

The screenshot shows the homepage of the JOPES 2020 website. At the top left is the logo of the Universidad Nacional de Ingeniería (UNI) featuring a red seal. Next to it is the acronym "JOPES" in large blue letters, with "JORNADAS PERUANAS DE ENERGÍA SOLAR" written below it. The top navigation bar includes links for "Home", "About JOPES", "Program", "registration", "Important dates", a language dropdown set to "English", and a search icon. The main visual is a photograph of solar panels against a bright sky with the sun. Overlaid on this image is the title "JOPES 2020" in large yellow letters. Below the title is the subtitle "Peruvian Workshop on Solar Energy 2020". Underneath that is the date "June 25 – 26, 2020". A yellow button labeled "PROGRAM" is visible. At the bottom of the main image area is a yellow bar containing the text "Countdown to JOPES 2020".

Ponencia presentada en:  
<http://jopes.uni.edu.pe/en/home/>  
25/Junio/2020

# Internet de las Cosas & Energía en Edificaciones

Guillermo Barrios del Valle

[gbv@ier.unam.mx](mailto:gbv@ier.unam.mx)

Instituto de Energías Renovables-UNAM

# Laboratorio de Tecnologías Abiertas [L A T A]

## Equipo

Dr. Guillermo Ramírez Zúñiga

—  
Lennin Román Avilés

Leonardo César Gómez

Julio Landa López

Abraham González Castro

# Contenido

---

1. Internet de las Cosas
2. Energía en Edificaciones
3. ThingsBoard
4. Dispositivos
5. Retos
6. Conclusiones

# Internet de las Cosas - IoT - Qué no es...

---



# Internet de las Cosas - IoT - Qué no es...

---

1. Comunicación de máquina a máquina, i.e. ssh gbv@chilpayatl
2. No es un sistema embebido, i.e. Celular conectado a la nube
3. No es solo IA
4. No es un sistema de adquisición de datos conectado a la nube
5. No es una plataforma de cómputo en la nube

# Internet de las Cosas - IoT - Qué SI es:

## Internet de las cosas

El **internet de las cosas** (en inglés, *Internet of Things*, abreviado *IoT*;<sup>1</sup> IdC, por sus siglas en español<sup>2</sup>) es un concepto que se refiere a una interconexión digital de objetos cotidianos con internet.<sup>3 4</sup> Es, en definitiva, la conexión de internet más con objetos que con personas.<sup>2</sup> También se suele conocer como *internet de todas las cosas* o *internet en*

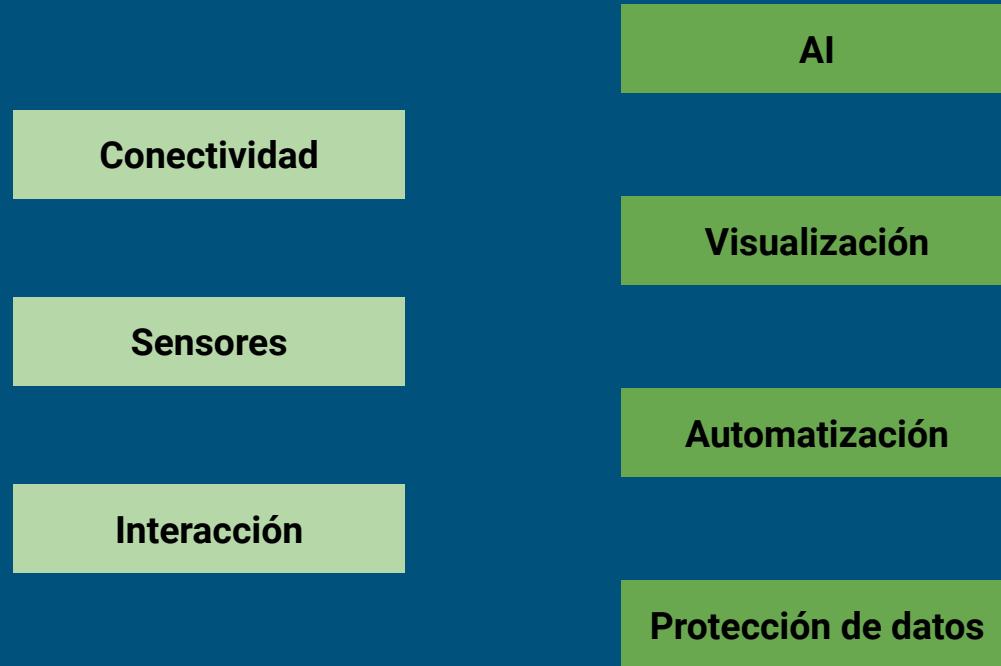
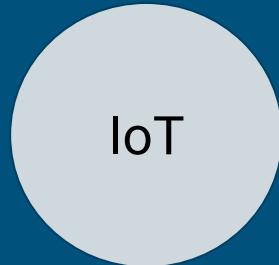
**INTERCONEXIÓN**  
**INTERACCIÓN**



