Expanding the Web beyond desktop and mobile to the Web of Things

Conference, Session 3, Web technologies
in the wild – from desktop to smart cities

15 March 2013

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Before the Web

Vannevar Bush

- Scientific advisor to President Roosevelt
  - "As We May Think" published July 1945 in The Atlantic Monthly
  - A conceptual machine (the Memex) that can store vast quantities of interlinked information
- Same article describes the Cyclops Camera:
  - "worn on forehead, it would photograph anything you see and want to record"
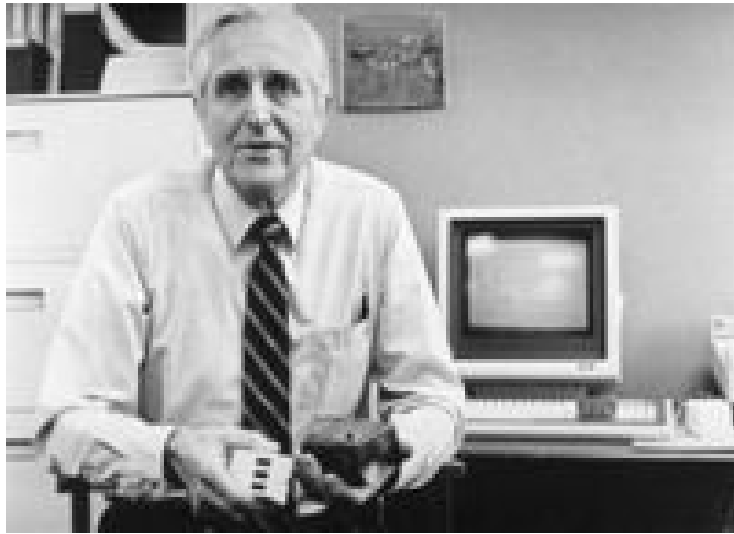
Douglas Engelbart

- Mid-1960's Inventor of the computer mouse, he led work on hypertext and graphical user interfaces at SRI International

Ted Nelson

- 1960 – launches Project Xanadu
  - Goal: a networked pay-per-document hypertext database encompassing all written information
- 1965 – Ted coins the term "Hypertext"
  - in "A File Structure for the Complex, the Changing, and the Indeterminate". 20th National Conference, New York, Association for Computing Machinery
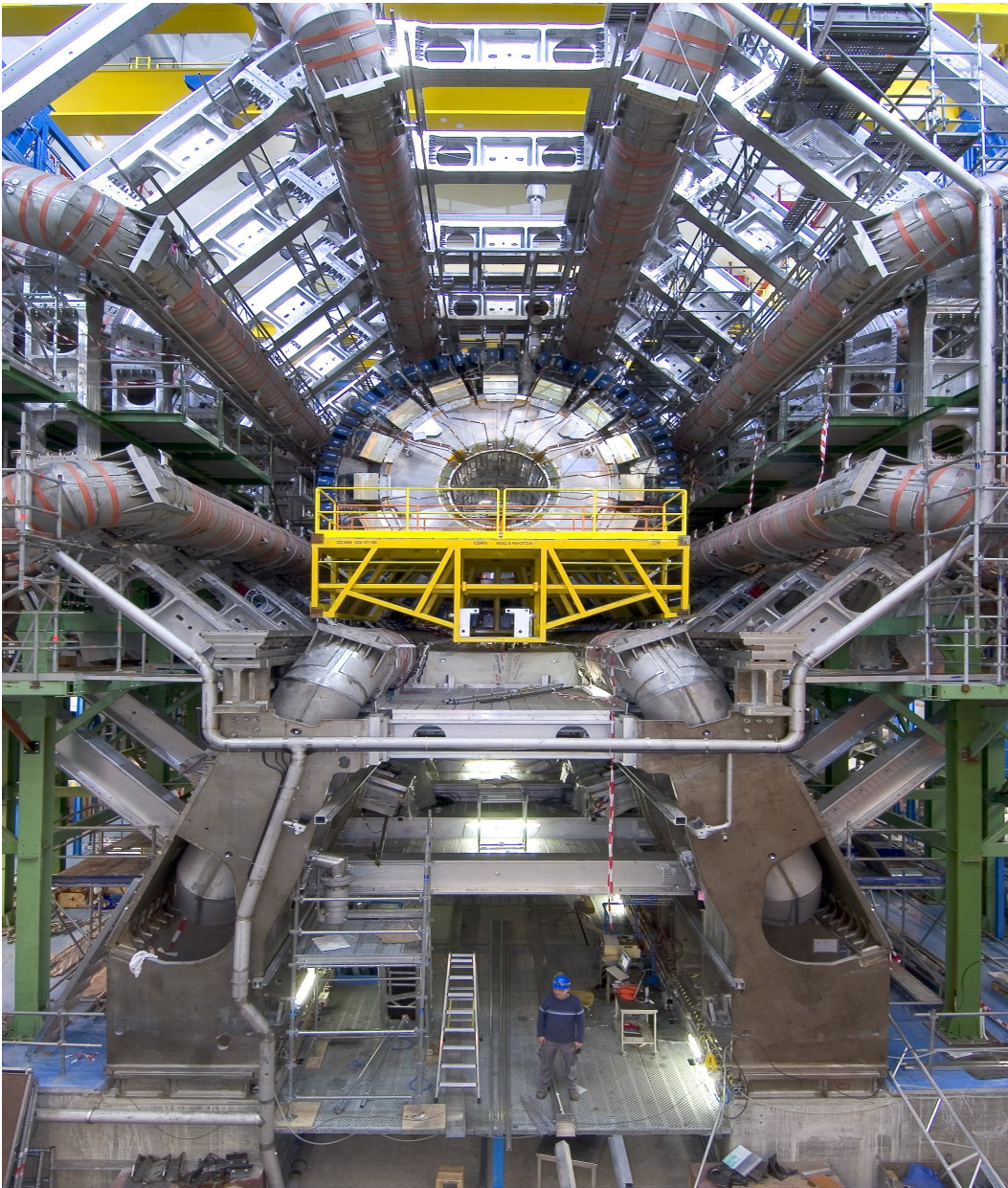
Other Pioneers
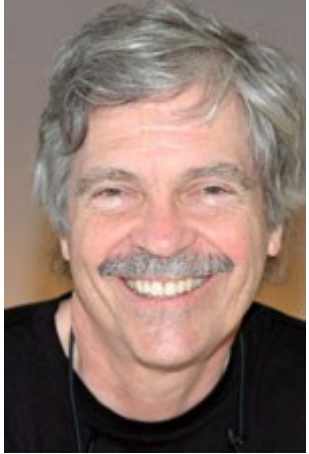
- **Alan Kay**

