Sustainability and IoT

Part 2

Smart-Edu4.0

Erasmus+ project

Co-funded by the
Erasmus+ Programme
of the European Union

Where should we be in 2030? or The 17 Sustainable Development Goals (SDGs)

Source: The United Nations

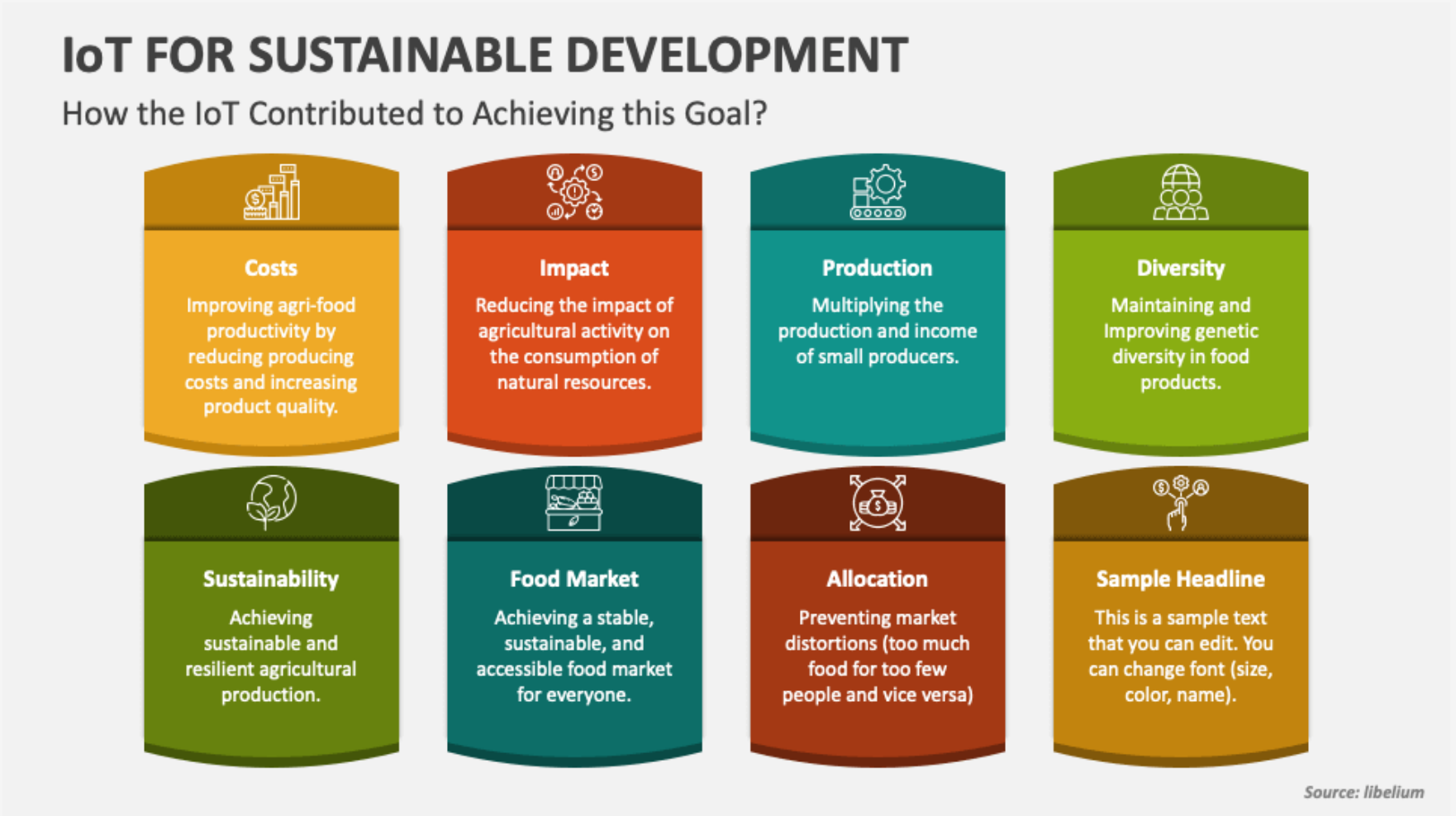
IoT and Sustainable Development Goals (SDGs)

https://www.collidu.com/presentation-iot-for-sustainable-development

IoT and Sustainable Development

https://www.collidu.com/presentation-iot-for-sustainable-development

IoT Contribution to Achieving SDGs



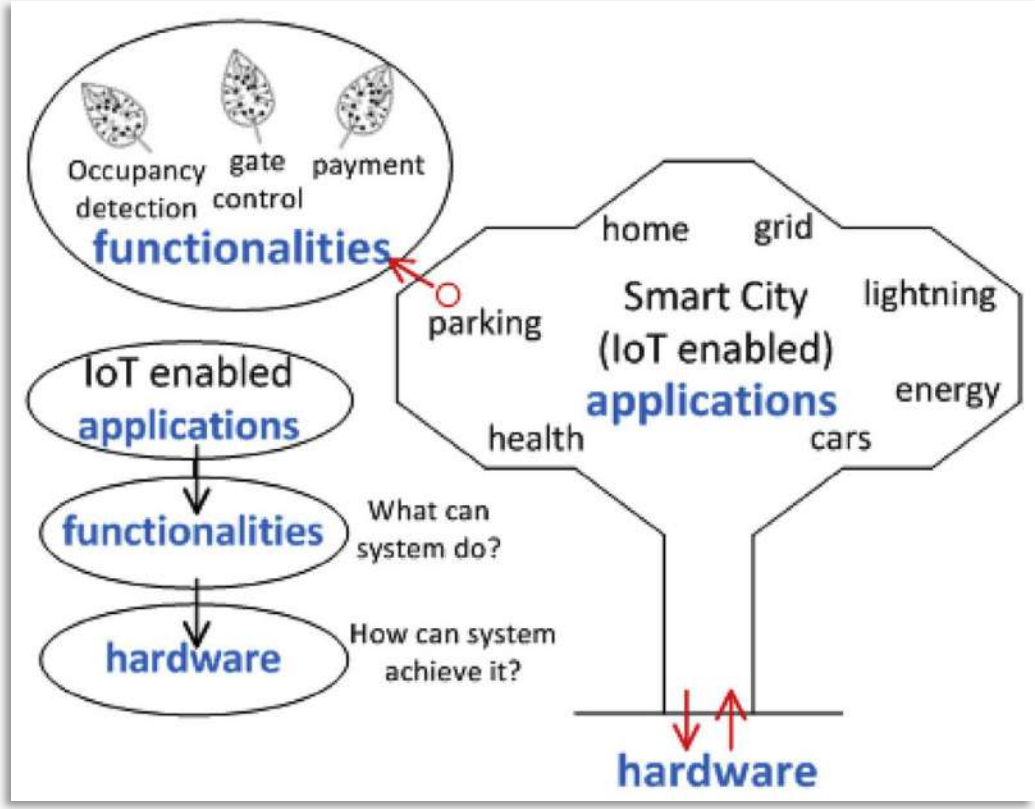
https://www.collidu.com/presentation-iot-for-sustainable-development

IoT technology applications - Examples

https://www.slideshare.net/GayaBranderhorst/iot-and-sustainable-development-united-nations

Generalized concept of IoT enabled Smart City Architecture

The branches of the given tree are dedicated to applications, wherein the leaves of the given branch are dedicated to the functionalities that each application can have.

