

ICT Solutions for Smart Cities

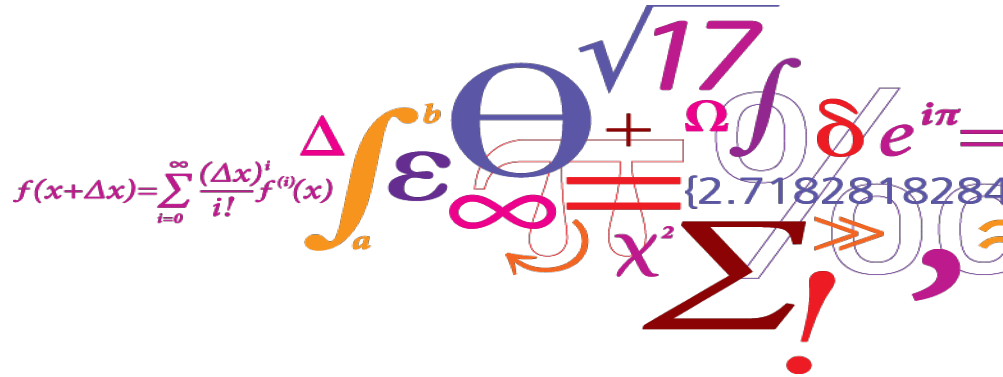
Per Sieverts Nielsen

Presented at:

Manado State University

UNIMA: Universitas Negeri Manado

22 March, 2018, Indonesia



Thanks to



- Angreine Kewo, LPDP (PhD student at DTU with LPDP scholarship)
- Centre to IT Intelligent Energy System, CITIES, which pays the cost me being here
- InnovationsFond Denmark (main funder of CITIES)

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- The Danish Power hub
- European legislation on protection of person data
- IoT solution on air pollution monitoring
- Summary

What will you be doing?

Work in the IT department of a company?

Work in a software company?

Will you work in a company developing IoT solutions?

Work on Blockchain solutions? Robotics?

Data security? --- Hacker!!!???

Develop Selfdriving – autonomous vehicles? Machine learning

Develop Selfdriving – autonomous businesses? Machine learning

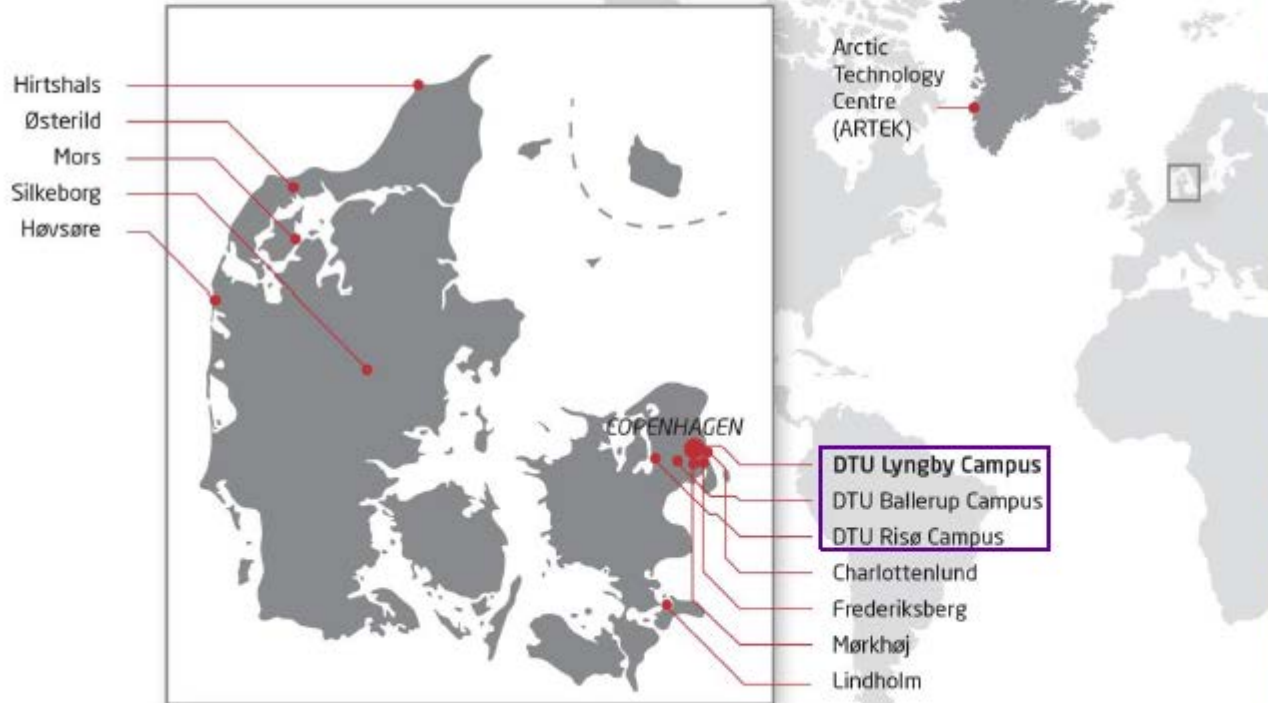
Work in the city/municipality/local government? Make smart cities?

Will you do a masters degree?

Will you stay in Manado?

