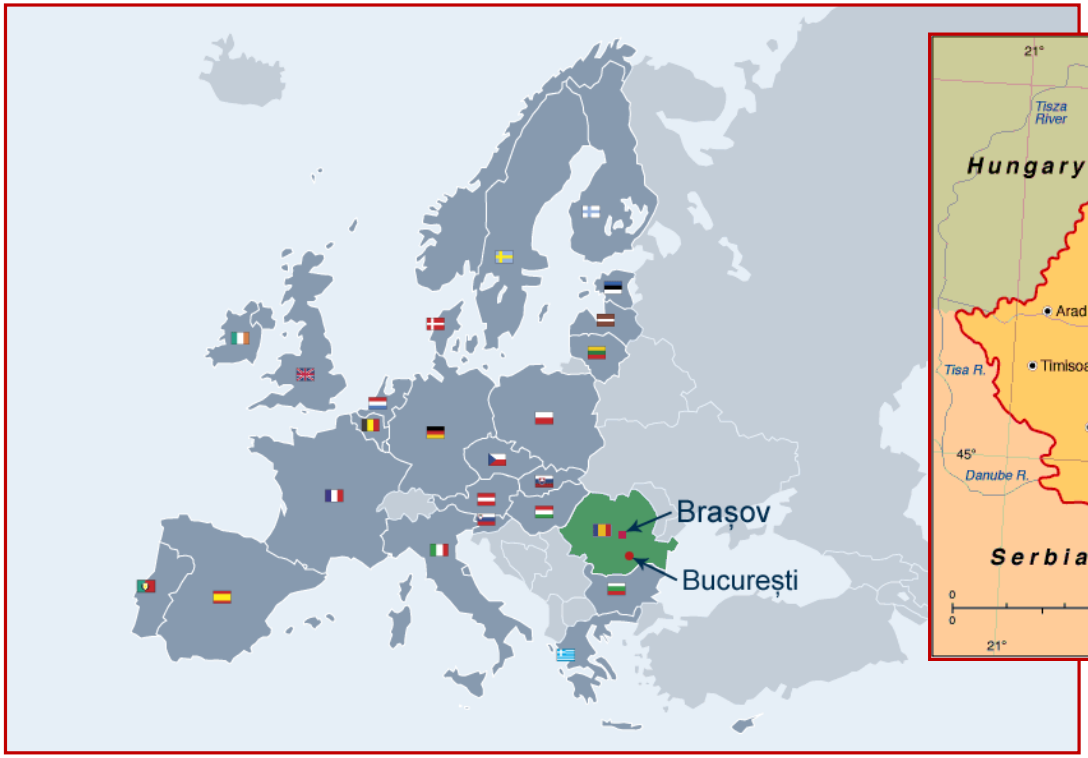
Sorin-Aurel Moraru, Ph.D.
Professor at the *Transilvania* University of Brasov, Romania, Director of the AECS Department

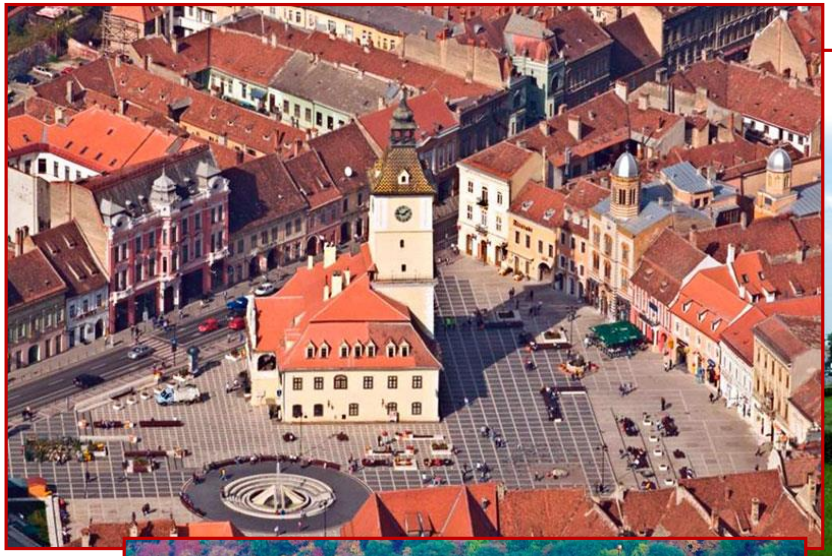
INSEED Skills Development for Assisting Living and Healthcare using IBM Technologies

