The Internet Of Things

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IOT Events

INTERNET OF THINGS EVENTS

USA
Austin
Berkeley
Boston/Cambridge
Cleveland
Denver
Minneapolis
Mountain View(Industrial Internet)
New York
New York (Sensemakers)
Pompano Beach
Portland (Thing Tuesday)
San Francisco
San Jose
Santa Clara (Open IoT)
Washington DC

EUROPE
Barcelona
Berlin
Bilbao
Brussels
Dublin
Lisboa
London
Madrid
Midlands UK
Milan
Munich
Paris
Stockholm
Zurich

CANADA
Montreal
Ottawa
Toronto

S. AMERICA
São Paulo

ASIA
Bangalore

AFRICA
None Yet

OCEANIA
Sydney

What is IOT?

What is IOT?

- Set of visions
  - Things oriented
    - The term was originally proposed in 1999 by Kevin Ashton in a P&G presentation.
    - Spime - Object that can be tracked through space and time throughout its lifetime.
  - Internet oriented
    - M2M
  - Information oriented
    - Web 3.0
    - Web of things
    - Linked data

What is IOT?

- Set of revolutions
  - New technologies
  - New concepts
- Set of interests
  - It's all about the money

What are Things?

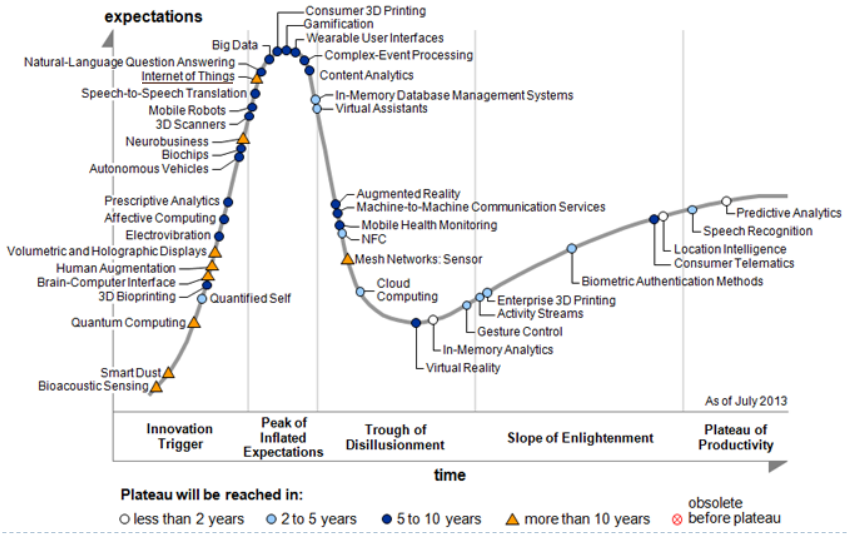
Market Values

Top Ten Connected Applications in 2020	Value to the Connected Life
Connected Car	US$600 billion
Clinical Remote Monitoring	US$350 billion
Assisted Living	US$270 billion
Home and Building Security	US$250 billion
Pay-As-You-Drive Car Insurance	US$245 billion
New Business Models for Car Usage	US$225 billion
Smart Meters	US$105 billion
Traffic Management	US$100 billion
Electric Vehicle Charging	US$75 billion
Building Automation	US$40 billion

Resource : gsma.com

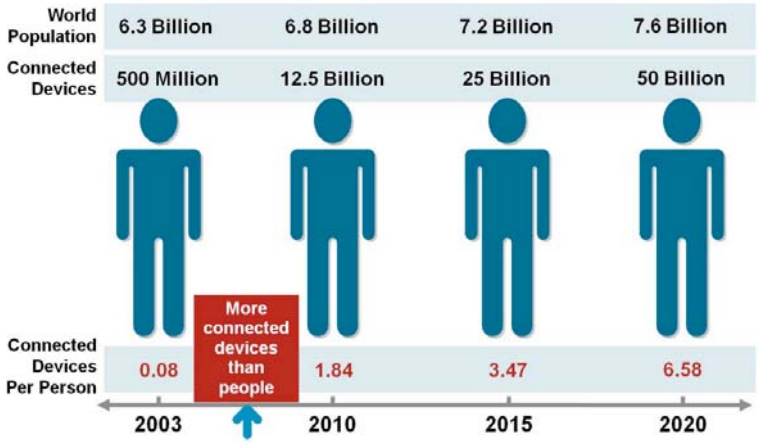
A May 2013 report from the McKinsey Institute suggests that connecting billions of ordinary devices to the Internet will add between $2.7 trillion and $6.2 trillion a year to the global economy by 2025