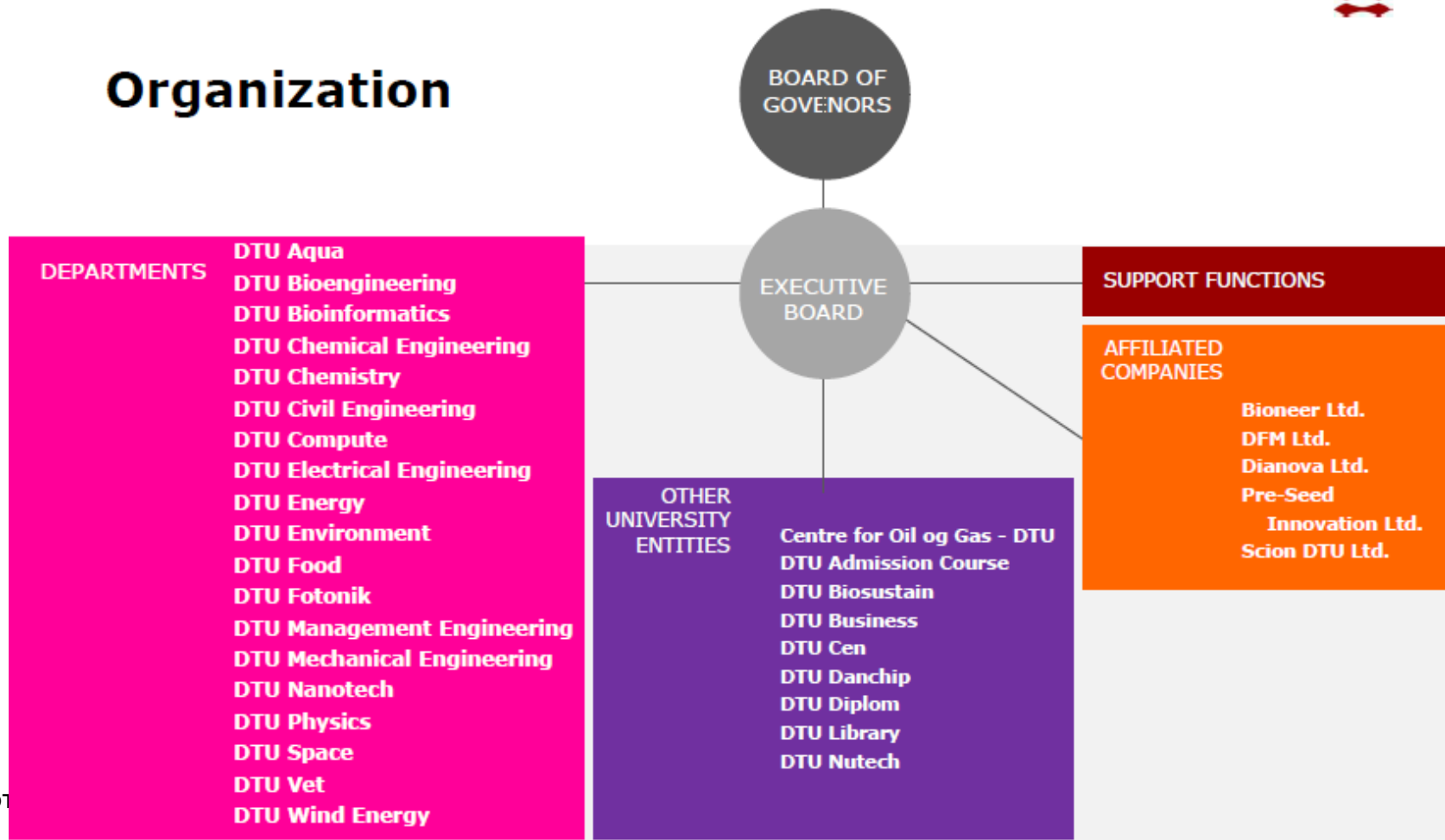
University locations across the kingdom

- centered in the capital region



Organization

DTU



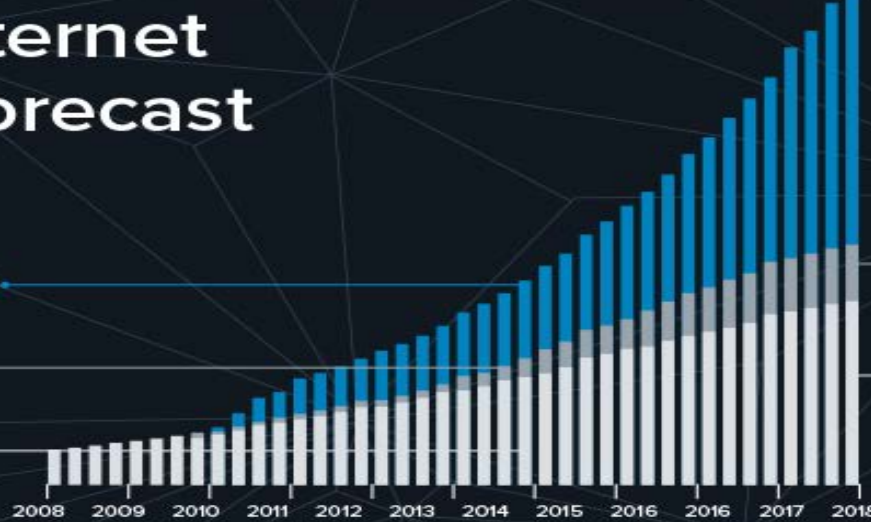
Global Internet Device Forecast

INTERNET OF THINGS
40 Billion Devices
in Use by 2020

INTERNET OF THINGS
8 Billion Devices
in Use by 2014

TABLETS
6 Billion Devices in Use
by 2014

SMARTPHONES
5 Billion Devices
in Use by 2014



TABLETS
9 Billion Devices
in Use by 2018

SMARTPHONES
8 Billion Devices
in Use by 2018

There will be as many as
40 To 80
BILLION
connected objects
by 2020.



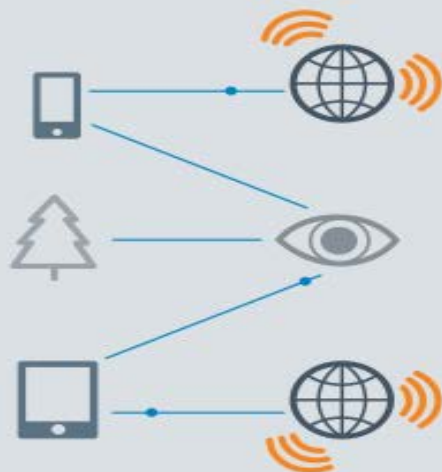
There will be
10 connected
objects
for every man,
woman, and child
on the **PLANET.**

<http://visual.ly/future-internet-things>

[†]There will be as many as
40 To 80
BILLION
connected objects
by 2020.



There will be
10 connected
objects
for every man,
woman, and child
on the **PLANET.**



Through the power of smart
devices, people will not only
consume data, but contribute
observed data to the IoT through
their phones and tablets as

human sensors

<http://visual.ly/future-internet-things>

Five global mega trends shaping the future



Rapid urbanisation



Demographic and social change



Climate change and resource scarcity



Shift in global economic power



Technological breakthroughs



**35%
more**

Expected
increase in
global food
demand by
2030¹

2030

**E7 E7 E7
E7 E7 E7
E7**

We predict
that seven of
the world's
biggest 12
economies
in 2030 will
come from
emerging
markets, the
'E7'²



Years taken for telephone to
reach half of US households;
the smartphone in under ten³

50%

of the world's
population
growth between
now and 2050
is expected to
come from Africa⁴



1.5 million

people are added to the
global urban population
every week⁵



The world's **85** richest
people own as much wealth
today as the poorest
3.5 billion⁶



2015

In 2015 the size of the middle
class in Asia Pacific is expected
to overtake Europe and
North America combined⁷



50%

of global GDP is generated
by the 300 largest
metropolitan areas⁸



Around half of US jobs are
at risk of being computerised
over the next two decades⁹

**AN AUTOMATIVE
REVOLUTION IS COMING**
AND THE IMPACTS WILL BE HUGE.

DRIVERLESS CARS

FREE POWER

FREE ELECTRIC POWER
SET TO SHAKE UP THE STATUS QUO

SET TO REDUCE



LIVES

ACCIDENTS



INSURANCE



PUBLIC
SECTOR COSTS



FUEL DEMAND

Industries will need to adapt or fade away:



