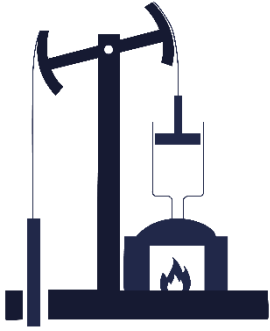


Orange Educational Program

Iasi - April 2019



What is it about in our times?



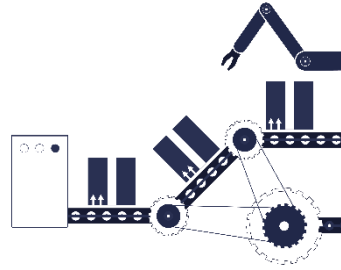
Industry 1.0
18th Century

Mechanical
Production.
Equipment
powered by
steam and water.



Industry 2.0
19th Century

Mass production
assembly, lines
require labor and
electrical energy.



Industry 3.0
20th Century

Automated
production using
electronics and IT



Industry 4.0
Today

Intelligent
Production
incorporated with
IoT, cloud
technology and
big data

The journey from data to Wisdom



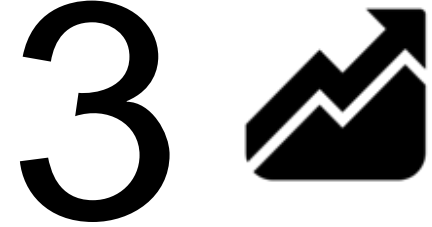
Collect the Information

Transform information into Data and transmit them in cloud



Share the data

Store Data into a flexible manner and make it available for applications and users



Analyse

Understand the patterns, make correlations and decide

The journey from data to Wisdom



Collect the Information

Transform information into Data and transmit them in cloud



Share the data

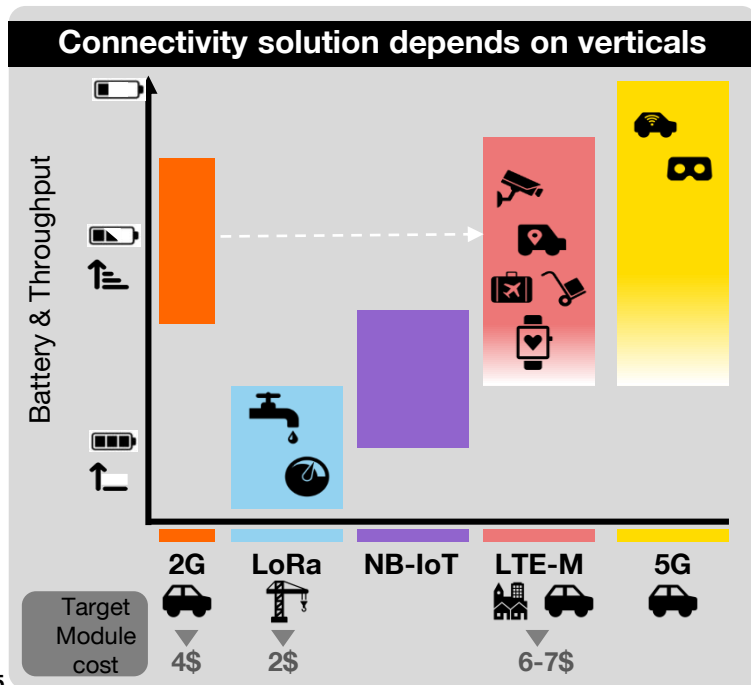
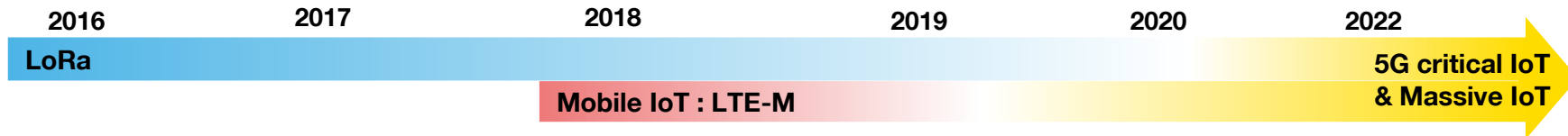
Store Data into a flexible manner and make it available for applications and users



Analyse

Understand the patterns, make correlations and decide

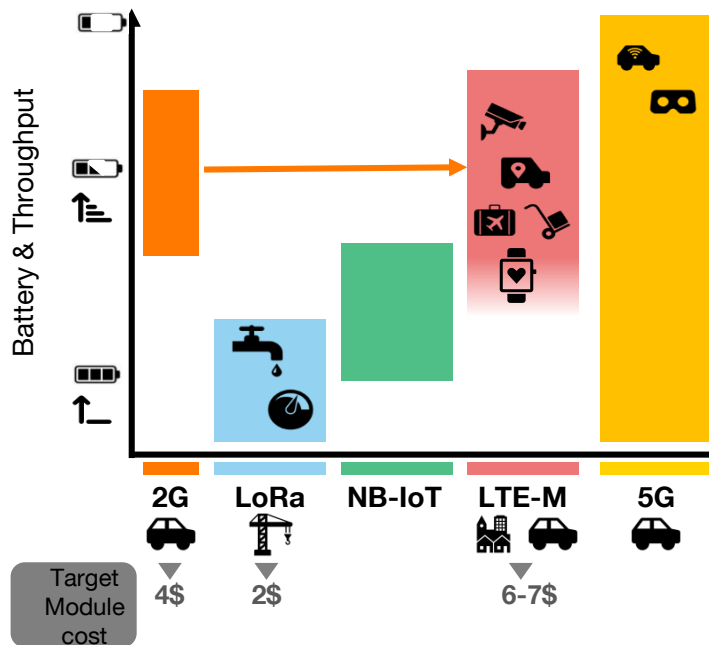
Current Orange Connectivity strategy



2022 Key Challenges

- Increasing deals requiring **multi-country connectivity** for car OEM (work in progress, lead group strat)
- Get ready to **manage objects integrating eSim** in **b2c** & promote them through **multisim offers**
- Some verticals rely on **on-premise connectivity or gateways** → **difficult** to address for MNO (vs integrators)
- will allow to **cover new use cases, but not before 2022 +** when affordable devices and full national coverage will be available

LTE-M: the most versatile connectivity for IoT (1/2)



- LPWA connectivity with 3GPP added features QoS / Real Time / VoLTE
- Futureproof replacement of 2G for M2M use cases
- Complementary to LoRa, which can be deployed anywhere on demand in specific & limited areas

➤ LTE-M is growing worldwide : NA (AT&T, Verizon, Bell), Asia (KDDI, China Mobile, SK Tel) and Europe (KPN, Telefonica, T-Mobile, ..)

LTE-M: the most versatile connectivity for IoT (2/2)

With some **unique** advanced features



3GPP based

Benefits from 4G : **roaming native**

Ex. : Worldwide tracking
Fleet management



Security

Support SIM and later eSIM security

Ex. : Health services
Wearables



Latency

From **110 ms** in normal coverage mode to > 10 s

Ex. : Smart Industry
Smart Grid



Datarate

Uplink 375 kbps (Max)
Dowlink 300 kbps (Max)

Ex. : Smart Home (**video**)



Protocols

IP, SMS, **VoLTE**

Ex. : Wearables
Smart Lift



Summary



Range (vs legacy 2G)	Good (+3dB)	Good (+4dB) with macro-diversity	Very good (+6/10dB (measured) to +16dB)	Very good (+12dB (measured) to +20dB)
Datarate Size of messages	100bps 12 bytes	From 250bps to 5,4 kbps From 50 to 250 bytes	DL : < 220kb/s UL : < 330kb/s No limit	DL : < 21kb/s UL : < 14kb/s No limit
Latency			Normal Cov =110ms	Normal Cov =1s
Mobility	Low (20 km/h)	Medium Speed (80 km/h)	Now: Idle Mode 2019: Connected Mode Speed (300 km/h)	Idle Mode
Battery Water metering case	<14 years	<20 years	<7 years < 5 years (ext. mode)	< 10 years (estimation under test)
Protocol(s)	Non-IP (API from Networks Server)	Non-IP (API from Networks Server)	2018; IP, SMS 2019: VoLTE , Non IP mode (optional)	2018: IP, optional SMS, Later: Non IP Mode
Security	Low	Low in 1.0 Medium in 1.1	Good (iso 4G)	Good (iso 4G)
Module price	2018: 2-4\$	2018: 3-5\$	2018: 8-12 \$	2018: 7-11 \$
Ecosystem maturity	Maturing	Maturing	Starting	Starting
Worldwide deployment (H1 18)	35 players in 44 countries	68 players in more than 44 countries	34 players in 32 countries	58 players in 47 countries

