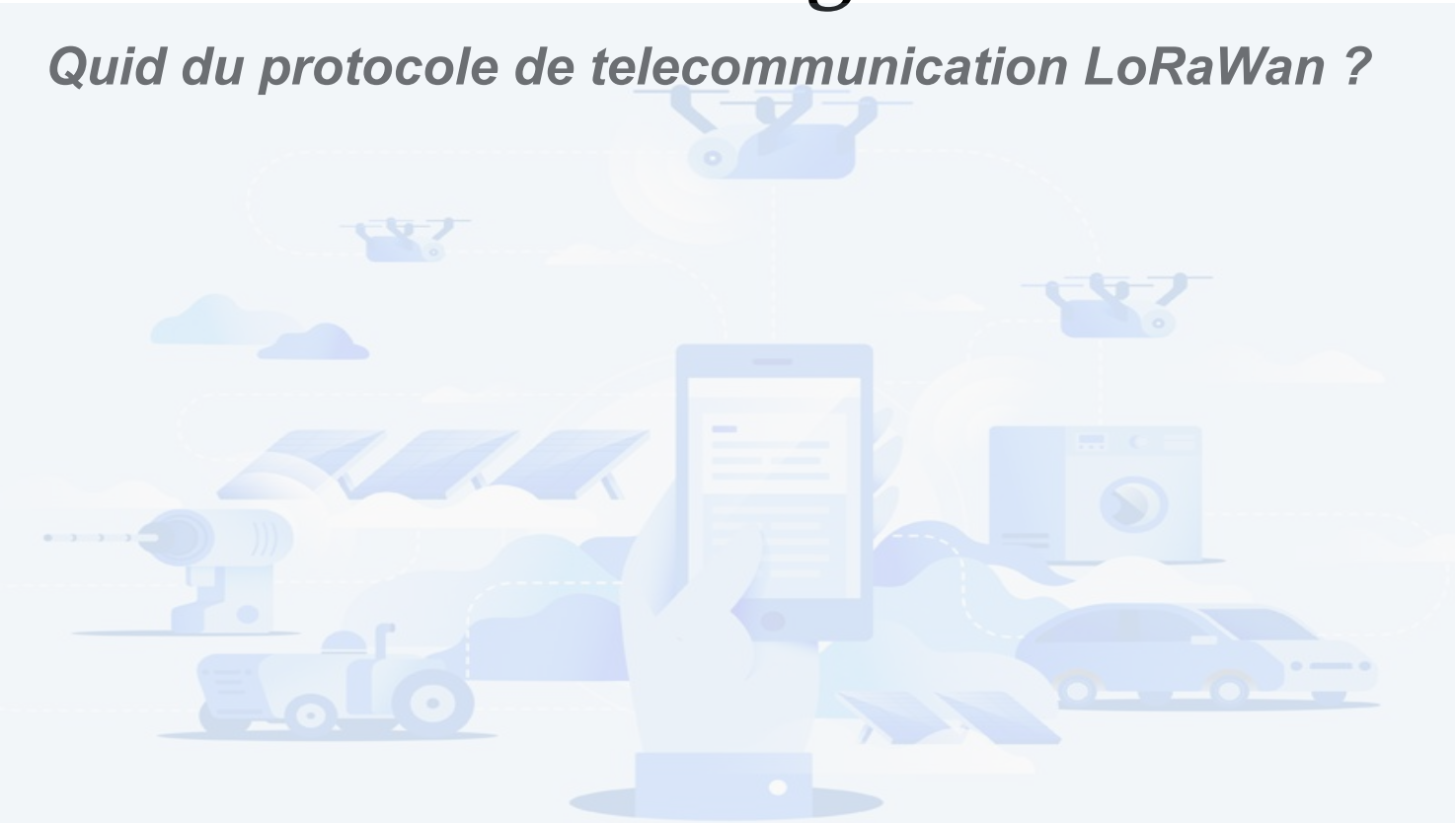
Corneliu
Gaina
15 / 01 / 18
Lovelace III

The Watch #4

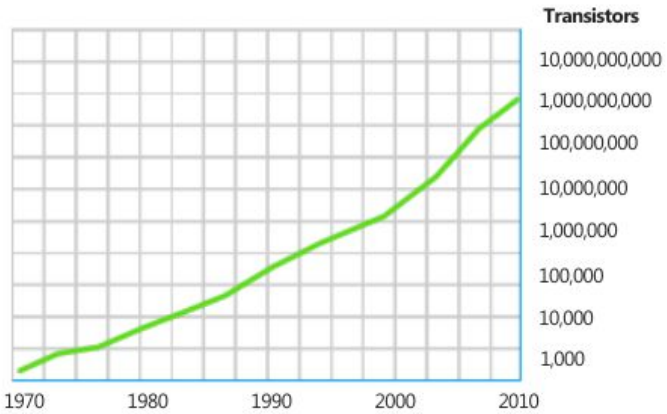
IoT : Internet of things

Quid du protocole de telecommunication LoRaWan ?

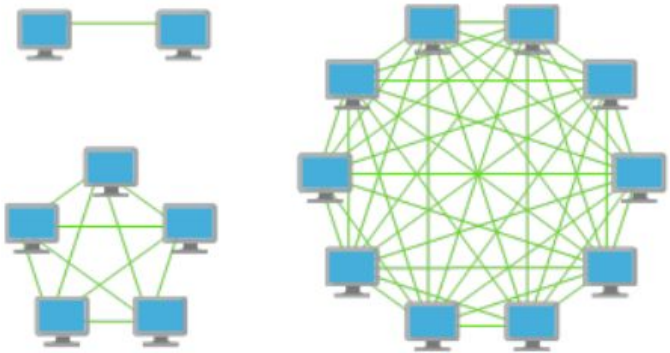


1.1 Qu'est ce qui a permis l'internet des objets ?

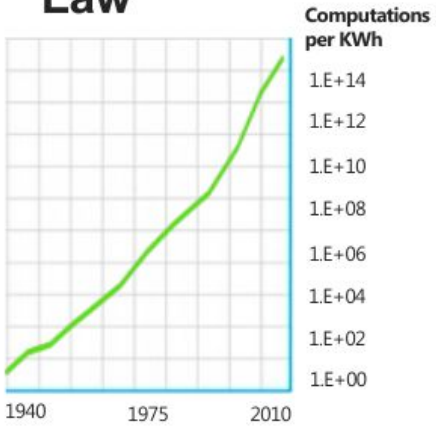
Moore's Law



Metcalf's Law



Koomey's Law



Miniaturisation = doublement du nombre des transistors dans les circuits tous les 18 mois.

