

On Internet of Things and the question of impact on the environment

**Presented at the ITU-T: Forum on Environmental Efficiency for Artificial
Intelligence and other Emerging Technologies**

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Collaboration Project sponsored by IFD: Telecom Sud Paris, Aarhus University,
2019

How IoT And AI Can Enable Environmental Sustainability



Naveen Joshi Co-Founder
COGNITIVE WORLD
AI

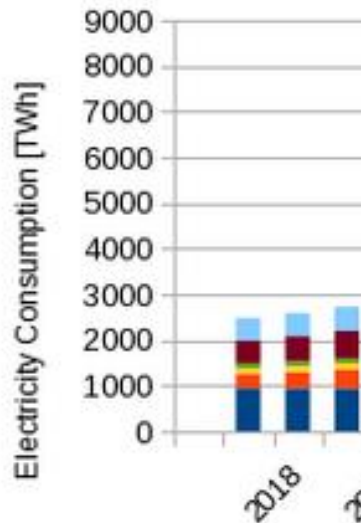


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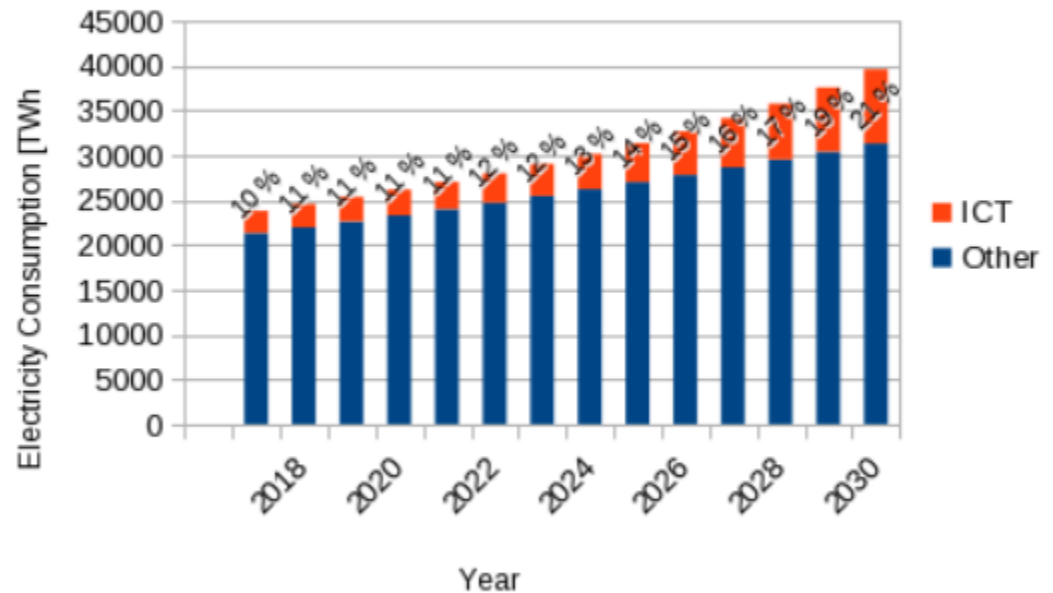
APPLICATION OF IOT AND AI FOR ENVIRONMENTAL SUSTAINABILITY

Global ICT electricity consumption

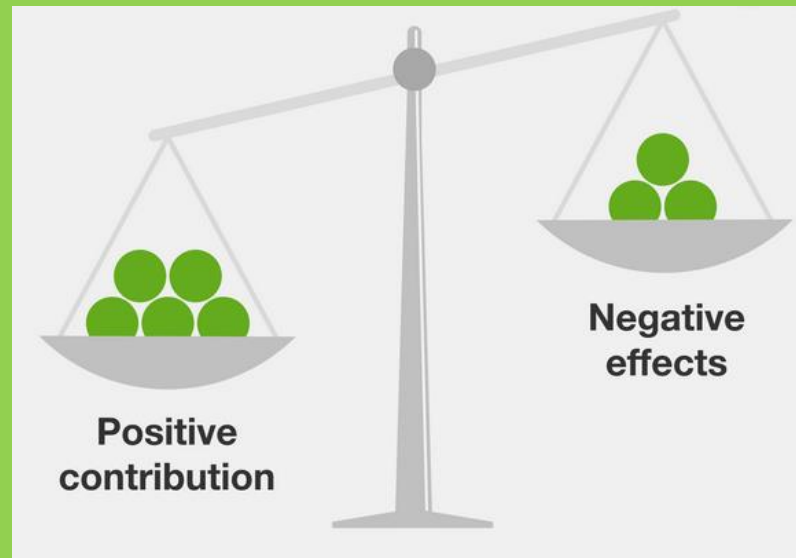


Global electricity consumption

2017 - 2030



What is the real balance between IoT and AI benefits and negative effects?



Project: Nature Friendly- Internet of Things (IoT), 2019 Grant



Relate and study the Role of ICT, especially Internet of Things (IoT), in sustainable development (SD) particularly in EU countries.



Dr. Ambuj Kumar, DK



Pr. Hakima Chaouchi, FR

IoT - A SMART WORLD of Sensors

Smart World

Air Pollution

Control of CO₂ emissions of factories, pollutant emitted by cars and toxic gases generated in farms.

Forest Fire Detection

Monitoring of combustion gases and preventive fire conditions to define start 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 technical elements.

Quality of Shipment Conditions

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

Smartphones Detection

Detect iPhone and Android devices and in general any device which works with Wi-Fi 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 Wi-Fi routers.

Traffic Congestion

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

Smart Roads

Warning messages and directions 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 offers in the point of sale according to customer habits, preferences, presence of allergen components for their shopping dates.

Noise Urban Maps

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

Water Leakages

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

Vehicle Auto-diagnosis

Information collection from CarBus 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.

