

# The Internet of Things

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ID 405: Human-Computer Interaction  
Spring 2015

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<http://info-design-lab.github.io/ID405-HCI/>

## Lecture Outline

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1. What is it
2. User interfaces
3. Technical challenges
4. A perspective shift

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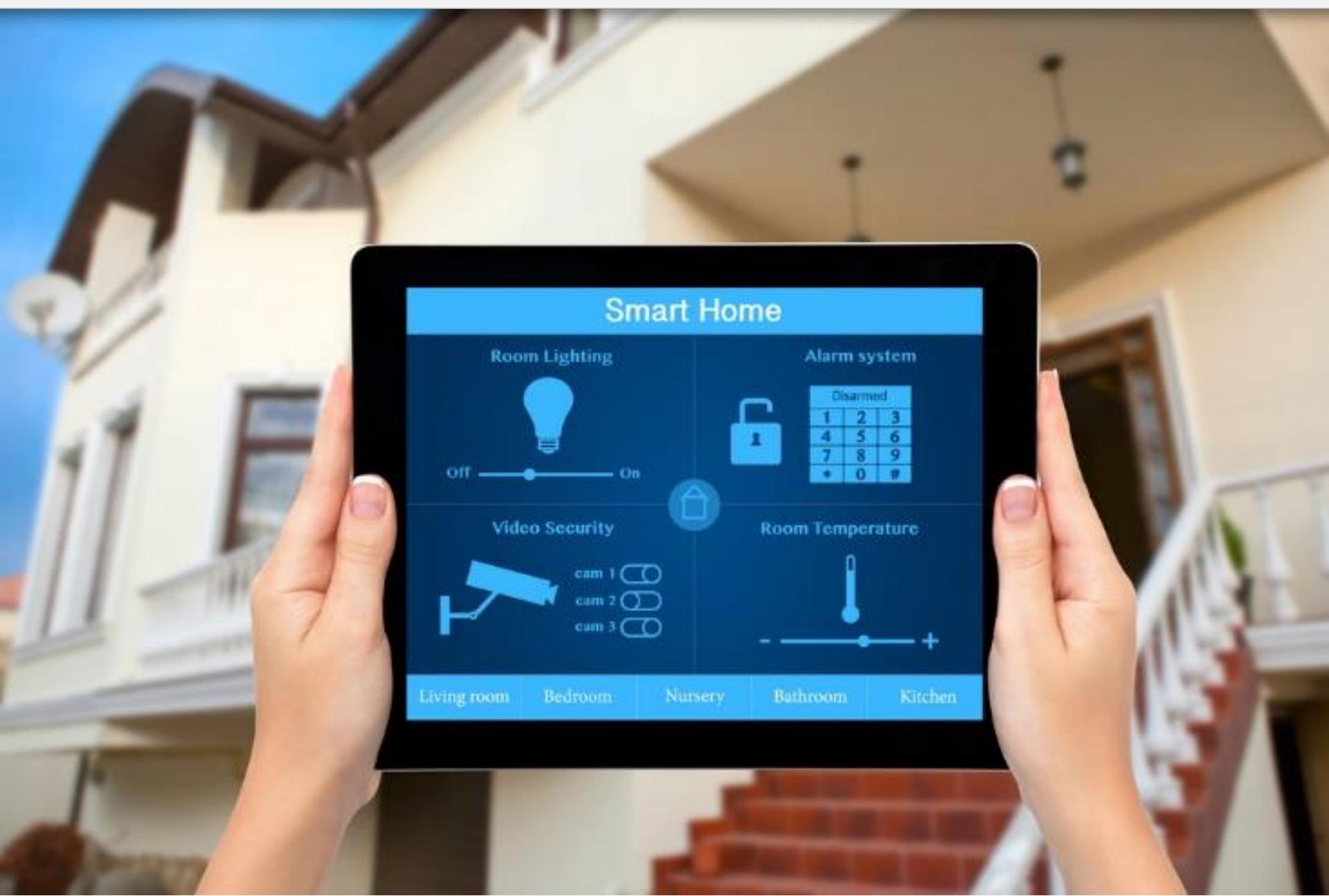
# What are Internet of Things?