(actuellement ~7nm)
(x10 entre 2015 et 2020)

Effet de reseau = l'utilité d'un réseau est proportionnelle au carré du nombre de ses utilisateurs.

Efficience au kWh = le nombre de calculs par joule d'énergie dépensé double tous les 18 mois environ (<-> Loi de Moore).

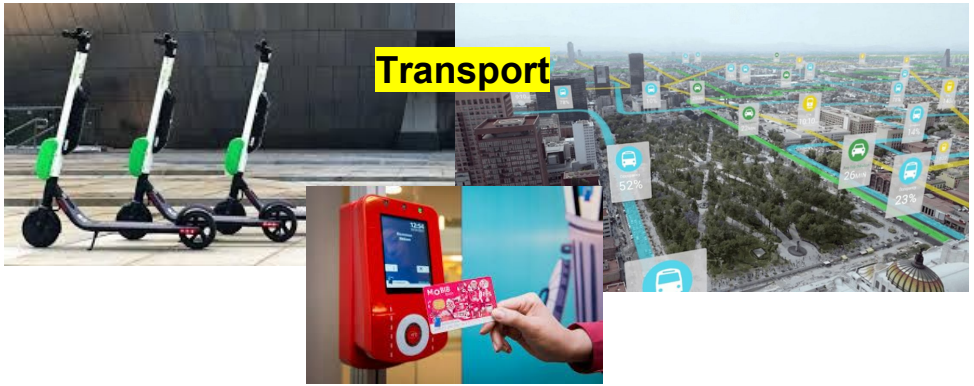
1.2 Exemples d’applications IoT

Enceinte => API Web

Wearables / Sante

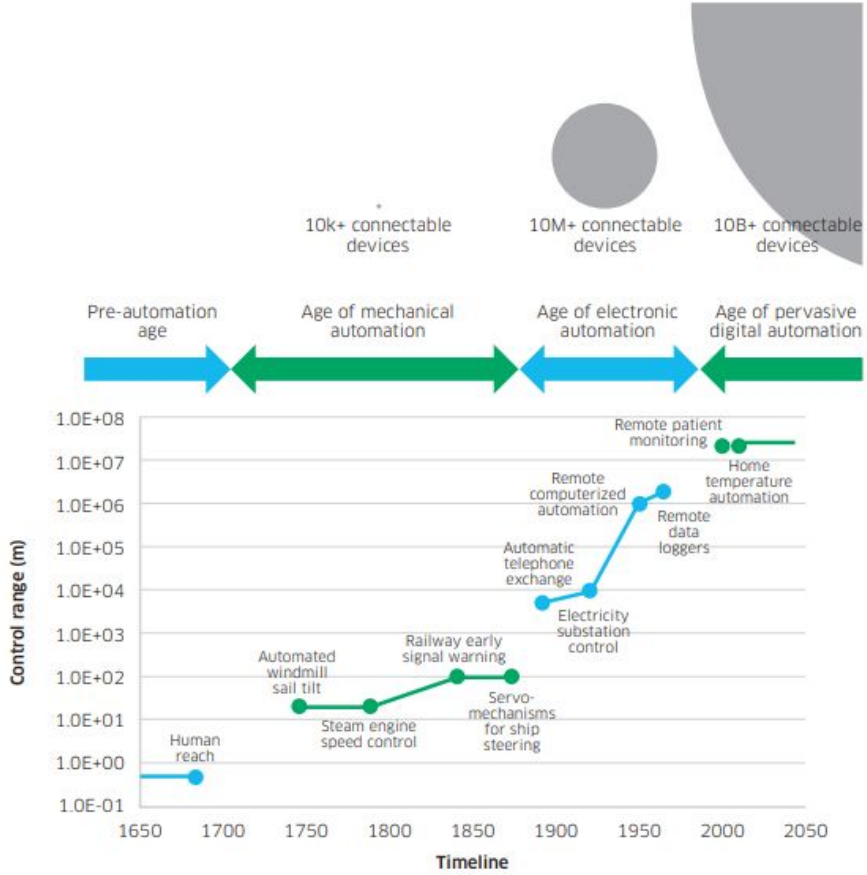
