



Developing an IoT Strategy for Your Company.....

Where to Start?

Ziaul Mannan

Database Architect

Yale New Haven Health Services



@ZiaulM

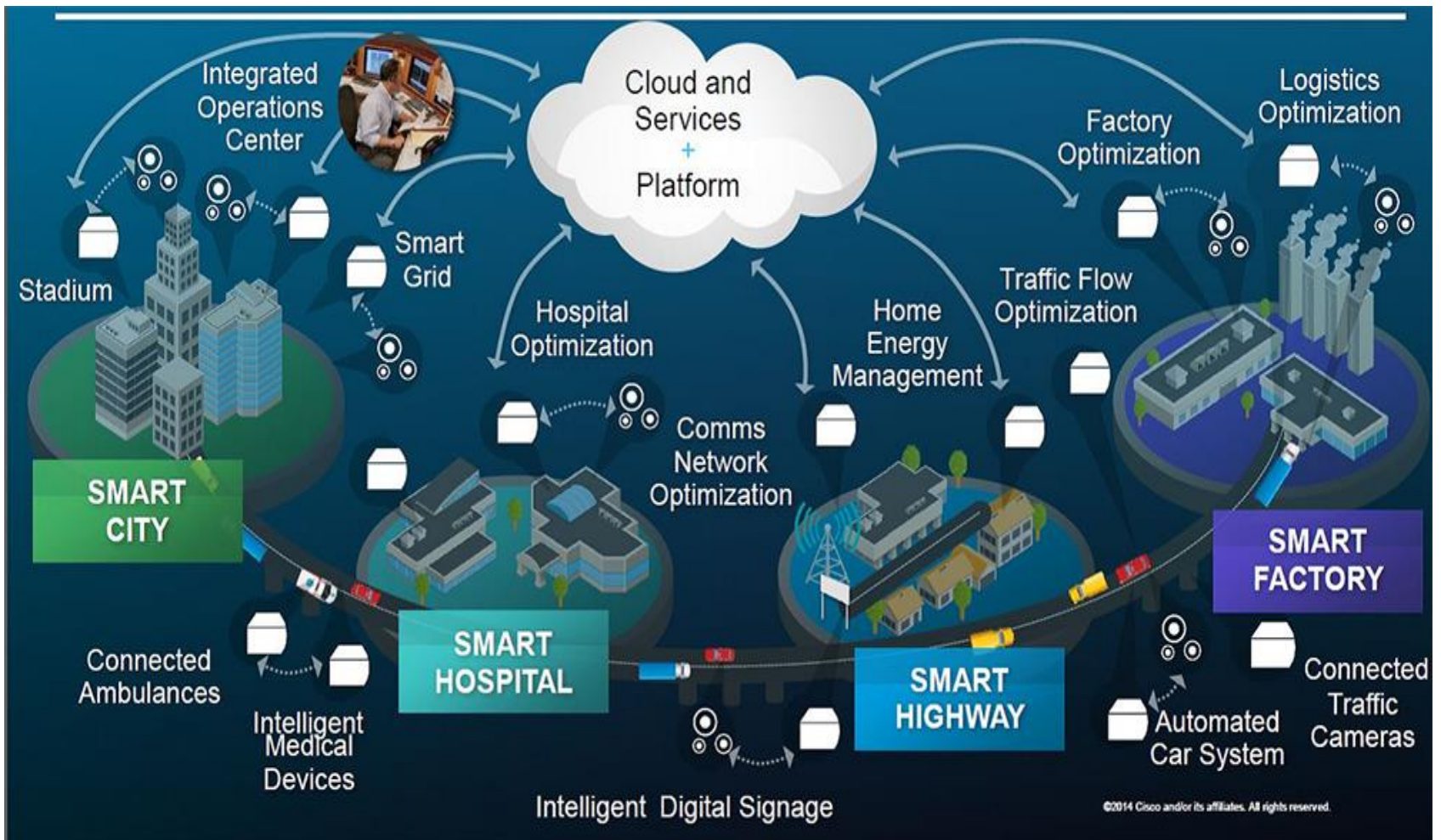


@Ziaul Mannan

Ziaul Mannan

- Database Architect at Yale New Haven Health Services
- Oracle, SQL Server, MySQL, Sybase,
- 15 Years in Healthcare IT
- Actively involved in charities aimed to provide quality education and healthcare to underprivileged children in developing countries
- Board member at CT STEM Foundation (CTStem.org) and Fair Director for Statewide Science Fair where High School students compete with their research work.
- Ziaul.Mannan@ynhh.org
- @ZiaulM
- NYOUG/IOUG Member since 2002!

IoT



IoT

The Internet of Things, or IoT, refers to the set of devices and systems that interconnect real-world sensors and actuators to the Internet.

- By 2020, an estimated 50 billion devices around the globe will be connected to the Internet.
- Perhaps a third of them will be computers, smartphones, tablets, and TVs. smart meters and smart objects
- The remaining two-thirds will be other kinds of “things”: sensors, actuators, and smartphones that are increasingly being used to measure the world around them..

IoT (Video)



Agenda

IoT: Basics, Devices and Examples

IoT: A New Frontier

IoT Data Analytics

What is it that makes something 'Internet of Things'?

Opportunities and predictions of IoT

Components of an IoT product

The IEEE architecture of IoT

Strategy Decisions: Technology-driven versus business-driven IoT

Digital Strategy

Requirements For A Reference Architecture

An IoT Reference Architecture

IoT In Healthcare

Conclusion and Wrap-up

IoT: Basics (Video)



IoT: Devices

IoT is an umbrella term that includes multiple different categories:

- Wireless sensor/actuator networks
- Internet-connected wearables
- Low power embedded systems
- RFID enabled tracking
- Use of mobile phones to interact with the real world (e.g. sensing)
- Devices that connect via Bluetooth-enabled mobile phones to the Internet
- Smart homes
- Connected cars

And many more.....

IoT: Examples

- Internet connected cars
- wearable devices including health and fitness monitoring devices, watches, and even human implanted devices;
- smart meters and smart objects
- home automation systems and lighting controls
- smartphones that are increasingly being used to measure the world around them
- wireless sensor networks that measure weather, flood defenses, tides and more
- Ingestibles?

IoT: Examples (Video)



IoT: A New Frontier?

- IoT can provide data analytics
- Allows to detect anomalies in real time
- Triggers an alert of something going wrong

IoT Data Analytics

- IoT devices transport huge amount of IoT data-- our things, in general, generate.
- Data analytics programs, however, is what gives that data some life.
- It is this knowledge and wisdom we can extract from IoT data, which makes the Internet of Things so interesting.

