AGT INTERNATIONAL

10 Years of Ubiquity: Remaining Challenges

Dr. Andreas Merentitis

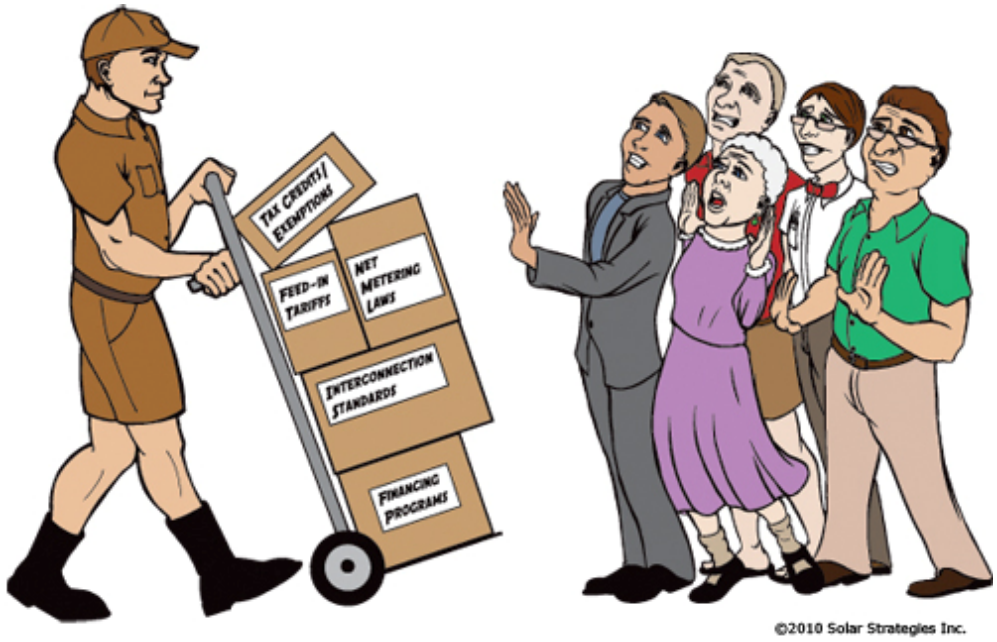
UBICOMM 2013

Is Virtualization a Solution for Real Problems in the Sensor / Internet of Things domain?

Does it offer the technological opportunity for disruptive development?

Is it required for further improvement in core areas?

Is it only supply based (technology push) or also demand base (technology pull)?



Motivation & Internet of Things

The Internet of Things is reaching maturity

- Estimated number of interconnected devices ~10 billion
- M2M communications are gaining momentum in the industrial domain (e.g., Smart grid)

The next wave in the evolution of the IoT is approaching

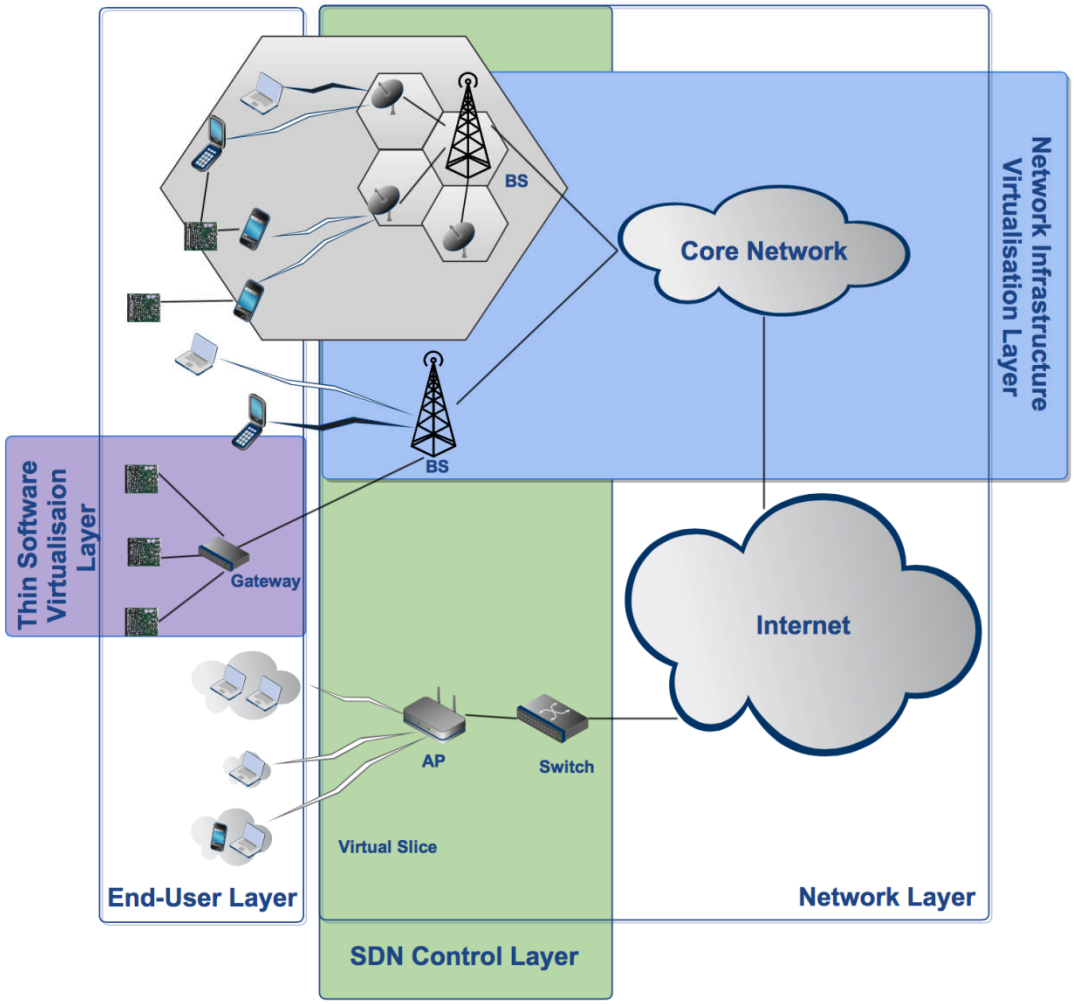
- Number of interconnected devices ~50-100 billion (est. CISCO)
  - Interoperability and **manageability of devices**
  - **Sharing** of sensor infrastructure for **different applications**
  - Exchange **relevant** information