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

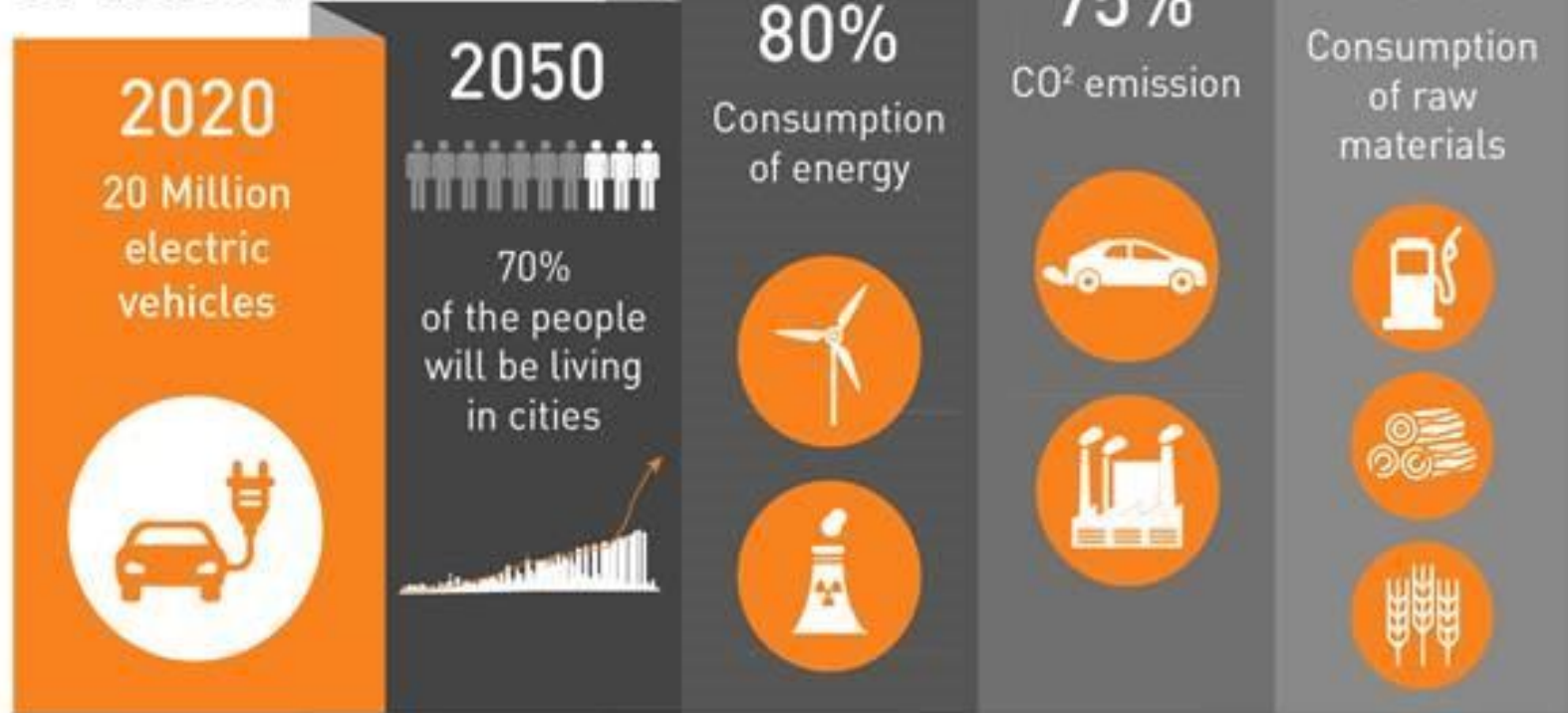
Selective irrigation in dry zones to reduce the water resources required in the green.

Water Quality

Study of water turbidity, iron levels and the use for fauna and eligibility for drinkability.

Why? Ressources monitoring and optimisation

The increasing relevance of cities.



But also economic growth!



2x

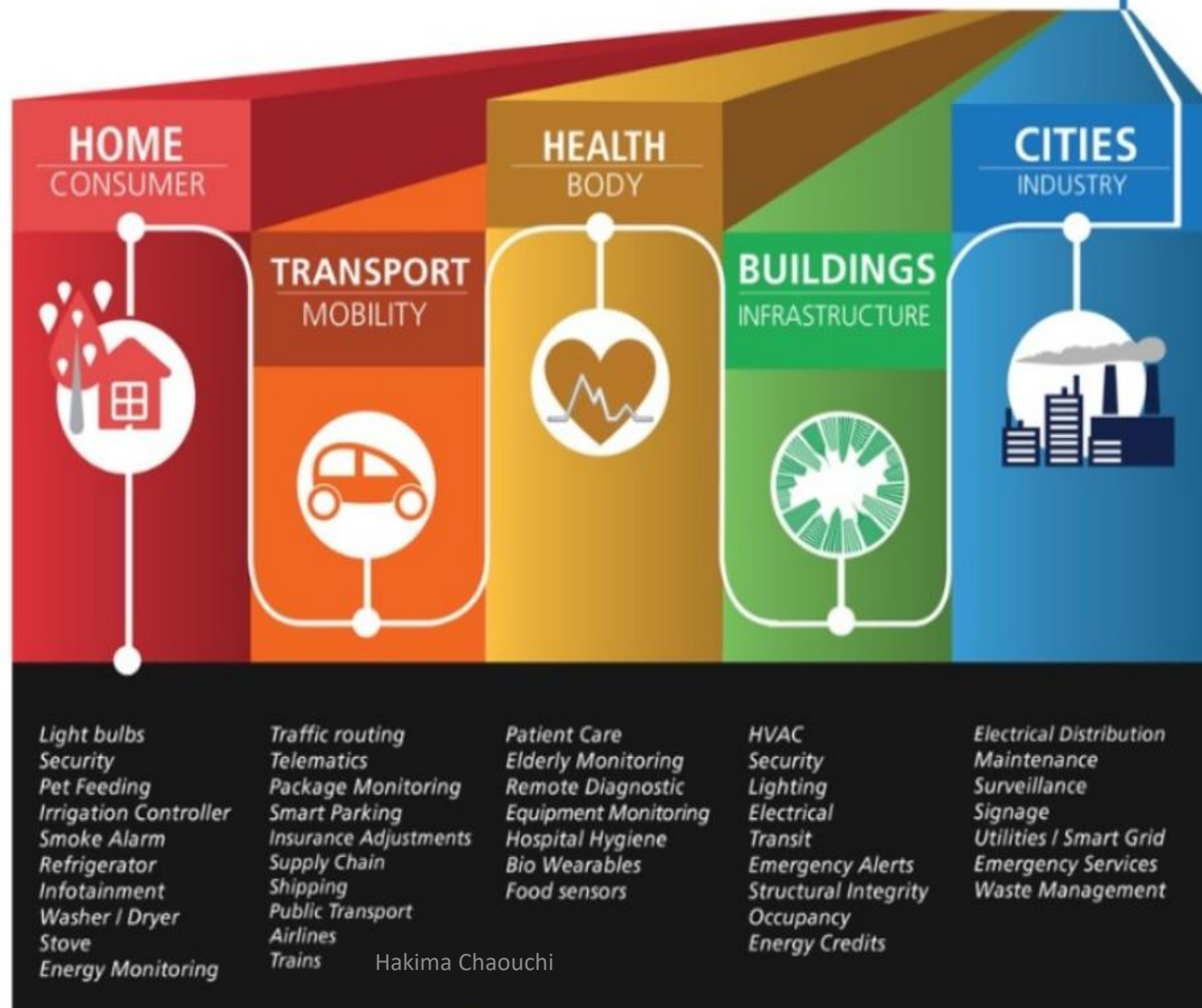
... a significant economic impact

potential value of connected things @ B2B vs. B2C markets

"B2B use cases can generate 70% of potential value enabled by IoT"
McKinsey

ALTRAN

FROM INVENTORY TO DIVERSE APPLICATIONS



More electronic IoT devices in consumer IoT!



