



ComResult
Committed to Result



Internet-of-Things / IoT

An (r)evolution that needs time to settle

hcc 

V1.3 – 29th of June 2017
@DokZUID / Apeldoorn



Bit of background info ...

Jeroen van Bussel

- Technical background
- 20 years experience in telecom (EMEA wide)
- Consultancy (Project Manager, Architect, Tech Strategy ...)
- Entrepreneur > 15 years
- Based in the Netherlands (Apeldoorn)

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ComResult

- IoT solution:
From Idea → Proof of Concept → Prototype → Solution / Product
- IoT consultancy
- Smart Industry ambassador



Internet-of-Things

Goal of this talk

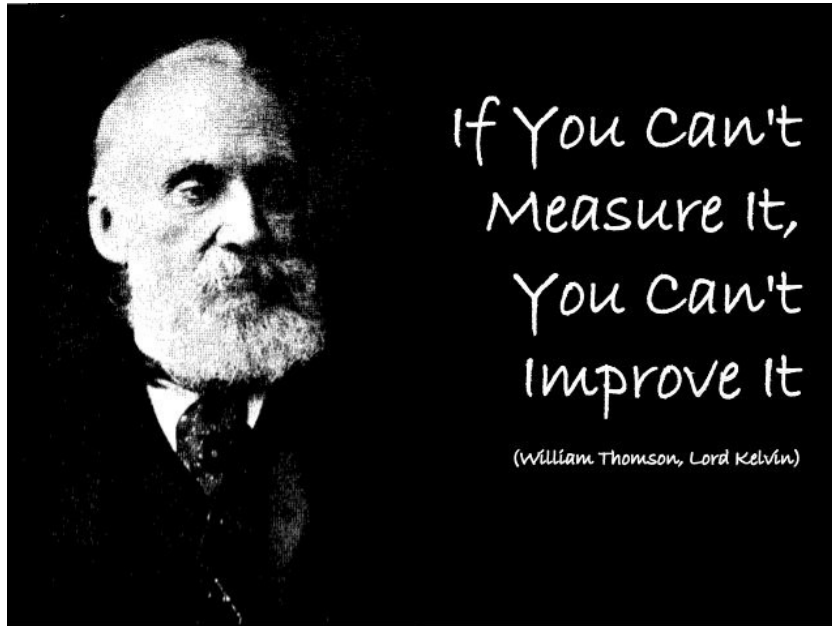
- What is IoT and where did it come from?
- Where is IoT today?
- IoT project example
- Technology
 - What IoT technologies are in place / expected?
 - LoRa as IoT technology
- What's next?



1. What is IoT?

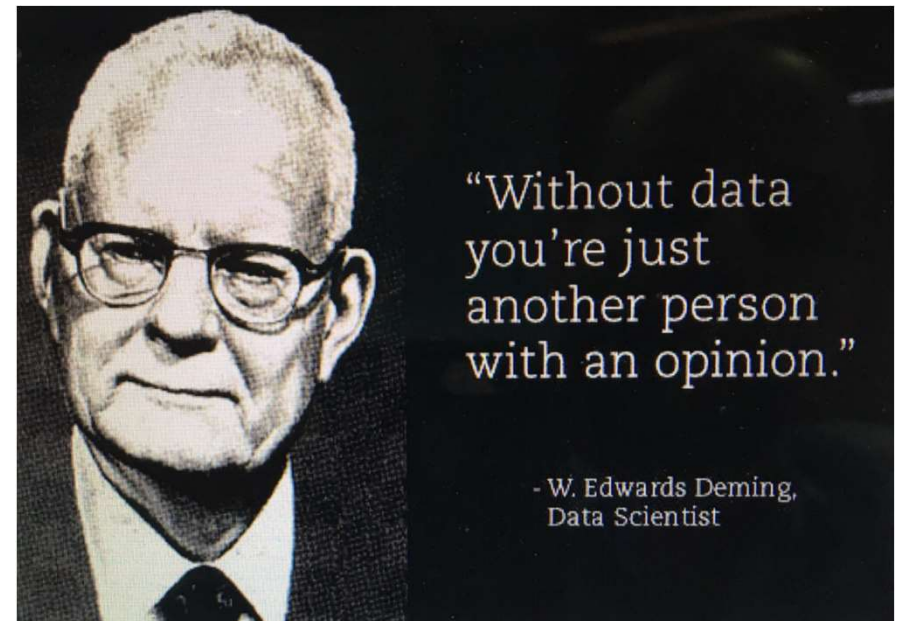


Meten = weten ...



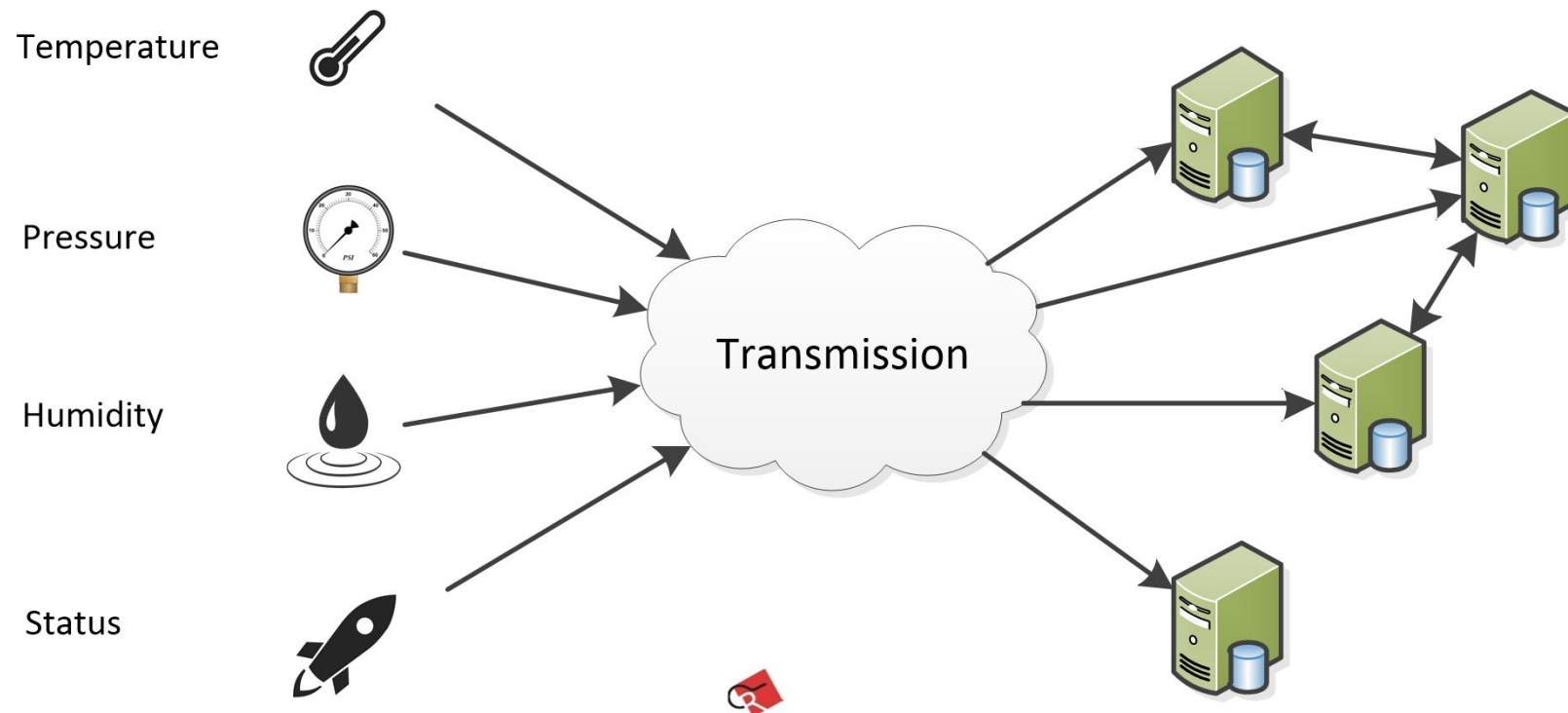
The Internet-of-Things allows us to objectively collect measurement, analyze them and based on that control 'things'.

