Ecodesign of Electronic Devices

UNIT 13: Internet of things - IoT

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Internet of things

- Nowadays, the term internet of things is often used. What exactly does this term mean, what does is describe and where does is it originated from?
- The internet of things is a system of interconnected computer devices, mechanical and digital machines, items, animals or people who are equipped with unique identificators and capability to transfer data through a network without the need for human presence or interaction with the computer.
- From this explanation, we can conclude that we are talking about devices that are part of internet network and that submit and receive data.

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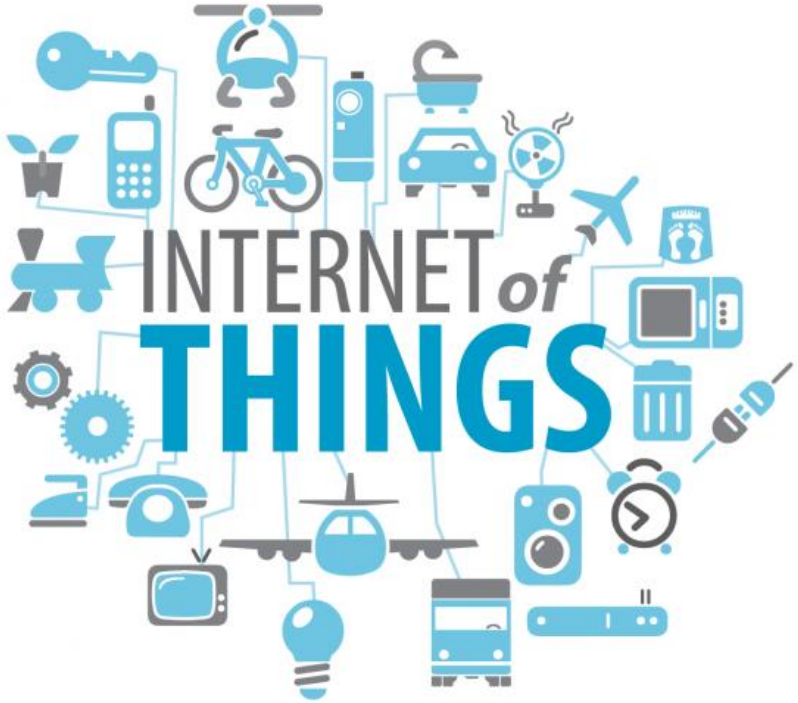
Internet of things

- A thing or a person in internet of things can be a person with heart pacemaker with built-in monitor, an animal on a farm with implanted biochip, automobile that has built-in sensors that alarm the driver if the pressure in tires is too low or any other thing that has a dedicated IP address and has the possibility to transfer data through the network.
- IoT has developed from the convergence of wireless technologies, microelectromechanical systems (MEMS) and the Internet. The convergence has helped eliminate the obstacles between operational technology (OT) and information technology (IT) that enable analysis of data gathered by hardware.



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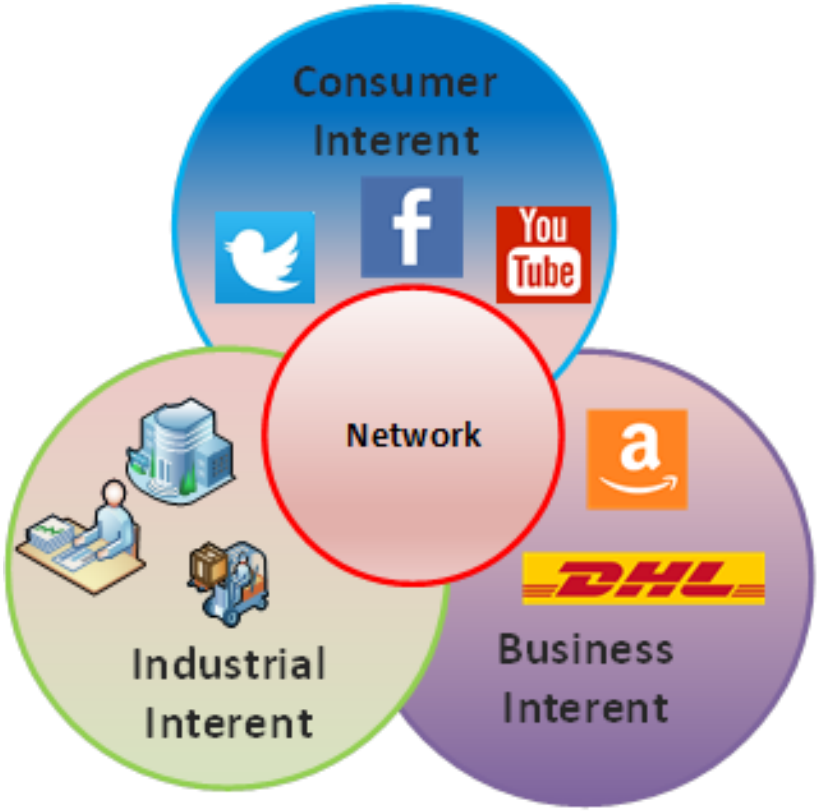
Internet of things

