# The Internet of Things: Are we running quickly into the darkness?

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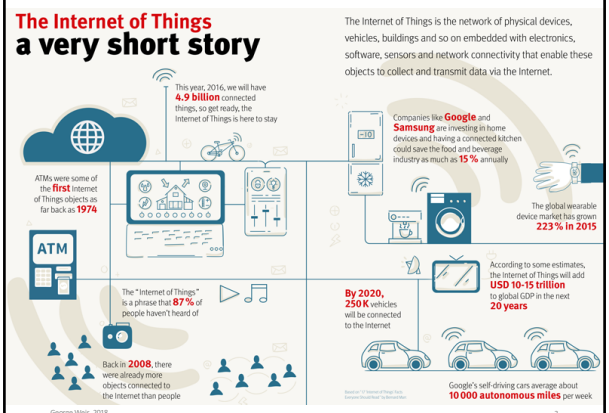
## Summary

- The Internet of Things: Are we running quickly into the darkness?
  - Yes
- Should we be worried?
  - Yes
- Can we mitigate the risks?
  - Yes (partly)

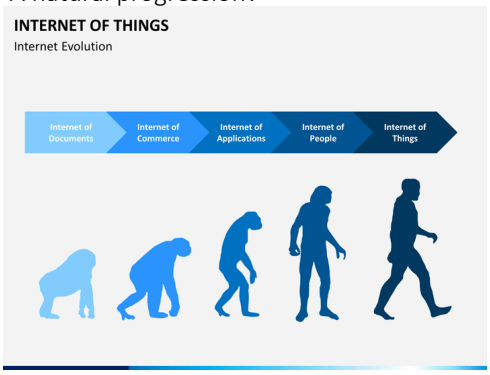




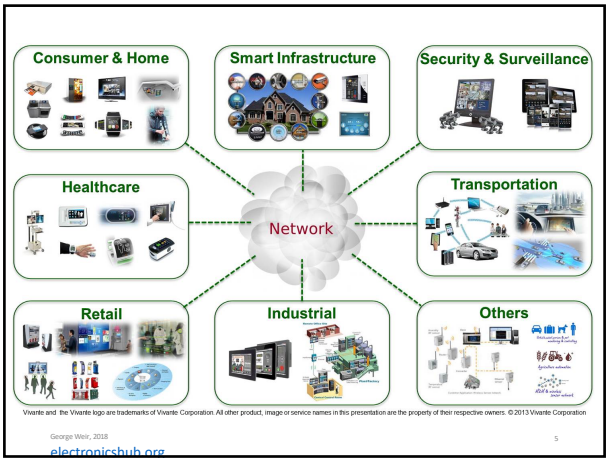



iso.org

## A natural progression?





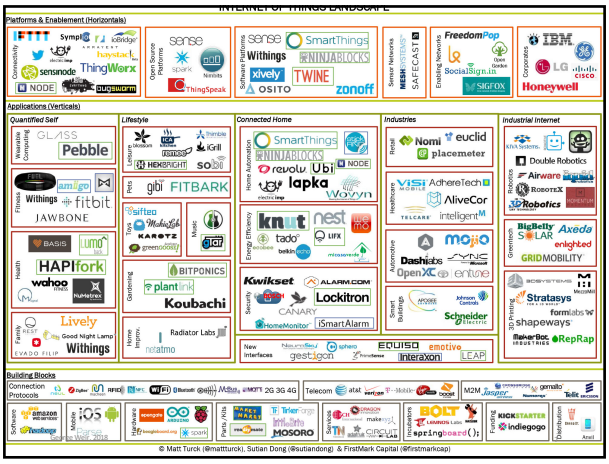





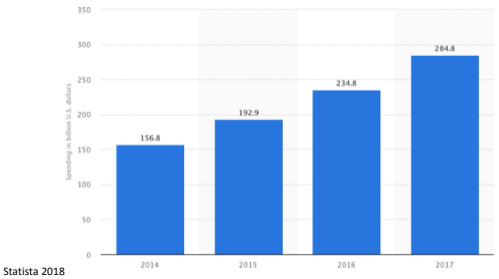

electronicshub.org

## Are we Running?

- Apparently, everyone is engaging with Cloud-based IoT:



