

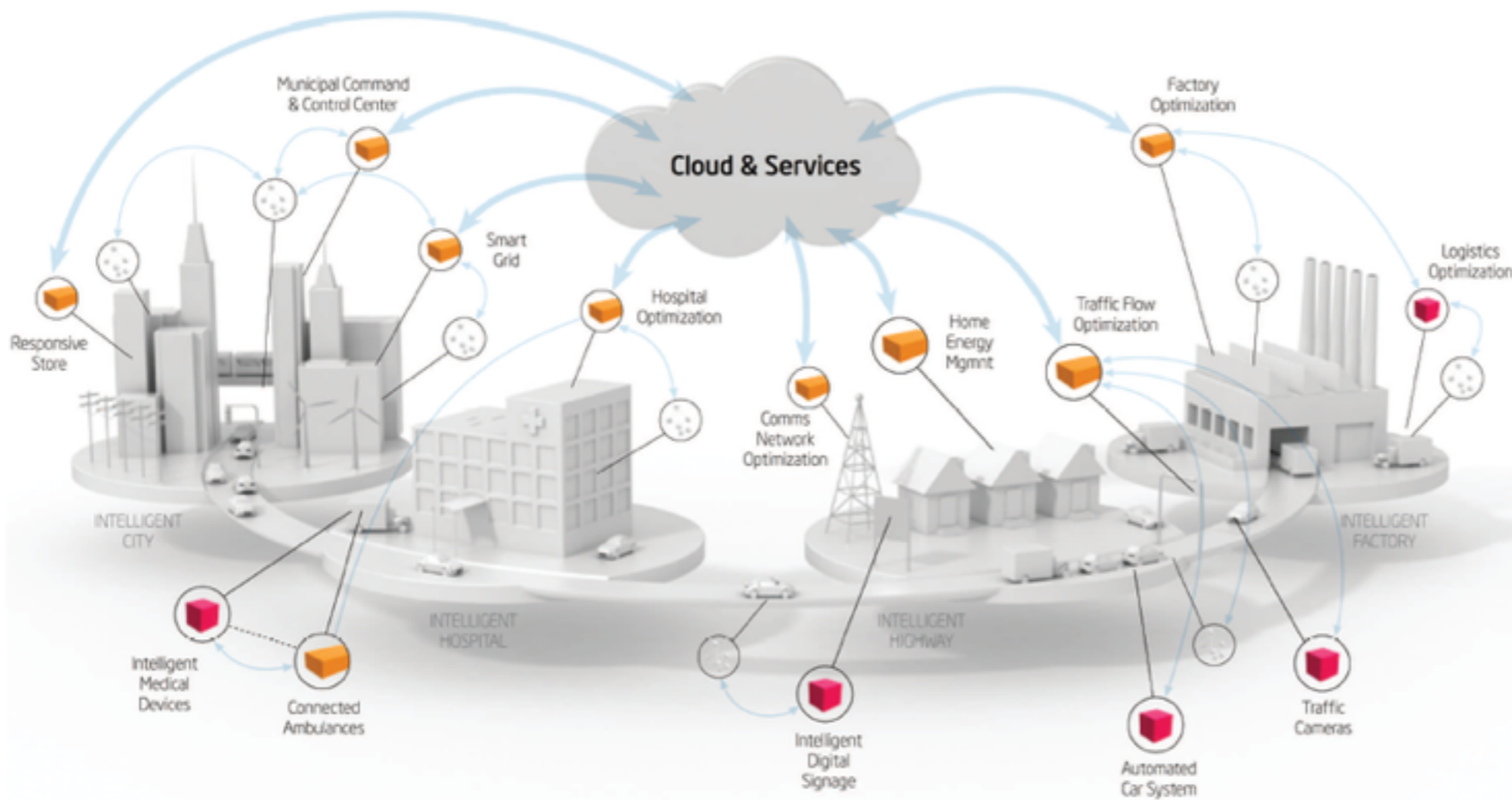


COMP327

Mobile Computing

Session: 2015-2016

Lecture Set 6 - The Internet of Things



Internet of Things

An invasion of devices for the home and the environment

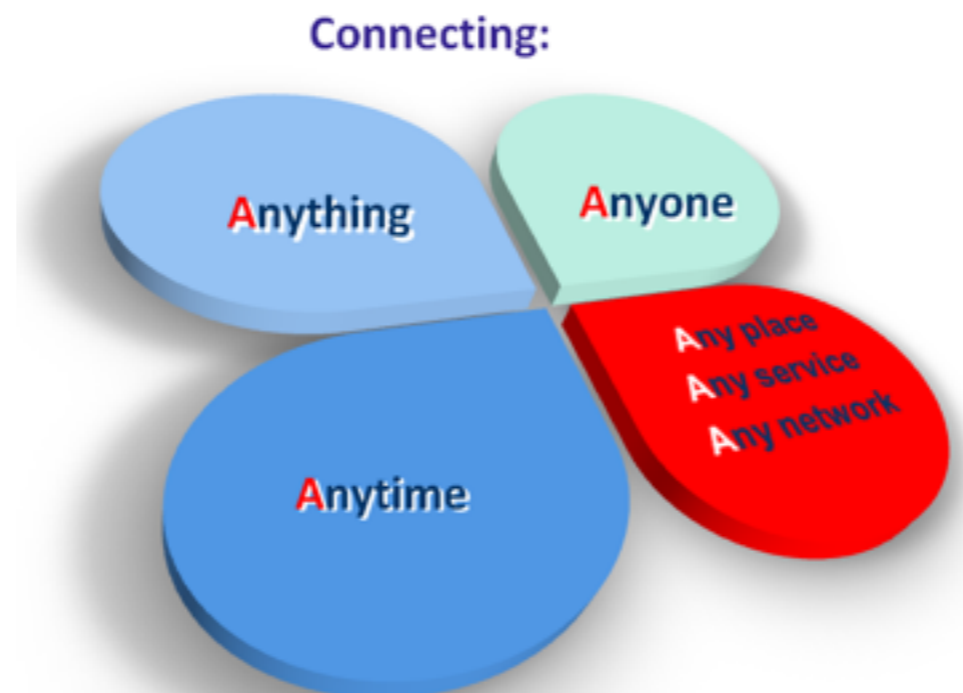
Internet of Things

- In 2008, the number of things connected to the internet was greater than the number of people living on earth!
- Within 2020 the number of things connected to the Internet will be about 50 billion



