



INTRODUCTION

INTERNET DES OBJETS

Pape Abdoulaye FAM / Mouhamadou Lamine KEBE

pafam@esp.sn / mouhamadoulamine.kebe@esp.sn

PLAN

Introduction

- ⊙ Transformation digitale

Internet des objets

- ⊙ Définition
- ⊙ Verrous technologiques
- ⊙ Avantages
- ⊙ Ecosystème
- ⊙ Applications et cas d'usage

Conclusion

INTRODUCTION



TRANSFORMATION DIGITALE

La transformation digitale



La transformation digitale

La transformation digitale... Oui, mais comment ?

- ⊙ Rendre les infrastructures intelligentes
- ⊙ Générer massivement des données et les stocker
 - Concevoir des capteurs communiquant
 - Déployer des réseaux de communications
 - Collecter et stocker les données des capteurs
- ⊙ Analyser et exploiter les données
 - Aider à la prise de décision
 - Fournir des applications et ~~services~~ à valeurs ajoutés

Collecter

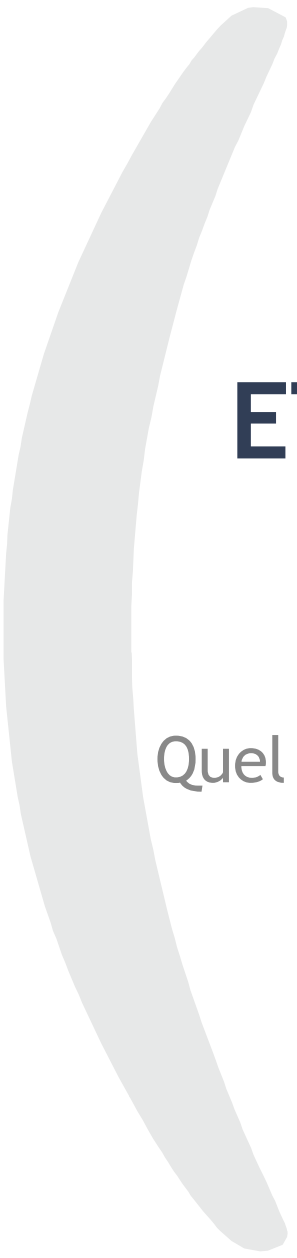
Stocker

Analyser

Prédire

Controller

Optimiser



ET L'INTERNET DES OBJETS ? #IOT

Quel lien entre transformation digitale et internet des objets ?

L'internet des objets

Des objets de plus en plus intelligent !

- Smartphones, smart-watches, smart homes, smart cities...



L'internet des objets



L'internet des objets

Comment rendre une ville intelligente ?

- Améliorer la qualité de vie et les usages des citoyens
- Créer des services et des ressources efficaces
- Utiliser les technologies et les données
 - Collecter & analyser les données → Automatiser
 - Déployer des applications technologiques

Levier → Internet of Things (IoT)

BY 2021
**CITIES WILL SAVE
\$19B**

source: Juniper Research

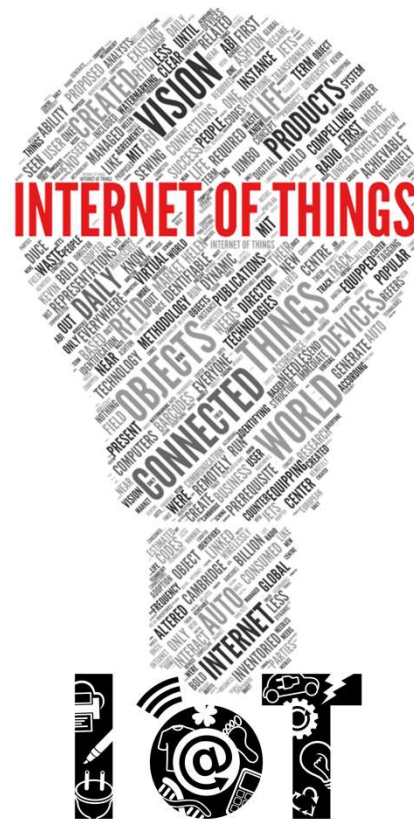
BY 2025
**SMART CITIES MARKET
\$1.2T**



DEFINITION DE L'INTERNET DES OBJETS

L'internet des objets : définition

Internet des objets



L'internet des objets : définition

Internet des objets



L'internet des objets : définition

Internet des objets



L'internet des objets : définition

« L'Internet des objets est un réseaux de réseaux qui permet via des systèmes d'identification électronique normalisés et unifiés, et des dispositifs mobiles sans fil, d'identifier directement et sans ambiguïté des entités numériques et des objets physiques et ainsi de pouvoir récupérer, stocker, transférer et traiter, sans discontinuité entre les mondes physiques et virtuels, les données s'y rattachant. »