  - Object oriented computing and window based graphical user interfaces in the 70's whilst at Xerox PARC

    - "The best way to predict the future is to invent it!"

- **Bill Atkinson**

  - Developer of the Apple Hypercard system

    - Hypermedia apps with a stack of cards, graphics and simple scripting, first released in 1987

CERN – birthplace of the Web

- International research centre for high energy physics located near Geneva

- Large Hadron Collider (LHC) Atlas detector

- Probing conditions at earliest moments of the Universe
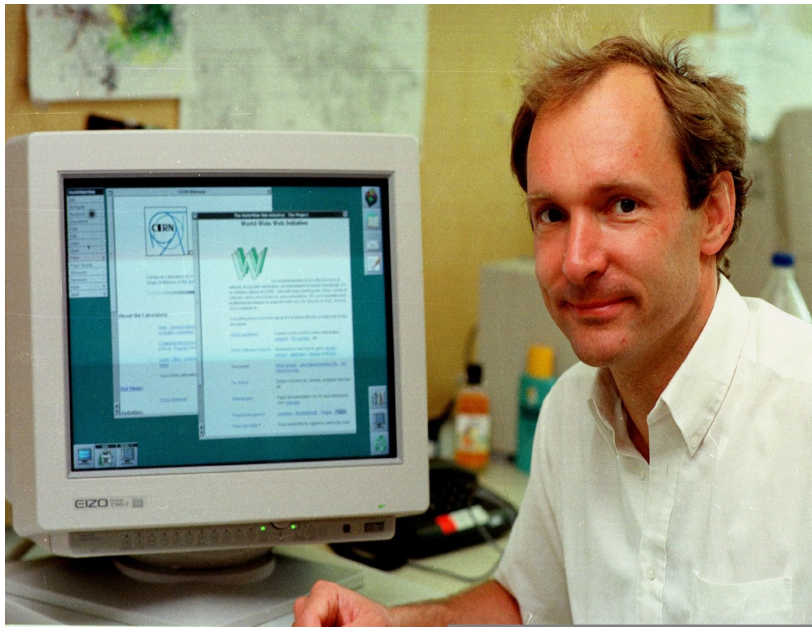
Tim Berners-Lee

- Friend of a friend at Oxford, we first meet in '92

- 1980 Develops "Enquire" as a simple hypertext system whilst consulting for CERN

