

Pr Marie-Pierre Gleizes – IRIT - UPS

# Overview of neOCampus initiative in Toulouse 3 University

- ❑ neOCampus Operation
- ❑ Platform of Innovative Experiments
- ❑ Scientific Challenges
- ❑ Scientific Projects



# Location: Université Toulouse III Paul Sabatier

Sudoe

- **30,000** registered students
- **2,500** teachers and teacher-researchers
- **2,000** administrative and technical staff
- **A multidisciplinary science university**
  - Exact Sciences
  - Life and Healthcare Sciences
  - Human, Social, Technological, Physical Activity
  - Sport Sciences



# neOCampus Operation

Sudoe

- Launched by the President of the University B. Monthubert in June 2013
- Supported by the President of the University J-P Vinel
- Initiative of researchers



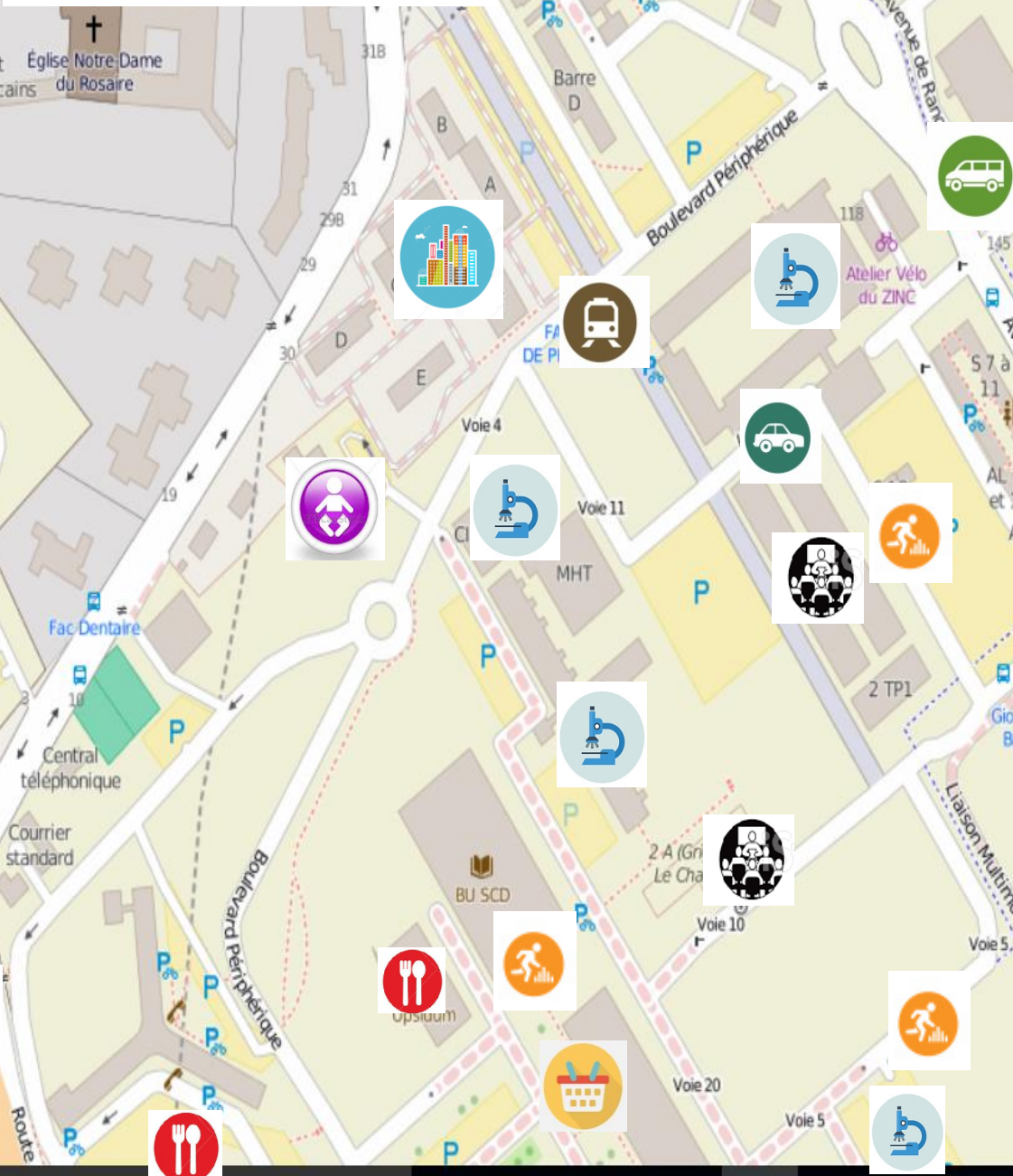
- Comfort to the everyday life for the university community
- Decrease of the ecological footprint of our buildings
- Cost cutting of functioning, in particular for the fluids