Hype Cycle for Emerging Technologies, 2013



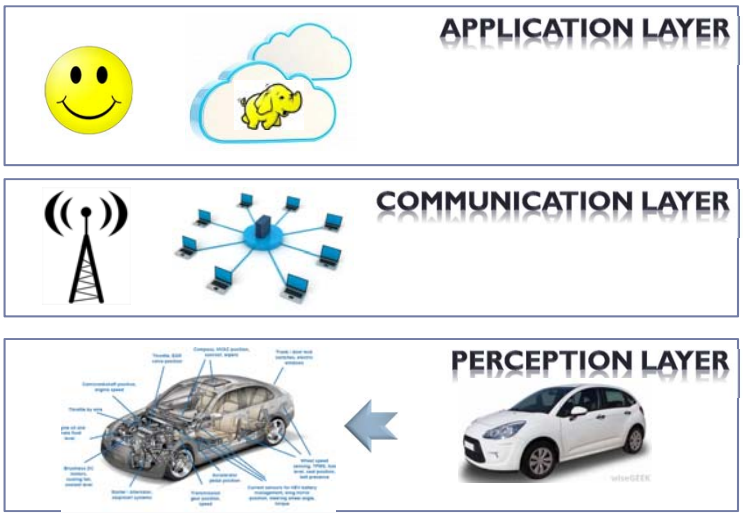
Source : Gartner

Number of Devices

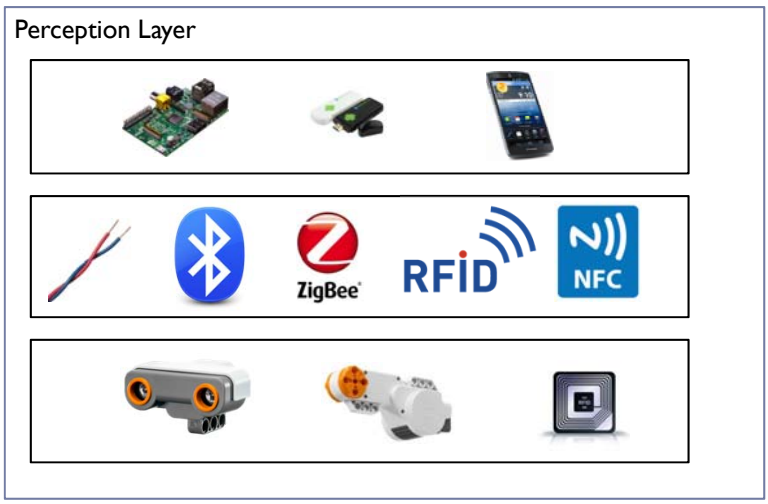


Source: Cisco IBSG, April 2011

IOT View



Perception Layer

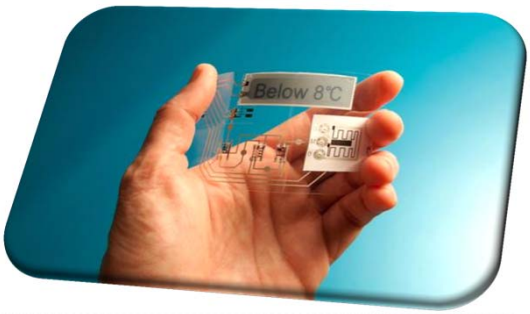


Low Level Protocols

- RFID
  - Passive
  - Battery-assisted passive
  - Active
- Neat Field Communication
- Bluetooth
  - Bluetooth LE
- Zigbee
- GPS

Printed Electronics

- Price : From Dollars to Cents
- Material : From rigid to flexible



Wearable Objects

- Functional and Health
- Quantified Self
- Electricity power
- Fashion

"Jawbone's new activity-tracking wristband can be used to start your coffeemaker when you get up"

