INTERNET OF THINGS IN BRIEF*

MARKUS GEBHARD, SEPTEMBER 2014

*very brief and potentially biased…

AGENDA

What is the Internet of Things?

Origin and Definition

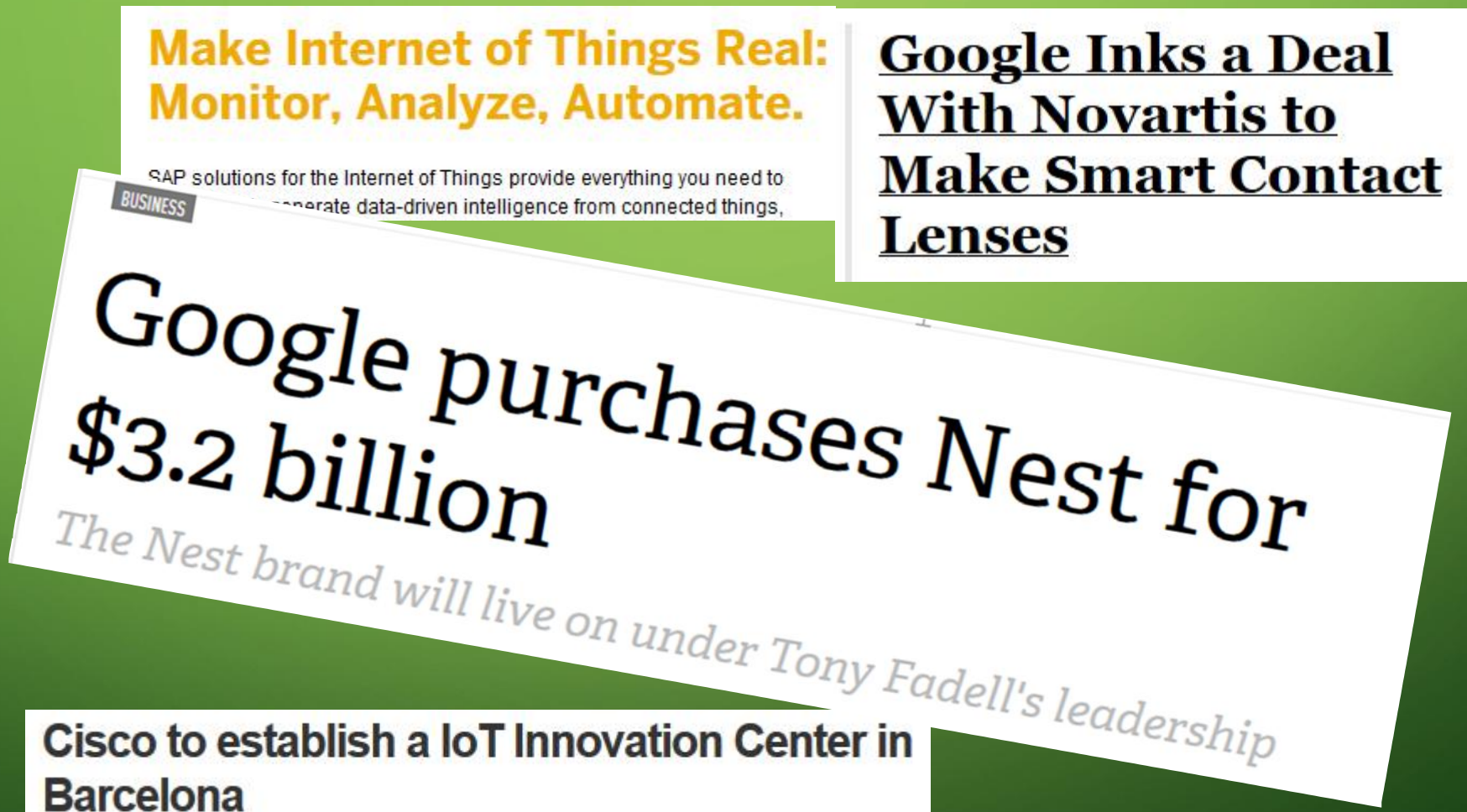
Use Cases

Requirements and Protocols

Challenges

A Small Example

HEADLINES


Make Internet of Things Real: Monitor, Analyze, Automate.
SAP solutions for the Internet of Things provide everything you need to
BUSINESS
Google purchases Nest for $3.2 billion
The Nest brand will live on under Tony Fadell's leadership
Google Inks a Deal With Novartis to Make Smart Contact Lenses
Cisco to establish a IoT Innovation Center in Barcelona
Internet of Things Conference | July 25, 2014

WHAT IS THE INTERNET OF THINGS (IOT)?

