Wize Protocol and Products: A technical brief

Agenda

- Introduction
- Some RF basics
- LPWAN concept
- RF European regulations
- The Wize Alliance
- Wize system architecture
- Wize infrastructures and operators
- Synthesis : Wize vs LoRaWAN, NB-IoT or Sigfox
- Q&A

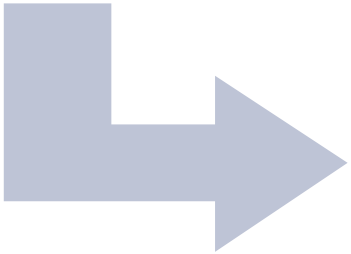
- Agenda
- Targets and organization of this webinar
- Presenters

Spare for Q&A

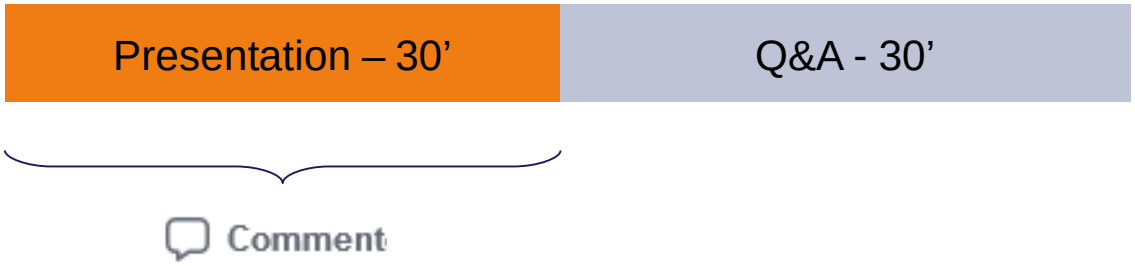
- Wize protocol in depth
- Designing a Wize-compatible device

Introduction: Targets and organization of this webinar

- 1 hours to discover Wize **technology and ecosystem**
- Based on **technology analysis**
- As **open-minded** and independant as possible



- To understand which **use cases** for Wize
- To understand what is the **actual Wize offer** to date
- To understand how to **develop a Wize product**
- To understand how to influence the **Wize standard**



Introduction: Presenters

Alain Désandré
Head of technical committee
Head of Smart Solutions at GRDF

Agenda

- Introduction
- Some RF basics
  - Free space propagation
  - Penetration losses
  - Sensitivy and energy vs bit rate
- LPWAN concept
- RF European regulations
- The Wize Alliance
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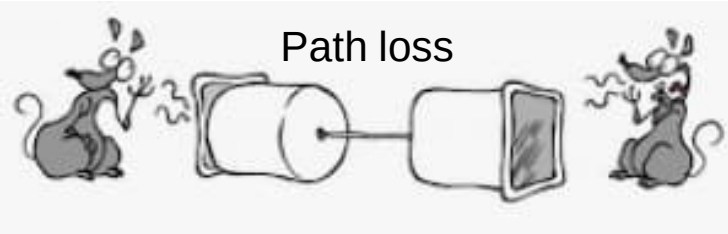
Some RF basics: Free space propagation (1/2)

- Wize is using a low frequency band (169MHz), why?



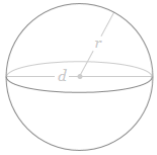
Open field : Friis formula

Real life

Path loss (dB) = 32,4 + 20 log (F/1GHz) + 20 log (d/1m) + obstacles, polarisation, fading,...

Loss function of carrier frequency
Linked to wavelength (and antenna size)
4x losses (6dB) if 2xF

Loss function of distance
Simply a square function
4x losses (6dB) if 2xd



$$A = 4\pi r^2$$

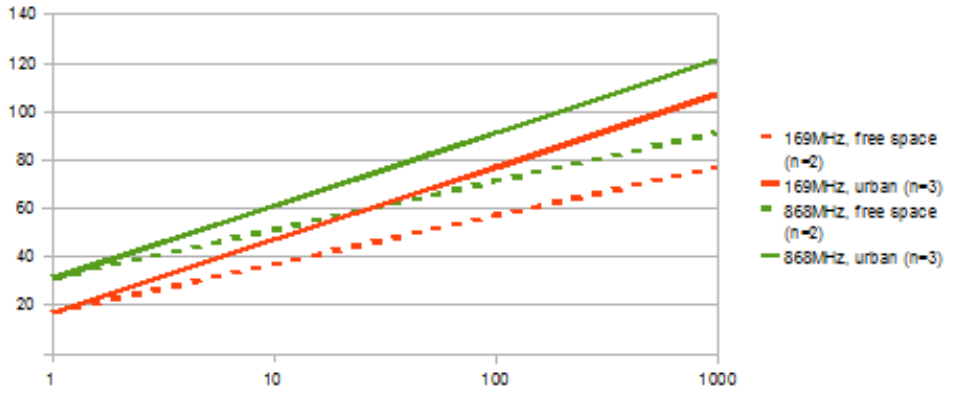
Some RF basics: Free space propagation (2/2)

- So: 14dB better path loss at 169MHz compared to 868MHz
- Same gain in open field or with polarisation or multipath losses

	Path loss (dB)			
Distance (m)	169MHz, free space (n=2)	169MHz, urban (n=3)	868MHz, free space (n=2)	868MHz, urban (n=3)
1	17	17	31	31
10	37	47	51	61
50	51	68	65	82
100	57	77	71	91
1000	77	107	91	121

Path loss (dB) = x + 20 log (F)

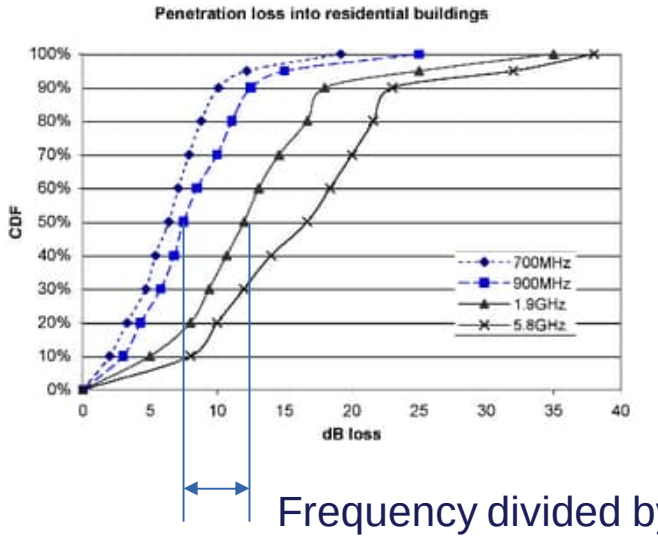
20 log (868/169) = 14,2 dB



- Downside: the antenna is 5 times larger for the same performance...

Some RF basics: Penetration losses

- Penetration losses: Roughly proportional to the frequency
- 12cm of concrete is 1λ at 2.4GHz, 0.35λ at 868Mhz **but only 0.07λ at 169MHz**…



Penetration loss (order of magnitude)	169MHz	868MHz
Light indoor	8dB	12dB
Deep indoor (meters)	25dB	35dB

Frequency divided by 2 => Penetration losses reduced by 5-6dB

- **Key advantage of low frequency bands for deep indoor**

Some RF basics: Sensitivity and energy vs bit rate

- On the receiver side, a fundamental result, true for any receiver:

$$\text{Sensitivity (dBm)} = -174\text{dBm} + \text{NF} + 10.\log(B) + \text{Eb/N0 (dB)}$$

Noise figure
(« quality » of the hardware)

« quality » of the demodulator and tolerated error rate

Useful bit rate
The slower the bits, the more energy per bit, the better the sensitivity

- Reducing the bit rate **always** improve the sensitity: **bit rate / 4 => +6dB => range x 2**
- But increases the transmission duration, so the battery usage: **bit rate / 2 => energy x 2**

Always compare two RF solutions for the same energy consumption

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  - What is a LPWAN?
  - Key applications
  - Private vs operator / Licensed vs unlicensed
  - An overview of the competitive landscape

Spare for Q&A

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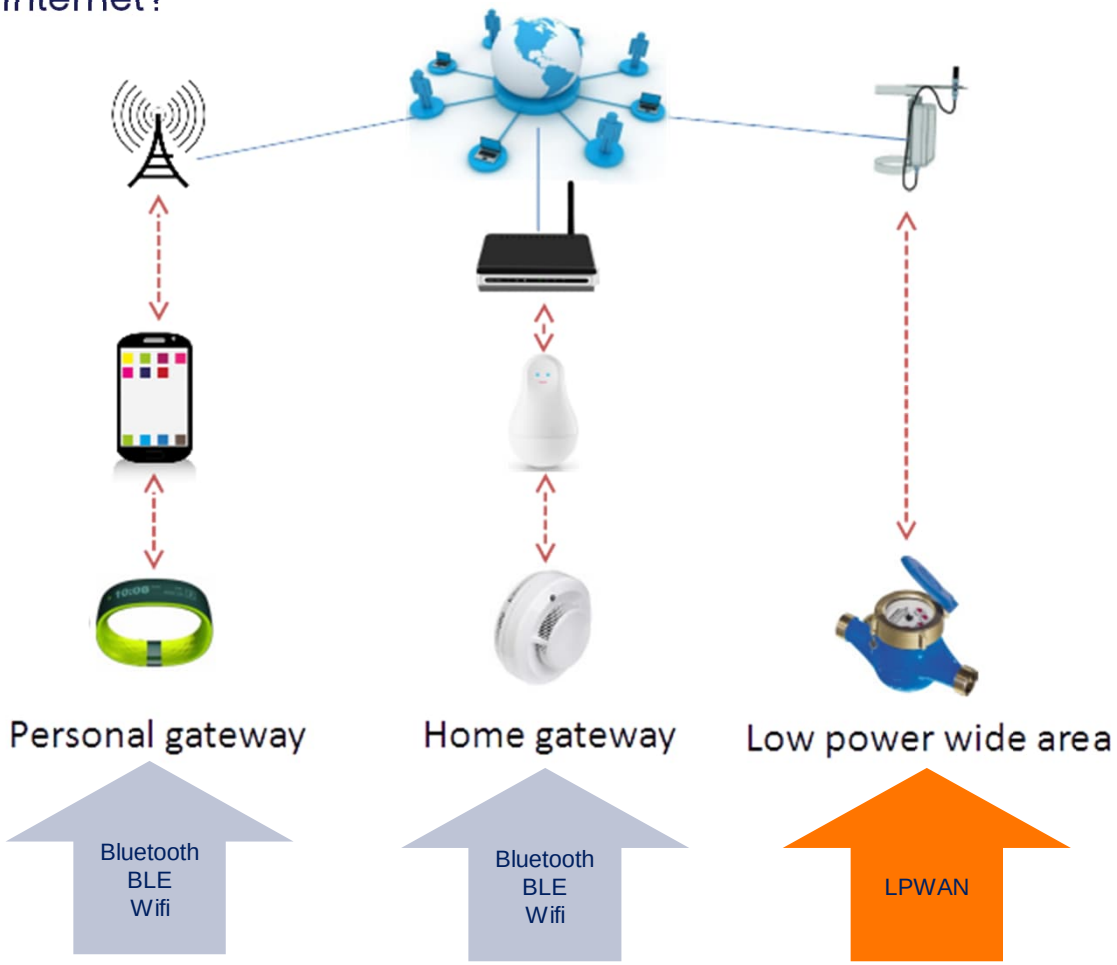
- Designing a Wize-compatible device

LPWAN concept: What is a LPWAN?

- How to connect to the Internet?



Nota: IIoT networks with gateways and repeaters may be considered as « home gateway »

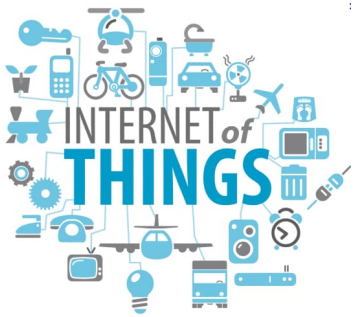
LPWAN concept: Key applications

Smart environment
Air pollution
Earthquake
Flooding and rivers

Smart metering
Electricity
Gas
Water
Heat

Smart city
Traffic
Parking
Lights
Waste
Advertising

Smart industry
Factory monitoring
Safety control



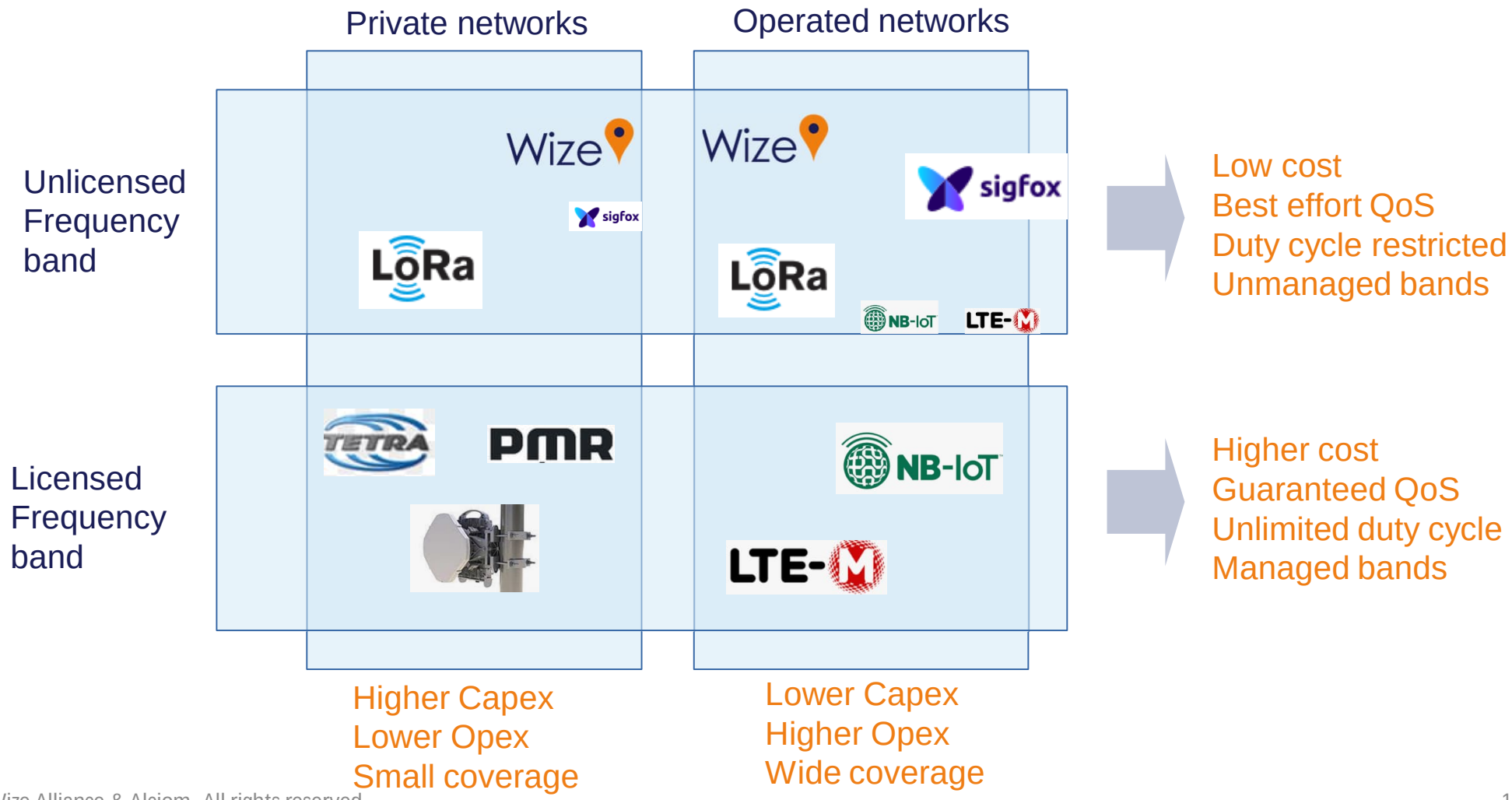
Smart homes
Security
Heat control
Smoke & fire detectors
Appliances