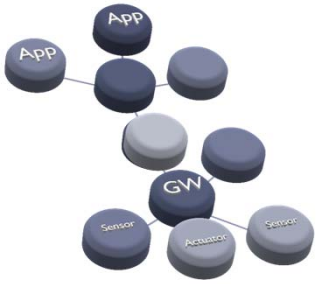
Source: MIT Technology Review

Mobile Devices

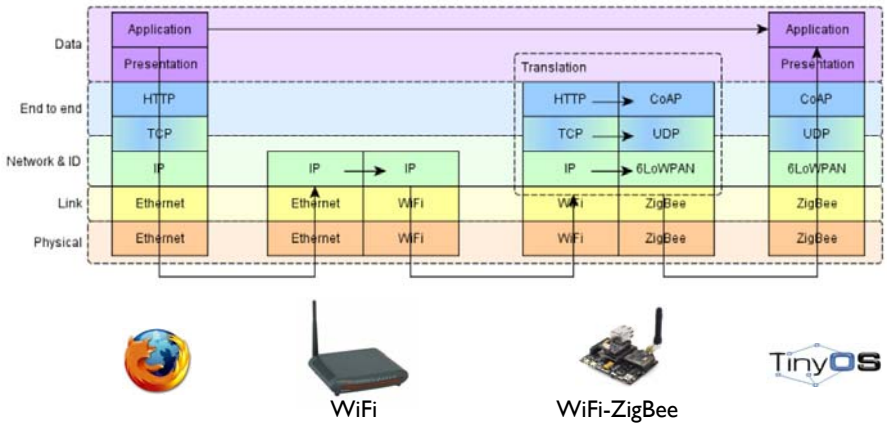
- First level computing
- Internet connection points
- OS Architecture
- May change their form.

IOT Communication

- Communication challenges
  - Low power devices
  - Synchronization between protocols
  - Packets size
  - Number of addresses
- Who's getting an IP?
- 6LoWPAN
- Constrained Application Protocol