# Things are everywhere



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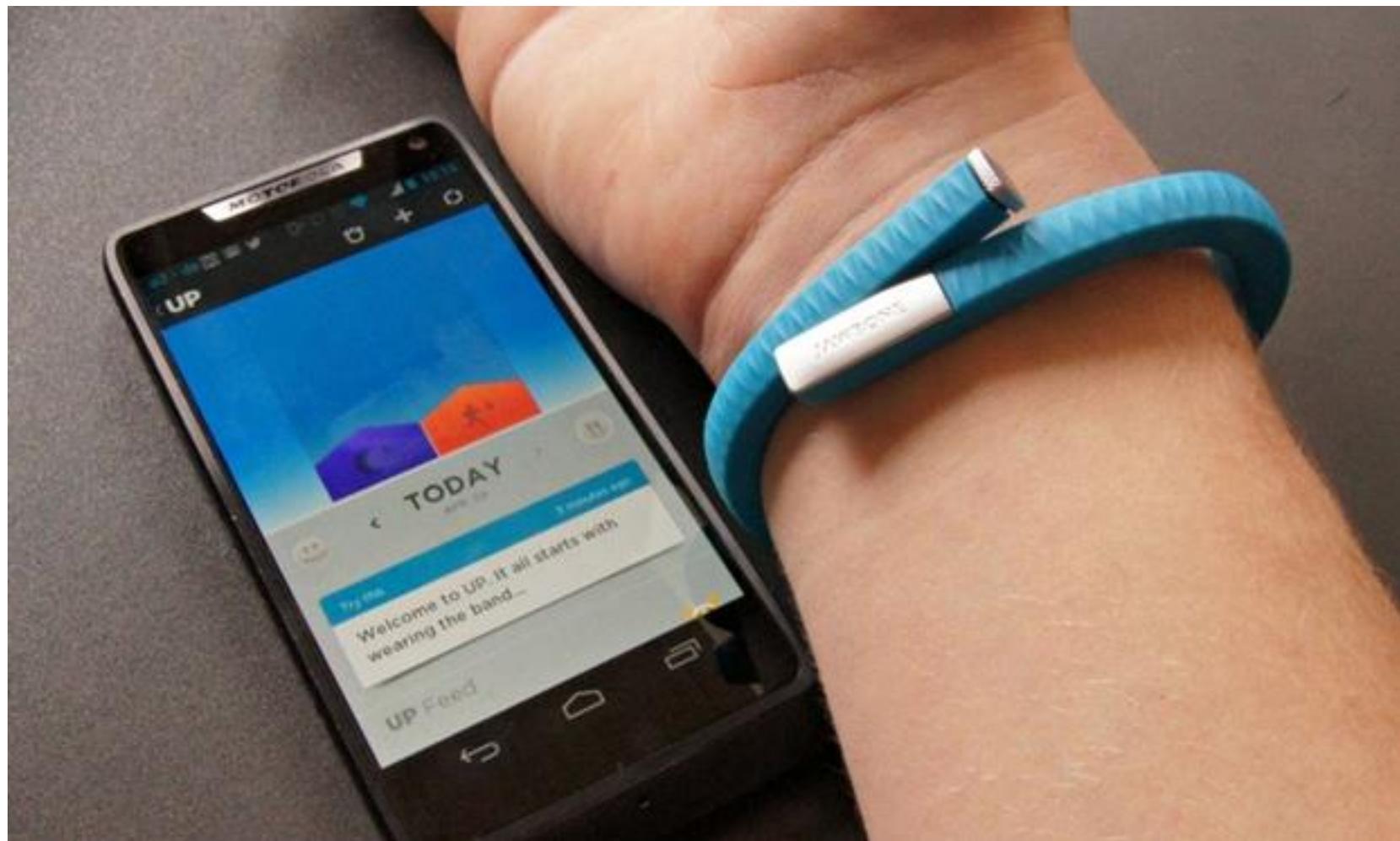
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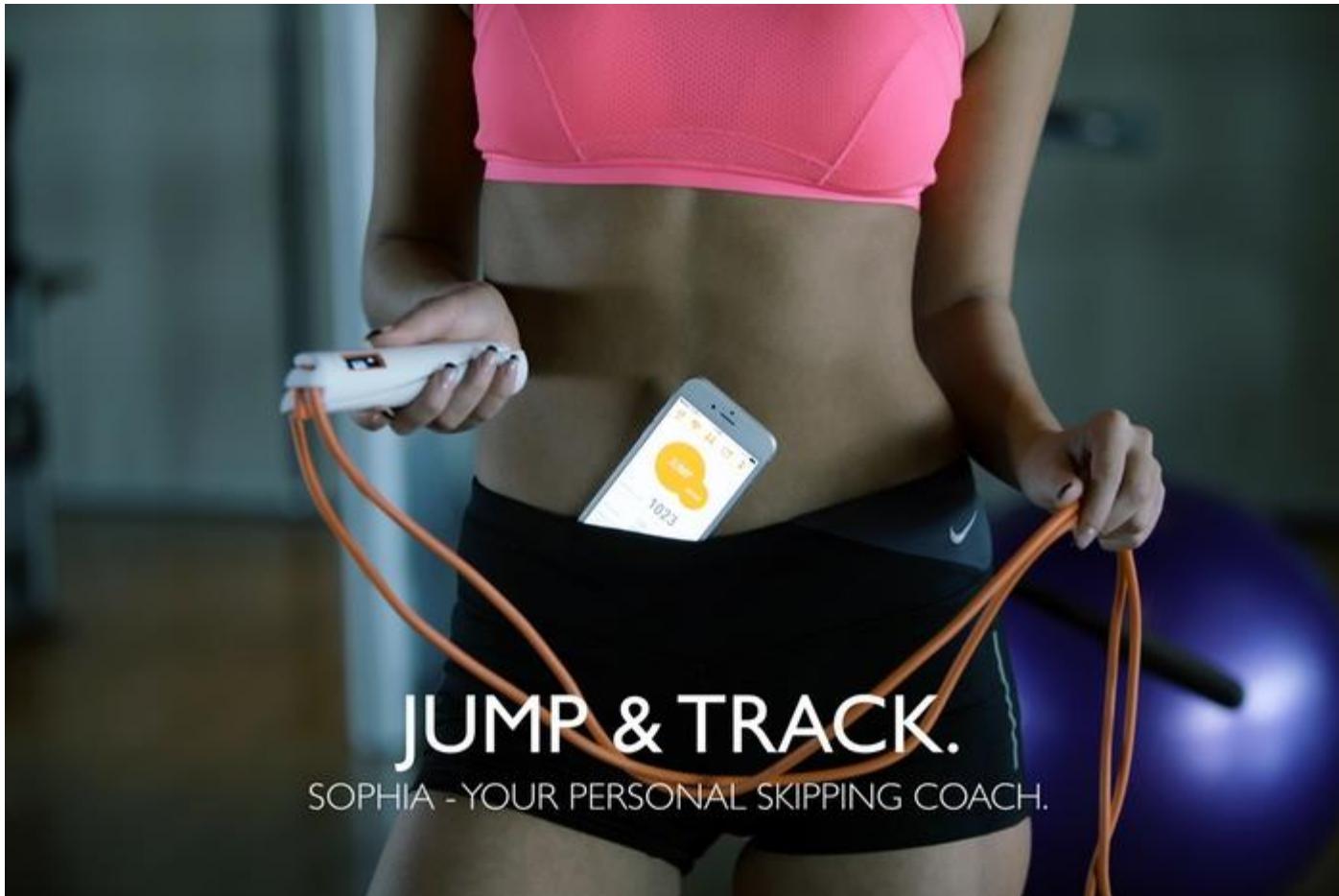
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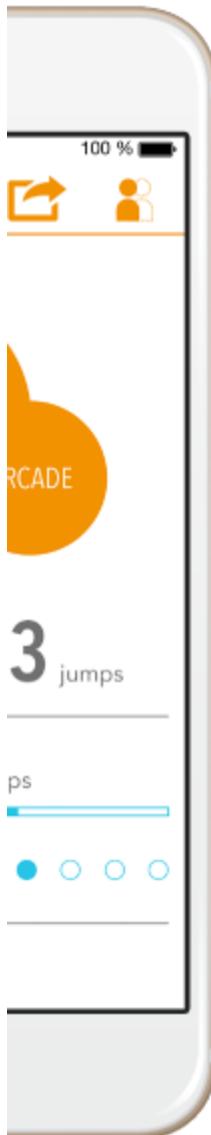
Things are everywhere



JUMP & TRACK.