TAXIS



PARKING
LOTS



FUEL
STATIONS



SUPERMARKETS



CAR DEALERS



MAPPING

HERE BY
2020

TECHNOLOGY & LIFE SCIENCES MEGA TRENDS TO WATCH



SOLAR CAPACITY
ABOUT TO EXPLODE

6400
GW



200
GW



Battery Technology
Rapidly Improving



Utilization of water
increasing

CYBER CASH & MOBILE PAYMENTS



The new
normal yields
Incredible
Fintech
Possibilities

FINTECH



CYBERCASH

CLOUD COMPUTING



Closed systems
getting integrated
via **Cloud
Connections**



Shift in Decision Making to Business Units



IT MANAGER



LINE OF BUSINESS MANAGERS

THE INTERNET OF THINGS



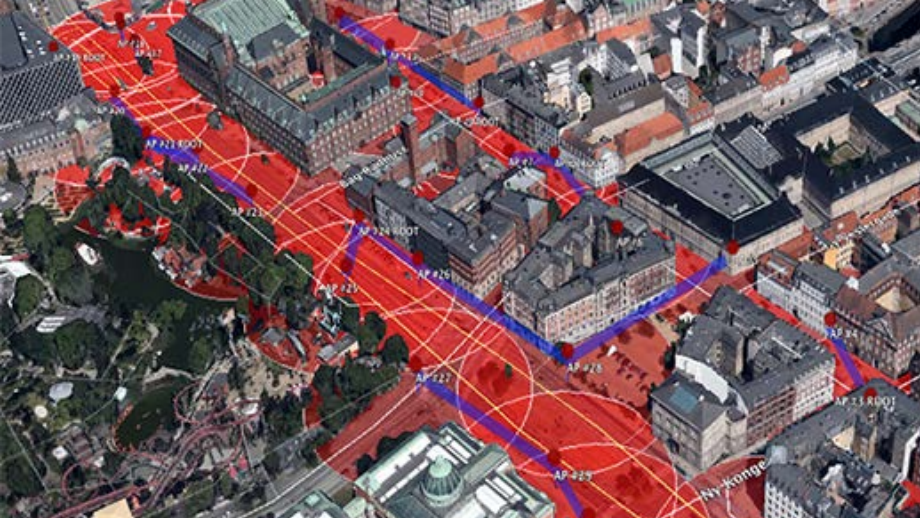
Smart City

Home

Social
Network

Incredible
Engineering
Opportunities





Du er cyklist nummer

4292

i dag

af sammenlagt

1258919

Cyklist siden 1. maj 2009
på denne strækning



Translation

Definition of a smart city

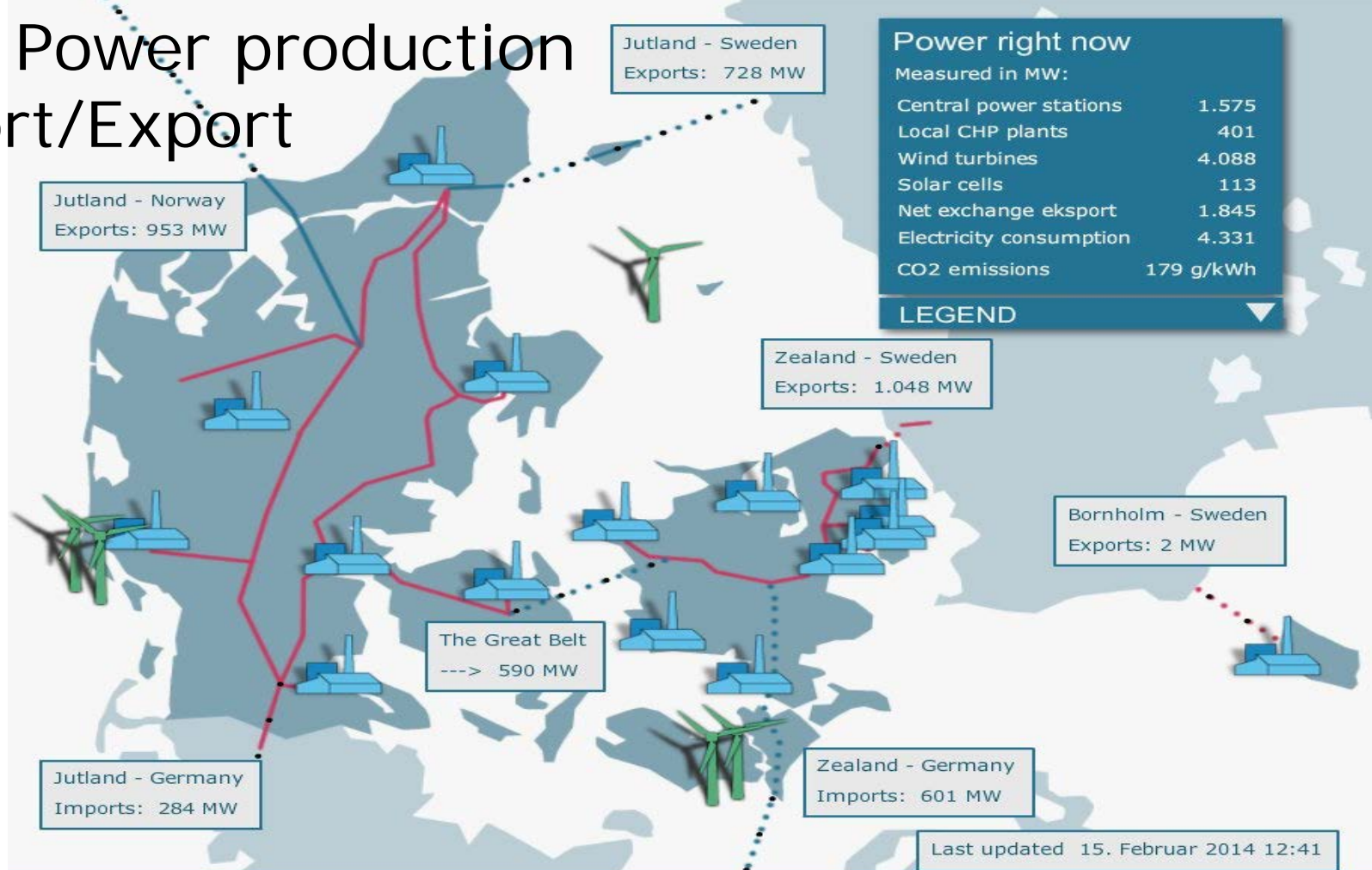
“The Smart Energy City is **highly energy** and **resource efficient**, and is increasingly powered by **renewable energy sources**; it relies on integrated and resilient resource systems, as well as insight-driven and innovative approaches to strategic planning. The application of **information, and communication technology** are commonly a means to meet these objectives. The Smart Energy City, as a core to the concept of the Smart City, provides its users with a liveable, affordable, climate-friendly and engaging environment that supports the needs and interests of its users and is based on a sustainable economy.”

What does it mean that we try to connect all aspects of Smart City?