The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment (*Gartner*)



IoT – So how did we get here?

- Telemetry (goes all the way back to the 19th century)
 - Measuring / collect information (sensors)
 - Mostly point-to-point communication
 - Isolated systems
 - Proprietary radio



IoT – So how did we get here?

- M2M (Machine-2-machine)
 - Two-way P2P communication
 - Isolated systems
 - Islands of identical or similar devices
 - Centralized server

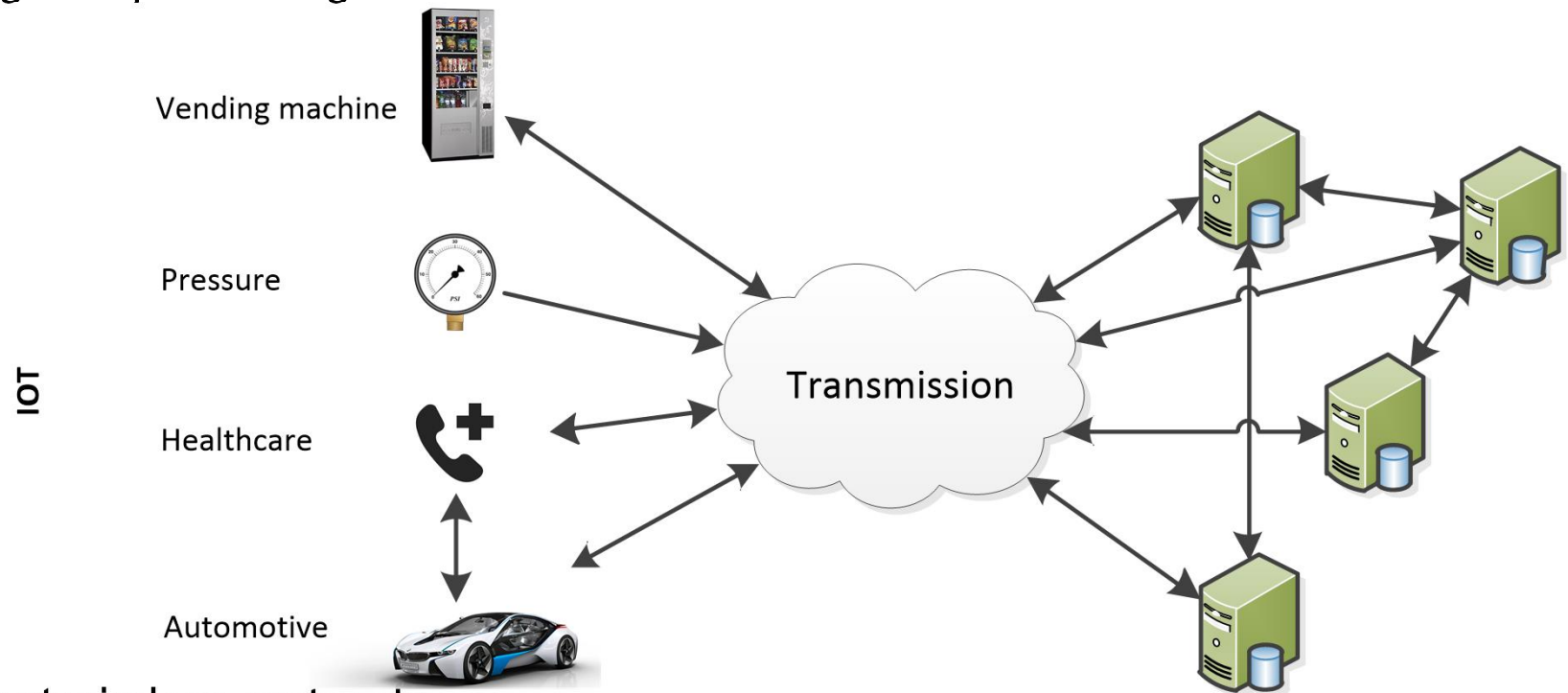
 - Analog modems
 - 2G cellular (data) modems
 - Leased lines



IoT – So how did we get here?

- IoT

- Two-way Point-to-multipoint communication
- Interconnected systems and devices
- Cloud and fog/mist processing



- Internet
- Lots of different wireless protocols

IoT – where do we see IoT?