IoT Data Analytics

- Data analytics algorithms vary significantly in capabilities and scope.
- So there are algorithms which help find us the 'known knowns'.
- Then there are algorithms which are able to extract the 'known unknowns'.
- And as of very, very recently, there are algorithms which are even able to extract the 'unknown unknowns' from our data sets : “Deep-learning Algorithms”.

IoT Data Analytics (Video)



IoT Data Analytics

- Some very difficult trade-offs typically need to be struck, since our IoT devices are highly constrained on resources.
- Should I use a lot of computing energy and memory in IoT device to crunch all that data and then only send the final result to the IoT data service?
- Should it be to use a lot of energy to submit all the raw data and rather have the calculus done in the back end server?
- Now that trade-off is heavily dependent on the IoT application at hand, and generally is not an easy call to make.

Is a smart phone an IoT device?

- There are about 14 sensors, which power quite a few applications.
- Applications can include geo location, lighting, traffic, temperature, humidity etc.
- They are gathering data on their own...
- But, are they talking to each other?
- The web applications really need the sensors which are on here-- so the location data, the temperature data, light etc. a lot of stuff these sensors feed into the web applications and they wouldn't work without them.

Is a smart phone an Internet of Things device?

Seamless connectivity makes it a little more Internet of Things...not quit enough!

Internet is actually the Internet, because every computer can talk to every other computer. So it's literally a flat and open architecture.

Problem with IoT things is, if you have Google using these sensors for the applications. You have Apple doing the same ways-- Uber et cetera-- but they're not really talking to each other in a totally open way.

So it seems to be more like an intranet, right?

The Internet was first the intranet, and then that evolution happened. And its worth wondering if perhaps the Internet of Things could also transition in that same way.

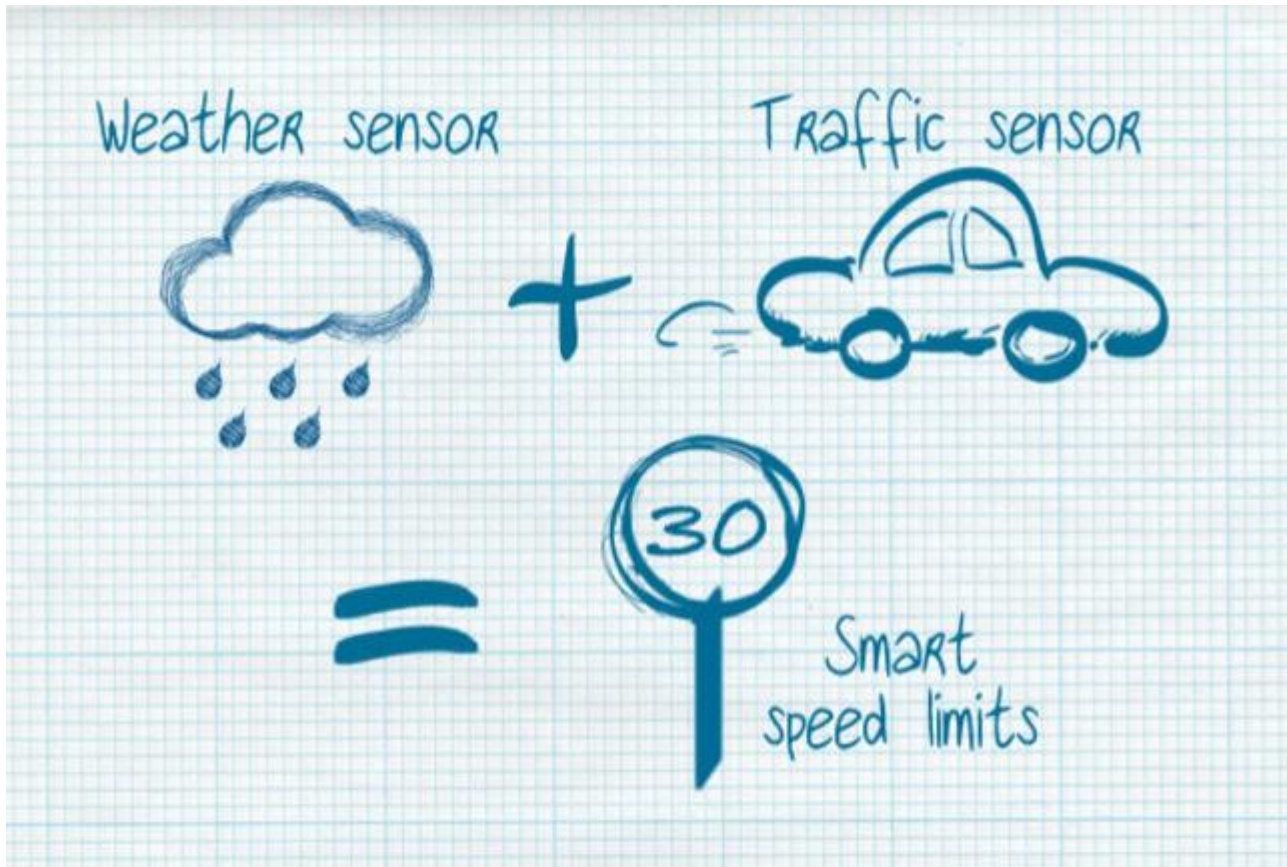
What is it that makes something 'Internet of Things'?

IEEE
definition:



“Internet of Things envisions a self configuring, adaptive, complex network that interconnects 'things' to the Internet through the use of standard communication protocols. The interconnected things have physical or virtual representation in the digital world, sensing/actuation capability, a programmability feature and are uniquely identifiable. The representation contains information including the thing's identity, status, location or any other business, social or privately relevant information. The things offer services, with or without human intervention, through the exploitation of unique identification, data capture and communication, and actuation capability. The service is exploited through the use of intelligent interfaces and is made available anywhere, anytime, and for anything taking security into consideration.”

What is it that makes something 'Internet of Things'?

