

International Hellenic University

‘Education and Research on Modern Technologies and Sustainable Growth’

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Dean

School of Science and Technology



Outline

- ✓ The International Hellenic University (IHU)
 - School of Science and Technology Programmes

- ✓ The Smart IHU project
 - Scope
 - Architecture
 - Results

- ❑ **State University with full recognition**
- ❑ Established in Thessaloniki in 2005 (Law No. 3391 October 2005)
- ❑ All programmes are **exclusively** taught in English
- ❑ Three Schools
 - *Science & Technology*
 - *Economics and Business Administration*
 - *Humanities*



School of Science and Technology Programmes

<http://www.tech.ihu.edu.gr/>

School of Science and Technology provides the student with an **interdisciplinary scientific foundation** of 1 year duration (**Full time**) or 2 years duration (**Part time**) in the areas of

- Master of Science (MSc) in ***Information & Communication Technology (ICT) Systems***
- Master of Science (MSc) in ***Energy Systems***



Four state-of-the-art specialisations

<http://www.tech.ihu.edu.gr/>

1. Health Information Systems

Health Information Systems support the current global trend in promoting quality of life, support for the elderly, remote and easy public access to medical information and services.

(e-care, tele-medicine, clinical records, medical research)

Courses:

- E-Health and Tele-care
- Clinical Information Systems
- Data Protection
- Medical Imaging
- Consumer Health Information Systems
- Database Management Systems
- Ubiquitous Computing
- ICT Law and Regulation



Four state-of-the-art specialisations

2. Information Systems for Sustainable Growth

A dominant trend in European and Global policies is to incorporate modern ICT solutions, pertaining to:

- Green ICT
- Energy management
- Environmental protection
- Natural Hazards
- Sensor Networks applications
- Public Safety



Courses:

- Sensor Networks
- Crisis and Disaster Management, Policies & Forecasting
- Environmental Monitoring
- Green ICT
- Geographical Information Systems and Remote Sensing
- Information Systems for Public Safety and Security
- Ubiquitous Computing
- ICT Law and Regulation

Four state-of-the-art specialisations

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3. Information Systems Management

Integral part in all modern and future enterprise and governmental services
(e-government, e-commerce, network security)



Courses

- Advanced Information Systems: Design, Development and Maintenance
- Financial and Enterprise Information Systems
- E-Commerce & E-Government
- Knowledge Management
- Multimedia Content Management
- Information Systems Security
- Database Management Systems
- ICT Law and Regulation

Four state-of-the-art specialisations

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4. Communication Systems Management

Telecommunications are still a booming technology sector, indispensable for modern society and businesses (wireless communications, ad-hoc networks, services management, Telecommunication companies)



Courses:

- Mobile Communication Networks
- Computer Networks
- Network and Services Management
- Multimedia Content Management
- Information Systems Security
- Marketing and strategies for Telecoms companies
- ICT Law and Regulation

MSc in Energy Systems



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The following Core Modules are required for all three streams of specialisation:

- Intro to Energy Technology Systems
- Intro to Energy Economics & Quantitative Methods
- Energy Project Valuation & Financing
- Energy Law in Europe



MSc in Energy Systems



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Three cutting edge specialisations

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1. Energy Systems Management

Financial, managerial, legal aspects of modern energy systems and introduction to current fossil and renewable energy

Courses:

- Fossil Fuels and Renewable Energy Economics
- Energy Markets, Trading and Risk Management

- Energy Strategic Management & Enterprise
- Emission Allowance Markets
- Environmental Law & Policy for Natural Resources & Energy
- Energy Transportation
- Energy Efficiency & Savings



Three cutting edge specialisations

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2. Renewable Energy

Modern renewable energy technology with an introduction to the managerial/financial aspects of energy systems

Courses:

- Renewable Energy I: Hydro, Tidal, Wave & Bio-energy
- Renewable Energy II: Wind, Solar & Geothermal

- Energy Transmission & Storage
- Autonomous Energy Networks (Smart Grids)
- Hydrogen Energy
- Sustainable Built Environment
- Energy Conversion Technologies
- Energy Efficiency & Savings



Three cutting edge specialisations

<http://www.tech.ihu.edu.gr/>

3. Fossil Fuels & Environmental Protection

Conventional fossil fuel technology with all the latest technological advances in energy efficiency with reduced environmental impact including managerial/financial aspects of energy systems

Courses:

