



DOLL

Lighting Up the Future of Smart Cities



# 1:1

# DOLL Living Lab

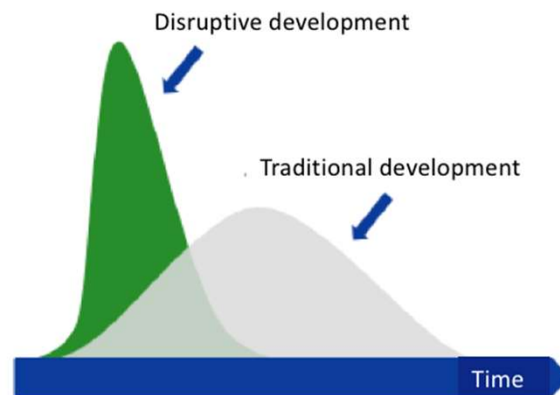
# Digitalization a new Basic Conditions

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## Digitalization a new Basic Conditions

→ Short product life time  
Disruptive vs. traditional development



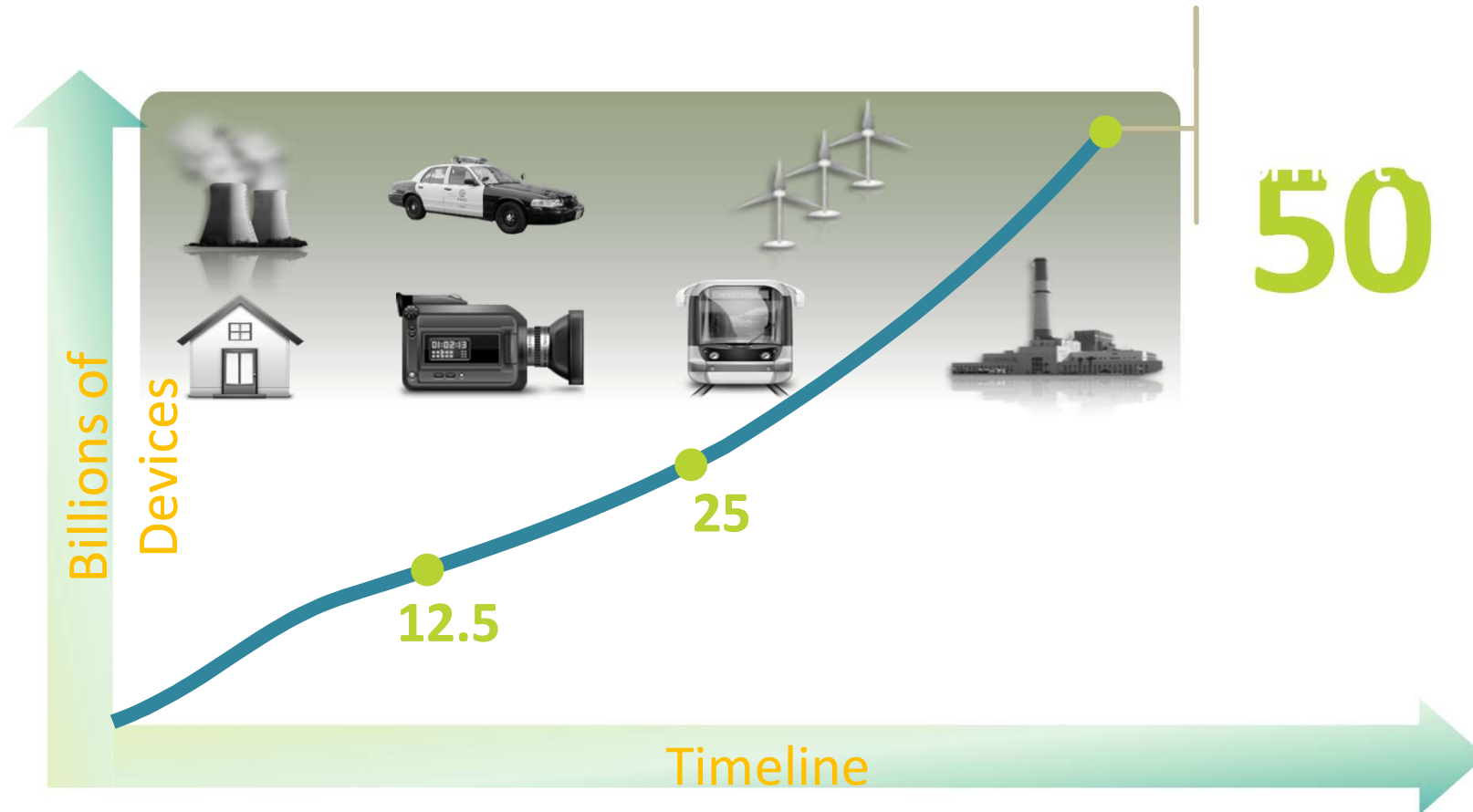
Kilde: Egen tilvirkning på baggrund af Downes & Nunes (2013)

→ Period of time to reach 50 millions users

	Phone	75 Years
	Radio	38 Years
	Television	13 Years
	Internet	4 Years
	iPod	3 Years
	Facebook	1 Years
	Twitter	9 Months
	Angry Birds	35 Days
	Pokémon Go	19 Days

Kilde: Egen tilvirkning på baggrund af McKinsey & Company (2012)

# Connecting Everybody & Everything





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More than **58%**  
of the Danish  
municipalities  
have visited  
DOLL Living Lab

Aabenraa - Aarhus - Albertslund - Allerød - Assens - Ballerup - Brøndby - Dragør - Egedal - Faaborg-Midtfyn - Favrskov - Fredensborg - Frederiksberg - Frederikssund - Furesø - Gentofte - Gladsaxe - Glostrup - Greve - Gribskov - Halsnæs - Helsingør - Herlev - Herning - Hillerød - Horsens - Hvidovre - Høje-Taastrup - Hørsholm - Ishøj - Kalundborg - København - Lejre - Middelfart - Norddjurs - Nordfyn - Næstved - Odense - Randers - Roskilde - Rudersdal - Rødovre - Silkeborg - Tønder - Tårnby - Vallensbæk - Varde - Viborg - Vordingborg - and many more...