Thermostat

Domotique/Alarme



Transport

1.3.1 Ecosysteme IoT (1) : explosion avec l'automation



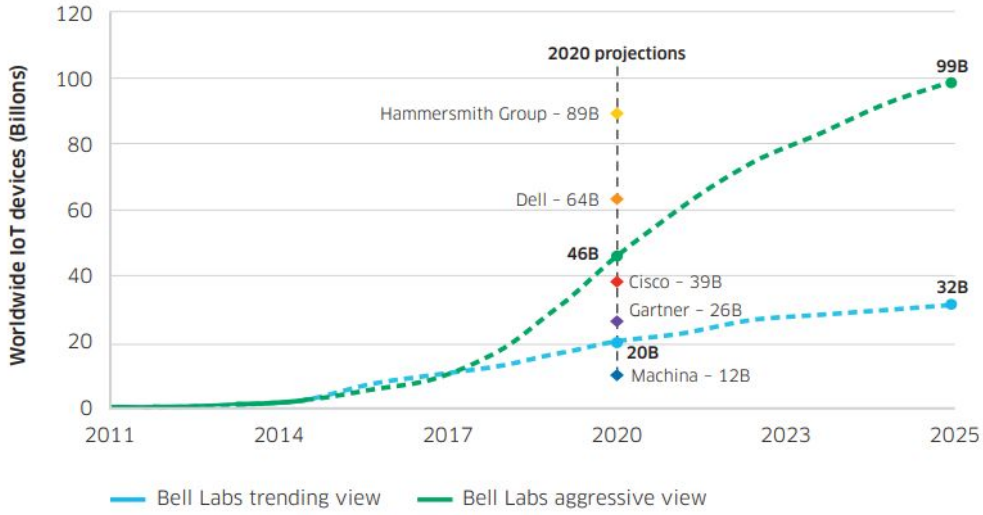
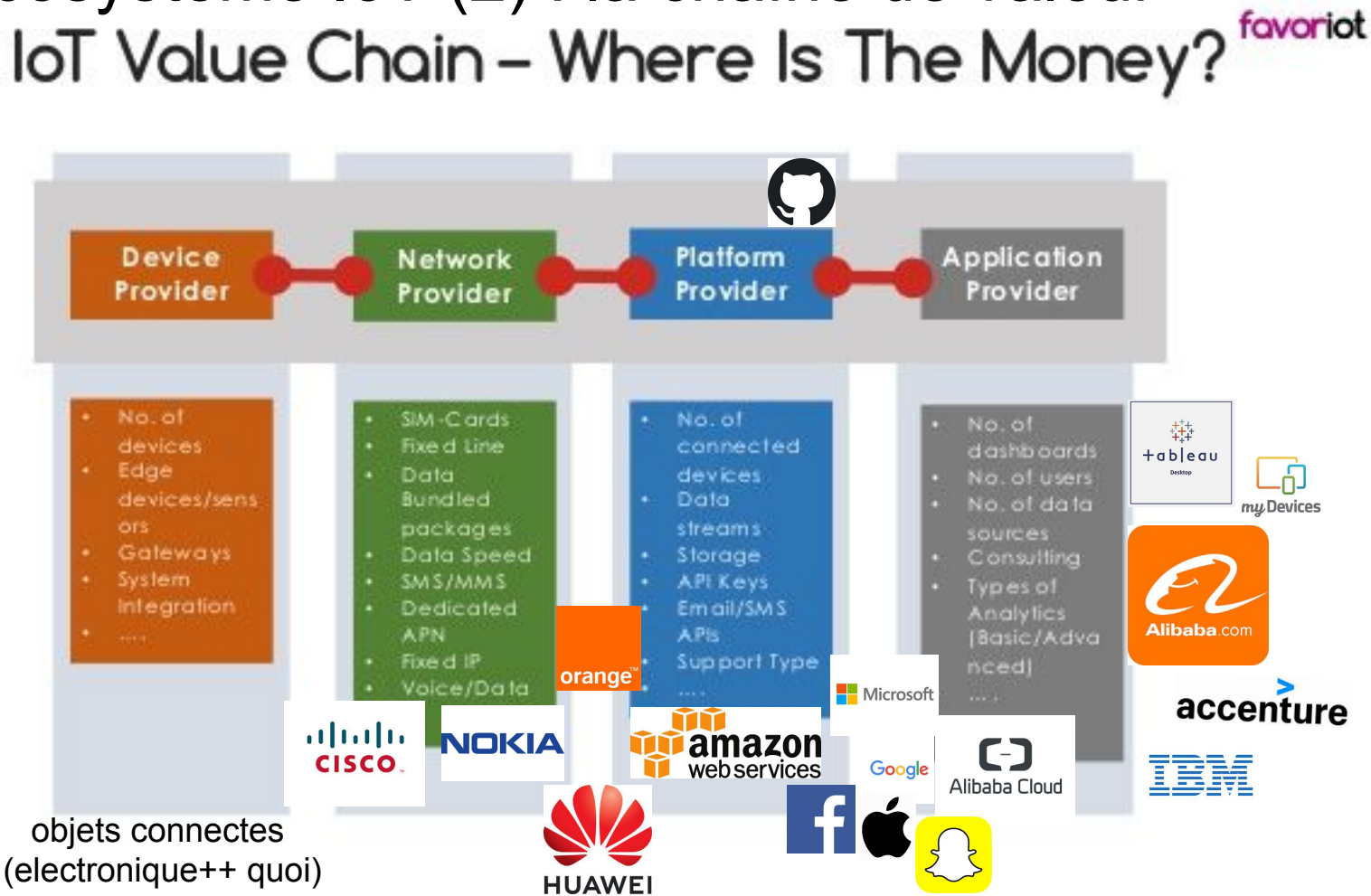


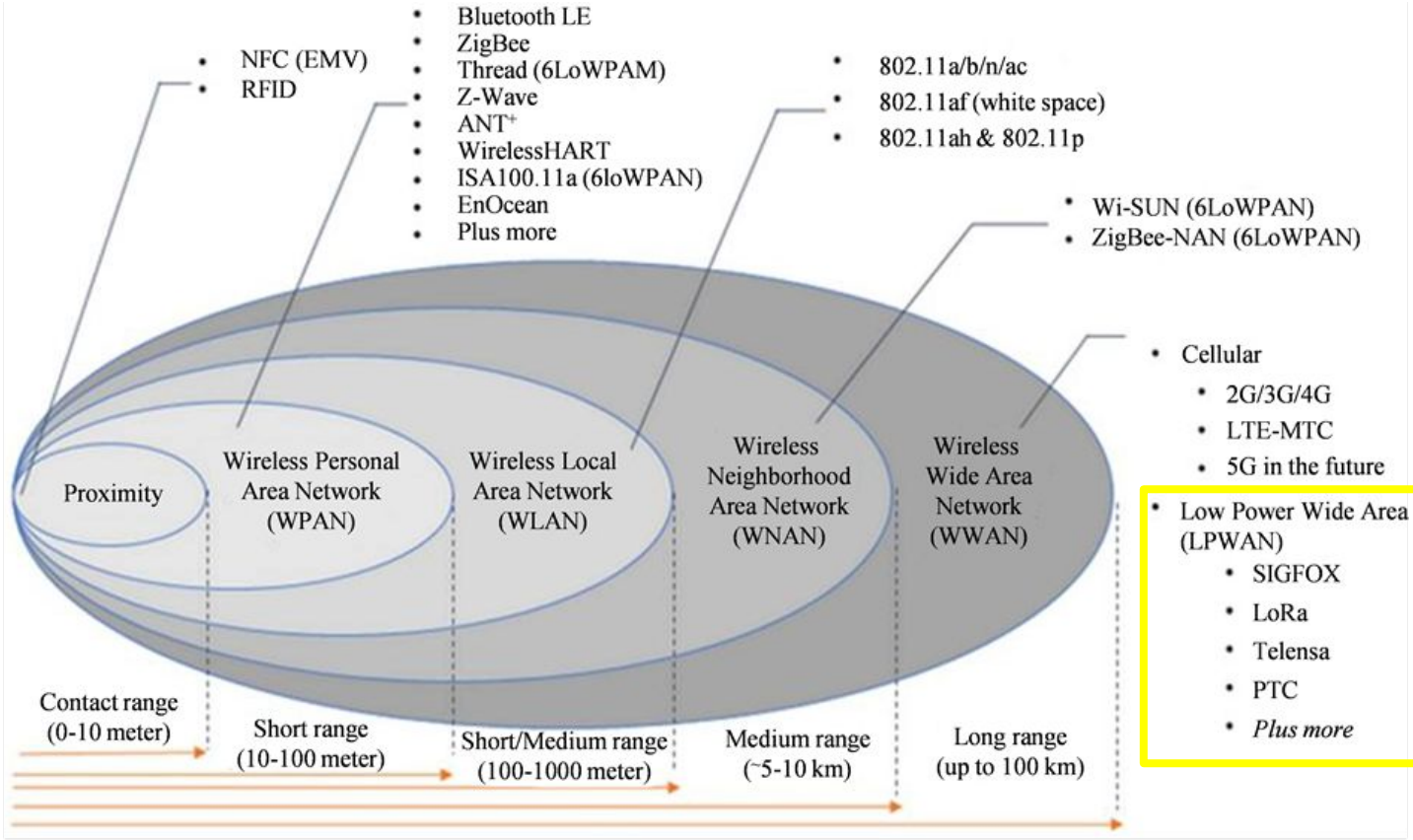
FIGURE 1: Depiction of four ages of automation, illustrating the reach of control over time (bottom) and the increase in the global number of connectable devices (top)

