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Big data and the internet of things

Monday, June 6, 2016

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Today

What is The internet of things?

What is big data?

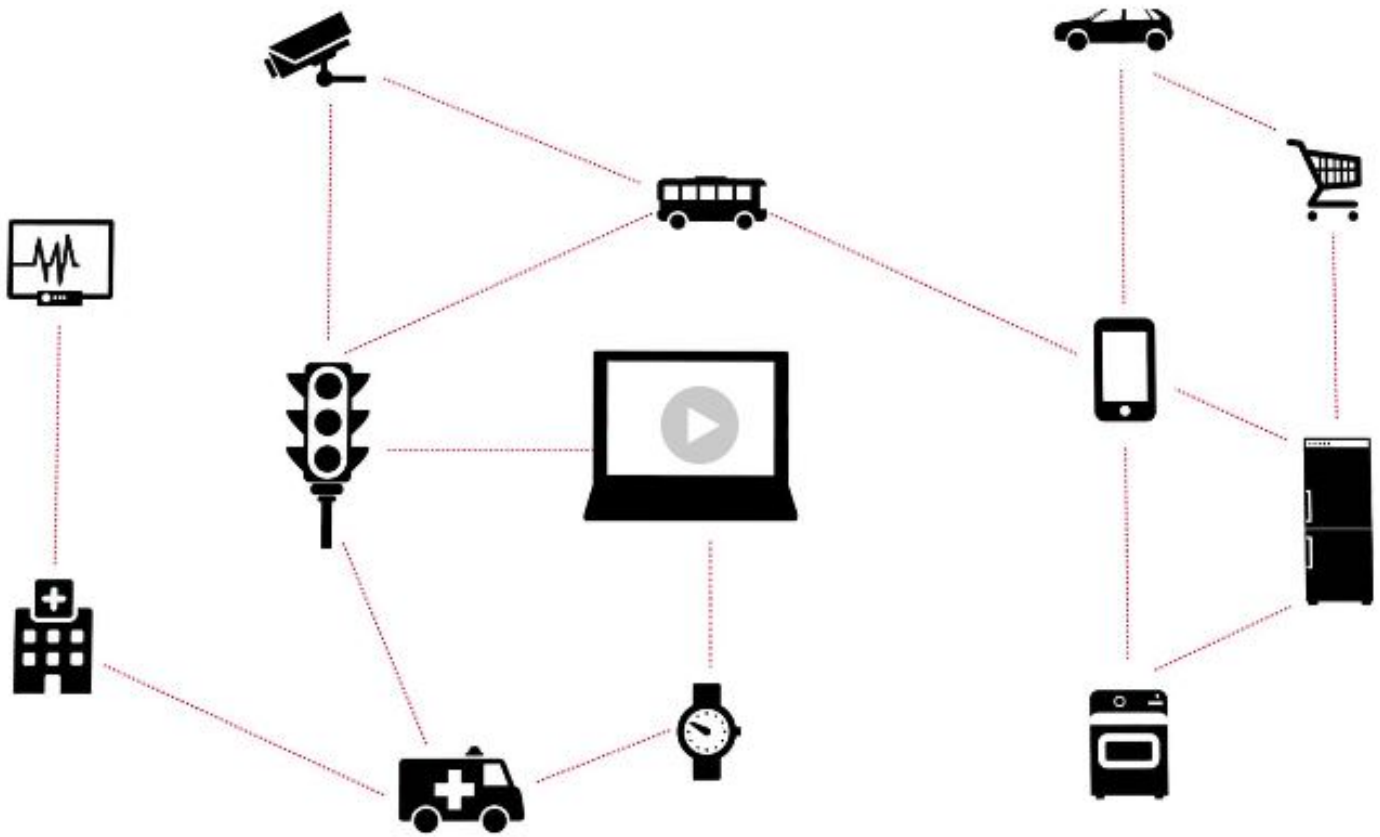
Legal issues and considerations

Privacy issues and considerations

Questions

Introduction to internet of things (IoT) and big data

