PhD Course on Smart Environments

Introduction to IoT

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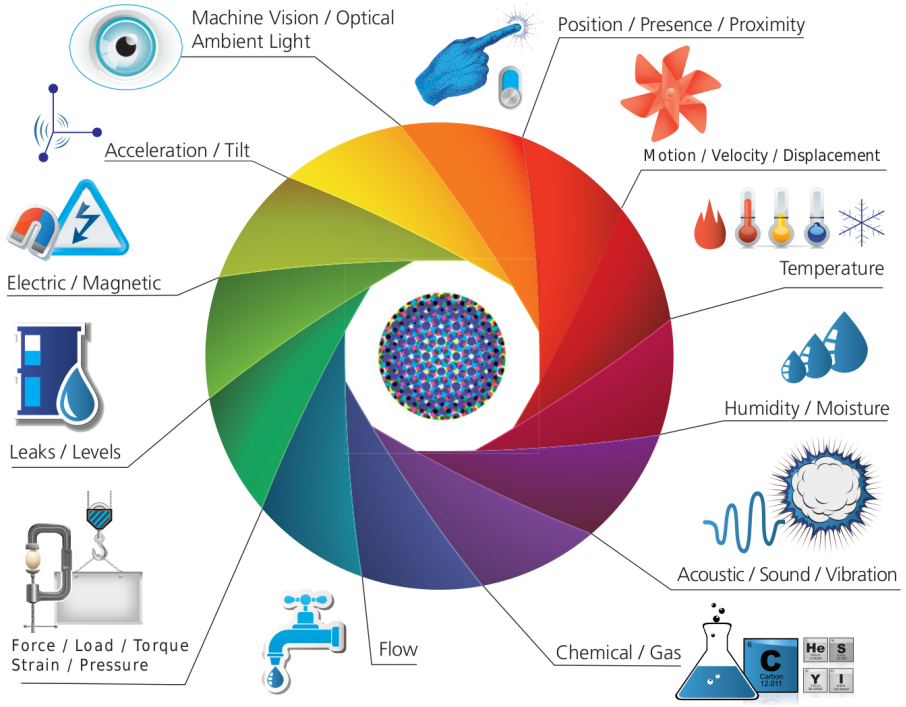
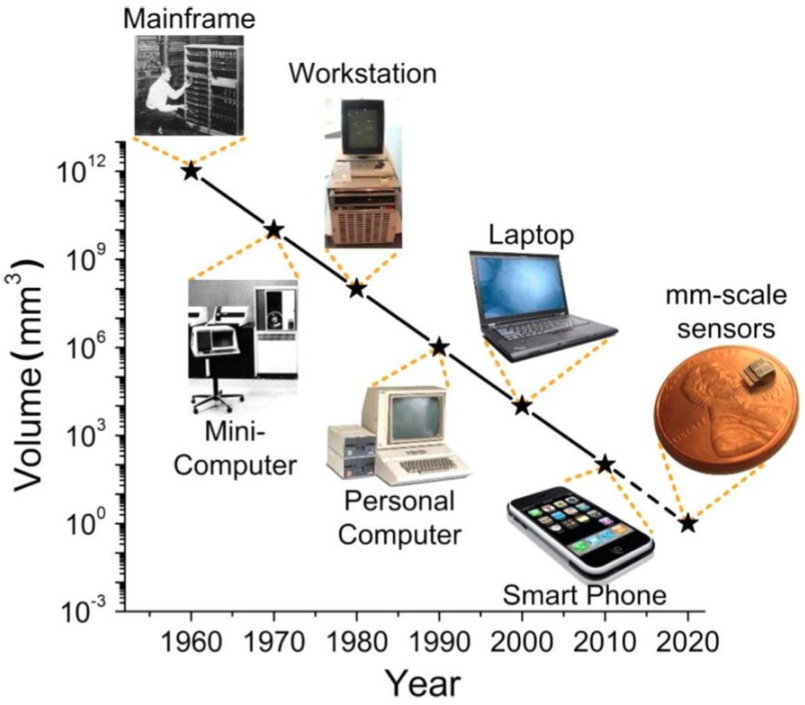
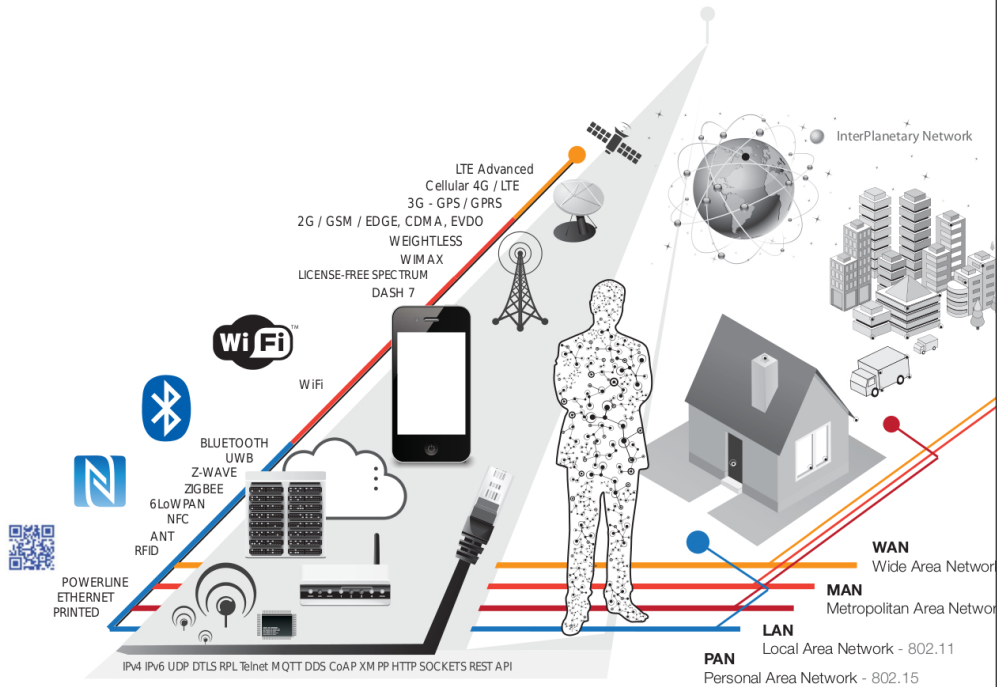
Lecture 1