1.3.2 Ecosysteme IoT (2) : la chaîne de valeur



objets connectes (electronique++ quoi)

1.4 Les réseaux de communication sans fil



1.5 Haut debit vs. Bas debit

Haut debit :	Bas debit = technologies LPWAN :
• **3G / 4G LTE / 5G future**	• **Nb-IoT** (<=> 4G, licenced spectrum) • **Sigfox** (techno proprietaire/licensed) • **LoRaWan** (unlicenced spectrum)
Avantages: Haut debit (1-20/Mbit/s 4G & >1Gbit/s) Portee moyenne.	Avantages: Longue portee (3km conditions urbaines/ +15 km plein air) Longue batterie (5-10 ans / node) Low cost (<7$ / node)
Inconvenients: Energivore et cher pour deployement.	Inconvenients: Debit de <50ko/s.

Google Trends Comparer

Connexion

LoRaWAN
Sujet

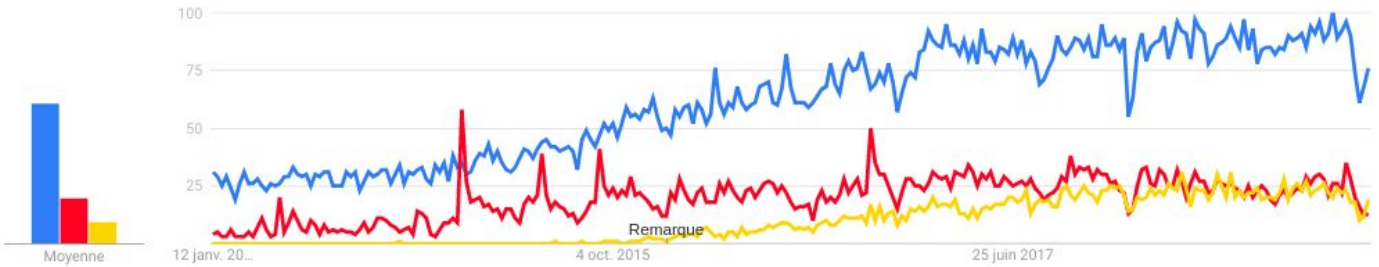
Sigfox
Sujet

Narrowband IoT
Sujet

+ Ajouter une comparaison

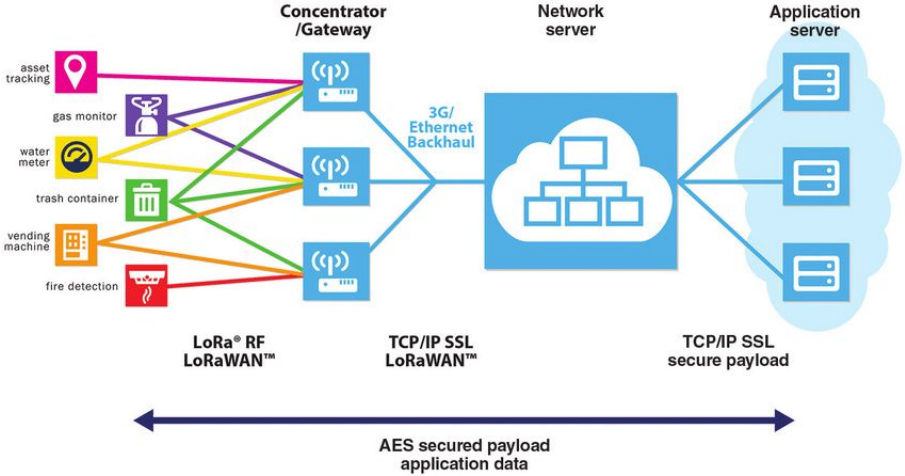
Dans tous les pays | Cinq dernières années | Toutes catégories | Recherche sur le Web