ampus



Buildings ~ 407,000 m<sup>2</sup>  
Users ~ 36,000



## Campus = Small city

Classrooms  
Research Laboratories

Flats

Administration

Restaurants

Store

Market

Nursery

Roads

3 subway stations

Buses

Cars

Bicycles

Walkers

BUILDINGS

SERVICES

MOBILITY

ENERGY

# Green and Smart Campus

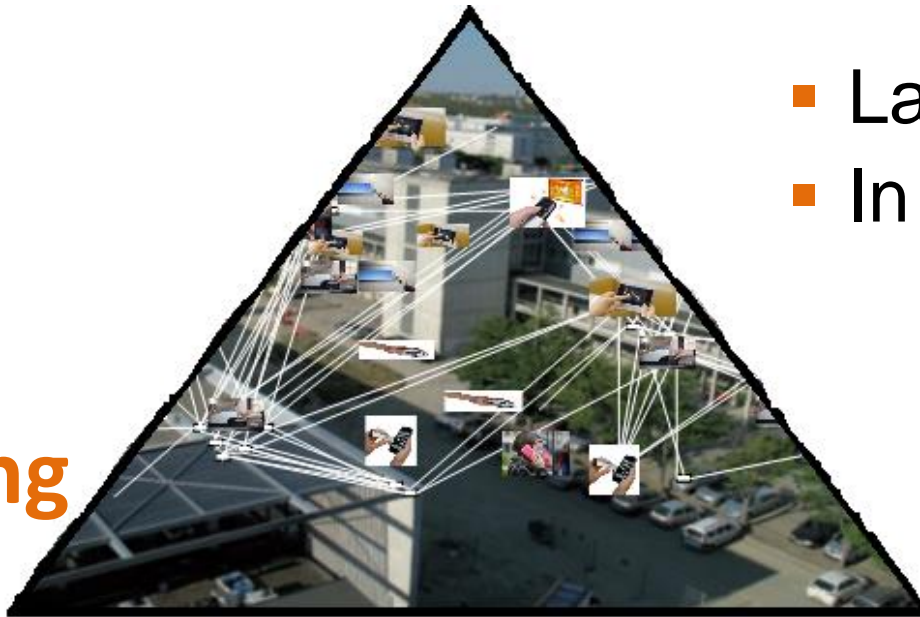
Sudoe

The campus = a platform  
for the deployment of innovative  
experimentations

Research

- Large scale
- In vivo ← **End-users**

Training



Industry

# 11 Research Laboratories

Sudoe

1. **CESBIO** : Centre d'Etudes Spatiales de la BIOsphère
2. **CIRIMAT** : Centre Interuniversitaire de Recherche et d'Ingénierie des Matériaux
3. **ECOLAB** : Laboratoire écologie fonctionnelle et environnement
4. **IRIT** : Institut de Recherche en Informatique de Toulouse
5. **LA** : Laboratoire d'Aérodynamique
6. **LAAS** : Laboratoire d'Analyse et d'Architecture des Systèmes
7. **LAPLACE** : Laboratoire Plasma et Conversion d'Energie
8. **LCC** : Laboratoire de Chimie de Coordination
9. **LERASS** : Laboratoire d'Études et de Recherches Appliquées en Sciences Sociales
10. **LMDC** : Laboratoire Matériaux et Durabilité des Constructions
11. **PHASE** : Physique de l'Homme Appliqué à Son Environnement

