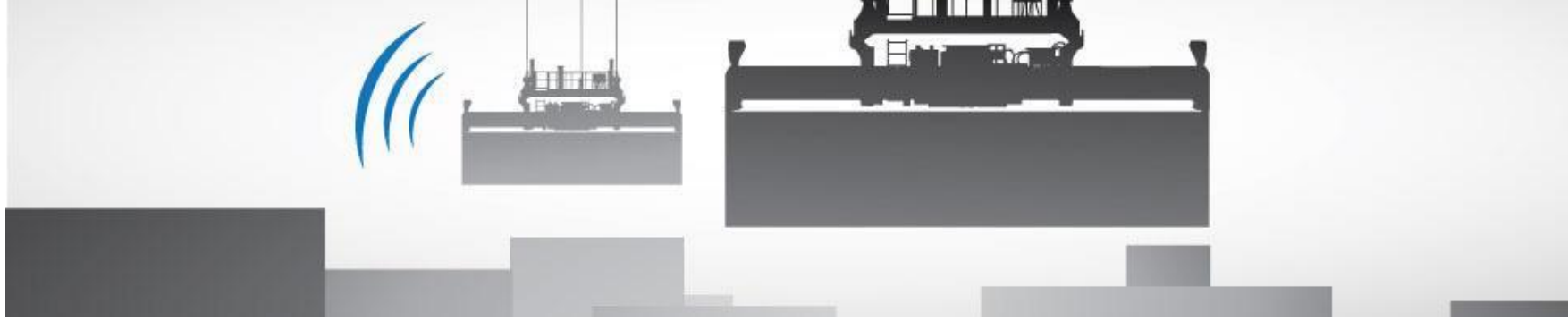
Smart Cities

- Smart Parking
  - Monitoring of parking spaces availability in the city.
- Structural health
  - Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.
- Noise Urban Maps
  - Sound monitoring in bar areas and centric zones in real time.
- Smartphone Detection
  - Detect iPhone and Android devices and in general any device which works with WiFi or Bluetooth interfaces.
- Traffic Congestion
  - Monitoring of vehicles and pedestrian levels to optimize driving and walking routes.
- Smart Lighting
  - Intelligent and weather adaptive lighting in street lights.
- Waste Management
  - Detection of rubbish levels in containers to optimize the trash collection routes.
- Smart Roads
  - Intelligent Highways with warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

Smart Environment

- Forest Fire Detection
  - Monitoring of combustion gases and preemptive fire conditions to define alert zones.
- Air Pollution
  - Control of CO_2 emissions of factories, pollution emitted by cars and toxic gases generated in farms.
- Landslide and Avalanche Prevention
  - Monitoring of soil moisture, vibrations and earth density to detect dangerous patterns in land conditions.
- Earthquake Early Detection
  - Distributed control in specific places of tremor
- Potable water monitoring
  - Monitor the quality of tap water in cities.
- Chemical leakage detection in rivers
  - Detect leakages and wastes of factories in rivers.
- Pollution levels in the sea
  - Control realtime leakages and wastes in the sea.
- Water Leakages
  - Detection of liquid presence outside tanks and pressure variations along pipes.
- River Floods
  - Monitoring of water level variations in rivers, dams and reservoirs.

Smart Metering



- Smart Grid
  - Energy consumption monitoring and management.
- Tank level
  - Monitoring of water, oil and gas levels in storage tanks and cisterns.
- Photovoltaic Installations
  - Monitoring and optimization of performance in solar energy plants.
- Water Flow
  - Measurement of water pressure in water transportation systems.
- Silos Stock Calculation
  - Measurement of emptiness level and weight of the goods.

Home Automation

- Energy and Water Use
  - Energy and water supply consumption monitoring to obtain advice on how to save cost and resources.
- Remote Control Appliances
  - Switching on and off remotely appliances to avoid accidents and save energy.
- Intrusion Detection Systems
  - Detection of windows and doors openings and violations to prevent intruders.
- Art and Goods Preservation
  - Monitoring of conditions inside museums and art warehouses.

eHealth

- Fall Detection
  - Assistance for elderly or disabled people living independent.
- Medical Fridges
  - Control of conditions inside freezers storing vaccines, medicines and organic elements.
- Sportsmen Car
  - Vital signs monitoring in high performance centers and fields.
- Patients Surveillance
  - Monitoring of conditions of patients inside hospitals and in old people's home.
- Ultraviolet Radiation
  - Measurement of UV sun rays to warn people not to be exposed in certain hours.