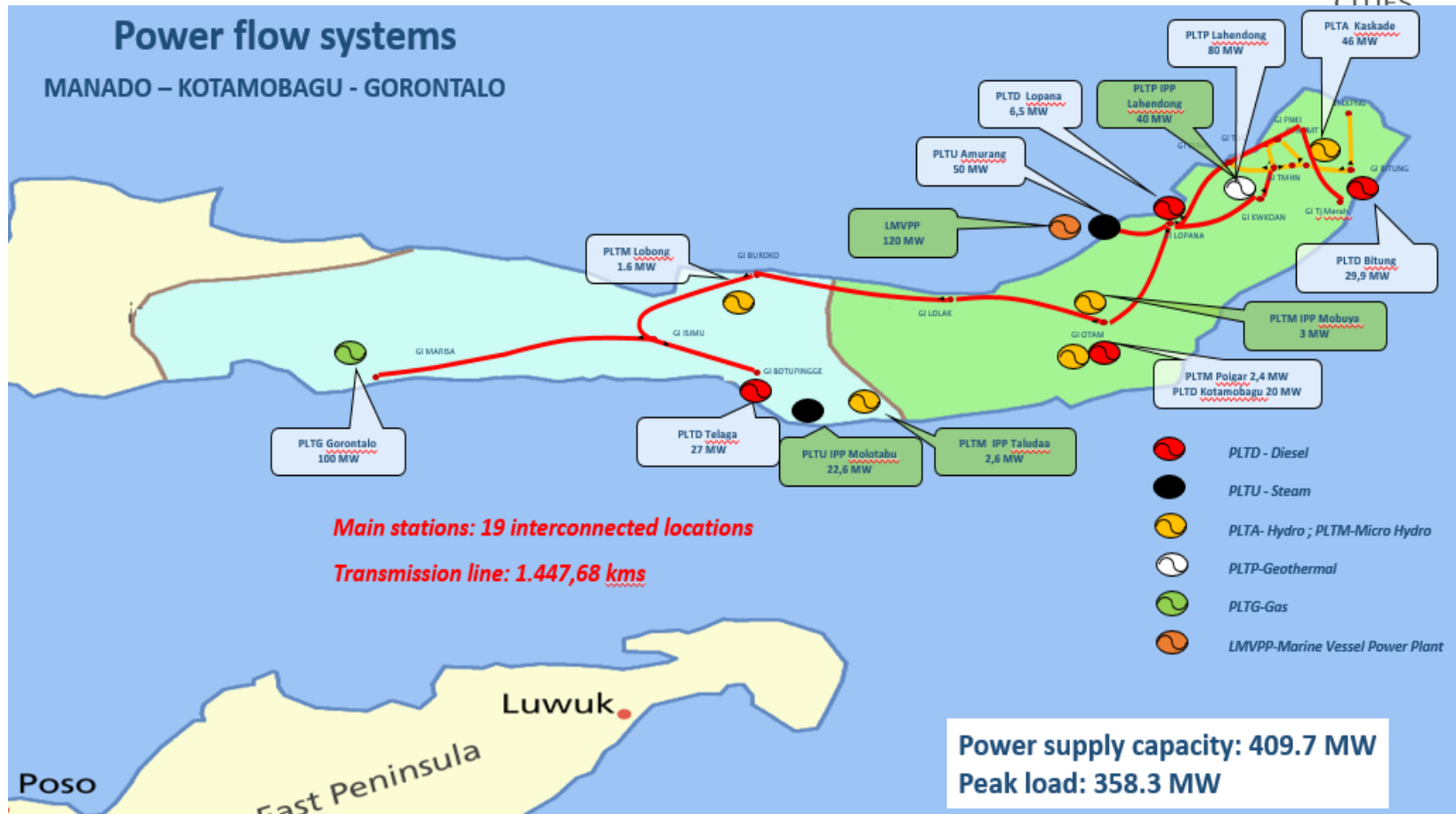


Danish Power production

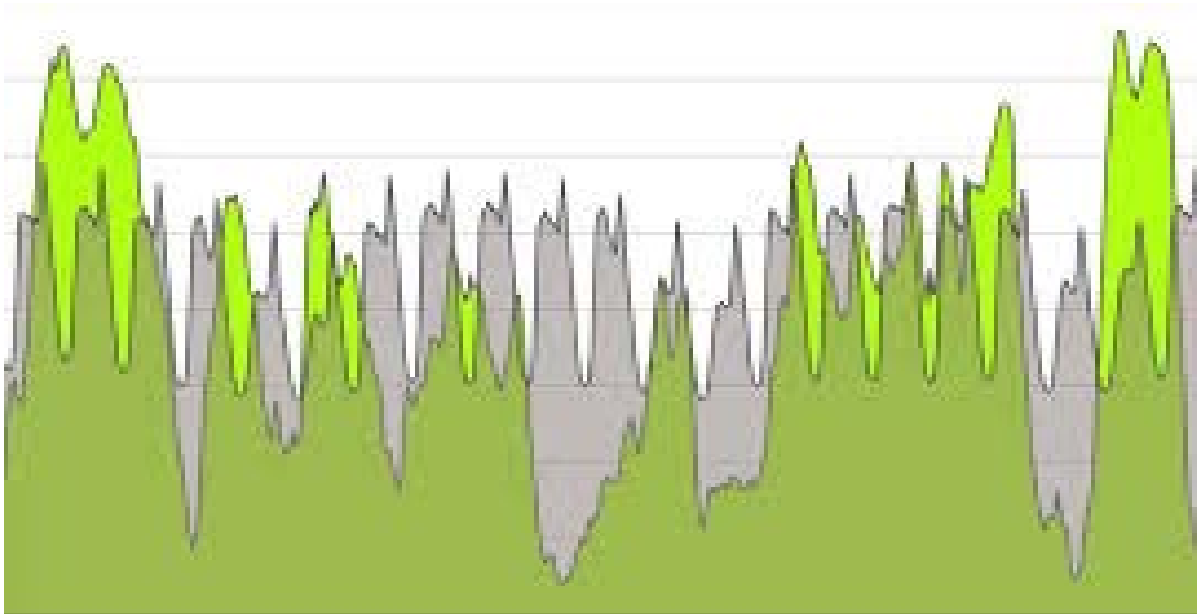
– Import/Export



Power flow systems in Manado

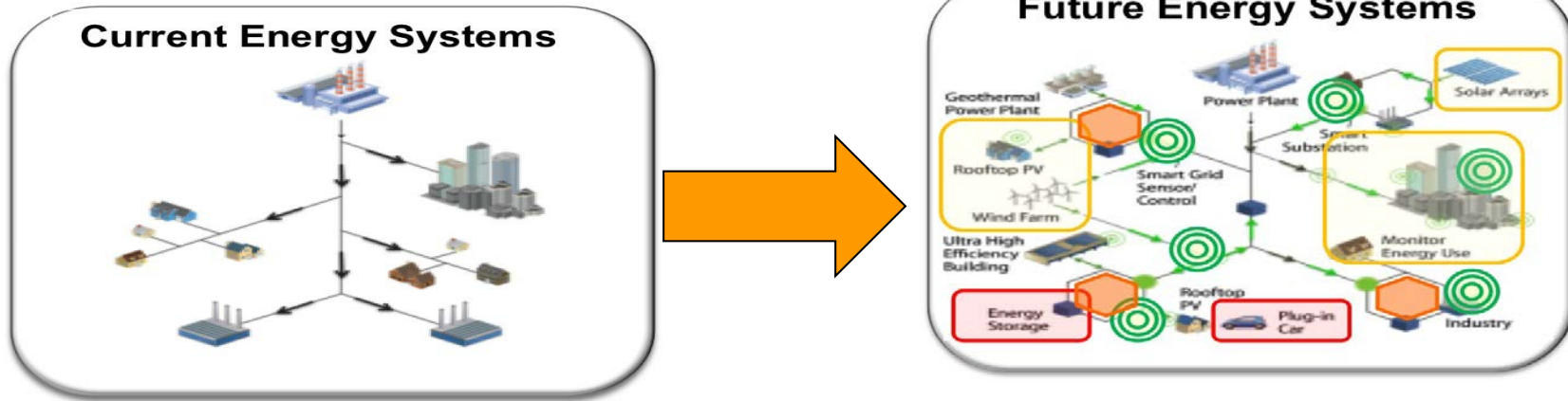


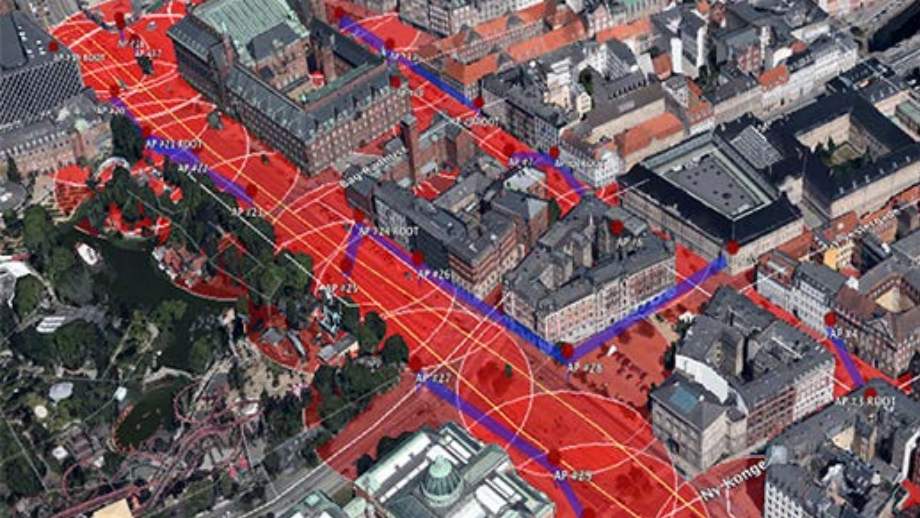
Electricity production (green) and electricity consumption (grey) over **three weeks** in Denmark



Change towards smart networks or decentral solutions

- From centralised to decentralised production





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Translation

Centre for IT Intelligent Energy Systems - CITIES

Scientific Objective

To establish **methodologies and ICT solutions** for **design and operation** of integrated electrical, thermal, fuel pathways at all scales.



Key Outcomes

- Modular **forecasting and control models/tools** for a variety of energy system components, including their interactions
- **Market structures** that support energy systems integration
- Operational **methods and scenarios** for energy systems integration and management, scenarios towards a fossil free future (Power and heating sectors fossil fuel free in year 2035)
- **2014-2019, 10 €Mio (Innovationfond Denmark 6 €Mio, 38 partners)**
- **18 Demo Projects finished, ongoing and planned.**
- **80 published papers**
- **Setting up an Innovation Centre**
- **www.smart-cities-centre.org**

Results: some examples

Software:

- HPMPC: A toolbox for High-Performance MPC
- MPC-R: A toolbox for MPC in R
- CTSM-R: A toolbox for semi-physical modelling in R Modelling and

Planning tools

- Modelling tools for aggregated loads
- Multiple Execution Tool (MultiNODE) for EnergyPLAN
- Sifre (Energinet.dk) - incl. tests in Sønderborg

Hardware

