Comparative Analysis of Open Source IOT Platforms

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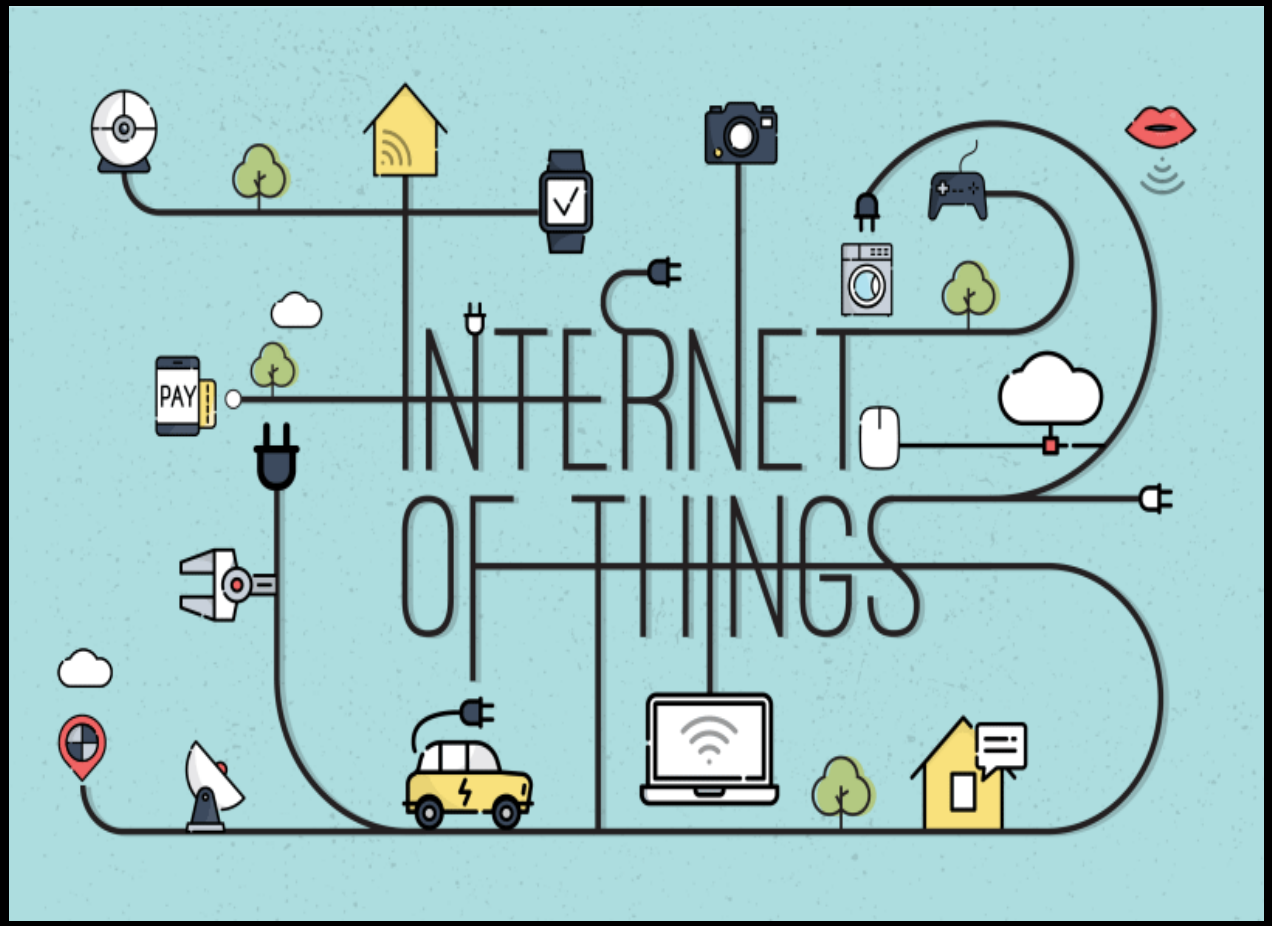
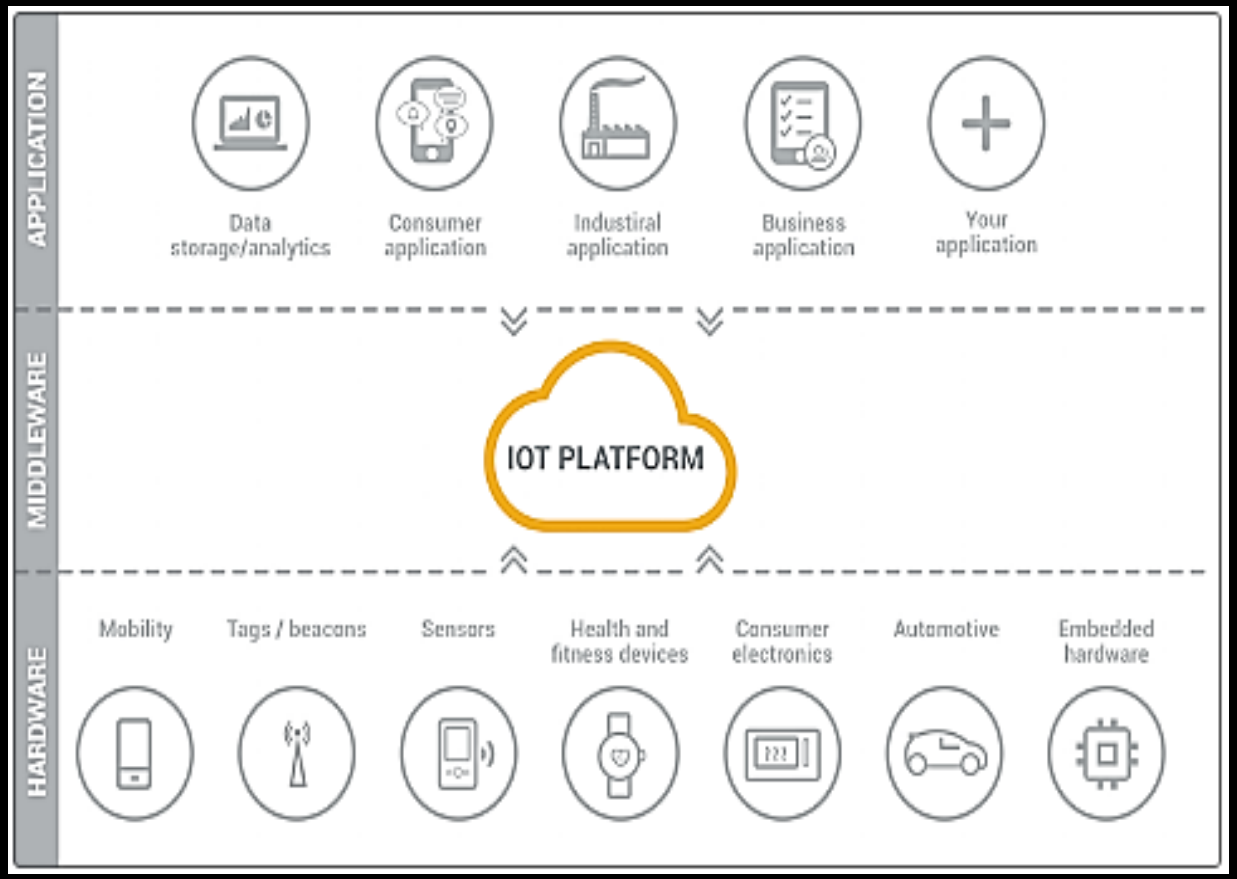
What is IOT(Internet of Things?)