- Very broad range of applications

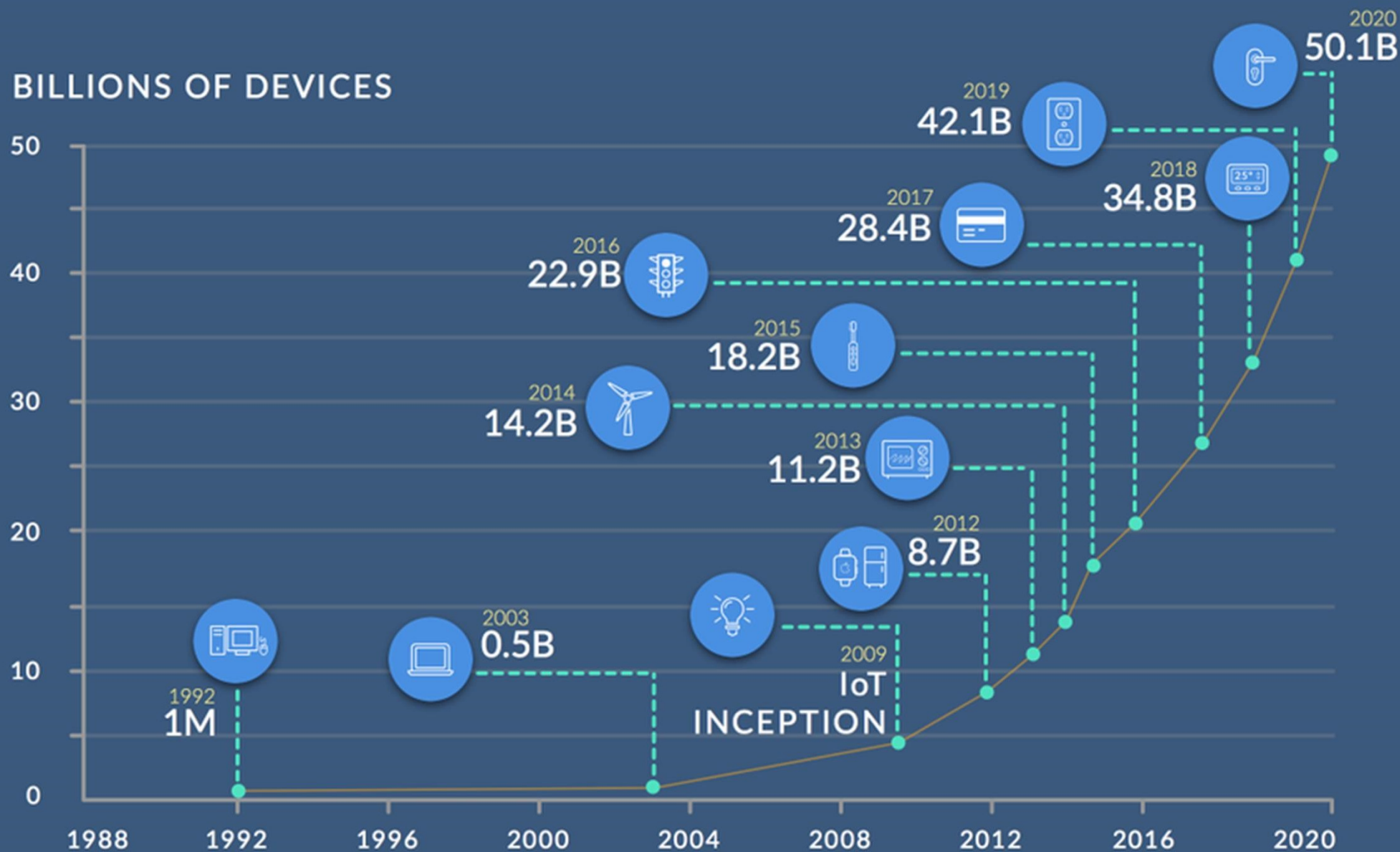




GROWTH IN THE INTERNET OF THINGS

THE NUMBER OF CONNECTED DEVICES WILL EXCEED **50 BILLION** BY 2020

BILLIONS OF DEVICES



IoT – Internet of Things



IoT will impact our life

- People get used to things

<https://www.youtube.com/watch?v=x7yDtJ0DrkU>

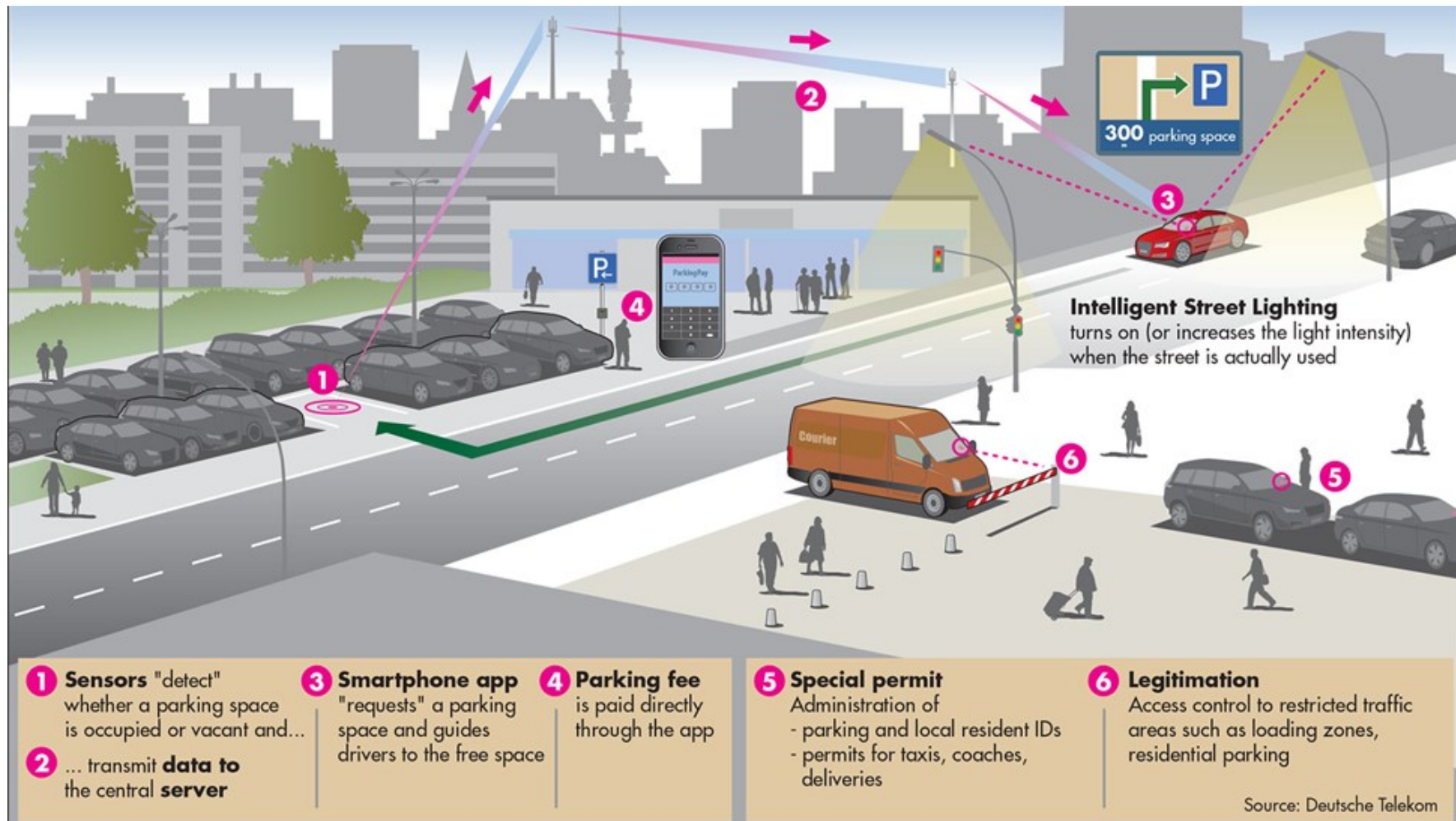


2. Today's IoT Use Case examples



IoT – Smart Parking

Smart City: Smart Parking



IoT – Hoosje Bootje (TTN 1st Use Case)