SOPHIA - YOUR PERSONAL SKIPPING COACH.

# Things are everywhere



- ⌚ Calculate calories burned
- \* Bluetooth connectivity
- 🔋 One month battery life
- 📱 iOS and Android companion app
- ❤️ iOS Health and GoogleFit integration
- 🏆 Compete with friends
- ⌚ Jump and step counter



Things are everywhere

# Egg Minder

THE SMART EGG TRAY



# Things are everywhere



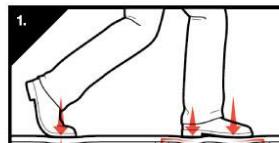
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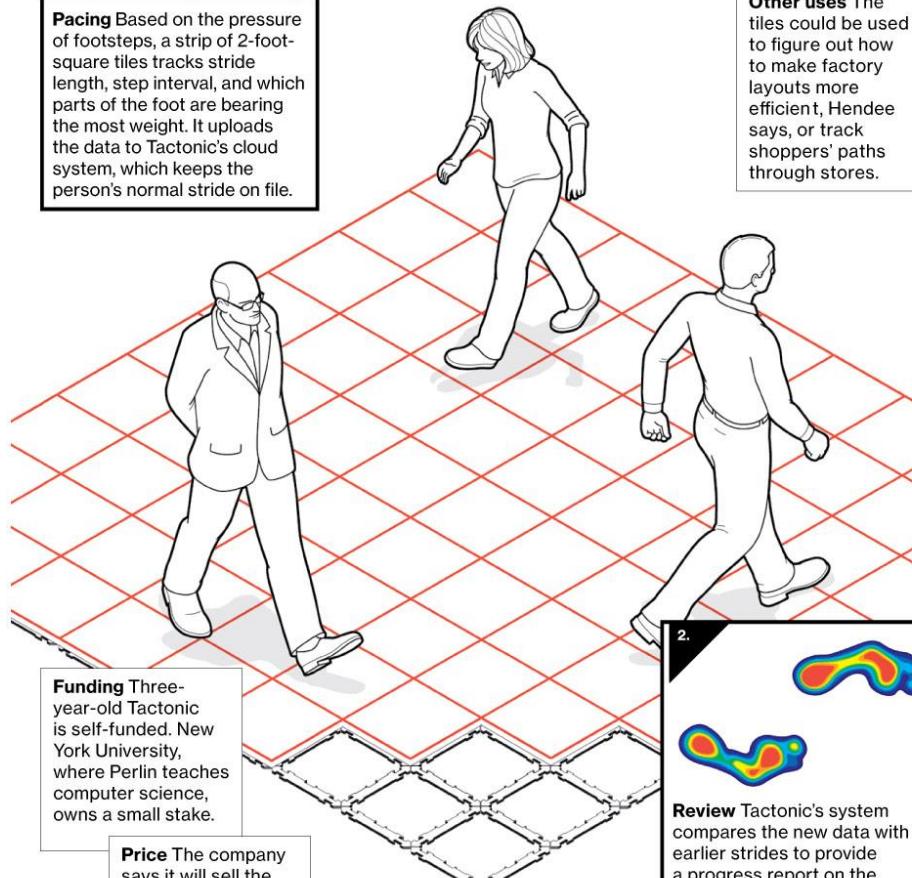
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**Pacing** Based on the pressure of footsteps, a strip of 2-foot-square tiles tracks stride length, step interval, and which parts of the foot are bearing the most weight. It uploads the data to Tactonic's cloud system, which keeps the person's normal stride on file.

**Hollywood past**  
Perlin won an Academy Award in 1997 for advances in computer imaging.

**Other uses** The tiles could be used to figure out how to make factory layouts more efficient, Hendeel says, or track shoppers' paths through stores.



**Funding** Three-year-old Tactonic is self-funded. New York University, where Perlin teaches computer science, owns a small stake.

**Price** The company says it will sell the system to home users for \$250 per strip of three tiles.

**Review** Tactonic's system compares the new data with earlier strides to provide a progress report on the person's mobility, balance, and activity, then sends that feedback to a caretaker using the company's app.

# Things are everywhere



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## About IFTTT

Put the internet to work for you by creating tasks that fit this simple structure:

# if this then that

Think of all the things you could do if you were able to define any task as: when something happens (**this**) then do something else (**that**).

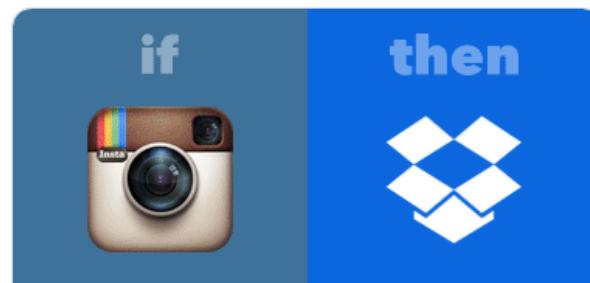
**What is IFTTT?** IFTTT empowers you with creative control over the products and apps you love.

*DO RECIPE*



Turn on or off your lights with a tap

*IF RECIPE*



If I post a picture on Instagram, save the photo to Dropbox

Things are everywhere

# Libelium Smart World

## Air Pollution

Control of CO<sub>2</sub> emissions of factories, pollution emitted by cars and toxic gases generated in farms.

