Plataformas de Middleware para IoT

Disciplina: **Introdução à Internet das Coisas - IMD0902**

Prof. Heitor Florencio
Prof. Leonardo Augusto
heitorm@imd.ufrn.br
leoaugustoam@gmail.com

UFRN | metrópole DIGITAL

Aula:

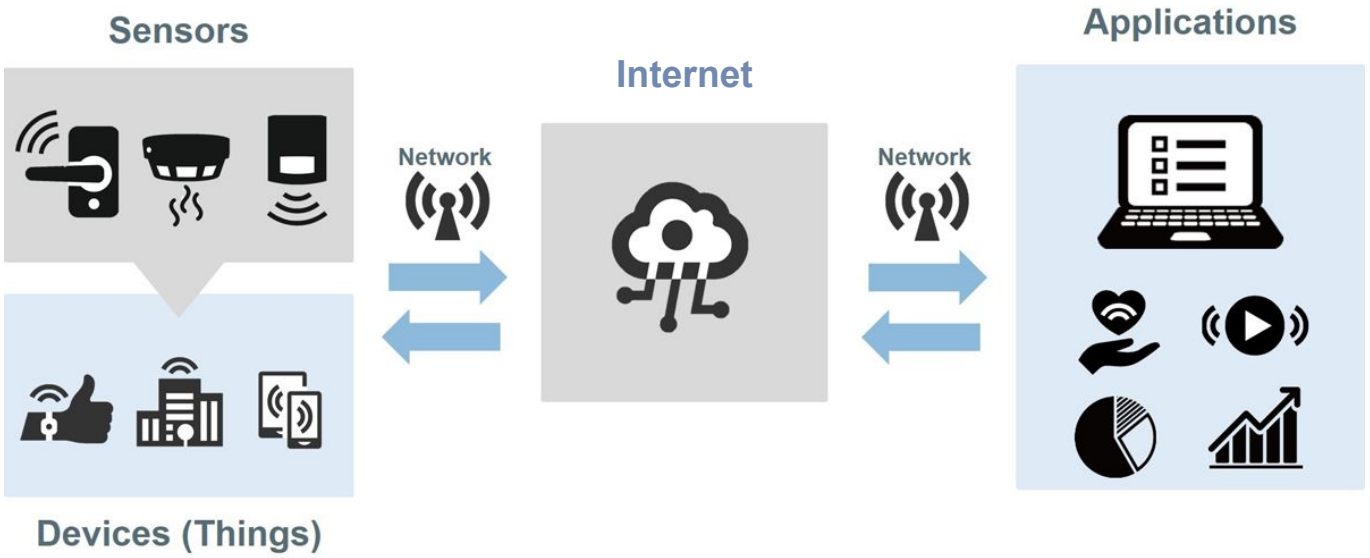
Plataformas (Middleware) para IoT

Tópicos

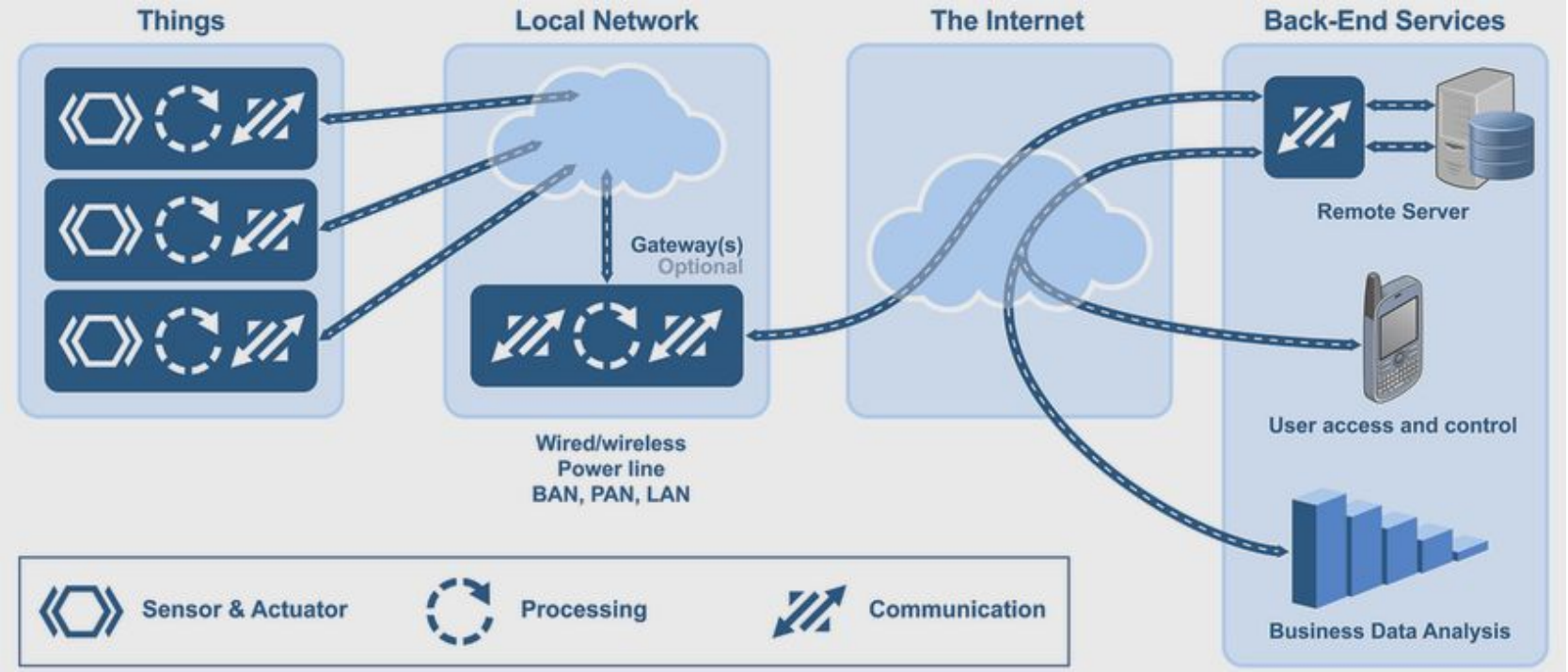
- Conceitos de Plataformas de Middleware para IoT;
- Requisitos para Plataformas IoT;
- Arquitetura de Referência para Middleware IoT;
- Exemplos de Plataformas IoT.