A buzzword
A continuous trend
A hype
A market opportunity
…still without clear boundaries…

…yet 2014 was declared “the year of the Internet of Things”

ORIGIN

Industry usable identification technologies to reduce errors, automate processes and "increase efficiency" – MIT Auto-ID Center

Kevin Ashton (1999) and David L. Brock (2001)

Radio Frequency Identification (RFID - 2003)

Allow computers to automatically identify man-made objects and track their flow from plant via distribution center to the racks to be sold from

An object can represent* itself digitally.

*Device-to-device communication capabilities are actually much older…
System term is SCADA (supervisory control and data acquisition)

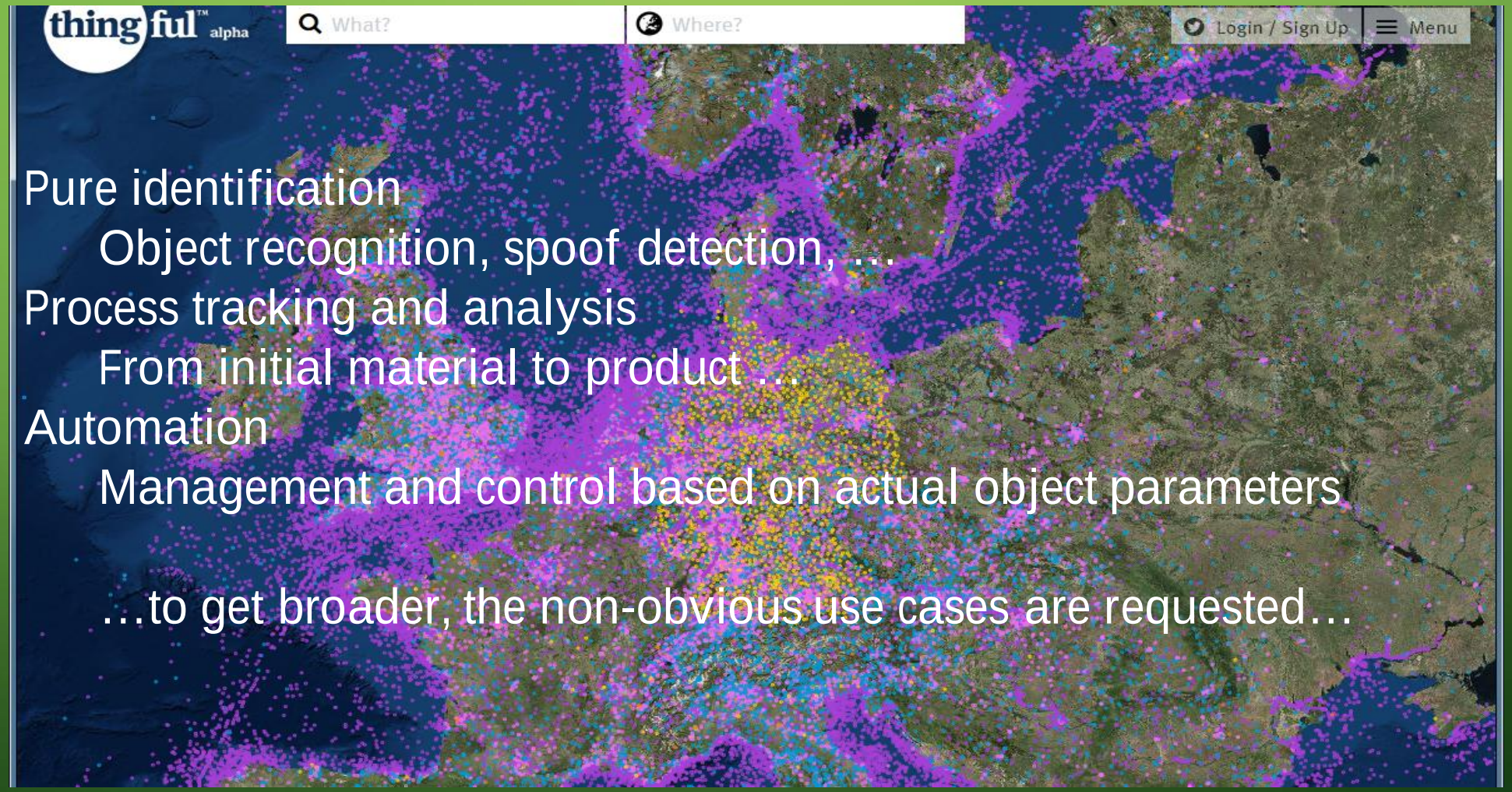
DEFINITION

There is to-date no commonly agreed upon definition

IoT* is a computing concept describing a future where everyday physical objects will be connected to the internet and will be able to identify themselves to other devices.