Video - Internet of Things



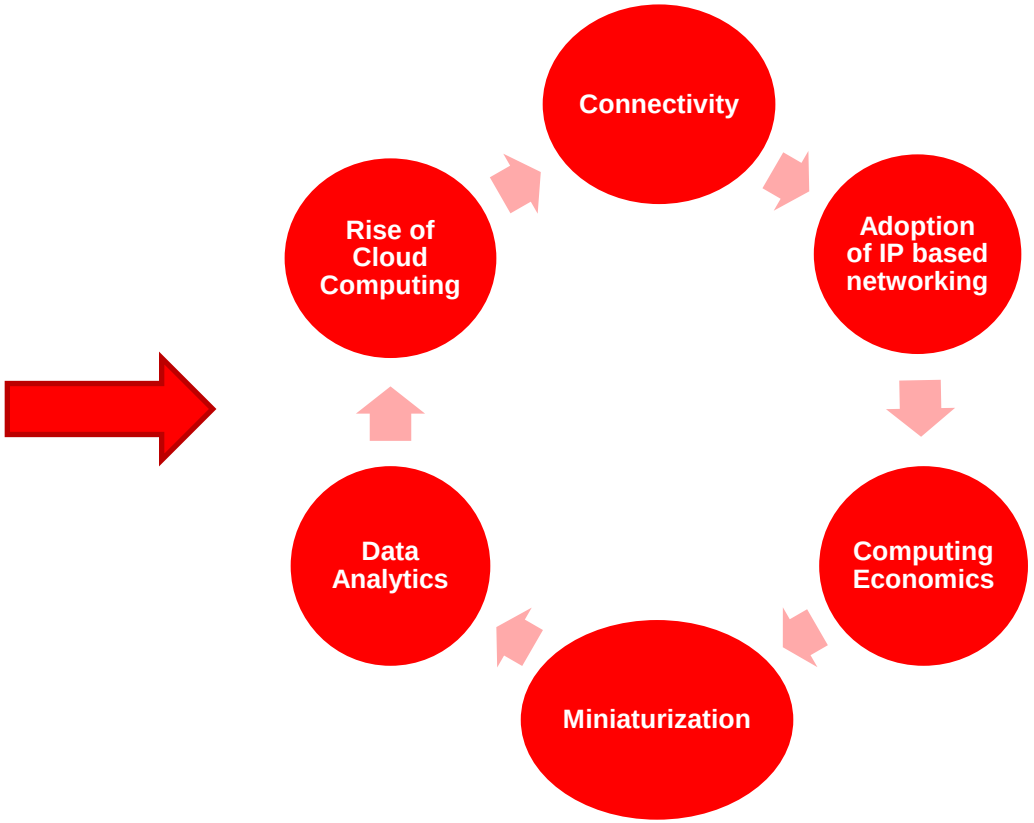
Source: http://www.nortonrosefulbright.com/knowledge/videos/133225/learn-more-about-big-data-and-the-internet-of-things

What is the internet of things ?

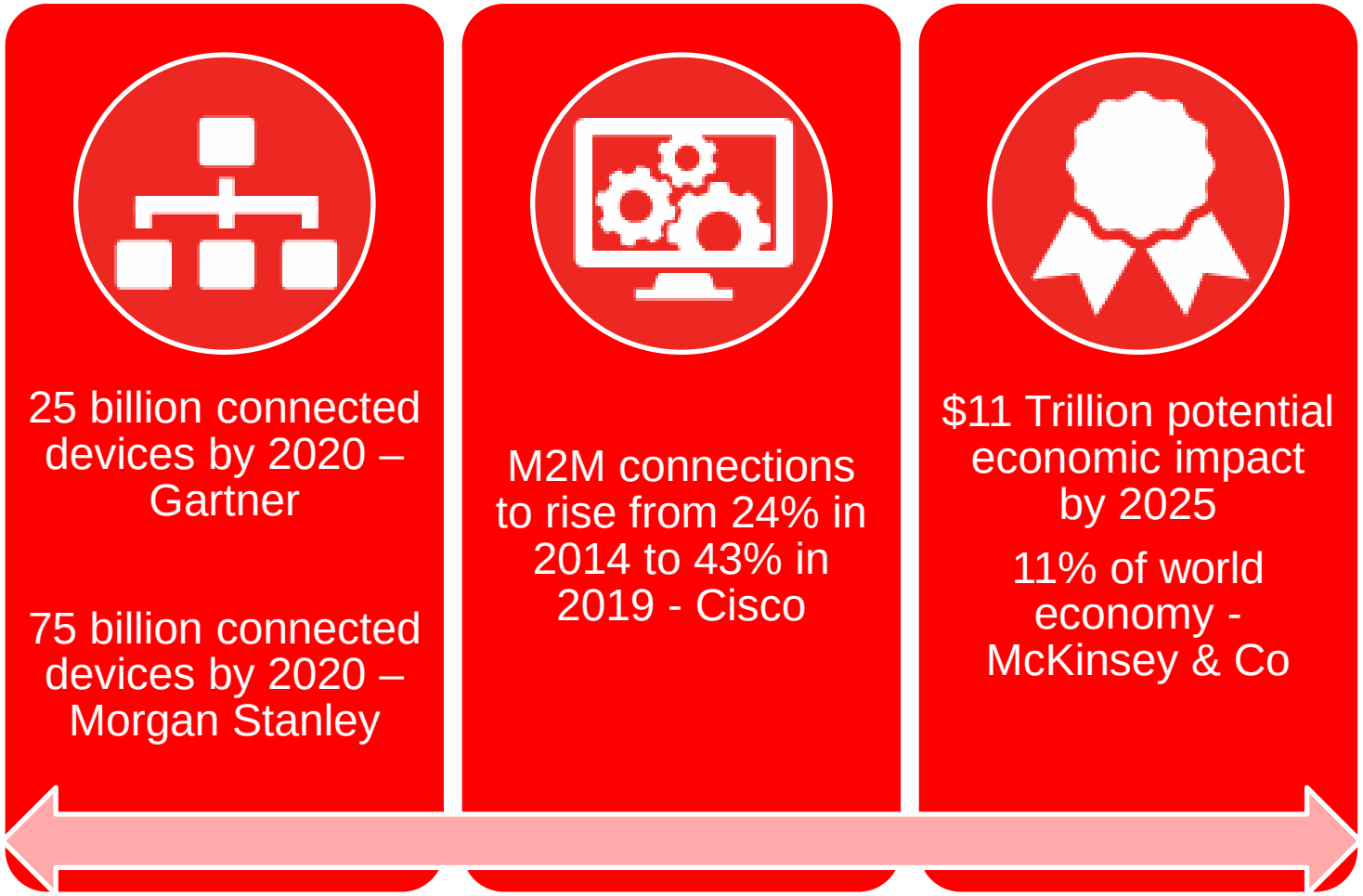
While no universal definition … the IoT generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention.