- 1989 Project proposal for World Wide Web

- 1994 Founds W3C to lead the Web to its full potential

Enquire

```
> ENQUIRE
Enquire V 1.1

Hello!
Opening file (PSK-PCP)VAC-V1:ENQR...

PSB Vacuum Control System                        (concept)  <    O>
--- ------ ------- ------

 [ 1] described-by: Enquiry System
      An experimental system for which this is a test.

 [ 2] includes: Vacuum History System
      Records and displays slow changes in pressure.

 [ 3] includes: Vacuum equipment modules
      Perform all the hardware interface

 [ 4] includes: Control and status applications programs
      Provide operator interaction from the consoles.

 [ 5] described-by: Controle du System a Vide du Booster 11-2-80
      Operational specification of the software

 [ 6] includes: PSB Pump Surveillance System        PCP 228
      Allows rapid monitoring of pressure changes

[number     ]
```
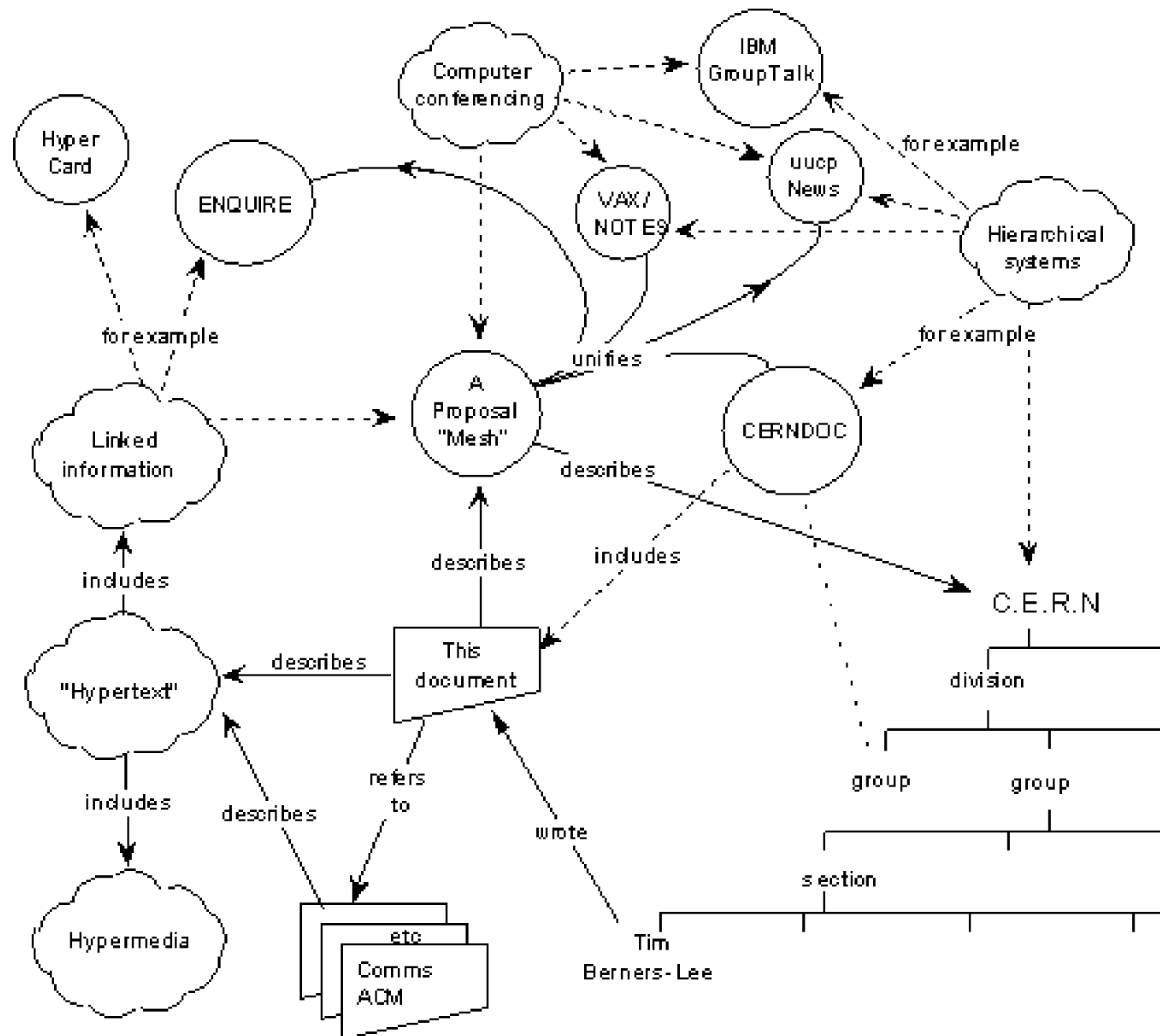
1990 – WWW Architecture

Initial Simplicity

- Tim made an explicit choice to start really simple to encourage widespread adoption

- Simple hypertext markup (html)
  - With link types for a machine interpretable Web

- Simple protocol (http) with global addresses

- Designed to be rendered on wide range of devices

- Images and other media shown in external viewers

Rapid Evolution

- Exponential growth in Web traffic

- Incremental expansion of features

- 90's Browser wars won by Internet Explorer

- The fightback: Firefox, Opera and Safari, and later Chrome

  - A new century and the rise of the webkit open source library

- Mobile browsers and more ...

The Web expands ...

1. TBL's Next Computer at CERN
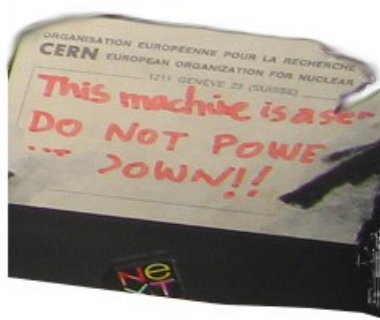
4. Smart Phone (Nexus S)

5. Connected TV

2. PC from early '90's

3. MacbookPro

6. HTML5 in the Car (QNX) ¹³

Competing with Native Apps

- HTML5 and the Open Web Platform as the obvious choice when you want to reach out to many devices

  - Non-proprietary open standards, that can be implemented free of royalties

  - Huge pool of developers

  - Reduced learning curve, and lower costs!