Range

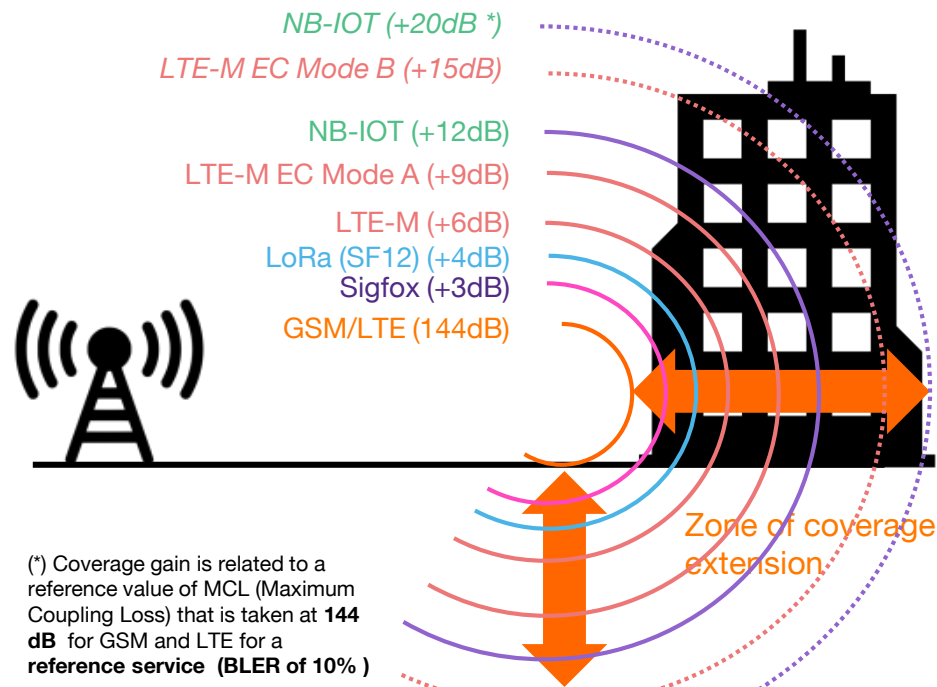
LPWAs extend coverage vs **legacy GSM/LTE** to better penetrate buildings and ground

Range is estimated and measured in dB

1 concrete wall = 10 to 15 dB of penetration loss

Measured

Estimated / target



(*) Coverage gain is related to a reference value of MCL (Maximum Coupling Loss) that is taken at **144 dB** for GSM and LTE for a reference service (BLER of 10%)

All LPWA technologies use **low frequency band** (Sigfox+LoRa ISM 868MHz, NB-IOT+LTE-M 800MHz (GSM 900MHz)).

On all LPWA technologies, range benefits from **repetition**

Passerelle	Ampère	Vigny	Mutualité	Pasteur	St Nizier	Meylan	Clair	Domène	Voreppe	Vif	St Egrève	Marianette	Croiles	PER global
Capteur														
80000171	39,3%	28,2%	8,5%	40,1%	6,4%	72,9%	34,2%	69,3%	81,9%	53,9%	8,5%	11,1%	92,4%	1,3%
80000171	27,8%	3,5%	0,4%	0,8%	0,4%	39,3%	6,5%	29,3%	84,2%	27,2%	6,1%	15,8%	88,8%	0%

% after 3 repetitions are better than **without repetition** [2015 LoRa tests]

- 3 systematic **repetitions** for Sigfox
- Adaptive **repetitions** for LoRa
- LTE-M target is to bring extra coverage by **repetition**
- NB-IOT target is to bring even extra coverage by introducing Narrow-band channel and **repetition**

In addition, Sigfox and LoRa benefit from **macro-diversity** = one message can be received by **several gateways**

	PER global	Ampère	Vigny	Mutualité	Pasteur	St Nizier	Meylan	Clair	Domène	Voreppe	Vif	St Egrève	Marianette	Croiles
80000171	1,3%	39,3%	28,2%	8,5%	40,1%	6,4%	72,9%	34,2%	69,3%	81,9%	53,9%	8,5%	11,1%	92,4%





Transmission global % is better than % of each gateway [2015 LoRa tests]

LoRa provides **adaptive rate/range** (based on Spreading Factor levels – SF7 to SF12)

PS : whatever range improvement, deep indoor coverage is a challenge. LoRa brings interesting on-demand facilities : **nano gateways** and **repeaters**.

Datarate and message size

When not fixed, datarate is decreasing with the radio condition

	 sigfox	 LoRaWAN	 LTE-M	 NB-IoT
Channel Bandwidth	100 Hz	125 kHz	1,08 MHz	180 KHz
Datarate Uplink	100 b/s	SF12: 250 b/s SF7: 5.4 kb/s	Max: 375 kb/s Field :286 kb/s Half Duplex	Max: 60 kb/s Field: 21kb/s Single Tone Half Duplex
Datarate Downlink	600 b/s	SF12: 250 b/s SF7: 5.4 kb/s	Max: 300 kb/s Field: 180 kb/s Half Duplex	Max : 30kb/s Field: 14kb/s Single Tone Half Duplex
Size of messages	UL: 12 bytes DL: 8 bytes	SF12: 59 bytes SF7: 250 bytes	No limit (IP Data) SMS:140 bytes	No limit (IP Data) SMS: 140 bytes
Constraint	Duty Cycle 0,1%, 1%, 10% depending on sub-channel	Duty Cycle 0,1%, 1%, 10% depending on sub-channel	N/A	N/A

Sigfox :

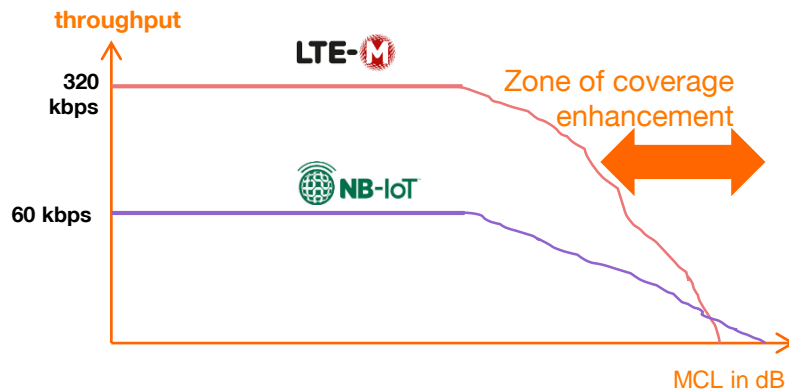
- Fixed data rate: 100 bps in EU (600 bps in US)
- Fixed messages size

LoRaWAN :

- Provides adaptive rate based on Spreading Factor levels – SF7 to SF12
- Size of message is limited by reasonable Time On Air (~1s), in order to avoid error transmission.

LTE-M and NB-IOT :

- Datarate depends on the RF link quality
- Coverage enhancement obtained thanks to repetitions reduces the throughput



Battery consumption

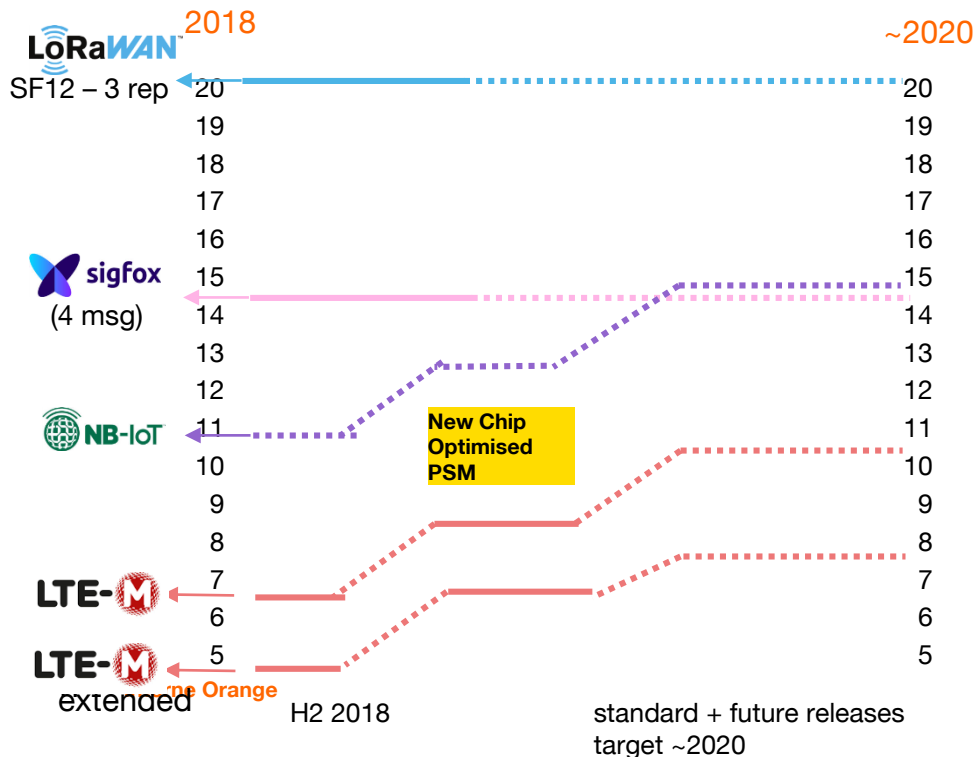
Whatever improvement, LoRa will best address very low consumption

Water Metering case : 2*50 bytes msg / day

2400 mAh battery

Measured

Estimated



Sigfox :

- Due to the fixe size of 12 bytes, 4 messages are needed to transmit 50 bytes

LoRaWAN :

- Battery consumption depends on the throughput (Spreading Factor) and number of repetition used.

Sigfox / LoRa : consumption may be decrease by future implementation of the technologies.