Many IoT concepts not new … however

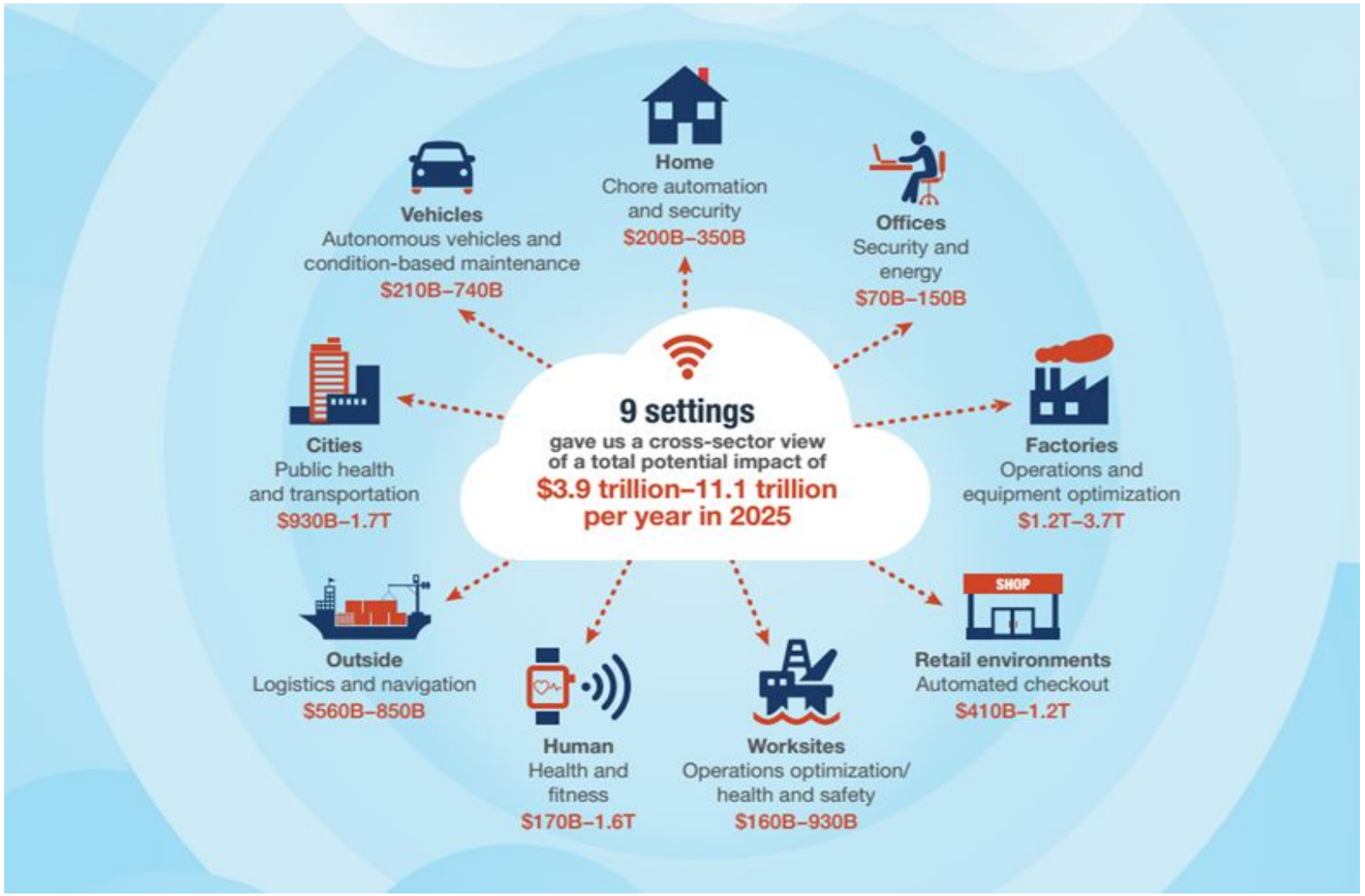
new technology and market trends are driving the IoT