➔ Interdisciplinarity  
**ne@campus**

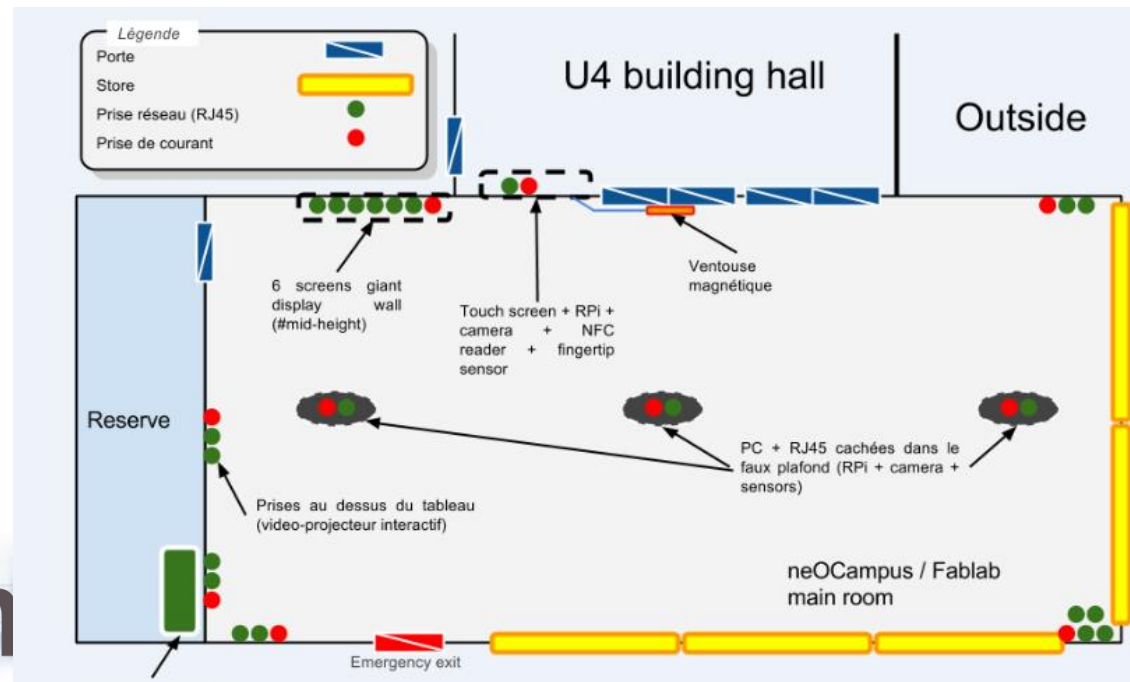
- **Members**
  - 70 Permanent lecturers/researchers
  - 20 Non permanent (UPS and Region–UPS)
- **Material**
  - Show-room
  - Lighting platform (UPS-PHILIPS)
  - WIFI neOCampus
  - Server neocampus.univ-tlse3.fr on the cloud platform CloudMI
  - neOCampusLabs: 3 classrooms