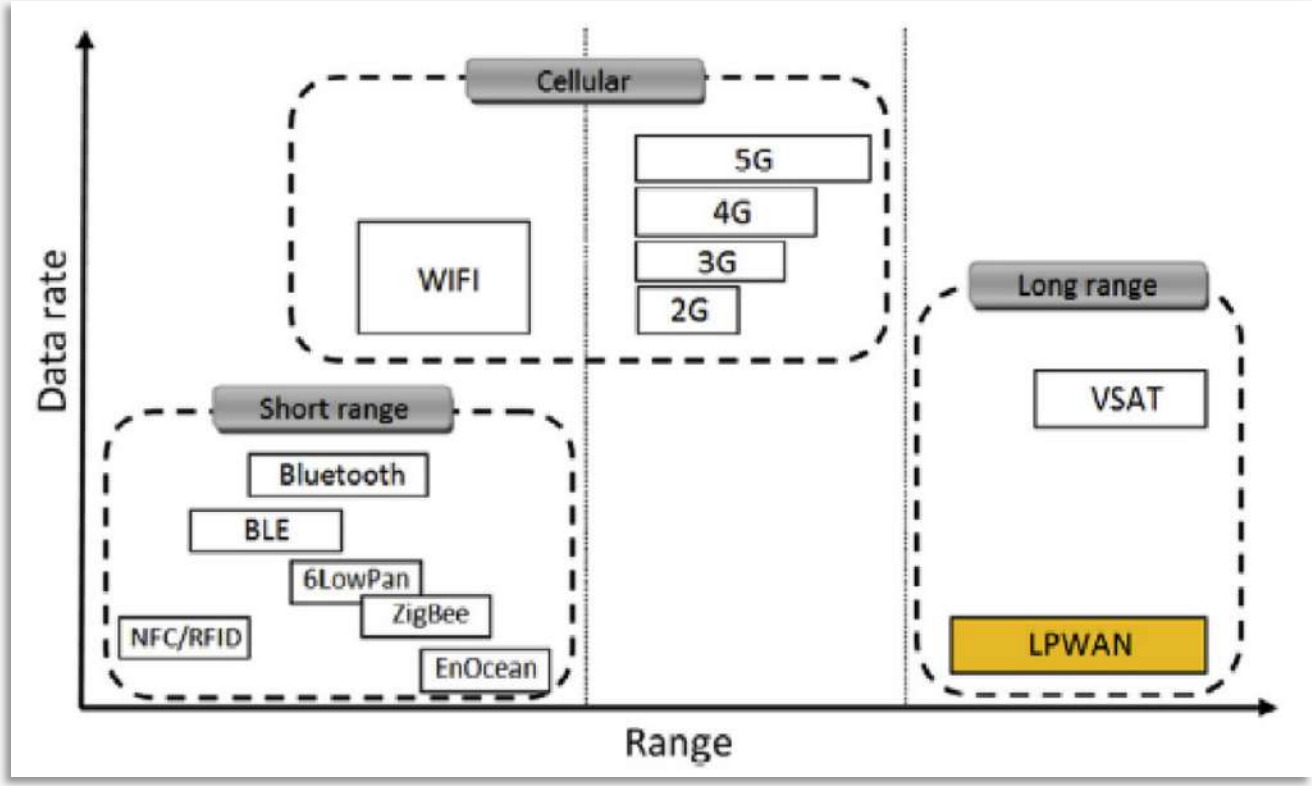


Perkovic, T., Damjanovic, S., Solic, P., Patrono, L., Rodrigues, J.J., 2020b. Meeting challenges in IoT: sensing, energy efficiency, and the implementation. In: Fourth International Congress on Information and Communication Technology. Springer, Singapore, pp. 419-430

Efficient IoT radio units

To achieve data transmission, a critical part is to deliver the data in an efficient manner. For this, the major idea and enabler is to provide data links between sensing nodes and receiving stations for transmitted data.

To satisfy different applications and related functionalities, it is important that these radios can timely transmit the data over larger distances while consuming less energy.



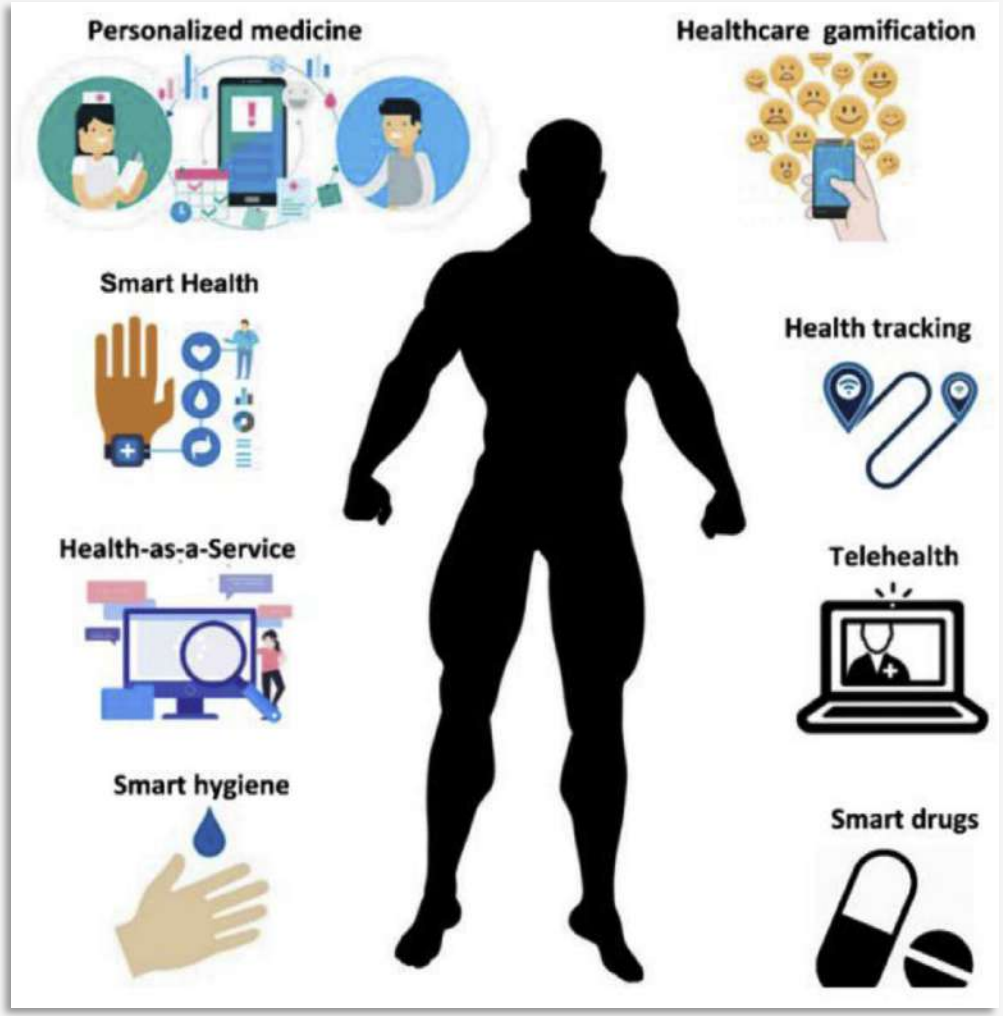
Mekki, K., Bajic, E., Chaxel, F., Meyer, F., 2019. A comparative study of LPWAN technologies for large-scale IoT deployment. ICT express 5 (1), 1-7

IoT technology applications for Ambient Assisted Living (AAL) domain

Ambient Assisted Living (AAL or simply assisted living) encompasses technological systems to support people in their daily routine to allow an independent and safe lifestyle as long as possible.

An AAL approach is the way to guarantee better life conditions for the aged and people with limited mobility, chronic diseases and in recovery status with the development of innovative technologies and services.

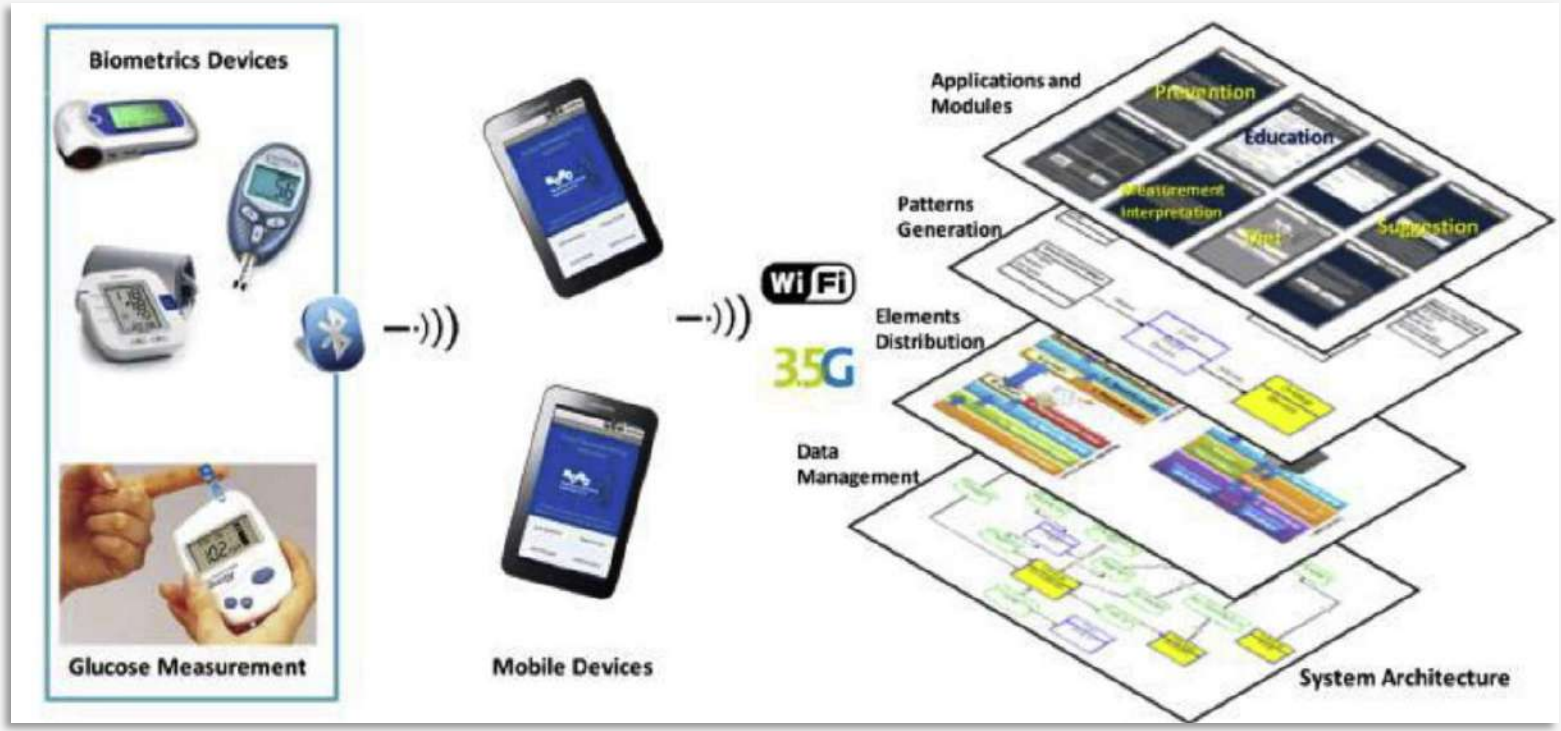
Modern assistive technologies constitute a wide range of technological solutions aimed at improving the well-being of the elderly. These technologies are used for personalized medicine, smart health, health tracking, telehealth, health-as-a service (HaaS), smart drugs and multiple other applications.



