IoT Academy

Digital Transformation: Enhancing IoT-driven Solutions for Smart Islands

Digital transformation concept: emerging digital technologies (IoT, AI, AR and etc.) and their role in transformation

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- CEO of IoT Academy (ITU Academia Member & ITU IoT Center of Excellence in Asia-Pacific)
- Faculty Member in ICT Research Institute
- International Internet of Things (IoT) Speaker & Lecturer
- International Telecommunication Union (ITU) Expert
- Chairman of The corresponding ISO/IEC JTC1 SC41 (Internet of Things and related technologies Standards) in Iran
- Chairman, Member of the founding board and the board of trustees of Non-Commercial Institute (as a NGO) of “Promoting the Internet of Things and data science” at national level.
- Doctor of Business Administration from the University of Tehran, MBA, M.Sc in Electrical Engineering- Telecommunication systems, B.Sc in Electrical Engineering- Electronics.

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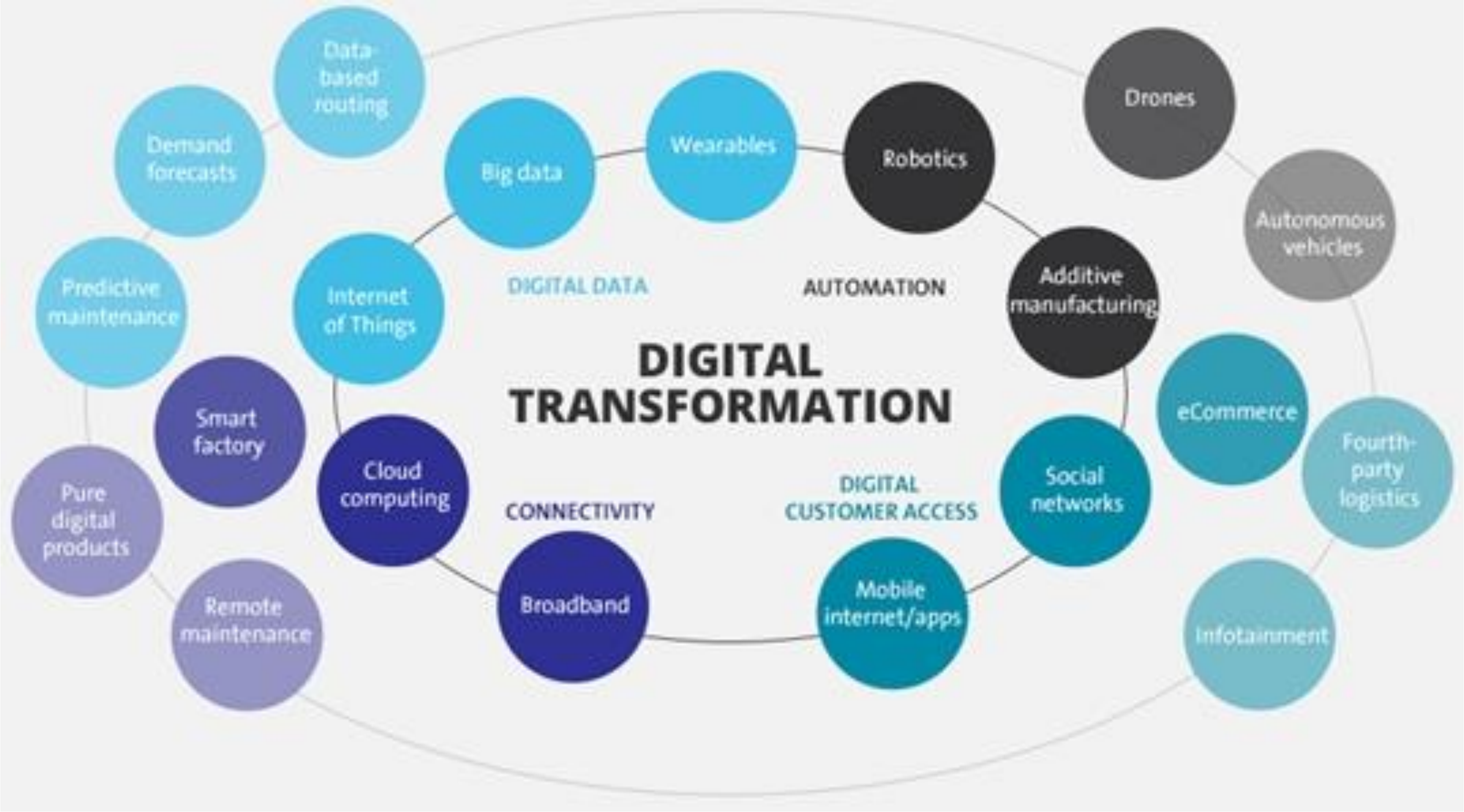
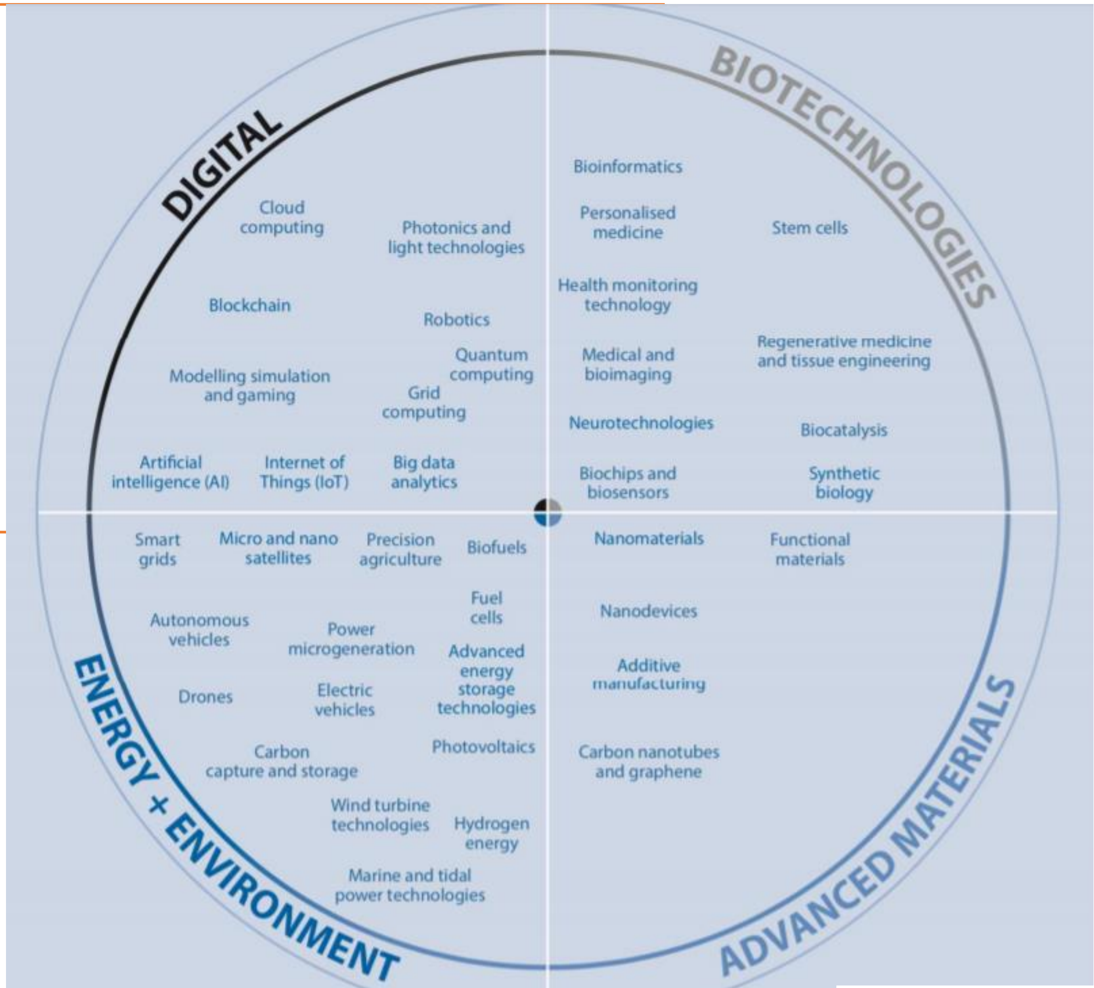

DIGITAL TRANSFORMATION
DIGITAL DATA
AUTOMATION
CONNECTIVITY
DIGITAL CUSTOMER ACCESS
Data-based routing
Demand forecasts
Predictive maintenance
Smart factory
Pure digital products
Remote maintenance
Big data
Wearables
Internet of Things
Cloud computing
Broadband
Robotics
Additive manufacturing
Drones
Autonomous vehicles
eCommerce
Fourth-party logistics
Social networks
Mobile internet/apps
Infotainment

What are the most important technologies for a digital transformation?

Digital transformations that leverage multiple technologies at the most effective points will be the most successful. For example, IoT, AI, AR/VR, cloud computing for data connection and extraction. The combination of these technologies allows customers to perform powerful analytics on extremely large and complex business data on the back end while providing a simple web-based front end that makes results easy to understand and actions easy to execute.

Key Emerging Technologies for the Future

ICT



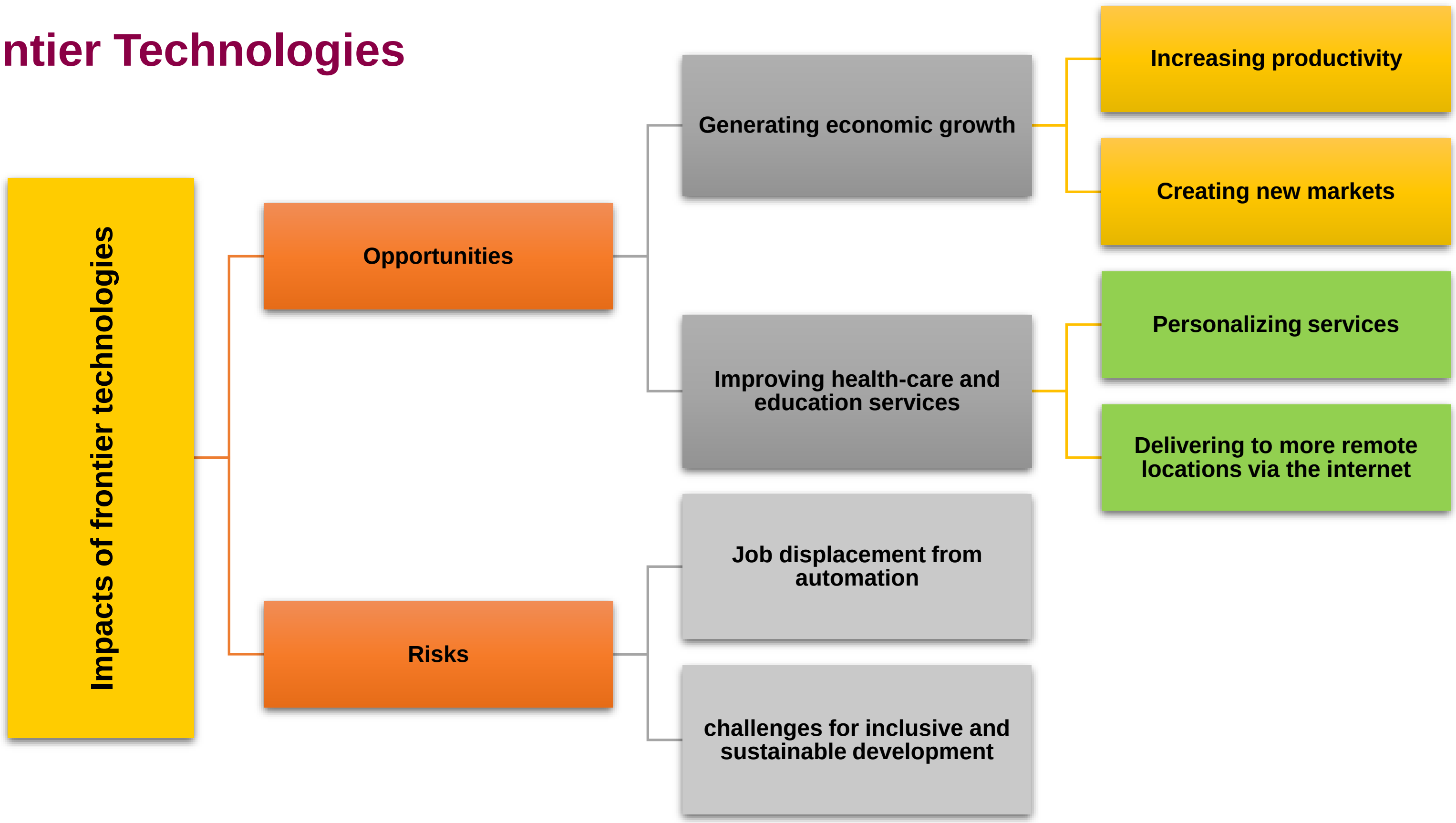
Source: OECD, 2016b.

Emerging Frontier Technologies In ICT

(Source: Capacity Building in a Changing ICT Environment, ITU, 2018)

- Broadband and ultra-broadband
- Mobile broadband and 5G
- Next Generation Networks (NGNs) and IPv6
- Internet of Things (IOT)
- Cloud Computing
- Big Data
- Artificial Intelligence (AI)
- 3D Printing
- Virtual Reality (VR) and Augmented Reality (AR)
- Machine Learning (ML)

Impacts of Frontier Technologies



(Source: Evolution of Science, Technology and Innovation Policies for Sustainable Development: The Experiences of China, Japan, the Republic of Korea and Singapore, ESCAP, United Nations 2018)

Key Policy Issues in Frontier Technologies

Maximizing the benefits while minimizing the risks of frontier technologies.

- **Building capabilities to leverage new opportunities**
- **Addressing the future of work**
- **Personal data protection and privacy**

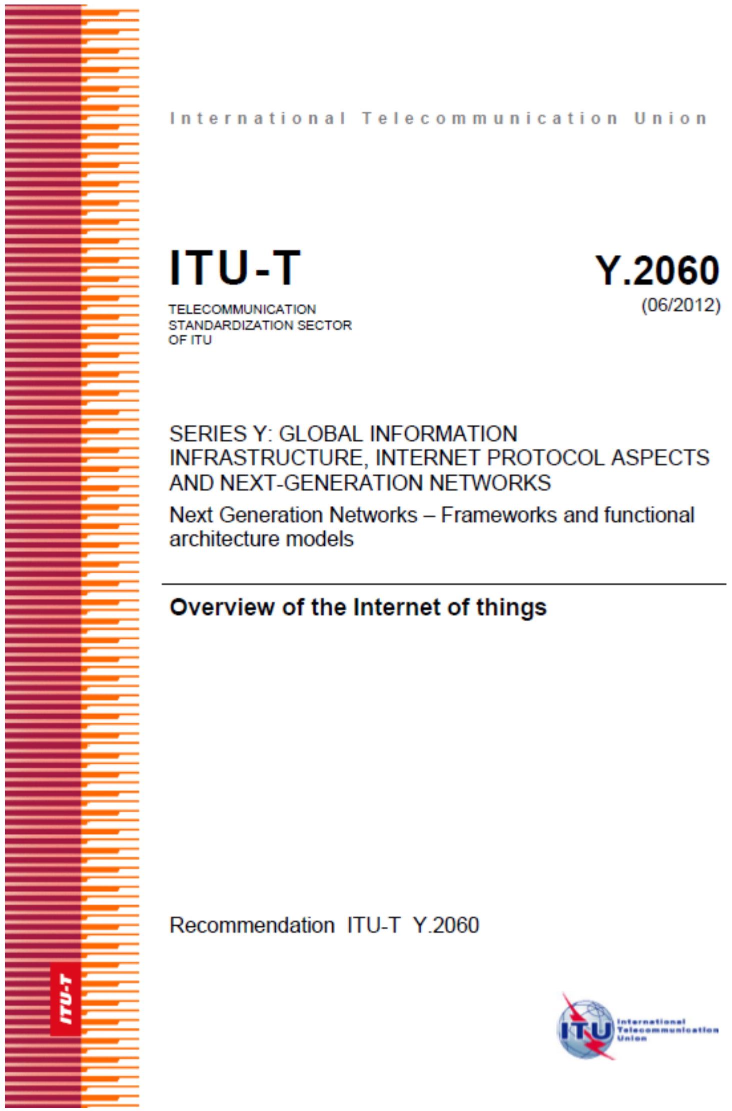
(Evolution of Science, Technology and Innovation Policies for Sustainable Development: The Experiences of China, Japan, the Republic of Korea and Singapore, ESCAP, United Nations 2018)

Internet of Things (IoT)

Internet of things (IoT): A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – From a broader perspective, the IoT can be perceived as a vision with technological and societal implications.



International Telecommunication Union

ITU-T

TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

Y.2060

(06/2012)

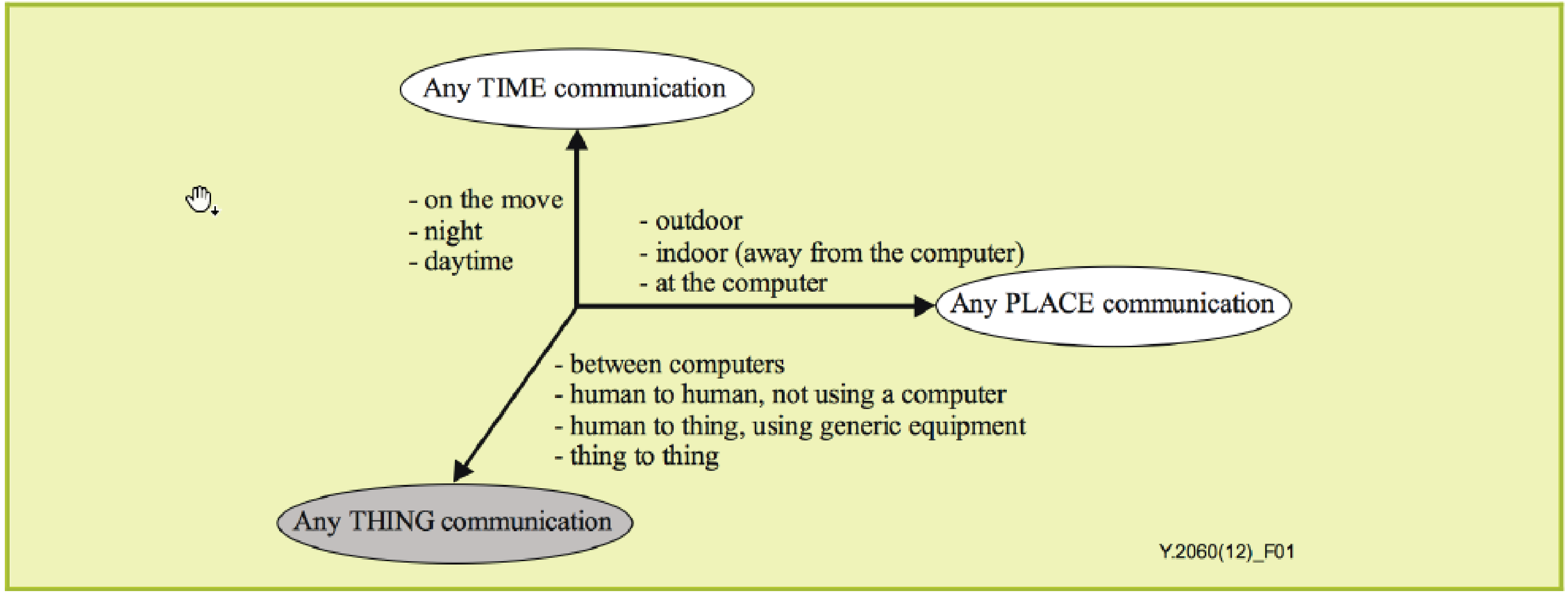
SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Next Generation Networks – Frameworks and functional architecture models

Overview of the Internet of things

Recommendation ITU-T Y.2060

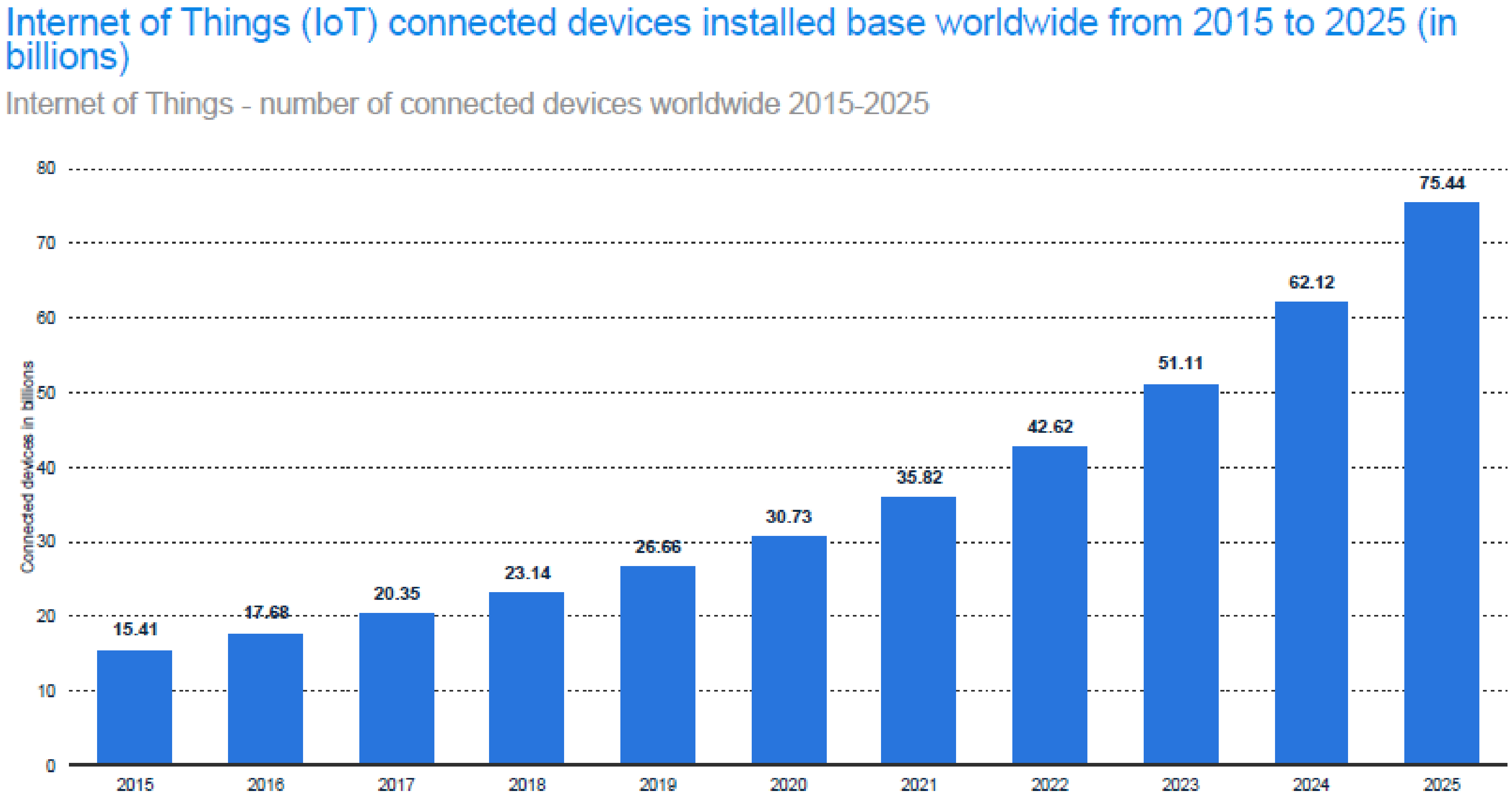
Any-Time/Place/Thing



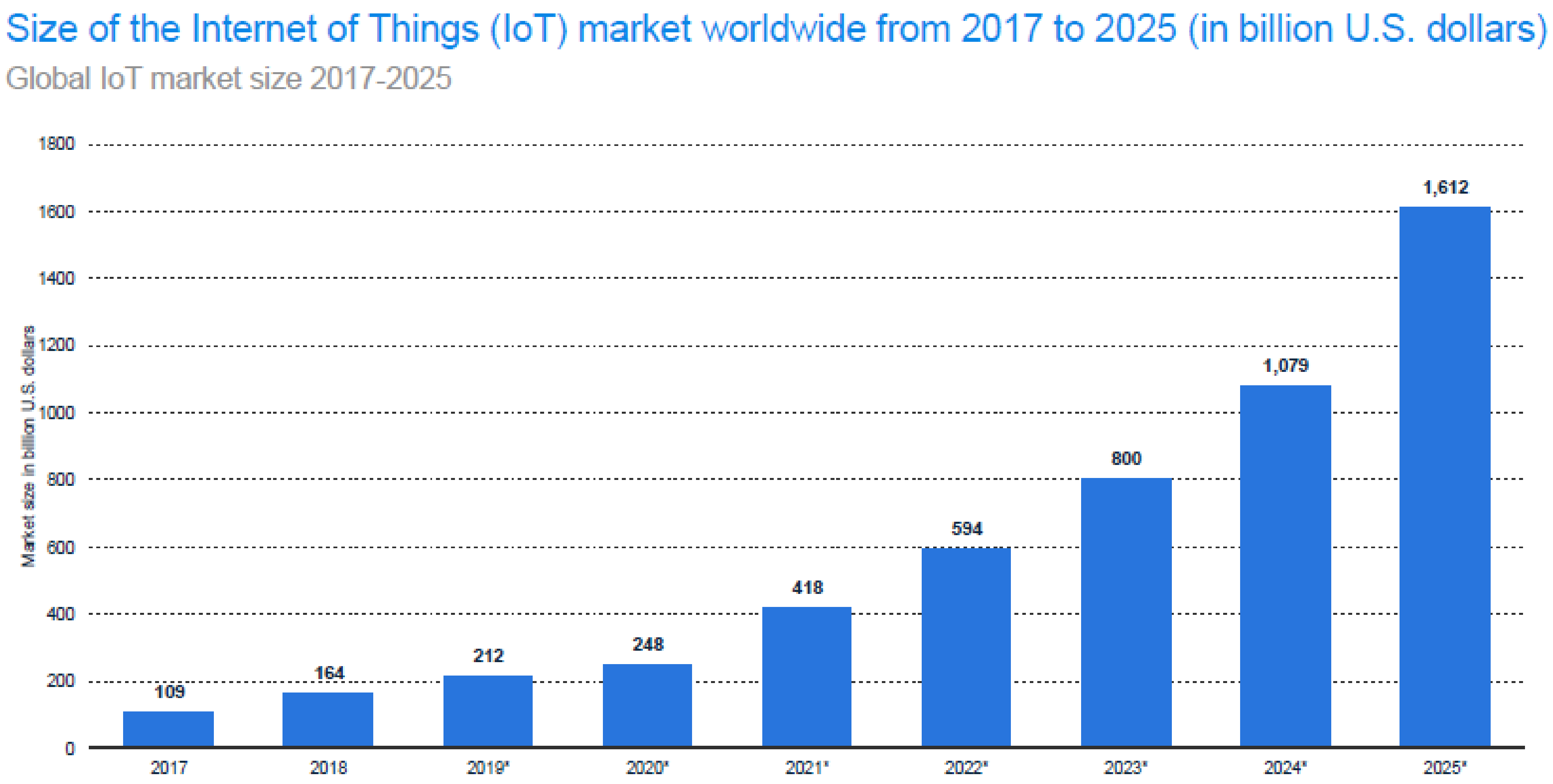
Source: Recommendation **ITU-T Y.2060**

To watch the video of this slide, refer to the video presentation.

Internet of Things Trend



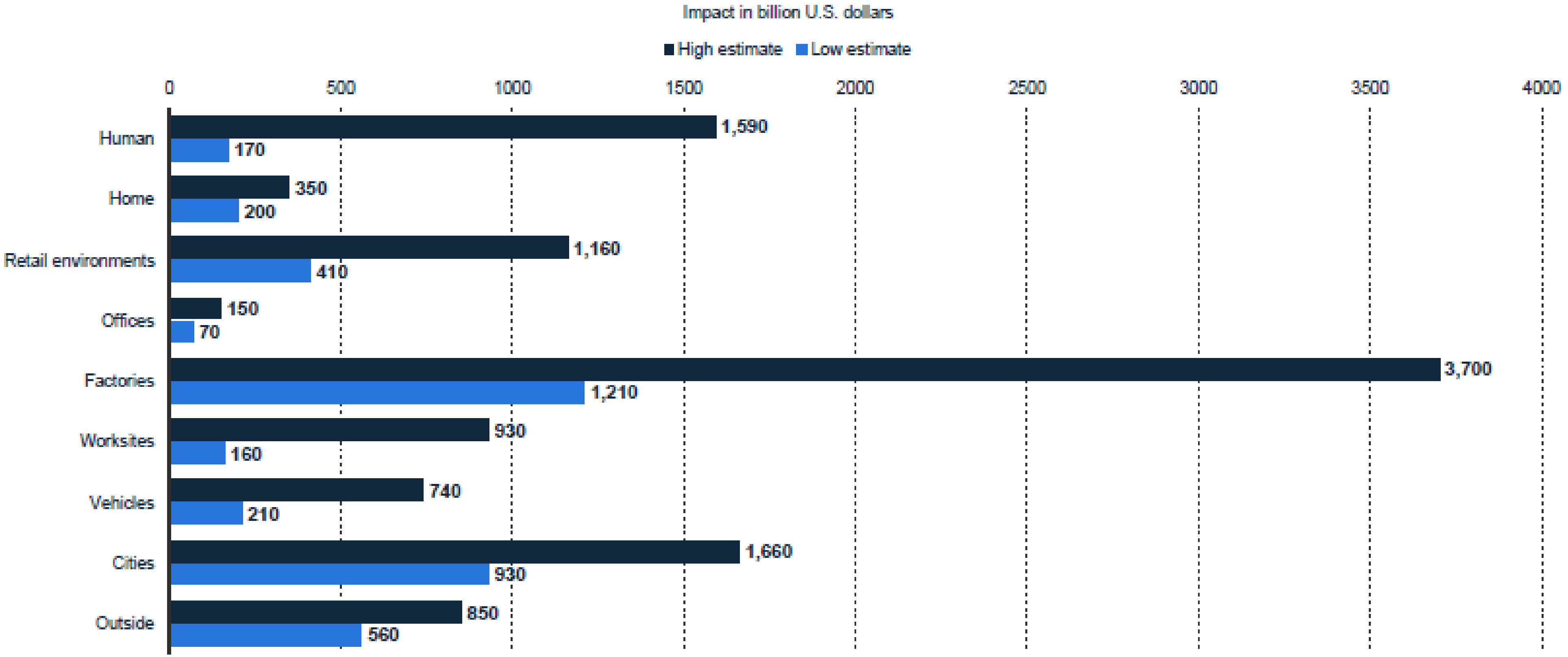
Internet of Things Market



Internet of Things Market

Forecast economic impact of the Internet of Things (IoT) in 2025 (in billion U.S. dollars)

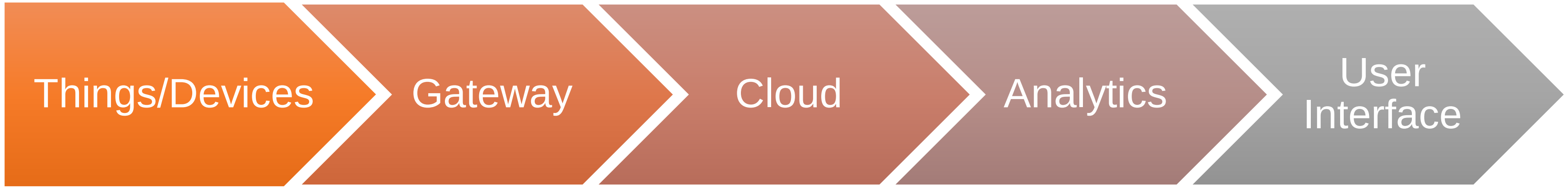
IoT economic impact forecast 2025, by sector



IoT Components

Conceptual overview

Implementation-driven overview



- Sensors can be classified / differentiated by their:
  - Purpose (what do they sense? Temperature? Location?)
  - Accuracy (How close is the data to reality?)
  - Reliability (How often do they work accurately?)
  - Range (How far can they sense, e.g. radiation?)
  - Resolution (Does a location sensor provides data in meters or in hundreds of meters?)
  - Level of Intelligence (Can the sensor self-calibrate? Can it recognize that something is wrong?)
- General trend: small, cheap and smart!

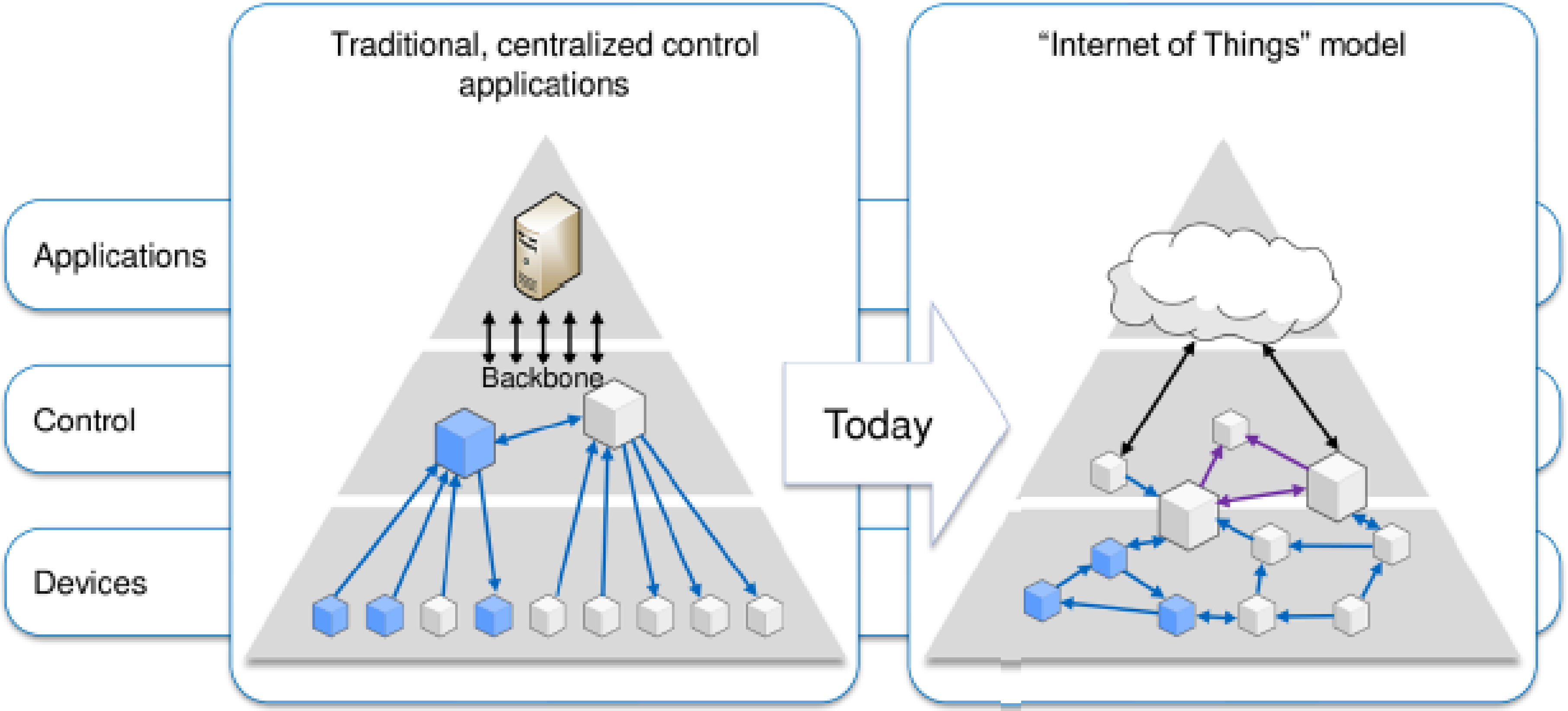
- Main challenges:
  - Many different network technologies, e.g. LTE, Wi-Fi, W-Max, Bluetooth, Ethernet, etc.
  - Power consumption
  - Enormous amount of devices
  - Changing traffic patterns
  - Security
  - Mobility

- Various standards and regulations:
    - Technology-related (networks, communications, data)
    - Health regulations
    - Private data handling regulations
- Mandatory vs. non-mandatory standards
    - Example: Company A decides to produce a new body-worn sensor. It can develop its own communication system and networking stack, but needs to adhere to health regulations, private data laws and frequency regulations for wireless communications.
- Main challenge: knowledge about standards and their adoption

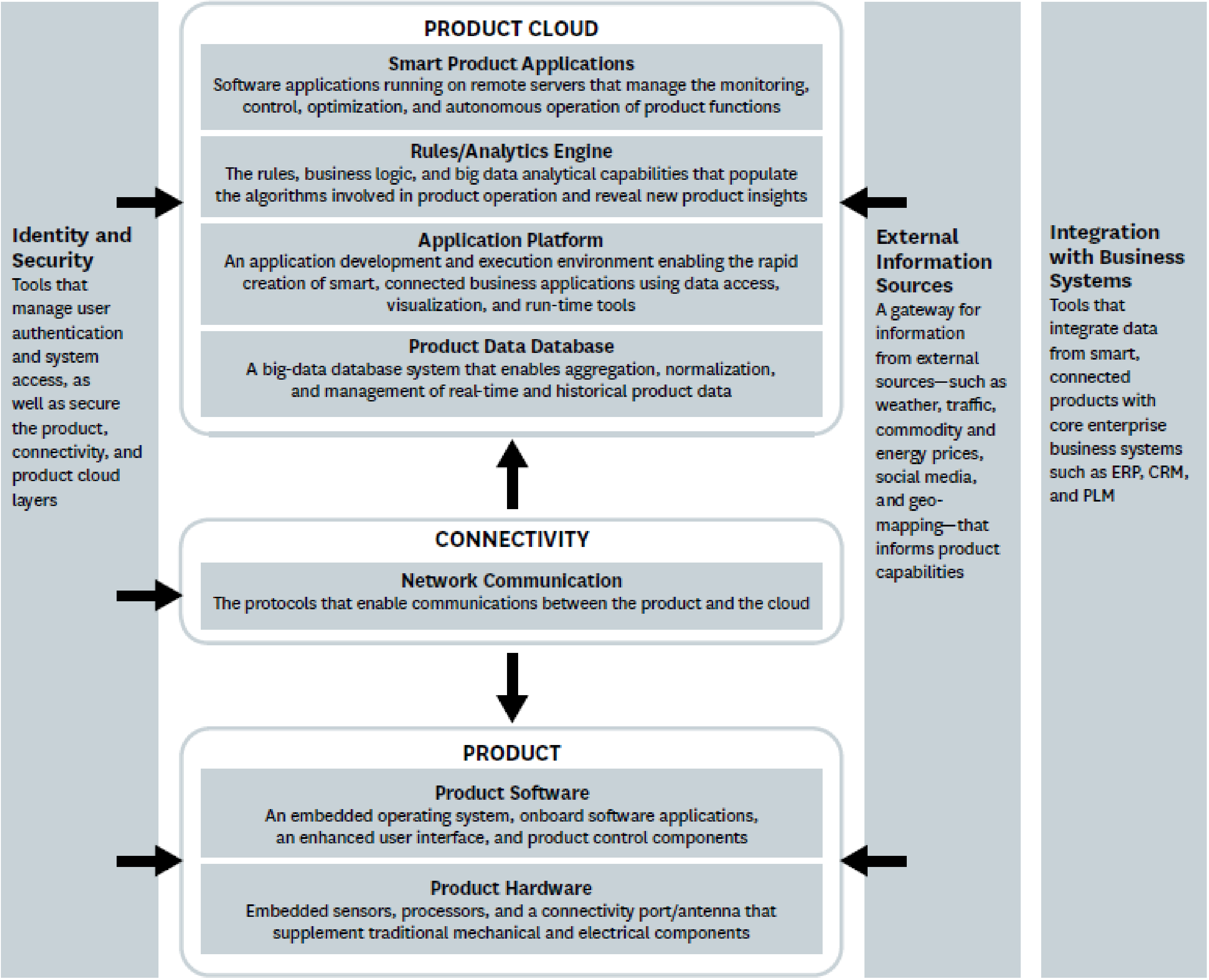
- Main techniques:
  - Computer vision: enables automatic “seeing”, e.g. for security, driving, etc.
  - Natural language processing, e.g. read signs and produce text or speech itself
  - Speech recognition to communicate with humans

- Depend strongly on Intelligent Analysis
- Main open question: how much a machine is allowed to do? When a machine is allowed to take decisions?
- Main challenge: decisions in new/unpredicted situations

TRADITIONAL MODEL AND MODEL OF INTERNET OF THINGS



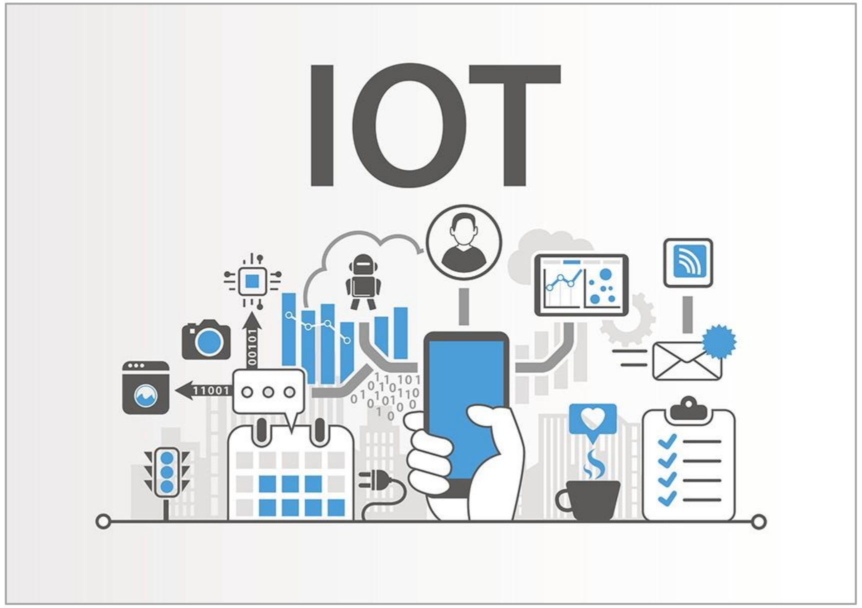
IOT ARCHITECTURE



IOT APPLICATIONS

To watch the video of this slide, refer to the video presentation.

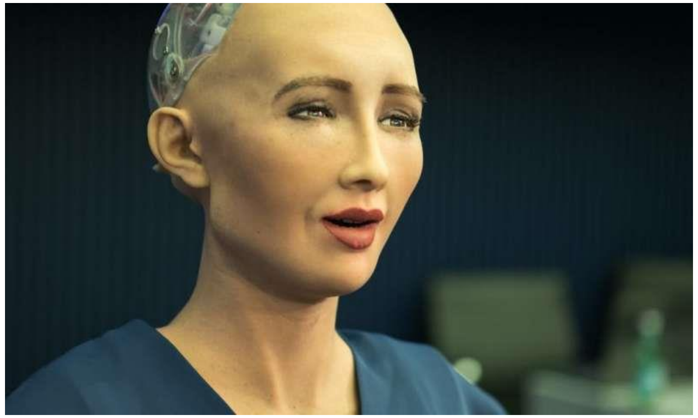
Critical steps to ensure success with the Internet of Things (IoT)



- Cut through complexity
- Make your data useful
- Architect for your analytics
- Secure opportunities

(Source: https://www.cio.com/article/3191167/four-critical-steps-to-ensure-success-with-the-internet-of-things-iot.html)

Artificial Intelligence



Artificial Intelligence

Artificial Intelligence (AI) is the science and engineering of making intelligent machines, especially intelligent computer programs. -John McCarthy, father of AI, Dartmouth, 1956.

- AI refers to the ability of a computer or a computer-enabled robotic system to process information and produce outcomes in a manner similar to the thought process of humans in learning, decision making and solving problems. In a way, the goal of AI systems is to develop systems capable of tacking complex problems in ways similar to human logic and reasoning.
- A straightforward, consensus definition of AI is not yet there. It is best understood as a set of techniques aimed at approximating some aspect of human or animal cognition using machines.
- AI is a science and a set of computational technologies that are inspired by—but typically operate quite differently from—the ways people use their nervous systems and bodies to sense, learn, reason, and take action.

AI for Good

- AI for Good is a United Nations platform that fosters dialog on the beneficial users of AI to solve challenging economic and social problems

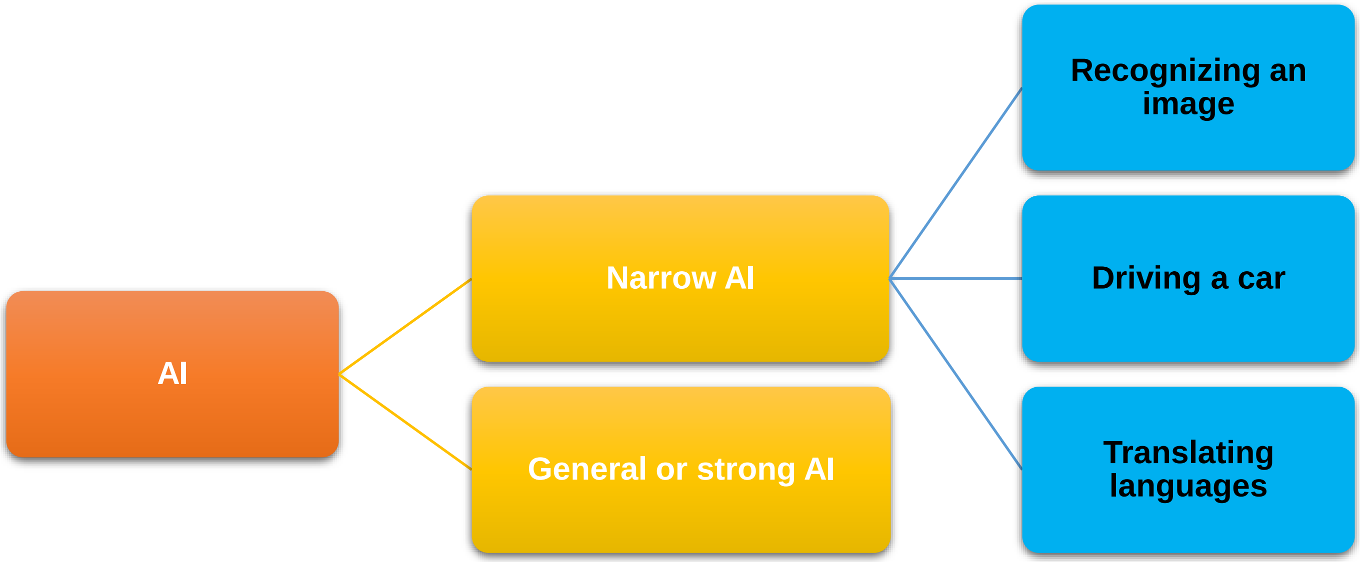
- ITU holds a global symposium where they bring together different stakeholders

- At Stanford University, researchers are using AI to analyze satellite images to identify which areas have the highest poverty level

To watch the video of this slide, refer to the video presentation.

Artificial Intelligence (AI)

Computer algorithms that can perform tasks that usually require human intelligence.



(Source: Frontier technologies for sustainable development in Asia and the Pacific, ESCAP, United Nations, 2018)

Critical Steps for a Successful AI Transformation

- **Build an informed business vision looking outside-in**
- **Devising a solid business strategy**
- **Focus on organizational culture and people**
- **Organizational readiness**
- **Avoid short-termism**
- **Assume risks and accept failures**

(Source: AI and Digital Transformation: A Comprehensive Guide, Mohak Shah, 2019)

Gartner's Predictions from AI to health to a digital society

(Source: https://bitprime.co/gartner-top-10-strategic-predictions-for-2020-and-beyond/)

1- Through 2023, 30 percent of IT organizations will extend policies with "bring your own enhancement" to address augmented humans in the workplace. Changing the human condition, changing our relationship to technology, and resetting our expectations for change

2- By 2023, the number of people with disabilities employed will triple due to AI and emerging technologies, reducing barriers to access. Disabilities will lead to "super abilities" where disabled people can do more than normal people, by using things such as augmented reality (AR). organizations that actively employ people with disabilities see a 72 percent increase in productivity, 89 percent higher retention rates, and a 29 percent increase in profitability.