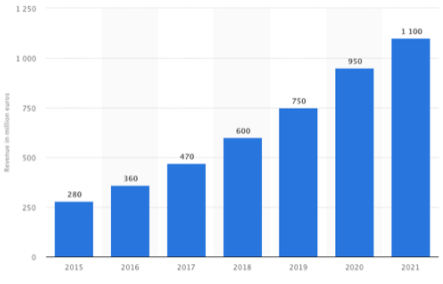

## Projected Internet of Things services spending worldwide from 2014 to 2017 (in billion U.S. dollars)




Statista 2018



## Third-party Internet of Things platform connectivity revenue worldwide from 2015 to 2021 (in million euros)

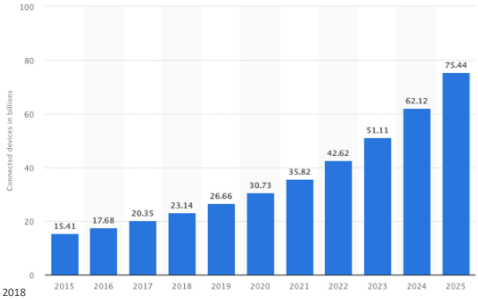



Statista 2018

Third-party connectivity platform revenue is forecast to reach 1.1 billion euros in 2021



## Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 (in billions)




Statista 2018



## Media prediction

- "A typical home will soon contain a network of gadgets designed to make life easier."
  (Sunday Times, 11.01.15)



## Government initiative?

The Internet of Things: making the most of the Second Digital Revolution

A report by the UK Government Chief Scientific Adviser

## Example devices

- Smart thermostat with remote control




## Apps on Your Fridge?

- 'Upgrade your life with a Wi-Fi enabled refrigerator
- Featuring a brilliant 8'' touchscreen that puts access to apps at your fingertips
- Check the morning weather, browse the web for recipes, explore your social networks or leave notes for your family—all from the refrigerator door'

Samsung advert



## Smart toothbrush


- Bluetooth smartphone interaction
- No internet connection (yet!)



## Smart energy meters

- Consumers with smart meters can have an in-home display (IHD) that lets them see how much energy they are using and what it will cost.
- This will let them have more control over their energy use and help them save energy and money.




## Wearable technology

- Smart watches with sensors
  - Health and fitness applications
- Smart clothing is predicted to overtake the sale of fitness trackers by 2017



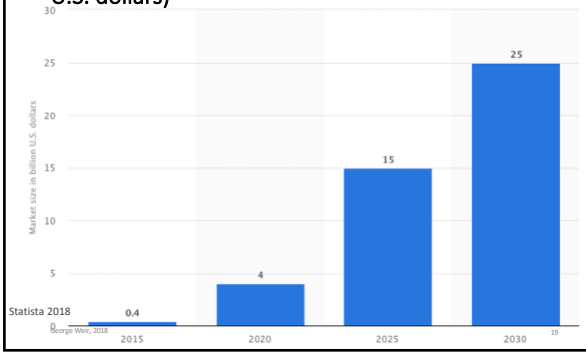
The Polo Tech smart shirt by Ralph Lauren, can measure heart rate and respiration connecting to a smartphone via Bluetooth



## Wearable technology (2)

- The Polo Tech smart shirt by Ralph Lauren
- Can measure heart rate and respiration, distance travelled and calories burned
- Connects to smartphone or tablet via Bluetooth

## Projected global market for autonomous driving sensor components from 2015 to 2030 (in billion U.S. dollars)




Statista 2018



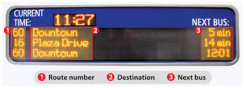
## Cars Will Talk, Then Collaborate

- Initial stage is 'car to roadside' communication
- Later stage extends this to 'car to car'



## Where we are

- Green wave system implemented in Glasgow City Centre (~2010)
  - Allows emergency vehicles to receive green waves to allow for safe and speedy journeys across the city
  - Vehicles tracked using GPRS transmission
- Bus stops showing expected arrivals






## Health applications

- Mainly monitoring and data capture
- Some remote access to consultations


Smartphone App Detects Sleep Apnea

Mobile technology could fit a gap in medical diagnosis

By MONICA ROZENFELD 23 January 2015

Loud snoring, restless sleep, morning headaches, and changes in mood are signs that someone may have sleep apnea, a disorder in which people stop breathing repeatedly throughout the night. Most people with the disorder, which increases the risk of a heart attack or stroke, are often unaware and go undiagnosed. To help solve this problem, one Ph.D. student has been working on an app for mobile devices to help detect sleep apnea. Eventually, he hopes it will be accurate enough to be used as a screening tool for the disorder.