Évolution de l'intérêt pour cette recherche

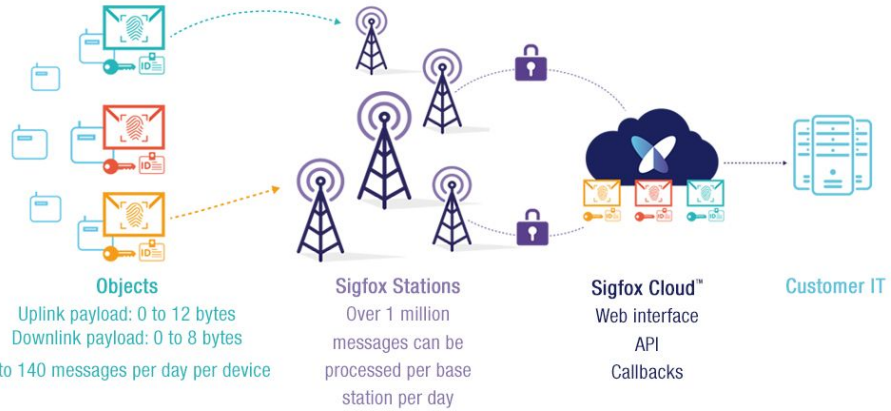


1.6 **L**ow **P**ower **W**ide **A**rea **N**etwork : LPWAN

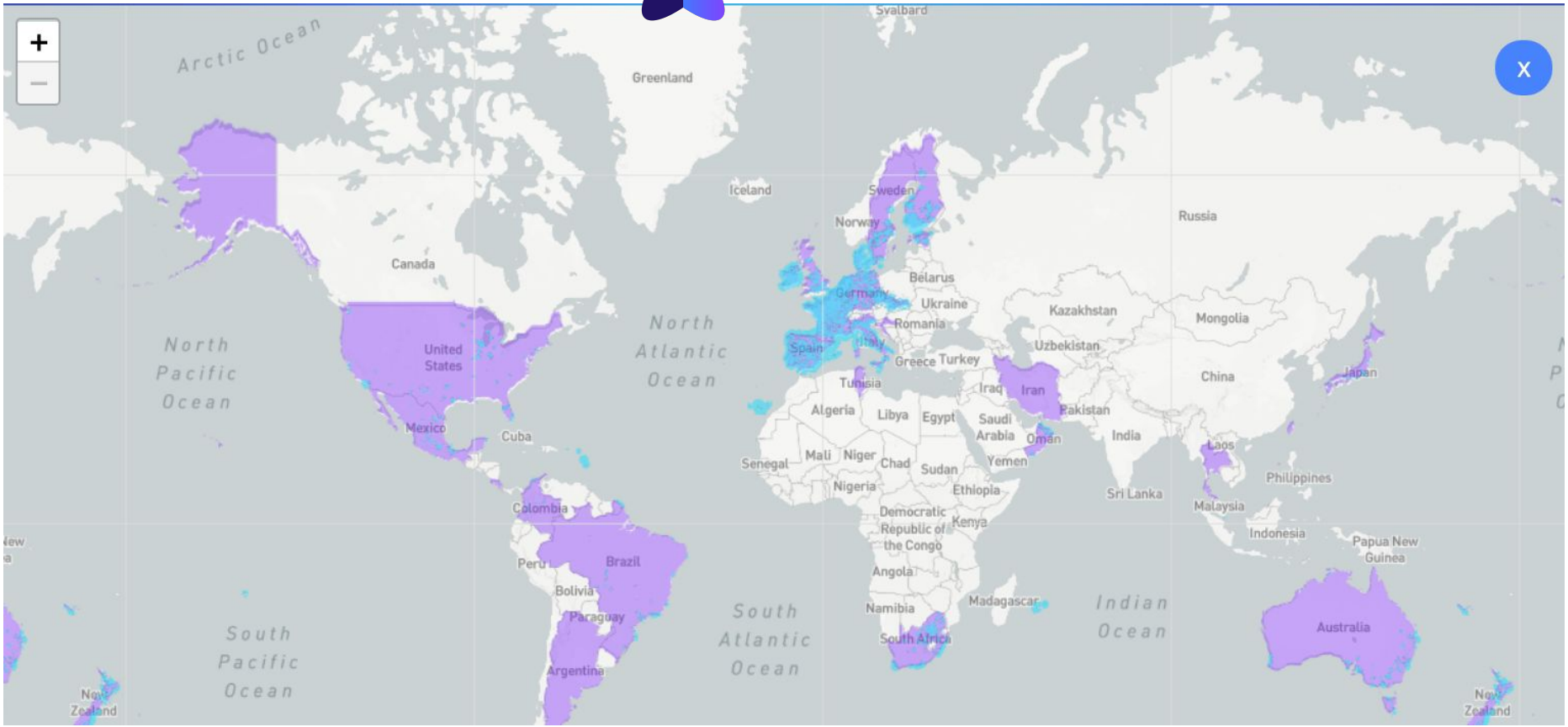
SEMTECH LoRa™ Cyklеo



sigfox



sigfox


Arctic Ocean
Svalbard
Greenland
Iceland
Sweden
Norway
Russia
Canada
Belarus
Germany
Ukraine
Kazakhstan
Mongolia
Romania
Uzbekistan
North Pacific Ocean
North Atlantic Ocean
United States
Spain
Italy
Greece
Turkey
China
Japan
Tunisia
Iraq
Iran
Pakistan
Algeria
Libya
Egypt
Saudi Arabia
Oman
India
Mexico
Cuba
Mali
Niger
Chad
Sudan
Yemen
Laos
Philippines
Senegal
Nigeria
Ethiopia
Sri Lanka
Malaysia
Colombia
Democratic Republic of the Congo
Kenya
Indonesia
Papua New Guinea
Peru
Brazil
Angola
Bolivia
Namibia
Madagascar
Indian Ocean
Paraguay
South Africa
Australia
South Pacific Ocean
South Atlantic Ocean
Argentina
New Zealand
New Zealand