3- By 2024, the World Health Organization will identify online shopping as an addictive disorder, as millions abuse digital commerce and encounter financial stress. we need to shift our user experience approaches to try to not make them addictive.

4- By 2024, AI identification of emotions will influence more than half of the online advertisements you see. "Hyper-personalization" is going real-time based on emotions, for instance, personal assistants can tell how you are feeling.

5- By 2023, individual activities will be tracked digitally by an "Internet of Behavior" to influence benefit and service eligibility for 40 percent of people worldwide. In our organizations we need to update our ethical data management policies, be transparent about how we use data, and position our brands as a company that protects user's data.

6- By 2023, 40 percent of professional workers will orchestrate their business application experiences and capabilities like they do their music streaming experience. CIOs need to reject monolithic solutions, take an outside/in view of their customers and employees, and accelerate product-style delivery

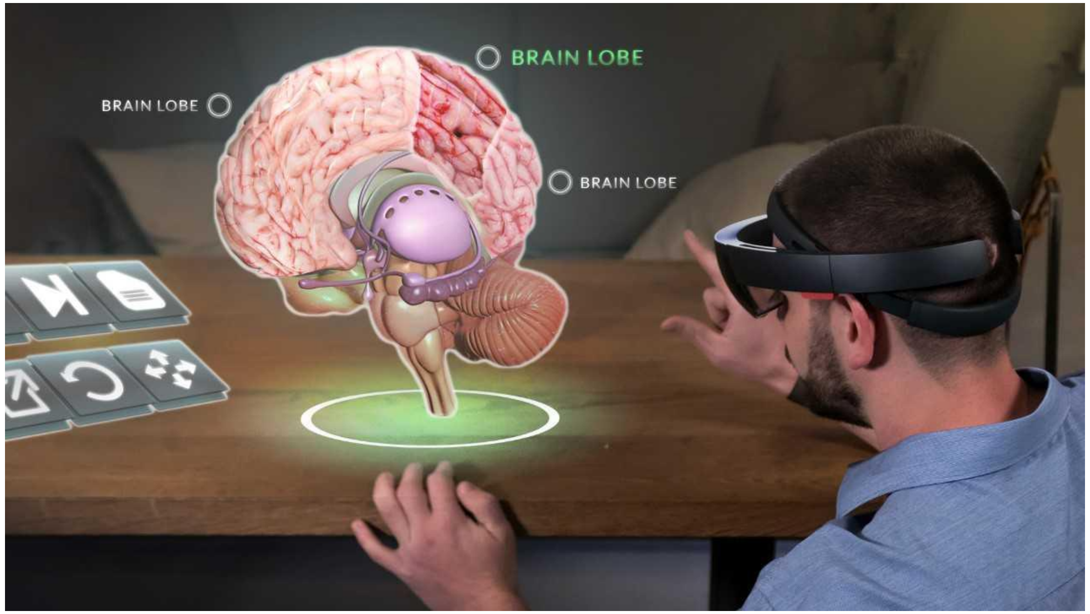
7- By 2025, 50 percent of people with a smartphone but without a bank account will use a mobile-accessible cryptocurrency account. we should be thinking that all customer apps should accept cryptocurrency payments, because this is become much more used in Asia/Pacific and in sub-Saharan Africa.

8- By 2023, up to 30 percent of world news and video content will be authenticated as real by blockchain, countering deep fake technology. blockchain will be used first to authenticate news stories and later deep fake videos, because its immutable ledger can prove the provenance.

9- By 2023, a self-regulating association for oversight of AI and machine learning designers will be established in at least four of the G7 countries**.** AI developers are creating systems that most people don’t understand the decision process, and many of these systems are becoming life-critical. CIOs need to monitor developing standards and certifications in the area, develop internal practitioner standards, and develop AI governance to monitor what is going on with AI, the decisions it makes, and who did the work.

10- Through 2021, digital transformation initiatives will take large traditional enterprises on average twice as long and cost twice as much as anticipated. Business leaders’ expectations for revenue growth are unlikely to be realized from digital optimization strategies, due to the cost of technology modernization and the unanticipated costs of simplifying operational interdependencies. Such operational complexity also impedes the pace of change along with the degree of innovation and adaptability required to operate as a digital business.

Augmented Reality
Virtual Reality



What is Augmented Reality?

Augmented reality is the result of using technology to superimpose information (such as sounds, images, text, video, 3D Objects,…) on the world we see from mobile, tablets or other equipments.

(Source: OPATEL Training Workshop, COE for e-Learning in Medical Education, Erasmus, 2018)

What is Virtual Reality?

Virtual reality is an interactive computer-generated experience taking place within a simulated environment.

A person using virtual reality equipment is able to "look around" the artificial world, move around in it, and interact with virtual features or items. The effect is commonly created by VR headsets consisting of a head-mounted display with a small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens.

(Source: OPATEL Training Workshop, COE for e-Learning in Medical Education, Erasmus, 2018)

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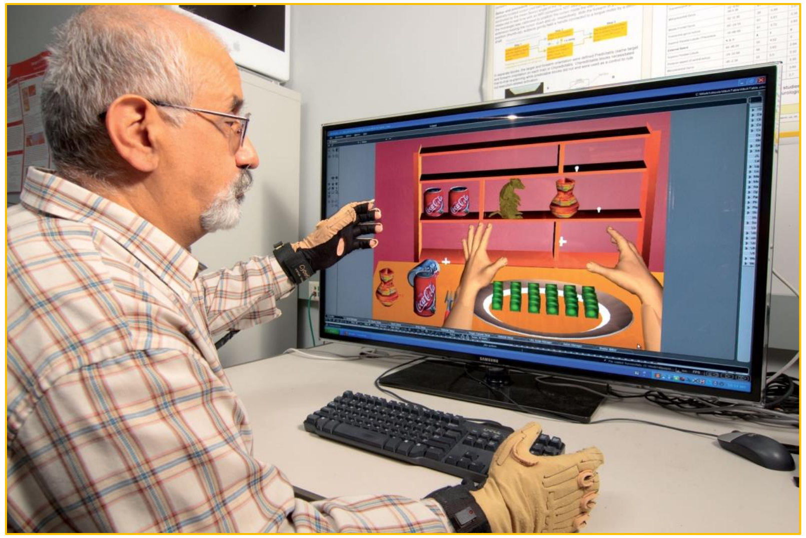
Usage of AR & VR in Health Care

(Source: OPATEL Training Workshop, COE for e-Learning in Medical Education, Erasmus, 2018)

Occupational Therapy



Ways AR/VR is Digitally Transforming Retail Customer Experience in 2019

- Interact and Inform
- Infuse Personalization
- Immersive Experiences

(Source:https://www.martechadvisor.com/articles/interactive-marketing/ar-digital-transformation-retail-customer-experience/)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IoT concept, trend and verticals related to smart islands

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Outline:

- **Internet of Things Definition**
- **Internet of Things Trend**
- **Internet of Things Market**
- **Internet of Things Elements**
- **Internet of Things Verticals**

History of the Internet of Things

- Early ideas about connecting devices to the Internet to control them: 1980’s: a toaster, a coffee machine, a Coke machine at MIT, ...
- Early terminology: pervasive computing, ubiquitous computing, embedded internet, wireless sensor networks, …
- Kevin Ashton in 1999 invented the term, when preparing a presentation for Procter&Gamble. He wanted to push forward the RFID technology and needed a good, new term.
- The term was not popular until 2010 and boomed in 2014.

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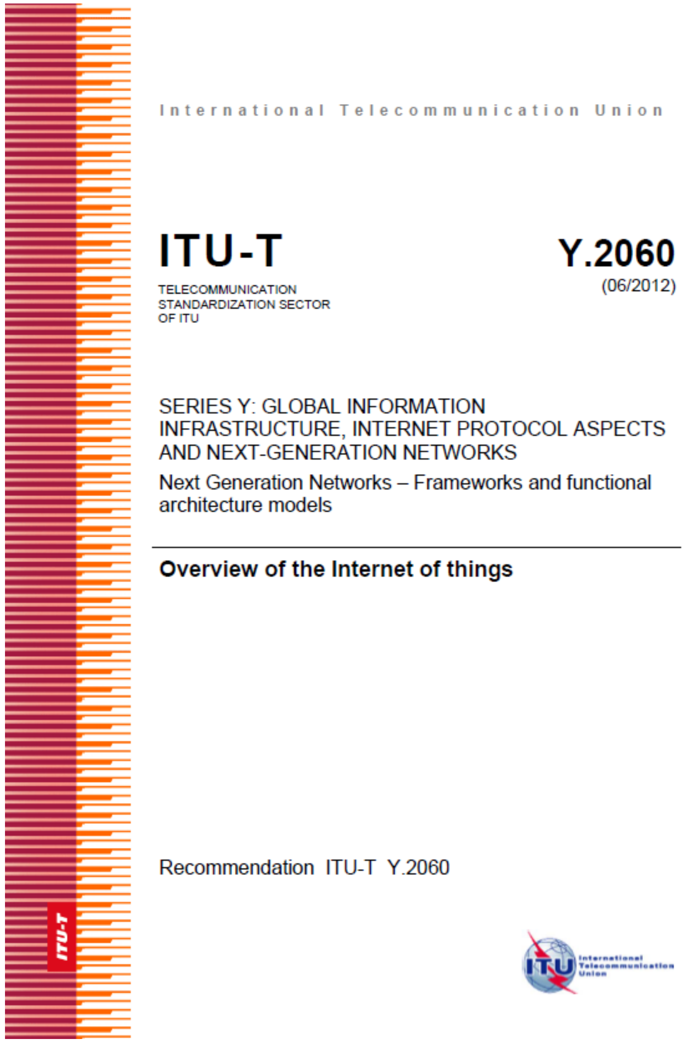
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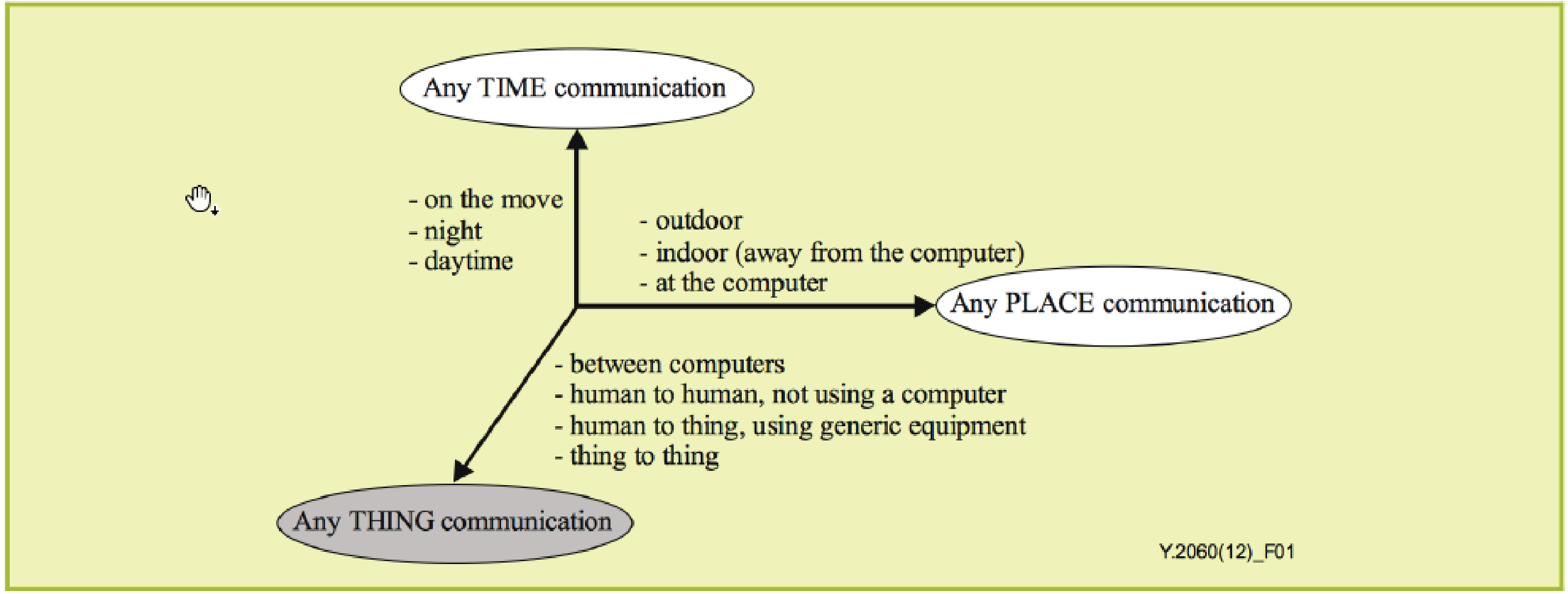
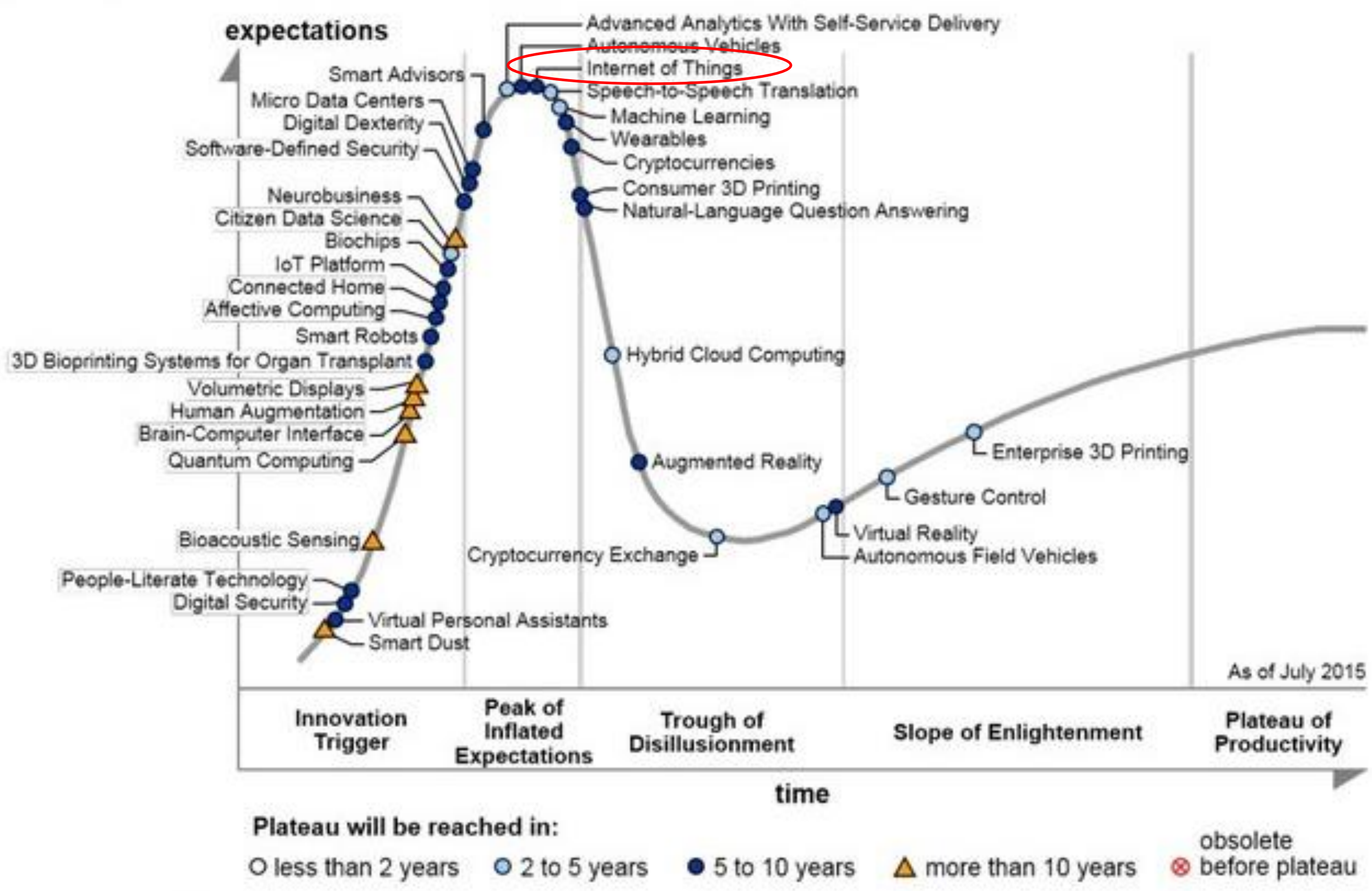
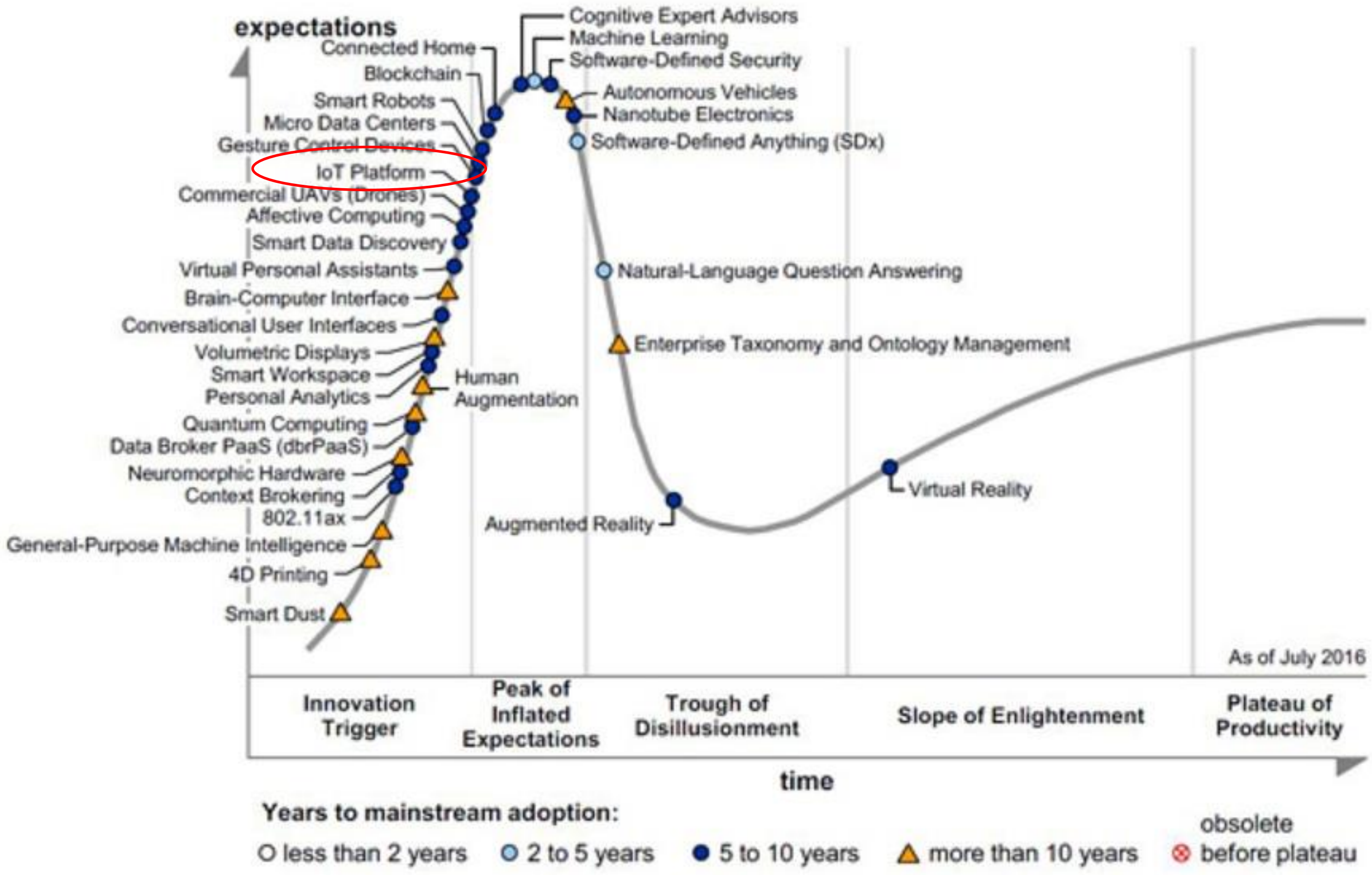


Source: Recommendation **ITU-T Y.2060**

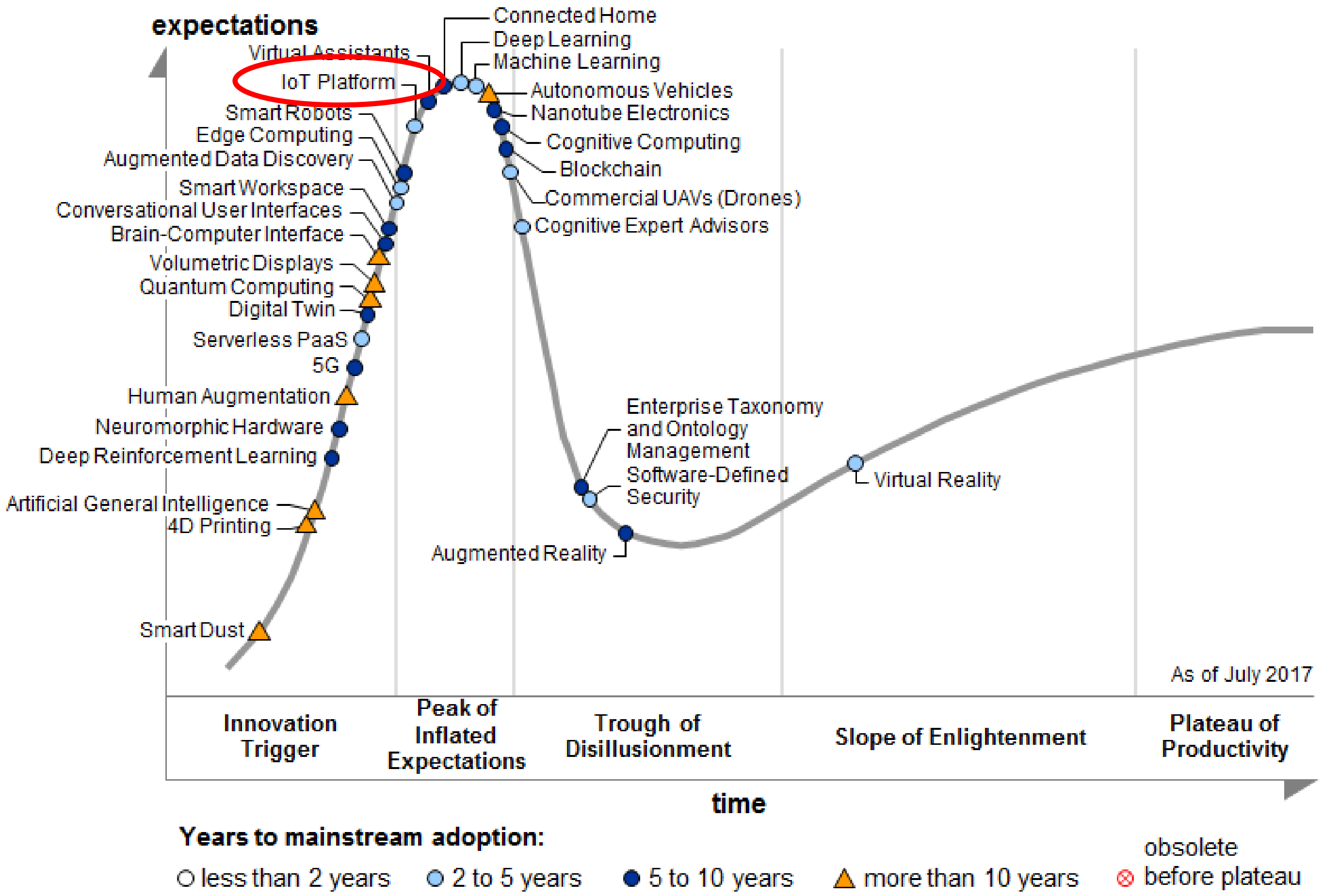
Hype Cycle for Emerging Technologies, Gartner - 2015



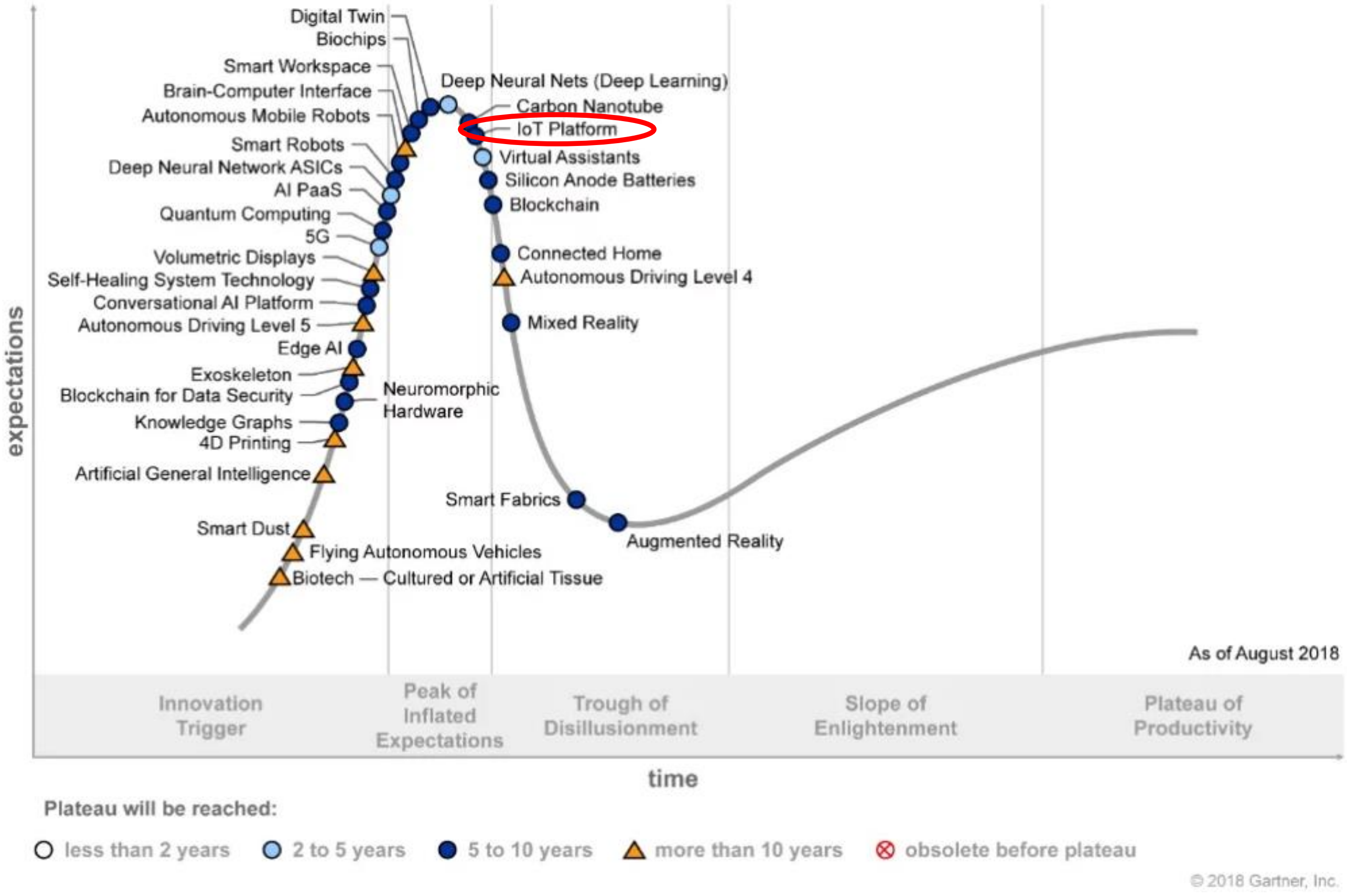
Hype Cycle for Emerging Technologies, Gartner - 2016



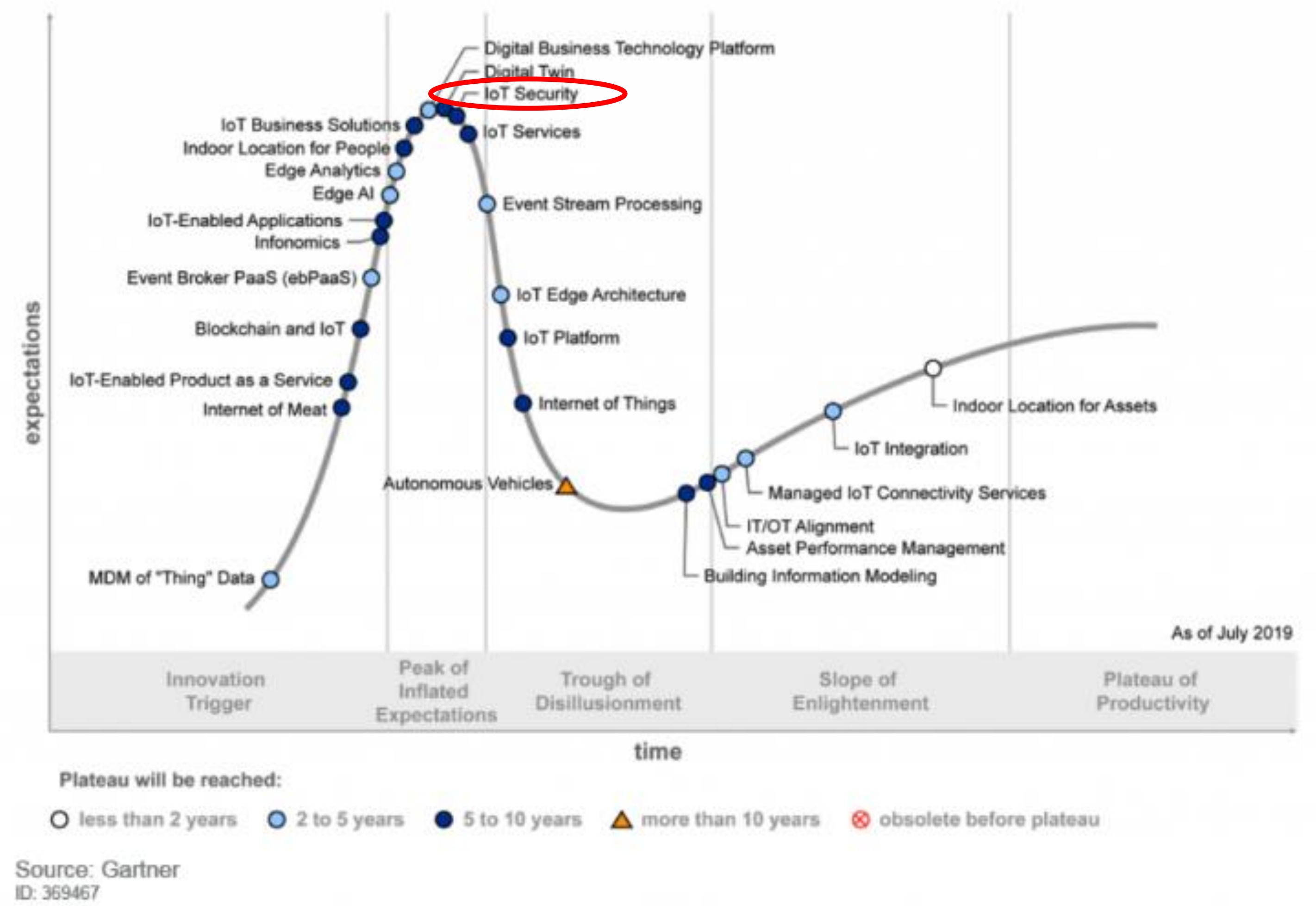
Hype Cycle for Emerging Technologies, Gartner - 2017



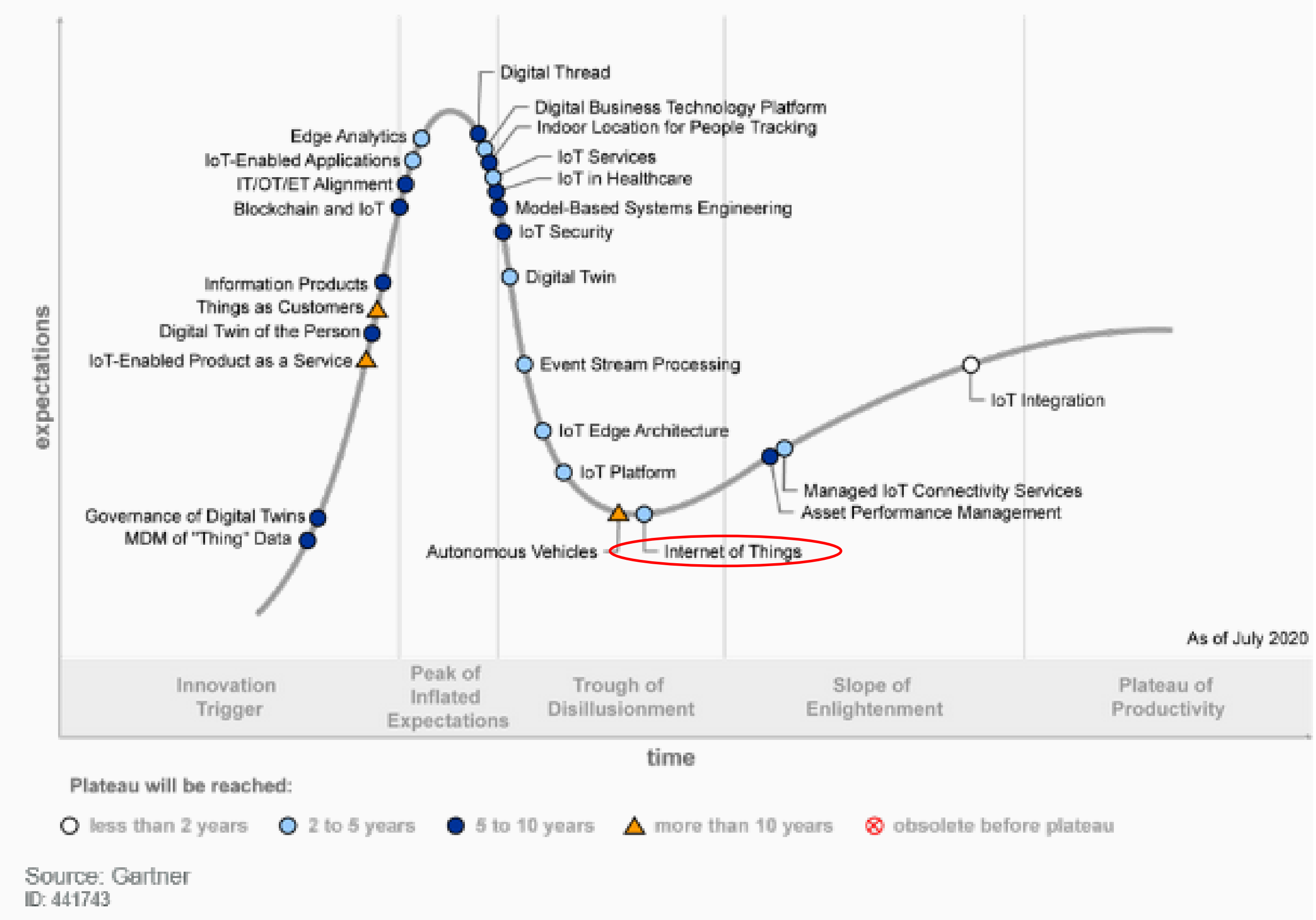
Hype Cycle for Emerging Technologies, Gartner - 2018



Hype Cycle for Emerging Technologies, Gartner - 2019



Hype Cycle for the Internet of Things, 2020



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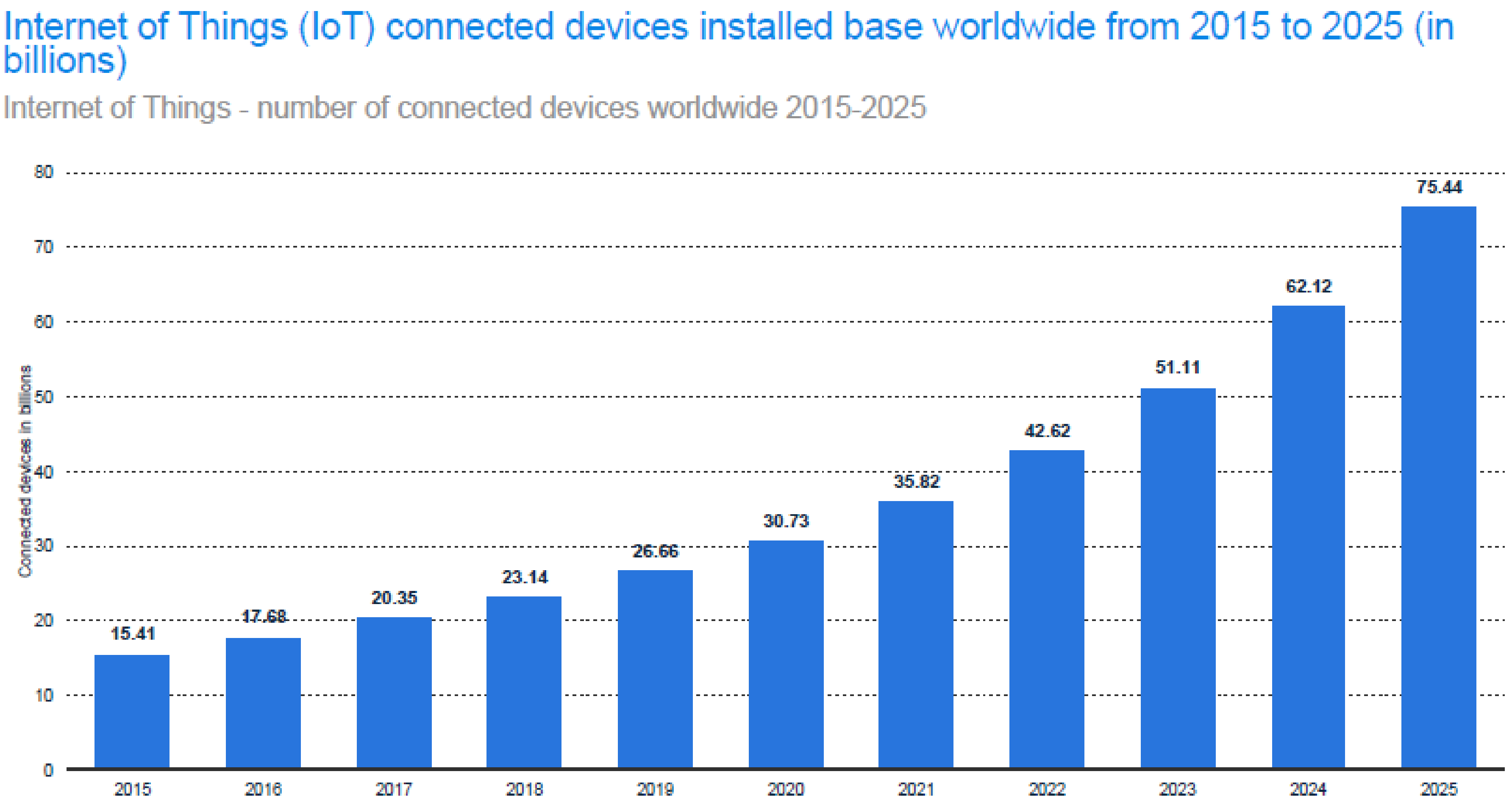
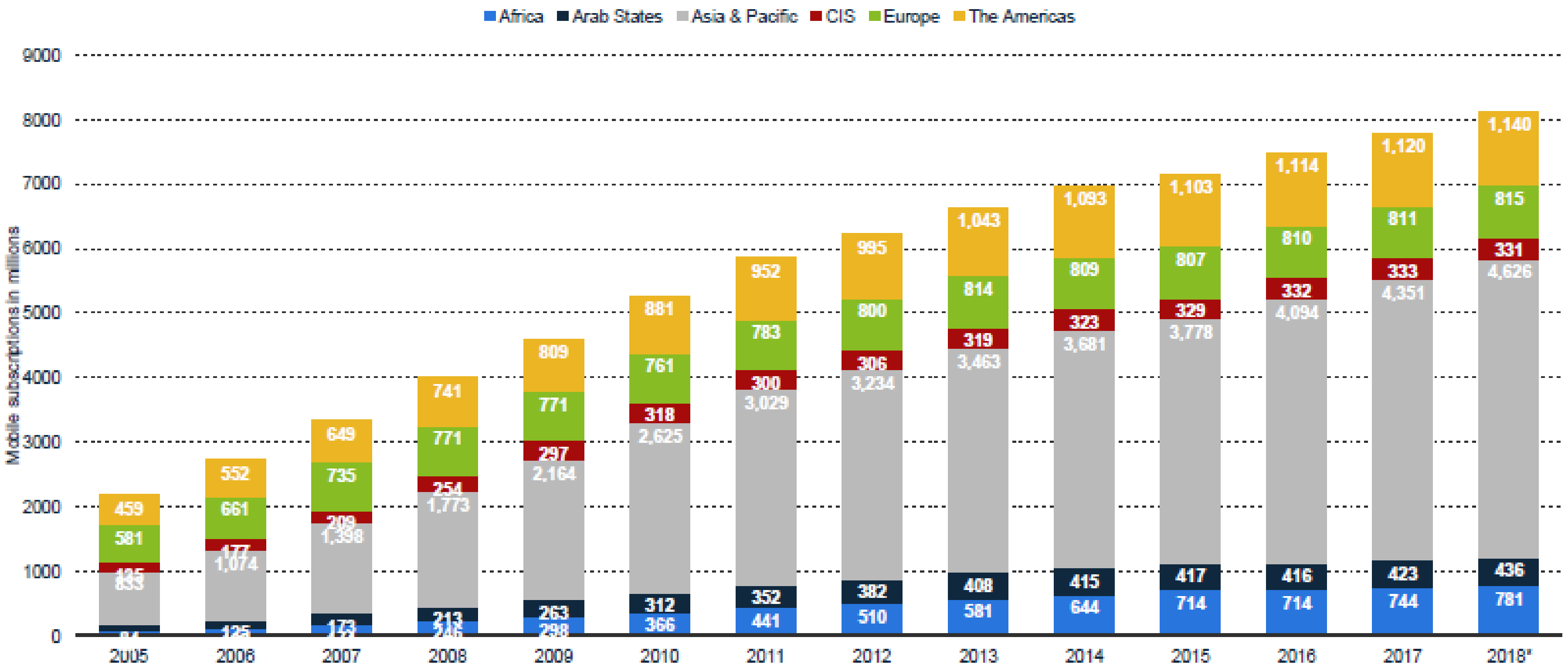
Internet of Things Trend



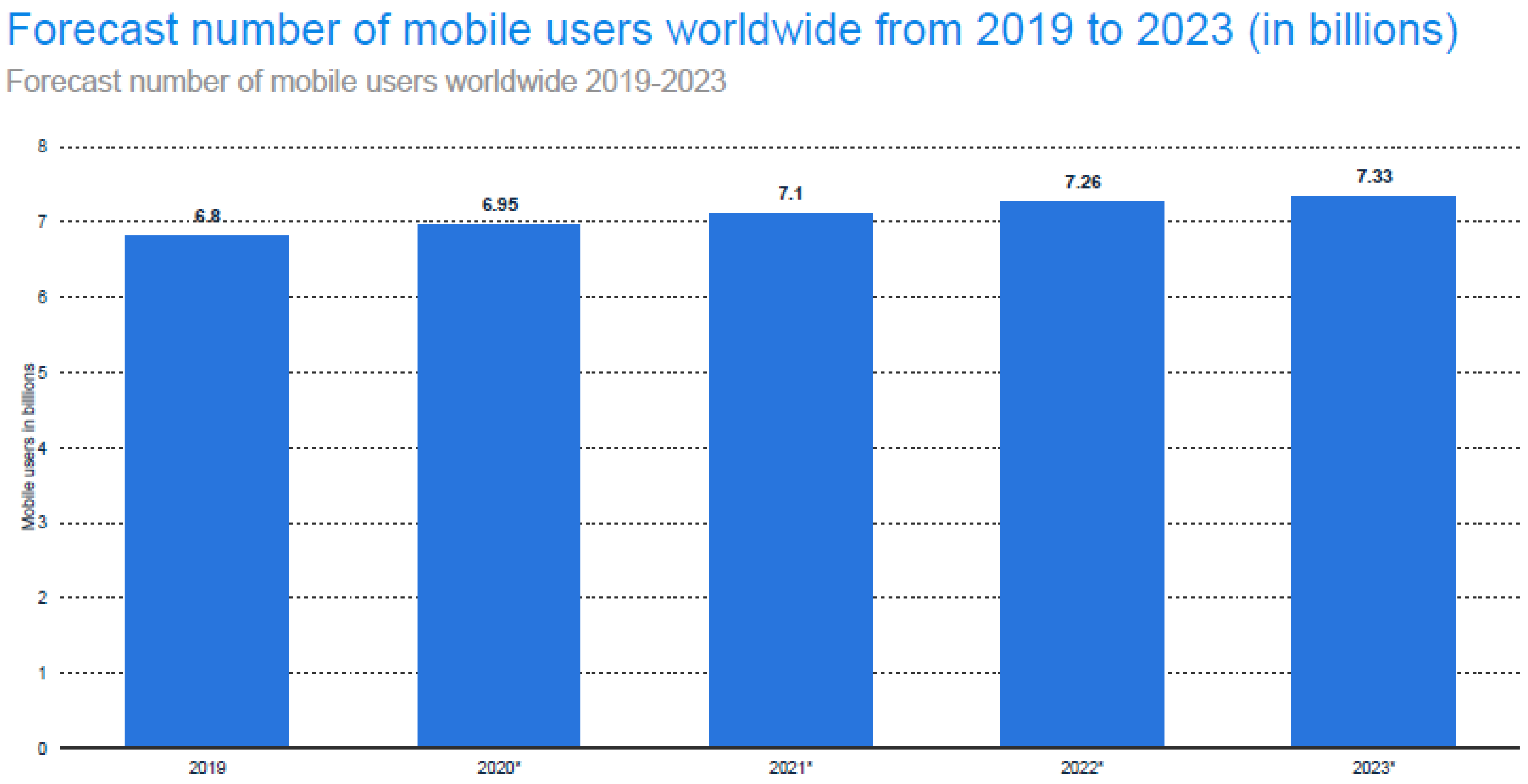
Internet of Things Trend

Number of mobile (cellular) subscriptions worldwide by region from 2005 to 2018 (in millions)