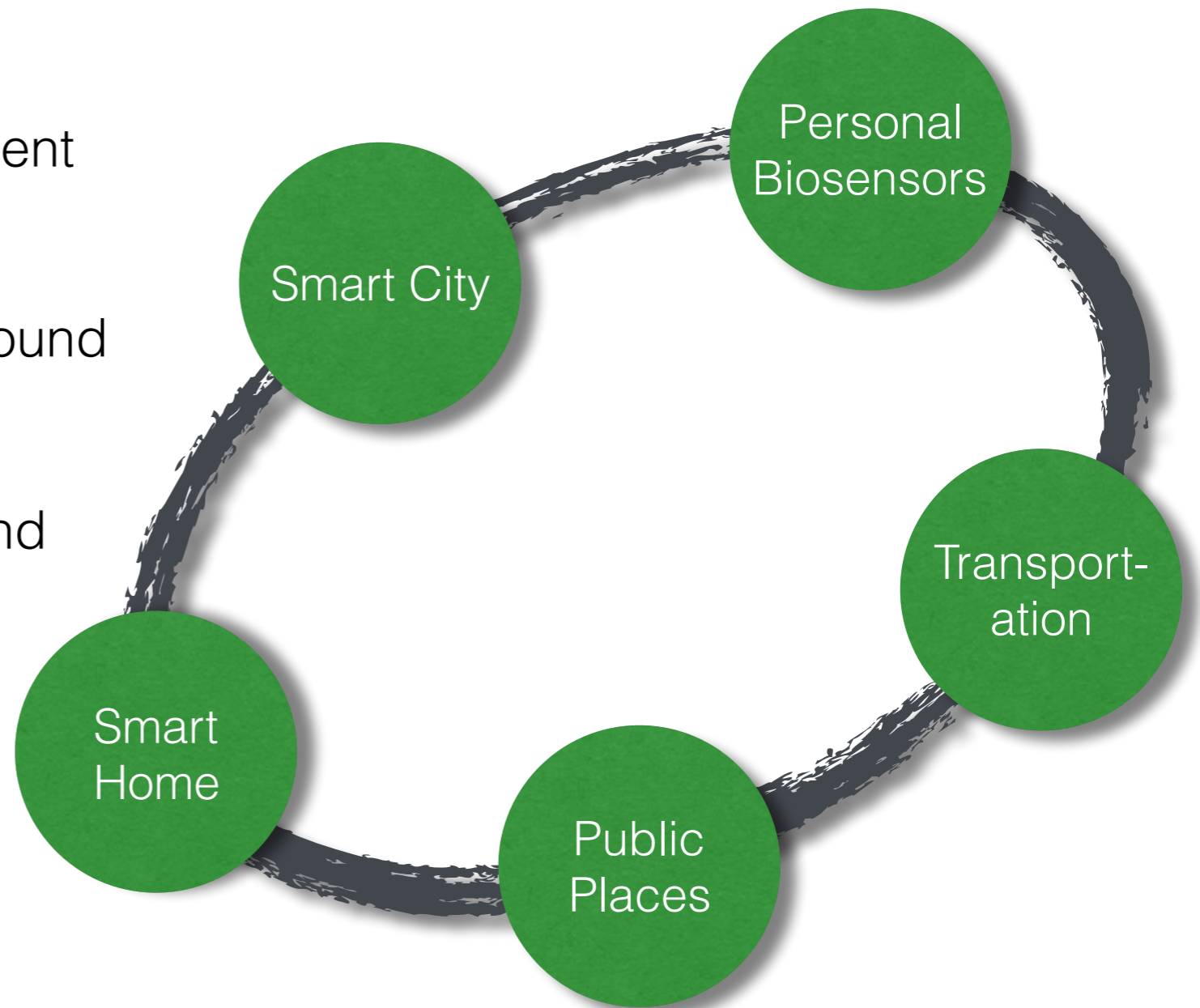
IoT: Definition

- By embedding short-range mobile transceivers into a wide array of additional gadgets and everyday items, enabling new forms of communication between people and things, and between things themselves...
- The term “Internet of Things” has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects
- Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, user contexts



Why Internet of Things

- Dynamic control of environment and daily life
- Improve use of resources around us
- Integrating human society and physical systems
- Flexible configuration
- Universal transport and internetworking
- Acts as a technologies integrator



From phone, to portal...

- Mobile Devices do more than just make calls
 - They interact with a number of local devices, forming a Personal Area Network (PAN)
 - Printers, Audio Equipment, Input Devices
- They also connect to other non-telephony networks to get Internet Access, through Local Area Networks (LAN)
 - WiFi, or the 802.11 standards
- They may also detect sensor nodes in the environment and act based on their discovery
 - Tagging



Master and Slave

- Mobile Phones can play both primary and secondary roles:
 - Primary Role
 - Other devices support the phone and its function
 - Output devices (e.g. Headsets, printers)
 - Input devices (e.g. keyboards, GPS devices, RFID tags)
 - Secondary Role
 - The phone acts as a comms device for another device
 - Modems (e.g. through tethering)
 - SMS transmitters/receivers (from a PC)



Peer relationships

- Mobile Phones can also have a peer-based relationship with other devices
 - Exchanging information
 - Typically with another user
 - Exchanging contact information, data, or multi-player games
 - Synchronising information
 - Typically with another device owned by the user
 - Address Books, Music, Images, Video
 - Receiving advertising
 - From wireless broadcast stations