Descripción gráfica del mundo interconectado

# Internet de las Cosas

---



# Energía en Edificaciones

---

- 4,700 kWh per capita en el mundo
- Canadá: 20,000 kWh per capita
- México: 2,500 kWh per capita (18% Total de energía de acuerdo al Balance Nacional de Energía SENER 2017)
- 44% de la energía eléctrica en edificaciones corresponde a uso de aire acondicionado cuando se requiere

# Energía en Edificaciones

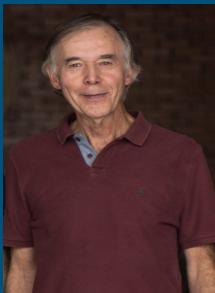
---

- México: 70% del territorio se puede alcanzar el confort higrotérmico sin uso de aire acondicionado
- Diseño bioclimático es clave
- Especialistas en diseño bioclimático y transferencia de calor:
  - EnergyPlus
  - Análisis de datos
  - Sistemas de bajo consumo de energía
  - IoT

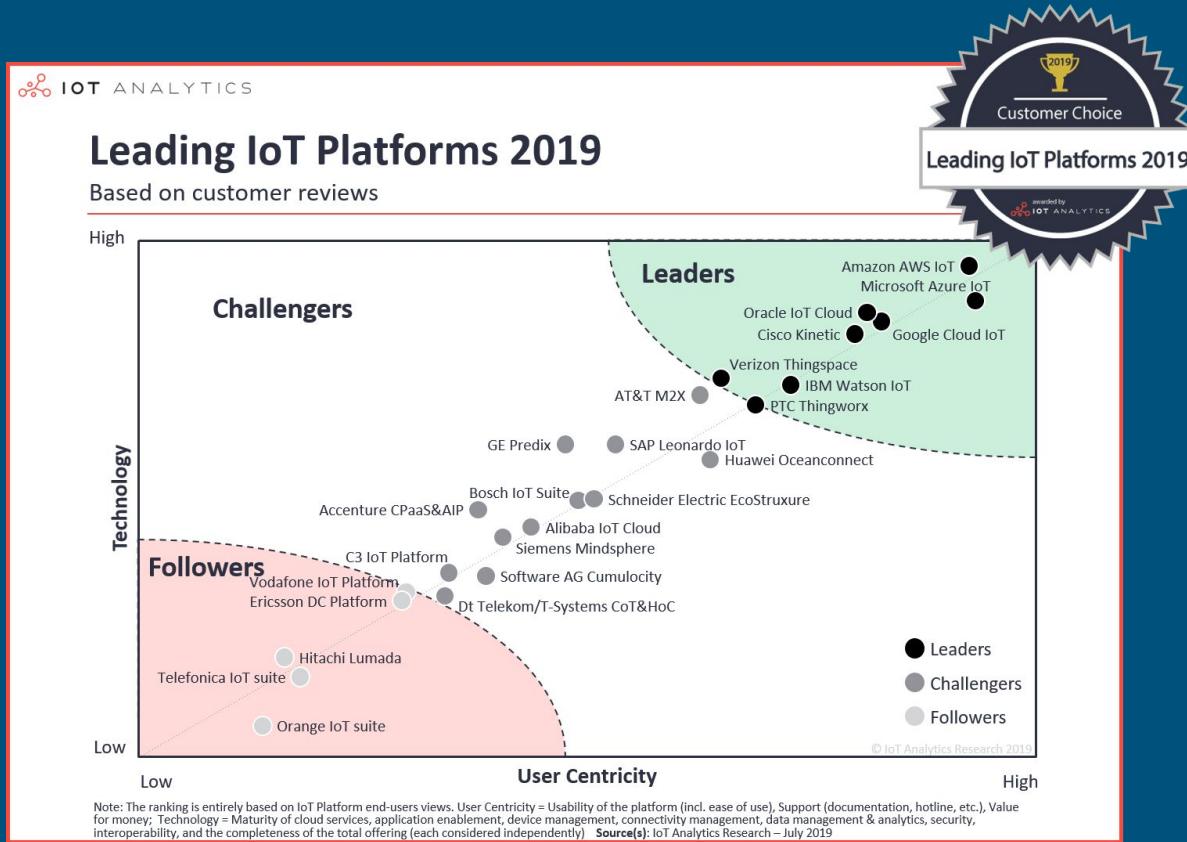
# ENERGY IN BUILDINGS

Hygrothermal comfort | Energy efficiency

[gee.ier.unam.mx](http://gee.ier.unam.mx)



# Cuál plataforma IoT



## Cuál plataforma IoT

2014 IEEE World Forum on Internet of Things (WF-IoT)

# A Framework for Evaluating Internet-of-Things Platforms: Application Provider Viewpoint

Oleksiy Mazhelis and Pasi Tyrväinen

Department of Computer Science and Information Systems  
University of Jyväskylä  
Mattilanniemi 2, Jyväskylä, Finland  
Email: {mazbelis,pasi.tyrvainen}@jyu.fi



2018 IEEE Global Conference on Internet of Things (GCIoT)

# Performance Evaluation of Open Source IoT Platforms

Ahmed A.Ismail  
*Information Technology Department*  
*Faculty of Computers and Information*  
Cairo University, Cairo, Egypt  
a.alaa@fci-cu.edu.eg