Aplicações - Industrial Control

- M2M Applications
  - Machine auto-diagnosis and assets control.
- Indoor Air Quality
  - Monitoring of toxic gas and oxygen levels inside chemical plants to ensure workers and goods safety.
- Temperature Monitoring
  - Control of temperature inside industrial and medical fridges with sensitive merchandise.
- Ozone Presence
  - Monitoring of ozone levels during the drying meat process in food factories.
- Indoor Location
  - Asset indoor location by using active (ZigBee) and passive tags (RFID/NFC).
- Vehicle Auto-diagnosis
  - Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.

Aplicações - Smart Agriculture

- Wine Quality Enhancing
  - Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.
- Green Houses
  - Control micro-climate conditions to maximize the production of fruits and vegetables and its quality.
- Golf Courses
  - Selective irrigation in dry zones to reduce the water resources required in the green.
- Meteorological Station Network
  - Study of weather conditions in fields to forecast ice formation, rain, drought, snow or wind changes.
- Compost
  - Control of humidity and temperature levels in alfalfa, hay, straw, etc. to prevent fungus and other microbial contaminants.

Segurança

- TV LG
  - Caso de roubo de senha
- Lâmpada Philips Hue
  - Caso do hacker que fez a luz ficar piscando
- Babá eletrônica
  - Espionagem
- Carro conectado
  - Qualquer um sabendo sua rotina e localização

Protocolos IoT

- Principais protocolos de comunicação
  - HTTP (HyperText Transfer Protocol)
  - CoAP (Constrained Application Protocol)
  - AMQP (Advanced Message Queuing Protocol)
  - XMPP (eXtensible Messaging and Presence Protocol)
  - MQTT (Message Queue Telemetry Transport)