IoT – Smart Mobility

- Example Smart Mobility



Fully connected schoolbusses



IoT – Smart Cars



IoT – Smart Cars

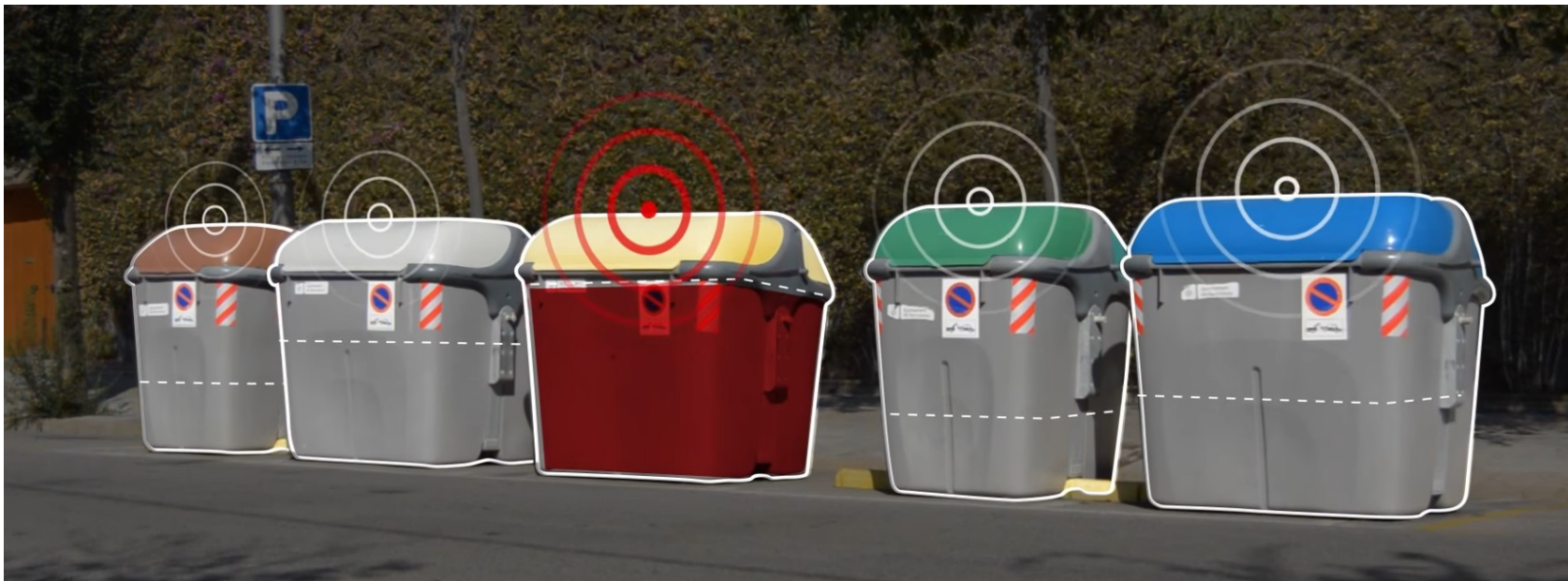
- Traffic junction in the near future 😊

<https://www.youtube.com/watch?v=Johmxw3cspA>



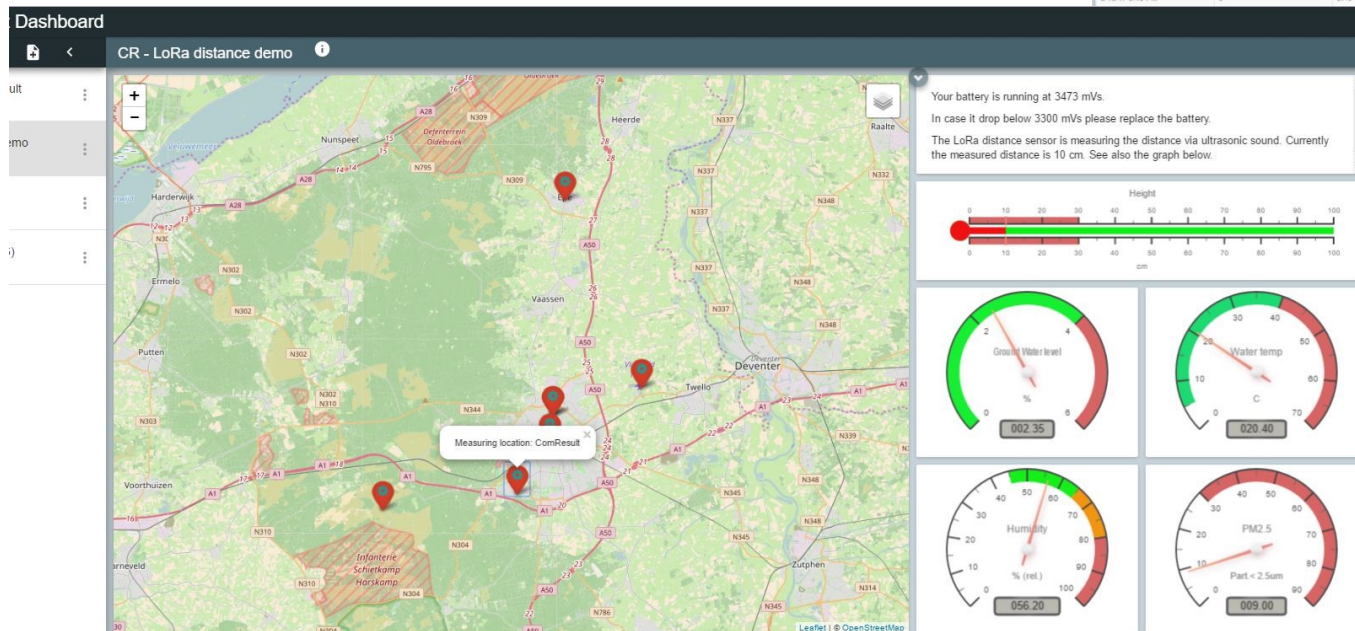
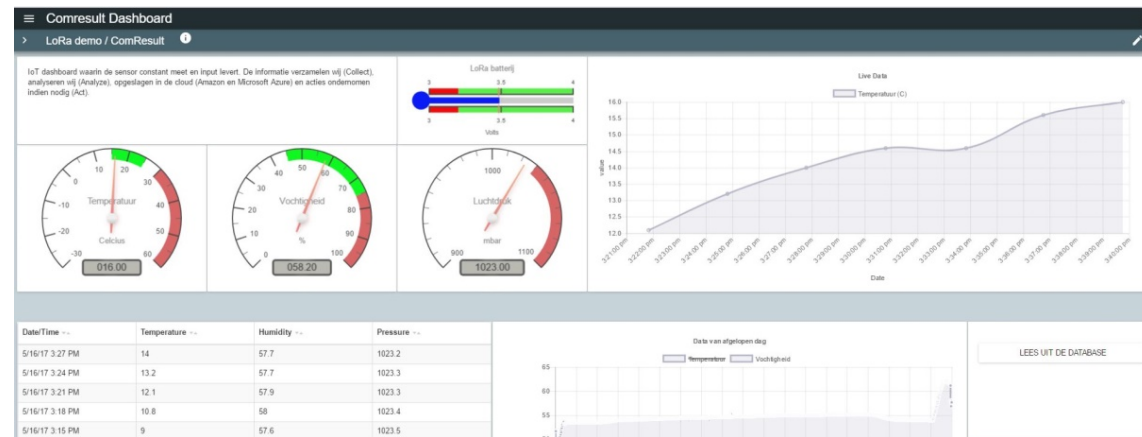
Use Cases

- Ballonvaart
 - Slijtage berekenen (temp, humidity)
- Streetlights with sensors (factory in Emmen)
- Asset tracking
 - GPS unit of geo-locatie
 - Container tracking (ships), theft
- Smart Garbage Collection



Dashboard demo

- ComResult partners with Swedisch Yodiwo (Your Digital World) (www.yodiwo.com)
 - Graphical interface to design IoT logic
 - Easy integration with any IoT provider
 - Full Device Management
 - Customizable dashboarding
 - Paas / SaaS
 -



3. IoT – real life example using LoRa



Groundwater, raincatcher



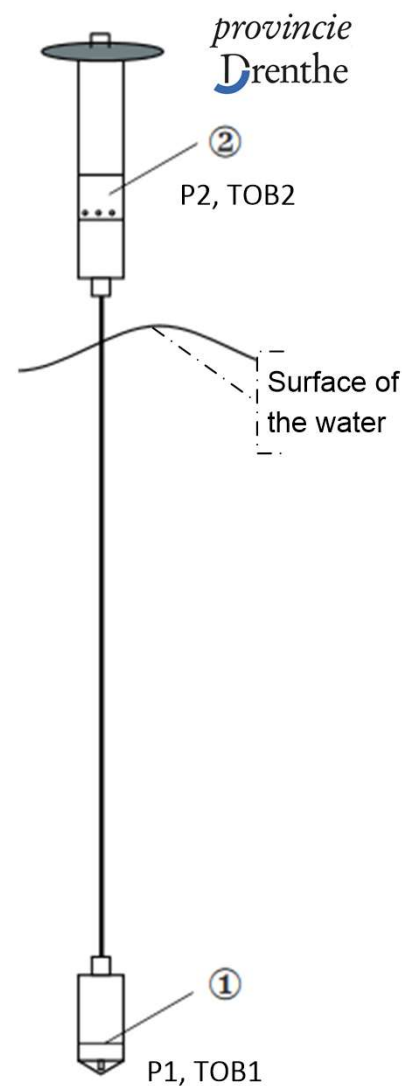
IoT pilot - Drenthe

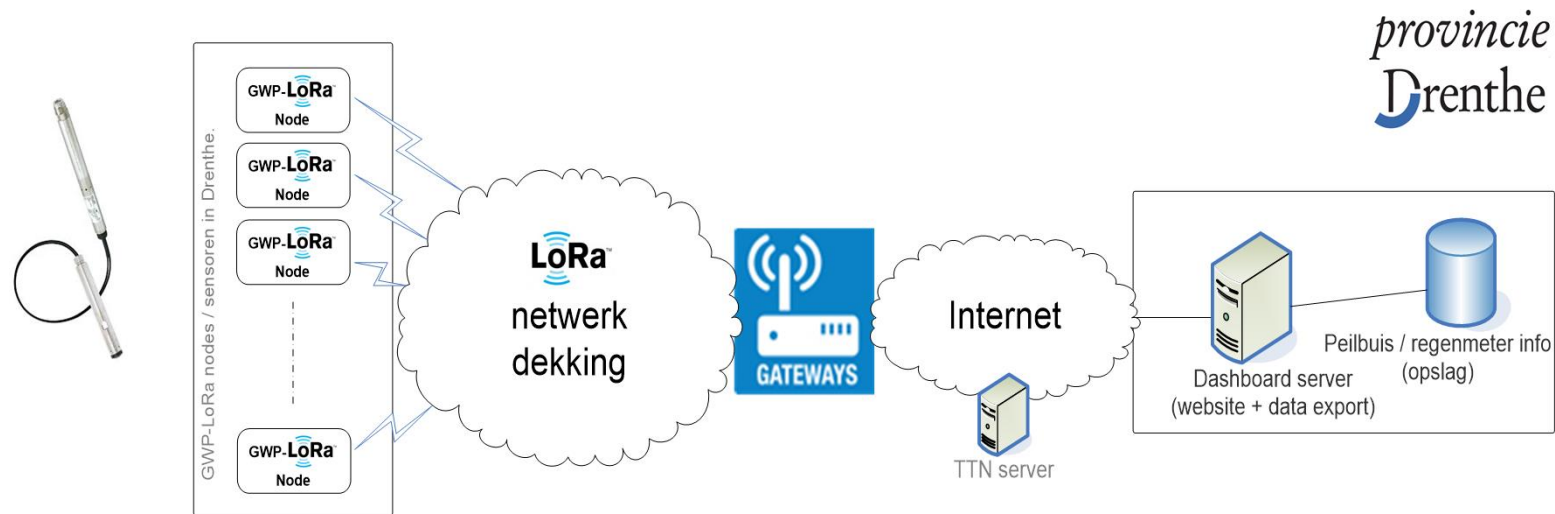
- Province Drenthe to support IoT innovations & initiatives
 - LoRa based on public TheThingsNetwork (TTN)
- Why?
 - Today data manually retrieved every 4 months
 - Not real time / no anticipation possible
 - Realtime measurement of groundwater and rain
 - Less frequent to location
 - Up-2-date data
 - Accessible via web and app