- Clean Fossil Fuels
- Environmental Pollution & Control Emissions

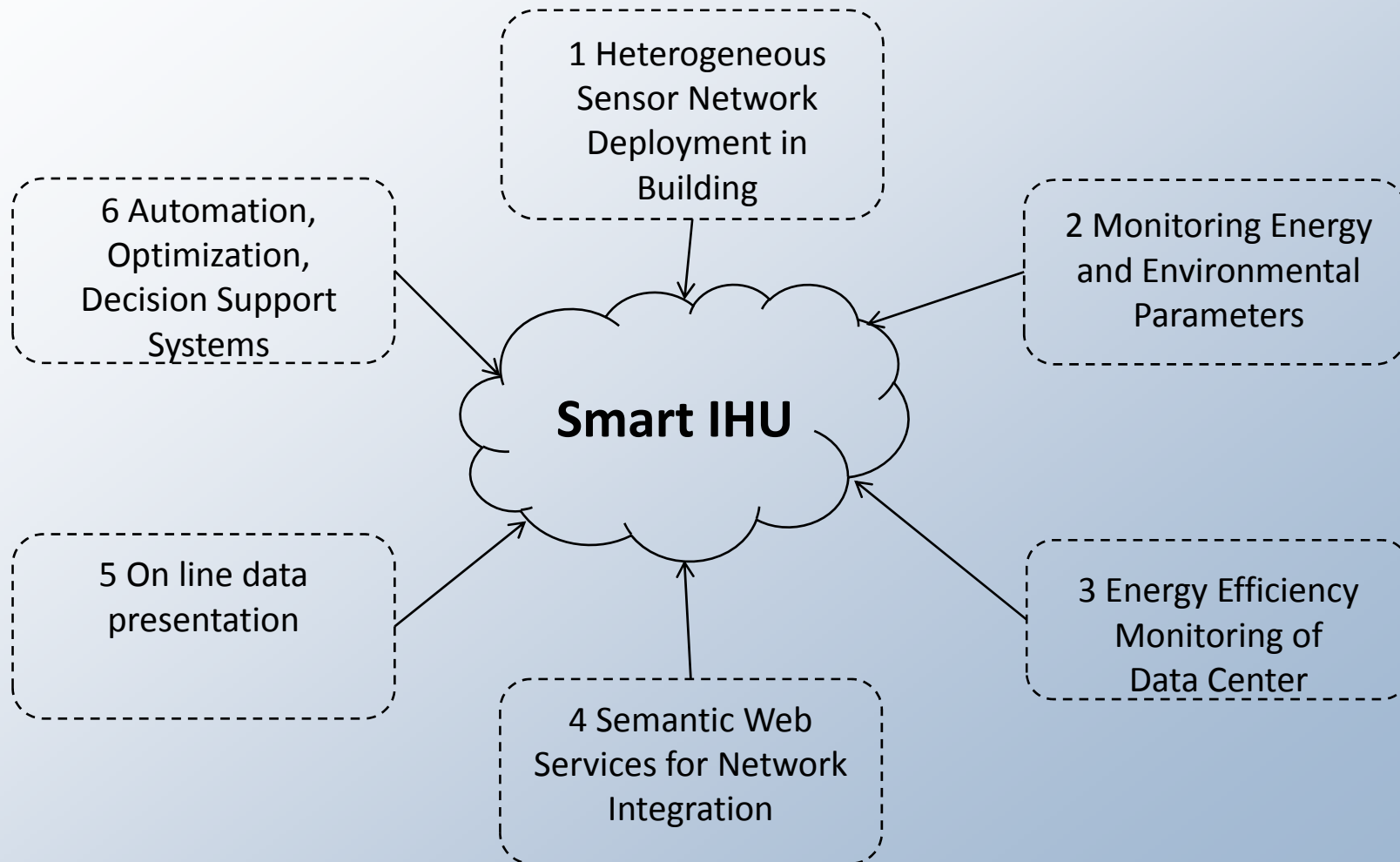
- Energy Transmission & Storage
- Fuel Cell Systems
- Sustainable Transport
- Nuclear Energy Systems
- Urban Energy Systems
- Energy Efficiency & Savings



Smart IHU Project

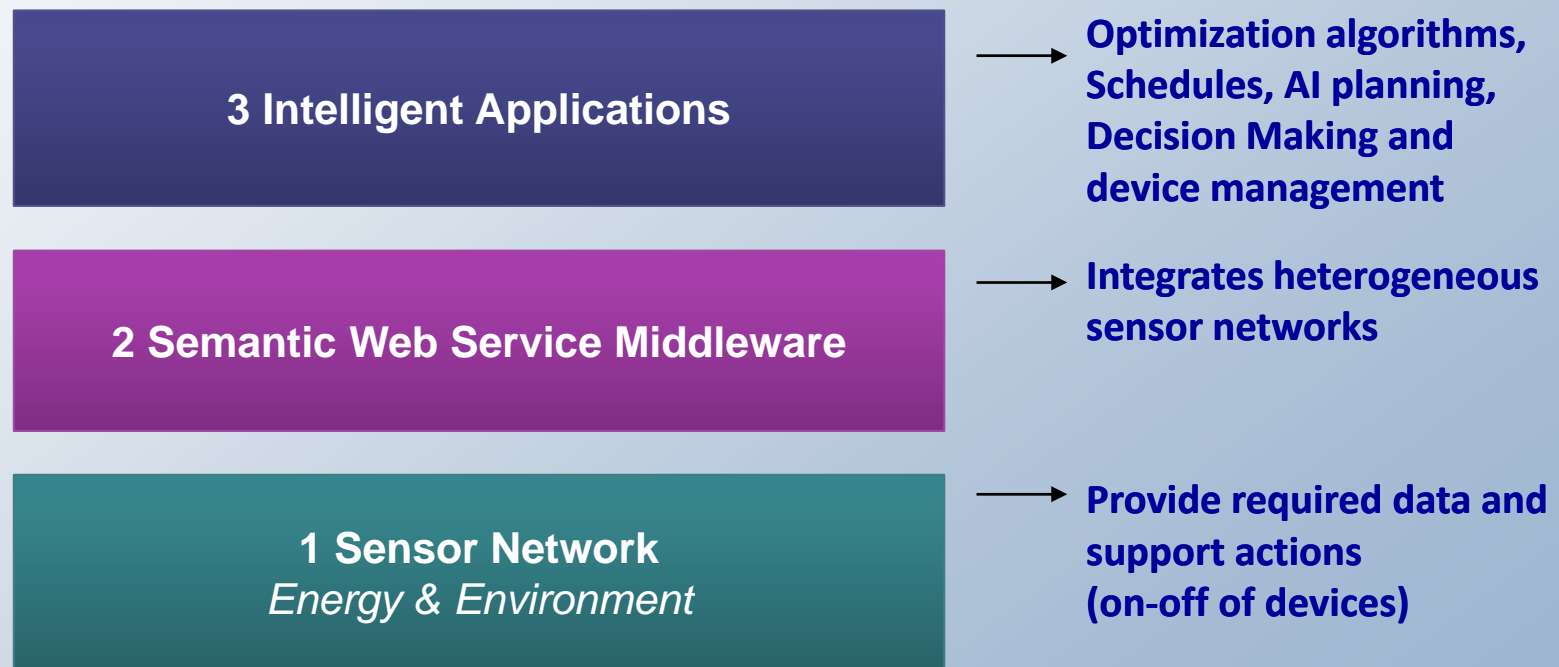
- ❑ Based on the Smart Building architecture International Hellenic University is carrying out an interdisciplinary research project entitled as '**Smart IHU**' in the field of ICT for Sustainable Growth, Energy efficiency and better quality of life.
- ❑ The aim is to deploy heterogeneous sensor networks that measures in real time critical environmental and energy parameters and develop Decision Support Systems for efficient energy management and automation at IHU