The problem with wires

- Early mobile phone connectivity approaches used wired connections...
 - RS232, through bespoke connectors
 - USB and Firewire cables
- However, this can limit connectivity, and contradicts the mobile wireless ethos
- Various wireless approaches have emerged to facilitate connection between the phone and other user devices
 - Wireless PAN - Personal Area Network



Sensors: NFC & RFID

- Radio-frequency Identification (RFID) uses a tag with a unique ID for tagging “things”

- Three tag types

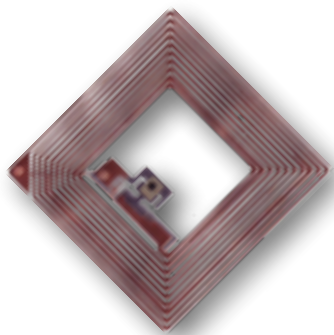
- Passive: no battery - coiled antenna induces current which powers the tag and encoded information is transmitted
- Active: battery operated - can transmit signals autonomously
- Battery Assisted Passive: requires external power to wake, but has greater range

- Used mainly in inventory and supply-chain management

- Increasing used in:

- Contactless Mobile Payment (e.g. Apple Pay)
- Location-based services (e.g. in museums)
- Bar code replacement

- Can be used as external cues by mobile devices



Bluetooth LE

- Reduced Power version of Bluetooth, targeted at the health / well being / sport and fitness market:
- Smaller size and lower cost
- Low power requirement aimed at months or even years of use on a button (battery) cell



Bluetooth LE

- Several new profiles:

- Health Care

- Health Thermometer Profile
- Glucose Profile
- Etc

- Sports and Fitness

- Heart Rate
- Cycle Speed
- Etc

- Proximity Sensing

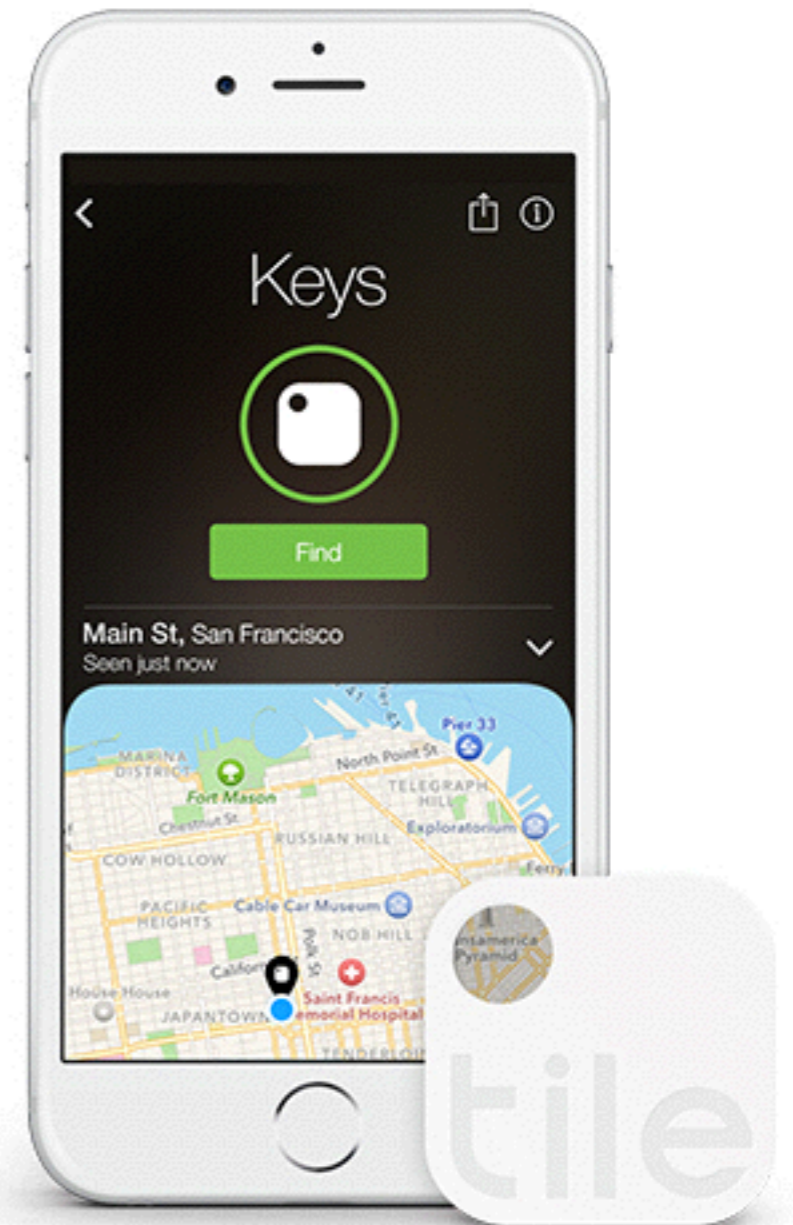
- Find me profile
- Proximity profile



Case Study: Tile

Watch
Video

- Tile is a tiny Bluetooth tracker and easy-to-use app that finds everyday items in seconds
 - like your phone, keys, and wallet.
- Exploits social networks to track down items that are out of range