Tracking
Vehicles
Goods
Kids
Stuff

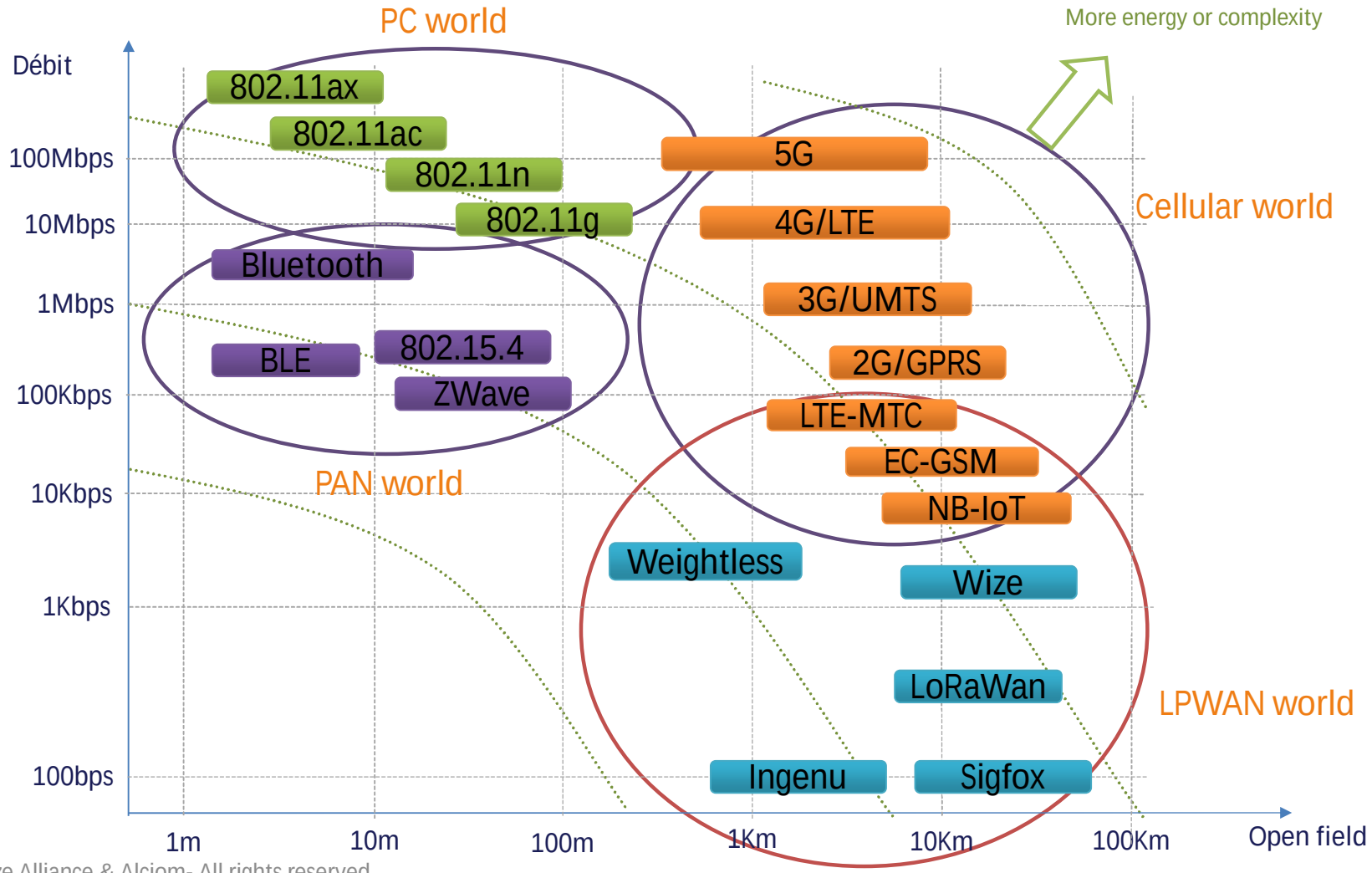
Smart Agriculture
Animals
Irrigation
Weather

- Common factor : small datas
- More globally : « Telemetry »

LPWAN concept: Private vs operator / Licensed vs unlicensed



LPWAN concept: An overview of the competitive landscape



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- RF European regulations
  - A look at REC/ERC/70-03…
  - The 169MHz band
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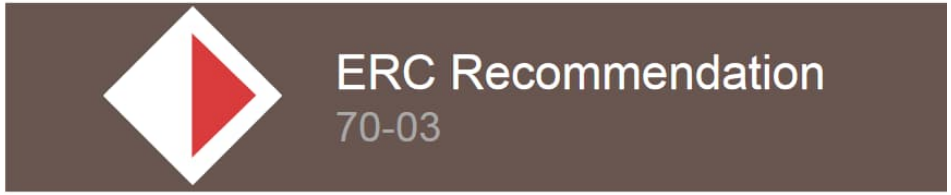
RF European regulation: A look at REC/ERC/7003



Relating to the use of Short Range Devices (SRD)

Tromsø 1997

Subsequent amendments

7 June 2019

Please Note

Implementation Status page 44

169, 433, 878,...

169,...

RF European regulation: The 169MHz band

- **Open and license-free frequency** since 2003 (e. g. Hermès band reserved for pagers)

ANNEX 1: NON-SPECIFIC SHORT RANGE DEVICES					
f1	169.4-169.475 MHz	500 mW e.r.p.	≤ 1% duty cycle	≤ 50 kHz	ECC/DEC/(05)02
ANNEX 2: TRACKING, TRACING AND DATA AQUISITION					
b	169.4-169.475 MHz	500 mW e.r.p.	≤ 10% duty cycle	≤ 50 kHz	ECC/DEC/(05)02

Wize can be used for any application but with a different duty cycle limit :

- Up to 10 % duty cycle for « annex 2 » devices (*), up to 1 % for other applications
- (*) : « Meter reading, sensors (water, gas, meteoreology, pollution...) and actuators (street lights...) »

- Available in all European countries (except Russia, Georgia, Bielo-R.):

Annexes to ERC/REC 70-03	ALB	AND	AUT	AZE	BEL	BIH	BLR	BUL	CVA	CYP	CZE	D	DNK	E	EST	F	FIN	G	GEO	GRC	HNG	HOL	HRV	I	IRL	ISL	LIE	LTU	LUX	LVA	MCO	MDA	MKD	MLT	MNE	NOR	POL	POR	ROU	RUS	S	SMR	SRB	SUI	SVK	SVN	TUR	UKR
Annex b: 169.4-169.475 MHz ECC/DEC/(05)02	Y	Y	Y		Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	U

- 169MHz band or close bands are also available in several countries out of Europe

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- The Wize Alliance
  - History and founders
  - Members
  - Working groups
  - Membership
  - Deliverables
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The Wize Alliance: History and founders

2005

- WM-Bus protocol release (433MHz and 868 MHz), aka **EN13757-4**
- Opening of the HERMES band (169MHz)

2008

- 1st 169MHz module for water metering

2012-2013

- GRDF decision to choose the 169 MHz band for GazPar, based on EN13757-4 with huge improvements
- R&D shared with Suez
- First application guide for Gas metering

2014-2016

- Protocol specification
- SDR-based high performance 169MHz multi-channel modem
- Carrier grade infrastructure and water & gas meters

2017

- Release **Wize specification 1.0**
- AFNOR application guide for **water and gas**
- Wize Alliance Link – CEN TC294

2018/2020

- EN13757/2018 release
- **Wize 1.1 release**
- Massive roll-out of Wize gas and water meters in Europe (**10M to date**)
- Trials worldwide
- **Some of the largest IoT networks worldwide ?**

The Wize Alliance: Members

Executive

GRDF · SUEZ · Sagemcom

Active

Alciom · DIEHL Metering · CONTAZARA · Itron

Regular

accenture · AllWize · life.augmented · JANZ · SILICON LABS · Radiocrafts Embedded Wireless Solutions · Aigües de Barcelona · SENSUS a xylem brand · Sofrel LACROIX · BORDEAUX MÉTROPOLE ÉNERGIES · maddalena · hydrelis

Start-up & Academics

IMT Atlantique · LCIS · Enless Wireless M2M & IoT Wireless Expert · Fuel it · TELECOM Lille · ffly4u connect your assets · UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH · TELECOM Bretagne · Koncepto · CNS INSTRUMENTATION · S E · NRGYBOX · kinéis · AOnChip · data2i · Edel ENERGY · SmartEmbed · sigrenEa · Orisun · Cedarnet · CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD · TELEREADING

The Wize Alliance: Working groups

Executive Board

- Sponsor level
- Board do not produce any work, board only undertake decision and validation

Executive Members

Strategic Committee

- develop and submit Alliance Roadmap to Executive Board at both an organizational and technical level
- develop and maintain long-range and annual strategic plans
- propose and validate Association accession to institutional, professional or advisory organisations
- appoint Association representatives to each institutional, professional or advisory organisations

Executive Members + Working Group Chairs + Experts (on specific request nominated by the Strategic Committee)

Communication Working Group

- dedicated to marketing activities, promotion of WIZE technology and communication activities within and outside the alliance
- developing an Alliance marketing plan;
- driving education, outreach, and awareness programs
- managing communication to Members
- developing marketing materials for the event and for the alliance

1 chair + experts

Technical Working Group

- dedicated to maintain the detailed specifications of the standard and to specify tests
- gathering, defining, and prioritizing requirements for Deliverables
- creating a working plan to accomplish the technical objectives of the Alliance
- organising certification and testing process

1 chair + experts

Development Working Group

- dedicated to business development of the technology, recruitment of new projects, new applications and upgrades
- defining the timing and form of ecosystem expansion
- tooling and implementation, monitoring and surveillance over projects

1 chair + experts

The Wize Alliance: Membership

Rights	Executive	Active	Regular
Eligibility for a seat on the Executive Board	●		
Initiate Working Group	●		
Chair Working Group	●	●	●
Participate in General Assembly	●	●	●
Vote in general assembly	●	●	●
Submit Deliverables for final approval by the Executive Board	●		
Contribute and access to draft Deliverables	●	●	
Access to Wize final Deliverables	●	●	●
Have certified Wize compliant products	●	●	●
Participate in press articles and interviews regarding the Alliance	●	●	●
Access private area of the website dedicated to Members	●	●	●
Receive Alliance's communications	●	●	●
Per year :	30K€	10K€	3K€ (*)

(*) Free for institutional and startups

The Wize Alliance: Deliverables

LAN PROTOCOL SPECIFICATION

V1.1

Version	Modifications	Date
1.0	Initial version	22/09/2017
1.1	Evolution of the Wize protocol specification to facilitate support for more countries and applications : - Frequency-band-agnostic main specification, Creation of a "Regional Parameters" document - Improved support for multiple application layers (L6App) - Improved support for roaming (L6NetwId) - Specifications for each application layer moved to separate documents - Minor clarifications and improvements Nota : Due to potential system impacts, alignment with EN13757-4:2018 version is deferred to next version	07/06/2019

+

REGIONAL PARAMETERS

V1.1

COMMON APPLICATION LAYERS

V1.1

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- Wize system architecture
  - EN13757-4 smart metering standard
  - Wize main features
  - The big picture
  - Message flows
  - Wize vs OSI model
- Wize infrastructures and operators
- Synthesis : Wize vs LoRaWAN, NB-IoT or Sigfox
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Spare for Q&A

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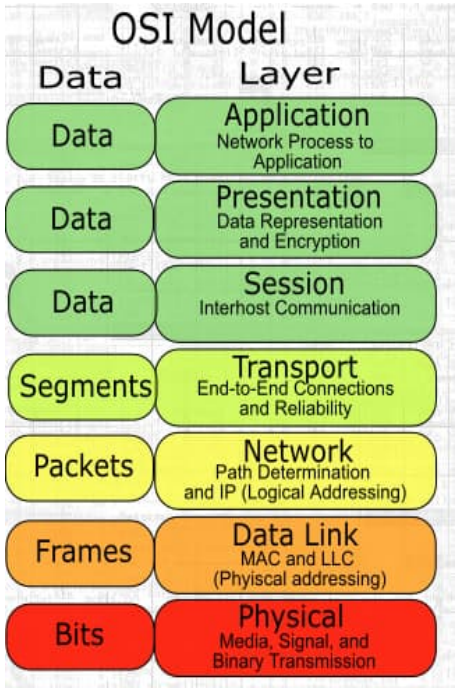
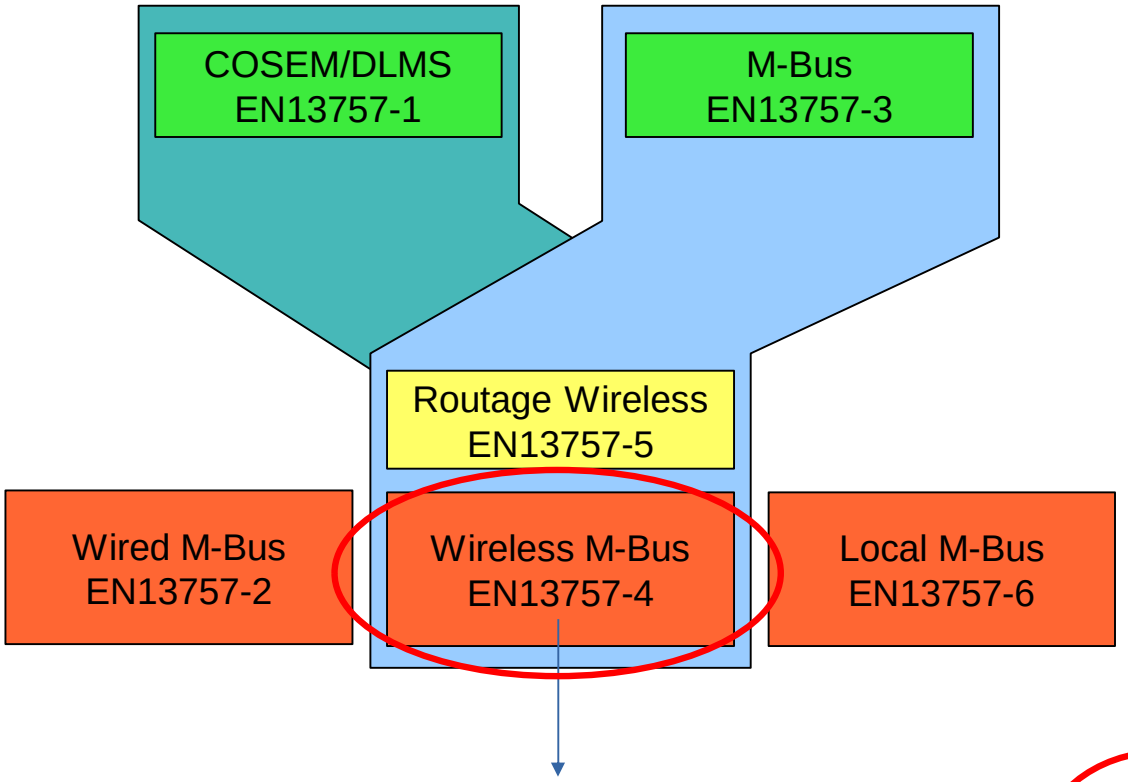
Wize system architecture: EN13757-4 smart metering standard

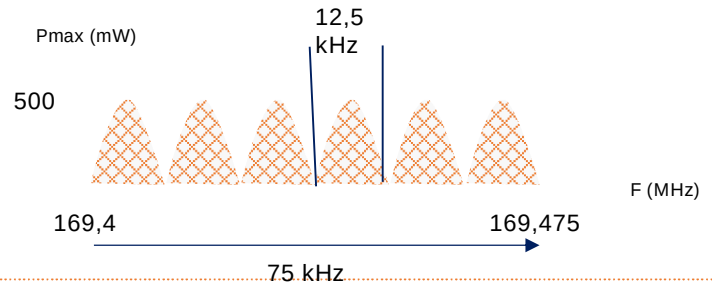




Mode	S1/S1-m	S2	T1	T2	R2	C1	C2	N1	N2	F2/F2-m
Band (MHz)	868,3	868,3	868,95	868,95/868,3	868,3	868,95	868,95/869,52	169,4-169,475	169,4-169,475	433,82
Bit rate (kbps)	32,768	32,768	100	100/32	4,8	100	100/50	2,4 to 19,2	2,4 to 19,2	2,4
Bidirectionnal	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes

Wize system architecture: Wize main features

Radio spectrum **divided into 6 channels (typically 5 up /1 down)**



Bidirectional connection

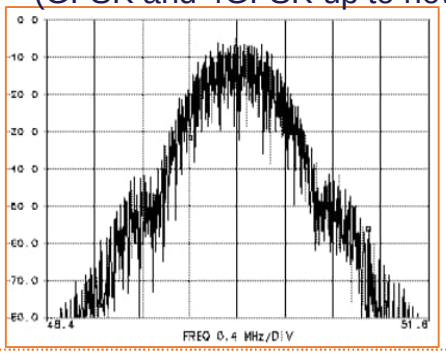
128 bytes

128/256 bytes

Speaking time

Duty Cycle: 10%
6 min / hour

Scalable Modulations / Software Defined Radio (GFSK and 4GFSK up to now)