Maskeliunas, R., Damasevicius, R., Segal, S., 2019. A review of internet of things technologies for ambient assisted. Living environments. Future Internet 11, 259. https://doi.org/10.3390/fi11120259.

Proposed system for continuous monitoring and real time services for patients

A solution for monitoring patients with specific diseases such as diabetes using mobile devices. The proposed system provides continuous monitoring and real time services, collecting the information from healthcare and monitoring devices located in the home environment which are connected to BT mobile devices

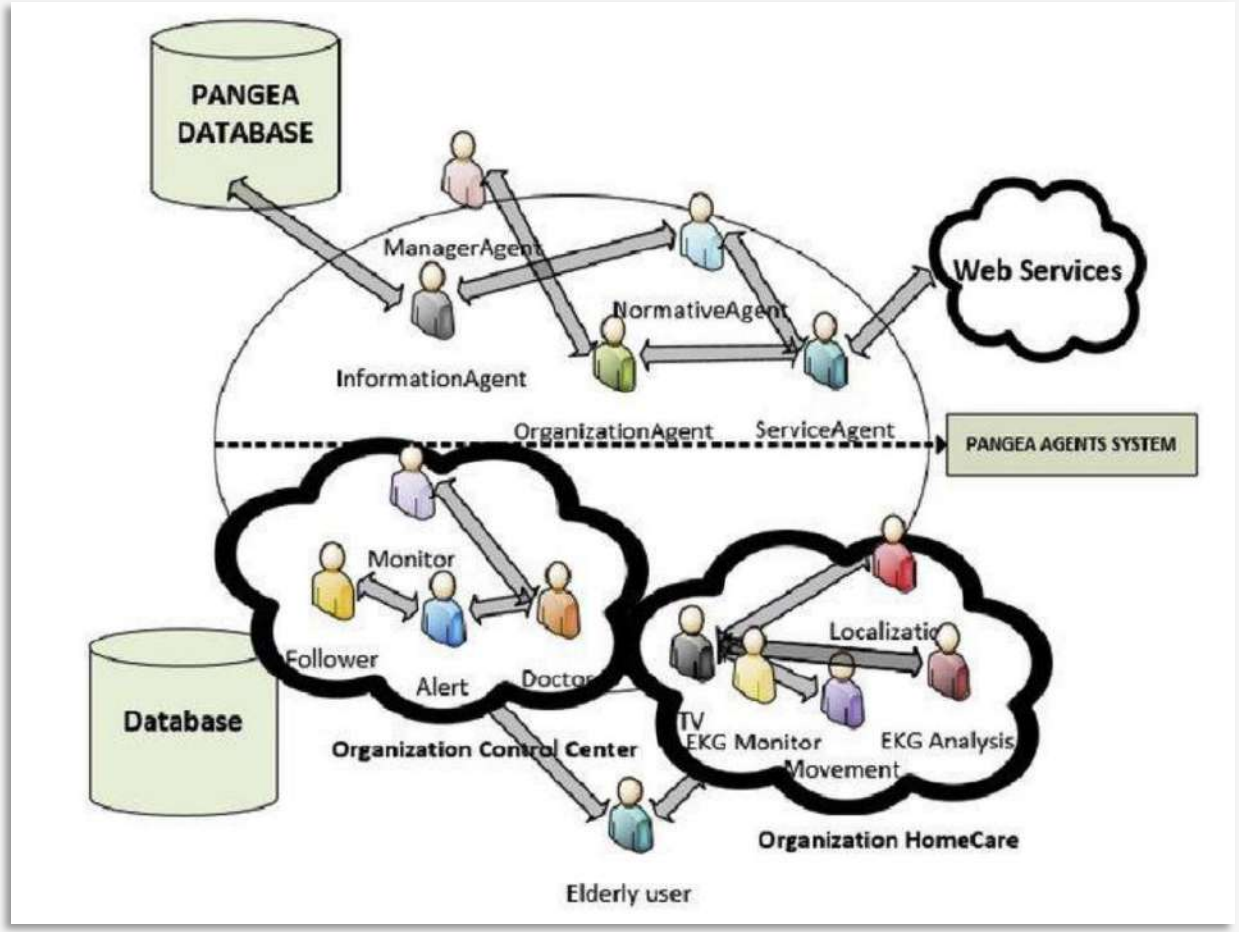


Source: Villarreal, V., Fontecha, J., Hervas, R., Bravo, J., 2014. Mobile and ubiquitous architecture for the medical control of chronic diseases through the use of intelligent devices: using the architecture for patients with diabetes. Future Generat. Comput. Syst. 34, 161e175. assisted. Living environments. Future Internet 11, 259. https://doi.org/10.3390/fi11120259.

A monitoring and tracking system for people with medical problems - Virtual organization of system

The solution includes a system for performing biomedical measurements, locomotor activity monitoring through accelerometers and Wi-Fi networks.
The interactive approach involves the user, through a smart TV.

The locomotor activity of the elderly is deduced through the analysis of Received Signal Strength Indication (RSSI) measurements through an algorithm. Mobile accelerometers are used to analyze the movement of users and detect steps.

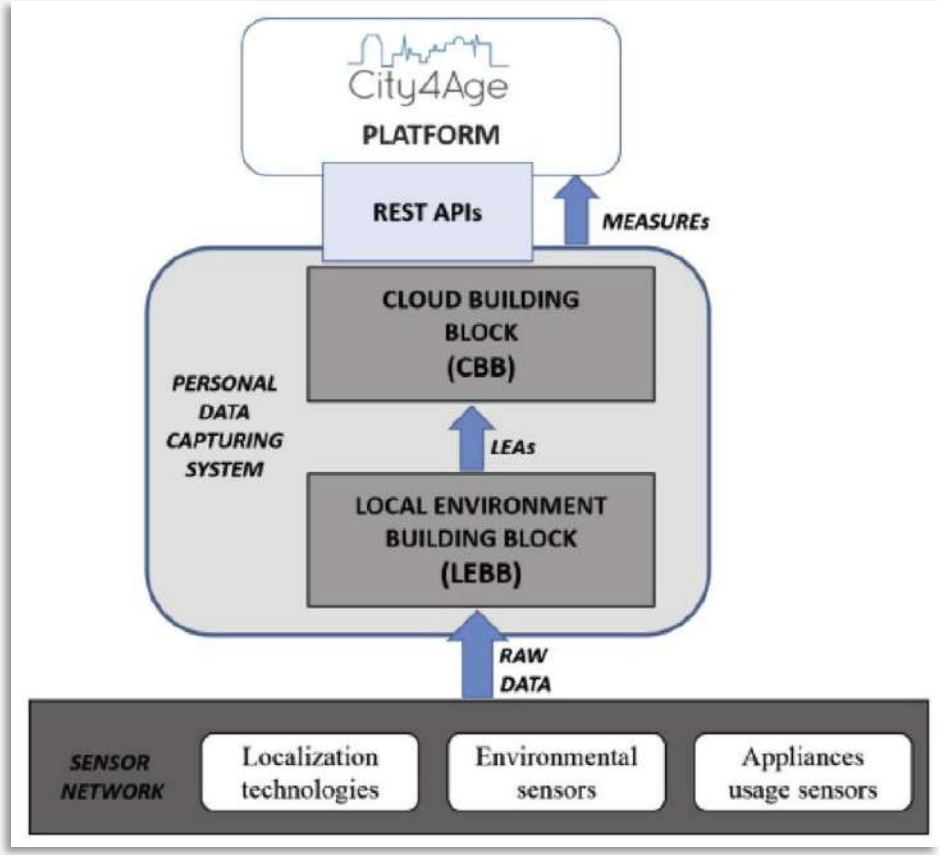


Villarrubia, G., Bajo, J., de Paz, J.F., Corchado, J.M., 2014. Monitoring and detection platform to prevent anomalous situations in home care. Sensors 14 (6), 9900e9921.

Architecture of a system performing a behavioral analysis of elderly people

An architecture that exploits IoT technologies to capture personal data for automatically recognizing changes in the behaviour of elderly people in an unobtrusive, low-cost and low-power manner.

The system allows performing a behavioral analysis of elderly people to prevent the occurrence of Mild Cognitive Impairment (MCI) and frailty problems.

