Computer and Communication Systems Laboratory (CCSL)

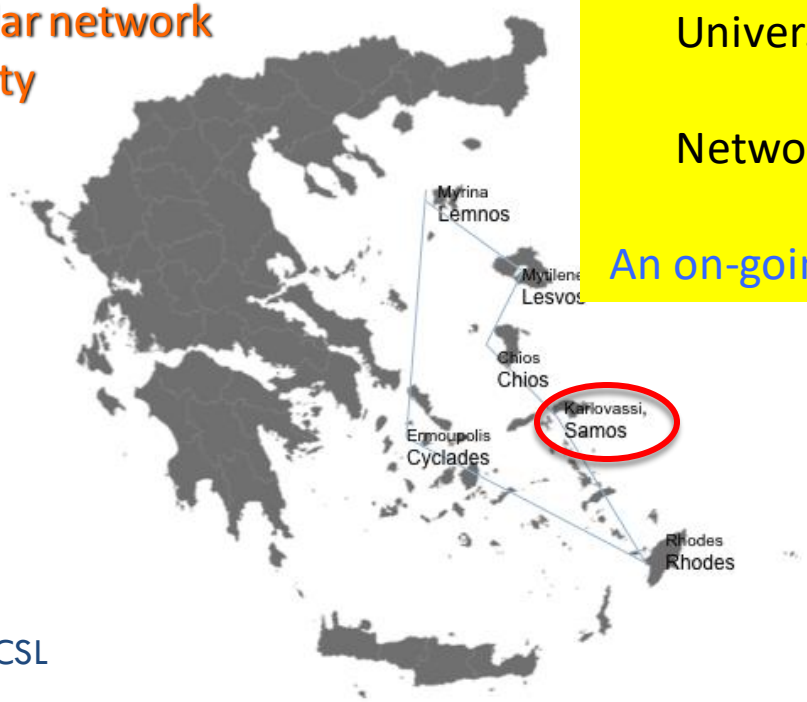
Department of Information and Communication Systems Engineering (ICSE)

2 Palama str., Karlovassi, GR-83200 Samos, GREECE

University of the Aegean

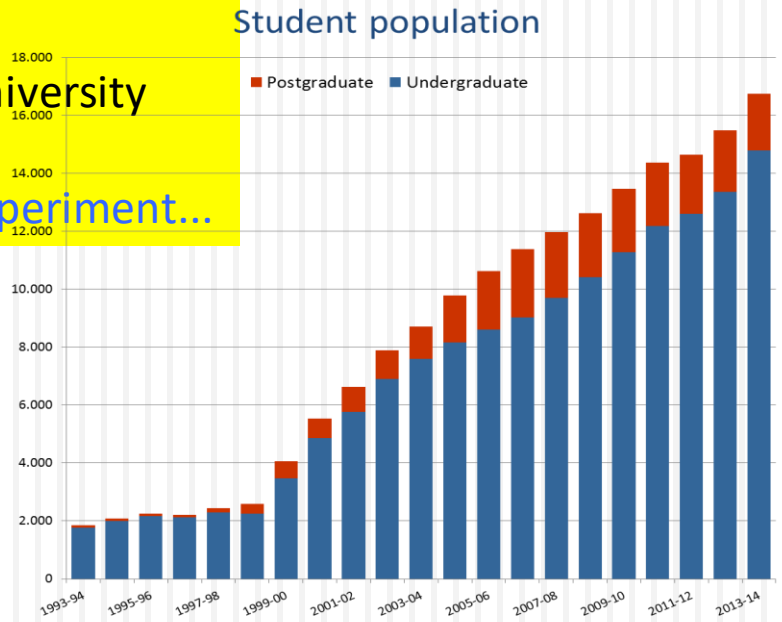
- University of the Aegean
  - Five Faculties in six islands (Samos, Chios, Mytilene, Rhodes, Syros, Limnos)
  - 5 Schools , 17 Departments, 300+ Faculty Members, 17.000+ Students

An insular network university



University Network
-or-
Network University

An on-going experiment...



University of the Aegean

- Modern studies in interdisciplinary thematic areas

Sustainable development

Education

Food &Nutrition

Informatics

Engineering

Economy

Society

Tourism

Product Design

Humanities

Management

Environment

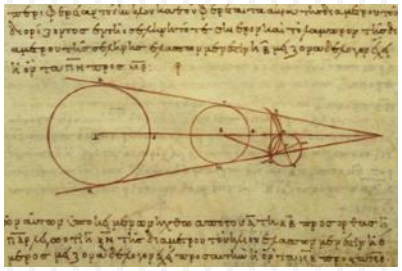
Mathematics

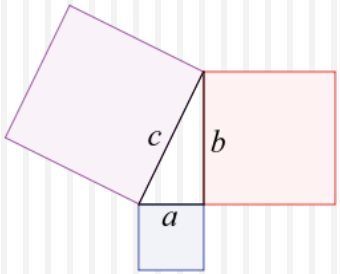
Culture

Shipping & Transport

School of Sciences

- Information and Communication Systems Engineering BSc, MSc (Samos Island)
- Mathematics BSc, MSc (Samos Island)
  - Mathematics
  - Statistics & Actuarial-Financial Mathematics
- Product and Systems Design Engineering BSc, MSc (Syros Island)
- Why Samos?
  - Pythagoras of Samos (496B.C.) → Pythagorean Theorem
  - Aristarchus of Samos (230B.C.) → Sun-centric Theory





Department of Information & Communication Systems Engineering

- Information
- Communication
- Systems
- Engineering

Engineer of
Information Systems
&
Communication Systems

- Est. 1997
- Key: Technology + Modern management
- "Information & Communication" indicates that information technology and communications technology converge.
- Located in Samos , 24 faculty members, 800+ students.
- 1 Undergraduate and 5 Graduate study programs

Department of Information & Communication Systems Engineering

- 4 Research Laboratories
  - Computer and Communication Systems – CCSL (Communications, Networks, Infrastructure, Mobile terminals, Internet of Things, Cloud, Software & Hardware)
  - Information and Communication Systems Security (systems authentication and services, trust, eID, legal issues)
  - Artificial Intelligence (Semantic Web, Agent based systems, data mining)
  - Information Systems (e-business, e-government, social networks)