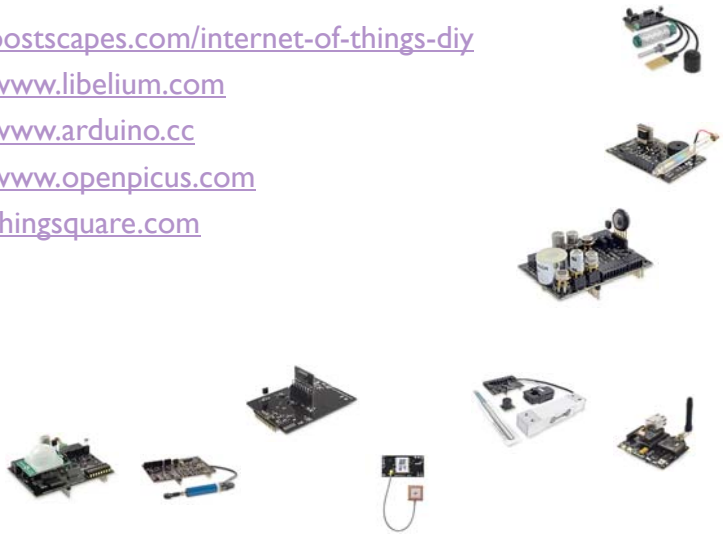


IOT Communication Example

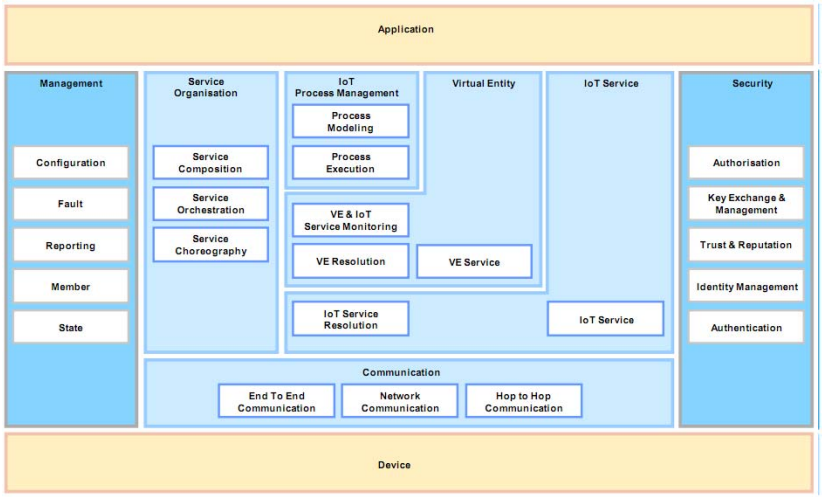


IOT DIY Resources

- http://postscapes.com/internet-of-things-diy
- http://www.libelium.com
- http://www.arduino.cc
- http://www.openpicus.com
- http://thingsquare.com

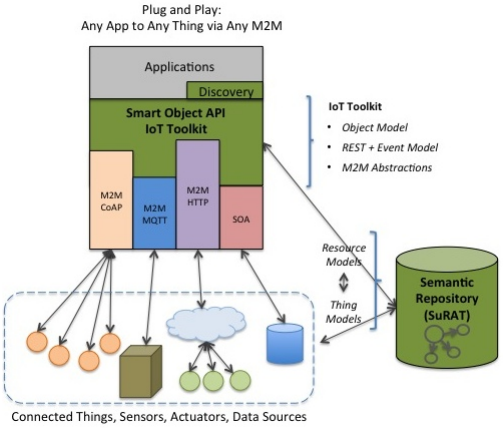


IOT Functional Model



IOT Bottom up Approach

- Smart Object API



Security, Privacy and Trust

- IOT is complex
  - Many systems and many protocols
  - Different sets of requirements
- IOT control critical aspects
  - Human health
  - Critical infrastructure
  - Lose control of your things
- IOT has more autonomy
  - Less human interaction
- IOT knows more
  - Where my privacy?
- IOT is young
  - Many uncovered vulnerabilities
  - Lack of regulation and standards

Privacy in IOT

- The big brother effect
- Very sensitive data
- Authorization and policies
- Regulations
- Change of thinking
- Privacy vs. Trust

IOT Data flow

- Data format
  - Standard is a good thing, that's why everybody create one of his own.
- Data scalability
  - Size does matter

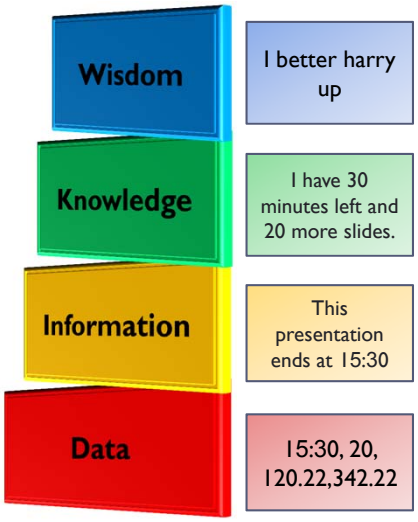
DIKW Pyramid

Applied knowledge
Joining of Wholes

Organized Information
Formation of a Whole

Linked Elements
Connection of Parts

Facts
Gathering of Parts



I better harry up

I have 30 minutes left and 20 more slides.

This presentation ends at 15:30

15:30, 20, 120.22,342.22

Tim Berners-Lee 5 Start Deployment Scheme

☐ Available on the web (whatever format) but with an open license.

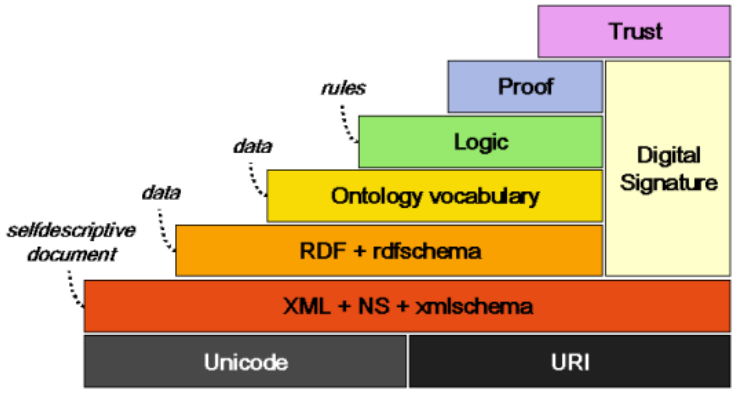
☐☐ Available as machine-readable structured data (e.g. excel instead of image scan of a table)