Number of mobile subscriptions worldwide by region 2005-2018



Internet of Things Trend



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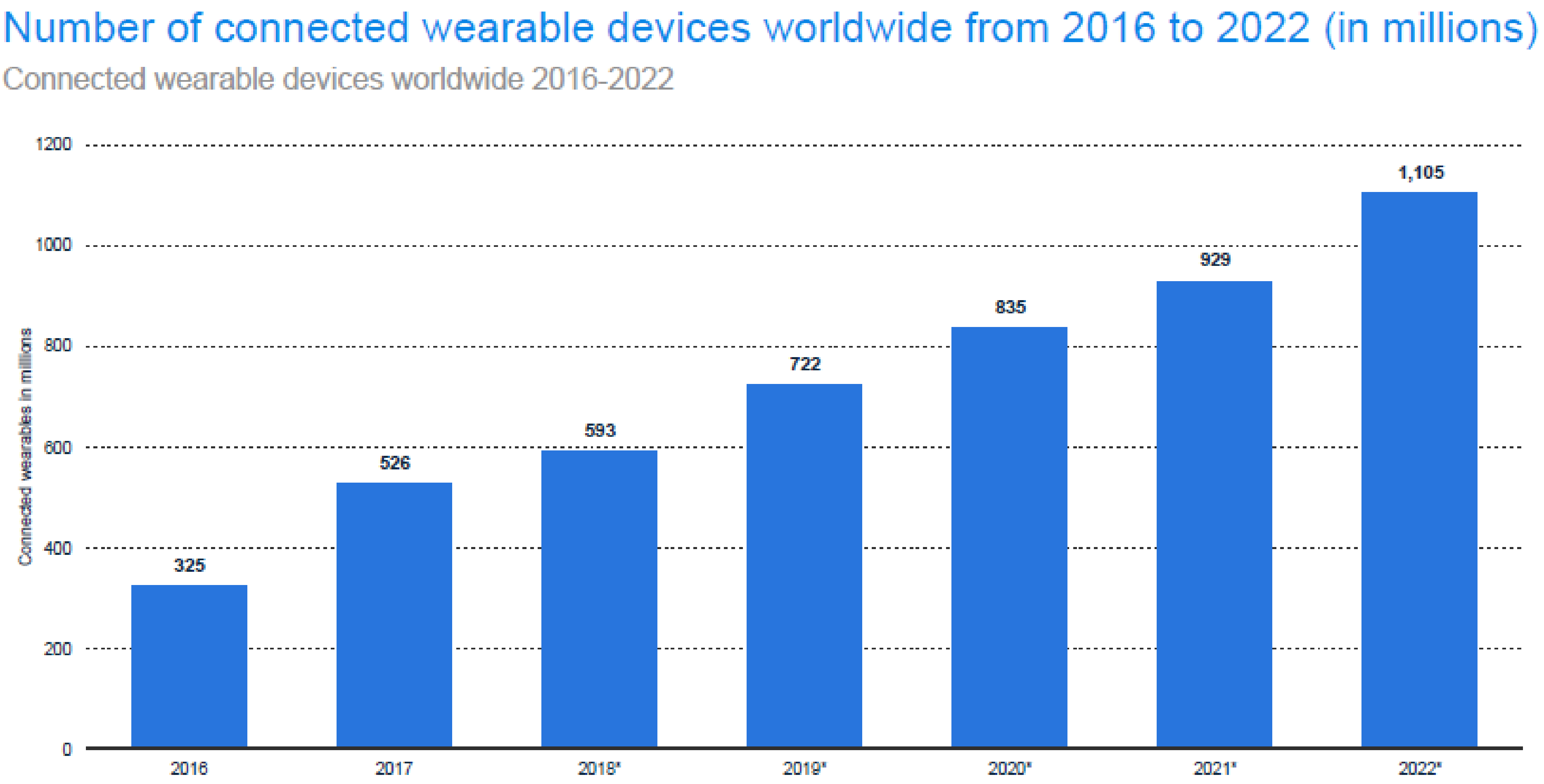

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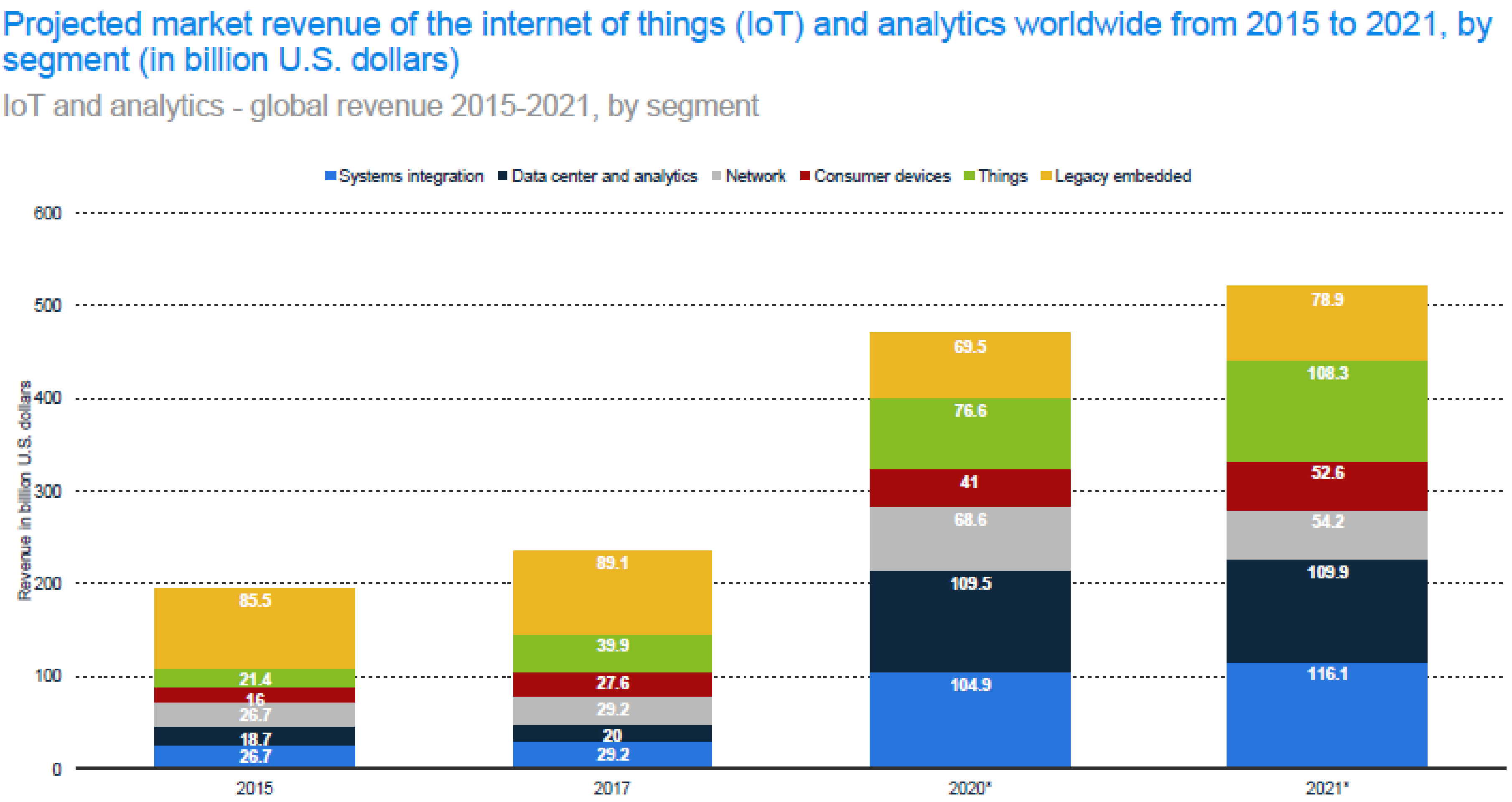

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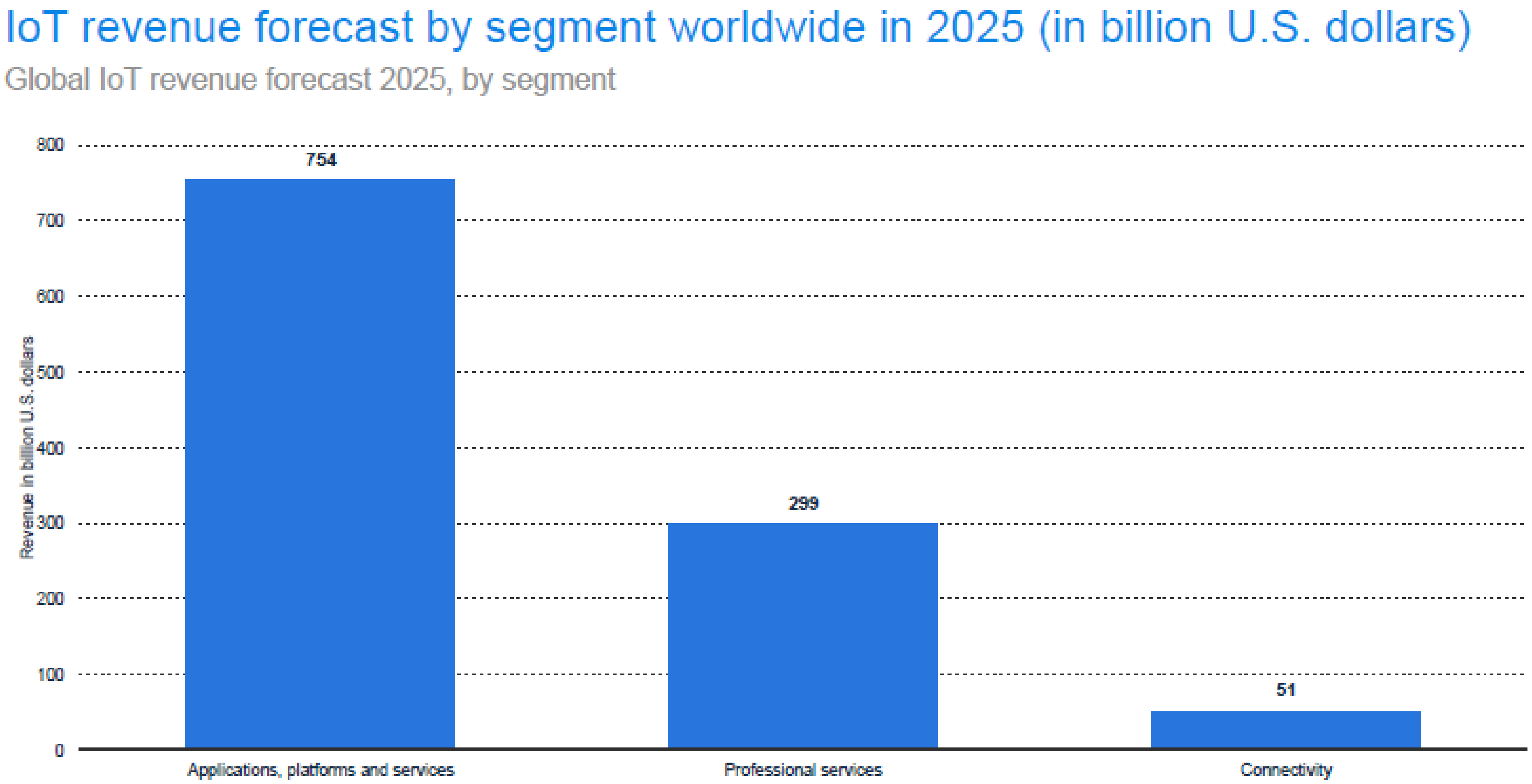
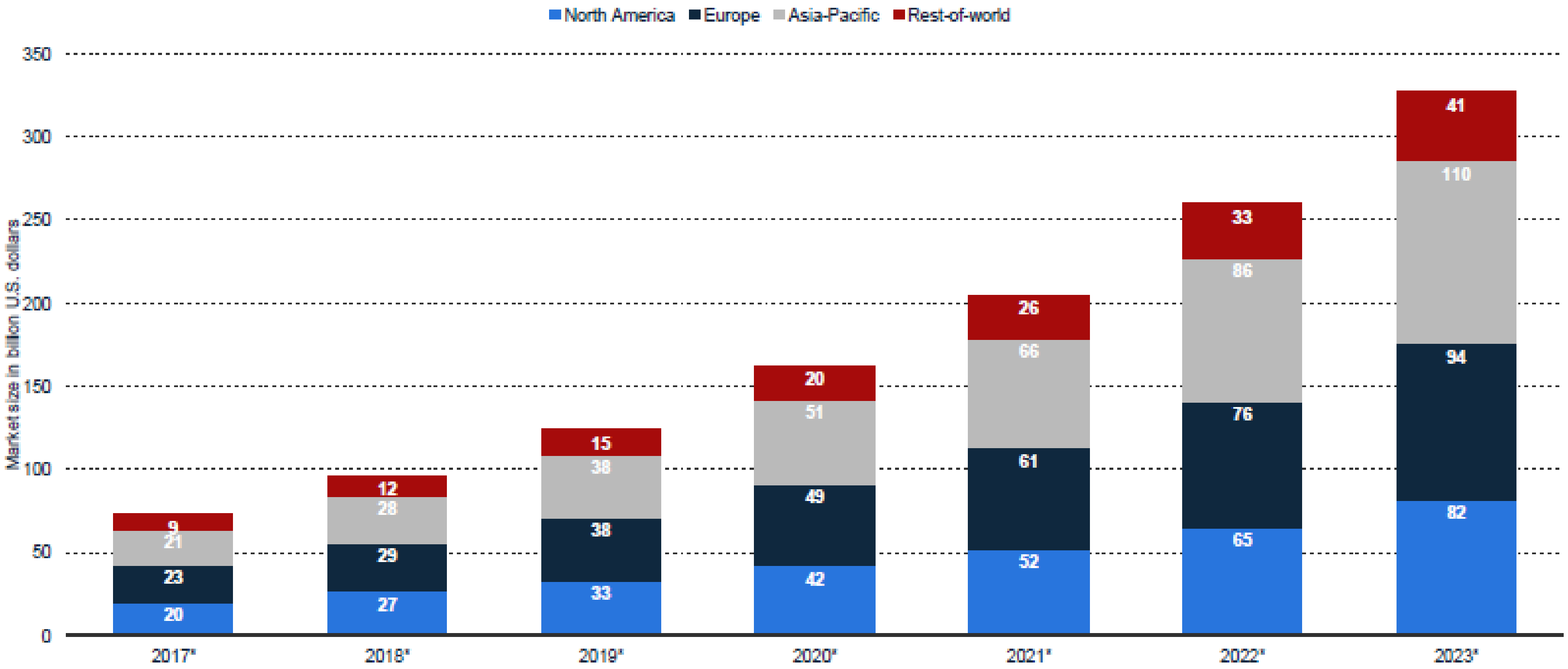


Internet of Things Market

Global smart systems, services and IoT platform market size from 2017 to 2023, by region (in billion U.S. dollars)

Smart systems, services and IoT platform market worldwide by region 2017-2023



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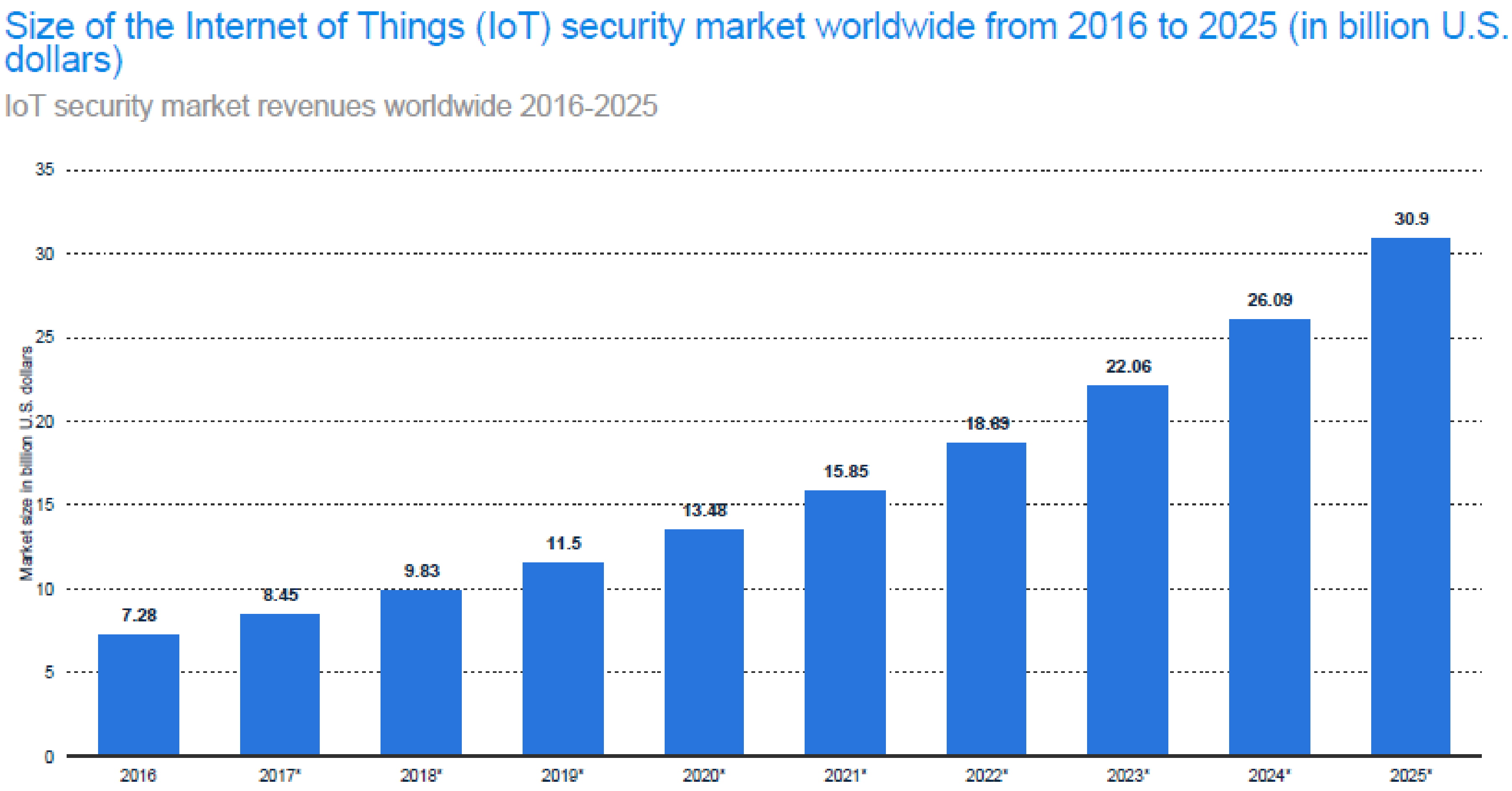
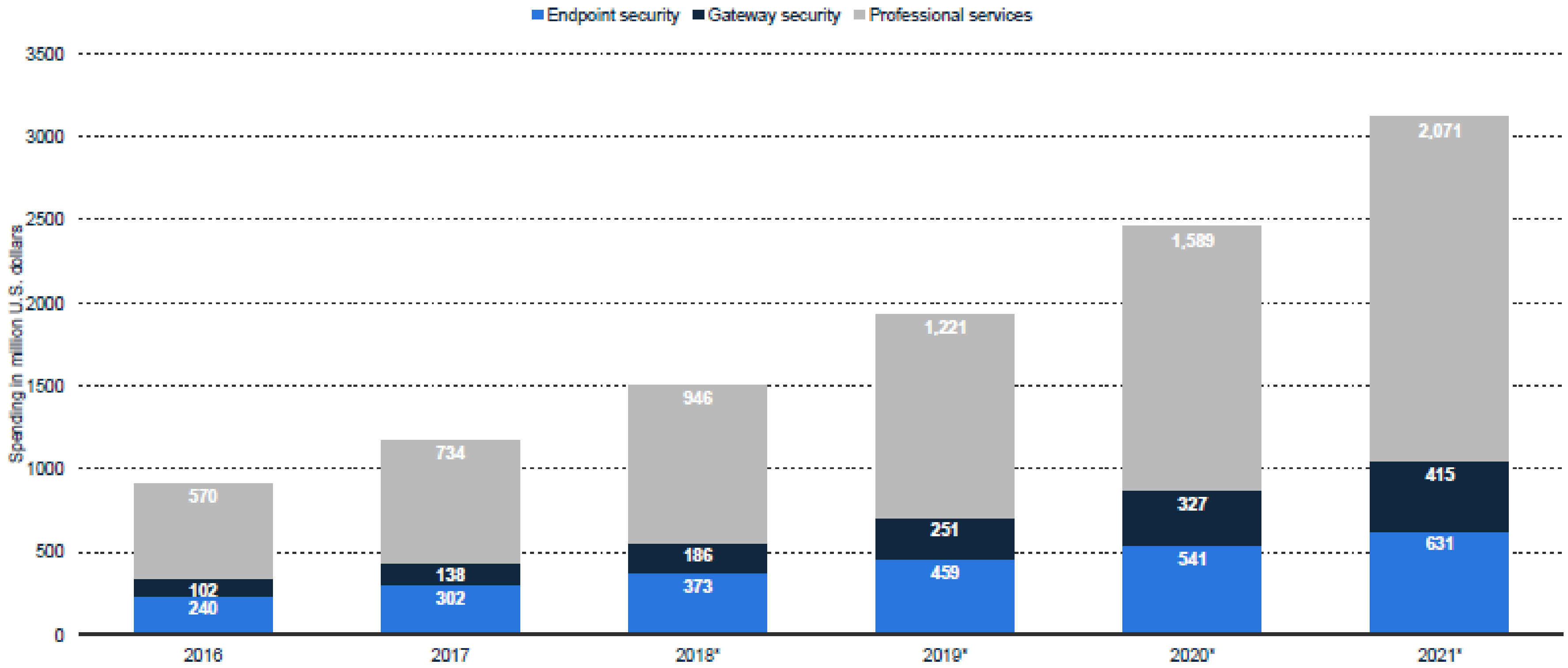


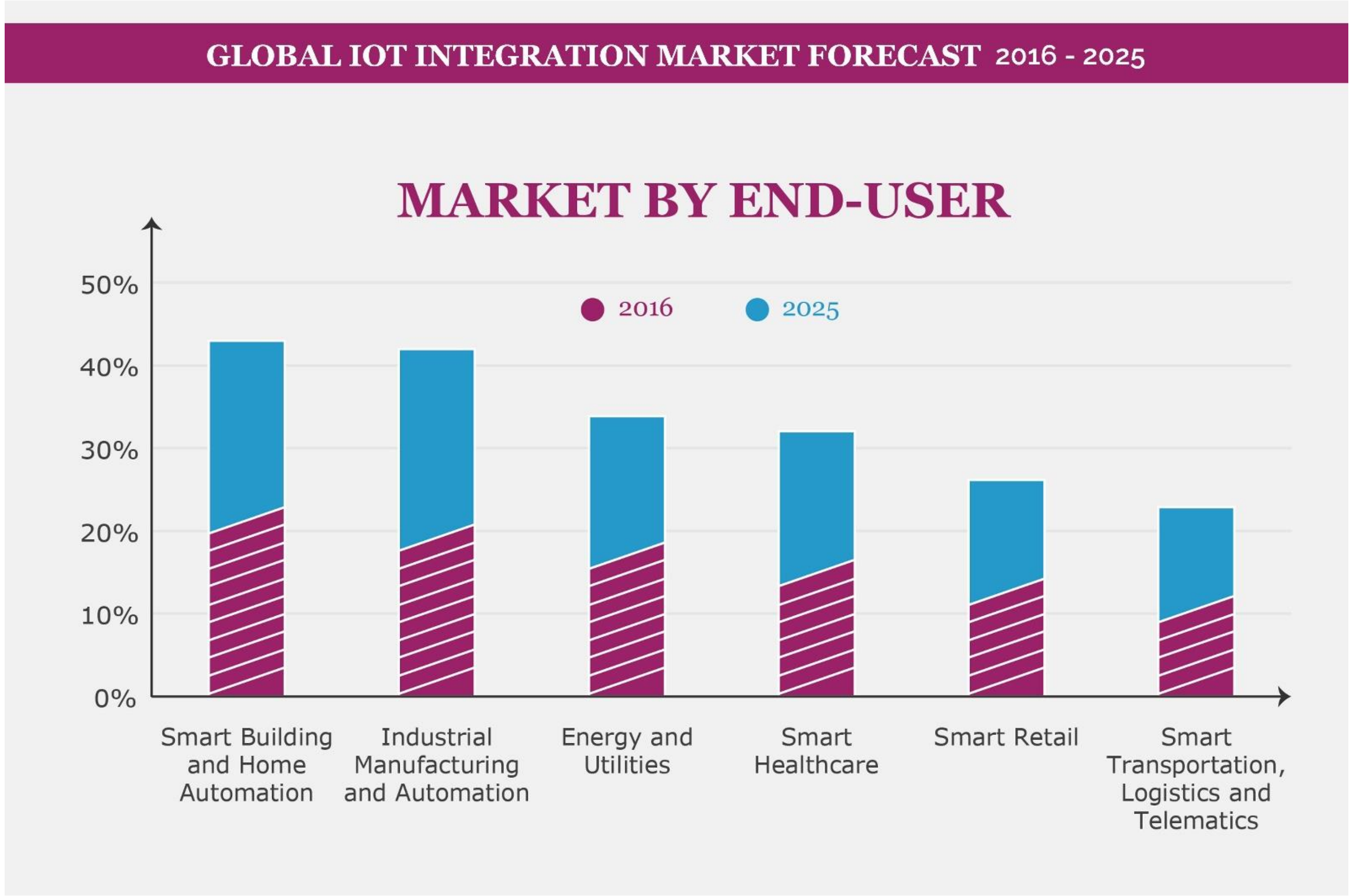
Internet of Things Market

Internet of Things security spending worldwide from 2016 to 2021, by segment (in million U.S. dollars)

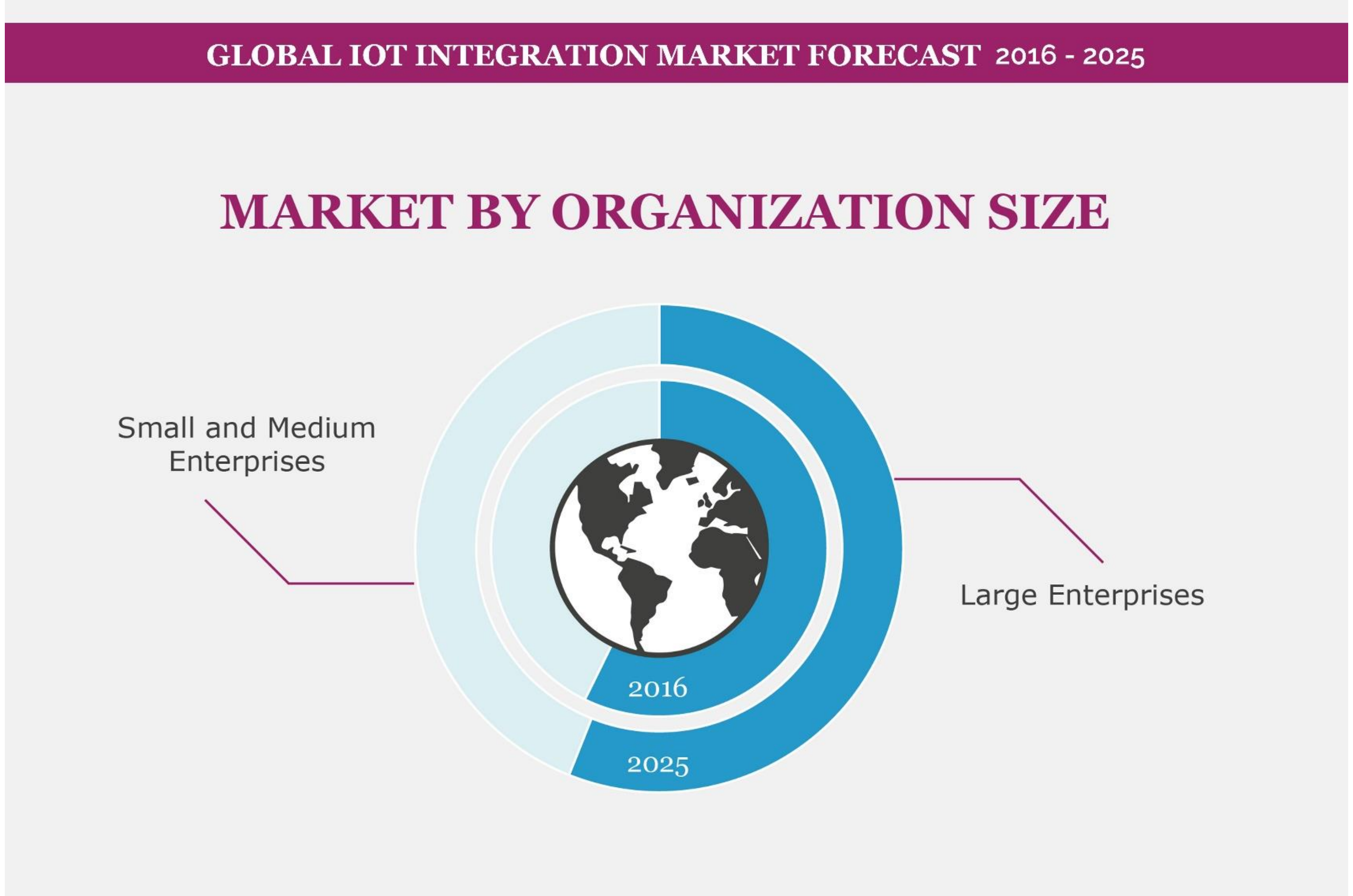
Global Internet of Things security spending 2016-2021, by segment



Internet of Things Market



Internet of Things Market



Outline:

- Internet of Things Definition
- Internet of Things Trend
- Internet of Things Market
- Internet of Things Elements
- Internet of Things Verticals

IoT Elements

Identification | Sensing | Communication | Computation | Services | Semantics

Identification and Addressing

Identification	Sensing	Communication	Computation	Services	Semantics

- Crucial to find and name services in the IoT
- Differentiate between object ID and its address
- Identifiers are not unique (e.g. temperature or humidity sensor)
- Addresses are unique, standards used include IPv4/IPv6

Sensing

Identification	Sensing	Communication	Computation	Services	Semantics

- Hardware and Software needed to sense phenomena
- Popular integrated platforms: WeMo, Nest, SmartThings, etc.
- Popular development platforms: Arduino, RapsberryPi, BeagleBoard, Android, iOS, etc.

Communication

Identification	Sensing	Communication	Computation	Services	Semantics

- Bring the data from the sensing/actuating hardware to the data cloud/user RFID, NFC, UWB, ZigBee, Bluetooth, WiFi, Z-Wave, WiFiDirect, LTE-A, IEEE802.15.4 and many more

Computation

Identification	Sensing	Communication	Computation	Services	Semantics

- Hardware: like sensing
- Software: operating systems
  Android, Arduino, Contiki, TinyOS, RiotOS, LiteOS, ...
- Software: clouds
  Nimbits, Hadoop, …

Services

Identification	Sensing	Communication	Computation	Services	Semantics

- Identity related services (who belongs to the system)
- Information aggregation services (process and summarize raw data – e.g. smart grids)
- Collaborative-aware services (on top of information aggregation, make decisions)
- Ubiquitous services (on top of collaborative-aware, provide services everywhere, any time to anyone)

Semantics

Identification | Sensing | Communication | Computation | Services | Semantics

- Describe data, services and items in a generalized way
- Example: all temperature data is tagged with “temp” and given in Celsius.
  - Counter-example: some call is “temp”, some call it “tmp” and others call it “heat”. Some give it in Celsius, others in Fahrenheit.

Outline:

- Internet of Things Definition
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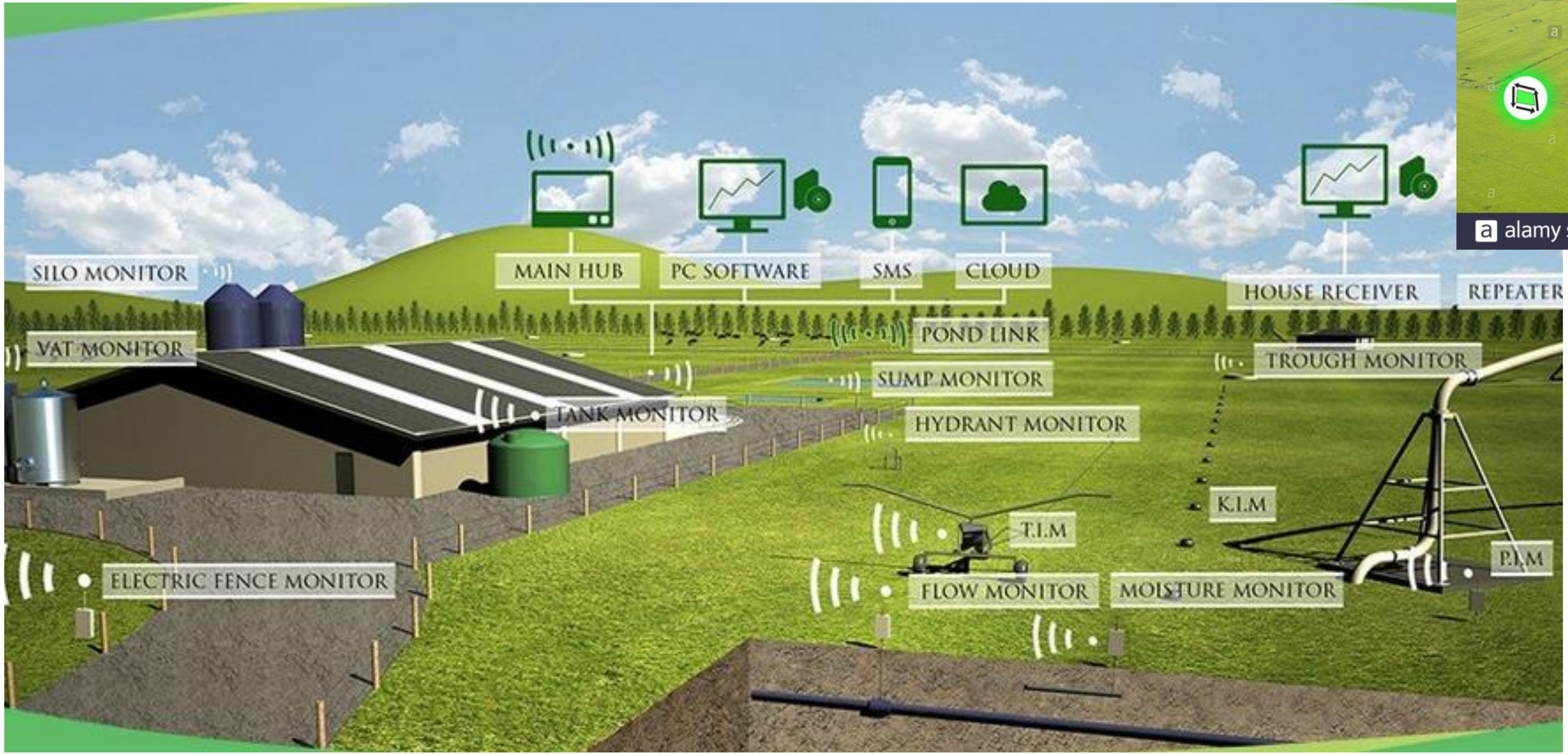
Internet of Things Market – Smart Agriculture



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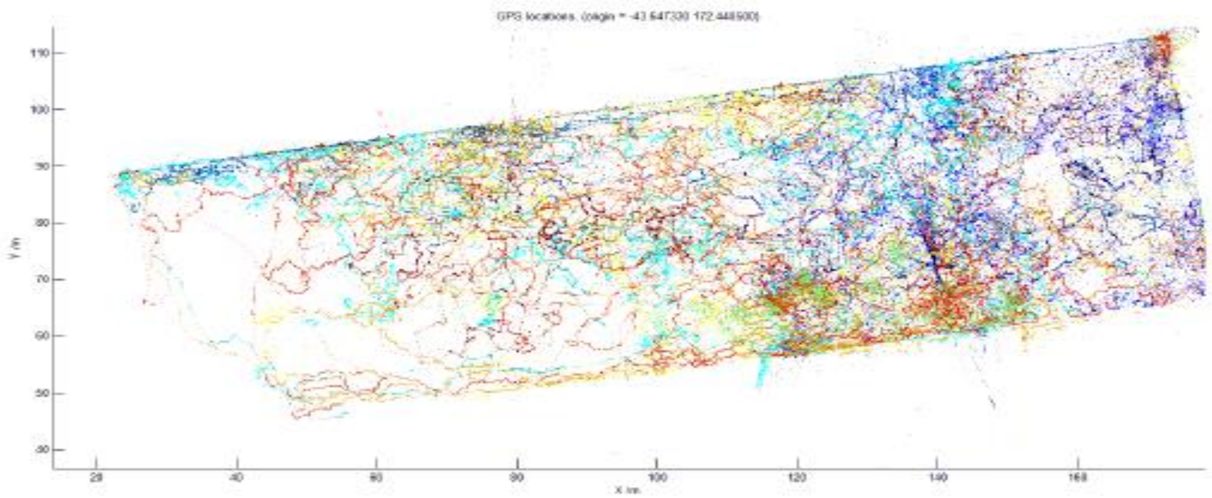
To watch the video of this slide, refer to the video presentation.

Internet of Things Market –Internet of Animals

Internet of Things Market –Internet of Animals

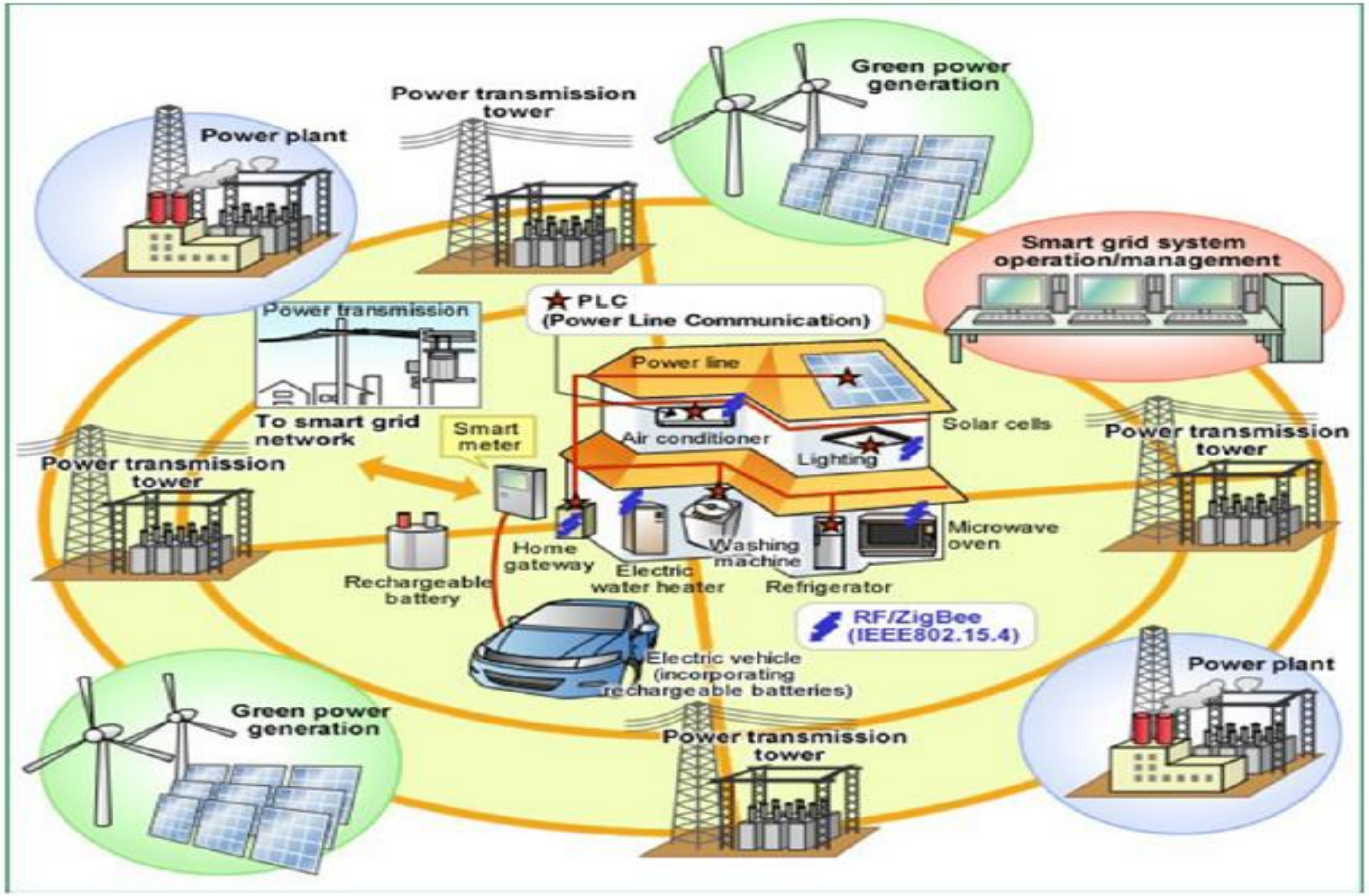


Internet of Things Market –Smart Livestock

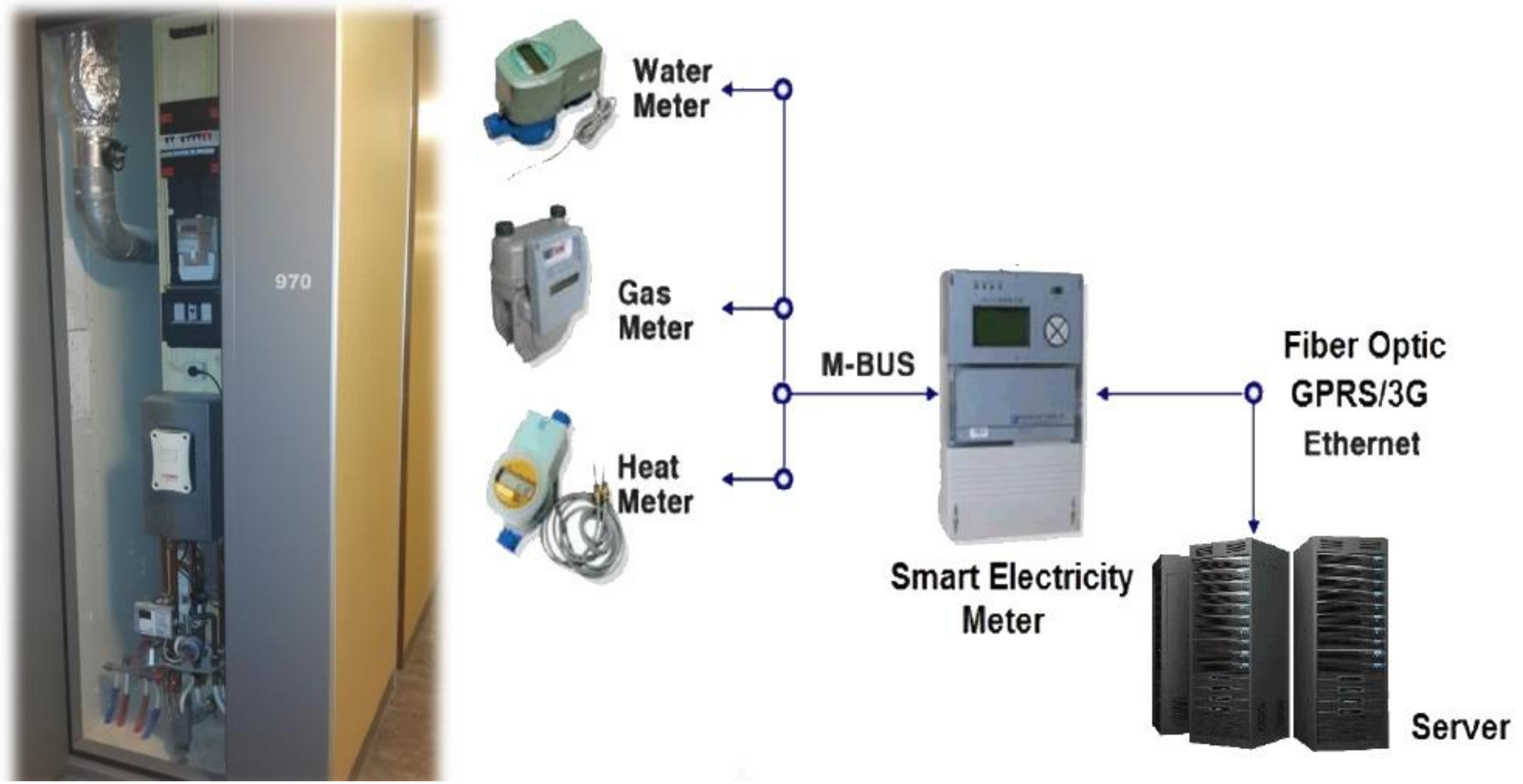
- Animal care, monitoring of body temperature, monitoring of activity and their health are some of the applications of the Internet of Things in Livestock farming.

To watch the video of this slide, refer to the video presentation.

Internet of Things Market –Smart Grid



Internet of Things Market –Smart Metering

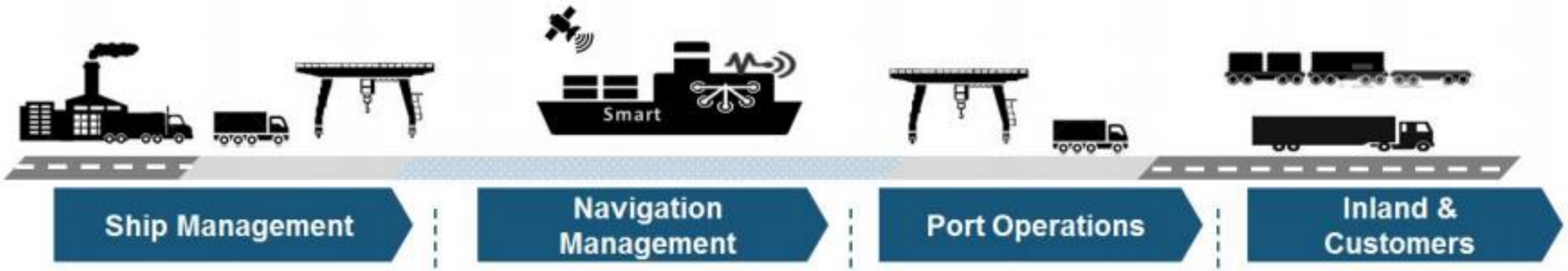


Internet of Things Market –Water Resource Management

- Up to 25% water savings on farms with the introduction of Internet of Things into the agricultural industry

To watch the video of this slide, refer to the video presentation.

Internet of Things Market –Smart Shipping



Internet of Things Market –Smart Mine

Internet of Things Market –Smart Mine

To watch the video of this slide, refer to the video presentation.


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
dziękuje
bedankt
спасибо
Баярлалаа
рахмат
sukriya
kop khun krap
go raibh maith agat
mochchakkeram
tapadh leat
grazie
arigatô
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dank je
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IoT Academy

Digital Transformation: Enhancing IoT-driven Solutions for Smart Islands

Smart islands infrastructure framework and KPIs

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- Active member of WSIS since the inception
- MEDICI delegate at UNESCO IFAP
- OCCAM Delegate at Vienna UN international Centre (1996-2001), UN Geneva (2002-2016)
- Expert / Advisor in e-Services
- Member BoD Global Forum, World Summit Award, European New Society Association, Sacred World foundation, FINC
- Member of Keio University NoE
- Appointed as Expert by; European Commission, Council of Europe, Italian Association of banks, National Research Council.
- Organize or program chair in W3C, ACM, IEEE events
- Author/contributor of more than 400 papers and various books: e-Culture, IPR, e-Government, e-Health, e-Learning, e-Citizens, e-Services, and e-Democracy. International projects coordinator.

Smart Islands

It all started with an island network

The Scottish Islands Federation started as a local authority funded network in 2000. Its mission was to assist island organisations to express their points of views, share their experiences and make better representations at local, regional, national and European level on all issues affecting the sustainability of Scottish islands.

Getting together with other island organisations in the EU

In May 2001, the **European Small Islands Network** – ESIN – was set up to bring together Danish, Finnish, French, Irish, Scottish and Swedish small islands. In 2005, ESIN formalised the network and became a Federation.

ESIN now has 11 members, with Estonia, Greece, Italy, Croatia and the Aaland islands joining in. Once a year, members get together for the ESIN AGM, alternating between Brussels and an island host. ESIN is now working closely with other representative organisations: the CPMR's Island Commission and FEDARENE's Island College.