Haitham S.Hamza  
*Information Technology Department*  
*Faculty of Computers and Information*  
Cairo University, Cairo, Egypt  
hhamza@fci-cu.edu.eg

Amira M. Kotb  
*Information Technology Department*  
*Faculty of Computers and Information*  
Cairo University, Cairo, Egypt  
a.kotb@fci-cu.edu.eg



# A survey of Internet-of-Things: Future Vision, Architecture, Challenges and Services

Dhananjay Singh *IEEE member*  
 Dept. of Electronics Engineering  
 Hankuk (Korea) University of  
 Foreign Studies,  
 Yongin, South Korea  
[dsingh@hufs.ac.kr](mailto:dsingh@hufs.ac.kr)

Gaurav Tripathi  
Central Research Laboratory  
Bharat Electronics Limited  
Ghaziabad, India  
[gauravtripathy@gmail.com](mailto:gauravtripathy@gmail.com)

Antonio J. Jara *IEEE member*  
Institute of Information Systems  
University of Applied Sciences  
Western Switzerland (HES-SO)  
Sierre, Valais, Switzerland  
[jara@ieee.org](mailto:jara@ieee.org)



Contents lists available at ScienceDirect  
 Computer Communications  
journal homepage: [www.elsevier.com/locate/comcom](http://www.elsevier.com/locate/comcom)

---

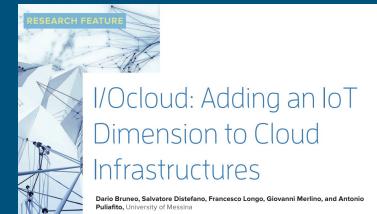
A gap analysis of Internet-of-Things platforms  
Julien Minerad<sup>a,\*</sup>, Oleksiy Matelko<sup>b</sup>, Xiang Su<sup>c</sup>, Saso Tarkoma<sup>d</sup>

<sup>a</sup>Department of Computer Science, University of Warsaw, Poland  
<sup>b</sup>Department of Computer Science and Information Systems, University of Jyväskylä, Finland  
<sup>c</sup>Center for Quantum Computing, University of Alberta, Canada

 CrossMark



# Review of Internet of Things (IoT) in Electric Power and Energy Systems



Contents lists available at ScienceDirect  
Computer Networks  
journal homepage: [www.elsevier.com/locate/comnet](http://www.elsevier.com/locate/comnet)

 ELSEVIER



# Cuál plataforma IoT

---

- Documentación
  - Actualizada
  - Vigente
  - Dispositivos heterogéneos
  - Arquitectura
  - OpenSource
- Escalabilidad
  - Dispositivos heterogéneos
  - REST
  - Lenguaje
  - Costo
  - Seguridad

# Cuál plataforma IoT

---

Plataformas gratuitas		
1 FIWARE	<a href="https://www.fiware.org/about-us/">https://www.fiware.org/about-us/</a>	No
2 OpenMTC	<a href="https://www.openmtc.org/">https://www.openmtc.org/</a>	Si
3 SiteWhere	<a href="https://sitewhere.io/">https://sitewhere.io/</a>	Si
4 Arduino IoT Cloud	<a href="https://auth.arduino.cc/login/">https://auth.arduino.cc/login/</a>	No
5 CloudFoundry	<a href="https://www.cloudfoundry.org/">https://www.cloudfoundry.org/</a>	No
6 Thingsboard	<a href="https://thingsboard.io/">https://thingsboard.io/</a>	Si
7 Nimbts		
8 Open IoT	<a href="https://openiot.in/">https://openiot.in/</a>	No
9 RealTime.io	<a href="http://realtime.io/">http://realtime.io/</a>	Si
10 TempoiQ*	<a href="https://www.tempoiq.com/">https://www.tempoiq.com/</a>	No
11 IFTTT	<a href="https://ifttt.com/collections/iot">https://ifttt.com/collections/iot</a>	
12 Cayenne	<a href="https://mydevices.com/">https://mydevices.com/</a>	Si
13 Carriots	<a href="https://www.altairsmartworks.com/index">https://www.altairsmartworks.com/index</a>	No
14 Eclipse	<a href="https://iot.eclipse.org/">https://iot.eclipse.org/</a>	Si

Más de 40 opciones

<https://thingsboard.io/>

The screenshot shows the ThingsBoard website homepage. At the top, there is a navigation bar with links for SOLUTIONS, USE CASES, PARTNERS, ABOUT US, PRICING, DOCS, and GUIDES. Below the navigation bar, the main heading reads "ThingsBoard Open-source IoT Platform". A sub-headline below it says "Device management, data collection, processing and visualization for your IoT solution". In the center, there is a large button labeled "LEARN MORE". To the right of the main text area, there is a small screenshot of the ThingsBoard rule engine interface showing a node configuration window titled "Add rule node". The window has fields for "Name\*" (set to "Log Other") and "Debug mode" (unchecked). Below this, a code editor shows a snippet of JavaScript-like code for a "TEST TO STRING FUNCTION". The code is as follows:

```
function ToStringFunction(data, msgType) {
    return 'Incoming message:\n' + JSON.stringify(msg) +
        '\nIncoming meta-data:\n' + JSON.stringify(data);
}
```

At the bottom right of the screenshot, there is a red button labeled "Save TS".