Tiré du livre :

L'Internet des objets

de Pierre-Jean Benghozi, Sylvain Bureau et Françoise Massit-Folléa

(Edition MSH)

L'internet des objets : définition

« *L'Internet des objets est un **réseaux de réseaux** qui permet via des systèmes d'identification électronique normalisés et unifiés, et des dispositifs mobiles sans fil, **d'identifier directement et sans ambiguïté des entités numériques et des objets physiques** et ainsi de pouvoir **recupérer, stocker, transférer et traiter**, sans discontinuité entre les mondes physiques et virtuels, **les données** s'y rattachant. »*

Tiré du livre :

L'Internet des objets

de Pierre-Jean Benghozi, Sylvain Bureau et Françoise Massit-Folléa

(Edition MSH)

L'internet des objets : définition

Qu'est ce que l'internet des objets ?

- ⊙ Objets intelligents
- ⊙ Accès à internet aux objets intelligents
- ⊙ Technologies & protocoles
- ⊙ Applications et services aux utilisateurs



LES VERROUS TECHNOLOGIQUES DE L'INTERNET DES OBJETS

L'internet des objets : les verrous technologiques

Capacité	<ul style="list-style-type: none"> ○ Sens de la communication: [uni - bi]- directionnelle ○ Passage à l'échelle ○ Débit et fiabilité des échanges
Couverture	<ul style="list-style-type: none"> ○ Outdoor / indoor ○ Zone urbaine / zone rurale ○ Hybridation de réseaux
Consommation énergétique	<ul style="list-style-type: none"> ○ Efficacité énergétique ○ Autonomie sur batteries ○ Latence
Coût	<ul style="list-style-type: none"> ○ Coût des objets ○ Coût d'opération et de maintenance du réseau ○ Passage à l'échelle
Sécurité	<ul style="list-style-type: none"> ○ Sécurité des objets ○ Protection des données utilisateurs ○ Confidentialité des échanges
Autres	<ul style="list-style-type: none"> ○ Besoins spécifiques dépendant des applications ○ Différents scénarios de déploiement ○ Stockage, analyse et traitement des données



AVANTAGES DE L'INTERNET DES OBJETS

L'internet des objets : avantages

Gain de temps

- ⊙ Automatisation des tâches manuelles répétitives
 - Éclairage, arrosage, chauffage...

Réduction des coûts

- ⊙ Réduction des dépenses
 - Énergies, surveillance, stockage

Hausse de la productivité

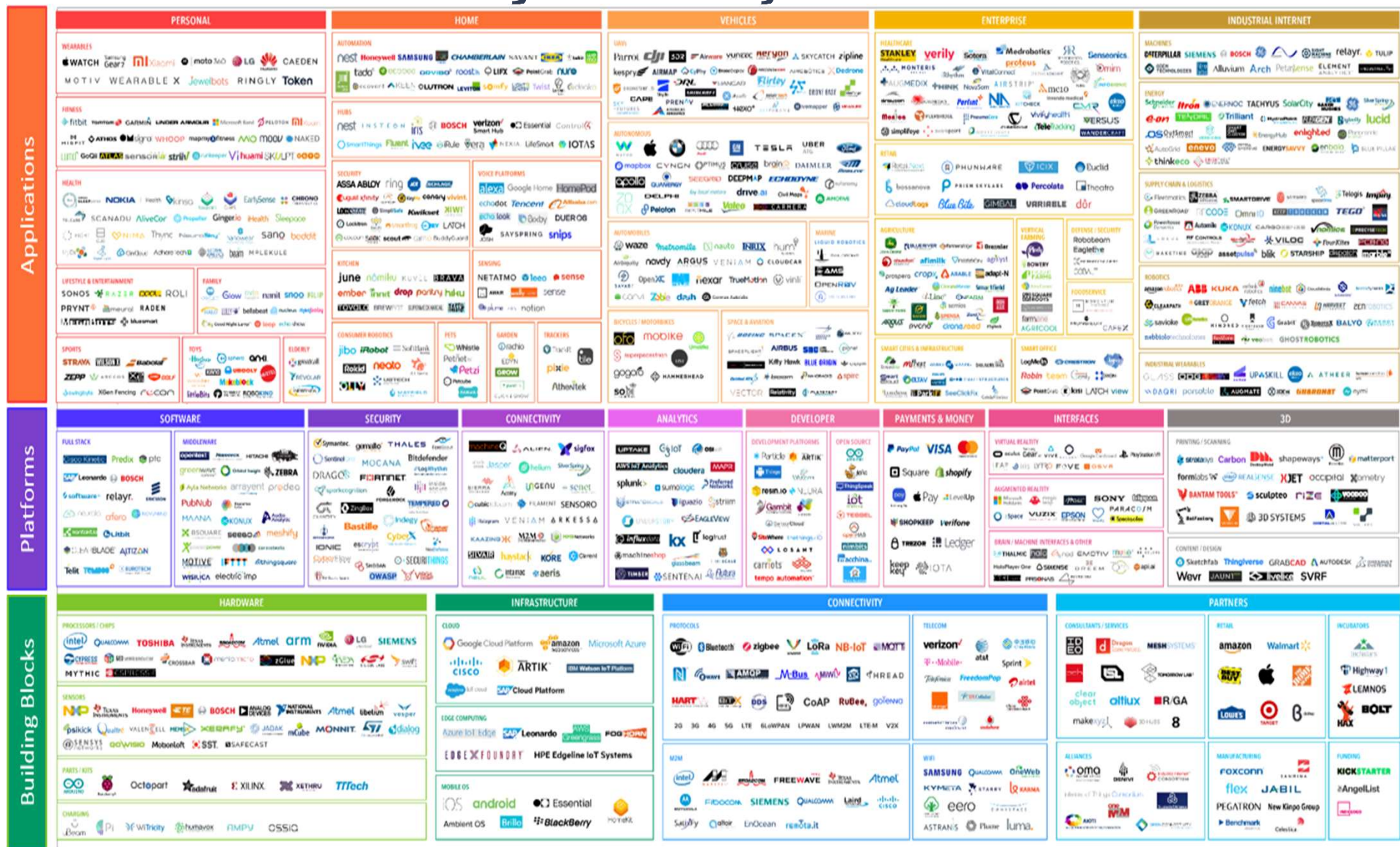
- ⊙ Recueil des données de capteurs
 - Gain en productivité et en autonomie...