The IoT by the numbers



IoT sector opportunities



Source: McKinsey & Company

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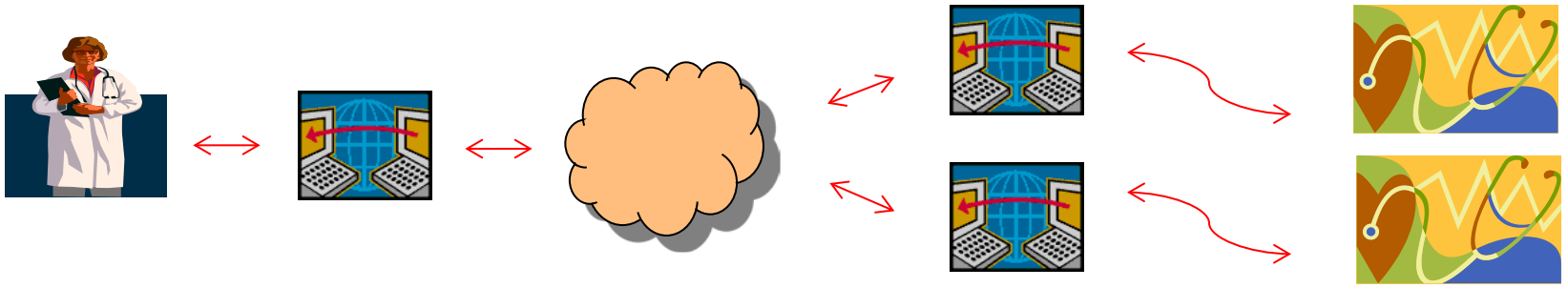
IoT Case Study - Healthcare



- **IoT Application**: Remote patient monitoring outside of clinical settings
  - evaluations by the healthcare professional or clinical support algorithms
  - used for long term diagnostic and monitoring of chronic conditions
  - used for big data analytics when collected as part of a wider clinical trial

- **Example:**
  - University of Toronto, Institute of Technology - Dr Carolyn McGregor
  - Combining cloud computing, sensors, wireless technology and big data analytics
  - Processes 1200 physiological readings per patient per second
  - Across multiple patients & multiple locations
  - Leading to earlier detection approaches to late neonatal sepsis – which is common in premature babies

What is big data?

Big data sets are “large, diverse, complex, longitudinal and/or distributed datasets generated from instruments, sensors, Internet transactions, email, video, click streams and/or all other digital sources available today or in the future”.

National Scientific Foundation Core Techniques for Advanced Big Data Science and Engineering

Big Data “is shorthand for the aggregation, analysis and increasing value of vast exploitable datasets of unstructured and structured digital information”

Richard Kemp “Legal Aspects of Managing Big Data (Kemp IT Law, v. 2.1, October, 2014)

Big data by the numbers:

- **More data has been created in the past two years than in the entire previous history of the human race.**
- Every second we create new data. For example, we perform 40,000 search queries every second (on Google alone), which makes it 3.5 searches per day and 1.2 trillion searches per year. By the year 2020, about 1.7 megabytes of new information will be created every second for every human being on the planet.
- Every minute up to 300 hours of video are uploaded to YouTube alone. In 2015 ~ 1 trillion photos will be taken and billions of them will be shared online.
- **In 2015 alone over 1.4 billion smart phones shipped – all packed with sensors capable of collecting all kinds of data, not to mention the data the users create themselves.**
- By 2020, we will have over 6.1 billion smartphone users globally.
- **420 million wearable health monitoring devices**
- 7 billion shares change hands every day on US equity markets – 2 out of 3 traded by computer algorithm
- Within 5 years there will be over 50 billion smart connected devices in the world, all developed to collect, analyze and share data.
- **By 2020 our accumulated digital universe of data will grow from 4.4 zettabyets today to ~ 44 zettabytes**

Sources: Forbes, IDC, NRF Big Data publication

Just how big is a Zettabyte anyways?