- New – HTML for system applications

  - Trusted apps with rich connection to the device

- Coming up – open standards for payment APIs

  - Escape constraints of today's app stores

Smart Cities

Smart Cities

- Combining sensors, actuators and other information to enable services that allow people to lead better lives
  - Public/anonymised data
    - Public services, e.g. transport, and utilities
  - Private/personal data
    - Healthcare, security and personal services
- Geographic information services and the Web of Things
  - Presenting information in context
  - Simulations and planning for the future
- Machine interpretable data and the Semantic Web

Smart City Expo World Congress 2012

Smart City Plaza

Smart Meters

Electricity meter – Southern Electric (UK)
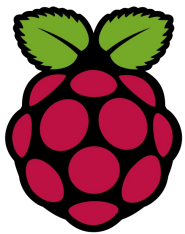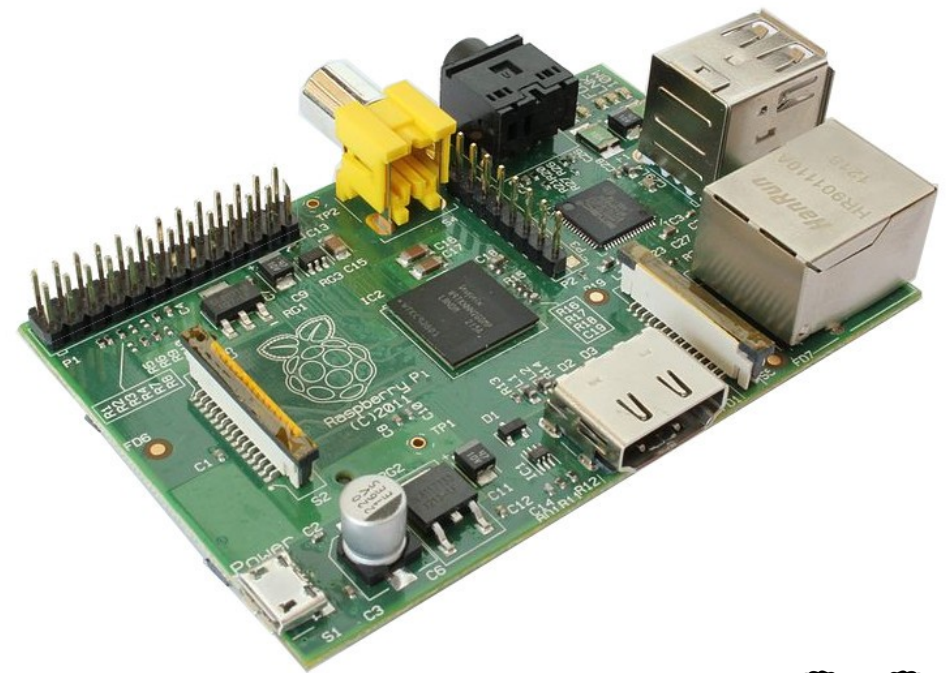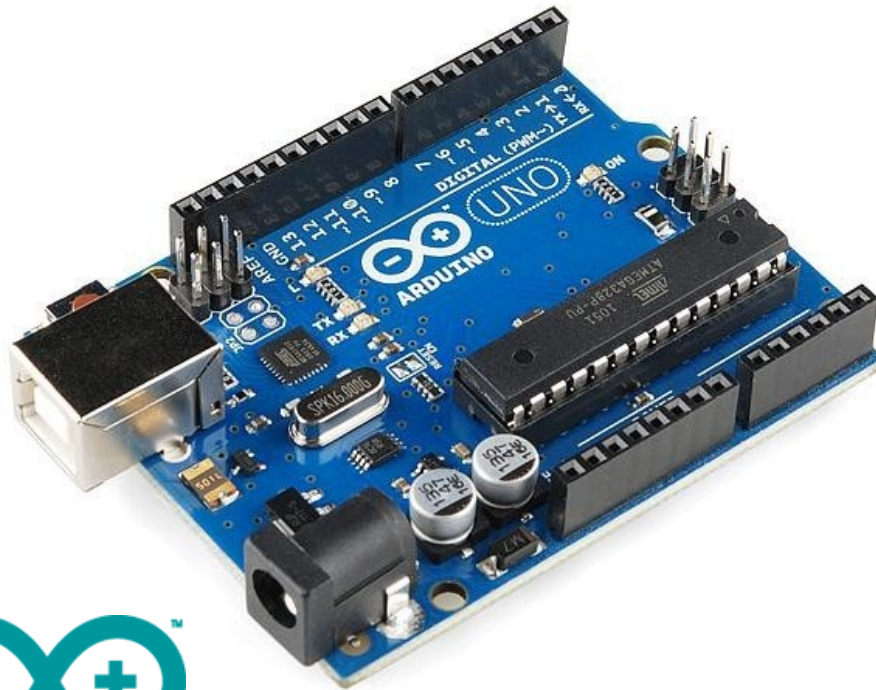