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**100+**

**cities worldwide from**

**30+**

**different countries have  
visited DOLL Living Lab  
(Danish cities not included)**

Addis Ababa - Accra - Adelaide - Beijing - Birmingham - Bogotá - Dublin - Frogn - Guanzhou - Hong Kong - London - Malmö - New York - Oslo - Portland - Reykjavik - Rio de Janeiro - Rygge - Seine et Marne - Seoul - Singapore - Stockholm - Sydney - Taipei - Tíme - Warszawa - Wellington - Xiaolab City - Zürich - Ås - and more...

# Largest facility in Europe

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- **Location:** A suburb to Copenhagen, industrial/commercial area, 10.000 employees
- **Area:** 1,5 km<sup>2</sup>, 12 kilometres of road and bicycle lanes, our sandbox environment
- **Zones:** 49 zones with Lighting and smart city-technology
- **IoT-infrastructure:** 5 types of digital networks
- **Sensor network:** For waste, parking, air quality, noise, temp., etc.
- **Intelligent lighting network:** 435 connected light points, IP-address, real time control
- **Intelligent lighting solutions:** 80 different lighting lumieres
- **Management systems:** 20+ systems
- **Data platforms:** 1

# 50+ Partner Companies in DOLL Living Lab

## 50+ Gate 21 Partners

Delux Denmark  
Riegens  
Swarco Danmark  
Focus Lighting  
Thorn Lighting  
X-Light  
Fagerhult  
Osram  
Bytebloccs  
Smart Bin  
Leapcraft  
Cisco  
Sweco  
Tridonic  
Louis Poulsen

Philips Danmark  
Alfred Priess  
Citelum  
Dong Energy  
Eniig  
SEAS NVE  
Zumtobel Group  
Danintra  
Rosa  
NordSense  
SoundEar  
Seneco  
Telensa  
Technical University of Denmark  
Global Light Standard

TDC  
LITE  
Amplex  
Schreder  
Force Technology  
Ewos  
Lightwell  
LED-mark ITS

Paradox  
Big Belly  
Joca  
Sensity  
TviLight  
Wastecontrol  
Exlumi  
CommuniThings

Schneider  
Electric  
IBM  
NCC  
Implement  
Rambøll  
HOFOR  
Movia  
Nobina  
Vitani

Kuben Management  
Next  
Bloxhub  
Ålborg University  
Roskilde University  
Capital Region  
Region Zealand  
42 municipalities





# Europe's largest Showroom & Test Field for Intelligent Lighting & Smart Urban Services



# Intelligent Light System

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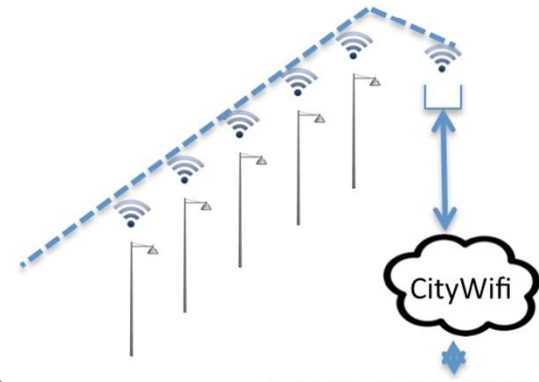
## SENSING the WORLD...

NO<sub>x</sub> and CO  
Temperature  
Pressure  
Humidity  
Ambient light  
Rainfall  
Wind  
Particulate matter  
Radiation  
UVA/UVB

Real-time location systems (RTLS)  
Ultrasound  
IR  
Power monitoring  
Motion  
Audio  
Video  
Accelerometer



## Smart Urban Services



## Innovation Platform



# Libelium Smart World

## Air Pollution

Control of CO<sub>2</sub> emissions of factories, pollution emitted by cars and toxic gases generated in farms.

## Forest Fire Detection

Monitoring of combustion gases and preemptive fire conditions to define alert zones.

## Wine Quality Enhancing

Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.

## Offspring Care

Control of growing conditions of the offspring in animal farms to ensure its survival and health.

## Sportsmen Care

Vital signs monitoring in high performance centers and fields.

## Structural Health

Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

## Quality of Shipment Conditions

Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.

## Smartphones Detection

Detect iPhone and Android devices and in general any device which works with Wifi or Bluetooth interfaces.

## Perimeter Access Control

Access control to restricted areas and detection of people in non-authorized areas.

## Radiation Levels

Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.

## Electromagnetic Levels

Measurement of the energy radiated by cell stations and WiFi routers.

## Traffic Congestion

Monitoring of vehicles and pedestrian affluence to optimize driving and walking routes.

## Smart Roads

Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

## Smart Lighting

Intelligent and weather adaptive lighting in street lights.

## Intelligent Shopping

Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.

## Noise Urban Maps

Sound monitoring in bar areas and centric zones in real time.