- Internet of things uses synergy that is made by the convergence of consumer, business, and industrial internet networks.
- The convergence creates an open, global network that connects people, data and things. This convergence uses the cloud to connect intelligent things that sense and transfer a wide amount of data that help create services that would not be possible without such connectivity and analytical intelligence.
- Use of platform is dependent on new information technologies, such as cloud, cloud computing, IoT devices and mobile phones.



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Internet of things

- IoT was enabled by technologies such as; sensor networks, RFID, M2M, mobile internet, integration of semantic data, semantic searching, IPv6, etc... These can be divided into three categories:
  - Technologies that allow IoT to gather information..
  - Technologies that enable that IoT to process information.
  - Technologies for improving safety and privacy.
- The first two categories can be seen as functional building blocks that require building of artificial intelligence in the device.
- These are advanced functions that differentiate IoT devices from regular devices and the Internet. The third category is not functional but a real requirement without which the use of IoT devices would reduce significantly.

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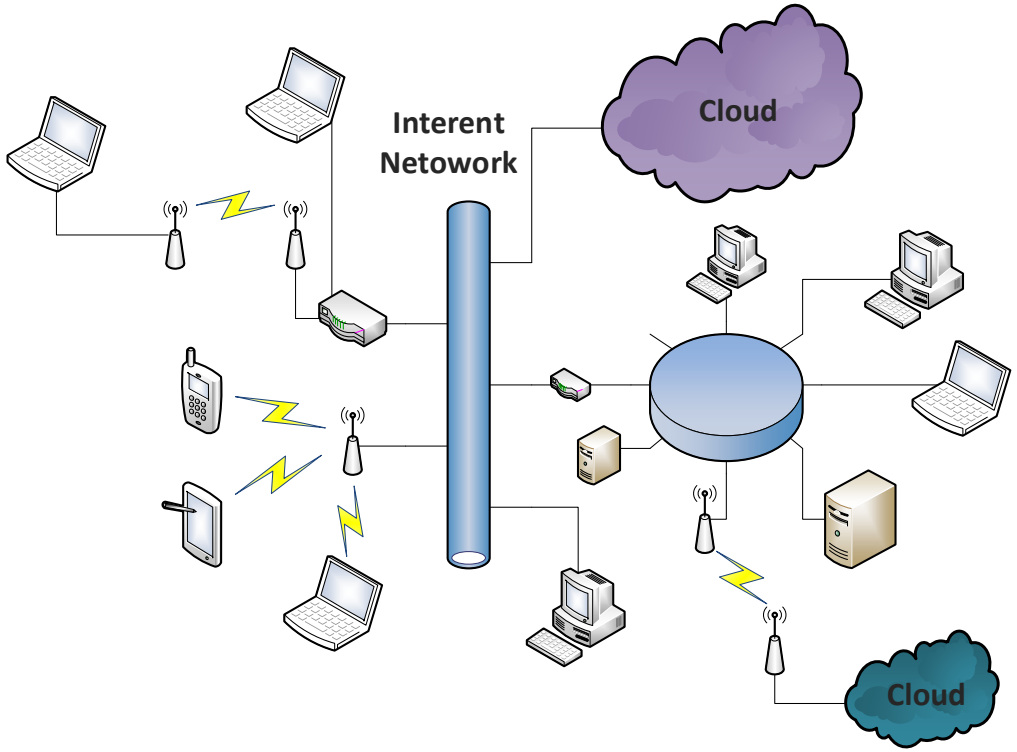
Internet of things

- With IoT devices, communication over the Internet extends to all the things that surround us.
- IoT is much more than M2M communication, wireless sensor networks, 2G, 3G, 4G, 5G and RFID etc ..
- These are only technologies that allow IoT.