Recognizing islands’ specific situation

The islands worked together to get their national and local governments take into account Article 174 of the Lisbon Treaty in their policy making; Article 174 acknowledges the islands ‘ permanent geographical constraints and asks for specific measures to mitigate these.

ESIN’s INTERREG 111C funded project – ‘Meeting the Challenges of Small Islands’ – aimed to make decision makers understand the smaller islands challenges. Many Scottish Islanders and island organisations took part in this exchange, which looked at a wide variety of themes pertinent to island life, enabling islanders from 6 European countries to share their experiences of sustainable development.

Concluding with a final conference on Islay in November 2006, the exchange results were disseminated to help influence national and EU policies in favour of small islands. You can read the project report here.

Turning challenges into opportunities

The exchanges showed how the islands' geographical isolation can also lead to opportunities:

- They come up with innovative solutions and community-led initiatives to ensure their island remain vibrant and strong.
- They are especially suited to the demonstration of sustainable and integrated solutions, especially regarding waste, the environment, energy, transport, baseline services and cultural products.
- They act as guardians of their natural and cultural environment, preserving the common heritage of their country as well as Europe.

To take advantage of these opportunities, islands need to develop in a way that allows their population to remain sustainable, enabling islanders to live and work on their island as well as attracting new residents.

The first SMART ISLAND Forum – Athens June 2016

The first Smart Islands Forum was hosted in Athens on 21 and 22 June at the initiative of the DAFNI Network of Sustainable Aegean and Ionian Islands and the Aegean Energy Agency.

The Forum gathered representatives of island local and regional authorities and actors from 13 countries, namely Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Italy, Malta, Spain, Sweden, the Netherlands and the UK. The UK was represented by Ian Stephen, Leader of the Isle of Wight Council, Camille Dressler from the Scottish Islands Federation and Felix Wight of Community Energy Scotland.

The 42 European island representatives were joined by organizations with an interest in the potential carried by islands including the European Commission, the European Economic and Social Committee, the European Small Islands Federation, the Network of the Insular Chambers of Commerce and Industry of the European Union, the Greek Energy Forum and the German Corporation for International Cooperation (GIZ). The Islands Commission of the Conference of Peripheral Maritime Regions also addressed the Forum

The Smart Islands Initiative - 1

The Smart Islands Initiative, inspired by the Smart Cities and Communities initiative, represents an excellent opportunity for island authorities to devise a place-based, transformative development agenda that taps into islands' competitive advantages, generates local growth and prosperity, and helps the EU meet the goals it has set in a number of policy areas, including climate change mitigation and adaptation, innovation, circular economy, sustainable transport and mobility.

During the Forum island representatives engaged in a collective process of drafting the Smart Islands Declaration, which outlines the aspirations on the role, challenges and potential of islands to become models of a smart, sustainable and inclusive development paradigm.

The Smart Islands Initiative 2

In the coming months Forum participants agreed to have Quadruple Helix actors (Local Authorities and local actors as well as Academic institutions as well as businesses) from respective islands endorse the Declaration in order to ensure all existing synergies are exploited through broad stakeholder engagement.

Last but not least participants discussed the possibility to set up a platform of EU island authorities and actors in Brussels that will advocate in favour of island affairs and facilitate partnerships for the realization of EU projects on islands. The platform was also well perceived as a structure to support the Pact of Islands Secretariat in strong collaboration with the Covenant of Mayors for Climate and Energy.

2nd Smart Islands Forum – Athens - 14 September 2018

22 representatives from 13 European countries with islands that are members to the Smart Islands Initiative met in Athens, Greece on 14 September 2018 to discuss how recent EU policy developments concerning islands can serve them best, in light of the on-going debate around the Union's post-2020 political priorities.

The Smart Initiative is a bottom-up effort of European island authorities and communities. It builds on years of collaboration between European islands and seeks to convey the significant potential of islands to function as laboratories for technological, social, environmental, economic and political innovation.

The Network of Sustainable Greek Islands – DAFNI, with 44 island local and regional authorities from Greece as members, currently coordinates the Smart Islands Initiative.

Why Islands

Islands worldwide step up action to fight climate change, since they are amongst the first to experience the devastating impacts this has on local ecosystems and livelihoods. Meanwhile, insularity implies energy dependency on fossil fuels, high transportation costs, limited economic diversification and access to markets, collectively labelled as island handicaps; yet , there is growing evidence that with the use of cutting-edge technologies complemented by an enabling regulatory and financial framewrok, islands can reverse this trend, address the challenges they are facing and tap their largely unexploited sustainable development potential.

A New Approach

Islands host locally most of the infrastructures for the management of their resources, while the often-intense seasonal demand for services takes a heavy toll on both infrastructures and resources. In response, the Smart Islands Initiative calls for an integrated approach to the management of natural resources and infrastructures. Drawing inspiration by the Smart Cities concept, the Initiative goes one step further by extending the synergies beyond energy, transport and ICT to also include water and waste, directly addressing circularity in the economy. This new approach suggests that through the deployment of smart, integrated solutions with the use of cutting-edge technologies, islands can transform into smart territories offering higher quality of life to local communities, while helping Europe become a sustainable and inclusive economy.

A New Approach

Island Living Labs

The Smart Islands Initiative portrays islands as ideal test-beds that can host pilot projects and produce knowledge on smart and efficient resource and infrastructure management. This knowledge may be then transferred to mountainous, rural and generally geographically isolated areas but also scaled-up in cities. Adding to this the unique ecosystems, significant social capital and entrepreneurial mindset, islands can embark on local development pathways that optimally combine environmental, social, economic and technological solutions and inspire other insular and mainland areas.

A Collaborative Process

To unlock islands' potential, it is crucial to recognize the role and strengthen the capacities of island authorities. If empowered, these will be in a position to ensure the optimal use of infrastructures and resources, laying the foundation for islands' sustainable growth. Moreover, island authorities should look to join forces with the business community, research and civil society actors to come up with a development agenda that's place-based and help island communities thrive!

Smart Island Declaration

The Smart Islands Declaration is the cornerstone document of the Smart Islands Initiative. It outlines the challenges facing islands as much as the potential these exhibit to usher in a low-carbon, smart, sustainable and inclusive development paradigm.

The Smart Islands Declaration was first drafted by representatives of European islands who attended the 1st Smart Islands Forum in June 2016 in Athens, Greece.

In the Declaration islands make an ambitious call for action and commit to 10 steps through which to become smart, inclusive and thriving societies!

10 ACTION POINTS TOWARDS BECOMING SMART, INCLUSIVE AND THRIVING SOCIETIES

TEN ACTION POINTS

1. Take action to mitigate and adapt to climate change and build resilience at local level
2. Trigger the uptake of smart technologies to ensure the optimal management and use of our resources and infrastructures
3. Move away from fossil fuels by tapping our significant renewables and energy efficiency potential
4. Introduce sustainable island mobility including electric mobility
5. Reduce water scarcity by applying non-conventional and smart water resources management
6. Become zero-waste territories by moving to a circular economy
7. Preserve our distinctive natural and cultural capital
8. Diversify our economies by exploiting the intrinsic characteristics of our islands to create new and innovative jobs locally
9. Strengthen social inclusion, education and citizens' empowerment
10. Encourage the shift towards alternative, yearlong, sustainable and responsible tourism

Energy - 1

We will tap into our significant renewable energy sources including solar, wind, tidal, ocean, wave, and geothermal potential and lead CO_2 emissions reduction efforts to become increasingly energy independent, minimizing fuel imports and subsequent costs and allowing the emergence of new business models favouring decentralized energy production and consumption and the rise of islanders as prosumers.

We will increase the energy efficiency of our building stock (electricity, heating and cooling) and infrastructures (e.g. street lighting, pumping stations), also within protected historic districts, to reduce subsequent CO_2 emissions, through the integration of innovative technologies and practices and the adoption of near zero-cost actions by islanders and visitors, triggering a shift to more responsible energy consumption patterns and more resilient infrastructures overall.

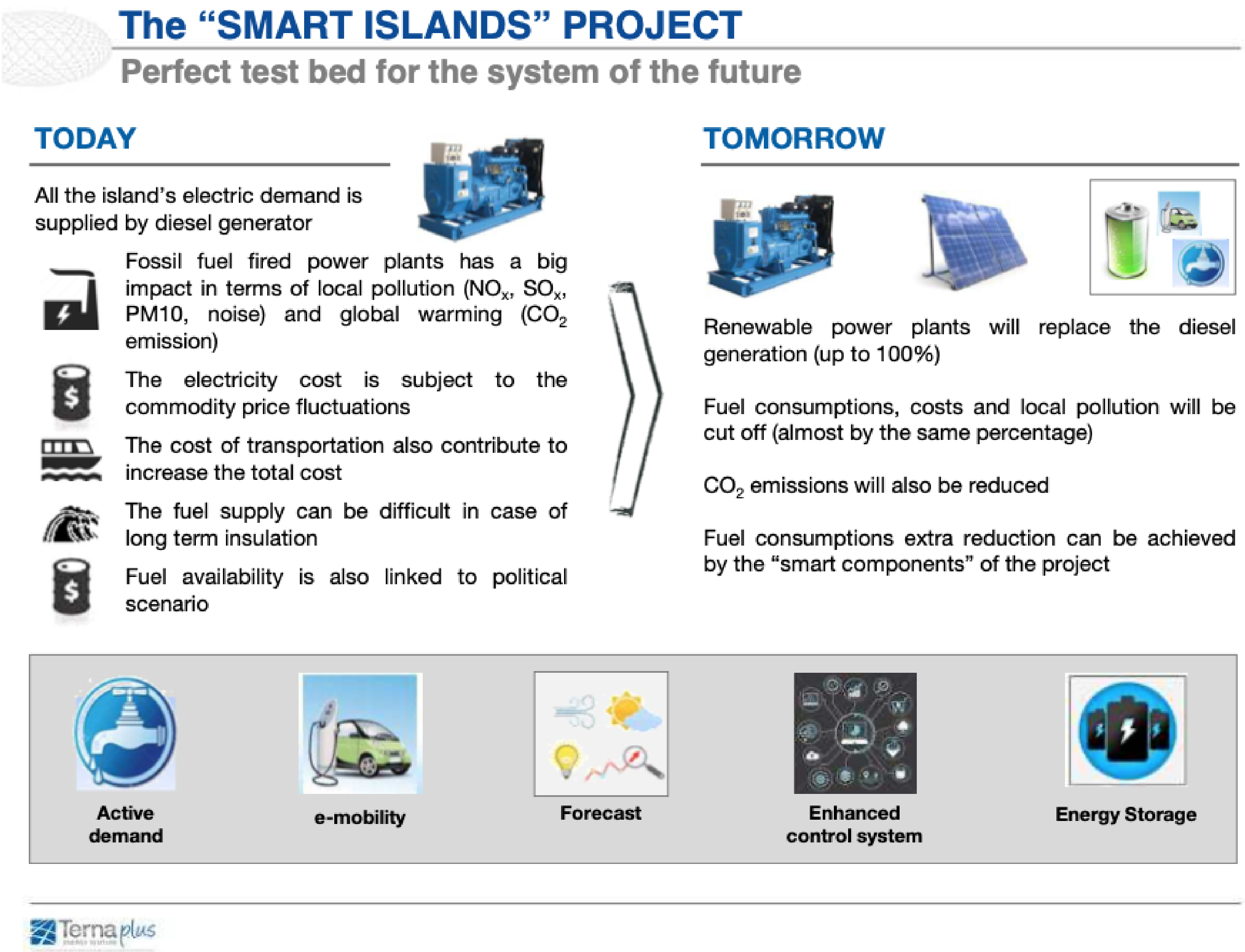
We will prioritize the use of biomass as renewable fuel for heating, cooling and transport and consider energy crops as an alternative to regular crops in islands with significant agricultural production.

Energy - 2

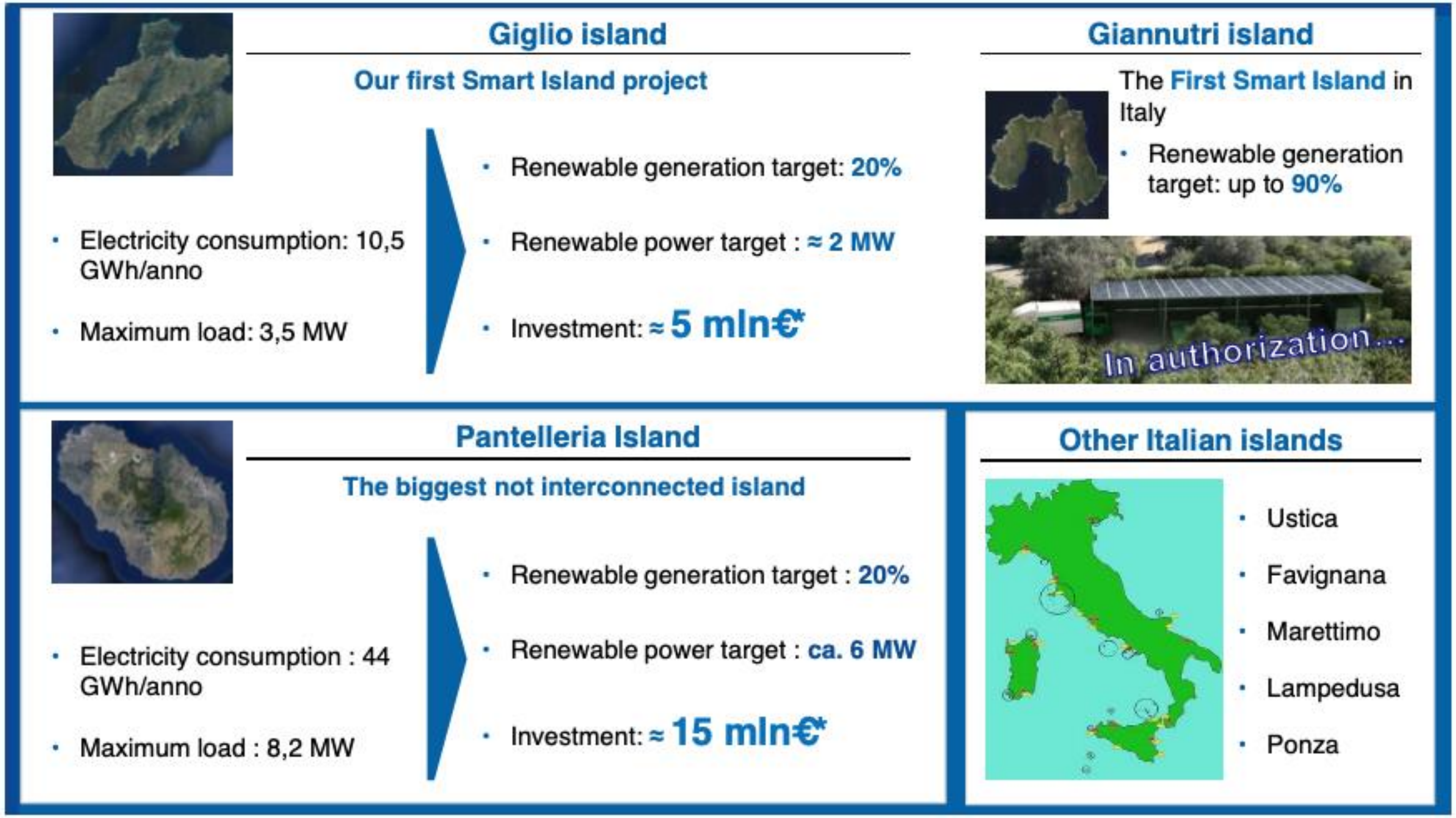
We will promote small islands in particular as test-beds for cutting-edge, sustainable energy technologies, including smart grids, storage and demand-response and by doing so make the operation of electrical grids more flexible, ensure increased penetration of renewables, improve the quality of life of the local population and provide useful insights on how these technologies can be transferred in other islands and geographically isolated territories and scaled up in big cities of continental Europe.

We will exploit existing synergies between sustainable energy and waste, water and transport sectors, underscoring islands' potential to emerge as laboratories for the development of integrated solutions including the production of renewable energy from waste, the use of excess renewable power in shipping and electric vehicles and use of renewable energy for water desalination purposes.

Terna approach - Italy



Terna – smart island energy implementation



Transport - 1

We will change our modal split towards sustainable transport modes including new ways of using the car (car-sharing, car-pooling), promoting walking and cycling (trails restoration, bike-sharing) and optimizing the design of multi-modal hubs and terminals, towards boosting the sustainable growth of key sectors, i.e. yearlong tourism, logistics, commerce, agriculture and fishing.

We will realize existing synergies between transport and energy, by promoting ferries using alternative fuels such as LNG or hydrogen, balancing intermittent power from renewable energy through cold ironing, promoting electro-mobility, integrating electric vehicles and ferries into islands' smart electric grids ensuring increased penetration of renewable energy at local level and minimizing the use of fossil fuels.

Transport - 2

We will introduce island hopping infrastructure in islands close to the mainland or island archipelagos in particular, using small-scale electric vessels and/or vessels fueled by LNG, methane or hydrogen that can also operate on automatic pilot to reduce environmental and transportation costs and bring tangible benefits to island communities and local markets.

We will promote intelligent transport management and information systems with a view to improving the quality of service provision and help with monitoring and mitigating pollution levels resulting from transport, especially in islands' ports and urban centers.

Water - 1

We will encourage non-conventional water resources management through grey water recycling and rain water harvesting coupled with the introduction of smart technologies for efficient water network upgrading in order to reduce water losses, realise projects on water energy nexus, minimize costs and effectively tackle water scarcity on islands, also exacerbated by climate change.

We will deploy, in anhydrous islands in particular and where it is proved cost-effective, water desalination plants that run on renewable energy and are energy efficient. We will raise awareness among the population on the qualities and need for responsible use of desalinated water.

We will promote the integrated management of our inland water resources, also by making use of traditional sustainable water management practices, in order to improve the quality and availability of freshwater, ensure the long-term health of aquifers and ultimately support the revival of sustainable island-scale agriculture that offers local products of high added value and quality.

Water - 2

We will make use of innovative approaches and tools such as the Ecosystem-based Adaptation and Integrated Coastal Zone Management to ensure the good environmental status of our marine and inland waters, crucial for livelihoods and human well-being and islands' overall resilience.

We will raise awareness on the need to shift to more responsible consumption patterns and thus turn economic activities on islands such as tourism and agriculture more sustainable, enhance ecosystems' resilience and build successful branding strategies, targeting the ever-growing market of responsible and sustainable tourism.

Waste – 1

We will pursue the transition towards zero-waste territories by adopting a circular economy development model through the strengthening of local value chains.

We will put in place smart waste management at island level consisting of small-scale decentralized infrastructure for collecting, sorting, reusing and recycling and adopt innovative technologies including ICT, so as to move away from traditional waste management techniques, improve environmental quality and create jobs locally.

Waste - 2

We will investigate the possibility of promoting, especially in small island archipelagos, the management of waste centrally, on the island that is bigger in size and can support the operation of such a facility, thus creating economies of scale.

We will introduce incentives for waste producers, in order to reduce mixed waste and increase recycling rates.

We will support targeted awareness-raising activities on sustainable consumption targeting islanders, including households and the business sector, and visitors, in order to address increased waste generation during peak tourism season.

Governance

We will work closely with the European Commission in promoting the clean energy transition on islands and to this end we will (a) develop island local sustainable and integrated plans that maximize synergies between infrastructures, i.e. energy, transport, waste, water (b) promote close collaboration between islands, regulatory and financial institutions in sharing best practice with regards to applying proper financial and regulatory tools and best available technologies. We underscore the need for a long-term framework promoting and supporting scalable projects with funding and technical assistance to accelerate the clean energy transition on islands.

We will make use of the Integrated Territorial Investment and Community-Led Local Development tools provided under Cohesion Policy to make public interventions more efficient and tailored to local conditions, also in alignment with private sector activities.

We will reinforce social inclusion through citizen empowerment and broad stakeholder engagement by focusing on participatory planning as well as participatory implementation, so as to ensure proper realization of projects and strategies and foster local ownership.

We will tap into our rich traditional knowledge and culture of collaboration to nurture social innovation and bottom-up governance initiatives.

ICT

We will ensure the uptake of smart and sustainable technologies in our islands, allowing for a more efficient and inclusive management and use of our natural resources and infrastructures.

We will improve the provision of digital services in our islands in order to create new opportunities for citizens and businesses, boost the growth of innovative SMEs and start-ups and facilitate access to markets and sources of funding.

We will tackle the digital divide in island societies and strive to provide all citizens with equal access to information and digital services.

We will incorporate ICT tools in our policy- and decision-making processes to make these more participatory and inclusive.

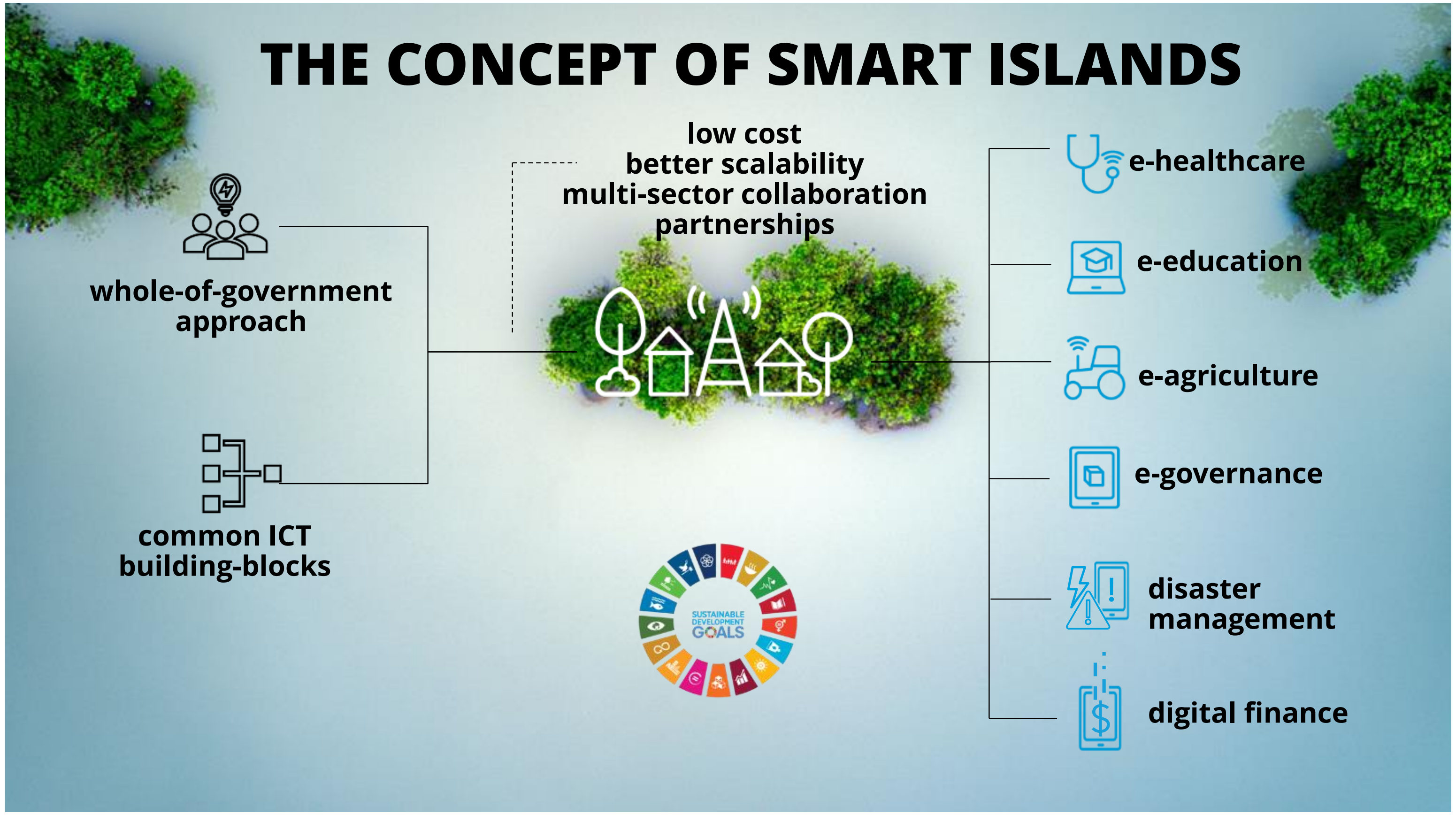
ITU SMART ISLANDS
BRINGING DIGITAL EXPERIENCES TO COMMUNITIES - 1

The Smart Islands programme adopts an innovative approach to deliver connectivity and digital services to disadvantaged island communities in a scalable and sustainable manner. It aims to transform rural and coastal communities, improving their livelihood and well-being by connecting them to a range of digitally enabled services. The programme, built on the ITU-led Smart Villages initiative (piloted in Niger and under development in Egypt and Pakistan), leverages shared services delivery infrastructure capabilities to provide digital services over connected devices (tablet, mobile phone, computer etc.).

ITU SMART ISLANDS
BRINGING DIGITAL EXPERIENCES TO COMMUNITIES - 2

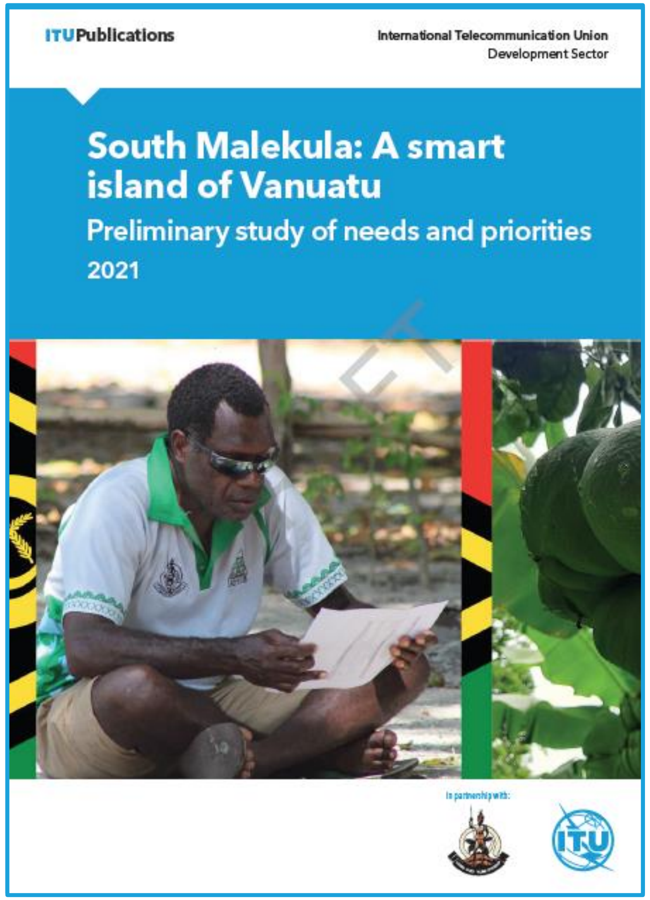
Small Island Developing States (SIDS) face a host of challenges, including geographic isolation, lack of human resources, low availability and quality of infrastructure, and vulnerability to external shocks. In remote areas and in outlying islands, access to information, government services, transport, health, finance, commerce, and education needs prioritized attention. The high costs of electricity and lack of affordable connectivity exacerbate the above challenges for SIDS. Not only does the absence of digital technology contribute to the digital divide, but it also deprives small island communities of the opportunity to leverage digital solutions to obtain better access to essential services. The Smart Islands programme adopts a whole-of-government approach that accelerates progress towards the Sustainable Development Goals (SDGs) through digital transformation.

The Concept of Smart Islands by ITU



Smart Islands in the Pacific - 1

A preliminary needs assessment of South Malekula village in Vanuatu, undertaken by the ITU as part of its support to the Government of Vanuatu, demonstrates the following outcomes that digital connectivity can positively contribute towards: (i) reliable and quality communication; (ii) digital training on the use of smartphone and other devices that improve business activities; (iii) improved educational environment, and (iv) improved health environment with digitally literate health workers. Following this assessment, the Government of Vanuatu has adopted Smart Islands in South Malekula as a national programme.



Smart Islands in the Pacific - 2

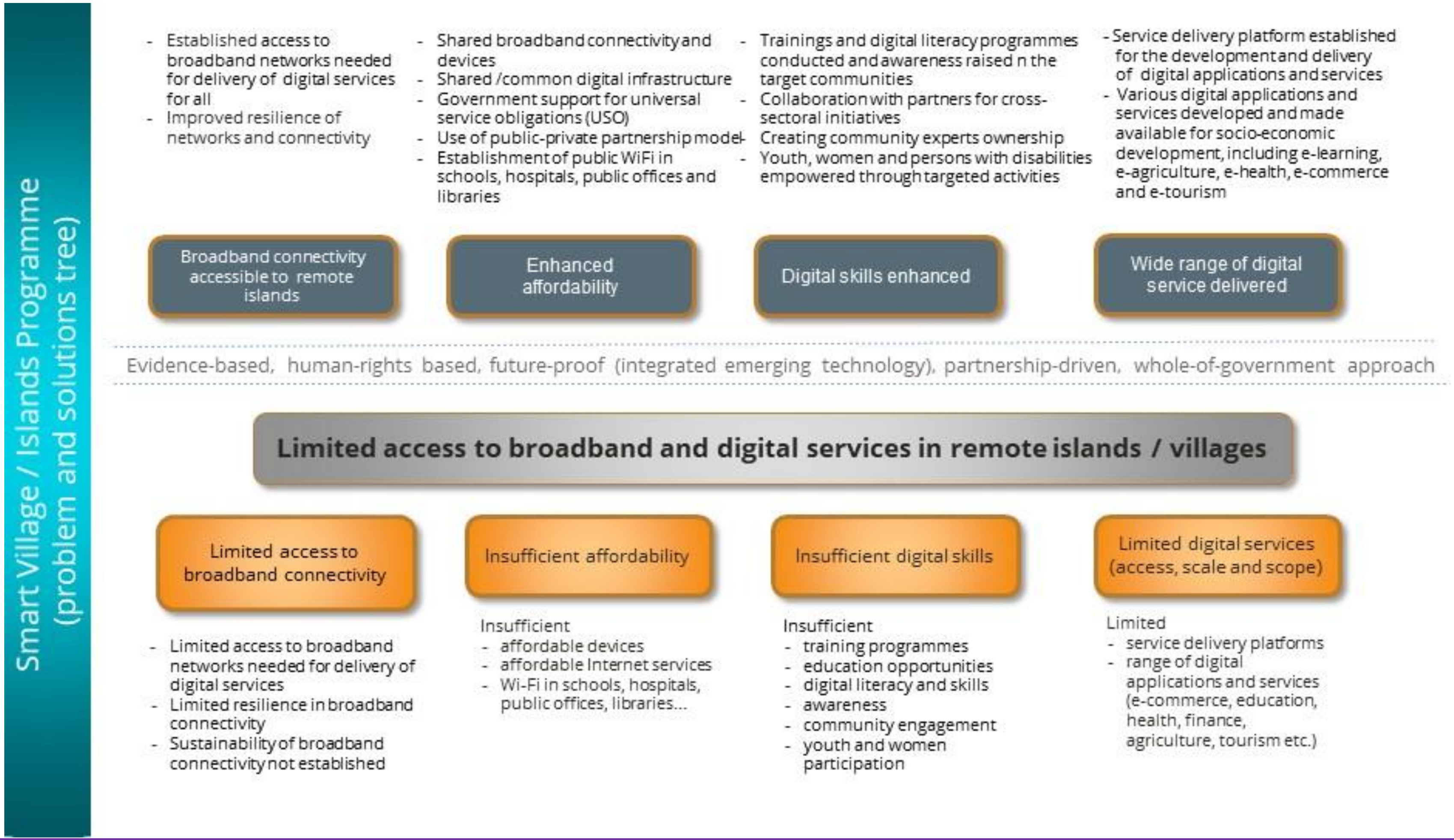
ITU has further received expressions of interest for Smart Islands from Fiji, Kiribati, Republic of Marshall Islands, Federated States of Micronesia, Nauru, Papua New Guinea, Samoa, Tonga, Tuvalu and Vanuatu. ITU is also engaged with UN agencies and other partners and stakeholders, in order to establish and promote a new holistic and inclusive approach to small island development, through the Smart Islands programme. Partnerships for financing of the programme are also being explored with development partners, UN SDG Fund and other international and national agencies.

Smart Islands Solution: Whole-of-government Approach at Community Level

Digital transformation has become a high priority for countries. To meet these ambitions, and to support post COVID-19 socio-economic recovery, an integrated multi-sector approach is required. This approach includes technical assistance and investments in the agriculture, education and health sectors to generate employment, as well as the digitization of services (e-commerce and/or e-government), particularly in the outer islands.

The Smart Islands programme is based on a whole-of-government approach. It is demand-driven, user-centric, flexible, and focused on sustainability, scalability, and multi-sector collaboration. It is designed to manifest digital transformation at the community level with an emphasis on vulnerable populations (women, youth, persons with disabilities, older persons) in order to leave no one behind. The initiative leverages the four pillars of (i) improving broadband connectivity (ii) making broadband affordable (iii) enhancing digital skills and (iv) providing digital services, to impact people's lives based on their local priorities.

Smart Islands Solution: Whole-of-government Approach at Community Level



ITU smart islands programme - 1

Health: the deployment of telemedicine and mHealth services to improve access to diagnosis, while also reducing the cost to the healthcare system. For example, mHealth programmes for diabetes prevention and control could be deployed based on the ITU-WHO joint ‘Be Healthy Be Mobile’ initiative.

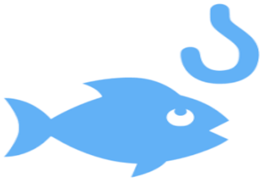
Education: access to open and distance learning opportunities will enable capacity building for teachers and education administrators, while also providing equitable access to quality literacy, lifelong learning and skills programmes for children, youth, and adults. Local teachers could improve their qualifications and experiences of their students by using engaging education content, curated and uploaded on digital school units.

Agriculture: e-Agriculture services can support efficient and productive farming capabilities among farmers, making rural communities more resilient from both the economic and nutritional standpoints. A specialized app could be provided that would help farmers better access markets or detect and treat pests in a timely manner, based on the analysis of photos taken by conventional smartphones.

ITU smart islands programme - 2

Multi-hazard early warning and response: ICT systems can support hazard risk monitoring, alert, and provide post-alert guidance and information. For example, an early warning system based on meteorological data analysis algorithms can provide messaging services to prevent potential damage due to hurricanes.

Digital financial services: provide access to much needed digital financial services and accelerate financial inclusion goals.



Tourism and fishing: the applications could support access to e-commerce and e-marketing to improve income opportunities and in turn support livelihoods.

Smart Islands : TEN Case Study

The Smart Islands project is based on the EESC TEN section's own-initiative opinion TEN/558 on Smart Islands, which was adopted on 19 March 2015. The project aims to gather feedback from island communities and to identify best practices introduced on some of the islands, which could suggest similar or adapted solutions for other island communities in the EU. In practical terms, the EESC is identifying remarkable infrastructures and network initiatives developed and often implemented in an interactive way.

The methodology is based on:

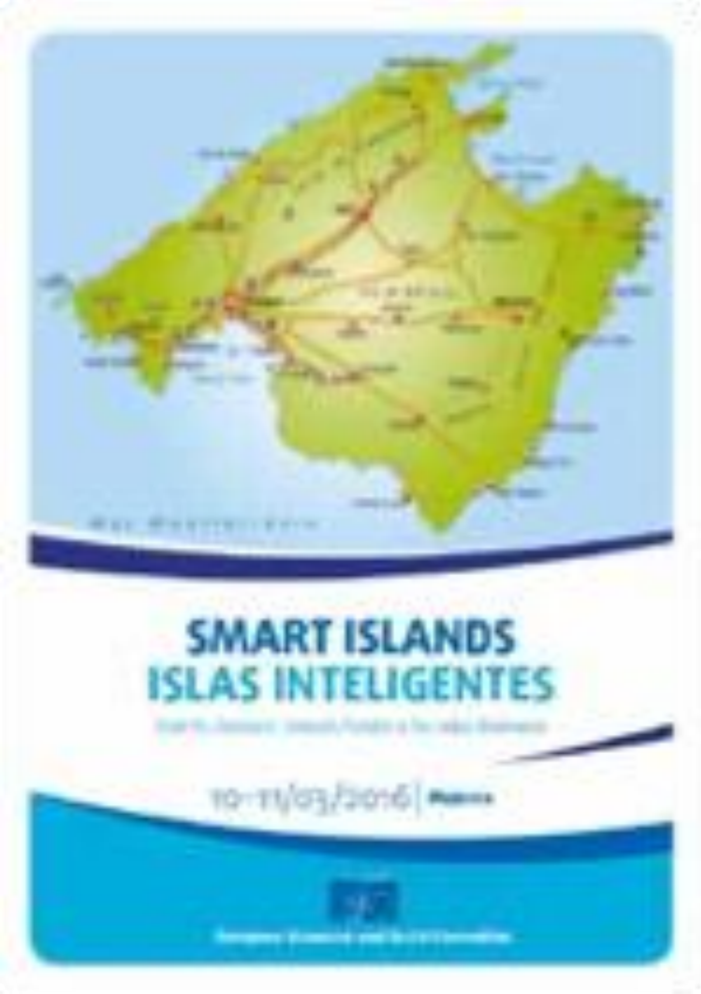
- the identification of islands, based on the current definition1: territories with a minimum of 1km2, a minimum distance between the island and the mainland of 1km, a resident population of more than 50 inhabitants, and no fixed link (such as a bridge, tunnel or dyke) between the island and the mainland;
- the location in Europe's oceans and seas: Aegean Sea, Atlantic Ocean, Baltic Sea, Mediterranean Sea, North Sea;
- six fact-finding missions;
- a questionnaire sent to local players.

Île d’Yeu

Located in the Atlantic, Île d’Yeu is an island and a municipality, just off the Vendée coast of western France. With a surface area of 23 km2, the island has 4 600 inhabitants. Around 10km long with an average width of 4km, its surface area is around 23km2. The island’s two harbours, Port-Joinville in the north and Port de la Meule, located in this rocky inlet of the southern granite coast, have been famous for the fishing of tuna and lobster. However, the decline of fishing activities is pushing Ile d’Yeu’s community toward the development of tourism, renewable energy and the digital economy.

Balearic Islands

The Balearic Islands are located in the middle of the Mediterranean Sea, and have a population of 1.120 million. Majorca is the largest island in the archipelago which has a total surface area of 4492km^2. The island's capital, Palma, is also the capital of the autonomous community of the Balearic Islands. Since the 1970s, the archipelago's economy has diversified from a model based on subsistence farming to one based on tourism. However, the Balearic Islands are facing saturation of the traditional tourism model. The answer is to diversify tourism by exploiting digital and new technologies. The objective is to make the islands more competitive by boosting the economy using innovation, particularly in the digital economy.



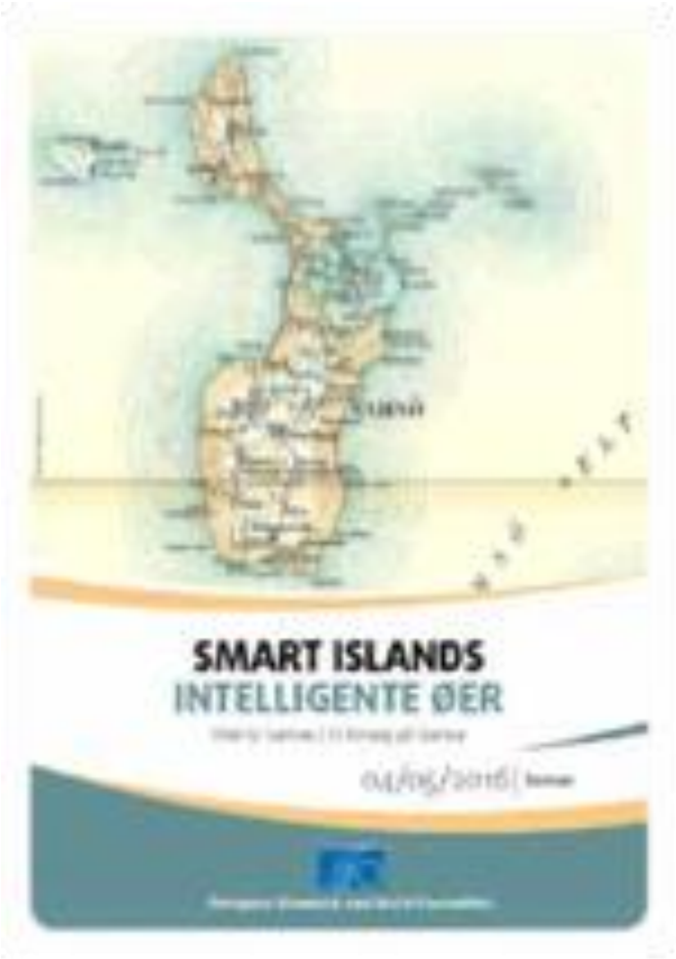
Egadi Islands

Located in western Sicily, the Egadi Islands are an archipelago of 37.45km2 made up of three main islands (Favignana, Levanzo and Marettimo) and two islets (Formica and Maraone). The main municipality, Favignana, includes the three islands of Favignana, Marettimo and Levanzo. Favignana is the largest of the three main Egadi Islands, with a surface area of 19.8km2 and a population of 4230 (31st december 2015). The island is famous for its caves of calcarenite rock (locally known as “tufo”) and the ancient fishing technique of “tonnara”, which involved the trapping and “mattanza” (culling) of Bluefin tuna.

Essentially based on tourism and fishing, the economy is driven by the Egadi Marine Protected Area (MPA), established by the government and managed since 2001 by the Municipality of Favignana. It is the largest marine reserve in the Mediterranean and has shaped a local policy which aims to extend the tourist season, repopulate the island and boost the economy.

Samsø Island

Samsø is a Danish island and municipality located 15km off the Jutland Peninsula. Covering an area of 114km2, the island was used during the Viking Age. Part of the island is Natura 2000 protected. The population of Samsø fluctuates from 3 700 (winter) to 25 000 (summer). The island is split between the north and the south. Residents use around 1 500 vehicles and have a network of cycle paths. Samsø's economy is based on small-scale fishing, farming (particularly potatoes and asparagus) and tourism. Ten years after the Kyoto Protocol entered into force (1997), Samsø won a national competition, reaching 99,6% renewable energy within ten years. Samsø is meeting its challenges (demography, transport and waste management) through an interactive approach which is already operating very well in the field of energy.



Kythnos Island

Kythnos is a 100km2 island and municipality located in the Western Cyclades. Very windy, the island hosts the first wind farm ever installed in Europe. The north of the island is a Natura 2000 protected area. Kythnos economy was driven in the 19th century by mining activities (e.g. iron). Today, its economy is based on small- scale fishing, the diversification of agriculture toward products with Geographical Indications (GIs), and the development of a sustainable tourism model. Theisland'spopulationisaround 2 400, rising to 25 000 during the summer. Remarkably, the local population is increasing. Today, the population is “ready to promote Kythnos”, adopting soft development (as opposed to the excessive tourism activities which prevail in Mykonos, for instance). Kythnos is also on the way to develop a Sustainable Energy Action Plan Master Plan Proposal entitled “Smart Island Kythnos”.

Saaremaa Island

Located between the Gulf of Riga and the Baltic Sea, Saaremaa is the largest of the 2 222 Estonian islands. Measuring 2 673 km2, this big island has a population of 33 000, which is shrinking. The island’s economy is diverse and generates growth and jobs, as illustrated by the industry. Apart from food, shipyards, small craft building, electrical equipment, plastic products (films for garbage and seals for car air conditioning systems), the municipality estimates that 94 SMEs employ around 1 000 people. In addition, companies from abroad are developing activities. Relatively wealthy, Saaremaa is trying to increase tourism and to improve its accessibility.

Geographical information on the islands

The project focused on Île d'Yeu in France, Mallorca in Spain, Favignana in Italy, Samsø in Denmark, Kythnos in Greece and Saaremaa in Estonia.

These islands represent a sample of islands in the EU. They range in surface area between 23.32km2 for Île d'Yeu and 2 714km2 for Saaremaa, 38.32km2 for Favignana, 99km2 for Kythnos, 114.26km2 for Samsø, and 208km2 for Mallorca. Geographically, the islands are spread across the Aegean, Mediterranean, North and Baltic Seas and the Atlantic Ocean.

Challenges

Despite their differences, all these islands face the same challenges: overcoming the difficulties associated with geographical separation and distance from the mainland; solving the conundrum of public facilities that need to be able to meet peak demand during the tourist season but may be excessive for most of the year (information and communication technologies, energy, transport, waste collection and processing, sewage treatment, etc.); maintaining the demography; organising the necessary educational structures and providing vocational training and jobs for local people; guaranteeing the livelihoods of people working in the tourist industry, who have short seasons and often perform several different jobs; protecting the natural coastal and marine environment that is put under significant pressure at certain times of year; finding the necessary funding to provide public services when the year-round population is often small and ageing; and providing affordable housing for young people when holiday homes, the protection of natural areas and limitations on areas approved for building development all lead to high housing costs.

The size and population of Mallorca mean that it is very different from the other islands visited, with their small size and low population. In general, islands constitute a concentrated version of the economic, social and environmental difficulties encountered on the mainland, albeit exacerbated by their limited size. The solutions proposed vary, but they all satisfy the desire to make the most of technological and environmental limitations, and they all require flexibility, adaptation, inventiveness and hard work.

Information and Communication Technologies (ICT) Emergency Quick Response Code

The Balearic Islands have a long tradition of tourism, which is reflected in its wide range of tourist facilities and services. In August alone at the peak of the tourist season, Mallorca usually has over 13 million tourists. The emergency and police authorities are involved daily in 150 to 200 interventions, of which 50 to 80 can be resolved swiftly. The main problems are lost children, people who have lost their bearings and injured cyclists. In order to promote the Balearic Islands as a destination, the Balearic authorities, including the port authorities, are giving due consideration to the issue of security, combining public, medical and environmental safety.

To improve the security and safety of tourists, the port authorities and the authorities of the Balearic Islands asked the University of Palma to develop an emergency system. A QR code (abbreviation for Quick Response Code) system is being developed for this purpose. The QR code is a machine-readable optical label that contains information about the item to which it is attached. It consists of black modules (square dots) arranged in a square grid on a white background, which can be read by an imaging device (such as a camera or scanner).

Information and Communication Technologies (ICT) Emergency Quick Response Code

In practice, the system has been used from summer 2016 for cruise tourists disembarking for a short period in Palma. The MSC Company will include the QR code in the medical questionnaire shared with the Spanish emergency system (112, hospitals, doctors). The QR emergency system is particularly suitable for groups with special needs (people with disabilities, minors and senior citizens, sportsmen, etc.). 2 045 characters can be stored on the square code. The system is totally safe since the information (identity, medical information, contacts and GPS location) is

not stored online but encrypted and printed in the square. The information is only readable using the requisite application and can always be updated by the person providing data about him/herself.

Using the QR code is also better than calling an ambulance or the police in all cases, as that will cause a serious disturbance in a tourist area. One challenge is to convince visitors to start using the QR codes on themselves, as this cannot be made compulsory. The project has great potential for island destinations which receive many seasonal visitors, often by cruise ships, who stay for a short time and would not become sufficiently familiar with the destination to be able to help themselves easily in an emergency.

Internet broadband community - Samsø

In 2012 the inhabitants of **Samsø** started to provide high-speed internet themselves, having experienced bad connections with earlier providers and a final provider who went bankrupt. The initiative has been run by the inhabitants themselves, initially on a voluntary basis. This initiative provides a better and cheaper connection than most of the private broadband companies operating in the country. Only in April 2015 was the first paid technician hired. By April 2016, the network had 1199 users, for an island of 3700 year-round inhabitants. The project is supported by the Danish government.