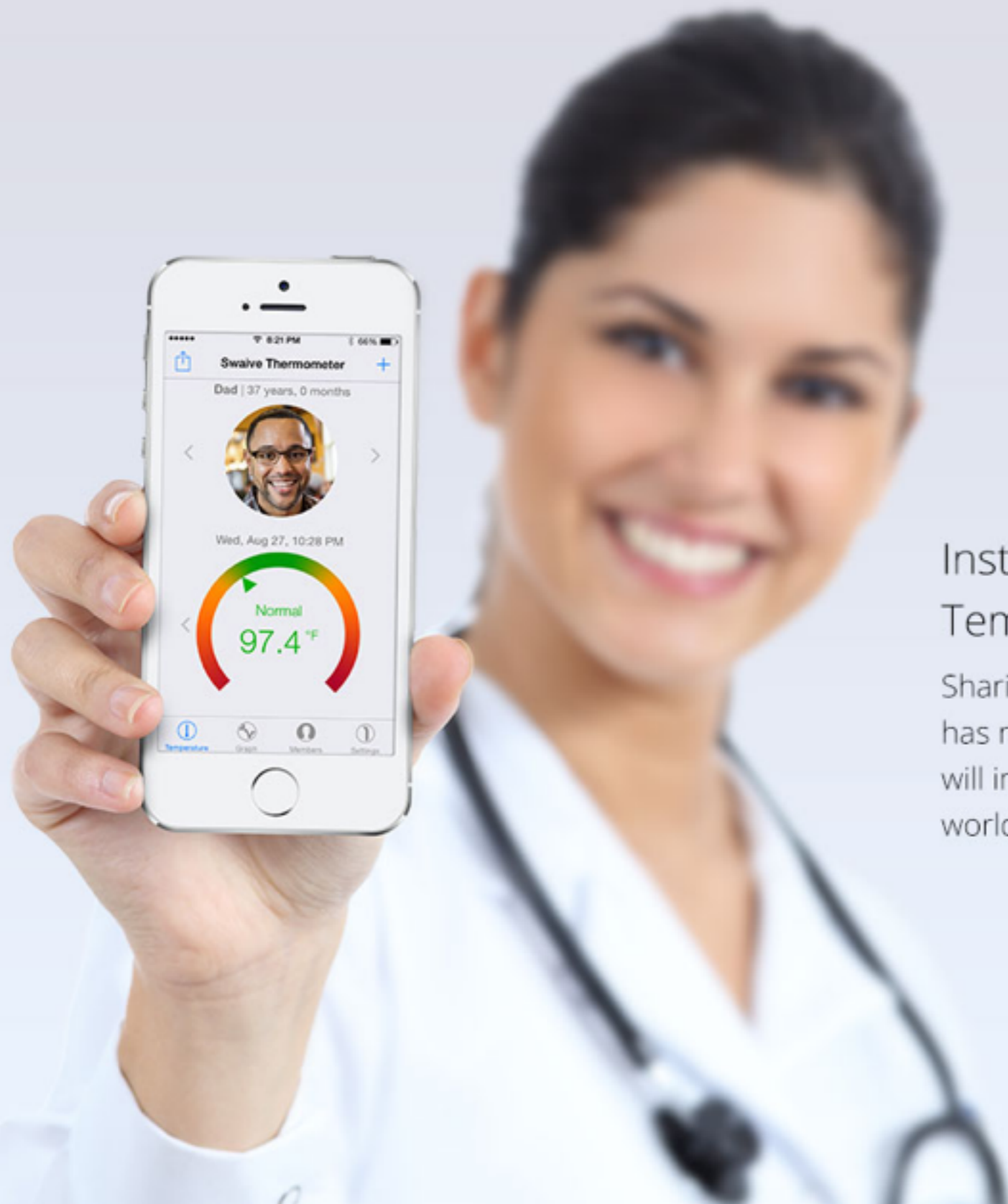


Personal Area Network

- Network for communicating between devices close to one's person
 - Range is typically a few meters
 - Wireless technologies now becoming ubiquitous:
 - IrDA - Infrared communication
 - Bluetooth Piconets
- **Desirable requirements**
 - “Plugging in” (automatic connection due to proximity)
 - Selective lock-out (prevent interference or unauthorised data access)



Health Tracking



Instantly Share Temperature Readings

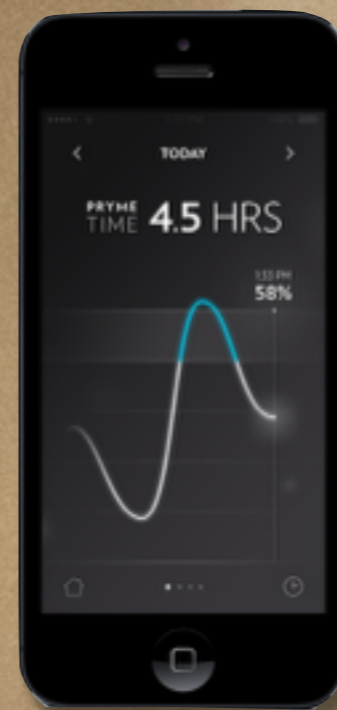
Sharing temperature results with doctors, physicians or spouses has never been easier. Simply add them to the sharing list and they will instantly receive all readings, no matter where they are in the world.



Case Study Vessyl

Visit
Site

Tracking hydration,
calories, and even the
type of beverage you're
drinking






Quantified Toilets

Every day. Every time.



This facility is proud to participate in the healthy building initiative.
Behaviour at these toilets is being recorded for analysis.
Access your live data at quantifiedtoilets.com

 **Quantified Toilets**
Every day. Every time.



Feed from alpha deployment @ CHI2014

Recent anonymized random data feed

Time	Toilet ID	Sex	Deposit	Odor	Blood alcohol	Drugs detected	Pregnancy	Infections
05:43:10 PM	T200	female	180ml	acidic	0.001%	no	no	none
05:43:03 PM	T119	female	255ml	neutral	0.012%	no	no	none
05:42:56 PM	T207	male	275ml	neutral	0.061%	no	no	none
05:42:53 PM	T314	female	75ml	neutral	0.023%	no	no	none
05:42:46 PM	T108	female	100ml	neutral	0.041%	no	no	none
05:42:39 PM	T319	female	65ml	neutral	0.000%	no	no	none
05:36:46 PM	T112	female	125ml	sulphuric	0.000%	no	no	none
05:26:35 PM	T107	female	140ml	neutral	0.000%	no	no	none
05:22:29 PM	T700	male	95ml	neutral	0.000%	no	no	chlamydia
05:21:34 PM	T301	female	205ml	neutral	0.000%	no	no	none
05:15:22 PM	T303	female	150ml	neutral	0.002%	no	no	none