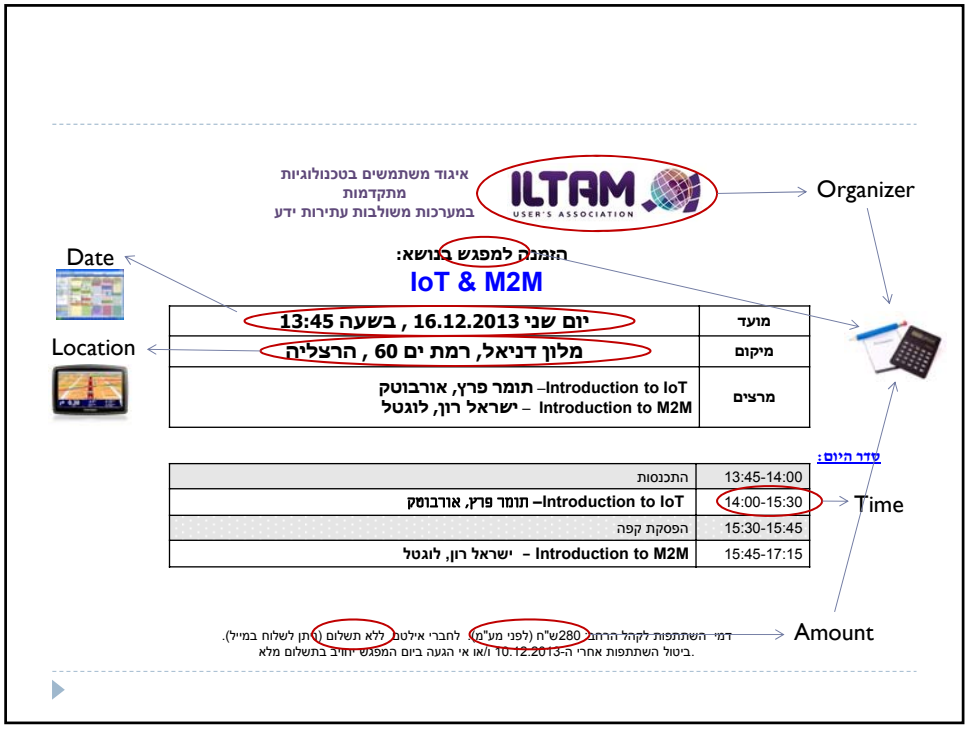
☐☐☐ All the above plus non-proprietary format (e.g. CSV instead of excel)

☐☐☐☐ All the above plus, Use open standards from W3C (RDF and SPARQL) to identify things, so that people can point at your stuff

☐☐☐☐☐ All the above, plus: Link your data to other people's data to provide context