The Internet of things is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.



What is IOT Platform?

- An **IoT platform** is a multi-layer technology that enables straightforward provisioning, management, and automation of connected devices within the Internet of Things universe.



The achievements of platforms and frameworks are related to different requirements…

- 1. Providing security and privacy APIs with easy configuration and management in order to be adopted by third-party systems.
- 2. Providing interoperability and extendable protocols to be adopted by third-party systems.
- 3. Providing efficient size bandwidth, energy consumptions, and low processing requirements.
- 4. Providing easy management and governance of heterogeneous networks of devices and applications.

Various IOT Platforms…

- **SiteWhere**
- An open-source IoT platform. It offers a system that accelerates the storage, handling, and incorporation of device data.
- SiteWhere provides an IoT server platform, device management, and third-party integration frameworks. This IoT platform aims to provide IoT functionalities for monitoring, automation, and analytics for healthcare systems.

DeviceHive

- An open-source IoT data platform that aims to connect devices to the cloud and device data stream.
- It also provides creation and customization of IoT/M2M (machine-to-machine) applications with a secure, scalable, and cloud-ready functionalities

Platformio:

- An integrated development environment for IoT. It supports cross-platform build functionality without external dependencies to the operating system software, having compatibility with 200+ embedded boards, 15+ development platforms, and 10+ frameworks.
- It also provides a built-in serial port monitor and configurable build flags/options and automatic firmware uploading for IoT system development.

RIOT

- A free, open-source operating system for the majority of the relevant open standards supporting the IoT.

- It provides code compatibility for 8,16,32-bit platforms, energy-efficiency, real-time capability due to an ultra-low interrupt latency, multi-threading with ultra-low threading.