City of Brasov – Best city to live in Romania



- **Old cultural city, hosting the first school in Romania**
- **Multinational and multilingual area (Romanian, Hungarian, German citizens)**

City of Brasov – Best city to live in Romania

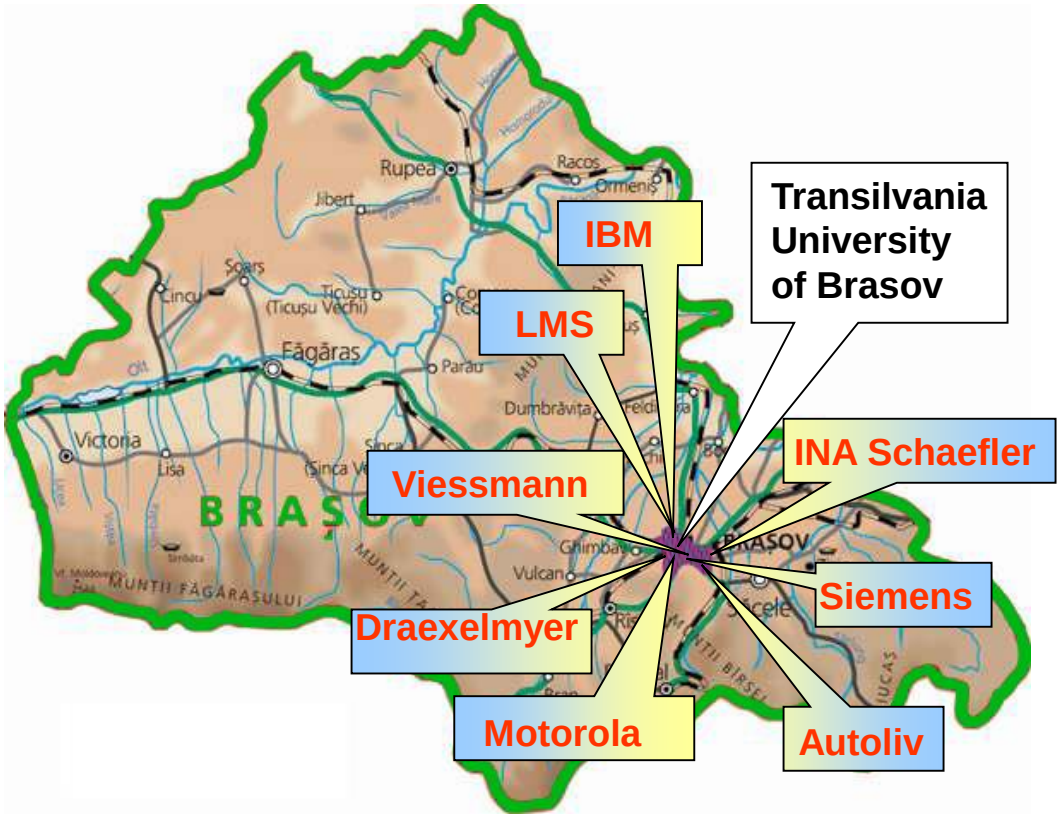


Transilvania University of Brasov

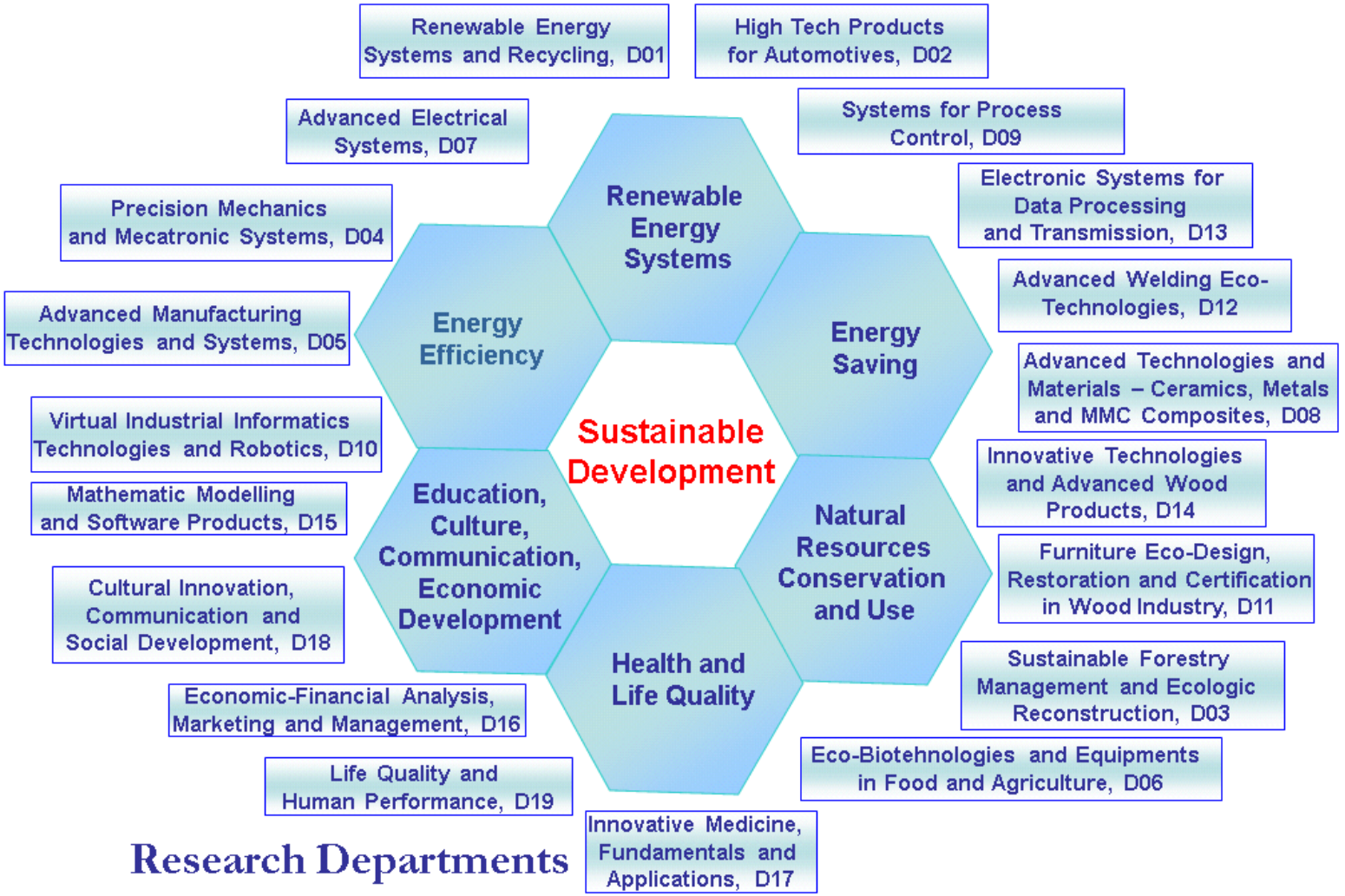
- **State University, founded in 1948**
- **"Full Confidence" in the national evaluation**
- **Ranked among the first at national level for Research of Excellence**
- **Extended cooperation with European universities**