## Water Quality

Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.

## Waste Management

Detection of rubbish levels in containers to optimize the trash collection routes.

## Smart Parking

Monitoring of parking spaces availability in the city.

## Golf Courses

Selective irrigation in dry zones to reduce the water resources required in the green.

## Water Leakages

Detection of liquid presence outside tanks and pressure variations along pipes.

## Vehicle Auto-diagnosis

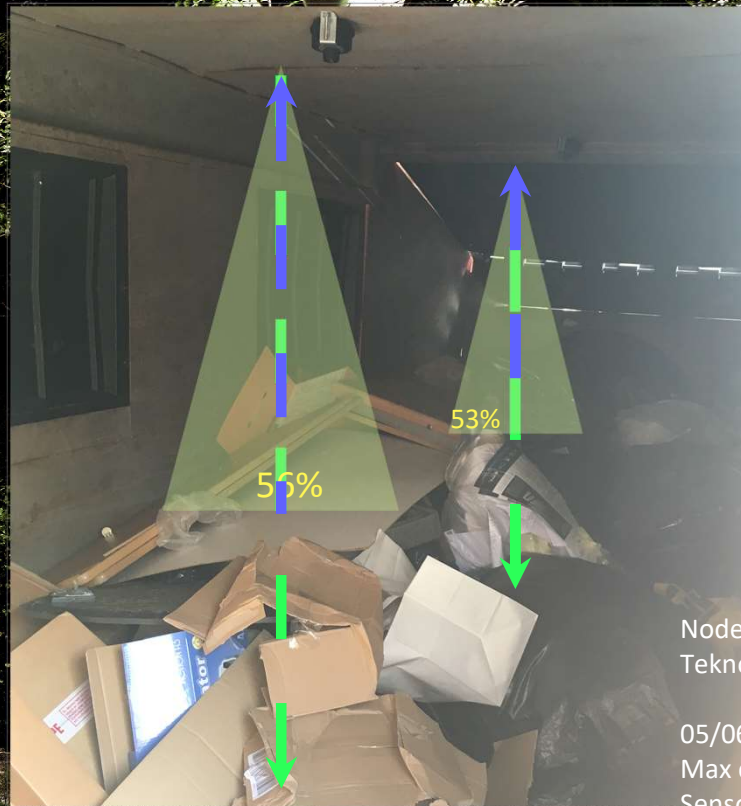
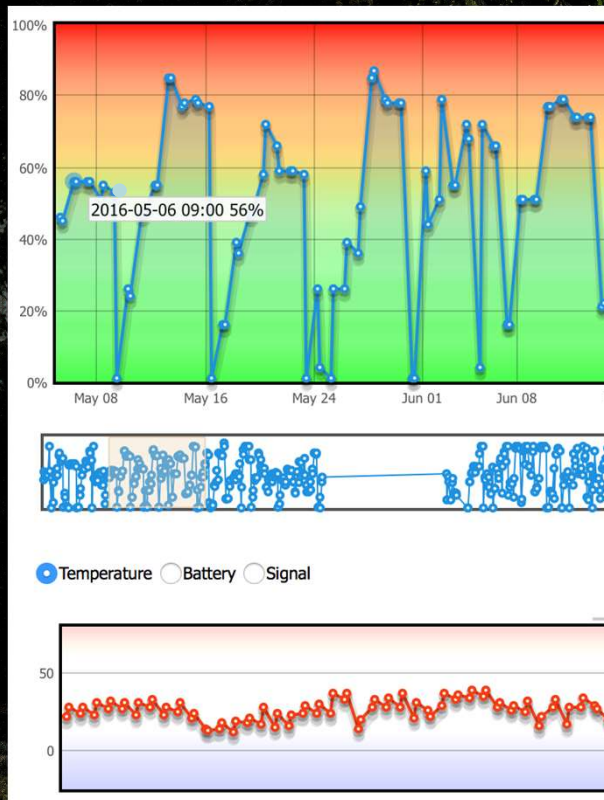
Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.

## Item Location

Search of individual items in big surfaces like warehouses or harbours.



# Example – Waste



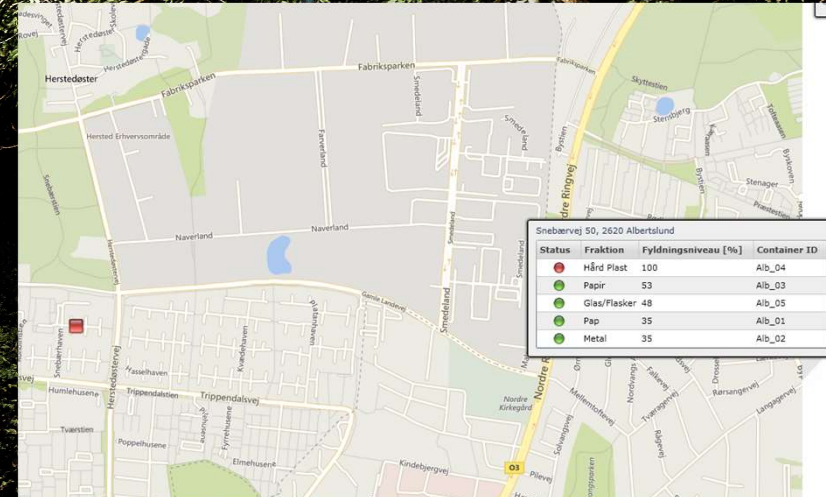
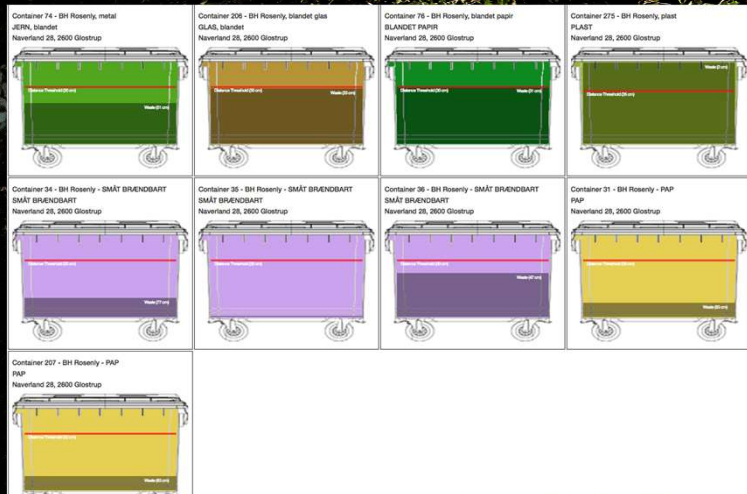
Node: Vipper 2  
Teknologi: Ultralyd