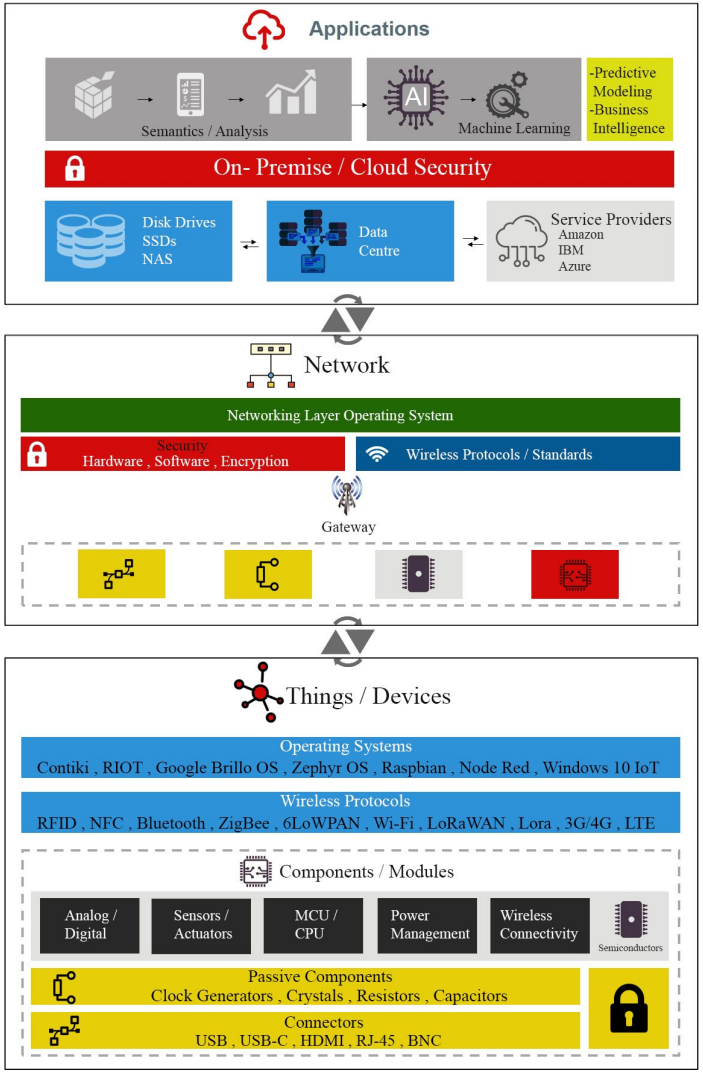
metrópole DIGITAL

Arquitetura de Soluções de Internet das Coisas

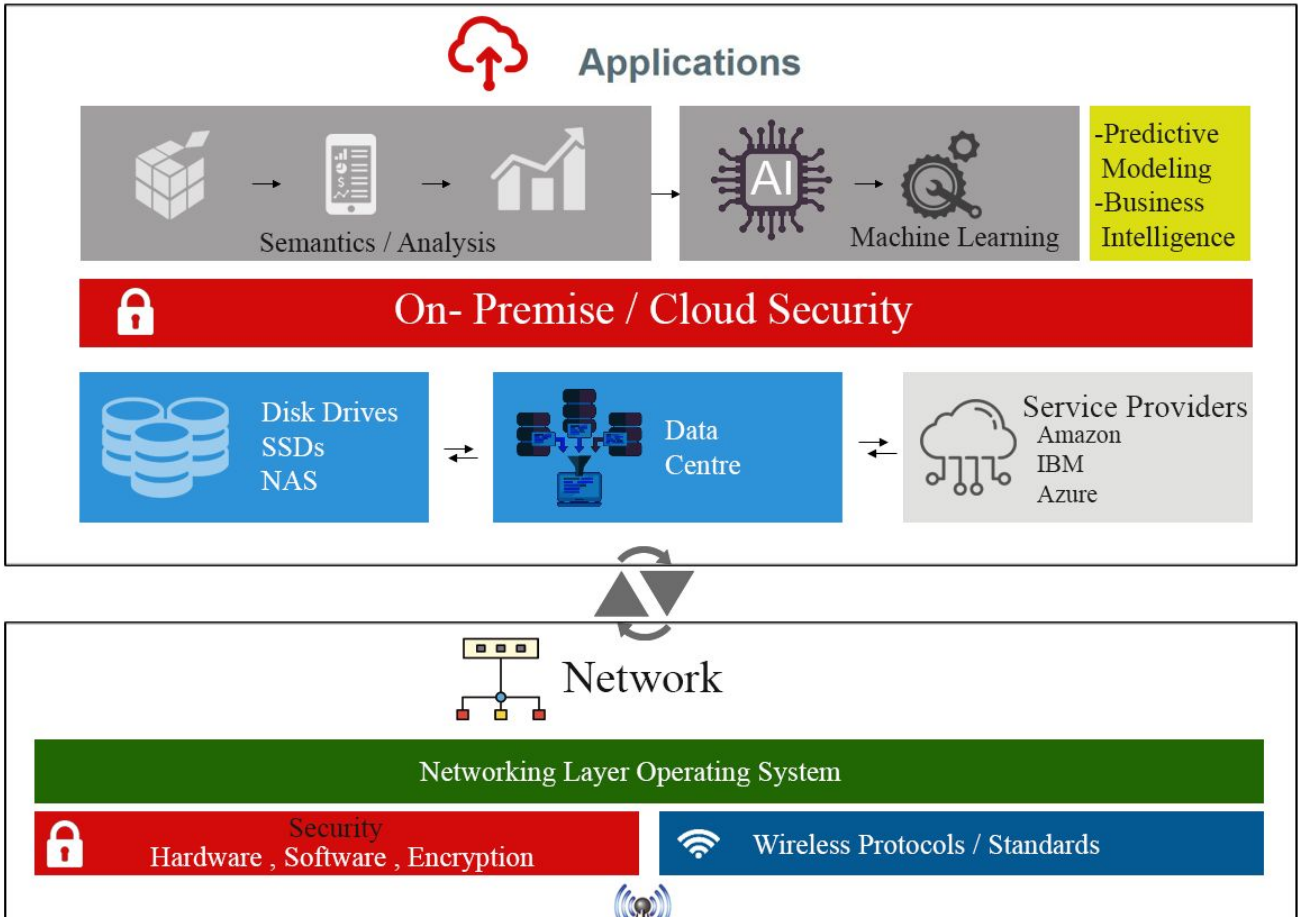


Arquitetura de Sistemas IoT





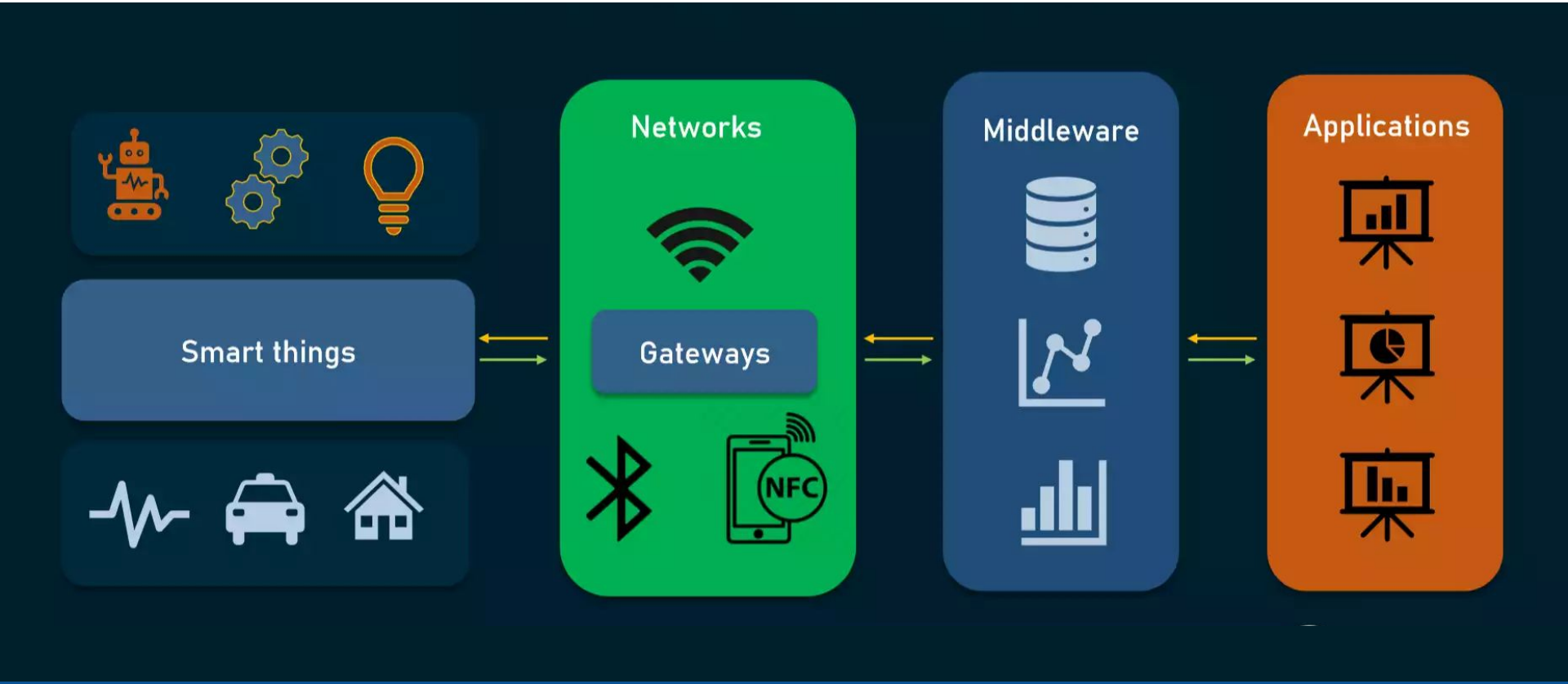
Fonte: ALI, 2022.


Applications
Semantics / Analysis
AI
Machine Learning
-Predictive Modeling
-Business Intelligence
On- Premise / Cloud Security
Disk Drives
SSDs
NAS
Data Centre
Service Providers
Amazon
IBM
Azure
Network
Networking Layer Operating System
Security
Hardware , Software , Encryption
Wireless Protocols / Standards

Em um futuro próximo, haverá uma grande quantidade de dispositivos conectados à Internet publicando dados.

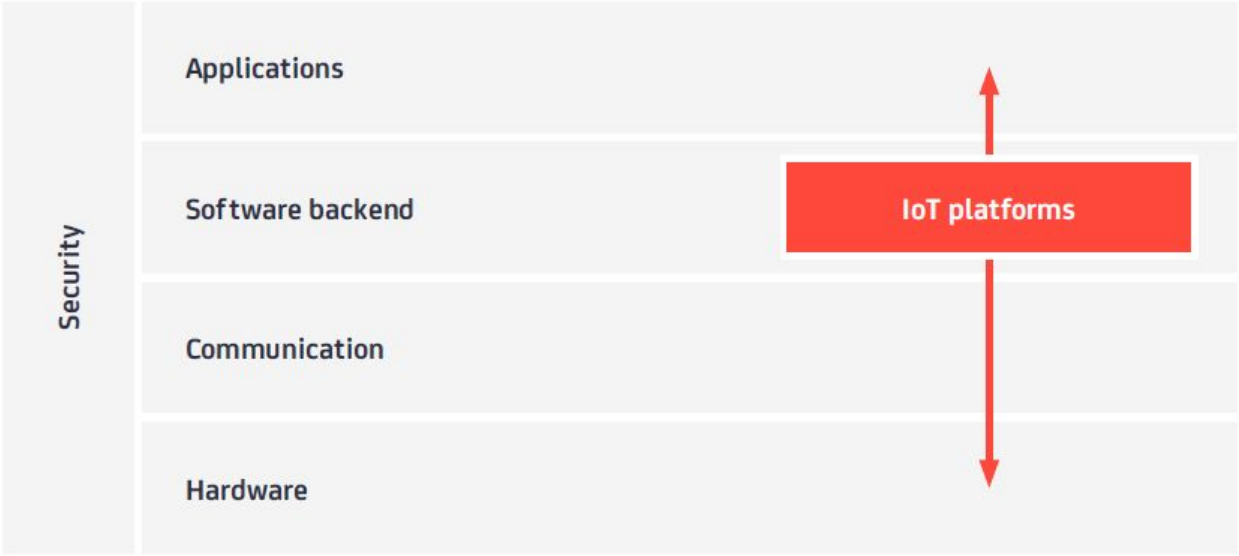
Em um futuro próximo, haverá uma grande quantidade de aplicações consumindo dados oriundos dos dispositivos IoT.

Arquitetura de Soluções de Internet das Coisas



Plataformas de Middleware para IoT

- Soluções de software para garantir a interoperabilidade e gerenciar a crescente variedade de dispositivos IoT e aplicações que consomem os dados IoT.
- Camada de software intermediária entre os dispositivos IoT (sensoriamento e comunicação) e as aplicações.



Plataformas de Middleware para IoT

- Plataforma de Middleware abstrai as complexidades dos dispositivos, permitindo que o desenvolvedor da aplicação concentre todo o seu esforço na tarefa a ser resolvida.

- Vantagens:
  - Aplicações consumidoras dos dados IoT **não precisam** lidar com funcionalidades de baixo nível (a nível de sensoriamento ou tratamento dos dados);
  - **Escalabilidade** de dispositivos com segurança;

Existem diferentes Plataformas IoT no mercado

Vantagens de Middleware para IoT

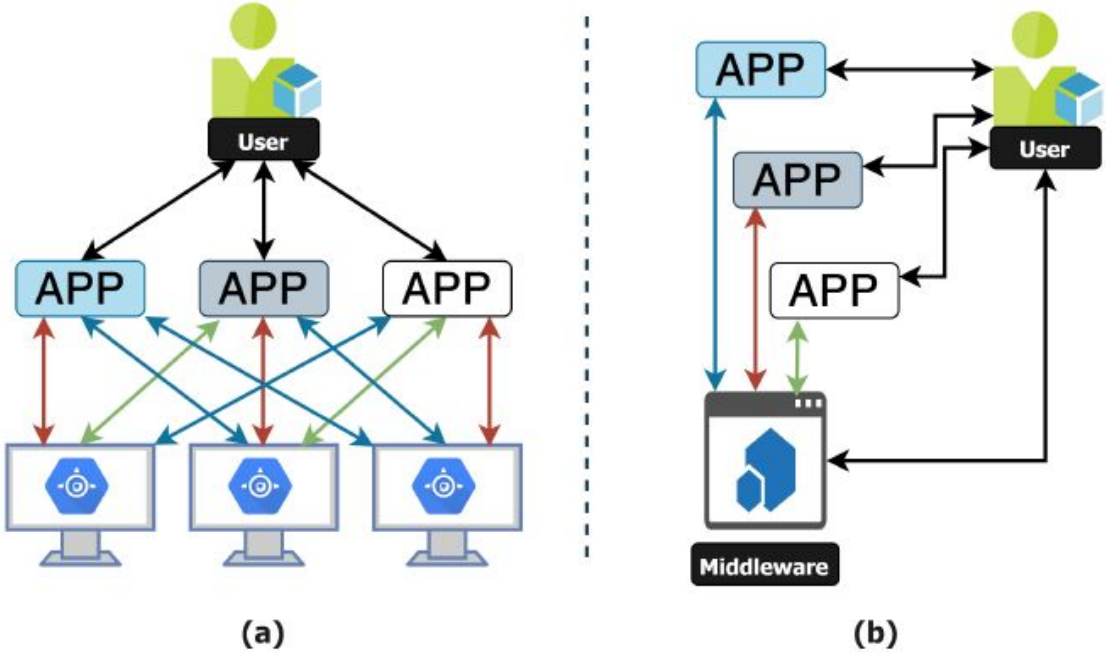
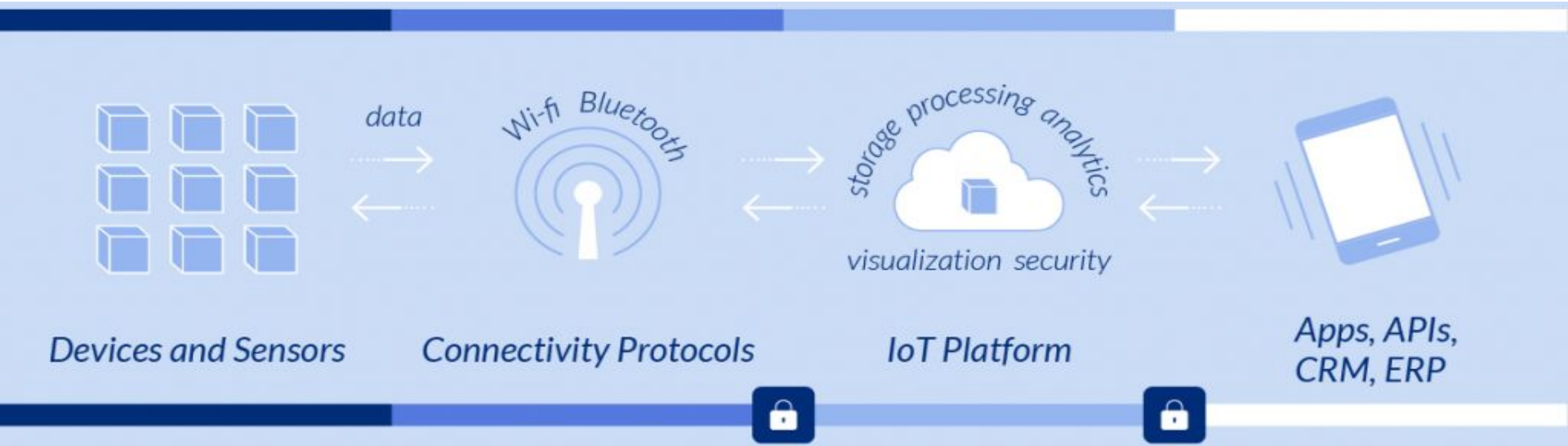


Figure 9. (a) Illustration of user data flow without middleware. (b) Illustration of middleware integrated IoT network responsible for handling data flow between users and multiple applications.