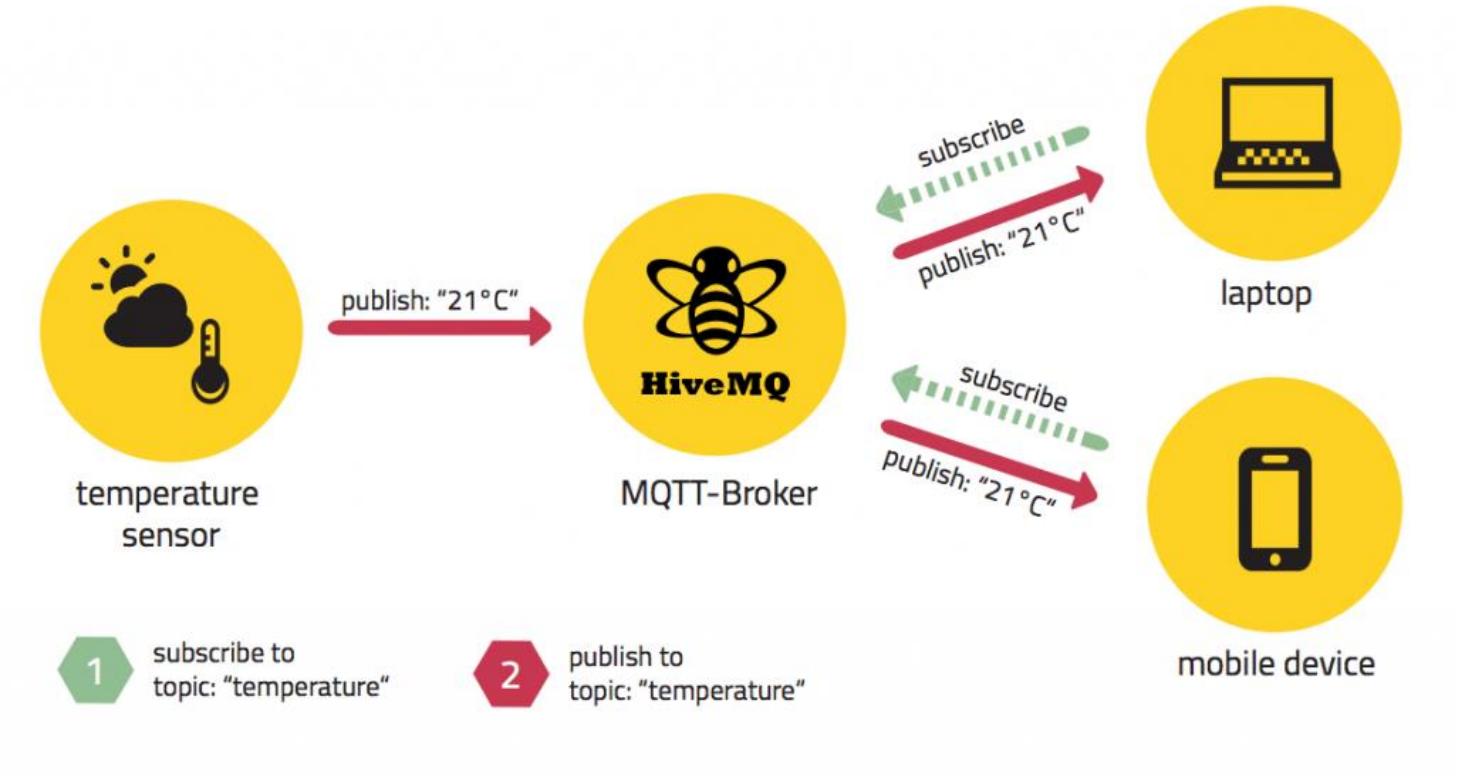
Protocolos IoT - MQTT

- Message Queue Telemetry Transport
  - Criado pela IBM/Arcom em 1999.
  - Publish/Subscribe
  - Simples e leve (poucos kb)
  - Minimiza uso de banda/internet e recursos
  - Possui QoS (garantia de mensagem entregue)
  - Precisa de um Broker para funcionar

Protocolos IoT - MQTT

- Comparado com HTTPS, MQTT:
  - 93 vezes mais eficiente (mais mensagens por intervalo de tempo)
  - 11 vezes menos bateria para transmissão
  - 170 vezes menos para recepção.
  - Garantia de entrega
  - Armazena mensagens não lidas
  - Last will & testament

Protocolos IoT - MQTT



ARDUINO

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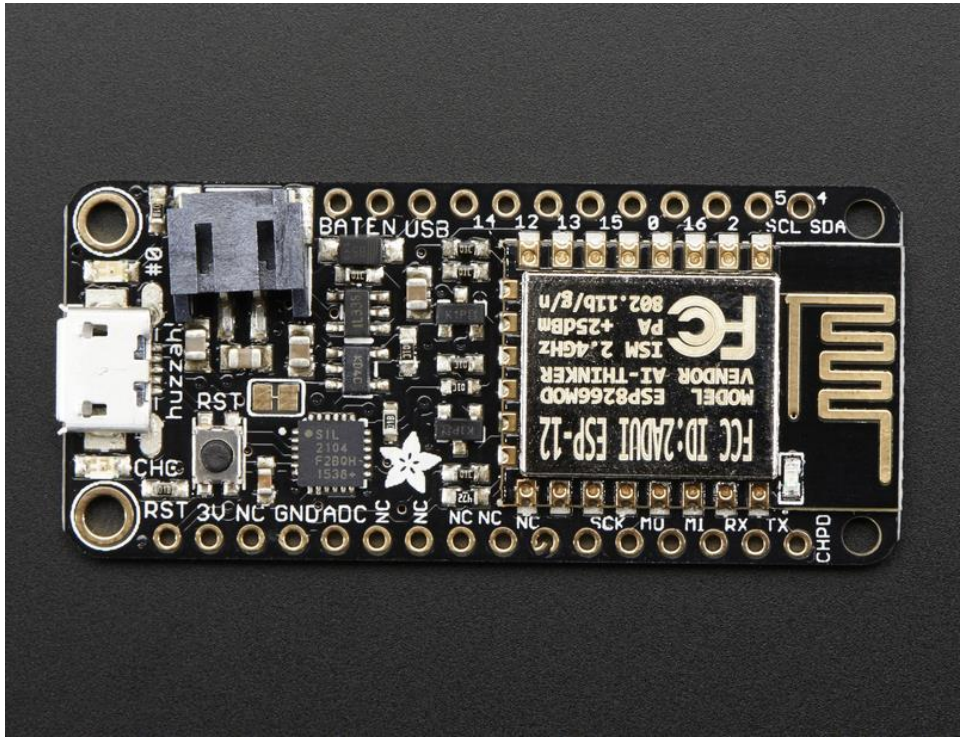
Arduino

- O que é?
  - Hardware
  - Ambiente de desenvolvimento
- Vantagens
  - Prototipagem
  - Open source (hardware e software)
  - Comunidade (wiki, exemplos, dúvidas)

Placas do Curso - ESP8266

- Light as a (large?) feather - 6 grams
- ESP8266 @ 40MHz with 3.3V logic/power
- 4MB of FLASH (32 MBit)
- 3.3V regulator with 500mA peak current output
- CP2104 USB-Serial converter onboard with 921600 max baudrate
- Auto-reset support for getting into bootload mode before firmware upload
- 9 GPIO pins - can also be used as I2C and SPI
- 1 x analog inputs 1.0V max
- Built in 100mA lipoly charger with charging status indicator LED
- Pin #0 red LED for general purpose blinking. Pin #2 blue LED for bootloading debug & general purpose blinking
- Power/enable pin
- Reset button



