Does ubiquity have limits?

Moderator
Sathiamoorthy Manoharan, *University of Auckland, New Zealand*

Panelists
Danh Le Phouc, *DERI - Galway, Ireland*
Diletta Romana Cacciagrano, *University of Camerino, Italy*
Maarten Weyn, *Artesis University College of Antwerp, Belgium*
Marta Rukoz, *Université Paris Ouest Nanterre La Défense, France*
Pedro José Marron, *University of Duisburg-Essen, Germany*

Introduction

- Ubiquitous computing, Pervasive computing, Ambient intelligence, Internet of Things, …

Introduction

- Current Limits (read Future Opportunities)
  - Power
  - Bandwidth
  - Connectivity
  - Screen real-estate
  - Context awareness
  - Standards
  - Storage
  - Applications
  - Consumer Acceptance

Power

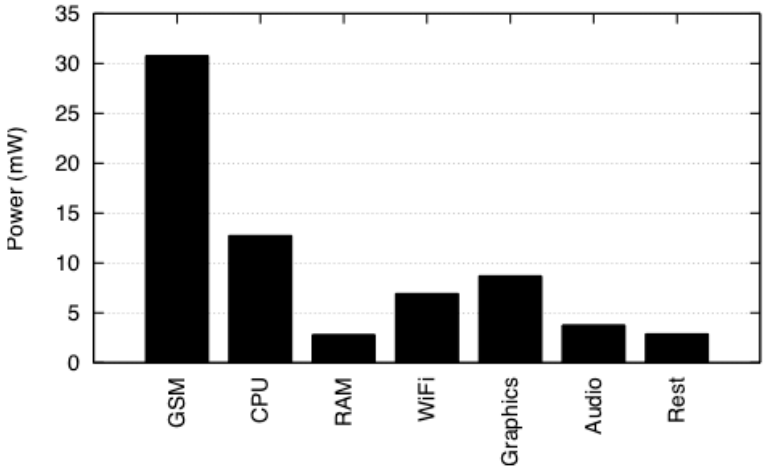


Figure 2: Power breakdown in the suspended state. The aggregate power consumed is 68.6 mW.

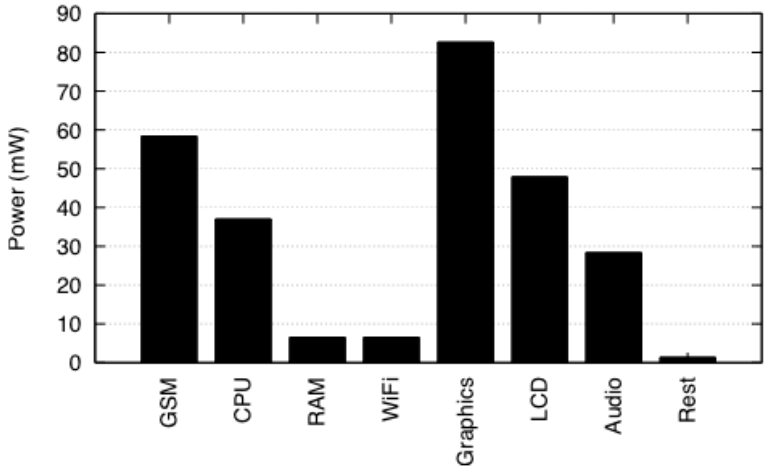


Figure 3: Average power consumption while in the idle state with backlight off. Aggregate power is 268.8 mW.

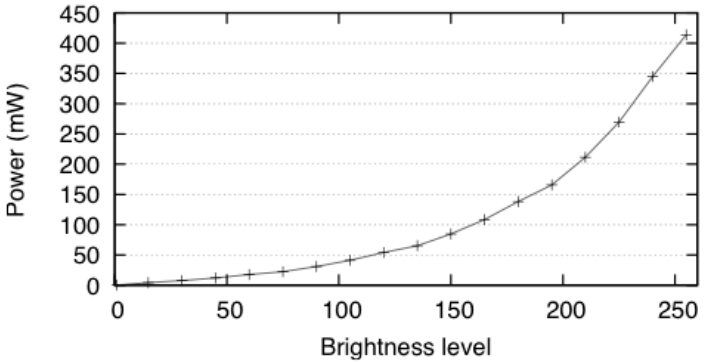


Figure 4: Display backlight power for varying brightness levels.

Aaron Carroll and Gernot Heiser. 2010. An analysis of power consumption in a smartphone. In *Proceedings of the 2010 USENIX conference on USENIX annual technical conference* (USENIXATC'10). USENIX Association, Berkeley, CA, USA, 21-21.

Bandwidth & Connectivity

- Devices need data – how do we maximize the available bandwidth?
  - Reuse: caching
  - Compression
  - Better protocols (e.g., WSP, SPDY, Google protocol buffers, WBXML)
- Connectivity – need to handle connection unavailability

Screen Size

- Depends on the device – Large enough for the purpose
- Rollable or foldable screens (e.g., Polymer Vision)
  - Large screen = more power consumption

Context awareness

- Environment perception
  - Simultaneous localization and mapping (SLAM)
- Geo-location capability
  - Errors, Power consumption, TTFF (time to first fix)
  - Assisted GPS

Standards

- Do we have standards?
- Do we have too many standards?
- Do standards constrain creativity?

Storage

- On-device storage is limited
  - Efficient storage formats (e.g., binary rather than XML)
  - Compressed data – but compression requires CPU – more power consumption

Applications

- What applications are best suited for devices
  - Do we want to run Eclipse on a small device?
- Application development environments
  - Different environment for different devices
- Do we need a standard?
  - Is HTML5 an answer?
  - App generators?