Fonte: ALI, 2022.

O que é uma **Plataforma IoT**?

- Plataforma IoT é um ambiente de software que conecta os dispositivos IoT com os serviços de armazenamento de dados, serviços de nuvem e aplicações.
- É um conjunto de software local ou em nuvem que gerencia os endpoints dos dispositivos IoT e as consultas de aplicações/serviços.

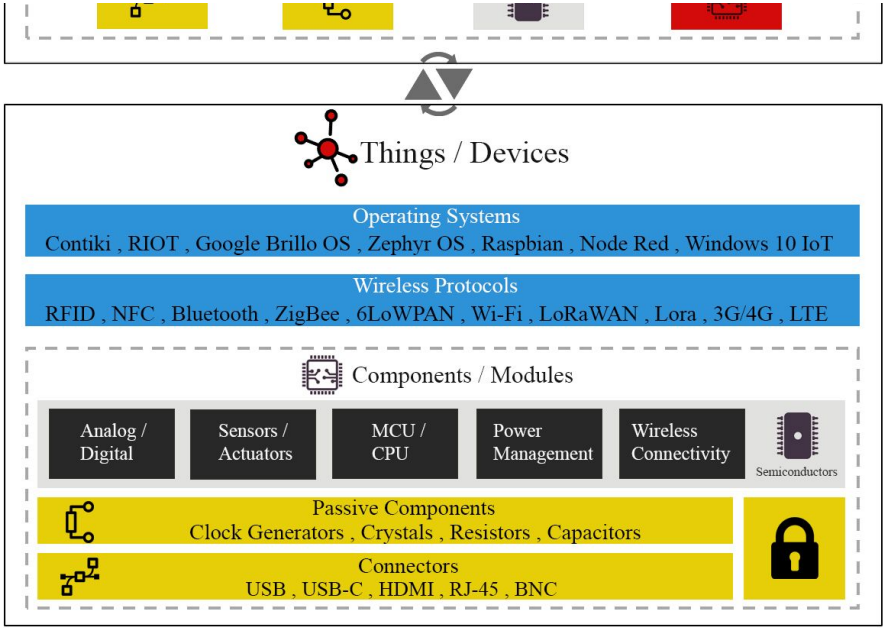


Requisitos para Plataformas de Middleware para IoT

UFRN | imetrópole DIGITAL

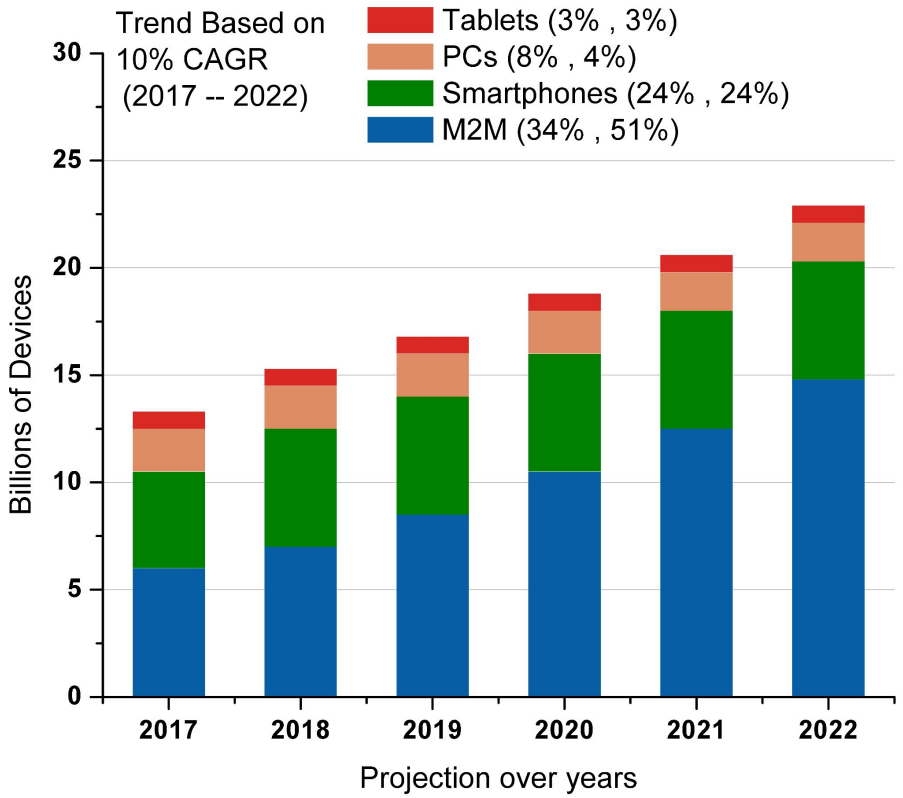
Requisitos para Middleware IoT

- **Interoperabilidade**:
  - interoperabilidade entre dispositivos e serviços;
  - integrar diferentes dispositivos físicos de modo a ocultar detalhes;
- **Ciência de contexto**:
  - coletar, gerenciar e processamento de informações de contexto, como estado do objeto, seus vizinhos e sua localização;
- **Facilidade na implantação;**



Requisitos para Middleware IoT

- **Escalabilidade:**
  - deve ser capaz de assimilar um número crescente de dispositivos e requisições e funcionar corretamente, mesmo em situações de uso intenso;



Fonte: ALI, 2022.

Requisitos para Middleware IoT

- **Descoberta de dispositivos**:
  - permitir a inserção de dispositivo mesmo em uma topologia dinâmica e frequentemente desconhecida;
- **Gerenciamento de dispositivos**:
  - fornecer informações de localização e estado do dispositivo;
  - permitir conectar e desconectar algum dispositivo;
  - permitir modificar configurações de segurança ou de hardware;
- **Gerenciamento de recursos**:
  - Monitorar e realocar recursos de software para execução dos serviços;
- **Gerenciamento de eventos**:
  - Monitorar e transformar os eventos gerados pelos dispositivos em significativos;
  - Analisar em tempo real os eventos;

Requisitos para Middleware IoT

- **Gerenciamento de grandes volumes de dados**:
  - Persistir, consultar e manipular dados em bancos externos;
- **Segurança:**
  - manter a integridade e privacidade dos dados disponibilizados;
  - adotar estratégias para promover a segurança dos recursos, tais como bloqueio de portas;
  - uso de protocolos de autorização e/ou autenticação;
- **Adaptação dinâmica:**
  - garantir a disponibilidade e qualidade das aplicações mesmo com a mudança no contexto;

Arquitetura de Referência para Middleware IoT

★ Não existe uma única **arquitetura de referência.**

Vantagens:

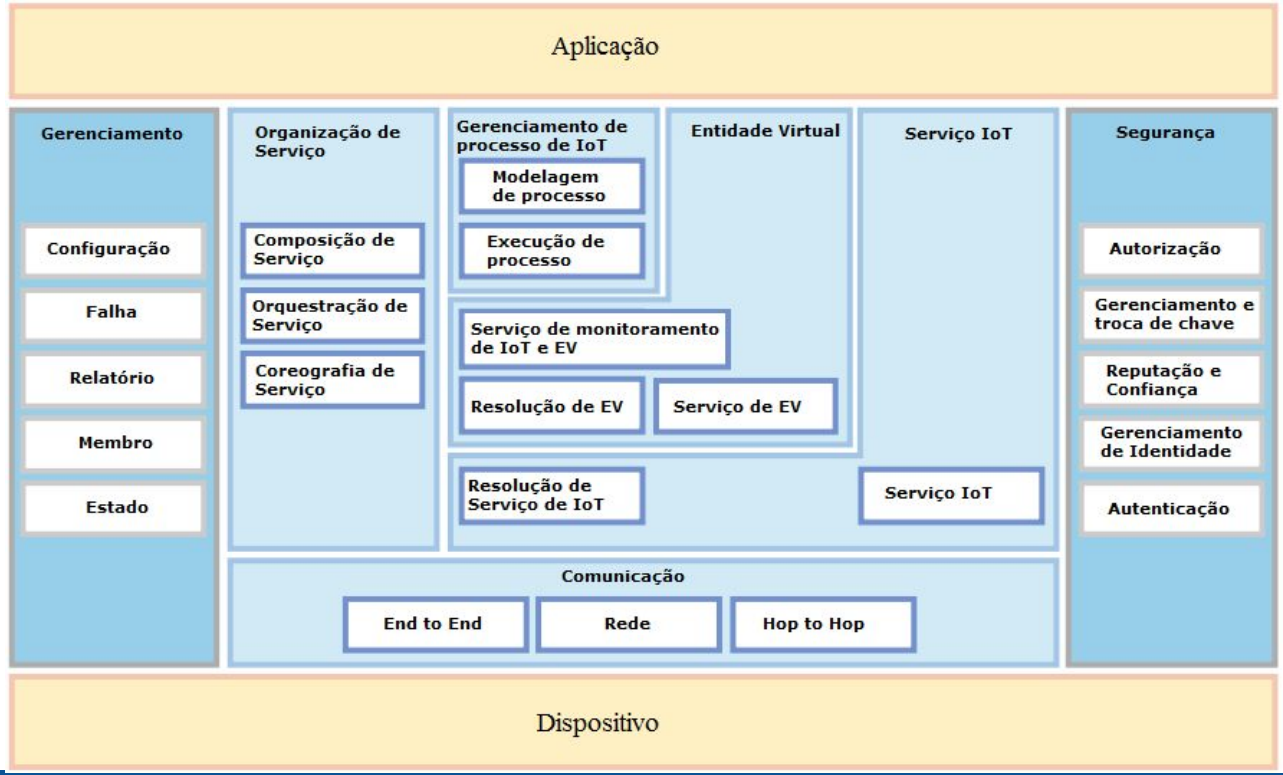
- ❏ Facilitar o desenvolvimento;
- ❏ Padronizar as soluções;