LTE-M : / NB-IoT

- Extended coverage has a significate impact (wake up and transmission periods)
- Consumption will be improved by :
 - Future chip generation (sleep mode optimization)
 - LTE-M network configuration (inactivity timer, C-DRX duration)

Latencies

Low consumption is deeply linked with latencies

Latencies are the time taken by packets to be processed by the network elements, when transmitted:

- One way uplink : from the device to the server,
- One way downlink : from the server to the device,
- Round trip : from the device to the network element, and back

LoRa :

- In Class A, the LoRa device is mainly in idle mode, and only able to receive command just after sending an uplink message.



uplink

Few seconds (repetition)

~1s (no repetition)
Few seconds (if repetition)

Not measured

Not measured

downlink

No info

Class A : link to UpLink msg period
Class B:

Not measured

Not measured

roundtrip

No info

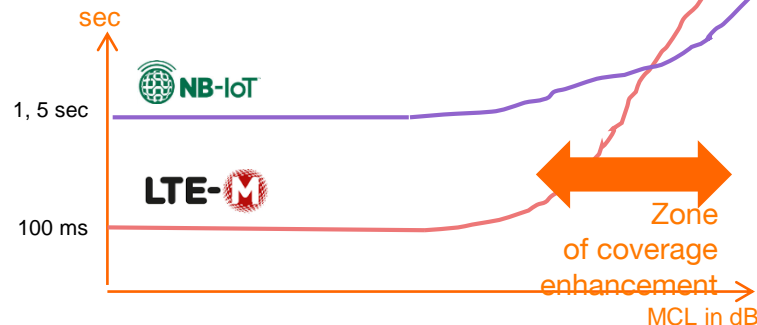
~1s (no repetition)
Few seconds (if repetition)

From 130ms to 12s

From 730ms to 29s





LTE-M and NB-IOT :

- Latency depends mainly on radio conditions
- Coverage enhancement



Security

LTE-M and NB-IOT benefit from 4G mechanisms

	 sigfox	 LoRaWAN	 LTE-M	 NB-IOT
Synthesis	Low	Low in 1.0 Medium in 1.1	Good (iso 4G)	Good (iso 4G)
Entity authentication	No. Only data acceptance based on root and non renewable key	Only root and non renewable key	Mutual authentication with USIM	Mutual authentication with USIM
Encryption	Not by default	Renewable and derived key	Yes (iso 4G)	Yes (iso 4G)
Integrity	Only root and non renewable key ?	Renewable and derived key	No on user plane (iso 4G)	No on user plane, Yes on sig plane (iso 4G)
Secure element	Not by default	Not by default	By default (UICC)	By default (UICC)
Replay	Simple counter on msg No info on authent	Simple counter on msg On authent, no anti-replay mechanism → attack may disconnect device (solved in 1.1)	Anti replay for any sig message (iso 4G)	Anti replay for any sig message (iso 4G)
Jamming	Very Difficult (at gateway)	Very difficult (at gateways)	Same as LTE: at device	Same as LTE (at device)

Synthesis :

- **Sigfox** : no detailed specifications seems available. A Sigfox network, though, is likely based on static/non renewable symmetric keys.
- **LoRaWAN** : (expert level to be conceived but then easily reproducible at low cost) attacks exist in V1.0, based on specification lacks. Partially solved in V1.1.
- **LTE-M** and **NB-IOT** : good level, based on 4G mechanisms

Authentication: in LoRaWAN, mutual authentication is based on a 32-bit MAC tag (AES-CMAC 128). In Sigfox, it seems that there is no proper authentication: entity authentication seems to rely upon data authenticity.





Encryption: in LoRaWAN AES-CCM 128. In Sigfox, not by default. If provided by application, it relies on an undefined algorithm based on AES, likely a stream cipher (AES in counter mode).

Integrity: in LoRaWAN 32-bit MAC tag (based on AES-CMAC 128). Sigfox: HMAC (?) with a 16 to 40-bit tag.

Secure Element : LTE-M and NB-IOT benefits from SIM card. Secure element can be added in LoRaWAN/Sigfox devices.

Jamming is easier for LTE-M/NB-IOT than in LoRaWAN/Sigfox, where no dialog is expected at device level
→ uplink jamming must be done at gateway(s): very difficult.

Protocol(s)

	 sigfox	 LoRaWAN™	 LTE-M	 NB-IoT
Protocol(s)	Non-IP only (API from Cloud Server)	Non-IP (API from Networks Server)	2018: IP over Userplane 2019 : Non IP mode (optional)	2018: IP over Userplane and control plane, Non IP Mode
SMS	NO	NO	YES	YES (Optional)
Voice	NO	NO	VoLTE from 2019	NO

Sigfox :

LoRaWAN : Support of IPv6 is being tested by Acklio

LTE-M and NB-IOT : compatible with existing LTE Data IP & SMS protocol

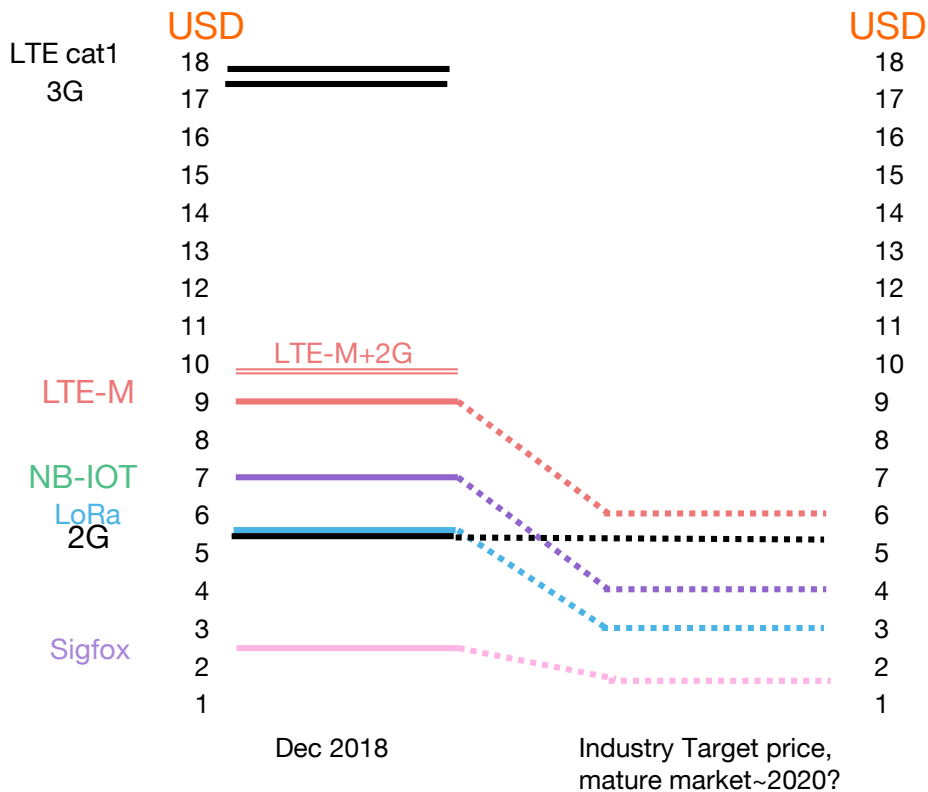
Device management protocol :

LoRaWAN : No standard protocol, LWM2M tested by Kerlink

LTE-M and NB-IOT : LWM2M / COAP recommended by GSMA as protocol for constrained device

Module prices

Decreasing with stable LoRa/Sigfox vs LTE-M/NB-IOT segmentation



Prices for ~100k pieces

With market maturity, all LPWA modules prices are expected to decrease but hierarchy shouldn't change

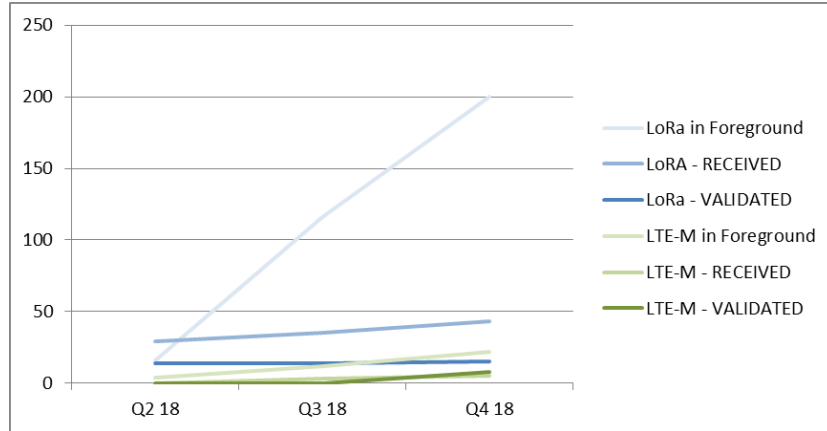
- LoRa and Sigfox target « ultra low cost » modules to keep differentiating [Sigfox and Semtech on Nano-tag]
- New Qualcomm 9205 chipset is expected to allow to decrease of 3\$ LTE-M and NB-IOT modules
- IPR has an influence :
Less expensive for NB-IOT than LTE-M
No IPR for 2G and Sigfox



Yet uncertainty remains regarding market traction and real gap between LTE-M and NB-IoT

➔ Monitored every 6 months

Ecosystem maturity : In a 18-24 months project time, LoRa/Sigfox ecosystem is now mature, LTE-M/NB-IOT still just starting



foreground.orange.com is an Orange referential of devices, accessible directly in write mode by manufacturers. Big increase in 2018 on LoRa devices is mainly due to late declaration.

Evolution of number of devices studied and tested by Orange OCP team :

- In Foreground : declared by manufacturers
- 1 - RECEIVED : received by COP team, through samples, for tests
- VALIDATED : validated, after all technical tests

Device manufacturers typology :

- Mainly same players adopting successive technologies
- Very fragmented, small local players but also major manufacturers positioning themselves on LTE-M

Even if LTE-M and NB-IOT device development will benefit from 2/3G (and LoRa/Sigfox) experience, maturity is start-date dependent.

