

Internet-of-Things (IoT)

Introduction

What is IoT

- Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with [electronics](#), [software](#), [sensors](#), [actuators](#), and [connectivity](#) which enables these things to connect, [collect](#) and exchange [data](#)¹.
- IoT refer to the connection of devices to the Internet.

¹https://en.wikipedia.org/wiki/Internet_of_things

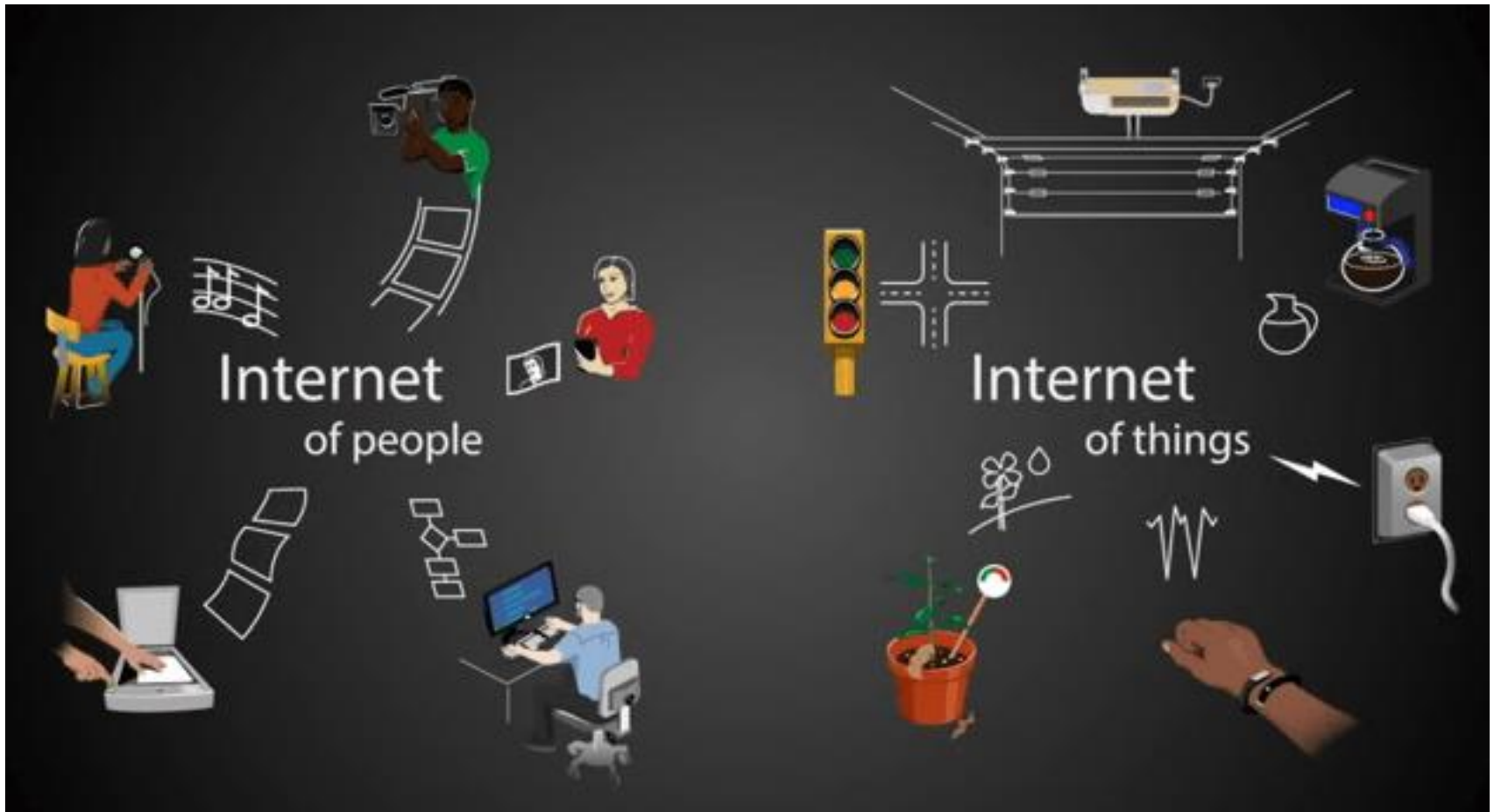
Internet of People (IOP)

- People are connected with the Internet.
- Internet is everywhere in the World.
- It is the primary connection between people.