Innovation



ECOSYSTEME DE L'INTERNET DES OBJETS

L'Internet des objets : écosystème





APPLICATIONS DE L'INTERNET DES OBJETS

IoT applications : suivi et gestion de flotte



IoT applications : alerte éruption volcanique

SMART ENVIRONMENT MASAYA VOLCANO

Predicting eruptions in the Mouth of Hell to save human lives



Description

Some volcanologists are currently focused on working with the latest technology to monitor in real-time everything that happens inside and outside the crater to predict eruptions. Qwake has trusted Libelium technology to develop a wireless sensor network in the Mouth of Hell, Masaya volcano in Nicaragua.

Masaya is one of the Latin American most active volcanoes with a lava lake in one of the craters with 600 m2 dimension that offers an unprecedented glimpse into the dynamic behaviour of magma plumbing system. Companies have worked in this project to bring the first volcano online with a wireless monitoring system able to collect, transmit and store data in real-time.



Sensors

- Ambient conditions: CO₂, H₂S, temperature, humidity and atmospheric pressure.

Protocols

900 MHz
Long Range

3G

Cloud

The information collected by the IoT Gateway has been visualized in Predix, a cloud-based software platform GE developed for the Industrial Internet. It allows connecting industrial equipment, analyzing data, and delivering real-time insights.

Benefits

- Predicting volcano eruptions with a digital early warning system.
- Providing a public service with open information by giving access to the general population and decision makers.

Libelium Insight

David Gascón, Libelium CTO, was a member of the expedition and experienced in first person the impressive landscape around Masaya volcano: "We are glad to contribute to a project that will help to save million of lives, not only in Nicaragua, but also in worldwide projects monitoring other volcanoes".



"Our team was able to quickly set-up and ensure that data was captured correctly. This allowed us to focus on solving actual problems related to deploying the sensors inside the crater and bringing the Masaya volcano online, rather than having to deal with connectivity and underlying data transfer", states Hugo Nordell, Qwake explorer.

Partner **Qwake**

IoT applications : monitoring de l'environnement

SMART ENVIRONMENT PERU RAINFOREST

Monitoring weather and water conditions to control climate change in the National Park of Manú in Peru

Sensors

- Ambient conditions: humidity, temperature, atmospheric pressure and weather station WS-300.
- Emission levels: carbon dioxide (CO₂), nitrogen dioxide (NO₂), oxygen (O₂), carbon monoxide (CO), methane (CH₄), ozone (O₃) and air pollutants.

Protocols

Cloud

Information gathered by the sensors is visualized in an own Cloud platform from RFID Radical Solutions.

Benefits

- Giving real-time and open information about the rainforest environment to current researchers.
- Combating against climate change.

Libelium Insight

Libelium is proud to contribute to help scientists and researchers to fight against climate change as it is one of the priorities of the Corporate Social Responsibility of the company. Alicia Asín, CEO of Libelium, states that "this project is interesting to show the capability of Libelium Wireless Sensor Platform to provide tools to monitor changes in biological conditions".