More electronic IoT devices in Industrial IoT!



2.5x

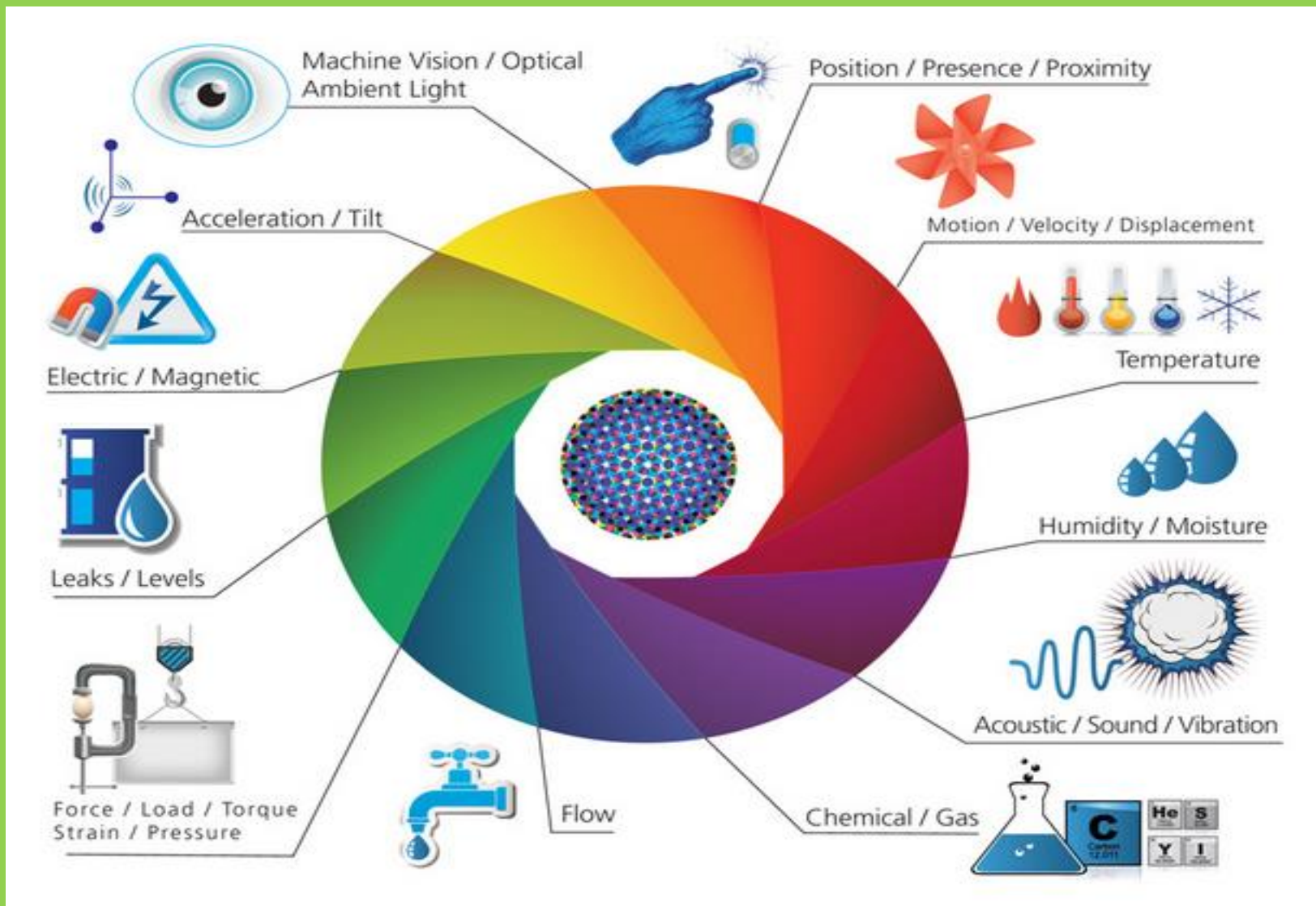
industrial & business connected things – B2B

rising cross-industries in business demand accelerates the momentum
3.1 bn units in **2017** >>>>>>>> **7.6 bn** units by **2020**

Source: Gartner (January 2017)