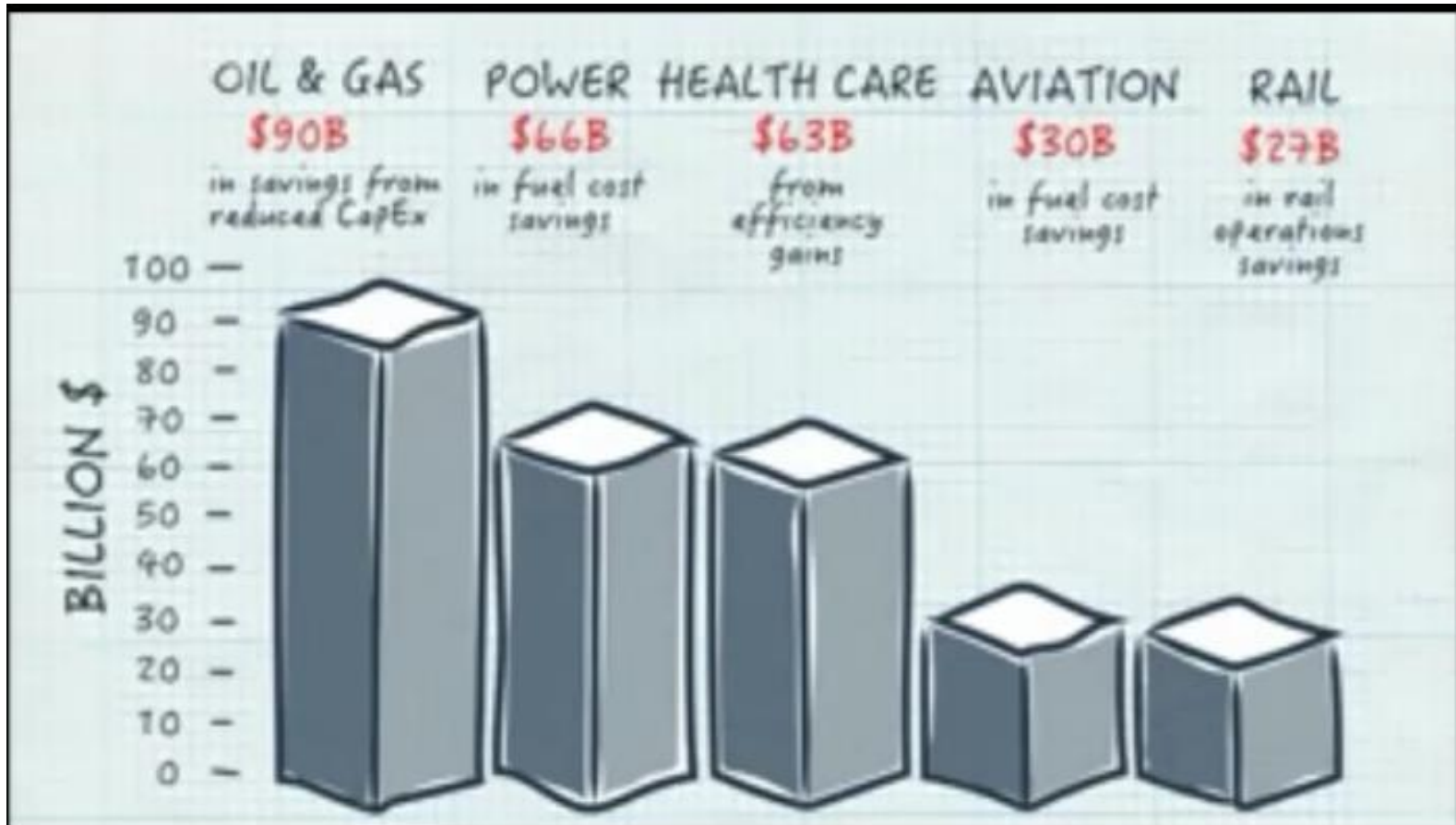


What is it that makes something 'Internet of Things'?

Comments from The Industry Experts

- ...I've heard about the Internet of Things. I think it's connected to objects which have extra intelligence, and you can obtain data from them, and control them in a different, or more intelligent fashion...
- ...The Internet of Things is mostly, let's say, components that can talk to each other...
- ...Anything that can sense its context can be an agent in the Internet of Things...
- Thing(s) >> Sensors >> Internet >> data >> Analytics >> Insights >> Actionables >> Outcomes...

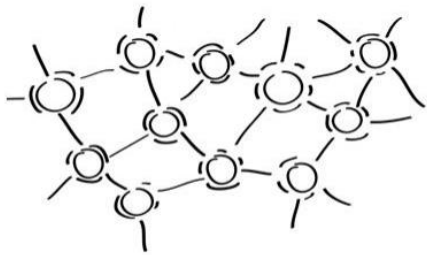
Opportunities and predictions of IoT



Ref: General Electric market study 2015

Components of an IoT product

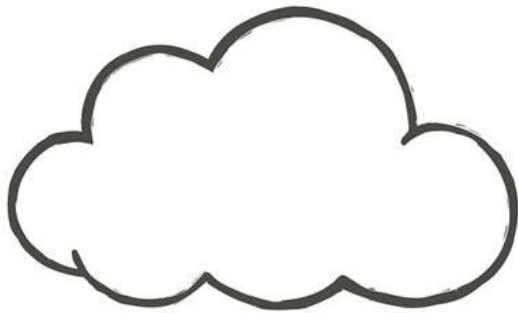
1. Sensors



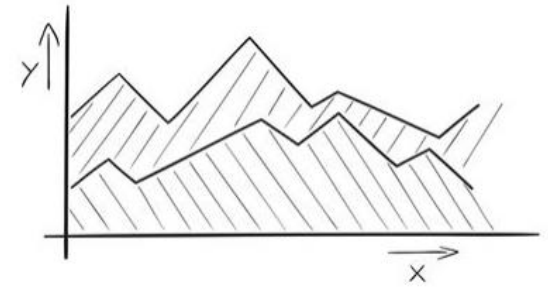
2. Connectivity



3. Platform



4. Analytics



5. User Interface



Components of an IoT product

Sensors

- we need things we want to connect. These could be sensors, actuators, robots, whatever can be connected.
- temperature, humidity,
- light, noise, pollution
- pressure, torsion, tension, acceleration
- position, images, magnetic fields, electric fields, etc,
- They used to be large, bulky and power hungry.
- Today they are invisible and energy efficient, whilst maintaining a high measurement precision.