## Forest Fire Detection

Monitoring of combustion gases and preemptive fire conditions to define alert zones.

## Wine Quality Enhancing

Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.

## Offspring Care

Control of growing conditions of the offspring in animal farms to ensure its survival and health.

## Sportsmen Care

Vital signs monitoring in high performance centers and fields.

## Structural Health

Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

## Quality of Shipment Conditions

Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.

## Smartphones Detection

Detect iPhone and Android devices and in general any device which works with WiFi or Bluetooth interfaces.

## Perimeter Access Control

Access control to restricted areas and detection of people in non-authorized areas.

## Radiation Levels

Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.

## Electromagnetic Levels

Measurement of the energy radiated by cell stations and WiFi routers.

## Traffic Congestion

Monitoring of vehicles and pedestrian affluence to optimize driving and walking routes.

## Waste Management

Detection of rubbish levels in containers to optimize the trash collection routes.

## Smart Parking

Monitoring of parking spaces availability in the city.

## Water Quality

Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.

## Golf Courses

Selective irrigation in dry zones to reduce the water resources required in the green.

## Smart Roads

Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

## Smart Lighting

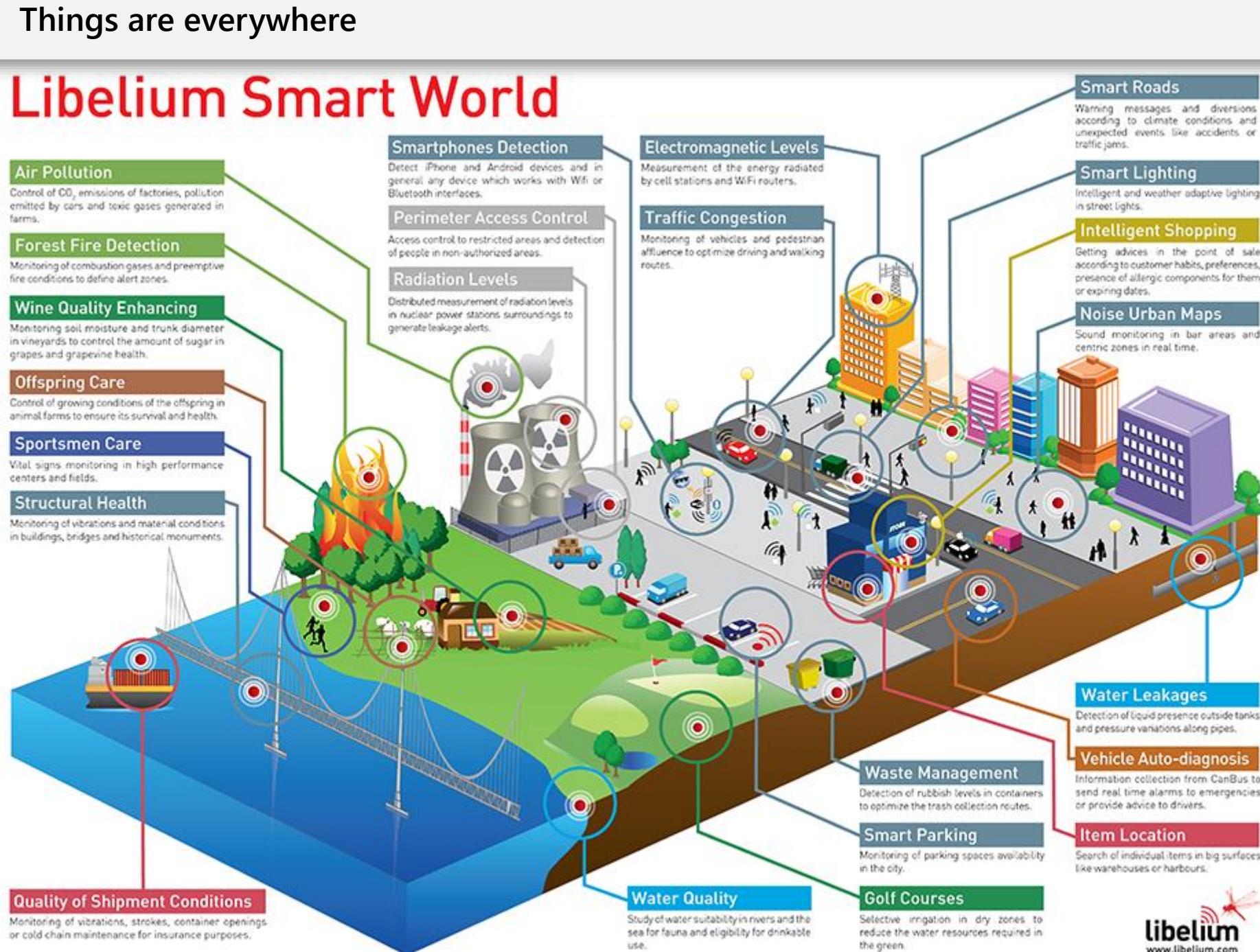
Intelligent and weather adaptive lighting in street lights.

## Intelligent Shopping

Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.

## Noise Urban Maps

Sound monitoring in bar areas and centric zones in real time.