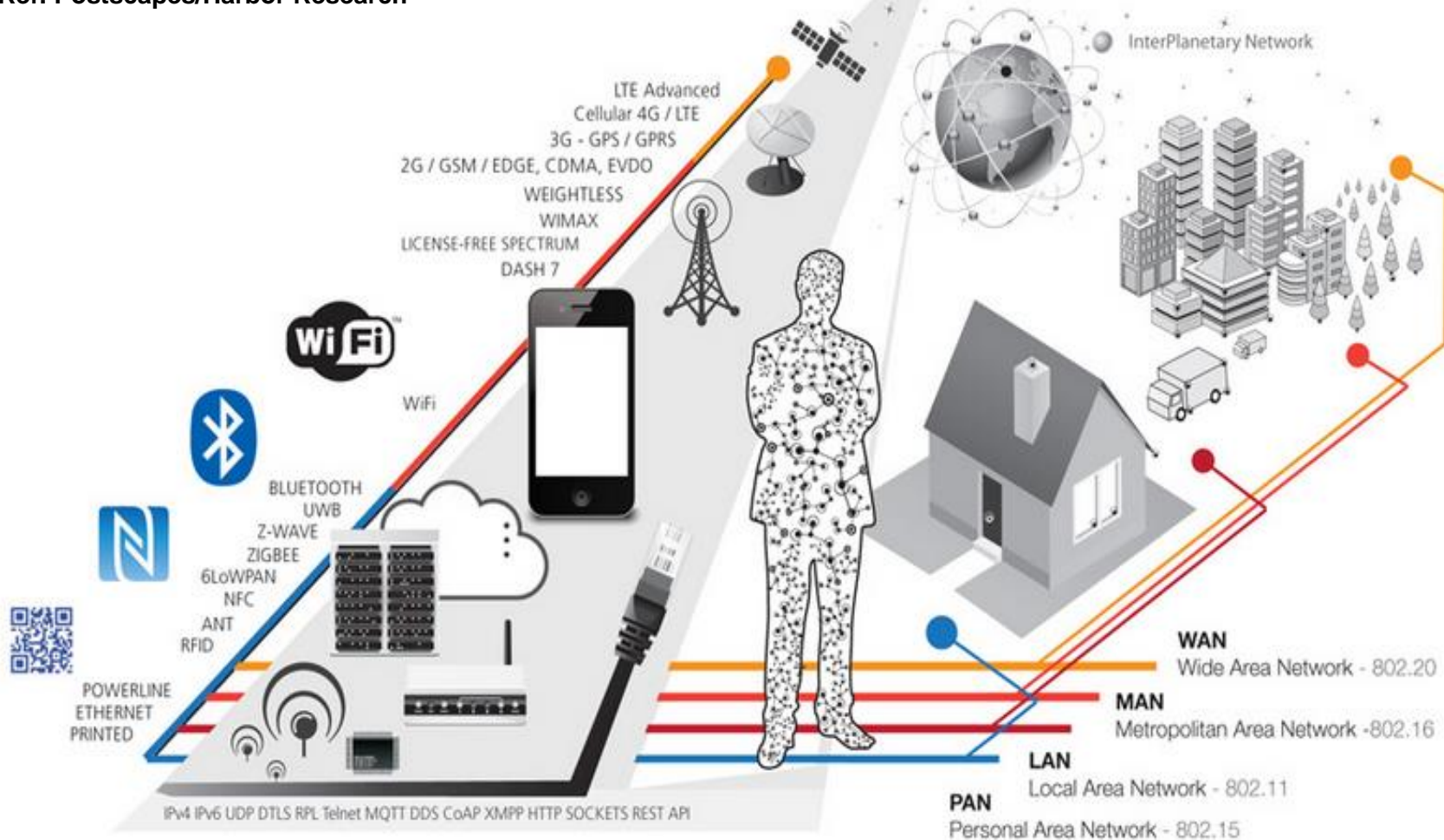
altran

Billions of electronic devices

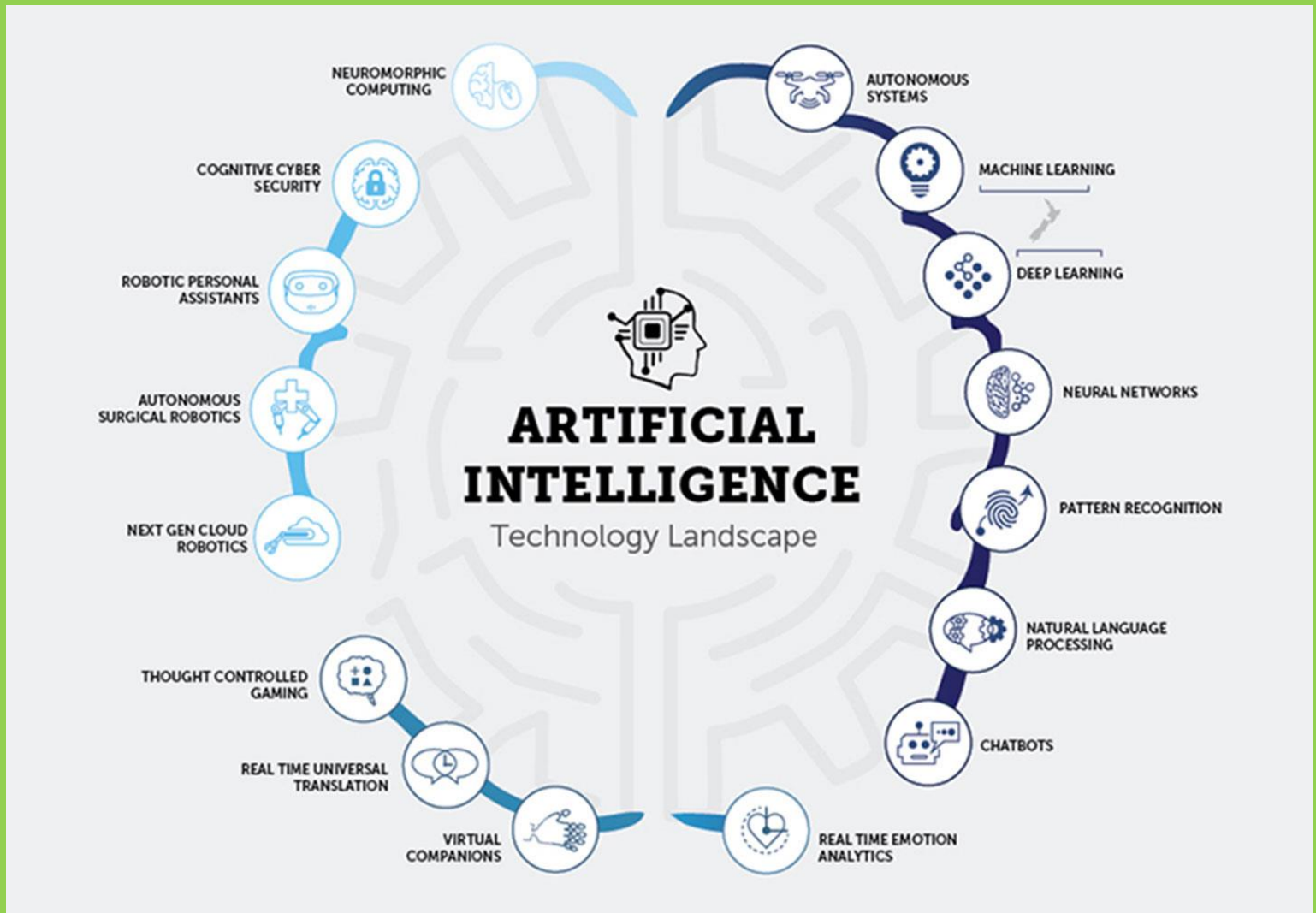


Communication technologies landscape!

Ref: Postscapes/Harbor Research



Algorithms: Artificial Intelligence



Data Factories!