Components of an IoT product

Sensors

Sensor type	Examples
Acoustic, sound, vibration	Microphone
Automotive, transportation	Parking sensor, speedometer
Chemical	Breathalyser, smoke detector
Electric current, electric potential, magnetic, radio	Metal detector
Flow, fluid velocity	Water meter
Ionizing radiation, subatomic particles	Geiger counter
Navigation instruments	Depth gauge, gyroscope
Position, angle, displacement, distance, speed, acceleration	Impact sensor
Optical, light, imaging, photon	Light sensor
Pressure	Barometer
Force, density, level	Hydrometer
Thermal, heat, temperature	Thermometer
Proximity, presence	Touch switch

IoT: Extreme Performance

*Team Oracle America's Cup Regatta...
Greatest Comeback in History Ever!*



**2013 34th America's
Cup vs.
Team New Zealand**

**3000+ Sensors in the
Catamaran
Feeding Exadata**



Components of an IoT product

Connectivity

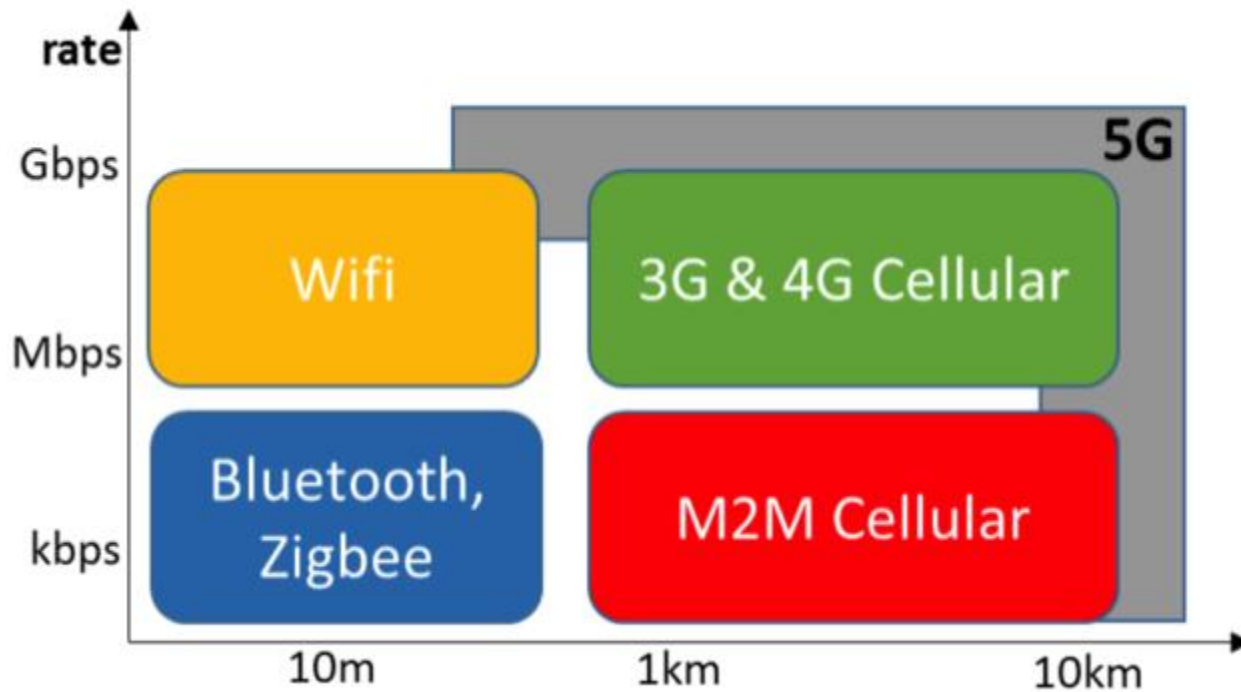
Sensor or actuator will need to be connected reliably to the Internet:

- Zigbee.
- Wifi
- Cellular
- Low Power Wifi
 - Sigfox
 - Cycleo
 - On-Ramp, and
 - Neul

Components of an IoT product

Connectivity

The Emerging Wireless Connectivity Ecosystem



Components of an IoT product

Platform

Collected data needs to be stored and processed somewhere. Known as IoT platforms, these are typically cloud-based infrastructures which:

- Receive and send data via standardized interfaces, known as API;
- Store the data; and
- Process the data.
- Scalable cloud solutions in a software-as-a-service model.
- No need to have a fully-fledged backend when only support 10 sensors at the beginning of a project.

Components of an IoT product

Analytics

- Some data analytics needs to be applied to the data
- Value is not in the raw bits and bytes, but rather in the insights gathered from them.
- Big data analytics tools are generally available today.
- From simple statistical tools to more sophisticated machine learning approaches,
- Deep learning being the latest trend.

Think of statistical tools finding us “the known knowns” in the data; machine learning finding the known unknowns; whilst deep learning is able to find the unknown unknowns.

Components of an IoT product

User Interface

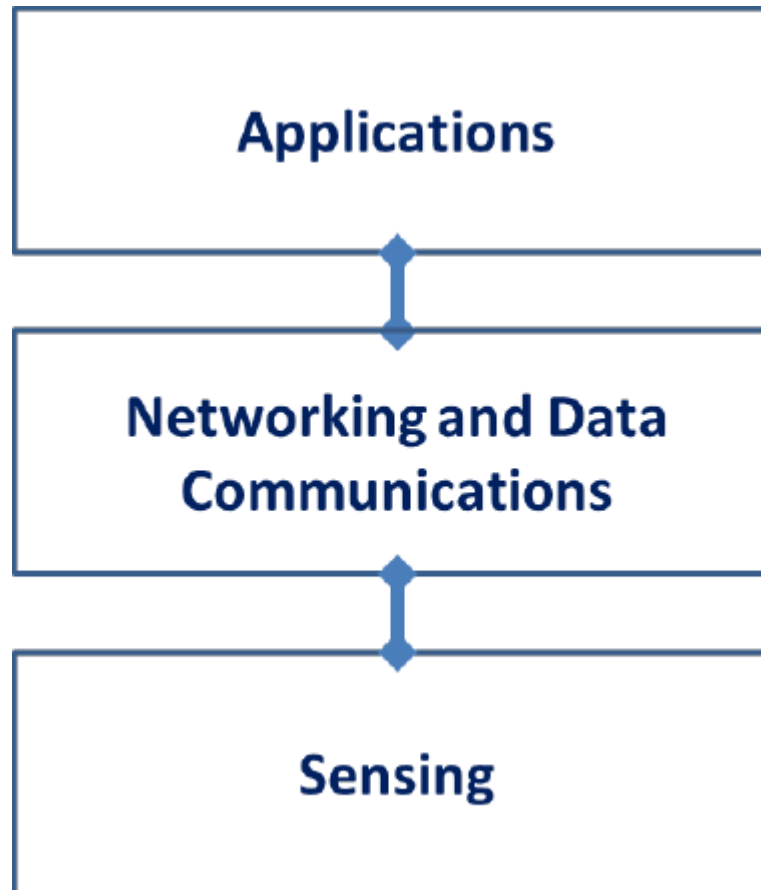
- How the data is presented to the final users.
- Make sure your IoT product has a very appealing user interface,
 - Web Based
 - Smart Phone or Tablet Based.
- Often a very sexy front-end which convinces clients to buy into the IoT journey.