Sensors & Actuators: a digital nervous system

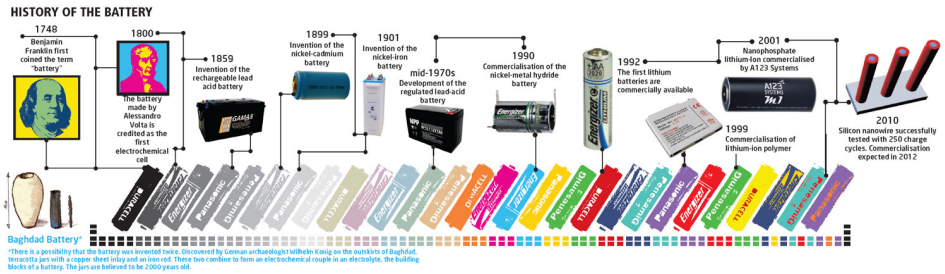


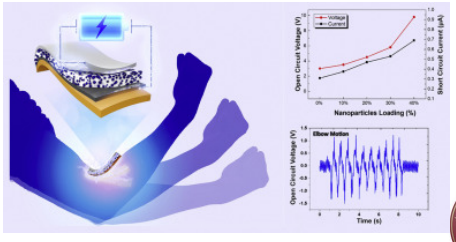


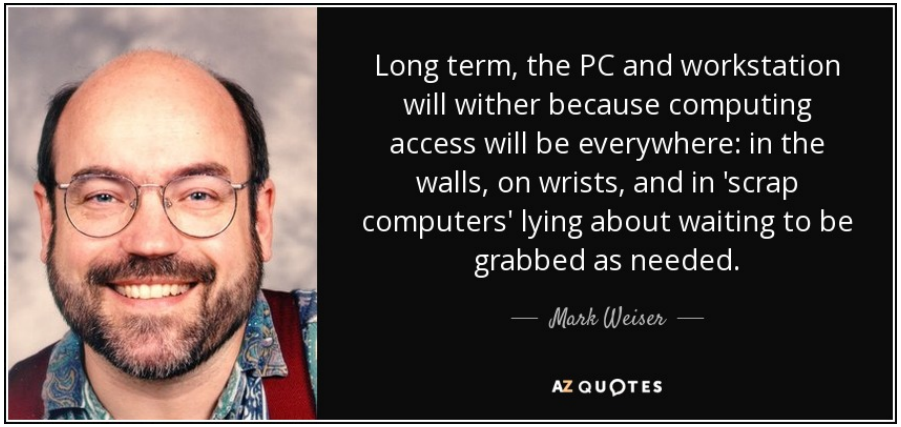
Broad range of options for connectivity



From batteries to energy harvesting, to nanogenerators







"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

Mark Weiser, 1991

`https://web.archive.org/web/20141022035044/http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html`

"A good tool is an invisible tool. By invisible, I mean that the tool does not intrude on your consciousness; you focus on the task, not the tool."

Mark Weiser, 1993

`https://web.archive.org/web/20141109145219/http://www.ubiq.com/hypertext/weiser/ACMInteractions2.html`

*"**Ubiquitous computing** names the third wave in computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives"*

Mark Weiser, 1988

*"A future in which we - individuals, neighbors, friends, and relatives - can use the technology around us to observe, discover, and act on the patterns that shape our lives. Whether your passion is personal or global, whether your interest is in health or the environment, whether you act alone or in a group, **Urban Sensing** is a new approach that empowers all of us to illuminate and change the world around us"*

D. Estrin, M. Srivastava

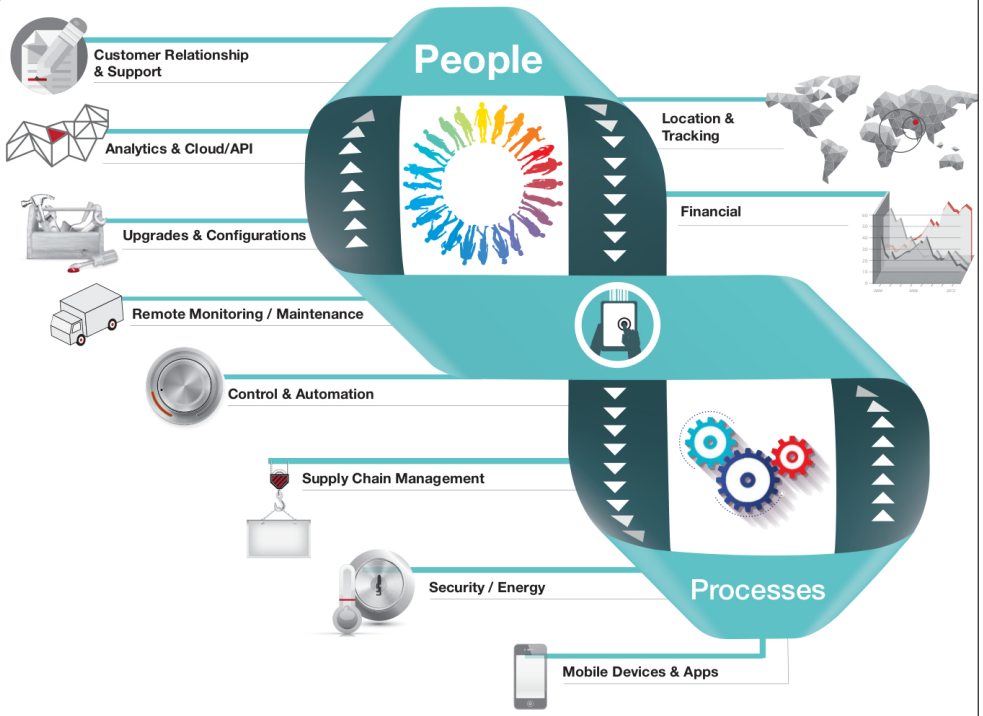
Senseable City Lab (MIT)