Consumer Acceptance

- Best technology is usually not the technology that sells
- A technology that does not sell dies
- Need for smart marketing … so that we can continue to invest in enhancing the technology

Pushing the Data Ubiquity Limit of Internet of Things with Linked Data

Danh Le-Phuoc
Digital Enterprise Research Institute
National University of Ireland, Galway

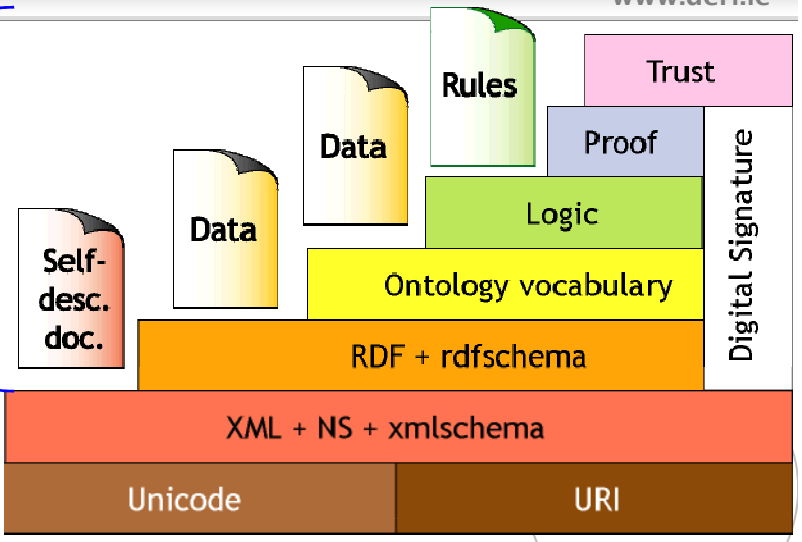
Ubiquitously Live Connections of Things

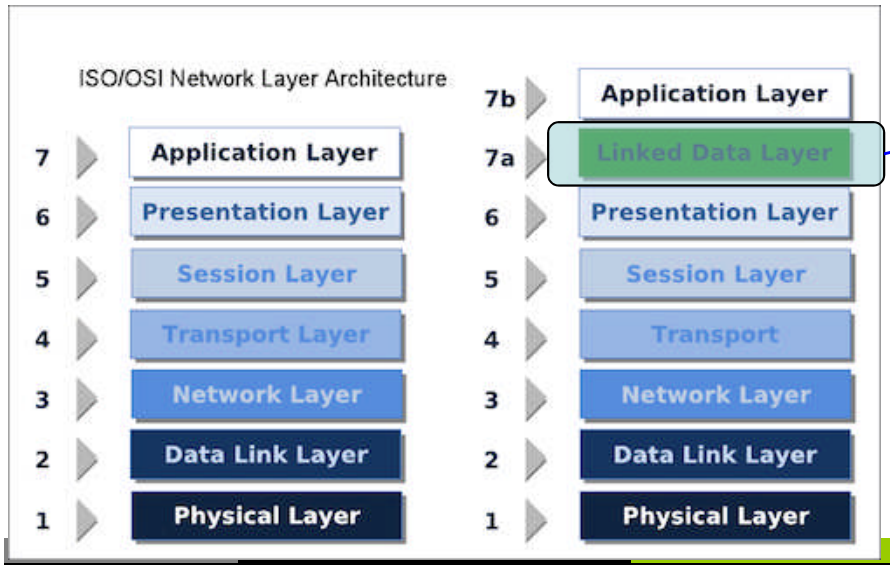
Linked Data for Connected Things

Unified Data model as graphs

Labeled edges (links)

Nodes (global identifiers)





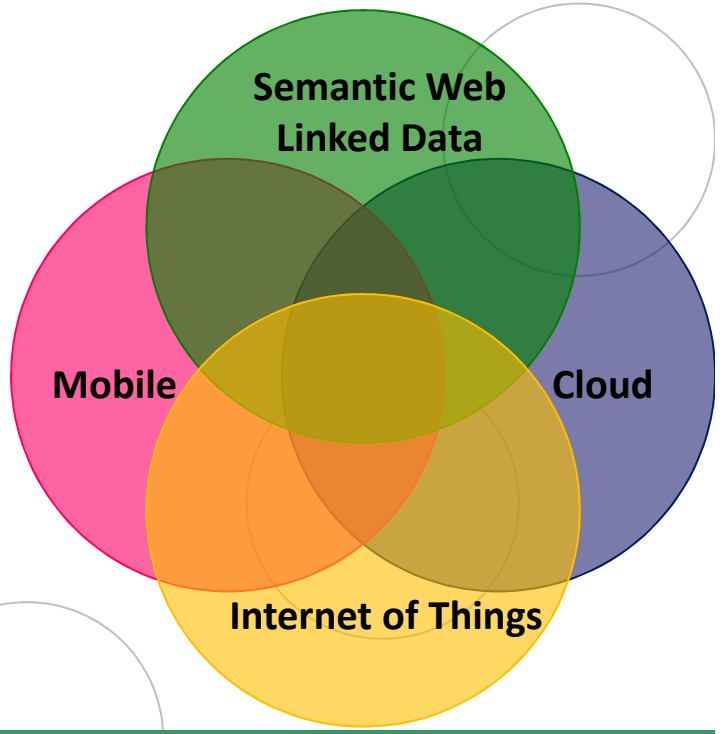
Layer for interoperability

Autonomous, distraction-free data integration

Data Ubiquity

Challenges

- Expressiveness v.s constraint resource
- Standardizations (format, query, encoding, compressing, etc)
- Cross-layers optimization
- Content-based routing
- Large/Web scale event/stream processing in graph-based data model
- Privacy issues
- Bring IoT information flows into Cloud



Involved Research Areas

Linking the Real World

- People
- Objects
- Information
- Communication

- Semantic Web
- Services
- Databases
- Distributed Systems
- Middleware
- Pervasive Computing
- Networking
- Internet of Things

- Ontologies
- Policies
- Linked Open Data
- LOD stream processing
- RESTful services
- Web services
- Distributed databases
- Distributed sensor networks
- Publish/Subscribe
- Mobile Networking
- Peer-to-peer
- Content Distribution Networks
- Information-centric networking
- Opportunistic routing
- CoAP
- 6LoWPAN
- Wireless Sensor Networks

Does Ubiquity have Limits?

Diletta Romana Cacciagrano

University of Camerino

School of Science and Technology

UBICOMM, Lisbon, 21th November 2011

Ubiquity

Ubiquitous Computing is based on the principle of **making computers themselves to vanish into the background**.

Immersion into the background

- the physical integration of computing technology into the world by embedding it into tools, things, tasks, and environments.
- the computerized tool or thing does not *interfere* with the activities in which it is used.

$\Rightarrow$ *Ultraconnectivity* in Ubiquitous Computing breaks **space** and **time** constraints: uniformity of places (e.g., **portable environments**) and times (e.g., **digital storage of the past**).

Ubiquity

The immersion into the background turns out to be a *furtive* way of introducing the technology into widespread use.