metrópole DIGITAL

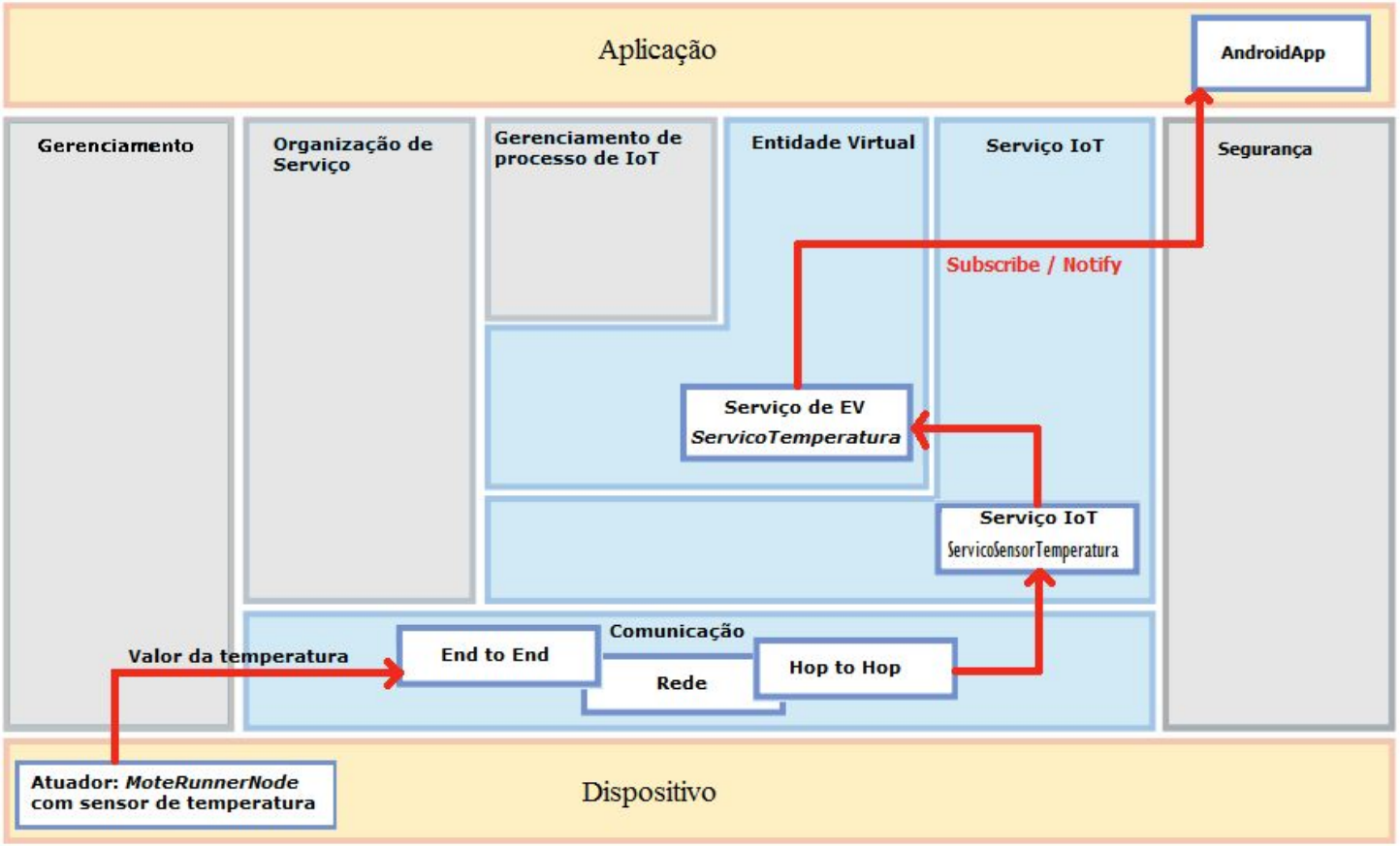
Arquitetura IoT-A: visão funcional

Exemplo de Arquitetura de Referência (AR):

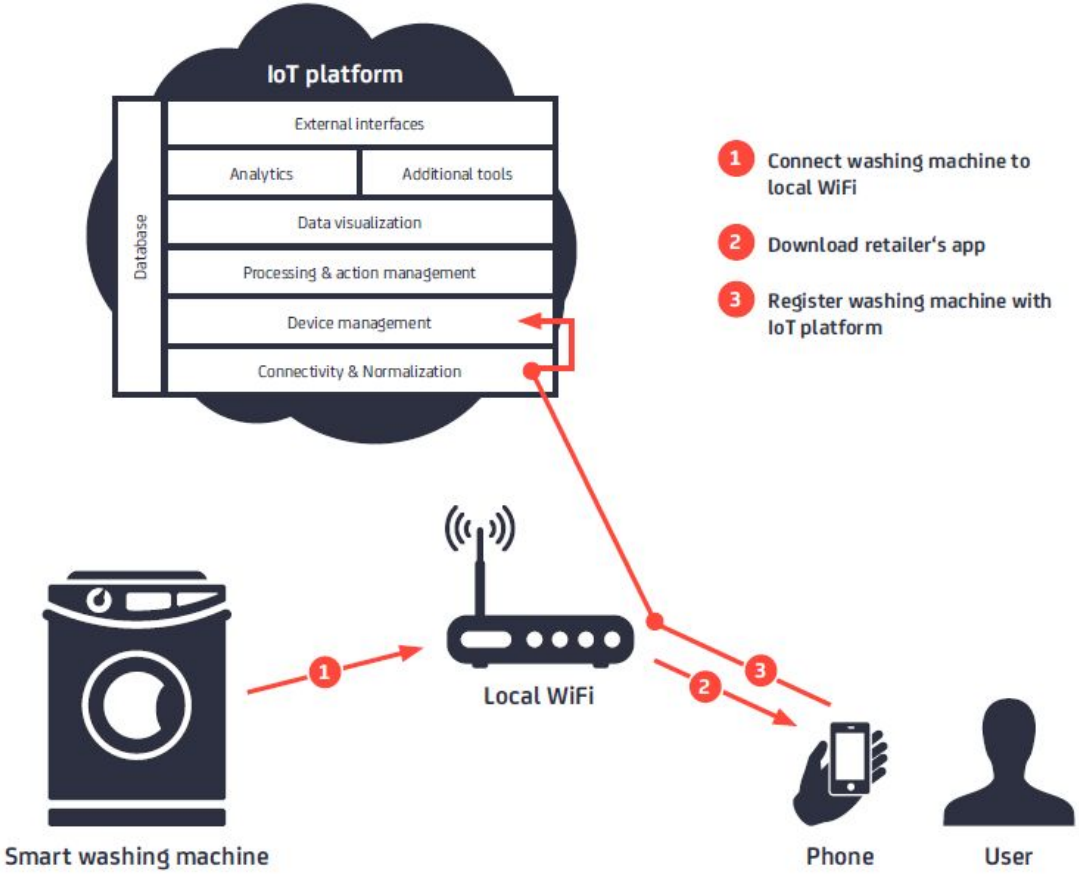
- Projeto europeu **Internet of Things Architecture (IoT-A)**. Link: https://www.iot-a.eu/



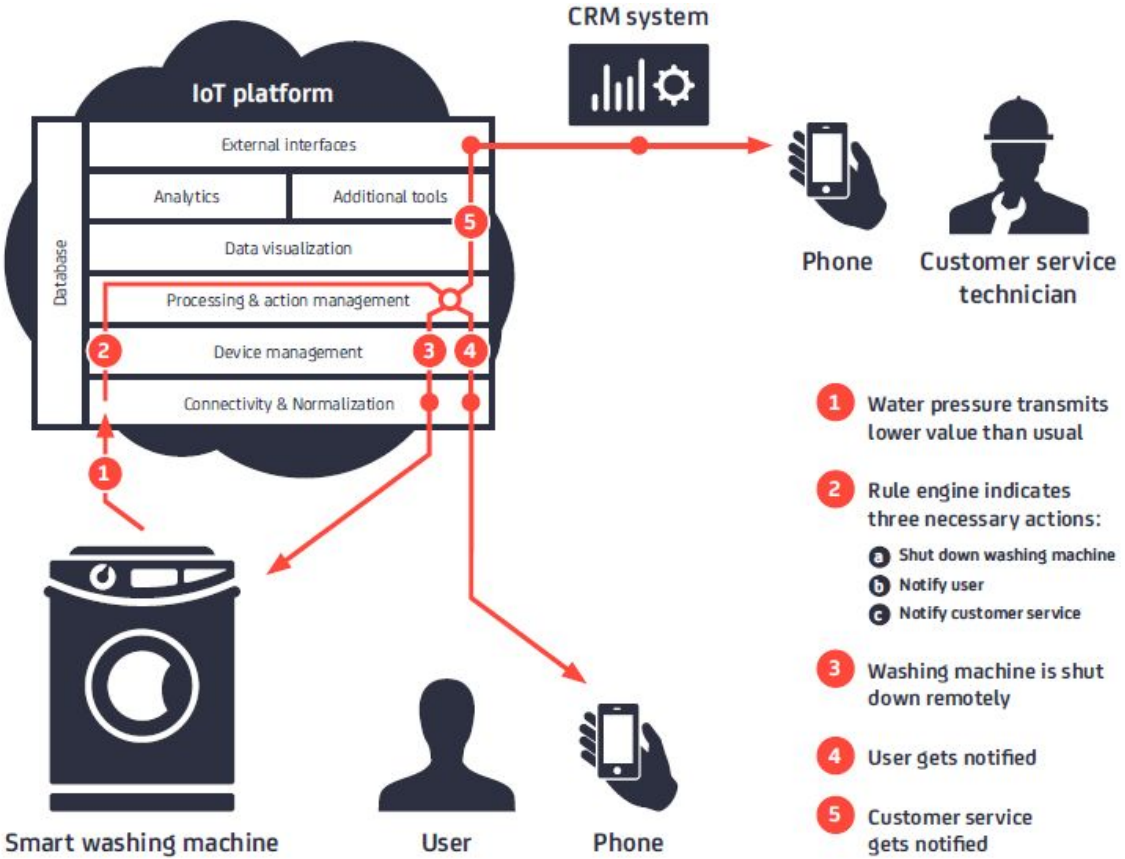
Arquitetura IoT-A: visão funcional



Exemplos


IoT platform
External interfaces
Analytics
Additional tools
Data visualization
Processing & action management
Device management
Connectivity & Normalization
Database
1 Connect washing machine to local WiFi
2 Download retailer's app
3 Register washing machine with IoT platform
1
2
3
Local WiFi
Smart washing machine
Phone
User

Exemplos


CRM system
IoT platform
External interfaces
Analytics
Additional tools
Data visualization
Processing & action management
Device management
Connectivity & Normalization
Database
Phone
Customer service technician
1 Water pressure transmits lower value than usual
2 Rule engine indicates three necessary actions:
a Shut down washing machine
b Notify user
c Notify customer service
3 Washing machine is shut down remotely
4 User gets notified
5 Customer service gets notified
Smart washing machine
User
Phone

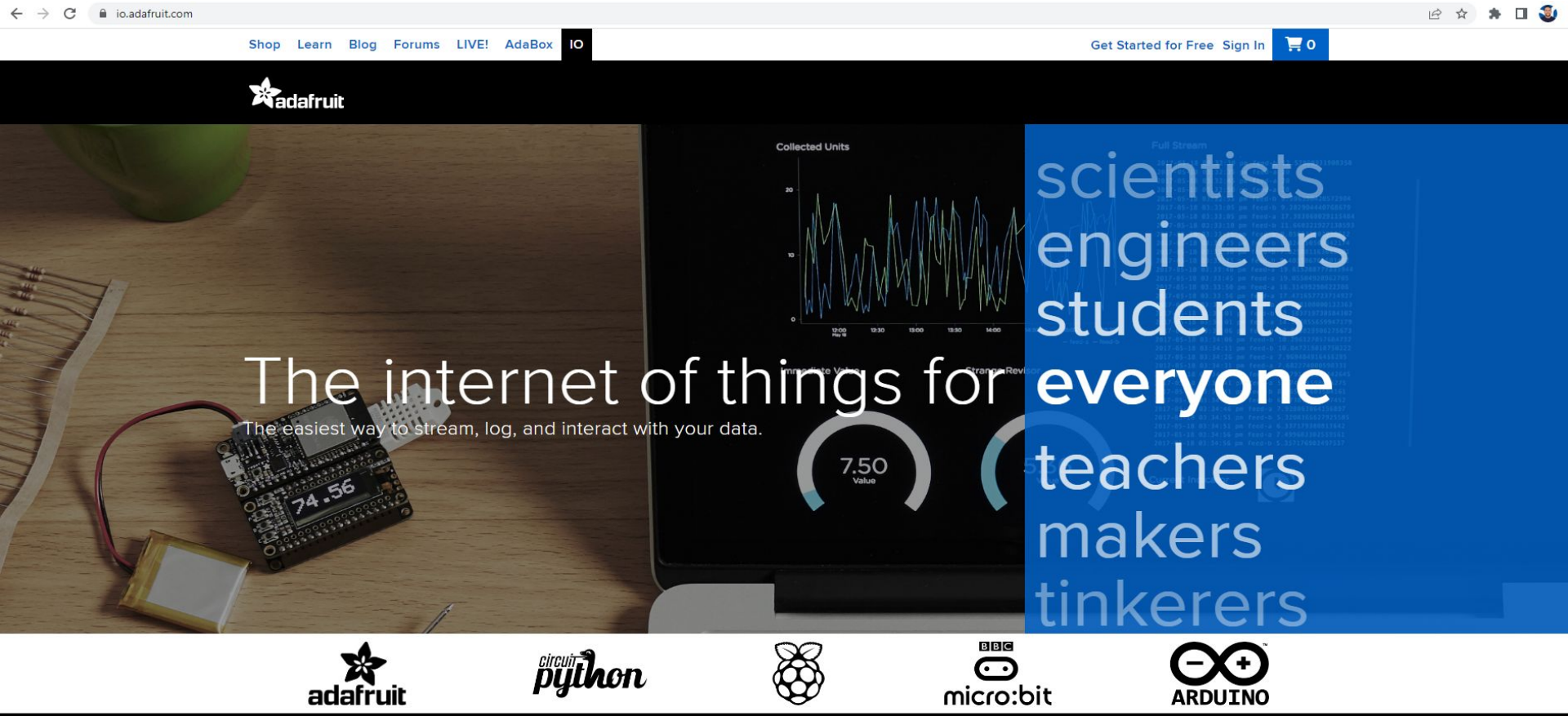
Plataformas de Middleware para IoT: **Exemplos**