The interactions between these

SENSORS + CONNECTIVITY + PEOPLE + PROCESSES

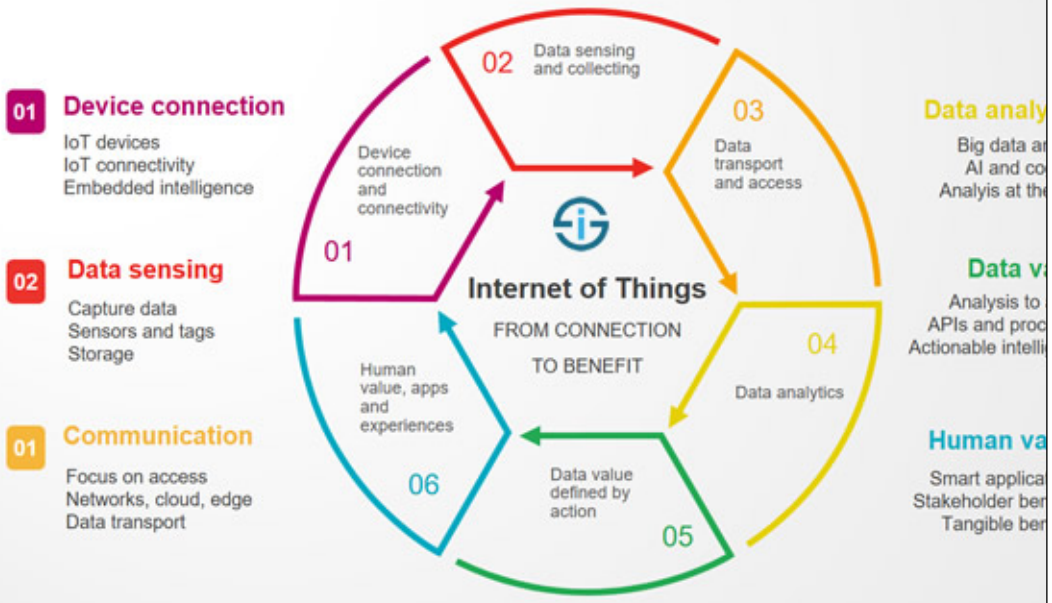
entities are creating new types of smart applications and services.

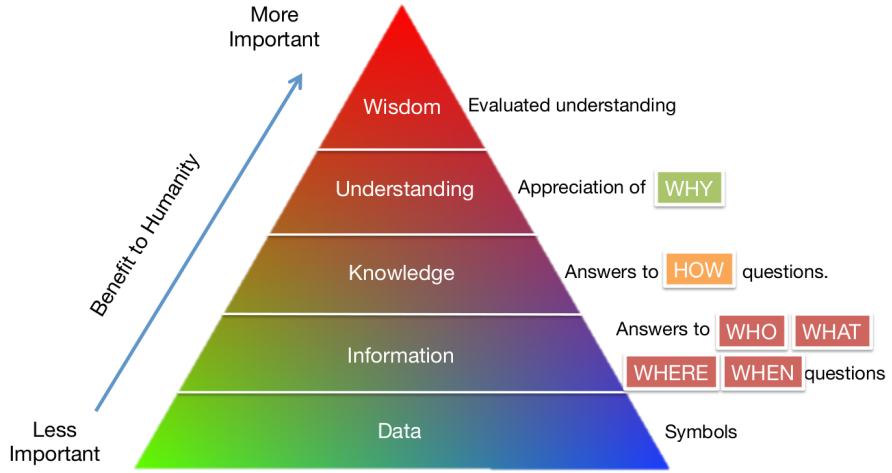
People & Processes: bi-directional systems



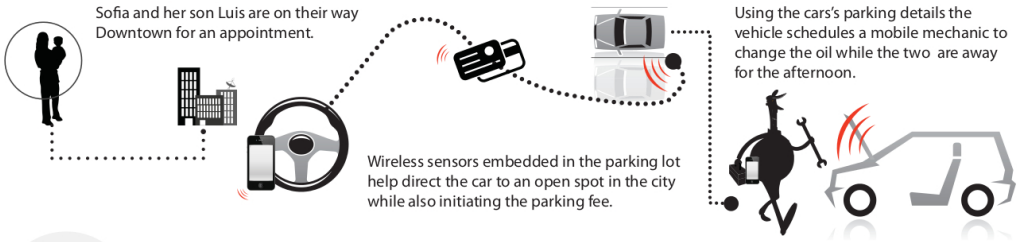
The Internet of Things

From connecting devices to human value





Transportation & Smart Cities

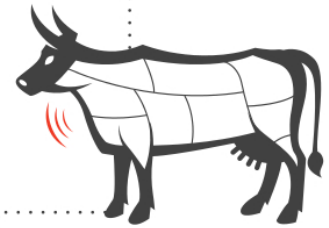


In Downtown San Francisco 20-30% of all traffic congestion is caused by people hunting for a parking spot.

