Actility
Connecting with intelligence

Building Massive IoT Episode 1

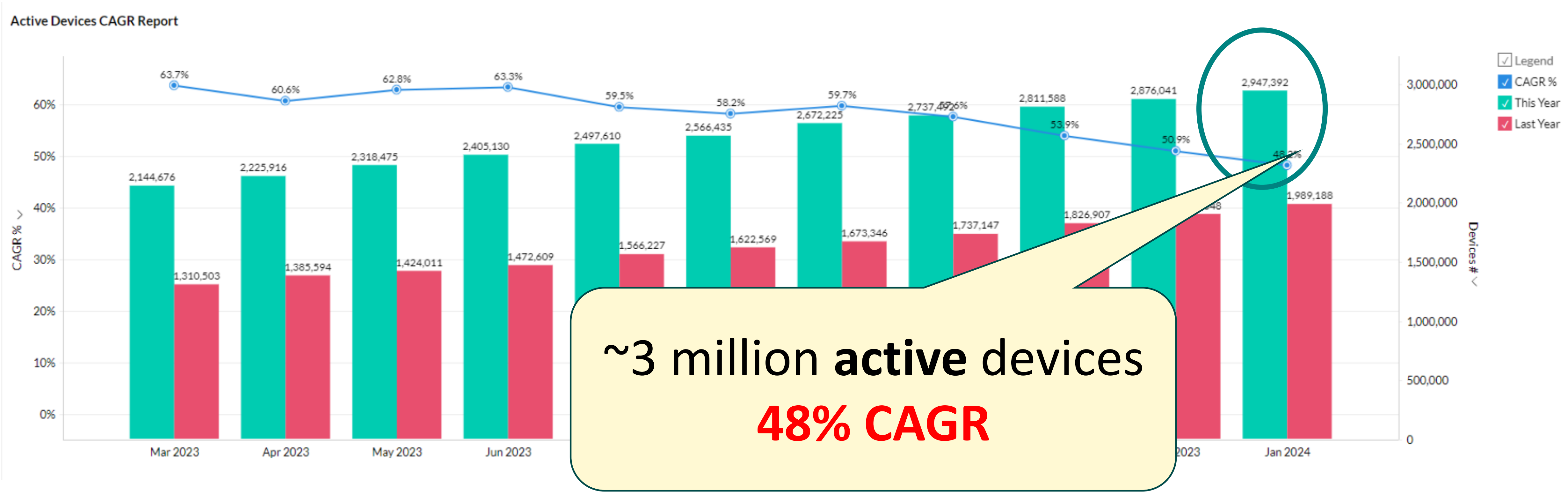
February 2024


Video:
Building Massive IoT
Episode 1
In 2015, LoRaWAN technology begar
with the publication of its first standar on
and the establishment of the LoRa Alliance.
LoRaWAN™
Actility
APIK
Connected Conservation FOUNDATION
Watch on YouTube

Network KPIs

LoRaWAN Active Devices

- Monthly cumulated total
- Previous year cumulated total



Aggregate growth index built from selected public operator data.

Last month data point not significant (not factoring full month)

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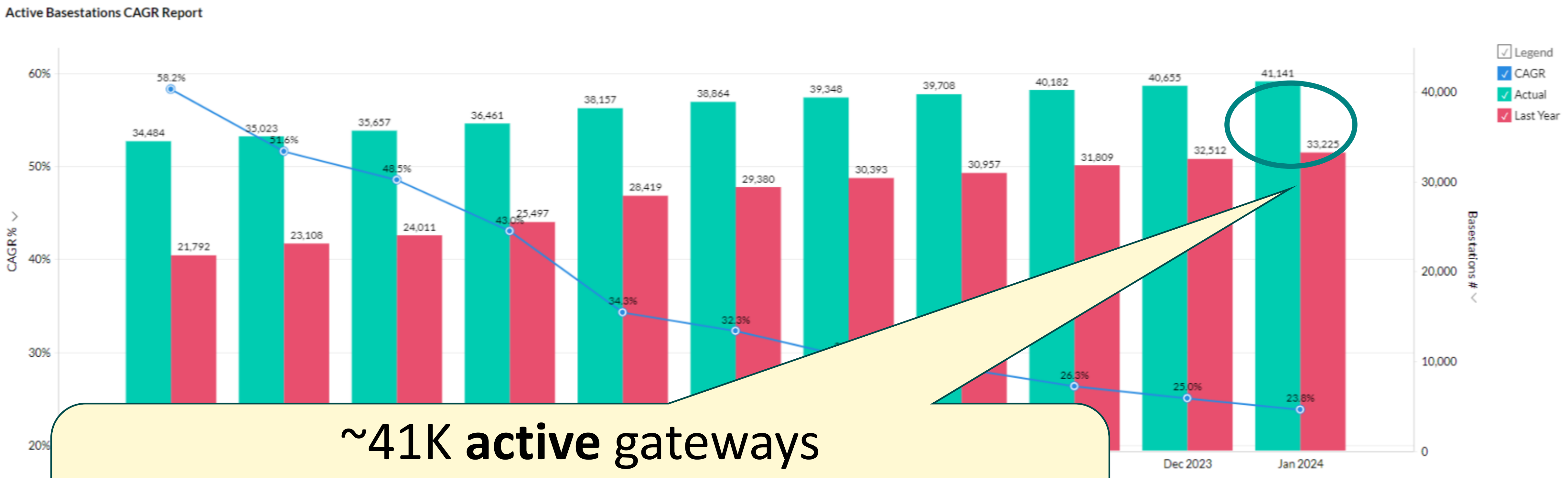
Network size evolution

- Monthly cumulated total
- Previous year cumulated total



~41K **active** gateways

23% CAGR → Covid precaution stocks were used in 2023, bounced expected in 2024

erator data.

Last month data point not significant (not factoring full month)

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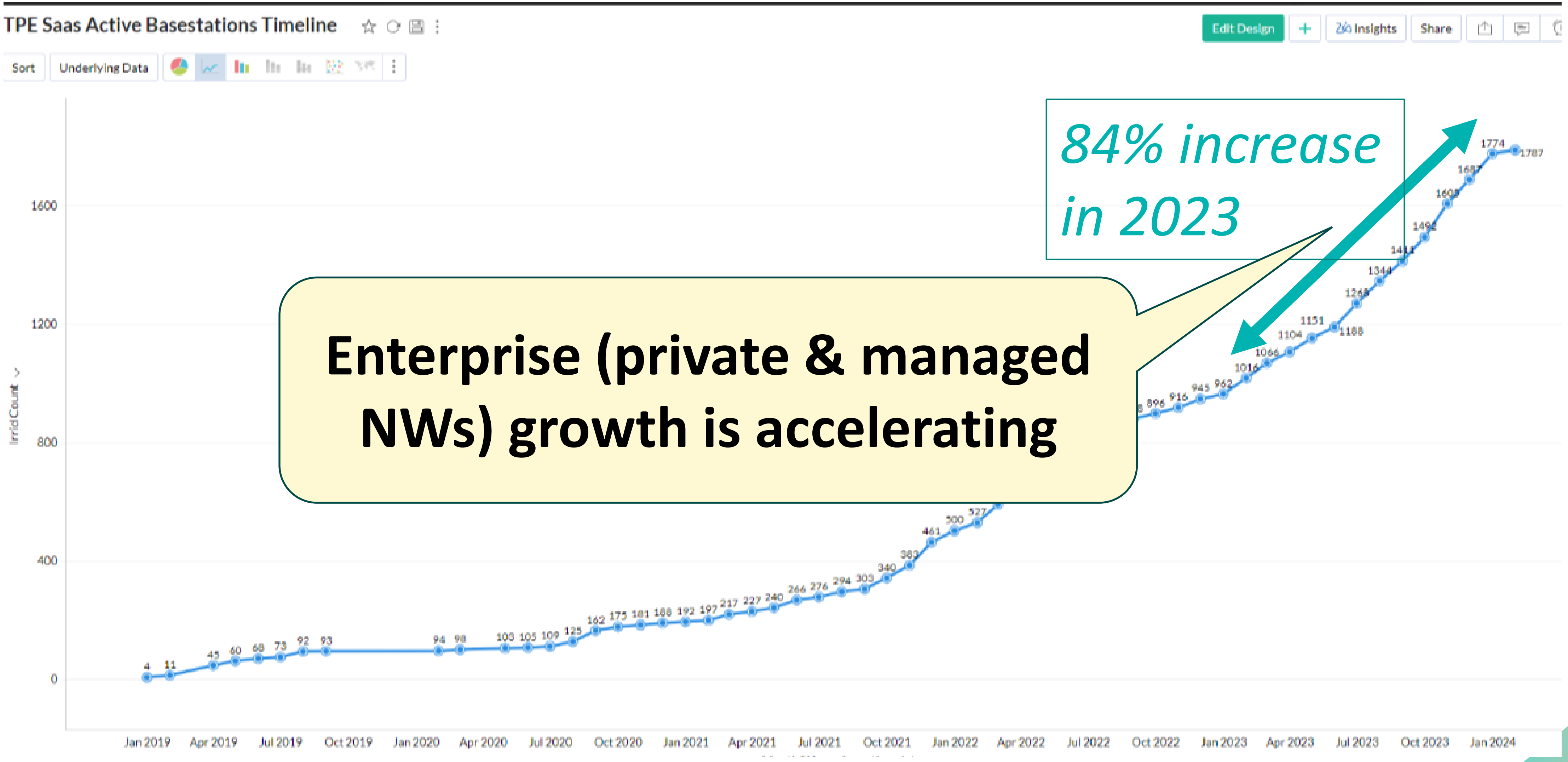
Network size evolution : Enterprise only



84% increase in 2023

Enterprise (private & managed NWs) growth is accelerating

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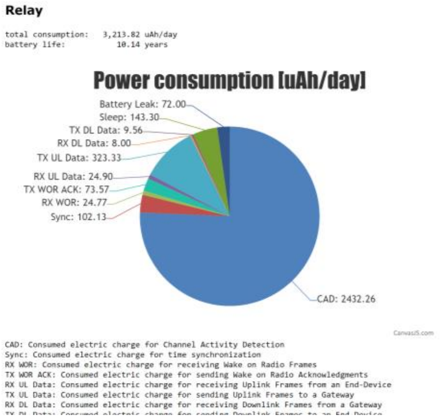
New in 2023

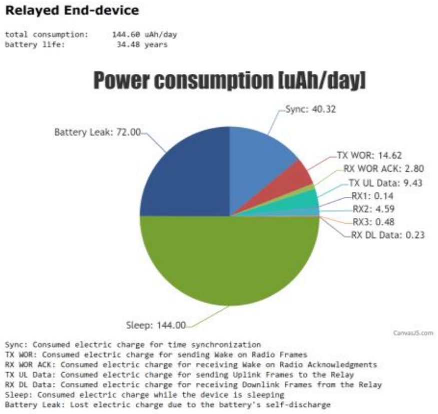
LoRaWAN Relays

A game changer for utilities and smart-building

- Much lower OPEX/CAPEX to cover the 10% “hard to reach” meters
- Addresses low-density sensing in small buildings and hard to reach rooms

- Need help to estimate battery impact ?