UFRN | metrópole DIGITAL

Plataforma IoT: **Adafruit IO**

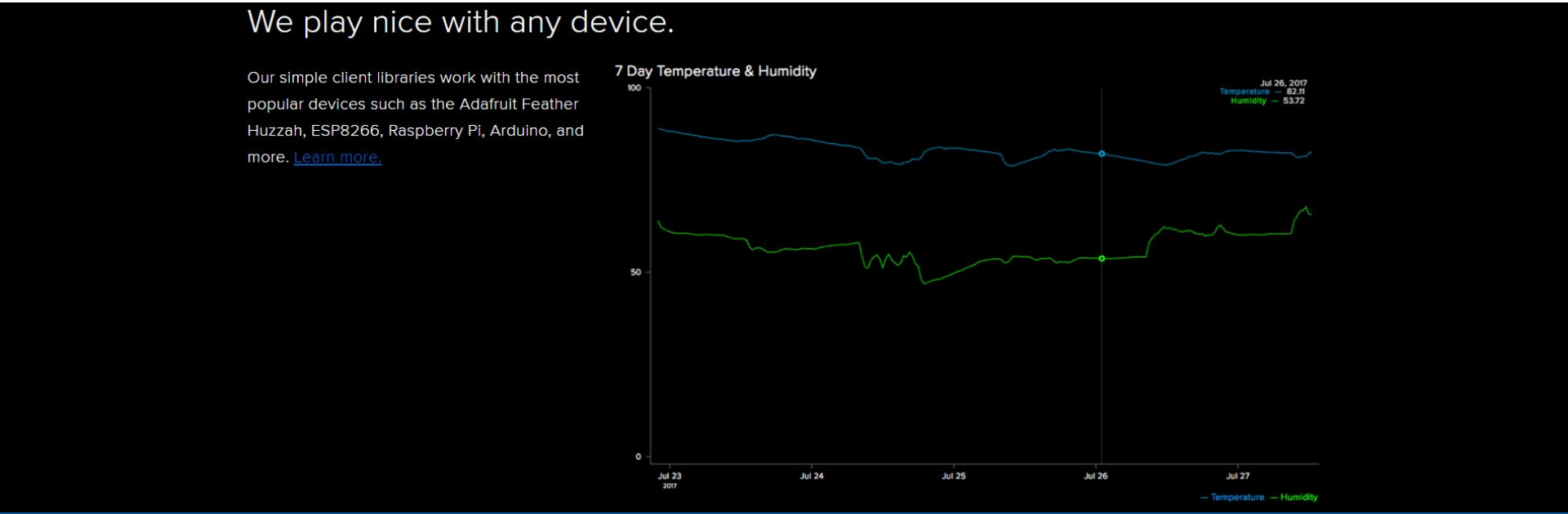
UFRN | metrópole DIGITAL

Adafruit IO


io.adafruit.com
Shop
Learn
Blog
Forums
LIVE!
AdaBox
IO
Get Started for Free
Sign In
0
adafruit
Collected Units
The internet of things for
The easiest way to stream, log, and interact with your data.
7.50
Value
scientists
engineers
students
everyone
teachers
makers
tinkerers
adafruit
circuit python
micro:bit
ARDUINO

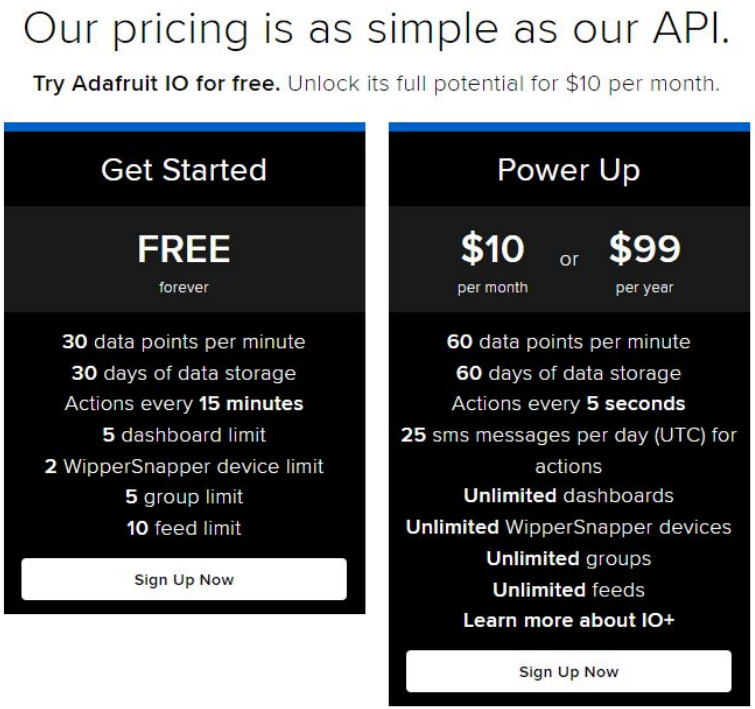
Adafruit IO

- Plataforma da empresa Adafruit de dispositivos e ferramentas eletrônicas.
- Plataforma IoT para visualizar e armazenar dados de dispositivos IoT.
- Suporta dispositivos IoT de diversos fabricantes.



Adafruit IO

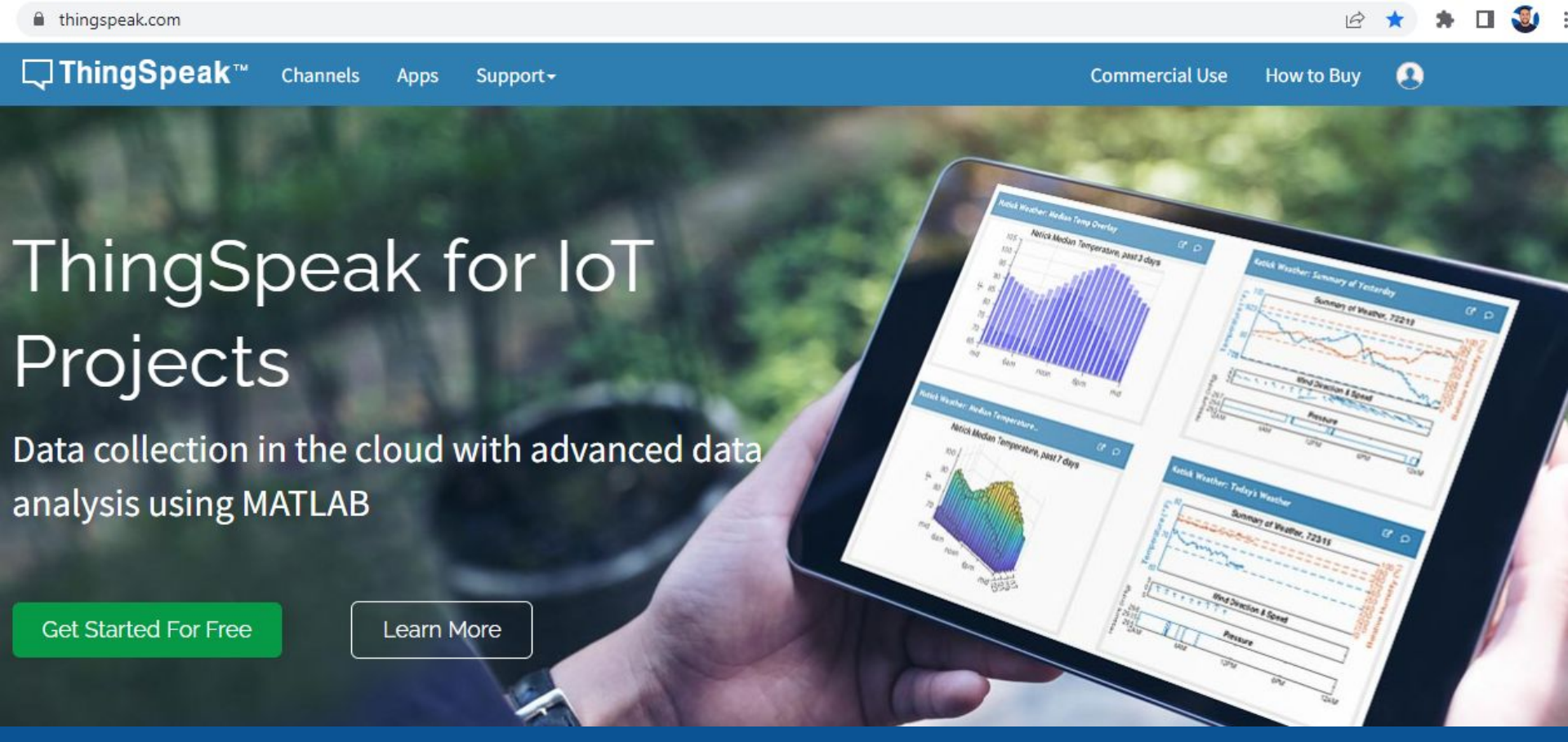
- Gratuito com limitações em pontos de dados, armazenamento e triggers.