Partner

Description

The National Park of Manú in Peru is one of the most impressive nature reserves in the world and it is the home of a great biological diversity. The UNESCO recognized it in 1987 as World Heritage Site and Biosphere Reserve. Nevertheless, this wide range of plants and animals, although they are protected, are also threatened by climate change.

In order to preserve these and others species, some Peruvian professional researchers have led a project with the aim to monitor nature's behaviour in real time and habitat. RFID Radical Solutions has trusted Libelium technology to gather information from soil, water and air in at least 30 kilometres of the nature reserve and to connect this data to the Internet.

"The sensors installed in this area will monitor the environment of the biosphere, both flora and fauna. There was a great need to know the different parameters because they reflect nature's behaviour. This scientific data will have a significant useful to the worldwide researcher and environmental communities", affirms Jorge Camus, engineer of the project.

IoT applications : gestion de l'eau

SMART WATER IWESLA

Saving water by improving water efficiency and safety in living areas with a smart management system



Description

The project called iWesla, which stands for Improving Water Efficiency and Safety in Living Areas, is a CPSE Labs funded by the European Union's Horizon 2020 research and innovation program. The consortium is formed by A-CING, Indra, Novelti and the Universidad Politecnica de Madrid (UPM).

The smart water project, based on Libelium technology, aims to develop and deploy a demand-side cyber-physical system (CPS) to optimize the water consumption efficiency and safety in living areas. The solution prototype was tested in UPM Campus Sur and two pilot sites provided by the Municipality of Rivas Vaciamadrid (Madrid, Spain).

Sensors

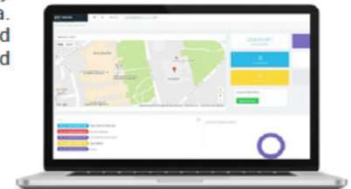
- Water flow: water flow meter sensors and solenoid-based electric valves to control (open-close) the water supply into the living area.

Protocols



Cloud

Novelti analytic service processes the water consumption information gathered by FEED IoT & Big Data Platform Sofia2 based Application, returning the disaggregated water usage made by all consumption points in the living area. The processed information is visualized in a web application designed and developed by A-CING.



Benefits

- Saving up to 50% of the water consumption in living areas.
- Reducing potential damages caused by leakages or open taps.
- Allowing users to be informed about the water consumption habits creating an impact on the citizen's water consumption patterns.

Libelium Insight

Water and electrical supply are two of the main concerns for public authorities. The demand of these resources grow as fast as the population in urban areas so they would become scarcer with the pass of the years. The optimization of water use and also the water supply network performance allow to cut down the waste of resources and also the water bill for organizations.

Partner



"The current rate of growth of the population in cities together with climate change effects requires the optimization of natural resources usage. The intelligent use of water in smart cities implies engagement and involvement from the water utilities to the demand side or end-users such as citizens, municipalities or building management staff", argues Asier González, project manager of Aqua-Consult Ingenieros.

IoT applications : maintenance préventive

INDUSTRY 4.0 INBLAY TECHNOLOGY



Monitoring temperature and vibration of industrial motors to warn when abnormal operation is detected

Description

As modern industrial machinery is expensive, it is usually important for businesses to ensure the upkeep of their investment. Preventive maintenance also may help ensure that machinery is safe, which can assist in maintaining the health of workers and equipment users.

Inblay Technology, a Mexican company that designs, develops and deploys industrial enhancement systems, has created a platform to monitor industrial motors using Waspnote. This system is able to monitor temperature and vibration of industrial motors, warning when abnormal operation is detected.



Sensors

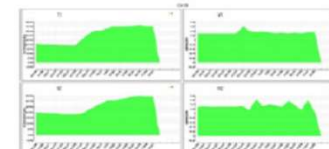
- Industrial motors: temperature and vibration.

Protocols



Cloud

Data is sent to Meshlium which stores them into a MySQL database.



Benefits

- Offering a better control for preventive maintenance in the industrial motors.
- Allowing facing peaks production thanks to a quick and easy scalability.
- Developing a friendly user interface providing field workers with a tool to ease maintenance.

Libelium Insight

Waspnotes sensors were able to provide Inblay with a friendly interface, but the end-user wanted to check if this platform was able to behave properly under real conditions. Real tests were carried out during several weeks in order to test the whole system. Thanks to the stability of the system, the end-user was totally satisfied and decided to install the system in the industrial motors.

Partner



"The end-user wanted to know temperature and vibration of industrial motors in real-time, and this was a key factor to use Libelium's products" says Antonio Perez, developer of Inblay System.