LTE-M devices are at the end of 2018 :

- **Mainly Asset Tracking** (11/22 in Foreground) [Nimbelink, Sercomm, BeWhere]
- **Then for multi-usage but not packaged/optimized** (PCB, routers)
- **Few for Smart City** (Oring (Metering+), ConnectedCycle (Metering+), Dingtek (waste management))

The journey from data to Wisdom



Collect the Information

Transform information into Data and transmit them in cloud



Share the data

Store Data into a flexible manner and make it available for applications and users

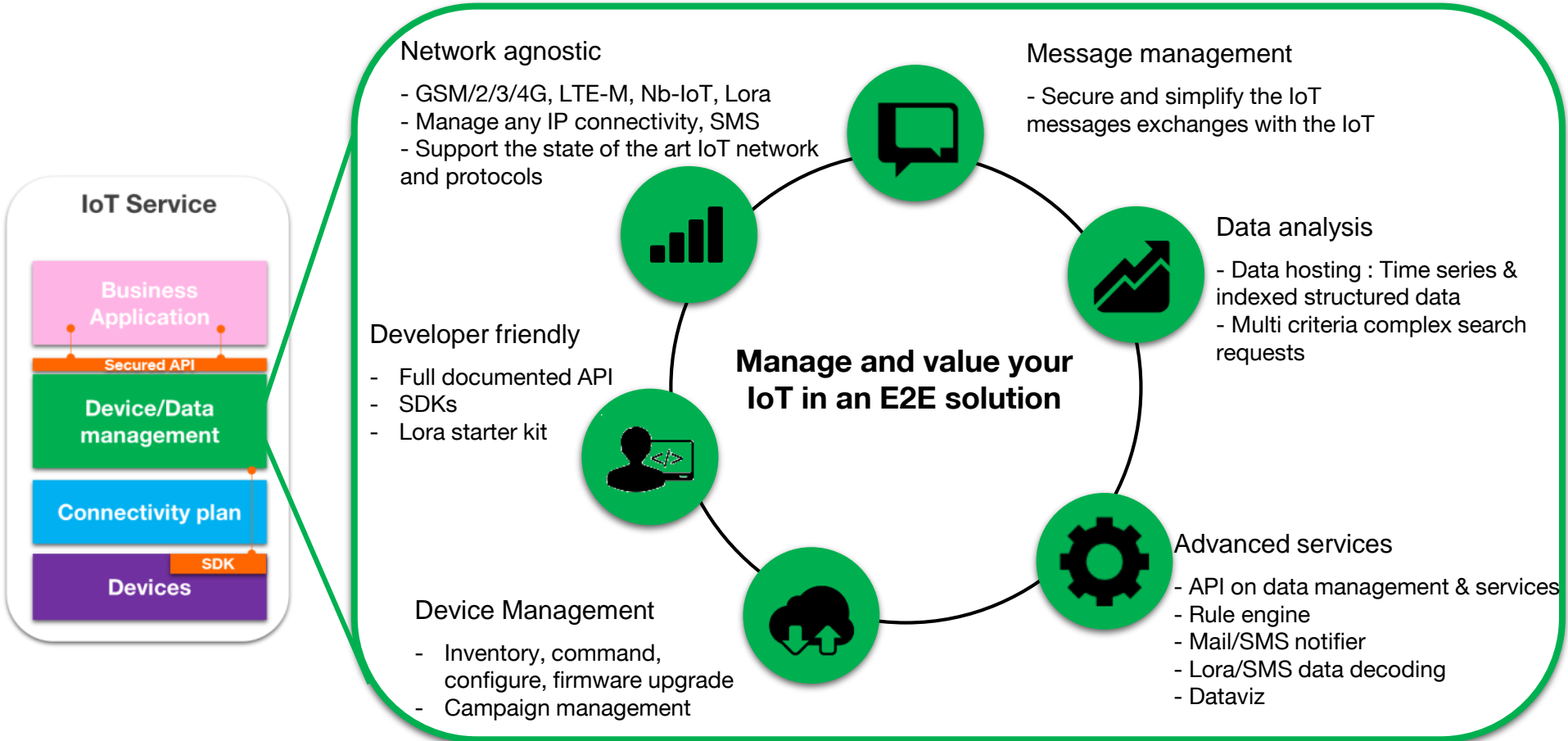


Analyse

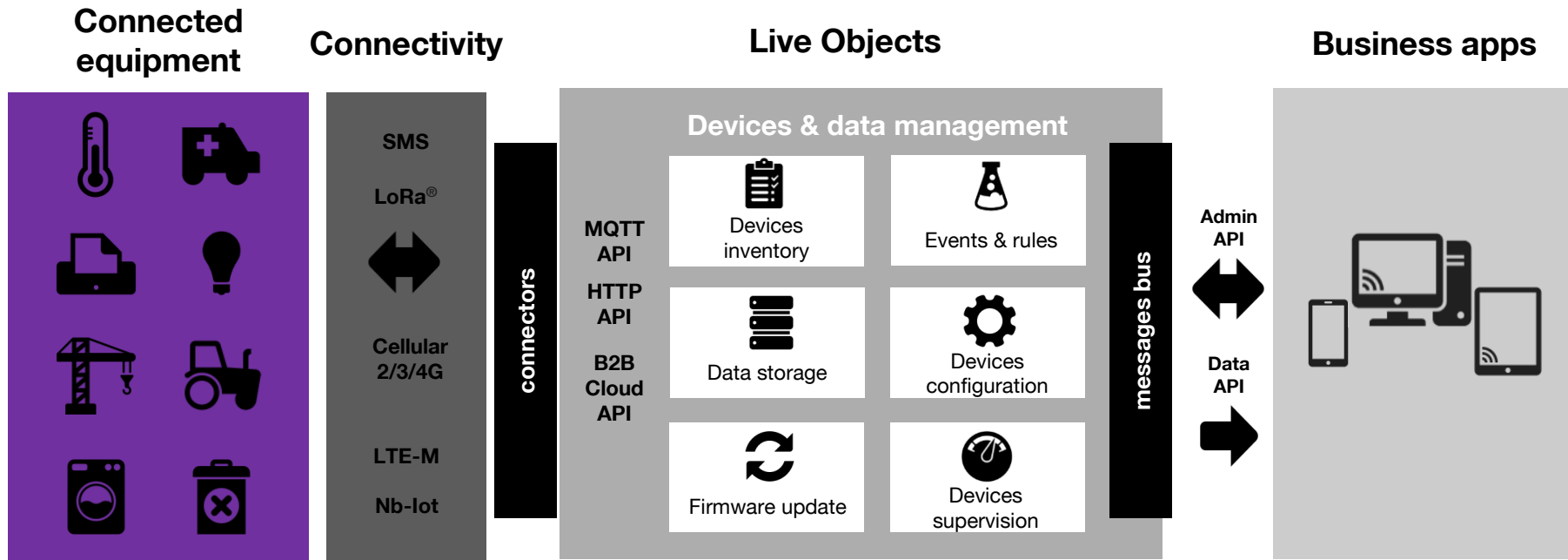
Understand the patterns, make correlations and decide

Live Objects in a nutshell

Where we are in value chain ?



with Live Objects



Live Objects assets



Simple

Rapidly integrate new devices.



Features

Covers the majors functions of IoT.

Open solution supporting market standards.



Scalable

Easy integration of new features.

Adaptable to increasing volumes.



Flexible

Adaptable to all project sizes.

Hosted in the cloud Orange or on your site.

Interoperability with other applications, APIs and web portals.



Security

Redundancy enhanced by database multiplication.

Secured by Orange.

No data loss.



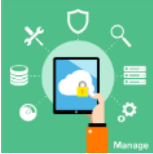
Expertise

Full management: platform and tools.

Technical expertise on all IoT components for an end-to-end support.



Manage connected devices & data processing



A secure, cloud-based and M2M protocols



Protocols/Gateways

Protocol:

- MQTT(s)
- REST/HTTPS
- SMS
- Lora
- NB-IoT, LTE-M



Message Management

Real time messages management

- delivery, filtering & routing :
 - Real-time messaging
 - FIFO (message persistence until delivery)
- Event Processing
- Raw data/messages API