Plataforma IoT: **ThingSpeak**

UFRN | metrópole DIGITAL

ThingSpeak


thingspeak.com
ThingSpeak™
Channels
Apps
Support
Commercial Use
How to Buy
ThingSpeak for IoT Projects
Data collection in the cloud with advanced data analysis using MATLAB
Get Started For Free
Learn More

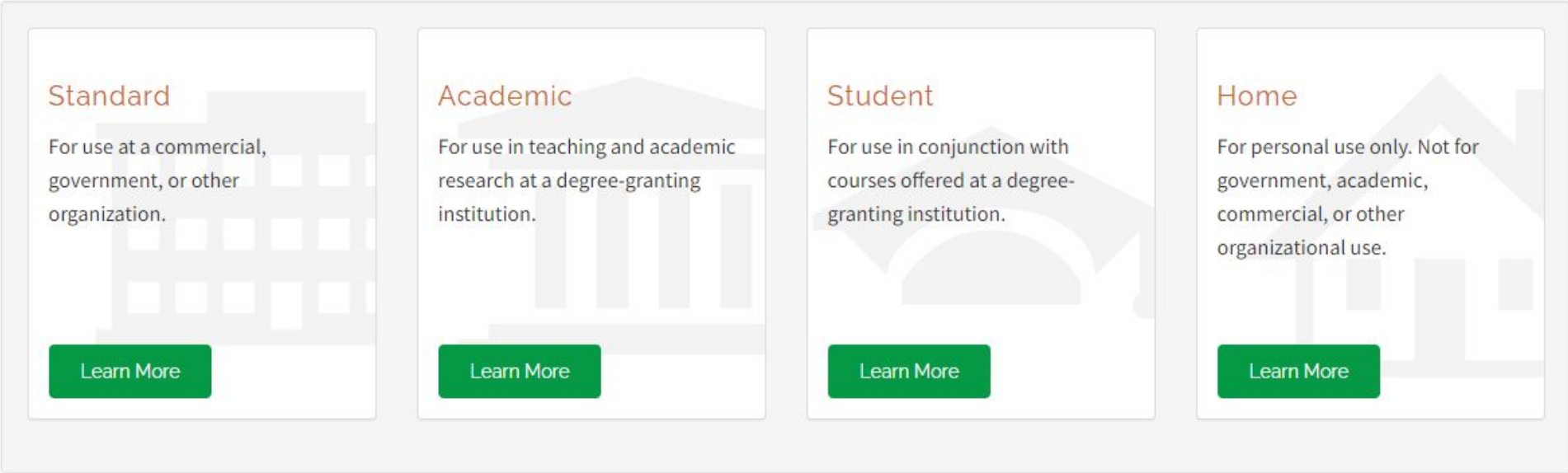
ThingSpeak

- É uma plataforma IoT que permite coletar, visualizar e analisar fluxo de dados em tempo real na nuvem (cloud).
- Solução da empresa *MathWorks*.
- Oferece versão gratuita por recursos e tempo (anual) limitados.

	FREE For time-limited commercial evaluation of the service	STANDARD For all commercial, government and revenue generating activities
Scalable for larger projects	✖ No. Annual usage is capped.	✔
Number of messages	3 million/year (~8.200/day)[2]	33 million/year per unit (~90.000/day per unit)[1]
Message update interval limit	Every 15 seconds	Every second
Number of channels	4	250 per unit
MATLAB Compute Timeout	20 seconds	60 seconds
Private channel sharing	Limited to 3 shares	Unlimited

ThingSpeak: soluções comerciais

- O ThingSpeak está disponível como um serviço gratuito para pequenos projetos não comerciais (<3 milhões de mensagens/ano ou ~8.200 mensagens/dia).
- Para projetos maiores ou aplicativos comerciais, quatro tipos diferentes de licença anual são oferecidos: **Standard, Academic, Student e Home**.



Funcionalidades **ThingSpeak**

ThingSpeak Features

- Collect data in private channels
- Share data with public channels
- RESTful and MQTT APIs
- MATLAB® analytics and visualizations
- Event scheduling
- Alerts
- App integrations

Works With

- MATLAB® & Simulink®
- Arduino®
- Particle devices
- ESP8266 and ESP32 Modules
- Raspberry Pi™
- LoRaWAN®
- Things Network
- Senet
- Libelium
- Beckhoff

Plataforma IoT: **ThingsBoard**

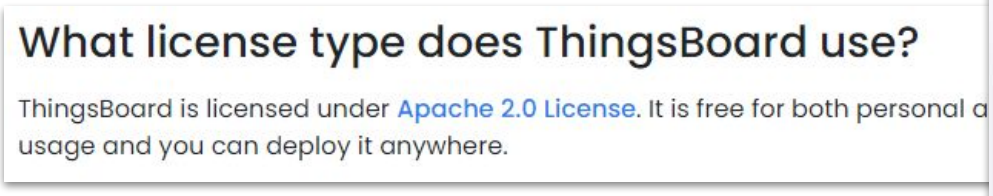
UFRN | metrópole DIGITAL

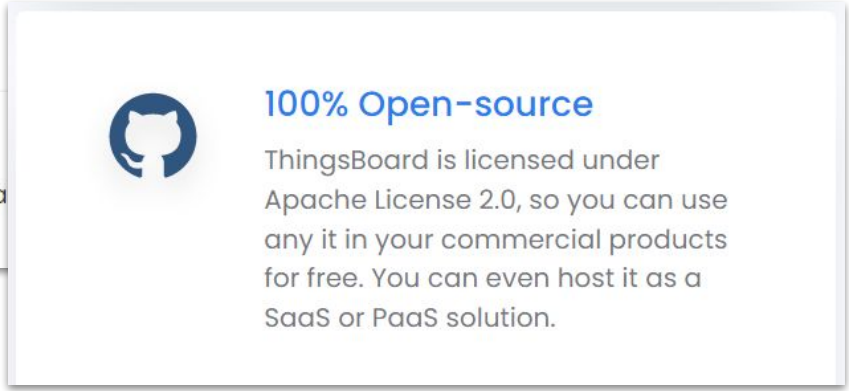
ThingsBoard

ThingsBoard

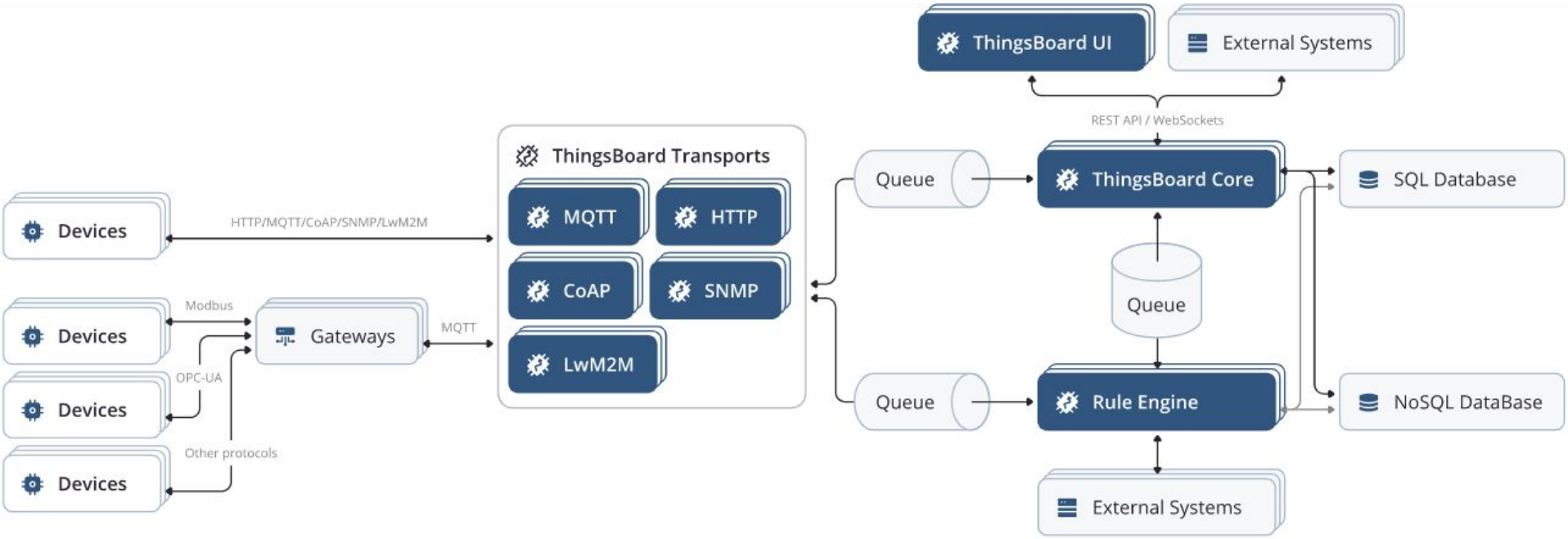
- É uma plataforma IoT open-source para coleta, processamento e visualização de dados e gerenciamento de dispositivos IoT.
- ThingsBoard Core escrito em Java.
- Permite conectividade com os protocolos MQTT, CoAP, LwM2M e HTTP.

➔ Solução open-source com licença Apache 2.0.



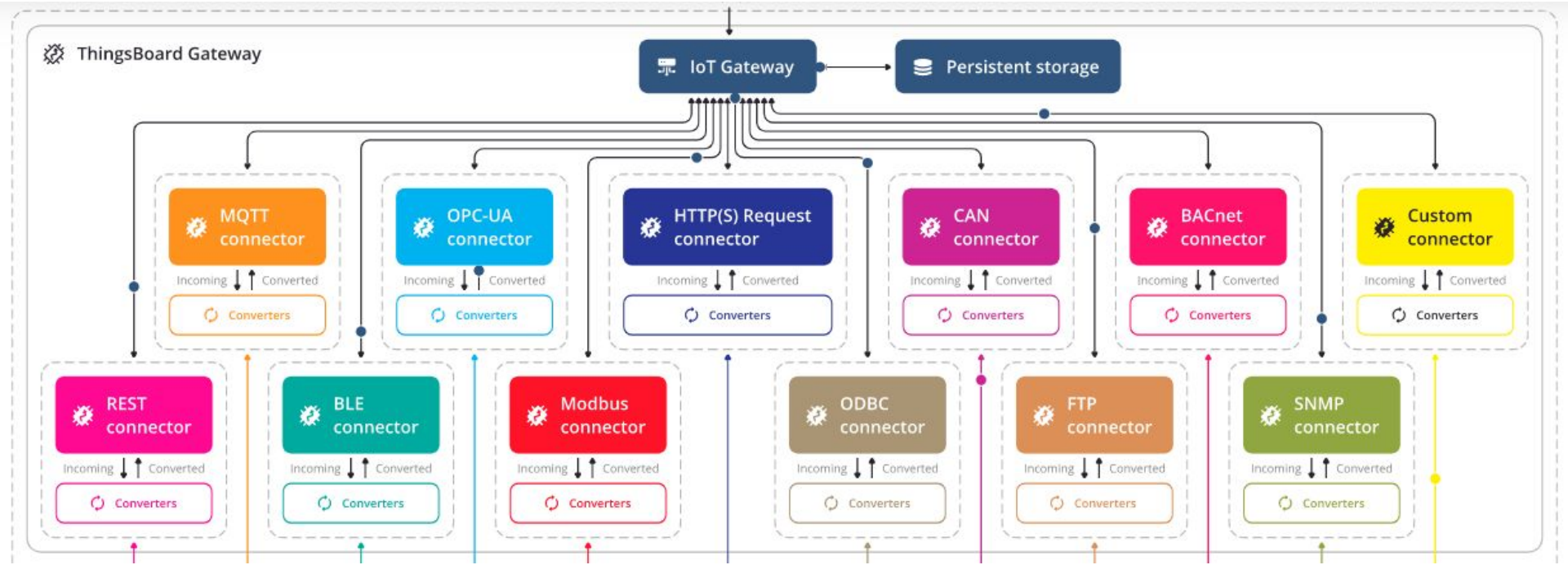


Arquitetura da plataforma **ThingsBoard**

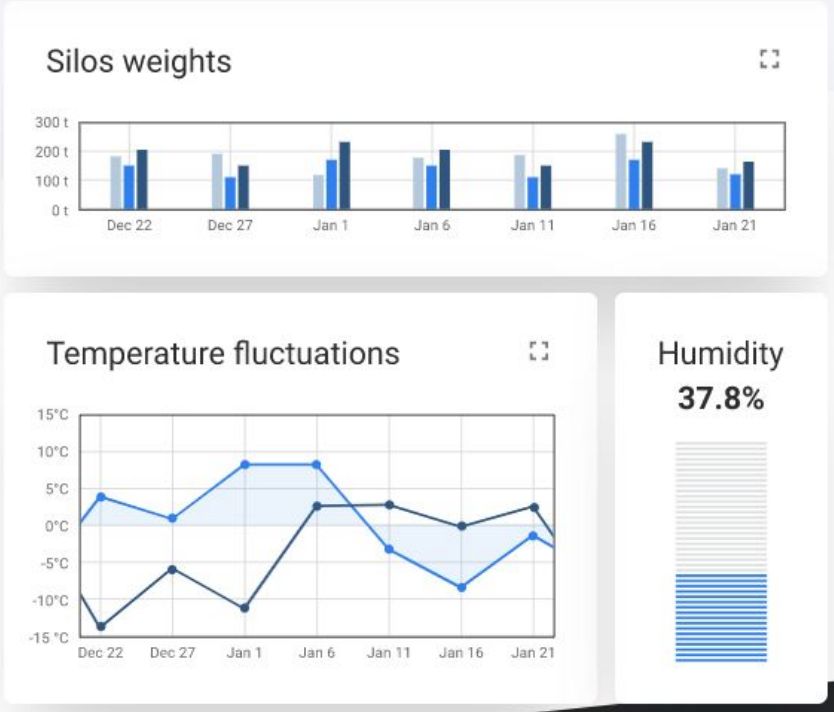


- ***Message Queue:*** suporte às tecnologias Kafka (Apache), RabbitMQ (broker MQTT), AWS SQS, Google Pub/Sub, Azure Service Bus.
- ***Databases***: PostgreSQL, TimescaleDB ou Cassandra (NoSQL).