# ThingsBoard <https://thingsboard.io/>

---

- OpenSource
- Documentado
- En desarrollo
- Multiplataforma
- Multiples dispositivos
- MQTT broker
- Se puede instalar en una Raspberry Pi 3

# ThingsBoard <https://thingsboard.io/>

---

Home Tenant administrator :

Rules management Customer management Asset management Device management

Entity View management Dashboard management Audit

RULE CHAINS CUSTOMERS ASSETS DEVICES

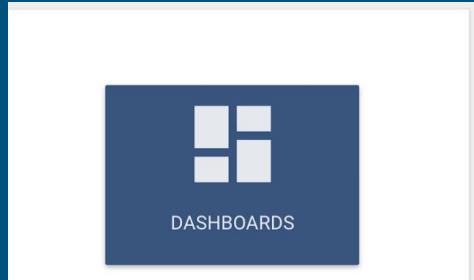
ENTITY VIEWS WIDGETS LIBRARY DASHBOARDS AUDIT LOGS

The screenshot shows the ThingsBoard interface with a dark blue header bar. On the left is a 'Home' icon and on the right is a 'Tenant administrator' profile icon. Below the header is a grid of eight cards, each with a title, a blue icon, and a sub-label. The first four cards are grouped by a green border at the top: 'Rules management' (icon: two arrows), 'Customer management' (icon: two people), 'Asset management' (icon: grid), and 'Device management' (icon: device). The last four cards are grouped by a green border in the middle: 'Entity View management' (icon: grid), 'Dashboard management' (icon: four squares), 'Audit' (icon: circular arrow), and 'Audit Logs' (icon: circular arrow). All icons are white on a dark blue background.

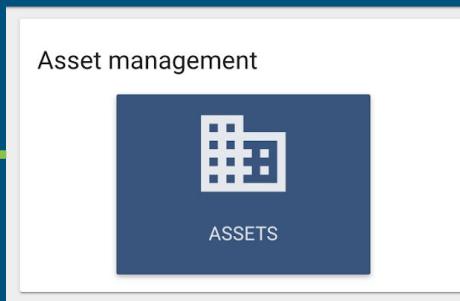
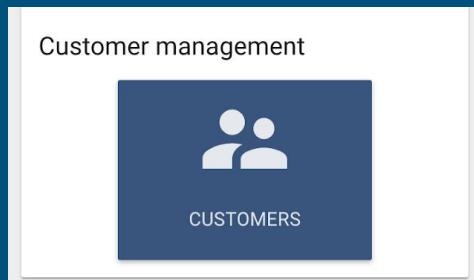
# ThingsBoard