Sensor Infrastructure Virtualization

- Can alleviate some of the manageability challenges
- Facilitates reusability of resources while meeting security requirements
- Paves the way for smarter sensors & analytics at the edge

Virtualization Layers

- **Virtualization can be performed at many layers:**
  - Here we focus on the sensor side
  - "Thin Virtualization" or "Embedded Hypervisors"
  - Some intelligence can be shared with or owned by other network elements
  - Relation to the sensor infrastructure is necessary

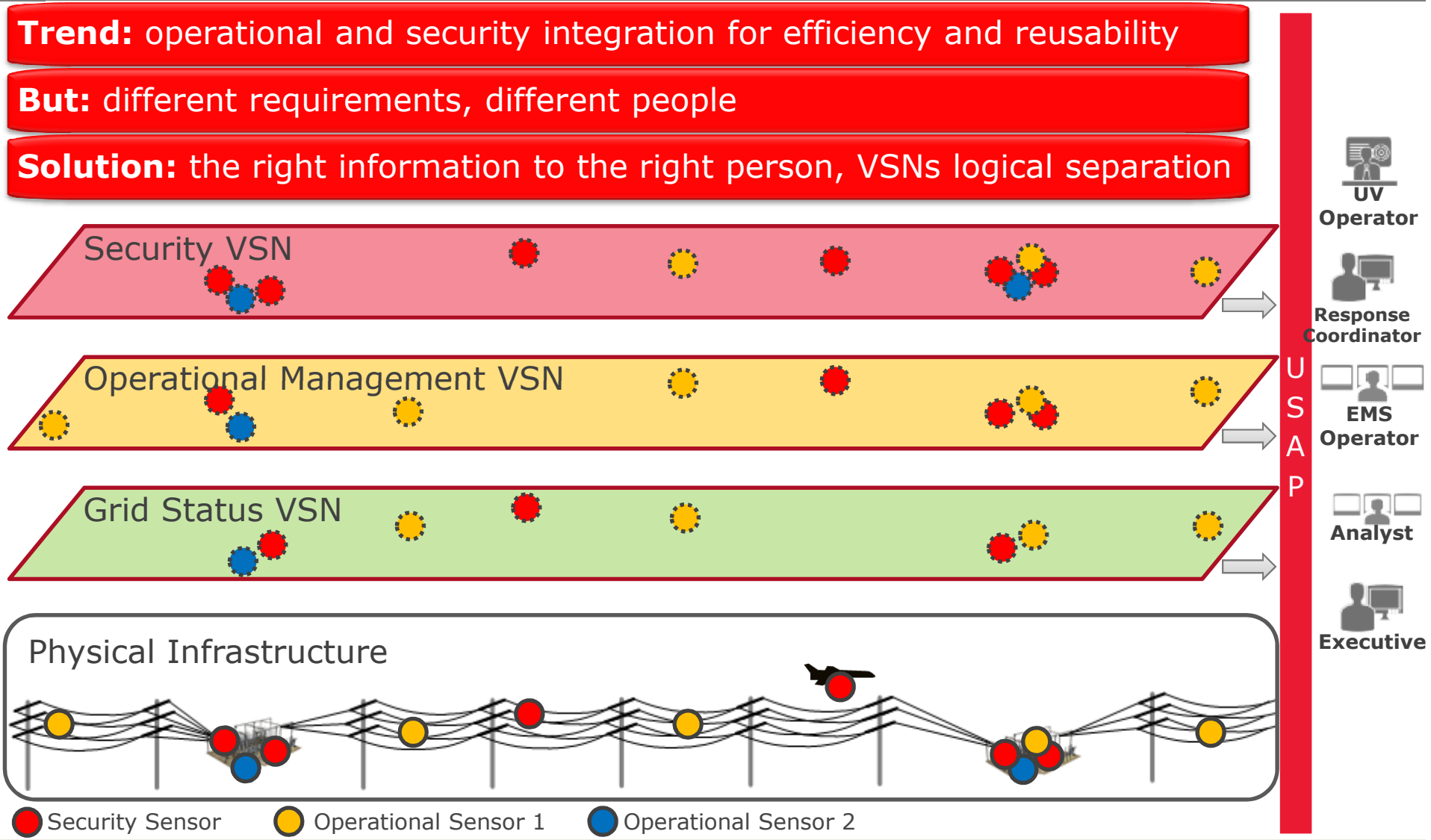


Virtual Sensor Networks

Trend: operational and security integration for efficiency and reusability

But: different requirements, different people

Solution: the right information to the right person, VSNs logical separation



Towards the Next Evolution Wave in the IoT

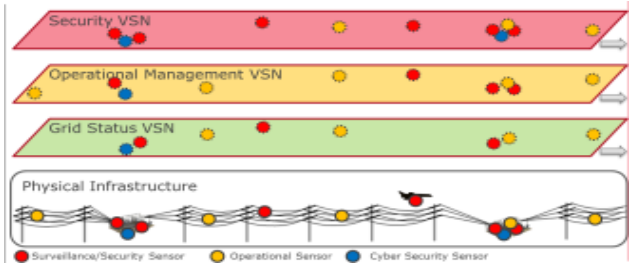
People

Data

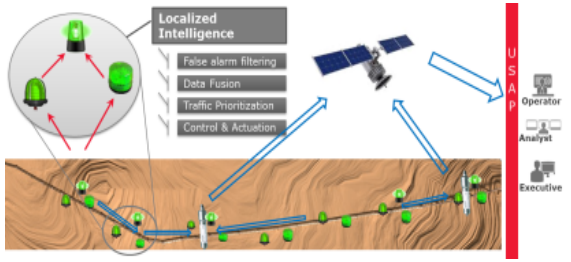
Processes

Things

Virtual Sensors



Virtual Sensor Networks



Soft and Hard Data Fusion

Analytics at the edge

Information Encapsulation

Security and Privacy

Prescriptive Analytics

Pervasive Analytics

Infrastructure Reusability

Enhanced Manageability

Ubiquitous Smart Systems

Machine Learning

Big Data

IoT

M2M

Today and Tomorrow

Today	Tomorrow
Standalone M2M systems	Integrated functions shared by multiple applications
Tedious configuration and management of smart things	Seamless interoperability and autonomic adaptation
Possibility for information leakage	Information encapsulation and role-based access
Large amount of sensor data for centralized analysis	Offloading - Intelligence and Analytics at the edge
Information overload for human consumers	The right information to the right person and detail