Smart IHU Scope



Smart IHU Layers

- Smart IHU will minimize the consumed energy of the University building and provide the required foundation for the efficient penetration of Renewable energy sources (e.g. Photovoltaics)



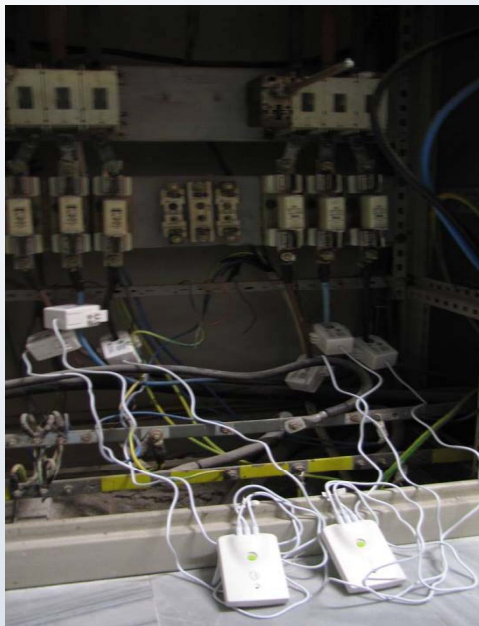
Layer 1: Large Scale Energy Monitoring



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The large scale energy consumption is monitored with a wireless star network topology of Smart Clamp Meters – OWL Business Pack (OWL electronics)



- Compatible to 3-phase installations
- Wireless link: 433 MHz Radio Frequency
- Real-time & Accumulated Display (Memory Function)

We monitor the energy consumption of the 3-phase installation at:

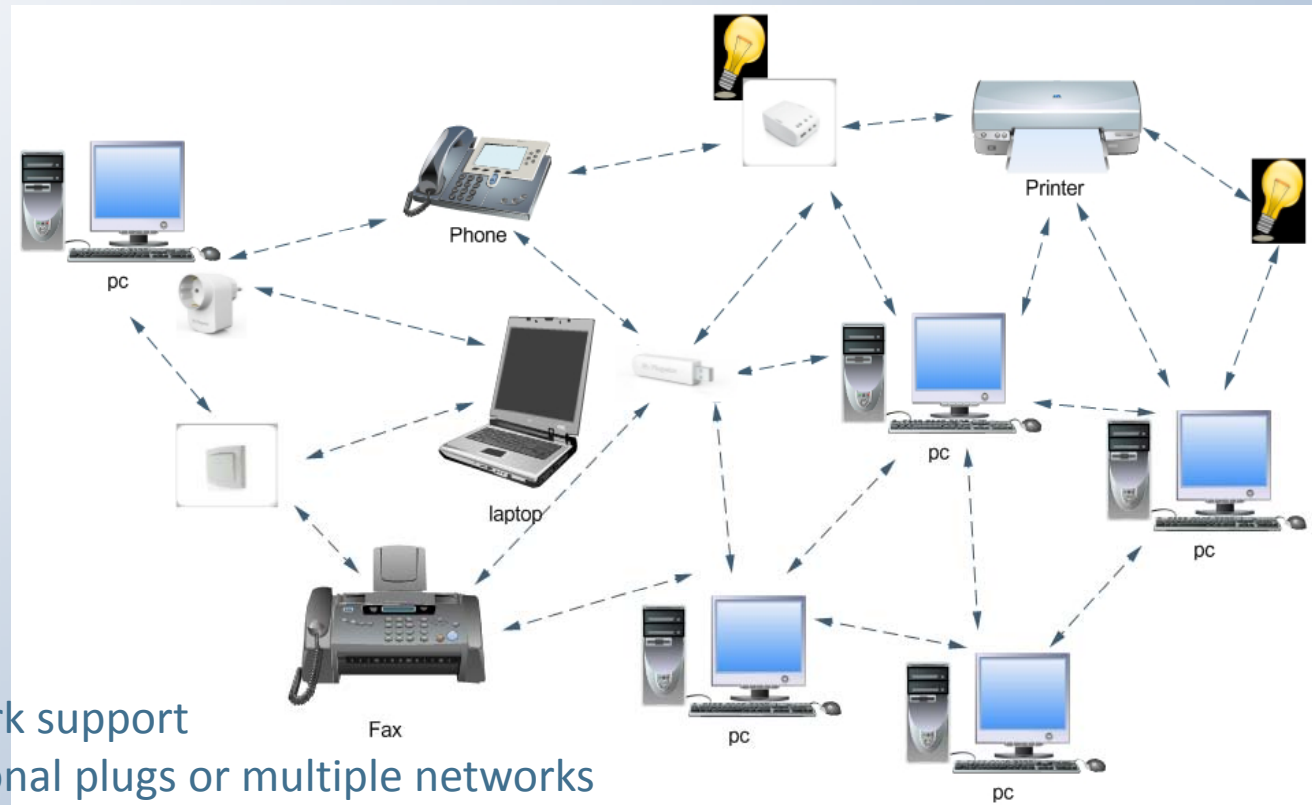
- the IHU building
- the IHU data center