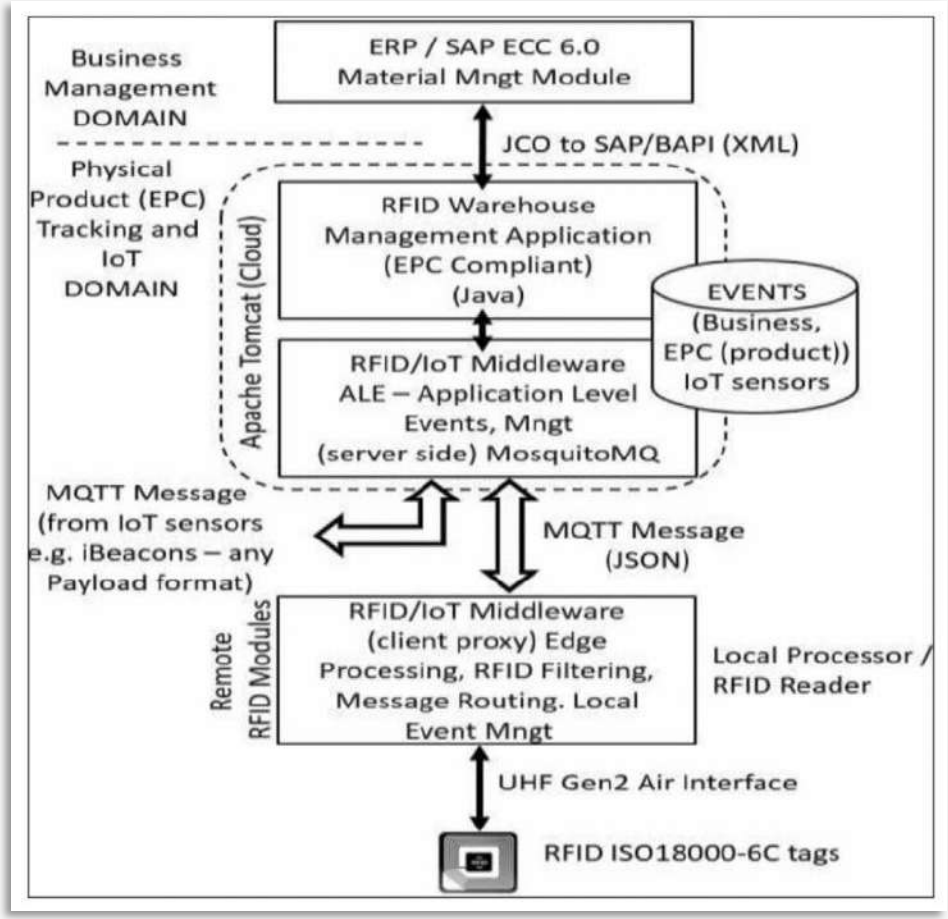


Mainetti, L., Patrono, L., Secco, A., Sergi, I., 2017. An IoT-aware AAL system to capture behavioral changes of elderly people. Journal of Communications Software and Systems 13 (2), 68e76.

IoT/RFID solution architecture for steel mill

IoT and RFID technologies are exploited to improve productivity in the value chain of a steel mill. An existing RFID solution architecture based on the reference EPCGlobal/GS1 framework was modified in order to be extended to the IoT domain.

The internet-connected devices collect large amounts of data which can be transmitted to a central system for further analysis. The integration between IoT and predictive analysis systems can help companies to create effective business development strategies, improve decision-making and manage risks.



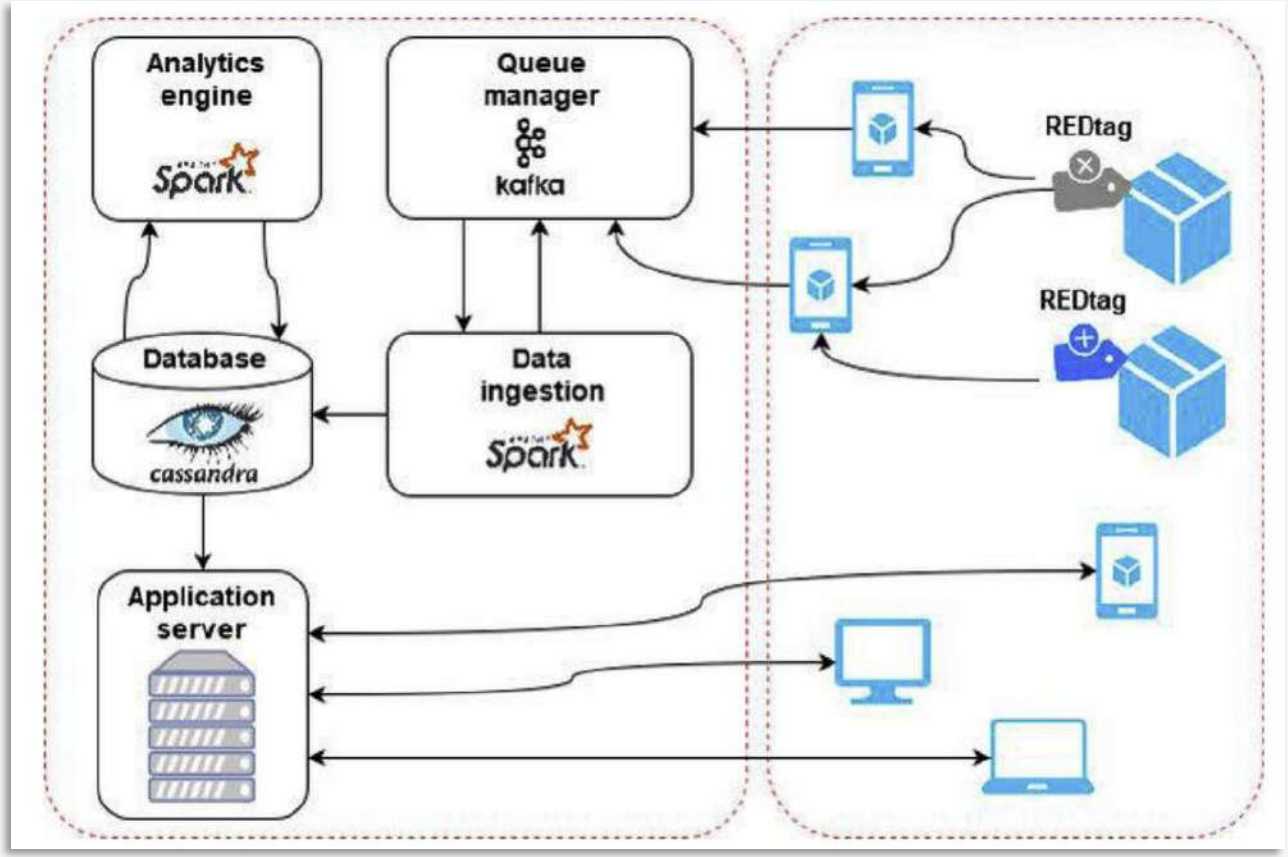
Valente, F.J., Neto, A.C., 2017. Intelligent steel inventory tracking with IoT/RFID. IEEE International Conference on RFID Technology & Application (RFID-TA), Warsaw, pp. 158e163. https://doi.org/10.1109/RFIDTA.2017.8098639.

An integrated framework to track and monitor shipped packages

Framework relies on a network of IoT-enabled devices, called REDTags, allowing courier employees to easily collect the status of package at each delivery step.
The framework provides back-end functionalities for smart data transmission, management, storage, and analytics.

A machine-learning process is included to promptly analyze the features describing event-related data to predict the potential breaks of goods in the packages.

Ensuring product quality and integrity is an interesting challenge that in recent years has led to the creation of smart systems that integrate IoT solutions and block chain technology.
The Blockchain technology associated with IoT sensors could allow the creation of a temporal "stamp" inside which a series of information is kept such as product delivery date, product characteristics and status, and origin of product.