- SN-10 Smart House Controller
- MPC setup – LabView – OPC-UA client (next PASSYS test cell)

Data Analytics and Energy Informatics

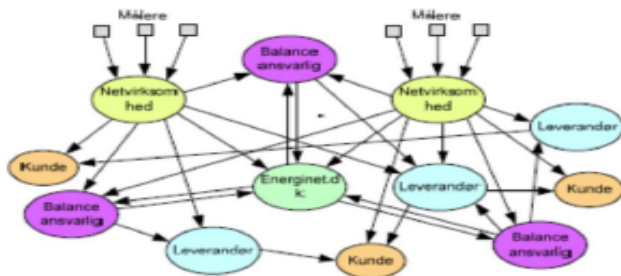
- WEB-service for forecasting and control (load, wind, solar,...)
- Cloud based model predictive control
- Smart-Energy Data Management Systems (OS, DATA, REP)

Demo projects

- Building Energy Demand Modelling
- Control of heat pumps
- Dynamic CO₂-based control of summerhouse swimming pool heating
- Dynamic prices for heat delivered to district heating systems
- Energy Supply Modelling in cities: A Case Study of Sønderborg Municipality
- Heating of indoor residential swimming pools by solar collectors in Denmark
- Load forecasting for District Heating
- Optimal Control of District Heating Supply Temperatures to Greenhouses
- Smart Meter Data Analytics
- Thermal mass for energy storage: Impacts and perspectives on a system scale
- Optimization under uncertainty of heat and power production in district heating systems
- Regulating Power Market; Modelling and Forecasting
- Data Intelligent Temperature Optimization of DH networks

The Danish DataHub solution

From decentralized market management



to centralized market management



Keywords: Digitization, unbundling, efficiency and transparency

Demo projects

Software solutions

Work Packages

Partners

Events

Communications

Publications

Vacant positions

Contacts



Software solutions

Software for combined physical and statistical modelling

Continuous Time Stochastic Modelling (CTSM) is a software package for modelling and simulation of combined physical and statistical models. You find a technical description and the software at CTSM.info.