LoRaWAN™ NETWORKS

LoRa Alliance™
Wide Area Networks for IoT

Alliance Member Public Networks
Other LoRaWAN Deployment

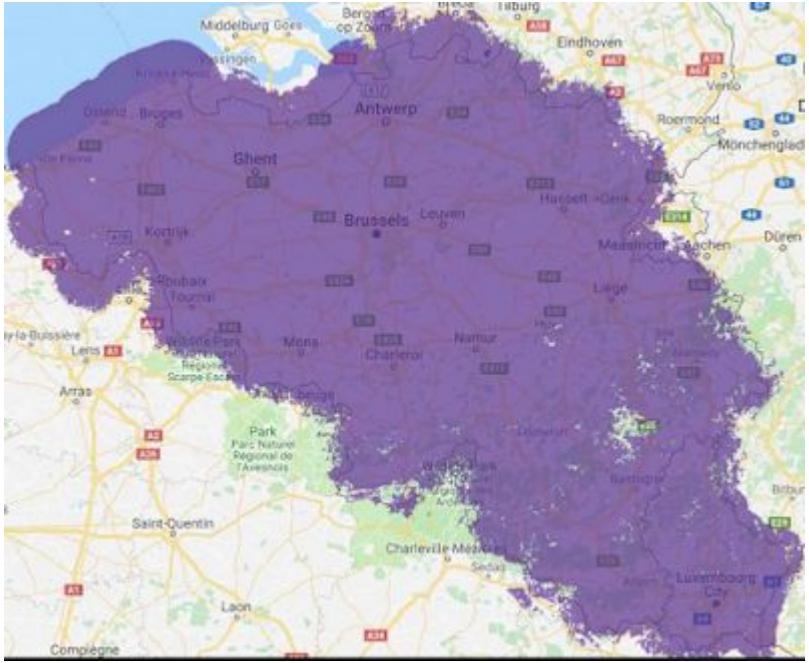
83
Network Operators

56
Alliance Member Operators

Operating in **49** Countries

~100 Countries With LoRaWAN Deployments

May 2018



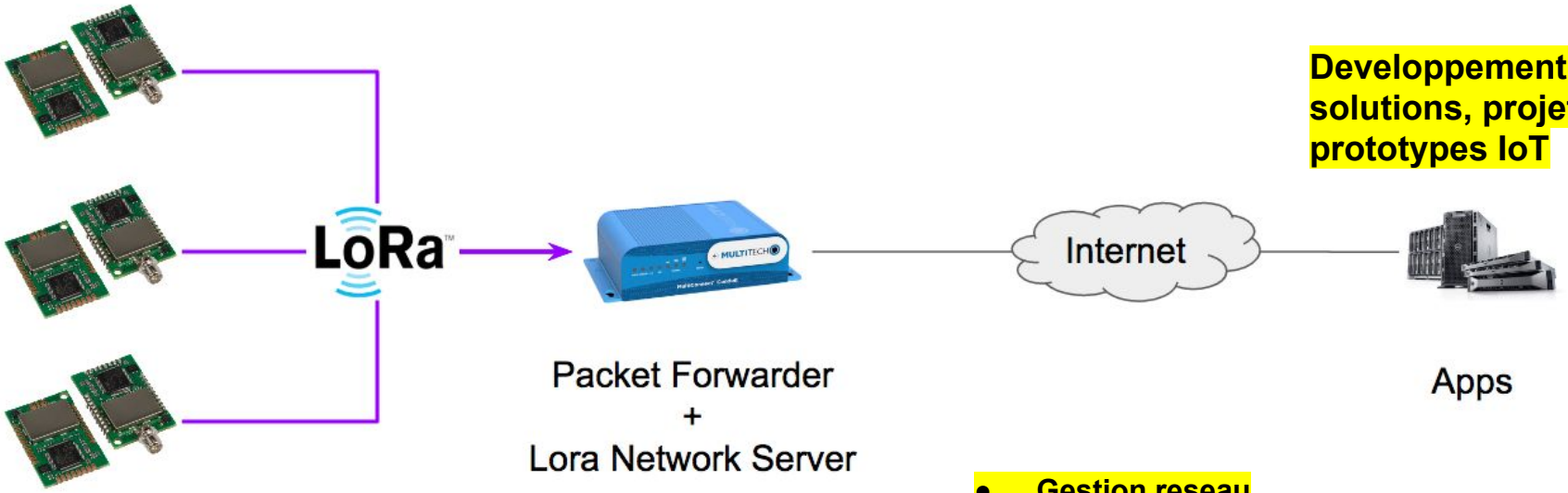
Couverture LoRa® Orange

2.1 Focus LoRaWan : origine et deployement

Feature	LoRaWAN	Narrow-Band	LTE Cat-1 2016 (Rel12)	LTE Cat-M 2018 (Rel13)	NB-LTE 2019(Rel13+)
Modulation	SS Chirp	UNB / GFSK/BPSK	OFDMA	OFDMA	OFDMA
Rx bandwidth	500 - 125 KHz	100 Hz	20 MHz	20 - 1.4 MHz	200 KHz
Data Rate	290bps - 50Kbps	100 bit/sec 12 / 8 bytes Max	10 Mbit/sec	200kbps – 1Mbps	~20K bit/sec
Max. # Msgs/day	Unlimited	UL: 140 msgs/day	Unlimited	Unlimited	Unlimited
Max Output Power	20 dBm	20 dBm	23 - 46 dBm	23/30 dBm	20 dBm
Link Budget	154 dB	151 dB	130 dB+	146 dB	150 dB
Batery lifetime - 2000mAh	105 months	90 months		18 months	
Power Efficiency	Very High	Very High	Low	Medium	Med high
Interference immunity	Very high	Low	Medium	Medium	Low
Coexistence	Yes	No	Yes	Yes	No
Security	Yes	No	Yes	Yes	Yes
Mobility / localization	Yes	Limited mobility, No loc	Mobility	Mobility	Limited Mobility No Loc