ARM mbed:

- An IoT platform that delivers the operating system, cloud facilities, tools, and designer ecosystem in order to develop scalable systems based on IoT.
- It implements safety functionalities, such as transport layer security (TLS) as well CoAP and RESTful API to design M2M networks.

Ubuntu Core (Snappy):

- A development version of Ubuntu for IoT systems that offers safety and extensibility of an Ubuntu operating system.
- It also delivers management systems for safe, reliable, transactional updates controlled by Canonical’s AppArmor security system.

IoTivity:

- An open-source software framework that provides device-to-device communications to the IoT systems.
- The IoTivity project is sponsored by the Open Connectivity Foundation (OCF), a specification and certification program to address IoT open issues

Distributed Services Architecture (DSA):

- An open-source IoT platform that aims to join the heterogeneous hardware and software in IoT and provide a scalable, resilient decentralized solution.
- DSA is composed of DSBroker, DSLink, and nodeAPI.
- DSBroker acts as a router for incoming and outgoing streams.
- NodeAPI provides node compatibility and bi-directional control and monitoring ability between connected things. DSLink is connected to the DSBroker that acts as the source of the data streams

Calvin-Base:

- An open-source platform built with a centralized architecture that supports REST API and it is particularly scalable implementing a variety of plugins for interoperability.

Cylon.js:

- A JavaScript framework for the IoT that uses Node.js.
- This framework provides code compatibility between different hardware for IoT.
- Supports multiple platforms, such as Arduino, Intel Galileo, Intel Edison, and Raspberry

Brillo:

- An Android-based operating system, with core services that provide a developer kit and developer console to build IoT applications.
- It aims to provide scalability with OTA updates, metrics, and error reporting. It is supported by the ARM, Intel x86, and MIPS-based hardware but also provide secure services.

Contiki:

- An open-source operating system for the IoT that provides standard IPv6, IPv4, 6lowpan, RPL, and CoAP protocols.
- This OS provides a network simulation environment for agile IoT development

Netbeast:

- An open-source IoT platform that aims to connect IoT devices and to provide agile development for IoT solutions.
- It is supported by 30 different types of smart home devices and 10 brands, such as Philips Hue, Belkin Wenmo, Google Chromecast, Parrot, etc.

Kaa:

- A multi-purpose middleware platform that delivers tools for software development for IoT with enhanced features that decrease related cost, risks, and time-to-market.
- It is an agnostic hardware solution that supports an SDK for a diversity of programming languages, such as C, C++, and JAVA

ThingsBoard:

- An open-source IoT platform for data collection, processing, visualization, and device management.
- This platform supports device connectivity using standard IoT protocols, such as MQTT, CoAP, and HTTP.
- Moreover, ThingsBoard support data processing rule chains and alarms configuration based on events, attribute updates, device inactivity, and user actions

Table 1. IoT platforms and operating systems comparison (√: apply; ×: not apply).

IoT Platform	Device Management	Security	Open-Source	Data Collection	Integration	Analytics	Visualization	Storage
SiteWhere	√	SSL, Spring Security	√	MQTT, JSON, AMQP, WebSockets	REST API	√	×	√
DeviceHive	√	JSON Web Tokens	√	REST API, MQTT	REST API, MQTT	√	√	√
Platformio	√	SSL	√	REST API, MQTT	Continuous Integration Software	×	×	×
RIOT	×	×	√	COAP, MQTT	REST API	×	×	×
ARM mbed	√	SSL/TLS, X.509 Certificate	√	REST API, MQTT	REST API	×	×	×
Ubuntu Core	√	RSA, SSH	√	MQTT, AMQP	REST API	×	×	√
IoTivity	√	DTLS/TLS	√	Message Queue	REST API	√	×	×
DSA	×	Basic Authentication	√	HTTP	REST API	√	×	√
Calvin-Base	√	×	√	REST API, HTTP	Calvin Script	√	×	×
Cylon.js	√	×	√	REST API, MQTT	REST API	×	×	×
Brillo	√	×	√	REST API	REST API	√	√	√
Contiki	√	×	√	REST API	REST API	√	×	×
Netbeast	√	TLS/SSL	√	HTTP, MQTT	REST API	√	√	√
Kaa	√	TLS/DTLS	√	MQTT, CoAP	REST API	√	√	√
ThingsBoard	√	TLS	√	MQTT, CoAP, HTTP	REST API	√	√	√

Reference

[1] Gonçalo Marques 1,2,3 , Rui Pitarma 1,* , Nuno M. Garcia 2,3 and Nuno Pombo 2,3, “Internet of Things Architectures, Technologies, Applications, challenges, and Future Directions for Enhanced Living Environments and Healthcare Systems: A Review” Electronics 2019, 8, 1081; doi:10.3390/electronics8101081