Environment Impact?

Environment cost and Energy Cost

#1: Pollution



- 2% of anthropogenic CO₂
- Roughly equivalent to aviation industry



Electronic Waste

As we add computing and radios to more things, we're also adding to the problem of e-waste. The United Nations found that people generated 44.7 million metric tons of e-waste globally in 2016, and expects that to grow to 52.2 million metric tons by 2021.

#2: Electromagnetic field large radiation

Our exposure to radiation on the electromagnetic spectrum

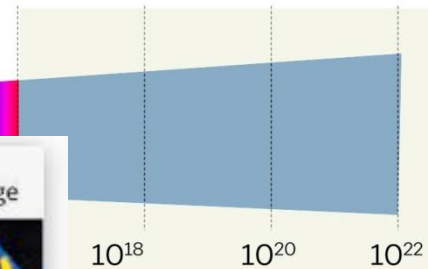
NON-IONIZING RADIATION

Traditionally perceived as harmless due to its lack of potency

IONIZING RADIATION

Can cause cellular and/or DNA damage with prolonged exposure

Frequency (Hz)



Activists fear radiation from 5G wireless service could be dangerous to public health. And they want more research done before carriers deploy the technology.
NurPhoto

#3: Power Consumption

ENERGY SCALE

Global electricity demand

20,000 TWh

Electricity use by ICT

2,000 TWh

Data-centre electricity demand

200 TWh

Bitcoin use by mid-2018

20 TWh

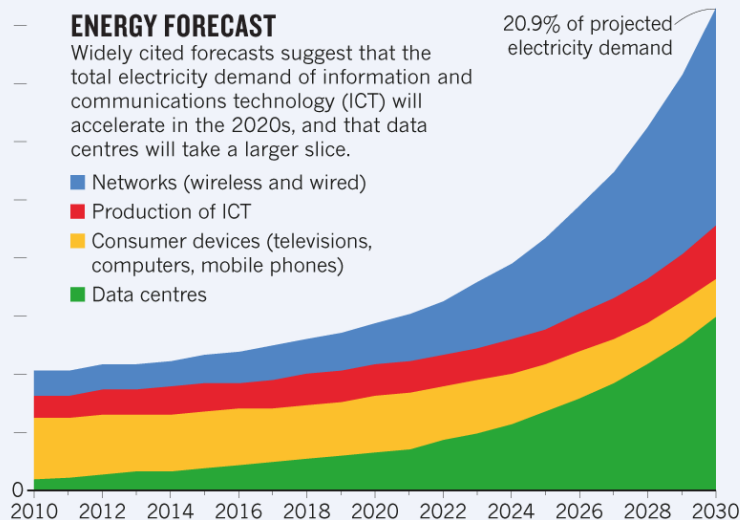
9,000 terawatt hours (TWh)

ENERGY FORECAST

Widely cited forecasts suggest that the total electricity demand of information and communications technology (ICT) will accelerate in the 2020s, and that data centres will take a larger slice.

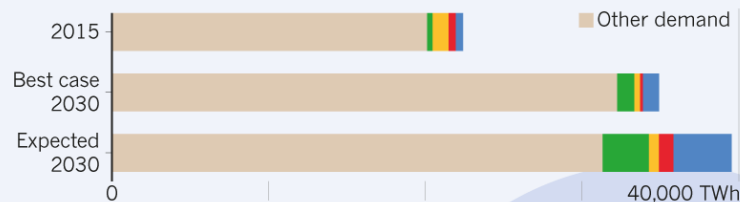
- Networks (wireless and wired)
- Production of ICT
- Consumer devices (televisions, computers, mobile phones)
- Data centres

20.9% of projected electricity demand



The chart above is an 'expected case' projection from Anders Andrae, a specialist in sustainable ICT. In his 'best case' scenario, ICT grows to only 8% of total electricity demand by 2030, rather than to 21%.

Global electricity demand



INTERNET EXPLOSION

Internet traffic* is growing exponentially, and reached more than a zettabyte (ZB, 1×10^{21} bytes) in 2017.

1987
2 TB†

1997
60 PB

2007
50 EB

2017
1.1 ZB

*Traffic to and from data centres.

†TB, terabyte (10^{12} bytes); PB, petabyte (10^{15} bytes); EB, exabyte (10^{18} bytes).

Methodology and sustainability indicators

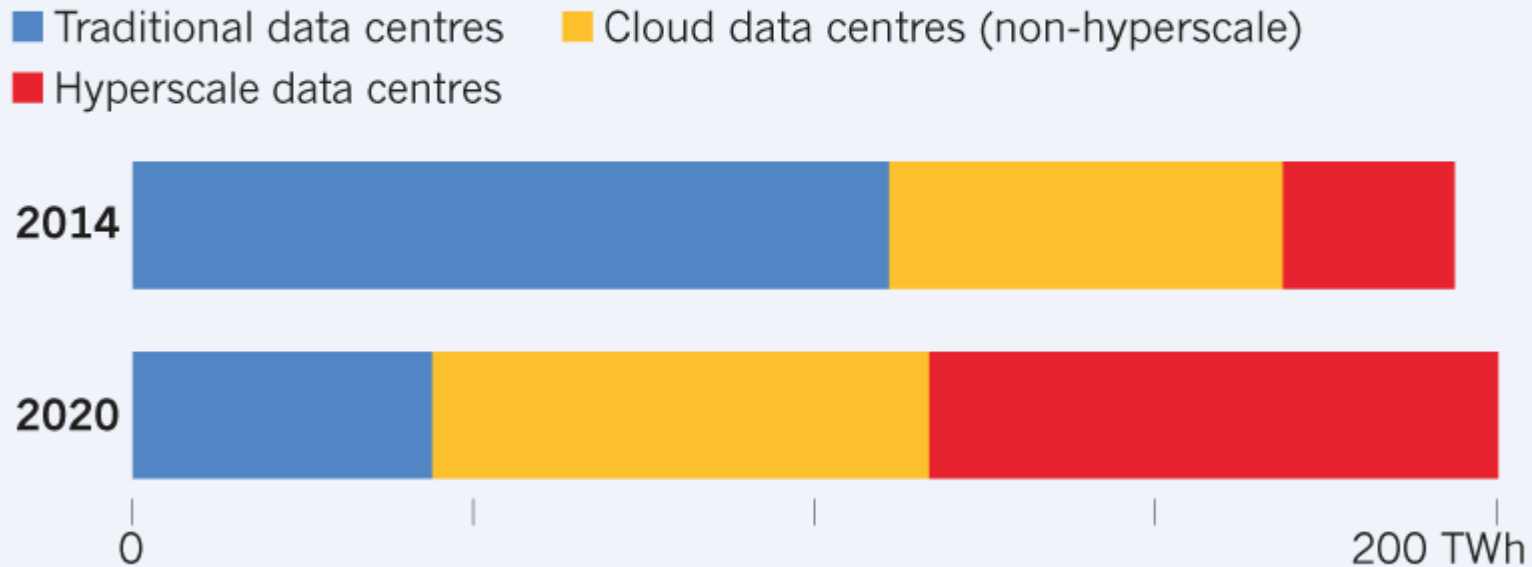


Solutions?