05/06/2016  
Max cap. 300kg  
Sensor E-0489



# GIS – Smart City Development - Sweco

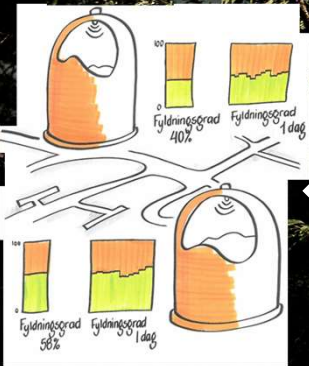
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# IoT Platform

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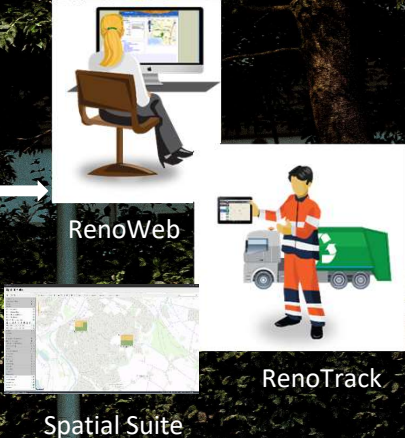
Sensors



Collection and sharing of data



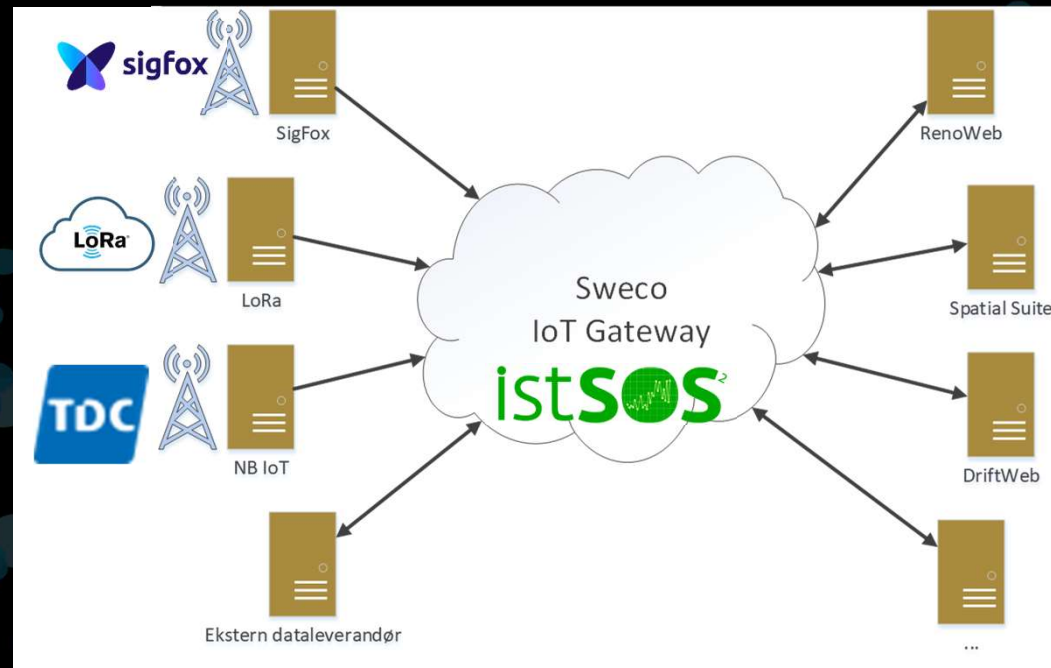
Professional systems





# Collection and sharing of data

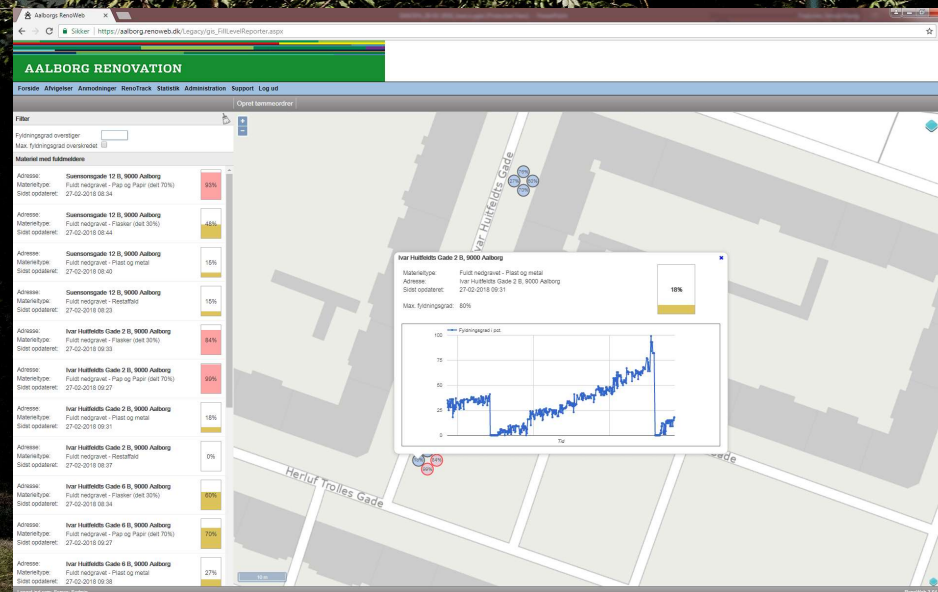