IoT Food Menu In Restaurants??

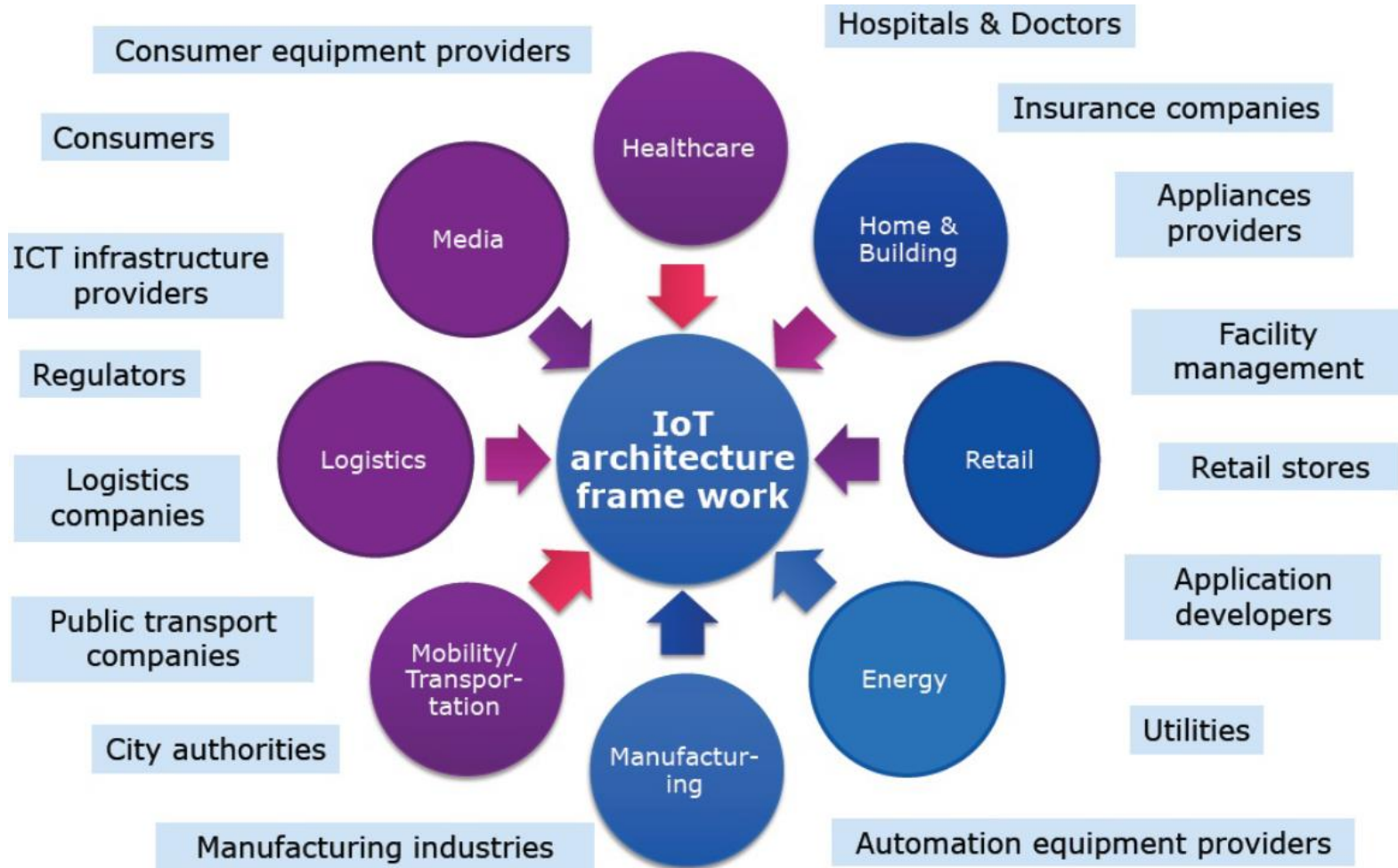
IEEE Architecture of IoT

IEEE P2413: The architecture of IoT as three-tiered



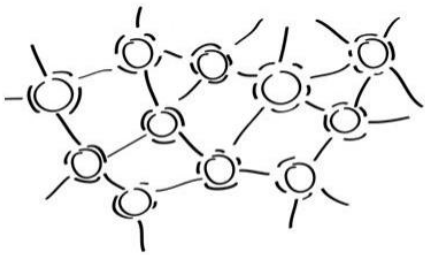
IEEE Architecture of IoT

IEEE P2413: IoT market and the stakeholders of IoT



Components of an IoT product

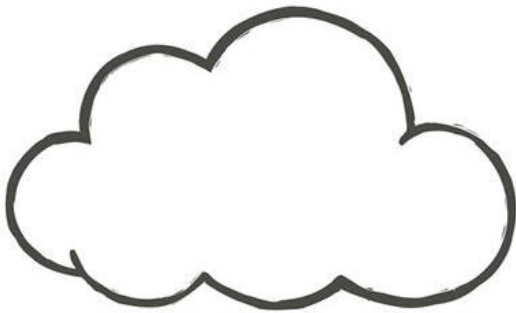
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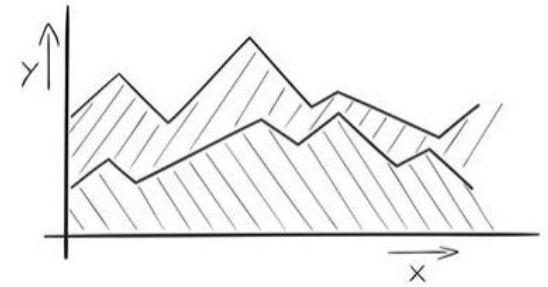
2. Connectivity