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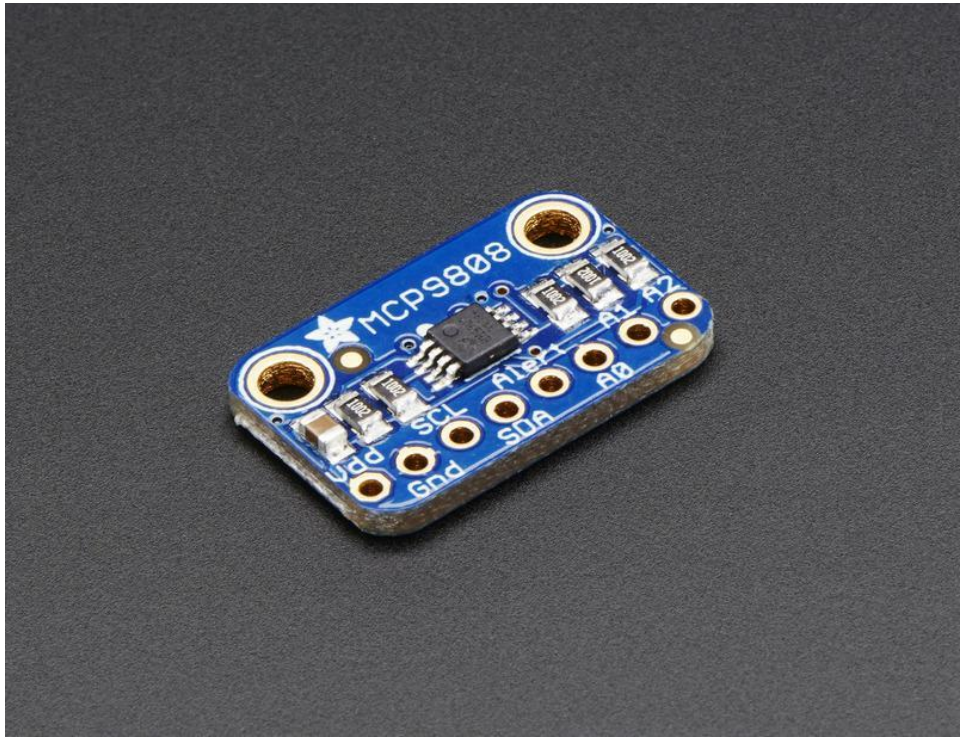
Placas do Curso - MCP9808

- Simple I2C control
- Up to 8 on a single I2C bus with adjustable address pins
- 0.25°C typical precision over -40°C to 125°C range (0.5°C guaranteed max from -20°C to 100°C)
- 0.0625°C resolution
- 2.7V to 5.5V power and logic voltage range
- Operating Current: 200 µA (typical)



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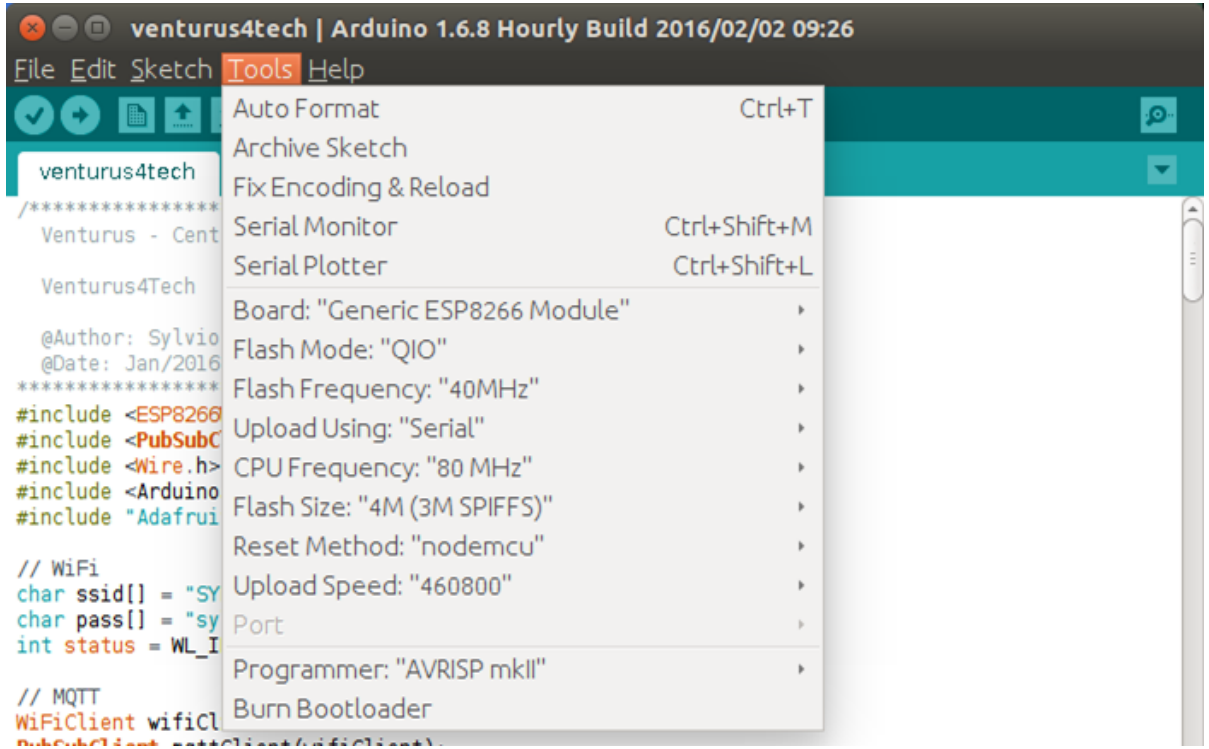
Preparando o ambiente (MAC)