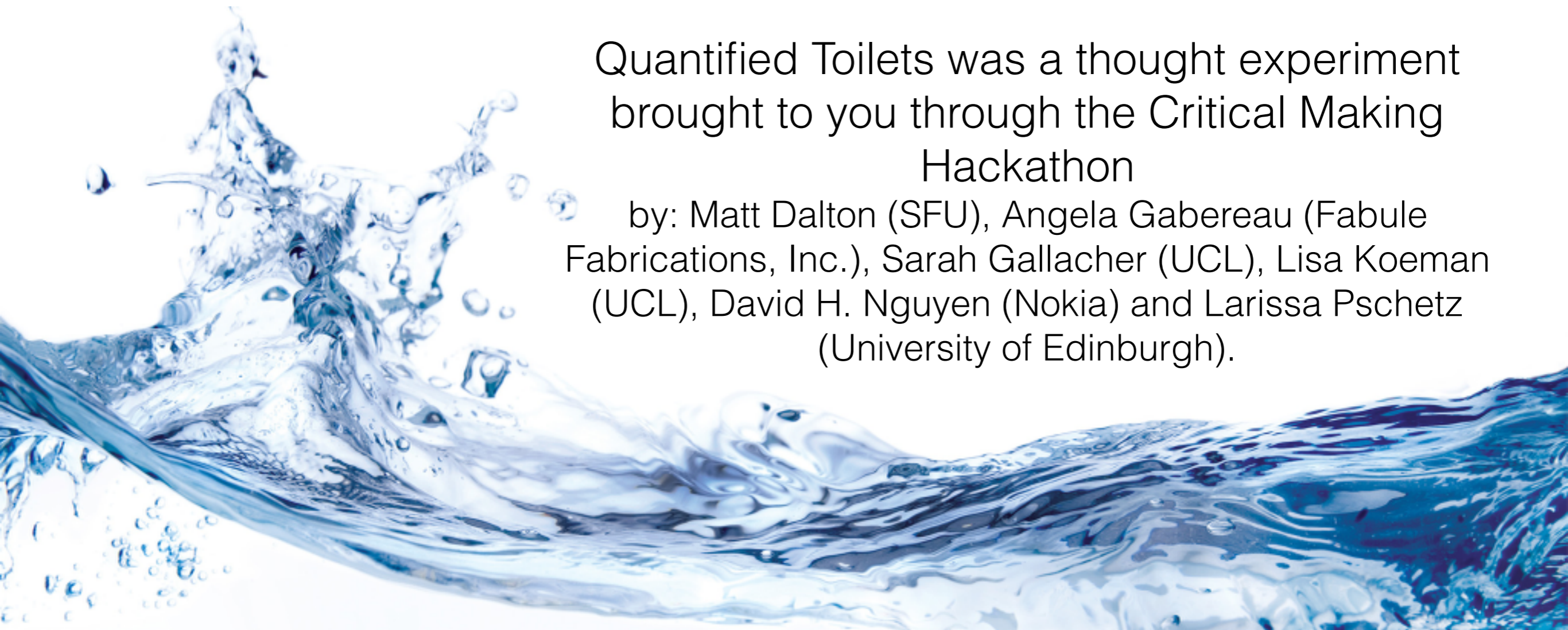
Using advanced sensing technologies and a state of the art centralized waste data collection system, we are able to discreetly capture data from each individual toilet. Activities at each toilet create unique signatures that enables us to track usage and analyze details from every toilet in a building. Our groundbreaking software is then able to catalog the data for a multifaceted health analysis not currently available through traditional means.

Quantified Toilet

Dystopia or Hoax???

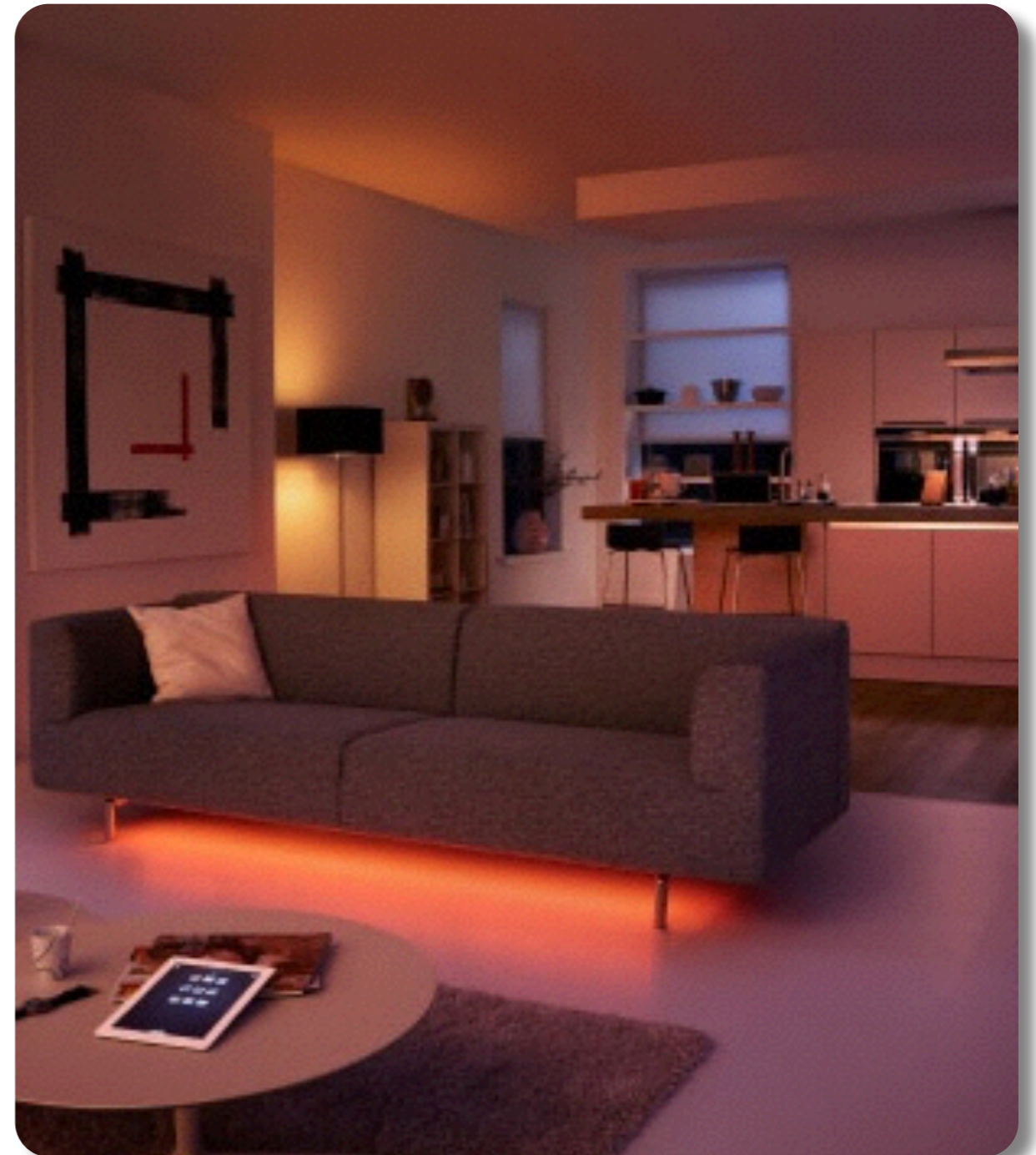
Quantified Toilets was a thought experiment brought to you through the Critical Making Hackathon