IoT applications : agriculture intelligente

SMART AGRICULTURE NURSERY

Controlling crops conditions to ensure crops health and to reduce losses



Description

Agnov8 has trusted Libelium technology to develop several wireless sensor networks to control crops conditions and to improve yields. The company has deployed a large environmental sustainability project of Cameron's Nursery wholesale plant grower located in Australia.

The smart system allows to monitor soil, water quality, water storage and environmental parameters. Farmers want to control the quality of the irrigation water and also the fill levels of the dams. In order to optimize the growth of the plants, the ambient conditions and the soil needs are monitored to improve crop yields.



Sensors

- **Water quality:** temperature, pH, electrical conductivity (EC), Oxidation reduction potential (ORP) and Dissolved Oxygen (DO).
- **Water level:** ultrasound.
- **Soil and leaves parameters:** temperature, soil moisture and leaf wetness.
- **Ambient conditions:** air temperature, humidity, luminosity and anemometer + wind vane + pluviometer.

Protocols



Cloud

Agnov8's multi-tenant SaaS is hosted on AWS Cloud Platform. Through the platform any user can access to each sensor module to review sensor measurement data based on their locations.



Benefits

- Reducing human error by taking scheduled water quality readings that have been completely replaced by automated readings.
- Improving reliability of the reading by taking more frequent ones, every 15 minutes providing more valuable insights of the daily actions.
- Taking decision based on real facts and improving daily work of each farmer.

Libelium Insight

Cameron's Nursery has won 13 awards related to sustainability water management and precision farming from the nursery sector or even the UN. The deployment of the smart project allows the company to avoid the potential of any adverse litigation which affects the business as a whole and continue being a reference as a sustainable company.

Partner



"Agnov8 with Libelium technology have enabled us to have insight into fluctuations with real-time evidence in water and greenhouse monitoring. This has empowered our staff to react to specific events ensuring crops health and reducing losses. We can see exactly what is occurring on farm whether we are on or off site", concludes Sonja Cameron, Cameron's Nursery director.

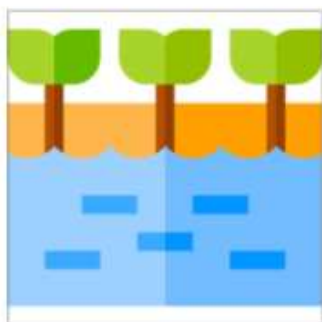
TolBi

Une startup innovante au Sénégal !



Tolbi : Une application IoT Agritech





**Gaspillage
d'eau**

50 % to 80 %



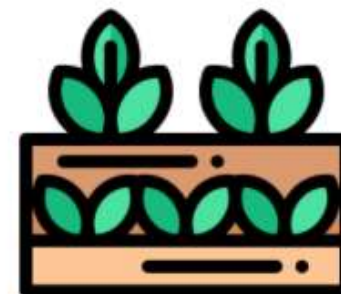
**Perte de
revenu**

**US\$ 577
/month**



**Perte en
temps**

**4 hours
US\$ 295
/month**



**Perte en
récolte**

-30%

Notre solution...



Kit d'objets connectés



Calcule les
besoins en
eau



Automatise
l'irrigation



Permet **de**
prendre de la
décision

Tolbi connecté



Tolbi sensor



Tolbi monitoring system



Tolbi command



Natural language
Technology (African
voices)