Question

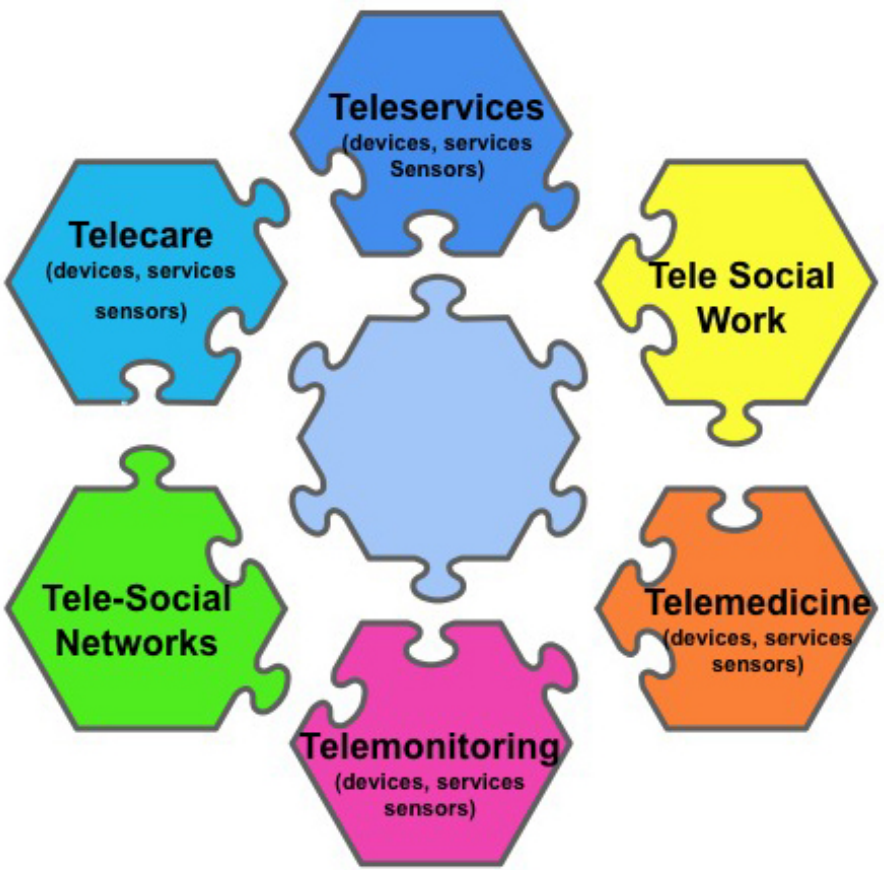
If not driven by the purpose of satisfying significant human needs, how does Ubiquitous Computing justify itself?

$\Rightarrow$ Ubiquitous Computing must take into account **who**..... but also **why**, **where**, **what** and **when**.

Ubiquity X.0

Ubiquity X.0 = Ubiquity+Mobility+Social networking+Semantics+Self-adaptiveness

Ubiquity X.0



- Different technological approaches
- Integration of different technological approaches can fulfill the user requirements and provide a context-aware world of ubiquitous computing
- Providing a new generation of **personalized** (i.e., customized to the specific individual needs) **ubiquitous/pervasive** (i.e., available at any place and at any time) **self-adaptive** (i.e., able to adapt, at run-time, to changes of user needs and environment) services

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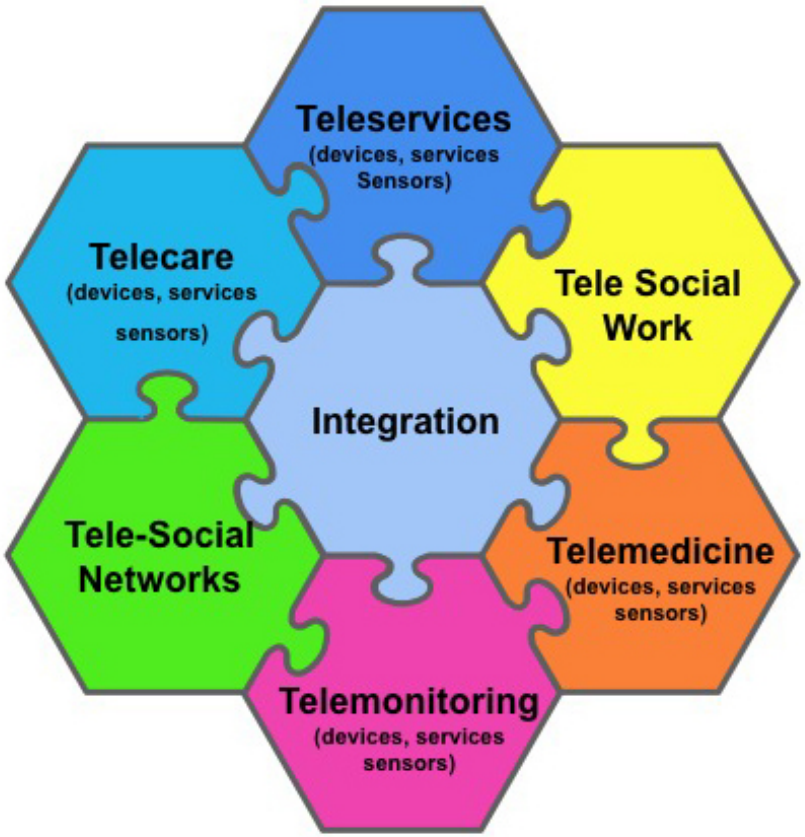