Kilobyte	Megabyte	Gigabyte	Terabyte	Petabyte	Exabyte	Zettabyte
1000 Bytes	1000 Kilobytes	1000 Megabytes	1000 Gigabytes	1000 Terabytes	1000 Petabytes	1000 Exabytes
2 Kilobytes of storage in lunar module guidance systems.	500 Megabytes in average DVD movie.	16 Gigabytes of RAM in Macbook Pro.	250,000 digital music songs or 330,000 photos.	The CIA is believed to generate 1 petabyte of classified records every 18 months, or the equivalent of 20 million four-drawer filing cabinets of documents.	1200 Exabytes of storage data existed in 2013 – 98% of information ever created. In CD stacks 5 time to the moon.	1 hour full-length episode of 24 running continuously for 125 million years.

Big data often characterized by the “3 V’s:

- **Volume:** the vast quantity of data that can be gathered and analyzed effectively
  - Costs of collecting and storing data dropping significantly
  - Millions of data points increase predictive power of analysis
- **Velocity:** the speed at which new data can be accumulated, analyzed and utilized
  - Aggregated datasets are analysed increasingly on a **real-time** basis rather than as **batch** data
  - Analyzed by **quantitative analysis** software (using artificial intelligence, machine learning, neural networks robotics and algorithmic computation)
  - Enabling a shift from **retrospective** to **predictive** insight
- **Variety:** the breadth of data that can be effectively analyzed
  - Ability to combine very different, previously unlinked data in many variable formats (text, image, video, sound, etc.)
  - Structured and unstructured data varieties

Creating value with big data

- More cost-effective robust research and correlation of data points
- Analysis of information to assist both consumers and businesses make choices
- Analysis of information provides insights to market needs, tastes and trends – helps to improve existing products and services and shape new products and services
- Allows for the personalization of services and products to consumers and business
- Provides predictive capabilities in many different contexts across multiple industries
- Improves decision making
- Monetize existing and new datasets
- Create new business models, products and services

Imagine the potential ….

- At the moment less than 0.5% of all data is ever analyzed and used
- **Examples** of the potential:
  - Estimates suggest that by better integrating big data, healthcare could save as much as $300 billion a year
  - For a typical Fortune 1000 company, just a 10% increase in data accessibility will result in more than $65 million additional net income.
  - Retailers who leverage the full power of big data could increase operating margins as much as 60%.

Big data case study

- **Big Data Application**: Collection and use of vehicle and telematics data
  - Real-time vehicle location data, behavior-based alert information (speeding, acceleration and braking), fuel consumption updates, idle time tracking, trip reporting, vehicle usage behavior and vehicle diagnostic information.
  - Uses: fleet management, road charging, infotainment, insurance, parking, safety

- **Example**: IMS' Drivesync UBI technology solution
  - Insurance sector application – actual driver data provides InsurCo with tools to better assess risk and price insurance premiums