Small Scale Energy Monitoring

<http://www.tech.ihu.edu.gr/>

The small scale energy consumption is monitored with a wireless mesh ZigBee network topology of Smart Plugs (Plugwise) deployed in every plug socket and electrical panel (box) of the building



- ZigBee technology
- Full dynamic 'MESH' network support
- Easily extended with additional plugs or multiple networks
- It supports very large networks (1000's)
- 128-bit AES encryption

Environmental Parameters Monitoring



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Environmental parameters are monitored through a mesh ZigBee wireless network (PRISMA electronics). Parameters that are considered now are

- ✓ Luminance
- ✓ Humidity
- ✓ Temperature



- A developing platform of wireless sensors
- Utilizes Zigbee wireless communication protocol
- Open source
- Gateway PRO 1112
(Zigbee to WiFi, Zigbee to Ethernet 10/100 or zigbee to RS232/485)
- Quax-DP PRO
Sensors: Temperature, humidity and luminance
- Server side software based on Microsoft framework 3.0

Layer 2: Semantic Web Service Middleware (1/3)



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Service Oriented Architecture (SOA)

- Technological paradigm of future IT systems
- Critical enabler of the Ambient Intelligence vision

Areas of Research :

Service Discovery ([UDDI](#)), Description ([WSDL](#), [OWL-S](#)), Composition

SOA provides :

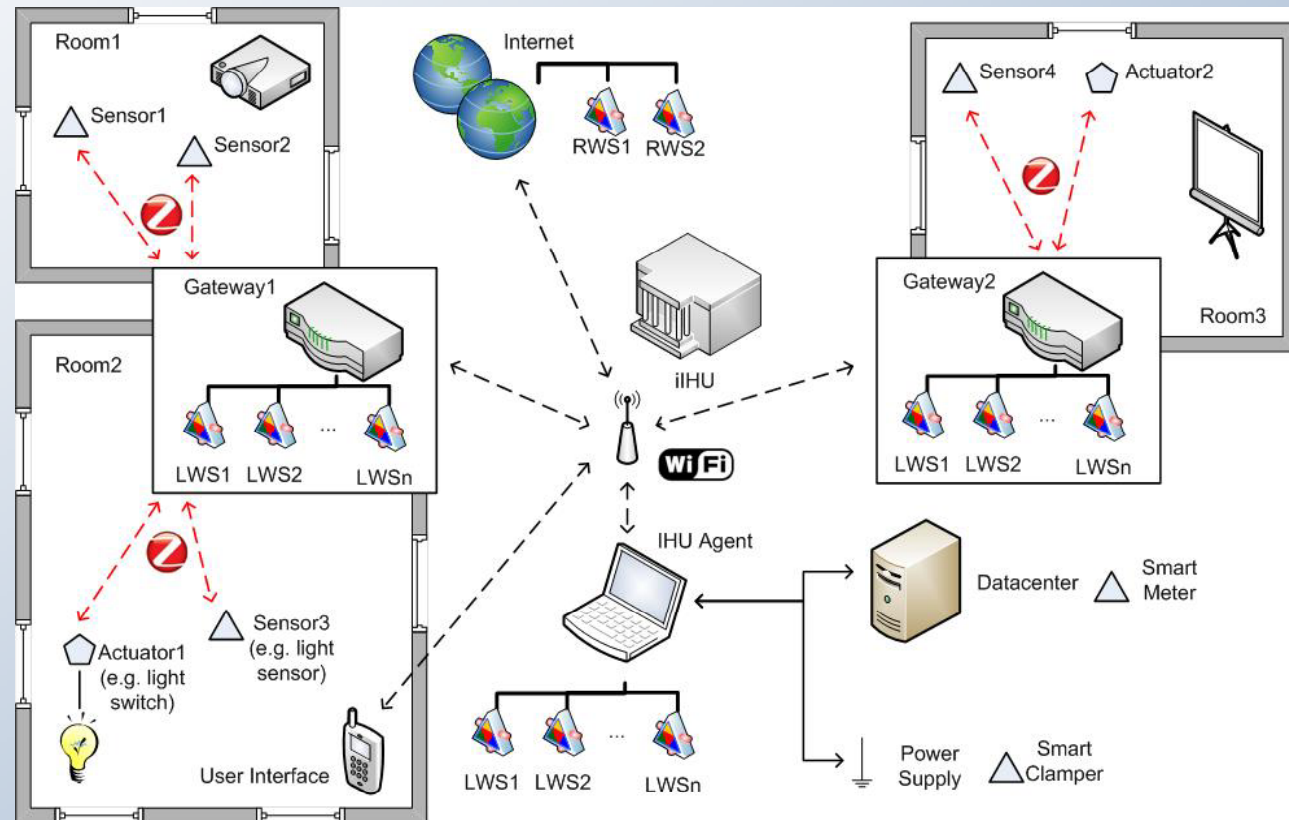
- Homogeneous access to sensor data and actuator functions
- Remote access
- Platform independent