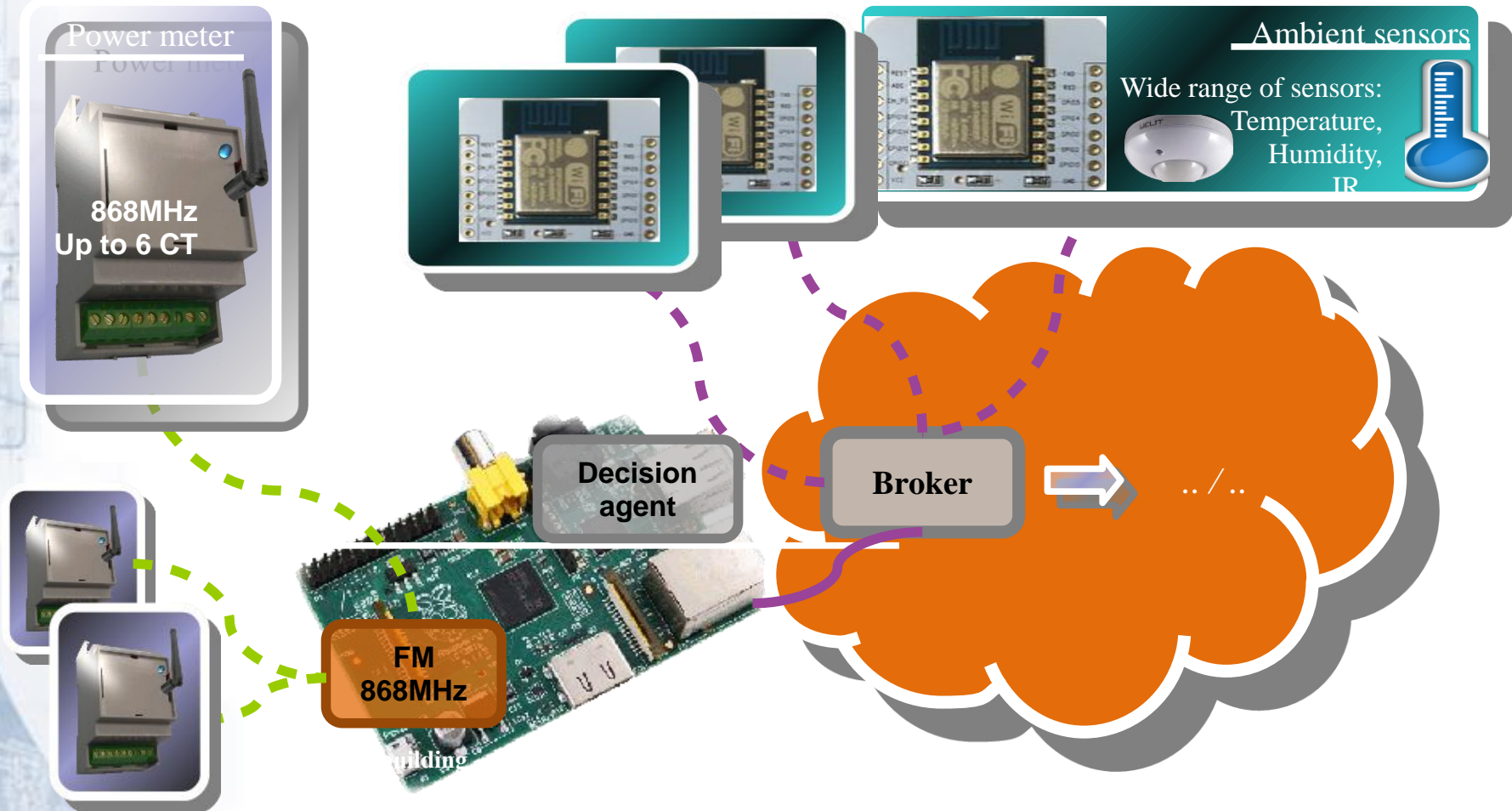


# Show-room CampusFab + neOCampusLabs



- Camera
- Sensors of luminosity, temperature,...
- Electric consumption
- Effectors: shutters, lights, video-projectors...