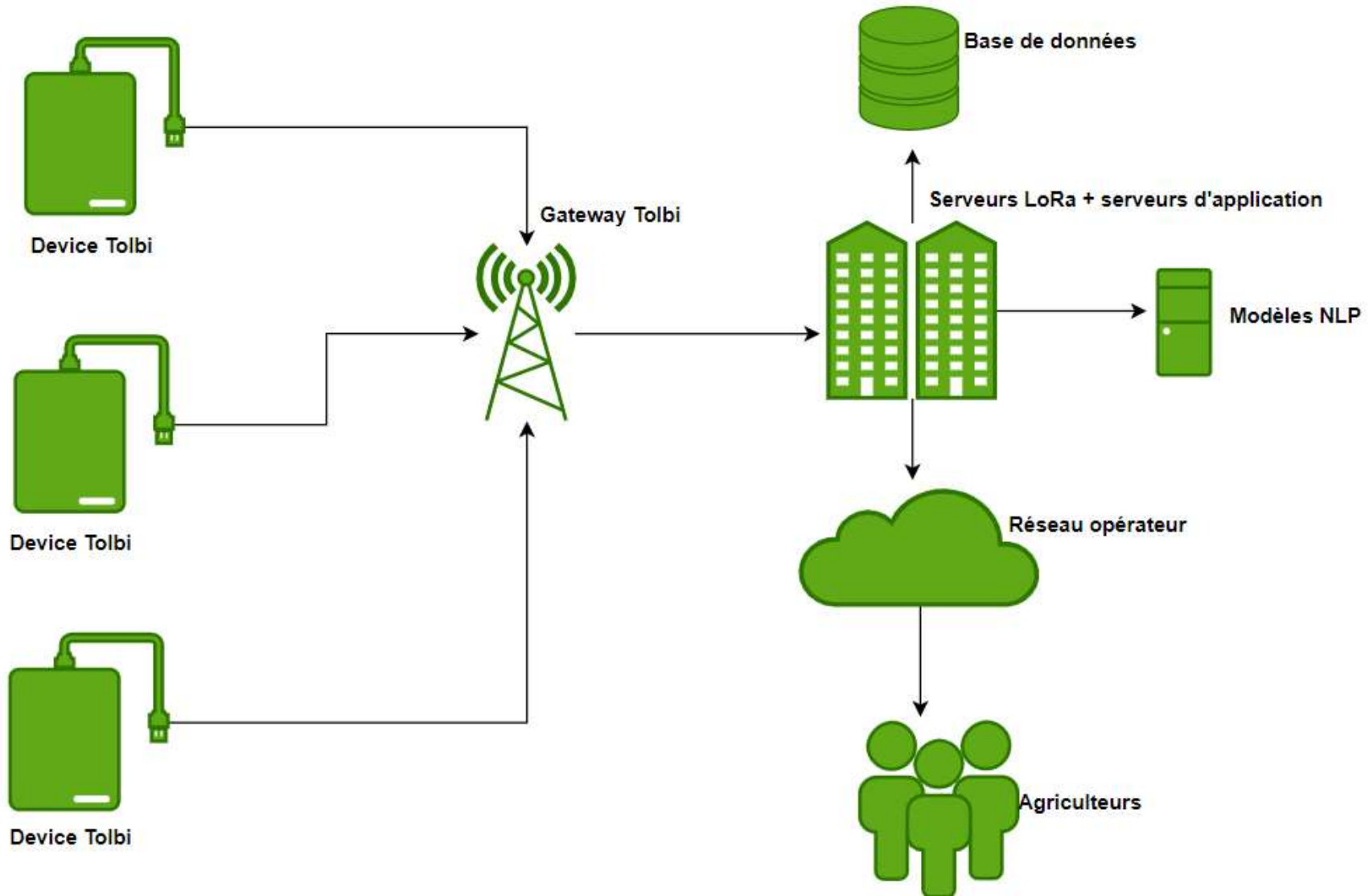
AI-based datasheet
of crops for the
water need



Web/Mobile
application



Comment ça marche ?



Le NewSpace ou un nouveau paradigme IoT



Teranga Space



Réseau Lora Teranga

Mission Teranga One

01

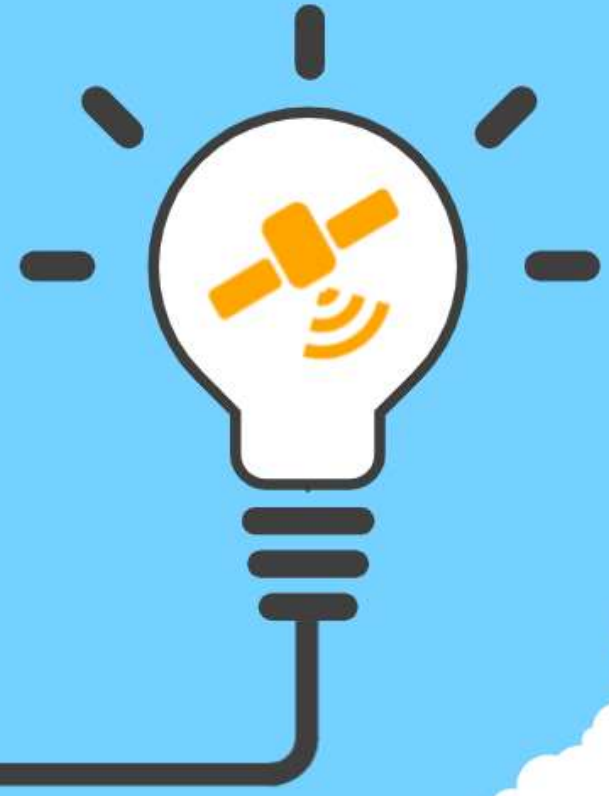
Réseau LoRa expérimental
basé sur une constellation
de nanosatellite Teranga