*Term introduced by Kevin Ashton,1999

USE CASES



Pure identification

- Object recognition, spoof detection, …

Process tracking and analysis

- From initial material to product …

Automation

- Management and control based on actual object parameters

…to get broader, the non-obvious use cases are requested…

REQUIREMENTS AND PROTOCOLS

Required is

- Integration of dynamic data
- Support of non-IP devices
- Integration of software agents
- Extended, federated discovery services
- Data synchronization for offline support
- Interface to federated billing services
- Security measures

- Protocols to chose from (excerpt)
  - (assuming an IP stack underneath)
- MQTT (message queuing telemetry transport)
  - Light-weight publish/subscribe messaging
- XMPP/Jabber (Extensible Messaging and Presence Protocol)
  - communications protocol for message-oriented middleware based on XML
- CoAP
  - Constrained Application Protocol – REST-based “HTTP++” for constrained nodes and networks (incl. push notification, group communication)
- Bonjour, DNS-SD, mDNS
  - Zero-configuration networking with service discovery, address assignment and hostname resolution

AN IOT ARCHITECTURE

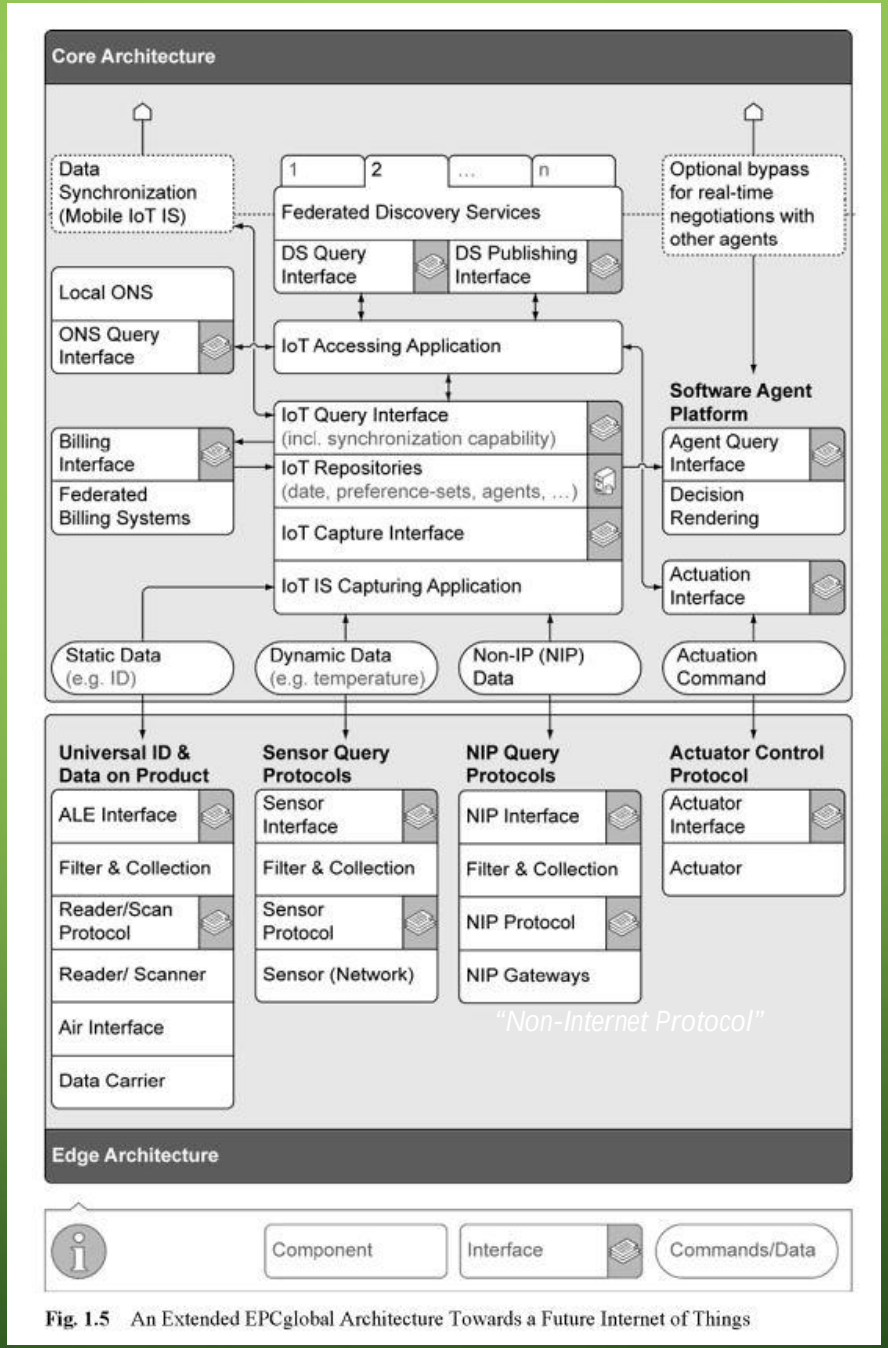


Fig. 1.5 An Extended EPCglobal Architecture Towards a Future Internet of Things

Consumption

Processing and Management

Data and Control