Website for the initiative: http://net4samso.dk

Virtual care and services for the elderly population - Saaremaa

On Saaremaa, the VIRTU/ELVI project aims to connect elderly people via the internet. The project started a few years ago as an EU Interreg project and is currently financed and sponsored by one of the nation-wide telecom enterprises (TELIA). The remote care service aims to improve the activity of elderly people and to save public money. The project also helps to maintain links and relations between elderly people and their relatives by increasing internet communication.

On the island, 20 people are connected to the initiative. The system helps people to socialise throughout the year, while the most frequent use is during the winter, when moving around is a bigger challenge for elderly people who often also have impaired mobility. People use VIRTU to avoid being isolated. The system requires a computer, a screen and internet. It can be used for bilateral meetings, group activities (e.g. singing) and to organise 24-hour surveillance. The service keeps people active, when they live in very remote areas or are unable to attend gatherings frequently. Online events are organised for the target group and the feedback has been positive. Users can communicate with each other as well as meet people or get back in touch. The initiative has great potential for sparsely populated areas with limited accessibility, which often include island communities.

Virtual care and services for the elderly population – Estonian islands

On **Estonian islands** and coastal harbours, it is difficult and costly to manage small harbours and provide services, as the numbers of visitors and residents is limited. In response, the authorities are encouraging, improving and expanding the network of harbours. A smart harbour system is being developed as part of solutions involving 50 harbours across Estonia. Information is provided for tourists, including online booking (accommodation and transport). An automated management system has been set up, including mobile payments. This "marine mastermind" model and the concept of "easy port" are particularly suitable for low tonnage vessels, small ports and service suppliers. Saaremaa is also changing its "business model" by receiving more cruise ships. A business label is emerging from the initiative.
The same model could be used for bigger boats and bigger harbours, and is not limited to one country; it can be enlarged and rolled out by other island and coastal communities. It could be a good solution for sparsely populated communities, where manning small harbours is not possible simply because the manpower would not be available.

Website for the initiative: www.marinaahoy.com

Innovation, including energy, transport and environment

Best practice demonstrated during on-site visits

The EESC observed several initiatives, such as the offshore wind farm and reduction of traffic on Île d'Yeu, solar energy on Favignana, energy efficiency and sustainable mobility on Favignana, use of straw from local farms for collective heating systems on Samsø, the introduction of renewable sources of energy in the power mix on Kythnos, the Energy Academy of Samsø, public filtered water fountains to prevent plastic waste on Favignana, and the Marine Protected Area of the Egadi islands.

Offshore wind farm - Île d’Yeu - 1

Together with Île de Noirmoutier, **Île d’Yeu** is planning to build an offshore wind farm. The farm would be built for 25 years of use. Île d’Yeu would be used as a base for construction and the project would create jobs for the islanders, partly since Île d’Yeu would be required to set up a maintenance base for the wind farm (setting up a maintenance base on the island means providing training for islanders and bringing in new skills and therefore new inhabitants/ families to the island).

The wind farm would have 62 turbines and be located 12km out. It would have an output of 496MW, a surface area of 82.5km2 and an estimated cost of EUR 2 billion.

The project promoters have been confronted with protests against the farm because of the visual impact from the seashore. There are also concerns about

fishing, but scientific experts generally consider that such construction has a positive impact on the renewal of fish stocks. These examples clearly show that dialogue with civil society is vital throughout such projects. People need dialogue and information.

Offshore wind farm - Île d'Yeu - 2

This initiative is necessary for the development of the island, and is backed by Île d'Yeu's excellence in energy, with its successful Yeu 2030 energy transition programme. The goal is to make Île d'Yeu a showcase of excellence in energy with local and renewable energy generation, energy storage (development of hydrogen storage), a smart grid project, etc. Another aspect involves reducing energy consumption by promoting energy-efficient building renovation and energy savings. From an economic point of view, the aim is to develop new markets, make companies more competitive and increase skill levels. Technological innovations in the field of energy transition also need to be accommodated (islands are an ideal test-bed given that input and output flows can be measured accurately).
From a social point of view, considerations involve combating energy poverty and reducing inequality in the face of rising energy costs. This ambitious action programme has received wide acclaim. Île d'Yeu is among 212 French districts lauded for their contribution to green growth ('Territoires à énergie positive pour la croissance verte').

Website for the project: www.iles-yeu-noirmoutier.eoliennes-mer.fr

Solar energy - Favignana

On **Favignana**, energy generation is a challenge. The Egadi Islands are not connected to each other, nor are they connected to the Sicilian mainland. The cost of energy generation is high for the population. Another problem is related to the level of consumption, which differs in summer and winter (households do not use heating systems in the winter, while consumption rockets during the summer due to the use of air conditioning and tourism. The municipality's storage capacity is only 30KW. For the time being, wind energy is not allowed due to a law protecting the landscape. It is impossible to develop a gas plant, unless the municipality builds a methanation unit. One private project to develop a new power plant is in breach of the MPA. Solar power is used as described in the Sun and Stars of the Egadi Islands project.

Website for the project: http://www.comune.favignana.tp.gov.it/po/mostra_news.php?id=174&area=H

Solar Energy - Samso

Ten years after the Kyoto Protocol entered into force (1997), **Samsø** won a national competition, reaching 99.6% renewable energy within ten years. On this Danish island, wind energy predominates thanks to a combination of offshore and land-based windmills, but there is solar energy as well. The EESC visited a farm, whose owner has begun the transition from traditional farming to energy generation.

The farmer has invested in solar panels which are installed on the stables and barn. In addition, to achieve scale, the farmer has invested in solar panels installed on factories in Germany and Italy, generating energy which is sold and injected into the grids. Shifting from traditional farming remains a challenge in all of Europe's developed countries, which is why the farm has diversified while also contributing to increased use of renewables.

Energy efficiency and sustainable mobility - 1

On Favignana, the “Sun and the Stars of the Egadi islands” project began in 2008, following a call for funding from the Italian Ministry of the Environment. The project has a number of pillars:

- Soft mobility: through the purchase of electric and hybrid vehicles for the city administration, and incentives for local residents and economic operators. In practical terms, financial contributions are granted to encourage the use of mountain bikes, electric bicycles and electric scooters. The initiative is open only to residents and local economic operators (e.g. accommodation and vehicle hire).

- Renewable energy: the public sector has already installed 6.72KW solar panels on the roof of the town hall, and 10.2KW panels on the school roof. Solar thermal energy installations are authorised only if they protect the landscape – the solar panels should not be visible and so spoil the island’s heritage. Households applying for funding will be reimbursed for 30% of the cost of the installation.

Energy efficiency and sustainable mobility - 2

- Recycling of vegetable oil: although the oil can be collected and recycled, residents have not yet started doing so.

- Energy efficiency: public lighting bulbs are being replaced by LEDs. Economic operators are given incentives for any investments in electrical bicycles and heat pumps.

The project is largely aiming to change mindsets, as traditionally the islanders have had little to do with using renewable energy. This initiative is a good start for further projects in renewable energy and innovation. In France, tourists going to **Île d'Yeu** are encouraged to travel by train, bus and ferry.
Access to Île d'Yeu is mainly provided by ferries of the Régie Départementale des Passages d'Eau de Vendée. Soft mobility is encouraged through a system of tariffs aiming to reduce use of personal vehicles (e.g. cars, motorbikes, bicycles).

Website for the maritime transport company: http://www.yeu-continent.fr/

Straw-fuelled heating systems - Samsø

In Denmark, energy generation is turning to renewables, even though the country has two coal-fired power plants. For the time being, most energy is supplied by biomass and waste.
Samsø has four public cooperative district systems, three of which are straw-fuelled heating stations and one a station combining woodchip and solar power. One straw-fuelled heating station is a 10-year
project with a unit working at local level. The working principle is that 3kg of straw produces the equivalent of 1 litre of oil. Households themselves own the plant and the remote heating water loop.
The system roduces very cheap energy. The straw used comes from Samsø's fields, although 20% of the straw is left on the land to regenerate and protect the soil. To be optimised, the straw needs 50% humidity. The straw is stored in the plant and then burnt.

The energy heats a 6km water loop which is connected to households. Ash is stored and spread on the fields as a fertilizer. The initiative is part of Samsø's fossil-free island philosophy. The broad energy mix, including the remote heating option combined with earth-heating, solar panels and wind energy is widely spread and so helps more and more inhabitants mobilise sustainable solutions for energy consumption.

Introduction of renewable sources of energy in the power mix - Kythnos

Kythnos' challenging geography encourages the use of local and renewable sources of energy. Several generation solutions are present on the island. The introduction of renewable energy sources into the power mix of Kythnos grid is key, particularly for an autonomous island supplied mainly by diesel generators. Although the wind and solar potential in these areas is excellent, the strong seasonal fluctuations in demand as well as the technical restrictions were a problem. The Aegean Energy and Environment Agency together with the Municipality of Kythnos are currently promoting the island of Kythnos as a "test-bed" for innovative technologies. This effort builds on a rich history of cutting-edge technology deployment on the island, namely:

- 1982: Installation of the 1st wind park in Europe (5 x 20kW);
- 1983: Installation of a 100kW photovoltaic (PV) system with battery storage (400kWh);
- 1989: Replacement of the wind turbines (5 x 33kW);
- 1992: Inverter installation for the PV system;
- 1998: Installation of a 500kW Vestas wind turbine;
- 2000: Installation of a fully automatic control system (Intelligent Power System);
- 2001: Operation of a PV-powered autonomous microgrid with batteries and diesel generator back- up in the Gaidouromandra area.

Introduction of renewable sources of energy in the power mix - Kythnos

A hybrid power plant system with battery storage and an intelligent management system on Kythnos combines diesel generators, wind turbines and solar panels, with a battery storage unit and a converter to alternating current. In practical terms, the power plant system can produce up to 2.8 megawatts during the summer.

Although the most recent wind turbines are not connected, the system meets the island’s demand. When solar energy covers demand, the diesel system is automatically turned off, and vice versa. The electricity is transported, stored and converted. During the winter, the system provides renewable energy for 12 or 13 hours per day. The diesel unit is made up of four diesel generators of 300kW and three of 400kW. A diesel engine is used as a back-up.

Three times a year, a ship delivers oil to the harbour. 16 truck convoys are needed to carry the oil. Energy and a converter are funded by the EU.

Introduction of renewable sources of energy in the power mix - Gaidouromandra

The microgrid of **Gaidouromandra** is a stand-alone system which is not connected to the island's electrical system. PV modules produce electricity which is fed into the local microgrid, powering a number of summer houses and one farm. The excess electricity is stored in batteries while a diesel generator is available as back-up. Inverters and power electronics ("Sunny Boy" and "Sunny Island") which were installed for demonstration purposes maintain the efficient operation of the microgrid. The microgrid is monitored and maintained by CRES, the Greek national entity for the promotion of renewable energy sources, rational energy use and energy conservation.

Furthermore, smart meters are currently being installed in Kythnos, in the context of the"Smart Grids in five Aegean Islands – Development of smart-grid infrastructure in autonomous islands of the Aegean Sea" project, run by the "European Local ENergy Assistance" (ELENA) programme of the European Investment Bank (EIB).The programme is funded through the European Commission's Horizon 2020 programme. Overall, the project will promote smart grids in the five Aegean islands, including Kythnos, in order to improve the quality of electricity provision, foster the penetration of renewable energy in local energy production and make energy loads more flexible through consumption-based measures.

IoT Academy

Introduction of renewable sources of energy in the power mix - Gaidouromandra

Building on the above, Kythnos, as one of the five demo sites across Europe for the HORIZON2020 project WiseGRID project, will host a state-of-the-art integrated electricity system that includes:

- \- electrical vehicle charging stations;
- \- procurement of electrical vehicles;
- \- energy storage systems (batteries) for public/municipal buildings;
- \- equipment for optimising the operation of a desalination plant;
- \- energy storage systems (batteries) to increase renewable energy penetration in the local energy mix;
- \- equipment for the flexible and optimal operation of the electricity network.
- *Website for WiseGrid project: http://www.wisegrid.eu/*

Website for ELENA programme: http://www.eib.org/products/advising/elena/index.htm

Introduction of renewable sources of energy in the power mix - Samsø

Samsø has amassed a great deal of experience with a wide variety of local renewable energy projects, from wind turbines to CO2-neutral district heating plants, rapeseed oil tractors and solar energy panels. Logically, the Samsø Energy Academy, situated close to the picturesque harbour village and tourist magnet Ballen, developed as a competence centre to spread information about smart solutions in energy.

This experience can be drawn upon through the Academy, and local and foreign researchers and scientists spend time at the Academy performing research based on the easy access to all these energy systems, where windmills, straw-fuelled district heating and thermal solar panel systems and the people who initiated them are close at hand.

The Academy also functions as a conference centre where companies, scientists and politicians can discuss renewable energy, energy savings and new technologies. Samsø Energy and Environment Office, Samsø Energy Agency and the Samsø branch office of the Danish Energy Service are located in the Energy Academy. From here, they run a broad spectrum of energy counselling services for commercial and private customers, organise guided energy tours, workshops and seminars and generally promote ‘energy tourism’ for energy professionals. Being very active in Europe in the area of energy mix, the Energy Academy is also opening its doors to visitors from third countries such as Japan.

Website for the initiative: www.energiakademiet.dk
Website for the project: www.visitsamsoe.dk/en/inspiration/energy-academy/

Public filtered water fountains to prevent plastic waste - Favignana

On Favignana, a micro-filtered water project began in 2014. 300 000 litres of water have been distributed to the island's population through one outdoor fountain. The main objective of the fountain is to reduce plastic waste. Since 2014, it is estimated that the equivalent of 150 000 plastic bottles have been saved.

The project also has a social impact since the water (natural or sparkling) is free for local households, which are entitled to up to ten litres per day. Once extracted, the ground water is micro-filtered. For the time being, the fountain consumes energy supplied locally by a diesel-operated power plant. However, solar panels will soon be installed on the fountain.

The island of Favignana will need additional units to cover local needs.

Marine Protected Area (MPA) – Egadi Islands

Italy intends to develop a network of 54 Protected Marine Areas (MPAs), which will ultimately include all the Italian islands. Currently, the Italian network of MPAs is made up of 27 protected areas. Established by the Ministry of the Environment in December 1991, the **Egadi Islands'** MPA is the largest marine reserve in the Mediterranean (around 54 000 ha), covering around 25% of the sea's vulnerable or protected areas. The size of the area is explained by the interaction of three marine currents, the nutrients and the transparency of the water whose hydro-dynamic conditions facilitate the treatment of waste water. The area includes the islands of Favignana, Levanzo and Marettimo and the islets of Maraone and Formica. The MPA is managed jointly by the government and the local community.

The Egadi islands MPA involves various internationally protected habitats and species included in the Natura 2000 network2. One of the most important and best preserved is the Posidonia oceanica seabed (almost 8 000 hectares), which contributes to rich biodiversity (fish nursery), mitigates coastal erosion and produces oxygen. The species protected include bottlenose and striped dolphins, sperm whales, storm petrels, sea turtles (especially C. caretta), and, above all, monk seals (Monachus monachus), repeatedly sighted in the archipelago after being absent from Italy for 60 years. Extensive formations of vermetid reefs (Dendropoma petraeum) are common along the coasts.

Marine Protected Area (MPA) – Favignana

In **Favignana**, partnership with local fishermen has been very important in establishing the MPA. Being key partners in the MPA since its establishment in 1991, fishermen are involved in the integrated coastal management system and the promotion of sustainable development. “Guardians of the Sea”, a bottom-up initiative, was developed and based on an approach where fisherman are considered “one of the protected species”. The MPA combats illegal trawling systems by setting up anti-trawling bollards, which reduced infringements by over 80% in five years. The “Guardians of the Sea” initiative has involved 93 fishermen in the protection of the archipelago based on a code of conduct, the reporting of abuses and research. In addition, educational activities have been introduced and financed by the EU LIFE+ programme, together with a monk seal observatory and monitoring with the Joint Research Center (JRC) of Ispra. Finally, the MPA created a label for environmental certification of tourist services used by 70 operators and placed 14 mooring buoys for yachting. In term of funding, the MPA is supported by the municipality, the state, LIFE+, the Structural Funds, entrance fees, merchandising, sponsorship, donations and a fundraising programme. The objective of the MPA is to increase the number of visitors in April, May, June and October. 45 people work for the MPA in the summer. The MPA has become widely known thanks to its practical action in preventing illegal fishing.

Website for the project: http://www.ampisoleegadi.it/

Economic development - Shipyards in Saaremaa

On Saaremaa, there are several shipyards which build small vessels, such as Luxury Yacht, Alunaut, Saare Paat and Baltic Workboats. During its “going local” event on Saaremaa, the EESC Smart Islands project could visit Baltic Workboats at Nasva.

In the past, the forerunner of Baltic Workboats was a company that built and repaired fishing vessels. Since breaking away from the original approach, the company has specialised in civil security (e.g. tugboats) as well as small ferries serving smaller islands. The company has already manufactured 100 vessels.

130 workers are employed (architects, engineers, painters, electricians and welders). The company uses modern and high-level materials, particularly to fold and weld metal (argon and semi-automatic system). Waste management is an issue for this industry: although the metal is collected and compressed, waste is shipped to the mainland for recycling. An important aspect of Baltic Workboats is that their design solutions are also developed on Saaremaa, unlike many others which use design solutions developed elsewhere. It was noted here that while the company provides maximum health and safety facilities, the implementation of those provisions needs to be monitored closely.

Website: http://www.balticworkboats.ee/

Economic development - Small-craft competence centre island of Saaremaa

Created by the National Business Development Agency (Enterprise Estonia Saaremaa branch) as a business support centre, in cooperation with local entrepreneurs, the centre is connected to an academic institution, Tallinn Technical University. It provides testing materials for small-craft shipyards. 1/10 models are tested in a pool owned by the centre for use by any ship-builders who might need it. It is an important centre for Estonia, since 80% of shipyards are located on the island of Saaremaa.

The centre uses state of the art technologies (3D printers, testing pool, laboratories for testing material durability, etc.). One of the six business clusters set up in Estonia, the small-craft competence centre is working very well and is the only one on an island. Due to the fact that it is run in cooperation with an academic institution which provides the shipyards of **Saaremaa** with a skilled workforce, the centre is likely to remain operational and to develop further.

Website for the centre: http://www.scc.ee/

Economic development - E-commerce - Palma de Majorca

In recent years, many big companies (supermarkets) have competed with local commerce and destroyed jobs, particularly in **Palma de Majorca**. The Balearic Islands need measures to avoid new supermarkets developing in the outskirts of big cities, disrupting the business opportunities of small shops in city centres.

The “E-Commerce” project has been developed by the government together with the business community and employer organisations.

The project involves 21 municipalities. However, because of the economic crisis, it is more difficult for small businesses to invest in digital technology. Despite that challenge, many companies have been adopting e-commerce solutions and are rescuing their businesses, which otherwise might be forced to close.

Economic development - Turning a declining market into a landing point

Traditionally, an important economic activity for island communities has been fishing. Although this activity has dwindled sharply, many island communities still have fisheries.
Specialising in small-scale fishing, **Île d'Yeu** is one of the few islands in France to have its own fish market. Although European regulations have significantly curtailed fishery activities, it is still very much a part of the island's economy, with a fleet of about thirty boats. The fish market is situated in Port Joinville and is well equipped with facilities for receiving and processing the fish, electronic sales to destinations far afield, and storage. The fish market on Île d'Yeu is run by the Vendée Chamber of Commerce and Industry (CCI) and employs some thirty people. The decline in sales in recent years has placed a question mark over the future of the only fish market to be held on a European island. The possibility of turning the market into a landing point is currently being discussed: part of the catch would be set aside for Île d'Yeu, with the rest being sent for sale in Sables d'Olonne. This would mean that the sales prices would only be known afterwards. A complex system of compensation would prevent the island from being penalised by this option. This innovative proposal could provide an alternative for the future for a declining market, and at the same time save jobs that are under threat.

Website for the initiative: http://www.vendee.cci.fr/le-port-de-peche-de-lile-dyeu

Economic development - Short supply chain - Île d’Yeu

An Economic Interest Group (EIG) has been set up by some of the **Île d’Yeu** fishermen to diversify the private sales points in the Nantes area. This short supply chain is the first Association for the Preservation of Agricultural Smallholdings (AMAP) for fish to be established in France, and the initiative is unique to France.

Website for the initiative: http://www.amap44.org/cartes-et-annuaires/les-amaap-s-poisson

Economic development – Circular Economy - Kythnos

Kythnos has a rich tradition of agricultural activities which, despite declining considerably in recent years, are showing signs of revival particularly at the small, family-farm level. Apart from small-scale fishing, subsistence agriculture is essential for the population since the products (vegetables) are an important part of the circular economy.

In cooperation with the local farm cooperative, and together with academic and research bodies, the municipality has taken steps to strengthen the agriculture sector and local produce. Vegetable produce is cooked and served in the island's restaurants, for example. The main produce is cheese (one with a geographical indication); honey (one an award-winner in an international competition) and wine. In general, young farmers are developing initiatives to bring back old production systems and are promoting high quality products (honey, wine, breeding/lamb and cattle).

Economic development – Circular Economy - Saaremaa

Saaremaa has been creating a label – Made in Saaremaa. The aim of the label is to encourage small producers of food, beverages and other goods to advertise and make local production more visible and more attractive for buyers. Other service providers such as hotels and spas can join the label if they are using the labelled products in their service provision.

Currently over 60 producers are using the label. They represent a wide range of products, along with handicraft products, cafés and restaurants. The initiative is backed by the EU Leader local development group.

Website for the initiative: www.ehtne.ee

Scientific initiatives to protect the marine environment Coastal observing and forecasting system –Mallorca. - 1

Oceanography has changed with the emergence of new technologies: whereas previously, work was conducted only by boat, nowadays, observing has shifted from single platform to multiplatform observation. Located in Mallorca, the Balearic Islands Coastal Observing and Forecasting System (SOCIB) is a joint initiative between the Spanish Ministry of Science and Innovation and the Balearic Islands Government.

The infrastructure was the result of public investment, backed by the government of the Balearic Islands and the national government. SOCIB activities are in the field of science and technology and are socially driven. SOCIB is designed to respond to international scientific priorities and to society's increasing need for intensive and quasi real-time monitoring and forecasting of the complex coastal environment. The three basic elements of SOCIB - the observation facilities, the modelling facility and the data centre facility - form a state of the art marine infrastructure that is ready to cooperate on cutting-edge research. This EUR 12 million marine research project located in **Palma** covers the entire Mediterranean basin. Ocean observation is based on physical observation (biological data such as oxygen and fluorescence). SOCIB is performing solid research but responding to social, environmental and economic needs. It has the capacity to provide new data in response to social (jelly fish warnings for tourists), environmental (pollution, oil spills) and economic needs (fishing activities).

Scientific initiatives to protect the marine environment Coastal observing and forecasting system – Mallorca - 2

SOCIB uses a vehicle with long cables, an Argo profiler, an oceanographic boat, a glider (US patent) and an application and forecasting systems for marine currents. All the information is freely and publicly available. SOCIB is enhancing capacity through big data streaming. Examples of activities conducted: observation of the erosion of Mallorca's beaches, the SASEMAR agreement (Servicio de Emergencia en el mar), meteorological forecasting to identify the state of halieutic resources (Bluefin tuna, jelly fish, sea turtles, mammals), coastal pedology, survey of pollution from the mainland, providing data for hotel chains, sea traffic and maritime safety. Data are also used for recreation (surfing), fishing and research purposes. SOCIB is connected to satellite systems: GALILEO, IRRIDIUM satellite communication and the COPERNICUS programme.

SOCIB has been identified by UNEP as an example of good practice. It is part of the new "Medclic: the Mediterranean in one click" programme, developed in cooperation with Fundación Caixa. "Medclic" has the dual objectives of promoting research and bringing the benefits of new marine and coastal observation technologies to society.

Website for the initiative: http://www.socib.eu Website for Medclic: http://www.medclic.es/en/

Scientific initiatives to protect the marine environment
Protection and study of marine meadows - Egadi islands - 1

In the **Egadi Islands**, the Ge.Ri.N Project (Natural Resource Management Project) carried out by ENEA (the Italian Environmental Agency) with the support of the MPA, focuses on many environmental matrices of potential interest, such as ground water and the coastline. They have a strong impact on the flow of tourists, the accommodation capacity of small islands and sustainable development.

The Egadi Islands' natural resources and distinctive landscape are in fact the key to the economic development of the archipelago, which is heavily dependent on tourism. Their conservation is therefore fundamental. The project's tasks are based on the study of coasts and seabed, hydrogeology and the epidemiological study of the territory. Particular attention has been paid to the management of marine sediments and vegetable beached biomass (the “posidonia banquette”), in order to use them for environmental conservation and compost production.

Scientific initiatives to protect the marine environment
Protection and study of marine meadows - Egadi islands - 2

Posidonia oceanica (commonly known as Neptune Grass or Mediterranean tapeweed) is a species of seagrass endemic to the Mediterranean Sea. It forms large underwater meadows that are an important part of the ecosystem. Posidonia is considered to be “the lung of the sea”, since 1m2 of the seagrass produces 1.2 litres of oxygen, more than 1m2 of Amazonian forest. The seagrass also mitigates the effect of erosion along the coastline. The fruit is free floating and known in Italy as “the olive of the sea” (l’oliva di mare). Balls of fibrous material from its foliage (known as egagropili) wash up on nearby shorelines.

The largest expanse of posidonia in the Mediterranean is in the Egadi. The MPA is currently working with the Università degli Studi di Roma “La Sapienza” to develop outdoor furniture made from foliage. An awareness-raising project will be implemented in order to explain the importance of posidonia to tourists.

Scientific initiatives to protect the marine environment
Rescue centre for Sea Turtles and Monk Seal Observatory - Favignana

A centre has been established on **Favignana** and provides first aid for injured sea turtles. The centre also operates as a seal observatory. The main work of rescuing and returning sea turtles to their proper environment occurs elsewhere, but the process begins here. The centre has a facility for small operations - preparing the sea turtles for transport to a rehabilitation centre. The rehabilitation centre itself is on Lampedusa (where the turtles are brought via Agrigento). Many sea turtles that have swallowed plastic bags or been injured in other ways have to be transported from Agrigento to Lampedusa by plane. The turtles found around Favignana have to travel back from Lampedusa as they must be released in the same place that they were collected. Various sponsors and programmes have financed the centre, such as the LIFE+ Tartalife project, the Ministry of Environment, Federparchi, and private sponsors – the largest of which is the Rio Mare company – which have also sponsored the monk seal and bollards project. The monk seal centre at Marettimo (Punta Troia castle) is an observatory, as monk seals prefer to avoid people. The first aid centre teaches fishermen what they have to do when they come into contact with injured sea turtles. They have to have a pillow, keep a wet towel over the turtle, and learn how to lift the turtle.

Website for the project: http://www.tartalife.eu/en/%E2%80%9Cegadi-islands%E2%80%9D-marine- protected-area

Scientific initiatives to protect the marine environment
Merging Vacations with Scientific Curricula

An interesting case study is due to an idea proposed by a Seyshells citizen, tourists and scuba divers are found of Seyshell Islands, why do not merge these interests with educational improvements.

Why do not establish a PhD course on Marine biology asking the cooperation to International universities ?

This will diversify the offer of Seyshell Islands compared with other scuba divers' paradises.

Smart solutions in governance and social innovation
Methods of cooperation

Samsø has a long tradition of cooperation which was useful for creating opportunities for renewables. This tradition "became a culture", says the mayor of Samsø. The project which brought Samsø to its current status actually began in 1998 with the wind turbines, before the change in heating systems, the new ferry line and the broadband system. The next project might be the development of a biogas plant to fuel the ferry (for the time being, energy is imported from Rotterdam). Farmers and the local population have been leading the projects from the beginning, somehow forcing the municipality to be involved.

The way of approaching the problems can be considered a type of social innovation, where inhabitants take planning and action into their own hands and create an efficient structure for further development.

Smart solutions in governance and social innovation SmileGov project - 1

The project was based on the idea that cooperation between different levels of governance of islands (i.e. national, regional and local) can play a key role in reaching the EU's 20-20-20 goals in the area of energy and climate change. Good multilevel cooperation has been identified as one of the key factors in consistent (between different levels) and possibly effective sustainable energy planning at local level. Particularly in island communities, this role has proven to be crucial for the balanced development of the island, resource management, economic growth and quality of life for residents and visitors.

SMILEGOV is based on success stories and close European cooperation, and will strengthen local capacity and work to improve multilevel cooperation in European islands in order to help implement their sustainable energy action plans with a view to achieving the EU's 20-20-20 goals. As regards islands that have not yet been through the sustainable energy planning process towards 2020, capacity building will be offered with the aim of supporting the island's structures and enabling them to develop their own planning and energy projects.

Smart solutions in governance and social innovation SmileGov project - 2

In order to support this process, clusters of European islands will be set up in the biggest European insular regions: the Atlantic (Canaries, Scotland), the Baltic Sea (Denmark, Sweden, Norway, Finland, Estonia) and the Mediterranean (Italy, Malta, Cyprus, Greece). The formation of clusters of islands and the exchange of knowledge at local and regional level, the identification of strategic guidelines to overcome existing barriers with assistance from advanced islands, as well as the process of learning from the experience of model areas ("learning from the experts") will guide islands along this path.

Smart solutions in governance and social innovation
The Pact of Islands

The Pact of Islands is a European initiative adopted by the European Parliament that embraces European island authorities that commit to taking concerted action in line with the EU 2020 energy targets through the support and promotion of renewable energy, energy efficiency and sustainable transport projects at local level. The European Parliament supports the role of island communities in the mobilisation against global warming through Declaration 37/2011 which recognises the Pact of Islands as an EU initiative parallel to the Covenant of Mayors.

The Pact of Islands highlights the vulnerability of islands to climate change, stresses the need for energy security and the importance of lowering dependence on imported fuels, while flagging up the high economic, environmental and cultural values of the most popular tourist destinations in Europe: the European islands.

Website for the initiative: http://www.islepact.eu/html/index.aspx?pageid=1020&langID=3

Smart solutions in governance and social innovation
Redeveloping the urban environment

In Mallorca, two areas in the centre of Palma need to be redeveloped and adapted to the needs of visitors and inhabitants. One of those is situated around a heritage listed 1970's building, the now abandoned former headquarters of Gesa, while the other is the area of Nou Llevant, currently deemed unattractive by inhabitants and visitors.

Discussion is ongoing at civil society level concerning projects on urban initiatives proposed by civil society. Based on these concerns, an initiative called "District scientific i technologic urban RAMON LLULL 2030", dedicated to innovation, science and technologies, has been rolled out. On 13, 14 and 15 April 2016, the Ramon Llull 2030 initiative was discussed; this would involve converting the seafront of Palma into an urban scientific development district and attracting talent to the area.
The initiative could be considered a type of social innovation – where possible stakeholders would create a multiplier effect, potentially resulting in more long-lasting and solid outcomes than a solution forced on the local communities.

Reccommendations

The site visits to these islands showed that there is an interest in getting to know the various smart solutions that island communities are using today and which have been proposed for further development.

- Despitetheirgeographicaldiversity,EUislandsfaceidenticalchallengessuchasterritorialdiscontinuity, demographic desertification, strong seasonal fluctuation of tourists, energy dependency on fossil fuels (e.g. diesel), waste management, water supply and funding scarcity.
- Islands are answering these challenges by developing innovative projects which can be a model for other territories, particularly in the fields of ICT, the environment, energy, transport, tourism and commerce.
- Islands are living laboratories since they optimise the use and management of local resources and infrastructures.
- The UNFCCC Paris Agreement is paving the way to a transition towards a low carbon economy. Smart islands have already started this journey through local decisions creating synergies between ICT, the environment, energy, transport, tourism and commerce.
- Innovative projects developed in the islands can be replicated in other EU territories such as less favoured areas in rural areas and EU urban territories in difficulty.

General EESC recommendations

- Impressed by the projects implemented by island communities, households and private actors, the EESC recommends that the European Commission list the islands' initiatives in a catalogue which could inspire other EU territories.

- The Eurostat publication "Portrait of the Islands (Eurostat 1994)" proposed a definition of an island3, which has been modified as shown by the fifth Cohesion Report (CEC, 2010). The EESC again calls for this definition to be revised, taking into consideration "smart" indicators. "Smart" indicators will be defined in cooperation with the local population, authorities and civil society representatives.

- Any Member States with islands could dedicate a specific administration to insular territories in order to better address the specific features of these territories.

General recommendations Information and communication technologies

- Island inhabitants should be guaranteed access to affordable high-speed internet, regardless of the size of the island and population.

- ICT technologies should be encouraged to overcome islands'territorial limitations, particularly in the areas of administration, health, education and training, infrastructure, commerce, spatial planning and social issues.

- The use of safe data protection systems, such as QR codes, should be encouraged.

- As regard free wifi, which has become an asset for increasing the attractiveness of islands, local authorities should ensure that the online storage of data is handled at national level so as to ensure effective control of users' personal information[4].

General recommendations - Energy and transport and the environment

- Decentralised energy production and consumption should be encouraged by Member States since they are a model for islands willing to cut CO2 emissions by reducing their dependence on fossil fuel.

- Renewable energies (such as solar, wind, geothermal and tidal) and energy efficiency (such as smart grid systems, heating systems and public lighting) should be accessible to islanders and encouraged through innovative funding. Funding programmes should support small-scale projects, but private financial institutions should also facilitate the small investments needed by local authorities and/or households.
-
- The EESC recommends that island administrations and islanders be encouraged to move toward soft mobility with the development of public maritime and inland transport modes using alternative fuels such as biogas from waste management (methane).

- Waste management is problematic for all islands. The EESC recommends that islands develop waste prevention projects, particularly for plastics which are expensive to recycle.

General recommendations - Tourism development

- The preservation of local architecture and the redevelopment of old factories, docks, buildings or paths can provide local jobs and attract tourists.

- Innovative, accessible and affordable modes of transport to reach the islands and move around on the islands is crucial for sustainable tourism development. Best practices from island communities, such as extensive use of bicycles, electrical vehicles and local policies supporting such developments, should be more widely disseminated among island communities.

General recommendations - Economic development

- To diversify the economy of the islands, the EESC recommends developing market “niches” based on traditional activities, local resources and e-commerce.

- The EESC recommends developing short supply chains, the circular economy and labels based on geographical indications (GIs) to sell high added-value products from the primary sector (seafood, agriculture).

General recommendations - Scientific initiatives

- The EESC draws the attention of the European Commission and the Member States to the fact that islands are territories suitable for testing innovation. As such, islands should be supported in hosting pilot projects, particularly in the fields of ICT, energy, transport, waste and water management, commerce and fisheries.

- The EESC welcomes the development of scientific and educational initiatives in the areas of renewable energy, marine protected areas and marine conservation, and preservation of cultural heritage. These initiatives create jobs and growth, particularly in small islands.

General recommendations - Governance

- The EESC recommends that local authorities use an interactive approach involving residents and civil society when designing and implementing a project.
- The EESC recommends that small islands exchange knowledge and develop cooperation when answering local challenges. On this point, the EESC considers that the Pact of Islands is a powerful initiative, particularly in the fight against climate change.

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Conclusions

Identical challenges but varied responses, due to opportunities, history and geographical situation.

Some islands have very similar circumstances, such as Favignana and Île d'Yeu, which used to be major centres for tuna fishing which has virtually disappeared due to European regulations. Mallorca and Saaremaa are industrial. Samsø and Kythnos are betting on energy self-sufficiency.

Development via tourism is a reality, but has to deal with the high degree of seasonality which is emphasised on islands.

The lack of jobs and the need to go to the mainland for secondary and higher education leads to a brain drain of young people and an ageing population, which has implications for all sectors but especially for healthcare demand.

Communication and promotion of islands and their unique aspects are an important factor for development, but circumstances vary widely in this respect, as illustrated by Kythnos, a wind power producing island that is far less well known than other Aegean islands.

The fact remains that attracting tourists, preserving an often exceptional environment, making greater use of ICT and sources of renewable energy, and communicating on the strengths of islands, are the pillars of economic and social development on islands.

The EESC will continue to support islands, in its role as bridge between civil society and the EU.


thank you
danke
рахмат
謝謝
ngiyabonga
teşekkür ederim
Баярлалаа
спасибо
gracias
dank je
bedankt
dziękuję
obrigado
sukriya
kop khun krap
go raibh maith agat
mochchakkeram
tapadh leat
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grazie
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Digital Transformation: Enhancing IoT-driven Solutions for Smart Islands

Big data solutions and strategies such as open data and data analytics services for smart islands

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  - The 7 Element of Digital Citizenship
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Course Goal

Train participant about Big Data Solutions, Technologies and strategies that can help them to solve real world problems.

Upon completion of this course, the Participant will be able to:

- Differentiate between Traditional Data solutions and Big Data Solution.
- Understand the Modules of Big Data.
- Explore the Different Big Data Technology options available and learn when to use each option.
- Implement this learnings in real world use cases.

Course Structure

- Traditional Data Solutions vs Big Data Solution
- Architecture Template
- Modules
    - What to architect
    - Best Practices
- Technology Options
    - Define
    - Use Cases
- Real Life Use Cases.

Characteristics of Traditional Data

Numbers, Simple Text

- Generated by applications like Finance, Sales, Payroll
- Well defined schema
- Pre-defined linking
- The data attributes hardly change
- Reside within an enterprise (no cloud)
- Centralized data repository (central server)
- Offline backups (cd, tape backup)

Processing Traditional Data

- Small “distances” between source and sink –instantaneous transfers
  - UI to Database
  - Database to Data Processor to Database
  - Database to Reporting
- Data moves from source to the application code for processing
- Data validation happened at the source (no incomplete /dirty data)
- Use RDBMS to manage data (number, text)
- Pre-summarized and computed data
- Reporting is primarily pre-defined format (fixed reports)

Traditional Solutions Architectures

- Have Single Centralized Data Store
- 3-Tier architectures
  - Presentation Layer (UI)
  - Business Layer (Backend)
  - Data Layer
- Use an App codded either at Home or Brought from the market
- Use Integration through custom Interfaces
- Any Changes require full life-cycle projects

Challenges in Traditional Data Solutions

- Cannot handle Text Processing economically
- Cannot handle Incomplete and dirty data
- High costs for storing text data (H/W, S/W)
- Backups restoration is time-consuming
- High management / licensing costs associated with data Management.
- Any Schema changes take significant time

Big Data Solutions

What is Big Data?

- Gartner: Big Data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation.
- Variety (Text, Video, Audio, machine data)
- Volume (Tera and Peta Bytes)
- Velocity (speed of data not under control)
- Veracity (dirty, incomplete, inaccurate)

What Lead / Trigger to Big Data

- Cloud adaption
- Social Media
- Mobile explosion
- Machine generated Data (like IOT sensors)
- Data driven management (need to Analyze data to take decision)

What is defined as Big Data Applications

- Data in Tera or Peta Bytes
- More than one source / form
- Text or media data
- Huge processing loads – required more processors
- Real time stream processing
- Advanced Analytics required may use ML / AI
- Big Deployment on multiple servers.
- Changing user requirements
- Deploying Big Data is Relatively cheaper

Characteristics of Big Data Products

- Open Source (free to use)
- Open Integration technologies / APIs
- High interoperability
- Constantly evolving with new features.
- Immature

Big Data Trends

- Numerous companies / projects focused on Big Data technologies
- Mainly open source
- Cloud focused
- Focus on “one thing” with open interfaces for integrations
- Growth in adoption by startup culture
- Number of immature alternatives in each segment

Software Product Organizations

- New domains are driving new product features
  - Cloud
  - Social Media
  - Mobile
- Big Data considered necessary for cost savings
- Flexible ad-hoc analysis capabilities demand flexible schema
- Advanced Analytics being added to reporting solutions

Enterprise with IT - Banks

- Curious and scared at the same time
- Mandated to look at Social / Cloud / Mobile data
- Competitive pressure to be data driven
- Wait and watch until technology is mature
- Starting off proof-of-concepts
- Moving towards the cloud for cost savings

What is a Big Data Solution Architecture?

- Acquire and assemble “big data”
- Various formats from diverse sources
- Process and persist in scalable and flexible data stores
- Provide flexible open APIs for querying
- Provide advanced analytics capabilities
- Use Big Data Technologies to “knit” the solution than building ground up.

Traditional Data Solution vs Big Data Solutions

Activity	Traditional Applications	Big Data Applications
Data Acquisition	Data Entry by end users	Fetch ffrom Databases (Traditionnal Applications) , Machine Logs, Social Media
Validation	Validated during Entry	Done post-acquisition – got durty data
Cleansing	Not required	Required for web / social media data
Transformation	Summarization	Text-to-numbers, enrichment, summarization
Persistence	Centralized RDBMS	Distributed Database, Different types of Databases like NOSQL
Applications	3-Tier –business layer centered	Data centered, integration oriented
Usage	Reporting, Analytics,	Analytics, Machine Learning, Predictive & Prescriptive

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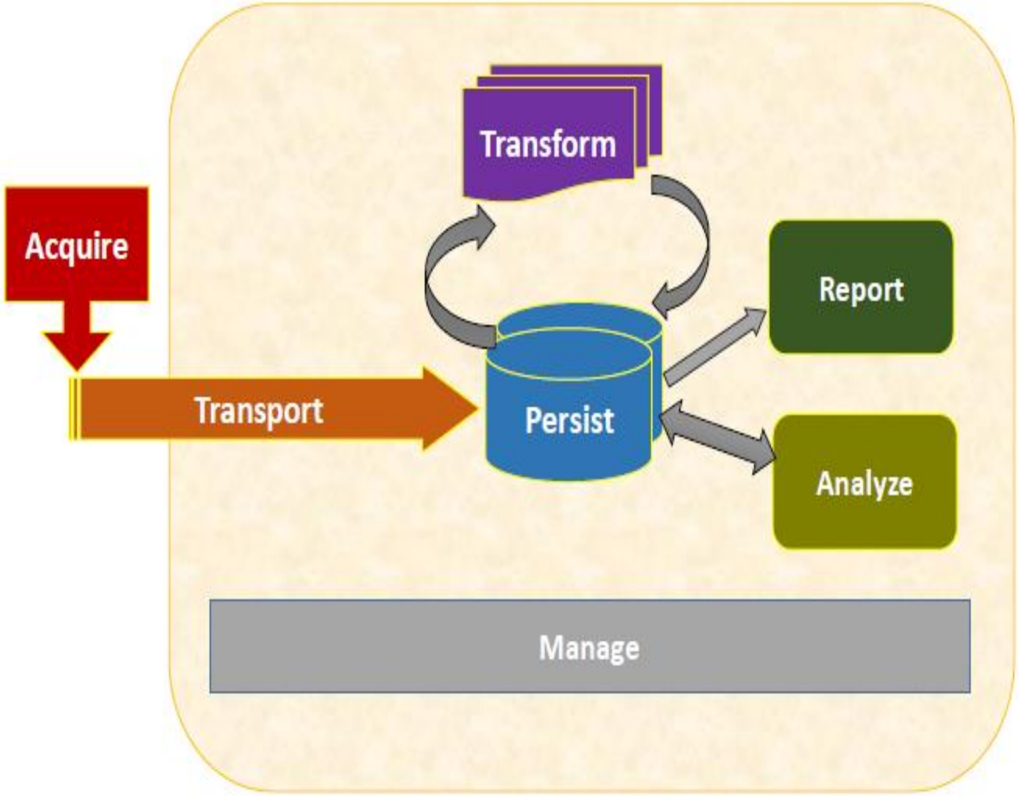
Historical Data vs Real Time data

Historical Data	Real Time Data
Store-and-forward – pulled Data	Streaming - Pushed Data
End-of-day or end-of-processing trigger(batch processing)	Event based trigger –as it happens
Completed records	Live records with updates
Publish full data/ republish	Can publish part of data
No loss of data , but slow	Possible loss of data , but fast
Detailed analytics	Snapshot / intraday / immediate analytics
Model building	Used to make prediction

Modules of a Big Data Solution (Architecture Template)

- **Acquisition (connect and get Data)**
  - Batch & Stream, multiple formats
- **Transportation (destination BT Source and Sink)**
  - Over internet and organizational boundaries
- **Persistence (store data in different format /places)**
  - Polyglot
- **Transformation**
  - Cleansing, Linking, translating, summarizing
- **Reporting**
  - UIs and APIs
- **Advanced analytics**
  - Machine Learning, Prescriptive
- **Management**



Technologies used for Traditional Data – Build from scratch

- Use an App codded either at Home or Brought from the market
- Single programming language –1000s of LOC written
- Single data store
- High development / maintenance costs

Technologies used for Big Data – Assemble and Stitch

- Big data processing has 2 common demands –scalability and reliability
- A number of products / technologies available especially open source
- They support excellent open integrations
- Acquire most suitable components (solution)
- Stitch /integrate them to create final solution
- Minimal custom work
- Very fast to-production times

Challenges with Big Data Technologies

1. **Too many options**
   - Everyone is coming up with a product
   - Each product addresses a narrow specific field
   - There is no one-product fits-all
   - Everyone is trying to expand to cover other use cases
   - Replacement technologies are invented in a fast pace.
2. **Immature and incomplete**
   - High change rate
   - Field support and services are still primitive
   - Need to still address administration and usability
   - Shortage of skilled and experienced personnel
   - Difficult to predict the future

Challenges with Big Data Technologies

3. **Its future is not safe**
    - Technologies going out of vague before the first release of the application
    - Enterprises like their investments to be safe for at least 10 years
    - Companies supporting most technologies are small / startups.
    - Market deployment size not significant except for a few .

What to expect in the next 5-10 years?

- Few products would grow and become the leaders
- Merging of products
- Fewer more mature options
- Stable features

Making investments and future safe

- Look for product and developer support
- Look at cloud options
- Adaptions by leading companies / products
- Open APIs and data formats

Big Data Solution Modules

1. Acquisition Module

Responsibilities

- Connect / maintain connection to the source
- Execute protocol responsibilities (reconnects, handshakes, error handling)
- Data Format conversion (JSON)
- Filtering
- Local caching
- Compression
- Encryption

Big Data Solution Modules

1. Acquisition Module

Data Source Types

- Databases / Data warehouses
- Files (DB, Logs, Audio, Video, etc)
- HTTP/REST
- Data Streams
- Custom applications

What to architect?

- Identifying new data
- Re-acquisition and retransmit
- Data Loss –not missing records
- Buffering at the source
- Security –source provider policies
- Privacy –policies
- Alerting /alarming for issues

Big Data Solution Modules

1. Acquisition Module

Best Practices

- Involve source owners to establish good handshakes
    - Identifying new data
    - Identifying missing data and retransmission
- Go for reliable Open APIs
- Native APIs/Formats should be standardized as early as possible
- Real-time vs historical –consider separate channels
- Pay attention to security and privacy

Big Data Solution Modules

1. Acquisition Module

Acquire Technology options

1. **SQL Query**
    - Traditional way of extracting data from Relational Databases
    - Mature technology
    - Ability to transform (joins, group by, cube) and filter data
    - Indexing takes care of performance without any programmer work.
    - Encryption and compression supported.
    - **Use Cases:**
        - RDBMS sources.
        - Apache Hive (open source)

Big Data Solution Modules

1. **Acquisition Module**

Acquire Technology options

2. **Files**

- Simple and common way of exchanging / moving data
- Data converted to files (CSV, TSV, XML, JSON)
- Media, text files can be easily stored in files
- **Use Cases:**
  - Inter-organizational data movement
  - Media files
  - Secure data encryption/ compression

Big Data Solution Modules

1. Acquisition Module

Acquire Technology options

3. Rest APIs

- Rest API is A web-based API standard for exchanging data and performing CRUD operations
- Decouples consumers from producers
- Provides Stateless existence
- It Uniform interface across sources : GET, POST, PUT, DELETE
- Support advanced security and encryption
- Support by most cloud and mobile data sources (Twitter, Facebook, Salesforce etc.)
- **Use Cases:**
  - Inter-organizational data movement
  - Media files
  - Secure data encryption/ compression

Big Data Solution Modules

1. **Acquisition Module**

Acquire Technology options

4. **Streaming – push data to client**
   - Real time data subscribe / publish model
   - Client subscribes to a specific topic/ sub-set of data
   - HTTP connection is kept “open”
   - Server pushes data to client whenever new data is available
   - Uses secure keys and encryption
   - **Use Cases:**
     - Real time sentiment analysis (Analyze social media data)
     - Real time reporting
     - Real time actions based on user behavior

Big Data Solution Modules

2. Transport Module

Transport Types

- Store and Forward
  - Receive from a source “at rest”
  - Move data in units
  - Track completion
  - Retransmit if required
- Streaming
  - Continuous moving data stream
  - Throttle at source
  - Throttle for sink
  - Inflight storage

Big Data Solution Modules

2. Transport Module

Responsibilities

- Maintain link with acquisition module
- Translate data to protocol optimal formats
- Move data
- Secure Data
- Maintain link with Persistence module
- Save data in Persistence module (and confirm)
- Track data as it moves
- Re-transport in case of failures
- Reporting

What to architect?