CCSL – Short Description

- **Computer and Communication Systems Laboratory (CCSL)** was founded in 1999 as a research and educational unit in the Department of Information and Communication Systems Engineering of the University of the Aegean

- CCSL has a highly experienced research team with a proven record of providing robust research and practical solutions in **a wide range of Information and Communication Technology (ICT)** fields including:
  - **Electromagnetic** Measurements and Safety Evaluation
  - Channel characterization, propagation models and **performance modeling** of wireless systems
  - **RRM** in Cellular, Wireless, Multi-hop and Cooperative Networks
  - **Cognitive Radio Systems**
  - **Energy-aware, Context-aware**, *-aware Next Generation Networks & Services

CCSL – Short Description

- **Self-Optimized** and Reconfigurable Networks
- Wireless, mobile and satellite **cooperative systems**
- Integration of **Heterogeneous radio technologies**
- **SDN/NFV/Cloud** Computing
- Design and Programming of **Pervasive Computing Systems**
- Digital systems design
- Digital image processing - Digital data forensics
- Security in **virtualized environments**
- **Physical-layer security** for wireless networks
- Satellite Communication Systems & Localization
- Convergence of Energy and ICT (e.g. IEEE-2030) for **Smart Energy Grid**

Laboratory Members (1)

- **Faculty Members (6)**
  - **Charalambos Skianis**, Professor, Vice Rector of Economics
  - **Demosthenes Vouyioukas**, Associate Professor, Director of the Laboratory
  - **George Kormentzas**, Associate Professor
  - **Charis Mesaritakis**, Associate Professor
  - **Emmanouil Kalligeros**, Assistant Professor
  - **Christos Goumopoulos**, Assistant Professor
- **Research Fellows & Associates (11)**
  - **Dr. Dimitrios Skoutas**, Laboratory Teaching Staff, Univ. of the Aegean
  - **Dr. Nikolaos Nomikos**, Postdoctoral Researcher, Univ. of the Aegean
  - **Dr. Irene G. Karybali**, Adjunct Lecturer, Univ. of the Aegean
  - **Dr. Evangelos Pallis**, Associate Professor, Tech. Institute of Crete

Laboratory Members (2)

- **Research Fellows & Associates (11)**
  - **Dr. Fotios Lazarakis**, Senior Researcher, NCSR Demokritos
  - **Dr. Christos Verikoukis**, Senior Researcher at CTTC (Centre Tecnològic Telecomunicacions Catalunya)
  - **Prof. Athanasios Kanatas**, Univ. of Piraeus
  - **Prof. Angelos Rouskas**, Univ. of Piraeus
  - **Prof. Ilias Maglogiannis**, Univ. of Piraeus
  - **Prof. Dimitrios Vergados**, Univ. of Piraeus
  - **Dr. Evangelos K. Markakis**, Postdoctoral Researcher
- **Young Researchers (12)**
  - PhD and postgraduate students
- **Research Assistants (18)**
  - 5 MSc students
  - 13 Undergraduate Students

CCSL – Research Projects

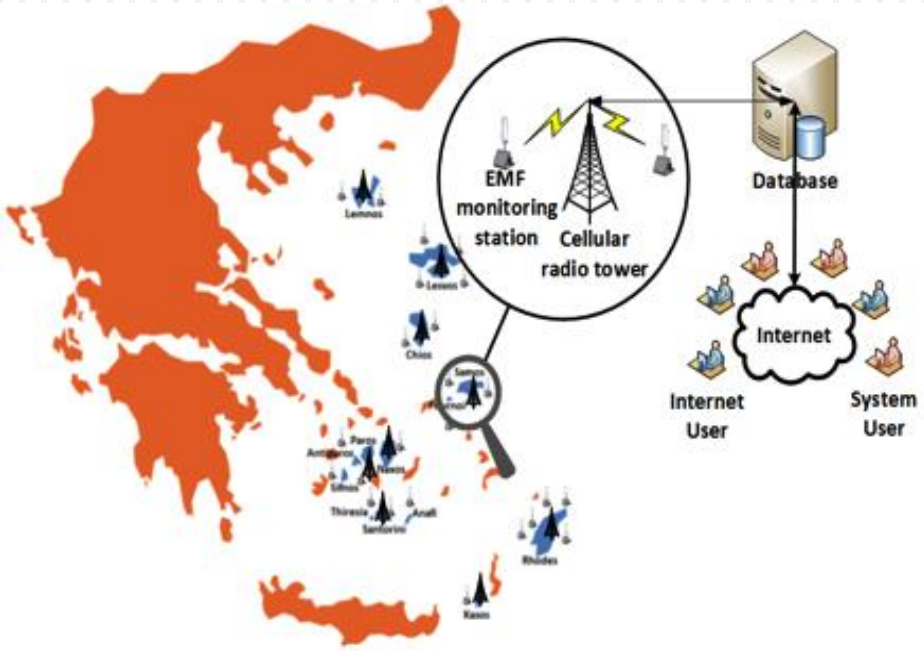
- **Relevant Research Projects:**
  - **PASSIVE:** Policy-Assessed System-Level **Security** Of Sensitive Information Processing In **Virtualized Environments**, http://ict-passive.eu, (EU-FP7)
  - **COGEU:** Cognitive Radio Systems For Efficient **Sharing Of TV White Spaces** In European Context, http://www.ict-cogeu.eu, (EU-FP7)
  - **HURRICANE:** **Handovers** For Ubiquitous And Optimal Broadband Connectivity **Among Cooperative Networking Environments**, http://www.ict-hurricane.eu, (EU-FP7)
  - **UNITE:** "Virtual Distributed **Testbed** For Optimization And **Coexistence Of Heterogeneous Systems**", www.ist-unite.org, (EU-FP6)
  - **PEDION 24:** "Design, Development And Operation Of A Network For The **Monitoring Of the non-Ionizing Electromagnetic Radiation**", http://www.pedion24.gr (COSMOTE - Mobile Telecommunications S.A.)
  - **National Observatory Of Electromagnetic Fields:** Development of a system for the **continuous measurement and recording** in real-time the levels of electromagnetic fields, due to different base stations' emissions, https://paratiritirioemf.eeae.gr (Ministry of Infrastructure, Transport and Networks)