Collaboration with local companies

- **Developing new education and training courses: M.Sc.**
- **Developing infrastructure (laboratories) in partnership with companies**
- **Applied research**
- **Joint research in Ph.D. programs**



R&D Institute of the University *Transilvania* of Brasov



The GENIUS Campus

- The R&D Institute: High-Tech products for Sustainable Development: PRO-DD
- A novel structure for advanced research on Sustainable Energy:
- The Green, Energy Independent University Campus GENIUS

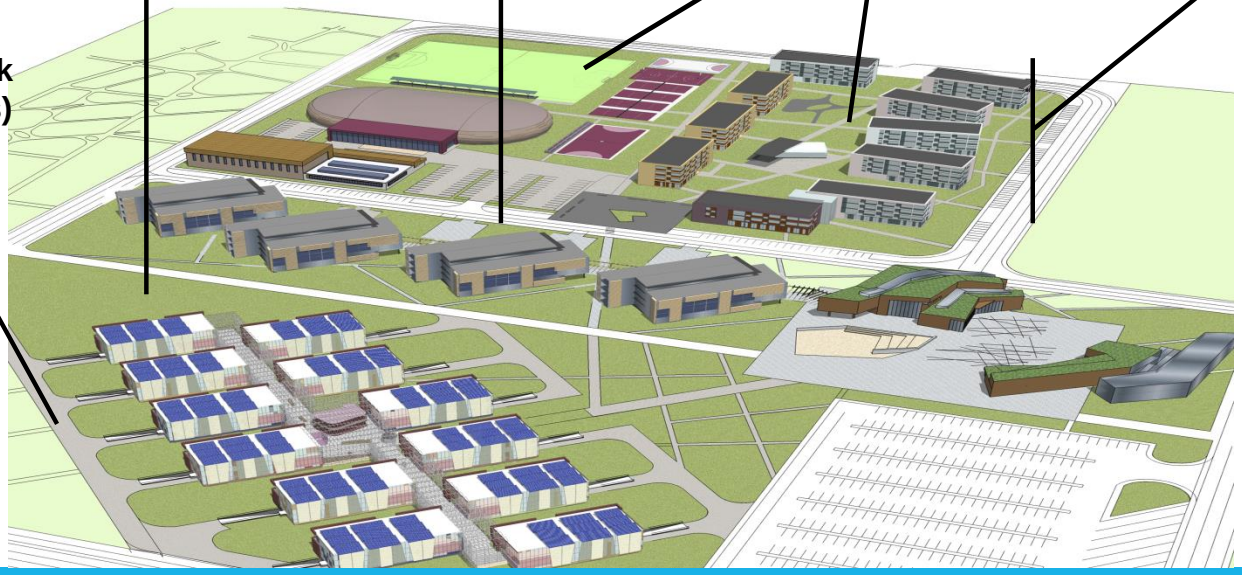
Phase 1
The Solar Park
(RTD Projects)