Input parameters

Channel Activity Detection (CAD)

CAD Period
1000 ms

CAD/WOR Spreading Factor
9

2nd CAD Channel
Not Used

2nd CAD SF
7

False WOR detection %
0 %

Relay to GW connection

Relay to Gateway SF
9

Gateway to Relay SF
9

Relay Battery

Relay Battery Type
SAFT LS 33600 (17Ah)

Number of batteries in Relay
1

Relayed End-devices

Number of relayed end-devices
10

End-device Uplink

Uplink SF
7

Number of UL Frames /Day
12

Average uplink frame size
50 bytes

End-device Downlink

Downlink SF
7

Number of DL Frames /Day
2

Average downlink frame size
20 bytes

End-device Battery

Battery Type
SAFT LS14500 (2.6 Ah)

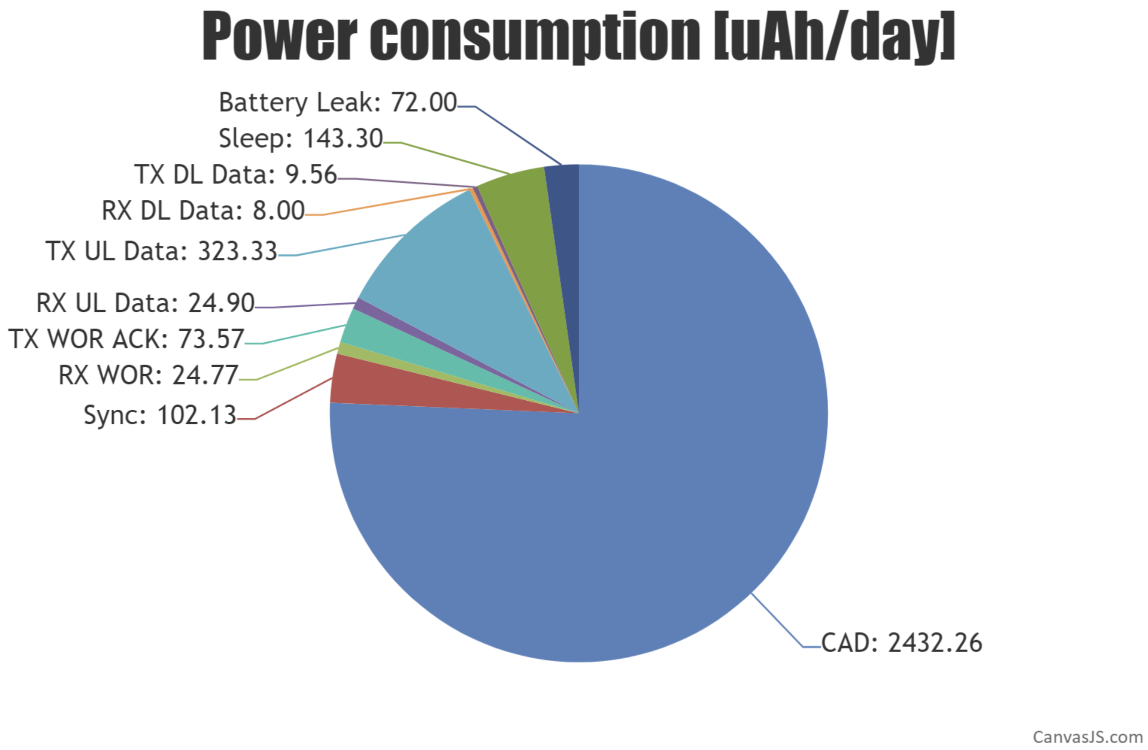
Number of batteries
1

Result of calculation

Calculate

Relay

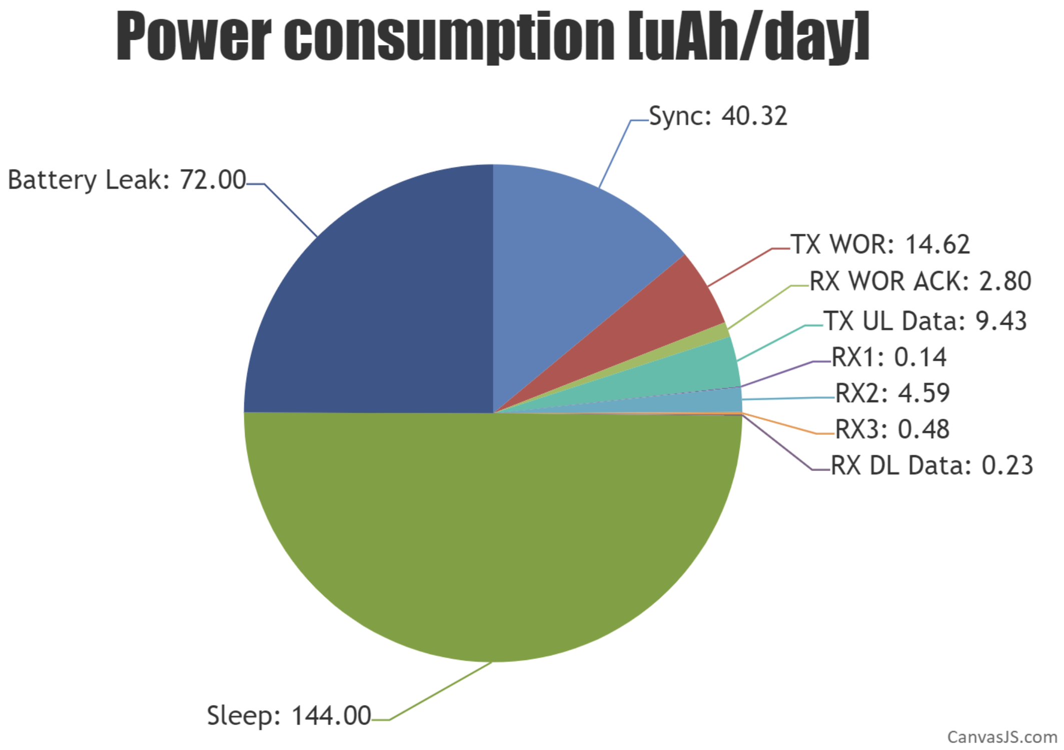
```
total consumption:   3,213.82 uAh/day
battery life:           10.14 years
```




```
CAD: Consumed electric charge for Channel Activity Detection
Sync: Consumed electric charge for time synchronization
RX WOR: Consumed electric charge for receiving Wake on Radio Frames
TX WOR ACK: Consumed electric charge for sending Wake on Radio Acknowledgments
RX UL Data: Consumed electric charge for receiving Uplink Frames from an End-Device
TX UL Data: Consumed electric charge for sending Uplink Frames to a Gateway
RX DL Data: Consumed electric charge for receiving Downlink Frames from a Gateway
```

Relayed End-device

```
total consumption:     144.60 uAh/day
battery life:           34.48 years
```




```
Sync: Consumed electric charge for time synchronization
TX WOR: Consumed electric charge for sending Wake on Radio Frames
RX WOR ACK: Consumed electric charge for receiving Wake on Radio Acknowledgments
TX UL Data: Consumed electric charge for sending Uplink Frames to the Relay
RX DL Data: Consumed electric charge for receiving Downlink Frames from the Relay
Sleep: Consumed electric charge while the device is sleeping
Battery Leak: Lost electric charge due to the battery's self-discharge
```

Public AND Private … the Grail for utilities

- Public networks don't cover 100% of meters
- Private networks for a single use case are too costly

Roaming

- Achieve 100% coverage by patching the public network by private GWs
- Use private GWs for high-density zones (e.g. residential buildings)
- Optimize CAPEX
- Increase QoS

Success in Oil & Gas & Mining

- **Large campuses**

Need for long range

- **Safety first**

High awareness of worker safety

- **ATEX/IECEx**

LoRaWAN low-power, low current makes it a perfect fit for challenging designs

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CBRS & LoRaWAN

- More and more requests for “5G and LoRaWAN”
- Complementary rather than completing
- CBRS backhauled LoRaWAN GWs a perfect initial use case for private cellular networks

RF planning for outdoor gateways

Ramez Soss

RF planning scope

- To estimate the coverage range of a LoRaWAN® gateway
- To estimate the hardware bill of quantity required to cover a given geographic area
- To choose the right placement for your gateways
- To assess the effective RF coverage provided by your gateway fleet
- To determine coverage gaps requiring gateway densification
- To estimate the radio capacity offered by your gateways (assessing the device density for a given mix of traffic profiles)

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Doing serious RF planning

Pathloss = Radiated Tx Power – Rx sensitivity

Is it as simple as this?

Nope!