Semantic Annotation enables :

- Machine interpretable
- Reasoning
- Research : Ontology for Aml Services
 - OWL-S language

Abstract Topology

- Central IHU Agent Collects WSN Data (e.g. via WiFi)
- Gateways & IHU Agent expose data and functions via Web Services
- Remote access to local service via the Internet and vice versa



Semantic Web Service Middleware

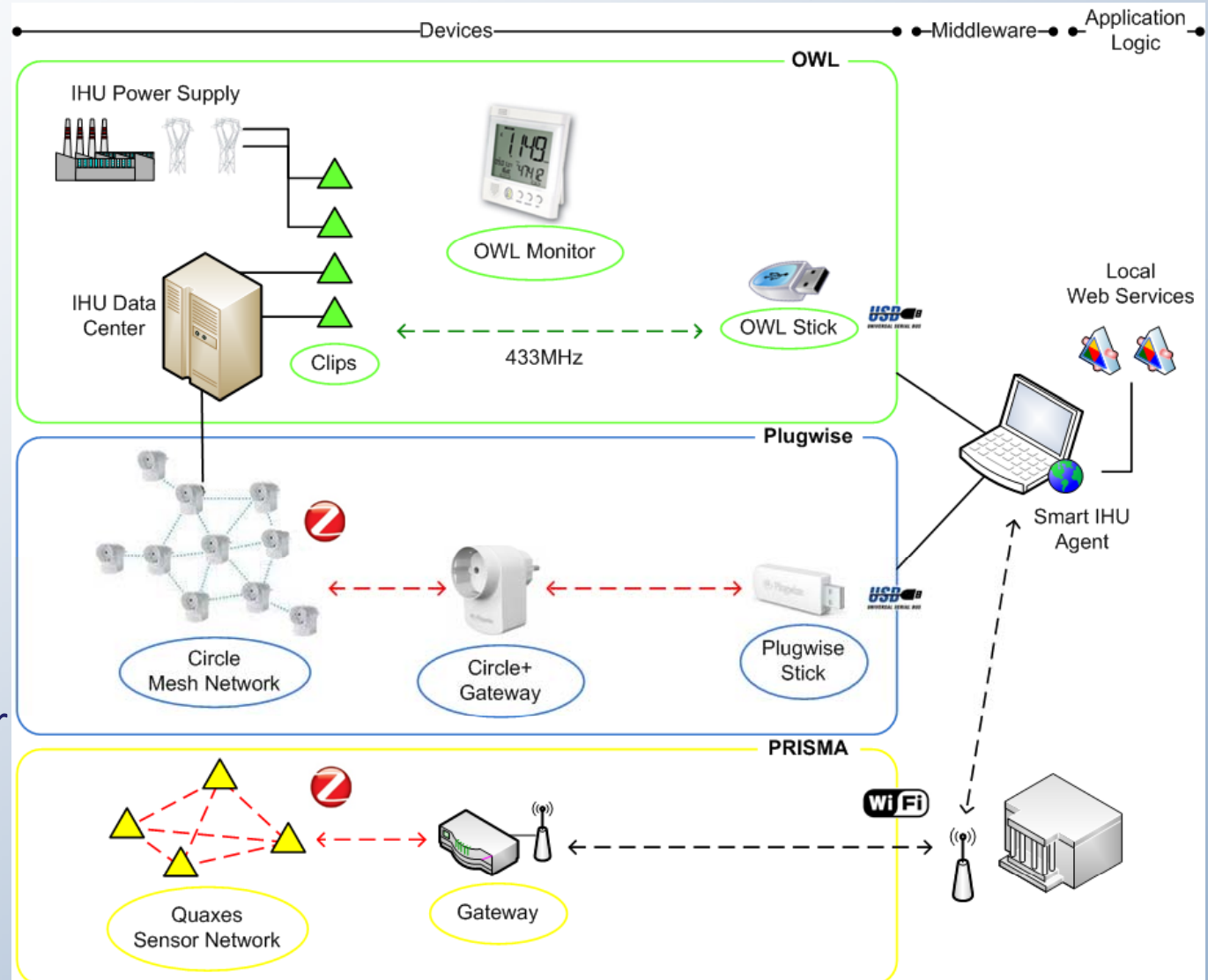


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Our current topology

- 3 WSNs
(Wireless Sensor Networks)
- Connect via USB or WiFi
- Expose data and functions via Web Services
- Access on a Browser or GUI





Layer 3: Intelligent Applications

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Based on Web Service Middleware