UBICOMM 2013 : 10 years of ubiquity
Remaining challenges

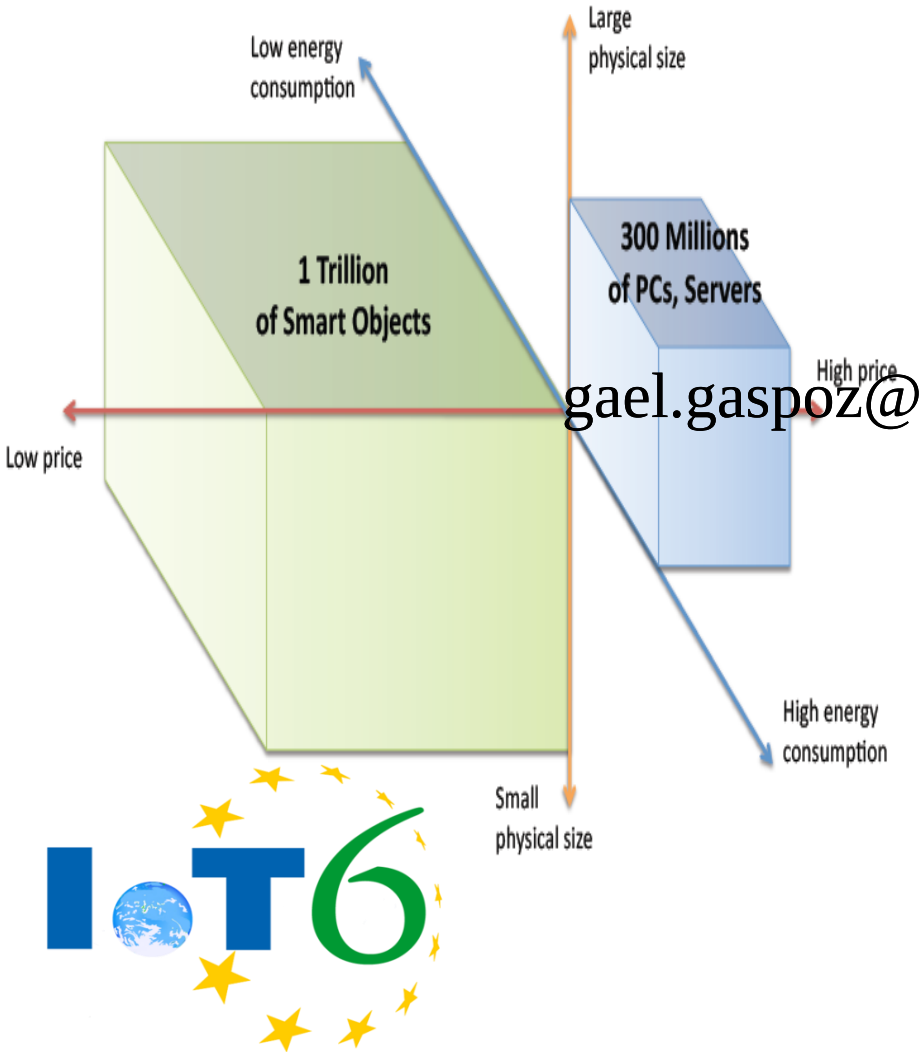
Porto 30.9.2014

Dr . Dominique Genoud Hesso//Valais
Institute of information systems
Switzerland

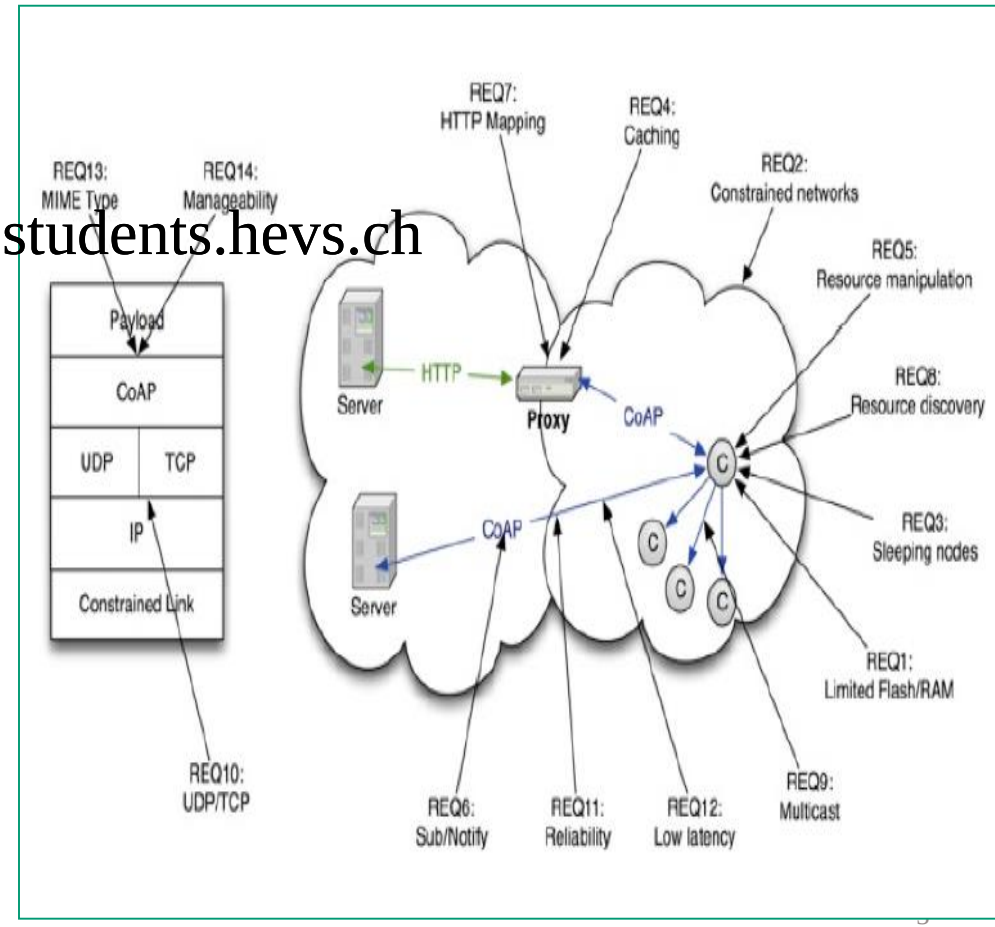
Ubiquitous Computing today's challenges

- Information transport and storage in reality : **interoperability**
- Knowledge extraction using ubiquitous networks