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Internet of things Areas

- It is impossible to predict all potential applications of IoT technology, especially considering the development of new technologies and different needs of potential users.
- These applications present important research, development, as well as economic challenges.
- IoT areas work on needs of society, progress, and new technologies.
- Amongst new technologies are also nanoelectronics and cyber systems. The latter are still working on technical, institutional and economic issues. The list of areas is limited to applications that IERC (European Research Cluster on the Internet of Things) has chosen for priority tasks for the next year.

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Smart cities

- Shortly, the development of city corridors and full cities connected in a uniform integrated city network is expected. The current trend predicts that more than 60% of world population will live in urban cities until year 2025.
- The urbanization as a trend will have a huge impact on future society and mobility. The rapid expansion of city centers due to the rapid increase of residents and development of infrastructure will force smaller cities to expand outside and from the near-by cities form megacities with more than 10 million residents.

Until 2024, 30 megacities are expected globally, of which 55% will be developing in economies of India, China, Russia and Latin America. This will lead to the development of smart cities with eight fundamental strategies, which are: smart economy, smart building, smart mobility, smart energy, smart information-communication technology, smart planning, smart citizenship and smart management.

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Smart cities

- The image presents several common actions that are done in a smart day, wherein each case also has a label which area is used. Such horizontal scenario means the use of heterogeneous basic communication technologies and provides the user with interaction with different advanced IoT services.
- In this context, there are several important development challenges for IoT applications in smart cities:
  - Overcoming of traditional city organizations that are outwards relatively closed and only work on own problems. Although this is not a technological problem, it is still one of the main obstacles.
  - Production of algorithms and processes for data flow and measurement that are gathered by different sensors in different applications. Gathered data needs to be suitable for use and exchange between different city services.
  - Develop cost-effective mechanisms of use and maintenance of these devices, including disposal or recycling.
  - Providing reliable measurements and use of data from many sensors. Effective calibrating of a large number of units, arranged on different locations, from lamps to workstations need to be provided.
  - Low-energy protocols and algorithms.
  - Algorithms for analysis and processing of data gathered in the city.
  - High integration of IoT technology.

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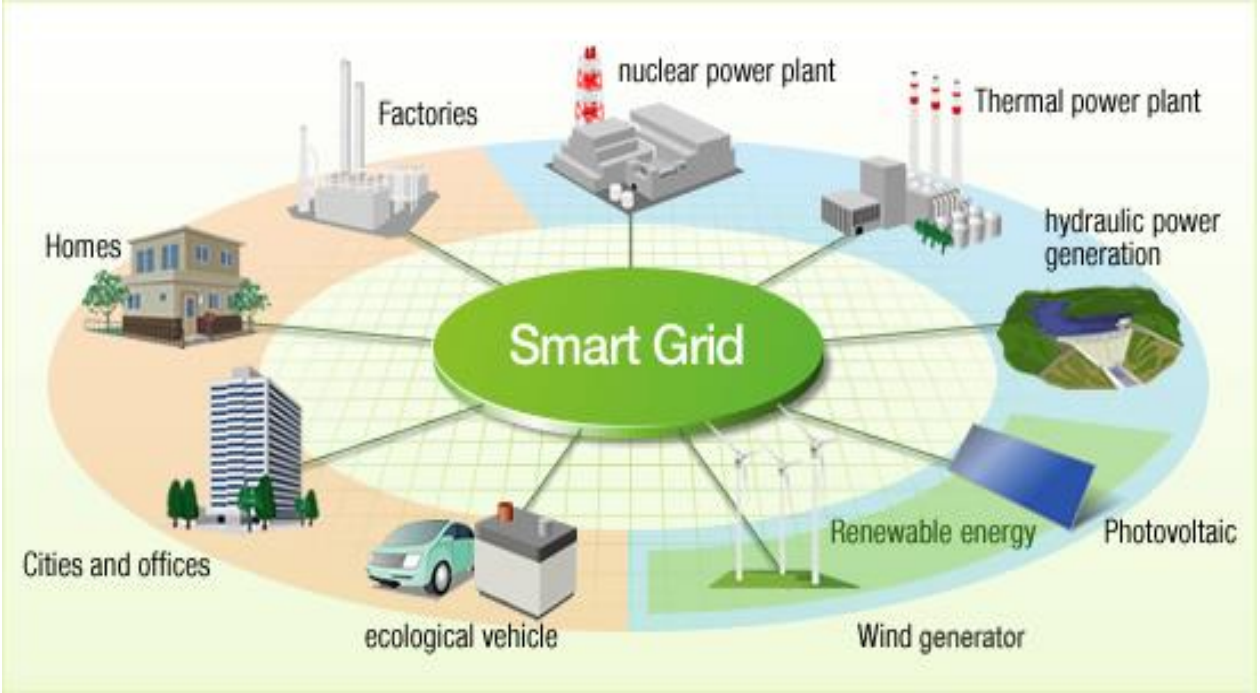
Smart Grid