CCSL – Research Projects

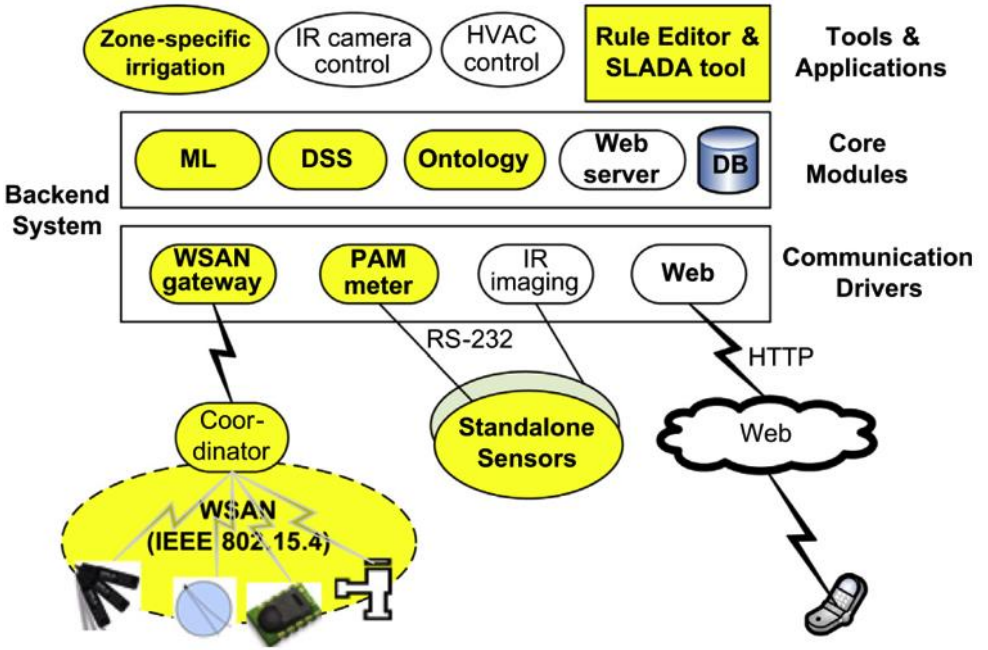
- **EPIKOUROS:** Virtualized platforms for innovative applications and multiple **heterogeneous sensor services in cloud computing** environment, http://www.converge.gr/projects/epikouros (General Secretariat for Research and Technology)
- **ELTAB:** ELDER TABLET. The project focuses on the area of Personal Health Systems in the field of Ambient Assisted Living and proposes an innovative platform that will have two modules: the health-care module; a service-oriented platform and cloud-based, http://daisy.cti.gr/eltab (LEADERA : Lead Market European Research Area Network)
- **ATRACO:** Adaptive and Trusted Ambient Ecologies. The aim is to research the factors and develop the technologies that will lead to the realisation of adaptive and trusted ambient ecologies, following an interdisciplinary effort, http://www.uni-ulm.de/en/in/atraco/ (EU-FP7)
- **ASTRA:** Awareness Services and Systems towards Theory and ReAlisation. The aim is to define a framework for supporting the conception and the design of Pervasive Awareness systems, specifically those that are intended to support social relationships (EU-FP6)
- **MIMOSA:** MIMO Techniques for Satellite and Stratospheric Communication Systems: Network of Excellence, that aims at shaping and enhancing the next generation fixed, mobile and hybrid satellite and stratospheric communication systems through MIMO techniques by contributing to both the theoretical and practical aspects of satellite technology, https://goo.gl/vqWGi1

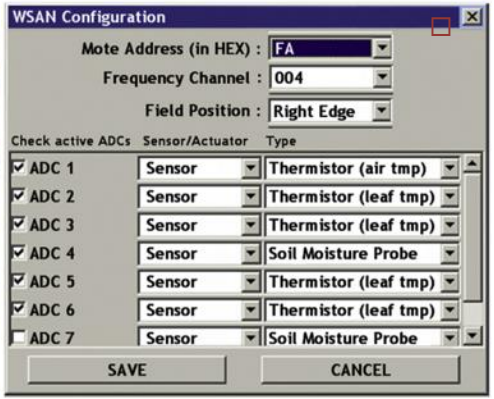
EMF Measuring Infrastructure

- CCSL has acquired a great experience on **EMF measuring** through the **Pedion24 project** whose scope is to inform the public about the levels of electromagnetic radiation in various areas of Greece
- **30 spectrum sensors (100KHz-3GHz) located on 17 Greek islands** measure on a 24 hour basis the total electromagnetic field emitted from different sources such as FM and television broadcasts and cellular telephony base stations
- CCSL has also been accredited to **ELOT EN ISO/IEC 17025:2005** by the Hellenic Accreditation System for the measurement of electromagnetic radiation of high frequency