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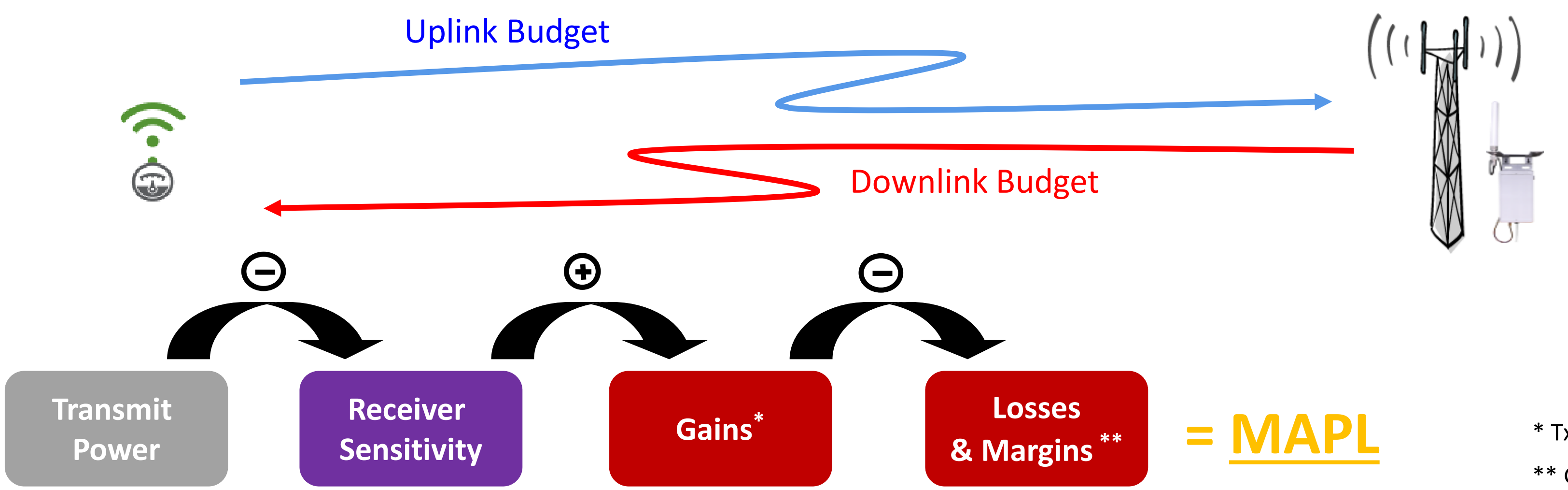
Maximum Allowable Path Loss (MAPL)

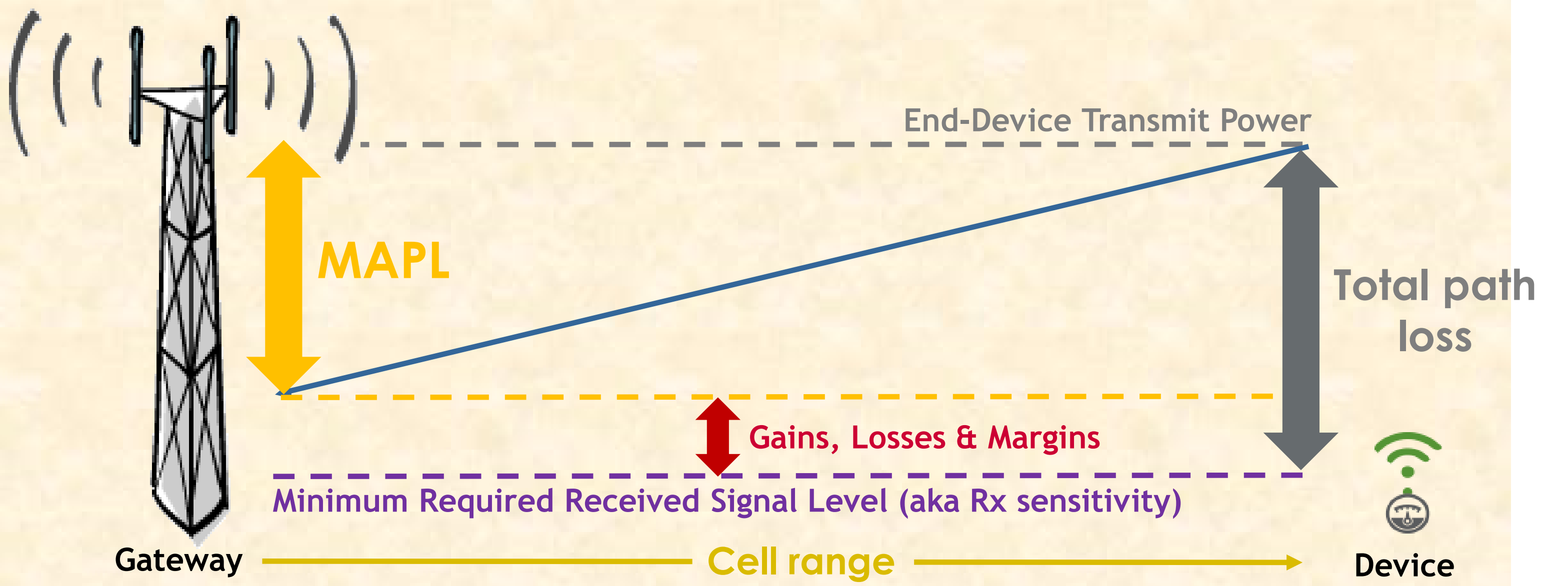


Both UL & DL link budgets should be analyzed to determine the limiting link

* Tx & Rx Antenna Gain + Best Server Selection Gain

** Gateway cable & connector losses + Penetration Loss + Large & Small Scale Fading Margins + Interference Margin

Example: for an UL-limited link budget



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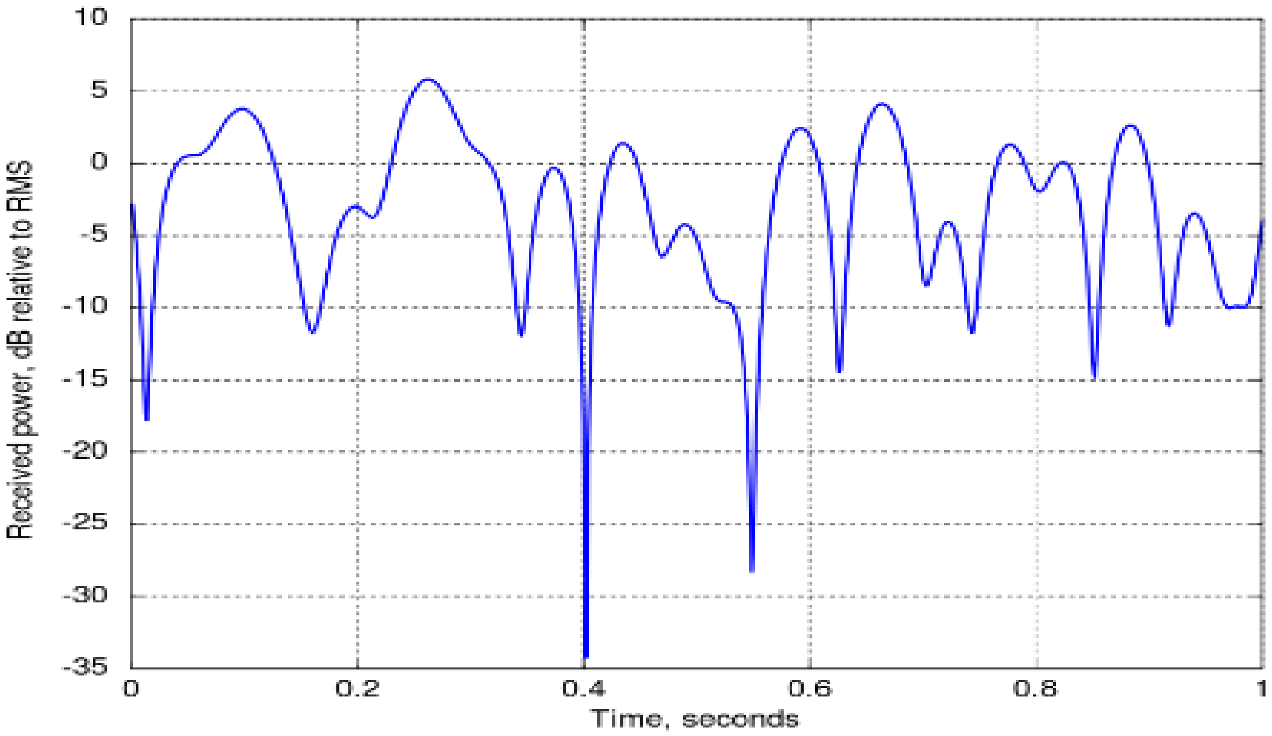
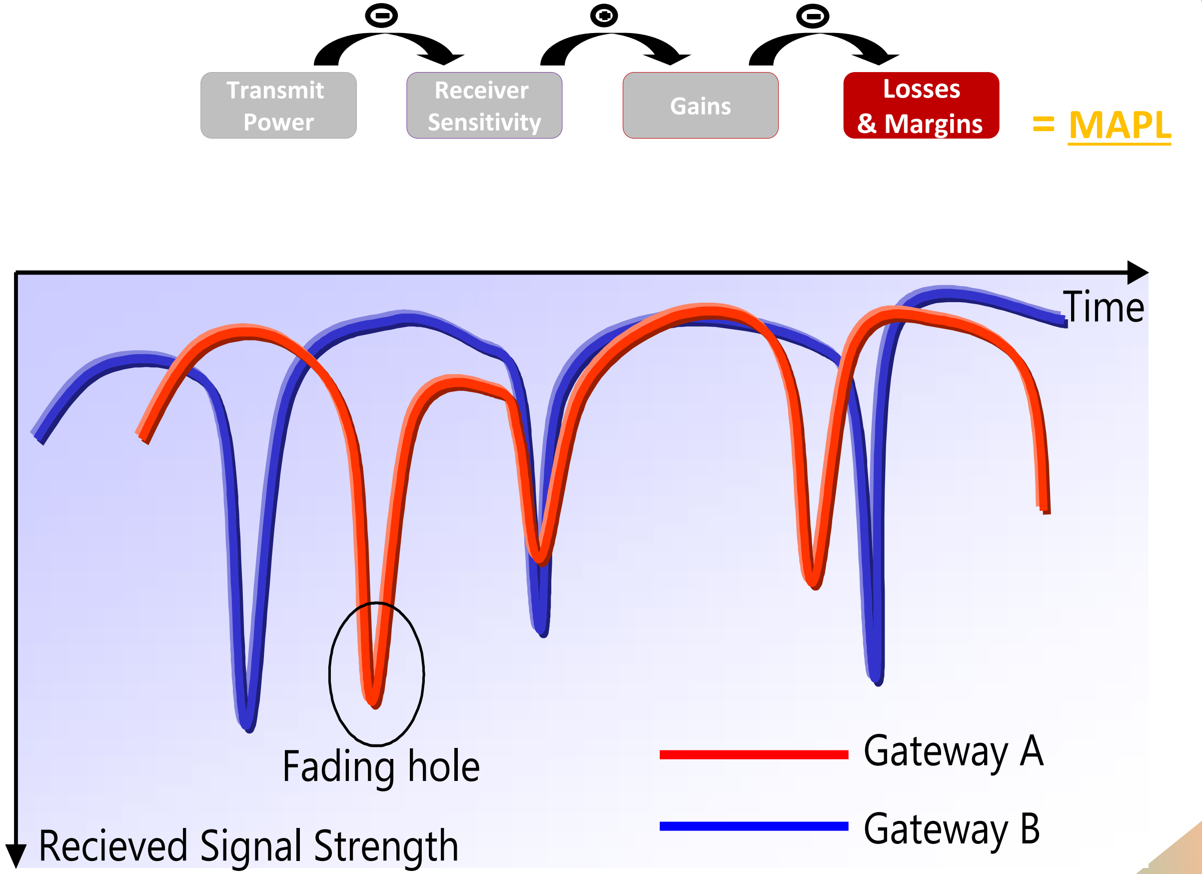
MAPL derivation (1/4)