Device Management

Manage device fleets

- Inventory
- Monitoring/status
- Configuration
- Firmware



Data Management

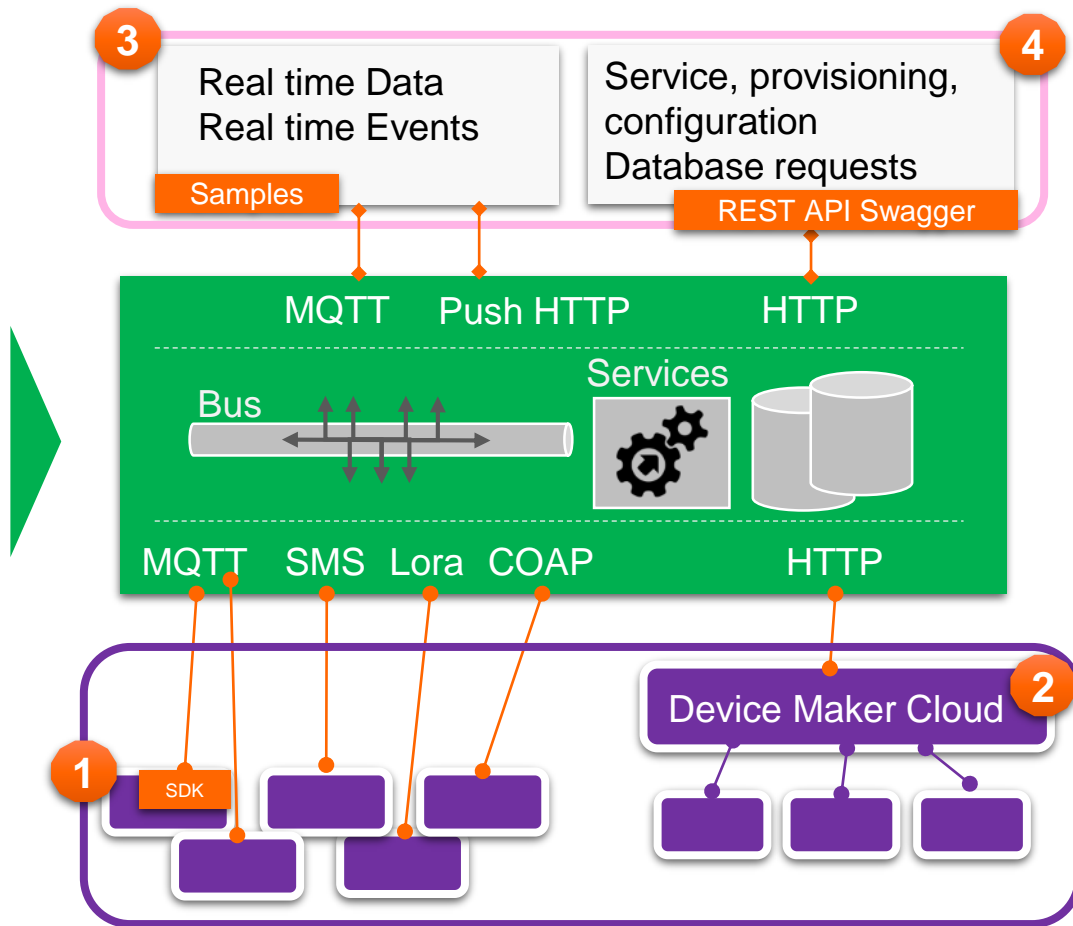
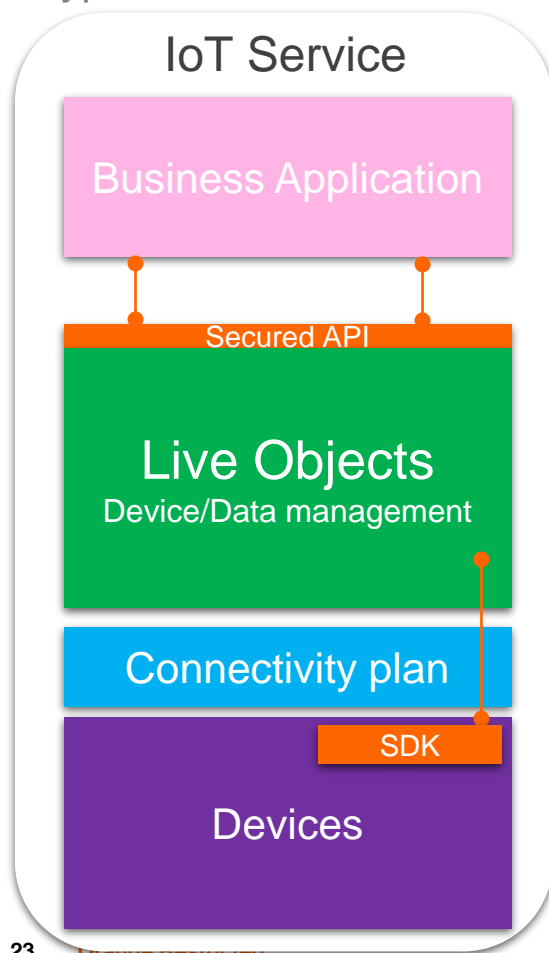
Store and manage Data

- 2 levels of storage
 - Time stamped
 - Indexed structured data
- complex search requests
- structured and advance API



Live Objects API

4 types of API to build end to end services

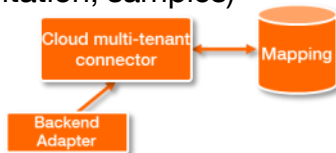


Open Cloud Framework for Device Makers



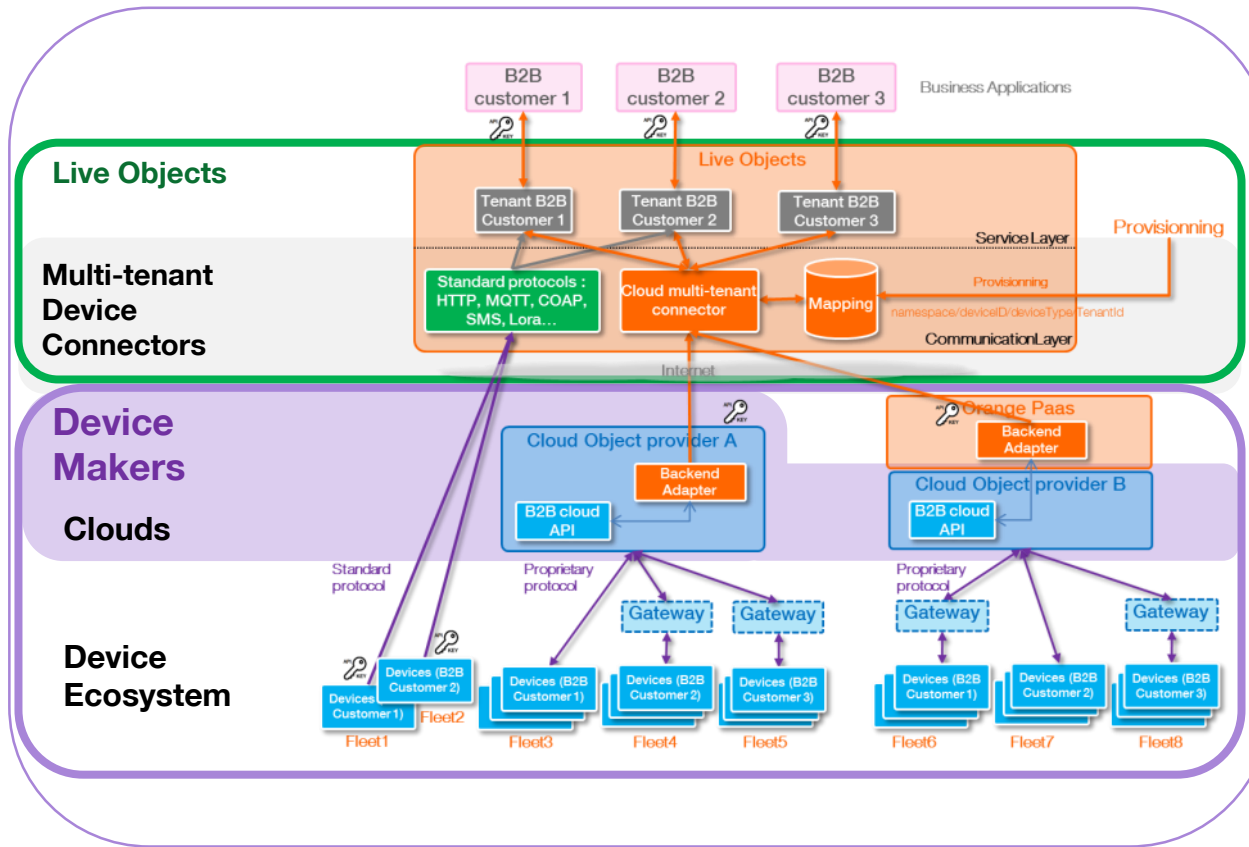
Connect the Device Makers Clouds

1 – Development and Promotion of an open Device Cloud Framework (documentation, samples)











Available for a 1st pilot

2 - Following Strategic/business opportunities : development of first backend adapters in 2018



Functional Overview & Value proposition

 Coming next/POC...

- 
Automotive
- 
Transport
- 
Industry
- 
Consumer electronics
- 
Retail
- 
Smart cities
- 
Smart home
- 
Healthcare

DEVICES

SDK / C Agents

Devices

Gateways

20
*Contract under negotiation

Functional Overview & Value proposition

 Coming next/POC...



Automotive



Transport



Industry



Consumer electronics



Retail



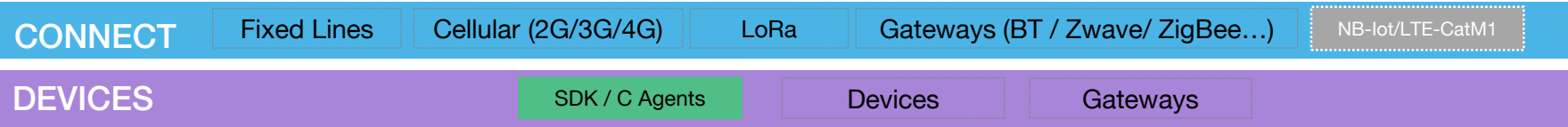
Smart cities



Smart home



Healthcare



20 Orange Restricted
*Contract under negotiation

Functional Overview & Value proposition

Coming next/POC...