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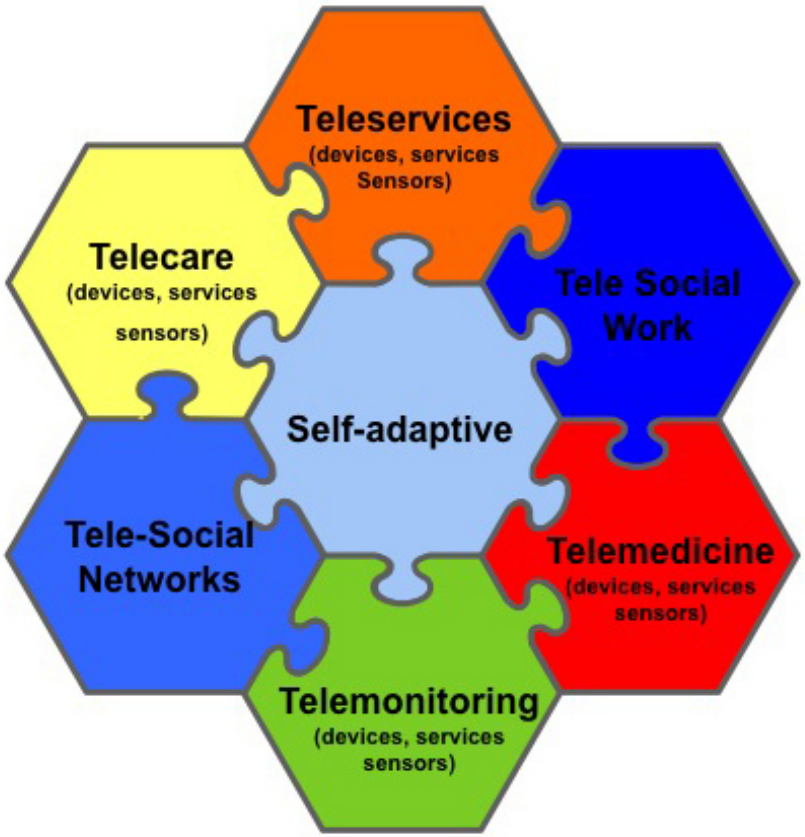

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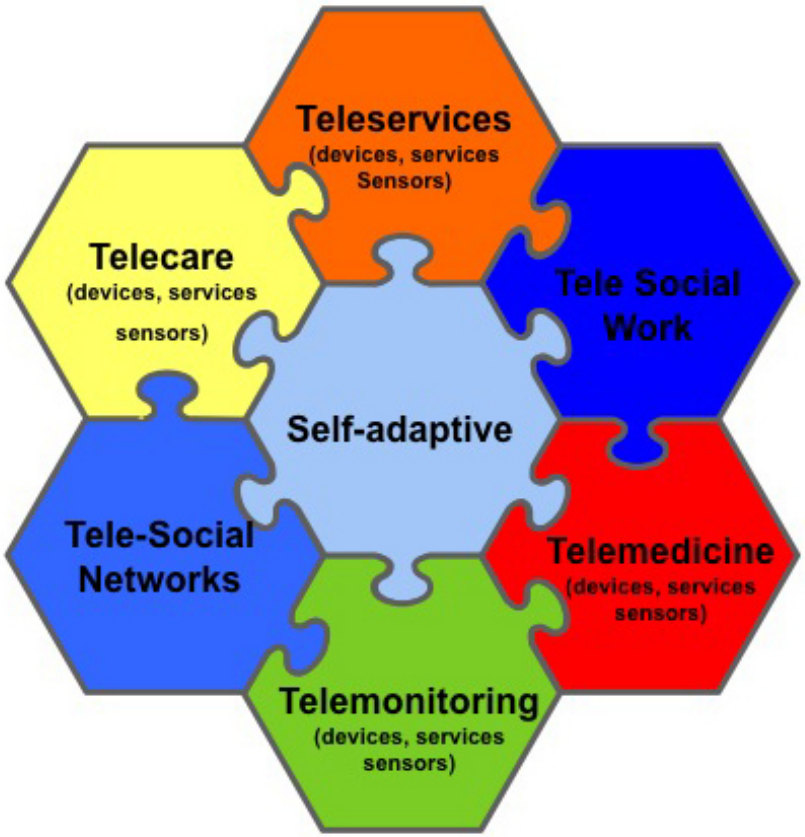

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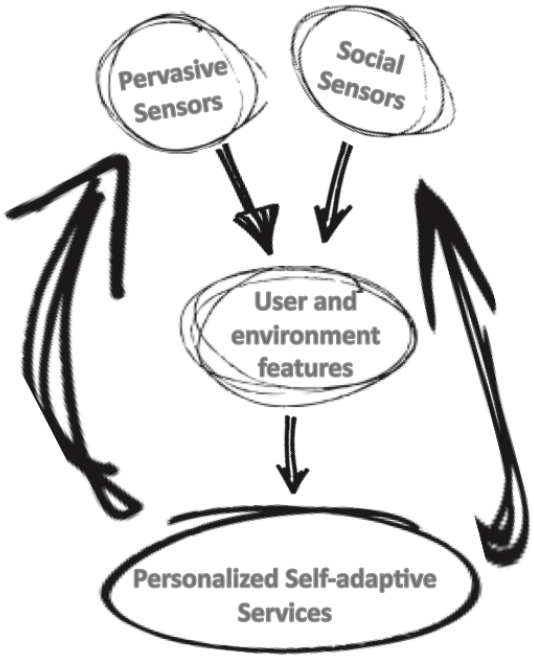
Ubiquity X.0 for monitoring facts and events that:

- **exist only in person's mind** and cannot be sensed by other pervasive sensing means
- **properly analysed, could avoid and prevent dangerous situations**
- **express knowledge and information about future situations**
- **could be indicators of potential problems**, can be detected by social sensors and pervasive sensors, but require history analysis and some inference to be properly recognized

Self-adaptive system

A system that, **at run-time**, can adopt a different behavior w.r.t. the initial one, as a consequence of changes in the user needs and the operating environment