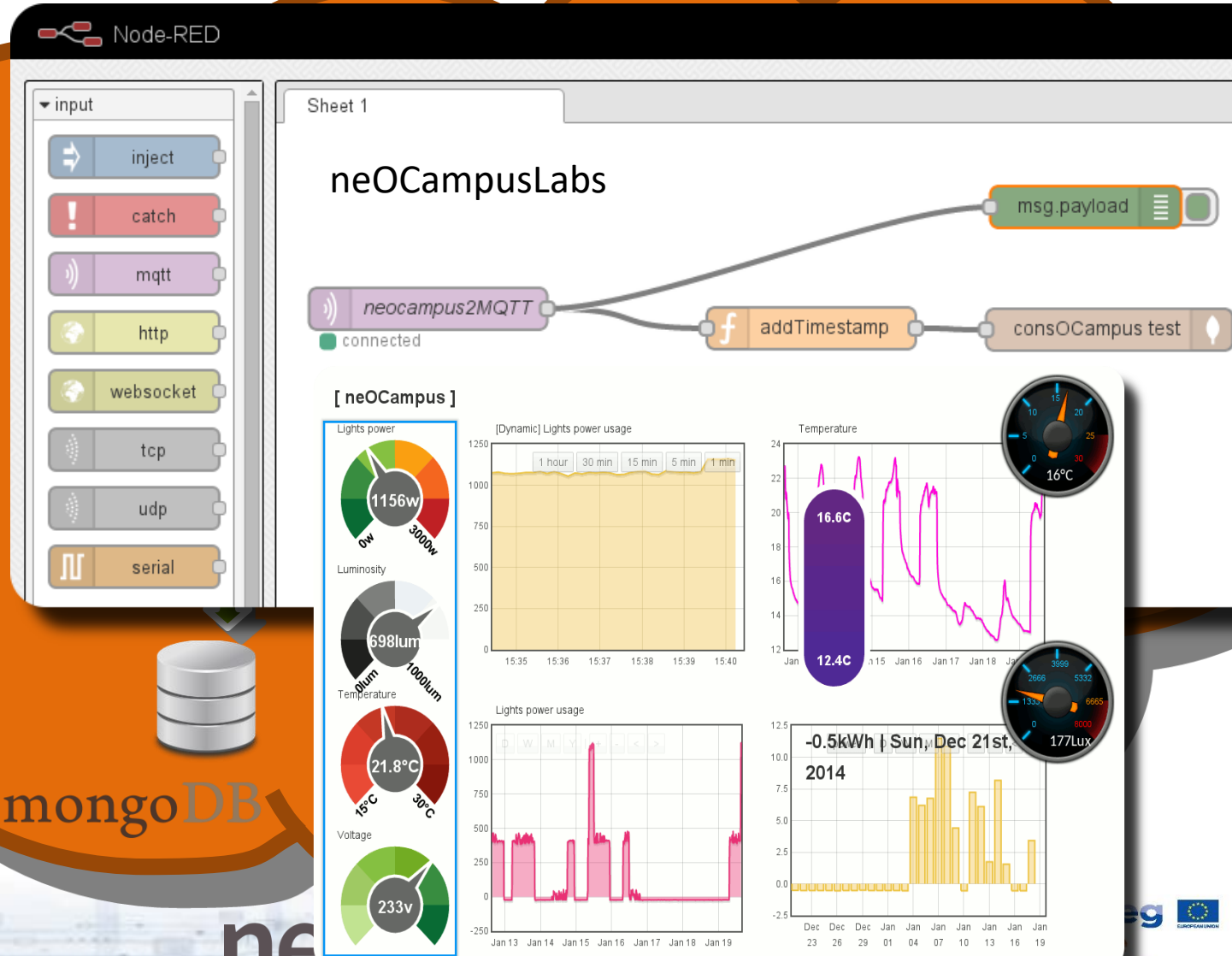


*\*At least, one Raspberry Pi per building in order for power meters to get reachable from its 868MHz link.*

# Infrastructure

Sudoe

Broker





# The university of the Future is possible today!

Sudoe

## ❑ Progressive evolution

The evolution towards the smart university will be progressive, without must be thought 20 years in advance

## ❑ Incremental approach

### ❑ Interoperability

### ❑ Open source

- SW and Physical devices
  - Resources sharing between projects
  - Driven by users needs: university technical services, library...
- Local distribution of research experiments

## ❑ Hybrid and multi-view simulation platform design

- Real sensors– simulated sensors

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- ❑ Hybrid simulation platform PAULSAB
- ❑ Energetically effective campus
  - ❑ Distributed production and storage
  - ❑ Converters and networks of lighting
  - ❑ Materials
  - ❑ Sensors
  - ❑ Energy saving in a network smart-grid, in a cloud
  - ❑ Monitoring of the System Indoor Environment - Occupant
- ❑ Management of the water and the air
- ❑ Quality of life and service in buildings
- ❑ Quality of life and service outside of buildings
- ❑ *Interdisciplinary design method*

# Smart City, Campus Main Characteristics

Sudoe

- Composed of heterogeneous cyberphysical systems
- Distributed
- Open
- Alive
- Big data
- Existing infrastructure, buildings
- End-users/actors
- Complex

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# Some Challenges

Sudoe

- Autonomy
  - Don't need human intervention
  - No cognitive overload
- Self-Adaptation
  - To end-users, changes
- Scalability
  - Thousands of sensors and effectors
- Bottom up approach
  - No finality
- Sustainable
  - Energy efficiency
- Big Data
  - Privacy, security, storage, analysis