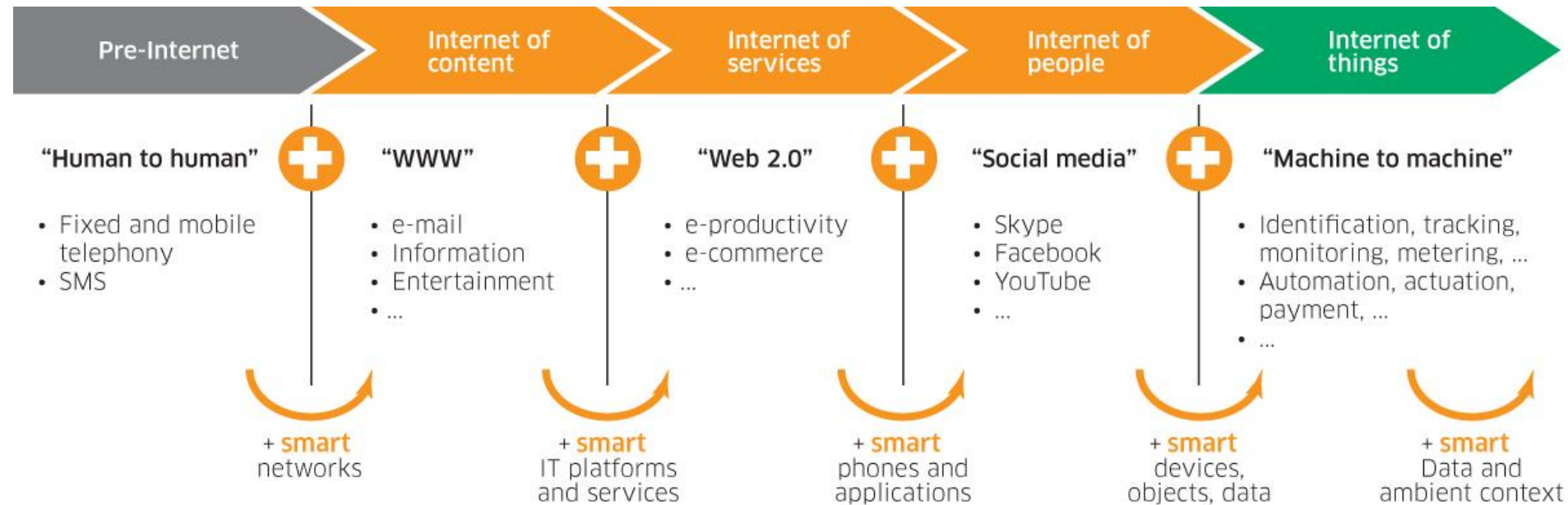


IOP

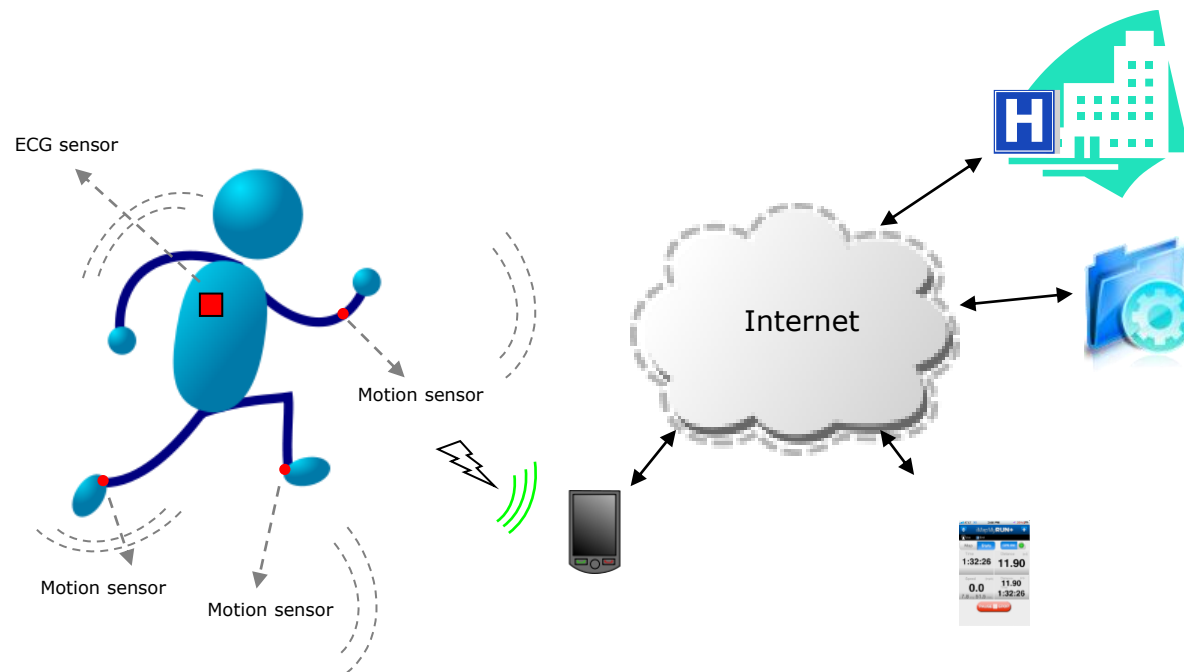
IOT



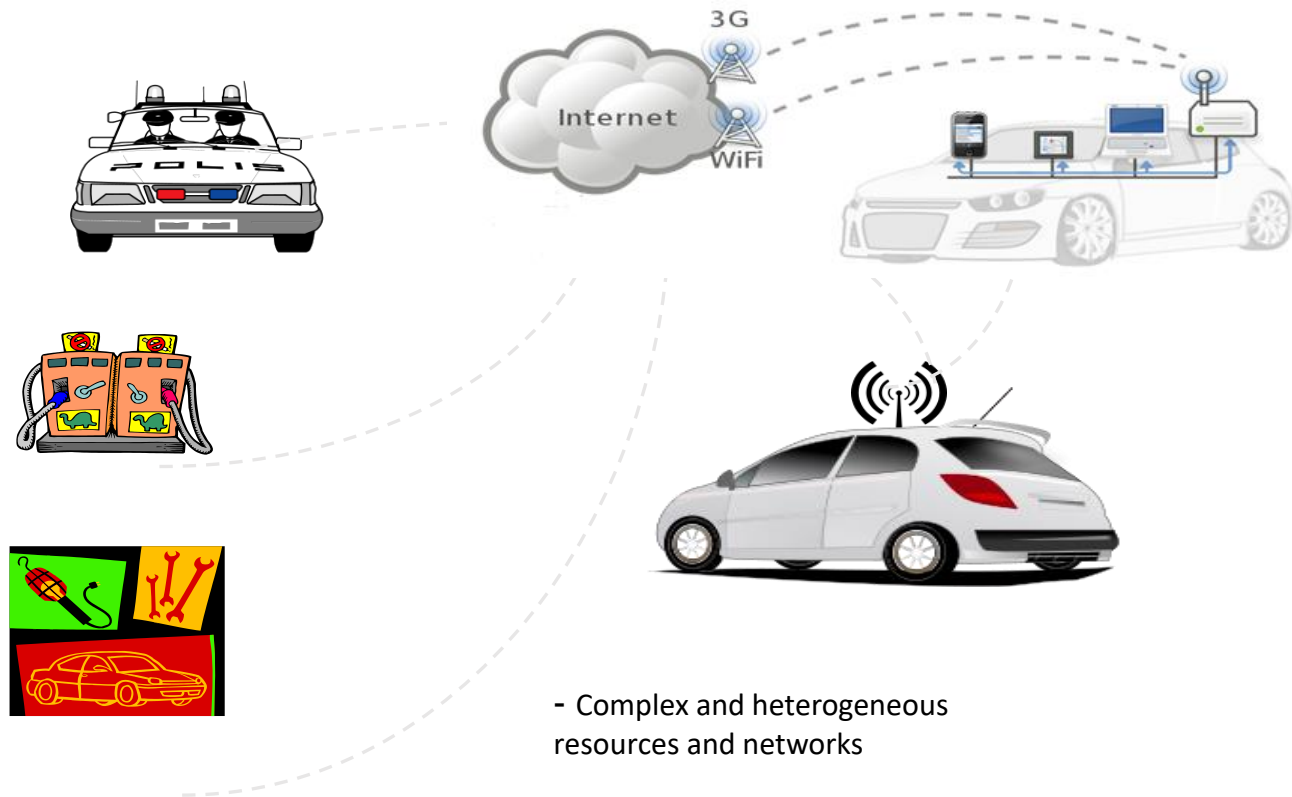
Internet-of-Things Evolution



People Connecting with Things



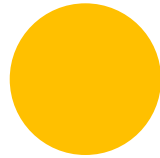
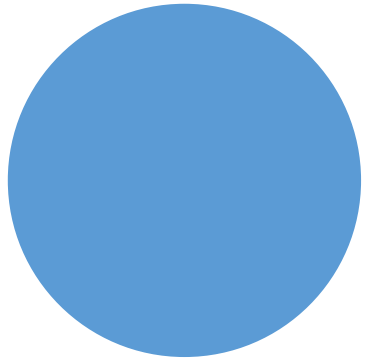
Things Connecting with Things



Where is IOT?

IOT is everywhere!