- Speed
- Throttling
- Reliability of data (no loss in transport)
- Redundancy
- Scalability
- Status Reporting and alarming
- Compression
- Encryption

Big Data Solution Modules

2. Transport Module

Best Practices

- Do not reinvent the wheel
- Piggy back on proven messaging/transfer frameworks and protocols.
- Look for integrations between transport technologies with acquisition, transformation and persistence technologies.
- Be aware of data transport costs
- Use reliable storage
- Consider security measures to prevent data theft.

Big Data Solution Modules

2. Transport Module

Transport Technology options

1. File Move / Copy commands
   - Simplest way of moving large files
   - Supported on all operating systems
   - Inter-operating system transfers would require adapters
   - Can be quickly scheduled /automated
   - **Use cases:**
     - Intra-enterprise.
     - Media Files.

Big Data Solution Modules

2. Transport Module

Transport Technology options

2. Secure File Transfer Protocol (SFTP)
    - Is Network Protocol for File Access and Transfer
    - Uses a secure channel for data protection (SSH)
    - Support Authentication/authorization (SSH)
    - Support Data integrity checks
    - Can resume interrupted transfers
    - Files carry basic source attributes like timestamps
    - Wide support across O/S, tools and utilities
    - **Use cases:**
        - Inter-enterprise file sharing, log files.
        - Media Files transfers.

Big Data Solution Modules

2. Transport Module

Transport Technology options

3. Apache Sqoop (open source)
   - A Command Line tool for transferring data between relational databases and Apache Hadoop
   - Allow to transport Entire databases, tables or results of SQL
   - Support various file format for Avro, Sequence, Parquet or Plain text files
   - Can transport data to Hive and HBase Databases.
   - Support Parallelism
   - Support Incremental transfers
   - BLOB support
   - **Use cases:**
     - Hadoop based backups and data warehouses
     - Move data to HBase/Hive
     - Analyzed data from Hadoop to RDBMS

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Big Data Solution Modules

2. Transport Module

Transport Technology options

4. Apache Flume (open source)

- Is A distributed Service for collecting, aggregating and moving large amounts of log/ streaming data
  - Each origin has a source component to get events
  - A Channel used to transport data
  - A sink where the event is deposited
- Sources can span a large number of servers
- Support for multiple sources (files, strings, HTTP POSTs, twitter streams)
- Support for multiple sink types
- Can add custom sources and sinks through code
- Robust, fault tolerant, has throttling, failover and recovery capabilities
- Inflight data processing through interceptors

Use Cases:

- Web log shipping
- Twitter streaming
- Edge server events processing

Big Data Solution Modules

2. Transport Module

Transport Technology options

5. Apache Kafka (open source)
    - An open source message broker platform for real time data feeds
    - Has Publish –subscribe architecture.
    - Developed by LinkedIn, written in Scala.
    - Topics are published. Multiple subscribers can be there for a topic
    - Ordering guarantees
    - Coding required for the publisher and the subscriber to interface with Kafka
    - Support Replication and high availability

Use Cases:

- Real time analytics
- Operational metrics aggregation
- Complex event processing

Big Data Solution Modules

3. Persistence Module

Responsibilities

- Offer reliable data storage.
- Comply with (Atomicity, consistency, isolation, durability)
- Can provide schema.
- Support logical Transactions
- Adopt various Data Access (drivers).
- Support strong response times.
- Support scalability (multi-cluster,..)

What to Architect?

- Scalability
- Consistency
- Transactions
- Read intensive vs write intensive.
- Mutable vs immutable data.
- Able to catalog, get meta-data.
- Latency : real time data vs historical data.
- Standard vs adhoc loads.
- Flexible schema.

Big Data Solution Modules

3. Persistence Module

Best Practices

- Keep schema /design flexible
- Keep data at lowest granularity – at transaction level
- Summarize data only if needed
- Consider your real time application needs
- Take backups

Big Data Solution Modules

3. Persistence Module

Persist Technology Option

1. **RDBMS**

- Still has a Big role in Big Data Architectures
- Stores data in Tables and Columns
- Optimized for numbers
- Excellent Query performance
- Limitations in scalability.
- Schema need to be predefined
- Mature options –Oracle, MySQL, SQL Server

Use Cases:

- Use it When we need Meta Data
- Multi Update cases – live update
- Work In Progress Data
- Store Summary data
- Store Results

Big Data Solution Modules

3. Persistence Module

Persist Technology Option

2. **HDFS (open source)**

- A distributed file system that can span across hundreds of data nodes
- Multiple copies of the same file eliminates need for backups
- Can run on commodity servers
- Resilient to node failures.
- Open Source Apache project
- Allows for parallel execution of Map Reduce tasks

Use Cases:

- Store and process Log files
- Media files (recordings)
- Online backup for RDBMS data

Big Data Solution Modules

3. Persistence Module

Persist Technology Option

3. Cassandra (open Source)

- Wide Column Big Table data store.
- Open source developed by Facebook
- Dynamic Schema
- Decentralized architecture
- Single index for each table
- Excellent single-row query performance
- Has Bad range scan performance
- No aggregation support

Use Cases:

- Required to provide Customer 360 view of data.
- Monitoring Statistics and analytics
- Location based lookup

Big Data Solution Modules

3. Persistence Module

Persist Technology Option

4. **MongoDB (open Source)**

- Document Oriented Database (JSON)
- Strong consistency
- Expressive Query Language
- Support Multiple Indexes on table.
- Support different types of Aggregations
- Support Replication and failover
- Based on Master Slave Model

Use Cases:

- Store documents
- Write once read many data stores
- Real time analytics
- Possible RDBMS replacement

Big Data Solution Modules

3. **Persistence Module**

Persist Technology Option

5. **Neo4j (open Source)**

- Graph oriented database
- Deals with Relationships –nodes and edges
- Has ACID Compliant similar to RDBMS
- Transaction support
- Cypher –Graph Query Language
- Easy to program complex joins

Use Cases:

- Master Data Management
- IT Network modeling
- Social network modeling
- Identity and Access Management

Big Data Solution Modules

3. Persistence Module

Persist Technology Option

6. ElasticSearch (open Source)

- A full text search-engine
- A distributed document store
- Every field is indexed and searchable
- Can scale hundreds of servers for structured and unstructured data
- Aggregation support

Use Cases:

- Not recommended as primary data store
- Adhoc query building and aggregation
- Real time analytics.

Big Data Solution Modules

4. Transformation Module

Responsibilities

- Cleansing data
- Filtering
  - Unwanted, incomplete
- Standardization
  - Format, content
- Enrichment
  - Adding ID-names mapping, categorization
- Integration
  - Between data sources
- Summarization

What to architect?

- Real time vs historical
- Create Templates to process data.
- Your data DE normalization
- Reprocessing
- Parallelism
- Speed
- Need Work-In-Progress Storage

Big Data Solution Modules

4. Transformation Module

Best Practices

- Keep Real time and historical separate for data > Tera bytes
- Use Map-Reduce concept for parallel processing
- Don’t reinvent the wheel
- Build template code /functions for enterprise known use cases
- Keep intermediate data for some time to enable reprocessing
- Summarize only if really required. Keep data in original detail
- Build monitoring capabilities for performance

Big Data Solution Modules

4. Transformation Module

Transform Technology options.

1. Custom Code

- Write custom code in your favorite programming language
- Build-it-yourself. Think before you got there
  - Scalability
  - Reliability
  - Parallelism
- People who built such actually ended up building products that we use today

Use Cases:

- Not recommended unless your use case has no readymade solutions

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Big Data Solution Modules

4. Transformation Module

Transform Technology options.

2. Hadoop Map-Reduce

- The first big data processing technology
- Processing Code moves to where data resides
- Mappers code works in parallel on individual records and transform
- Reducers code summarize and aggregate data
- Series of map-reducers work on a pipeline
- Uses cheap hardware with extreme parallelism

Use Cases:

- Batch mode processing
- Text mining
- Data Cleansing & Filtering
- Analyzing media files

Big Data Solution Modules

4. Transformation Module

Transform Technology options.

3. *QL Query

- Data Products today have some form of SQL support either native or through other interface
  - Hive, Impala
- Can use *QLs to do:
  - Filtering
  - Cleansing
  - Transformation
  - Summarization
  - Insert/update back to source
- The SQL engine does the heavy lifting

Use Cases:

- Filtering
- Summarization
- Copying Data

Big Data Solution Modules

4. Transformation Module

Transform Technology options.

4. Apache Spark (open source)

- New Generation general data processing engine.
- Eliminates a number of issues in traditional Map-Reduce
- Works on data in memory and in distribution fashion
- Supports Map-Reduce type operations, but a lot faster.
- Can work on Streaming real time data
- Support for Java, Python, R
- Has SQL and Graph capabilities
- Interactive processing capabilities

Use Cases:

- Wide range of use cases
- Interactive processing
- Stream processing

Big Data Solution Modules

4. Transformation Module

Transform Technology options.

5. ETL Products

- Talend, Pentaho, Jaspersoft, Snaplogic.
- Commercial and Open Source offerings
- Visual ETL / pipeline builders with almost no coding
- Can build flows from acquisition to transformation to storage
- Custom functions possible
- Have Operational management modules

Use Cases:

- Any use case is supported on paper.
- Please try out the product before jumping in

Big Data Solution Modules

5. Reporting Module

Responsibilities

- Pre-defined Reports
- Do-it-yourself report designer
- Dashboard Designer
- Need API to extract data from the persistence layer (storage)
- Have Authentication and Authorization
- Real time data presentation
- Alerting

What to architect?

- Focus on Response times
- Access reports from mobile and Mobile.
- Personalization
- Advanced Graphical capabilities
- Threshold management
- Integration with other systems
- Search

Big Data Solution Modules

5. Reporting Module

Best Practices

- Pick a tool with easy to use graphics capabilities
- Tool should have integrated with variety of data sources
- Can Aggregate on the fly without compromising on performance
- Use open standards for data access/integrations
- Provide for personalized dashboards
- Design for multiple interfaces –mobile, web, embedded
- Search is a key capability today

Big Data Solution Modules

5. Reporting Module

Reporting Technology options

1. Cloudera Impala

- In-memory distributed query engine for Hadoop
- Interactive Shell for Queries
- Very fast compared to Hive (no Map Reduce)
- Supports Joins, sub-queries, aggregations
- Supports Hadoop and HBase
- Has ODBC Drivers and Thrift APIs

Use Cases:

- Adhoc querying on Hadoop
- Has API interface for file management applications
- Has HBase data access

Big Data Solution Modules

5. Reporting Module

Reporting Technology options

2. Spark SQL

- Provides SQL like programming –easy to use
- Internally implemented as Map-Reduce operations on Spark .
- Very fast and flexible
- Supports aggregations and joins
- Machine Learning integration with Spark ML
- Can be used for interactive and stream programming

Use Cases:

- Programmed Querying of large datasets
- You have Single system for ETL, Analytics and Advanced Analytics
- Real time analytics

Big Data Solution Modules

5. Reporting Module

Reporting Technology options

3. Elastic

- Elastic has product called ElasticSearch which provides an excellent search engine on existing data
- Has another product called Kibana which provides visualization capabilities on ElasticSearch data
- Has Aggregation capabilities
- Has Streaming data support
- Has Graphics support
- Scalability
- Search support.

Use Cases:

- Enterprise Dashboards and Reports
- Adhoc Query UIs
- Real time Monitoring

Big Data Solution Modules

6. Advanced Analytics Module

Types of Analytics

Types of Analytics	Description
Descriptive	Understand what happened
Exploratory	Find out why something is happening
Inferential	Understand a population from a sample
Predictive	Forecast what is going to happen
Causal	What happens to one variable when you change another
Deep	Use of advanced techniques to understand large and multi-source datasets

Big Data Solution Modules

6. Advanced Analytics Module

Responsibilities

- Model building capabilities
  - Supervised and unsupervised
- Support Validation techniques
- Support Ensemble algorithms
- Support Interactive development
- Has Automation capabilities
- Predictions

What to Architect?

- Scalability
- Performance –especially predictions
- Validations –both model and predictions
- Algorithms –options, configurations, tuning
- Automation and operationalization

Big Data Solution Modules

6. Advanced Analytics Module

Best Practices

- Architecture aligned with methodology –work with data scientists
- Plan adhoc model building –make sure they do not affect other processing
- All Advanced Analytics projects don’t yield results
  - Set expectations right
  - Choose easy projects initially
- Keep an eye on automation and operationalization

Big Data Solution Modules

6. Advanced Analytics Module

Advanced Analytics Technology Options

1. R

- Language / Environment for Statistical Computing and Graphics
- Long history of use by Statisticians
- Wide package set for various machine learning algorithms
- Data Cleansing, Transformation and Graphics capabilities
- RStudio –IDE for interactive programming
- Runs on data in memory
- Limited to the memory of the node where it runs

Use Cases:

- Interactive Model building / Trials on small data sets
- Small data science applications
- Presentations

Big Data Solution Modules

6. Advanced Analytics Module

Advanced Analytics Technology Options

2. Python

- Standard Programming language that has Big Data / Data Science related packages and capabilities
  - NumPy, SciPy, Pandas, Scikit-Learn
- Vast array of third party libraries
- Data Cleansing and Graphics capabilities
- IDEs available for interactive programming
- Integration with Apache Spark
- Multi purpose language –can be used for other capabilities too

Use Cases:

- Interactive Model building / Trials on small data sets
- Data Cleansing
- Small Advanced Analytics applications

Big Data Solution Modules

6. Advanced Analytics Module

Advanced Analytics Technology Options

3. Apache Spark

- Apache Spark has ML Library –supports a good set of machine learning algorithms
- ML library uses Data Frames from Spark SQL
- ML algorithms scale horizontally across a cluster
- Can use Java, Scala or Python
- Interactive model building possible –can run on a windows desktop
- Excellent integration with Big Data Sources
- Real time analytics / predictions

Use Cases:

- Predictive modeling for large datasets
- Model building on NoSQL data sources
- Real time predictions

Big Data Solution Modules

6. Advanced Analytics Module

Advanced Analytics Technology Options

4. Commercial Software

- Tableau, SAS, RapidMiner etc.
- Good set of algorithms
- Good graphics support
- Can Scale
- Can use various Data sources
- Very Pricey.

Use Cases

1. Enterprise Data Backup

Use Case Description

- ABC Enterprise currently keeps 18 months of CRM data in RDBMS and 7 years of archived data on tapes.
- ABC Enterprise wants to move from tape backups to HDFS backups
    - Access of data is easier
    - Can use commodity hardware with potential to move to the cloud
    - No offline backups required
- Provide adhoc querying capability on the data

Use Cases

1. Enterprise Data Backup

Characteristics

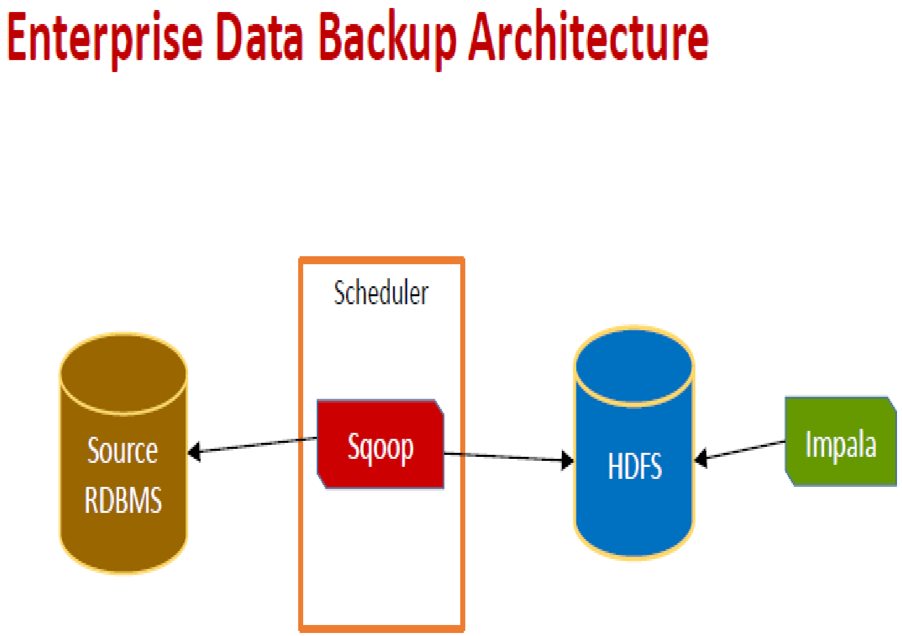
Characteristics	Type	Notes
Sources	RDBMS	
Data Types	Numeric and relational	
Mode	Historical	
Data Acquisition	Pull	
Availability	After 1 day	Data needs to be available in the data warehouse after 1 day since the original data is created
Store type	Write once, read many	
Response Times	As good as possible	Given adhoc querying requirements, queries can run for a few seconds.
Modelbuilding	None	

Use Cases

1. Enterprise Data Backup

Big Data Solution

Module	Technology option	Notes
Acquire	Sqoop	Default choice for Database Extract
Transport	N/A	
Persist	HDFS	Store in native HDFS format as Sequence Files
Transform	N/A	
Reporting	Impala	Basic adhoc querying tool
Advanced Analytic	N/A	



Use Cases

2. Media File Store

Use Case Description

- ABC Enterprise has contact center where all calls are recorded. These recordings need to be archived for analytics
- ABC Enterprise wants to move from tape archive to online archive
- Provide adhoc querying capability on the data

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Use Cases

2. Media File Store

Characteristics

Characteristics	Type	Notes
Sources	Contact Center recording solutions	
Data Types	Media files	
Mode	Historical	
Data Acquisition	Pull	
Availability	After 1 day	Data needs to be available in the media store after 1 day since the original data is created
Store type	Write once, read many	
Response Times	As good as possible	Given adhoc querying requirements, queries can run for a few seconds.
Modelbuilding	None	

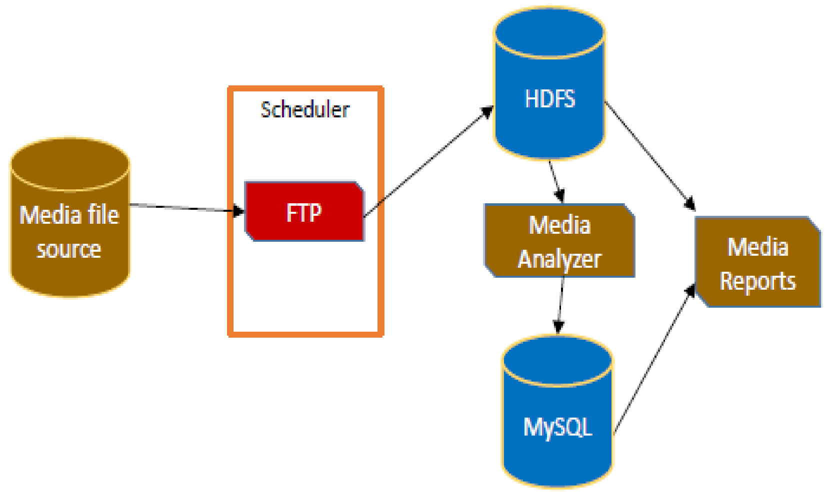
Use Cases

2. Media File Store

Big Data Solution

Module	Technology option	Notes
Acquire	Files	Only choice for media files
Transport	FTP	Easy transfer; security and compression capable
Persist	HDFS, MYSQL	Media files stored in HDFS ; Meta-data and analytics stored in MySQL
Transform	Custom	Custom Media Analyzer for tagging media files and storing meta data
Reporting	Impala	Custom Media Reporting tool to analyze meta data and listen to recordings
Advanced Analytic	N/A	

Enterprise Data Backup Architecture



Use Cases

3. Social Media Sentiment Analysis

Use Case Description

- ABC news corporation tracks popular topics on social media and uses them for their news reporting
- They want an automated system to capture social media interactions on popular topics and do real time sentiment analysis
- Sentiment Analysis need to be summarized and archived for future analysis too.

Use Cases

3. Social Media Sentiment Analysis

Characteristics

Characteristics	Type	Notes
Sources	Twitter, Facebook	Social media popular topics. Topics are configurable
Data Types	Tweets, posts (JSON)	
Mode	Real time	
Data Acquisition	Streaming / push	
Availability	Real time	On the fly analytics
Store type	Write many, read many	
Response Times	Real time	Given adhoc querying requirements, queries can run for a few seconds.
Modelbuilding	Sentiment Analysis	

Use Cases

3. Social Media Sentiment Analysis

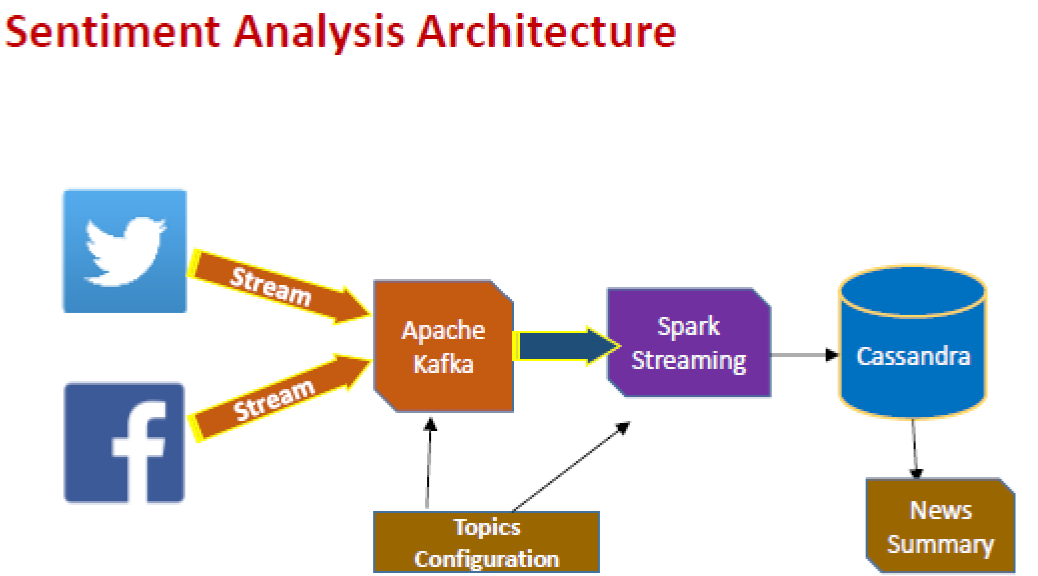
Big Data Solution

Module	Technology option	Notes
Acquire	Streaming	Streaming supported by all social media websites
Transport	Kafka	Kafka provides scalable real time transport for data. Has interfaces to Twitter streaming as well as Spark
Persist	Cassandra	Store data by topic. The social media topic would be used as the key.
Transform	Apache Spark	Real time stream subscription and transformation
Reporting	Custom	Custom application for reading Cassandra data and summarizing for news
Advanced Analytic	Apache Spark	Sentiment Analysis on the fly with stream processing

Use Cases

3. Social Media Sentiment Analysis

Big Data Solution



Use Cases

4. Credit Card Fraud Detection

Use Case Description

- ABC Systems runs a web based retail solution where customers can order any kind of products (like Amazon)
- Sometimes credit card thieves use stolen information to make purchases. This later results in loss of revenue
- ABC systems needs a real time Credit Card Fraud prediction system so that the purchase is blocked before its complete.

Use Cases

4. Credit Card Fraud Detection

Characteristics

Characteristics	Type	Notes
Sources	web transactions	Data is captured in real time while payment is being made on the web
Data Types	Numeric / CRM	
Mode	Real time / Historical	Historical data collection ; prediction in real time
Data Acquisition	Streaming / push	Data pushed from browser as transactions happen
Availability	Real time	Real time predictions
Store type	Write once , read many	
Response Times	Minimal	Prediction need to be made when the purchase is made.
Modelbuilding	Binary Classification	Model to predict if a transaction is fraudulent or not.

Use Cases

4. Credit Card Fraud Detection

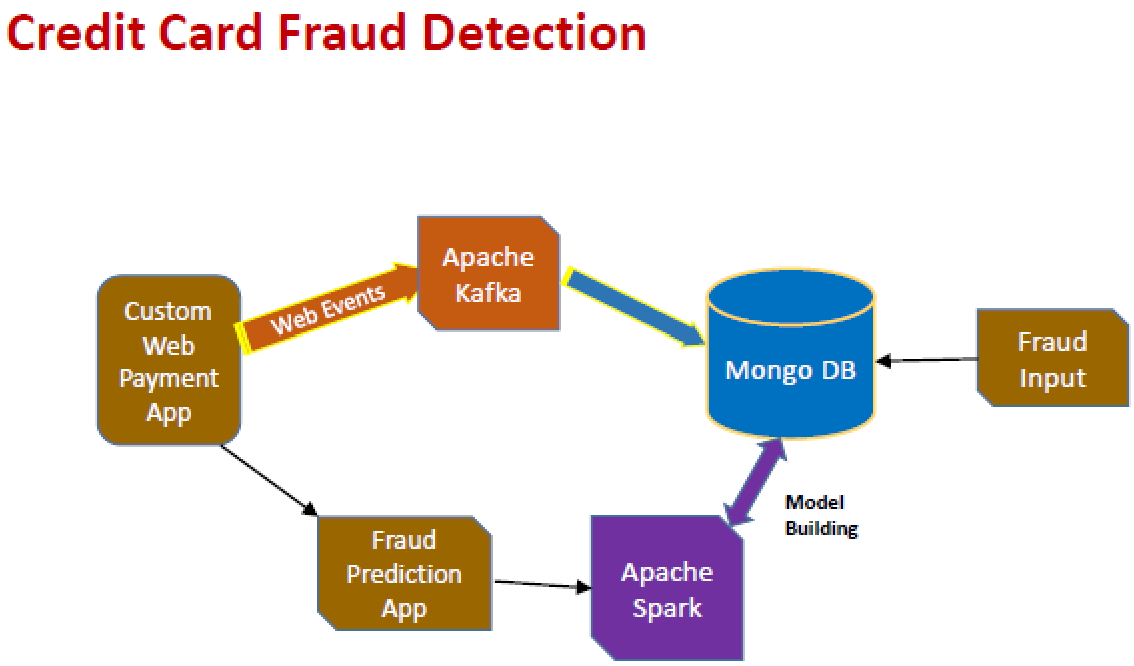
Big Data Solution

Module	Technology option	Notes
Acquire	Web Events	Generated by custom web app. Deployed on a web farm
Transport	Kafka	Kafka provides scalable real time transport for data. Web Transaction events from web app.
Persist	MongoDB	Web events/transactions accumulated and stored in Mongo DB; Also models built are stored in Mongo DB
Transform	Spark	
Reporting	None	Architecture can be enhanced to add adhoc reporting on the web transactions if required.
Advanced Analytic	Apache Spark	Binary Classification model building

Use Cases

4. Credit Card Fraud Detection

Big Data Solution



Use Cases

5. Connected Car - IOT

Use Case Description

- ABC Car company wants to connect cars in real time to analytics engine
- Cars have multiple sensors. Sensor data need to be analyzed (real time / historical) to generate alarms for possible failures to the driver
- ABC needs a satellite enabled data collection and alarm system backed by a big data infrastructure

Use Cases

5. Connected Car - IOT

Characteristics

Characteristics	Type	Notes
Sources	Car sensors	Sensors in car
Data Types	Numbers	Numeric event sensor data
Mode	Historical / Real time	Critical data processed real time. Rest historical
Data Acquisition	Push	Sensors send data to collection centers
Availability	Real time	Real time alarms needed
Store type	Write many, read many	Car profile need to be stored
Response Times	Real time	Real time profile fetches for real time alarming
Modelbuilding	Car issue prediction	Predict possible future issues

Use Cases

5. Connected Car - IOT

Big Data Solution

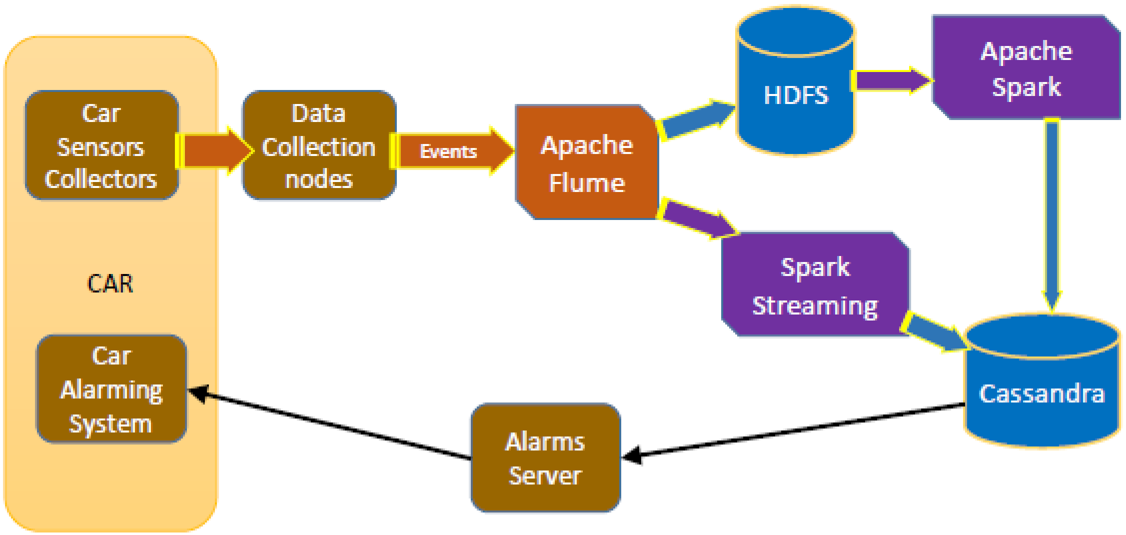
Module	Technology option	Notes
Acquire	Events from Car Sensors	
Transport	?	
Persist	?	
Transform	?	
Reporting	Custom	
Advanced Analytic	?	

Replace the Question Mark (?) with appropriate Technology option for each Big Data Module.

Use Cases

5. Connected Car - IOT

Big Data Solution




thank you
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謝謝
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Digital Transformation: Enhancing IoT-driven Solutions for Smart Islands

Security considerations for smart islands

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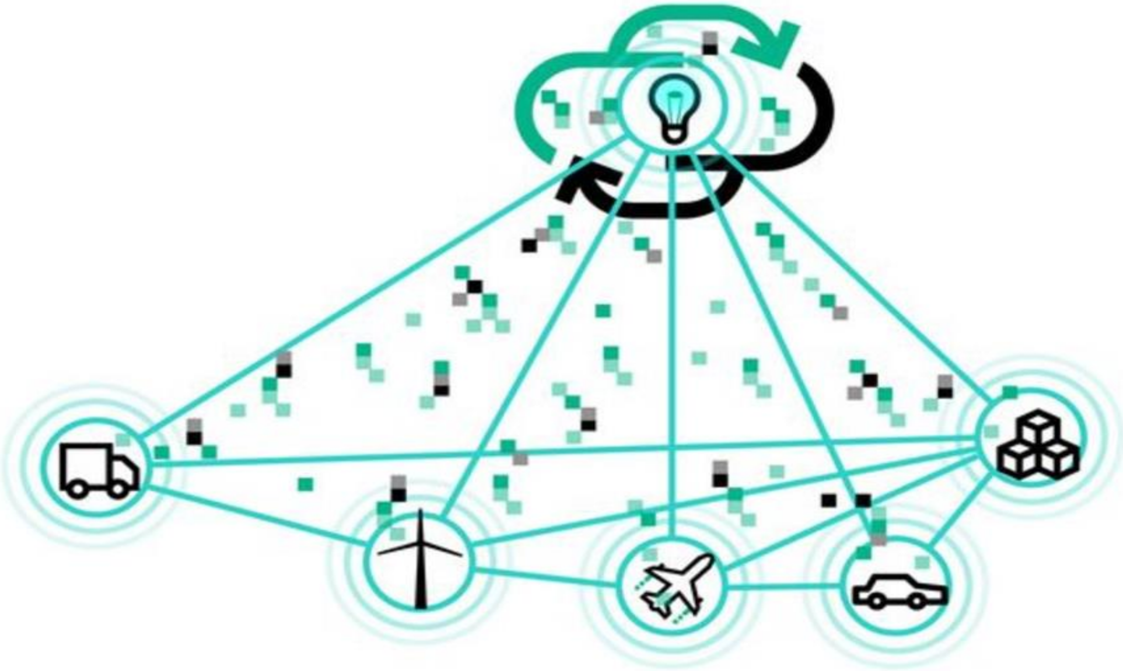
What *is* the Internet of Things?



It's about connected devices, systems, and "things" …

Gartner estimates 26 billion connected devices by 2020.

It's about data from the "things …

IDC predicts IoT data will account for 10% of the world's data by 2020.

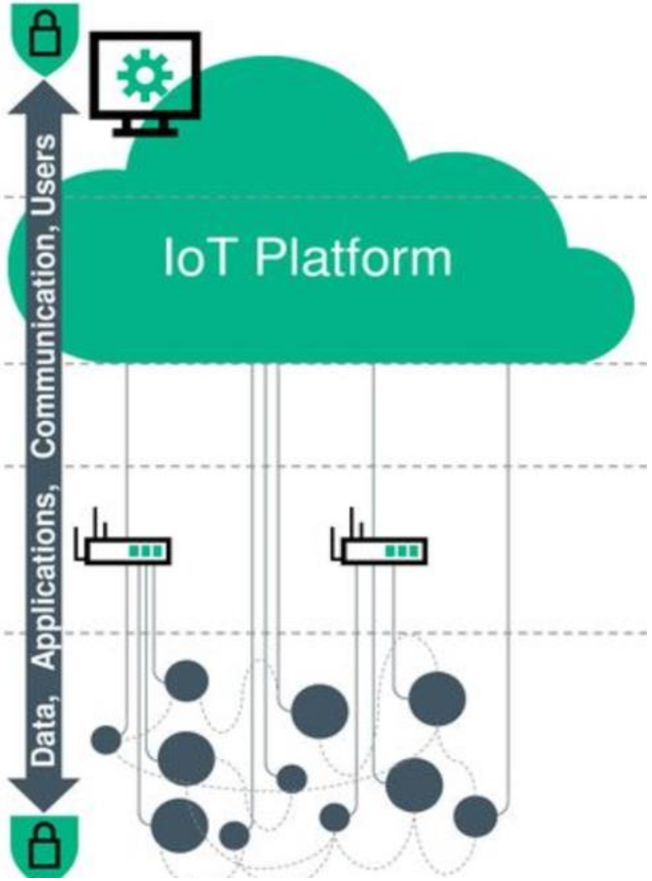
It's about new insights…

Business, engineering, scientific insights


What *is* the Internet of Things?
Collaboration & Analytics
Interconnect Operations Technology (**OT**) and Information Technology (**IT**) to enable Machine to Machine communication (**M2M**) and collaboration.
Collect all **data** and **transform** the business model with **Analytics** to gain **new business insights**.
One single breach though,
can destroy the whole business model!
In-band Analytics
Out-of-band Analytics and Long-Term Learning

What are the main IoT Building Blocks that need to be secured?

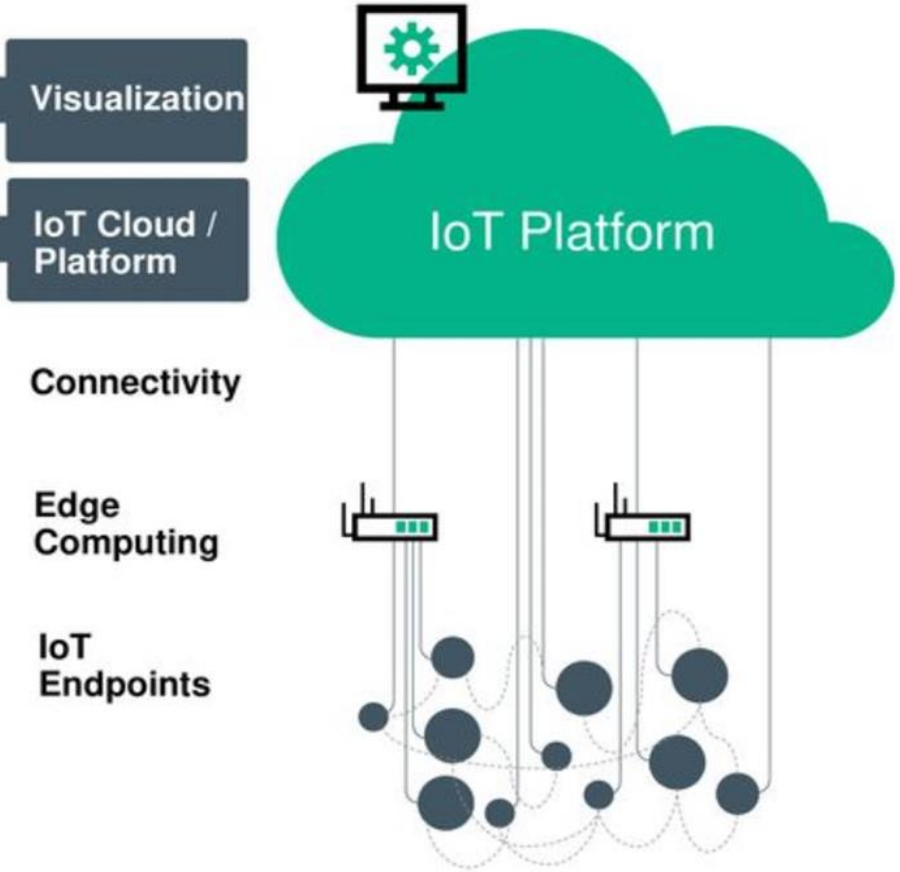
Applications that present and visualize the findings and key performance indicators (KPI). Open ecosystem for partners and suppliers.	**Visualization**
Operations and control of the IoT infrastructure. Central **data storage**. Contextual enrichment, **Big-Data analytics** and (deep) machine learning. Turning Data into insights. Turning insights into Business Transformation.	**IoT Cloud / Platform**
Ubiquitous, reliable and secure **communication** technology for all endpoints and edge devices.	**Connectivity**
Processing unit sitting on the same physical entity (e.g. car, turbine, airplane, building) as the IoT endpoints. Translates the **OT protocol** (e.g. SCADA) to an **IT protocols** (e.g. TCP/IP). Ingests and pre-processes the data (also called **Edge Analytics** or **Real-Time Analytics** or **In-band Analytics**).	**Edge Computing**
Distributed Sensors and **Actuators** - either mobile or stationary but always connected to the IoT cloud via the internet or a private network. IoT endpoints can connect directly or via an edge computing device. IoT endpoints can also communicate to each others (**machine to machine** – M2M)	**IoT Endpoints**



What are the main Attack Scenarios and Risks?

Vulnerable Web Applications and APIs
Vulnerabilities in the IoT clouds web applications and API interfaces can lead to a denial of service, data loss or a complete take over of the application. The most common web application security flaws are listed in the OWASP Top10 and must be protected by all means.

Targeted Attacks
IoT infrastructures are like all other environments for attackers if and when there is sensitive data that can be monetized. Targeted attacks (Advanced Persistent Threats – APT) must be detected as soon as possible to take away what the attackers need most – time to find and exfiltrate/damage the valuable data.

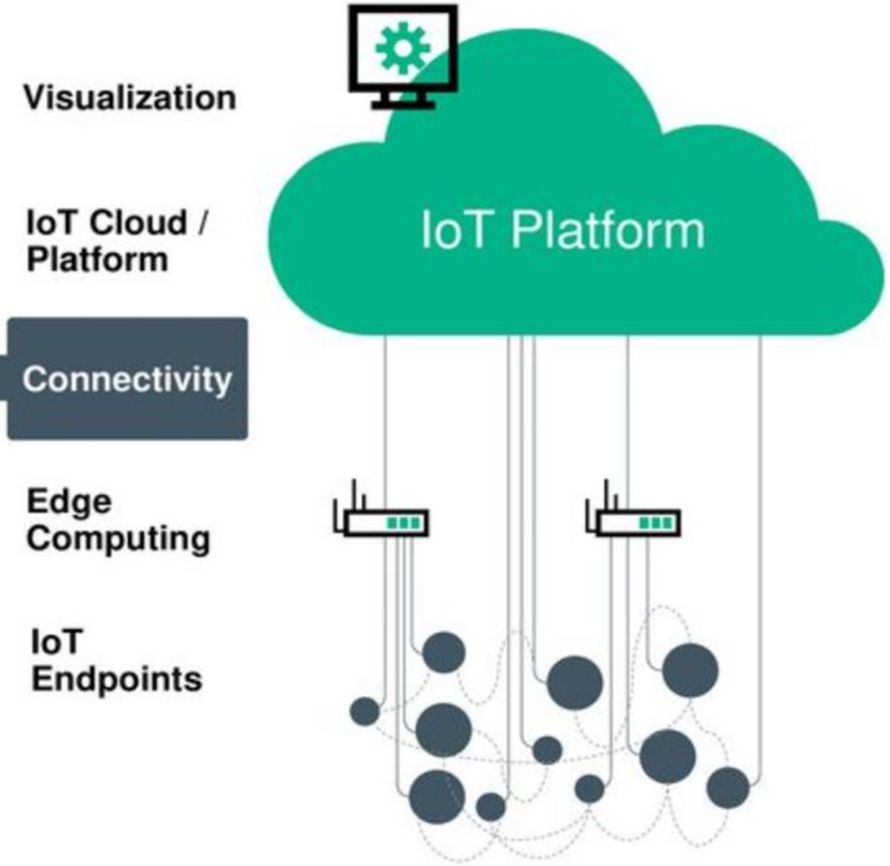


What are the main Attack Scenarios and Risks?

Man-In-The-Middle Attacks (MitM)
Attackers that sneak into the communication between two parties (e.g. IoT Edge and IoT Cloud) who believe they are directly communicating with each other, can cause immense damage to the whole IoT system.

Denial-of-Service Attack (DoS)
IoT cloud services like Web(APIs) portals, VPN can be disrupted and made unavailable temporarily or indefinitely.

Unauthorized Access
By simulating the identity of authorized endpoints, rogue endpoints can sneak their way into the system.

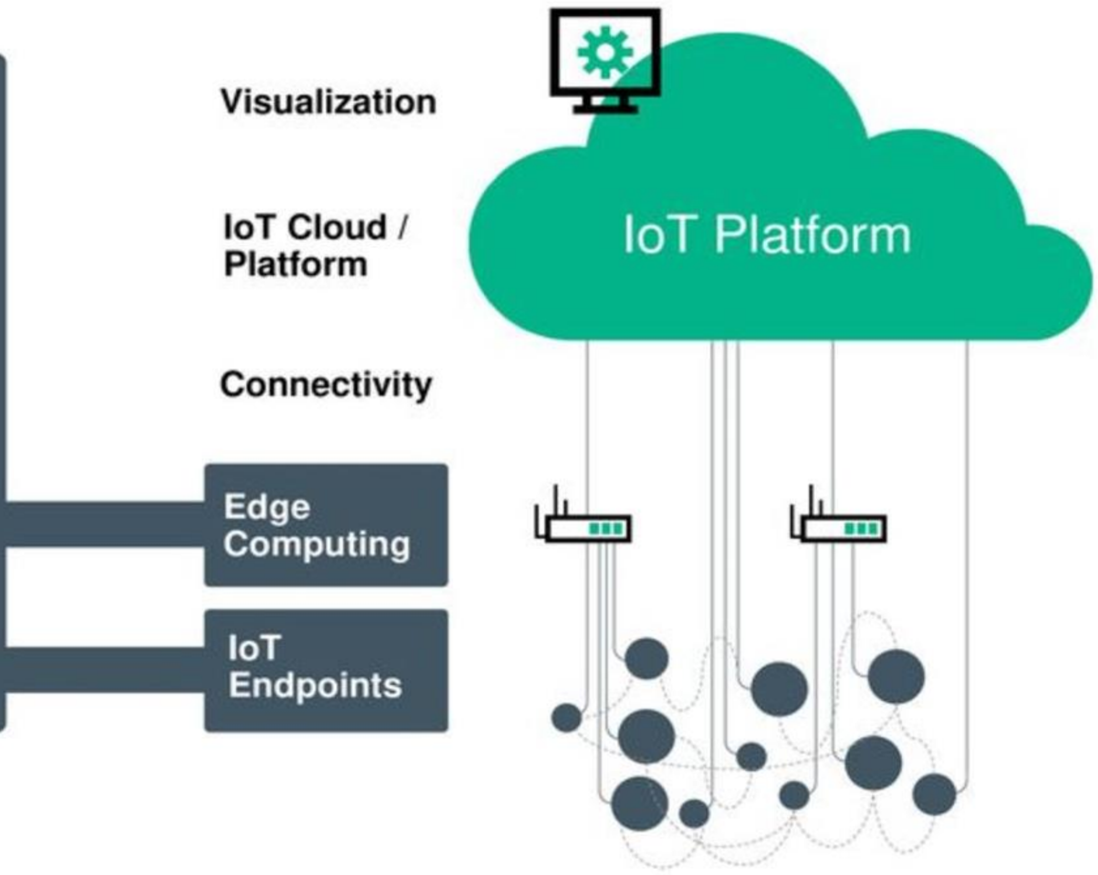


What are the main Attack Scenarios and Risks?