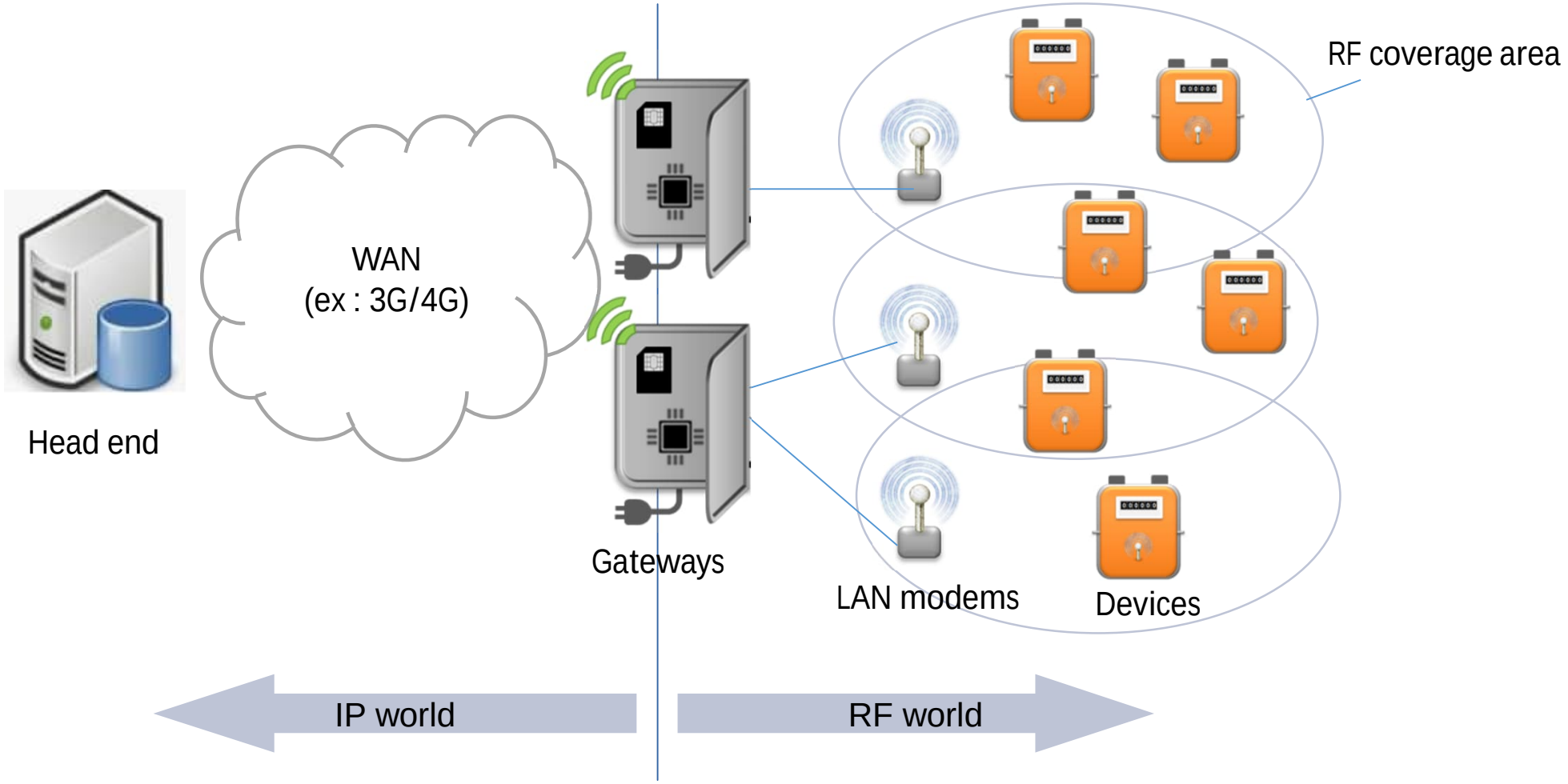
Speed

Between 2400 and 6400 bits/s

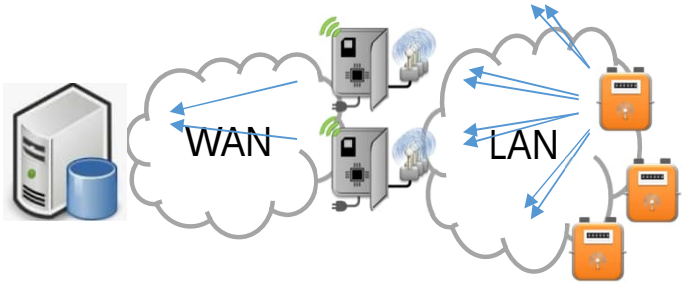
Security

Dual layer security
AES128

Wize system architecture: The big picture

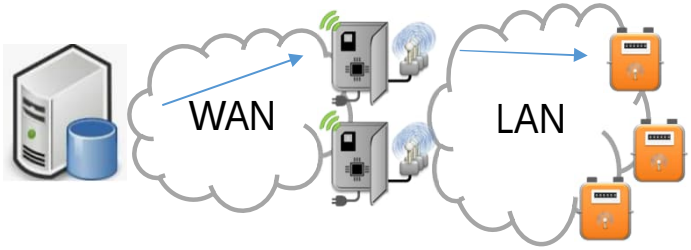


Wize system architecture: Message flows (1/2)



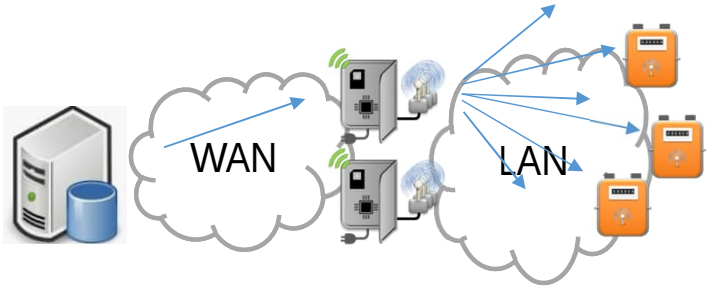
Upstream messages :

- A device sends a message on any channel & bit rate
- One or more gateway receive it, check it,
- … and forward it to the head system for processing



Downstream messages :

- After each transmission, the device listen to a given channel
- The head system check if a downlink message is ready...
- … and send it to one gateway for transmission

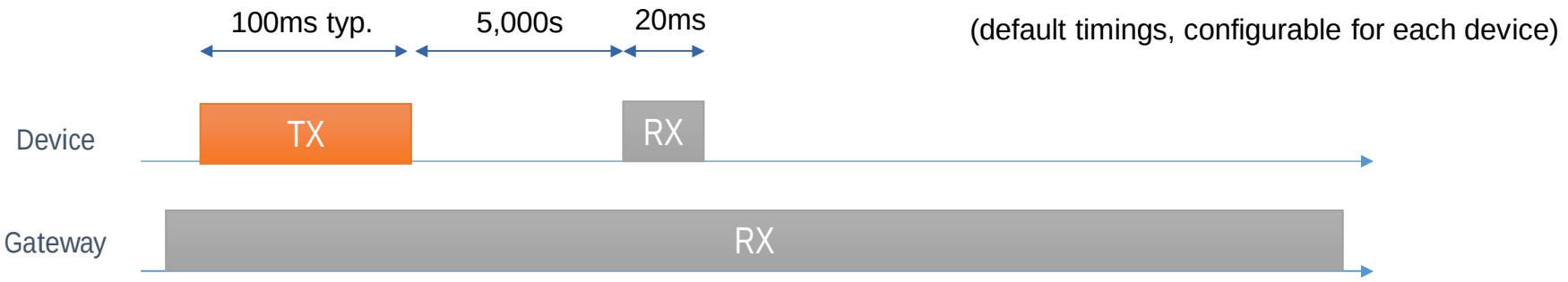


Multicast messages :

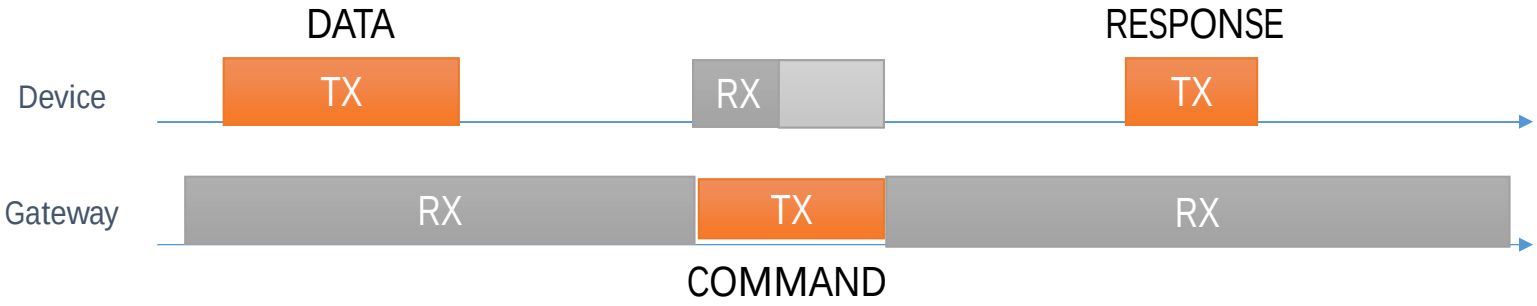
- A specific multicast mechanism is also specified by Wize
- Used for other the air firmware upgrade
- Based on preprogrammed *rendez-vous*

Wize system architecture: Message flows (2/2)

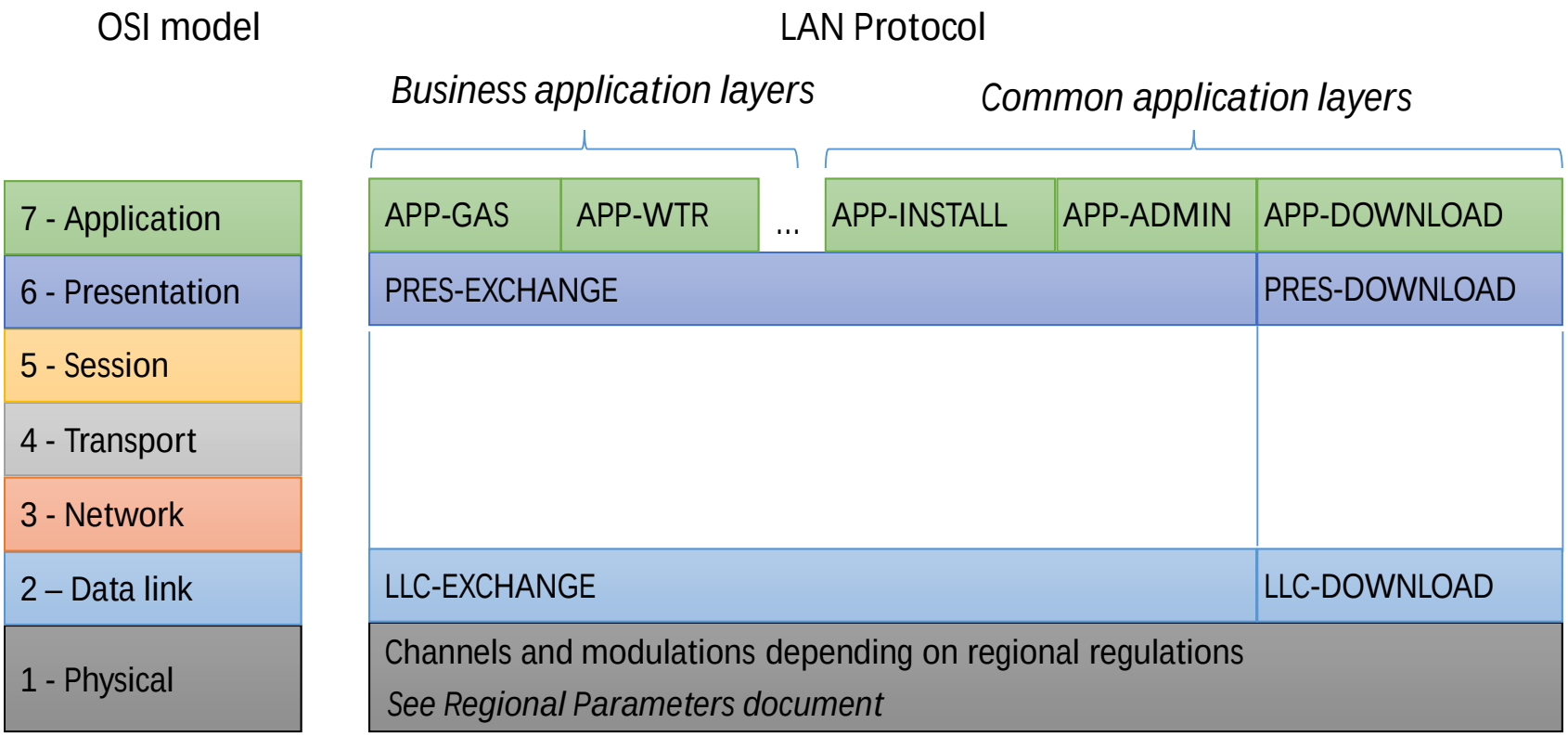
- Timings precisely defined for the lowest possible power consumption on device side
- If no downlink message :



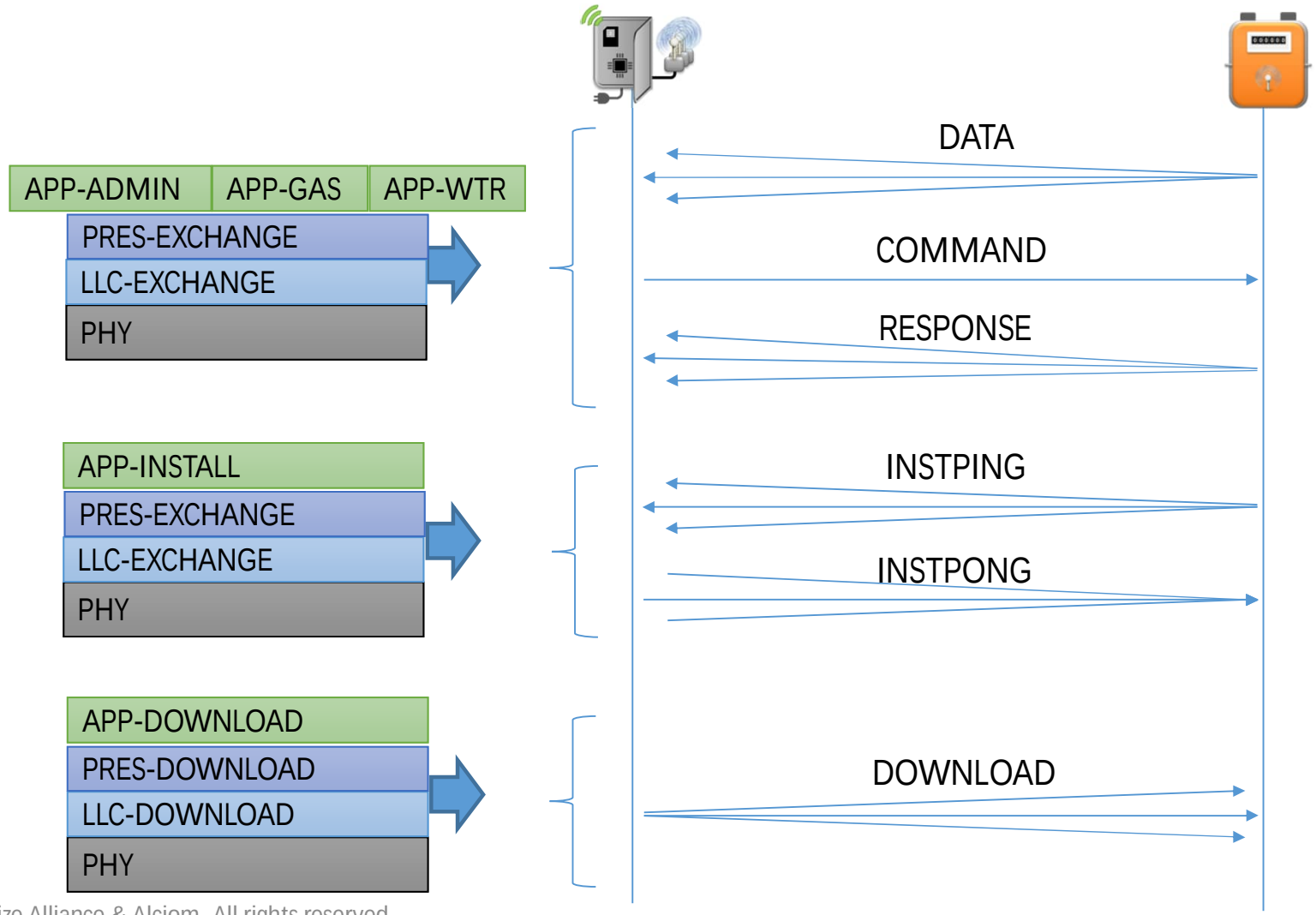
- With downlink message :



Wize system architecture: Wize vs OSI model (1/2)