by: Matt Dalton (SFU), Angela Gabereau (Fabule Fabrications, Inc.), Sarah Gallacher (UCL), Lisa Koeman (UCL), David H. Nguyen (Nokia) and Larissa Pschetz (University of Edinburgh).



Home Environment

- Devices connected around the home, typically through Wifi
 - Connection through to company servers
 - Personal data stored remotely, but allows devices to query data
- May support the notion of scenes:
 - Pre-set settings for devices in the house such as lighting, blinds, heating
 - Support the notion of contexts (family-time vs romantic)...
 - Or locale settings (family-room vs dining-room)



Wake Up




Arrive Home

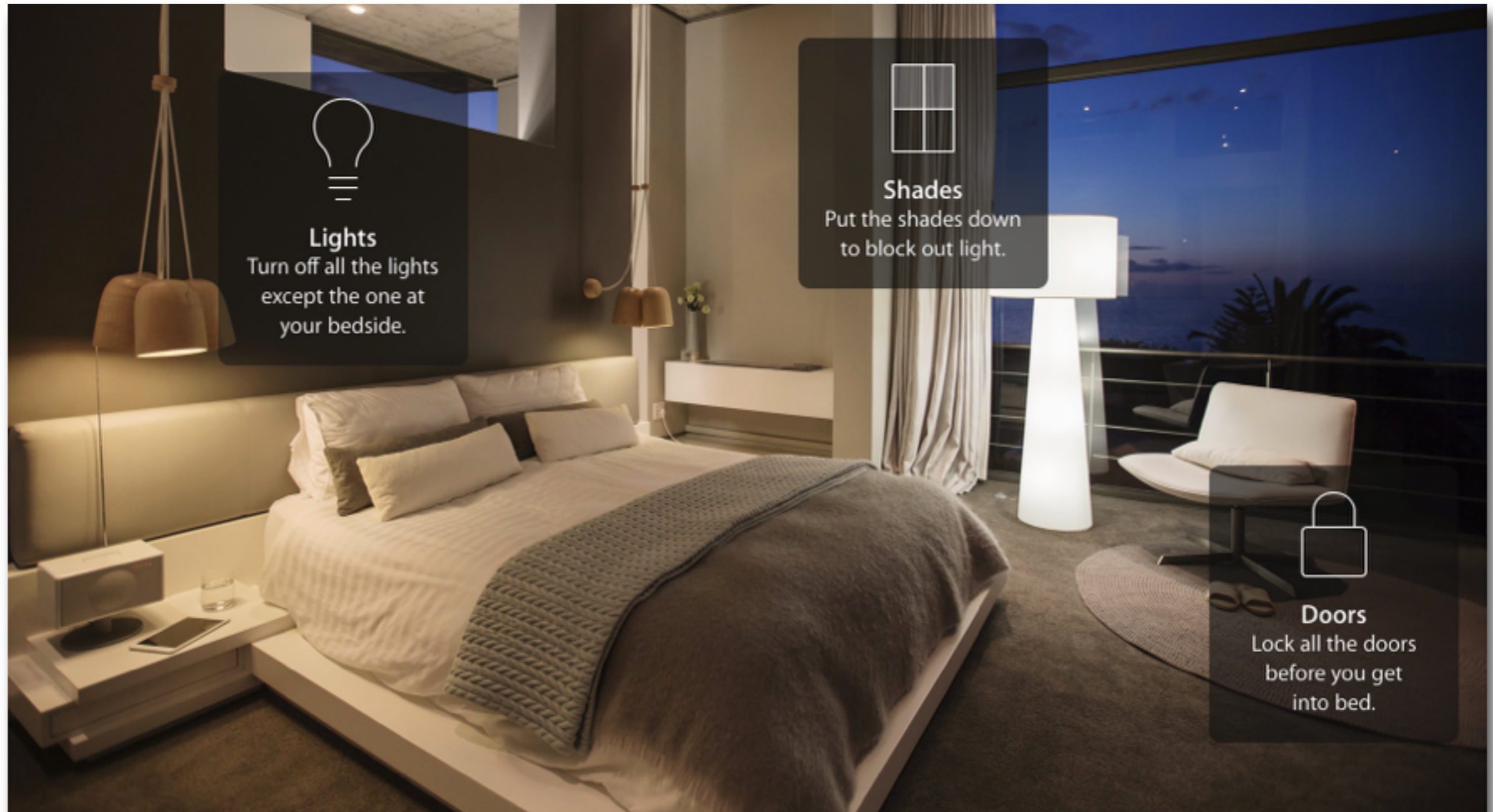



Lights
Turn on the lights so you don't come home to a dark house.