IoT data must flow between the systems



# Use of data in professional systems

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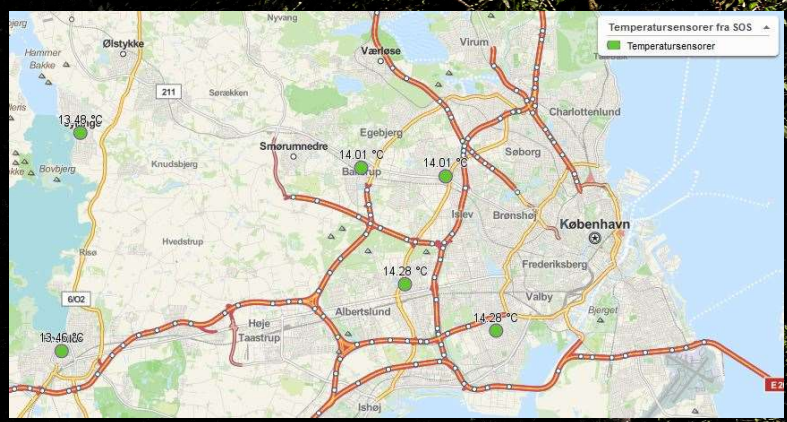
- Here you see sensor data in RenoWeb / RenoTrack, where data is used to optimize waste collection



# Use of data in professional systems

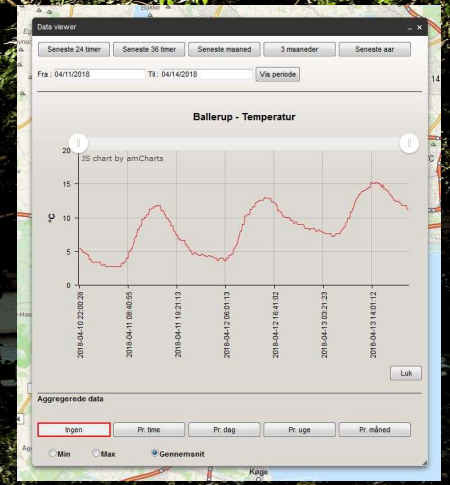
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## Here you see temperature data in Spatial Suite