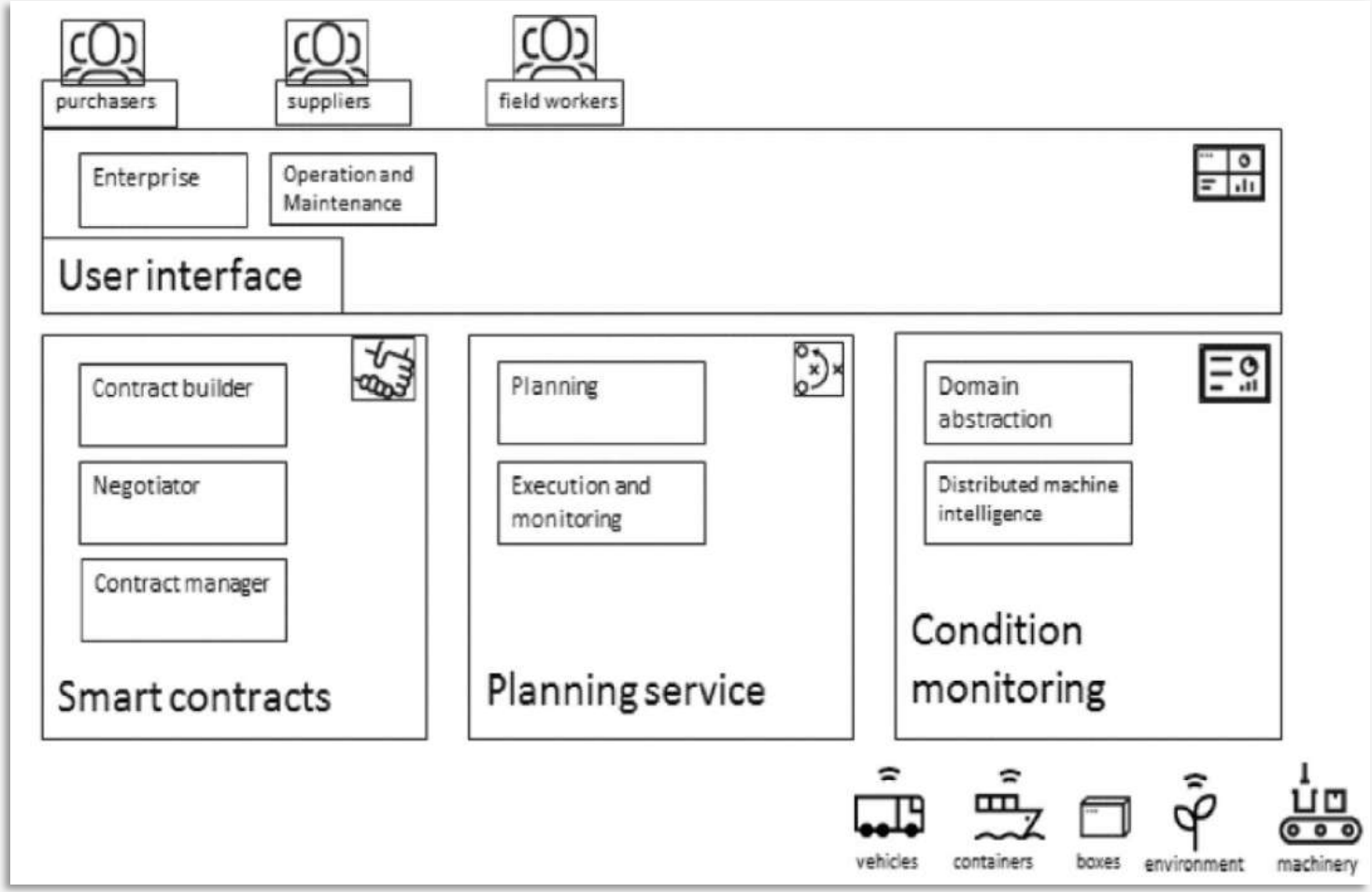


Proto, S., Di Corso, E., Apiletti, D., Cagliero, L., Cerquitelli, T., Malnati, G., Mazzucchi, D., 2020. REDTag: a predictive maintenance framework for parcel delivery services. IEEE Access 8, 14953e14964. https://doi.org/10.1109/ACCESS.2020.2966568

IoT and block chain technologies in a smart logistics solution

Block chain infrastructure and IoT can also revolutionize company logistics in the field of document management (i.e., invoices, transport documents, etc.), traceability of goods (origin of products, monitoring of vehicle fleets, etc.), and play a substantial role in fighting counterfeiting.

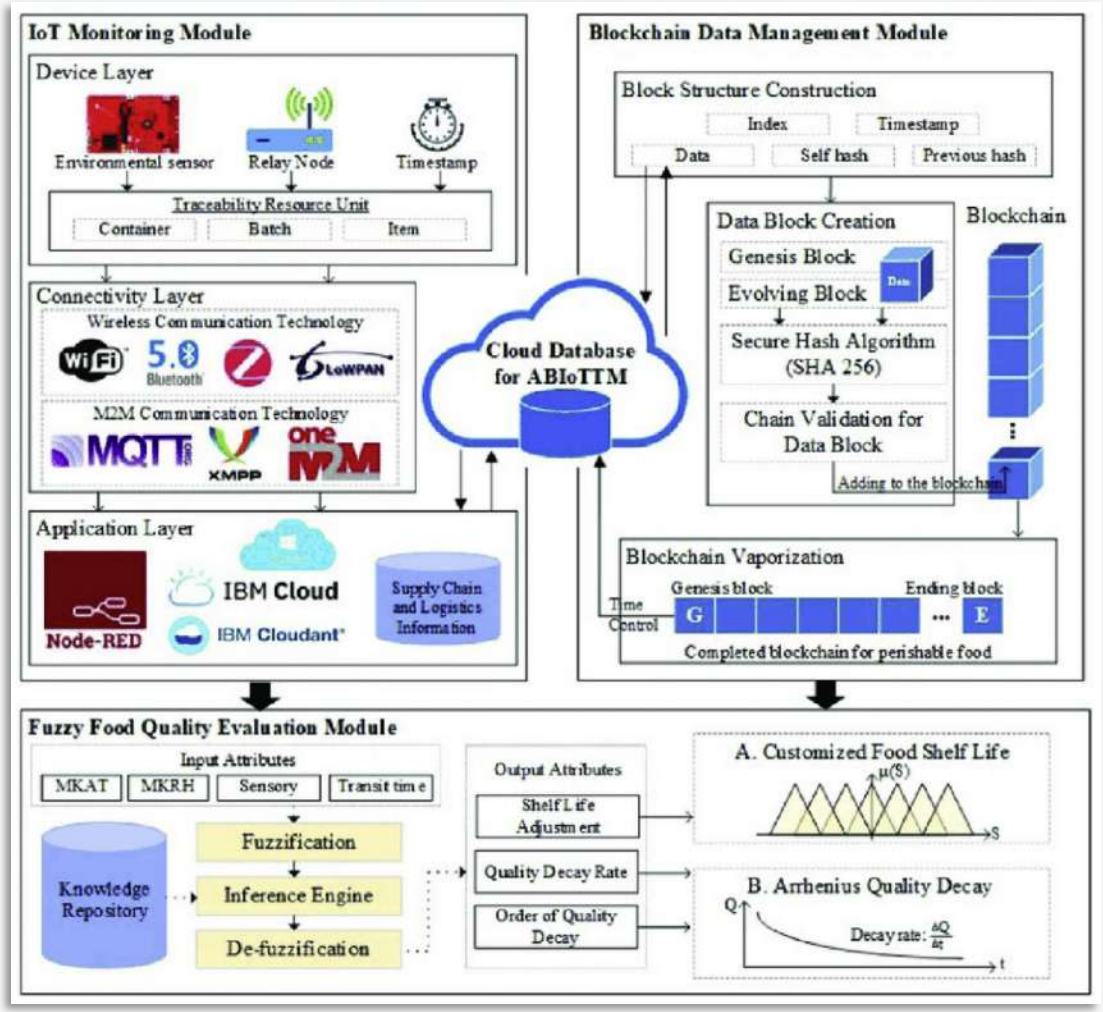
Example: IoT and block chain technologies in a smart logistics solution encapsulating smart contracts, logistics planner and condition monitoring of the assets in the supply chain management.



Arumugam, S.S., Umashankar, V., Narendra, N.C., Badrinath, R., Mujumdar, A.P., Holler, J., Hernandez, A., 2018. IOT enabled smart logistics using smart contracts. In: 2018 8th International Conference on Logistics, Informatics and Service Sciences (LISS). https://doi.org/10.1109/LISS.2018.8593220.

IoT and block chain technologies in a food traceability system

The block chain-IoT-based food traceability system (BIFTS) to integrate the novel deployment of block chain, IoT technology, and fuzzy logic into a total traceability shelf-life management system for the managing of perishable food.



https://www.researchgate.net/figure/Hybrid-use-of-IoT-technologies-cloud-computing-and-blockchain_fig4_335742563

Arumugam, S.S., Umashankar, V., Narendra, N.C., Badrinath, R., Mujumdar, A.P., Holler, J., Hernandez, A., 2018. IOT enabled smart logistics using smart contracts. In: 2018 8th International Conference on Logistics, Informatics and Service Sciences (LISS). https://doi.org/10.1109/LISS.2018.8593220.

Artificial Light: What can be changed with IoT?

City's identity + safety + business + tourism

Lighting = 19 % of all electricity consumed

One-third of the world's roads are still lighted by old technology

LED lighting + smart controls = energy savings

https://www.seniainternational.org/senia-beijing-resources/

https://www.perfomatix.com/what-designers-must-know-about-machine-learning/

Water – Internet: What can be changed with IoT?

2.5 B people lack access to improved sanitation

748 M people lack access to improved drinking-water

Digital divide between developed and developing countries: 2015 Internet users representing 82 % and 35 % respectively

Examples of IoT in developing countries

Slum fires

Fires can move quickly in informal settlements and slum areas, given that homes are close in proximity. Faulty wiring and indoor open hearths, when combined with the density of these settlements, make combating fires quite difficult, and more likely to start.

Low-cost, solar powered sensors networked together can quickly detect and relay to authorities when fires emerge. Its connected sensors identify via GPS where the fire has started. The network sounds alarms, sends texts to threatened residents, and notifies authorities of the location where fire mitigation efforts should be targeted) .