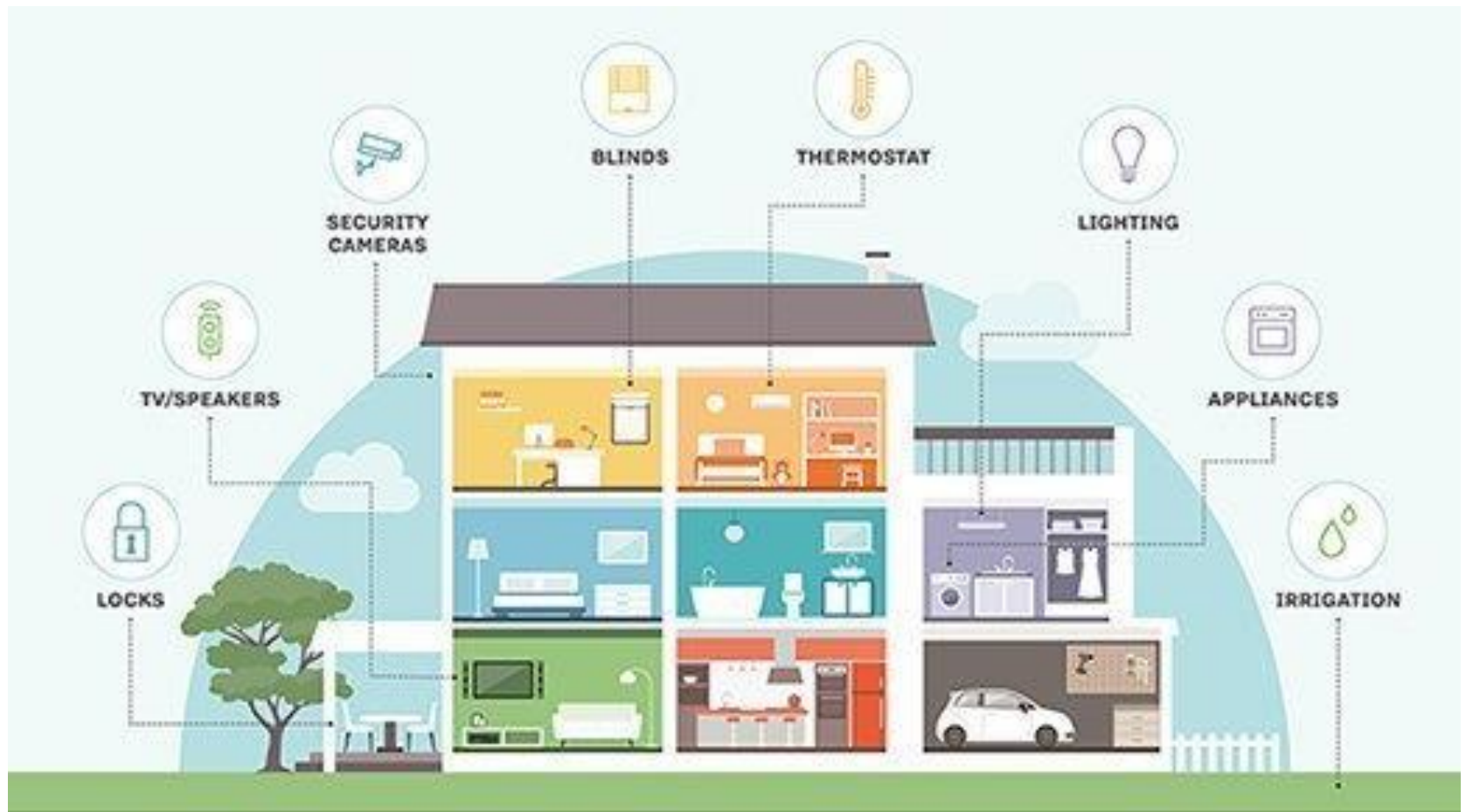




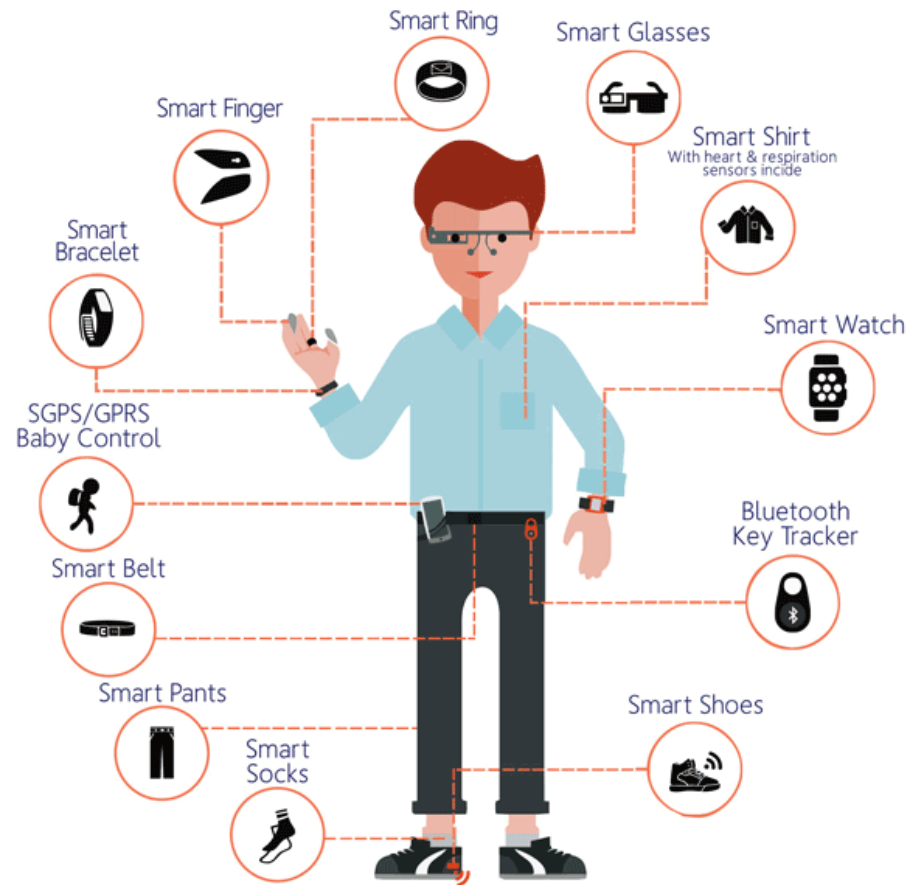
Applications



Smart Homes

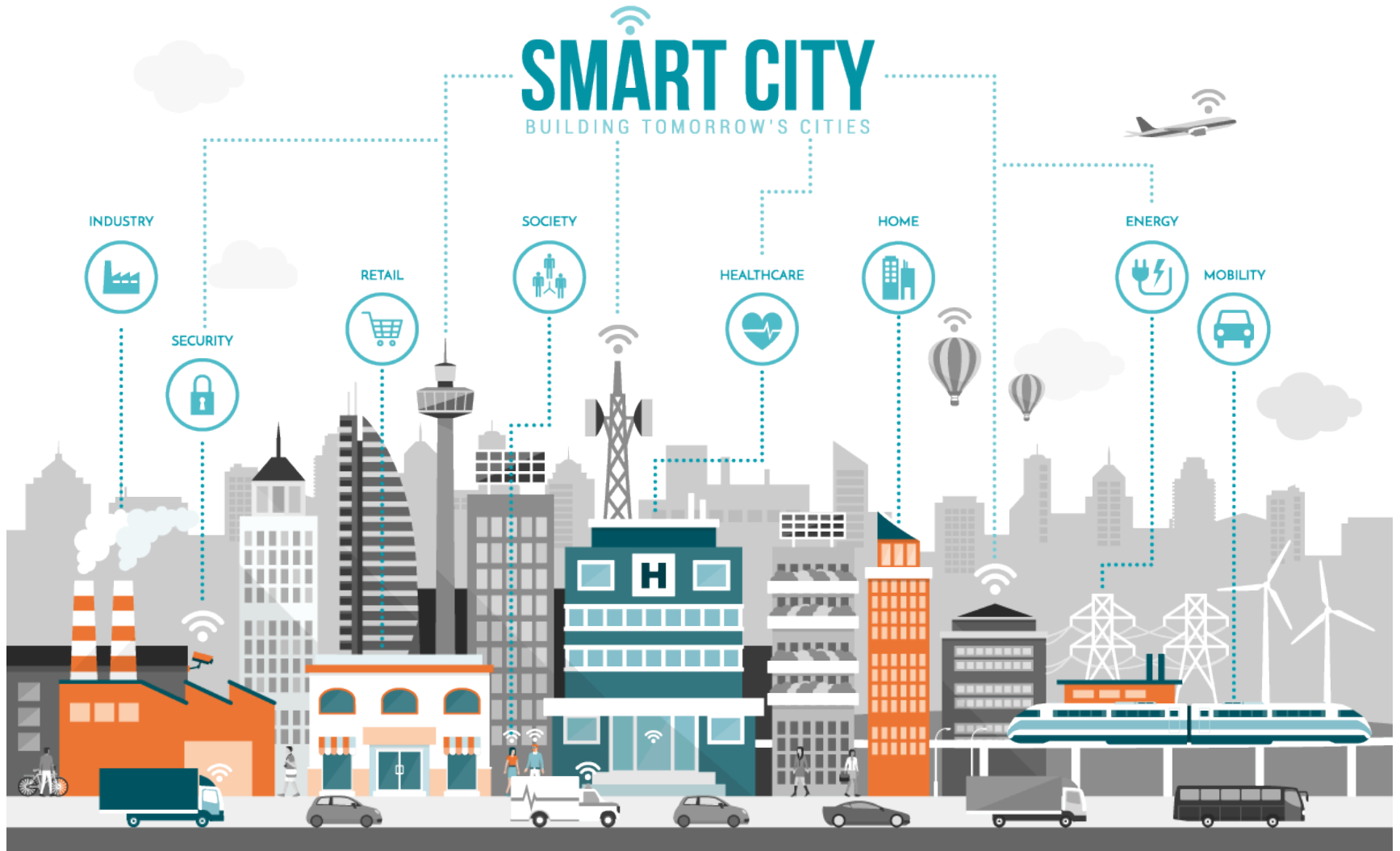


Wearable



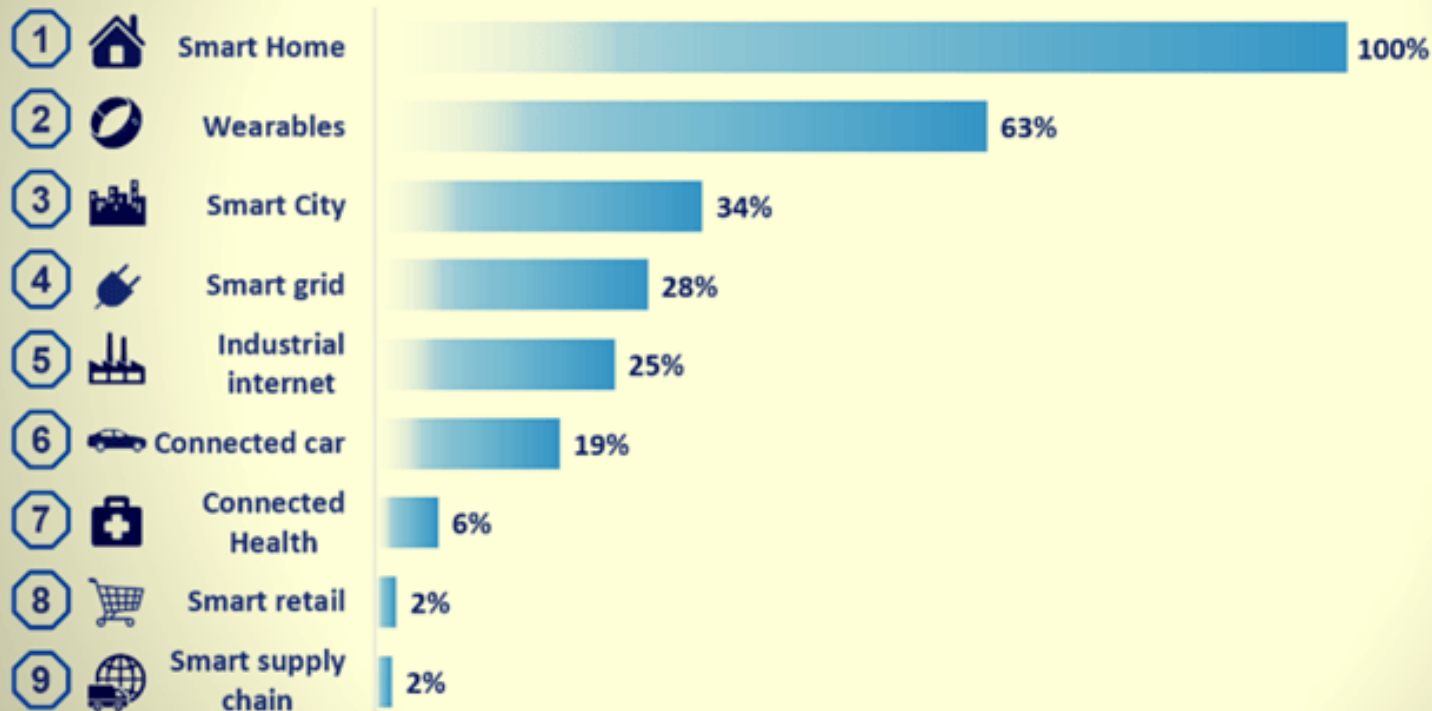
SMART CITY

BUILDING TOMORROW'S CITIES



The 10 most popular Internet of Things applications

A ranking based on web analytics



Augment Existing Things





Augmenting Life With New Things

- Smart City