IoT pilot - Uitdaging

- Peilbuis? Grondwater?
- Hoe?Zo!
- LoRa node ontwikkelen
- Integratie met peilbuisleverancier
- Integratie met TTN / KPN
- Database
- Website / dashboard
- LoRa GW (lokaal netwerk opzetten)





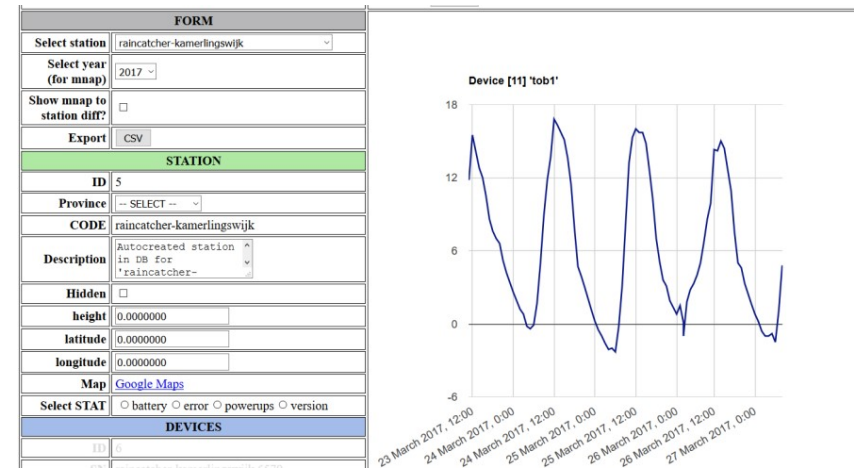
• Ervaringen

- LoRa gateway & locatie vinden (nu eigen nw)
- Ontwerp voor 'outside conditions'
- Over-The_Air data minimaal
- Stroomverbruik & batterijkeuze
- Hardware design flaws
- Software optimalisatie
- LoRa network server integratie & webserver



IoT pilot

- Dec 16 – jan 17: First HW & SW
- Data integrated in dashboard / website
- Pilot completed successfully
 - Pilot from feb to april 2017
 - Final version -> 4th of May



Low battery usage (single AA battery 2600 mAh)

- E.g. measurements send each hour (24x/day).
 - Battery lifetime of 10 years
- (4x/day) → battery lifetime 10-15 years

- It is NOT rocket science!
- Do not over-complicate things



4. IoT technologies



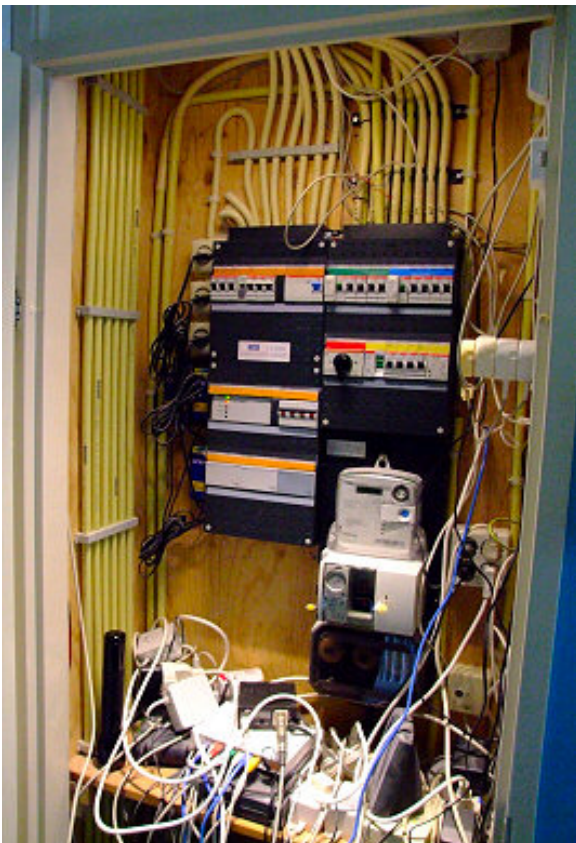
IoT – technologies

- Today cellular technologies
- IoT specific WAN / MAN technologies
- Wireless IoT technologies (LPWAN) – suitable for battery powered device
 - LoRa/LoRaWAN (full country coverage)
 - SigFox (full country coverage)
 - NB-IoT (today)
 - LTE-M (today)
 - Weightless (today?)
- What about LAN, HAN and BAN technologies used in domotica?
 - Zigbee, Zwave, BLE, ULE, WiFi (AH), Thread, ANT+, RFID, NFC, EnOcean plus many proprietary protocols like Somfy, Sonos, DigitalSTROM, Insteon, Philips HUE etc. etc.
 - ‘Legacy’: wired installations, X10, KNX etc.