## Varieties of device

- Three varieties of 'device'
  - Inert (with location markers)
  - Data gathering and relay
    - Sensor-based with data transfer
  - Decision making
    - Action based upon detected conditions

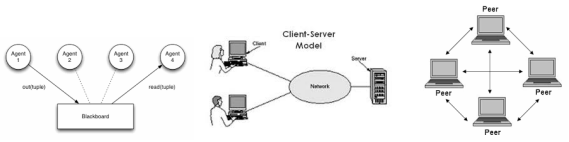


## networking models

- Two networking models
  - Mobile device to local network
    - As we have presently
  - Close proximity, ad hoc networking
    - Device to device
    - Peer to peer
- These models will interact

## Communication models

- Three communication models
  - Blackboard (e.g., cloud-based)
  - Client-server
  - Peer to peer






## Where we might be

- Highly integrated monitoring and control
  - domestic, district, regional and national
- Device self-monitoring for fault tolerance and timely repair
  - e.g., engine status monitor
- Environment monitoring for smart control
  - e.g., weather forecast affecting thermostat settings
- Significant cost benefits through better insight on system demand
  - e.g., cheaper health service
- Better guarantees of system performance
  - Quality of service enhancements through optimised production



## We should be worried about

- Reliability/robustness
- Locus of control
- Privacy
- Integrity
- Accountability
- Security
- Digital Forensics
- Availability



## Reliability and robustness

- Integrated systems could become mission or life critical
- Must have minimum failure rate
- issue of performance and capacity
- priority and contention management



## Reliability and robustness (2)

- Multiple points of failure?
  - Individual devices
  - Communication links
  - Centralised services



## Reliability and robustness (3)

- Mission critical?

## Locus of control

- Who is in control?


*"Bad news - the scale is threatening to cut off our access to the fridge..."*



## privacy

- Centralised data collection?
- The rise of 'big data' and data analytics
- Who owns the information?
- How can it be used?
  - Timely intervention (e.g., health care)
  - Targeted advertising
  - Product development
- Nowhere to hide?
- Tracking via our portable devices



## Buckhacker

**A website created by anonymous hackers has been launched that allows anyone to search for unsecured sensitive data stored in the cloud.**

Buckhacker is a tool that trawls servers at Amazon Web Services (AWS), a popular cloud computing platform.

AWS provides data storage to private firms, governments and universities, among others.

Exposed data has been found on it before, but Buckhacker makes searching for it much easier.

The name comes from the fact that AWS Simple Storage Servers (S3) are known as "buckets" - this is the part of AWS that Buckhacker accesses.

http://www.bbc.com/news/technology-43057681



## Strava

**Fitness tracking app gives away location of secret US military bases**

The app, made by Strava Labs, shows the movements of its app users around the world.

**Kabul, Afghanistan on the Strava heat map**



## Integrity/Accountability

- Can you trust the results of data analysis?
- How could you verify?
- Who can be held to account?
  - Distributed responsibility means more complex accountability



## Security

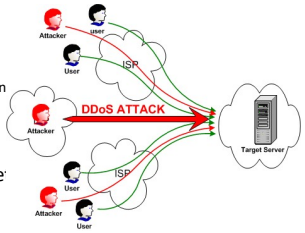
- Internet of Insecure Things
- 'Anything that can be hacked will be hacked'
- Shodan - the world's first search engine for Internet-connected devices
- Recent DDoS attacks employing IoT devices
- Malware (originating in China) has been found on US SCADA systems

## Recognising the risks?



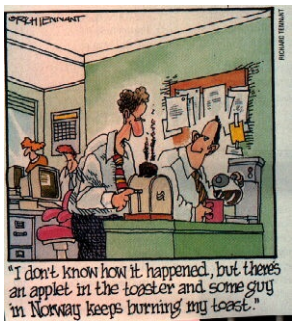

## Security: risks

- Forms of attack
  - Target devices
  - Target infrastructure
  - Unauthorised access (to data or con
  - Denial of service
- Most attacks use standard protocols to overwhelm targe
- If you are connected, you are vulnerable