3. Platform



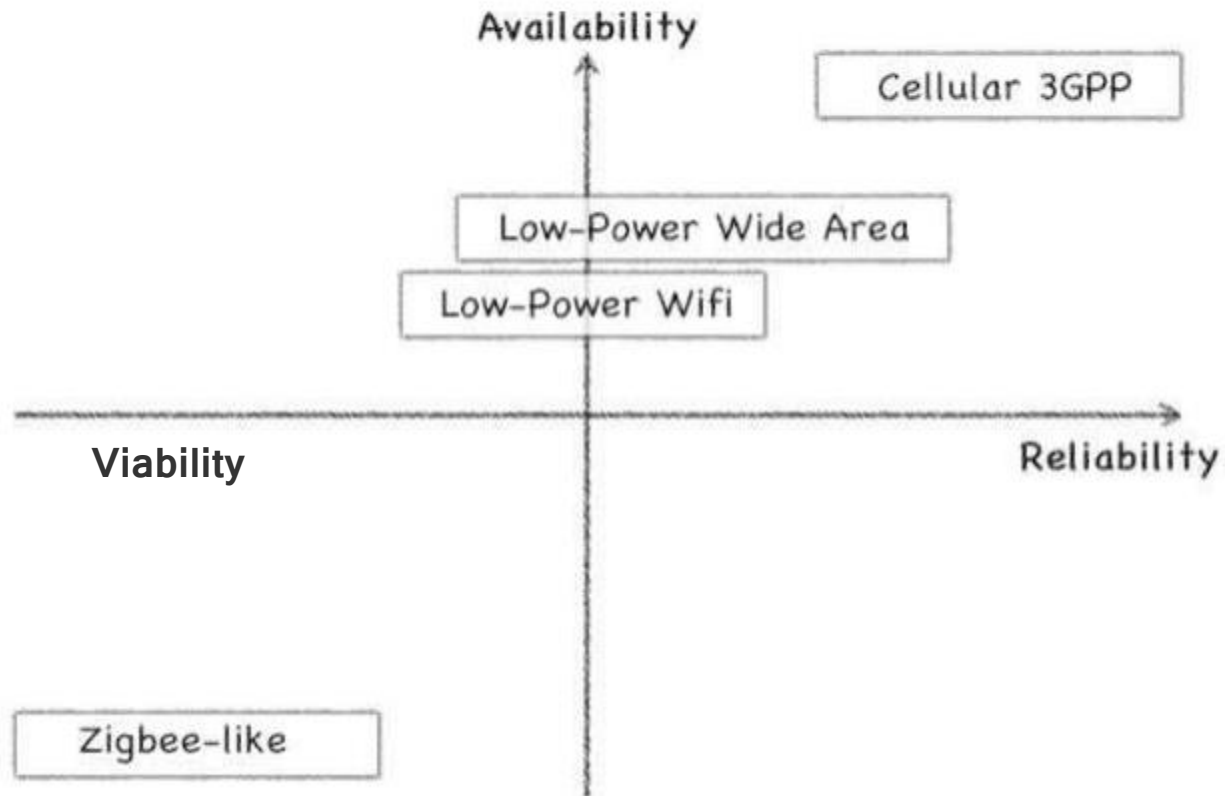
4. Analytics



5. User Interface



Strategy Decisions: Technology-driven versus business-driven IoT



Digital Strategy

2 Key Definitions:

■ Digital Disruption

- The changes in the competitive environment resulting from the use of digital technologies by new market entrants or established competitors in ways that undermine the viability of your product/service portfolio or go-to-market approach

■ Digital Strategy

- Integrated business strategy inspired by the capabilities of powerful, readily accessible technologies (like SMACIT) and responsive to constantly changing market conditions
- 2 types of strategies: customer engagement and digitized solutions

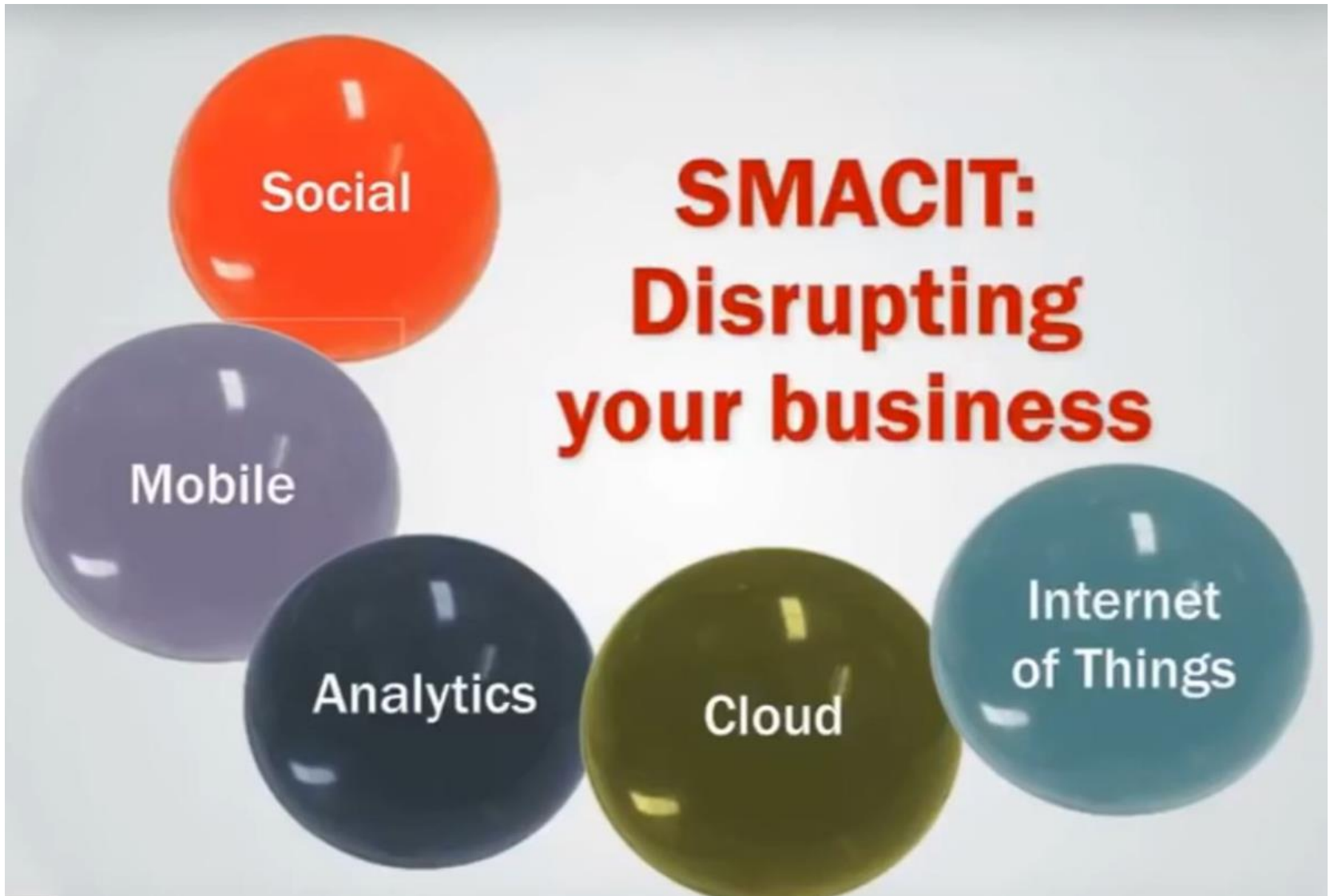
Digital Strategy: Digital Disruption

- Postal Mail
 - Telegraph
 - Trains
 - Metal / Wood / Glass
 - Pictures (Chemical)
 - Computer
 - Floppy/Zip Drive
 - Encyclopedia
- ➔
- Email
 - Telephone / Cell Phone
 - Cars / Planes
 - Plastics
 - Digital Pictures
 - Smartphone/Tablet
 - USB
 - Wikipedia