Edificio

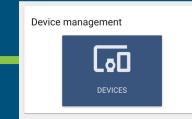
Visualizar



Control

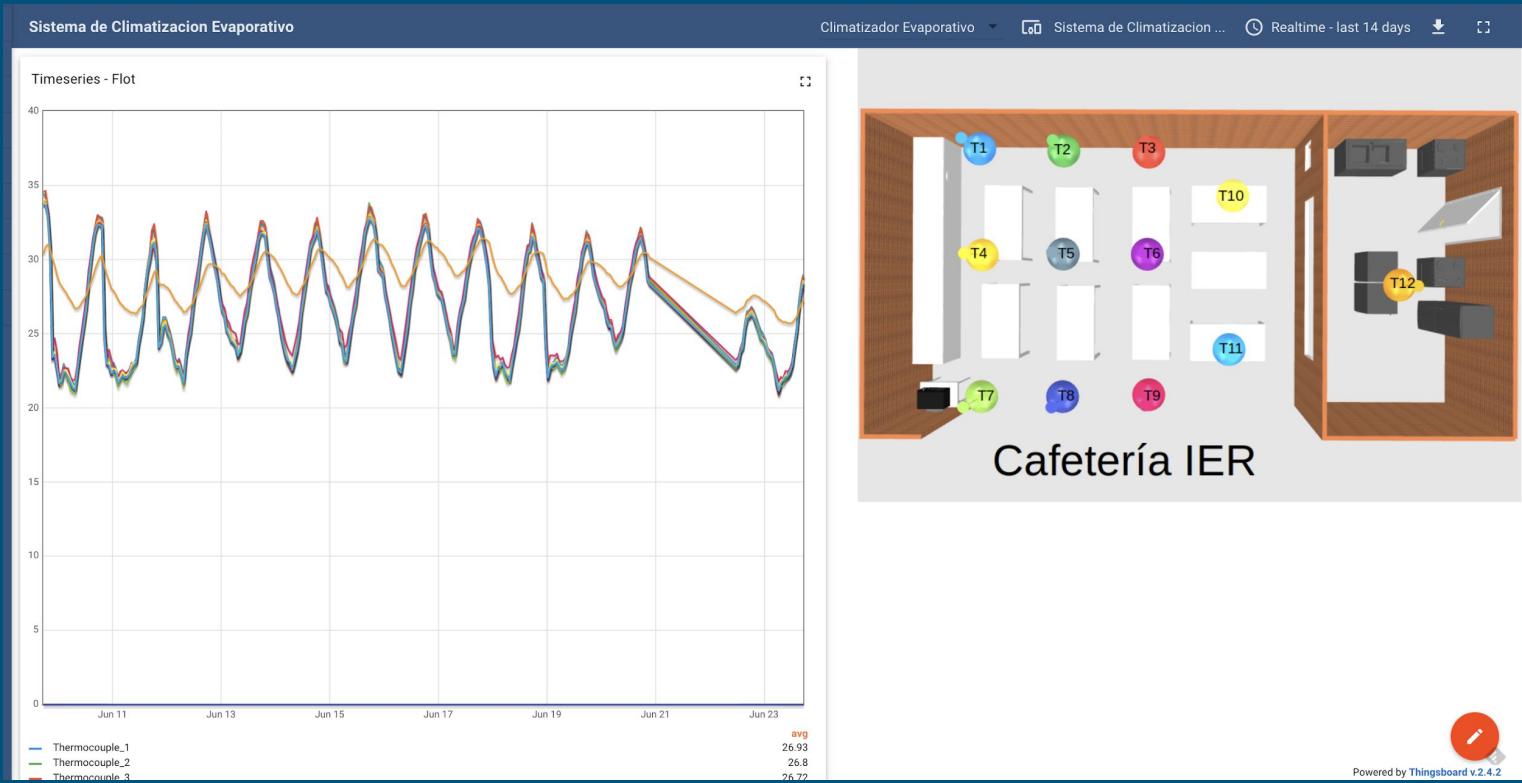


Dispositivos

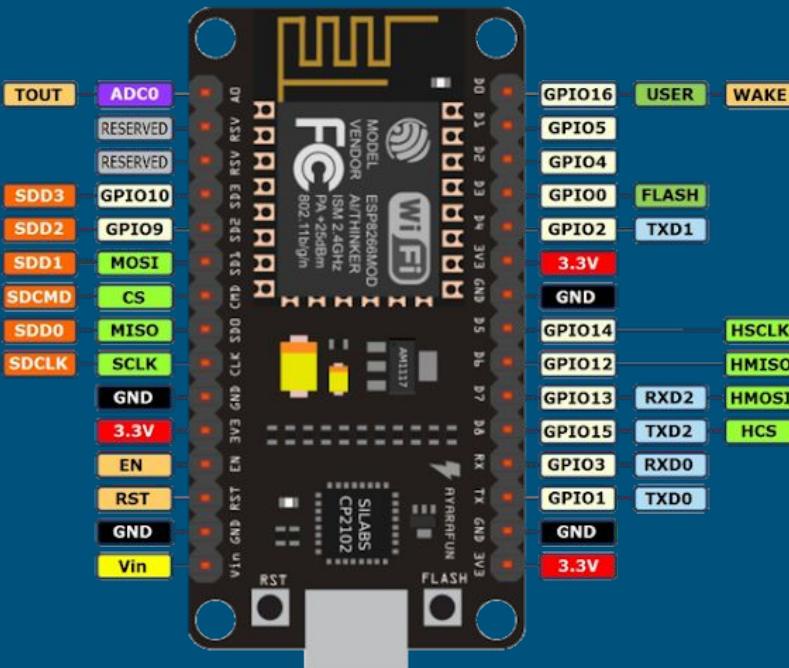


Sistemas bajo consumo

# ThingsBoard



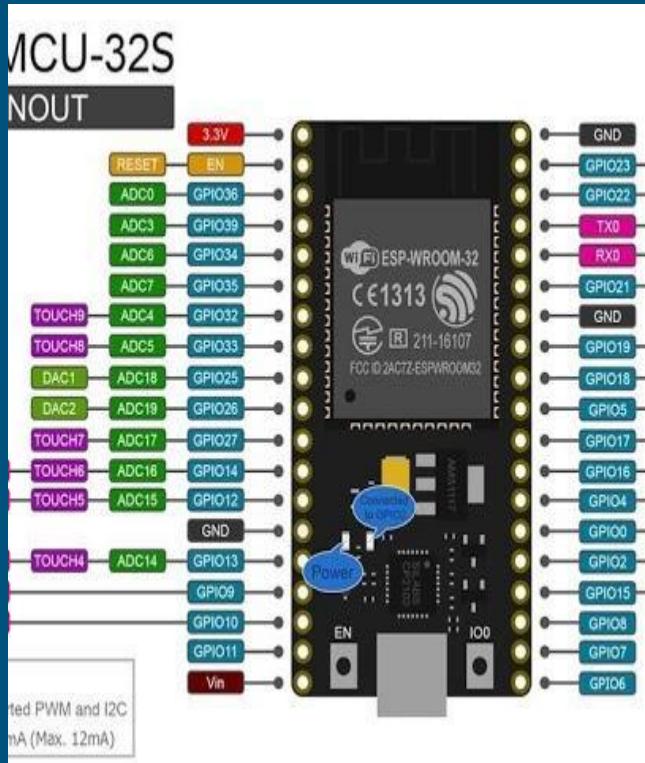
# Dispositivos



**Las especificaciones del ESP8266 son:**

- CPU RISC de 32-bit: Tensilica Xtensa LX106 a un reloj de 80 MHz
  - RAM de instrucción de 64 KB, RAM de datos de 96 KB
  - Capacidad de memoria externa flash QSPI - 512 KB a 4 MB\* (puede soportar hasta 16 MB)
  - IEEE 802.11 b/g/n Wi-Fi
    - Tiene integrados: TR switch, balun, LNA, amplificador de potencia de RF y una red de adaptación de impedancias
    - Soporte de autenticación WEP y WPA/WPA2
  - 16 pines GPIO (Entradas/Salidas de propósito general)
  - SPI, I<sup>2</sup>C,
  - Interfaz I<sup>2</sup>S con DMA (comparte pines con GPIO)
  - Pines dedicados a UART, mas una UART únicamente para transmisión que puede habilitarse a través del pin GPIO2
  - 1 conversor ADC de 10-bit

# Dispositivos



Las especificaciones del ESP32 son:

- CPU: Xtensa dual-core (or single-core) 32-bit LX6 microprocessor, operating at 160 or 240 MHz and performing at up to 600 DMIPS
  - Ultra low power (ULP) co-processor
- Memory: 520 KiB SRAM
- Wireless connectivity:
  - Wi-Fi: 802.11 b/g/n
  - Bluetooth: v4.2 BR/EDR and BLE
- Peripheral interfaces:
  - 12-bit SAR ADC up to 18 channels
  - 2 × 8-bit DACs
  - 10 × touch sensors (capacitive sensing GPIOs)
  - Temperature sensor
  - 4 × SPI
  - 2 × I<sup>2</sup>S interfaces
  - 2 × I<sup>2</sup>C interfaces
  - 3 × UART
  - SD/SDIO/CE-ATA/MMC/eMMC host controller
  - SDIO/SPI slave controller