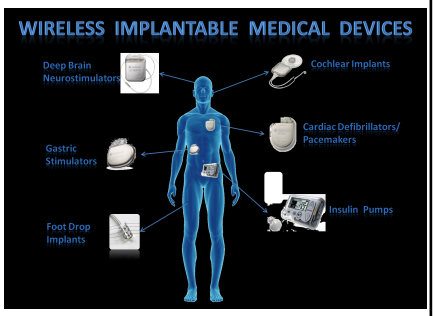

## Security: Unauthorised access






## Security: Health risks?

- Implanted networked medical devices

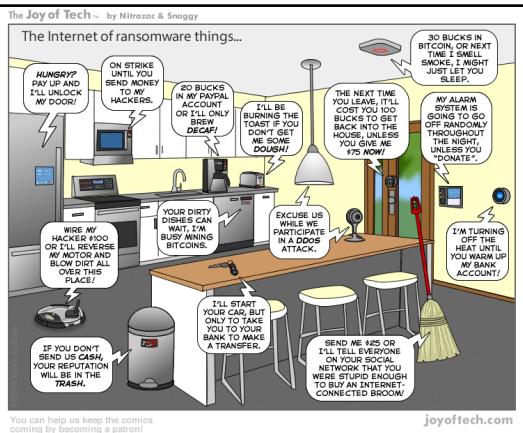


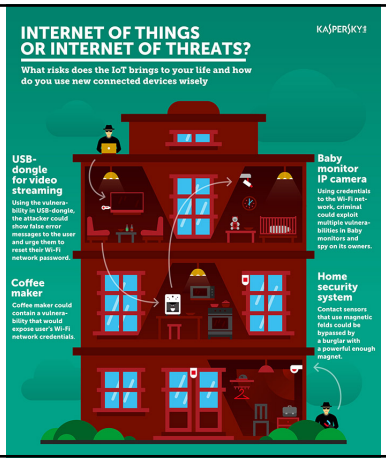



## Security: Health risks?

- Moving toward implanted devices
- Risk of illicit device access

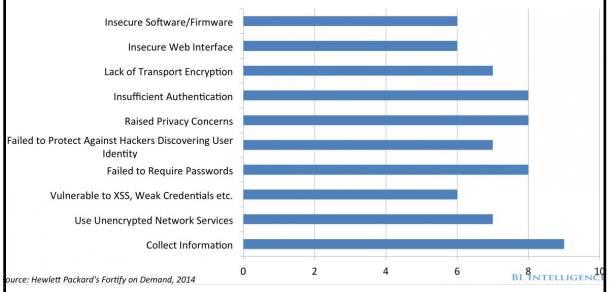







## Top Ten IoT Security Flaws




*ource: Hewlett Packard's Fortify on Demand, 2014*



## Digital forensics

- Where does the data reside?
- Who has authority to access logs or centrally stored data?
- Can we keep up with the proliferation of different devices?

Google Home


Amazon Echo



## Availability: services

- How do we spread the benefits?
- We don't all have the necessary infrastructure
  - High speed broadband
  - Domestic networks
  - Centralised monitoring and control systems
  - New era of 'haves and have nots'?



## Availability: quality of service

- Differing service options at different costs?
- Two tier health service with two access modes:
  - personal contact and on-line
- Latter will initially be cheaper option
- May evolve into more specialised service
  - e.g., advice and input from world leading medics, at a premium cost



## Availability: data

- Who gets access to the data?
- At what cost?
- New scope for data brokers?
- New avenues for personalised adverts…

## Availability: A new digital divide?

- Integrating old and new?
- Accommodating rich and poor?
- New education required?



## Conclusion (1)

- The Internet of Things: Are we running quickly into the darkness?
  - Yes
- Should we be worried?
  - Yes
- Can we mitigate the risks?
  - Yes (partly)



## Conclusion (2)

- What can we do?



performancemarks.com

## Walk forward (with a flashlight)

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