Semantic Web

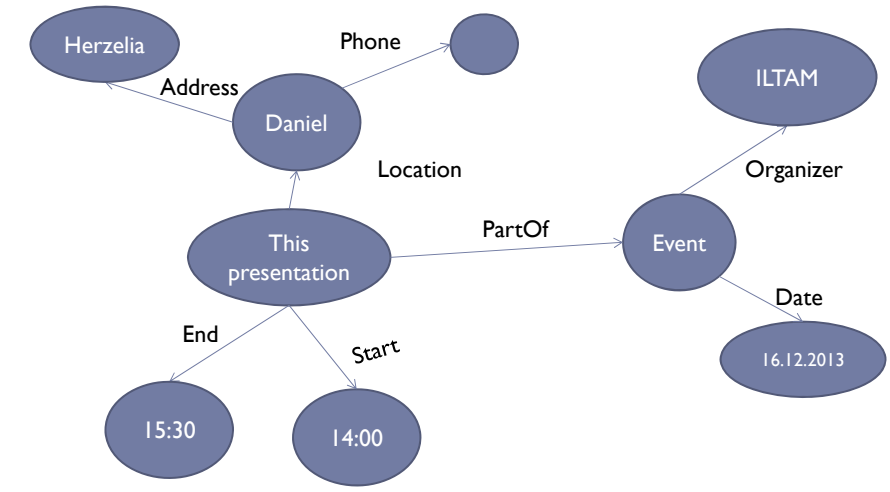




Resource Description Framework

- RDF Triple: < Subject, Predicate, Object >
- "This presentation starts at 14:00"
- RDF Triple: < This presentation , starts , 14:00 >
  - Subject and predicate must be resource
  - Object can be resource or literal
  - RDF Triple: < URI#This presentation , URI#Start , "14:00" >

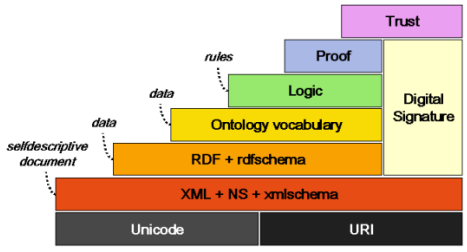
```
<rdf:Description rdf:about="URI# This presentation">
   <rdf:type rdf:resource="URI#Start"/>
          14:00
   </ rdf:type>
</rdf:Description>
```



RDF Schema (RDFS)

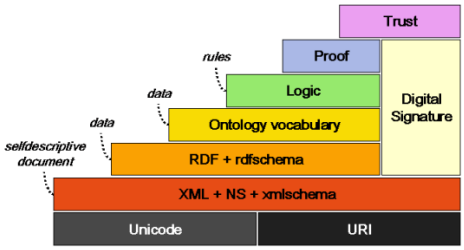
- RDF Schema (RDFS) introduces the notion of a properties and class.

URI:Event1	rdf:type	URI:Event
URI:Event2	rdf:type	URI:AfternoonEvent
URI:AfternoonEvent	rdfs:subClassOf	URI:Event



Web Ontology Language (OWL)

- OWL adds more vocabulary for describing properties and classes.
- Adds relations between classes, cardinality, equality, enumerated classes and more.



SPARQL

- RDF Query language

```
PREFIX ex: <http://example.com/exampleOntology#>
SELECT ?capital ?country WHERE {
        ?x ex:cityname ?capital ;
        ex:isCapitalOf ?y .
        ?y ex:countryname ?country ;
        ex:isInContinent ex:Africa .
}
```

Web Semantic Usage - DBPedia

```
SELECT ?name ?pop ?capital ?drivesOn ?dateFormat ?callingCode ?country  WHERE {
    ?country a o:Country ;
             foaf:name ?name ;
             p:capital  ?capital ;
             p:dateFormat ?dateFormat ;
             p:drivesOn ?drivesOn ;
             p:callingCode ?callingCode;
             p:populationEstimate ?pop .
     FILTER (?name  = "Israel"@en) .
```

Results: Browse Go! Reset

SPARQL results:

name	pop	capital	drivesOn	dateFormat	callingCode	country
"Israel"@en	7993100	"Jerusalem"@en	"right"@en	"dd/mm/yyyy"@en	:Telephone_numbers_in_Israel	:Israel