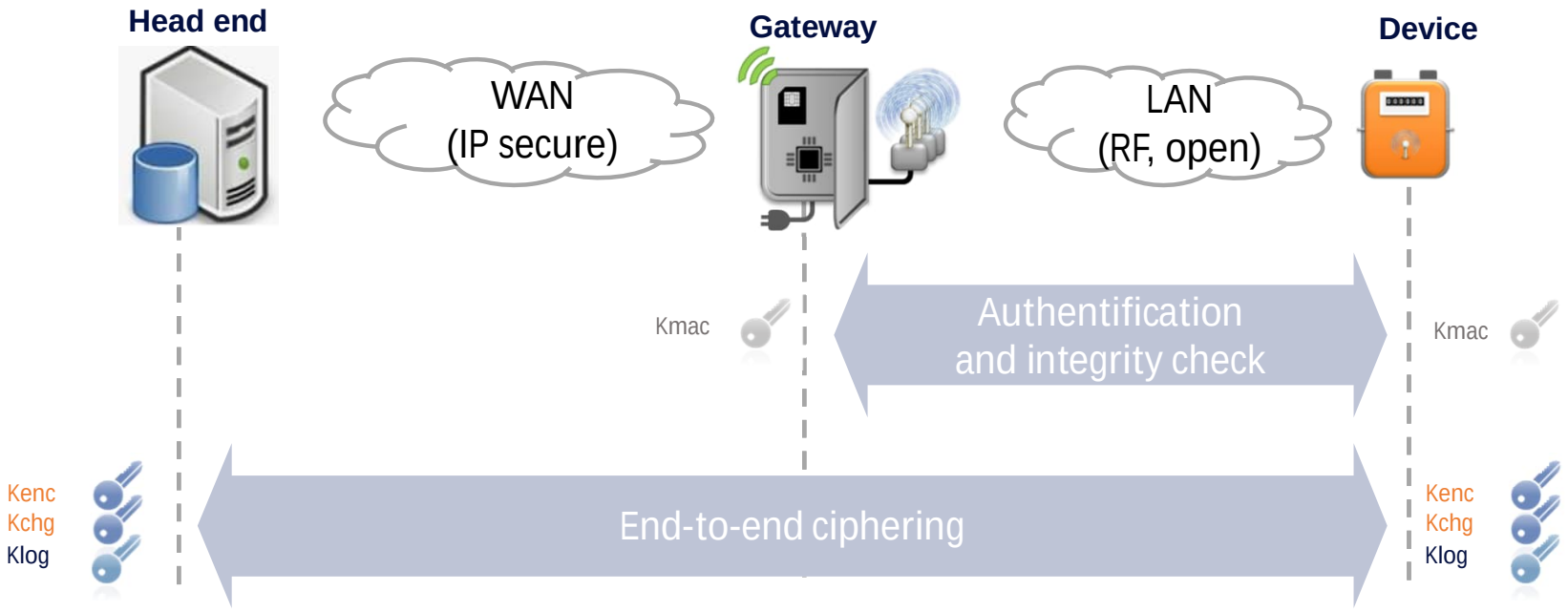


Wize system architecture: Wize vs OSI model (2/2)



System architecture : Security (1/2)

- Multi-layer security protocol
- Minimize gateway complexity and key dissemination, while keeping full security



- Up to 14 Kenc preprogrammed in a device (and shared with head end)
- AES128 upgradable to AES256

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- Carrier-grade Wize equipments
- Single-channel Wize gateways
- Wize operators & network models
- GRDF Wize network
- SUEZ Wize networks
- A rollout example : Bordeaux M. Energies

Spare for Q&A

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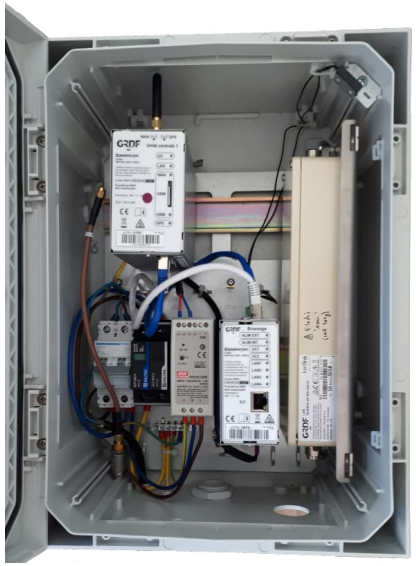
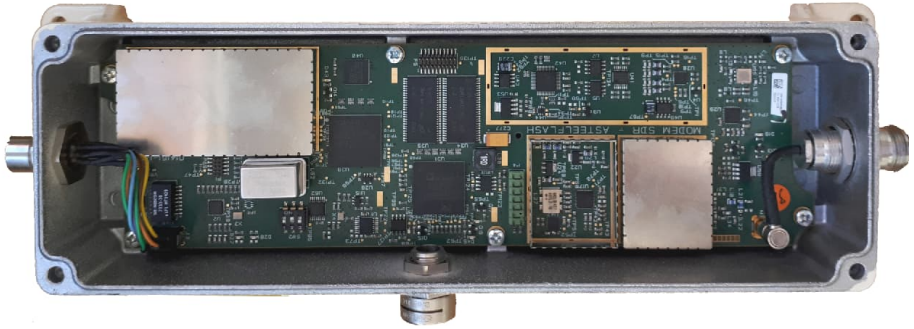
Wize infrastructures and operators: Carrier grade Wize equipments

- Carrier-grade Wize concentrators, LAN modem and head-ends developped for SUEZ and GRDF networks
- One concentrator = Up to 2 CPU, 4 LAN Modem (1 internal, 3 remote) and cellular connectivity
- Manufactured by SagemCom and Kerlink on behalf of GRDF & SUEZ, LAN modem design by ALCIOM





- Equipements and patended technology available through transfer agreement from SUEZ and GRDF

Wize infrastructures and operators: Single channel Wize gateways

- Single-channel Wize gateways possible for small private networks and experiments
- Single channel / single modulation (vs 6 channels x 3 modulations), limited feature set and performance
- Supported by RC1701-Wize module (Radiocraft)
- Example of integrated solution for experiments/small trials : Wize-to-Wifi gateway (AllWize):

AllWize

The AllWize I1

50,00 €

Quantity

1

Wize infrastructures and operators: Wize operators & network models

- Already extensive Wize Roll-outs

+ 10 million
devices deployed

10 000 cities
in 15 countries

- Flexible network model

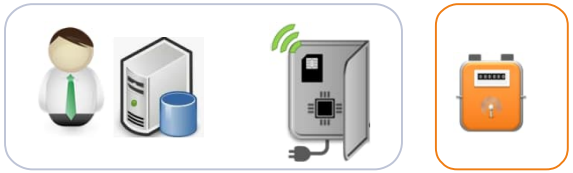
Private network

Gateways = Customer's property
+ Own operation

Hybrid network

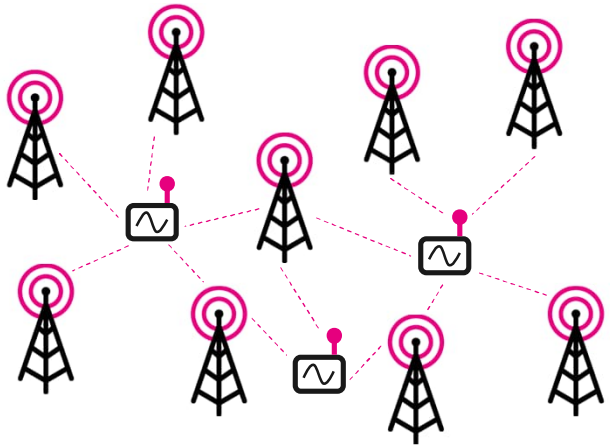
Gateways = Customer's property
+ Operation by a Wize operator

Operated network



Gateways = operator's property
+ Operation by a Wize operator

Wize infrastructures and operators: GRDF Wize network



2019

7000 gateways

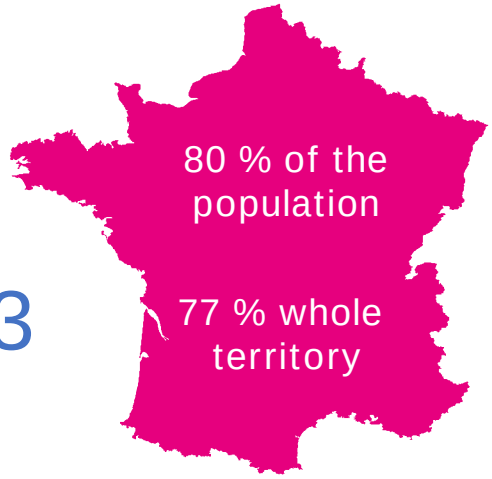
5,5M devices

2023

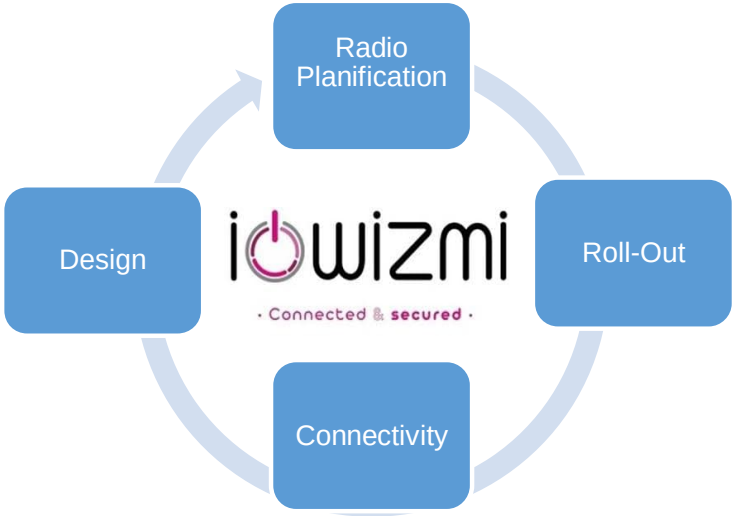
12 000 gateways

11M devices

National Coverage



Dedicated Subsidiary

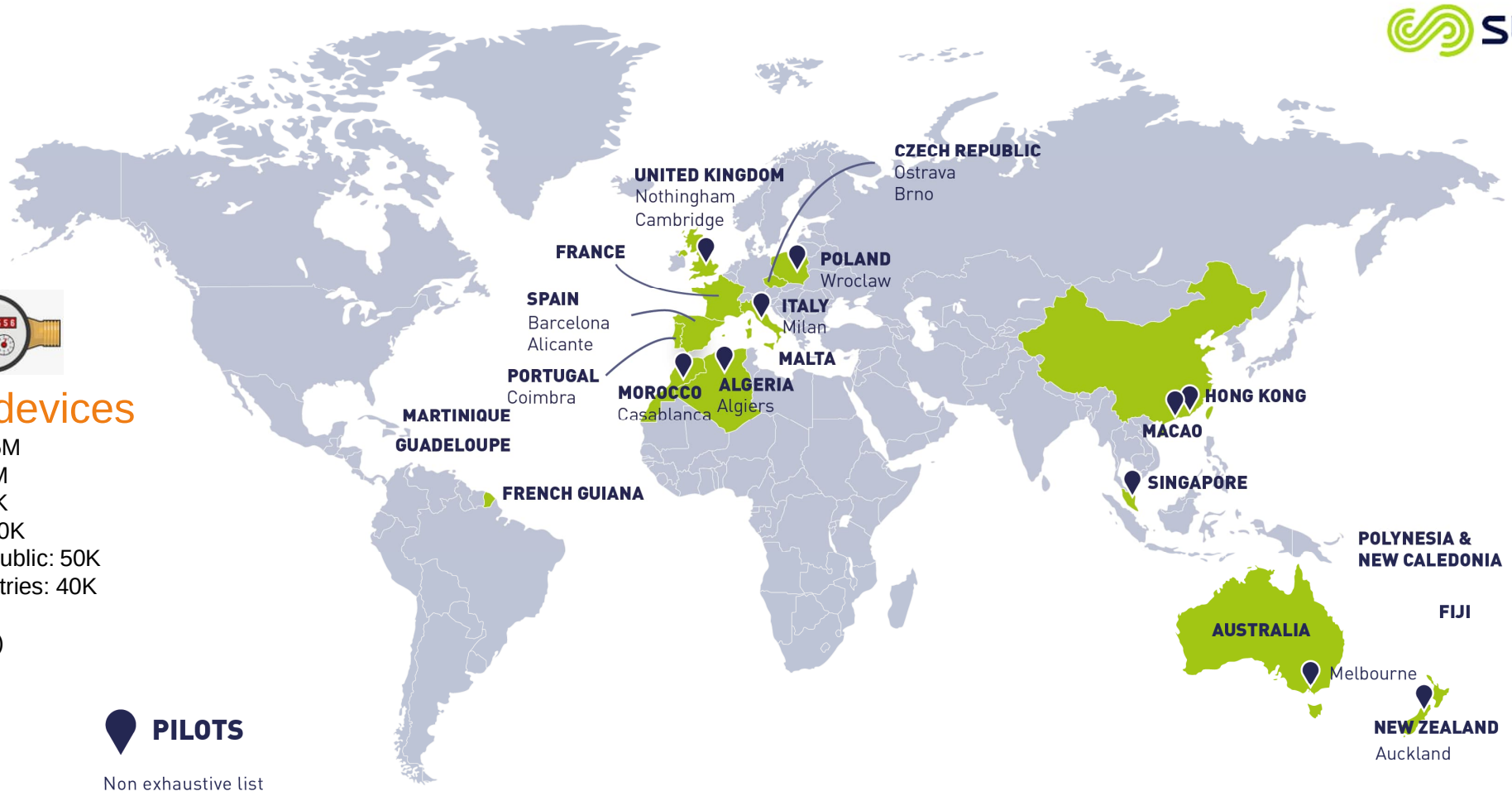


Wize infrastructures and operators: Suez Wize networks (1/2)

4.5M devices

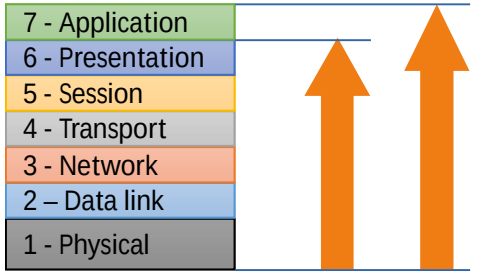
France: 2.5M
Spain: 1.6M
Malta: 250K
Portugal: 60K
Czech Republic: 50K
Other countries: 40K

(April 2020)



Wize infrastructures and operators: Suez Wize networks (2/2)

- SUEZ offer : Connectivity service alone, or connectivity + value added services



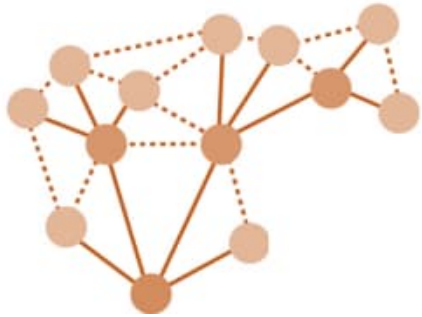
- What if there is no SUEZ Wize network in your area ?

1 **Support for the deployment** and/or operation of a Wize network on behalf of a customer or city

For whom ? any player who must cover a territory of the size of a city or a site. No need to be a Wize member.

2 **Development of a new Wize "Suez owned" network**

For whom ? As part of a more global IoT service operation contract.

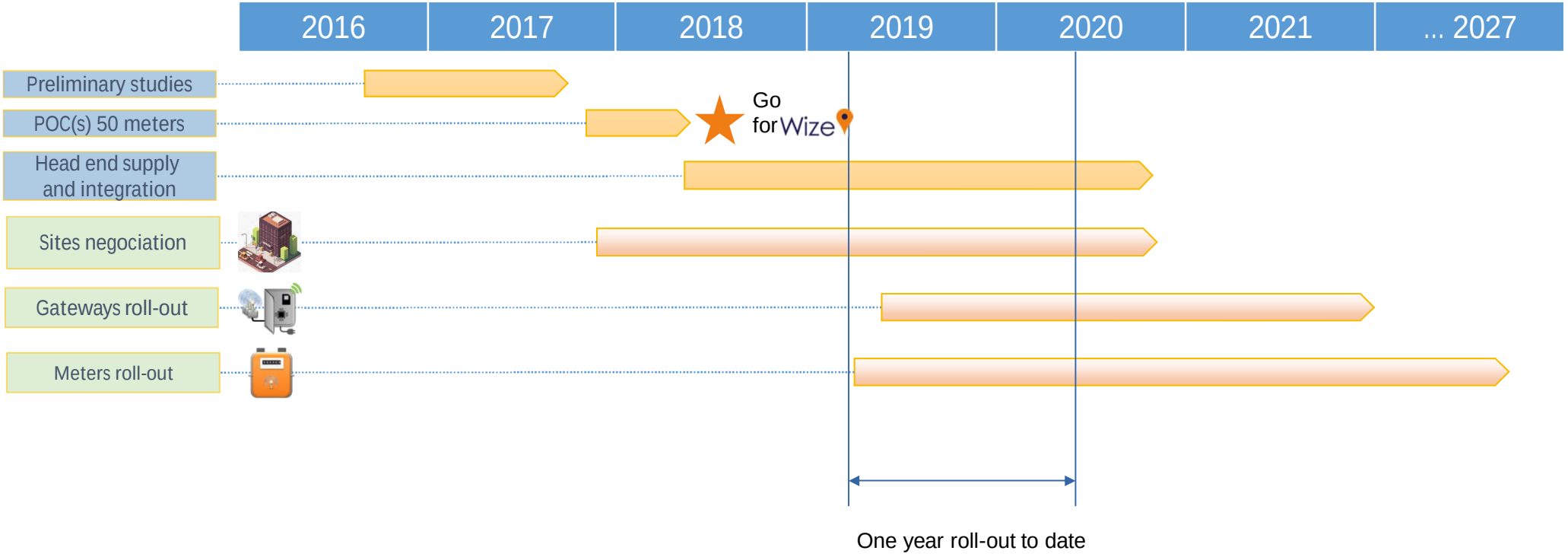


Wize infrastructures and operators: Bordeaux Métropole Energies (1/3)

- An example of a local Wize network : Bordeaux Métropole Energies
- Holding including REGAZ, Gaz distribution operator for 46 cities around Bordeaux (France)

Wize infrastructures and operators: Bordeaux Métropole Energies (2/3)

- What was is the actual schedule of Bordeaux Metropole Energies project ?