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- **Autonomy** → each component is able to perceive, decide and act
- **Self-adaptation** → self-organisation of components using local knowledge
- **Scalability** → distribution and local knowledge
- **Bottom up approach** → self-organisation
- **Sustainable** → self-observation and self-maintaining
- **Big Data** → let the data in each component, when it is possible

# Some projects



# Energy Efficiency

Sudoe

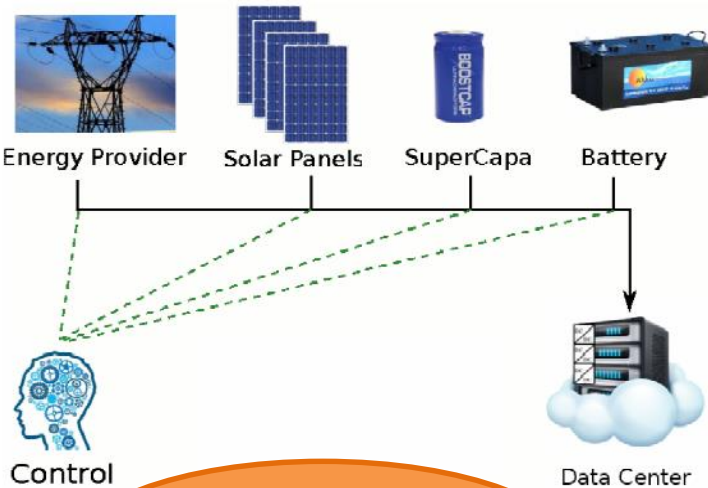
Energy  
Management



Storage units modelling and study  
Lead-Acid batteries

Better comfort

Material with hemp



Optimisation for  
mix energetic



Lithium iron phosphate  
batteries



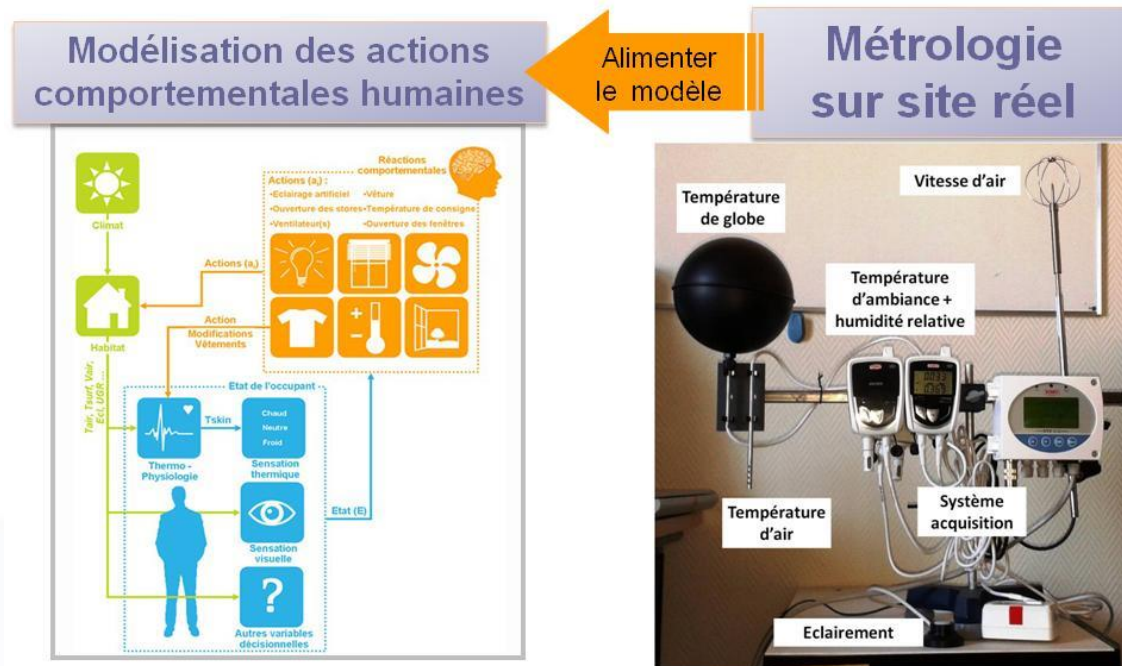
Lithium supercapacitors  
and hybrids



# MSH<sup>2</sup>: Monitoring of the System Indoor Environment - Occupant

Sudoe

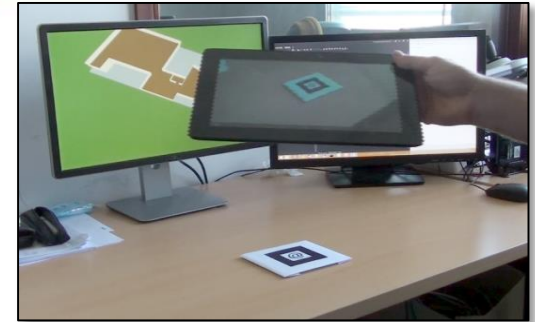
- Study the impact of the human thermal and visual sensations on his(her) reactions towards the atmospheres



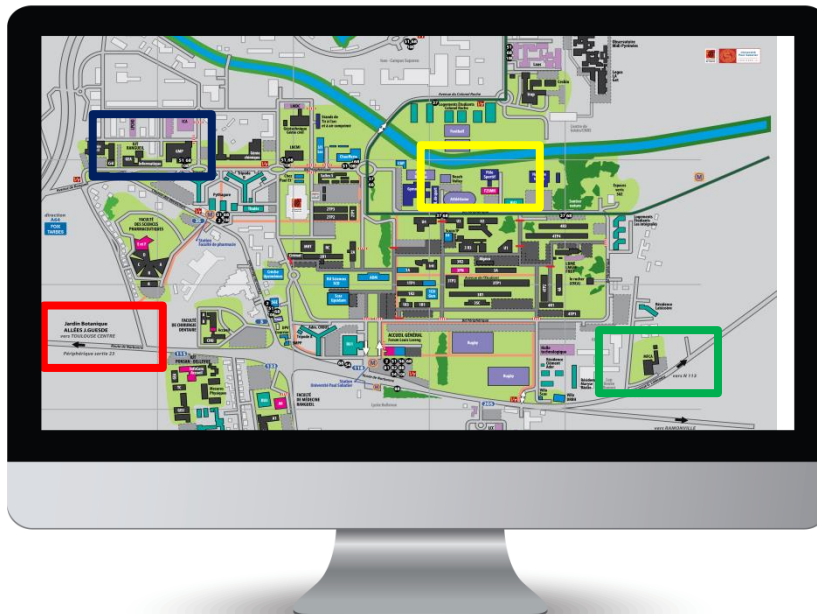