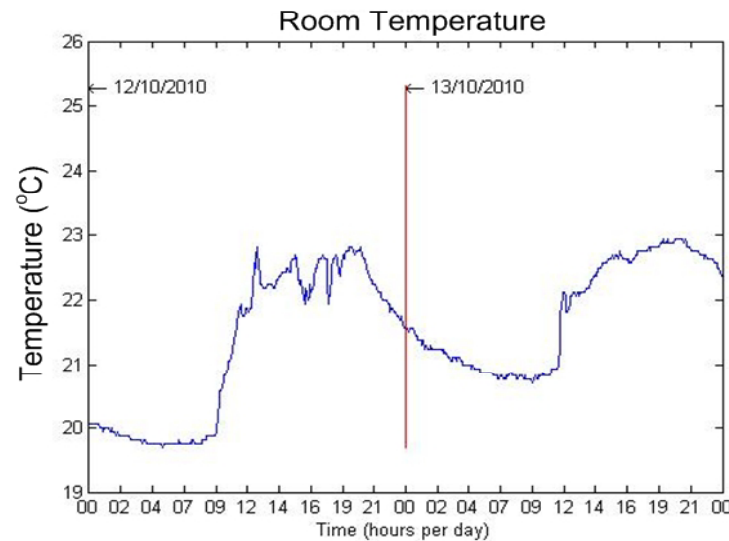
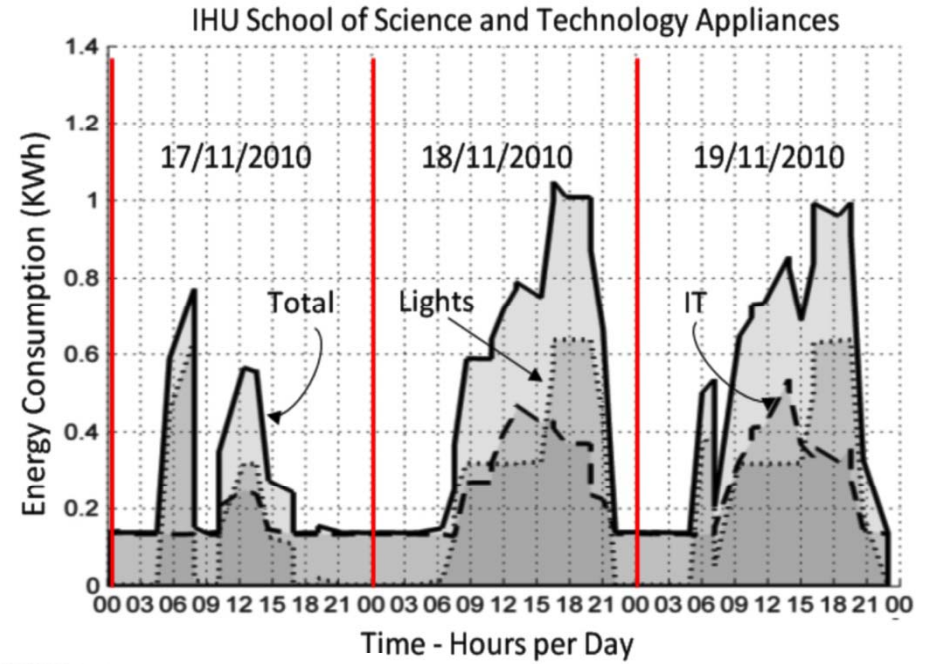
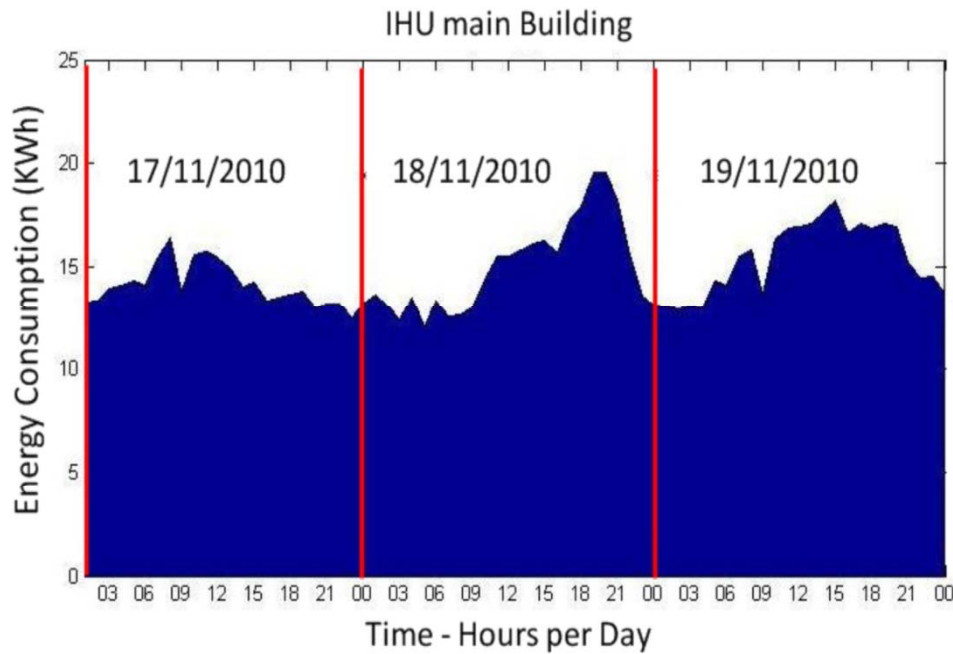
“Simple” non-Intelligent Applications

- Web or Local applications for Monitoring and Control

Intelligent Applications

- Web Service Composition via AI-Planning
 - Activity Oriented Computing
 - Optimization - Shortest solutions
 - Mobile Services (smartphone hosts come and go)
 - Context-awareness
- **Platform for Aml research**