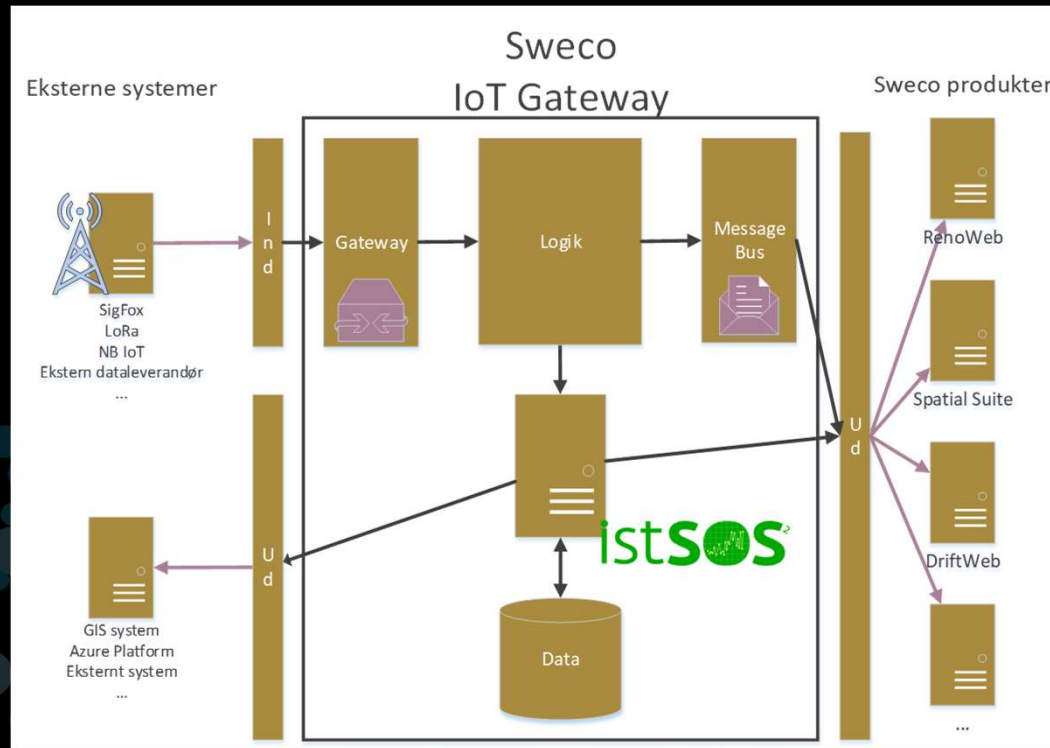


Sensor navn	Type	Altitude værdi	Enhed	Tidsp.
Ballerup	Temperatur	14.01	°C	2018-05-07T08:01:39+00
Roskilde	Temperatur	13.46	°C	2018-05-07T08:01:39+00
Hvidovre	Temperatur	14.28	°C	2018-05-07T08:01:39+00
Herlev	Temperatur	14.01	°C	2018-05-07T08:01:39+00
Jyllinge	Temperatur	13.48	°C	2018-05-07T08:01:39+00
Glostrup	Temperatur	14.28	°C	2018-05-07T08:01:39+00

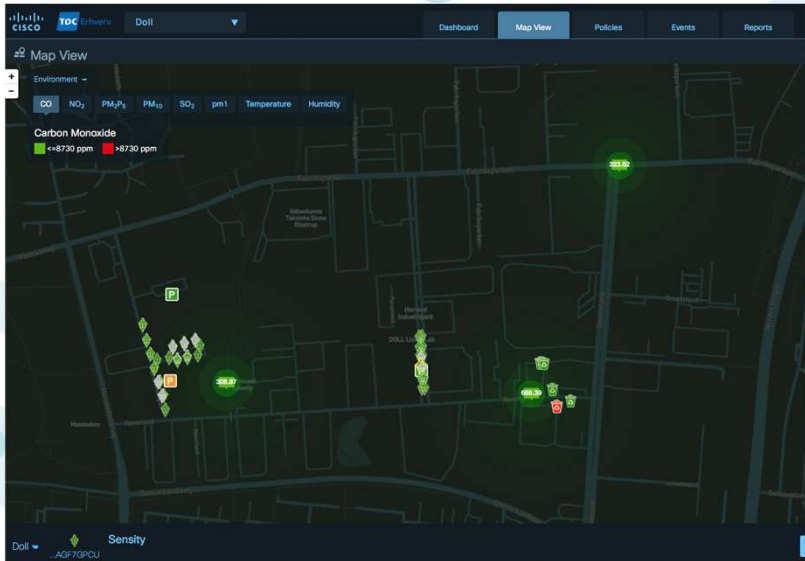
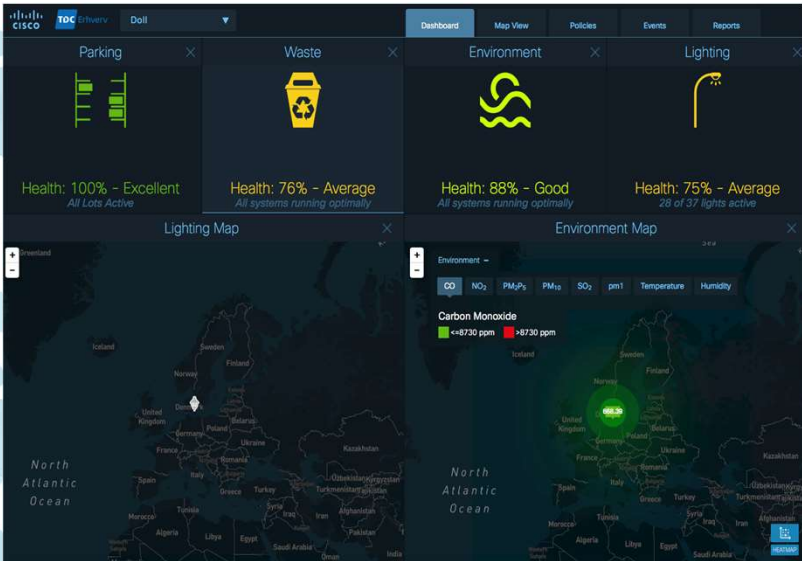
Metadata viewer	
Navn	Ballerup
Beskrivelse	Temperatur + Humidity - Virtual sensor. Python script source
Identifikation	urn:ogc:def:procedure:x-itsos:1.0:Ballerup
Type	inst:fixed-point
EPSG	25832
Koordinater	POINT (711055.2 6181336.4)
Observationer fra	---
Observationer til	---