02

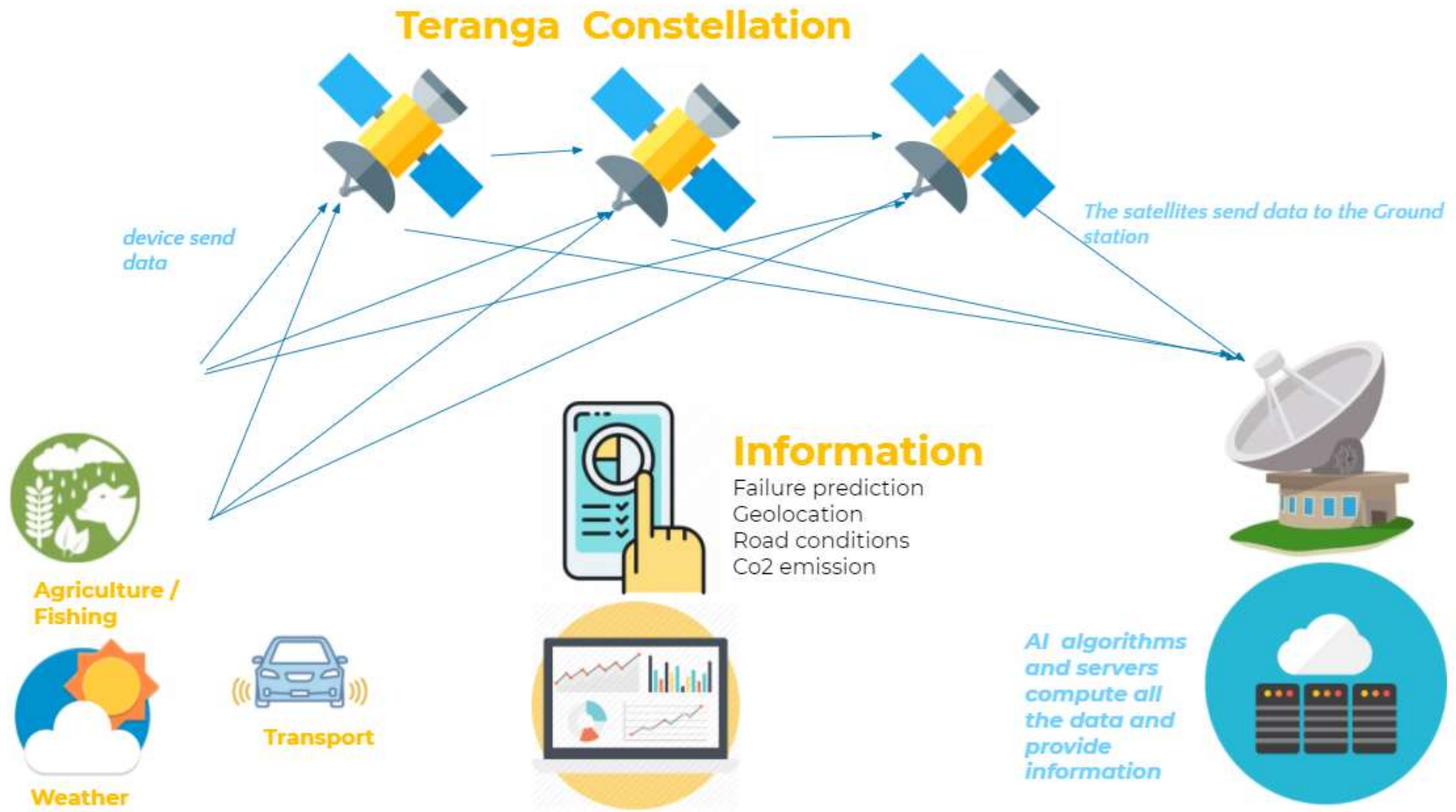
Ville et village intelligente
avec des kit IoT
expérimental

03

Prise de décision basée sur
de la donnée



Réseau Lora Teranga



Teranga-sat-1

Teranga Sat 1 : Le premier picosatellite d'Afrique



Mission : Démonstration connectivité LoRa sur satellite

Equipe : Teranga Space Foundation

Lancement : Falcon 9 , SpaceX , Décembre 2021 / Mars 2020

Dimension : 5*5*5 cm (1P)