- Of course, just an example. Planning & roll-out phases remain specific to each project

Wize infrastructures and operators: Bordeaux Métropole Energies (3/3)

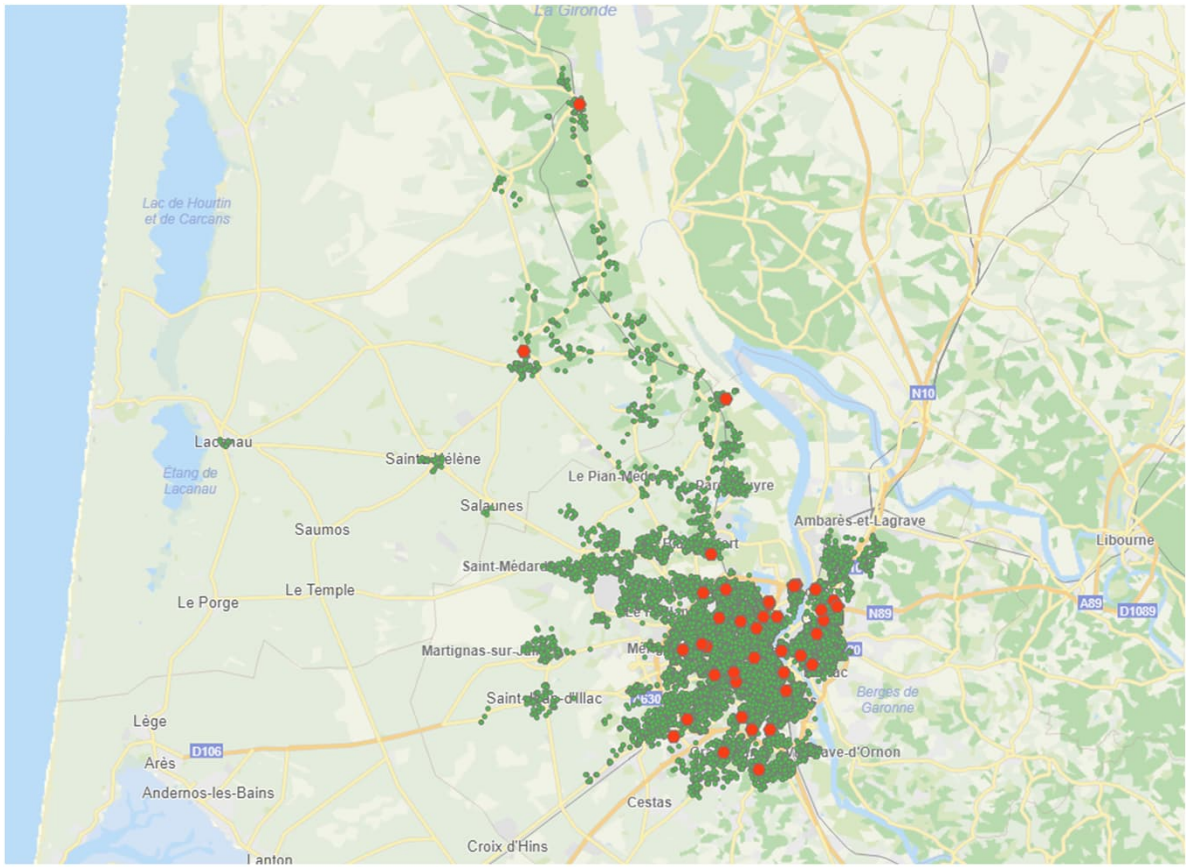
- Roll-out status and actual field experience ?

Overall roll-out targets

- 46 cities
- 210 000 meters (30 000/year)
- 80 to 100 gateways

Where are we, April 2020 ?

- ✓ 40 gateways installed (40%)
- ✓ 47 570 DATAGAZ meters installed
- ✓ 45 281 DATAGAZ meters well received !



Agenda

- Introduction
- Some RF basics
- LPWAN concept
- RF European regulations
- The Wize Alliance
- Wize system architecture
- Wize infrastructures and operators
- Synthesis : Wize vs LoRaWAN, NB-IoT or Sigfox
  - Link budget
  - Energy
  - Key differentiators
  - Which use case for Wize ?
- Q&A

Wize vs LoRaWAN, NB-IoT or Sigfox: Link budget (1/2)

- A tentative comparative analysis of the respective link budgets
- Figures could of course be discussed, just orders of magnitude for typical metering projects and typical chips

	LoRaWAN		SIGFOX		Wize		NB-IoT
	Uplink	Downlink	Uplink	Downlink	Uplink	Downlink	Balanced
Tx Power	13	23	13	23	27	24	
Sensitivity	-141	-137	-142	-123	-126	-119	
bit rate	300	300	100	600	2400	2400	10000
Link budget	154	160	155	146	153	143	160
Device antenna gain	1	1	1	1	-6	-6	1
Gateway antenna gain	4	4	4	4	3	3	8
Radiated link budget	159	165	160	151	150	140	169
Frequency correction	0	0	0	0	14	14	0
Free space performance	**159**	**165**	**160**	**151**	**164**	**154**	**169**
Typical indoor penetration loss	-35	-35	-35	-35	-25	-25	-35
Indoor performance	**124**	**130**	**125**	**116**	**139**	**129**	**134**

- In a nutshell : All solutions are more or less equivalent outdoor (at least uplink)…
- … but Wize has the best uplink link budget for indoor (5 to 14dB better)
- Even better for deep indoor, as well as with advanced Wize modulations (not currently in the standard)

Wize vs LoRaWAN, NB-IoT or Sigfox: Link budget (2/2)

- What means a 6dB or 12dB difference?
- +6dB = Twice the range = 4 times less concentrators = Nearly 4 times lower OPEX...
- +12dB = 16 times lower OPEX…

6dB difference

Wize vs LoRaWAN, NB-IoT or Sigfox: Energy

- What about energy usage for a typical device?
- Assumption : 15 bytes transmitted + 6 bytes in EN13757 header, and downlink reception capability

	LoRaWAN	SIGFOX	Wize	NB-IoT
Message length (bytes)	21	21	15	21
Max message length (bytes)	51	12	121	N/A
Number of messages	1	2	1	1
Overhead per message (byte)	18	8	30	N/A
Total transmitted (bytes)	39	29	45	N/A
bit rate (bps/s)	300	100	2400	10000
Transmit duration (s)	1,04	2,32	0,15	
Repetion factor	1	3	1	
Total transmit duration (s)	**1,04**	**6,96**	**0,15**	
Transmit current (mA)	33	33	300	
Transmit energy (mA.s)	**34,32**	**229,68**	**45,00**	
Reception window (s)	0,16	20	0,02	
Receive current (mA)	15	15	15	
Receive energy (mA.s)	2,40	300,00	0,30	
Total energy (mA.s)	36,72	529,68	45,30	100 to 600

- Energy side, LoRaWAN (SF12) and Wize (2400bps) are close
- NB-IoT 2 to 15 times worst (module and network dependant, would be better for larger frames)
- Sigfox significantly worst in this specific use case (more than 12 bytes, and systematic downlink capability)

Wize vs LoRaWAN, NB-IoT or Sigfox: Key differentiators

- More globally and for a smart metering use case (could of course be discussed!):

	LoRaWAN	SIGFOX	Wize	NB-IoT
Outdoor link budget	3	3	3	3
Deep indoor link budget	2	2	3	2
Bidirectional link budget	3	1	2	3
Low energy for metering	3	1	3	1
OTA upgrade support	2	1	3	3
Security	2	1	2	3
Open and standardized	2	3	3	3
Low device cost	2	3	2	1
Small size device support	3	3	2	3
In-band noise	1	1	2	3
Network capacity	1	2	2	3
Worldwide coverage	2	2	1	2
Private network support	3	2	3	1

- In a nutshell, Wize best choice for deep indoor, low power, OTA compatible, all-size networks
- But not for very small devices or worldwide roaming (to date...)

Wize vs LoRaWAN, NB-IoT or Sigfox: Which use case for Wize?

- Deep indoor, long range, low power, not too small, flexible networks, low cost : Plenty of good use cases!







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Q&A

Ask your questions in the chat area of Team

Agenda

- Introduction
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- Wize system architecture
- Wize protocol in depth
  - Modulations and RF performances
  - Link layer
  - Presentation layer
  - Security
  - Application layers
  - Commissionning support
  - Time and frequency management
  - Adaptative power and modulation control
  - OTA download
  - Wize versions & Future works
- Designing a Wize-compatible device
- Wize infrastructures and operators
- Synthesis : Wize vs LoRaWAN, NB-IoT or Sigfox
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Wize protocol in depth: Modulations and RF performances (1/3)

- Wize modulations: Defined by EN13757-4 standard
- 6 channels, 3 modulation formats: Fine-tuning of link budget & network capacity

Frequency channel number	Central frequency
100	169.406250 MHz
110	169.418750 MHz
120	169.431250 MHz
130	169.443750 MHz
140	169.456250 MHz
150	169.468750 MHz

Physical layer	Description
PHY-WM2400	Physical layer using mode EN13757-4 N2a-f at 2400bps
PHY-WM4800	Physical layer using mode EN13757-4 N2a-f at 4800bps
PHY-HSPEED	High speed specific physical layer for very densely populated zones, using a 12.5KHz channel similar to modes EN13757-3 N2a-f

- Typical conducted performances when using carrier grade equipments:

RX :
-126dBm (WM2400)
-123dBm (WM4800)
-120dBm (WM_HSPEED)

TX : +27dBm

147dB to 153dB

Path loss

146dB

TX : +27dBm

RX : -119dBm (WM2400)

Wize protocol in depth: Modulations and RF performances (2/3)

- What means « Path loss = 146dB »? Remember:

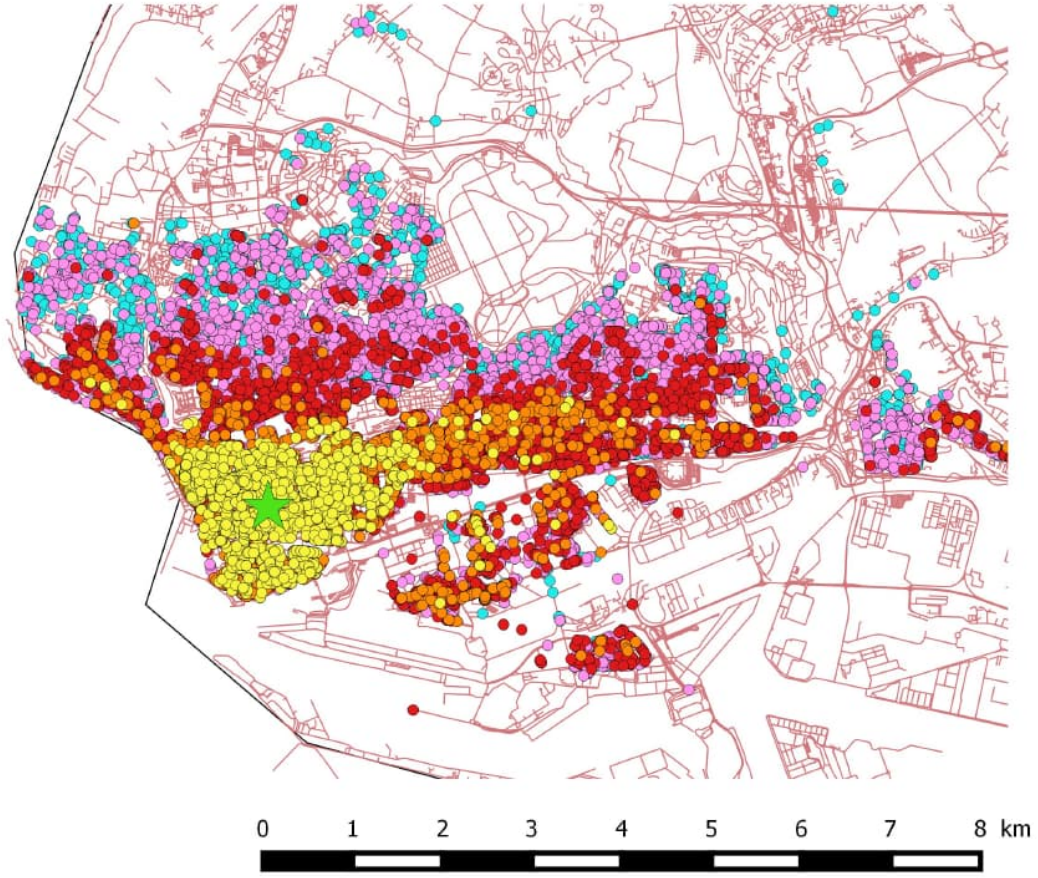
> Path loss (dB) = 32,4 + 20 log (F/1GHz) + 20 log (d/1m) + obstacles, polarisation, fading,...

- Hypothesis: device antenna gain = -8dBi, gateway antenna gain = +1dBi
- Open field? Pathloss = 146dB => Bidirectionnal link, up to 1250km (theoretical)
- Indoor? Add 25dB penetration loss and 7dB polarisation/fading losses: Still up to 30km

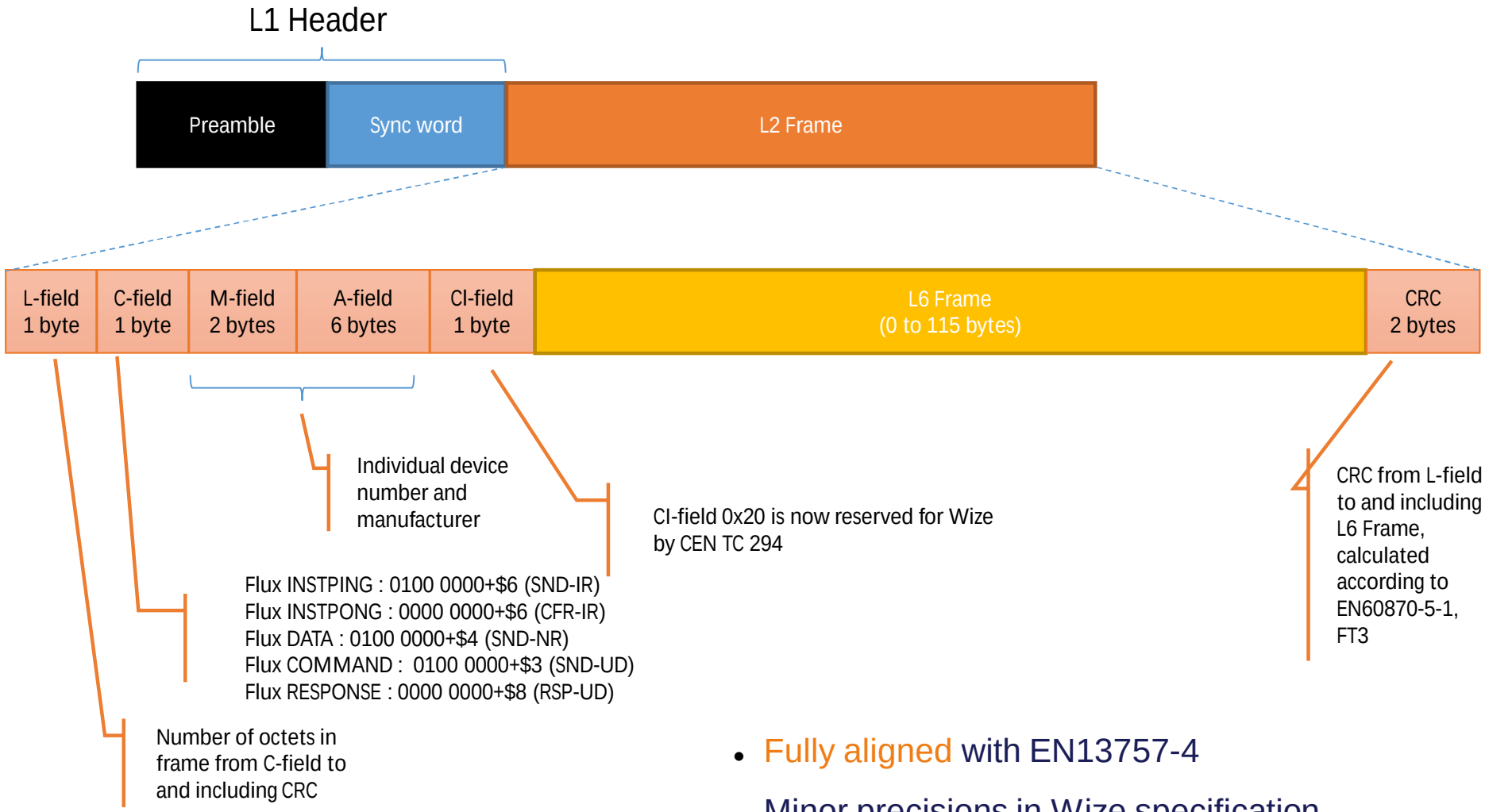
Is it real ?