Gas meter – British Gas

Enable people to learn to reduce their consumption, and lower the cost of their bills. If lots of people do this, we can reduce risk of power cuts from overloaded power grids, and help the environment!
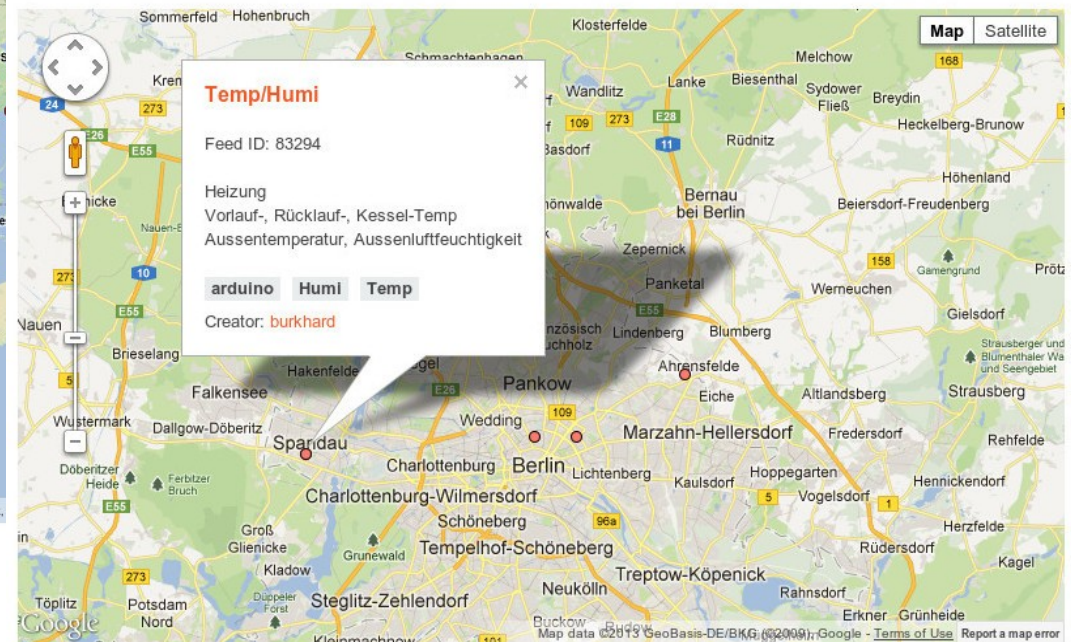
Open source hardware

- For DIY projects

Publishing your sensor data

http://cosm.com/

Architectural Issues

- **The role of biological metaphors**

  - Sensor pipeline

    – Progressively higher levels of interpretation

    – Challenges for combining different sources of data

  - Actuator pipeline

    – Progressively lower levels of representation

    – Challenges for synchronizing different actuators

- **Open markets and federated search**

  - Counter to monopolistic walled gardens for app stores

- **Dealing with very large amounts of data**

- **Heterogeneous vocabularies for metadata**

- **Reducing the barrier to creating services**

Web of Things

- Applying web technologies to reduce the cost of implementing services

  - RESTful HTTP, Web Sockets, etc. for communication

  - JavaScript APIs acting on local proxies

  - Overlay networking model to hide information that is best dealt with at a lower level of abstraction

  - Rich descriptions and live context management

  - Distributed processing (in devices and in the cloud)

    - Sticky policies for privacy and access control

  - Re-establishing control over your personal devices, apps, services and data

    - Personal Zones

Overlay Network Model

- Decoupling applications and services from things best dealt with at a lower level in the stack

  - Interconnect technologies
    - WiFi, BlueTooth, ZigBee, NFC, USB, IEEE 1394, IR, GPRS/3G/4G, WiMAX, the list keeps on changing ...

  - Some devices are low powered, requiring gateways
    - Pushing storage and computation close to the edge

  - Mix of discovery technologies, e.g. mDNS, UPnP
    - Plus federated and intent-based search across the Internet

  - Heterogeneous mix of old and new devices
    - Ensuring applications work with yesterday's and tomorrow's devices
    - Establishing design principles for fault tolerance