- Fast fading effect (aka small-scale Rayleigh fading)





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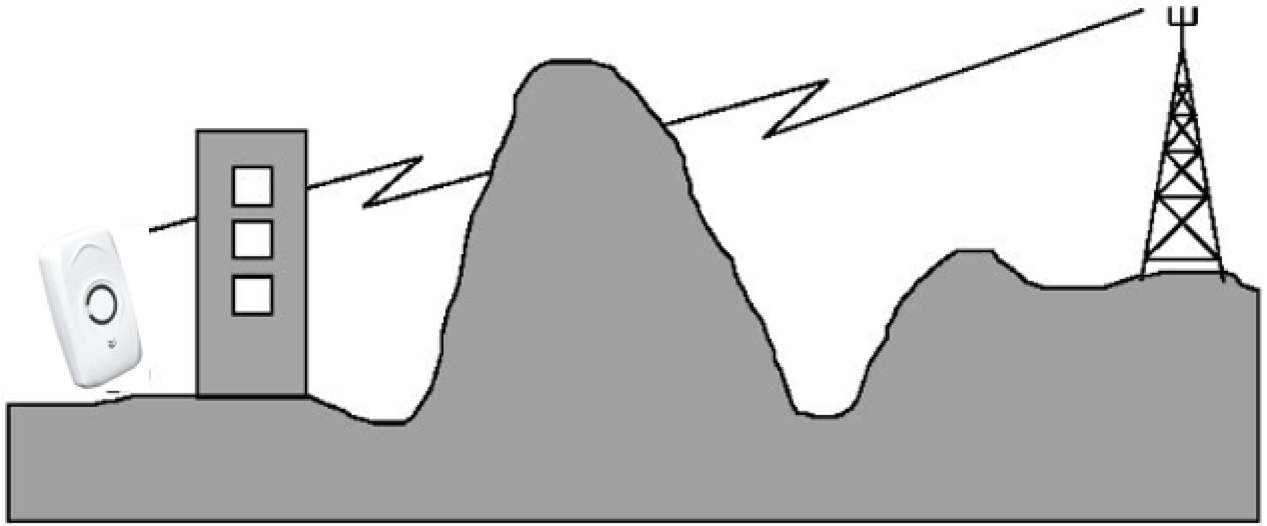
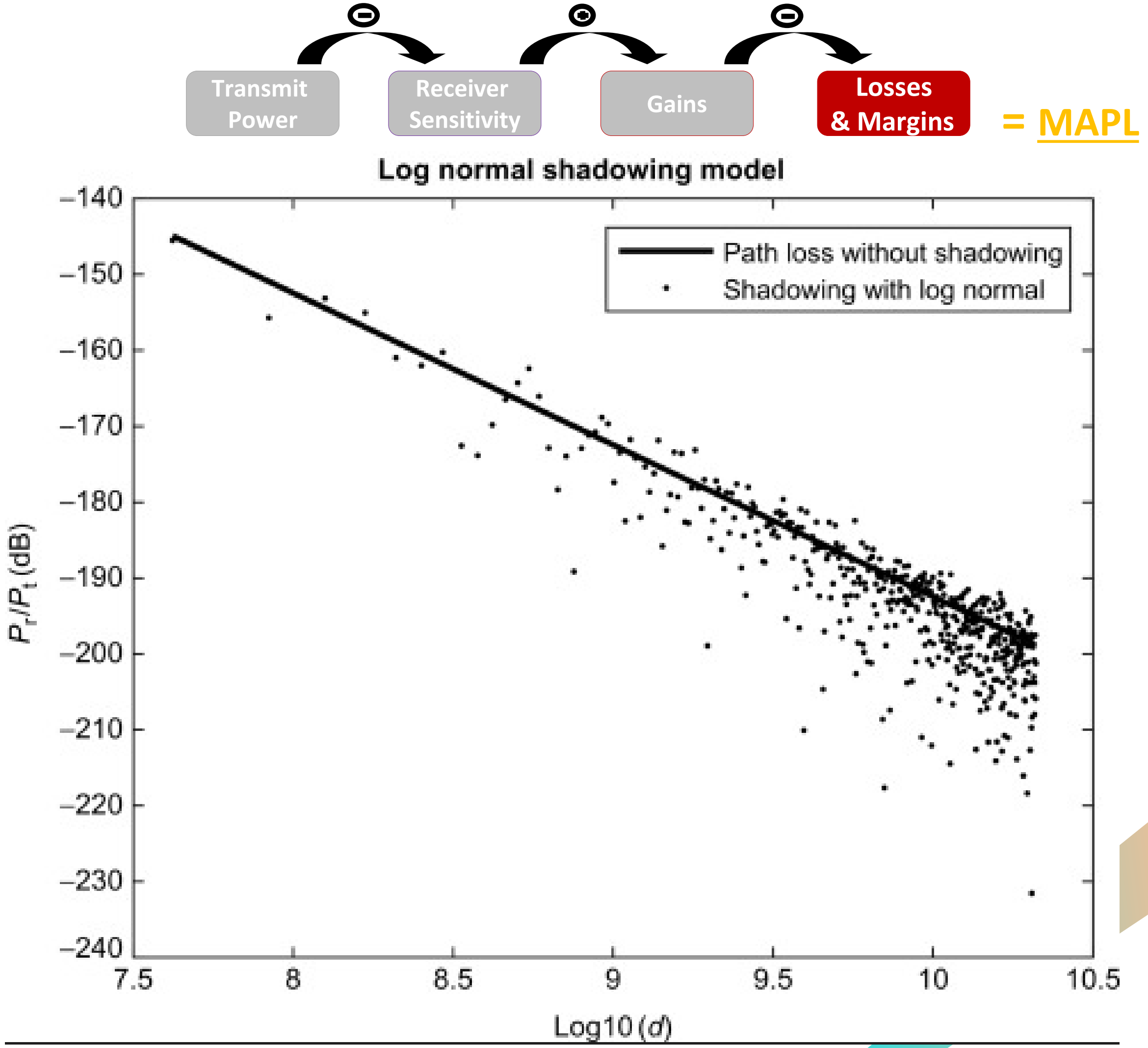
MAPL derivation (2/4)

- Shadowing effect (aka large-scale fading)





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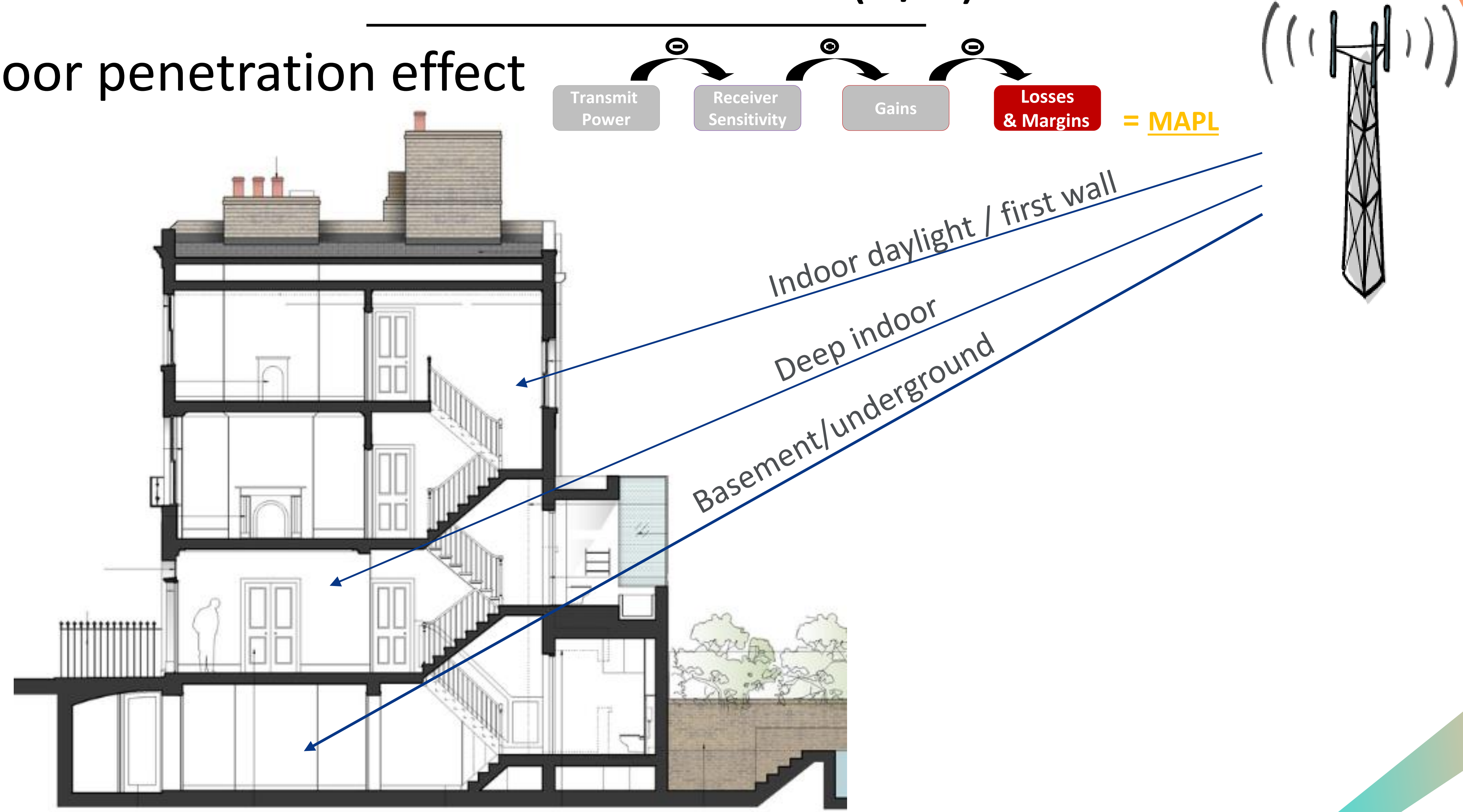
MAPL derivation (3/4)