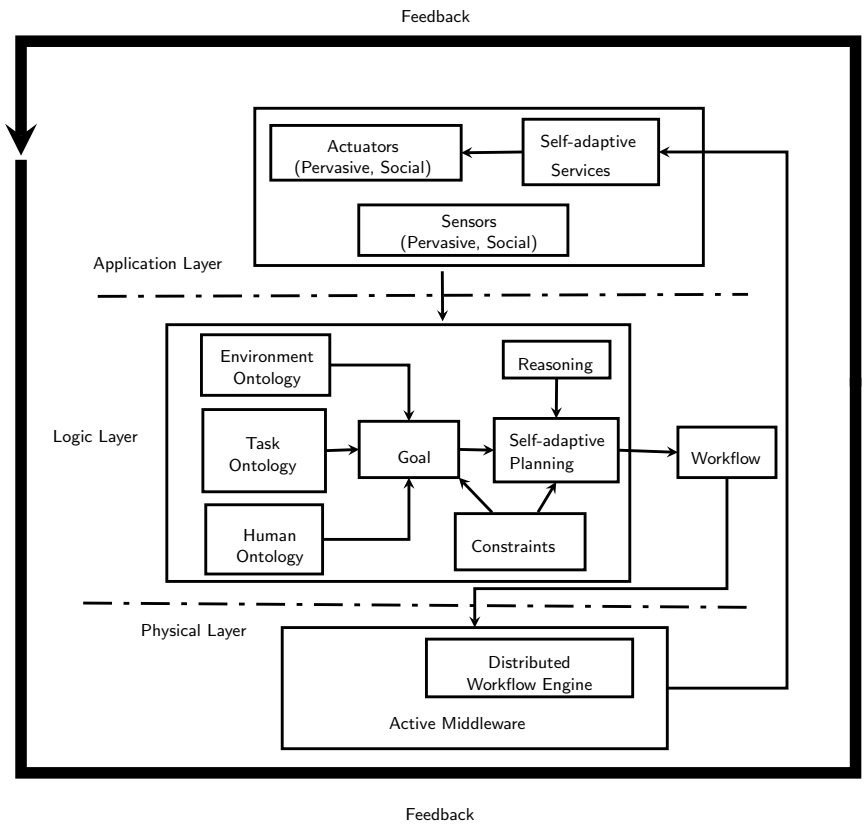


Example. A self-adaptive service designed and developed by *ACTIVAge* is able to:

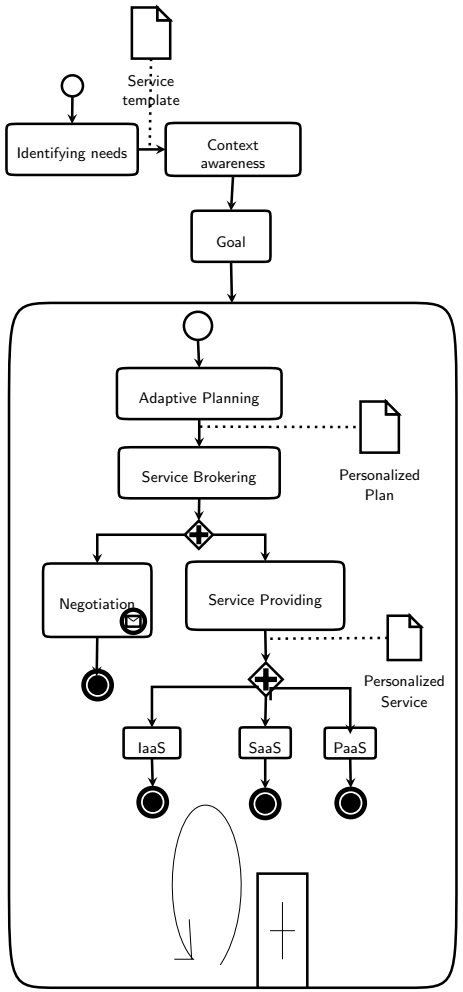
- identify (dangerous) interactions between people and objects
- analyze (dangerous) configurations in the environment
- predict (dangerous) situations
- control the environment, adapting itself to the user needs

ACTIVAge : an Ubiquity X.0 implementation

ACTIVAge framework architecture



ACTIVAge self-adaptive planning



Many thanks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Ubicomm 2011

Does Ubiquity Has Limits?

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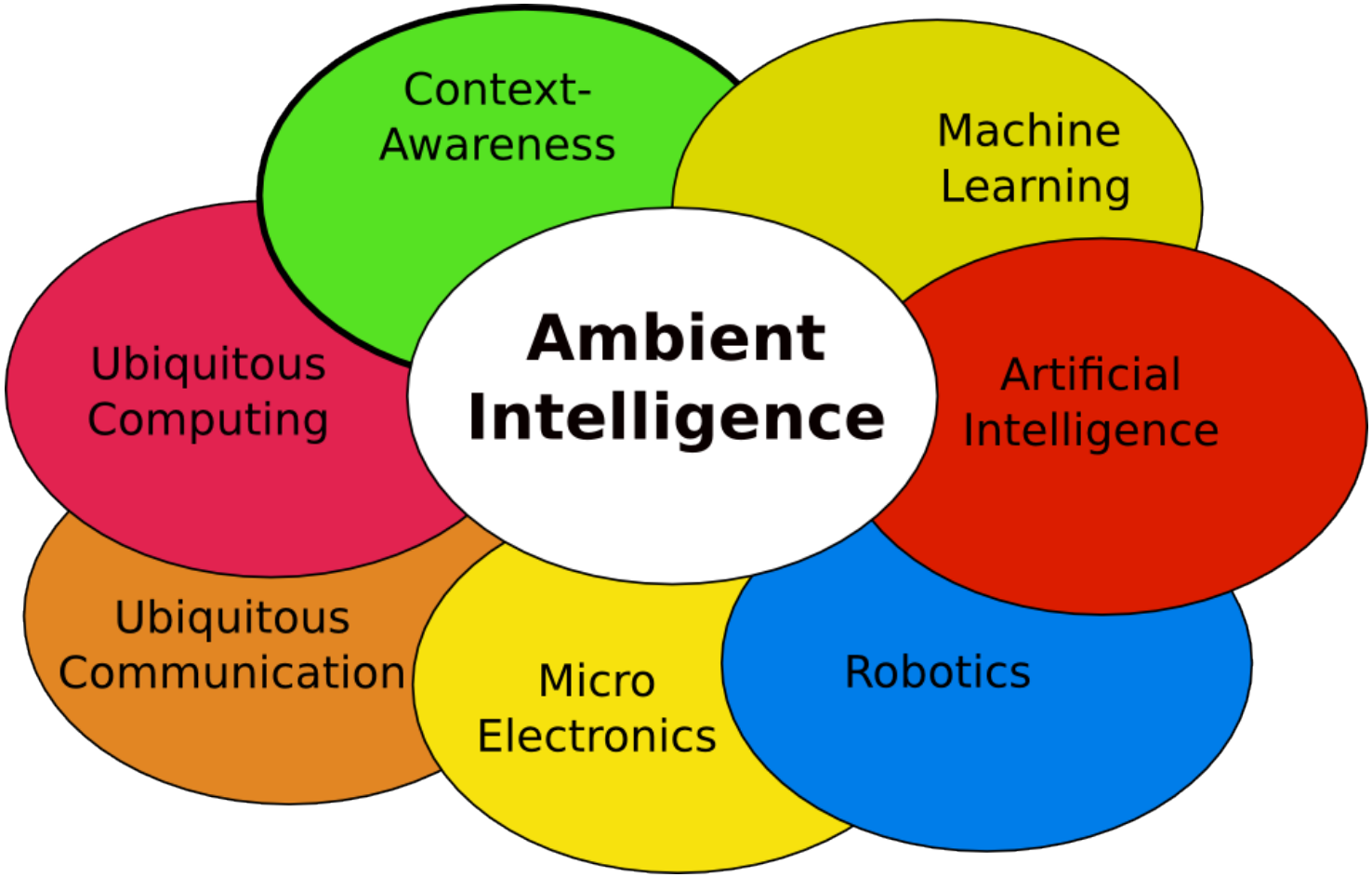
November 2010