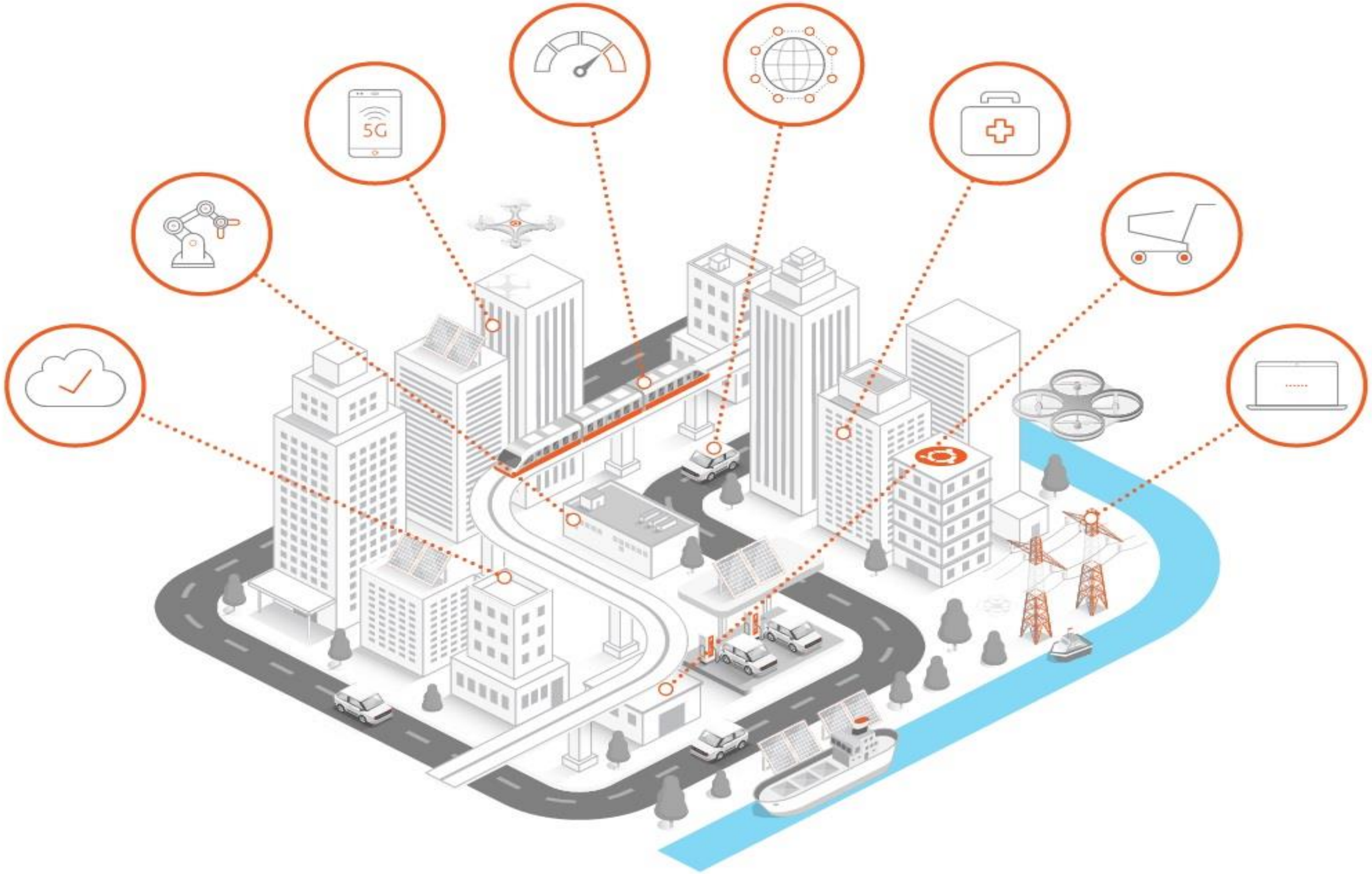
Rogue Endpoints / Edge Devices
A rogue device (endpoint or edge computing device that has been installed on the IoT network without explicit authorization, added by a malicious person) whose data is accepted by the rest of the IoT infrastructure can cause immense damage by rendering the data useless and/or causing unwanted behavior in the whole system.

Compromised Endpoints / Edge Devices
Vulnerable Software on the devices may result in compromised systems. Especially lightweight and price sensitive endpoint devices are extremely hard to patch in a timely manner after a vulnerability has been detected.

Data Leakage
Data from the endpoint- and edge computing devices can hold sensitive information such as personally identifiable information (PII). Leakage of unprotected data can lead to financial and reputational damage.

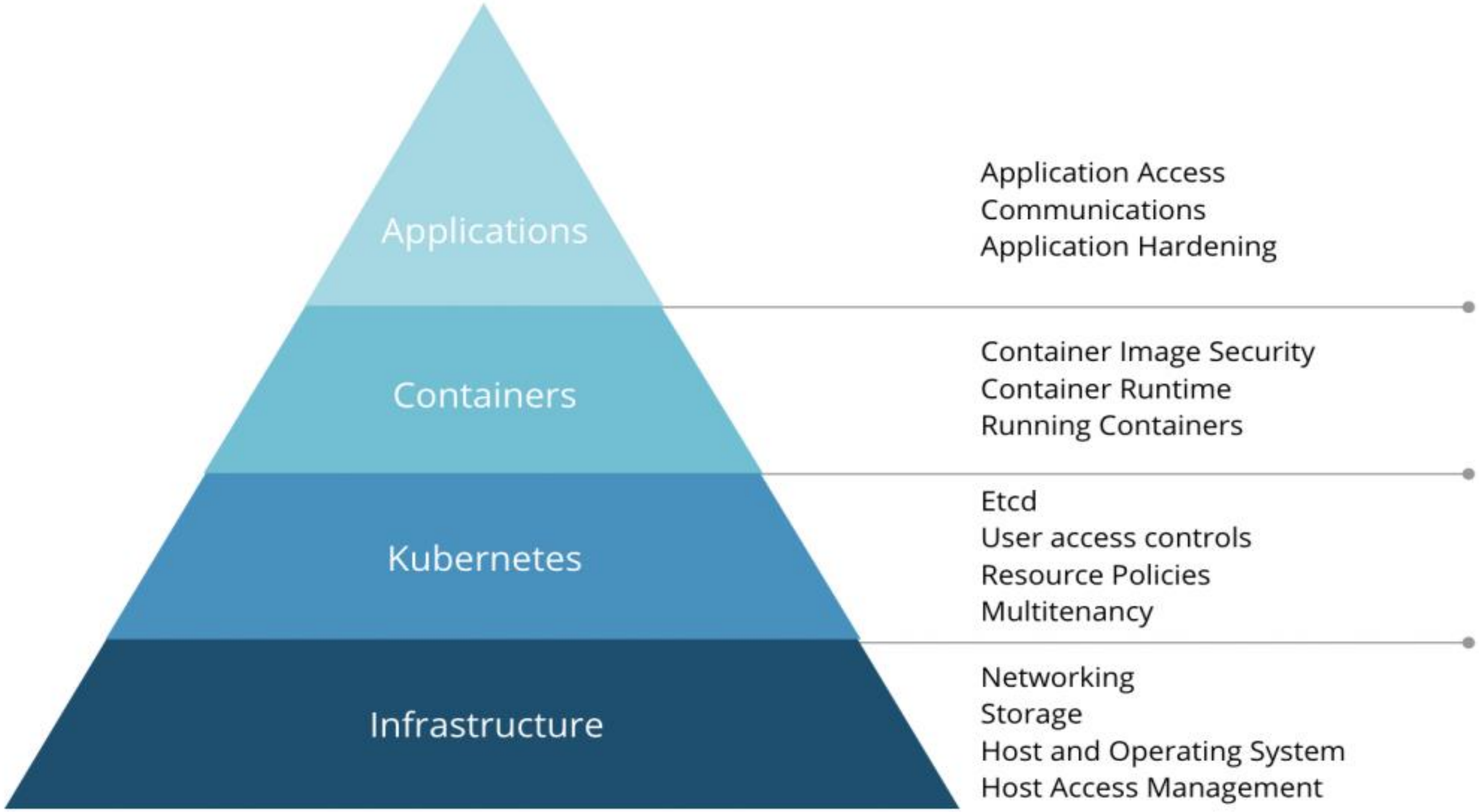


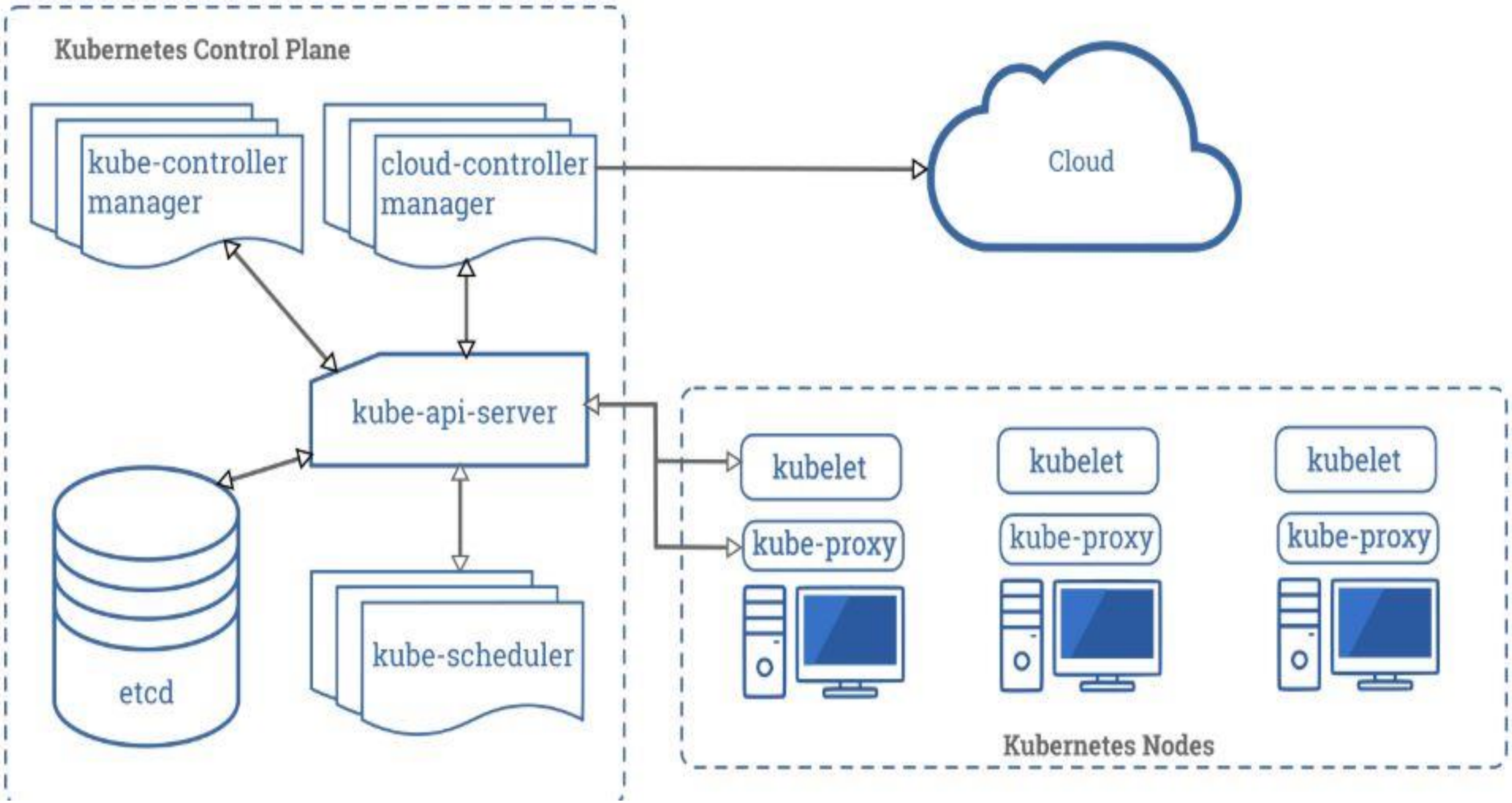
UBUNTU OS for IOT


5G

Attack Surface	Vulnerability
Ecosystem Access Control	• Implicit trust between components • Enrollment security • Lost access procedures
Device Memory	• Cleartext usernames • Cleartext passwords • Third-party credentials
Device Physical Interfaces	• User CLI • Admin CLI • Privilege escalation
Device Web Interface	• SQL Injection • XSS • Weak Passwords
Device Firmware	• Hardcoded credentials • Sensitive information disclosure • Encryption keys

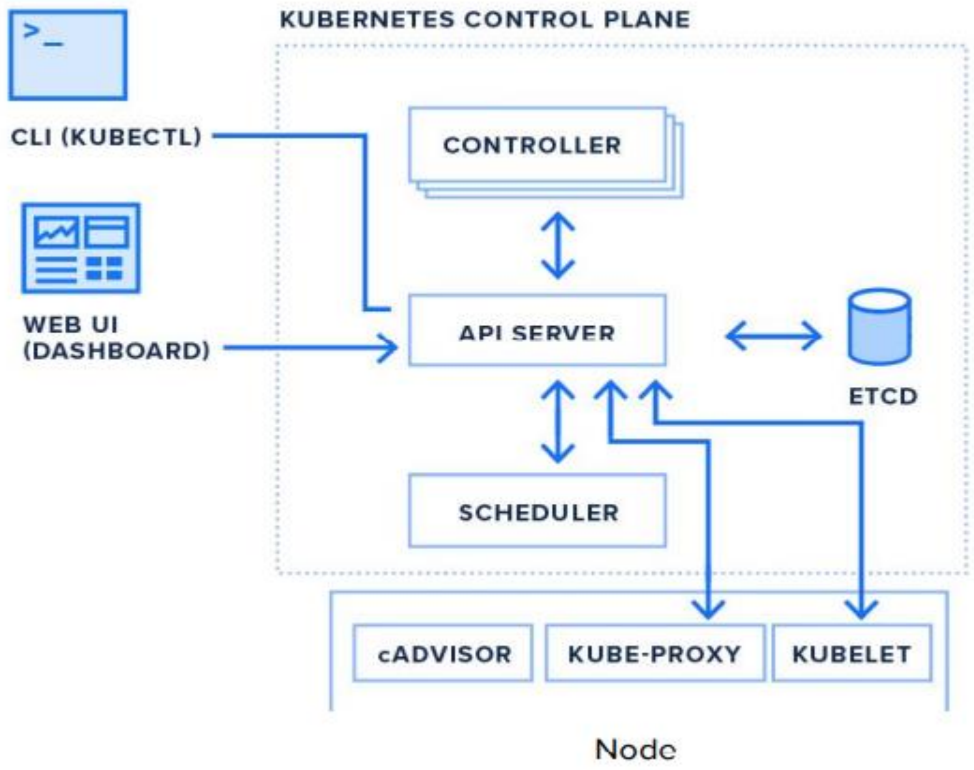
Attack Surface	Vulnerability
Device Network Services	• Denial of Service • Buffer Overflow • Poorly implemented encryption
Administrative Interface	• SQL Injection • Account lockout • Two-factor authentication
Local Data Storage	• Unencrypted data • Data encrypted with discovered keys • Lack of data integrity checks
Cloud Web Interface	• SQL Injection • Weak passwords • Username enumeration
Third-party Backend APIs	• Unencrypted PII sent • Device information leaked • Location leaked


Applications
Containers
Kubernetes
Infrastructure
Application Access
Communications
Application Hardening
Container Image Security
Container Runtime
Running Containers
Etcd
User access controls
Resource Policies
Multitenancy
Networking
Storage
Host and Operating System
Host Access Management


Kubernetes Control Plane
kube-controller manager
cloud-controller manager
Cloud
kube-api-server
etcd
kube-scheduler
kubelet
kube-proxy
kubelet
kube-proxy
kubelet
kube-proxy
Kubernetes Nodes

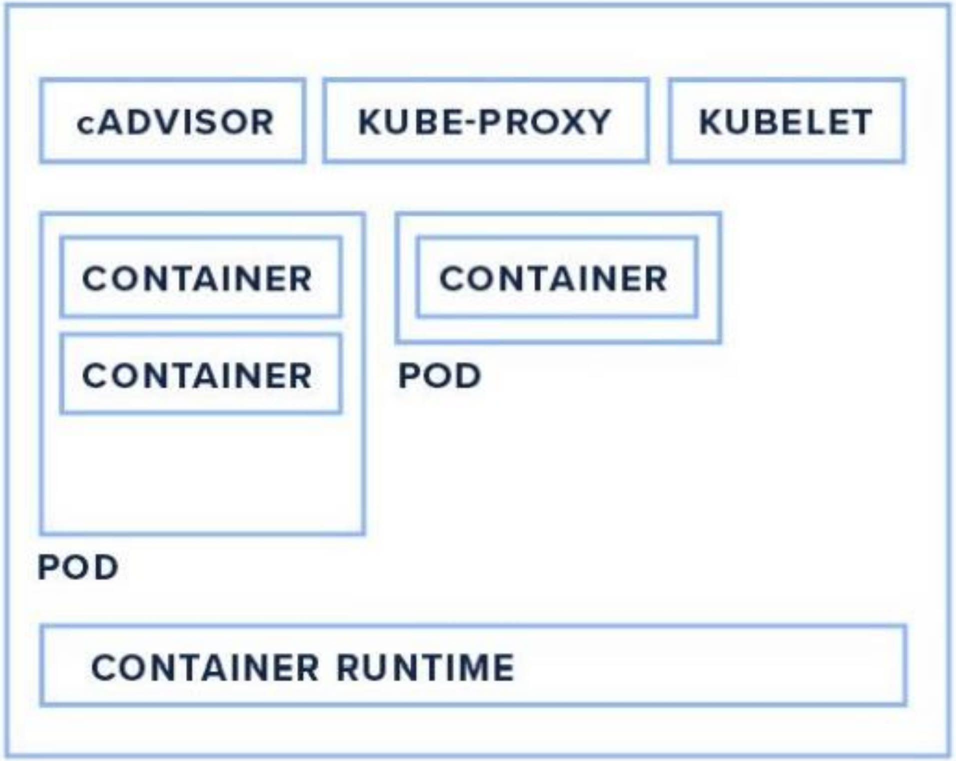
Kubernetes Architecture

- Control Plane
  - API server
  - Scheduler
  - Controllers
    - Kubernetes
    - Cloud
  - Etcd



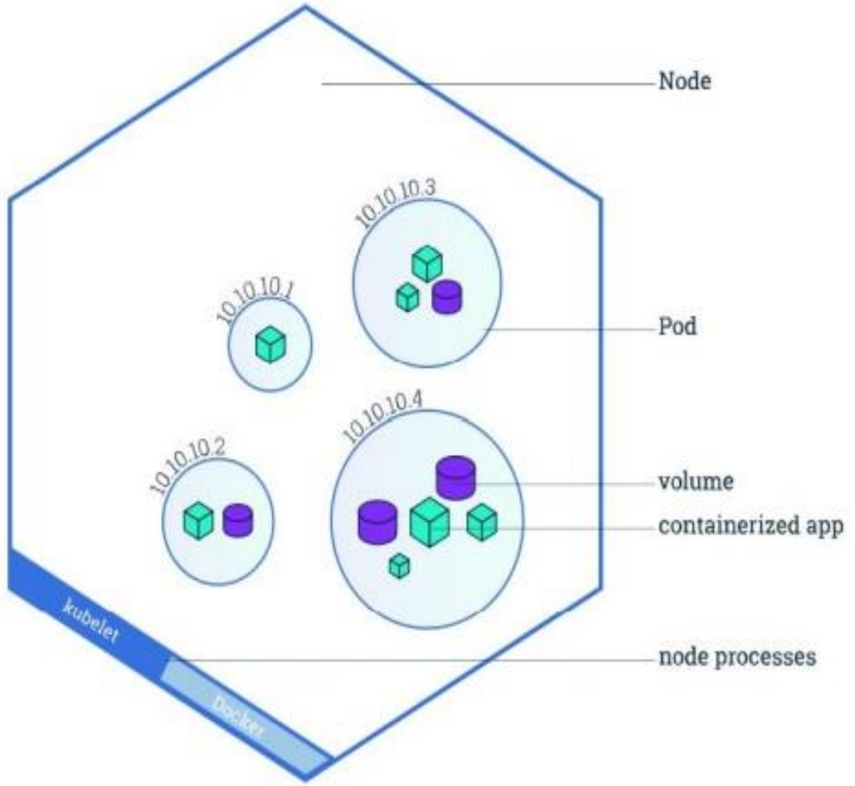
Kubernetes Architecture

- Nodes
  - Kubelet
  - Kube-proxy
  - cAdvisor
  - Container runtime



Pods

- Fundamental Kubernetes work unit
- Can run one or more containers
    - Why more than one?
- Pod containers share resources
    - Storage
    - Network (localhost)
    - Always run on the same Node



Kubernetes Security Checklist and Requirements

- Authentication. ...
- Authorization. ...
- Secure work with secrets. ...
- Cluster Configuration Security. ...
- Audit and Logging. ...
- Secure OS configuration. ...
- Network Security. ...
- Secure configuration of workloads.

Calico Cloud enables fine-grained, zero-trust workload access controls between your microservices and external databases, cloud services, APIs, and other applications. It also prevents the lateral movement of threats with identity-aware segmentation that works across all of your workload environments, including hosts, VMs, Kubernetes components, and services. Finally, Calico Cloud provides workload-based security controls for runtime intrusion detection and prevention, protection from DDoS attacks, deep packet inspection (DPI) and an envoy-based web application firewall (WAF) capability.

Data plane - Linux eBPF	Kubernetes Network Policy	High-performance scalable pod networking	Multi and Hybrid Cloud
Data plane - Linux iptables	Policy for Hosts, VMs, and Kubernetes	Advanced IP address management	On-premises
Data plane - Windows	Security Policy for Kubernetes Services	Direct infrastructure peering without the overlay	Data-in-transit encryption
Data plane - VPP	Security policy for high-connection workloads	Kubernetes Networking	


thank you
danke
рахмат
謝謝
ngiyabonga
teşekkür ederim
Баярлалаа
спасибо
faafetai lava
mersi
barka
welalin
tack
spas
kia ora
dank je
misaotra
matondo
paldies
grazzi
mahalo
tapadh leat
yinaka
спасибі
blagodaram
gracias
хвала
asante
manana
obrigada
tenki
murakoze
kiitos
dankie
dhanyavad
nanni
nandri
bedankt
enkosi
bayarlalaa
gracje
hvala
maururu
köszönöm
dankon
akun
aciu
djiere dieuf
tau
mochchakkeram
дякую
mamnun
chokrane
dziękuję
chnorakaloutioun
gratias ago
gracies
sulpay
taiku
go raibh maith agat
sobodi
dėkuji
obrigado
mèsi
sagolun
sukriya
kop khun krap
ありがとう
tanemirt
grazie
arigatô
takk
dakujem
trugarez
didi madloba
najis tuke
kam sah hamnida
terima kasih
rahmet
rahmat
diolch
dhanyavadagalu
shukriya
merce
мерси
감사합니다
xiexie
ευχαριστώ
merci

IoT Academy

Digital Transformation: Enhancing IoT-driven Solutions for Smart Islands

IIoT and Industrial developments in smart islands

Dr. Farzad Ebrahimi
CEO of IoT Academy
ITU Expert

ebrahimi@iotaci.com

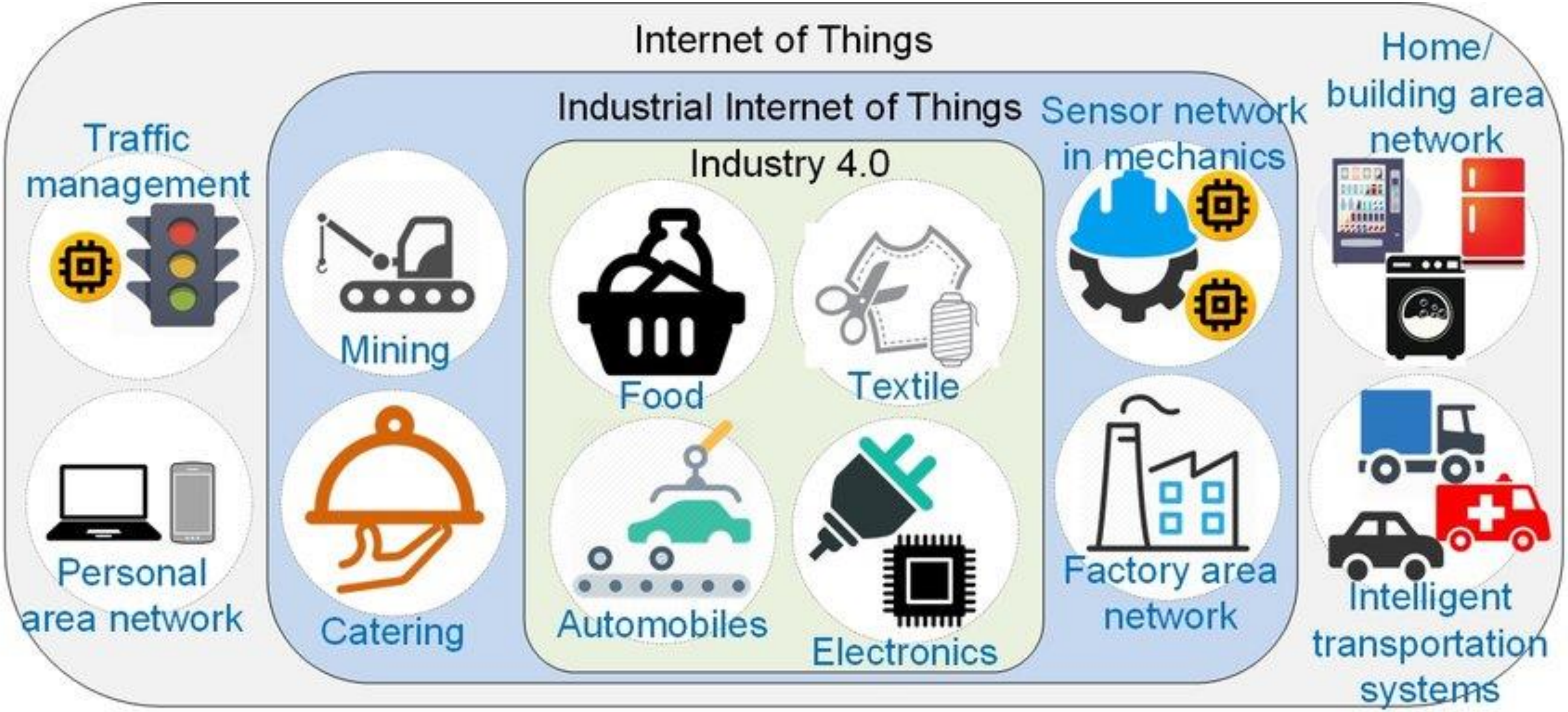
Farzad Ebrahimi

- CEO of IoT Academy (ITU Academia Member & ITU IoT Center of Excellence in Asia-Pacific)
- Faculty Member in ICT Research Institute
- International Internet of Things (IoT) Speaker & Lecturer
- International Telecommunication Union (ITU) Expert
- Chairman of The corresponding ISO/IEC JTC1 SC41 (Internet of Things and related technologies Standards) in Iran
- Chairman, Member of the founding board and the board of trustees of Non-Commercial Institute (as a NGO) of “Promoting the Internet of Things and data science” at national level.
- Doctor of Business Administration from the University of Tehran, MBA, M.Sc in Electrical Engineering-Telecommunication systems, B.Sc in Electrical Engineering- Electronics.

Other Records:

- Counselor of the Director of ICT Research Institute
- Superintendent of IT Faculty in Iran Telecom Research Center
- Deputy of IT Faculty in Iran Telecom Research Center
- Head of Multimedia Systems Research Group in Iran Telecom Research Center
- Project Manager, Consultant and Observer of more than 50 Regional and National ICT related Projects.

Internet of Things and Industry 4.0



The fourth industrial revolution

Digitization of products and production

Networking of the manufacturing working environment

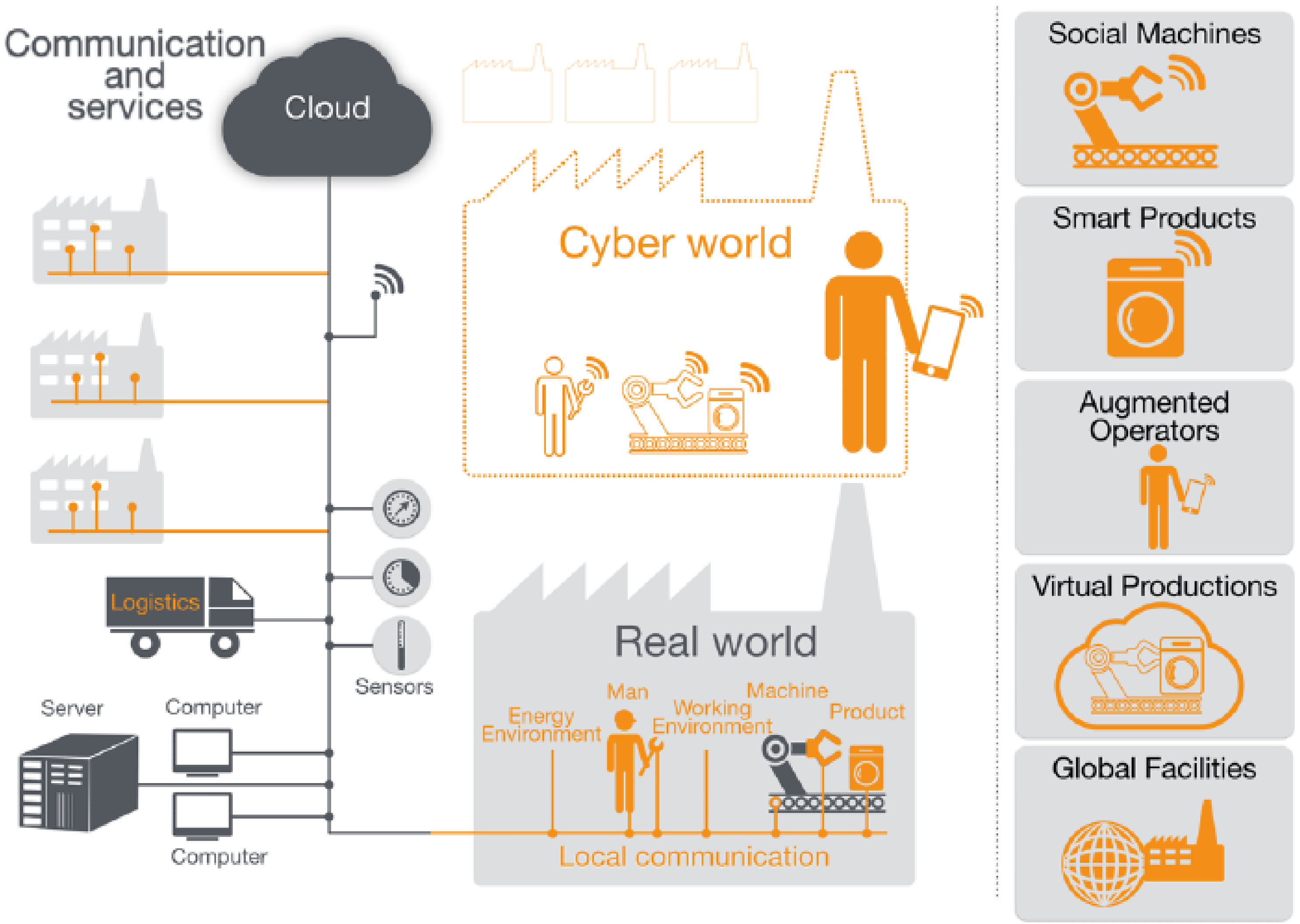
Decentralization of processes

Decentralization of decision-making structures

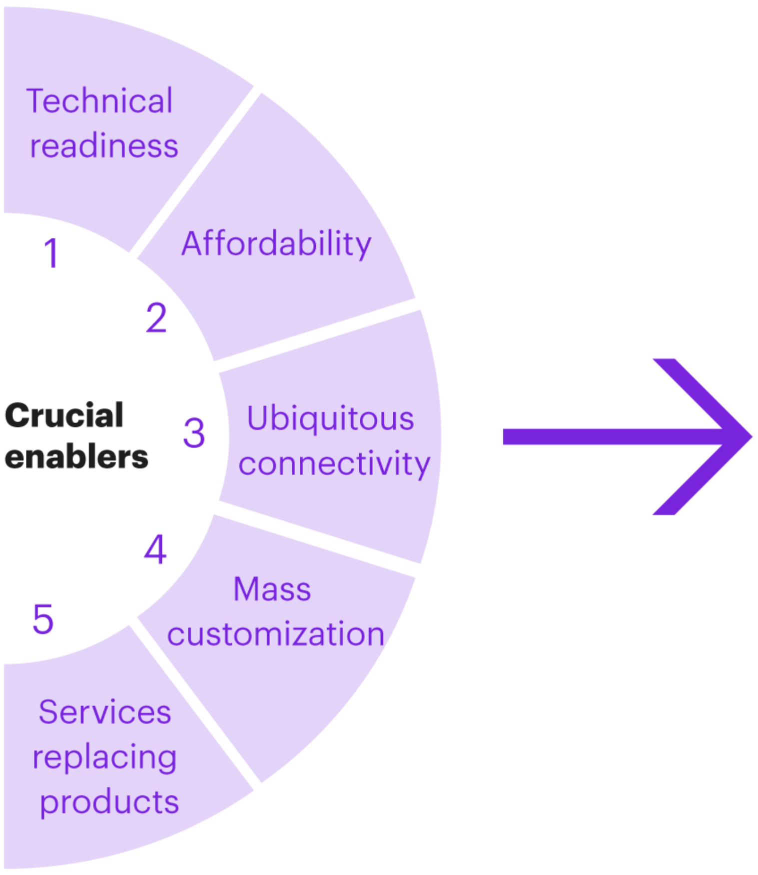
Intelligent/smart factory

Cyber-physical systems

1. **Mechanization** Mechanical production	2. **Industrialization** Mass production	3. **Automation** Electric automation	4. **Cyber-physical systems** Integrated automation
Industry 1.0	**Industry 2.0**	**Industry 3.0**	**Industry 4.0**
End of the 18th century	Beginning of the 20th century	Early 1970s	Today


Communication and services
Cloud
Cyber world
Logistics
Sensors
Server
Computer
Computer
Real world
Man
Machine
Energy Environment
Working Environment
Product
Local communication
Social Machines
Smart Products
Augmented Operators
Virtual Productions
Global Facilities

Five factors are accelerating the Fourth Industrial Revolution



1

- Ease of implementation and use of technologies are improving.
- Industry 4.0 technologies are quickly moving from research and development toward mass deployment.

2

- The unit selling price of technologies has declined by 50 to 75 percent along with reducing implementation costs.
- Worker training costs are decreasing.

3

- The Internet of Things is connecting production assets more rapidly.
- About 40 percent of equipment is connected.

4

- Production processes are more flexible with interchangeable tooling options enabling product customization.

5

- The huge capex required for such technologies is being mitigated through service-focused models.
- 3D printing on demand and “robot on rent” models are replacing the need to buy new technology.

Source: Kearney analysis

Week 1-6 IIoT and Industrial developments in smart islands

The Industry 4.0 Strategy is based on three Pillars

Week 1-6 IIoT and Industrial developments in smart islands


Focus on People
• Adaptation to changing working environments
• Human-machine interaction, ensuring safety
• Innovative assistance systems
• Intuitive and simple operation of systems
• Develop new operating concepts

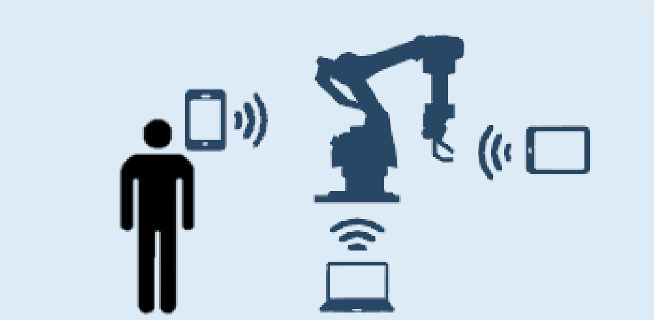
Focus on Qualification 4.0

Fundamental paradigm shift in Industry 4.0

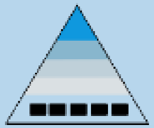
3.0

Third industrial revolution
The use of computers and robots leads to greater production **automation**.

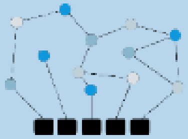
4.0



Fourth industrial revolution
Industry 4.0 describes the **networking** of people, machines, and products – in real time, via the Internet.

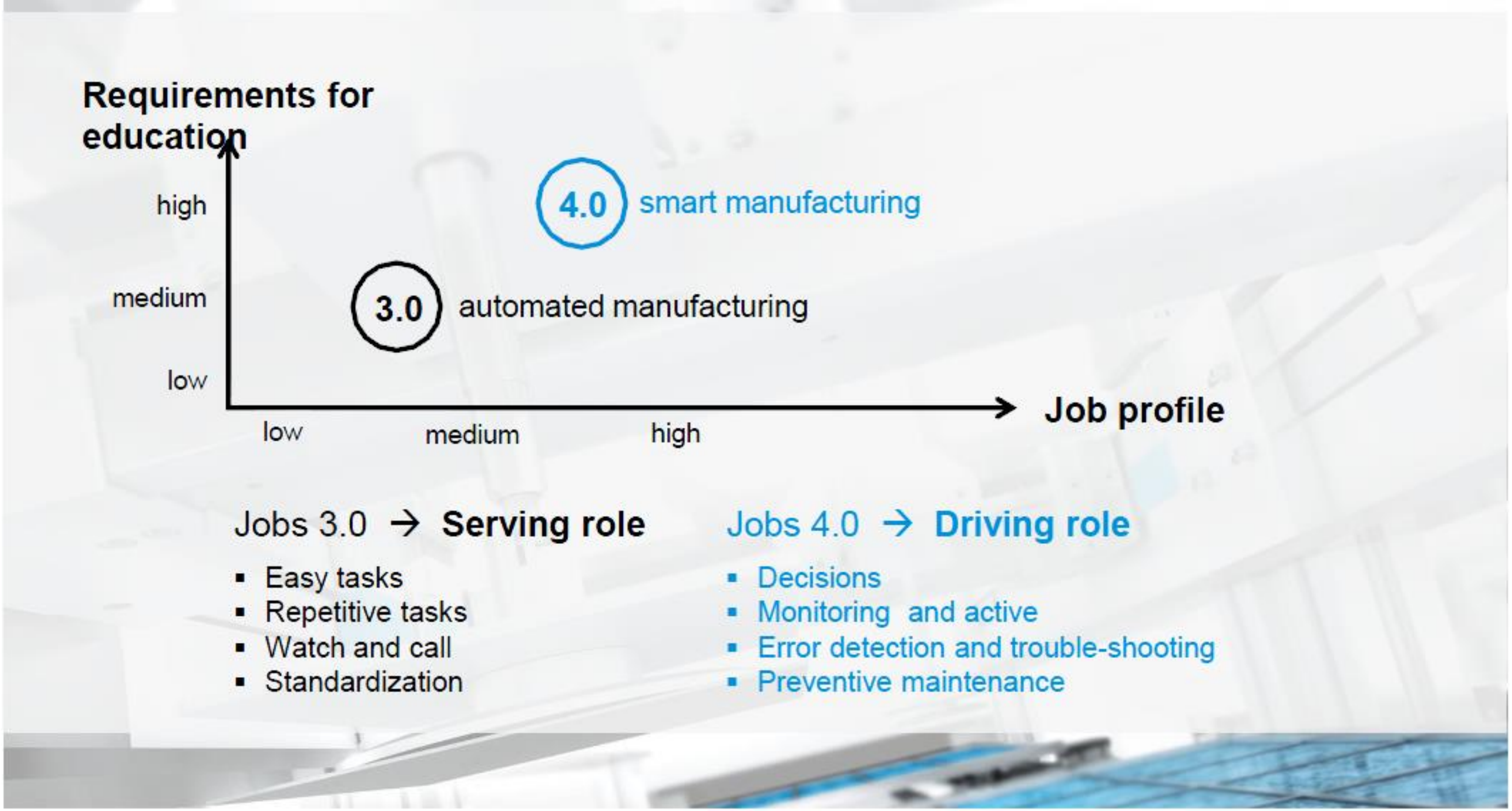


- Hierarchical central control
- Established value chains
- Production system operation is planned in advance
- Products are passive objects in the processing operation



- Decentralized self-organization through ad-hoc networking
- Virtual ad-hoc organizations
- Autonomous, self-organizing production units
- Active production process supported by intelligent products

Week 1-6 IIoT and Industrial developments in smart islands



"Livestock sector is one of the fastest growing parts of the agricultural economy, contributing 40% of the global value of agricultural output and support the food security of 1.3 billion people"

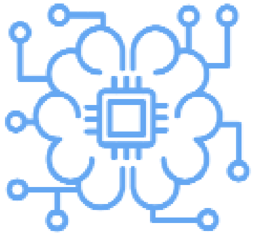
FAO FIAT PANIS
Food & Agriculture Organization

Approach

We approach our solutions to be powered by AI + IoT, end to end

IoT is about automated data collecting,
storing, visualisation, and reacting, in massive scale

"Data Supplier"



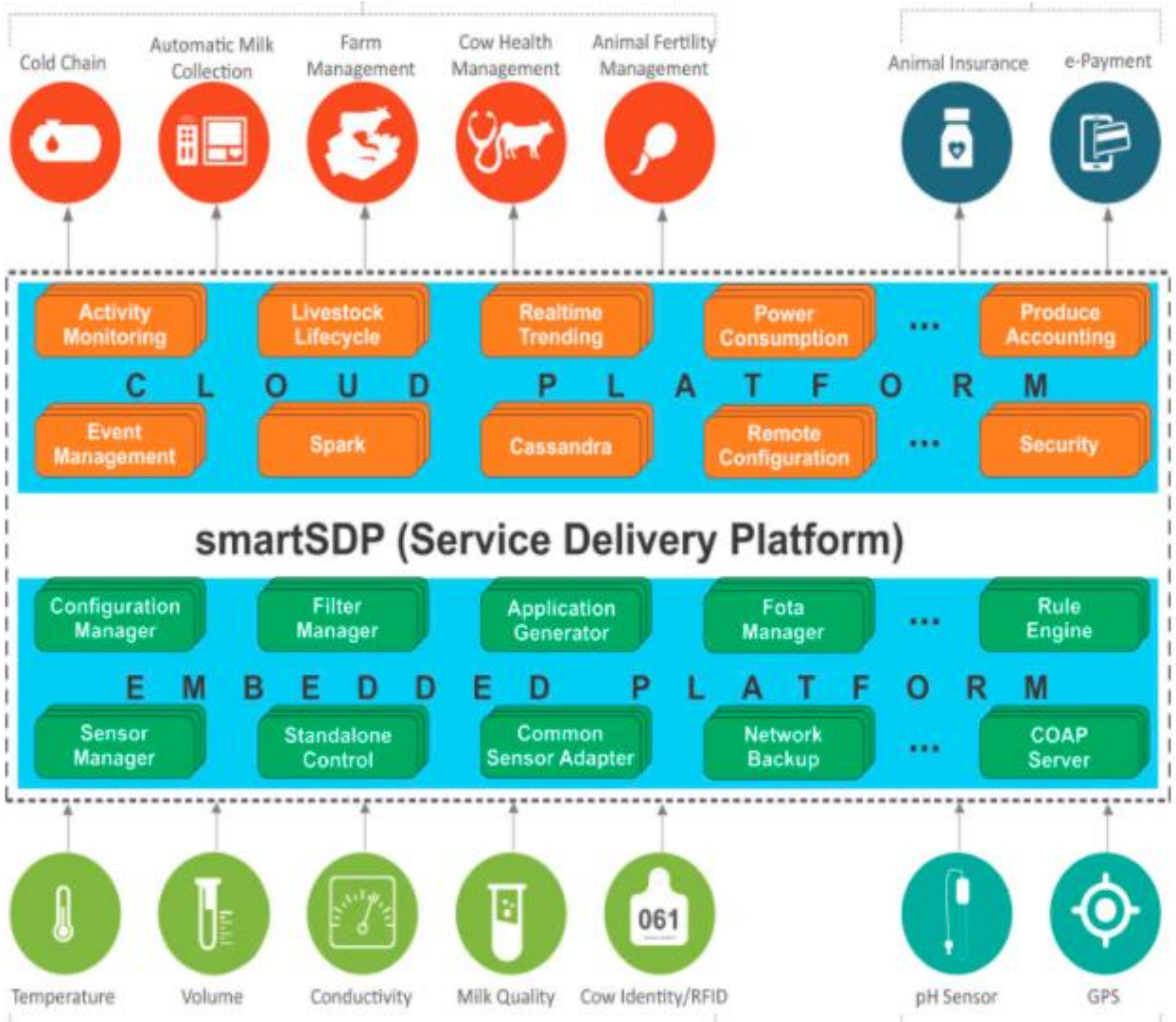
AI is about making sense of the massive data,
providing insights & recommendation,
and predicting the future outcome

"Data Miner"

Combining AI + IoT (AIoT) enables a lot of opportunities!

Data acquisition and recording is the first step towards creating measurable value in any supply chain. While automated, IoT based acquisition ensures Data integrity, the ability to plug-in sensors and applications on the fly ensures agility in catering to multifarious supply chains. Data synthesis across the Rural-Agri supply chain will undoubtedly result in innumerable use cases and can help unlock unprecedented value on a very large scale. Click on the images to get a feel of these tools and our smart Service Delivery Platform.