- Smart Car
- Smart Me (healthcare, fitness, wellness)

Example: Connected Roadways

Under the bonnet

How a self-driving car works

Signals from **GPS (global positioning system)** satellites are combined with readings from tachometers, altimeters and gyroscopes to provide more accurate positioning than is possible with GPS alone

Lidar (light detection and ranging) sensors bounce pulses of light off the surroundings. These are analysed to identify lane markings and the edges of roads

Video cameras detect traffic lights, read road signs, keep track of the position of other vehicles and look out for pedestrians and obstacles on the road

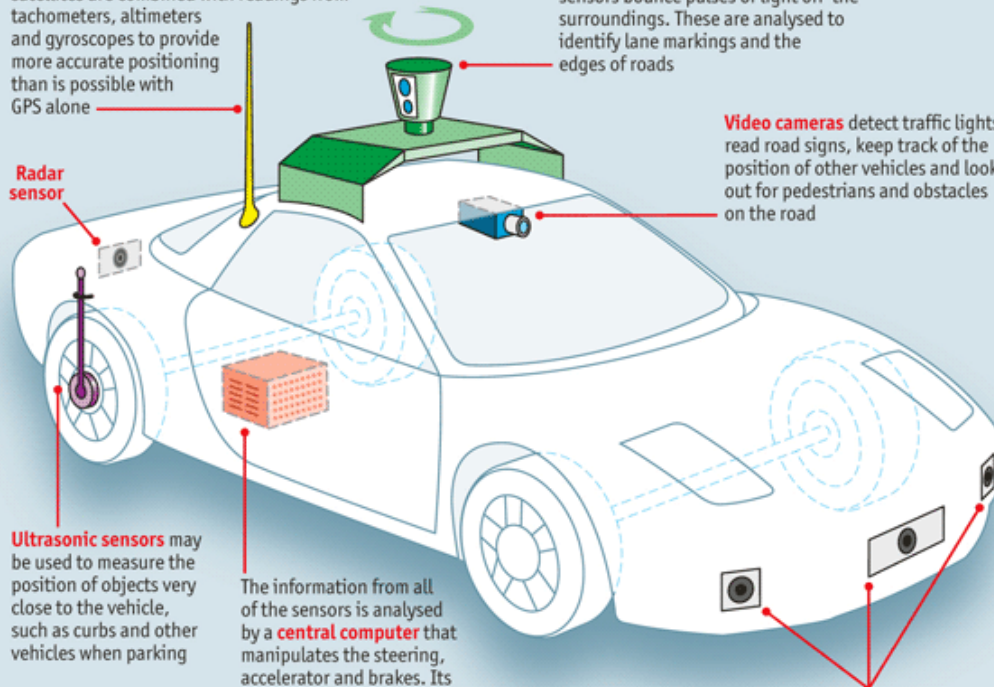
Radar sensor


Ultrasonic sensors may be used to measure the position of objects very close to the vehicle, such as curbs and other vehicles when parking