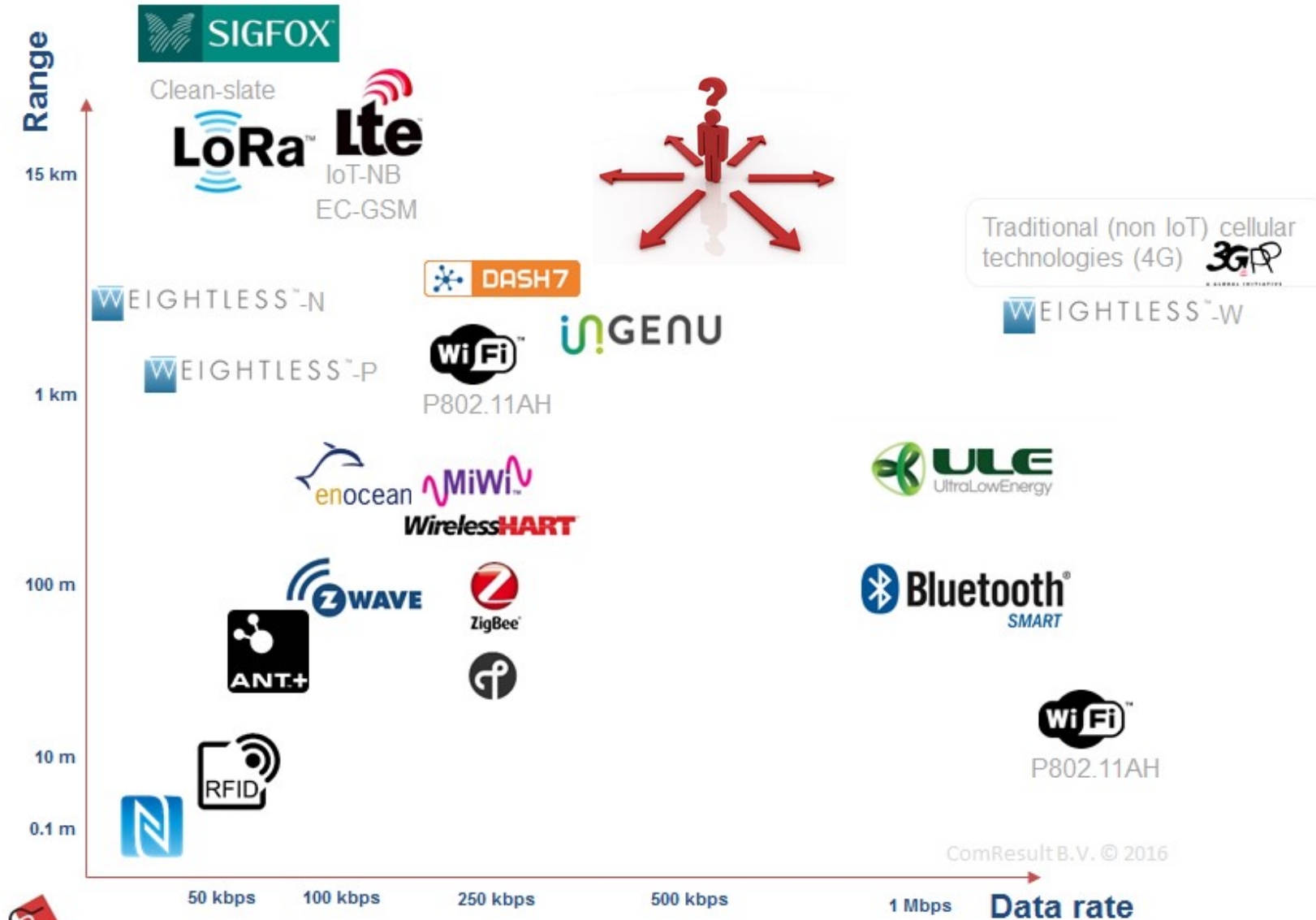
IoT – technologies

- Too many protocols in the LAN domain! (e.g. domotica)
- To support all protocols – multiple GWs required
- And multiple apps for different in-house purposes (verticals!)



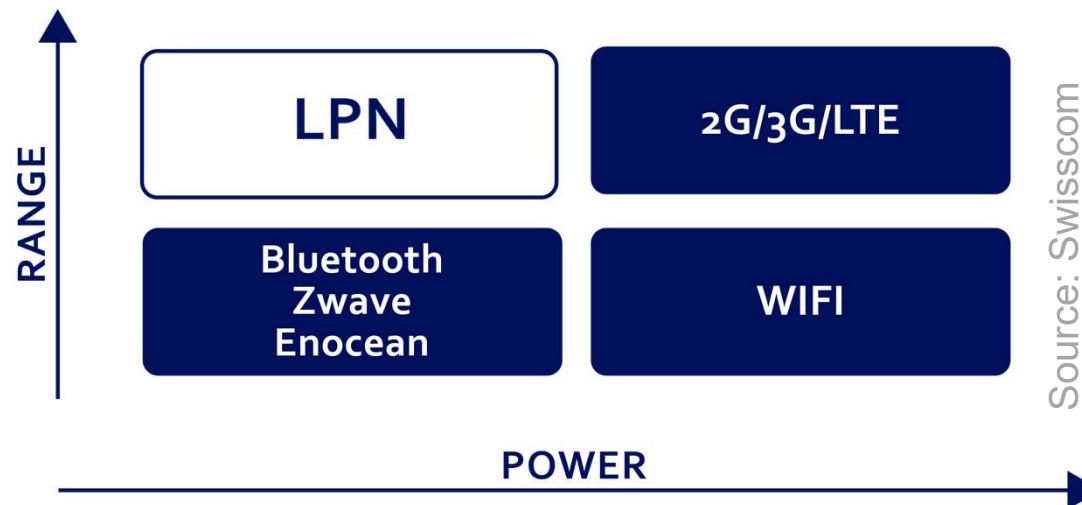
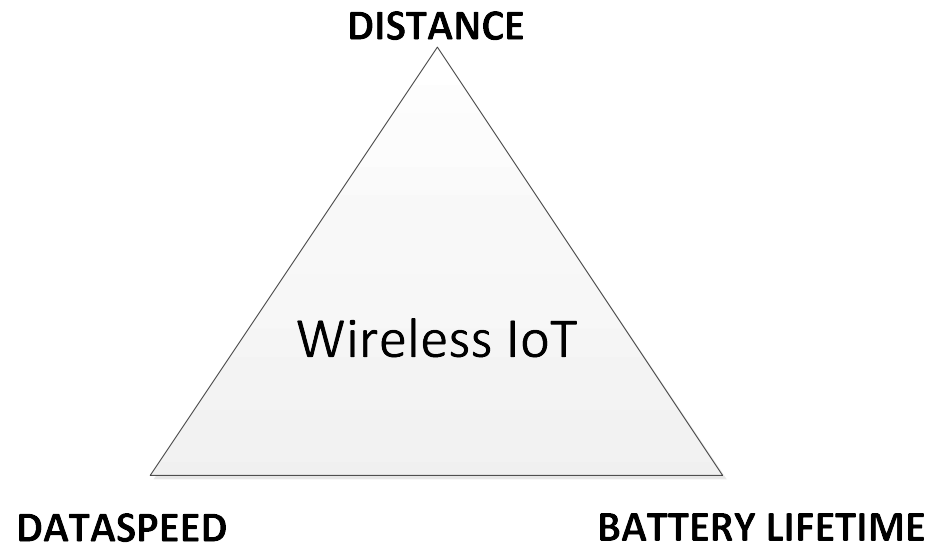
IoT – Internet of Things