Protocols

"Things" accessed or publishing

Taken from

Uckelmann/Harrison/Michahelles (Ed.) Architecting the Internet of Things,

Springer 2011

CHALLENGES

Economist Intelligence Unit (EIU)

By 2020 12-50 billion devices will be connected to the Internet

Gartner

40-50% compound annual growth rate (CAGR) for the IoT market until 2020

➔ How to “speak” to a thing?

➔ Will there be generic machine-to-machine (M2M) communication?

➔ What protocol(s) will these “things” support?

➔ What is the semantic behind a “thing”?

➔ What are security considerations?

➔ Who will be allowed to identify/discover/connect to a “thing”?

➔ Who will be allowed to gain data from a “thing”?

Convergence of multiple technologies

Wireless, embedded, micro-electromechanical, sensors, control, and automation

A VENDORS APPROACH

http://global.sap.com/campaigns/digitalhub-internet-of-things

"The Internet of Things connects people, machines and things in order to enable bidirectional flow of information and enable real-time decisions."

SAP follows a phased approach

Integrate

OPTIMIZE

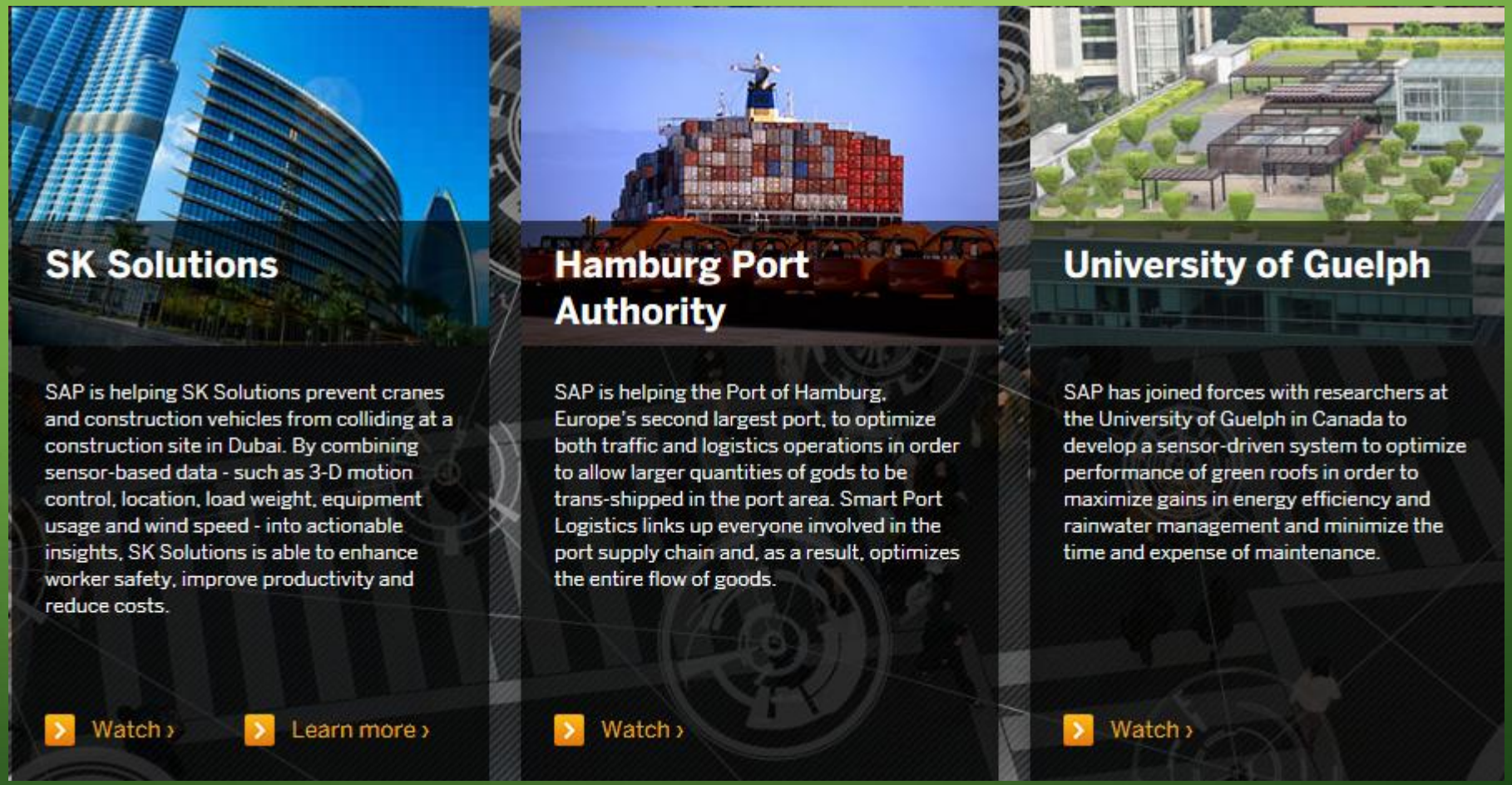
Integrate real-time data into existing transactional technologies (location, demand, etc.); adopt new capabilities (predictive analytics, big data tools, cloud computing) → Example: Delivery to vending machines on demand (route planning on alerts)