# The Internet of Things

- Things which are Internet connected
- They will log data
- They will do things
- They will take decisions
- They will follow orders
- They will issue instructions
- They will discover each other
- They will collaborate

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## The Key Components

1. The devices themselves: the “things”
2. A local “hub” for a bunch of devices close by (optional)
3. Cloud-based storage and processing
4. An app to configure, manage and monitor the “thing”

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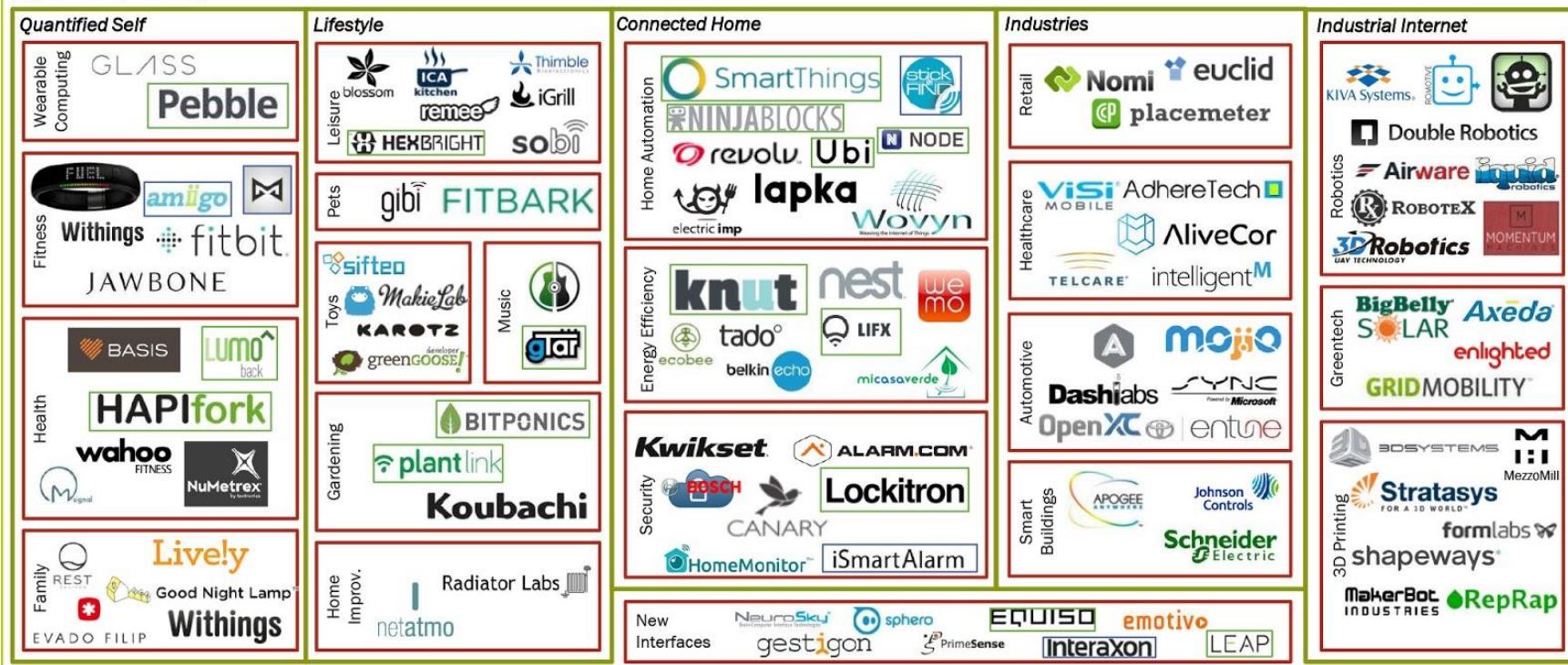
# Players in the field

## INTERNET OF THINGS LANDSCAPE

### Platforms & Enablement (Horizontals)



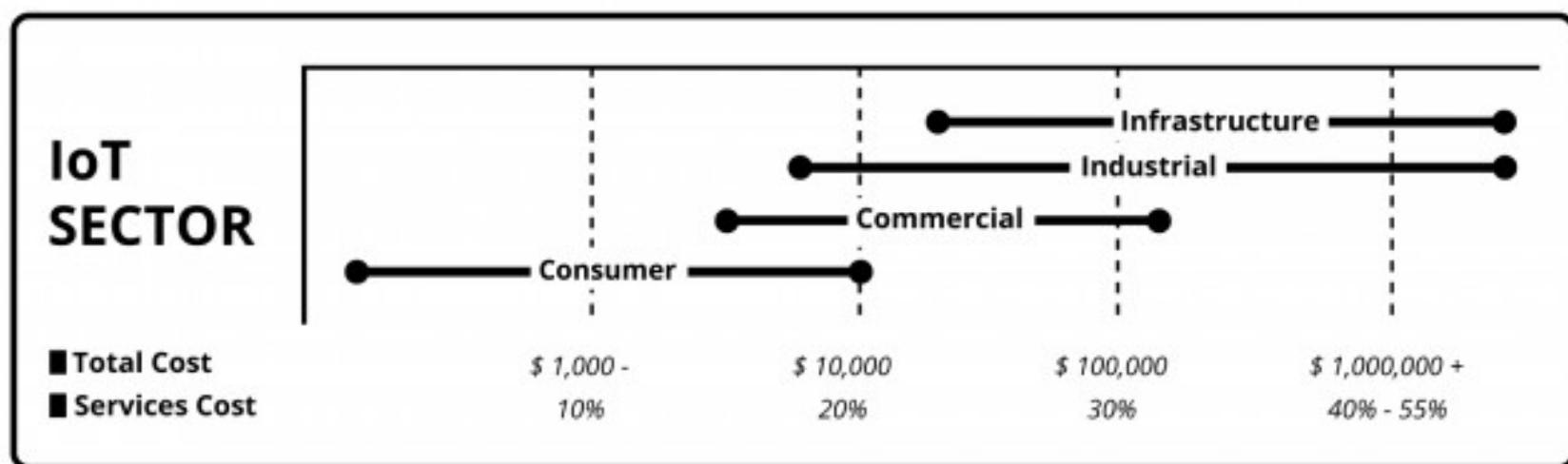
### Applications (Verticals)



### Building Blocks



## Investment expected



**ORDERS OF MAGNITUDE OF IoT INVESTMENT**

## Key enabling technologies

1. A few billion hubs
2. Atomised processing power: ARM and family
3. Wireless connectivity:
  - Bluetooth Smart for indoor short-distance stuff
  - IEEE 802.11ah for backhauls and extended-range wifi
4. Sensors: Galaxy S5 has ten
5. IPv6: unlimited IP addresses
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- USD 7.1 trillion market opportunity by 2020
- Global GDP today is USD 74 trillion
- One billion electricity meters exist today
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  - \$210 b: unnecessary services
  - \$160 b: excess admin costs
  - \$55 b: missed prevention opportunities
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- Better IoT-based monitoring may reduce hospitalisation durations
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2. User interfaces
3. Technical challenges
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## User Interfaces

- Many of the devices will not have any “user interface”
- Some of the devices will be lost behind existing interfaces
- Some will have machine-control interfaces
- Totally functional design, minimal complexity of UI
- Focus shifts from UI to function
- Makes UI design much more challenging

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# mother.