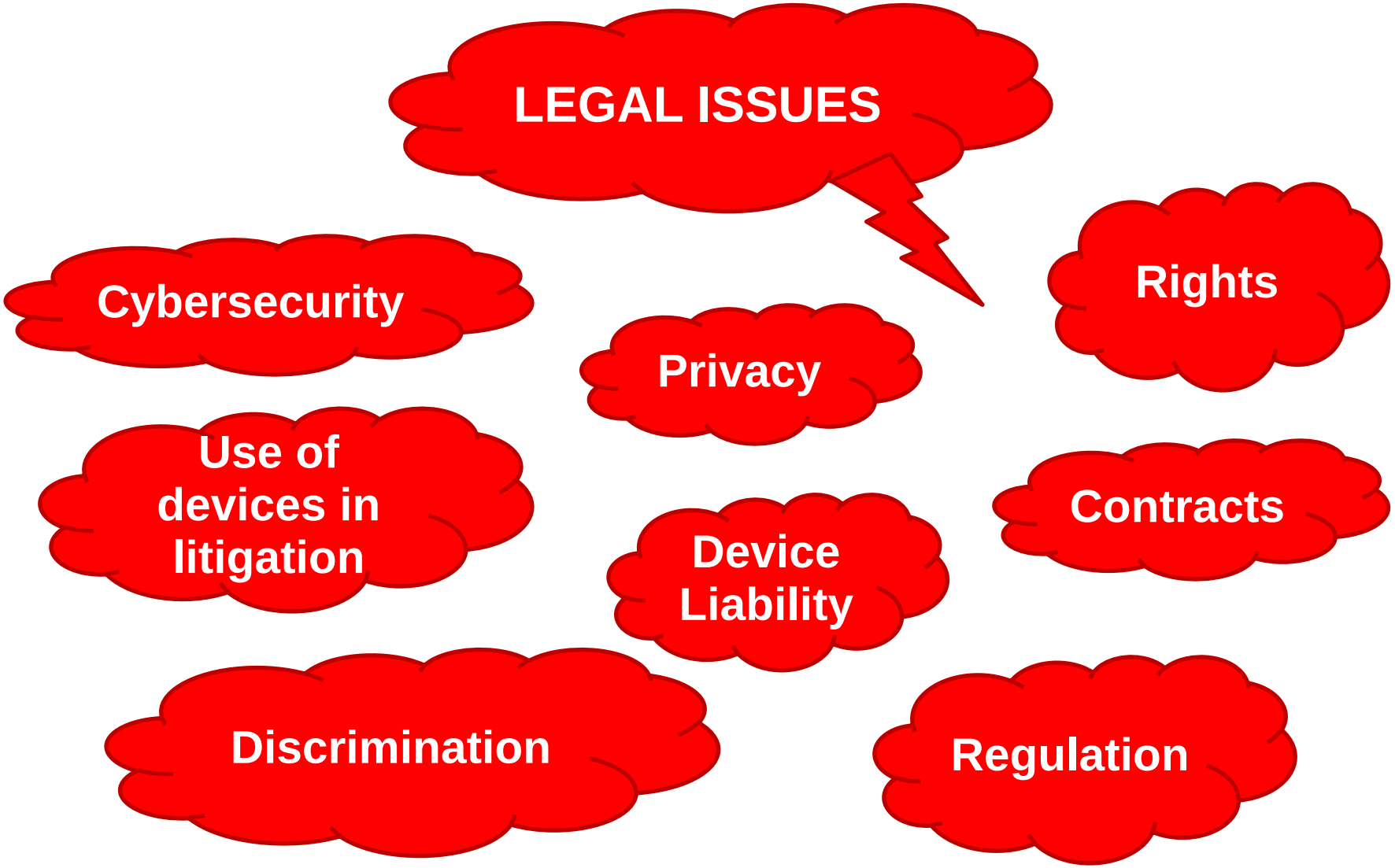
The IoT and big data – what it all means

- Technology & market forces are rapidly converging
- IoT and the Big Data generated by IoT are:
  - transforming existing businesses processes
  - creating new business opportunities
  - enabling new business models
- Will have profound technological, social and economic impacts

- HOWEVER …like all new things and opportunities …

Legal issues and considerations

New opportunities come with some legal challenges



Big data in the organization

1. Input data

From Multiple Sources

- instruments & sensors
- email, video
- click streams
- internet transactions
- social media & mobile
- market data
- personal data
- confidential data
- licensed in data
- government data
- employee data

The Internet of Things

2. Processing operations

Using Multiple Platforms

- processing of input data on:
  - internal platforms/
  - external platforms
- using:
  - business intelligence & analytics applications
  - data visualisation
  - machine learning
  - 'secret sauce' algorithm
  - pan-enterprise search
- to produce
  - 're-purposed' data
  - output data
  - an enterprise single view

Big Data

3. Output data

For Multiple Purposes

- for internal use
  - business analysis
  - product development
  - sales & marketing
  - risk management
  - capital management
  - MIS
  - Finance
- for external use
  - distribution
  - marketing partners
  - regulatory

Legal rights reside in….. what, exactly?

- ISO/IEC Standard 2382-1: 1993: Information Technology-Vocabulary:
  - "**information** (in information processing) is knowledge concerning objects, such as facts, events, things, processes, or ideas, including concepts, that within a certain context has a particular meaning"; [and]

    "**data**" is a reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing [which] can be processed by humans or by automatic means".
- Some say "there are no rights **in** data but there are extensive rights and obligations arising **in relation to** data". Is this right? What's best?
- Key legal rights currently in play:
  - Intellectual property rights (IPR)
  - Contract
  - Regulation

A legal framework

Level 6: Information Management & Security	• strategy, policy, process. • Standards: PCI, DSS, ISO 27000, SSAE 16, ISAE 3402
Level 5: Data Regulation	• non-sector specific: personal information protection, competition law • sector specific: financial services, professional services, etc.
Level 4: Contracting for Data	• 'contract is king' • protection strong but limited ('*in personam*' – only contracting parties)
Level 3: IPR in Relation to Data	• copyright, database right (sometimes), confidentiality, patents, trademarks • protection extensive ('*in rem*') but uncertain (extent of IPR in relation to data unclear)
Level 2: Information Architecture	• data structure, design configurations, schemas, format • data model as representation of data flows through data, attributes and interrelationships
Level 1: Platform Infrastructure	• software : operating system, database middleware, business intelligence & analytics applications • equipment: processing, storage, connectivity