- For new energy, networks will be typical a large number of distributed small, and medium sited energy source and power plants that can be combined in large virtual power plants.
- In case of outage or accident in energy network, some areas can be separated from the main network, and local internal source can still supply this area.
- Local energy sources can be small power plants and photovoltaic on building roofs. Image 4 presents modern smart electrical network that consists of different sources.



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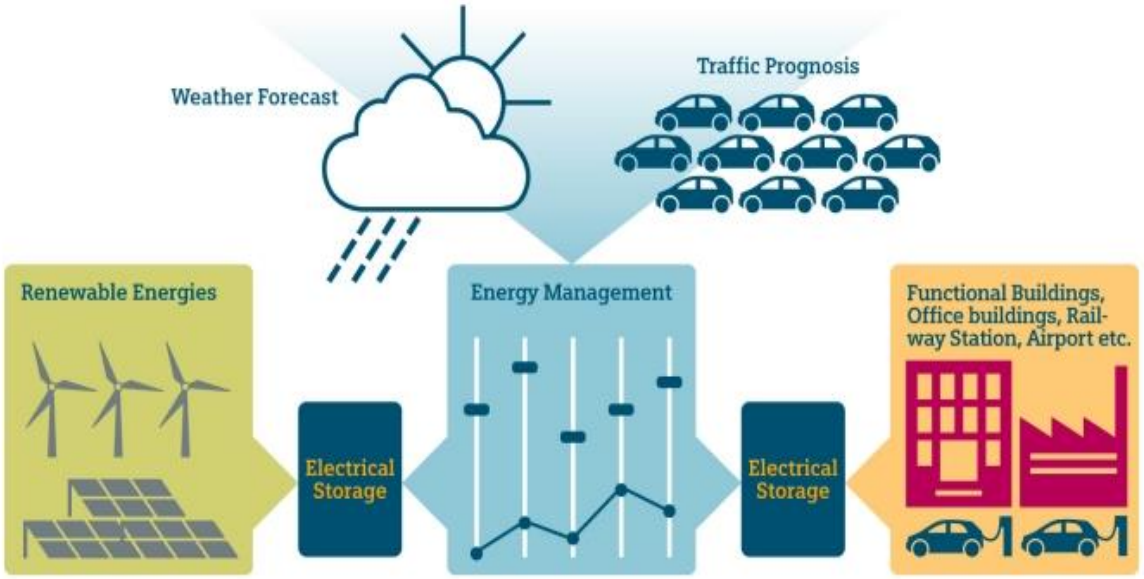
Smart Grid

- In this aspekt, the concept of 'energy internet'-IoE (' Interent of Energy ') is set up as a network infrastructure based on standard, communications transmitters, nodes and protocols.
- They must allow a balance between local and global production and storage capacity.
- This will also enable a high level of awareness and integration of consumers in the energy system.
- IoE provides an innovative concept of distribution, energy storage, network monitoring and communication.