The care you need, the care you want

Sense Mother is at the head of a family of small connected sensors that blend into your daily life to make it serene, healthy and pleasurable.



## Motion Cookies

the magical sensors that tune to your wishes



MOTION  
**cookie**

Motion Cookies are the first essential members of the ever growing Sense Mother family.

Small and slick, they can be affixed to almost anything. They have the power to detect and understand the movements of objects and people.



## Designing the user interfaces

- Designing the app's interface
- Designing the communication between app and device
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- Specialised devices: e.g. medical monitoring "things":  
UX must be driven by the doc's way of working  
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- Heart monitoring device: bio-safe
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- Hub and spoke communication layout
- Intelligence to throttle data rates
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- Conflicts with low power requirements

- On the cloud

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- IoT security, unlike conventional server security, can directly and literally be used to kill victims
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- A lot of work happening in device security
- Issues of identity management and identity theft are getting attention

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## How should we relate to the “things”?

Samsung



Recognition features to you. In addition, Samsung may collect and your device may capture voice commands and associated texts so that we can provide you with Voice Recognition features and evaluate and improve the features. Please be aware that if your spoken words include personal or other sensitive information, that information will be among the data captured and transmitted to a third party through your use of Voice Recognition.

If you do not enable Voice Recognition, you will not be able to use interactive voice recognition features, although you may be able to control your TV using certain predefined voice commands. While Samsung will not collect your spoken word, Samsung may still collect associated texts and other usage data so that

Behind Winston's back the voice from the telescreen was still babbling away about pig-iron and the overfulfilment of the Ninth Three-Year Plan. The telescreen received and transmitted simultaneously. Any sound that Winston made, above the level of a very low whisper, would be picked up by it, moreover, so long as he remained within the field of vision which the metal plaque commanded, he could be seen as well as heard. There was of course no way of knowing whether you were being watched at any given moment. How often, or on what system, the Thought Police plugged in on any individual wire was guesswork. It was even conceivable that they watched everybody all the time. But at any rate they could plug in your wire whenever they wanted to. You had to live--did live, from habit that became instinct--in the assumption that every sound you made was overheard, and, except in darkness, every movement scrutinized.