Wize protocol in depth: Modulations and RF performances (3/3)

- Field tests do prove it! Example with GRDF network in Le Havre, coverage of a **single concentrator:**

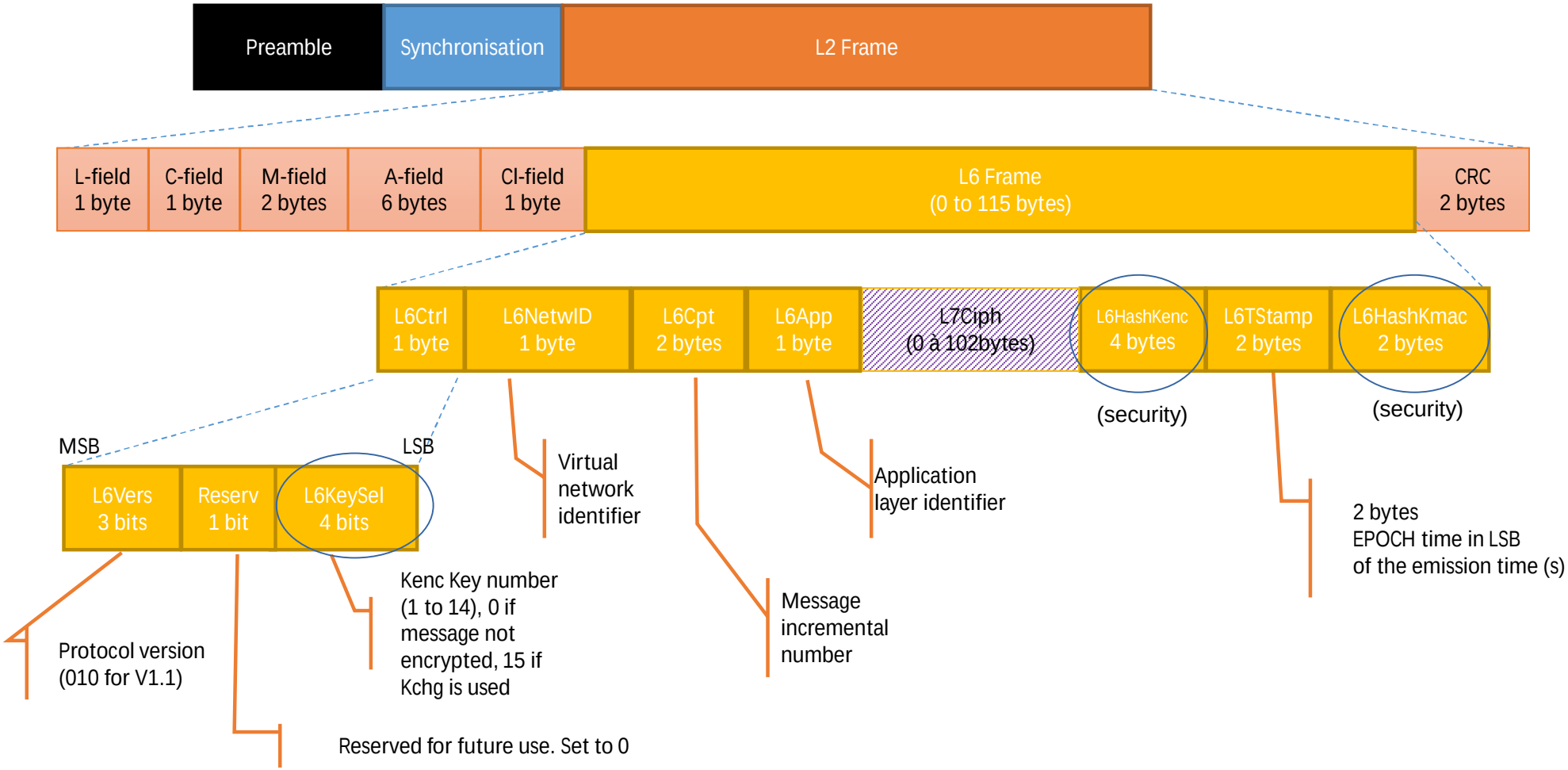


Wize protocol in depth: Link layer

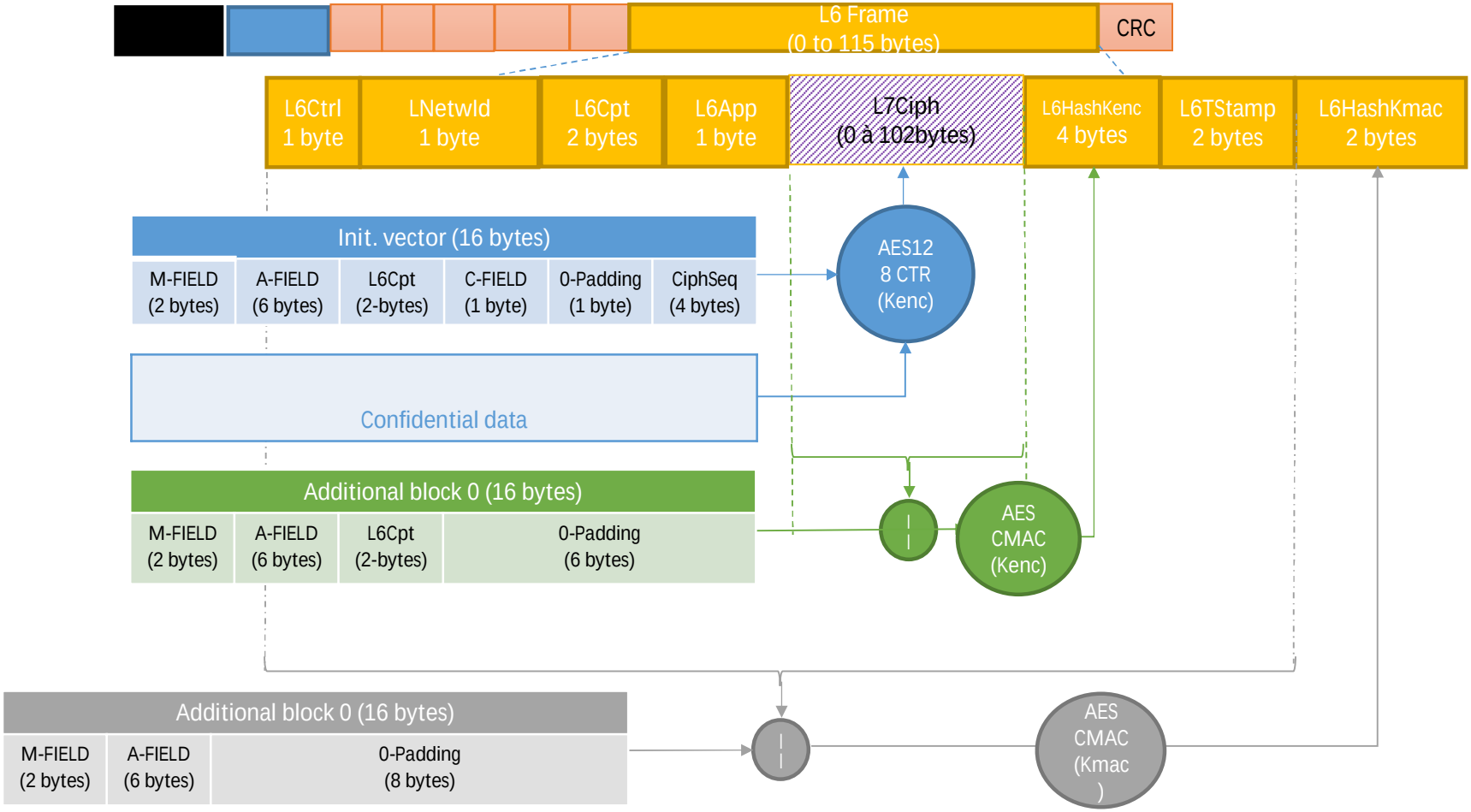


- Fully aligned with EN13757-4
- Minor precisions in Wize specification

Wize protocol in depth: Presentation layer (L6)



Wize protocol in depth: Security



Wize protocol in depth: Application layers (1/3)

- Application layer = format and semantic of the actual data
- Three mandatory application layers : APP-INSTALL, APP-ADMIN, APP-DOWNLOAD
- Optional application-oriented layer. Gaz and water meters defined by Wize Alliance, but open

COMMON APPLICATION LAYERS

Category	Application layer	Description	Specification	L6App code
GENERIC APPLICATION LAYERS (Mandatory)	APP-INSTALL	Connectivity test messages format, i.e. for the INSTPING and INSTPONG flows	See section 4.3	0x01
	APP-ADMIN	Device configuration and monitoring messages format	See section 4.4	0x02
	APP-DOWNLOAD	Software download messages format, i.e. for the DOWNLOAD flow	See section 4.5	N/A (*)
		Reserved for future use		0x03 to 0x0F
SPECIFIC APPLICATION LAYERS (optional)		Application layers dedicated to a given type of device and/or format of applicative message	See Wize Alliance web site for the list of currently specified specific application layers	0x10 to 0xFD (allocated by Wize Alliance)
PROPRIETARY		Can be used freely for experimental devices or proprietary application-level protocols.		0xFE
RESERVED		Reserved for future use		0xFF

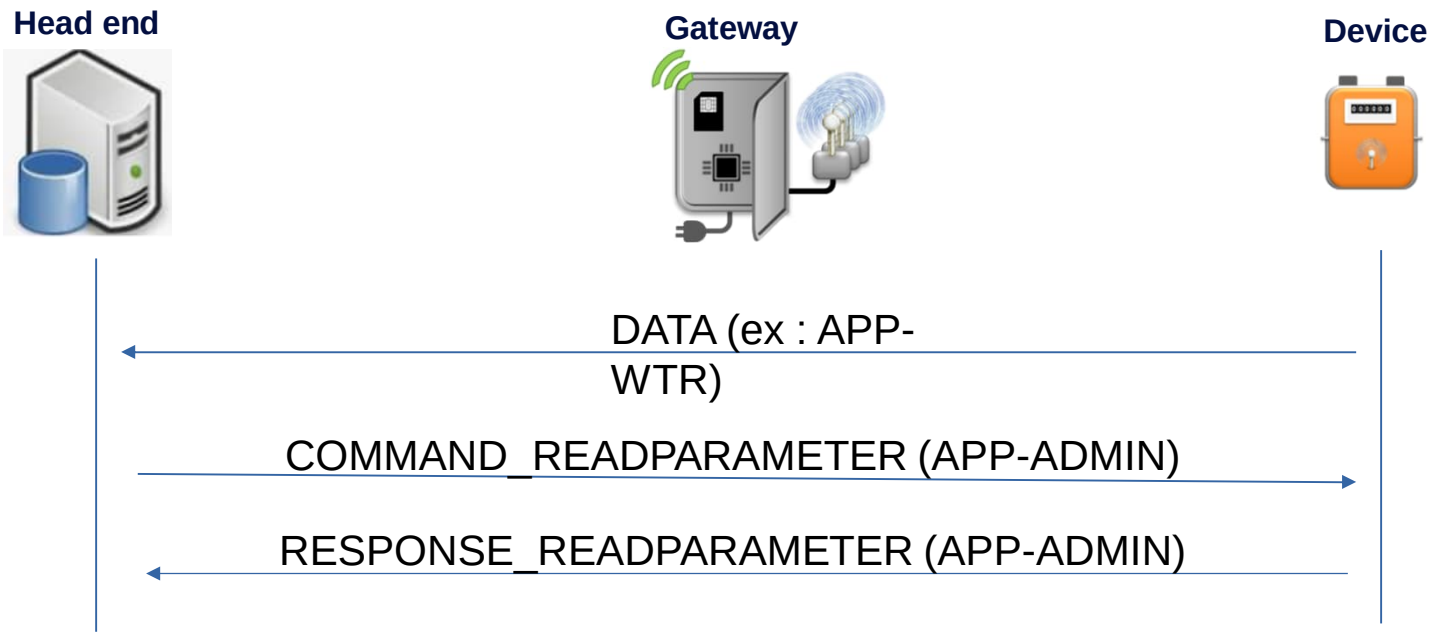
INSTPING
INSTPONG

COMMAND_READPARAMETERS
COMMAND_WRITEPARAMETERS
COMMAND_WRITEKEY
COMMAND_ANNDOWNLOAD
COMMAND_EXECINSTPING

Application layer	Description
APP-METER-GAS	Specific application layer for gaz smart meters
APP-METER-WTR	Specific application layer for water smart meters

Wize protocol in depth: Application layers (2/3)

- APP-ADMIN: A very flexible mechanism, used in particular for device configuration
- Mandatory parameter dictionnary defined by Wize, extendable for any device needs



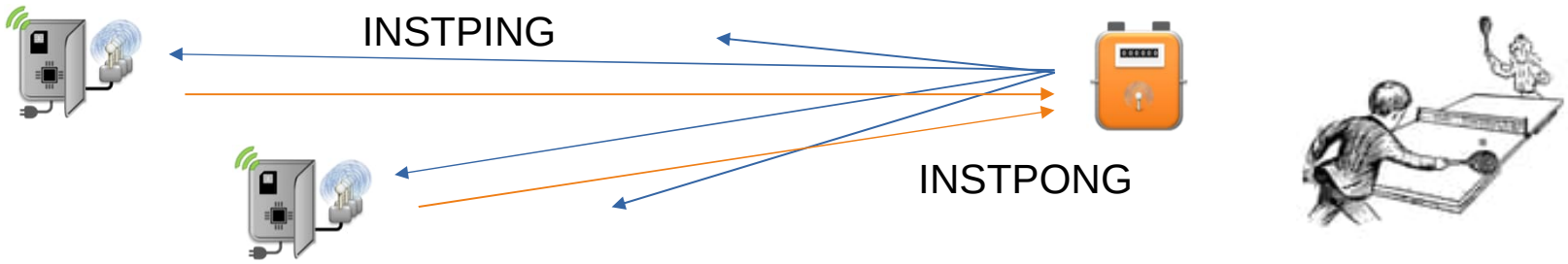
Wize protocol in depth: Application layers (3/3)

- See « Common Application Layers » for detailed specification of these messages and dictionnary

Id	Parameter name	Description	Size (bytes)	Mode	L/R	Coding	Default value
01	VERS_HW_TRX	Hardware version number of the device (or transceiver for a remote module)	2	R	L/R	Byte 1 : Version, Byte 2 : Revision	As per MANUFACTURER
02	VERS_FW_TRX	Software version number run by the device (or transceiver for a remote module)	2	R	L/R	Byte 1 : Version, Byte 2 : Revision	As per MANUFACTURER
03	DATEHOUR_LAST_UPDATE	Date/time of the last successful firmware download	4	R	L/R	EPOCH encoded on 32 bits and corresponding to the number of seconds since 1st January 2013 at 00:00: MSBs first (big endian)	00000000
08	RF_UPLINK_CHANNEL	Frequency channel to be used for all uplink message transmissions	1	R/W	L/R	See Regional Parameters document in the corresponding frequency band for parameter value.	See Regional Parameters document.
09	RF_DOWNLINK_CHANNEL	Frequency channel to be used for all message receptions (except firmware download)	1	R/W	L/R	See Regional Parameters document in the corresponding frequency band for parameter value.	See Regional Parameters document.
0A	RF_UPLINK_MOD	Modulation to be used for all uplink message transmissions	1	R/W	L/R	See Regional Parameters document in the corresponding frequency band for parameter value.	See Regional Parameters document.

Wize protocol in depth: Commissionning support

- A mandatory application layer for standardized installation and commissionning : APP_INSTALL
- Managed by the concentrator, no involvment of the head end, therefore authentification but no encryption



INSTPING

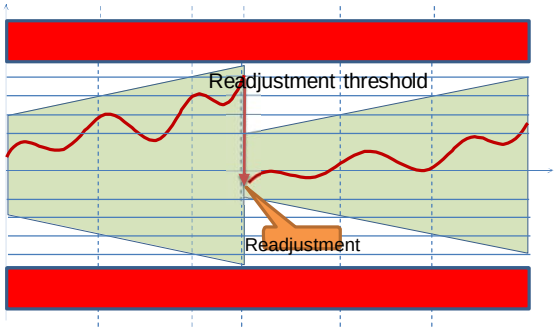
Byte	Description	Comments
1	L7DownChannel	Frequency channel to be used by the gateway for the response (same coding as RF_UPLINK_CHANNEL parameter, see Regional Parameters document)
2	L7DownMod	Modulation to be used by the gateway for the response (same coding as RF_UPLINK_MOD parameter, see Regional Parameters document)
3	L7PingRxDelay	Value of the current PING_RX_DELAY parameter of the device, see APPENDIX A.
4	L7PingRxLength	Value of the current PING RX LENGTH parameter of the device, see APPENDIX A.