- Indoor penetration effect

Transmit Power − Receiver Sensitivity − Gains − Losses & Margins = MAPL



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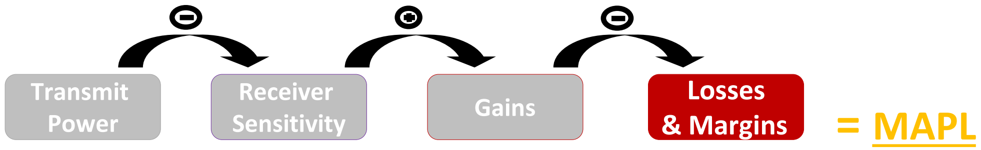
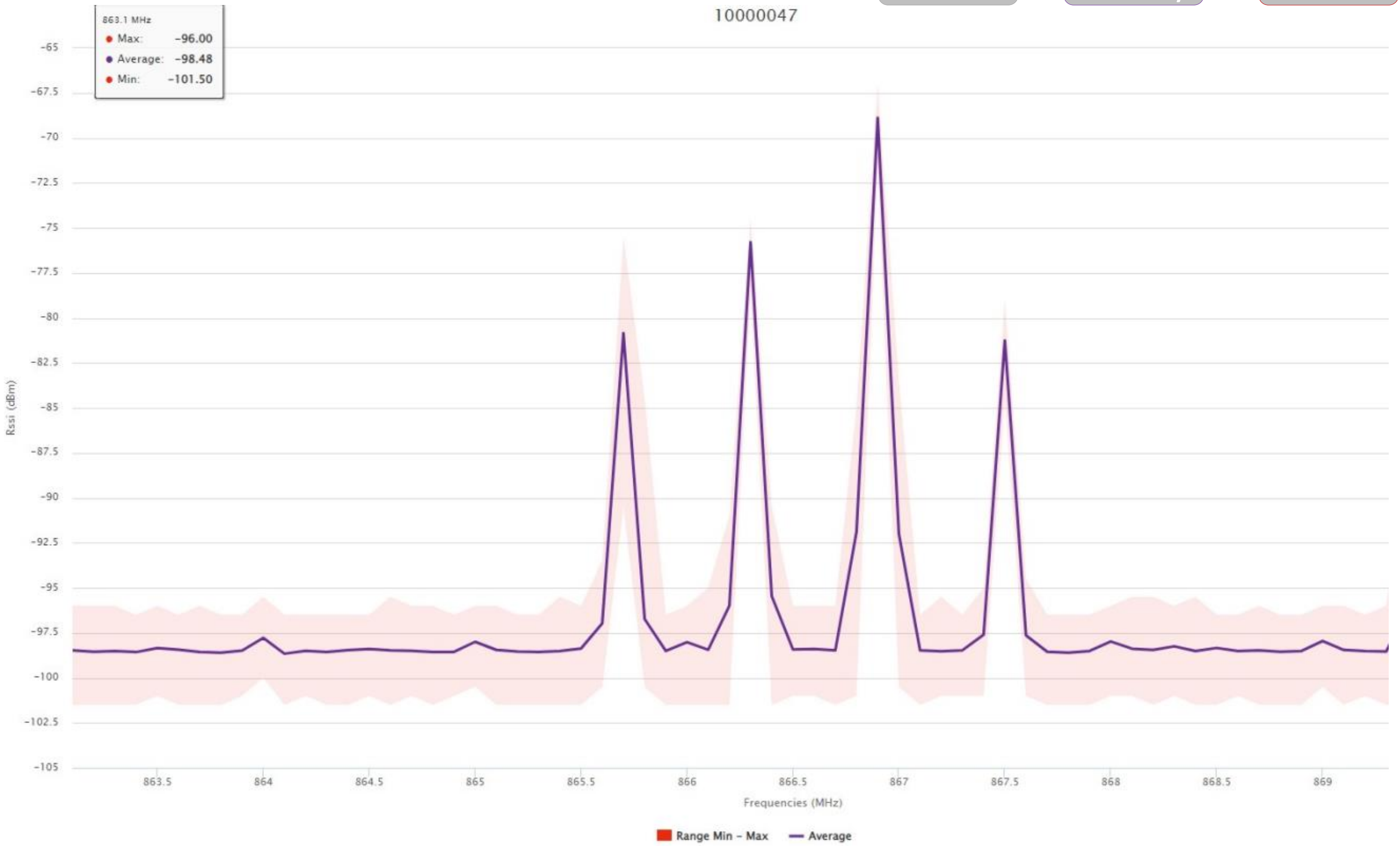
MAPL derivation (4/4)

- Interference/noise effect





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RF planning methodology

1

Link Budget Analysis

- Maximum Allowable Pathloss (MAPL) analysis
- Approximate Cell Range estimation
- Initial Site Count

2

RF coverage simulations

Precise coverage estimation based on realistic design info (site coordinates, antenna patterns, calibrated propagation models…)

3

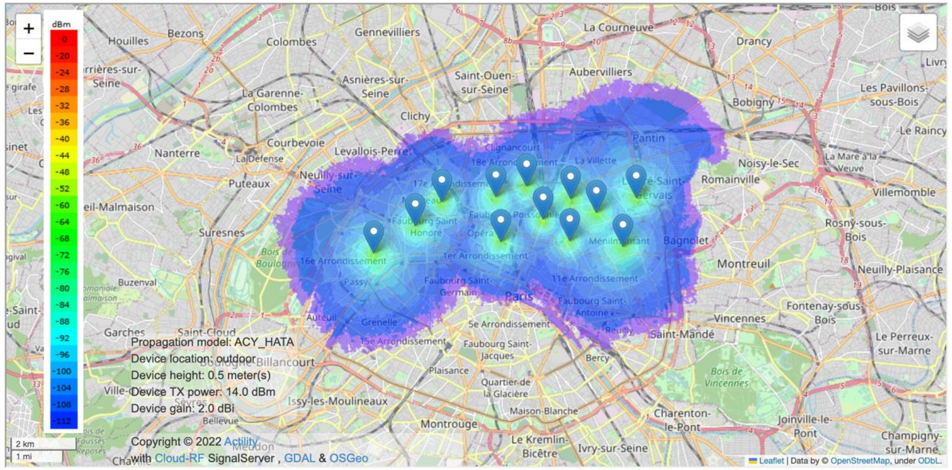
Field Tests

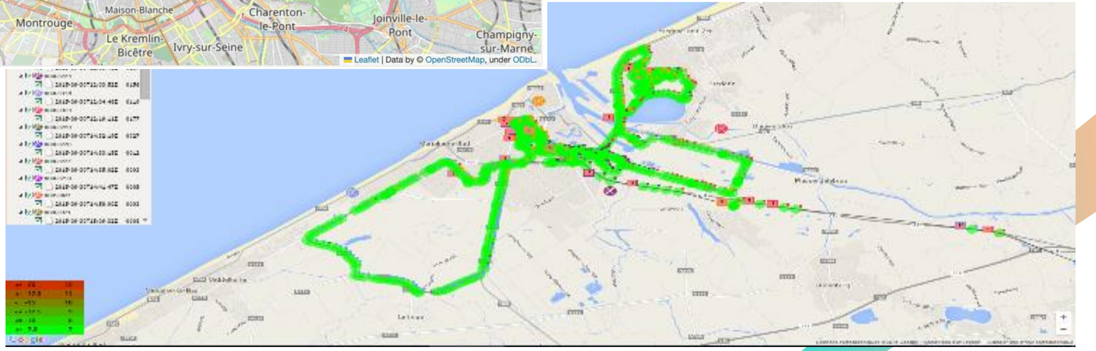
- Drive/walk tests using test devices to assess actual coverage
- Analysis using Network Survey tool

LoRa Link Budget Summary - Europe - 868 MHz

Export LKB Sheets

	Dense Urban		Urban		Suburban		Rural	
	DL RX1	DL RX2	DL RX1	DL RX2	DL RX1	DL RX2	DL RX1	DL RX2
Target UL Cell Edge Data Rate	LoRa SF12 / 125KHz		LoRa SF12 / 125KHz		LoRa SF12 / 125KHz		LoRa SF12 / 125KHz	
Corresponding DL Data Rate	LoRa SF12 / 125KHz	LoRa SF9 / 125KHz	LoRa SF12 / 125KHz	LoRa SF9 / 125KHz	LoRa SF12 / 125KHz	LoRa SF9 / 125KHz	LoRa SF12 / 125KHz	LoRa SF9 / 125KHz
Limiting Link	Downlink	Downlink	Downlink	Downlink	Downlink	Downlink	Downlink	Downlink
Maximum Allowable Path Loss (MAPL)	111.1 dB	116.0 dB	114.2 dB	119.1 dB	117.2 dB	122.1 dB	118.1 dB	123.0 dB
Cell Range	0.34 km	0.47 km	0.47 km	0.64 km	0.84 km	1.15 km	2.88 km	4.00 km
Inter-Site Distance	0.59 km	0.82 km	0.81 km	1.10 km	1.46 km	1.99 km	4.99 km	6.92 km
Site Coverage Area	0.31 km²	0.58 km²	0.56 km²	1.06 km²	1.85 km²	3.43 km²	21.57 km²	41.56 km²
Number of Sites for Target Data Rate	164 sites	87 sites	89 sites	48 sites	109 sites	59 sites	10 sites	5 sites
RNP Design Level (Outdoor)	-94.6 dBm	-86.5 dBm	-97.7 dBm	-89.6 dBm	-100.7 dBm	-92.6 dBm	-101.6 dBm	-93.5 dBm