# How should we relate to the “things”?



Narrative

Products

Shop

Community

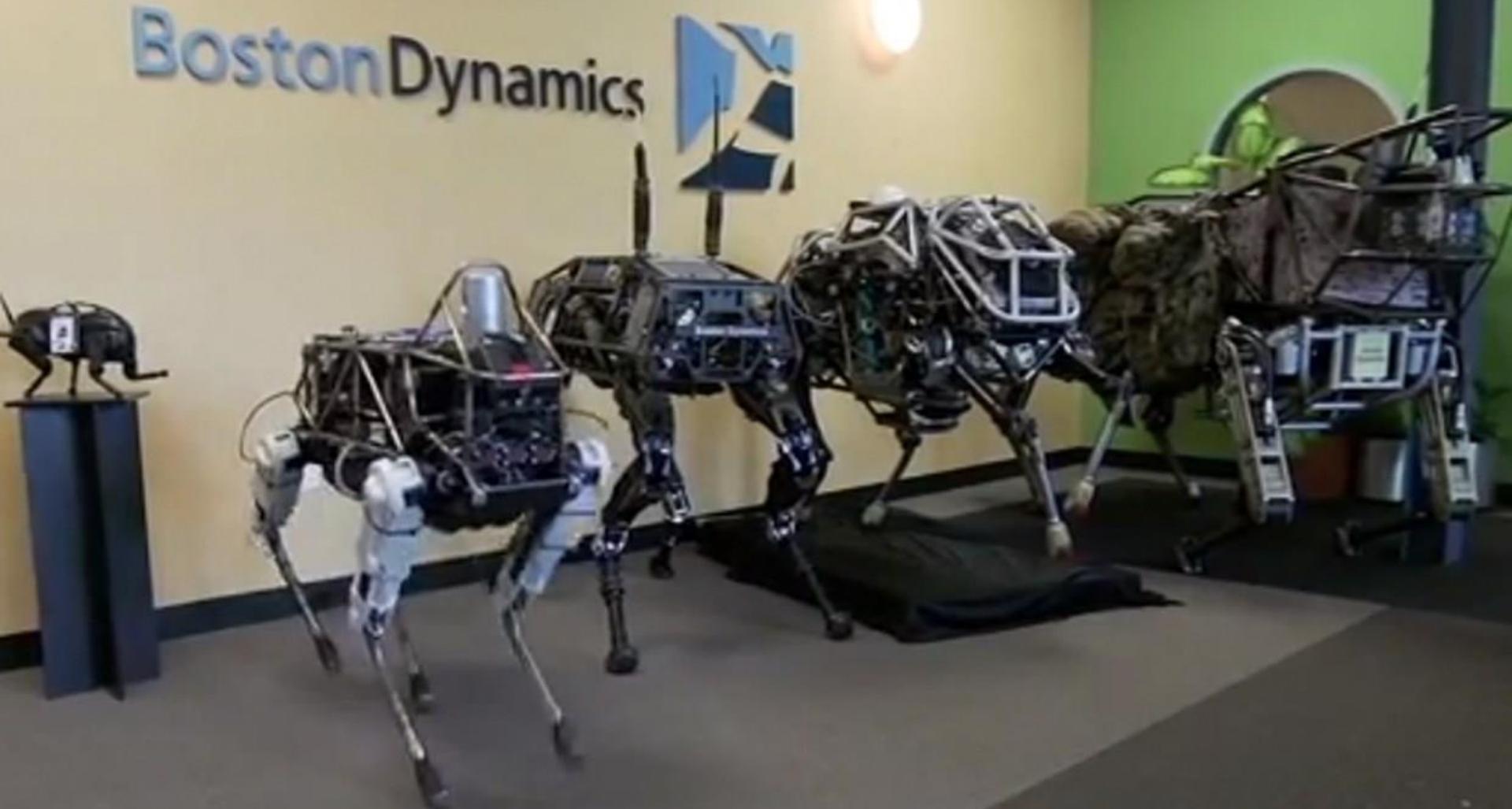
Support

## A new kind of photographic memory

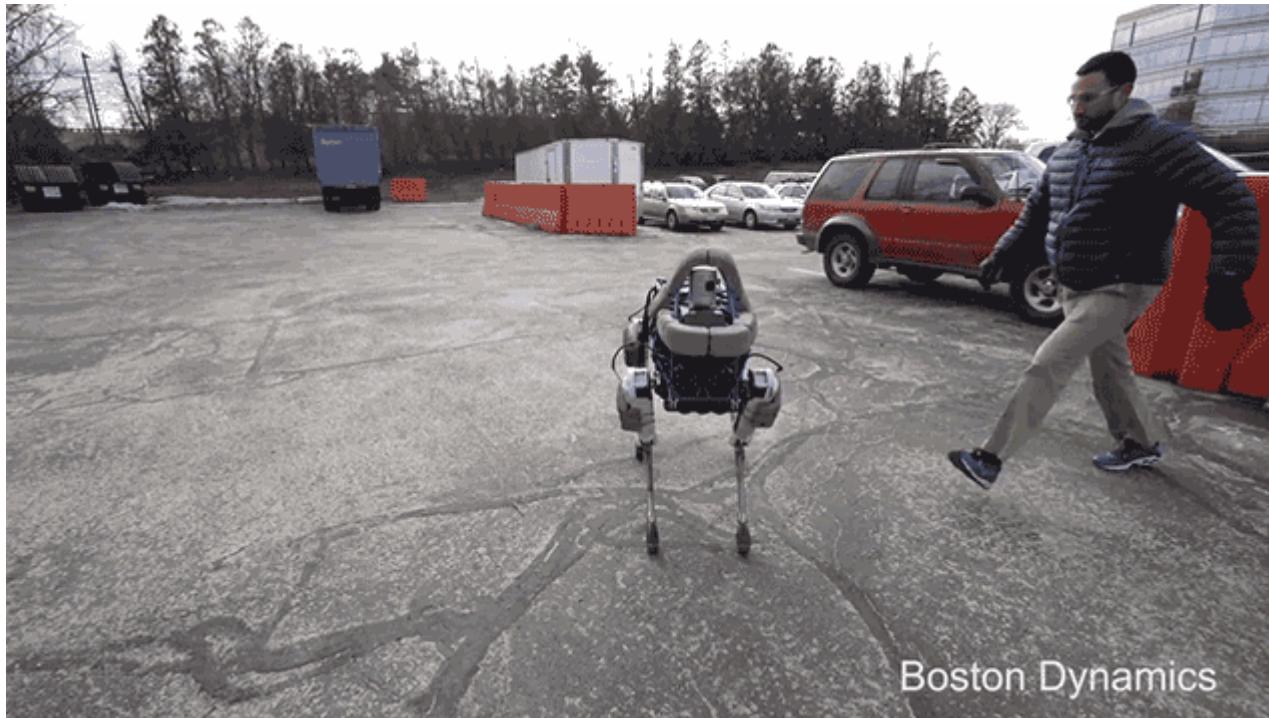
The Narrative Clip is a tiny, automatic camera and app that gives you a searchable and shareable photographic memory.



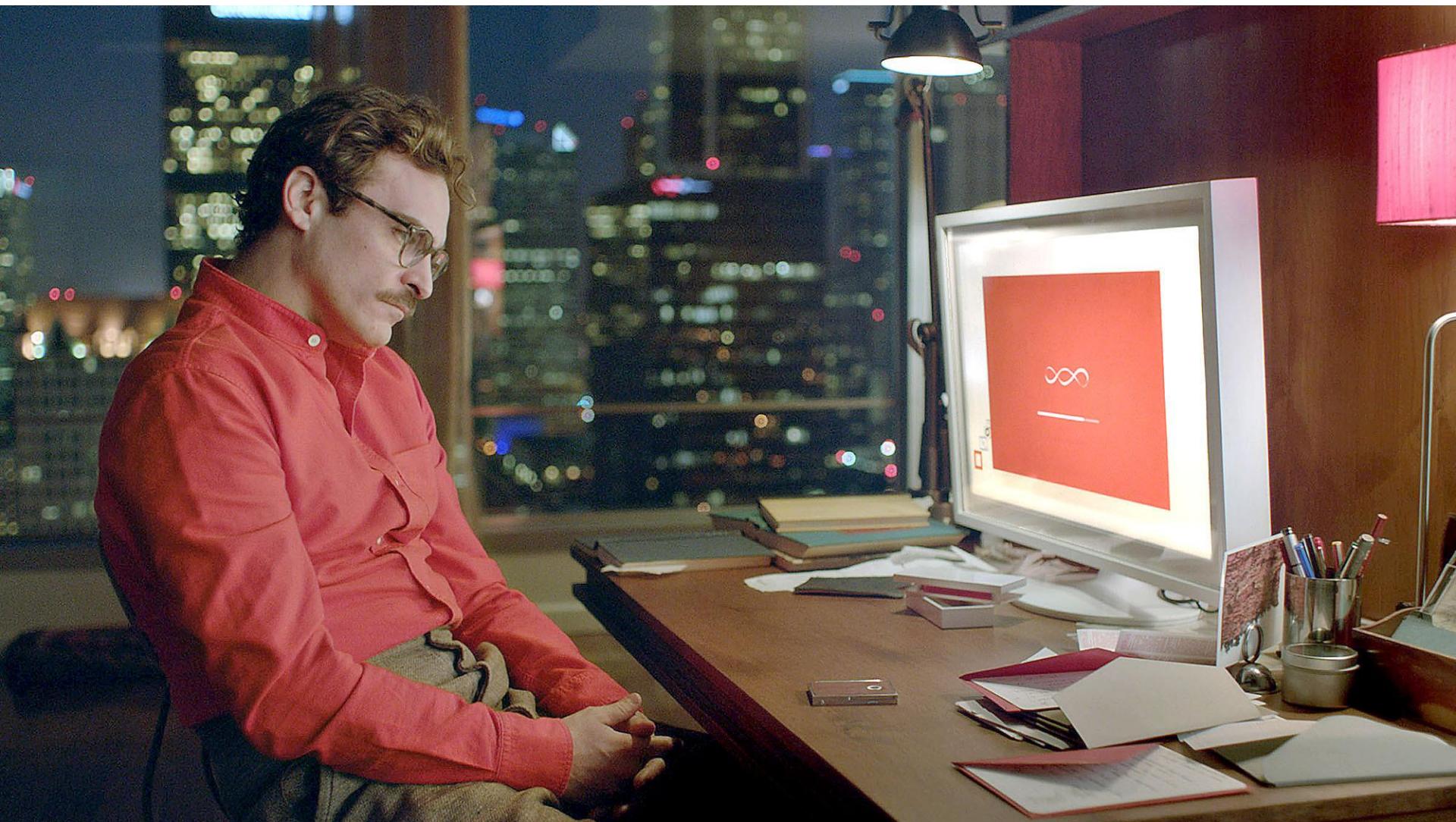
How should we relate to the “things”?