Objects as Proxies for Services

Scripts running within web run-time, or embedded agent or cloud, e.g. using node.js
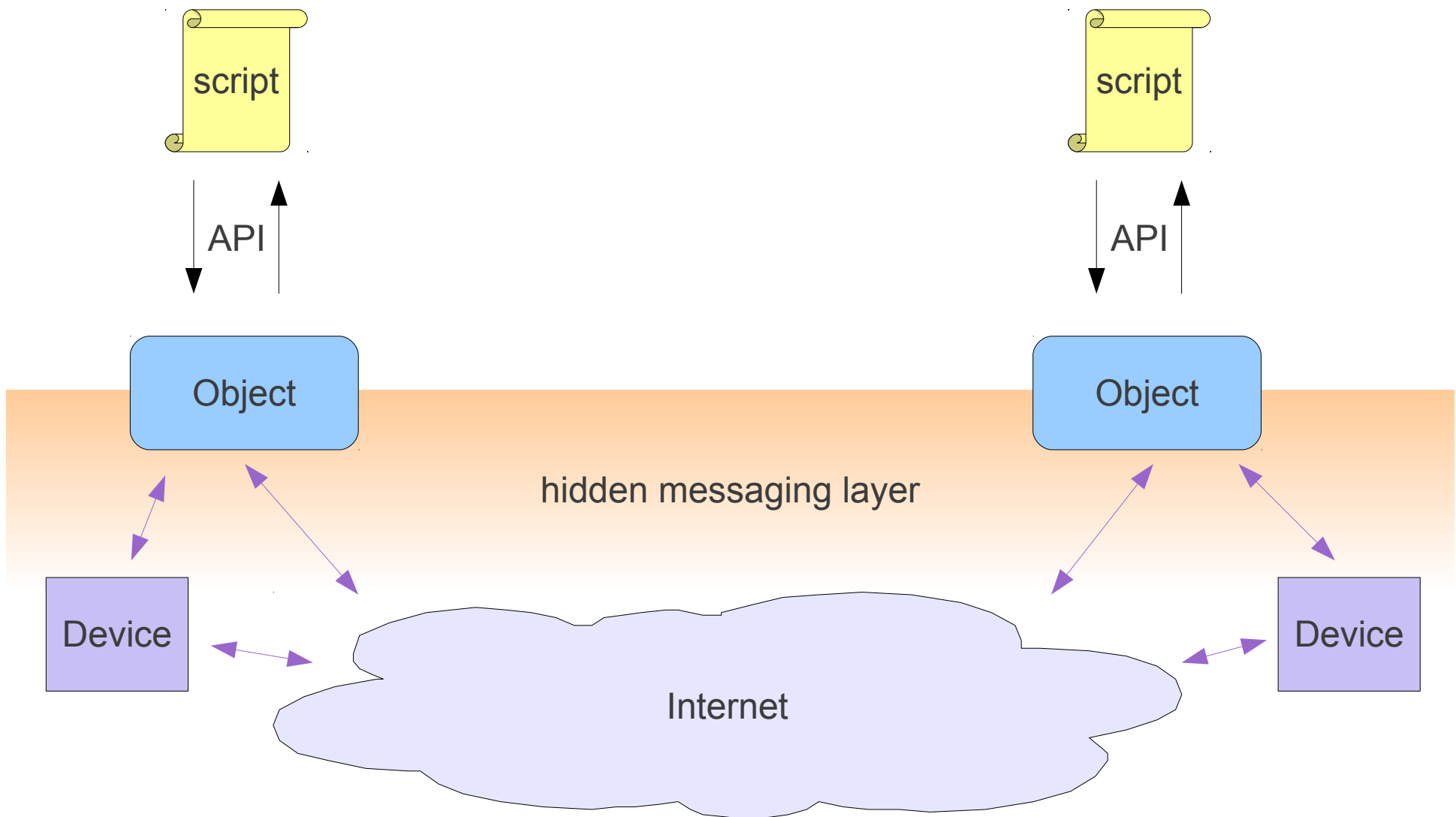
Public / Private
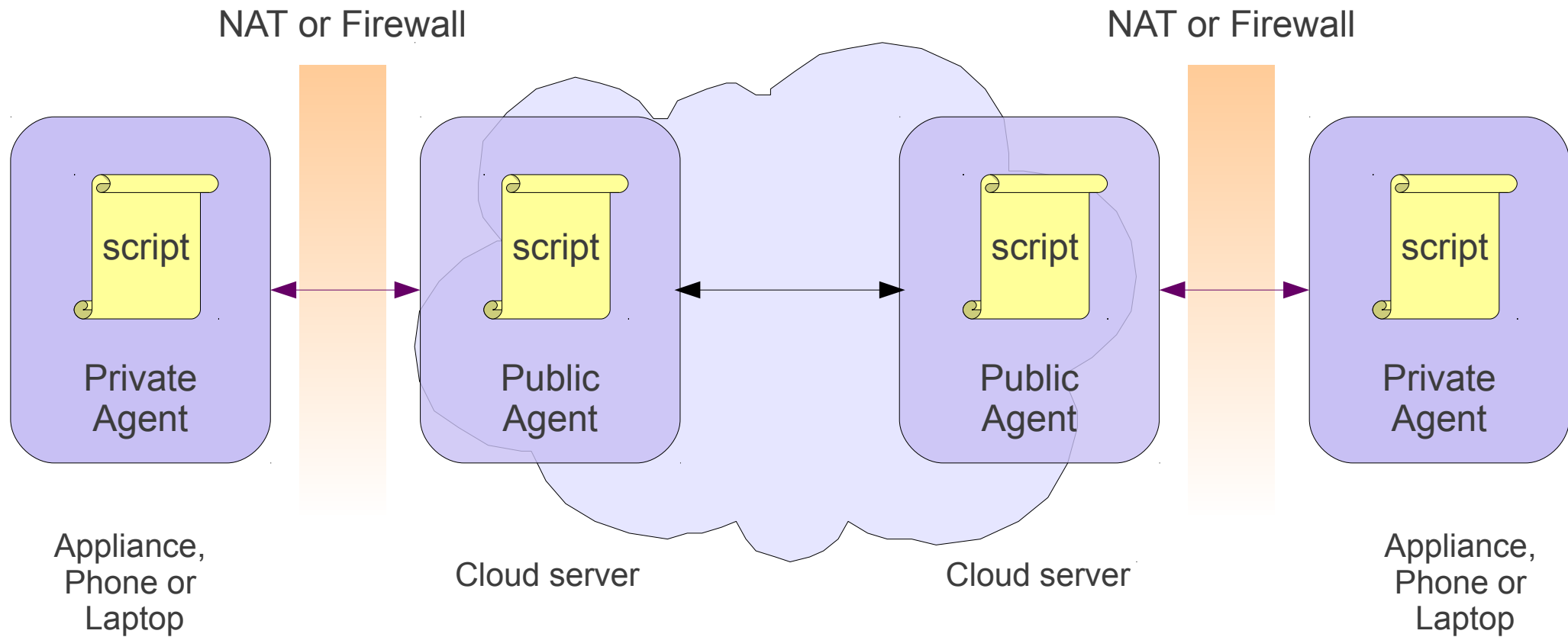
Personal Zones