  - Ethernet MAC interface with dedicated DMA and IEEE 1588 Precision Time Protocol support
  - CAN bus 2.0
  - Infrared remote controller (TX/RX, up to 8 channels)
  - Motor PWM
  - LED PWM (up to 16 channels)
  - Hall effect sensor
  - Ultra low power analog pre-amplifier

# Dispositivos



The image shows the MicroPython website's header. It features the MicroPython logo (a stylized 'M' icon) and the word "MicroPython" in white on a dark background. To the right are links for "FORUM", "DOCS", "QUICK-REF", "DOWNLOAD", "STORE", and "CONTACT".

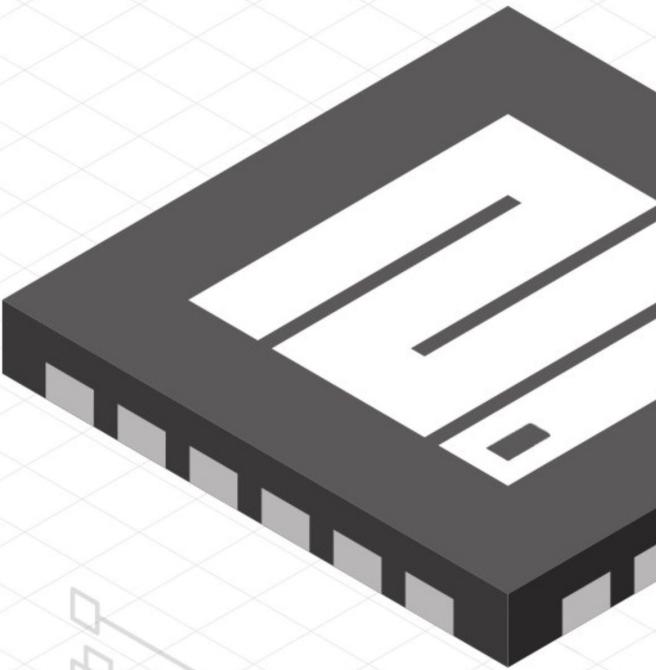
## MicroPython

MicroPython is a lean and efficient implementation of the [Python 3](#) programming language that includes a small subset of the Python standard library and is optimised to run on microcontrollers and in constrained environments.

The MicroPython [pyboard](#) is a compact electronic circuit board that runs MicroPython on the bare metal, giving you a low-level Python operating system that can be used to control all kinds of electronic projects.

MicroPython is packed full of advanced features such as an interactive prompt, arbitrary precision integers, closures, list comprehension, generators, exception handling and more. Yet it is compact enough to fit and run within just 256k of code space and 16k of RAM.

MicroPython aims to be as compatible with normal Python as possible to allow you to transfer code with ease from the desktop to a microcontroller or embedded system.



A 3D perspective rendering of a microcontroller chip, showing its rectangular shape, internal circuitry, and pins along the bottom edge. The chip is set against a light gray grid background.