- The energy cost of ubiquity vs purpose
- Purpose of ubiquitous : humans among the machines

Internet of Things challenges : interoperability



gael.gaspoz@students.hevs.ch



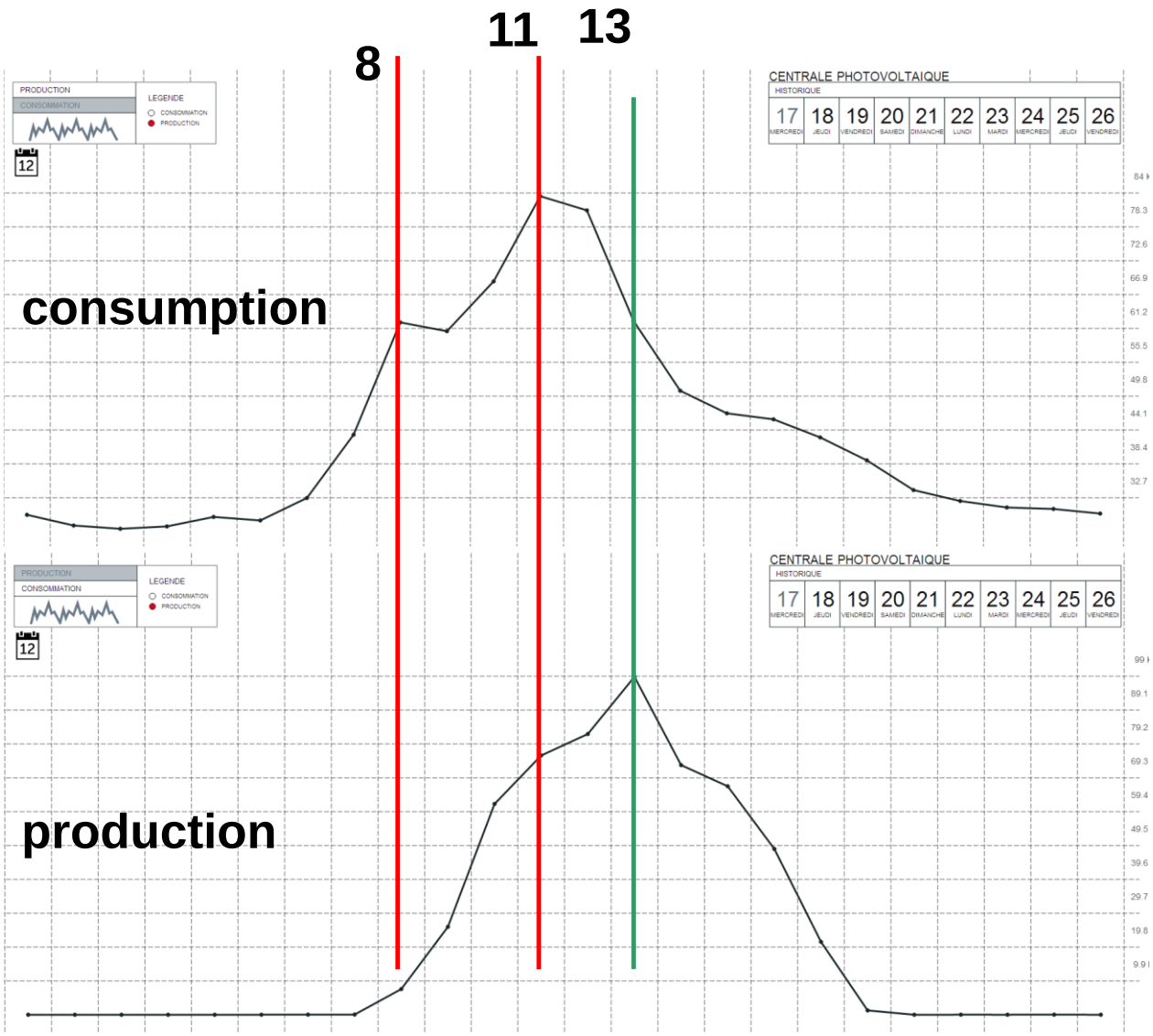
Cloud Computing and IoT

- « out » players need an architecture that is:
  - Standardized
  - Independent
  - Adapted to any automation application
  - Unified management/supervision interface