Software for Model Predictive Control

Latest news

Summer School at DTU, Lyngby,
Denmark – July 4th-8th 2016

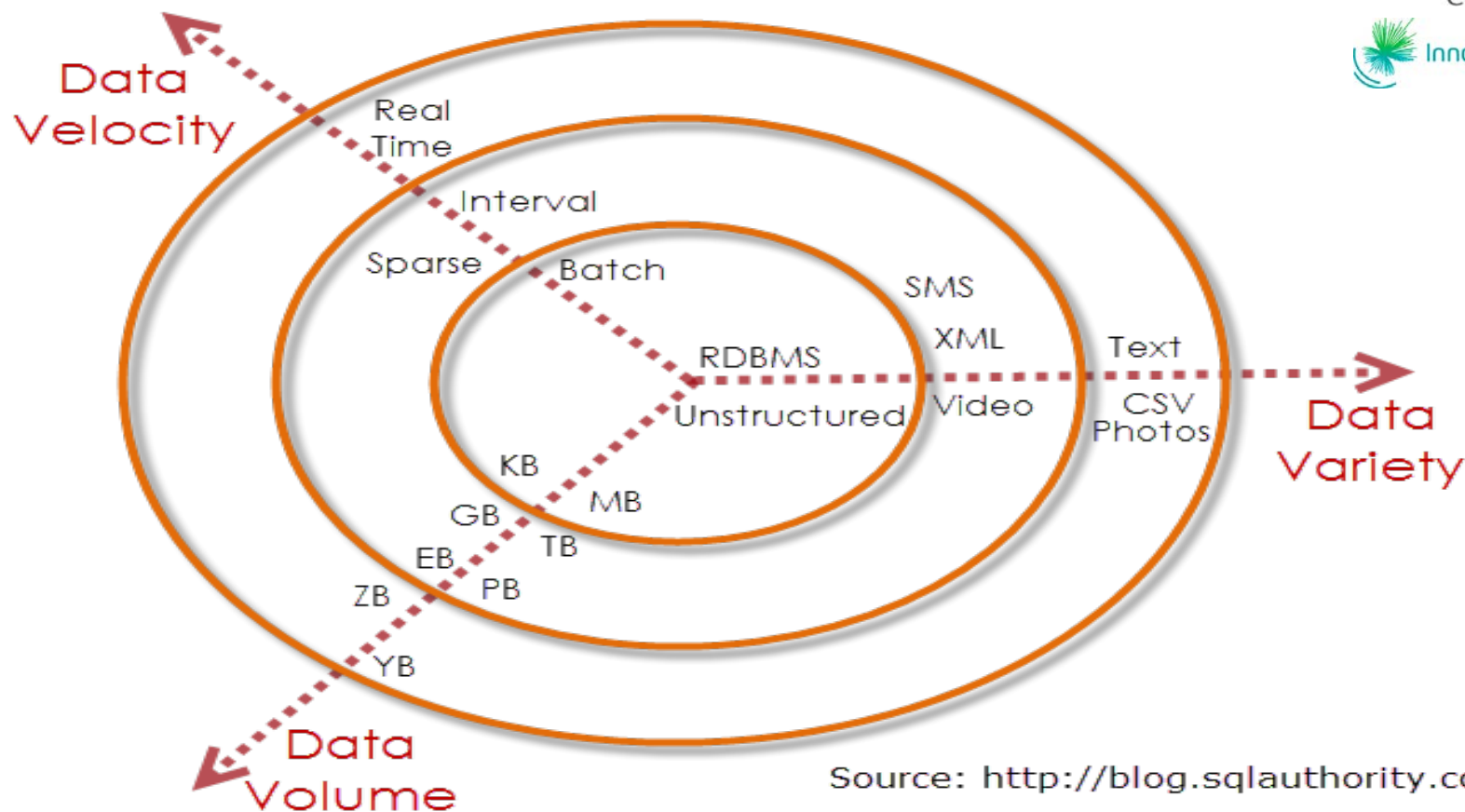
Summer School – Granada



Topics



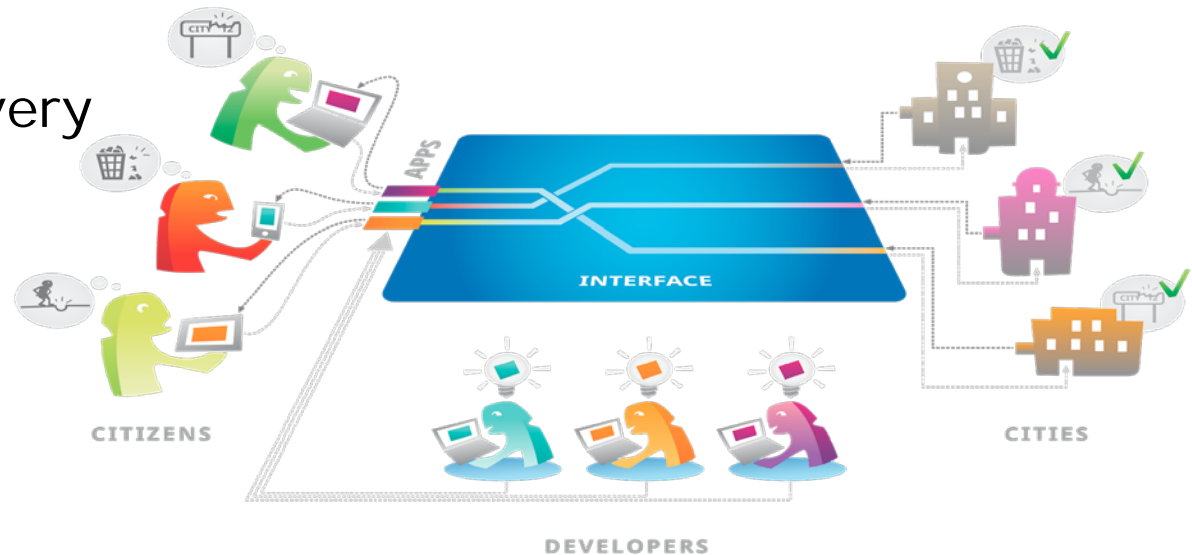
3Vs of Big Data



Source: <http://blog.sqlauthority.com>

Open Data for Smart Cities: what are the benefits?

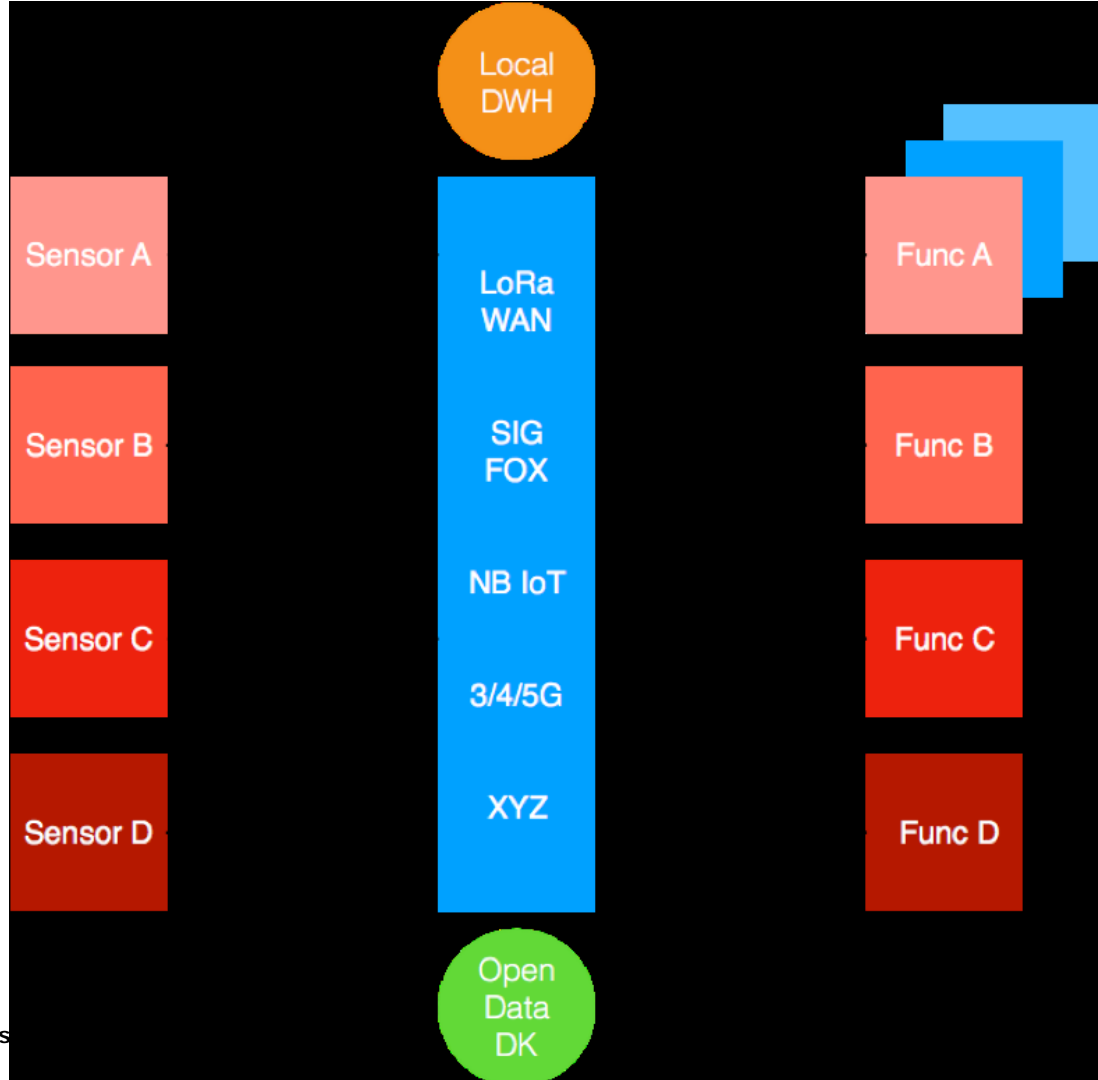
- Transparency
- Accountability
- Efficiency
- Public Service Delivery
- Engagement
- Data Improvement
- Societal value
- Economic value