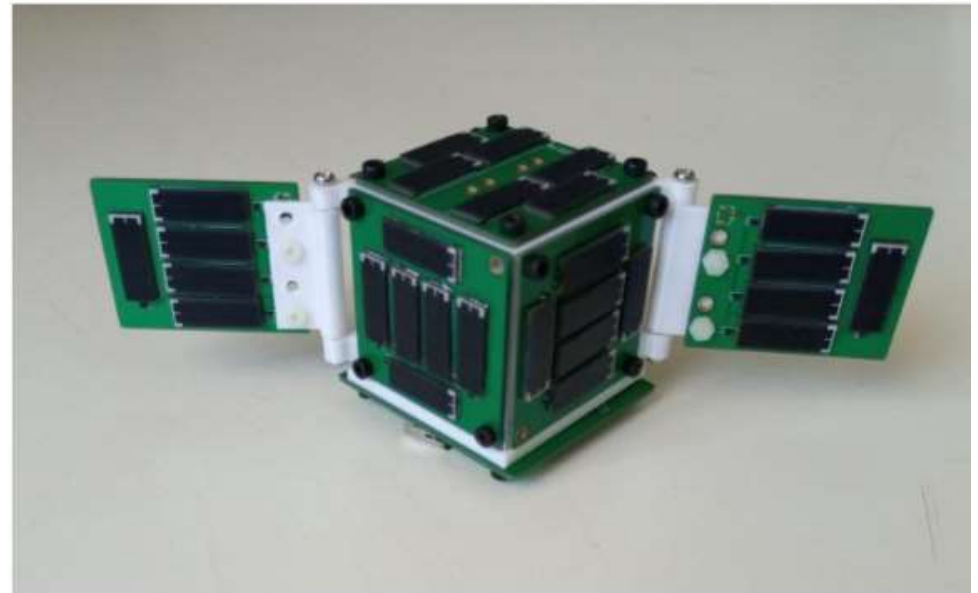
Poids : 0,6 Kg

Contrôle d'attitude : Stabilisation passive avec aimants

Ordinateur de bord : STM32

Communication : SX1262T UHF/VHF (Band ISM/Amateur bande sénégal)

Puissance : Cellule solaire SM141K06L , 184 mW

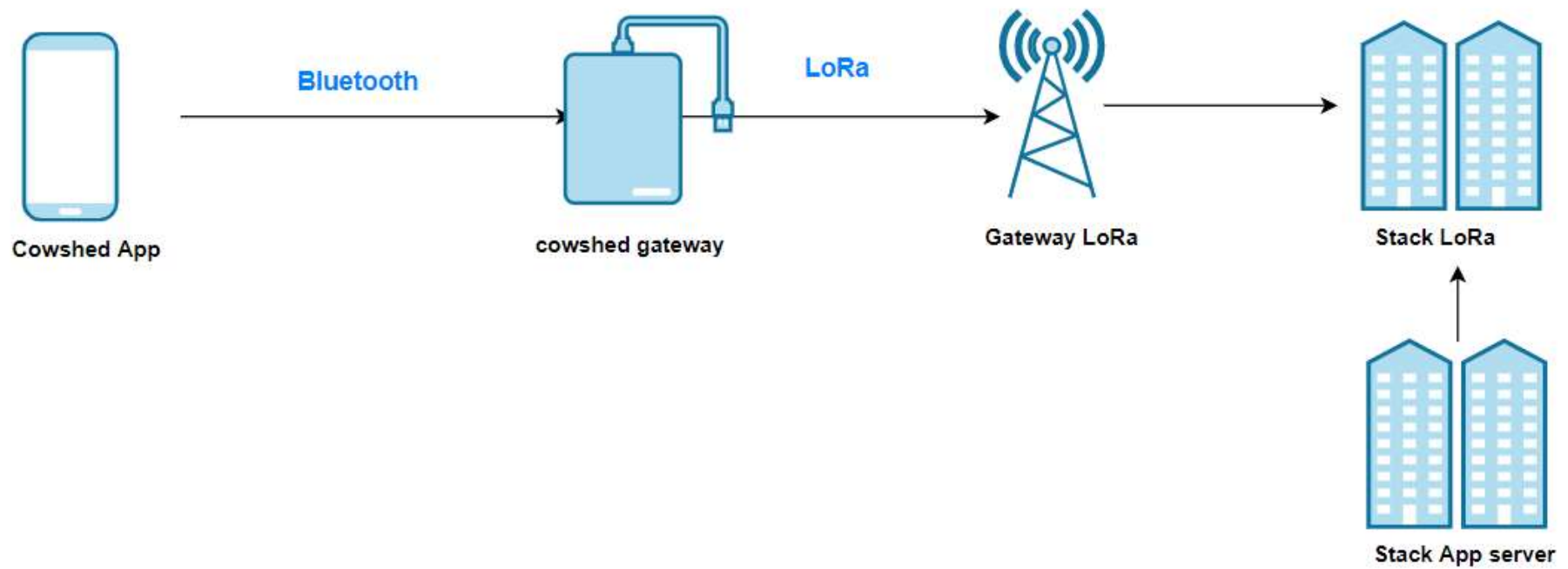


Modèle d'ingénierie de Teranga Sat 1 - Avril 2021 - Dakar

IoT et élevage intelligente : le projet cowshed



Comment ça marche ?



CONCLUSION



MERCI DE VOTRE ATTENTION

Questions ?