Knowledge extraction using ubiquitous networks

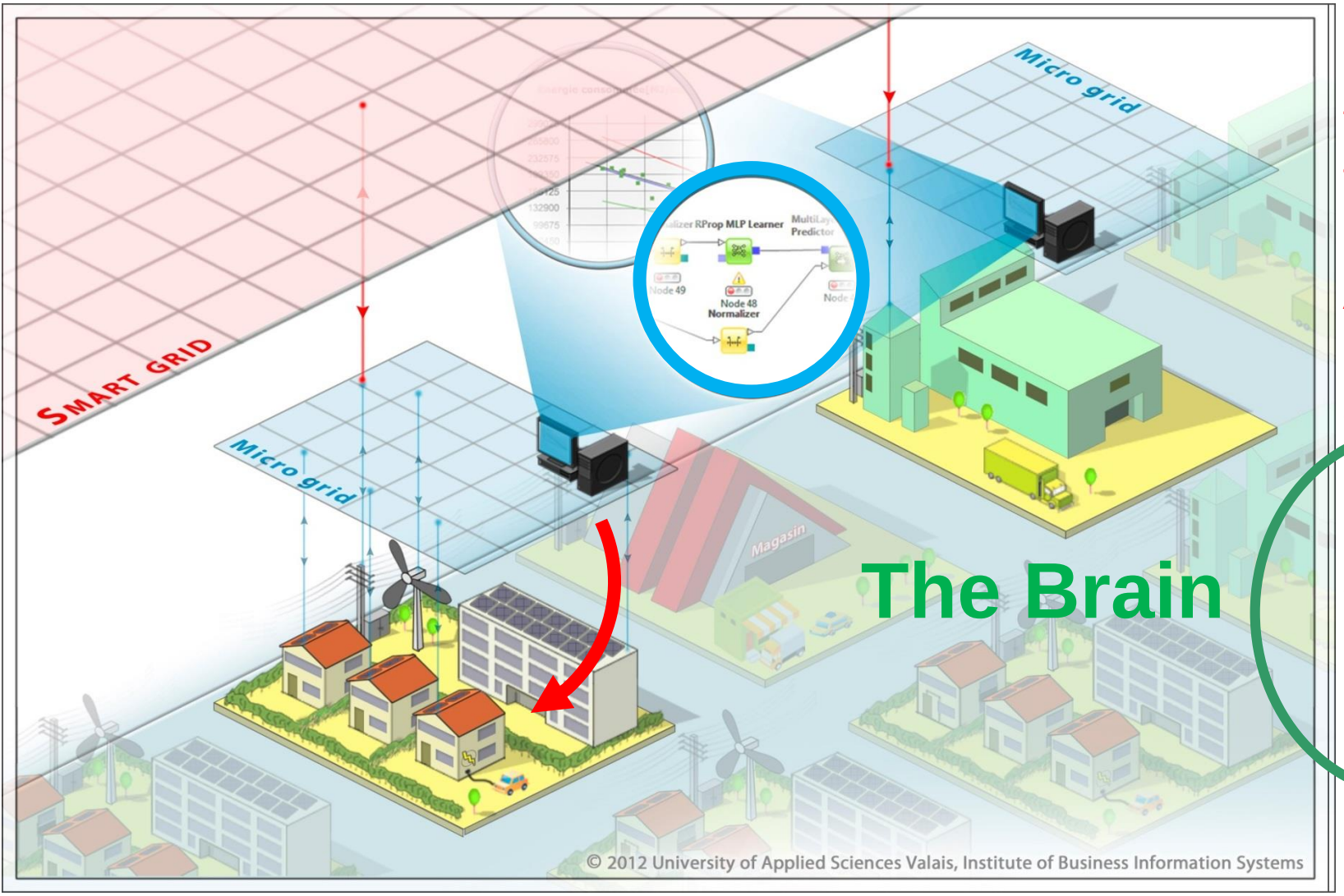
- Data → Models → knowledge
- Microgrid example

Site



- Production and consumption are not in sync

Chosen Concept : block optimisation (microgrid)



Concept :