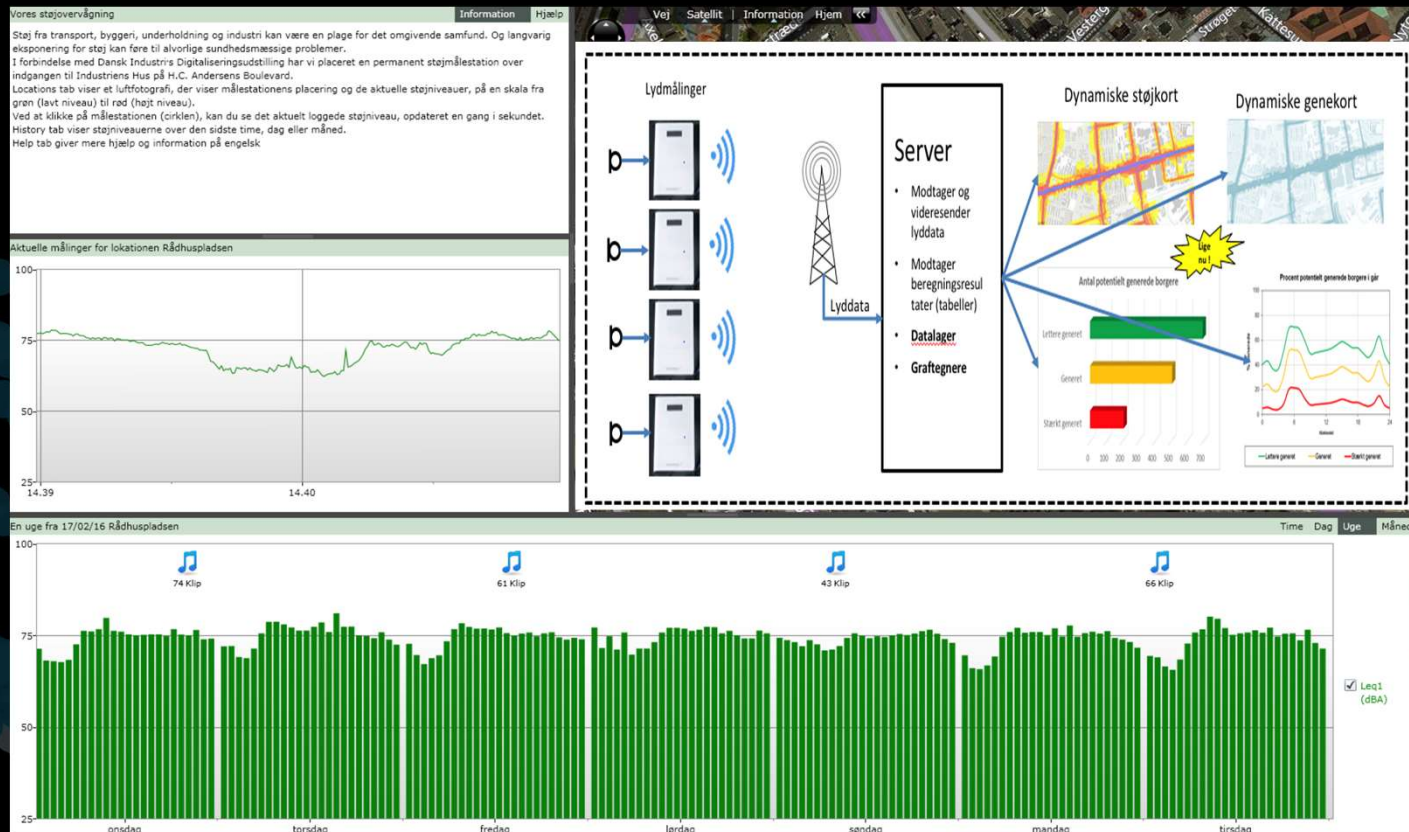
# IoT Gateway architecture



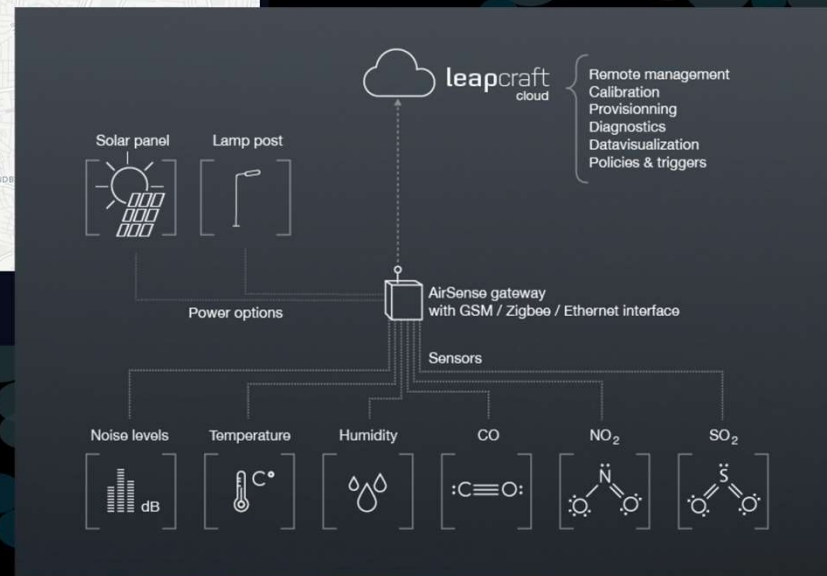
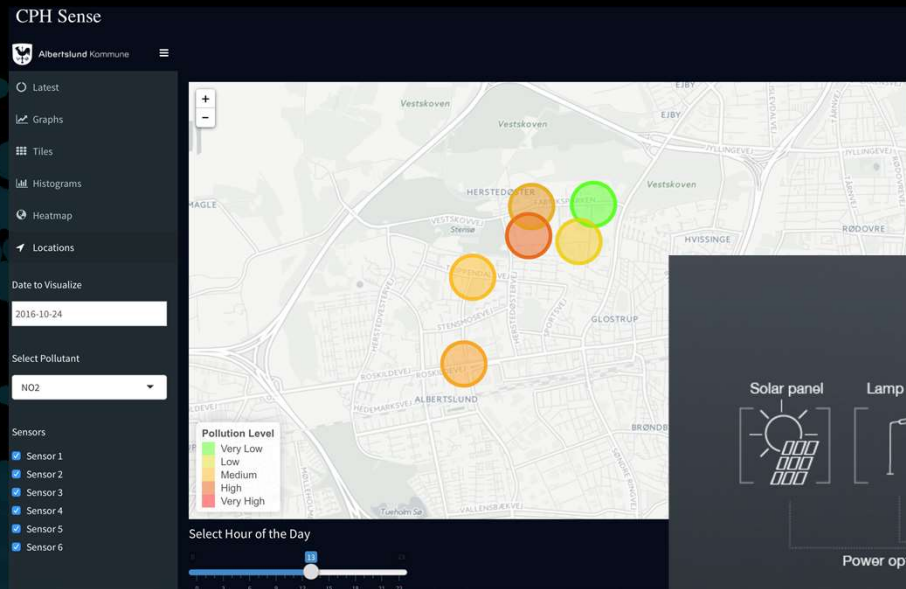
# Kinetic for Cities