- Huge amount of connectivity technologies & protocols enabling IoT

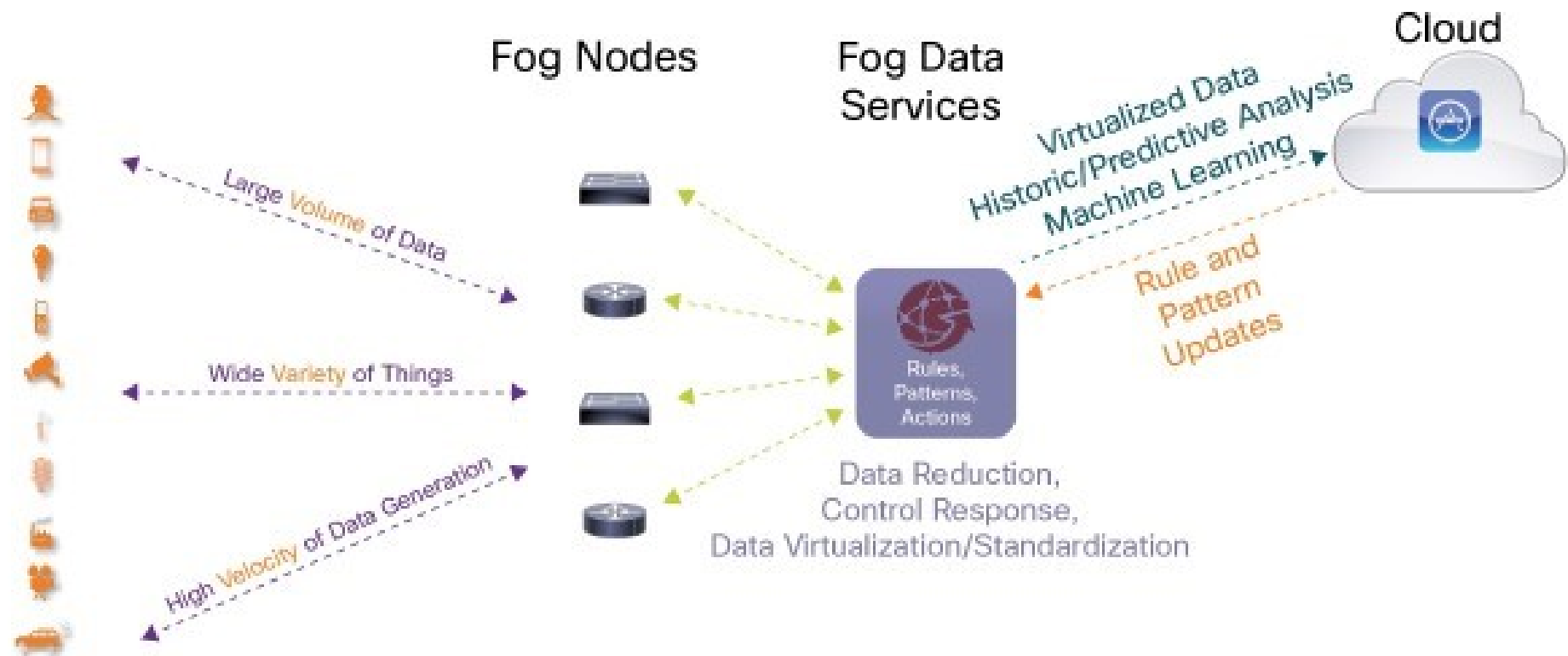


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IoTriangle



IoT - Fog Computing



4a. LoRa



LoRa – IoT network



- LoRa (**Long Range**)
 - Radio technology developed by Semtech.
 - Protocol between ‘Things’ and LoRa Gateway
 - 868 MHz in Europe / 915 MHz in USA (ISM freq)
 - Extreme low power
 - ▶ 100 mW (similar as WiFi power) – (achieved > 100 kms)
- LoRaWAN
 - Protocol stack by the LoRa Alliance
 - Between ‘Things’ and LoRa backend / core.
 - Part of LPWAN family (Low Power Wide Area Network)

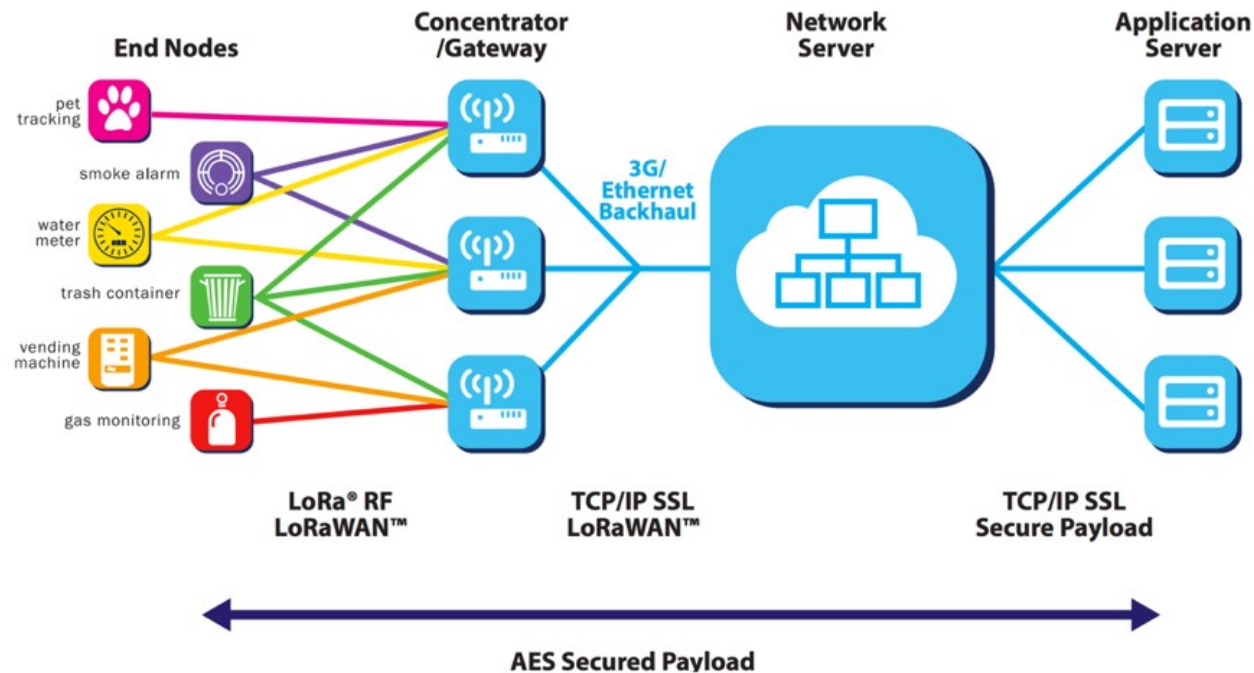


LoRa – IoT network



- What is LoRa?

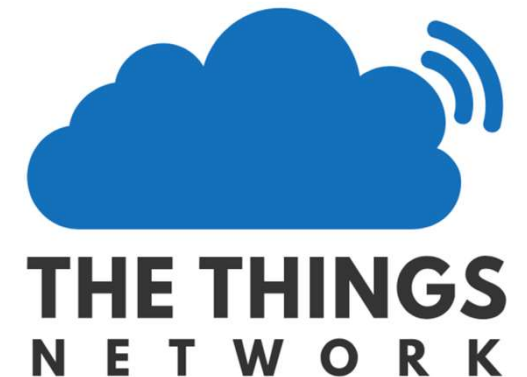
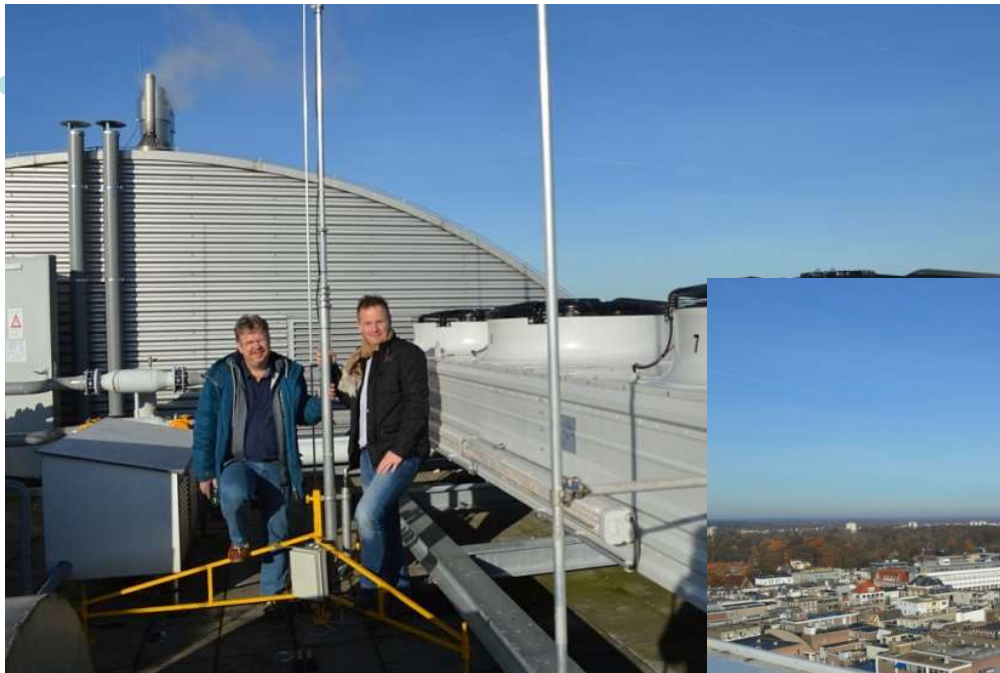
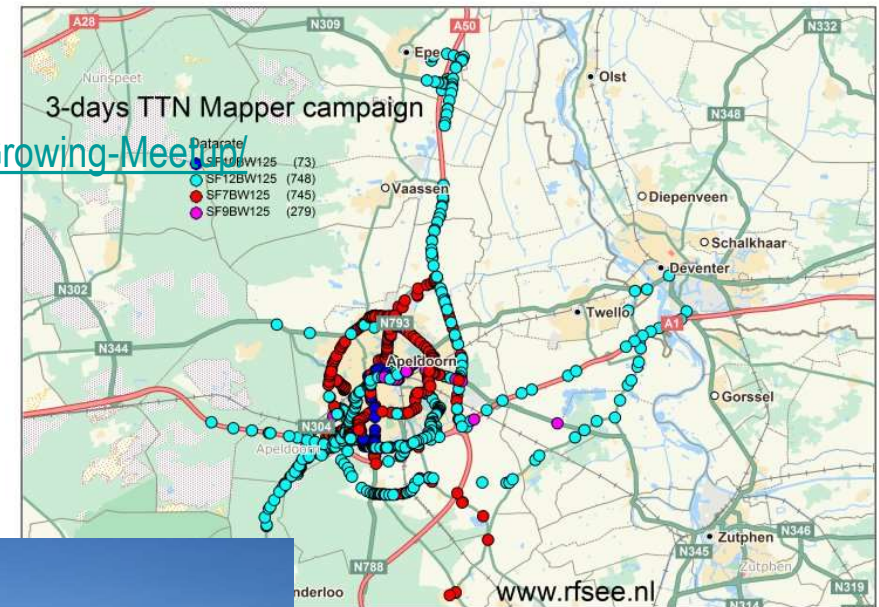
- Long Range
- Small bandwidth
- Long battery lifetime
- Low costs
- Little configuration
- Secured data transfer