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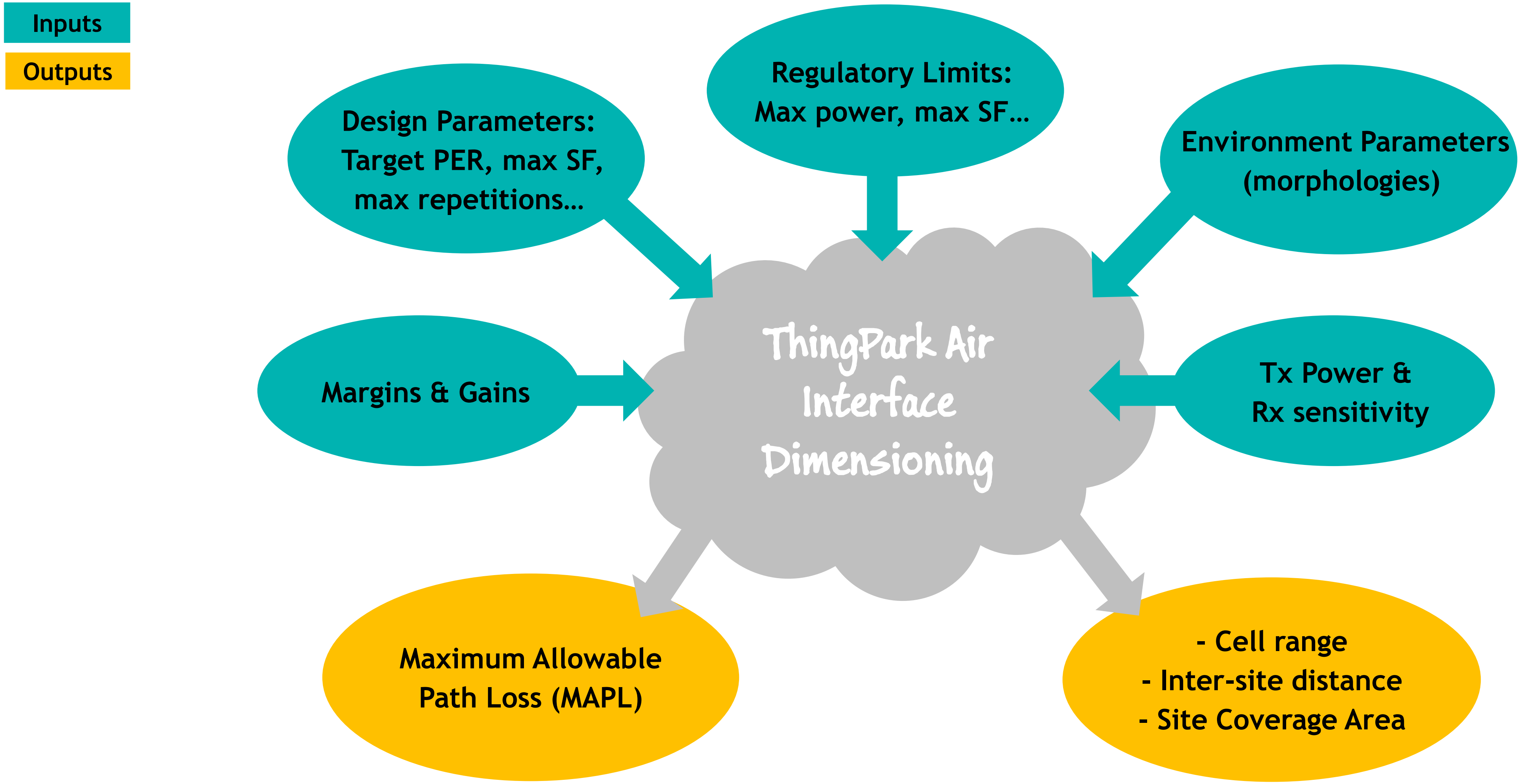
Zoom-in ThingPark Air Interface Dimensioning tool



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Zoom-in ThingPark Network Coverage tool

- Scope
  - Predict RF coverage for greenfield deployments and determine the optimum antenna placement
  - Generate coverage heatmaps for already-deployed gateways and detect potential coverage holes
- Built-in link budget analysis with configurable RF design parameters
- A large set of off-the-shelf antenna patterns
- Built-in Digital Elevation Model database for the whole world (30m resolution)
- Consideration of the diffraction loss caused by hilly obstacles
- 2 propagation models validated by field tests, for 4 different propagation environments (Dense Urban, Urban, Suburban and Rural)

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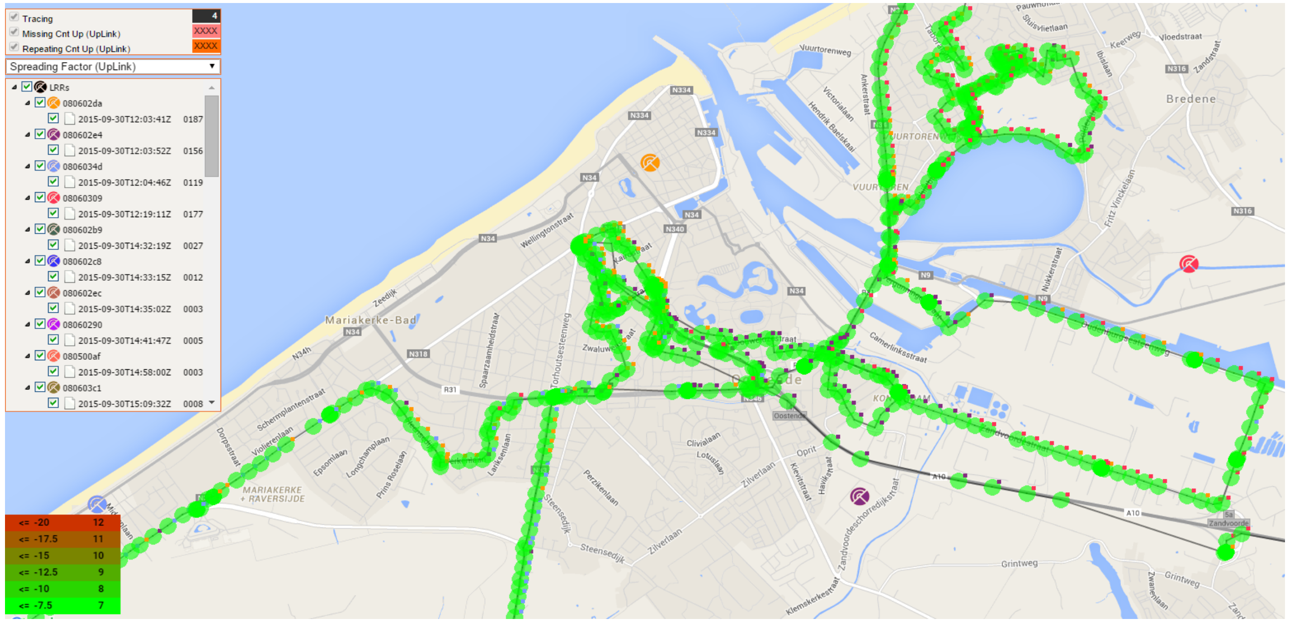
Zoom-in ThingPark Network Survey tool

- Field test analysis tool with real devices and gateways
- A rich set of RF metrics:
  - Packet loss analysis, showing coverage holes on the map
  - Uplink/downlink SNR, RSSI and estimated signal power
  - Estimation of the uplink and downlink interference levels along the walk test



  - Assessment of the network geolocation precision vs. device’s GPS coordinates

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Zoom-in ThingPark Spectrum Analysis tool

- Assess the noise level of your frequency band
- Choose the best frequencies for your deployment, avoiding noisy channels
- ThingPark's Spectrum Analysis tool offers:
  - A user-friendly interface to simplify the analysis of noise scan results
  - Time and spatial aggregation of individual scan results over a given group of gateways
  - Fully integrated with ThingPark's base station management interface

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Sign-up to ThingPark Community

https://community.thingpark.org/index.php/sign-up-tpcp/

Or scan this QR code:

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Connected Conservation FOUNDATION

Connected Conservation

Protecting wildlife and natural ecosystems through technology, since 2015

United capabilities in 7 countries

Enabling LoRaWAN for conservation

Sophie Maxwell
LinkedIn:
sophie-maxwell-9a09411a

Actility CISCO AIRBUS FOUNDATION dimension data EARTHRANGER A product of AI2

1 million

species now face extinction

Ecosystem collapse

Nature’s decline is happening 100 times faster than ever seen before, causing the sixth mass extinction.

UN IBES Report: Species extinctions accelerating

30%

of the planet by

2030

Technology has a critical role to play to reach 30%.
To double land and quadruple marine protected areas