Ref: Rich Niemiec, ROLTA/TUSC

Digital Strategy



Digital Strategy

(How IT Units Can Respond to SMACIT)

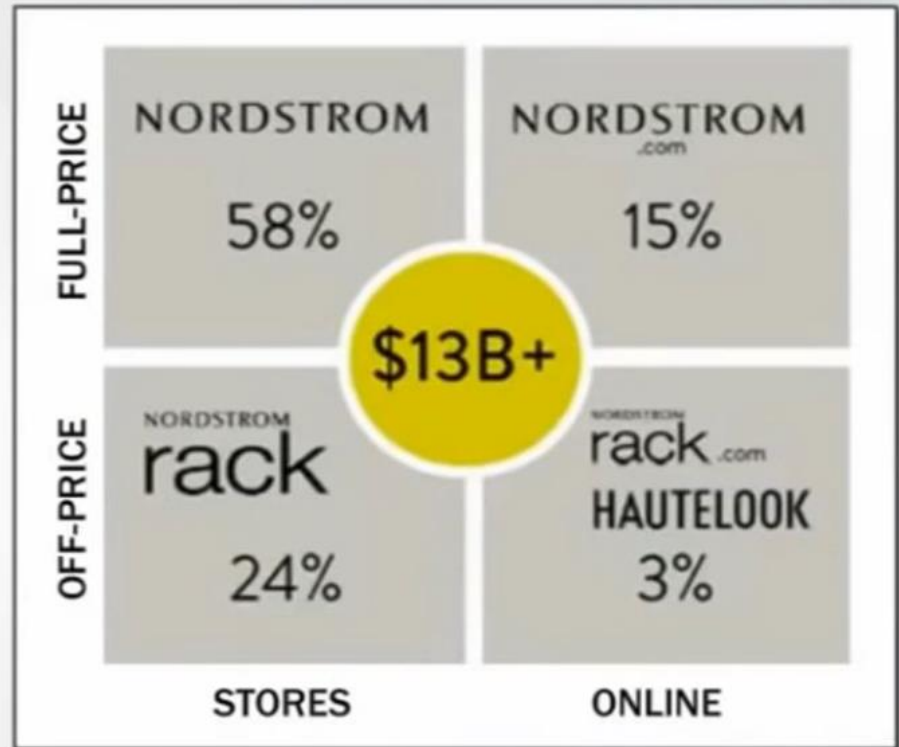


Ref: MIT Center for Systems Research (CISR)

Digital Strategy

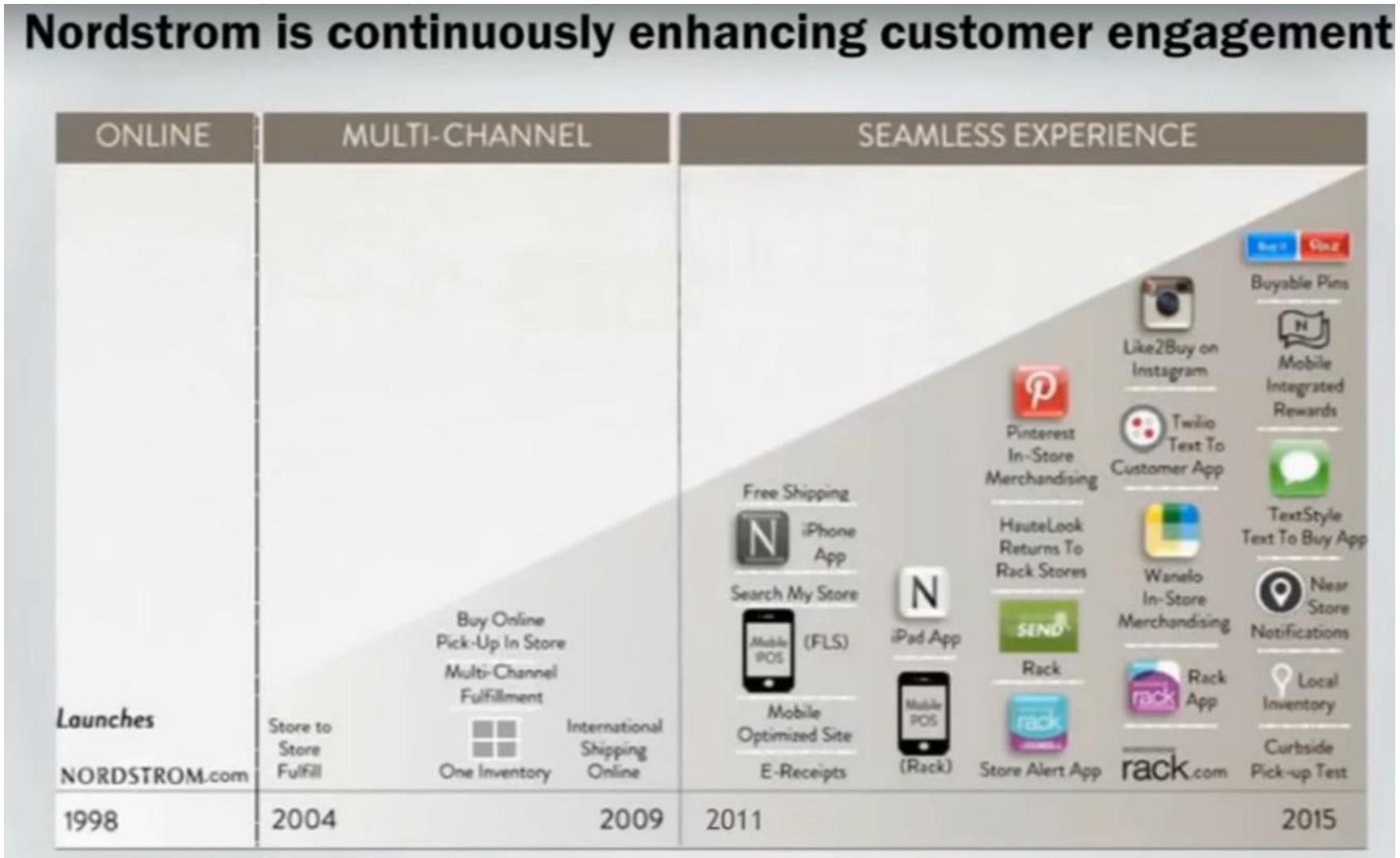
Nordstrom Inc. focuses on customer engagement