Apeldoorn - LoRa IoT dekking



- Sinds december 2016 volledige LoRa dekking in Apeldoorn
 - Gebouwd door community en enkele bedrijven
 - Geïnitieerd door Permanent Future Lab
 - MEETUP: <https://www.meetup.com/LoRa-Network-in-Apeldoorn-Growing-Meetup/>



LoRa – communication



**Suitable for Spotify, Netflix,
large file exchange**

**Suitable for battery powered,
connected sensors & actuators**



Battery powered ... load of possibilities today



Luchtkwaliteit
Luchtdruk
Verlichting
Parkeren
Gevaarlijke gassen

Fijnstof
Asset tracking
Track & Trace (GPS)
Sproeiinstallatie
Hek open/dicht
Fietsers tellen
Voetgangers tellen

Overstroming
Temperatuur
Vochtigheid
Alarmering
Rioolmetingen
Beweging
Waterniveau

Geluidsmeting
Zoutgehalte wegdek
Anti-vandalisme Lantaarnpaal
Pollen
Bodemvochtigheid
CO2
Paniekknop ouderen

Airco
Vuilnisbakken

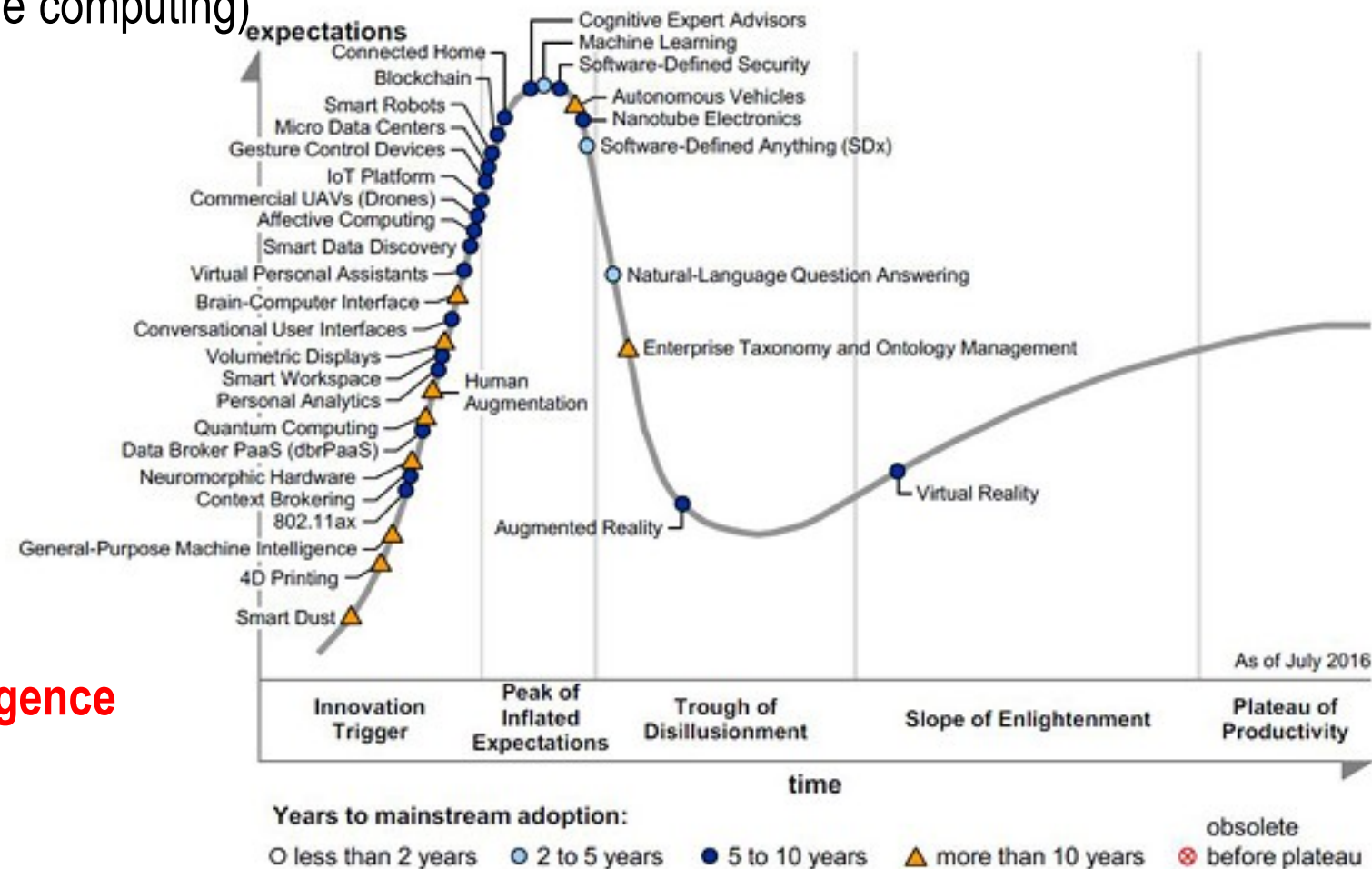


5. So much more ..



Huge tidal wave of new technologies

- 5G
- NFV / SDN
- Fog computing (near-edge computing)
- (Commercial) drones
- Blockchain
- MQTT / CoAP
- Cloud technologies
- OpenStack (IaaS)
- 4D printing
- NoSQL
- Virtual Reality
- PaaS
- BigData, **Artificial Intelligence**
- And many more



Source: Gartner (July 2016)

The future ...

- **IoT will disappear** and become part of our daily life.
 - Many protocols will disappear / few de-facto standards to remain
- Big Data and Artificial Intelligence
- **IoE ... Internet of Everything (cows today, humans tomorrow)**
 - Chip implants in our human body
 - E.g. access the internet via your brains

TECH

Elon Musk Launches Neuralink to Connect Brains With Computers

Startup from CEO of Tesla and SpaceX aims to implant tiny electrodes in human brains

By **ROLFE WINKLER**

March 27, 2017 3:24 p.m. ET

Building a mass-market electric vehicle and colonizing Mars aren't ambitious enough for Elon Musk. The billionaire entrepreneur now wants to merge computers with human brains to help people keep up with machines.





Questions?

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ComResult BV – Committed to Result

- Founded in 2001
- IoT consultancy:
 - Strategic and technical advice
 - Feasibility study, technical design & engineering, architecture and business cases.
 - e2e system integration.
 - Project and program management.
- IoT solutions:
 - Full end-2-end IoT solutions (one stop shop)
 - Design and and (limited) production of customer tailored IoT (LoRa) sensors/actuators.
 - On-site LoRa RF coverage (e.g. at customer premisses).
 - Collection and analyzing IoT data.
 - Dashboard design (website / app) – graphical and interactive
- For more information check www.comresult.com.



IoT – Internet of Things