Transfo 400V

Microgrid Analysis

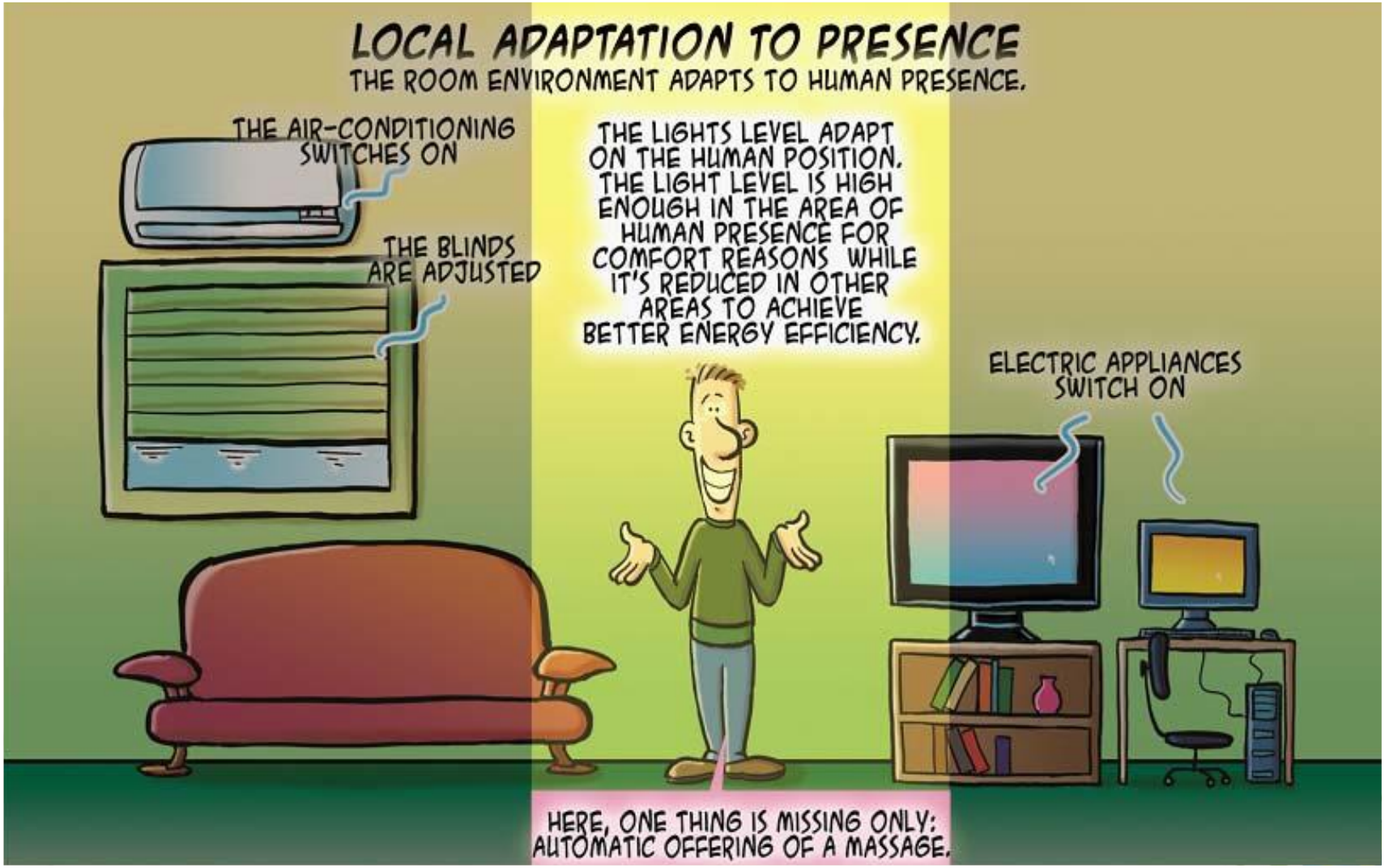
Information extraction

Data intelligence analysis

System activity prediction

System control

The energy cost of ubiquity vs purpose



Purpose of ubiquitous : humans among the machines

- What should be adopted → comfort and help
- What might be rejected → percieved as invasive

- Propose scenarii that can be accepted, pushed by humans

- Definition of new social rules and behaviour → human among machines

- Definition of new machines behaviour → machines among humans

h e p i a

Haute école du paysage, d'ingénierie et d'architecture de Genève

Ubiquitous communication

Security in Smart city

Tewfiq EL MALIKI
(tewfiq.elmaliki@hesge.ch)
University of applied Sciences in Geneva
Telecommunication LAB

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES ÉCONOMIQUES ET SOCIALES
Département des systèmes d'information

Ubiquitous computing

Definitions

Ubiquitous computing is the method of enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user