artesis
industriële wetenschappen

Research


Context-
Awareness
Machine
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Ubiquitous
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Artificial
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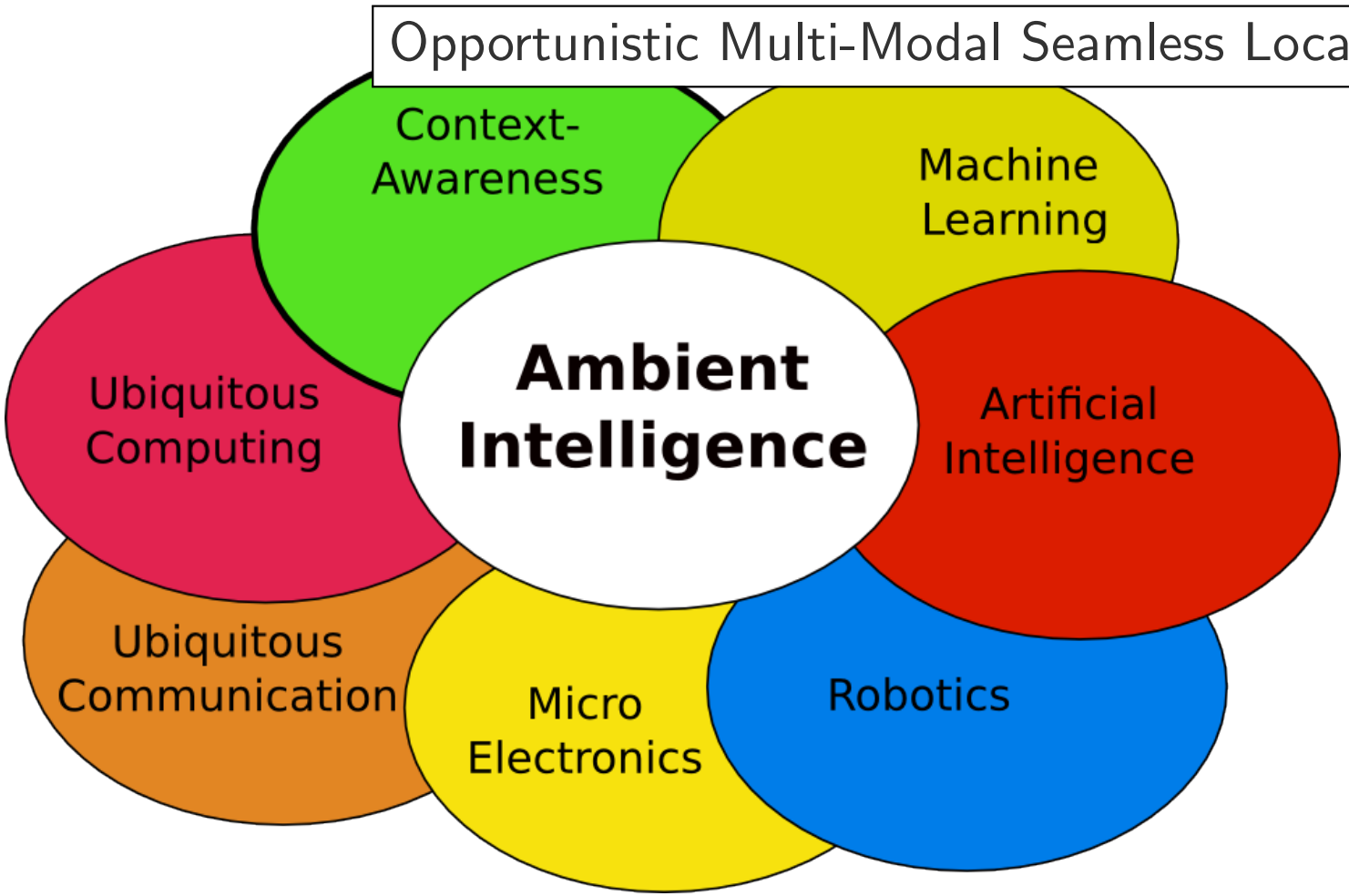
Research