Hyperscale Computing

HYPERSCALE SHIFT

Efficient 'hyperscale' data centres are predicted to swallow up half of data-centre electricity demand by 2020, as smaller, less-efficient centres shut down.



Smart Data centres cooling system



Energy Harvesting

Energy Harvesting (EH)

Typical Energy Harvester Output Power

- RF: $0.1\mu\text{W}/\text{cm}^2$
- Vibration: $1\text{nW}/\text{cm}^2$
- Thermal: $10\text{mW}/\text{cm}^2$
- Phot

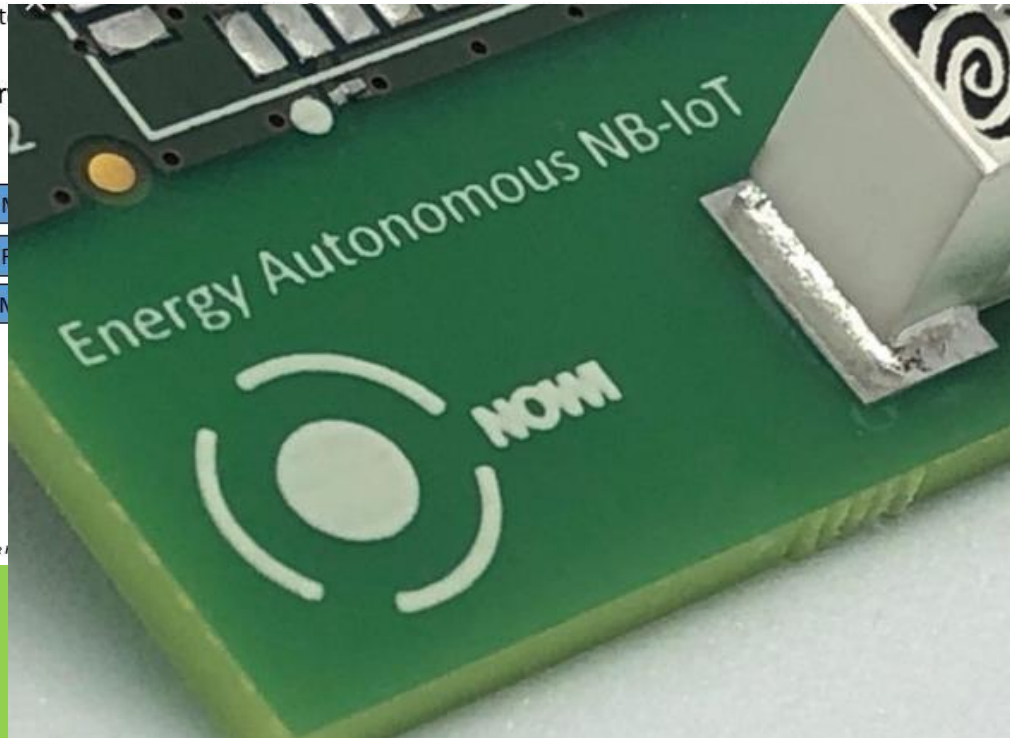
Typical Energy Harvester Voltages

- RF: 0.01mV
- Vibration: $0.1 \sim 0.4 \text{ V}$
- Thermal: $0.02 \sim 1.0 \text{ V}$

Energy Har



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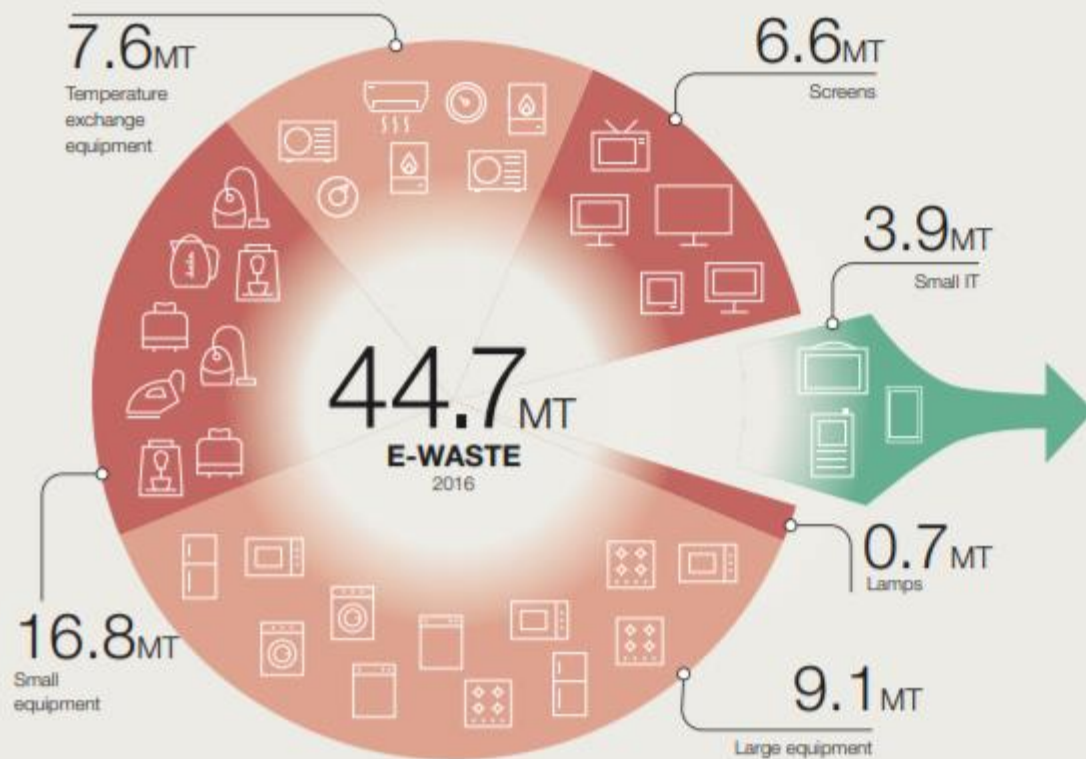