- Fashion specialty retailer known for outstanding customer service
- Disrupted by increasing popularity of online shopping options and discount retailers
- **50% sales increase since 2009; 10-year total shareholder return of 14% (compared to 8% for S&P 500)**



Digital Strategy

Nordstrom is continuously enhancing customer engagement



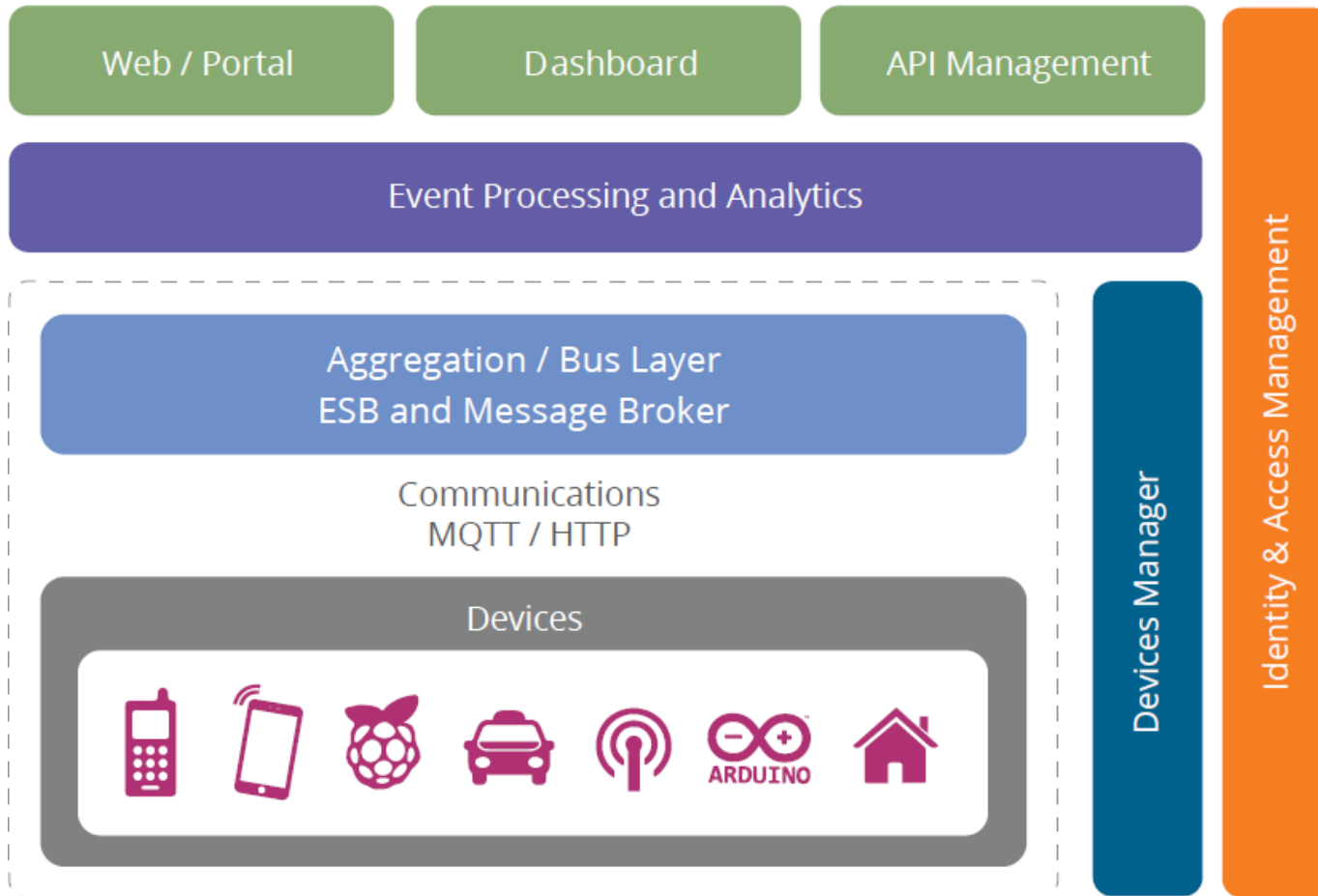
Ref: MIT Center for Systems Research (CISR)

Requirements For A Reference Architecture

- Connectivity and communications
- Device management
- Data collection, analysis, and actuation
- Scalability
- Security
- HA
- Predictive analysis
- Integration

Ref: WS02.com: IoT

An IoT Reference Architecture



Ref: WSO2.com: IoT

IoT In Healthcare

- IoT can help shift healthcare from cure to prevention. E.g. Multi-Center Perioperative Group (MPOG)
- Give people greater control over decisions affecting their wellbeing. E.g. “My Chart”
- Integrate the delivery of care, improve clinical outcomes; yield considerable cost efficiencies. E.g. Epic
- Delivery of remote health: related services. E.g. Telehealth, e-ICU

IoT In Healthcare

Prevention and Early Identification

- Monitor patients' vital signs – blood pressure, heart rate and blood sugar levels for example - in near real-time.
- The stream of health data can immediately alert users to anomalies and can be analyzed with sophisticated software to support early diagnosis.
- SMS reminders for clinical appointments reducing costly missed appointments
- Embedded sensors in Homes are making it possible for the elderly and people with mental health conditions to safely lead independent lives for longer.
- Smart devices may also increasingly be used to help patients with chronic health conditions. ; this data could be monitored by clinicians, intervening as required.

IoT In Healthcare

Prevention and Early Identification

Despite the huge potential benefits, there are considerable challenges to deploy the Internet of Things at scale. Skilled professionals will be needed to interpret the data, and both they and the patients will need robust security and privacy safeguards in place.

Building your IoT Strategy...

If we aspire to build game-changing companies,
we'll need game-changing leaders.



References

- *MIT Center for Systems Research (CISR): Digital Disruption.*
- WSO2.com: A Reference Architecture for The Internet of Things
- Prof Mischa Dohler: Kings College, London: The Internet of Things

Q/A