The information from all of the sensors is analysed by a **central computer** that manipulates the steering, accelerator and brakes. Its software must understand the rules of the road, both formal and informal

Radar sensors monitor the position of other vehicles nearby. Such sensors are already used in adaptive cruise-control systems

Source: *The Economist*



An aerial view of a city intersection featuring several self-driving cars. Each car is surrounded by concentric circles representing its sensor range (LiDAR or radar). The sensor ranges are color-coded: red for the closest range, orange for the middle range, and green for the outer range. The cars are positioned at various points in the intersection, including a brown car in the bottom left, a blue car in the top right, and a red car in the bottom right. Pedestrians are visible on the sidewalks, and the scene includes urban elements like buildings, trees, and streetlights.

Example: Connected Roadways

[State of Self-Driving Car](#)

The Connected Factory in Action



INNOVATION

TAP COMMERCIAL INNOVATION

Mobilize employees and supervisors to move across the factory floor and access data wherever they are. The iPad and other like devices are making their way into industrial settings – along with an expectation that much of the commercial innovation it brings will also apply to industrial activities.

CONNECT ENGINEERS WITH MACHINES (M2M)

Apply predictive maintenance. Gain early warnings when production, machinery or network performance is about to degrade.



EFFICIENCY

LINK INFORMATION & OPERATIONAL TECHNOLOGY

Bridge the gap from data center to control room to collaborate and share best practices and common goals between manufacturing and IT.

OPTIMIZE ASSETS

Identify where your people, equipment, works in process and finished goods are in real-time. Adjust the schedule and inventory on the fly.



AGILITY

CONNECT & COLLABORATE EXTERNALLY

Extend visibility beyond your four walls. Link the extended supply chain and distribution to create dynamic workflows. Help and expertise are available in an instant.

EXPANDABLE INFRASTRUCTURE

Design and build an Industrial Ethernet infrastructure to minimize cost and effort to expand or improve processes. One infrastructure for safety, control, SCADA, Physical Security, and LAN.



RISK

SECURE PHYSICAL & CYBER ASSETS

Traditional security devices, like keypad entry systems, call boxes and security cameras, need power from Industrial Ethernet cables, with secure networks, to protect your processes, people, and plans from cyber sabotage.

MAXIMIZE UPTIME

Design ruggedized industrial networking infrastructure that will endure in harsh environments with redundant communications, power and configuration backup – especially for business processes under extreme conditions.



Example: Connected Factory

- New product and service introductions faster
- Increasing production, quality, uptime
- Mitigating unplanned downtime
- Protecting from cyber threats
- Worker productivity and safety

Example: Smart & Connected Buildings

- Energy management
- Lighting
- Safety
- HVAC
- Building automation
- Smart spaces



Example: Smart Creatures

The connected cow

Necklace

Connecterra, a Dutch company, makes Fitbit-style necklaces that monitor a cow's movement and feeding habits. The sensor can be used to detect health problems and to tell when the cow is in heat, so that insemination can happen at an optimum time.

Acid monitor

Well Cow, a British company, has developed a bolus that is inserted into the cow's rumen to monitor acidity levels. This helps detect digestive problems.

Pedometer

Afimilk, based in Israel, makes a pedometer for cows. Cows typically increase their walking as they come into oestrus, so the pedometer alerts farmers to the best time for insemination.

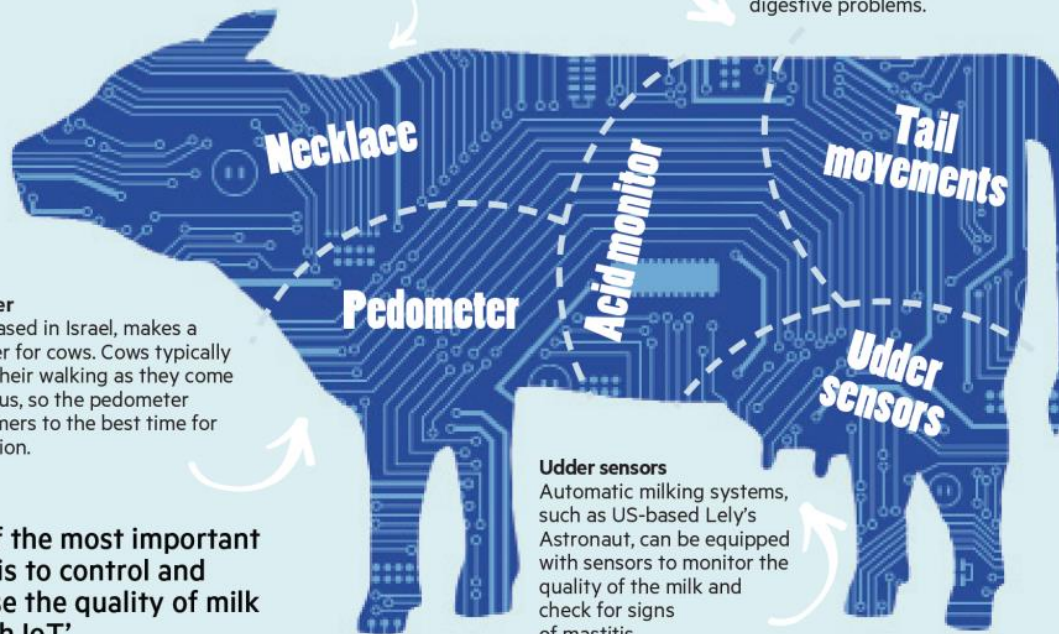
'One of the most important issues is to control and increase the quality of milk through IoT'

Tail movements

Moocall, an Irish company, makes a birthing sensor that attaches to the tail. It measures tail movements triggered by labour contractions, and sends a farmer an SMS alert approximately one hour before a cow is due to calve.