Opportunistic Multi-Modal Seamless Localization
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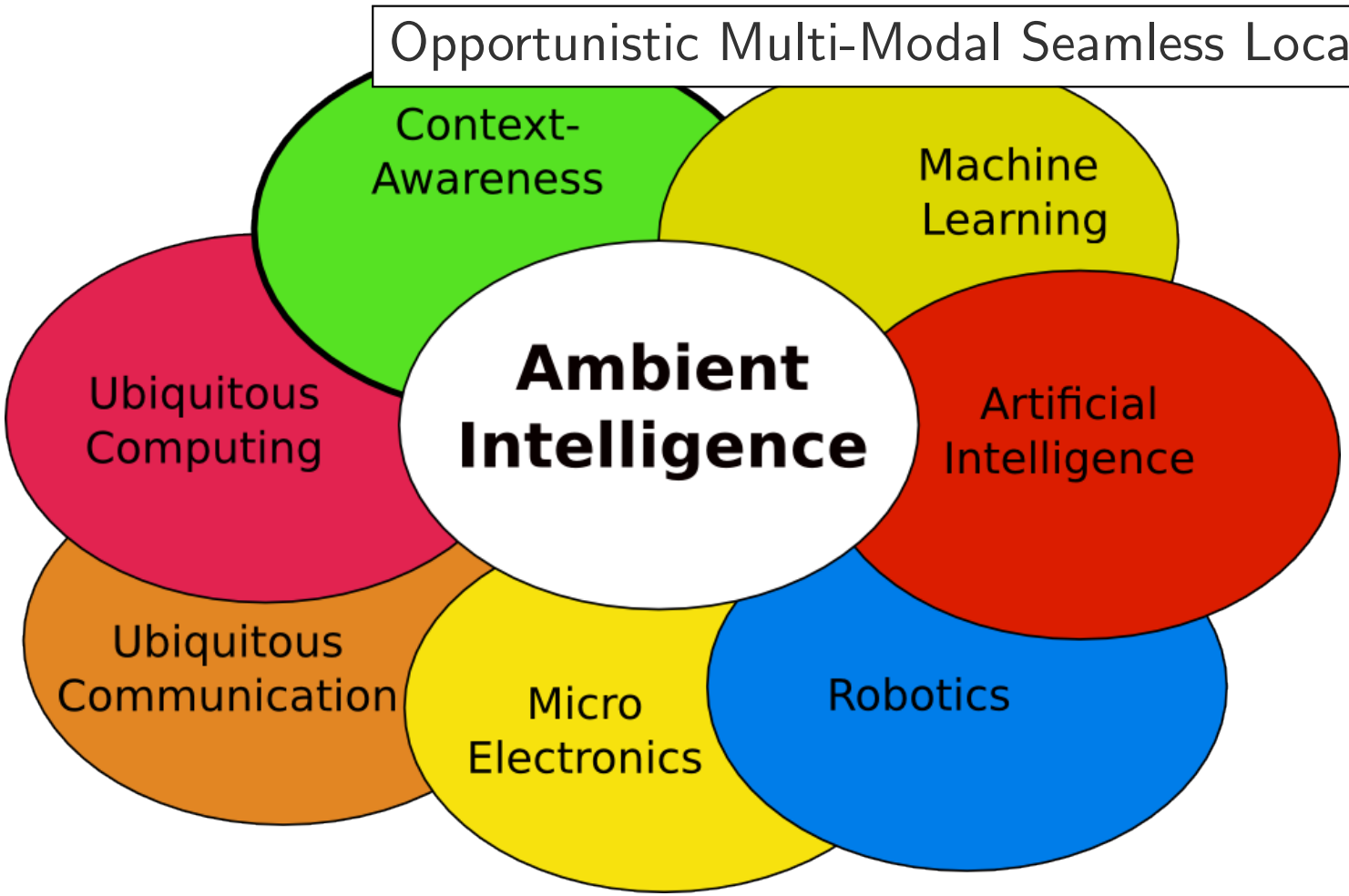

Success $\Longleftrightarrow$ Technology & Society & Business

Ubiquity

- Weiser ('88): *Calm* Technology
- Ubiquity is a vision, not a goal

Ubiquity

- Weiser ('88): *Calm* Technology
- Ubiquity is a vision, not a goal

We can and will go towards a more technology penetrated world where computing will be more ubiquitous!

Does Ubiquity Has Limits?

Does Ubiquity Has Limits?

Vision

Does Ubiquity Has Limits?

Vision $\longrightarrow$ NO

Does Ubiquity Has Limits?

Vision $\longrightarrow$ NO

Practical Implementations

Does Ubiquity Has Limits?

$$\begin{aligned} \text{Vision} &\longrightarrow \text{NO} \\ \text{Practical Implementations} &\longrightarrow \text{OF COURSE} \end{aligned}$$

Does Ubiquity Has Limits?

- Ubiquitous $\rightarrow$ autonomous?

Does Ubiquity Has Limits?

- Ubiquitous $\rightarrow$ autonomous?
- Autonomous $\rightarrow$ no human interaction?

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- Do we trust systems which are still learning?

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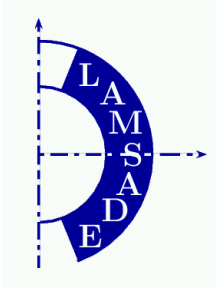
- Perception

Does Ubiquity Has Limits?

- Ubiquitous $\rightarrow$ autonomous?
- Autonomous $\rightarrow$ no human interaction?
- Do we trust systems which are still learning?
- Perception
- Privacy

université Paris Ouest Nanterre La Défense



Does Ubiquity have Limits? Theorical Vs Practical possibilities: Composite applications

Marta RUKOZ

International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM2011)

Web 3.0 goals:

- User fully automated on the Internet.
- Automatic and transparent to users the WS selection and composition to form more complex services.
- Intelligent programs.

Published Data are enhanced with semantics!

- Standards to annotate and describe data: XML, RDF, RDFS, OWL.
- Standards to query data: SPARQL.
- Ontologies representing almost any domain.
- Standards to describe services: OWL-S

Maximal Interconnectivity (Omnipresence).

- Explosion in the number of:
  - Linking Open Data resources and databases
  - Different quality parameters.
  - Controlled vocabularies: MeSH, GO, PO…
  - Highly interconnected data sources:
    Different Sizes, many links, different in- and out-degrees, etc
- Biological Web: large datasets of linking data.
  - Genes, Diseases, Clinical Drugs, Proteins, and so on.
- Explosion in the number of web services applications and open APIs

- A lot of Standards (SOAP, RFID)
- A lot of ontologies even for the same domain.
- Multiplicity of relationships or interactions among different actors are a complex system capable of integrating new autonomous actors

What Next:

•Standard of standards

•Integration of ontologies

•Automatic data transformation

•Interpretation of an event in a contextual way.

•Development and use of "massively" parallel information systems

Does Ubiquity Have Limits?