OS2

A common platform for municipalities in Denmark

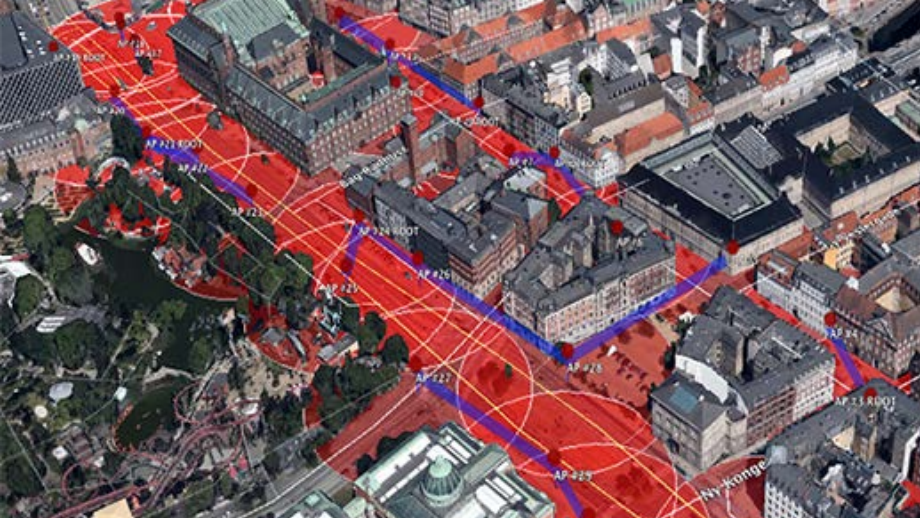
- Support all transmission standards
- Modular core which can be used in all services
- Backbone for Danish IoT work and smart city activities



OS2 - A common platform for municipalities in Denmark



- Receive data from all IoT sensors
- Monitor units
- Forward data, notifications, visualisation and analyses
- Maps, dashboards, “situation room”
- Continuous development of functionalities, in cooperation with other cities



Translation

Upcoming European protection of personal data

Regulate the use and protection of personal data.

Major changes:

- Elaborates the right of the registered
- Right to be forgotten
- Data portability: Take ALL your data from one social media to another.
- Stricter documentation requirements: Must be able to document the effort in securing data
- Greater fines: % of global sales

Intended to harmonize

- But approximately 50 areas where each country can make own legislation
- Still going to be complicated

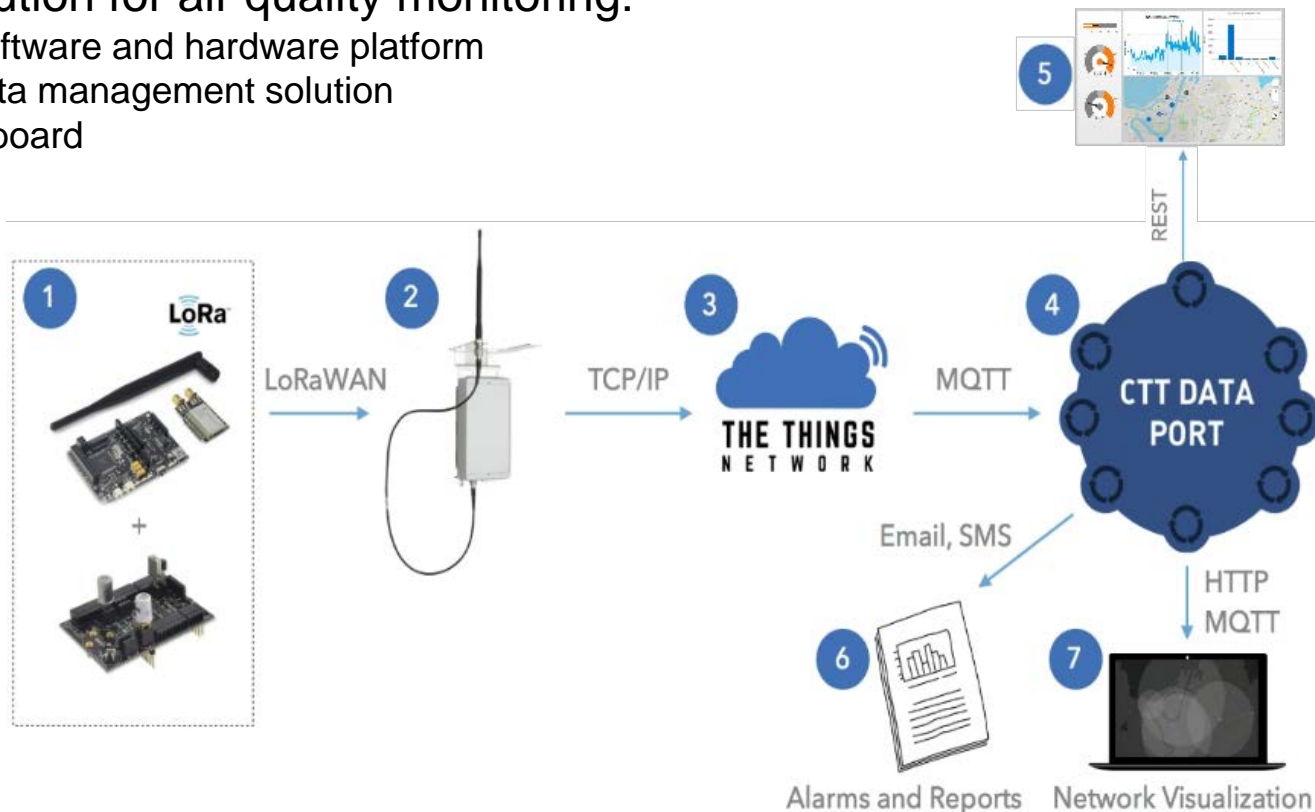
IoT sensors for monitoring air quality



CTT: An IoT-based carbon track and trace system

A holistic IoT solution for air quality monitoring:

- Open source software and hardware platform
- Scalable IoT data management solution
- Real-time dashboard