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Numerator

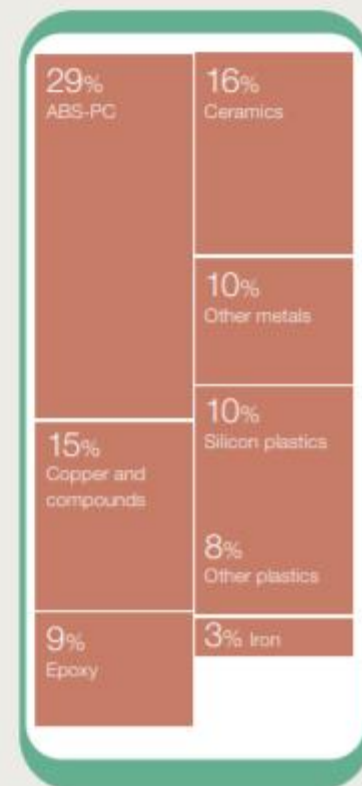
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IMAGE CREDIT: Mike

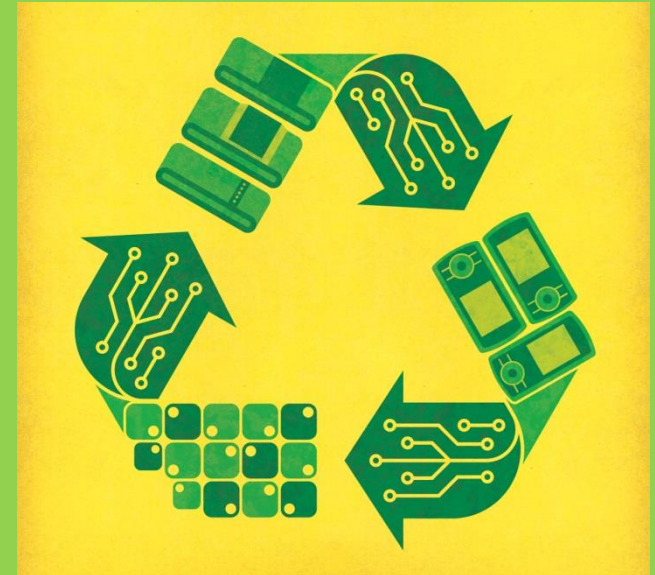
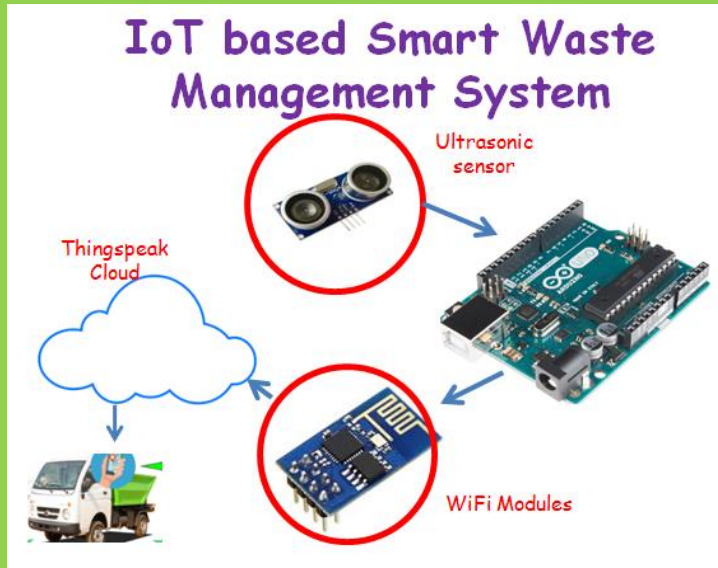
WHAT IS E-WASTE?



What's in a typical mobile phone?