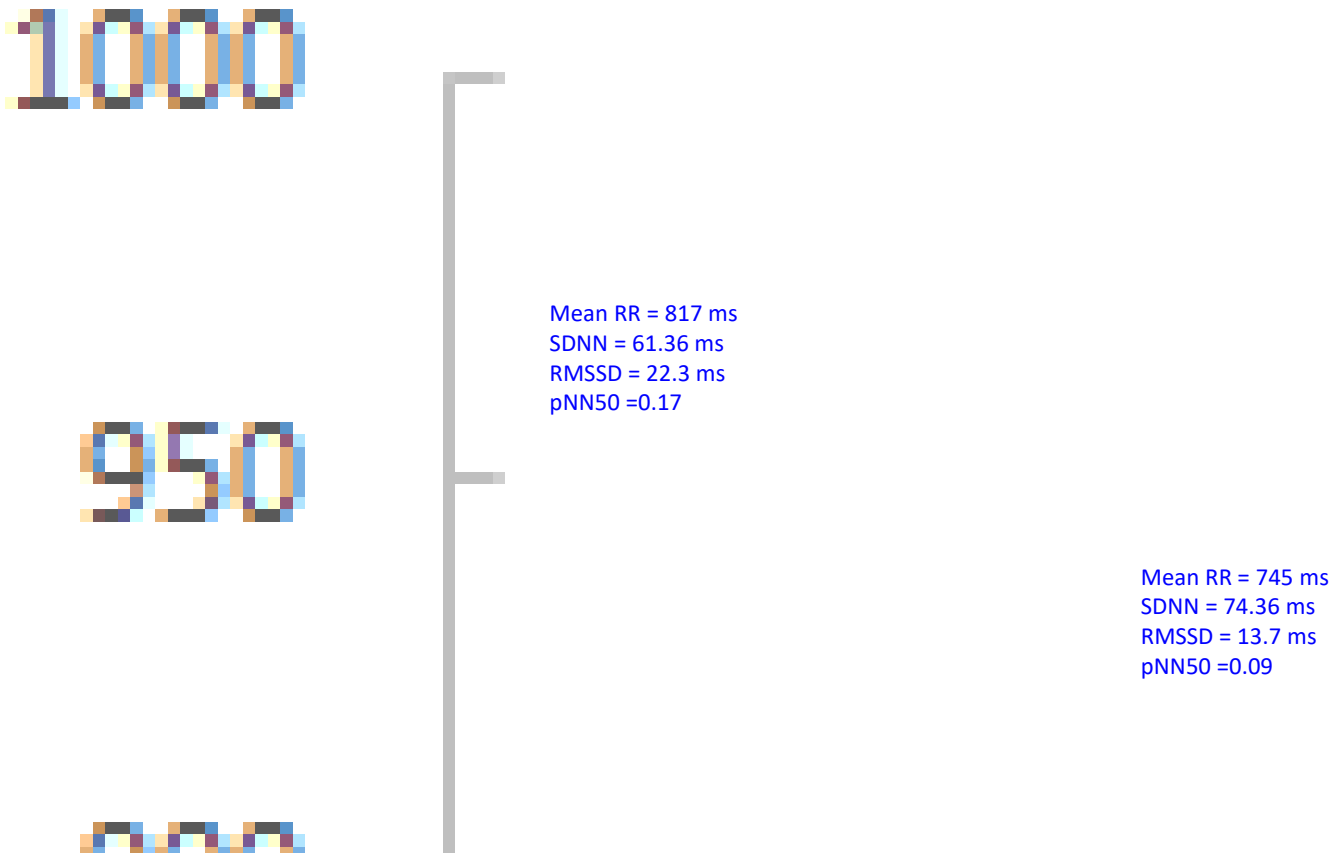


Smart Agriculture





- The aim of this work was to optimise the efficiency and productivity of plant growth. An array of sensors positioned around the crop detects subtle plant/environmental signals and uses these as the basis for precision applications of water, pesticides or fertilisers (precision agriculture).
- Design and development of a distributed system to monitor and control the growth of plants. Decisions (e.g. whether to irrigate) are based on the 'ontology', a directory of rules and definitions about plant parameters and characteristics.
- Furthermore, machine-learning algorithms are used for inducing new rules by analysing logged datasets to determine accurately significant thresholds of plant-based parameters.

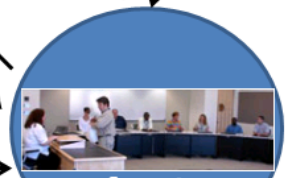

1000
950
Mean RR = 817 ms
SDNN = 61.36 ms
RMSSD = 22.3 ms
pNN50 =0.17
Mean RR = 745 ms
SDNN = 74.36 ms
RMSSD = 13.7 ms
pNN50 =0.09

Smart classroom

Technology Management/Support
- Remote management
- Control/Monitoring server (e.g. system diagnostics, network activity, device status)
- Failure reporting
- Troubleshooting
- Server virtualization

Physical Infrastructure
- WAN/LAN high speed
- Wireless networking (WiFi access points)
- Communications/ cabling
- Lighting, acoustics (sound-proofing), HVAC control
- Accessibility (e.g. people with special needs)

System and Data Management
- Data and content repositories (e.g. student information, digital educational content, learning objects, learning profiles, etc.)
- Systems(e.g. virtual classes, collaboration support, etc.)
- SSO-Single Sign On



Security
- Physical security
- Data ciphering algorithms
- Single smart card access control
- RFID wireless asset management
- IP Digital Video Surveillance

Enabling Technologies

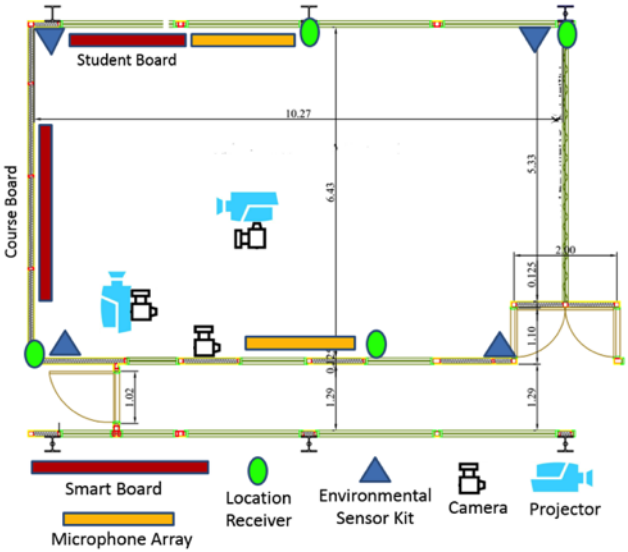
Context awareness
- light, temperature
- position, activity
- speech recognition
- gesture recognition
- automatic camera focusing
- lecture capturing

Natural interaction
- Pen-based writing
- Voice commands
- Laser-based remote controls
- Biometric login