Thermostat
Set the thermostat so it's already comfortable when you walk in the door.

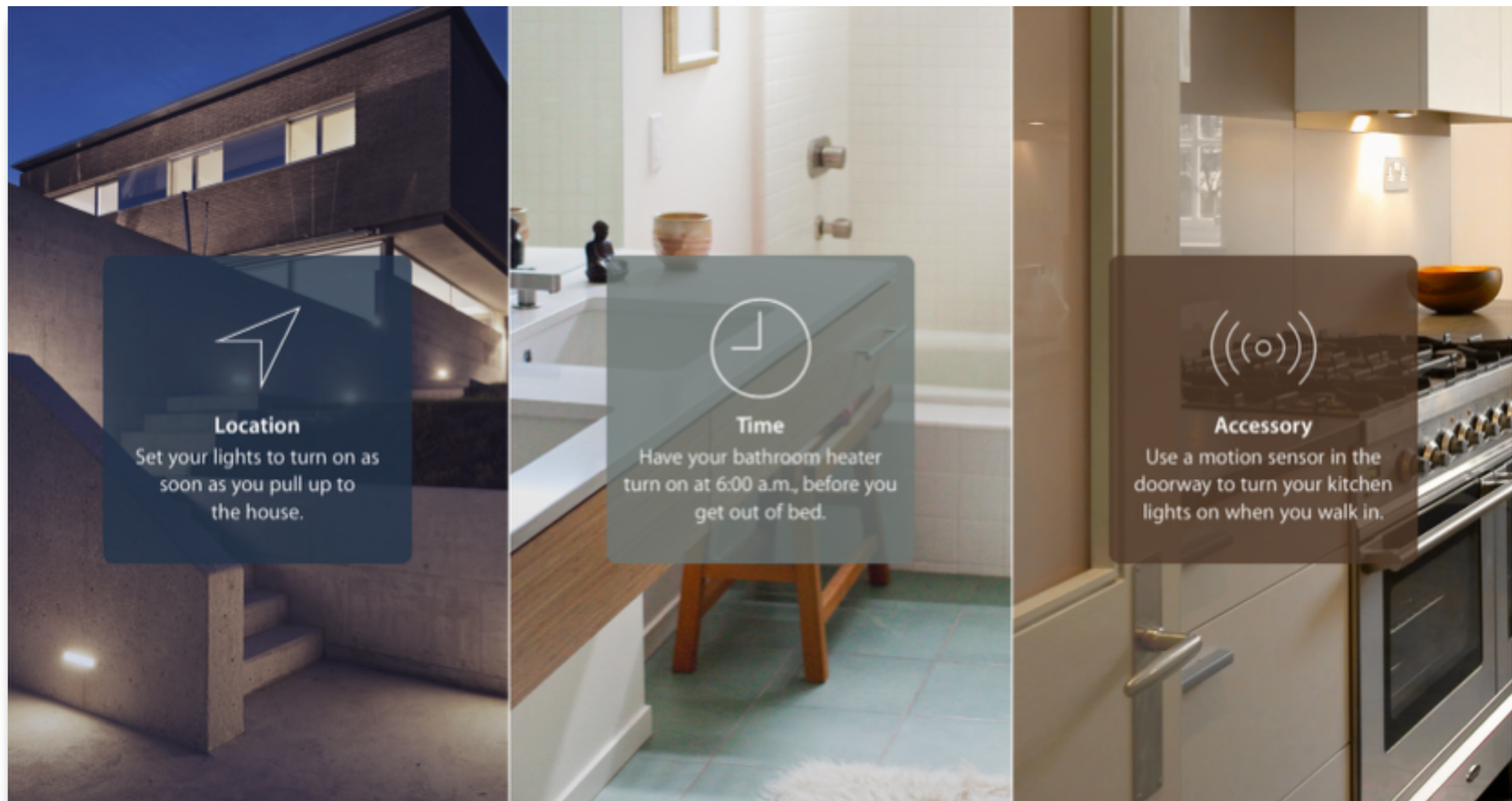

Front Door
Unlock the front door without having to hunt for a key.

Bedtime



The intelligent home

Devices can turn on or off automatically based on other triggers, so the home is always ready



Case Study: Nest Labs

- Originally started by Tony Fadell
 - One of the “Fathers of the iPod” at Apple 2001-08
- Developed the nest learning thermostat
 - Nest Protect smoke and CO detector



Works With Nest...

Watch
Video

- 11,000 developers working with Nest, with 1 in 8 Nest homes have Works with Nest connections up and running
- Lights automatically turn off when no one's home
- Stereos quiet down when a Nest Protect alarm goes off
- And washing machines know not to run when energy is in high demand