- San Francisco Municipal Transportation Agency (SFMTA)

DIGITAL FARM TO TABLE

- Farm & Livestock ID & Sensors
- Food packaging sensors
- Retail Supply Chain Monitoring
- Health Services



Cattle
AIN: 840 003 123

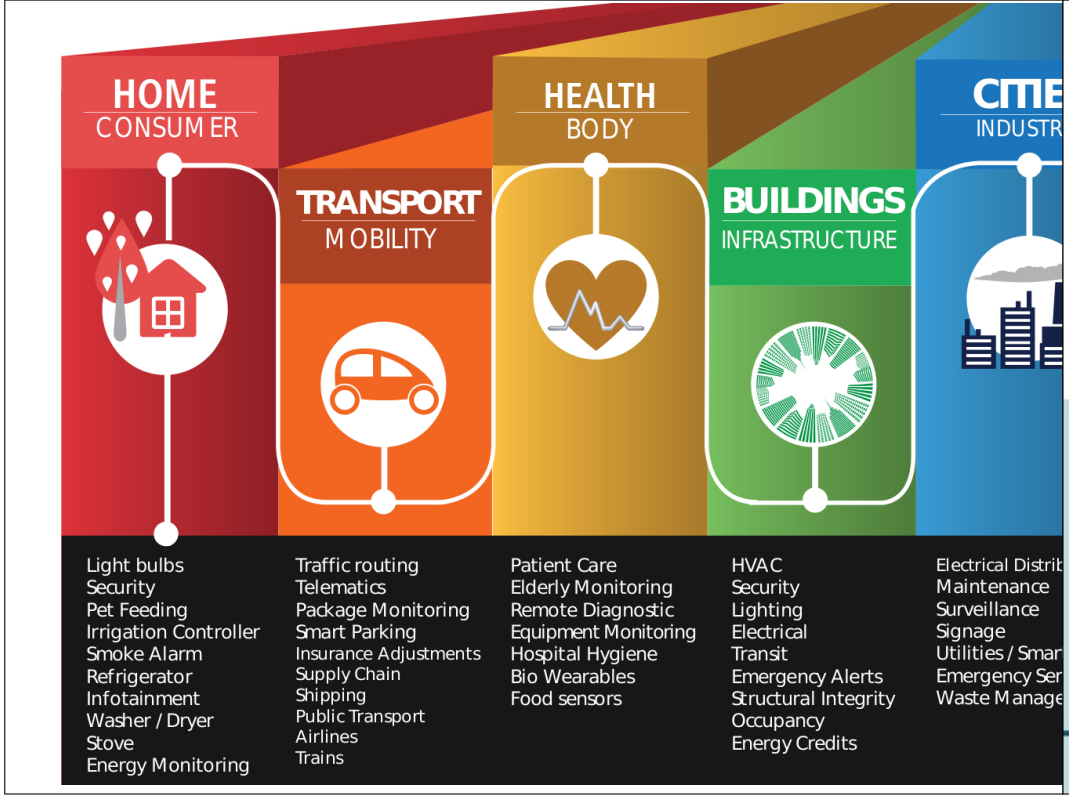
Location: ID: Braymea
#00285453543
Slaughterhouse ID:
Sensor: *Temperature, A*
Connectivity: *RFID, N*