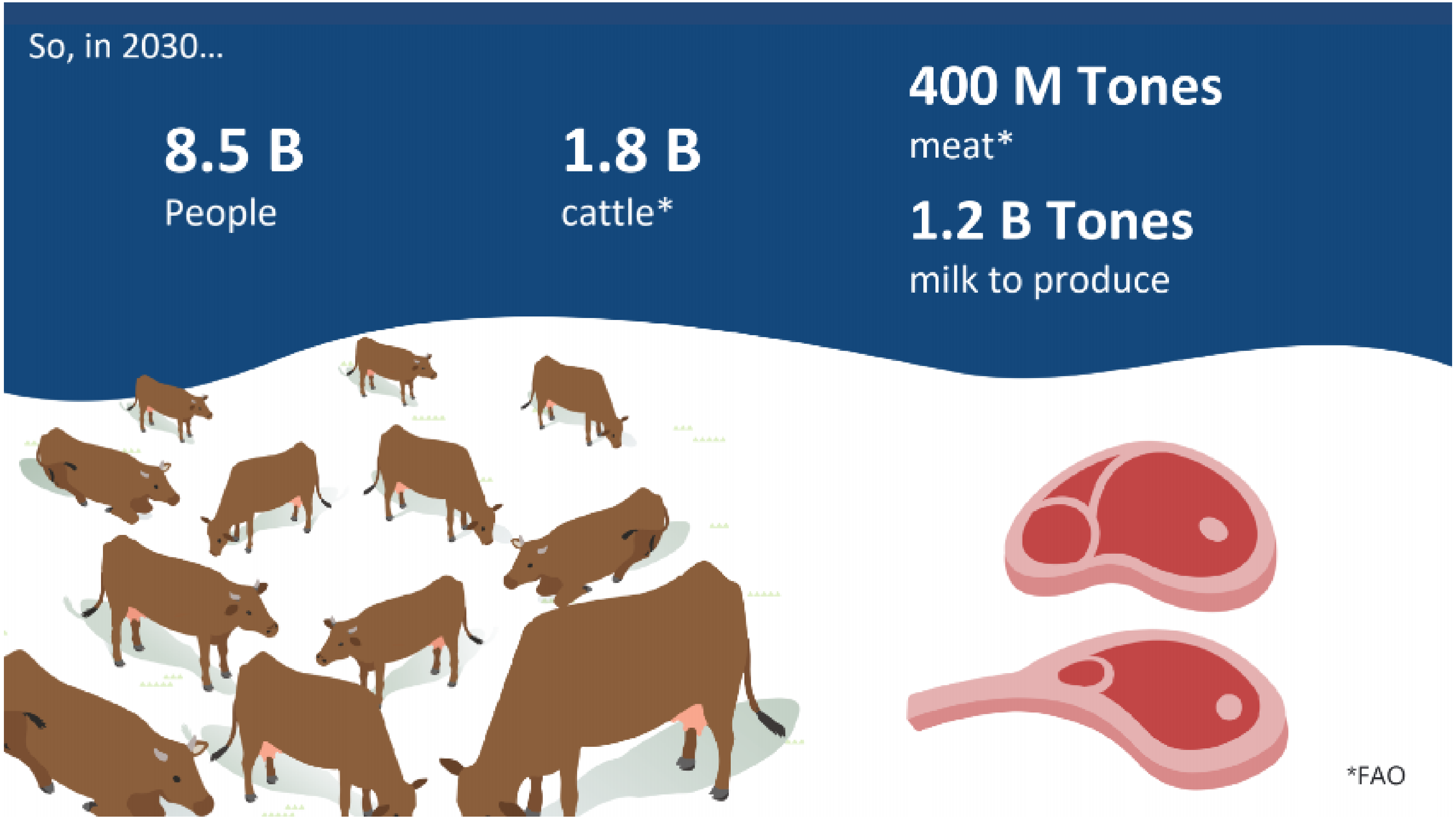
Week 1-6 IIoT and Industrial developments in smart islands



Livestock - Poultry – Fish

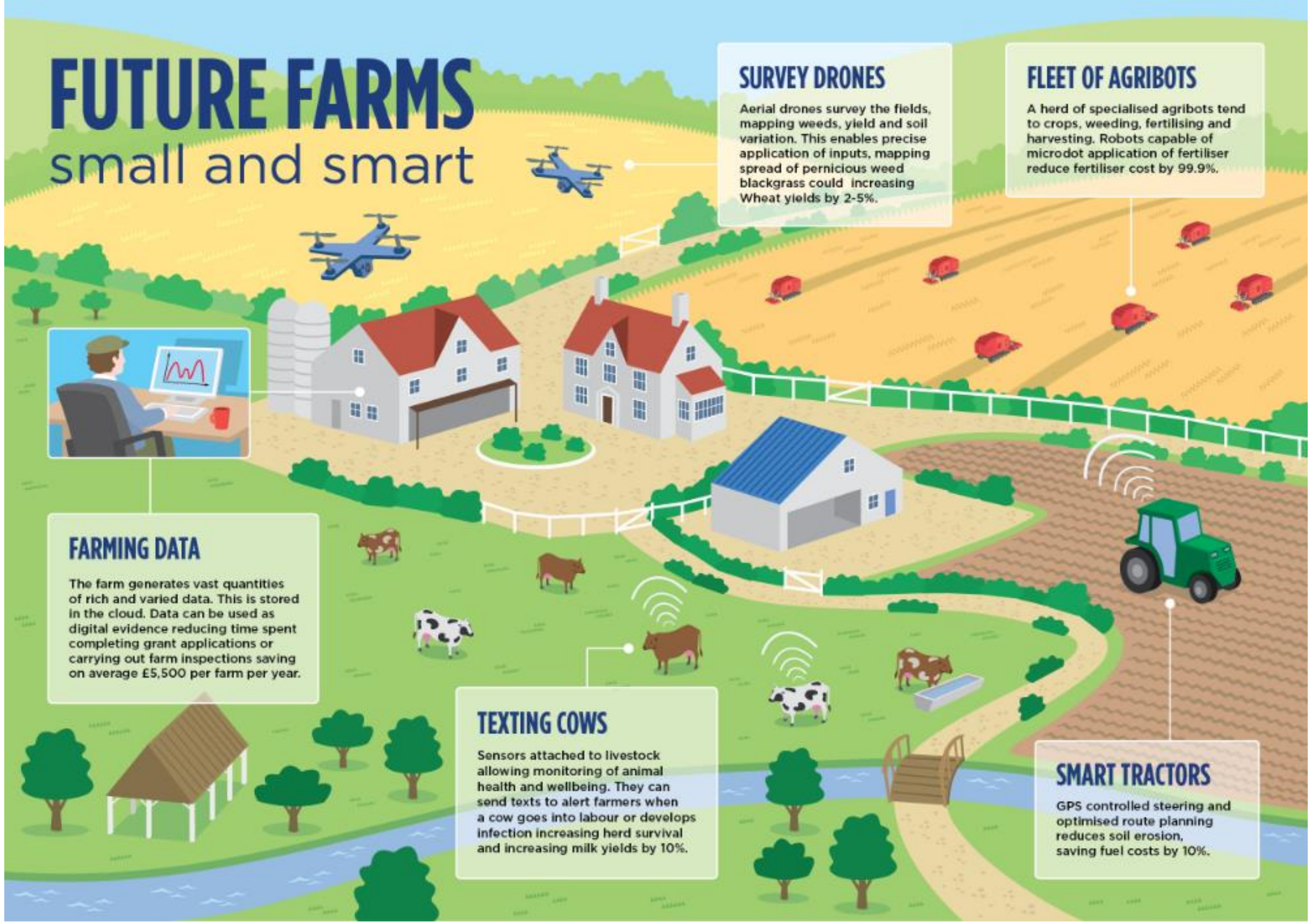
- Identification and tracking
- Feeding
- Grouping
- Behavior
- Environmental control
- Weather monitoring

…

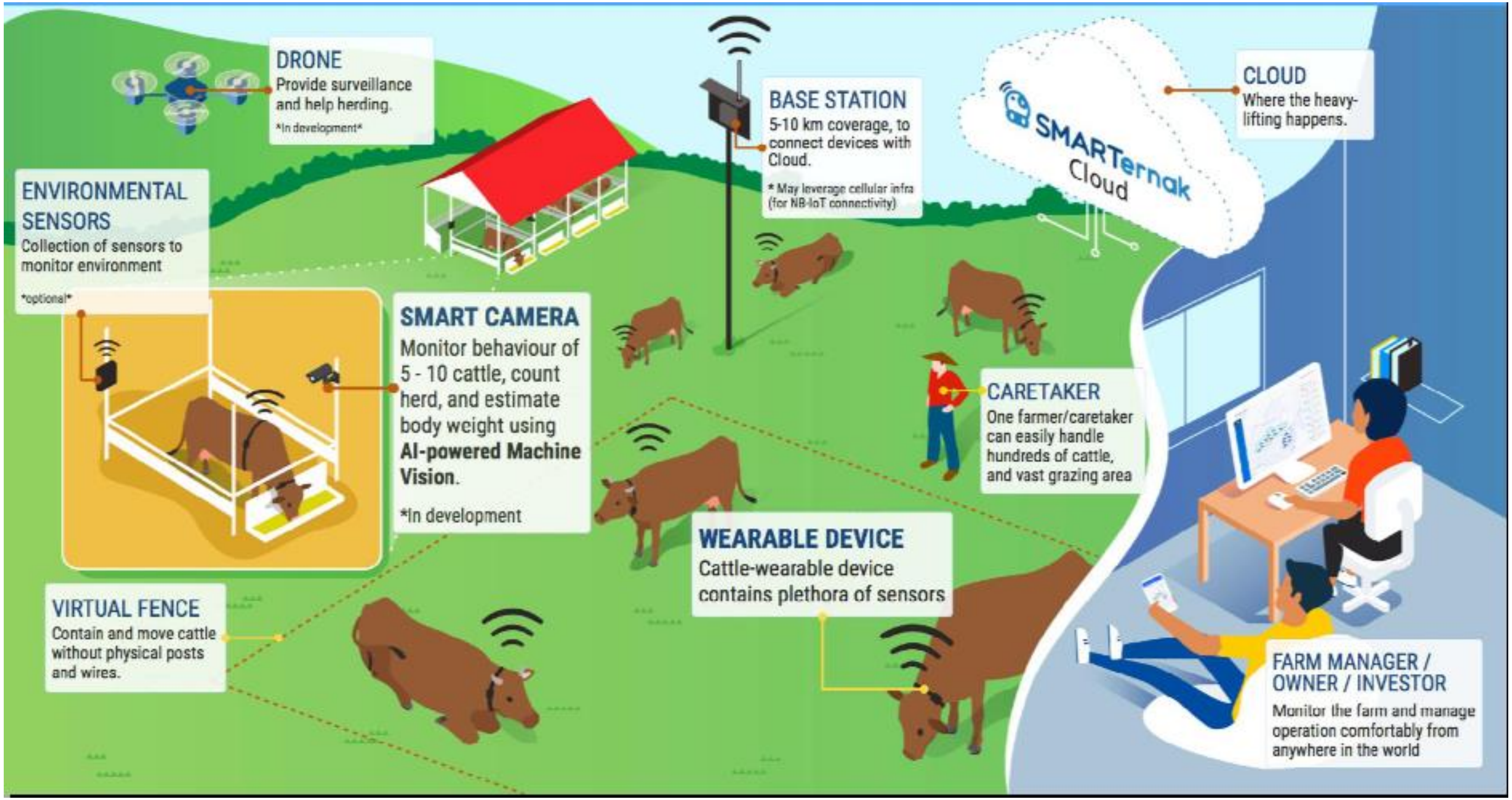

So, in 2030...
8.5 B
People
1.8 B
cattle*
400 M Tones
meat*
1.2 B Tones
milk to produce
*FAO

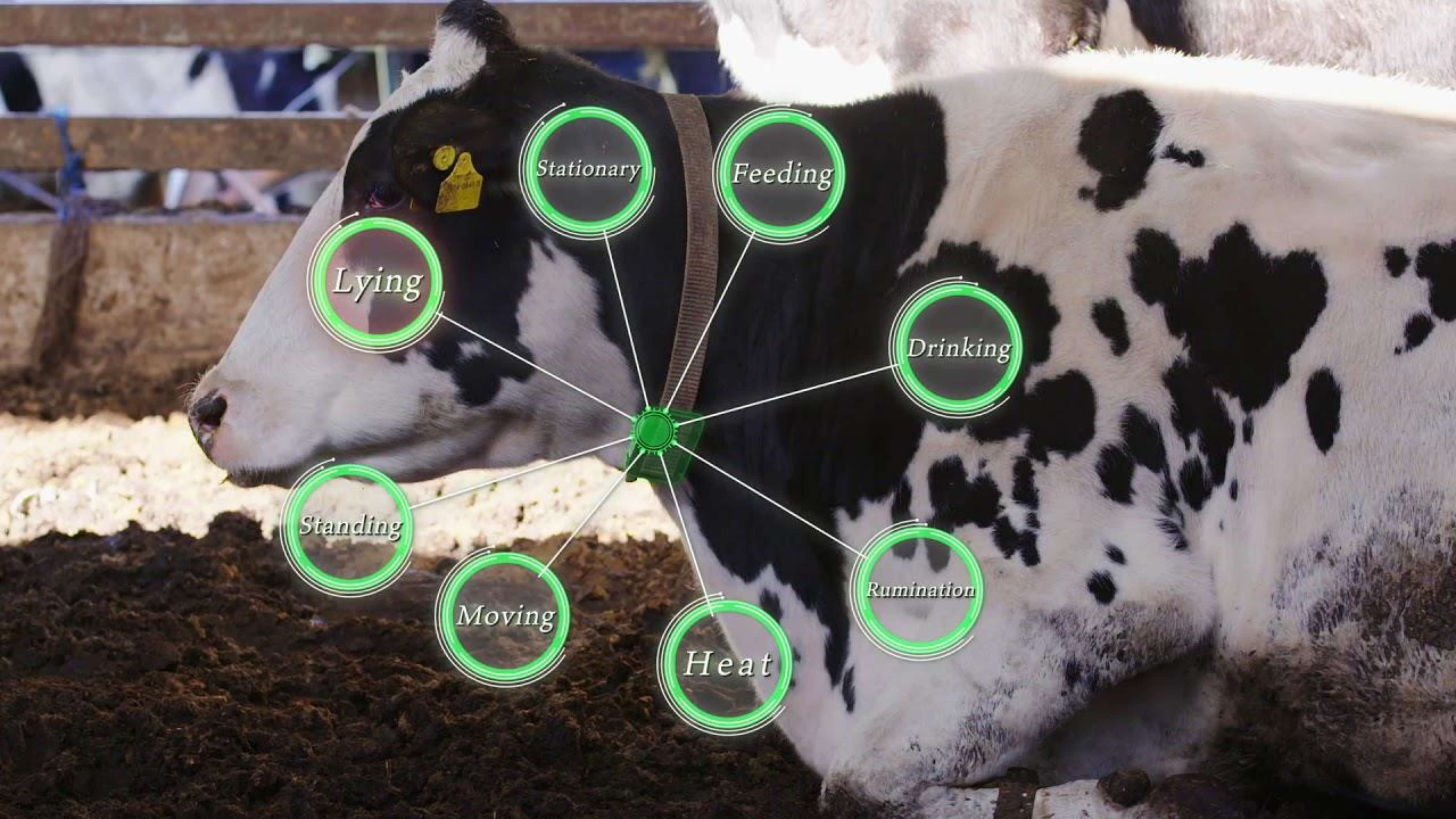
Precision Livestock Farming

Data-driven management of livestock by continuous automated real-time monitoring of production/reproduction, health and welfare of livestock and environmental impact.

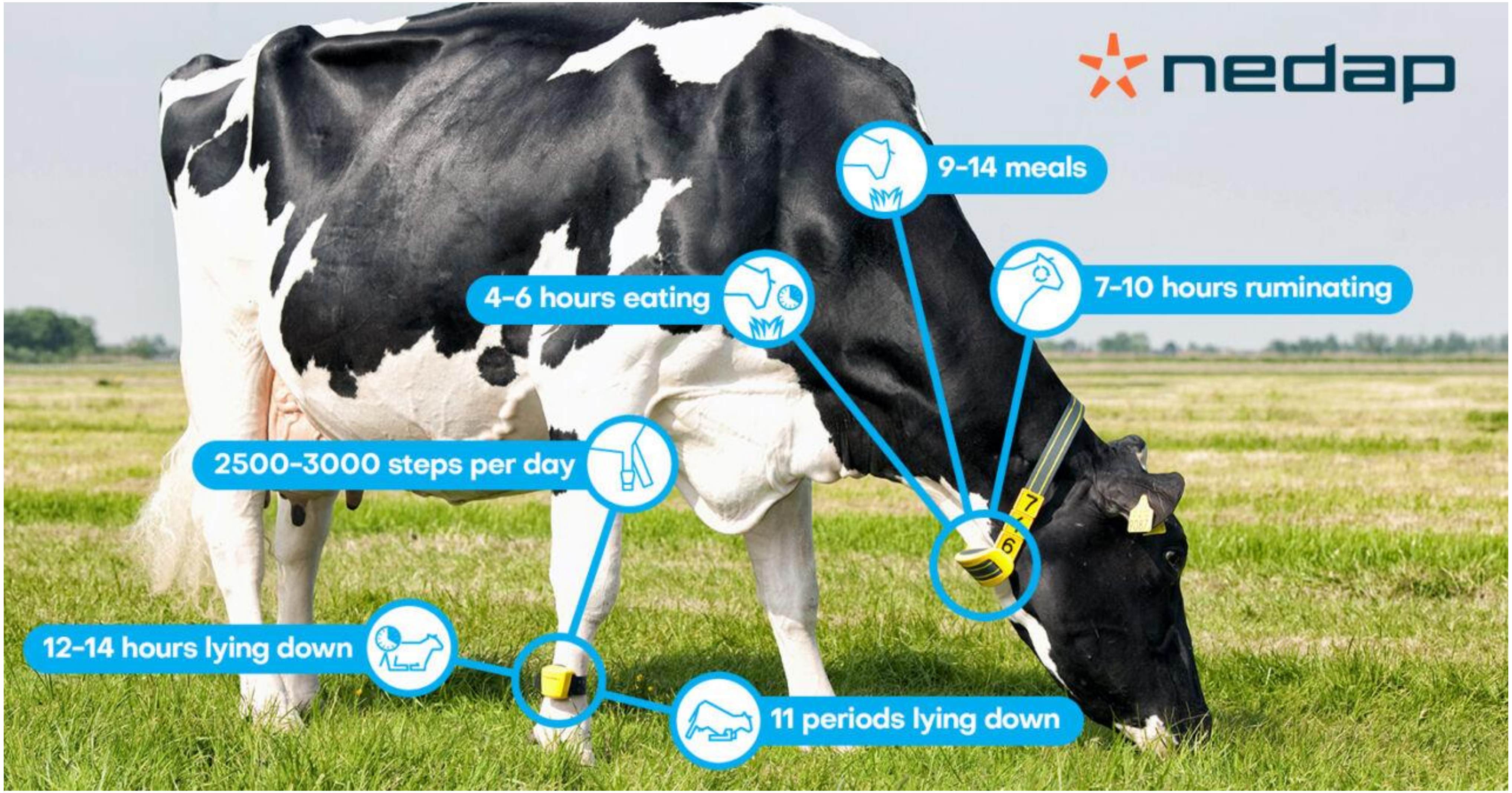


Week 1-6 IIoT and Industrial developments in smart islands




Stationary
Feeding
Lying
Drinking
Standing
Moving
Heat
Rumination

Cattle-wearable Device


nedap
9-14 meals
4-6 hours eating
7-10 hours ruminating
2500-3000 steps per day
12-14 hours lying down
11 periods lying down

Wearable Device Internals

Electronic board is 100% designed in-house, mass-produced in Indonesia, by 100% Indonesian

Dual IoT Connectivity

Short Range: 1 km WiFi, Bluetooth v4.2, BLE
Mesh-supported. High speed, e.g. for firmware update

Long Range: **NB-IoT,**
for low power yet long range coverage

Powerhouse

Low Power, Dual Core Microcontroller
with on device Machine Learning inference

Actuators

Audio Alert/Speaker
LED

Packed with Sensors

GPS / GNSS
Accelerometer, Gyroscope
Body Temperature
Ambient Temperature & Humidity
Barometric Pressure
Ambient Light
MEMS Microphone
Device Removal Detector

Smart Energy Management

Battery Monitoring
Solar Energy Harvesting
Smart Switching Between Main & Backup Battery
Firmware-optimised power consumption

To watch the video of this slide, refer to the video presentation.

Monitoring & Insights

Monitor cattle where-about & well-being Provide insights - powered by AI farmer doesn’t really care about (raw) data

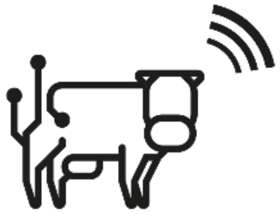
Environmental Sensors:
Monitor ambient temperature, humidity, and air quality in barn

On-farm Smart Camera:
Monitor activity of 5 - 10 cattle - focus on group activity
Count herd & movement
Estimate weight

Cattle-wearable device:
Precisely monitor each cattle for: Location (latitude, longitude, movement speed, direction) Body temperature Ambient temperature & humidity Ambient light & sound Movement (linear acceleration, angular velocity, direction) Device removal status Battery voltage & capacity

To watch the video of this slide, refer to the video presentation.

Wireless communication

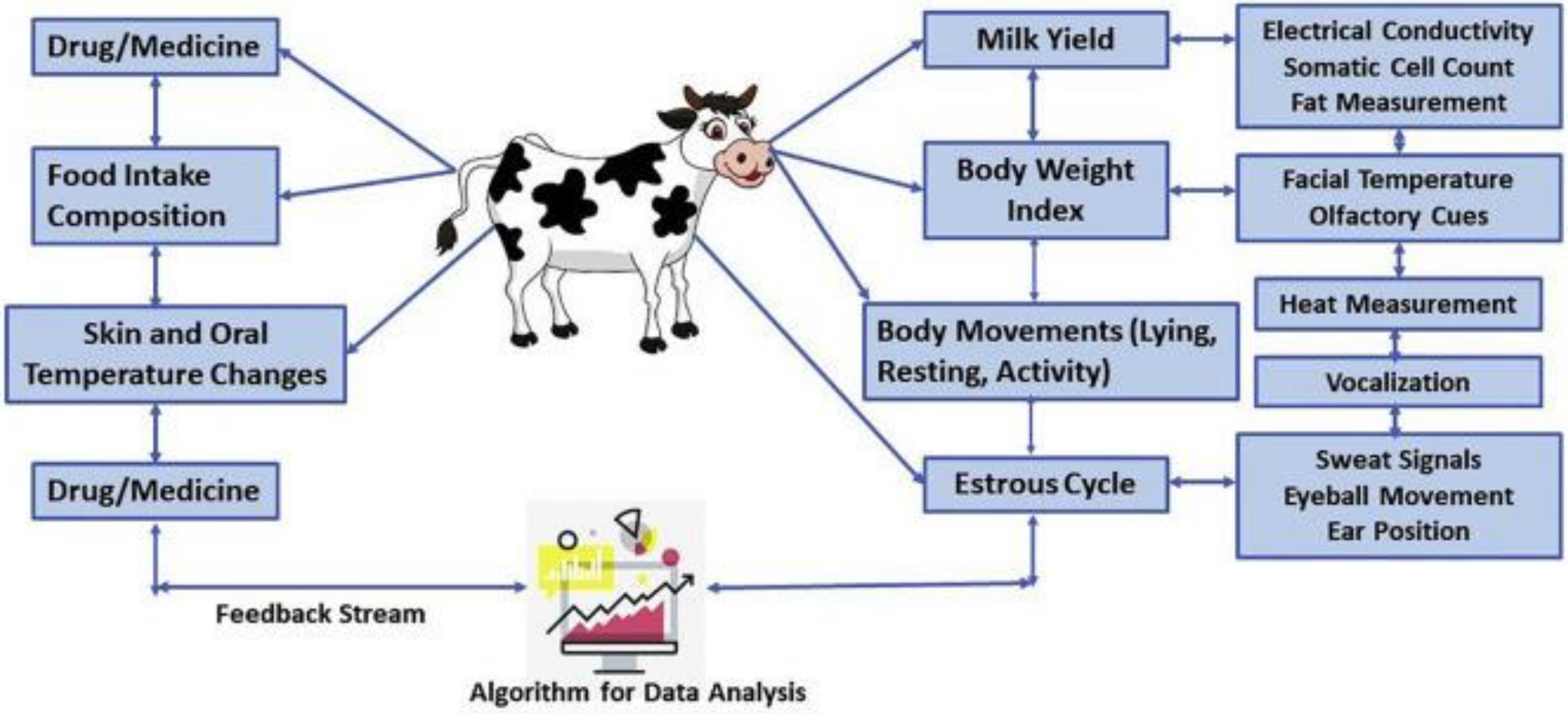


Data-Driven Sustainable Farming

With LoRaWAN® technology, whose long-range, low-power wireless sensors can send data from the farm to the Cloud, via private or public networks, farmers have easy access to a host of information for improving their businesses, with a distinct advantage over satellites and drones. Such high value data can be transmitted over distances of up to 15 km from sensors with batteries lasting up to 10 years, resulting in lower maintenance and operating costs along with greater operational visibility, which in turn empower farmers to scale their businesses.

For example, recurrent tasks on the field can be replaced by automatized modes of monitoring and maintenance. The benefits are two-fold: farmers are able to detect irrigation necessities based on weather recording and forecast, plant estimated needs , soil moisture, etc. while detecting defaults in the irrigation system. This avoids time consuming checking of the systems on the field, it optimizes efficiency of irrigation and avoids potential loss of crops.

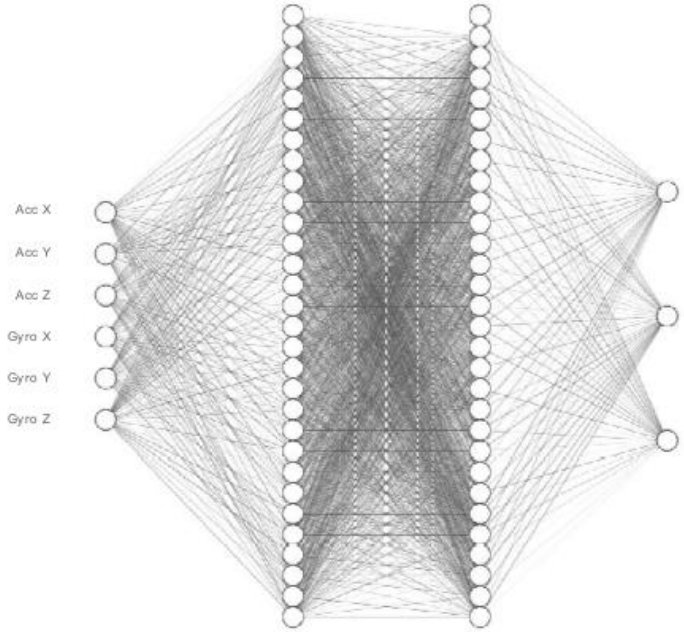
Individual monitoring of high value animals (cattle, horses…) or environmental monitoring of mass production animals (poultry, swine…) improves reproduction, grow factors and animal welfare while reducing the use of medication thanks to early detection of disease. This results in better milk quality and decreased environmental pollution.


Drug/Medicine
Food Intake Composition
Skin and Oral Temperature Changes
Drug/Medicine
Feedback Stream
Algorithm for Data Analysis
Milk Yield
Body Weight Index
Body Movements (Lying, Resting, Activity)
Estrous Cycle
Electrical Conductivity
Somatic Cell Count
Fat Measurement
Facial Temperature
Olfactory Cues
Heat Measurement
Vocalization
Sweat Signals
Eyeball Movement
Ear Position

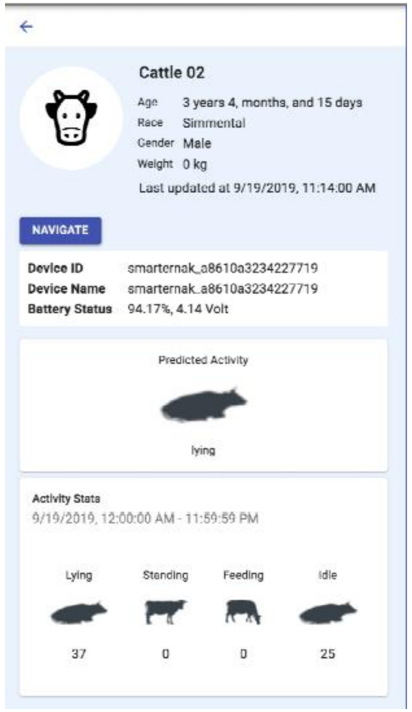
Artificial Intelligence at The Edge

Learn & det etc. cattle behavior's to tailor actionable insights & recommendation based on sensor data with the help of on-device Artificial Intelligence

Motion captured by
Inertial Measurement Unit (IMU)
sensor inside cattle-wearable
device



Deep Neural Network



Predicted activity
(standing, lying-dow n, feeding,
and more)

Real-Time Location System (RTLS) for Indoor Tracking

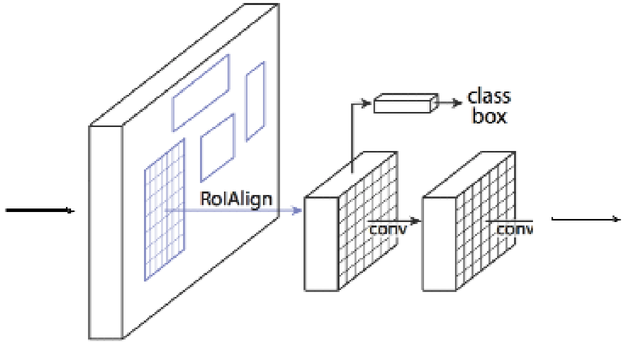
The sensors operate at a frequency of 2.4ghz, tracking the animals every second. It has a range indoors of 30-100 meters and outside 500 meters. It will tell you where an animal is to within 1.2 meters.

To watch the video of this slide, refer to the video presentat

On-farm Smart Camera

Cattle Counting & Behaviour Analysis using on-farm camera with the help of Machine Vision & on-device Artificial Intelligence

Image/video stream from camera



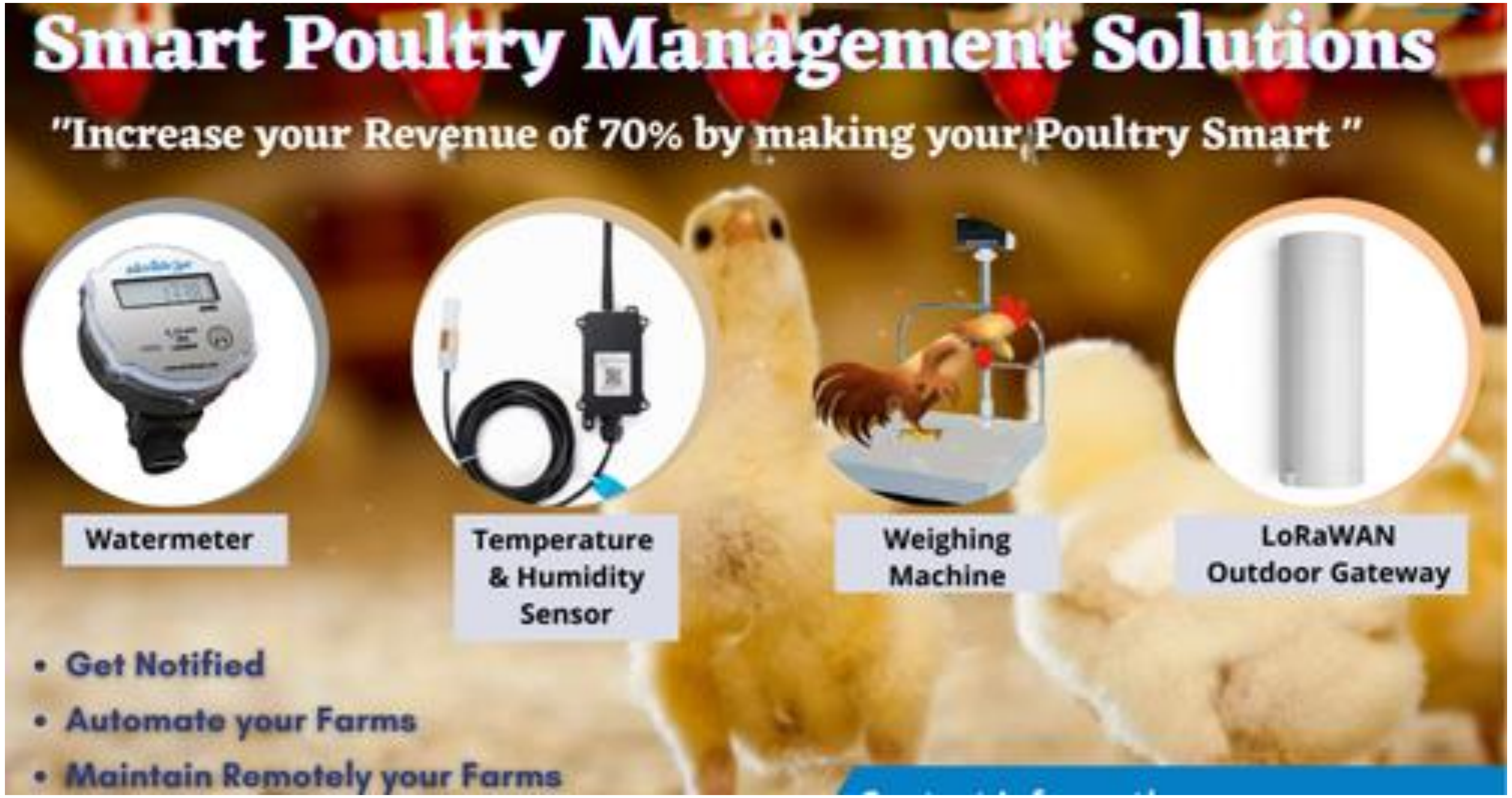
Deep Neural Network (Instance Segmentation)

Detected cows and predicted activity (standing, lying-down, feeding, …)

To watch the video of this slide, refer to the video presentation.

Smart Poultry

The word poultry refers to the rearing and breeding of avian species like ducks, chickens, turkeys, geese and guinea-fowls that have been domestic. They are the most excellent converters of feed into animal protein compared to another livestock. Chickens are the most general poultry enterprises. Chickens alone take up 90% of the net poultry.



Smart Poultry

In most of the countries, the demand of poultry meat is increasing progressively because of high protein, low energy and low cholesterol meat. The high production of chicken depends on the environment, breeding process and the active operations. To monitor and control the farm actively, in most cases sufficient manpower is required, however in turn it increases the production cost significantly. So it requires a mechanism that may manage the poultry farm easily for better improvement in the production with lower cost. Usually, the poultry farms are located in suburbs, away from populated areas. There can be more than one poultry farm nearby, and it requires a lot of manpower (labor) to manage each poultry farm. The advancement that has been made in the technologies now make it possible for remote monitoring and controlling system and thus reduces the manpower cost and enhances the production

Smart Poultry

By utilizing the internet of things (IoT) system, this goal can be achieved easily. IoT can be defined as many physical objects (having capability of sensing something from environment) connected to a WAN (Wide Area Network) network to collect, share and convey information for some analysis. With the help of these small network connected sensors or objects we can easily control a certain system . There is a great extent of using IoT like smart hospital, smart home and smart traffic. Smart poultry farm system can be a good implementation of IoT system.

IoT can help the poultry farm owners to enhance production while lowers the cost substantially. The size of poultry farm is generally 60 x 120 meters. Different type of controller and monitoring devices are used to maintain the temperature, humidity, feeding and watering inside poultry farm, that may be controlled remotely. In some developing countries, there are certain issues, such as lack of water, hard weather conditions, lack of infrastructure and transport facilities.

Smart Poultry

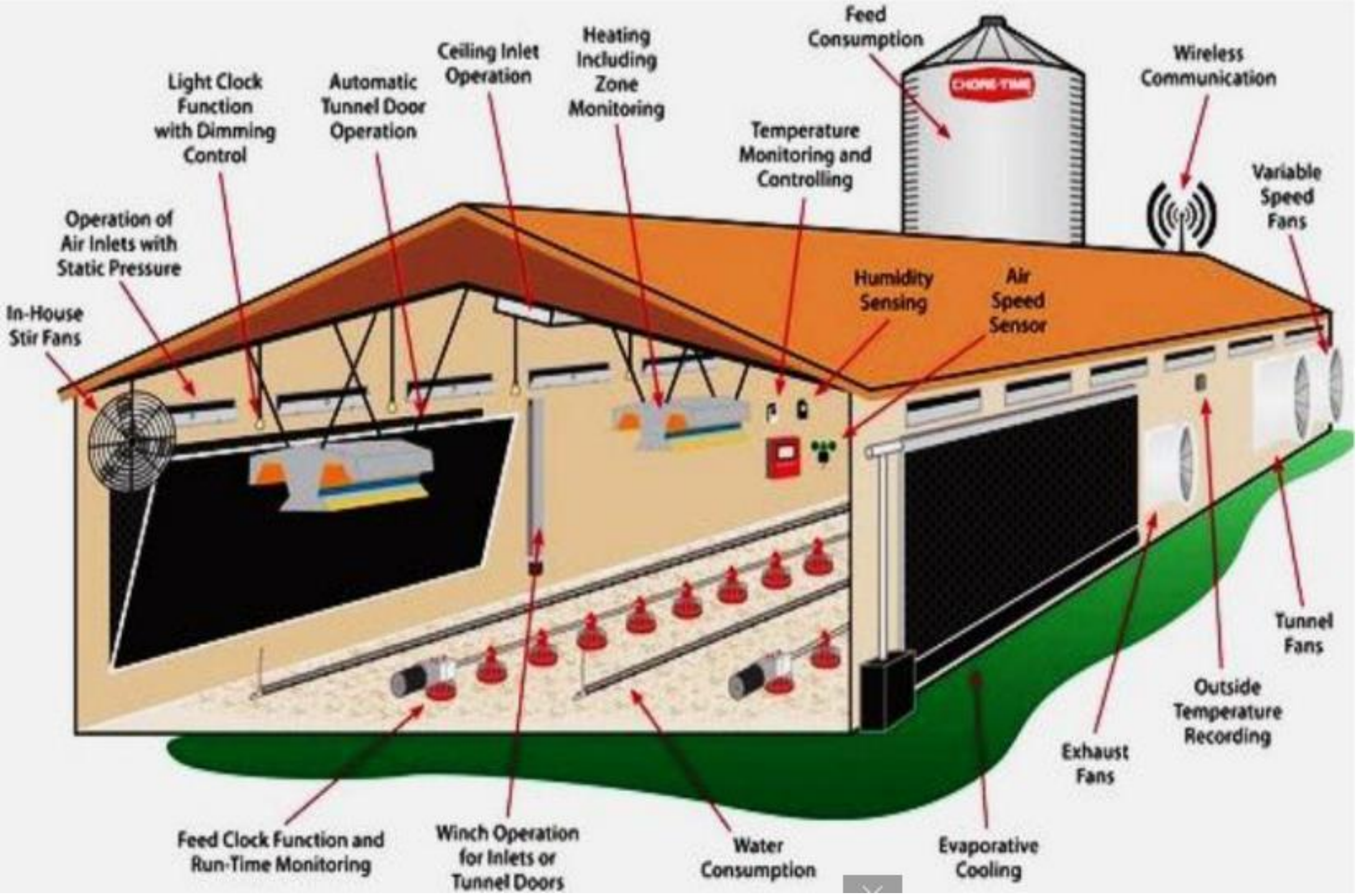
For such countries an IoT based smart poultry farming may help to resolve these issues up to some extent.

As discussed earlier, there can be environmental monitoring and controlling system which can be controlled remotely. These monitoring and controlling system are often based on wireless network . Wireless communication is steadily grows in recent years and it can be easily implemented in a places, that are located in remote areas with hard weather conditions and without complete communication infrastructure. For these reasons, wireless network has advantage over wired network, and seen as a best candidate to avoid the cable layouts and its management . In a wireless communication, the Wireless sensor network (WSN) is most suitable for such type of environments.

Smart Poultry

It provides connectivity to different sensors while inter connected with internet using a wide area network (WAN).The WSN is consisting of small sensor nodes, coordinator and internet gateway (WAN access). Sensor node has low processing and power capabilities than a coordinator. A coordinator is a powerful device which has more processing capabilities and a good battery life.

An internet gateway can be a cellular network or any other internet access point. An overview of wireless connectivity of typical poultry farm is depicted in Figure .



To watch the video of this slide, refer to the video presentation.

Smart Fish Farming

SMART means to have Fish Farm one click away!

Live Monitoring
Online access to the actual parameter values of each tank, from any device connected to the Internet.
Alerts
Instant alerts by e-mail or SMS when the pre-set parameters` values are exceeded.
Control
Remote switching on and off the automate installations of oxygen and tank water circulation.
Graphs
Display one or more parameters within the monitored tanks in progress graphs.
Records
Online records with recorded values for parameters monitored within different time periods.
Automate Control
Integral automation of the farm for automate control of parameters in accordance with the values recorded.

Smart Fish Farming

Online management means efficiency!
The high density of fish in aquaculture tanks leads to the acceleration of water quality degradation and requires permanent attention to parameters adjustment.

- **Real-time** online monitoring of temperature, pH, dissolved oxygen, and other relevant water tank parameters such as ammonia, conductivity and turbidity from any computer, tablet, or smartphone connected to the Internet.
- **Receive** alerts via e-mail or SMS when pre-set values are exceeded for any monitored parameter in order to quickly control any situation.
- **Analyze** records and graphs with values recorded during different time periods, by simply clicking on them, in order to improve production planning.
- **Send** parameter adjustment commands from any computer, tablet or smart phone , at any time, from anywhere.
- **Complete fish farm automation**, Automation of oxygen pumps, water circulation valves and fish feeders can be done according to the actual values of the parameters.

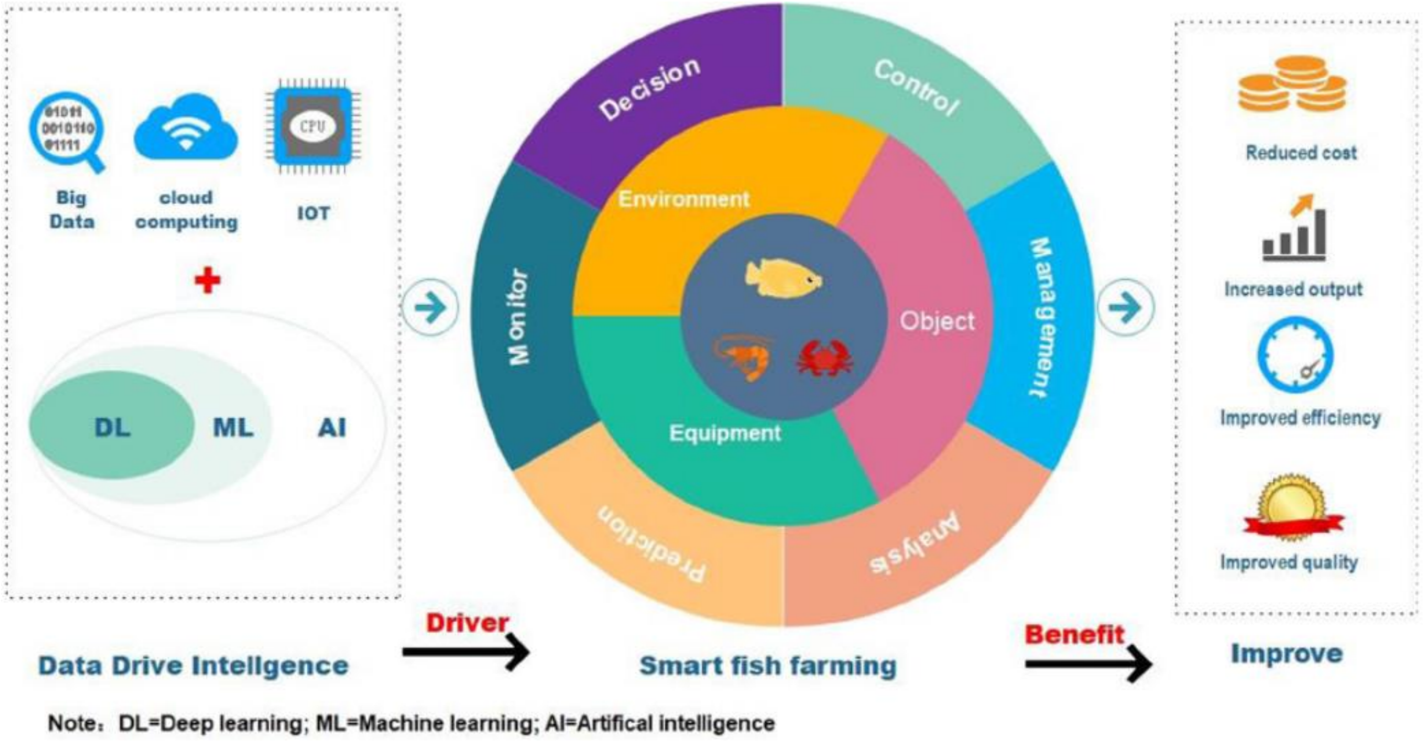
Deep learning for smart fish farming

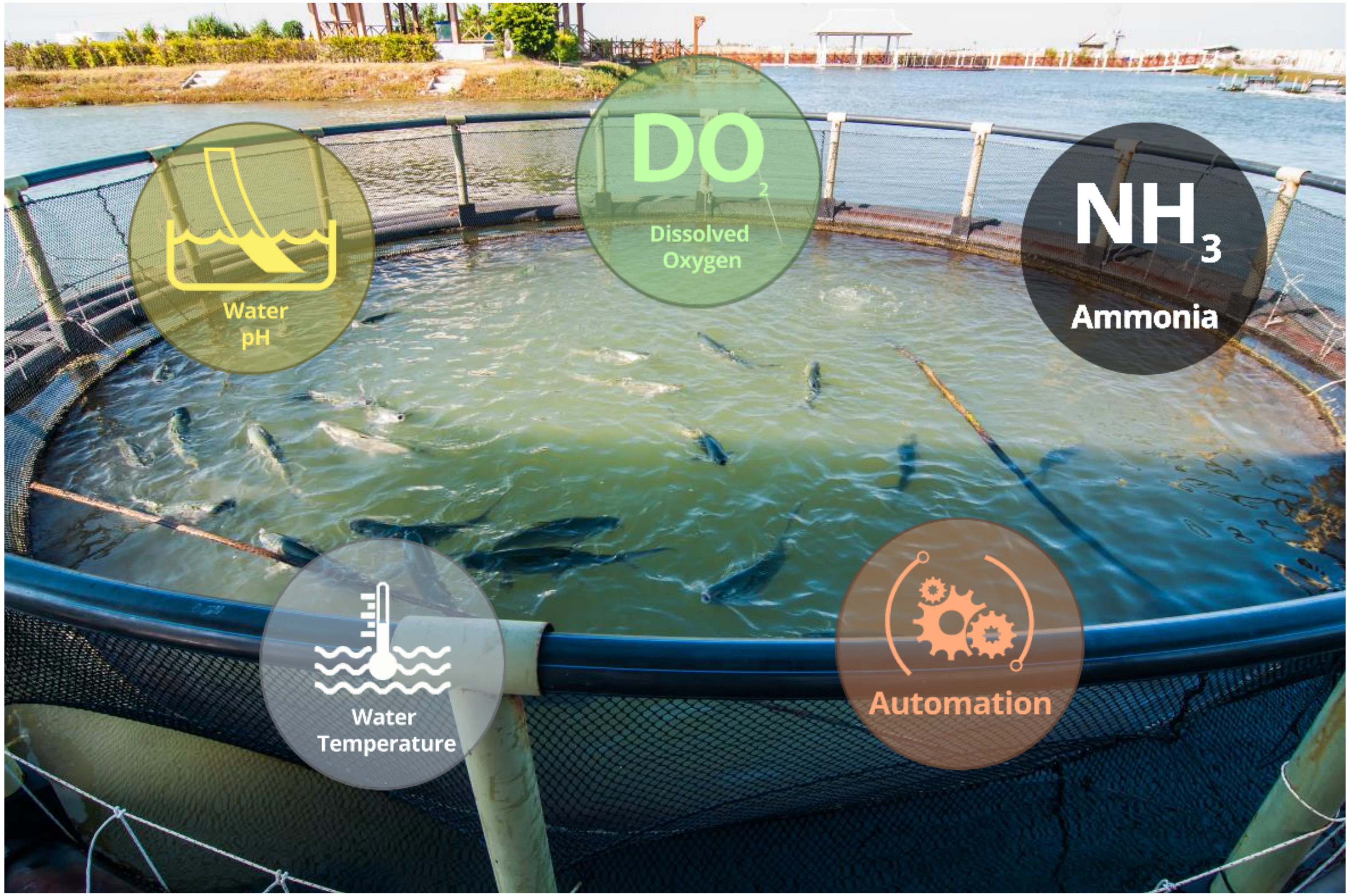
In 2016, the global fishery output reached a record high of 171 million tons. Of this output, 88% is consumed directly by human beings and is essential for achieving the Foodland Agriculture Organization of the United Nations(FAO)'s goal of building a world free from hunger and malnutrition (FAO 2018). However, as the population continues to grow, the pressure on the world's fisheries will continue to increase .

Smart fish farming refers to a new scientific field whose objective is to optimize the efficient use of resources and promote sustainable development in aquaculture through deeply integrating the Internet of Things (IoT), big data, cloud computing, artificial intelligence and other modern information technologies.
Furthermore, the real-time data collection, quantitative decision-making, intelligent control, precise investment and personalized service have been achieved, finally forming a new fishery production mode.
In smart fish farming, data and information are the core elements. The aggregation and advanced analytics of all or part of the data will lead to the ability to make scientifically based decisions.

Deep learning for smart fish farming

However, the massive amount of data in smart fish farming imposes a variety of challenges, such as multiple sources, multiple formats and complex data. Multiple sources include information regarding the equipment, the fish, the environment, the breeding process and people. The multiple formats include text, image and audio.
The data complexities stem from different cultured species, modes and stages. Addressing the above high-dimensional, nonlinear and massive data is an extremely challenging task.





DO_2
Dissolved Oxygen
Water pH
NH_3
Ammonia
Water Temperature
Automation


рахмат
ngiyabonga
danke
謝謝
spas
teşekkür ederim
Баярлалаа
mersi
kia ora
barka
welalin
tack
спасибо
faafetai lava
vinaka
спасибі
blagodaram
dank je
misaotra
matondo
paldies
grazzi
mahalo
tapadh leat
kiitos
dankie
nanni
nandri
dhanyavad
thank you
gracias
хвала
asante
manana
obrigada
tenki
bedankt
bayarlalaa
gracje
hvala
maururu
köszönöm
dankon
aciu
akun
djiere dieuf
tau
mochchakkeram
murakoze
enkosi
дякую
mamnun
dziękuję
chnorakaloutioun
gratias ago
gracies
sulpay
go raibh maith agat
chokrane
sobodi
dėkuji
obrigado
sukriya
kop khun krap
taiku
arigatô
takk
dakujem
trugarez
mèsi
sagolun
ありがとう
tanemirt
grazie
didi madloba
najis tuke
terima kasih
rahmet
diolch
dhanyavadagalu
shukriya
merce
мерси
kam sah hamnida
rahmat
감사합니다
xiexie
ευχαριστώ
merci