TRANSFORM

Imply data on actual use and consumption of products into complete production and supply chain fostering iterative product design

Take smart decisions

SAP'S IOT SAMPLES



A PERSONAL EXAMPLE OF A “THING” – POWER MONITORING

Current sensor(s)

MQTT broker

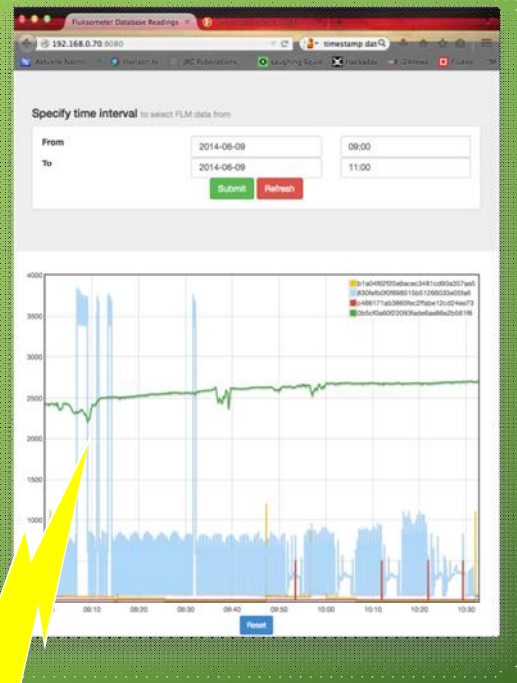
MQTT

Bonjour

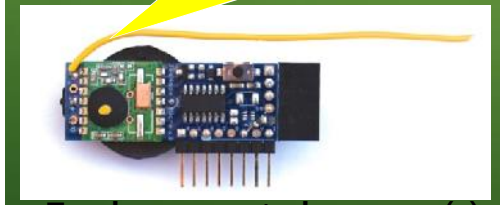
node.js

HTML

Bonjour



jeeNode



Environmental sensor(s)

Database and analytics server

```
});

// use mqtt for client, socket.io for push,
var mqtt = require('mqtt');
var io = require('socket.io')(http); // the socket listens on the http port

// multicast DNS service discovery
var mdns = require('mdns');
// advertise the http server on the httpport
var ad = new mdns.Advertisement(mdns.tcp('http'), httpport, {
                name : 'FLM data processor'
        });
ad.start();
```

NICE VIEW

- Designing for the Internet of Things
- http://www.element14.com/community/videos/13272/l/designing-for-the-internet-of-things

RESOURCES

Links of interest

- Eclipse initiative http://iot.eclipse.org/
- Publishing things http://thingful.net
- An IoT infographic http://www.pcmag.com/article2/0,2817,2418471,00.asp
- An explanation https://www.linkedin.com/today/post/article/20140804163105-98377657-the-internet-of-things-explained
- IoT Threats http://venturebeat.com/2014/08/18/why-the-internet-of-things-is-a-ticking-bomb/