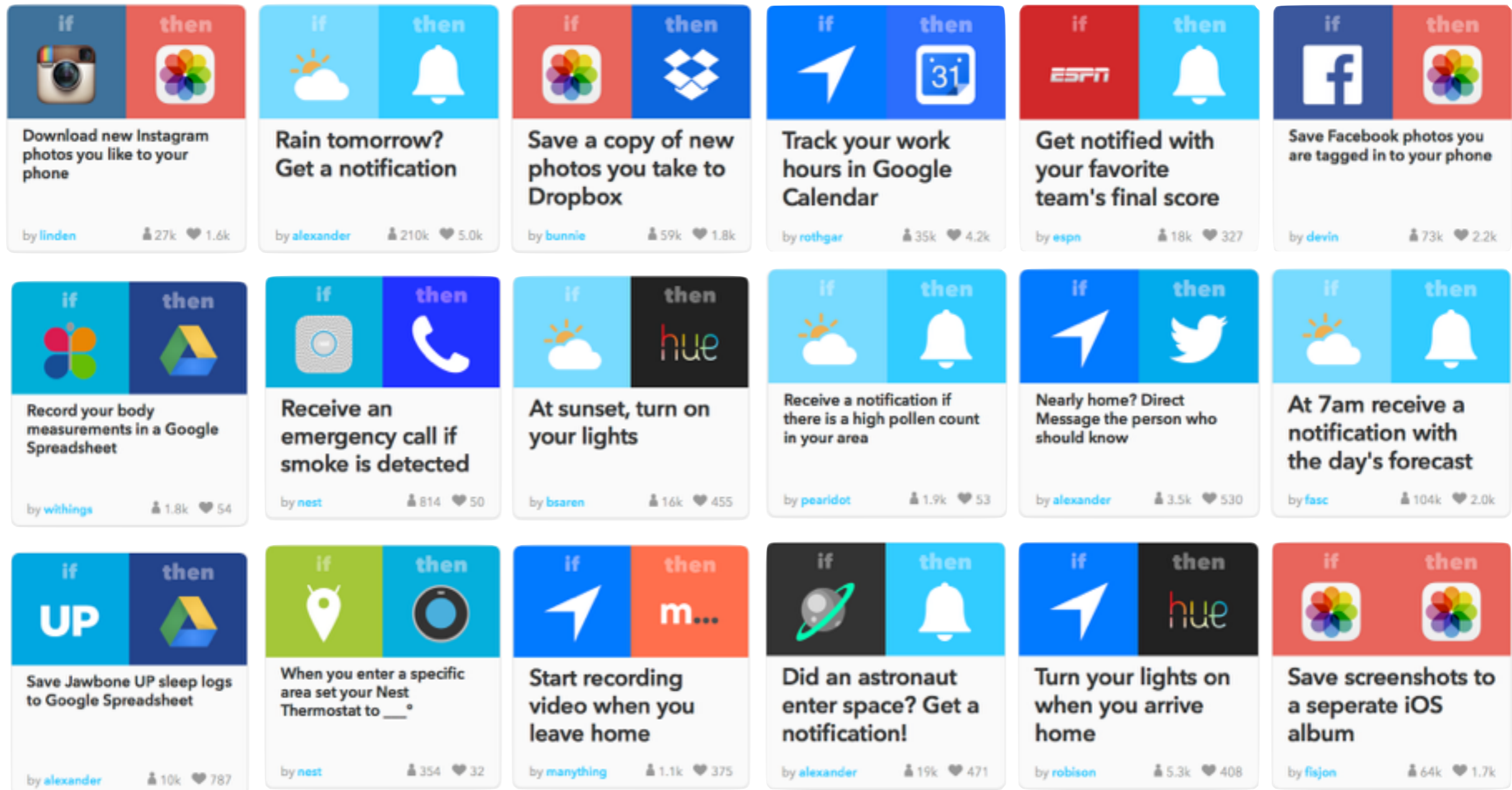


IFTTT: If this then that



- IFTTT is a web-based service that allows users to create chains of simple conditional statements, called "recipes", which are triggered based on changes to other web services such as Gmail, Facebook, Instagram, and Pinterest.
- An example "recipe" might consist of sending an e-mail message if the IFTTT user tweets using a certain hashtag. Or, if the user is tagged by someone on Facebook, then that photo will be added to the user's cloud-based photo archive.

IFTTT: Sample Recipes



Source: <https://ifttt.com/recipes/collections/42-recipes-for-ios>

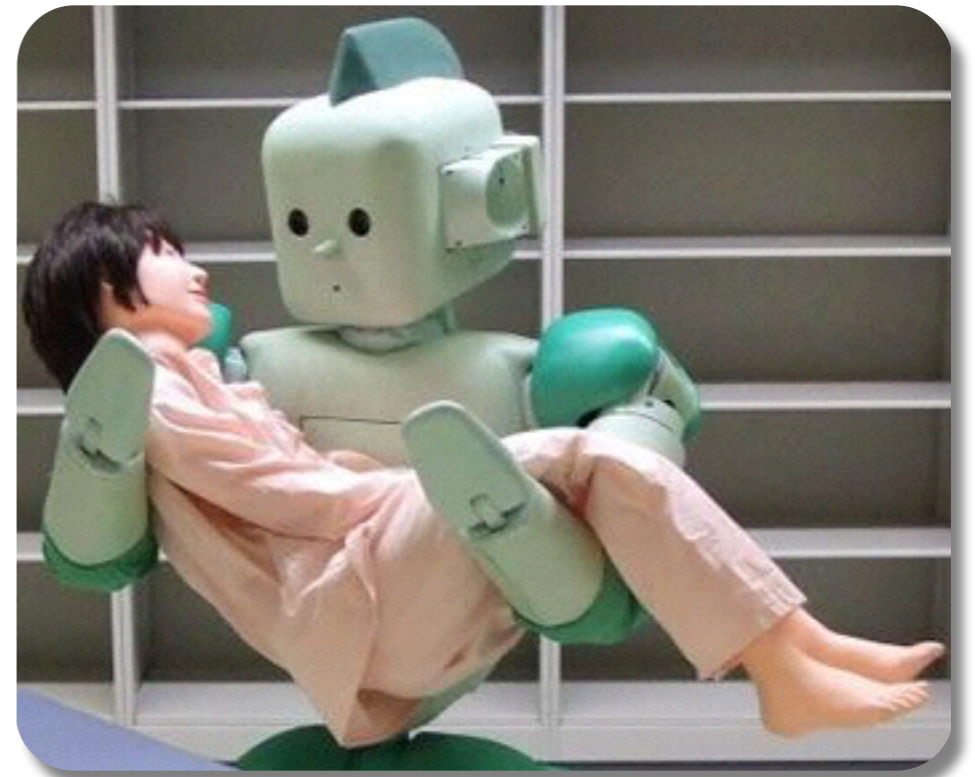


Concluding

This talk gives a snapshot of what is emerging in the connected device market

Haven't started looking within the assisted living and healthcare domain...

... that's for you



Questions ???