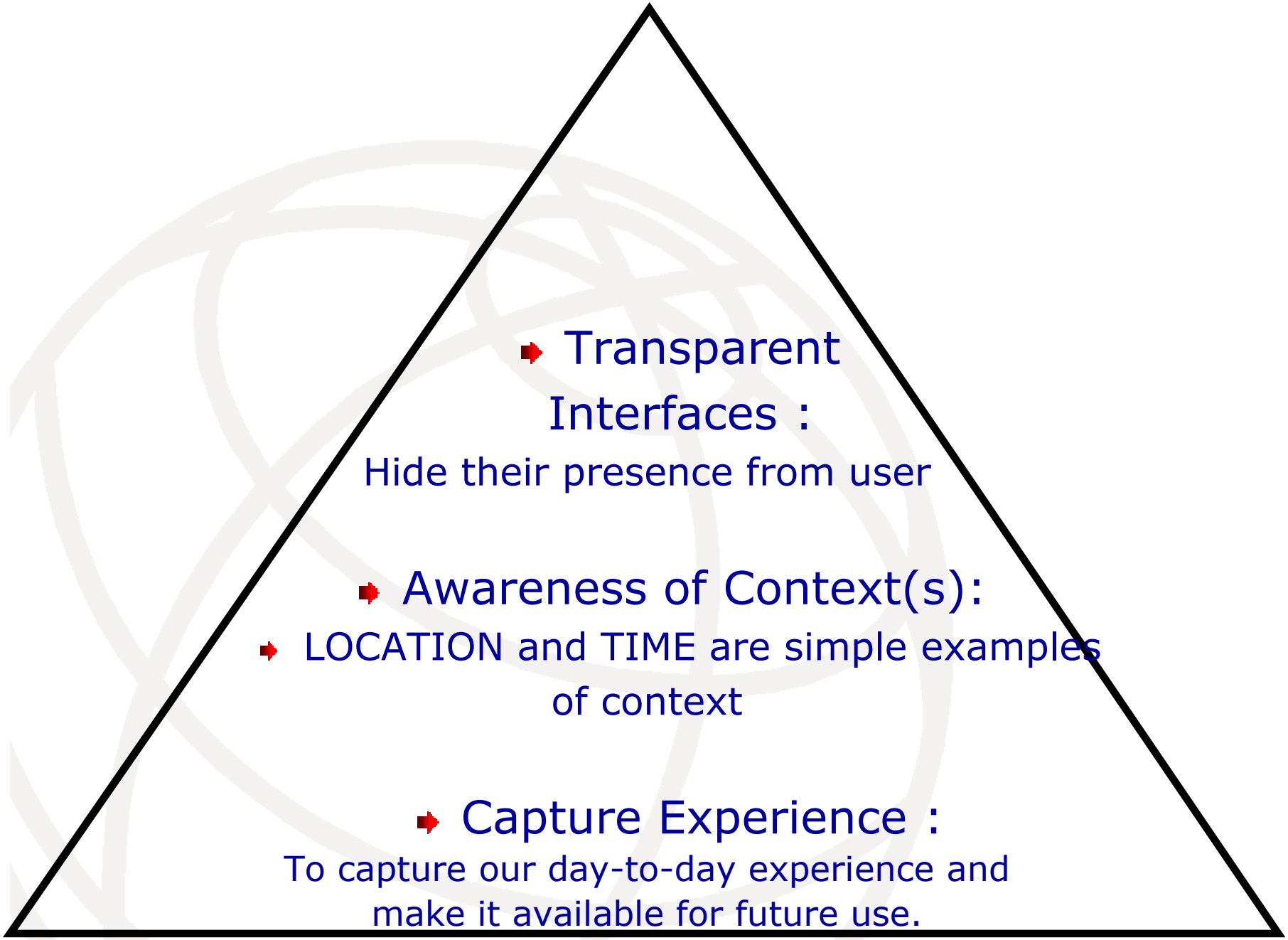
– ***Mark Weiser***

Ubiquitous computing, or calm technology, is a paradigm shift where technology becomes virtually invisible in our lives.

-- Marcia Riley

(Georgia Institute of Technology, Atlanta.)

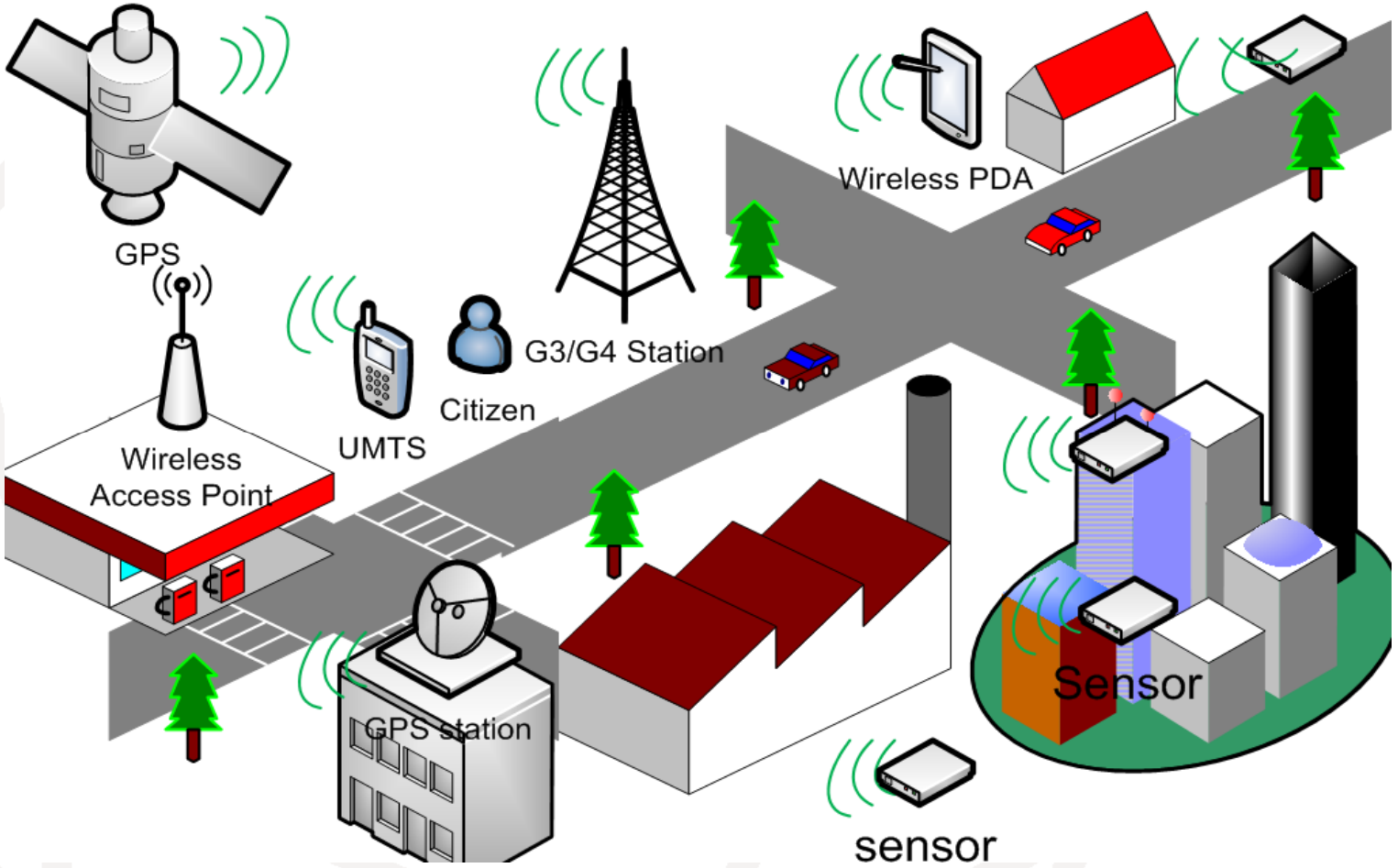
- filling the real world with computers


Transparent Interfaces :
Hide their presence from user
Awareness of Context(s):
LOCATION and TIME are simple examples of context
Capture Experience :
To capture our day-to-day experience and make it available for future use.