Currently being tested in Nairobi and Cape Town, with participation by two thousand households.

Infectious outbreaks

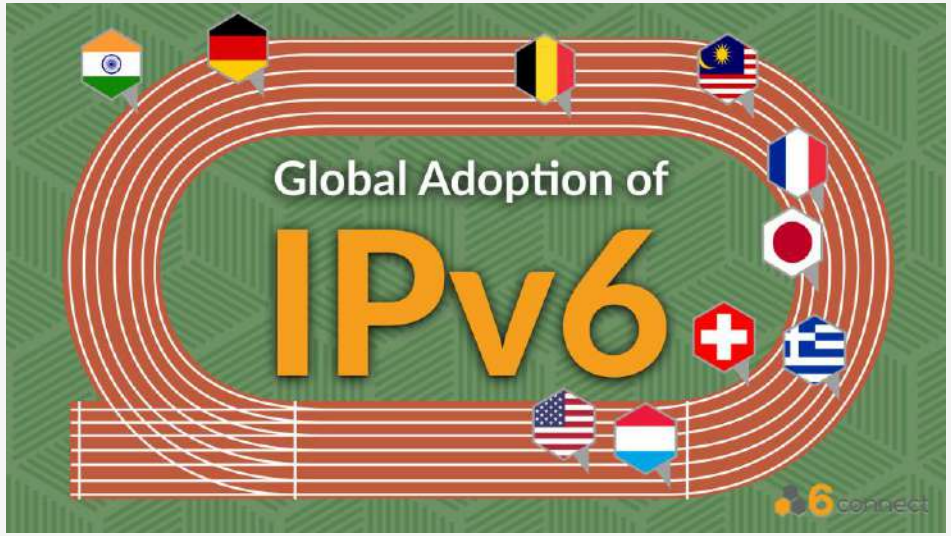
Epidemiological models of the spatial spread of Ebola can (and have been) developed to model the spread of the virus. These models can help assess the likely routes of infected individuals between populations, predict possible new outbreaks and help focus the delivery of eventual vaccines. However, challenges remain in terms of establishing the processes by which such data can be shared (privacy!) and released in a timely fashion.

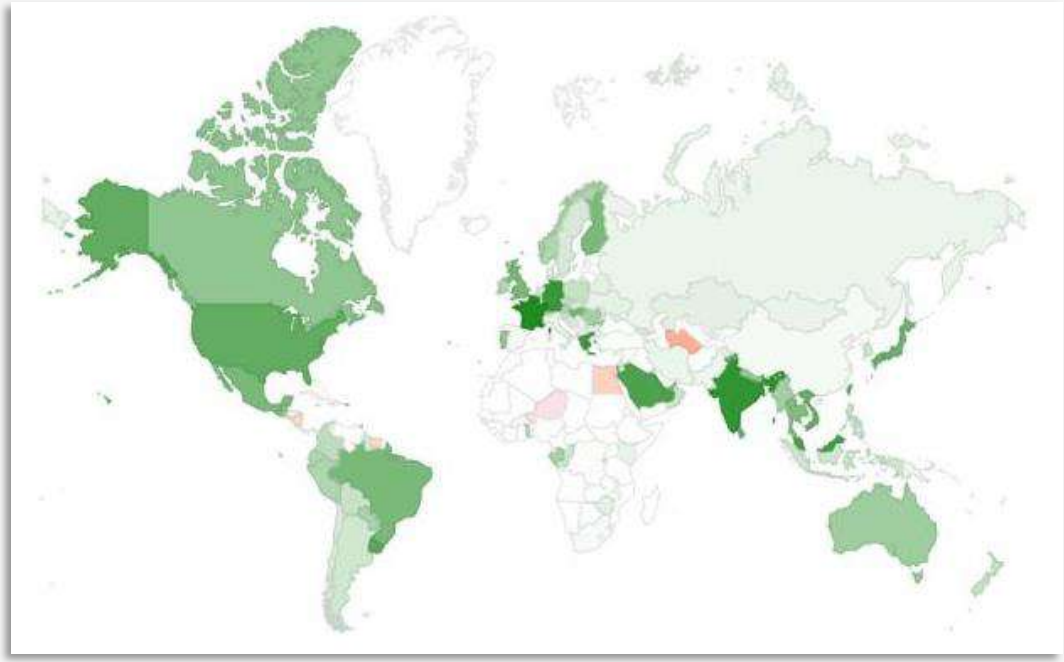
https://robertcowley.wordpress.com/tag/africas-urban-revolution/

https://www.allerin.com/blog/developing-countries-and-their-tryst-with-iot

https://www.slideshare.net/GayaBranderhorst/iot-and-sustainable-development-united-nations

IPV6 Adoption: developed and developing countries

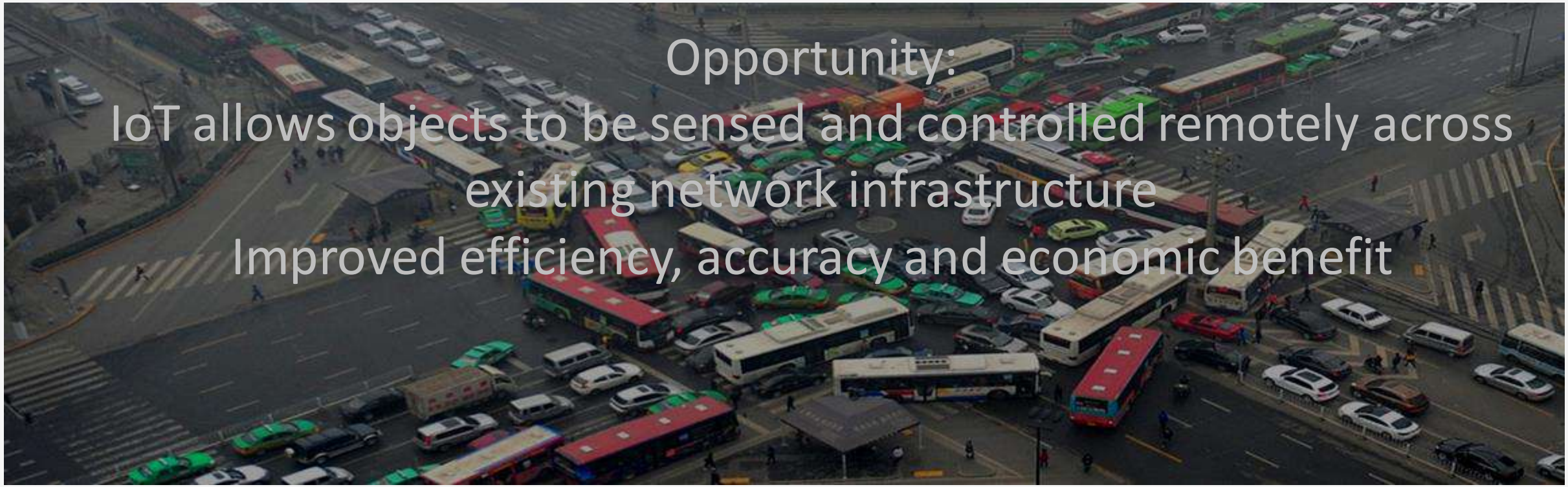




The chart above shows the availability of IPv6 connectivity around the world.

- Regions where IPv6 is more widely deployed (the darker the green, the greater the deployment) and users experience infrequent issues connecting to IPv6-enabled websites.
- Regions where IPv6 is more widely deployed but users still experience significant reliability or latency issues connecting to IPv6-enabled websites.
- Regions where IPv6 is not widely deployed and users experience significant reliability or latency issues connecting to IPv6-enabled websites.

Source: https://www.google.com/intl/en/ipv6/statistics.html#tab=per-country-ipv6-adoption&tab=per-country-ipv6-adoption
https://www.6connect.com/blog/global-adoption-of-ipv6-top-ten-countries/



Things should talk to each other -New divide? Adoption of IPV6

Avoid polarized development: smart cities should be a priority for developing countries