2.2 LoRaWan : architecture de deployment

Single Conduit acting as Packet FW + Lora Server

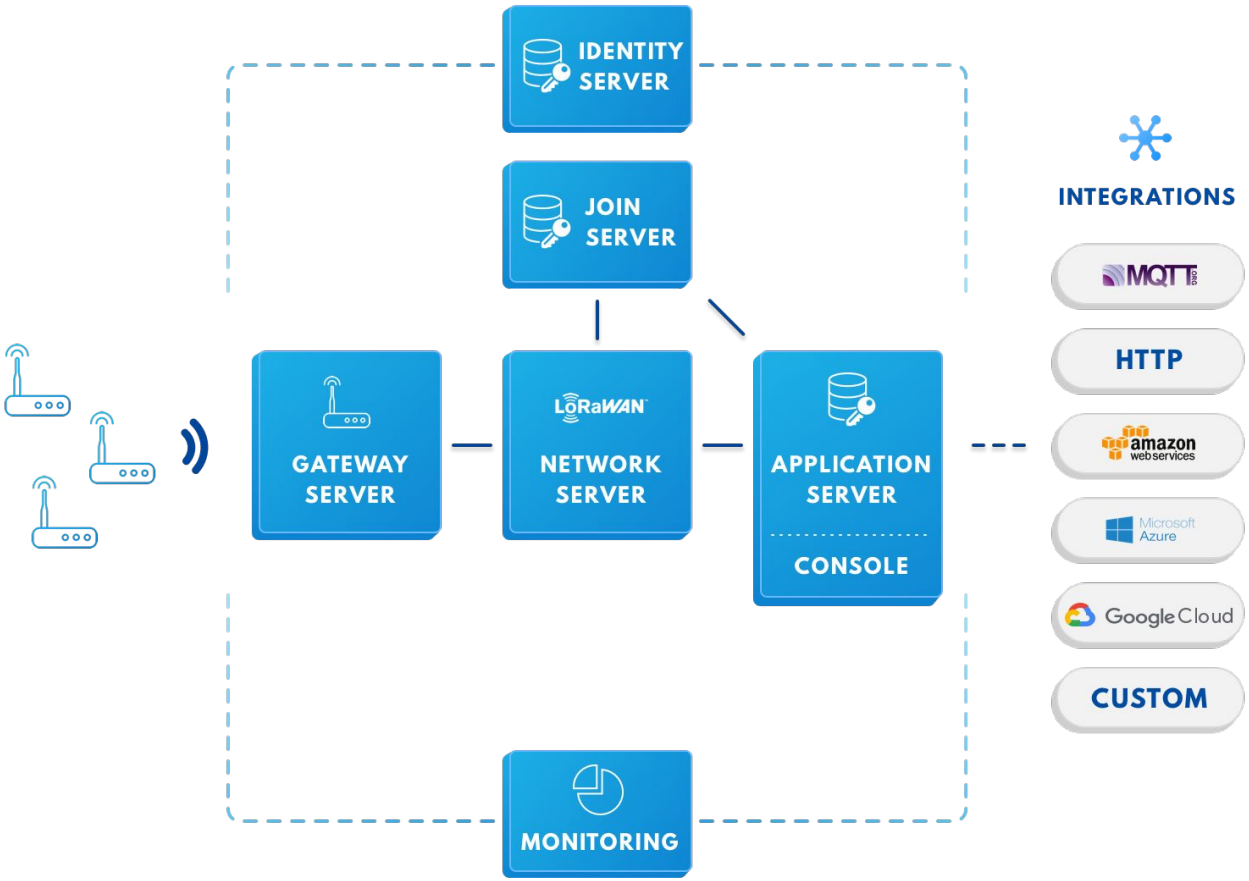


Developpement des solutions, projets et prototypes IoT

Transmet les data recoltees

Sert de relais du node vers le serveur réseau base dans le cloud

- **Gestion reseau**
- **Filtrage des paquets redondants**
- **Check de securite**
- **Ajustement des vitesses de transmission**



Documentation & setup:
LoRa Server application

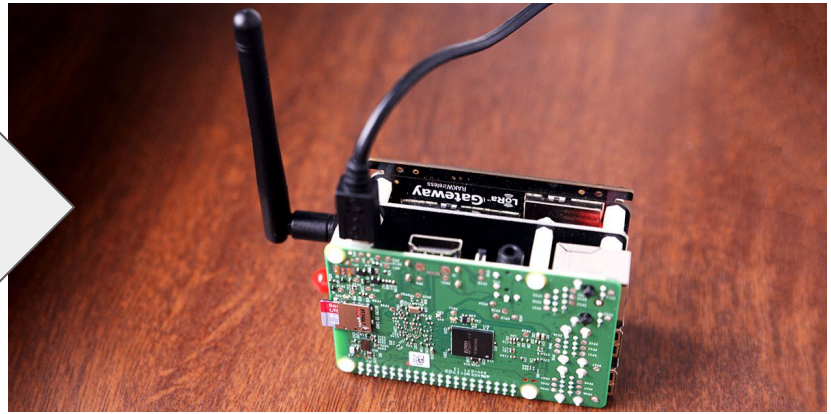
- Envoi/Reception des donnees du serveur via le protocole MQTT (Message Queuing Telemetry Transport) ou HTTP.

Integration custom & open-source dans les projets (client-serveur) :

- gRPC API (code client peut être généré dans tous les langages: Java, Go, PHP, Node.js, Python...)
- RESfful JSON API (Javascript Object Notation)

2.3.1 Prototyper un projet LoRaWan (1)

Abonnement à un opérateur (Proximus, Orange, tiers) ou bricolage *Do It Yourself*.



2.3.2 Prototyper un projet LoRaWan (2)

Irrigation vignes

Tracker GPS

Temperature, Humidite, Lumiere, CO2 and presence (mouvement).

Moisissure (humidite + temperature)

Parking sensor

Opinion

Mesure d'eau

Mesure qualite d'air (NO2, CO, NO)

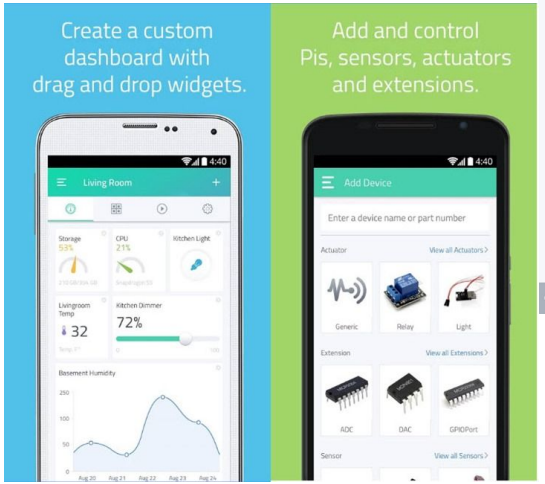
Mesure courant electrique

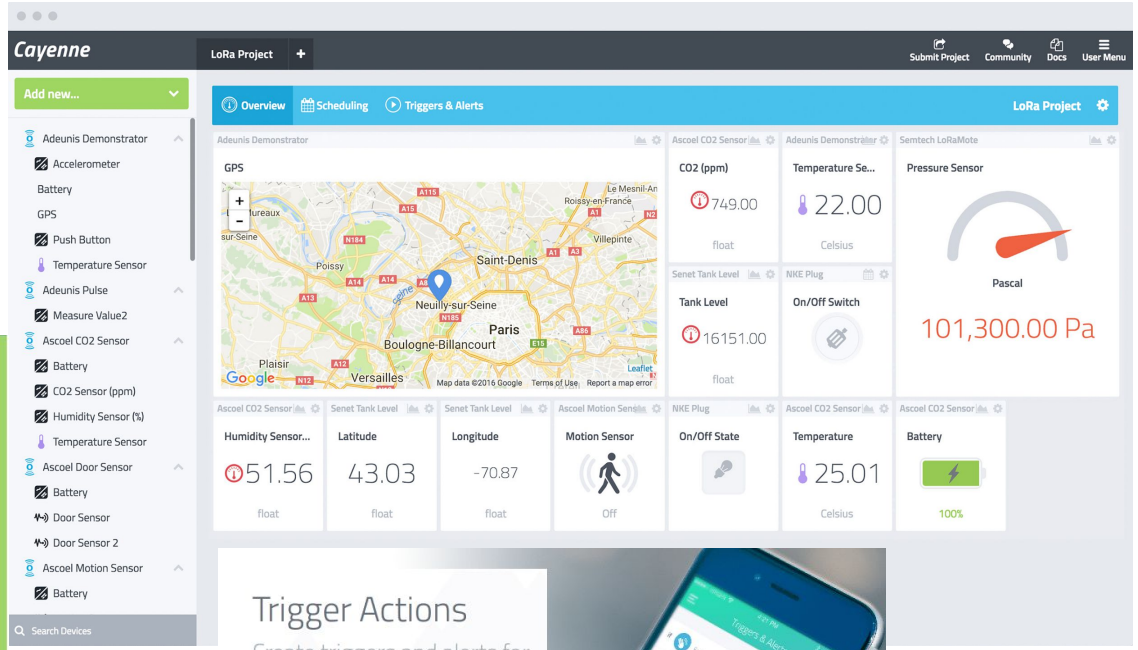
Differents sensors/objets, differentes gammes et standards industriels (3-300$).