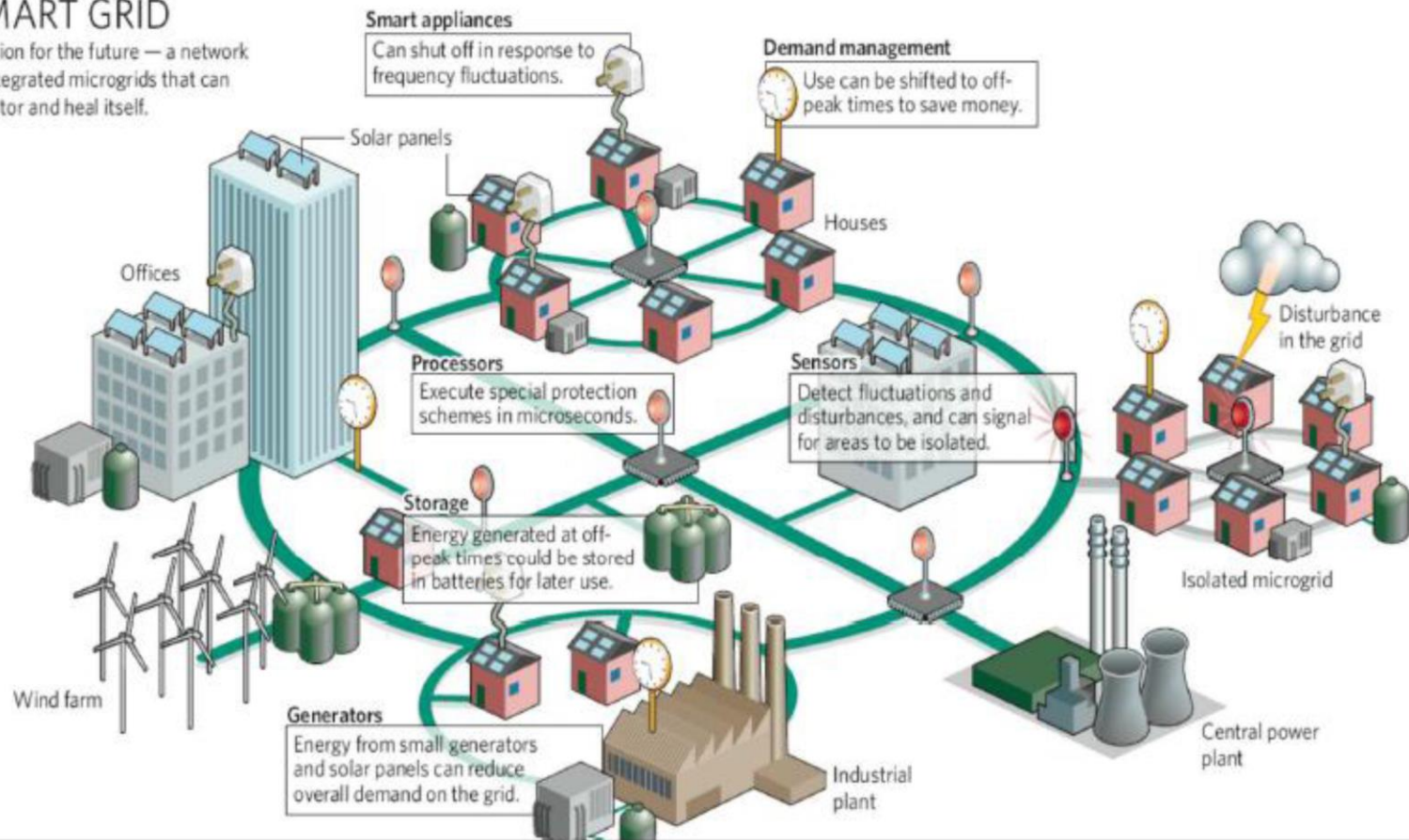
Udder sensors

Automatic milking systems, such as US-based Lely's Astronaut, can be equipped with sensors to monitor the quality of the milk and check for signs of mastitis.



SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



Example: Smart Grid



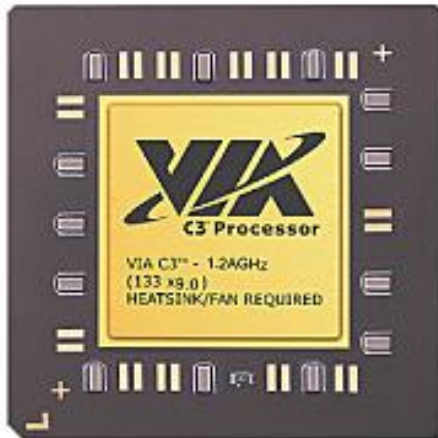
Enablers: Portability

Reducing the size of hardware to enable the creation of computers that could be physically moved around relatively easily



Enablers: Miniaturization

Creating new and significantly smaller mobile form factors that allowed the use of personal mobile devices while on the move