# Dispositivos: El futuro es MicroPython

The screenshot shows the Arduino website's product page for the Portenta H7. At the top, there's a teal header with the Arduino logo (infinity symbol with minus and plus signs) and a navigation bar with links for STORE, SOFTWARE, EDUCATION, PRO, RESOURCES, COMMUNITY, and HELP. A yellow banner below the header contains the text "Learn about Arduino Response to the COVID-19 outbreak". The main content area has a teal header with links for STORE, SOFTWARE, EDUCATION, PRO, RESOURCES, COMMUNITY, and HELP. Below this, the product details for the Portenta H7 are shown: the name "PORTENTA H7", the price "\$103.40" (tax not included), a quantity selector set to "1", an "ADD TO CART" button, a "PRE-ORDER" link, and a "Add to Wishlist" link. To the right, a section titled "Two Parallel Cores" describes the STM32H747 dual-core processor and its features, including running Arduino sketches, Mbed OS, MicroPython, JavaScript, and TensorFlow Lite.

ARDUINO

STORE SOFTWARE EDUCATION PRO RESOURCES COMMUNITY HELP

Learn about Arduino Response to the COVID-19 outbreak

PORTENTA H7

Code: ABX00042  
Barcode: 7630049202252

\$103.40  
tax not included

Quantity: 1

ADD TO CART

PRE-ORDER

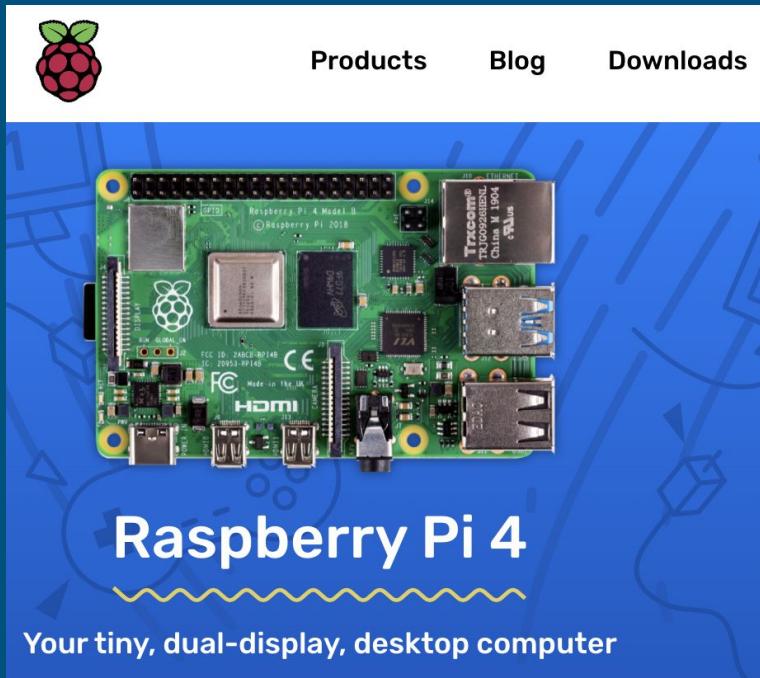
Add to Wishlist

Two Parallel Cores

H7's main processor is the dual core STM32H747 including a Cortex® M7 running at 480 MHz and a Cortex® M4 running at 240 MHz. The two cores communicate via a *Remote Procedure Call* mechanism that allows calling functions on the other processor seamlessly. Both processors share all the in-chip peripherals and can run:

- Arduino sketches on top of the Arm® Mbed™ OS
- Native Mbed™ applications
- MicroPython / JavaScript via an interpreter
- TensorFlow™ Lite

# Dispositivos



- OpenHardware
- Linux
- Python
- C
- Arduino
- PoE
- Puede correr ThingsBoard!

# Dispositivos

---

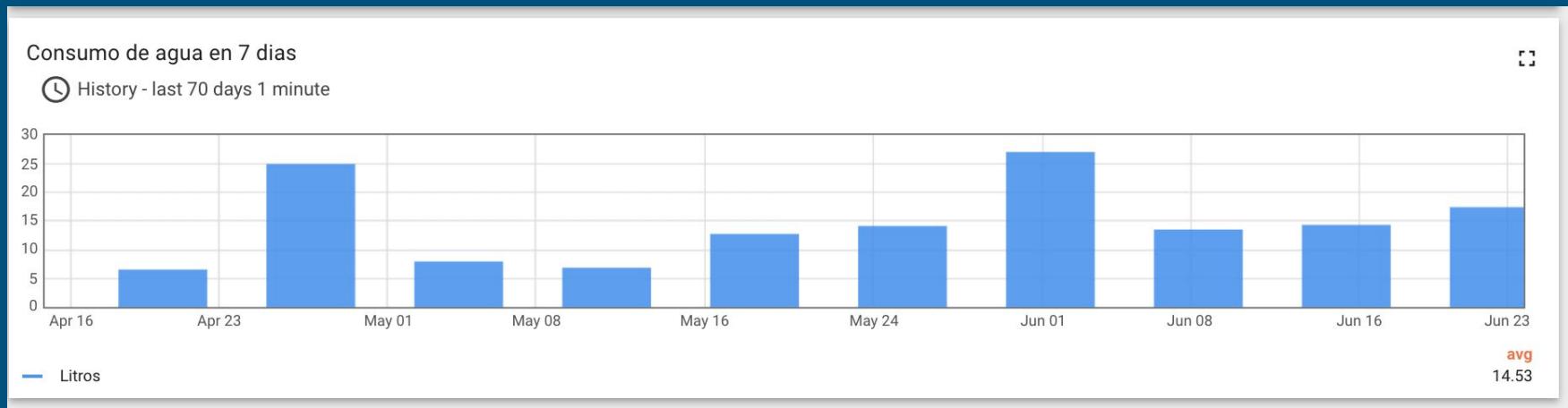
THIS: Temperatura Humedad Iluminación y Sonido