Prof. Dr. Pedro José Marrón

Lisbon, Panel Ubicomm 2011, November 22nd, 2011

European Center for Ubiquitous Computing and Smart Cities

NES UNIVERSITÄT DUISBURG ESSEN

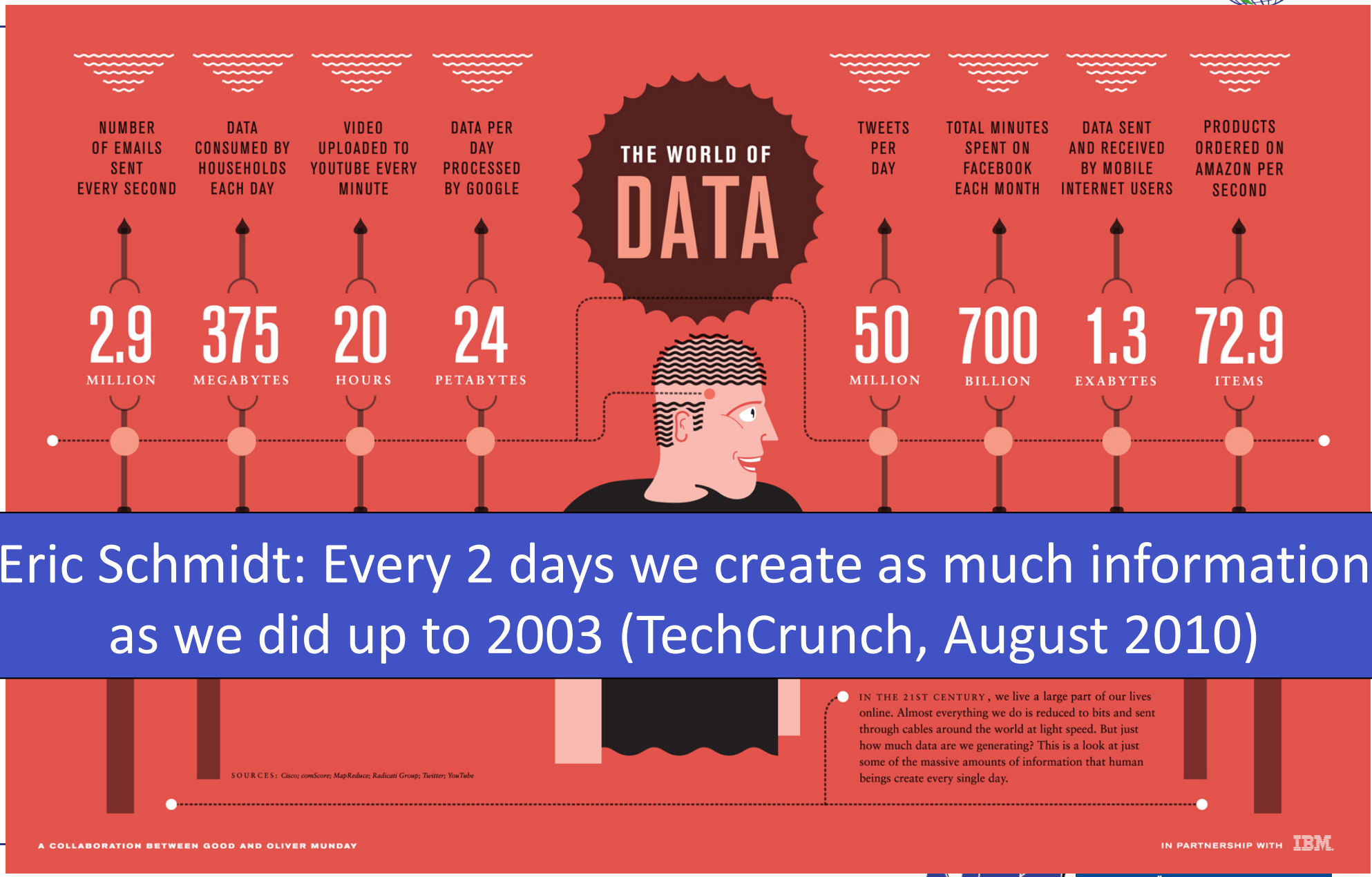
Open-Minded

Does Ubiquity Have Limits?

YES!

Thank you for your attention!

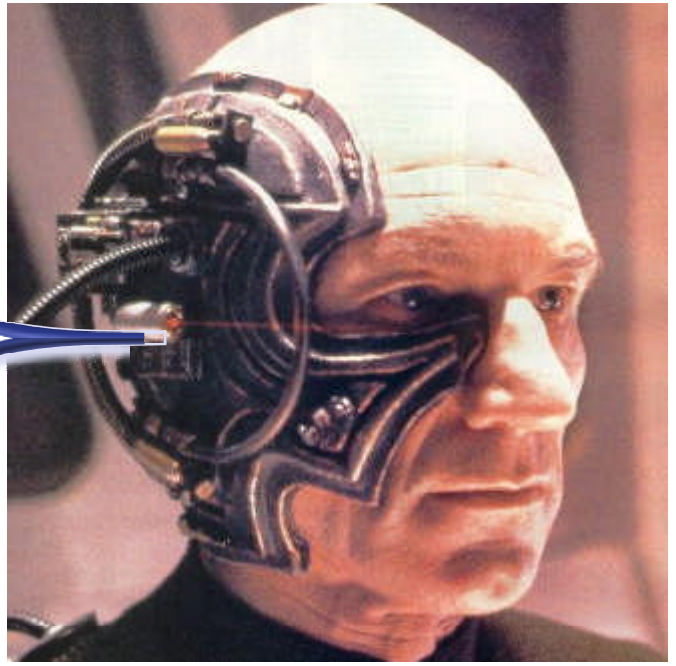
Main Limiting Factors of Ubiquity



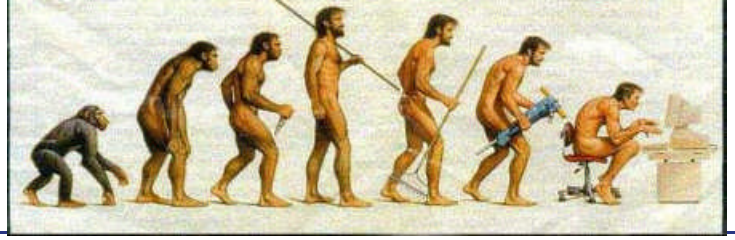
Eric Schmidt: Every 2 days we create as much information as we did up to 2003 (TechCrunch, August 2010)

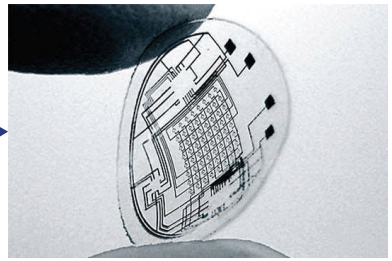
There is Only One Way Out

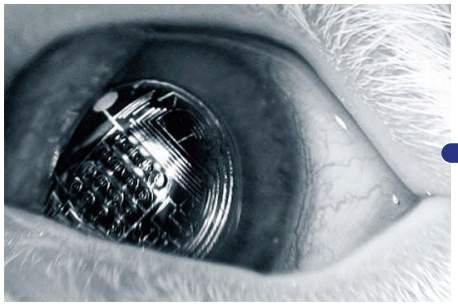
- Data gathering / storage
  - Discern important from trivial information
  - Automatically inferring the context of data
- Making sense out of data
  - Data -> Information -> Knowledge
    - Data mining
  - In-network data processing
  - Localized / Scoped algorithms
  - Ubiquitous Knowledge Discovery
- Processing of data by people / for people
  - Context-aware data processing
  - Activity recognition



Evolution of Technologies







Source: University of Washington

Thank you for your attention!