Automotive



Transport



Industry



Consumer electronics



Retail



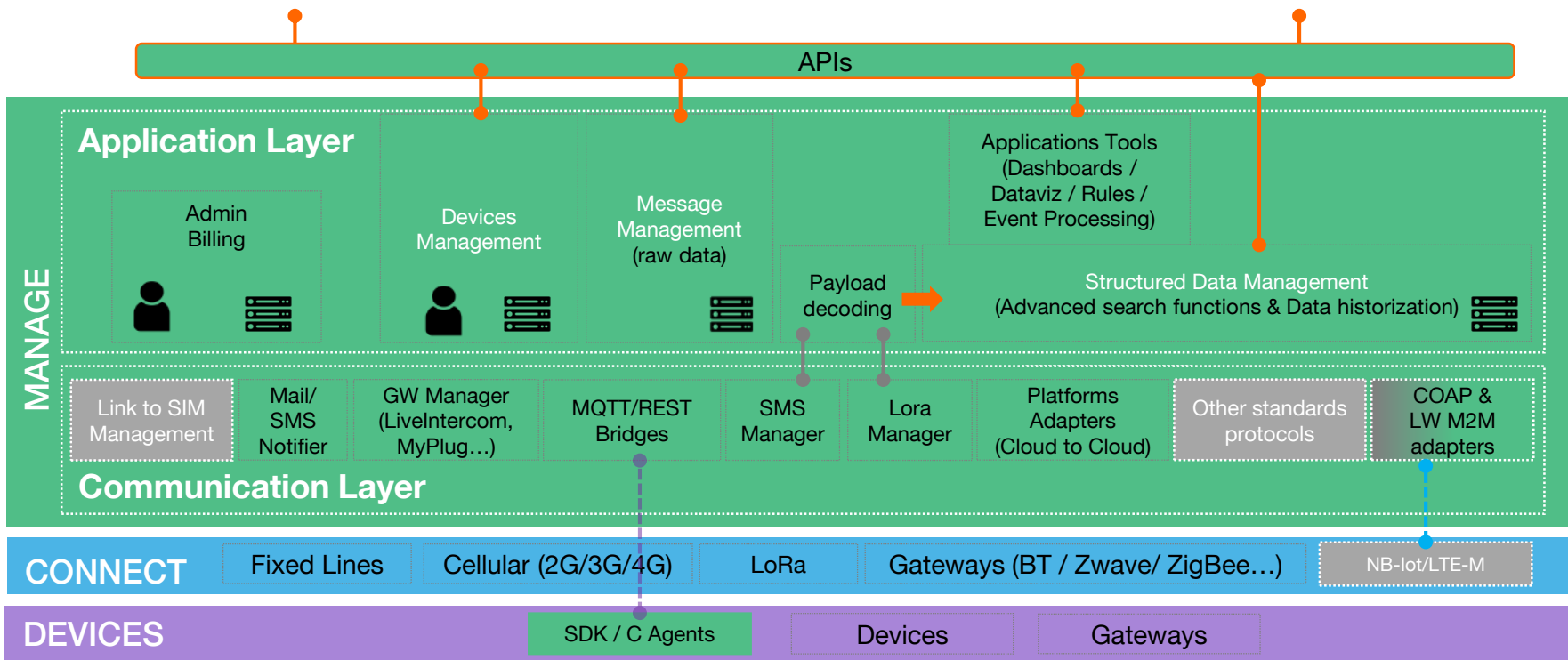
Smart cities



Smart home

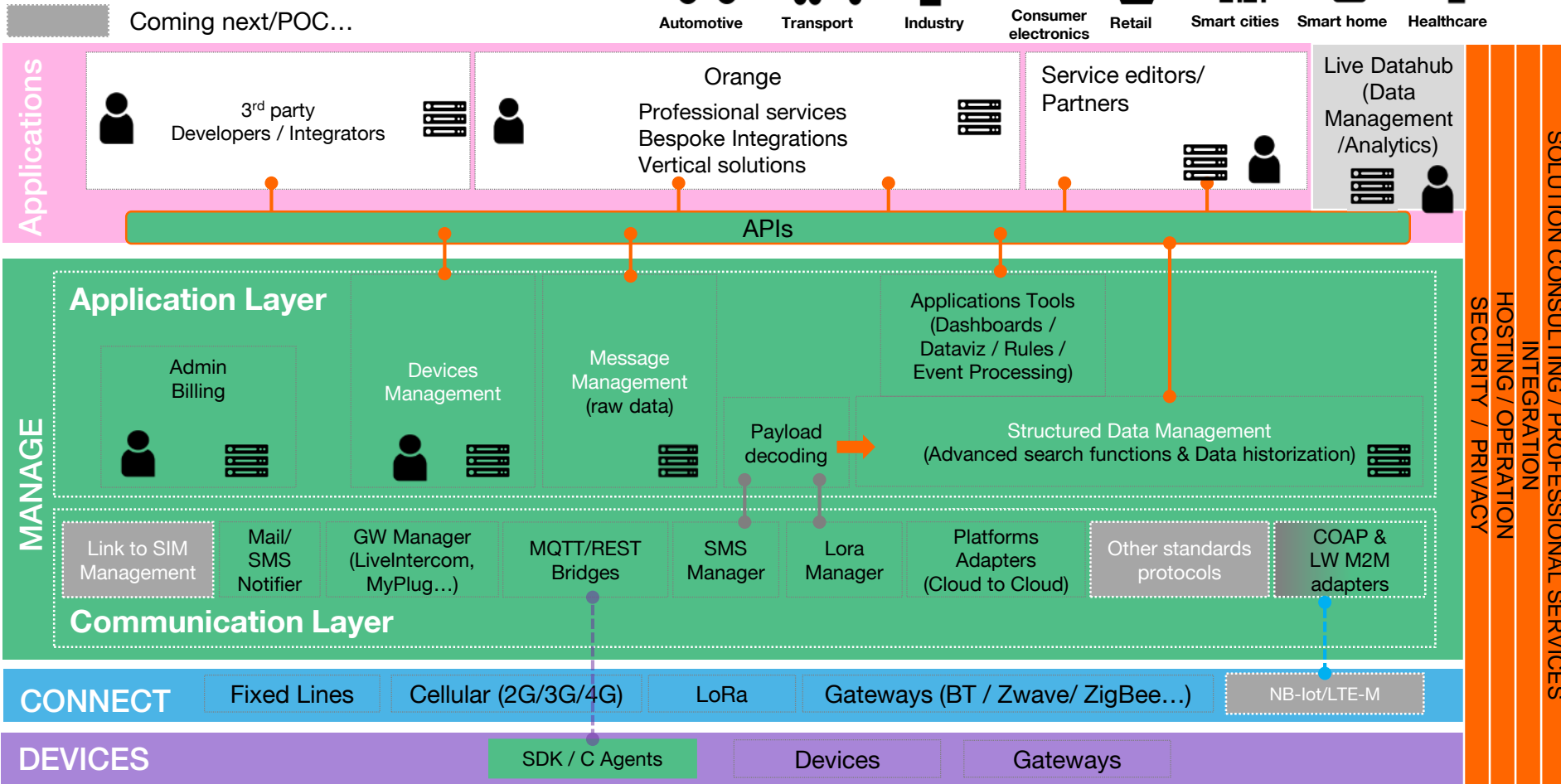


Healthcare



*Contract under negotiation

Functional Overview & Value proposition



The journey from data to Wisdom



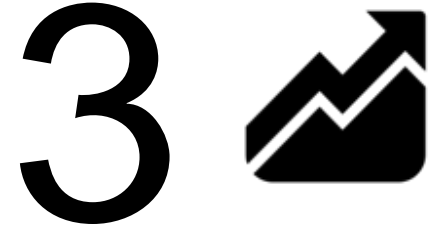
Collect the Information

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Understand the patterns, make correlations and decide



Flux Vision

Instrument de analiza a
miscarii populatiei in vederea
optimizarii business-ului dvs.



orange™



Smart Data

Flux Vision- platforma Orange de Big Data

Statistici de trafic din datele colectate de catre retelele mobile

Indicatori pentru masurarea:

- traficul de vizitatori in una sau mai multe locatii de interes
- originea geografica a vizitatorilor
- profilurile socio-demografice ale vizitatorilor



Indicatorii statistici sunt livrati prin

- prezentare Microsoft PowerBI® (interactiva si dinamica)
- rapoarte in format excell