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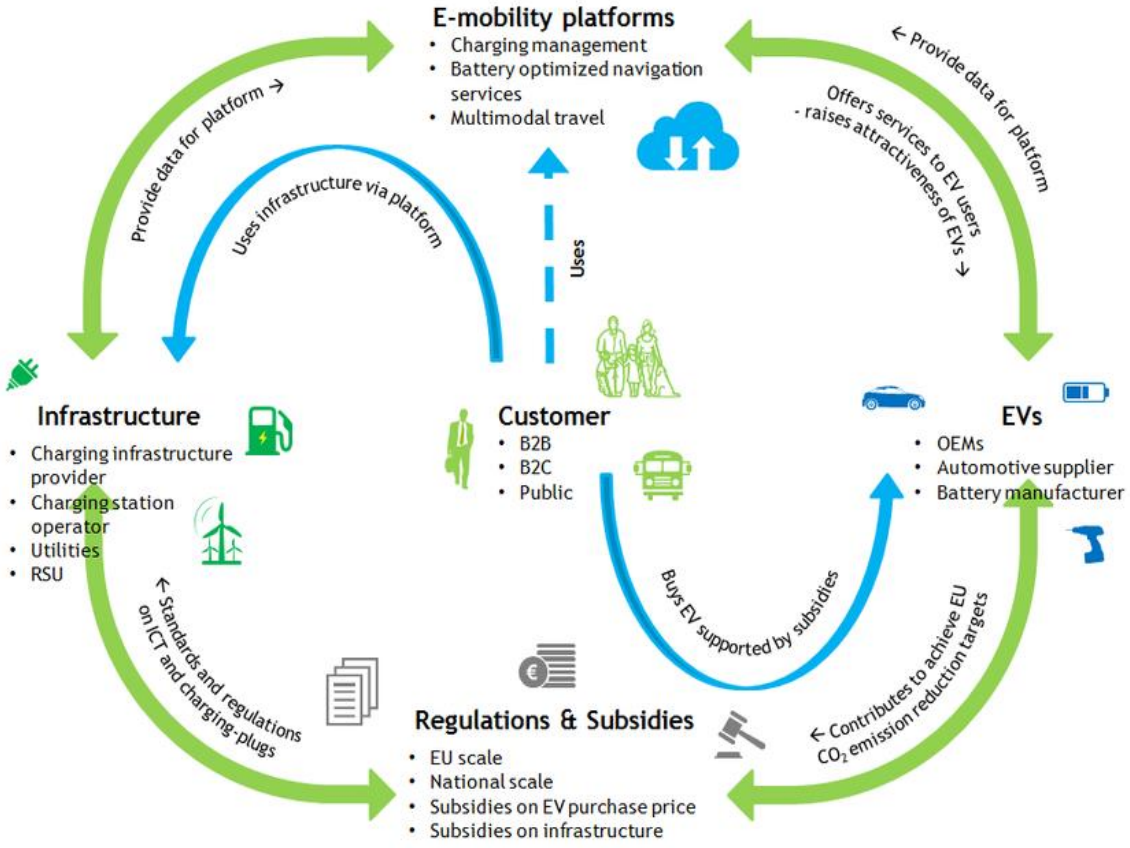
Smart Grid

- Long-term, electromobility will become another important element of smart electro-energetic networks.
- An example of electrical mobility ecosystem is presented in right picture. Electrical vehicles (EV) can only work as network load or as mobile energy storage.
- The vehicles will be connected to IoT devices via a smart network. When managing electrical vehicles through IoT devices with the smart network, we will need to consider also energy demand and offers in residential areas and near main roads based on traffic and weather forecast.



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Smart transport and mobility

- Connecting to all vehicles types, not only electrical ones with the internet will cause many new possibilities and applications that can make transport easier and more functional.
- In this context, we are talking about the Internet of Vehicles (IoV) that is connected to the concept of IoE, which presents future trend and bases of smart mobility.
- Simultaneous establishment of new mobile ecosystems that are based on safety, comfort of mobile services and transport applications, will provide high comfort of transactions and services.

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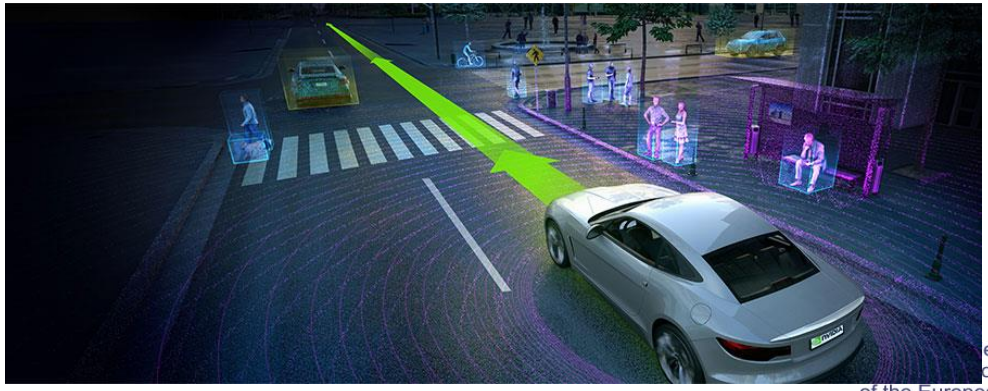
Smart transport and mobility