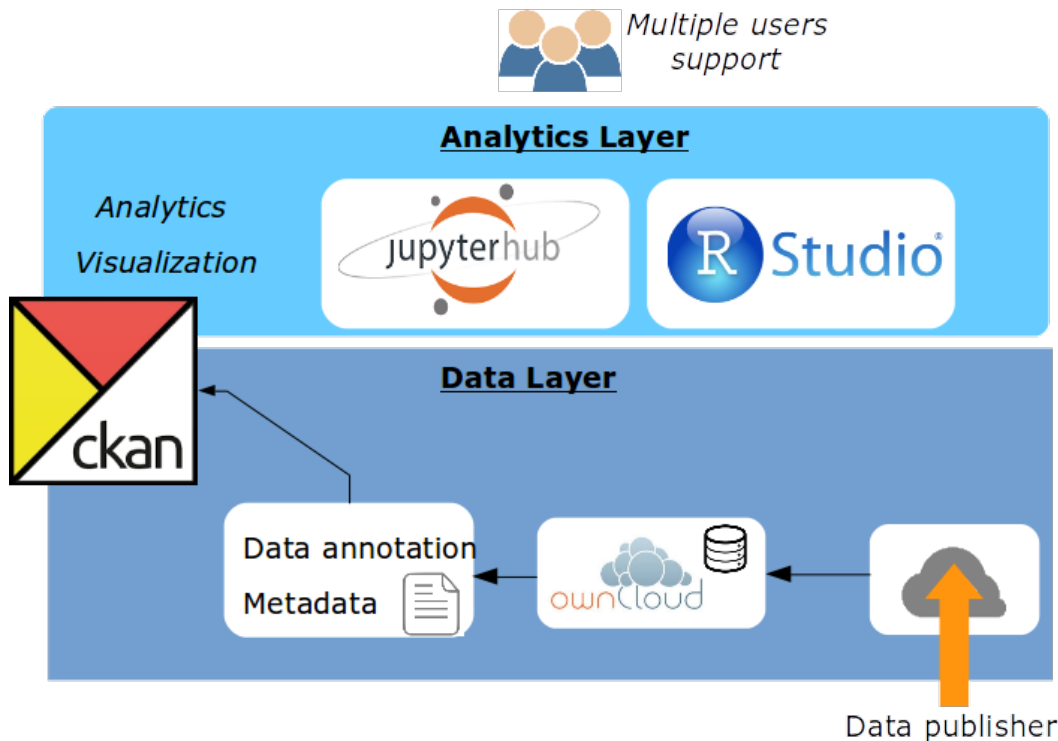


SciCloud Service - *Cloud-based data and analytics service*

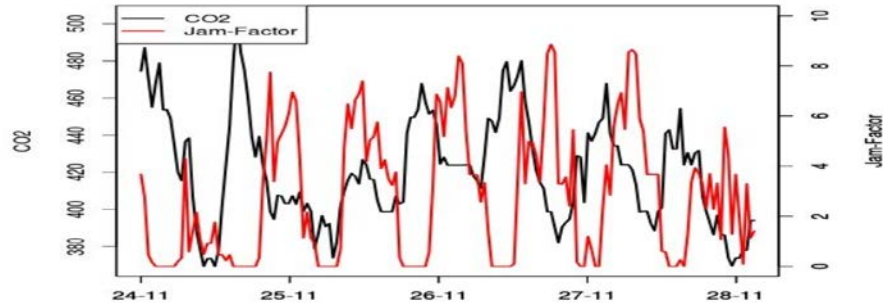
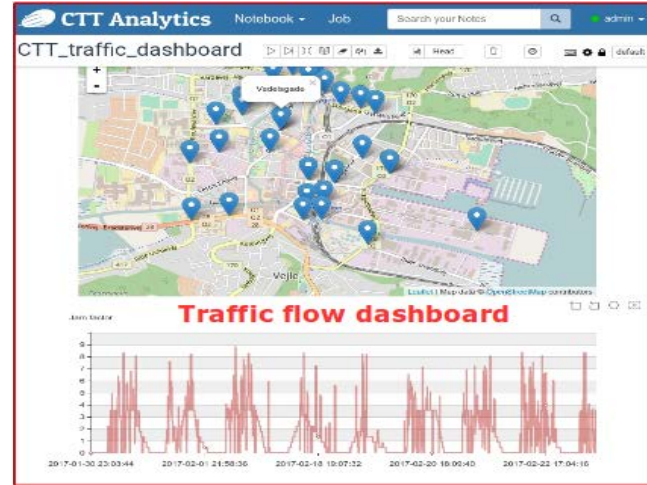
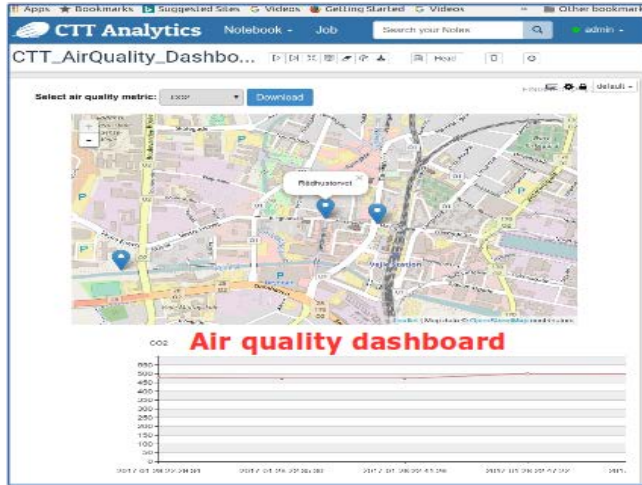
Cloud-based data management

Open data portal

In-place data analytics service



Analytics and visualization



Model the correlation between traffic jam factor and CO2

Smart city projects in Denmark

Copenhagen city: <https://cphsolutionslab.dk/en>

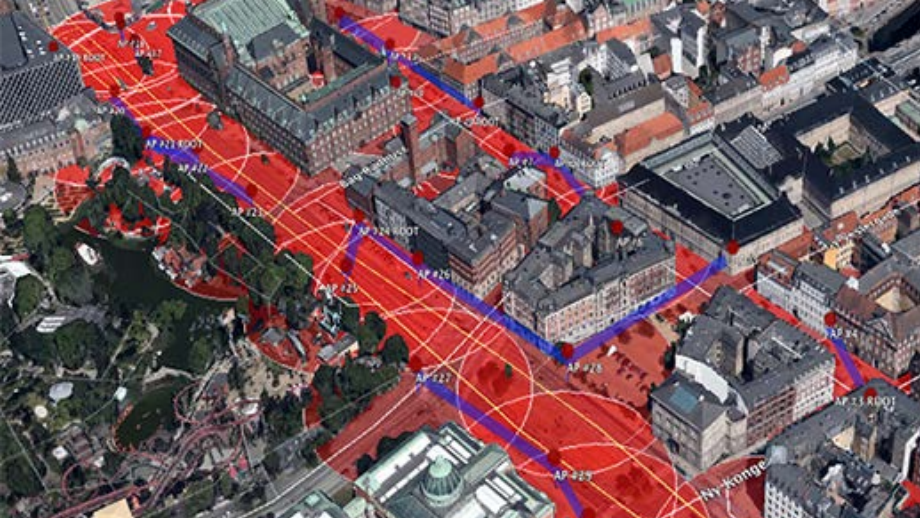
Aarhus: <http://www.smartaarhus.eu/>

Summary

You are ahead of the rest of the society with ideas which potentially can improve quality of life for its citizens.

You should remember to keep the big picture in mind in your systems development and remember where you are “right now” in this process.

Smart cities need smart people and smart stakeholders to work together. It will not happen by itself.



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Thank you
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