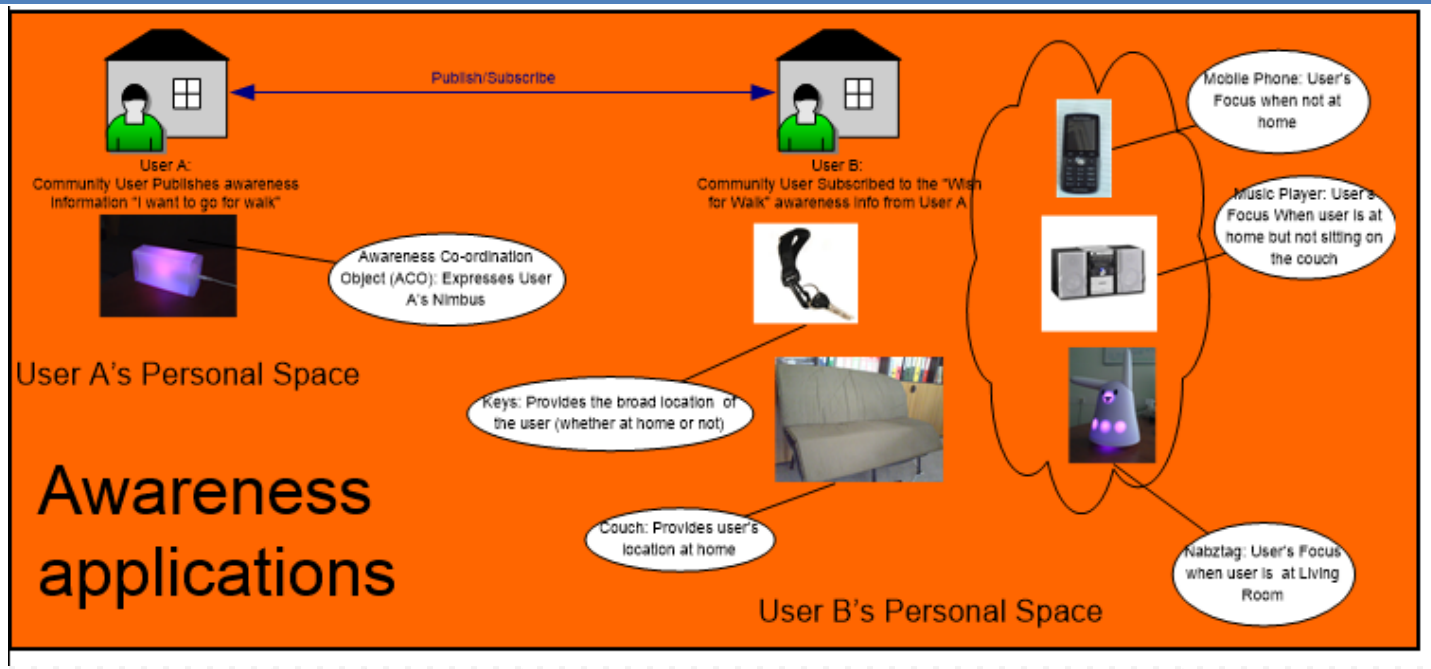
Rendering
- Smart/Interactive Boards
- Multiple Projection Screens
- Large Screens
- Student response systems
- Audio amplification system
- Document camera
- 3D imaging

Information Transmission
- Videoconferencing
- VoIP διασύνδεση
- Reliable multicast

Other
- Control Panel System
- Smart Lectern
- Laptop/Desktop
- Video Camera
- Microphones
- PC virtualization



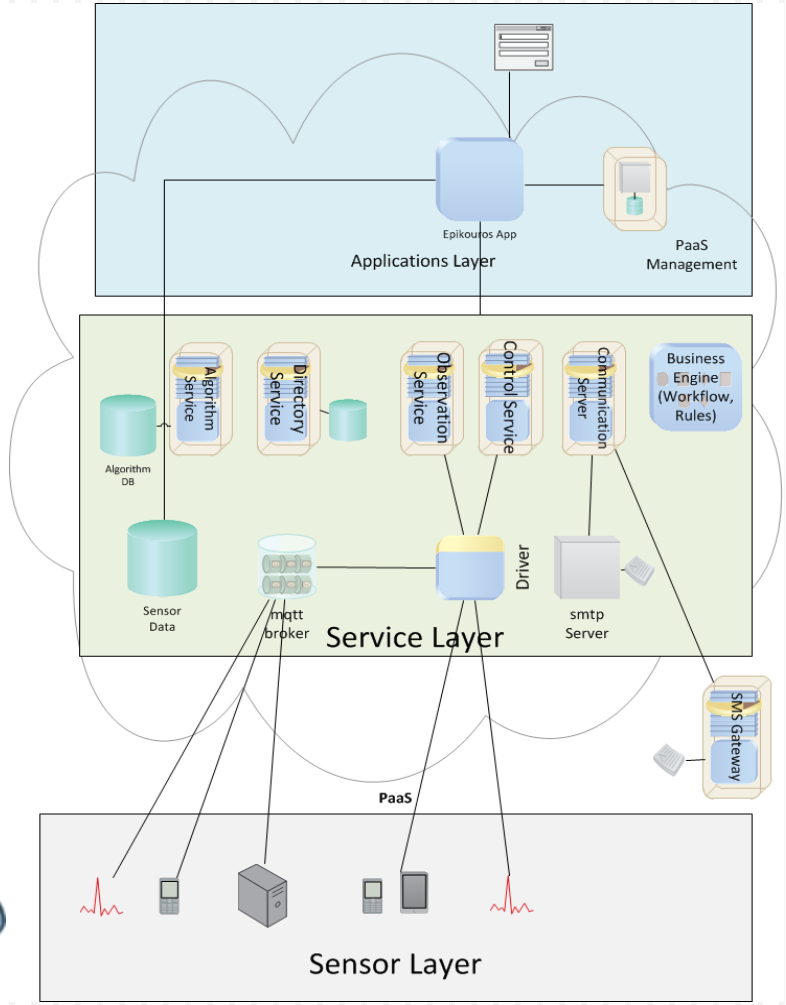
Smart Home



- The aim was to define a framework for supporting the conception and the design of **Pervasive Awareness** systems, specifically those that are intended to support social relationships.
- This will consist of theories and technological solutions, addressing the two aims of the project:
  - to develop a theory to guide the design and evaluation of pervasive awareness systems supporting social use
  - to develop supporting technology (a service oriented architecture, tools and applications) that support communities to create, adapt and appropriate Pervasive Awareness systems.
- Definition, design and implementation of the End-User Development Framework:
  - an interaction model
  - tools for service management (publish, discovery, composition, configuration)
  - the semantic mapping layer (implemented as an ontology) responsible for making semantic translations between the concepts perceived by the end-users and the functionality provided by the underlying system and
  - a visual programming language for application definition.