Some Results



IHU Data Center

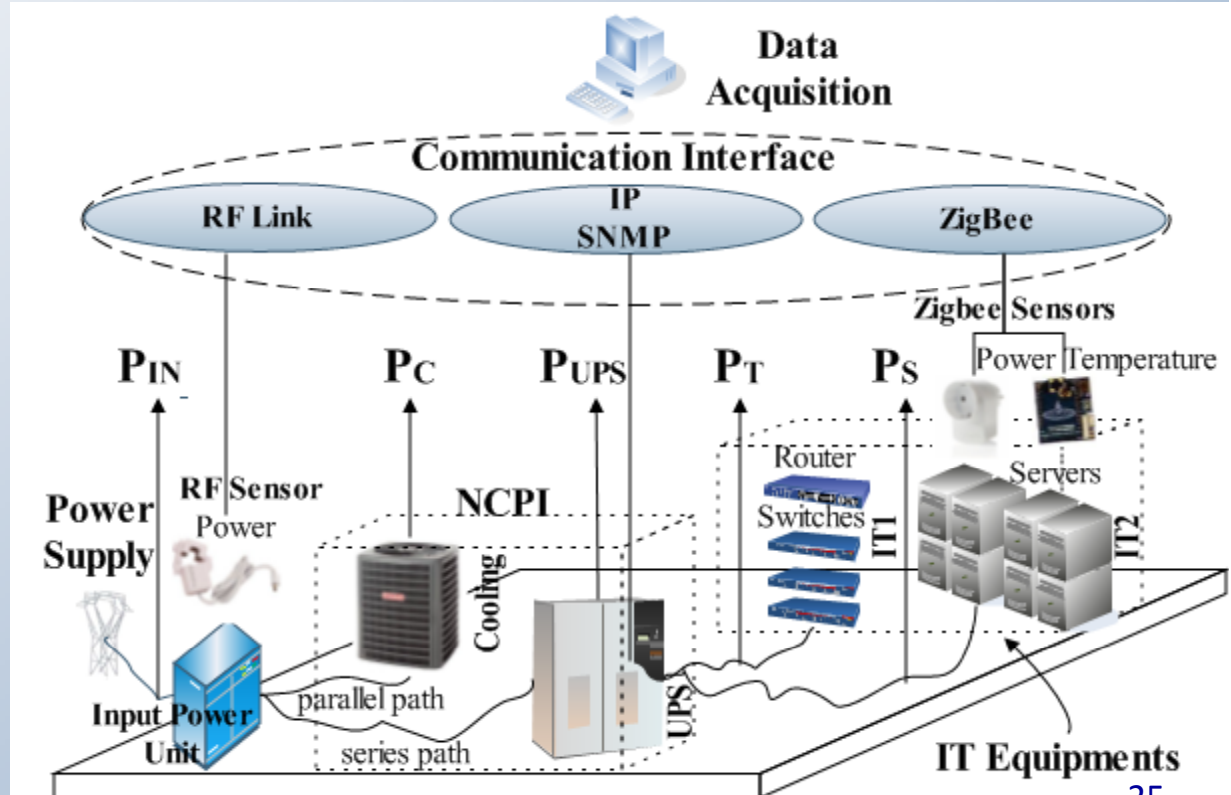
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The energy efficiency of IHU's Data Center is monitored in real time based on metrics published by the The Green Grid Association in 2009.

- P_{IN} - Total power consumption of data center (clamp Sensors)
- P_{IT} - Power at the IT level ([SNMP](#) requests from UPS)
- P_S - Power at the server rack (Plug sensors)

➤ Server jobs, CPU and Bitrate values are measured by SNMP requests

➤ Data center temperature is measured by Zigbee wireless sensors



Metrics of Non Critical Physical Infrastructure

$$PUE = \frac{1}{DCiE} = \frac{P_{IN}}{P_{IT}}$$

Metrics of Server Productivity

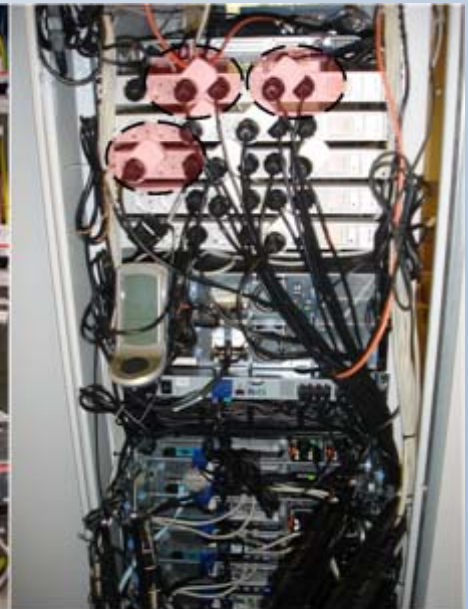
$$MSP_{\left\{ \begin{matrix} D \\ S \end{matrix} \right\}} = \frac{T \cdot \sum_{i=1}^n \left[U_i \cdot S_i \cdot \left(\frac{CC_i}{CB_i} \right) \right]}{\left\{ \begin{matrix} E_{DC} \\ \sum_1^n E_{S,i} \end{matrix} \right\}}$$

3 other IT related metrics are also considered...