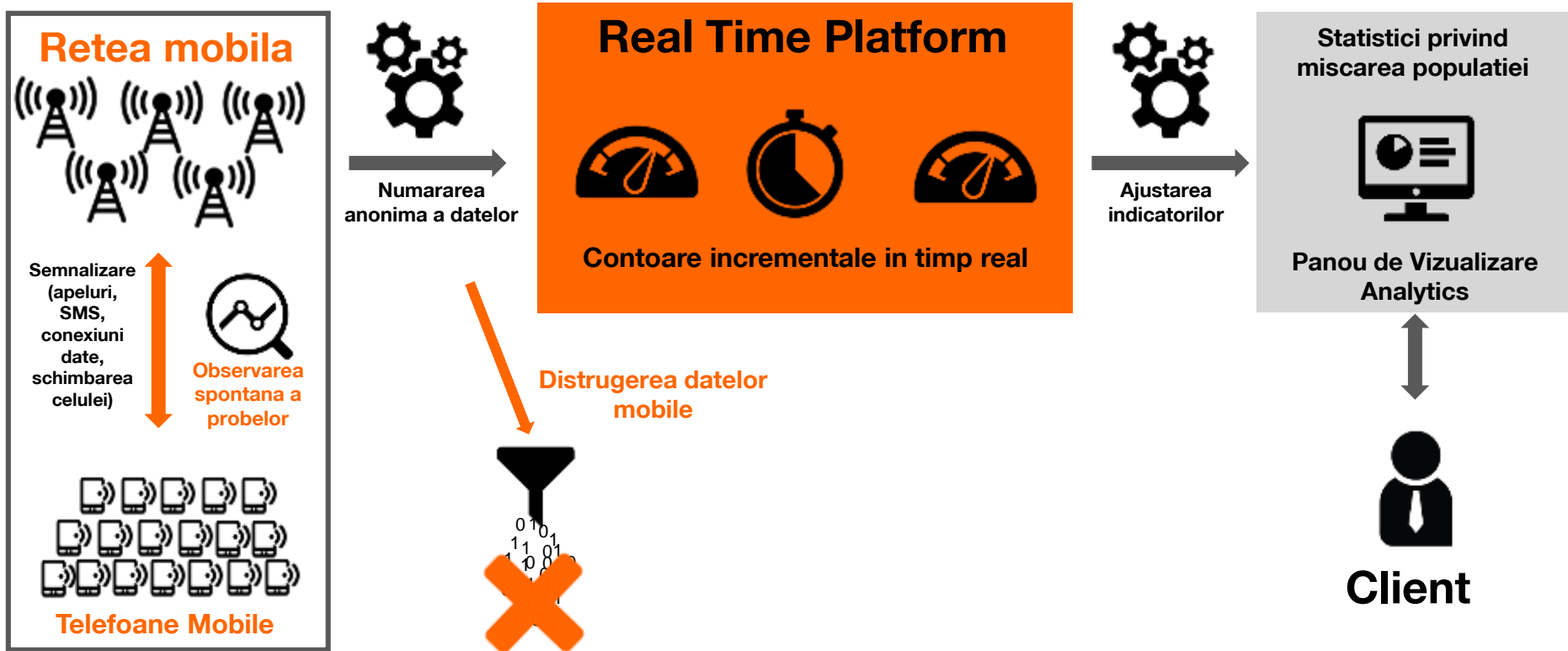
Metode de anonimizare in conformitate cu cerințele de securitate a datelor cu caracter personal.

Esantioane reprezentative din reseaua noastra de telefonie mobila din Romania.



Flux Vision : schema functionala

Fluxul de date



Parcursul datelor

1

Ajustarea limitarilor
rețelei

2

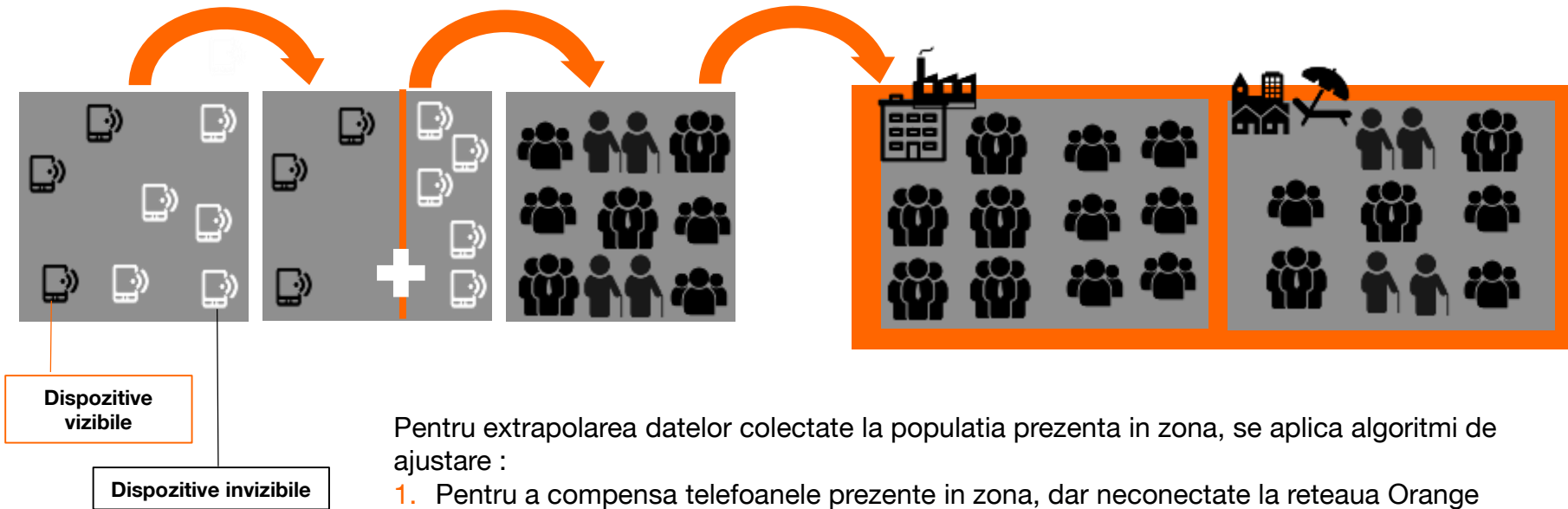
Extrapolarea
dispozitivelor la
populația standard

3

Ajustarea cifrelor se face în
funcție de publicul țintă și
statistici publice

Numărarea vizitatorilor cuprinde :

- Utilizatori mobili ai Orange România
- Utilizatori străini care fac roaming în rețeaua Orange

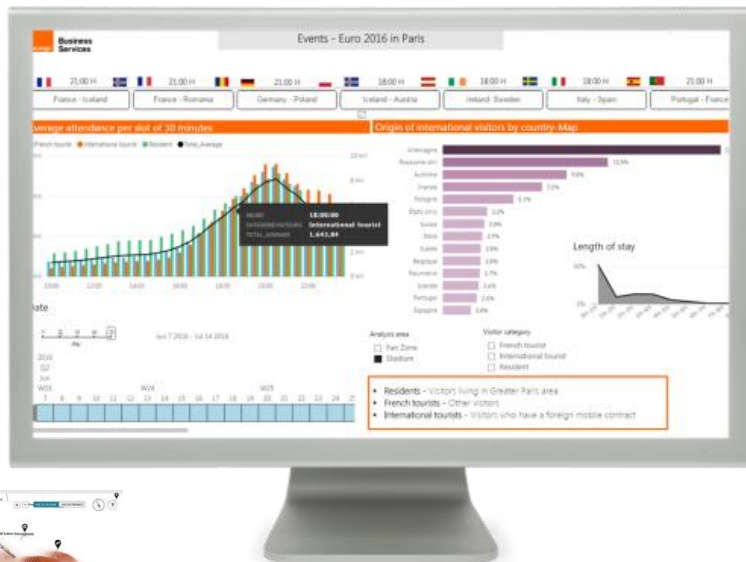


Pentru extrapolarea datelor colectate la populația prezentă în zonă, se aplică algoritmi de ajustare :

1. Pentru a compensa telefoanele prezente în zonă, dar neconectate la rețeaua Orange
2. Pentru a fi reprezentativă pentru specificul populației din zonă
3. Pentru a evita lipsa de reprezentare a anumitor segmente de populație

Flux Vision. Platforma Orange de Big Data

Instrumentul optim pentru deciziile de business



Sursa
de incredere datorita
volumului mare de
date



Analiza
Miscarii populatiei



Indicatori
statistici adaptati
sectorului de retail



Vizualizare
Platforma Interactiva
Business Intelligence



Strategia de
extindere sau
restrangere a
punctelor de vanzare



Adaptarea
serviciilor si
resurselor



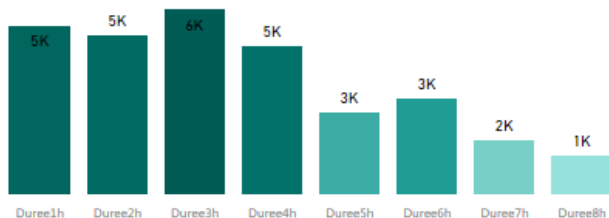
Lansarea campaniilor
de publicitate si
masurarea impactului



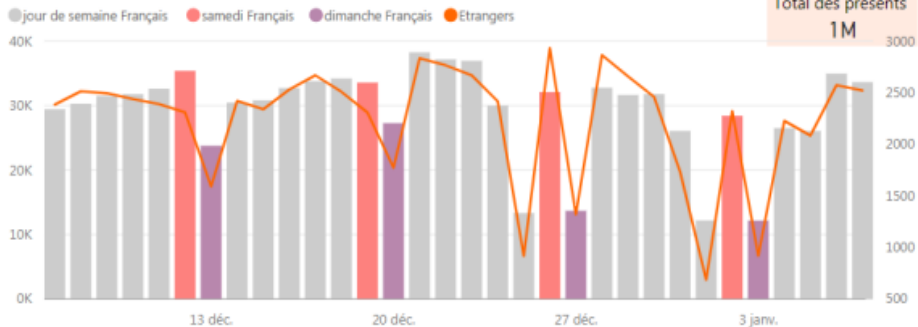
Analiza competitiei
si a clientilor lor

Exemple de vizualizare a datelor

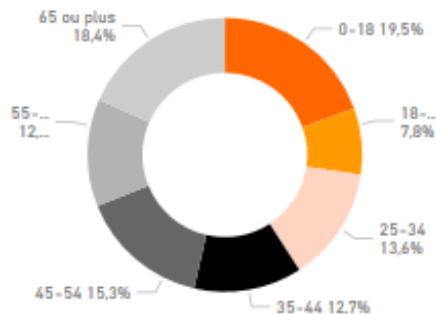
Durata medie petrecuta in zona analizata