EPIKOUROS Project

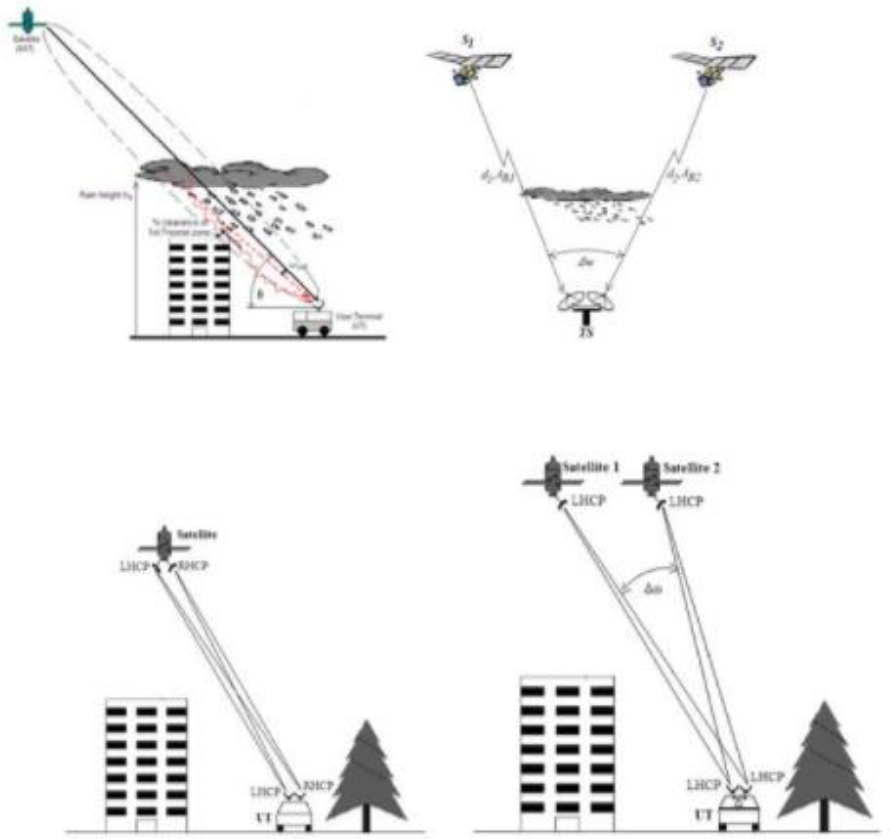
Virtualized Platforms for Innovative Applications and Multiple heterogeneous Sensor Services in Cloud Computing Environment



- The main goal is to design and develop a virtualized middleware platform that would allow to easily create and structure environments that, in turn, would allow the collection, management and integration of information generated by multiple sensors and sensor-networks, as well as the management of business process procedures that are supported by the sensors' infrastructure.
- The virtualized platform "Epikouros" provides an application development environment as well as management of business procedures based upon multiple heterogeneous sensors.
- This environment provides the tools for accessing the information and capabilities of the sensors, the ability to combine information from different sensors, as well as the business process management based on the sensor system.

MIMOSA Project

- Derivation of a plethora of valuable results for the design of next generation fixed, mobile and hybrid satellite and stratospheric communication systems.
- Novel physical layer techniques for increasing capacity (multiplexing gain) and performance (coding and diversity gain).
- Conduct a state-of-the art MIMO radiochannel measurement campaign for various propagation scenarios.
- A series of research articles published in the most prestigious Journals and Conferences relevant to Satellite Communications and Digital Communications.
- Create and making of a critical mass of resources and expertise in order to set up a Network of Excellence and in Satellite Communications in Greece and, in the long term, creating a Hellenic Space Agency.



CCSL – Ongoing Research

- **Our ongoing research** includes the following areas:
  - **Half and full-duplex techniques**, power adaptation and interference cancellation, opportunistic relay selection algorithms
    - Research based on MATLAB simulations
  - **Software-Defined Radio and Beamforming:** Implementation and prototyping of digital beamforming for Massive MIMO systems in the mmWave band, using advanced modulated waveforms
    - Research based on MATLAB simulations and USRPs hardware - Ettus Research
  - **Physical-layer security**, with focus on **a)** secrecy outage probability minimization in the presence of eavesdroppers, **b)** exploiting interference as a jamming technique for malicious nodes and **c)** studying the trade-off between delay minimization and security
    - Research based on MATLAB simulations
  - **Precise user positioning for mmWave Access** - Position estimation techniques for indoor/outdoor UWB systems
    - Research based on MATLAB, WinProp and TruNET Wireless simulations

CCSL – Ongoing Research

- Development of **new traffic classification schemes** (H2H, M2M and mixed type of traffic flows) for the future IoT/HetNET environment. **SDN dynamic prioritization** of traffic flows
  - Research based on mininet and C++ custom made simulations
- **Development of IoT prototypes** for **smart city (smart street lighting)** and **agricultural environments (measuring humidity, temperature, solar radiation, evapotranspiration)** supported by cellular (UMTS, LTE) and WiFi infrastructures
  - Cooperation with **Samos municipality** and **Union of Vinicultural Cooperatives of Samos** (EOSS)
- **Impact of backhaul latency in CoMP** (Coordinated Multipoint Transmission) – Delay of the CSI feedback - formation of CoMP clusters. Reduction of **CoMP related backhaul traffic load**
  - Research based on MATLAB and Java/C++ custom based simulations
- **Exploiting the caching capability of edge transmission nodes** (e.g. small cells, femto-cells, generic relays) for **a)** packet delay minimization, **b)** energy-efficient transmissions and **c)** interference mitigation
  - Research based on MATLAB and WinProp simulations