ThingsBoard IoT Gateway



Funcionalidades do **ThingsBoard**



Collect and visualize data

Collect and store telemetry data in scalable and fault-tolerant way. Visualize your data with built-in or custom widgets and flexible dashboards. Share dashboards with your customers.

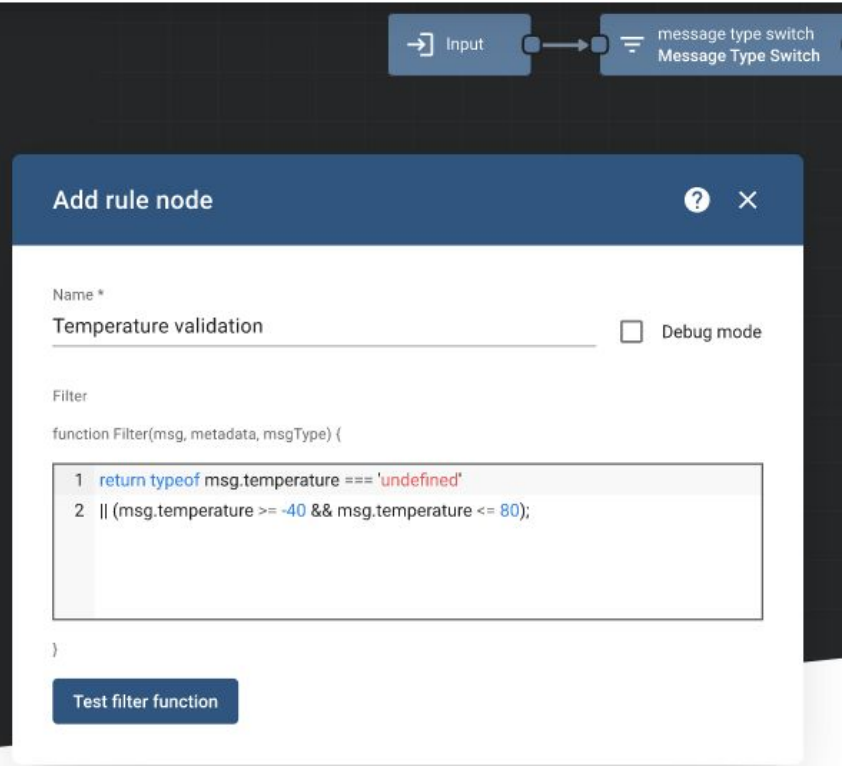
Read more >

Funcionalidades do **ThingsBoard**

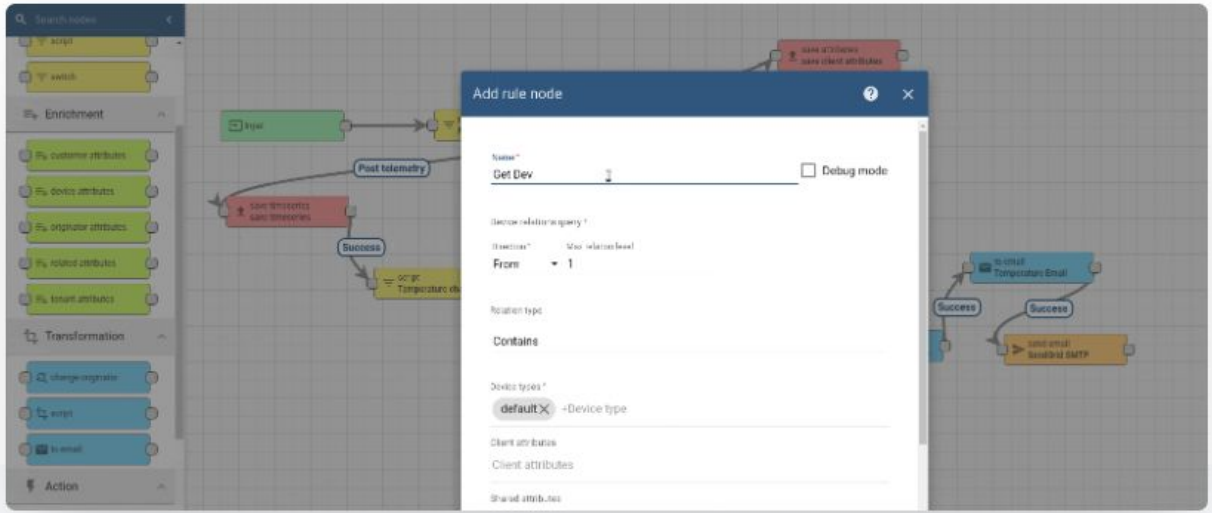
Process and React

Define data processing rule chains. Transform and normalize your device data. Raise alarms on incoming telemetry events, attribute updates, device inactivity and user actions.

Read more ›



Funcionalidades do **ThingsBoard**



IoT Rule Engine

ThingsBoard allows you to create complex **Rule Chains** to process data from your devices and match your application specific use cases.

Read more ›

Funcionalidades do **ThingsBoard**

Device Management

Provides ability to register and manage devices. Allows to monitor client-side and provision server-side device attributes. Provides A server-side applications to s commands to devices and v versa.

Alarms Management

Provides ability to create and manage alarms related to your entities: devices, assets, customers, etc. Allows real-time alarms monitoring and alarms propagation to related entities hierarchy. Raise alarms on device disconnect or inactivity events.

Multi-tenancy

Support multi-tenant installations out-of-the-box. Single tenant may have multiple tenant administrators and millions of devices and customers.

Security

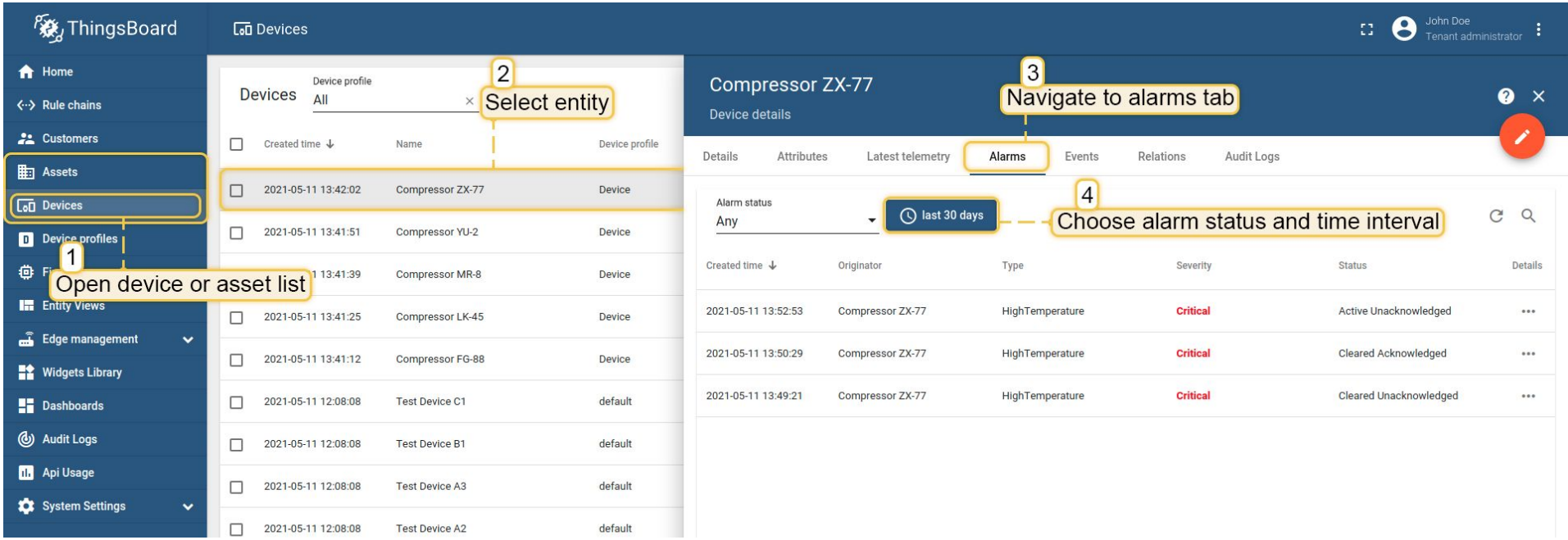
Supports transport encryption for both MQTT and HTTP(s) protocols. Supports device authentication and device credentials management.

Microservices or Monolithic

Supports monolithic deployment for getting started or small environments. Provides ability to upgrade to microservices for high availability and horizontal scalability.

Funcionalidades do **ThingsBoard**

★ **Gerenciamento de alarmes:**



Versões do **ThingsBoard**:

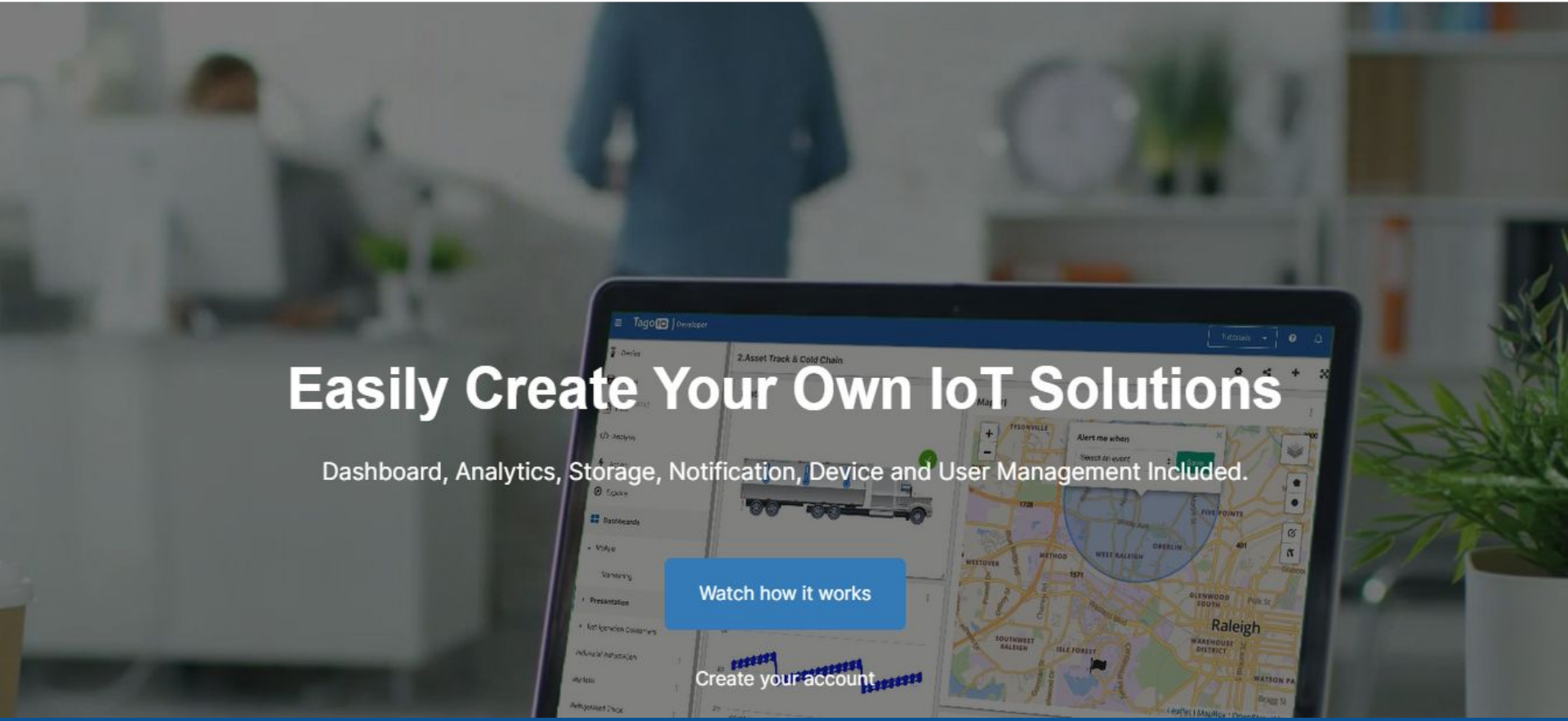
★ **ThingsBoard Cloud:** 30 dias para teste gratuito

Outras **Plataformas IoT**

UFRN | metrópole DIGITAL

tago.io

Tago IO | Use Cases | Product | Resources | Pricing | Request Demo | Contact us | Get Started



Easily Create Your Own IoT Solutions

Dashboard, Analytics, Storage, Notification, Device and User Management Included.