Phase 1
RTD Institute
(Structural Funds)

Phase 2
Education Area
(Regional Funds)

Phase 2
Students Facilities
(Governmental &
Regional Funds

Phase 3
Business Center
(Structural Funds)
Clusters research
providers + research
direct and indirect
beneficiaries
Technology Transfer



1. Research
2. Education
3. Technology Transfer

The GENIUS Campus – PRO-DD Institute

- **The R&D Institute: High-Tech products for Sustainable Development: PRO-DD**

The Solar Park
- PV Platforms
- 2MWp PV
- Residential buildings
  testing optimised solutions
  for integrating renewables

The PRO-DD Institute

12 Laboratories (3 floors) - Smart Buildings:
- -Renewables: solar thermal, PVs and heat pumps
- -Monitoring and data acquisition

Outdoor: testing stands for optimising complex sustainable energy solutions

Indoor: advanced research centre on Sustainable Energy

Financing: 2009 – 2012 (Structural Funds)

The GENIUS Campus – PRO-DD Institute

The partners

- High-Tech companies
- The Chamber of Commerce
- Sustainable development bodies
- Authorities

The PRO-DD Institute and the Students facilities

- R&D staff
- Post-doc
- Ph.D. students
- M.Sc. students

The GENIUS Campus – PRO-DD Institute

The R&D Institute: High-Tech products for Sustainable Development: PRO-DD

The GENIUS Campus – PRO-DD Institute

The R&D Institute: High-Tech products for Sustainable Development: PRO-DD

The GENIUS Campus – PRO-DD Data Center

The PRO-DD Data Center

-Based on Green Technologies:

-Hardware:

- **-Low energy consumption**
- **-Efficient cooling solutions**

-Software:

- **-Optimal process management**

July 2010:

Pilot project - MiniData Center
Collaborative environment for content and flow management of documents

-Functions:

- Data acquisition, monitoring and management
- Communication **(internal, external, multimedia, video-conference)**
- Complex data processing and storage
- Remote applications
- Security **(data, buildings)**
- Safety **(fire, CO2)**
- Habitat comfort
- Advanced training tool
- **Services delivery to the entire university and 3rd party**

May-July 2012:

Data Center
Multimedia infrastructure
Telecommunications trunks

The GENIUS Campus – PRO-DD Data Center

- **Design Principles taken into account:**
  - Centralize computing resources
  - Reduce electricity consumption
  - Reduce operating costs

BladeCenter Servers

The GENIUS Campus – PRO-DD Data Center

- **Centralize computing resources**
- Control over software used
- Providing increased computing power, the same for all users
- Reducing the number of licenses
- Using on the client side a very simple and inexpensive computing systems that requires only one monitor, keyboard, mouse and a modest software product for communication with servers
- Improved data security through: backups of all existing data; store data in the data center not on each computer
- Allows use of virtualization technology that leads to: increasing computational power provided to each user; reducing total cost of operations; reducing the number of servers (consolidation)
- Remote access to data and resources
- Conditions for effective collaboration between users (the data is all in one place)

The GENIUS Campus – PRO-DD Data Center

- **Reduce electricity consumption**
- Reducing physical space needed for data center servers to decrease the maximum volume of air to be cooled
- Reducing number of servers to reduce power consumption for cooling
- Every W on server leads to consumption of another 2 W for cooling and UPS
- BladeCenter technology consumes only 80 W / CPU
- Multi-core processors increase performance computing at the same energy
- BladeCenter technology and multi-core processors lead to a 35-100% increase in performance and power reduction of up to 40-50%
- Power consumption may drop by up to 25% using power management tools
- Virtualization leads to additional reduction of energy consumption between 20 and 50%