Global Framework for Nature CBD

TRANSFORMING CONSERVATION

Connected Conservation FOUNDATION

PROTECT

Early warning, to stop threats

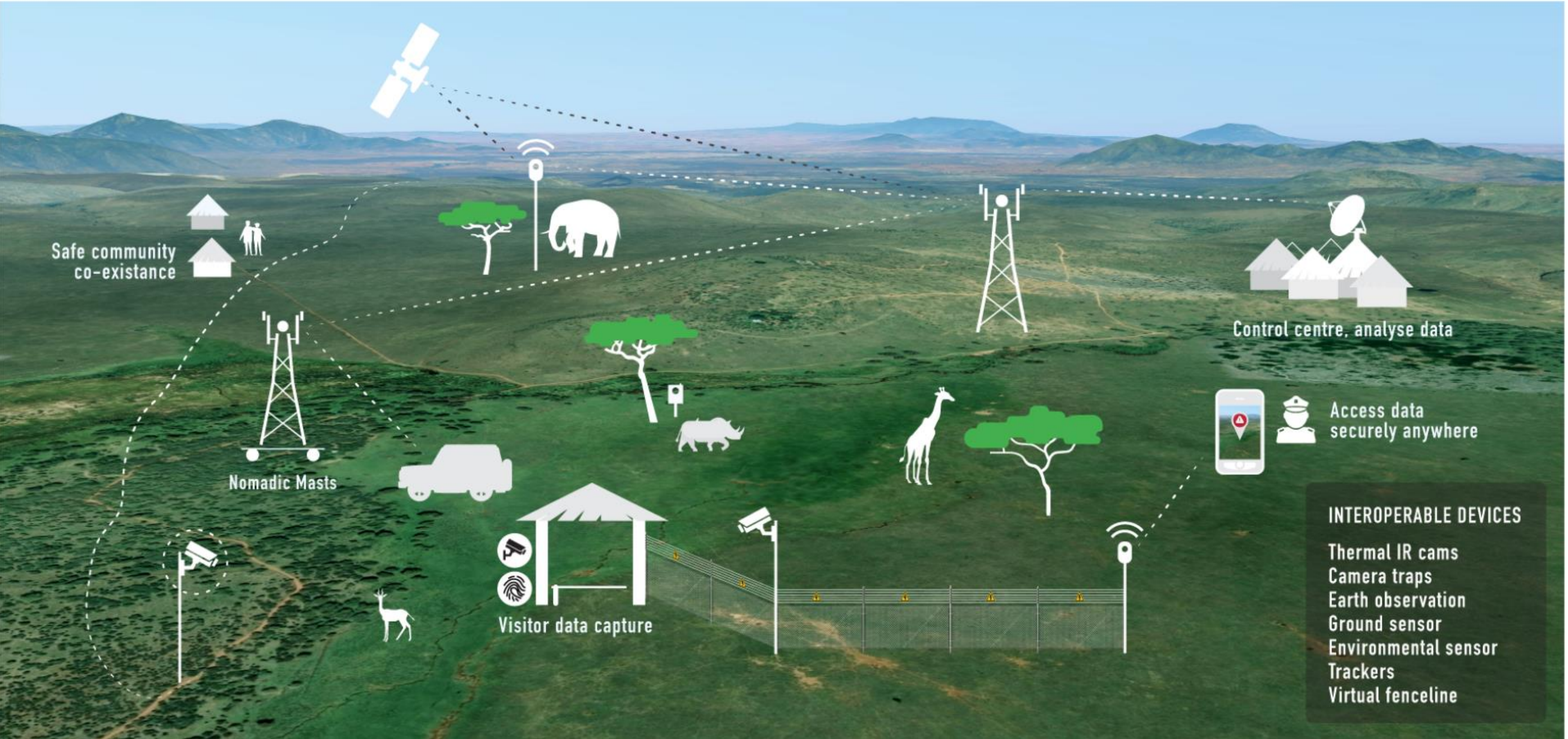
MONITOR

Wildlife, ecosystem health and resources

VERIFY

Analyse, report, inform decisions

CONSERVATION PROTECTION AND MANAGEMENT



CENTRAL CAPABILITES FOR DECISION

“Technology is our big multiplier, giving us an extraordinary jump ahead in our capacity to respond to conservation issues.” Ian Craig, Executive Director, Lewa


LoRaWAN®
FOR CONSERVATION
Connected Conservation FOUNDATION

LoRaWAN IN CONSERVATION

AFRICA

South Africa
Sabi Sand
Madikwe
Majete
Hluhluwe-iMfolozi
uMkhuze
Tembe Elephant Park
Manyoni
Babanango
Tanglewood

Kenya:
Northern Rangelands Trust, (22 conservancies),
Lewa
Ol Jogi
Loisaba
Borana
Tsavo
Kora

Zambia
Kafue

Mozambique
Zinave
Bazaruto
Luwire

Congo
Garamba

Tanzania
Mkomazi
Serengeti

Malawi
Liwonde
Majete

Rwanda
Akagera

Chad
Zakouma

Botswana
Koro
Limpopo
Lipadi

Angola
Iona

Benin
Pendjari

Namibia
Timbila
N/a'an ku sê
Skeleton Coast

Zimbabwe
Gonarezhou
Matusadona

EUROPE

Netherlands
Kennemerduinen
NH Duinreservaat
Veluwe
De Maashorst
Verrebroekse Pl
Sikken v/d Heen
Biesbosch
Wilder Blean

NORTH-AMERICA

United States
Greenwood NY

Canada
Edmonton

ASIA

India
Assam
Gundalar

SOUTH AMERICA

Mexico
Baja California

UPCOMING IN 2024

Chobe, Botswana
Masai Mara, Kenya
Amboseli, Kenya
Simalaha, Zambia
Maputo, Mozambique
Kidepo, Uganda
Lapalala, South Africa

CCF ENABLING

29 protected areas

5,600,000 ha

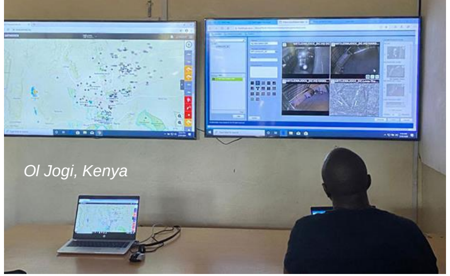
7 New parks for 2024

NRT NORTHERN RANGELANDS TRUST

SABI SAND NATURE RESERVE

Madikwe FUTURES COMPANY

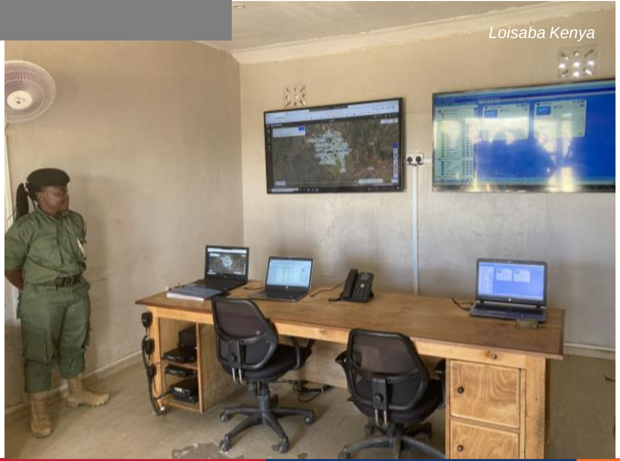
Kafue National Park Zambia

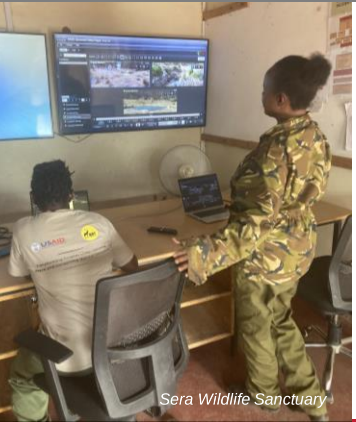

Ol Jogi, Kenya


Madikwe, South Africa


Sabi Sands, South Africa

Kafue Zambia


Loisaba Kenya


Sera Wildlife Sanctuary


Sabi Sands, South Africa


Lewa, Kenya

NORTHERN RANGELANDS TRUST, KENYA

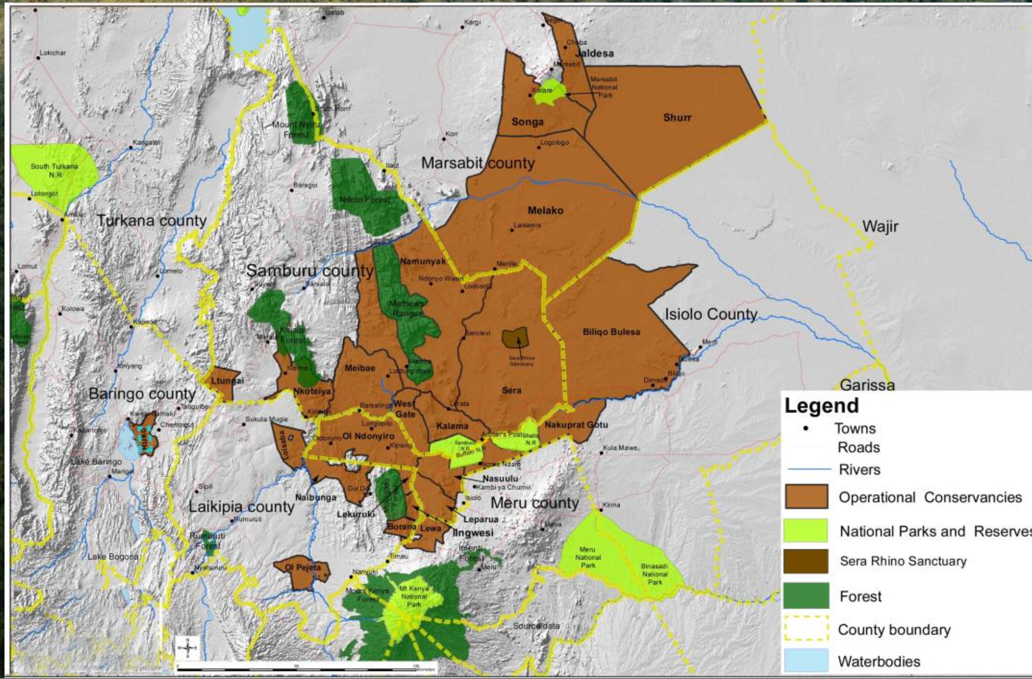
26 CONSERVANCIES

21 LoRa Gateways

01 Largest conservation IOT network in Africa

02 Joining conservancies to share technology and operations for improve collaboration

03 Increase in rhino numbers
Reduced Human Wildlife Conflict
Reduced poaching

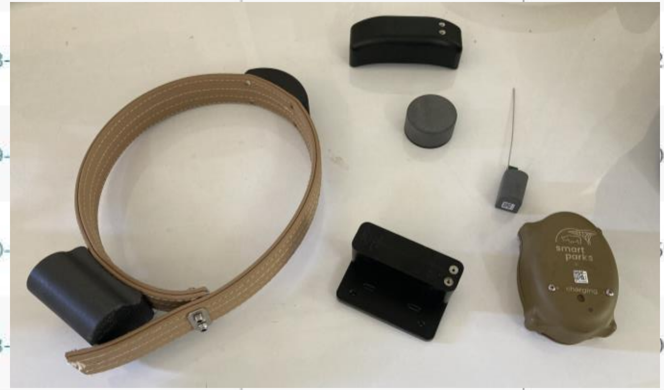


NEARLY 300 SENSORS

DEVICES

1-100 of 298 Add filter

SP010097-LSB-Rhino6	00-16-C0-01-F0-04-A4-05	Today 17:01:4					
SP010098-LSB-Rhino3	00-16-C0-01-F0-04-A4-19	Today 16:25:3					
SP010103-LSB-Rhino1	00-16-C0-01-F0-04-A4-11	Today 16:23:3					
SP010107-LSB-Rhino13	00-16-C0-01-F0-04-A4-39	Today 16:59:0					
SP010108-		2:5					
SP010109-		2:2					
SP010110-		9:1					
SP010113-		0:1					
SP010114-LSB-Rhino12	00-16-C0-01-F0-04-A4-46	Today 17:01:13	18	SF9	59.68 %		...