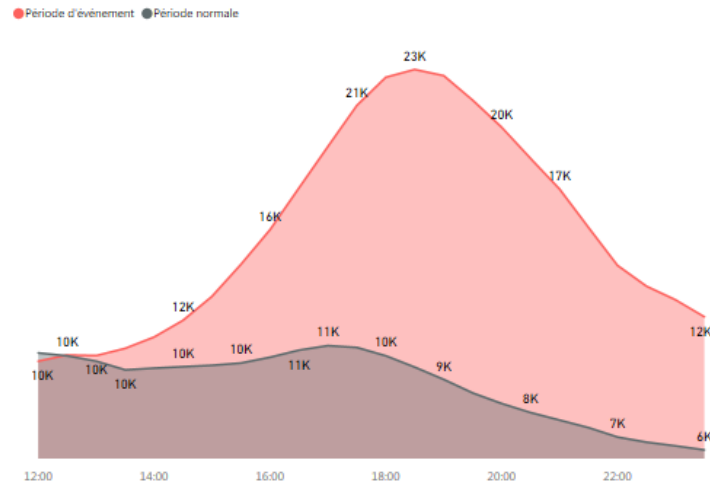
Afuenta pe zile



Distributie pe grupe de varsta



Prezenta zilnica pe sloturi de 30 min



Originea vizitatorilor



Alegerea zonei studiate

Nivelul de precizie depinde de distributia antenelor Orange

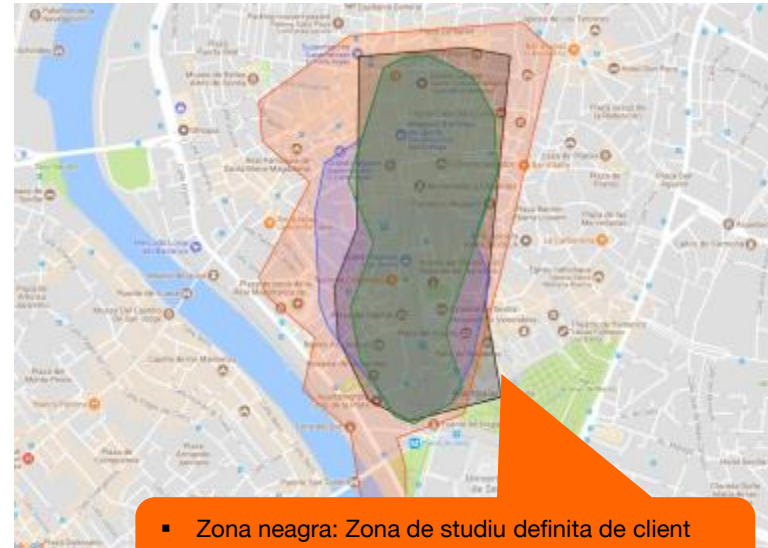
Pachet Standard

Bazat pe organizare administrativa: judet, sector



Pachet Advanced

Zone personalizate definite de clienti



- Zona neagra: Zona de studiu definita de client
- Zone adiacente (rosu, albastru, verde): zone alternative in functie de aria de acoperire Orange

Indicatori standard

Prezenta

Vizitatori unici:

- Pe zi
- Pe o perioada de maxim 2 saptamani

Vizitatori pe parcursul unei zile

- Vizitatori prezenti la fiecare 30 de minute intre 7AM si 11PM

Estimare intrari -iesiri

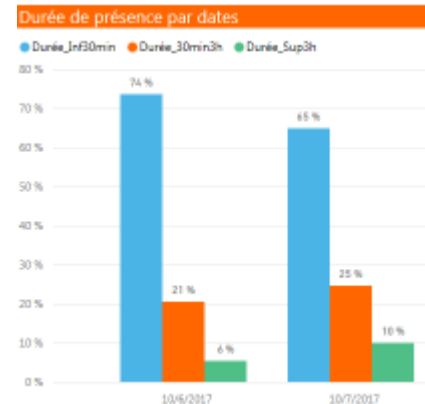
- La fiecare 30 de minute intre 7AM si 11PM

Timp petrecut in zona intr-o zi

- Durata scurta: < 30 minute
- Durata medie: intre 30 minute si 3 ore
- Durata lunga: > 3 ore

Segmentare

Vizitatori nationali
Vizitatori staini





Segmentare

- **Vizitatori nazionali**

Adresa aferenta Sim-ului este din tara analizata

- **Vizitatori straini**

Sim-ul este asociat unui operator mobil din afara tarii

Exista posibilitatea de a crea sub-segmente in functie de:

- ✓ Perioada petrecuta in zona: rezidenti/personal versus persoane aflate in tranzit (excluzand pe cei care au stat in zona mai putin de 30 de minute)
- ✓ Dupa zona de unde provin vizitatorii: din zona analizata, din alte judete, etc.



Indicatori standard

Origine

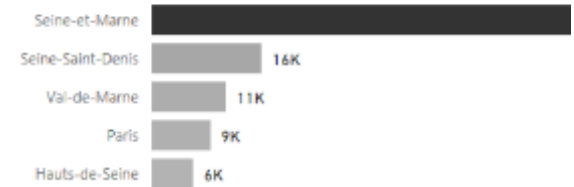
Originea la nivel general

- Vizitatori nazionali dupa zona de unde provin*
- Vizitatori straini in functie de tara**

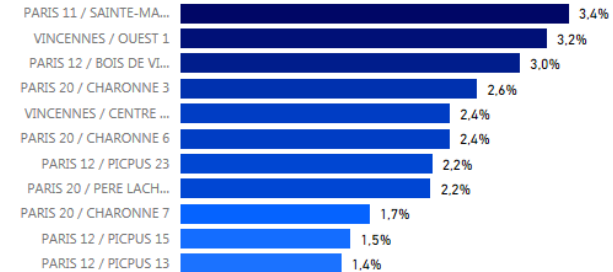
Originea in functie de zonele de proximitate

- Dupa localizarea Sim-ului in noptile anterioare: (riverani sau turisti) sau lucratori in zona
- In functie de 3 perimetre: zona analizata, cod postal, vecinatate, oras
- Disponibil pentru totalul vizitatorilor unici zilnici si la fiecare 30 de minute

Provenance des visiteurs Français par département



Zones de nuitée des visiteurs la veille du jour de visite



* Info din bazele de date Orange

** In functie de operatorul de telefonie mobila asociat simului aflat in roaming



Indicatori avansati si optiuni

Indicatori avansati: Profil socio-demografic al vizitatorilor nationali*

- Distributie in functie de varsta
- Distributie in functie de gen



Optiune: Recurenta vizitatorilor unici

- Numarul de zile dupa segmentul vizitatorilor (pe o perioada maxima de 2 saptamani)
- Optiunea este disponibila pentru perioade viitoare (nu si cele anterioare)

Optiune: Flux origine- destinatie

- Numarul mediu de vizitatori din zona de origine adiacenta si zona de destinatie, calculate cu 3 ore inainte si 3 ore dupa intervalul selectat
- Disponibil pe zona de studiu la fiecare 30 de minute

* Based on mobile carrier data

Metoda de livrare a datelor



Fisier Excel trimis catre un server FTP

Livrare zilnica, cu optiunea de livrare la fiecare 30 de minute



Avantaje

- Integrare usoara in sistemele informatice
- Flexibilitate in afisarea informatiilor in functie de nevoi: agregarea indicatorilor se poate face zilnic, saptamanal etc.



Instrument Interactiv de vizualizare (Microsoft PowerBI)

Optiuni diferite de livrare:

- La finalul perioadei de studiu
- Lunar
- Saptamanal
- Zilnic

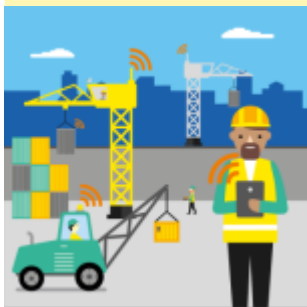


Avantaje

- Actualizare zilnica a indicatorilor
- Vizualizare imediata si simplificata a indicatorilor
- Optima pentru compararea mai multor zone de studiu, in special cele desfasurate pe perioade mai mari de timp
- Analiza imbunatatita cu informatii despre vreme

IoT use cases

Industrial



- Preventative maintenance
- Worker safety
- Optimize inventory
- Kaizen (flow optimization)
- Smart Grids

Smart Cities



- Manage physical access in buildings
- Energy savings & efficiency
- Security
- Metering
- Parking
- Lighting
- Waste management

Retail



- Optimize inventory
- Automatic re-ordering
- Alerts when out of stock

Healthcare



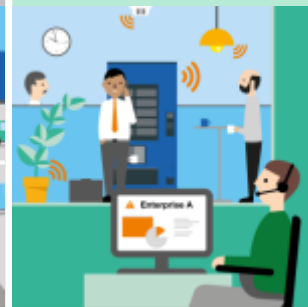
- Monitor patients with chronic diseases (post hospitalization or therapeutic educational programs)
- Connect medical devices
- Proof of patient compliance

Transportation



- Improve service for passengers by informing them of the time they will have to wait & of traffic issues
- Remote maintenance on vehicles
- Productivity enhancement

Insurance



- Develop safe driving behavior
- Tele assistance
- Monitor risks related to health insurance & create pay-as-you-live models
- Monitor risks related to home insurance

Thanks