- Raspberry Pi 3
- Python
- Sensor de humedad relativa
- Sensor de temperatura
- Sensor de presión acústica
- Cámara

# Dispositivos

## H2O: Consumo de agua

- ESP8266
- MicroPython
- Sensor de volumen YF-S201



# Dispositivos

## E: Consumo eléctrico

- Arduino UNO o Arduino Mega + ESP12
- Sensor voltaje ZMPT101B
- Sensor corriente SCT-013



# Retos

---



# Retos

The image shows a terminal window and a GitHub repository page side-by-side.

**Terminal Window:**

- Time: 23/6 8:04 PM
- Prompt: ~ (zsh)
- Command: {20-06-23 20:03} iMac:~ gbv% pip3 install nelier
- Error Output:

```
ERROR: Could not find a version that satisfies the requirement nelier (from versions: none)
ERROR: No matching distribution found for nelier
```
- Completion: {20-06-23 20:03} iMac:~ gbv%

**GitHub Repository Page (AltamarMx / DTHIS):**

- Repository: AltamarMx / DTHIS (Private)
- Code, Issues, Pull requests, Actions, Projects, Wiki, Security, Insights, Settings tabs are visible.
- File list:
  - cjmcu-8128-sensor-breakout-mast... (Add files via upload, 2 months ago)
  - DTHIS2\_TH.py (Update DTHIS2\_TH.py, 2 months ago)
  - Microphone.py (Add files via upload, 4 months ago)
  - mic.py (Update mic.py, 2 months ago)
- Text at bottom: Help people interested in this repository understand your project by adding a README.
- Add a README button.

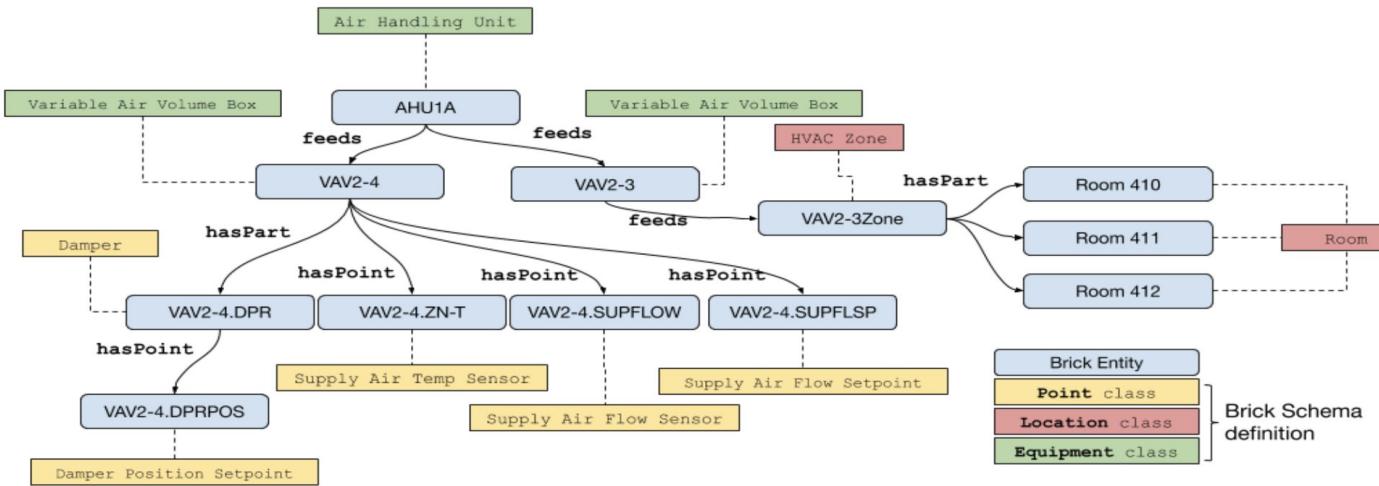
# Retos

<https://brickschema.org/>



**Brick**

A uniform metadata schema for buildings



# Conclusiones

---

1. IoT con ThingsBoard
2. Adquisición de datos, automatización, AI
3. Detección de fugas
4. Mejora de hábitos
5. Visualización en tiempo real

# Dr. Guillermo Barrios del Valle

[gbv@ier.unam.mx](mailto:gbv@ier.unam.mx)



Guillermo Barrios del Valle  
167 suscriptores



Guillermo Barrios  
@altamar

← → ⌂ [github.com/altamarMx/](https://github.com/altamarMx/)



Search or jump to...