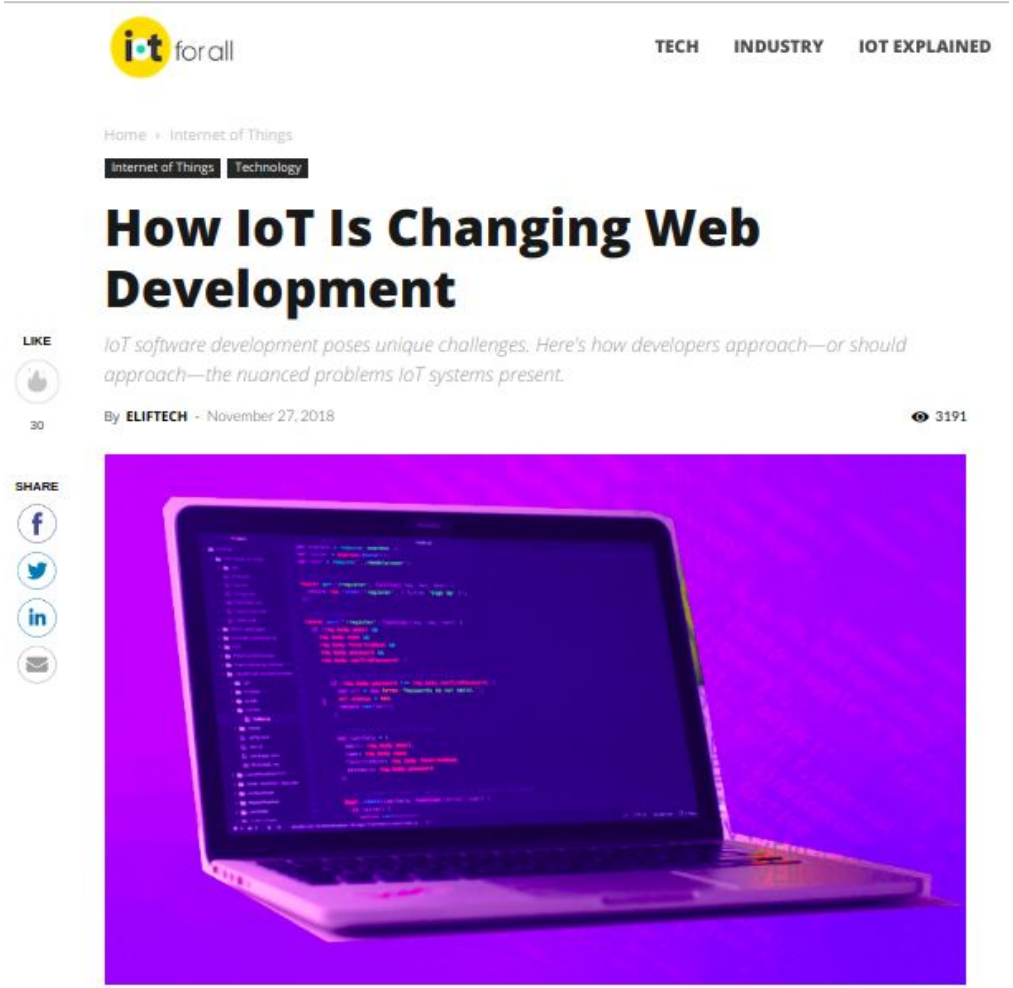
2.4 LoRaWan : quel codage / plateforme ?

ARDUINO

JS







Quid pour nous ?

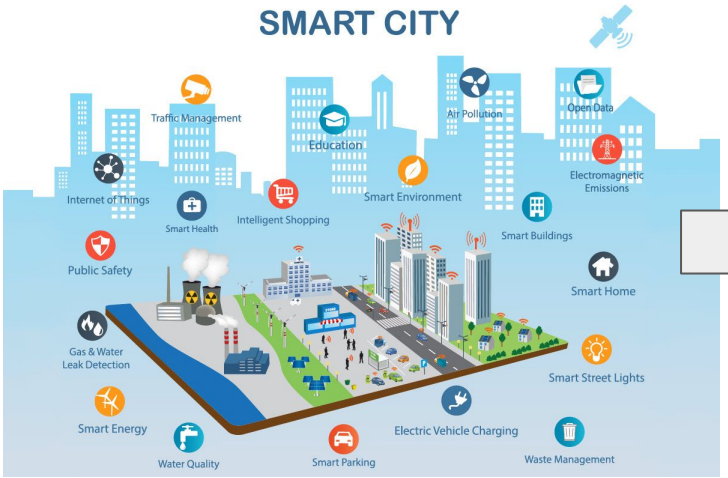
1. La collecte de beaucoup de datas, donc assurer la *scability* et *reliability*.

   -> **Javascript**: programmation de scripts et oriente objet, pour le web (95% des sites web).

2. Certaines programmations matérielles se font via le framework Node.js

(Python : programmation objet et datascientist)
(Java sur la programmation objet et logiciel)
(Javascript utilise pour le developpement web)

Pistes de reflexion sur l'IoT …



Le Big Data ?

L'Intelligence Artificielle ?

Innovation environnementale et sociale ?

Sources

- Pages wiki dans liens cliquables.
- A technical overview of LoRa® and LoRaWAN™, 2015, LoRa Alliance.
- Documentation LoRa Server: https://www.loraserver.io/
- LoRaWan Security : Full End-to-End encryption for IoT Applications providers
- Prototypes et tutoriels : www.hackster.io

  Petit resume:
  https://www.objetconnecte.com/tout-savoir-reseau-lora-bouygues/