Watch how it works

Create your account

openiot.in

ICFOSS OPENIOT

HOME RESOURCES BLOG FORUM CONTACT US

OpenIoT

OpenIoT.in promoted by ICFOSS is a community enabled knowledge sharing platform to share, discuss and collaborate on Open Source Hardware and Software for Internet of Things (IoT).

BLOG

LoRaWAN End-End Architecture

By admin / April 7, 2020

LoRaWAN Tutorial 102 - Architecture Network Topology LoRaWAN is a star of stars network where gateways act as bridges relaying...

Read More

Resources

Nodes

Nodes are edge/end devices that can add value to the interconnects based on which decisions can be made.The nodes, which in most cases is Hardware Device, is a combination of Open Source Hardware, Sensors and Open Source firmware.

View details

Gateways

Gateways act as bridge between two different networks. In most IoT application the purpose of gateway is to offer interconnects between a Non-IP network such as Zigbee, LoRaWAN, RF, Bluetooth, etc and an IP network such as LTE, WiFi.

View details

Middleware

Middleware helps establish a common standard amongst the diversity of devices, sensors, OS and applications that makes up the IoT ecosystem architecture.It essentially connects different, often complex and already existing applications that were not originally designed to be connected.

View details

Dashboards

OS

Protocols

Navigation

- Home
- Search
- Downloads
- FAQ
- Contact us

Hydra Information

- Project overview
- Project information
- Partners
- Related projects
- Scientific papers
- Internal articles
- Deliverables
- Hydra online demos
- Web Links

Hydra Newsroom

- News categories
- Hydra in the press
- Events

Users Online

- Guests Online: 1
- Members Online: 0
- Total Members: 1
- Newest Member: Admin

Affiliation

Hydra is affilliated with the following programs and organisations:

About the project

Dear colleagues

The Hydra project ended on 31 December 2010. In the last phase of the project we encountered a problem with IP rights to the name "Hydra". This name has been registered in Germany and although we do not feel that the IPR will cover the areas in which the Hydra project has been targeted, we decided to avoid any doubt and to change the name of the middleware after the project had ended.

LinkSmart

The new name of the middleware is thus the **"LinkSmart" middleware**. The LinkSmart middleware has been completely re-factored and it is continuously being updated and expanded. The present version (November 2014) is version 2.1. The LinkSmart Open Source repository is maintained by Fraunhofer Institute for Information Technology (FIT) and you can find it here: http://www.linksmart.eu.

From the LinkSmart Open Source repository you can:

- download a LinkSmart binary distribution
- explore the source code or clone our git repository
- find documentation
- get support

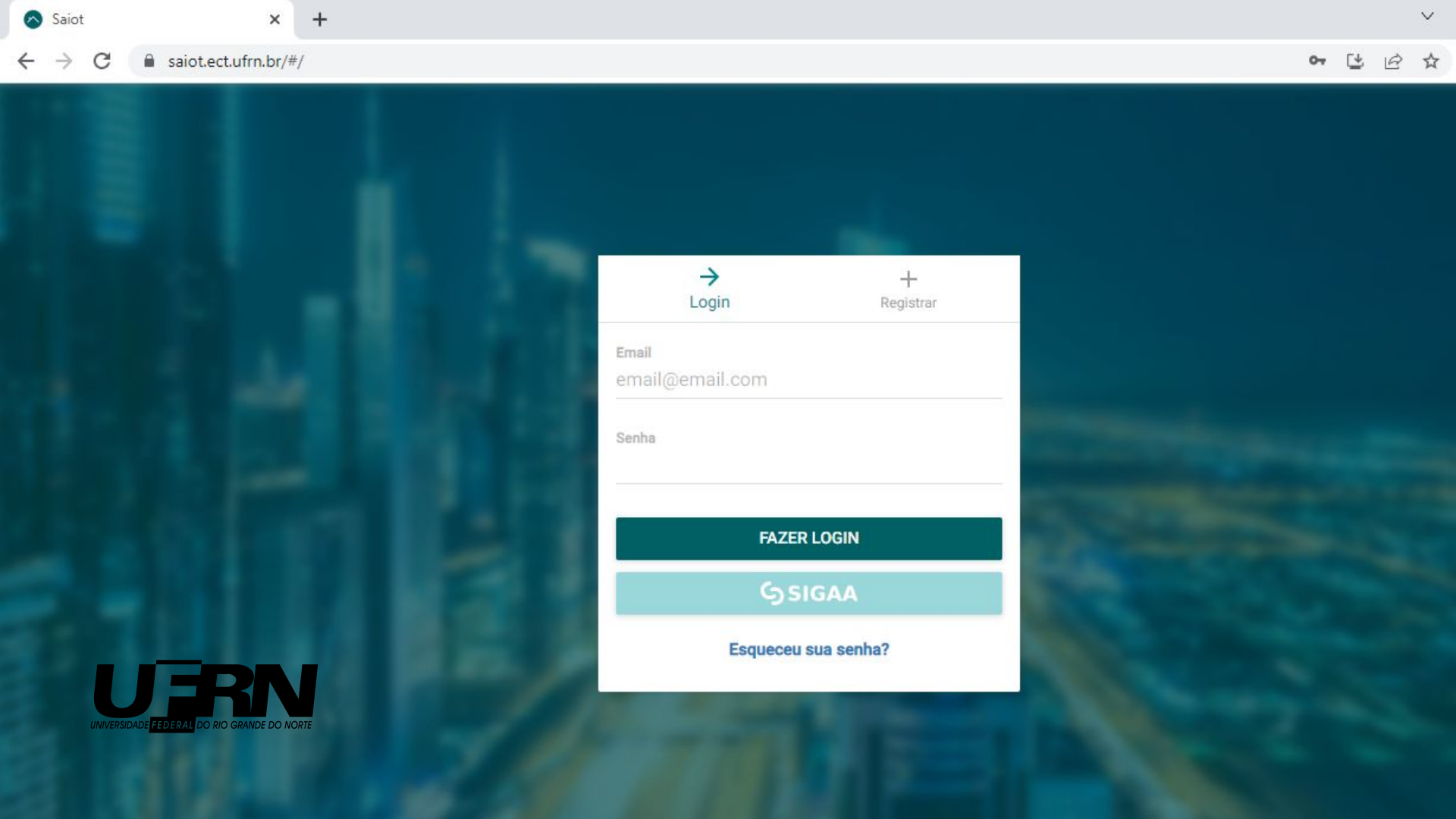
Kind regards

The Hydra Project Team - now the LinkSmart Open Source Team.

About the Hydra Project

HYDRA

Middleware for networked devices


Saiot
saiot.ect.ufrn.br/#/
Login
Registrar
Email
email@email.com
Senha
FAZER LOGIN
SIGAA
Esqueceu sua senha?
UFRN
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

ubidots.com

ubidots

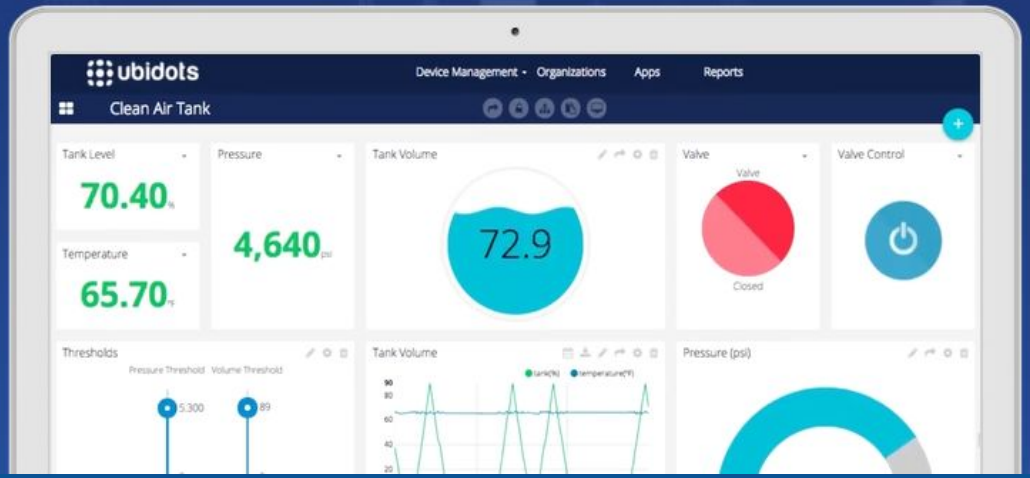
ABOUT INDUSTRIES IOT ECOSYSTEM PLATFORM PRICING RESOURCES

SIGN UP LOGIN

Data Drives Decisions

Rapidly assemble and launch Internet of Things (IoT) applications without having to write code or hire a software development team.

GET STARTED FOR FREE



Não tem versão gratuita.

O que discutimos **hoje**?

Tópicos

- Conceitos de Plataformas de Middleware para IoT;
- Requisitos para Plataformas IoT;
- Arquitetura de Referência para Middleware IoT;
- Exemplos de Plataformas IoT.

metrópole DIGITAL

Dúvidas?

Prof Heitor Florencio
IMD/UFRN
Sala 103 - nPITI/IMD
heitorm@imd.ufrn.br

metrópole DIGITAL

Referências

Material:

- PIRES, Paulo F. et al. **Plataformas para a internet das coisas.** Minicursos SBRC-Simpósio Brasileiro de Redes de Computadores e Sistemas Distribuídos, 2015.
    - Disponível em: https://sbrc2015.ufes.br/wp-content/uploads/Ch3.pdf

ARTIGOS:

- ALI, Omer et al. **A Comprehensive Review of Internet of Things: Technology Stack, Middlewares, and Fog/Edge Computing Interface**. Sensors, v. 22, n. 3, p. 995, 2022.
- RAZZAQUE, Mohammad Abdur et al. **Middleware for internet of things: a survey.** IEEE Internet of things journal, v. 3, n. 1, p. 70-95, 2015.
- NGU, Anne H. et al. **IoT middleware: A survey on issues and enabling technologies.** IEEE Internet of Things Journal, v. 4, n. 1, p. 1-20, 2016.

OUTROS:

- ANALYTICS, IoT. **IoT Platforms The central backbone for the Internet of Things**. White paper, 2015.