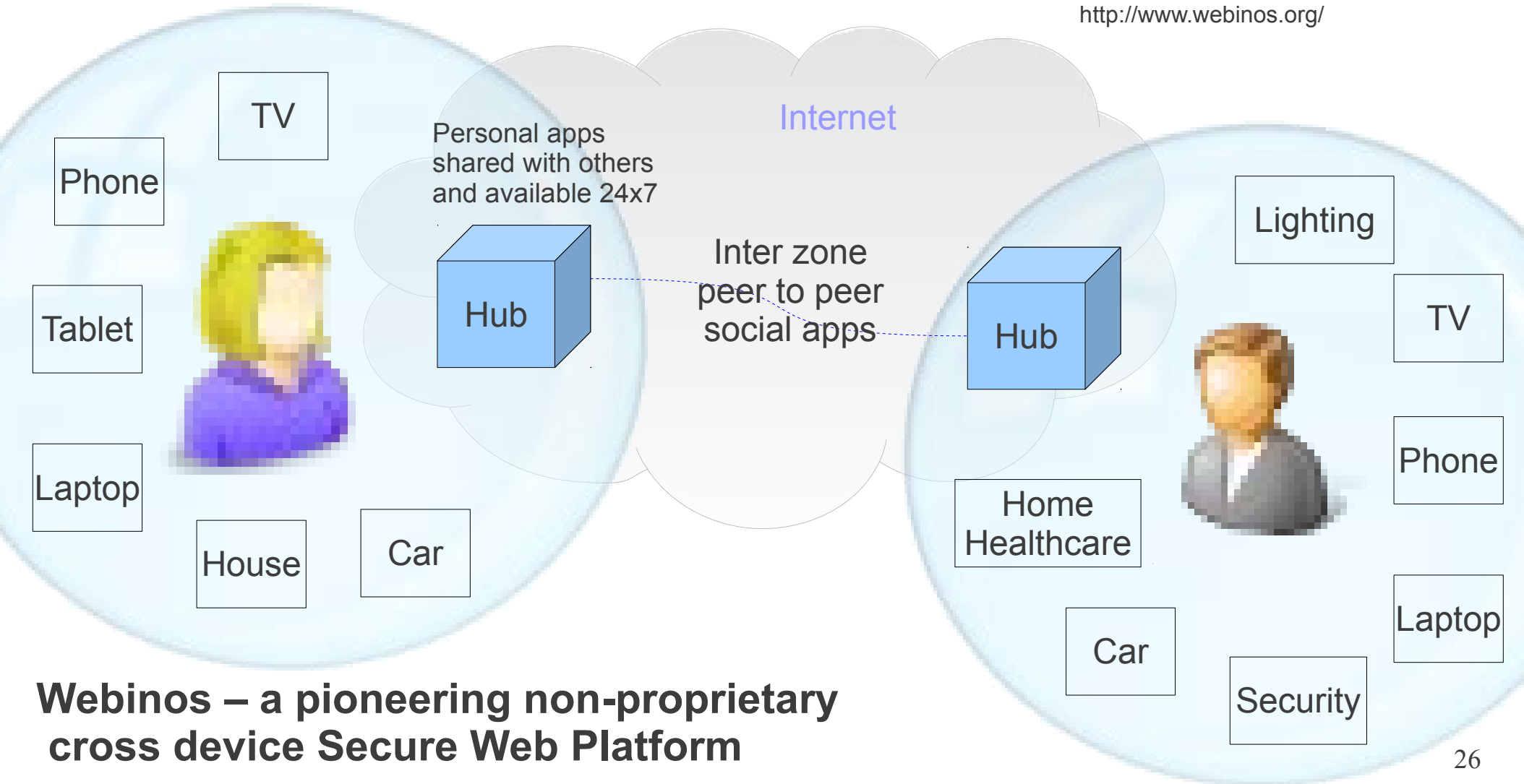**Getting the most out of my devices**
Multiscreen/multidevice apps

Trusted Applications with rich access to device Capabilities

http://www.webinos.org/

TV

Phone

Tablet

Laptop

House

Car

Personal apps shared with others and available 24x7

Hub

Internet

Inter zone peer to peer social apps

Hub

Lighting

TV

Phone

Home Healthcare

Car

Security

Laptop

Webinos – a pioneering non-proprietary cross device Secure Web Platform

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Home Services

- Extended warranty services for home devices

  - Central heating, washing machine, refrigerator, etc.