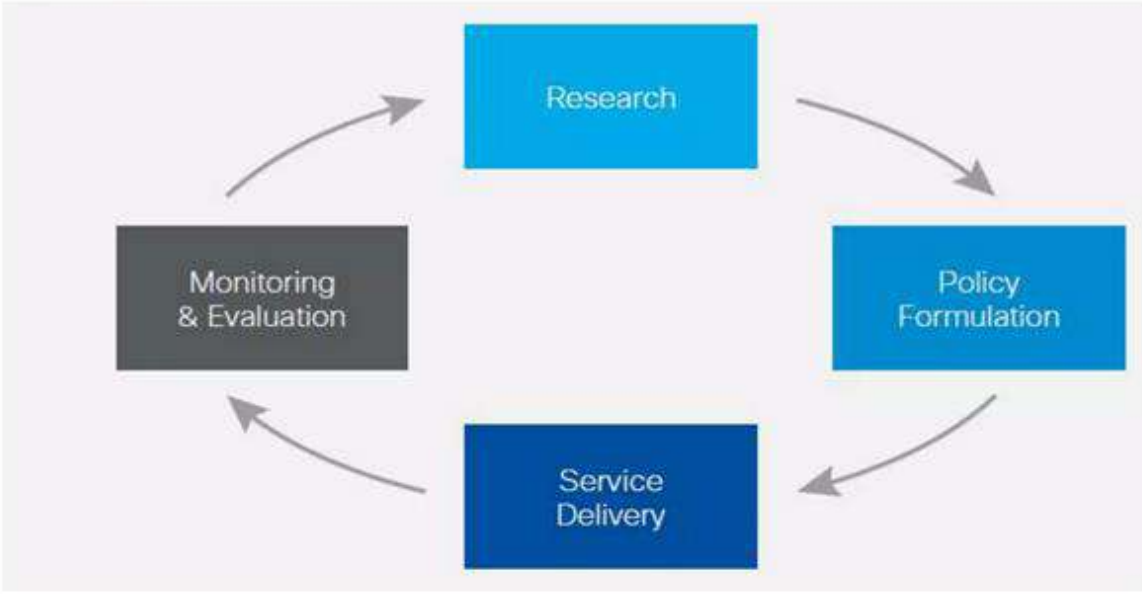
Source: Forum on "Powering Smart Sustainable Cities With the Internet of Things" 5th ITU Green Standards Week

IoT and Sustainable Development Policy

How can IoT strengthen policy-making?

i. **Help policy be more iterative and adaptive.**

ii. **Measuring and monitoring.**



Source: Cisco Systems

IoT and Sustainable Development Policy

How can policies support the possibilities that IoT offers for sustainable development in becoming a reality?

Necessary conditions:

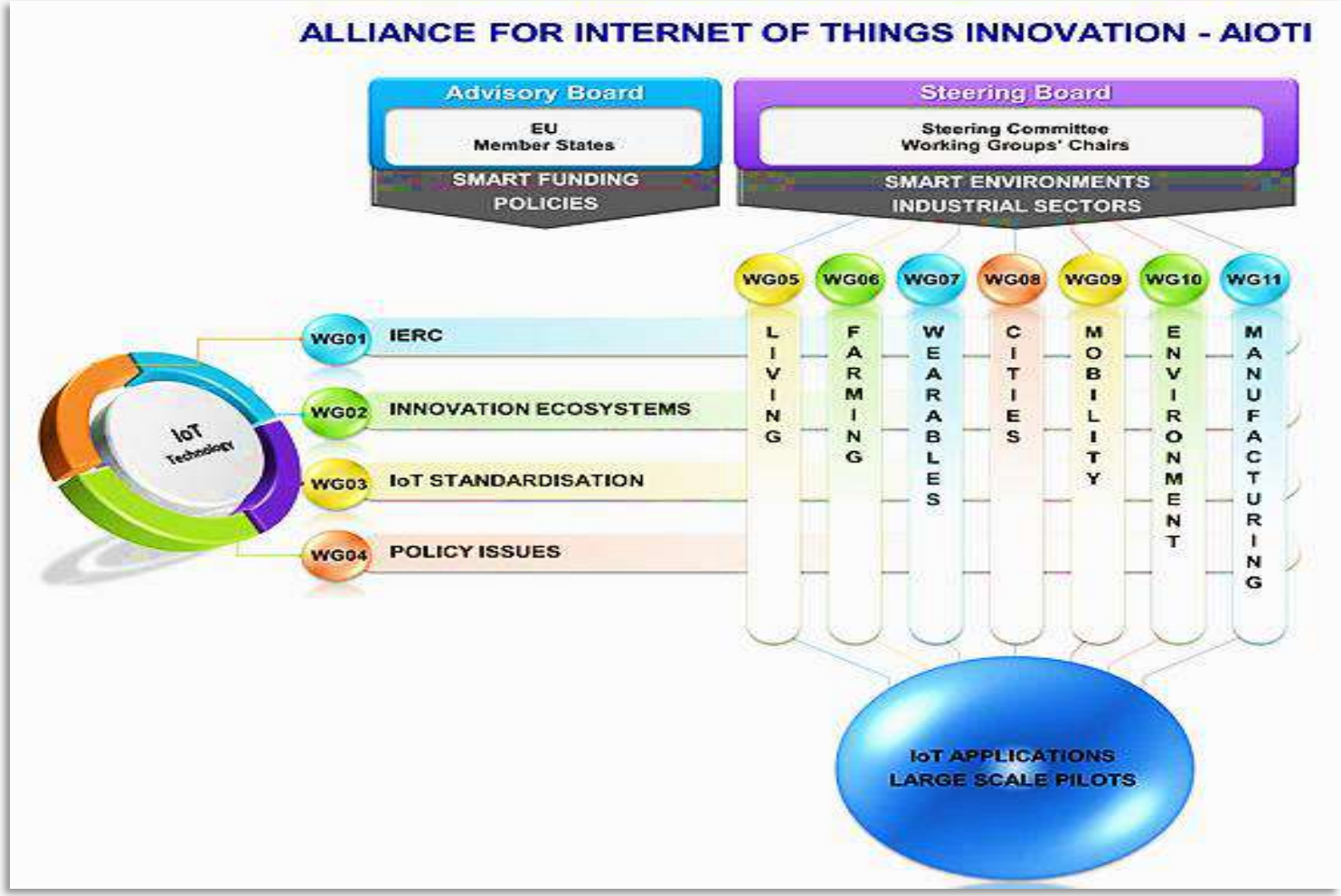
Internet Infrastructure, and energy to power it.

Privacy and Security laws.

Local know-how need to be enhanced.

Scherf, T. (2016). "internet of Things" – hype or hope for developing countries? KfW Development Research.

Alliance for Internet of Things Innovation (AIOTI)



https://forcetechnology.com/en/articles/force-technology-member-european-iot-organisation-aioti

https://aioti.eu/

Five key challenges on IoT in the EU

Rapid technological development

Users' take up and acceptability

Need to move into deployment

Risk of fragmentation

International competition

https://aioti.eu/

What has the European Commission done?

51 M€ EC funding in 2015 for IoT Innovation **Ecosystems**

In FP7 - 3 calls **100 M€** budget for R&D and piloting (see IERC-WG1)

IoT: hot topic for industry, investors and start-ups in Europe

140 M€ EC funding in 2016- 2017 for IoT

https://aioti.eu/

EC Call for proposals for Internet of Things (#H2020)

1. IoT-01-2016: Large Scale Pilots Total Budget 100 MEUR (funding rate: 70%)

- Pilot areas:
- Pilot 1: Smart living environments for ageing well (EU contr. up to 20 MEUR)
- Pilot 2: Smart Farming and Food Security (EU contr. up to 30 MEUR)
- Pilot 3: Wearables for smart ecosystems (EU contr. up to 15MEUR)
- Pilot 4: Reference zones in EU cities (EU contr. up to 15MEUR)
- Pilot 5: Autonomous vehicles in a connected environment (EU contr. up to 20 MEUR)

WHERE TO APPLY: http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/calls/h2020-iot-2016-2017.html#c,topics=callIdentifier/t/H2020-IOT-2016-2017/1/1/1&callStatus/t/Forthcoming/1/1/0&callStatus/t/Open/1/1/0&callStatus/t/Closed/1/1/0&+identifier/desc).

2. IoT-02-2016: IoT Horizontal activities. Total budget: 4 MEUR

- a) up to 3 MEUR (funding rate: 100%),
- b) up to 1 MEUR (funding rate: 100%)

EC Call for proposals for Internet of Things (#H2020)