CCSL – Ongoing Research

- **Security of sensitive information in virtualized environments** (coordinator of the **PASSIVE** project: Policy-Assessed System-Level Security Of Sensitive Information Processing In Virtualized Environments, http://ict-passive.eu, (EU-FP7)).
- **Designing an integrated IoT environment** where the information of a selected combination of sensors can be offered as an **on demand NFV service** to the end user
  - Research based on **a)** the **Pedion 24** infrastructure in combination with developed IoT prototypes and **b)** cooperation with **PASIPHAE** laboratory (http://www.pasiphae.eu/ - TEIC, T-NOVA project http://www.t-nova.eu/).
- **Study and Development of pico/nano/cube satellite**. Advanced Space Systems Design and Management with the cooperation of the Lamdasat group http://lambdasat.com/.
- **Study and Development of Handover Techniques in Satellite Constellations** exploiting advanced network coding technique
- **Orbital Mechanics:** Simulator development using SGP4/SDP4 perturbations models to predict the orbit of a near earth or deep space satellite. Research based on JAVA/Matlab Simulator
- **Satellite Channel Modeling and Propagation Impairments:** study and analysis of new channel models in E-Band (mmWave).

Collaboration – Synergies (National)

National Technical University of Athens	Synelixis
National and Kapodistrian University of Athens	Greek Air Force
NCSR Demokritos	PeSYP of Thessaly
University of Piraeus	PeSYP of North Aegean
University of Patras	Municipality of Samos
University of Ioannina	Municipality of Rhodes
Technological Educational Institute of Larissa	Municipality of Lemnos
Technological Educational Institute of Crete	Administrative Division of North Aegean
Athens Information Technology	Informatics and Telematics Institute
COSMOTE SA	General Hospital of Athens G. Gennimatas
Space Hellas SA	Foundation for Research and Technology
ERICSSON HELLAS	Alfa Logic SA
F-IN	Minoan Lines

Collaboration – Synergies (International)

Aalto University (Finland)	Universität Dresden (Germany)
Anect (Czech Rep.)	OmegaCube SA (Italy)
ATOS (Spain)	Rohde & Schwarz (Germany) Technische
Boston (USA)	SIGINT Solutions Ltd (Cyprus)
CEA LETI (France)	Thales (UK)
CERN (Switzerland)	Open University of Cyprus (Cyprus)
Cyprus Institute of Neurology and Genetics (Cyprus)	University of Cyprus (Cyprus)
Duke University (USA)	University of Malaga (Spain)
ENGINEERING (Italy)	University of Portsmouth (UK)
EURECOM (France)	University of Surrey (UK)
FRANCE TELECOM R & D (France)	Waterford Institute of Technology (Ireland)
Harvard Medical School (USA)	Centre Tecnològic de Telecomunicacions de Catalunya (Spain)
IBM (Zurich)	Huawei (Sweden)
Indra Espazio SA (Spain) Mondragon-Enyca SA (Spain)	Institut für Rundfunktechnik (Germany)
INSTITUTO TELECOMUNICAÇÕES (Portugal)	Poznan University of Technology (Poland)
Nowcasting International (Ireland)	Trinity College Dublin (Ireland)

Quantity facts (1)

- **Funding**

International Projects	29 / 2.9 MEuros
National Projects	38/ 1.4 MEuros
Consulting Services/Projects	13 / 0.8 MEuros

- **Publications**

Books	15
Journals	190
Book chapters	33
Conference proceedings	405
Citations (GoogleScholar)	5500

Quantity facts (2)

- Organization and hosting conferences

General/Technical Conference Chair	31
TPC/OC Member	213

- Member in Boards & committees

Editorial Board Members	17
Committee Members	26

Summer School

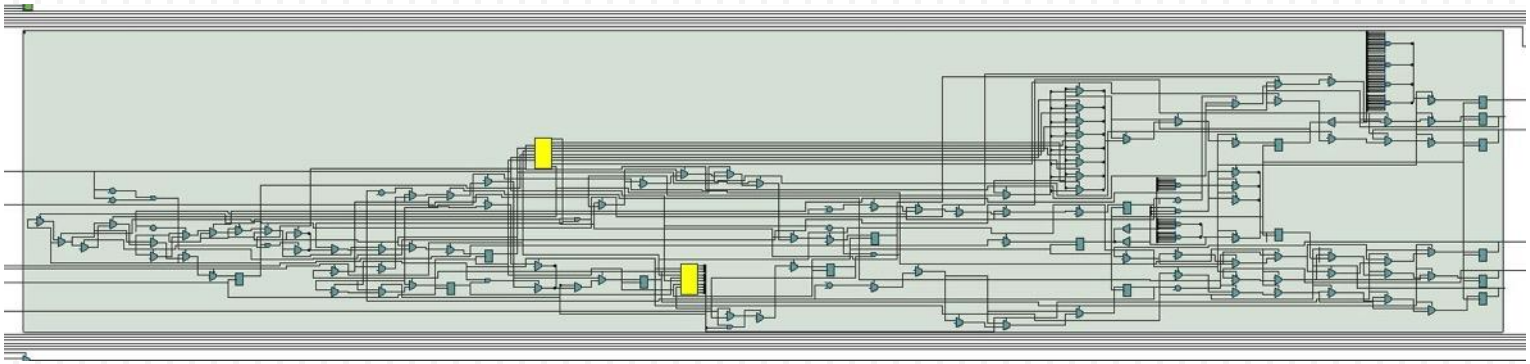
- Emerging Architectures & Key Technologies for 5G Networks

CCSL – Hardware & Image processing

- CCSL members have great experience in implementing digital systems and digital image processing algorithms and systems
  - Digital systems
    - FPGA-based systems
    - Embedded systems
    - Industrial control systems
  - Digital image processing
    - Image registration (for medical purposes as well)
    - Digital image forensics