BASE STATIONS

Active	20
Initialization	0
Connection Error	4
Radio Error	0

DEVICES

Active	295
Initialization	3
Connection Error	0

SERVING 20+ USECASES

Ranger tracking
Promoting safe and effective patrols and tracking rangers in times of crisis

Vehicle tracking
Balancing sustainable tourism and providing alerts of suspicious behavior or safety concerns

Fence alarms
Detecting fence weak spots & tampering caused by poachers and wildlife

Rhino trackers
Giving early warning of sick or vulnerable animals

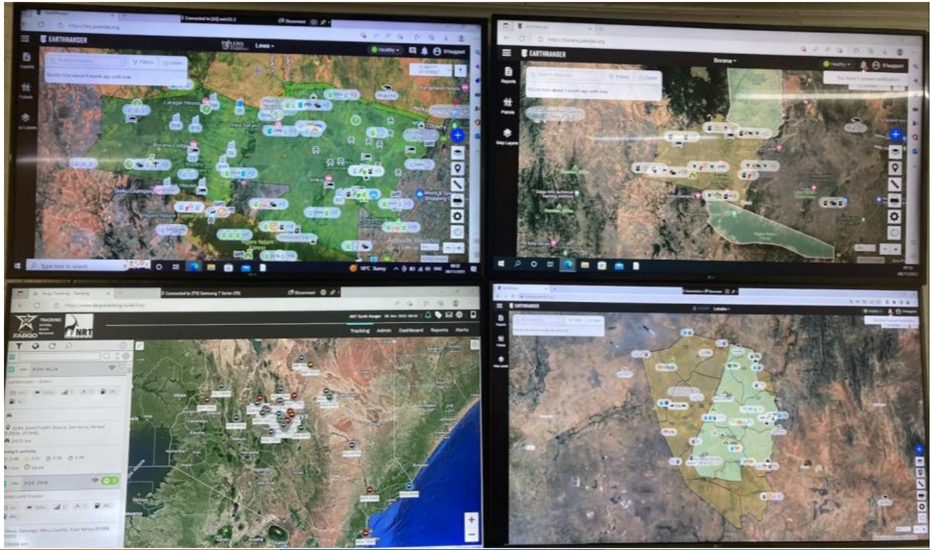
Elephant, lion, cheetah and leopard tracking
Providing early warnings to prevent human-wildlife conflict

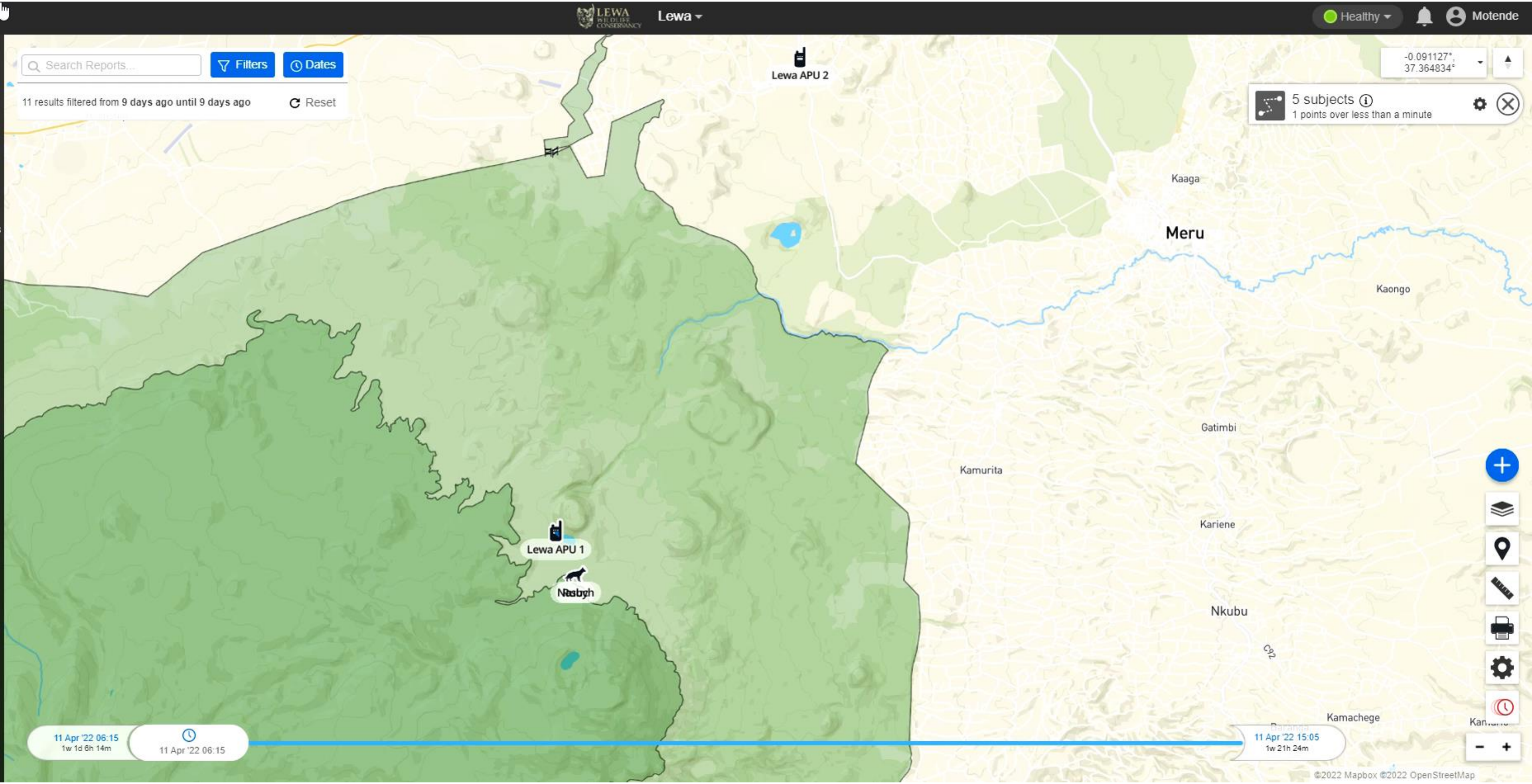
Livestock tracking
Helping manage sustainable grazing strategies

Environmental
Helping manage and respond to resource shortages and migitate conflict

Resource tracking
Providing data from remote areas, saving time, cost and traveling to manage resources

Reporting and verification
Validating protected area effectiveness and unlocking new revenue streams





LEWA WILDLIFE CONSERVANCY
Lewa
Healthy
Motende
Search Reports...
Filters
Dates
11 results filtered from 9 days ago until 9 days ago
Reset
-0.091127°, 37.364834°
5 subjects
1 points over less than a minute
Lewa APU 2
Kaaga
Meru
Kaongo
Gatimbi
Kamurita
Kariene
Lewa APU 1
Nkubu
C92
Kamachege
11 Apr '22 06:15
1w 1d 6h 14m
11 Apr '22 06:15
11 Apr '22 15:05
1w 21h 24m
©2022 Mapbox ©2022 OpenStreetMap

MADIKWE

Madikwe FUTURES COMPANY

2023, 750,000 hectares

01 **LoRa Network** complimenting cameras. Ranger, vehicle, fence and dog trackers

02 **Sensors, cameras and satellite phones** for real time threat response and tracking

03 **PNEO 100km2 capture** supporting investigation for rhino poaching. Places beyond patrols, to understand routes, access and how to deploy counter security.

04 **Training local engineer** on support and maintenance

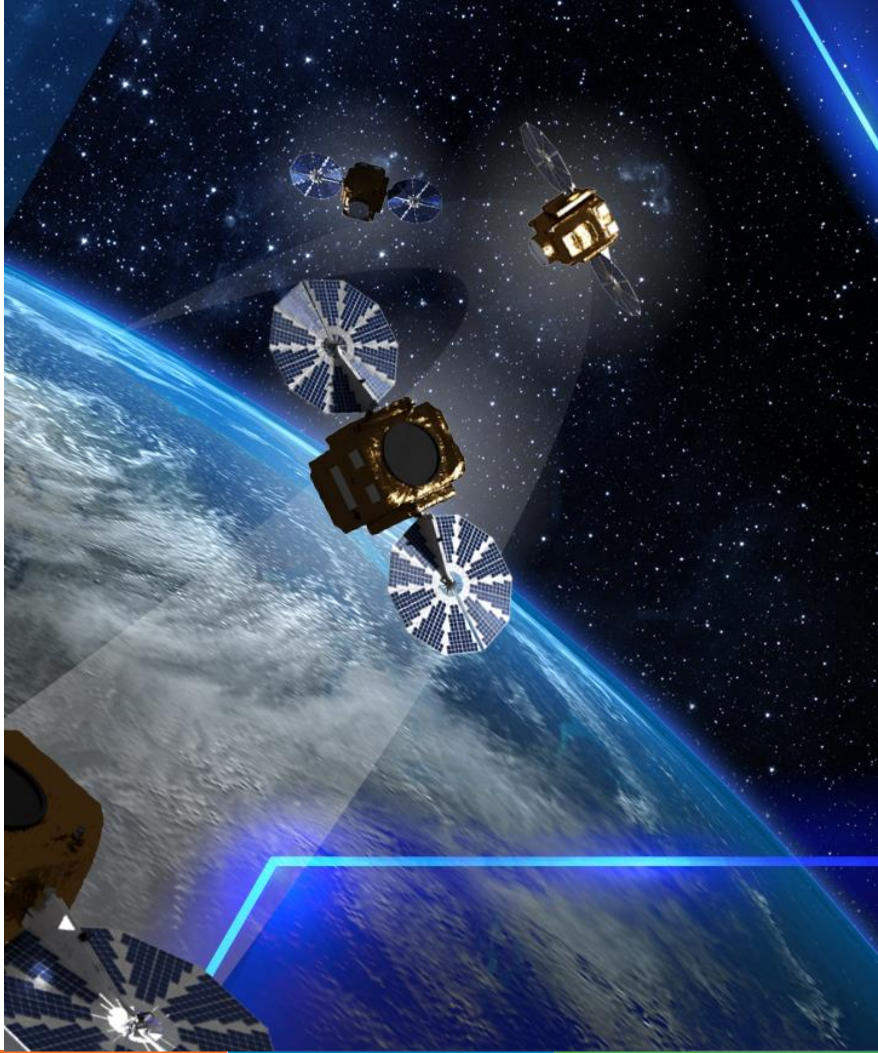
FUTURE

Enhanced with space based

Kenya wide conservation network. Anyone working in conservation can work through single server, with data roaming throughout parks

Registrar of tested sensors, proven over time

Community between LoRaWan conservation leaders



2024 PROJECTS, 50% FUNDED

KIDEPO
UGANDA

CHOBE
BOTSWANA

MASAAI MARA
KENYA

ETOSHA
NAMIBIA

Seeking new tech partners and supporters
www.connectedconservation.foundation

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Connected Conservation FOUNDATION
THANK YOU!