3. IoT International Cooperation. Total budget: 17 MEUR

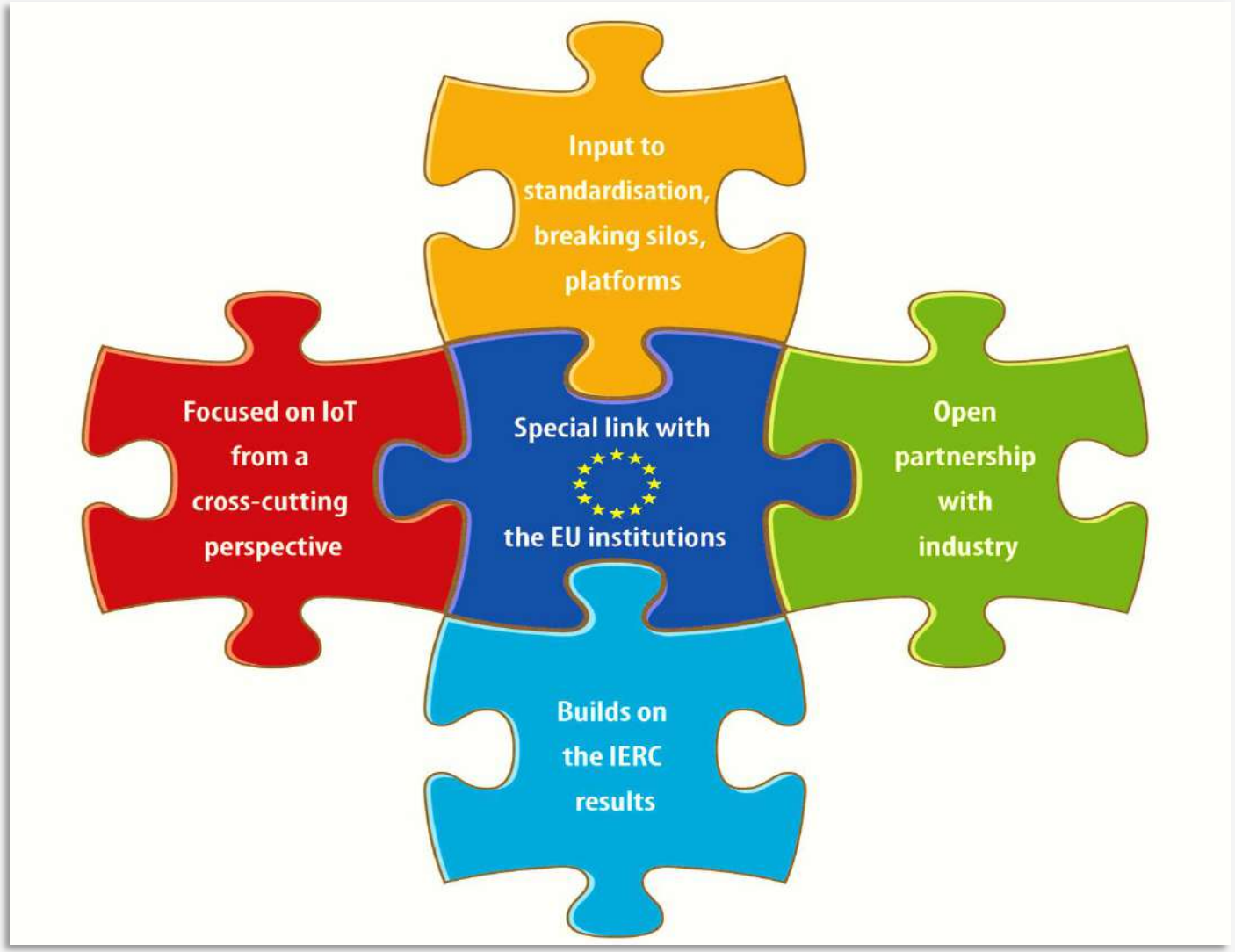
- ICT-37-2016: China: Collaboration on Future Internet (CSA)
(http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5079-ict-37-2016.html)

- EUJ-02-2016: Japan: IoT/Cloud/Big Data platforms in social application contexts (RIA)
(https://ec.europa.eu/research/participants/portal4/desktop/en/opportunities/h2020/topics/2419-euj-02-2016.html)

- EUK-02-2016: South Korea: IoT joint research (RIA)
(http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/2334-euk-02-2016.html)

- EUB-02-2017: Brazil: IoT Pilots (RIA)
(http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/2080-eub-02-2017.html)

Why the AIOTI is unique?

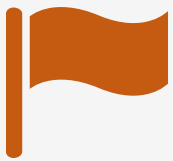


https://aioti.eu

AIOTI Mission Areas

Deployment

- Identify barriers
- Gather evidence
- Contribute to the Digital Single Market



IoT Ecosystem

- Build across different application areas
- Mapping and bridging of IoT innovation activities
- Encourage the growth of start-ups in IoT

IoT Uptake

- Identify spearhead players
- Communicate
- Champion

Large Scale Pilots

- Experimentation, replication and deployment
- Convergence
- Interoperability
- H2020

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More than 350 AIOTI members from 24 countries

Large companies

Start-ups

Associations

SMEs

AIOTI is an IoT global key player and the voice of #Europe on #IoT

https://aioti.eu

AIOTI in the long term and stepping stones

2015

March

Phase 1: Ignition

2015

December

Phase 2: First Positioning

2016

April

Phase 3: Awareness raising

2017

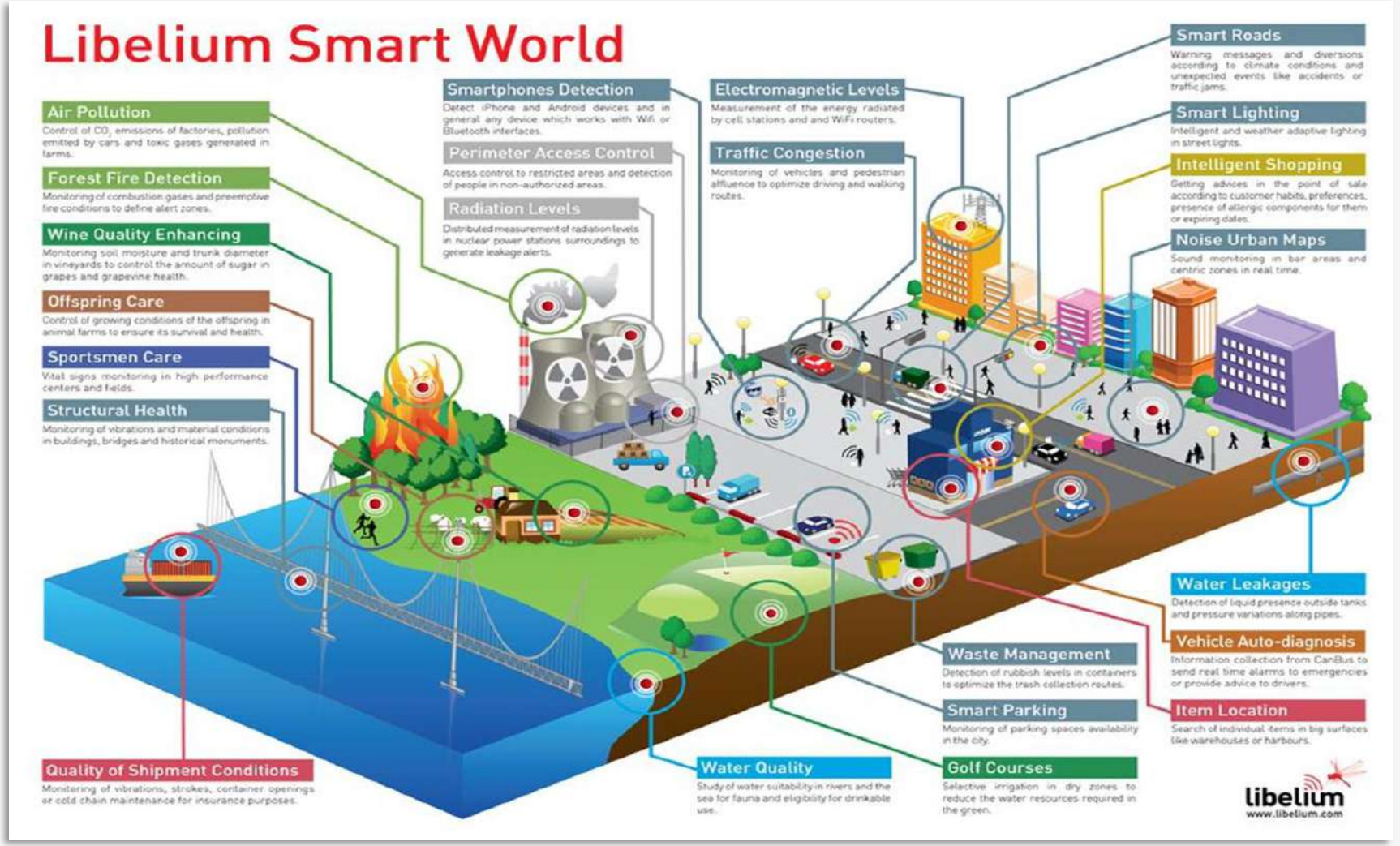
Phase 4: Strategy road map

2020

Phase 5: Sustainability

https://aioti.eu

The smart world of the future using IoT



https://www.forbes.com/sites/jacobmorgan/2014/05/13/simple-explanation-internet-things-that-anyone-can-understand/#ef2433f1d091

Future directions in the field - further issues 1

- The rapid development of IoT technologies causes fast consumption of raw materials to produce different electronic devices where unfortunately some of raw materials are already rare or becoming,

- Electronic devices are becoming more economically acceptable where a potentially large population would be affected. High production volumes are expected which can finally cause a rebound effect and a more rapid unwanted utilization of already limited resources,

- The sustainability aspect and long-term effects of IoT technologies are not clear and insufficiently investigated. A noticeable amount of energy would be needed to operate IoT devices, and the electronic industry is leaving different unfavorable environmental footprints that also need to be carefully investigated,

- Electronic waste will become one of the major issues caused with the planned rise of IoT products. Recycling rates must be improved, and better e-waste management should be secured,

Future directions in the field - further issues 2

- IoT technologies can cause social impacts in specific industrial branches or businesses since working labour could be reduced and direct social contacts have also been reduced. In that sense, the application of IoT technologies should be carefully considered taking the raised issues into account,

- Significant advancements in both specific electronic components as well as user-friendly software solutions are required,

- Further development in sensing technologies and advanced data acquisition systems is also required,

- The minimization of energy consumption in IoT devices is a crucial target, i.e., reduction of energy supply

Any questions?

Thank you ☺

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NETWORK MANAGEMENT & OPTIMAL DESIGN LAB