# Example - Noise

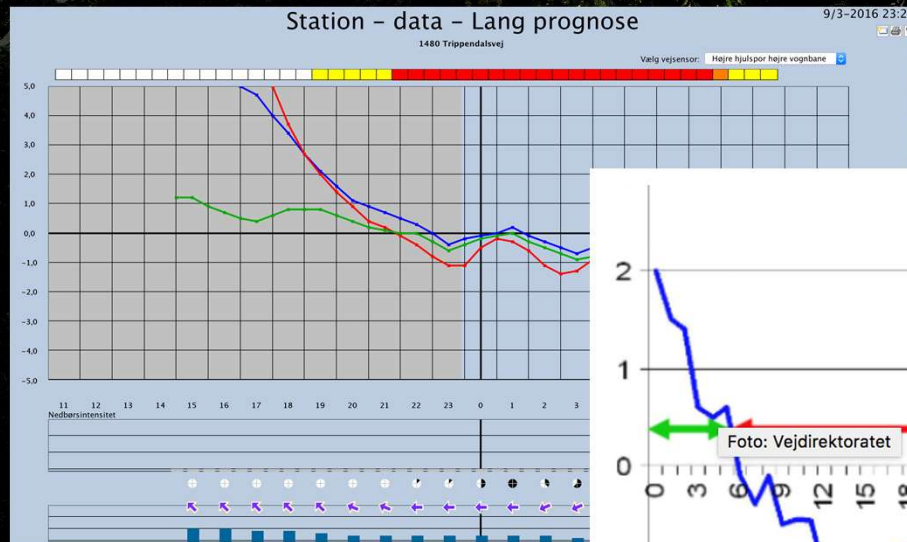


# Example – Ambient Sensors



# Example - Winter preparedness

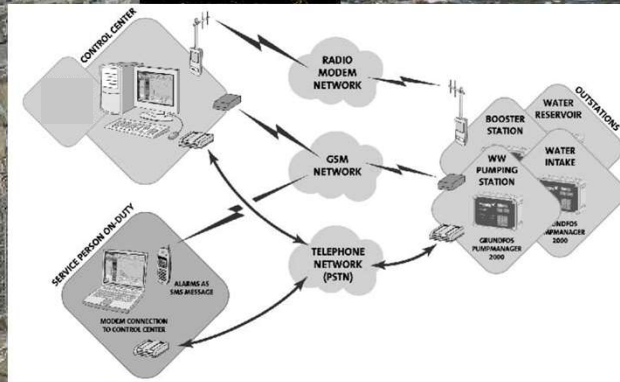
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# Example – Water pumps

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# Autonomous Vehicles

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Albertslund Kommune



GLADSAXE



Technical University  
of Denmark



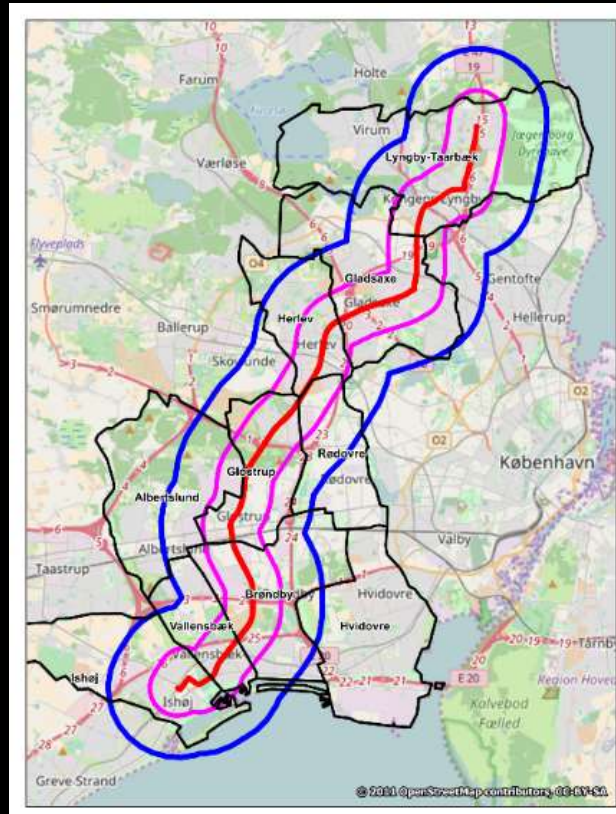
LOOP CITY



# Regional Data Platform



**LOOP CITY**



A photograph of a street lamp at dusk. The lamp is illuminated, casting a warm glow. The sky is a deep blue, and the silhouettes of trees are visible in the background. A semi-transparent blue rectangular box is overlaid on the center of the image, containing the text "Thank you" in white, sans-serif font.

Thank you