* *with thanks to Richard Kemp "Legal Aspects of Managing Big Data (Kemp IT Law, v. 2.1, October, 2014)*

Level 3: Data IPR

- These are "*in rem*" rights
- Database copyright: real IPR:
  - *"CCH Canadian Ltd. V. Law Society of Upper Canada" 2004 SCC 13*
    - "compilations" may have two levels of protection
    - "originality" test: skill and judgment
    - structure over content
  - *"Geographical Service Inc. v. Encana Corp." 2016 ABQB 230*
    - copyright in underlying data and its compilation
    - rejected common challeges
    - fact-driven assessment

Level 3: Data IPR

- Database rights: unsettled IPR:
  - Specific *sui generis* rights in a database itself
  - European Union's 1996 "Database Directive" 96/6/ECL
    - protects "contents" of a compiled database
    - trigger is a qualitative or quantitative "investment"
    - *"Football Dataco"* 2013 case
  - US and Canada have not pursued a *sui generis* right
    - is "investment" the proxy for "skill and judgment"?
- Confidentiality and trade secret common law: Provides a type of IPR where no contract exists

Level 4: Contracting for data

- These are "*in personam*" rights
- Most powerful, but very limited scope
- Easier to apply than IPR. Simply claim rights in the data!
- Key license contract terms:
  - Scope of rights being licensed
    - internal use/onward dissemination;
    - territoriality – where the rights licensed may be used, etc;
    - combination/use with other data;
    - treatment of derived data;
  - What purposes can the data be used for:
    - check whether anticipated analysis of data is expressly permitted;
    - what are the mechanisms for re-purposing/adding new purposes?
    - particularly for use of social media data, check that the standard terms of the provider expressly permit anticipated uses;

Level 4: Contracting for data

- Ownership of underlying rights and rights to derived data;
- (Mutual?) warranties of compliance with laws and regulation – data protection; sector specific regulation; audit/investigation;
- Risk allocation:
  - reliance on data being provided – ‘as is’ or reasonable skill and care?
  - supplier and customer indemnity and liability positions;
- Duration, suspension and termination of supply; and
- Post-term use of data supplied in-term, derived data, etc.

Level 5: Data regulation

- Regulated data protection through “personal information” laws
- Information Commissioner’s Office July 28, 2014 Report on “*Big Data and Data Protection*”:
  - Key issues:
    - fairness
    - consent
    - purpose limitations and repurposing
    - data collection minimization
  - Key strategies:
    - anonymization
    - PIA
    - building trust
    - information governance
- Competition law
- Sector specific regulation

Level 6: Information management and security

- Data management and security standardization
- Examples:
  - Payment Card Industry and its “Data Security Standards”
  - International Standards Organization (27000 series of “Information Security Management Systems” Standards)
  - Statement on Standards for Attestation Engagements (SSAE) 16 “Reporting of Controls at a Service Organization”

And all in a salad

- IPR, Contract and Regulation are **discrete** with their own normative and technical rules
- IPR, Contract and Regulation act **concurrently** on each data stack element
- Legal rights and duties arise in **multilayered** ways
- Great **speed** of data processes challenges its management
- IPR, Contract and Regulation are **national** where data flows are often international

So, legal rights in, and in relation to, huge data sets that are created and expanded by both humans and machines, will continue to push legal theory

Data brokers

- US Concerns:
  - Ever heard of Aexiom, Experion, Epsilon (or about 4000 others)?
  - Various reports and recommendations by the Federal Trade Commission
  - *"Data Accountability and Trust Act"* , and others, never passed
  - *"Sorrell v. IMS Health Inc"* protecting First Amendment rights seen as a challenge
- Canadian Overview
  - Federal Privacy Commissioner's Report: *"Data Brokers: A Look at the Canadian and American Landscape"* (2014)
  - A comprehensive legislative landscape in Canada protecting personal information
  - But an opaque industry

Developments on internet of things analysis

- US developments:
  - *Developing Innovation and Growing the Internet of Things Act* (DIGIT): Bill s. 2607 Commerce, Science and Transportation Committee
  - US Department of Commerce's National Telecommunication's Information Administrations (NTIA) "*Request For Comment*" and Green Paper to follow
  - Federal Trade Commission's "*Internet of Things: Privacy & Security in a Connected World*" (2015)
- Canada developments:
  - Global Privacy Enforcement Network (GPEN) launched an IoT "sweep" in April:
    - home IoT devices
    - health connected devices
    - well-being connected devices

    and will consider: the quality of information provided to users, data security, user privacy empowerment
  - Federal PC's Feb 2016 Paper: *"An introduction to privacy issues with a focus on the retail and home environments"*