IoT electronics Recycling

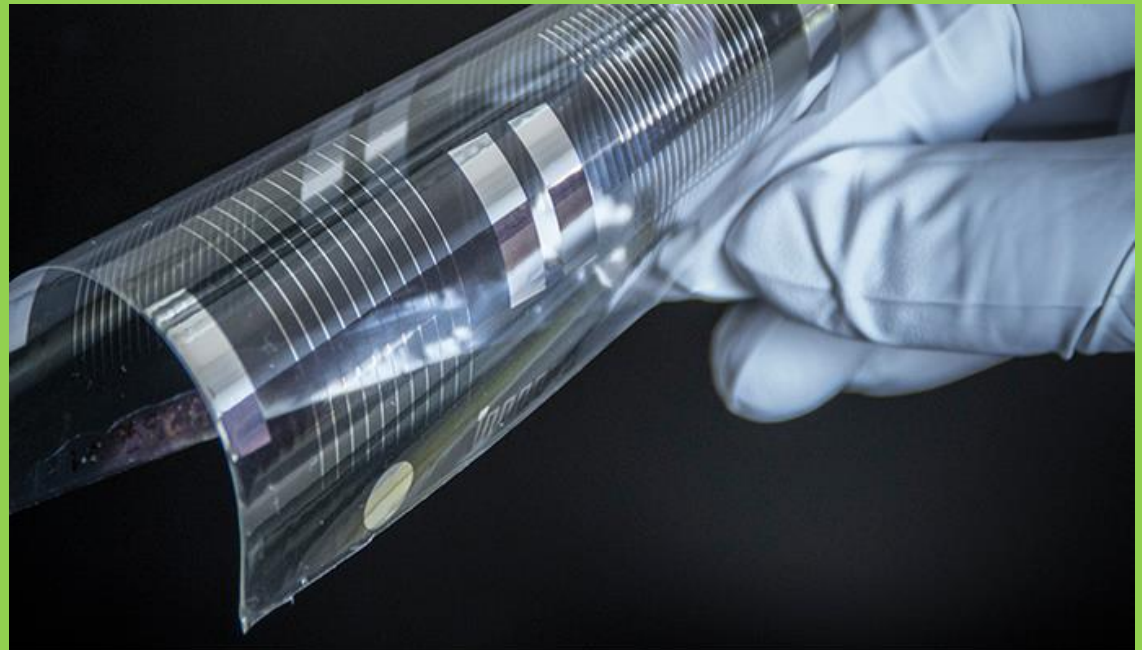


IoT batteries Recycling

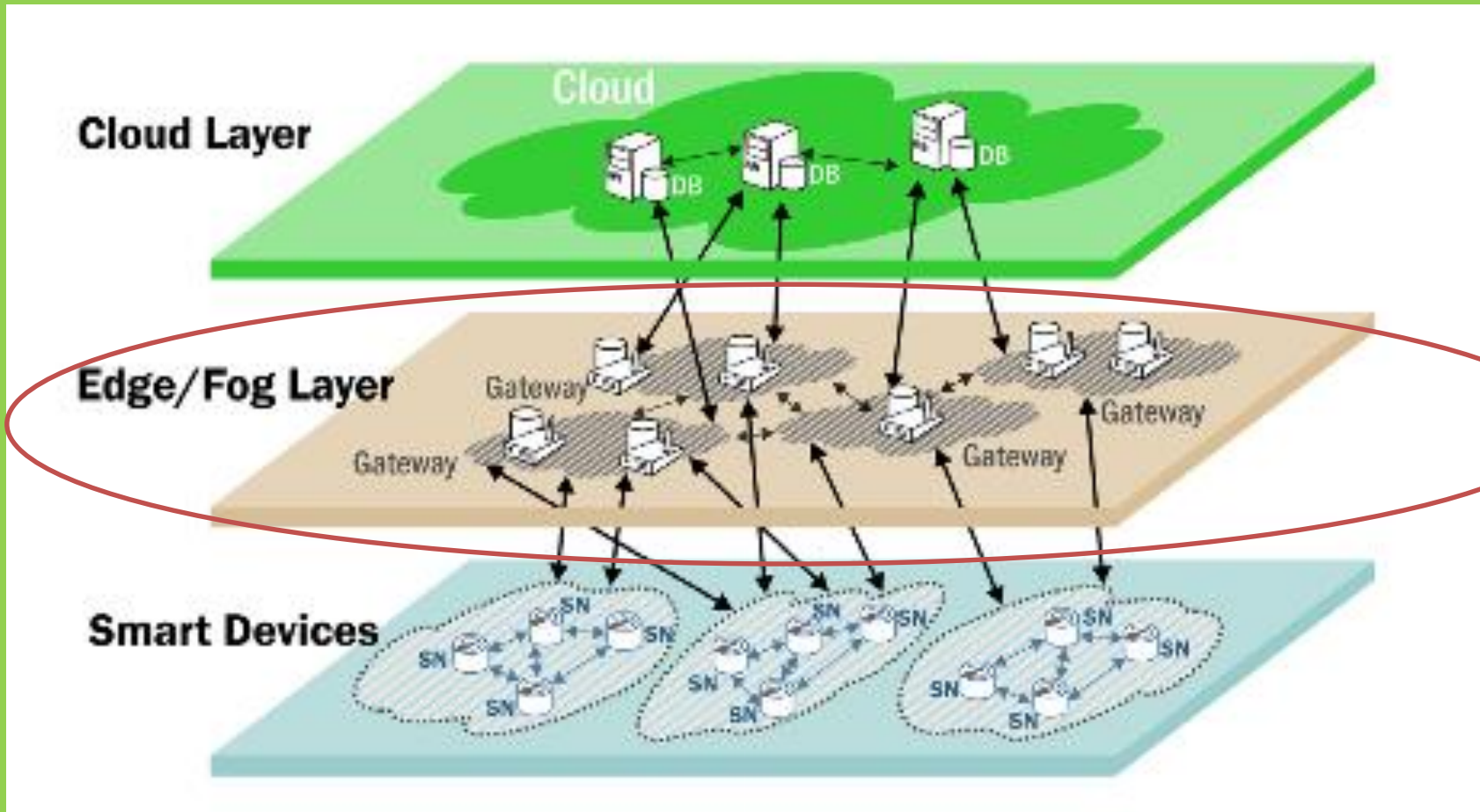


Biodegradable electronics

**Biodegradable
Electronics Could Save
Us From The
E-Wasteland**



Distributed AI: Faster learning, faster inference



Data processing and management lifecycle

DATA STORAGE BEST PRACTICES

When it comes to data retention, how long should data be stored?

§ ITUT-T FG-DPM : Data Processing and management in IoT and Smart Cities

ICT standardisation



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ITU-T SG 5 C (2019-09-16)

ITU-T SG 5

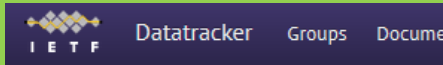
Environment, climate change and circular economy

Study Period 2017

Meeting from 2019-09-16 to 2019-09-20

held in Switzerland [Geneva]

Other Meetings : [2019-05-13](#) [2018-09-11](#) [2018-05-21](#) [2018-03-05](#) [2017-11-13](#) [2017-05-15](#)



Liaison statement

Green ICT Standards Landscape Questionnaire

Statement [History](#)

State	Posted
Submitted Date	2015-03-26
From Group	ITU-T-SG-5
From Contact	Cristina Bueti
To Group	IETF
To Contacts	The IETF Chair
Cc	The IESG
Purpose	For action
Deadline	2015-03-31 Action Needed
Attachments	Green ICT Standards Landscape Questionnaire

Related activities in the IETF/IRTF

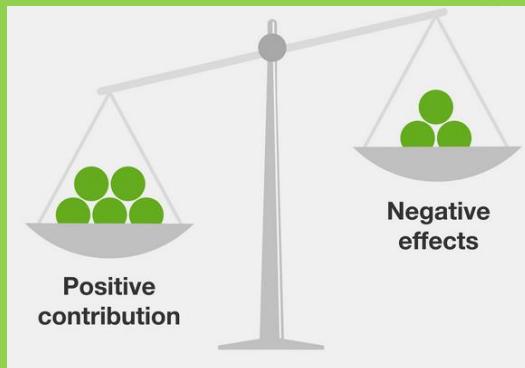
- IETF EMAN – energy management (SNMP)
- IRTF DTNRG – delay tolerance
- IETF 6LOWPAN, ROLL, CORE – constraint networks
- Interconnecting Smart Objects with the Internet (WS in Prague) – see also material referenced at <http://www.ietf.org/mail-archive/web/recipe/current/msg00041.html>
- ...

To Wrap up:

1/ Find the balance: IOT&AI Positive Vs Negative effects per industry

2/ Build a standard Networking and Processing framework that optimizes the processing and storage resources but also follows a sustainability method while supporting more data and related AI algorithms.

3/ Policy making related to best practices in data storage and datacentres management.



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