- Instalar FTDI Driver:
  - https://goo.gl/lXSTRO
- Adicionar ESP8266 board package:
  - http://arduino.esp8266.com/stable/package_esp8266com_index.json
- Instalar board: Menu Tools/Board/Boards Manager
  - Instalar esp8266
- Adicionar Libraries: Menu Sketch/Include Library/Manage Libraries
  - PubSubClient
  - ArduinoJson
  - Adafruit MCP9808

Configurando a placa ESP8266

- Port:
  - usbserial OU
  - usbmodem



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Exemplo 1 - Piscar LED

```
// Setup é executada apenas na inicialização
void setup() {
  pinMode(0, OUTPUT); // configura porta 0 como saída
}

// Função executada sem parar
void loop() {
  digitalWrite(0, LOW); // liga o LED
  delay(1000);          // aguarda 1 segundo
  digitalWrite(0, HIGH);// desliga o LED
  delay(1000);          // aguarda 1 segundo
}
```

Exemplo 2 - Piscar LED sem bloqueio

```
int ledState = LOW;

unsigned long previousMillis = 0;
const long interval = 1000;

void setup() {
  pinMode(0, OUTPUT);
}
```

```
void loop() {
  unsigned long currentMillis = millis();
  if(currentMillis - previousMillis >= interval) {
    previousMillis = currentMillis;
    if (ledState == LOW) {
      ledState = HIGH;
    } else {
      ledState = LOW;
    }
    digitalWrite(0, ledState);
  }
}
```

Exemplo 3 - Porta Serial

```
int ledState = LOW;

unsigned long previousMillis = 0;
const long interval = 1000;

void setup() {
  Serial.begin(115200);
  pinMode(0, OUTPUT);
}
```

```
void loop() {
  unsigned long currentMillis = millis();
  if(currentMillis - previousMillis >= interval) {
    previousMillis = currentMillis;
    if (ledState == LOW) {
      Serial.println("Desligou LED");
      ledState = HIGH;
    } else {
      Serial.println("Ligou LED");
      ledState = LOW;
    }
    digitalWrite(0, ledState);
  }
}
```

Exemplo 4 - WiFi

```
#include <ESP8266WiFi.h>

// WiFi
char ssid[] = "WSony_Lab";    // Nome da rede WiFi
char pass[] = "Wsony2016";    // Senha

// Declarando funções do código
void setup_wifi();

void setup() {
  pinMode(0, OUTPUT);
  setup_wifi();
}
```

```
void setup_wifi() {
  Serial.println();
  Serial.print("Conectando ao SSID: ");
  Serial.println(ssid);

  WiFi.begin(ssid, pass);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.println("");
  Serial.println("Conectado ao WiFi!");
  Serial.print("Endereço IP: ");
  Serial.println(WiFi.localIP());
}
```

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Exemplo 4 - WiFi + LED Azul ligado

```ino
#include <ESP8266WiFi.h>

// WiFi
char ssid[] = "WSony_Lab";    // Nome da rede WiFi
char pass[] = "Wsony2016";    // Senha

// Declarando funções do código
void setup_wifi();

void setup() {
  pinMode(0, OUTPUT);
  pinMode(2, OUTPUT);
  setup_wifi();
}
```

```ino
void setup_wifi() {
  (...)

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    digitalWrite(2, !digitalRead(2));
    Serial.print(".");
  }

  digitalWrite(2, LOW);
  (...)
}
```

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