Privacy issues and considerations

Privacy: inventing solutions for the future

For Big Data and the IoT to be accepted, useful and advance the needs of society, citizens must feel that:

- there is transparency in the use of the data and
- they control the use of that data through meaningful opportunity to exercise consent

This means earning the consumer's trust through strong governance, transparency and well-publicized policies setting out:

- What is being collected
- Who collects, analyzes, stores and uses the information
- The purposes for which used
- To whom it will be communicated
- The decisions that will be made based on it
- Rights of the individual in respect of his or her information
- How long it will be retained: using timely destruction a means of risk mitigation

Privacy: Inventing solutions for the future

Critical questions to be asked and answered

Original consent: what was scope?

- Consumer may have consented to installation of a smart meter for "billing purposes"
- But only need to read the meter at the beginning and end of the month to bill; so why track hourly consumption rates?
- Does this exceed the scope of the original consent?

Change of purpose or use: new consent required?

- If utility now wants to track hourly consumption to determine specific appliances that contribute to peak or over-loads, is this a new purpose?
- If so, it should require new consent

Consent: opt-in or opt-out?

- If new consent is required, should it be opt-in or opt-out?
- Contradictory rulings by OPC on opt-out for marketing purposes

Privacy: Inventing solutions for the future

Modification of consent is a challenge with technological devices such that the OPC has remarked:

"There are many interesting options to deal with the challenges of consent in the Internet of Things environment. Many of these, such as setting machine-based rules for proxy-decision making or having a device "learn" what actions are acceptable (or not) to users at certain times and places, will be considered in the OPC's future work on consent. (footnotes omitted)[1]"

[1] *The Internet of things: An introduction of privacy Issues with focus on the retail and home environments*: Office of the Privacy Commissioner of Canada, February 2016 https://www.priv.gc.ca/information/research-recherche/2016/iot_201602_e.asp#fn137

Privacy: Inventing solutions for the future

And more recently

In its staff report on the IoT, the FTC lists a number of promising solutions being implemented to improve the effectiveness of privacy messaging in the IoT environment. These include:

- *Codes on the device, such as QR codes, that lead consumers to more in-depth information;*
- *Privacy choices during set-up of the device, taking advantage of set-up wizards to explain and select privacy settings;*
- *Management portals or dashboards that include privacy settings consumers can set up and revisit; and*
- *Out-of-band communications that allow individuals to receive privacy information through another device, such as e-mail…*

Privacy: Inventing solutions for the future

…The Online Trust Alliance(OTA) developed the Internet of Things Trust Framework aimed at manufacturers, developers and retailers of connected home devices and health and fitness wearables. The framework consists of best practices such as:

- *Disclosing prior to purchase a device's data collection policies, as well as the impact on the device's key features if consumers choose not to share their data; and*
- *Disclosing if the user has the ability to remove or make anonymous all personal data upon discontinuing the device or device end-of-life[2].*

[2]*Consent and privacy: A discussion paper exploring potential enhancements to consent under the Personal Information Protection and Electronic Documents Act; Prepared by the Policy and Research Group of the Office of the Privacy Commissioner of Canada, May 2016: https://www.priv.gc.ca/information/research-recherche/2016/consent_201605_e.asp*

Privacy: Inventing solutions for the future

Access requests: can they be carried out?

- How can you request access if you don't know you are being tracked?
- To whom do you address the request?
  - Manufacturer of equipment
  - Software provider
  - Cloud service provider – would you even know who that is?
  - Vendor?
- To make the right of access meaningful there must be transparency of what is collected, by whom, where it is stored, who analyses, who has predictive results, who is making decisions on these results
- Information must be stored in retrieval form: more complicated than one might think

Privacy: Inventing solutions for the future

Does anonymization cure lack of consent?

- If done properly it can

However, possibilities for re-identification need to be reduced to acceptable level

- Takes surprisingly little to re-identify data with minimal other publicly available information unless done with proper expertise
- Cannot assume aggregation or hashing truly anonymizes data

Linking with other data – public or otherwise

- Makes re-identification easy in some cases, with as little as the last three digits of a postal code
- Successful re-identification increases as the availability of other public data does – such as information on an individual's Facebook page
- Privacy analytics: Prof Khaled El Emam: k=11 for open data

Privacy: Inventing solutions for the future

Can longitudinal data be anonymized?

- Yes, with vault

If you have any questions regarding today's presentation or would like to discuss any of the topics that have been presented, please feel free to stay behind or leave your business card behind and we will be sure to follow-up with you.

Thank you.

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Resource material

Big Data and the Internet of Things

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