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## Three trends moving to mainstream

- Life-streaming
- Quantified Self
- Life-logging

## How should we relate to the “things”?

- Our past has been in master-slave mode
- For the first time, “things” can collaborate
  - ... with each other
  - ... with cloud based components
  - ... and with us
- The driverless-car shift in control
  - We configure and command them ...
  - ... then we abdicate, for the ride

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- Opaque intelligence / algorithmic aversion

## How does it change interface design?

- It reduces the primacy of the human-device I/F
- Separates “control” from “inform”
- Loosely defined inter-device collaboration options
  - neighbour discovery opportunities
  - freedom to change partners and routes
  - decision-making based on collaborators’ inputs
- Human becomes observer and team member
- Big culture shift, which we don’t yet fully understand

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## How does it change **design** itself?

- Higher evolved experiencing (the Now) and remembering (the Past).  
The latter will be outsourced by technology
- We become intuitive and (delayed) reflective/rational at the same time
- Assumption: integration will be seamless, automatic and implicit,  
instead of explicit and interruptive
- We make the invisible visible and social
- Planned serendipity and synchronicity
- Everybody/thing/object will become an open platform with an open API

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## How does it change business?

- IoT key enabler of **intention economy**
- The intention economy grows around buyers, not sellers
- In the intention economy, the buyer notifies the market of the intent to buy, and sellers compete for the buyer's purchase
- The intention economy is built around more than transactions. Conversations matter. So do relationships. So do reputation, authority and respect. Those virtues, however, are earned by sellers (as well as buyers) and not just "branded" by sellers on the minds of buyers like the symbols of ranchers burned on the hides of cattle
- The intention economy is about buyers finding sellers, not sellers finding (or "capturing") buyers
- Free markets require free customers. Tools & strategies that will make customers both independent of vendors and better able to engage with them voluntarily and genuinely will succeed
- The volume, variety and relevance of information coming from customers in the intention economy will strip the gears of systems built for controlling customer behaviour or for limiting customer input

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# How does it change business?

## THE INTERNET OF THINGS REQUIRES A MINDSET SHIFT

Because you'll create and capture value differently.

		TRADITIONAL PRODUCT MINDSET	INTERNET OF THINGS MINDSET
VALUE CREATION	Customer needs	Solve for existing needs and lifestyle in a reactive manner	Address real-time and emergent needs in a predictive manner
	Offering	Stand alone product that becomes obsolete over time	Product refreshes through over-the-air updates and has synergy value
	Role of data	Single point data is used for future product requirements	Information convergence creates the experience for current products and enables services
VALUE CAPTURE	Path to profit	Sell the next product or device	Enable recurring revenue
	Control points	Potentially includes commodity advantages, IP ownership, & brand	Adds personalization and context; network effects between products
	Capability development	Leverage core competencies, existing resources & processes	Understand how other ecosystem partners make money

SOURCE SMART DESIGN

HBR.ORG

## IoT reading list

- Bruce Sterling, *Shaping Things*, 2004
- Adam Greenfield, *Everyware: The Dawning Age of Ubiquitous Computing*, 2006
- Nathan Shedroff, *Design Is the Problem: The Future of Design Must be Sustainable*, 2009
- Mike Kuniavsky, *Smart Things: Ubiquitous Computing User Experience Design*, 2010
- Hazenberg, Huisman, Rubino, *Meta Products: Building the Internet of Things*, 2012
- Doc Searls, *The Intention Economy*, 2012
- Adrian McEwen, *Designing the Internet of Things*, 2013
- Robert Scoble, *Age of Context: Mobile, Sensors, Data and the Future of Privacy*, 2013
- Jaron Lanier, *Who Owns the Future?*, 2013
- Erik Brynjolfsson, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, 2014
- Evgeny Morozov, *To Save Everything, Click Here: The Folly of Technological Solutionism*, 2014
- Jeremy Rifkin, *The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism*, 2014
- Bruce Sterling, *The Epic Struggle of the Internet of Things*, 2014

**This lecture borrows heavily from a IoT lecture by Shuvam Misra  
Images are uncredited. For class circulation only.**

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