When we are talking about IoT in the context of automotive telematics, we can present the following scenarios:

- The standards regarding power electronics supply voltage are needed, but it is also needed to determine if all charging processes are controlled by a system inside the vehicle or in the filling station.
- It is needed to develop systems for two-sided operations: charging and emptying – energy storage.
- IoT can be a component of vehicles that controls and manages the vehicle. Already today, service center monitors some parameters in the vehicle and inform the user of vehicle condition and possible needed service. The service centers also take care of timely spare parts delivery and organizing work.
- IoT enables management and control over the traffic. Vehicles and routes would be organized in a way that we could avoid traffic jams and optimize fuel consumption. This could be done with the suitable infrastructure of smart city
- IoT enables new transport scenarios – modal traffic. In this case, the automobile manufacturers would be mobility providers and not only vehicle manufacturers. They would offer the user an optimal solution for transport from point A to point B based on available and suitable means of transport.



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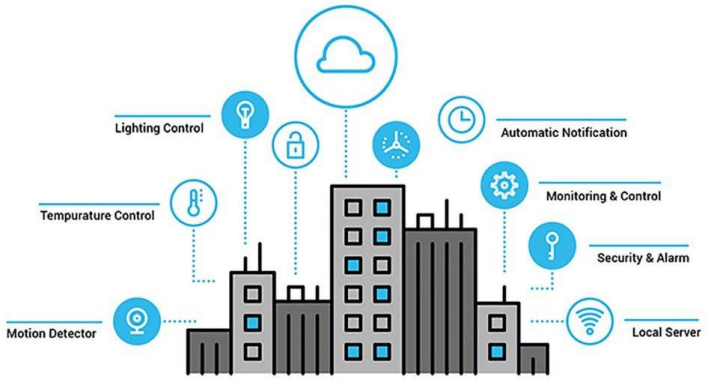
Smart building

- With the expansion of WiFi networks in office buildings and homes, there was the possibility of smart building management.
- All devices in the building are connected to the Internet network and are part of the Internet network inside the building.
- The advantage of such a smart building is that there is no need for your own home network, but the IP protocol is used for communication.
- All devices on the network must have a wired or wireless connection to the Internet. This way also allows remote control over the building. This means that the user can connect the heating, turn off the lights, etc., even though the building is not present.



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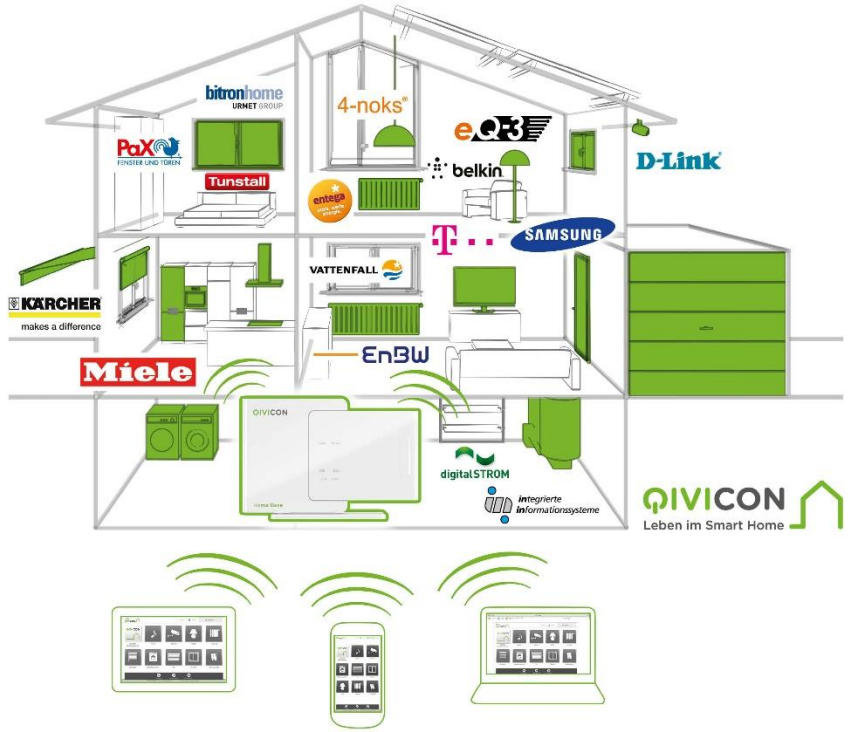
Smart building