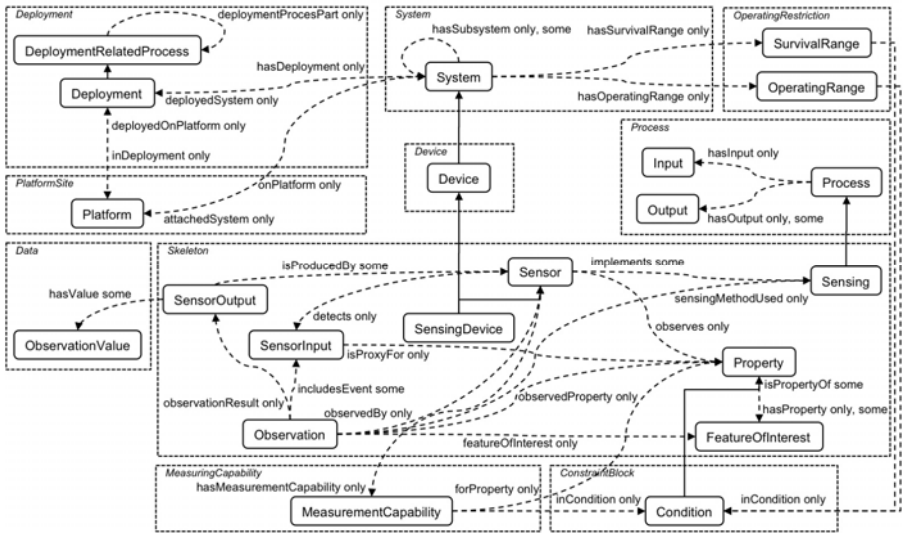
	Israeli new shekel (₪) (ILS)
Time zone - Summer (DST)	Israel Standard Time (UTC+2) Israel Summer Time (UTC+3)
Date format	dd-mm-yyyy (CE)
Drives on the	right
Calling code	+972
ISO 3166 code	IL
Internet TLD	.il

Telephone numbers in Israel

Semantic Sensor Network

- The SSN ontology can describe sensors in terms of their capabilities, measurement processes, observations and deployments
  - Data discovery and link-ing,
  - Device discovery and selection,
  - Provenance and diagnosis,
  - Device operation, tasking and programming