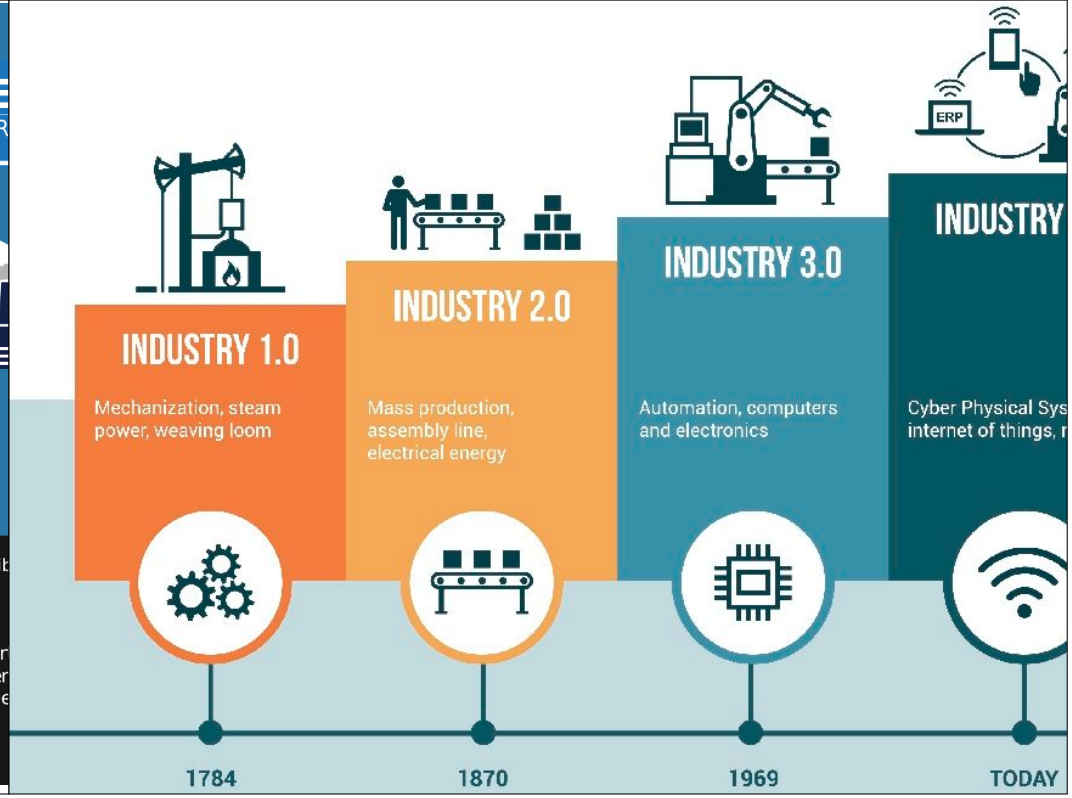
Maria and her daughter are picking up groceries for the packaging with printed sensors, the two can make sure beef they are purchasing has never reached unsafe tem while on the shelf or being transported.

The packaging also contains a QR code which they can the cow's RFID tag and bring up its history:

- *Where it was raised* - *Where it was slaughtered* - *Where it was*
- *What it was fed* - *How it was transported* - *The last time i*

A week later the U.S. Department of Agriculture's Food S determines ground beef from originating from a region company and sold at a neighboring store is contaminat O157:H7. All packages from this distributer change thei color and notification messages are sent to those shopp have been impacted.


HOME
CONSUMER
TRANSPORT
MOBILITY
HEALTH
BODY
BUILDINGS
INFRASTRUCTURE
CITIE
INDUSTR
Light bulbs
Security
Pet Feeding
Irrigation Controller
Smoke Alarm
Refrigerator
Infotainment
Washer / Dryer
Stove
Energy Monitoring
Traffic routing
Telematics
Package Monitoring
Smart Parking
Insurance Adjustments
Supply Chain
Shipping
Public Transport
Airlines
Trains
Patient Care
Elderly Monitoring
Remote Diagnostic
Equipment Monitoring
Hospital Hygiene
Bio Wearables
Food sensors
HVAC
Security
Lighting
Electrical
Transit
Emergency Alerts
Structural Integrity
Occupancy
Energy Credits
Electrical Distrib
Maintenance
Surveillance
Signage
Utilities / Smar
Emergency Ser
Waste Manage


INDUSTRY 1.0
Mechanization, steam power, weaving loom
INDUSTRY 2.0
Mass production, assembly line, electrical energy
INDUSTRY 3.0
Automation, computers and electronics
ERP
INDUSTRY
Cyber Physical Sys
internet of things, r
1784
1870
1969
TODAY