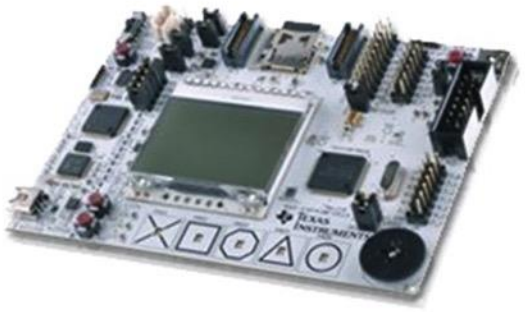
FPGA-based systems

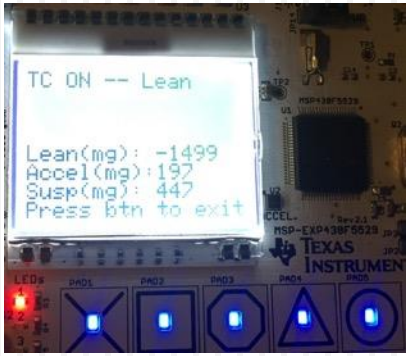
- Verilog is the Hardware Description Language (HDL) we mainly use in our implementations
  - There is also experience in VHDL implementations
- We currently use Altera-based FPGA boards and the Altera toolchain
  - Quartus II – Quartus Prime suite
  - ModelSim simulator
- Xilinx FPGA boards have been utilized in the past
  - Xilinx ISE, Vivado



Embedded systems

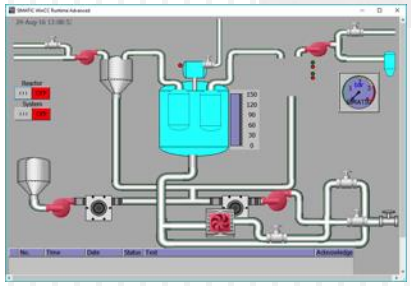
- Various systems have been implemented using MCUs of the following families:
  - Atmega (Atmel AVR – 8-bit)
  - MSP430 (TI – 16-bit)
  - MIPS (Imagination Technologies – 32-bit)
  - NIOS II (Altera – 32-bit)
- Programming languages
  - C/ C++
  - Assembly (only small parts)
- Programming environments
  - Eclipse (Code Composer Studio, NIOS II)
  - Arduino IDE



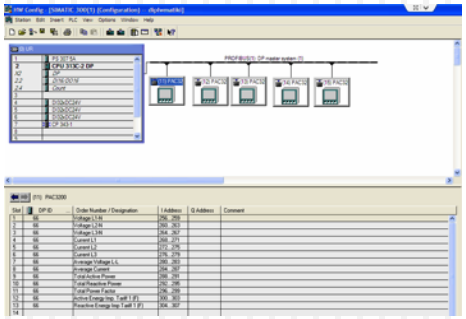


Industrial control

- PLC-based systems have been also realized
  - Siemens



- An electrical power surveillance and recording system implemented as part of a diploma thesis, was installed and evaluated at Larco's smelting plant, Larymna, Greece (http://www.larco.gr/smelting_plant.php)



Digital Image Processing & Forensics

Digital Image Processing

- Efficient schemes for image registration (subpixel accuracy and low complexity)
- Image registration for multispectral imaging* used for medical diagnosis (visual diagnostic method for detecting, in vivo, dysplasias and malignancies of cervix)

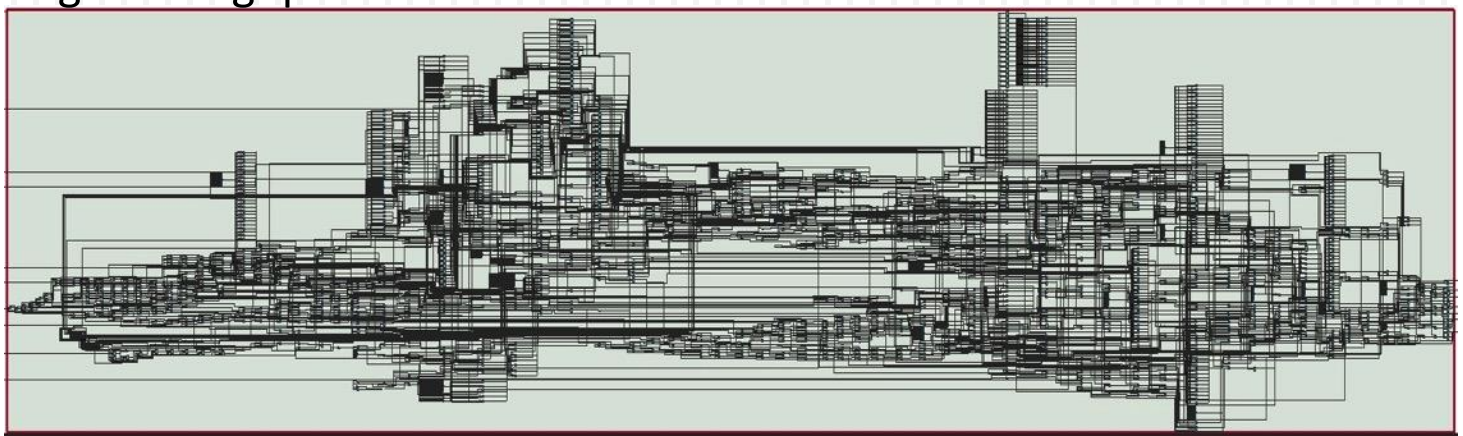
* Provided by Medical Imaging Lab, IESL/FORTH, Heraclion, Crete, Greece

Digital Image Forensics

- Digital image watermarking
- Digital image steganalysis
- SCI – Source Camera Identification

Hardware efficient design for digital image processing

- Hardware system for digital image watermarking
  - No processors, just custom hardware
- Theoretical optimization to keep complexity low, in terms of data width (fixed-point arithmetic)
- MATLAB simulations for the evaluation of the introduced optimizations
- Hardware implementation. The final system included:
  - Serial communications
  - Memory interface (SRAM)
  - A complex datapath with parallel adders, multipliers, a divider and an sqrt unit for high throughput with reduced hardware cost



Other research areas of interest

- Hardware security
- VLSI design and test
- Design for Testability (DFT)
- CAD methodologies and tools for VLSI testing
- Built-In Self Test (BIST)
- Test-data compression architectures
- Network-on-Chip (NoC) architectures

Thank you!

- Contact details:
  - Associate Prof. Demosthenes Vouyioukas
    - dvouyiou@aegean.gr
    - Office.: +30 22730 82270
    - Mob: +30 694 5491615
    - Fax: +30 22730 82009

http://www.icsd.aegean.gr/ccsl