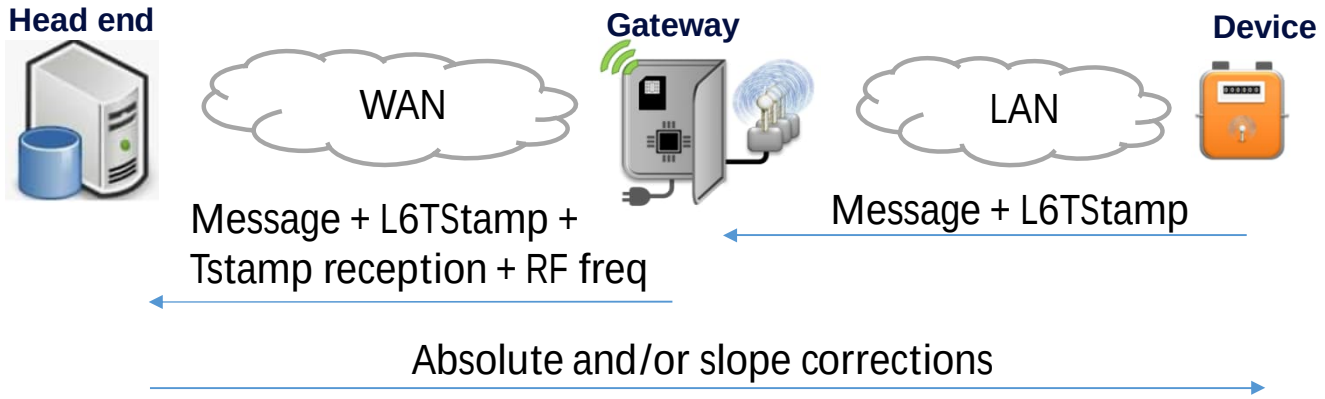
INSTPONG

Byte	Description	Comments
1	L7ConcentId	Gateway numerical identification: same as the ID Used in WAN messages. MSBs first
2		
3		
4		
5		
6		
7	L7ModemId	Numerical identification of the LAN modem that has received the message
8	L7RSSI	Reception RSSI by the LAN modem of the INSTPING message transmitted by the device. Value in steps of 0.5dBm, from 0 (-147.5dBm) to 255 (-20dBm)

Wize protocol in depth: Time and frequency management

- Time and carrier frequency adjustment though APP-ADMIN
- Allows to measure and correct long term drift of devices, thus keeping device cost low
- Carrier frequency : Absolute correction ; Time/clock : Absolute and drift correction

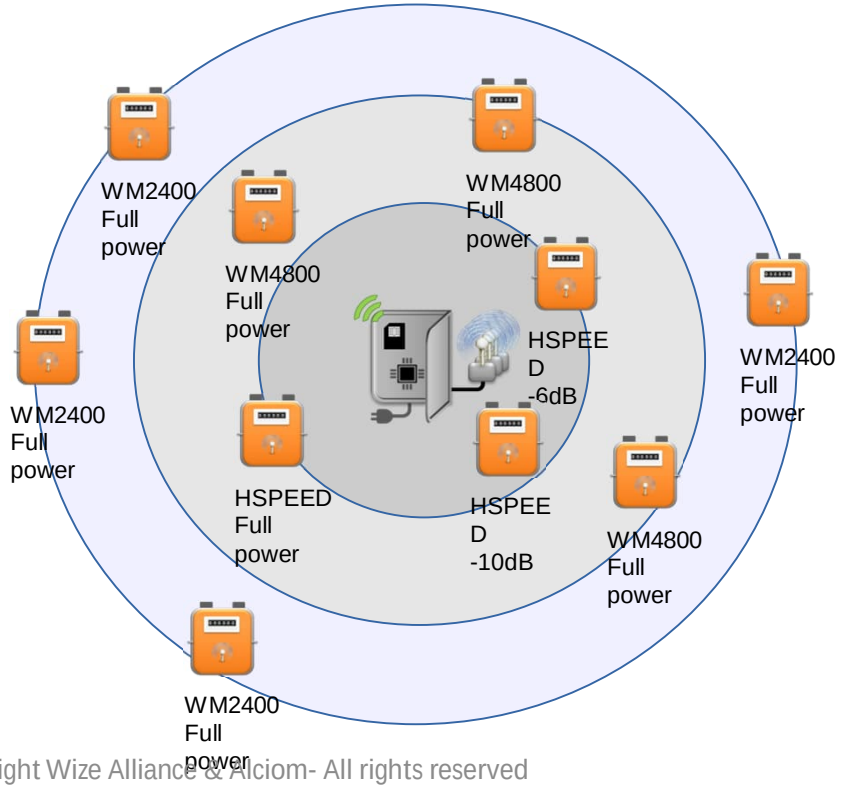


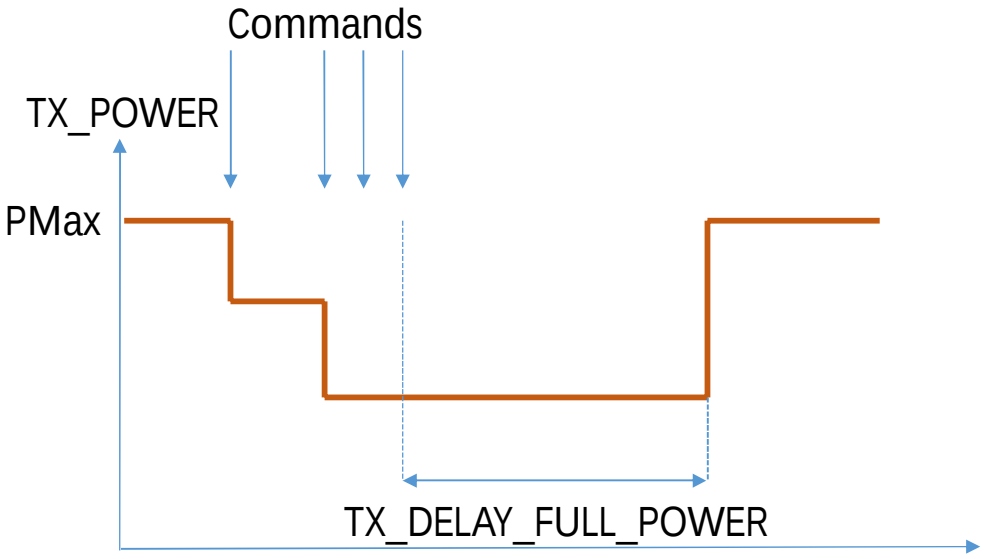


- Measurement made by gateway & LAN modem
- Correction algorithm either on head system or on device

Wize protocol in depth: Adaptative power and modulation control

- Wize supports static and dynamic configuration of device power and modulation rate
- Dynamic configuration implemented on the head end, through APP_ADMIN - Optimize network capacity
- Automatic fallback to default setting if no downlink for a long time

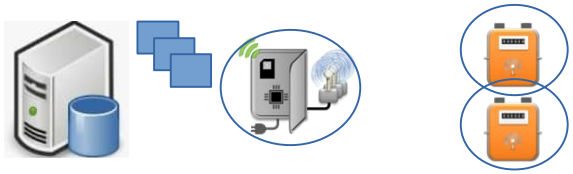




Wize protocol in depth: OTA download (1/4)

- Specific multicast mechanism defined by Wize for other-the-air (OTA) software upgrades
- Four step process :

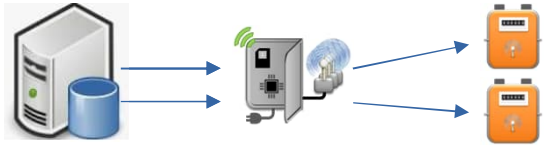
1 : Planification



Head end decide :
- which devices must be upgraded
- which referent gateway & LAN modem to use

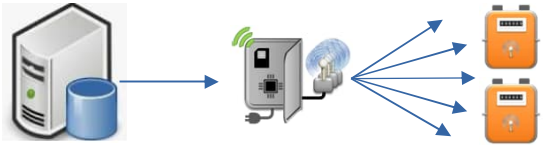
Manufacturer splits the firmware in chunks of up to 210B

2 : Invitation



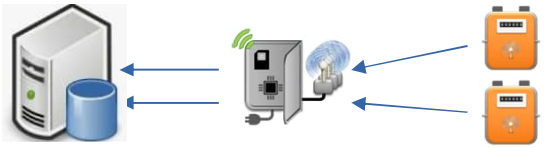
Downlink COMMAND_ANNDOWNLOAD message sent to each device (APP-ADMIN).
Defines the appointments and provides Klog

3 : Broadcast



At appointment time (several sessions) :
- All devices switch to receive mode simultaneously
- Head end ask gateway to broacast all chunks
- Devices gets some chunks...

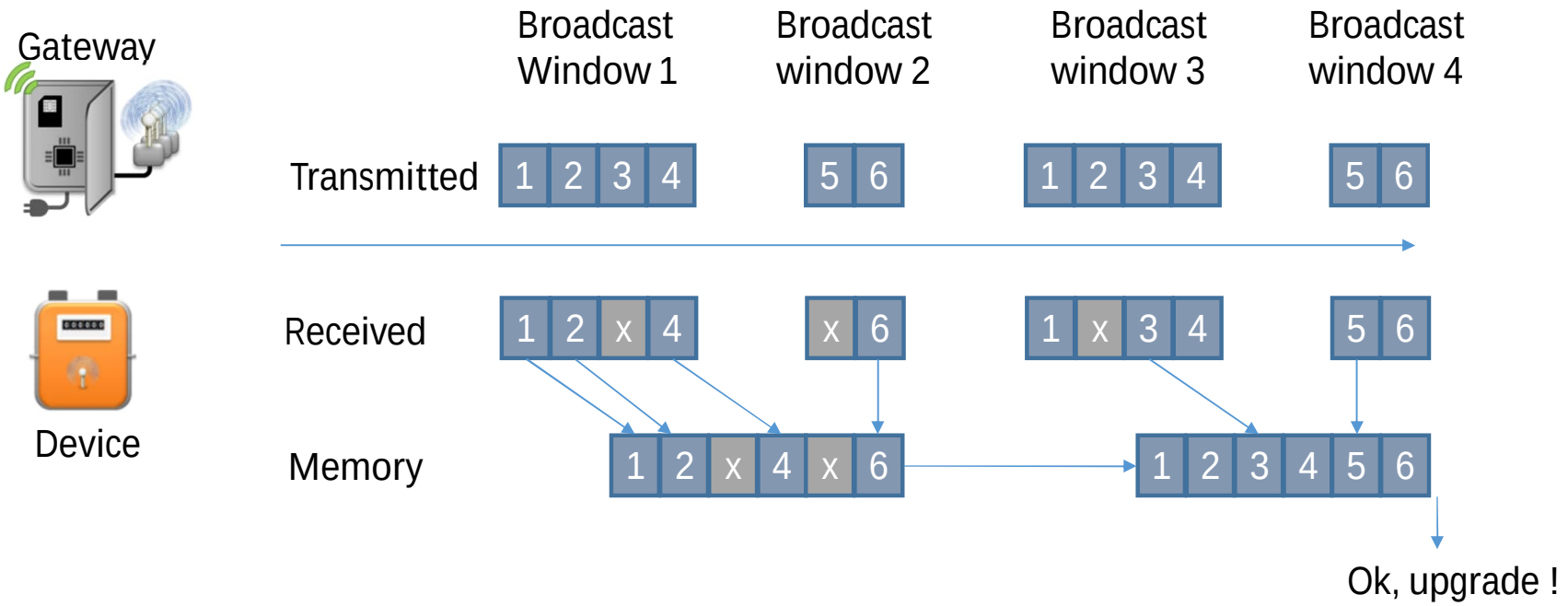
4 : Confirmation



When a device has got all chunks :
- Devices check the integrity of the firmware
- Then upgrades itself and sends a confirmation

Wize protocol in depth: OTA download (2/4)

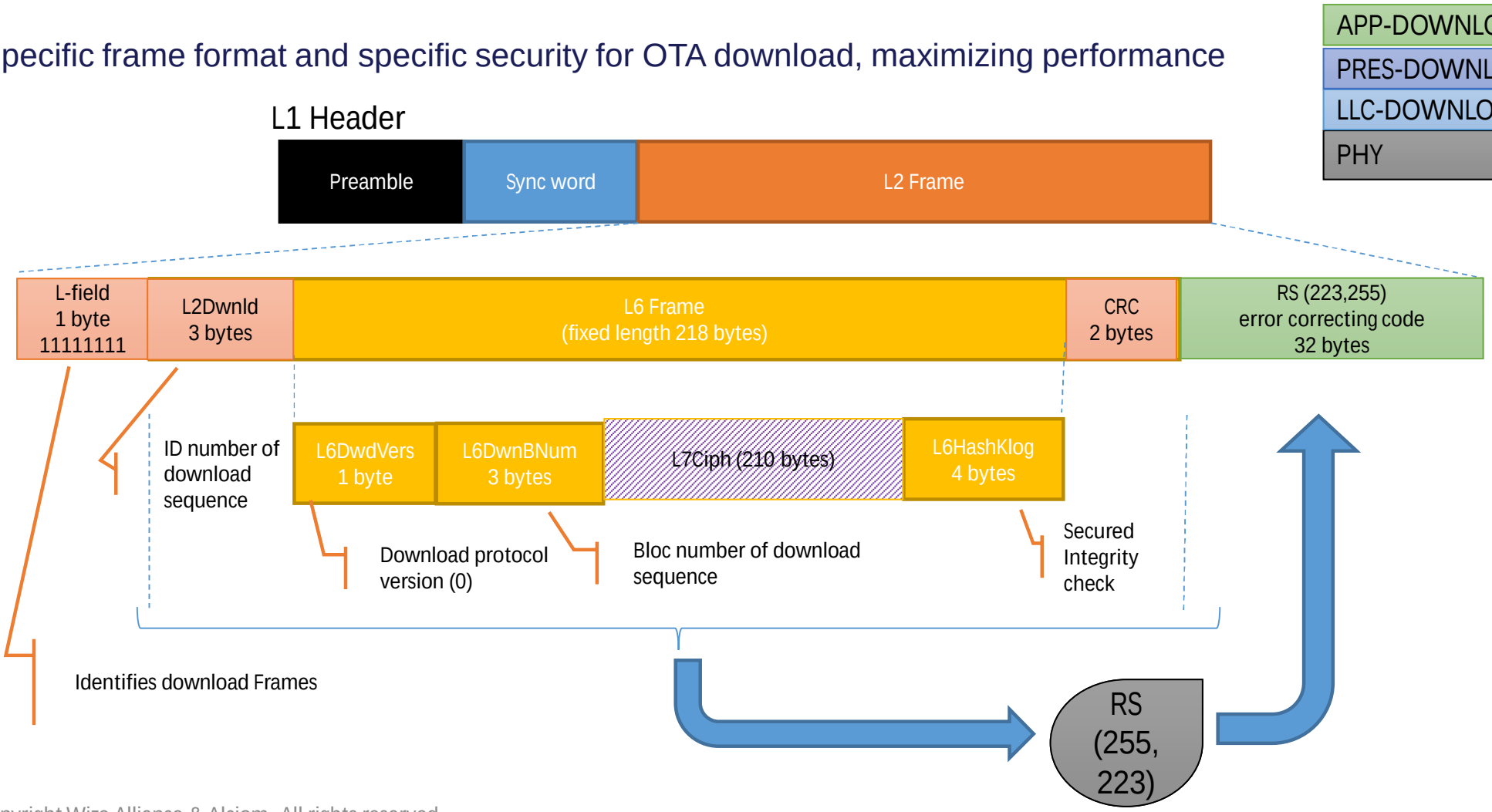
- A very flexible mechanism, the head end can simply broadcast always the same content ,
- or can optimize duty cycle and transmission windows



- Field tested by GRDF on tens of thousands of devices : 99 % successful updates the first night !

Wize protocol in depth: OTA download (3/4)

- Specific frame format and specific security for OTA download, maximizing performance



Wize protocol in depth: OTA download (4/4)

- What is defined by the COMMAND_ANNDOWNLOAD message?

Byte	Description	Comments
1	L7CommandId	Fixed value $30 ID COMMAND_ANNDOWNLOAD
2	L7DwnldId	Identification number of the software download sequence (the same ID is then used in the L2Dwnld field on effective download of the software, see **Erreur ! Source du renvoi introuvable.**) MSBs first
3		
4		
5	L7Klog	Encryption key used for software download 128 bits, MSBs first
…		
20		
21	L7SwVersionIni	Initial software version of the device MSBs first
22		
23	L7SwVersionTarget	Final software version of the device MSBs first
24		
25	L7MField	Indication of the device MANUFACTURER as per EN13757-4 (LSBs first)
26		
27	L7DcHwId	Identification of the hardware version of the device MSB first
28		
29	L7BlocksCount	Number of software download blocks
30		
31	L7ChannelId	Identification of the software download channel (same coding as RF_UPLINK_CHANNEL parameter, see Regional Parameters document)
32	L7ModulationId	Identification of the modulation used for software download (same coding as RF_UPLINK_MOD parameter, see Regional Parameters document)
33	L7DaysProg	First broadcasting date, encoded over 4 bytes as EPOCH. The device must check : Current_epoch-(10x24x3600)<= L7DaysProg and L7DaysProg <= Current_epoch+(60x24x3600). If not error is returned
34		
35		
36		
37	L7DaysRepeat	Number of broadcasting days (From 1 to 15).
38	L7DeltaSec	Time between the transmission of the two data blocks from beginning to beginning in tele distribution, in seconds According to the value of parameter L7ModulationId : • The parameter of L7DeltaSec can take on a value of 10 to 255 to 2400 bauds, and of 5 to 255 to 4800 bauds • The recommended value of L7DeltaSec is of 10 (10 seconds) to 2400 bauds, and of 5 (5 seconds) to 4800 bauds
39	HashSW	Integrity check of the complete software. This field is defined by the MANUFACTURER, transmitted in the software download notification by the Head-End system, and checked by the software developed by the MANUFACTURER once all the blocks for a software download have been received
40		
41		
42		

Wize protocol in depth: Wize versions and future works

- Initial version (2017)
- Already including OTA, APP-INSTALL, adaptative control, security, ...