- External access to the building is enabled through different services. A smart building can be accessed through portable devices, such as phones, tablets, laptops or online applications that are not dependent on portable platform.
- IoT devices that collect information on building with sensors together with cloud technology enable deeper analysis and optimal management of buildings with maximum efficiency.
- The main problems in integrating smart building integration are most commonly at ownership of multi-apartment houses and payment of initial costs. Another problem is lack of cooperation with the construction industry and slow penetration and accepting of new technologies



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Smart manufactory

- IoT enables access to devices and machines that together build digitalized production systems.
- This way, IoT will undertake a series of applications and services that are important for successful production functioning. This could first include connecting of plants into smart networks, sharing of production sectors which would significantly increase agility and flexibility of production system.
- In this sense, the production system would present one IoT unit where we could determine new ecosystem for smarter and more efficient production.

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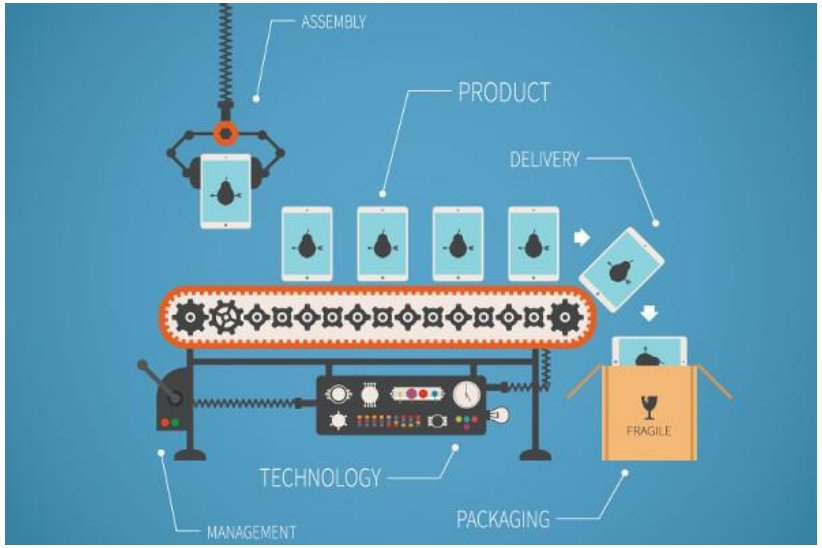
Smart manufactory

- The first evolution step to smart plant in common use could be done in a way that the access to the plant would be given to external stakeholders.
- Those would access production processes and the plant via the internet. Stakeholders would include suppliers, production, logistics, and maintenance.
- Such IoT architecture challenges the hierarchical and closed plants that usually have a pyramid system where external stakeholders have lower influence.
- The room for innovation and new applications could be increased to the same extent as for embedded systems that have steeply risen since the implementation of smartphones.



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Health

- The current market of devices for health control is very fragmented and unstructured. We know many different electronic devices for monitoring and measurements of vital bodily functions. For all devices, it is common that their usefulness is different depending on their intended use.
- Devices are built on different platforms.
- Although individual products are intended for reaching price objectives, the long-term goal is directed towards reaching of lowest technological costs.

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Health

- Convergence of biosensors, communication technology, and engineerings, changes healthcare into a new type of information industry.
- In this context, the advancement that exceeds IoT technology for healthcare is anticipated in the following steps:
  - Standardization of interfaces and sensors with the open platform for creating a wide and open market for biochemical innovators.
  - Providing a high level of automatization when accepting and processing information.
  - Data in real time through the network have to be accessible anywhere on the internet and have to be supported with suitable software.
  - Reuse and uniform structure of device components for an easier transition to a cheaper device for home use. More expensive professional devices would be stationed in hospitals and nursing facilities.
  - Data have to be portable between authorized devices that are used in clinical care at home, clinic or hospitals.

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