  - Preventative maintenance based upon
    access to sensor data

    – Very low incremental cost to manufacturers

    – Ability to sense impending failures

- Home security

  - Remote monitoring and peace of mind

- Home healthcare

  - Improved quality of life, outcomes and reduced costs

Re-establishing control over your devices and personal data

- Today companies provide services, but require centralization of personal data over which you have little control, making it hard to switch companies

- Personal Zones provide an architecture for reclaiming control!

- You decide what/when to share with 3rd parties

- This facilitates intent based smart search!

- Your data is managed within your zone, by the services you install

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EU FP7 Compose Project
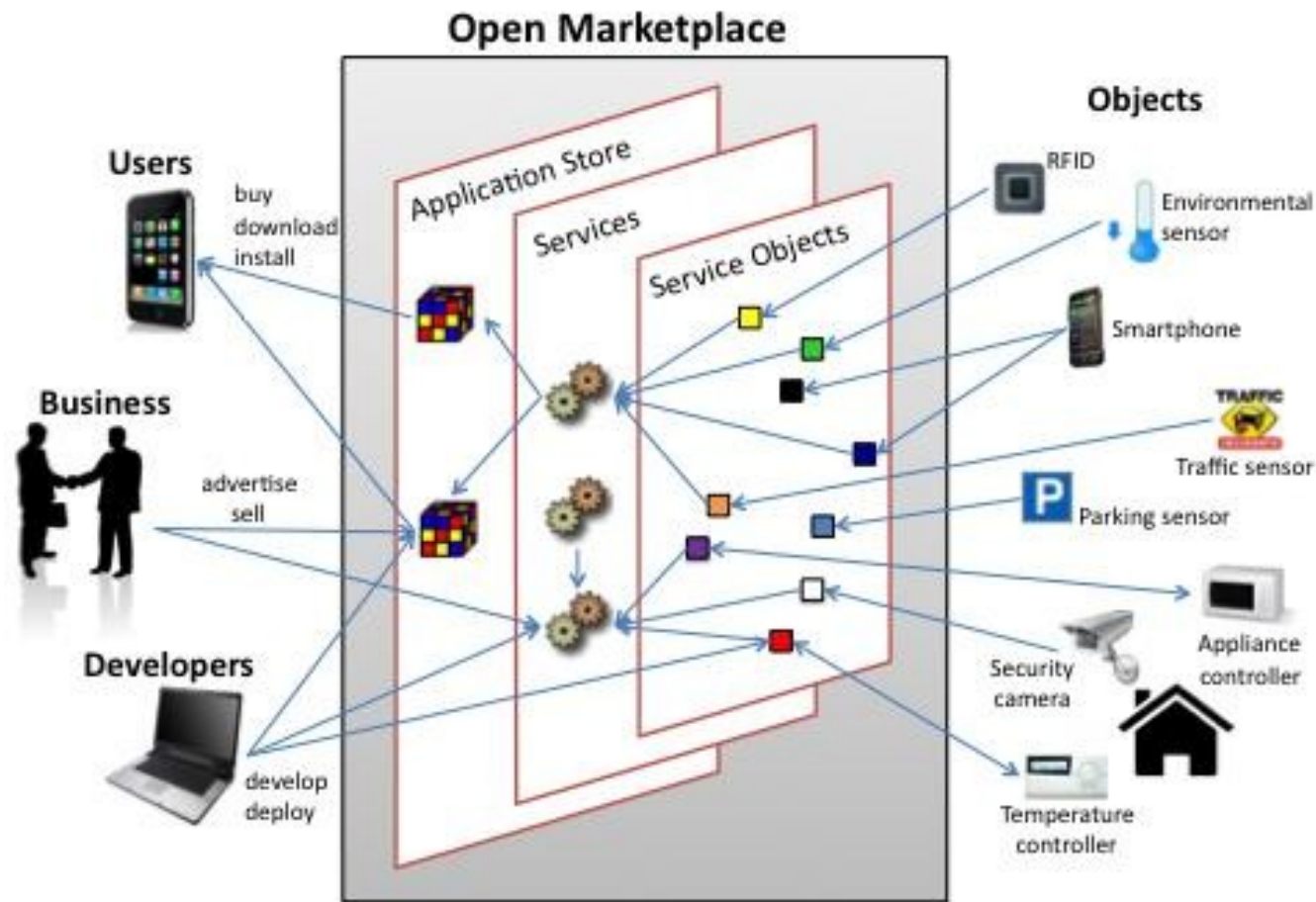
- Enabling open markets of services for the Internet of Things

http://www.compose-project.eu/

Coming soon: W3C Community Group for the Web of Things

Any other questions?

Dave Raggett <dsr@w3.org>

Join W3C to help drive the Web to its full potential – http://www.w3.org/