50mm x 50mm

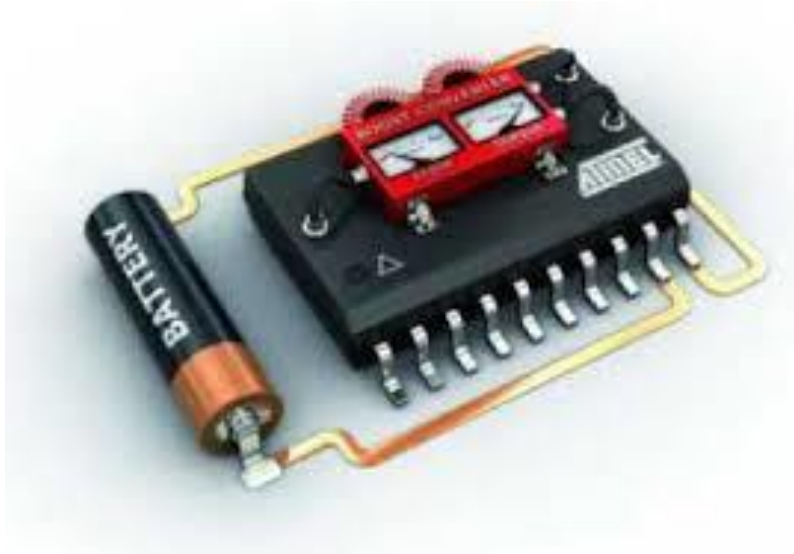


35mm x 35mm



15mm x 15mm

Enablers: Low Power and Low Heat



- Low power architectures
- Low power radios
- Sleep modes
- Energy harvesting

Enablers: Connectivity

- Developing devices and applications that allowed users to be online and communicate via wireless data networks while on the move



Bluetooth®

Enablers: Convergence

Integrating emerging types of digital mobile devices, such as Personal Digital Assistants (PDAs), mobile phones, music players, cameras, games, etc., into hybrid devices.



Enablers: Divergence

Opposite approach to
interaction design by
promoting
information
appliances with
specialized
functionality rather
than generalized ones



Enablers: Ecosystems



The emerging wave of *digital ecosystems* is about the larger wholes of pervasive and interrelated technologies that interactive mobile systems are increasingly becoming a part of.

Example: Smartphone

- Portability: carry it anywhere you want
- Miniaturization: make it possible to build device to fit in your pocket
- Connectivity: Wi-Fi, LTE/4G, cellular, Bluetooth
- Convergence: phone, camera, gaming device, movie streaming, music player, ...
- Digital Ecosystem: cloud, social networks, software development kits, app stores, big data, standardization ...

IoT Issues & Challenges

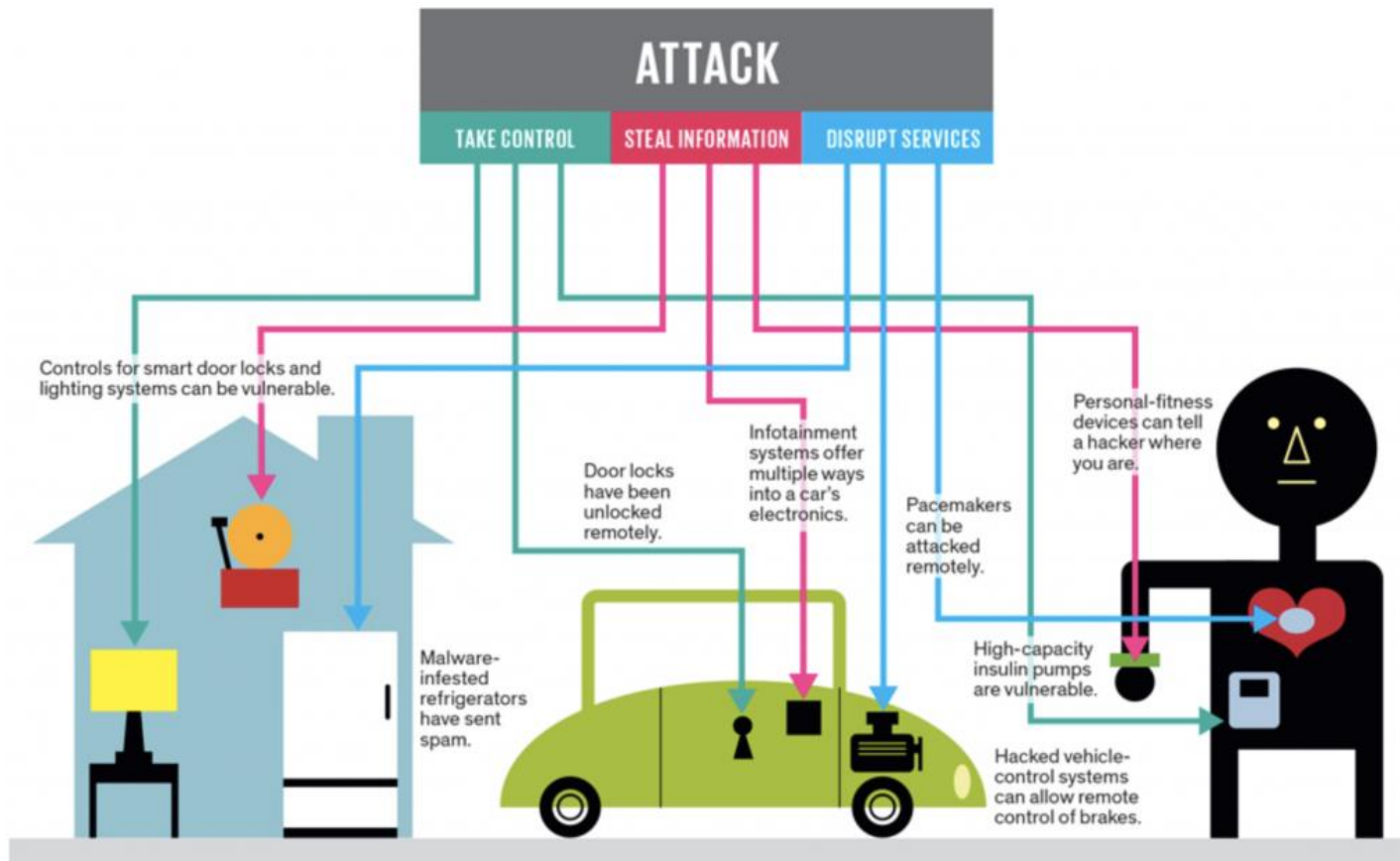


Illustration: J. D. King

BREAK