# Centered on the user

Sudoe

- Self-Adaptation
- Privacy
- Pervasive system
- Innovative Interaction



Spatial Mode  
Overview+ details

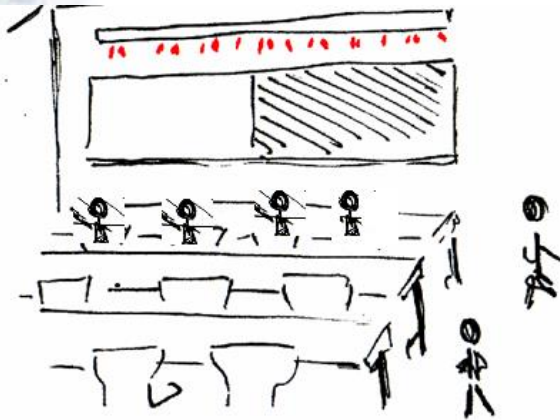




# Emergence of services

Sudoe

- Spontaneous indication of a path



Relevant  
Information

- Number of students on the campus
- and preparation of the meals

Data correlation  
Big data



# consOCampus: Comfort and Consumption Optimisation

Sudoe

- Orchestration of multiple effectors/sensors: *shutters, lights, presence, luminosity*
- Scalability
- Intelligence in sensors and effectors

## Solution: Multi-agent systems

- Decentralized decision
- Open
- Self-adaptive

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## cons@campus

RÉDUCTION DES CONSOMMATIONS  
ET AMÉLIORATION DU CONFORT

### DÉMONSTRATION

- Interdisciplinary
  - In vivo projects
  - Innovative
- 
- Sharing resources for research but also for Services inside the university



# Thank you for all the participants in neOCampus



## Thank you for your attention