SSN Ontology

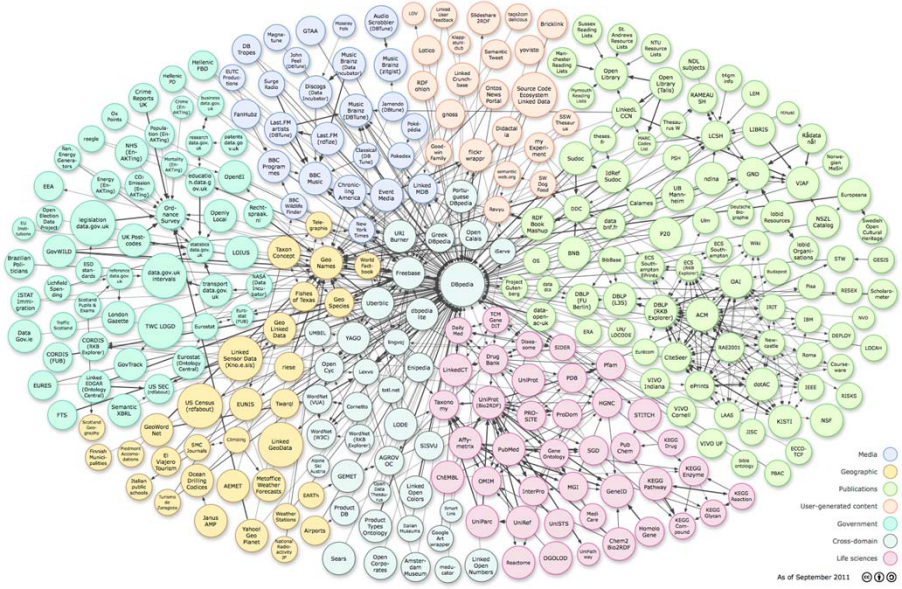


Source :W3.org

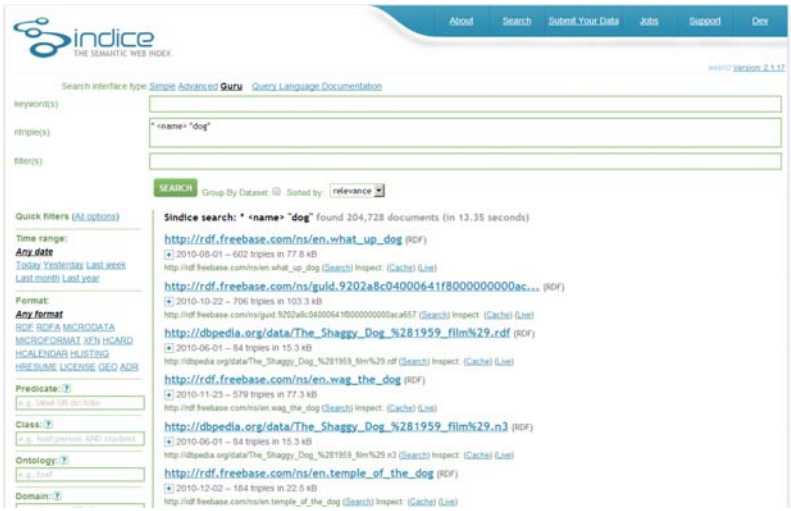
SSN Example

A ssn:Sensor is something that has ssn:implements property who may be ssn:Sensing and is aDUL:PhysicalObject and has ssn:detects property who must be a ssn:Stimulus and has assn:observes property who must be ssn:Property and has ssn:hasMeasurementCapability property who must be a ssn:MeasurementCapability

Linked Data

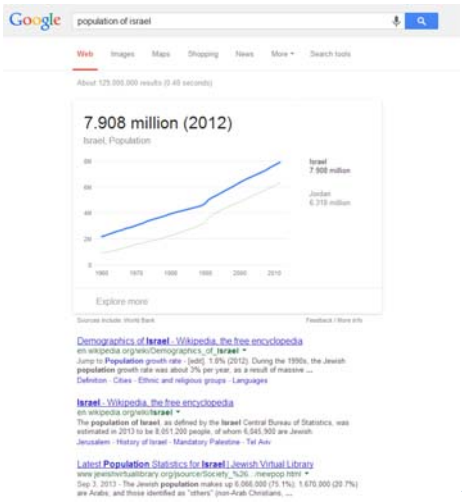


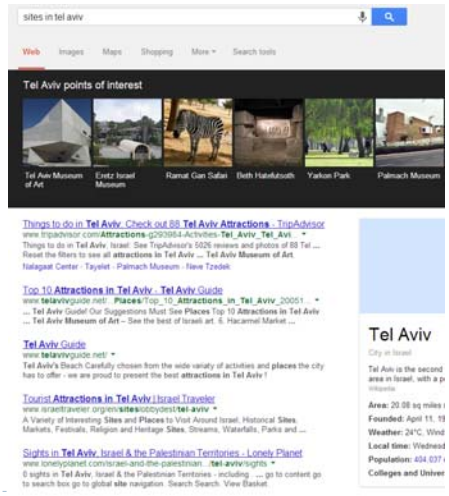
Search



Source : sindice

Knowledge Graph





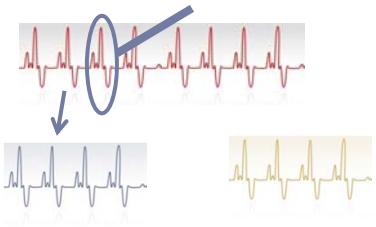
Handling Data in IOT

- Age of data
- Big data
  - Map reduce
- Where the data is stored

"What the use of putting so much data on the internet if you can't do anything with it"

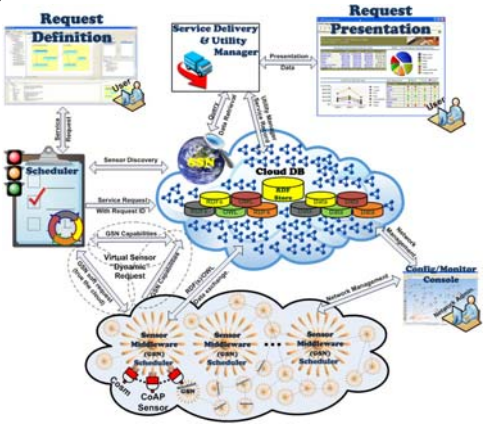
IOT and Data Mining

- Data anomaly detection
- Data clustering and classification
- Data prediction
- Data stream mining



IOT & Cloud Computing

- IaaS
  - Computation resources
- PaaS
  - Axeda
  - Thingworx
  - Cumulocity
- SaaS
  - Sensor As A Service
  - Sensing cloud



IOT on the Cloud Example

Source: air quality egg

What's Next

ILTAM USER'S ASSOCIATION

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ILTAM USER'S ASSOCIATION

iot.il