Toward ubiquitous computing in Smartcity

- Demographic trends that have already largely been determined will contribute to a substantial reshaping of the global landscape between now and 2050.
- Indeed, people will be far more concentrated in urban areas.
- by 2015, and for the first time in human history, the majority of the world's human population will live in cities.
- According to UN projections, nearly two-thirds of the population of the developing world will live in cities by 2025. [11]

Ubiquitous communication Smartcity

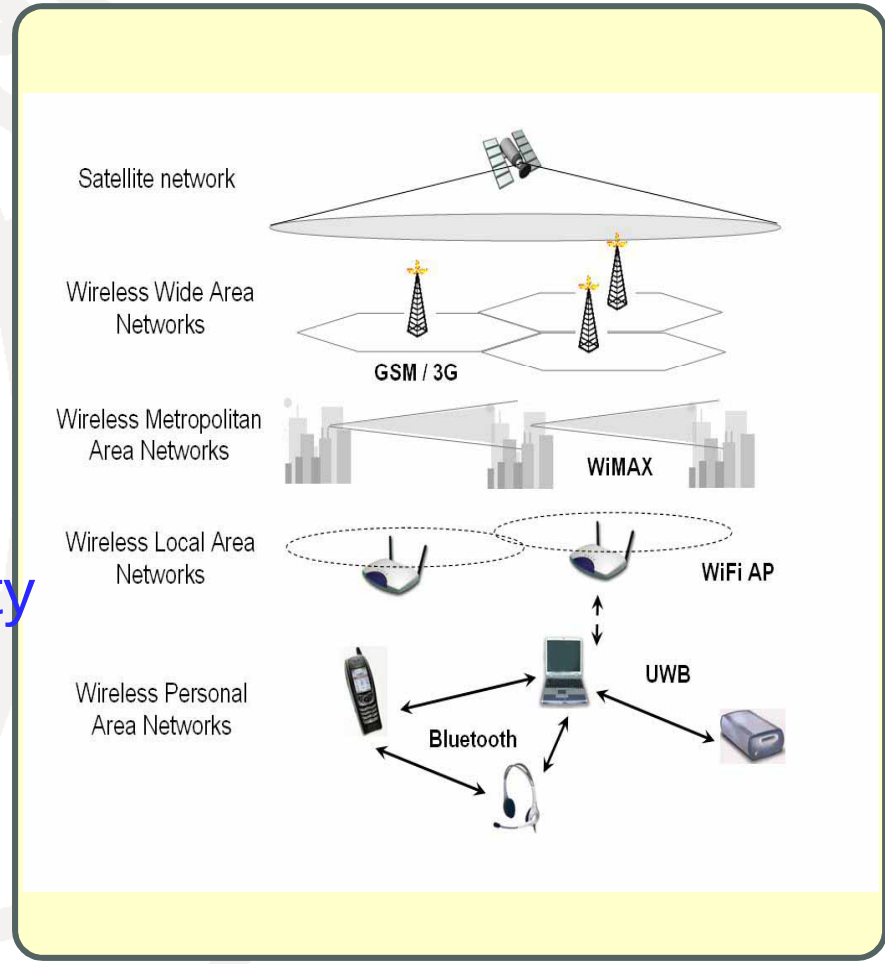


Problems of Security in Smartcity

Networks are increasingly heterogeneous and dynamic

- Dynamic changing attacks
- Applications are unaware of what security mechanisms to use
- Key issue is energy (sensors)
- Network survivability
- Framework

-> Critical to keep the overall security (Runtime changing context)



layered security solutions are inadequate and/or inefficient

- Because of the following limitations [36]:
  - Redundant Security Provisioning: systematic security at each layer consume more resource than necessary
  - Non-adaptive Security Services: Because attacks on a dynamic network come from any layers and any protocols, a countermeasures scheme at only one layer is unlikely to guarantee security all the time.
  - Power Inefficiency: energy efficiency must be addressed because it is a crucial issue in WSN. The power efficiency design cannot be addressed completely at any single layer in the networking stack.

Solutions ?

New solutions are needed

- The concept that must cope with these new security challenges :
  - a. Dynamic adaptation security system to satisfy an overall performance such as power consumption
  - b. Autonomic Computing Security pattern
  - c. Imperative to address these problems from the beginning of the system design
  - d. Using cross layer security

Questions

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UBICOMM 2013 Panel on the Future of Ubiquitous Computing

PROF. TIMOTHY ARNDT, DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE, CLEVELAND STATE UNIVERSITY

Cleveland State University

Ubiquitous e-Learning

- Many of our students work full time
- Can they use "slack" time to study?
- Add value to our educational offerings

Slack times

- Commuting
- Between classes
- Waiting for meeting to start

Ubiquitous e-Learning

- Learning materials viewed on smart phones and tablets
- But ubiquitous means more than just this
  - Time available can vary
  - So can distractions

Situational awareness

- Sensors can help us achieve this
- Ambient lighting & noise
- Camera to capture facial expression to test understanding
- GPS to find nearby classmates for impromptu study
- Need sensor fusion for awareness

Situational awareness

- Also need classification of learning materials
  - Length
  - Difficulty
  - Ordering

Conclusions

- Take advantage of general advances in ubiquitous computing
  - Interoperability - move from vertical to horizontal integration
  - Scale up - e.g. from smart home to smart city
- Lots of work to do!