- Minor update and improvements (6/2019)
- Segmentation of the specification (core + regional parameters + application layers)
- Clarification of L6App and L6NetwId for easier interoperability and openess

In study and/or planned for next versions :

- Advanced uplink modulations for ultra-deep indoor (already field tested, 8dB improvement)
- Advanced downlink modulation and coding for deep indoor bidirectional links
- Virtual networks and extended roaming support with segmented security
- Better alignment with new EN13757 version (EN13757-4:2018)
- Walk-by/Drive-by support (trials planned for Q2 2021)

Agenda

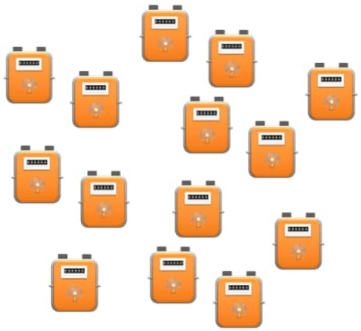
- Introduction
- Some RF basics
- LPWAN concept
- RF European regulations
- The Wize Alliance
- Wize system architecture
- Wize protocol in depth
- Designing a Wize-compatible device
  - Asymetrical hardware
  - Integrated transceivers
  - Wize protocol stacks
  - Wize modules
  - And the antenna ?
  - Wize design houses
  - Off the shelf Wize products
- Wize infrastructures and operators
- Synthesis : Wize vs LoRaWAN, NB-IoT or Sigfox
- Q&A

Designing a Wize-compatible device: Asymetrical hardware

- Like all LPWAN and cellular networks, Wize hardware platforms are different for device and gateway
- Allows to maximize performance while reducing overall CAPEX

Tens to thousands of gateways

- Site acquisition and maintenance is key, so high performance is a must
- Installed on high points, so high immunity to blockers is critical
- Unit hw cost is less an issue
- Energy must be minimized but comes from the main



Thousands to millions of devices

- Unit hw cost is heavily critical, especially in metering
- Battery life is critical
- Performances should be adequate
- RF immunity is less an issue

Designing a Wize-compatible device: Integrated transceivers (1/2)

- Several low cost sub-GHz integrated transceivers are Wize compatible
- Some examples, already industrially tested (but others could be used too...):

Texas Instruments
CC1120

Analog Devices
ADF7030

Silicon Labs
SI4460

Silicon Labs
EFR32FG14

2$ to 4,50$ (1000)

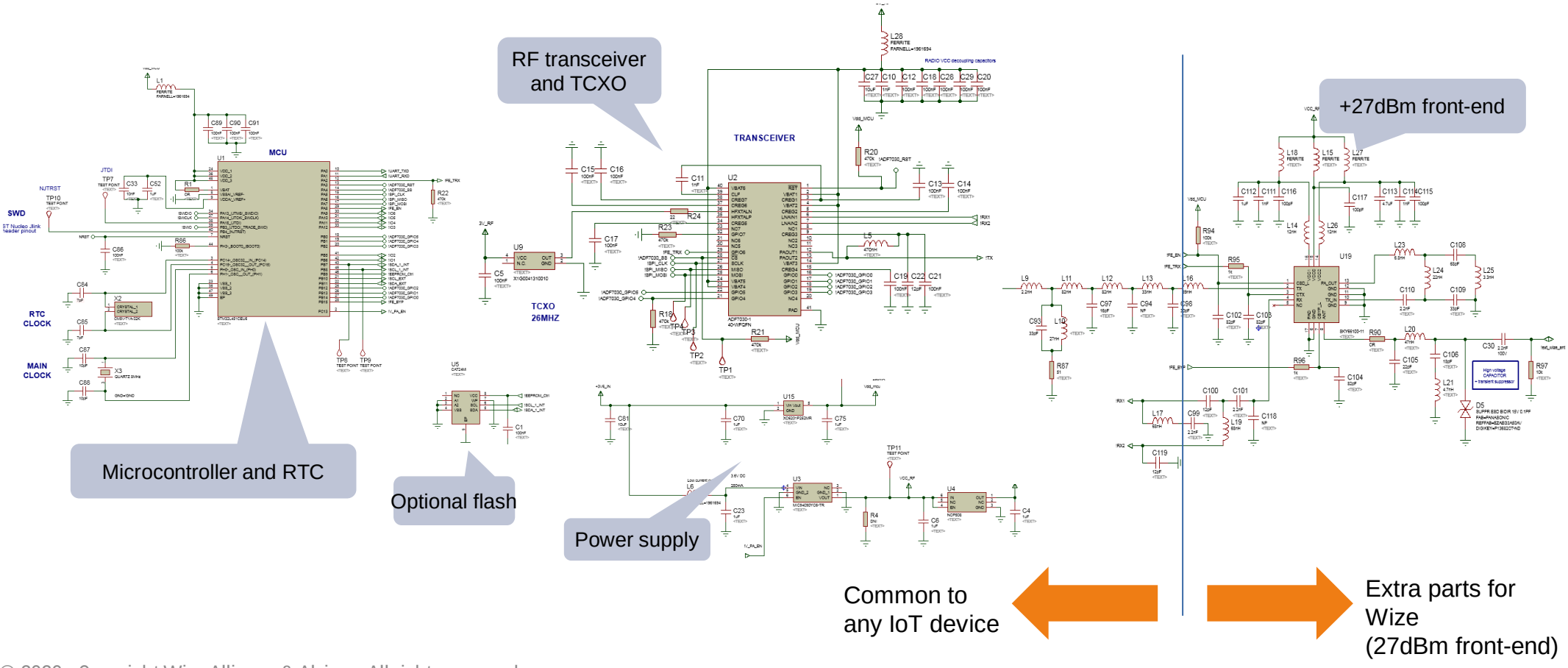
- Dedicated 169MHz front-end amplifiers available (Skyworks)

Product	New	PDF	RF Frequency (MHz)	Rx Insertion Loss (dB) Typ.	Rx Gain (dB) Typ.	Tx Gain (dB)	Rx NF (dB) Typ.	Saturated Output Power (dBm) Typ.
SKY66121-11	NEW	PDF	169-170	0.9	TBD	TBD	TBD	31
SKY65367-11		PDF	169-170	0.7	-0.7	35	-0.7	30
SKY66100-11		PDF	169-170	0.4	-0.5	30	–	24

1,50$ (1000)

Designing a Wize-compatible device: Integrated transceivers (2/2)

- Circuit design for Wize a marginaly more complex than 868MHz, due to higher transmit power. Example:



Designing a Wize-compatible device: Wize protocol stacks (1/2)

- Using an integrated transceiver « from scratch » : What about the Wize protocol stack (firmware)?
- Three options to date:

Code it yourself

DIEHL Metering Sagemcom Itron

- Not so complex for basic Wize, more challenging for OTA
- Low level layer (EN13757-4/N) already available from chip suppliers (SiLabs AN805, Texas Instruments AN121, STM AN4772, ADI AN1285)
- Already millions of devices on-field using this approach...

Use Wize SoC

suez

- Fully validated Wize stack proposed by SUEZ on EFR32 system-on-chip
- Two versions : Wize core protocol, or Wize + water application layer
- Chip already available through ARROW France
- Free licence for generic protocol, royalties for water app layer
- Professional service support available from SUEZ SMART SOLUTIONS

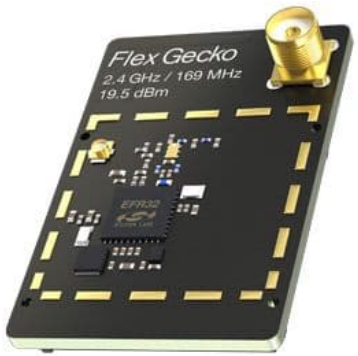
Use open-source

GRDF
GAZ RÉSEAU DISTRIBUTION FRANCE

- Open-source Wize core stack + framework in development by GRDF
- Will initially be available on STM32L4 + ADF7030 hardware platform
- V1 release scheduled Q4 2020 for beta testers
- Will be compatible with Wize'Up open-hardware module (ALCIOM)

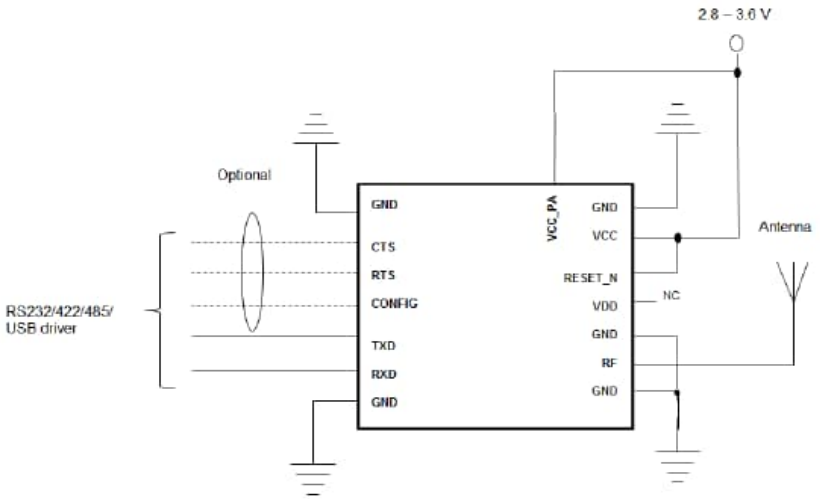
Designing a Wize-compatible device: Wize protocol stacks (2/2)

- Focus on the stack developped by SUEZ SMART SOLUTIONS, **available now** !
- **Free licence** (no royalty) – options for maintenance services
- Based on a standard **low cost SoC**
- One metering product development at finalization stage, several generic product development on-going
- Demo board from SiLabs are available
- A development kit proposed soon



Designing a Wize-compatible device: Wize modules (1/2)

- Simpler solution for low to medium volume applications: Wize module from Radiocrafts, two variants
- RC1701HP-WIZE: Incl. core Wize stack, application layer on external MCU (UART link). No built-in OTA
- RC1702HP: Plaftorm module, could be customized to include Wize stack + application, incl OTA if needed



Radiocrafts
Embedded Wireless Solutions

RC1701HP-WIZE

Wize protocol RF Transceiver Module at 169 MHz

ADVANCE INFORMATION
This document contains information on a new product. Specifications and information herein are subject to change without notice.

Product Description
The RC1701HP-WIZE is part of a compact surface-mounted Wireless M-Bus module family that measures only 12.7 x 25.4 x 3.7 mm. The module contains a communication controller with embedded Wize protocol (v.1.1) as specified by the Wize Alliance based on Wireless M-Bus (EN 13757-4) operating at 169 MHz with 500 mW output power. The module is pre-certified for operation under the European radio regulations.

Applications
- LPWAN
- Smart City
- Industrial IoT
- Utility meters (water, gas, electricity)
- Smart sensors

Digi-Key ELECTRONICS

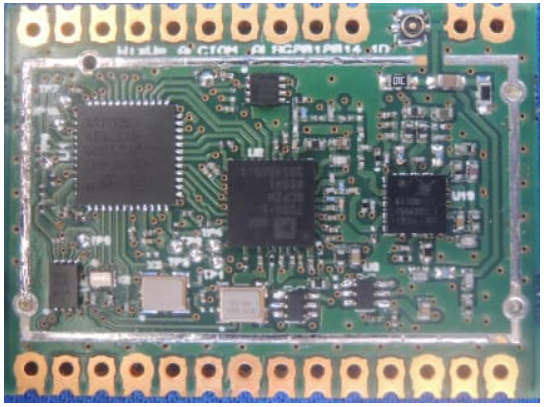
All prices are in EUR.

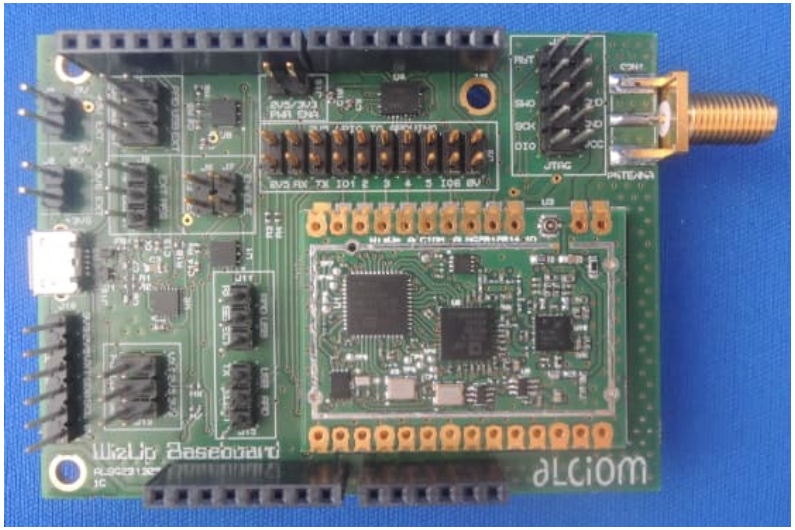
PRICE BREAK	UNIT PRICE
1	26,07000
10	24,06200
25	22,05640
100	20,38560
250	19,38304
500	18,04628
1 000	17,37789
5 000	16,37532

- Modules and evaluation kit off-the-shelf from Radiocrafts
- Arduino-compatible versions and evaluation kits also availabe from AllWize (RC1701 based)

Designing a Wize-compatible device: Wize modules (2/2)

- Wize'Up, open hardware module in development by ALCIOM
- Joint development with GRDF open source Wize stack
- No royalties, schematics & routing will available be under CERN OHL licence
- Assembled modules, eval board & design/customization services proposed by ALCIOM
- HW/SW integration and beta customers Q4 2020...





Designing a Wize-compatible device: Wize design houses

- Experienced design houses and end-to-end solution providers are member of the Wize Alliance
- Don’t hesitate to ask for help for your projects...

Designing a Wize-compatible device: Off the shelf Wize products (1/2)

- Off-the-shelf or customizable Wize-enabled products are available from member of the Wize Alliance too
- Somes examples:

Sagemcom

Itron

sigrenEa
CONNECTIVITY FOR SMART RECYCLING

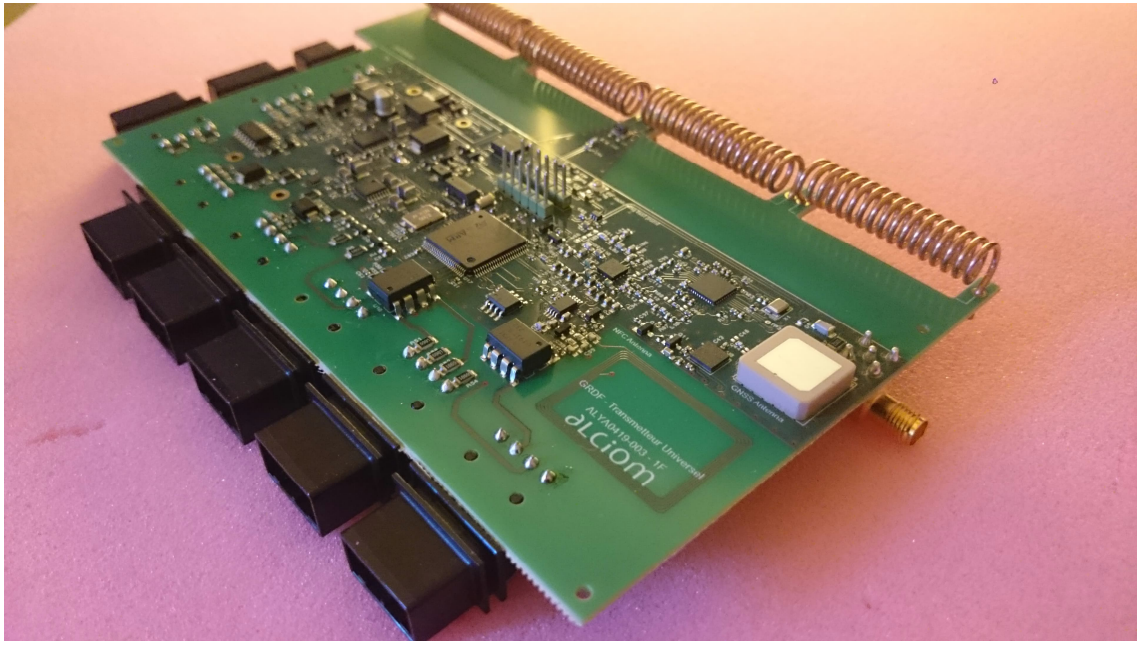
DIEHL
Metering

Enless Wireless
M2M & IoT Wireless Expert

Designing a Wize-compatible device: Off the shelf Wize products (2/2)

- Example of a semi custom design by GRDF: The Universal Transmitter

- External or internal power supply
- External or internal antenna
- +27 dBm maximum Transmit power.
- Two TOR inputs and one outpout.
- Two 4-20 mV analog inputs.
- One 0-10 mv analog input.
- I2C Interface.
- 422/485 serial interface with Modbus support.
- One shock detector.
- Programmable by NFC.
- Option : QZSS, DGPS, SBAS,
- (WAAS/EGNOS/MSAS/GAGAN) support,
- ATEX Ready
- Open source Wize Stack



More information on **www.wize-alliance.com**

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