Datacenter electricity input

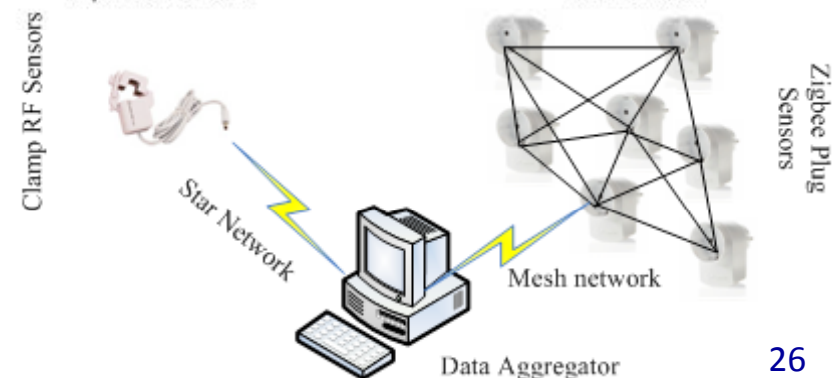


Servers

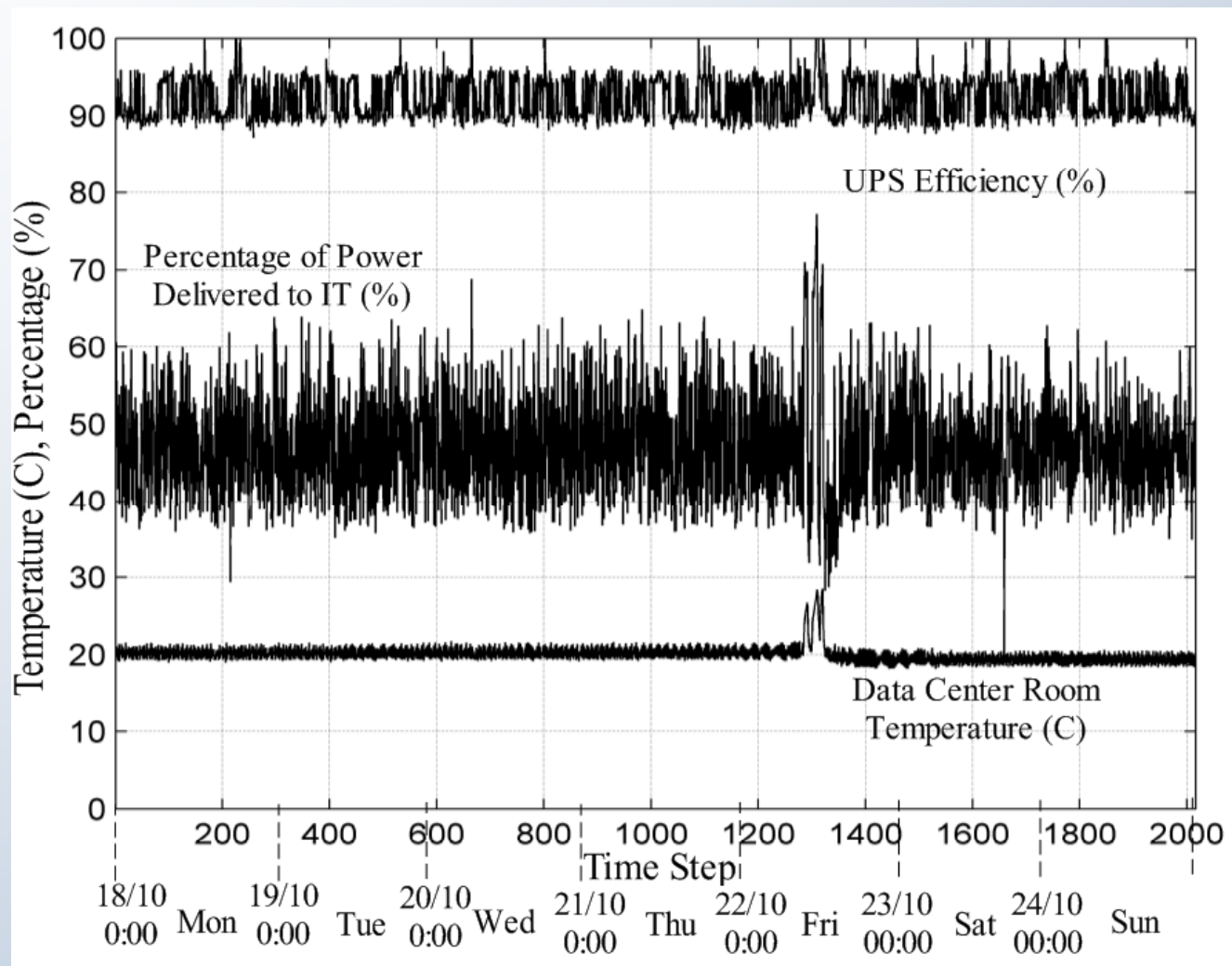


Input Power Unit

Server Rack



Non Critical Physical Infrastructure parameters



Smart IHU Publications

Published

“System Architecture for a Smart University Building”, Thanos G. Stavropoulos, Ageliki Tsioliaridou, George Koutitas, Dimitris Vrakas and Ioannis Vlahavas, Intelligent Environmental Monitoring, Modelling & Management Systems for better QoL ICANN, 2010.

Submitted

“A Sensor Network Deployment for Energy Efficiency Monitoring in Local Data centers”, George Koutitas, Ageliki Tsioliaridou, Iraklis Kamilatos and Ioannis Vlahavas, Green Communications, IEEE ICC, 2011

Journal papers are about to come...



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Students at IHU

- ❑ *International Hellenic University* has in total **252 Students, 205 Greek** and **48 Foreigners**. During the intake of 2010-2011, IHU has **134 students, 110 Greek** and **24 Foreigners**.
- ❑ *School of Science and Technology* during its first year of operation received **152 applications, 60 Accepted** and **92 Rejected** (acceptance rate 38%). **80% Greek** students, **6.67% Greek Origin** and **13.3% Foreigners**