The GENIUS Campus – PRO-DD Data Center

- **Reduce operating costs**
- Using of BladeCenter servers:
- Reducing energy consumption (14 Blade servers consume about. 3.5 kW, while 14 regular servers consume approximately. 9.8 kW)
- Reduction of occupied space (42U handles 56 Blade servers instead of 21 regular servers)
- Each regular server has its own network connections while BladeCenter servers have a single connection (via chassis)
- Reducing the number of servers using virtualization (consolidation) leads to a decrease of: Administration cost; Software cost; Cost of electricity (by shutting down the unused servers); Reduce the time for networking configuration for 1.5 hours per server; Increase availability by 80% (moving virtual machines from one server to another in case of detection of failures)
- According to consulting firms, the cost for a data center server is approx. 10.000 USD / year (7535 euros)
- By virtualization costs go down to 7,000 USD / year (5274 euros)

The GENIUS Campus – PRO-DD Data Center

- **PRO-DD Data Center Hardware Equipment characteristics**
  - Number of processors: 29
  - Number of processor cores: 174
  - RAM Memory: 1440 GB
  - Video Memory: 6 GB GDDR5
  - Storing capacity: 28TB
  - Computing power: approx. 1TFlops

The GENIUS Campus – PRO-DD Data Center

- **CONCEPTS**
  - Virtualization
  - Cluster
  - Cloud computing
  - Consolidation
  - Grid computing

The GENIUS Campus – PRO-DD Data Center

- **Cloud Computing and Virtualization Architecture**
- The resources administration system is designed as an efficient integrated solution for all of the hardware and software resources available. It allows complex hardware and software product integration.
- The system is designed to use all available hardware and software resources in order to solve complex problems that require extreme hardware performance (eg. Design of complex models needed for very large matrix operations). Using virtualization and cloud computing techniques eliminates the need to purchase very expensive equipment like supercomputers or mainframe computers.
- On the infrastructure built on virtualization different platforms can implemented:
  - Platforms for different services (search, payment, etc.)
  - Stacks for Java, .Net, PHP, etc.
  - Platforms for structured storage (database and file systems)
  - Platforms for high performance computing applications, etc.

The GENIUS Campus – PRO-DD Data Center

- **Cloud Computing and Virtualization Architecture**
- Cloud computing allows the build of a virtual desktops infrastructure and even to replace the normal desktop computers with thin client devices (netbooks, tablet PCs and smartphones) that have access to the resources stored in the could.
- Cloud computing application services:
  - Provide the entire computing infrastructure as services.
  - Provide the solutions stacks as services.
  - Provide the applications as services using the Internet with no need to install and configure them on the clients' computers.
- Cloud computing infrastructure services:
  - Computing services: on real machines, on virtual machines, at the level of the operating system.
  - Network services.
  - Storing services.

The GENIUS Campus – PRO-DD Data Center

- **Cloud Computing and Virtualization Architecture**
- To access an application as a service using the Internet the system has the following main components:
- Web based GUI (Graphical User Interface).
- Resource administrator that distributes the available resources in the cloud, makes sure that the security rules are respected, monitors the system's performance, manages the virtual network.
- Virtual machines library.
- Active network equipment.
- Advanced security module.
- One instance of the application can be used by more users (in this case students) in the same time.

The GENIUS Campus – PRO-DD Data Center

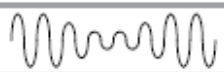
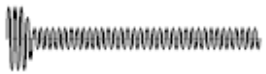
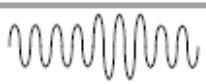
- **Information system components**
- Large computing infrastructure (High Performance Computing).
- Mathematical libraries for analysis and modeling.
- Management software for parallel or sequential processing of tasks.
- Specific software for application development.
- Project Management Software.
- Databases (history and simulation).
- Subsystem for presentation and reporting based on an application portal for communication.
- Virtual library component required for academia.
- Specific applications of different research areas.

The GENIUS Campus – PRO-DD Data Center

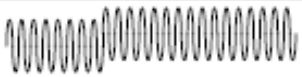
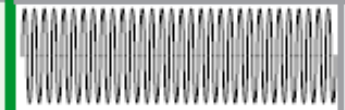
- **Expected features and performance**
- Improving access to scientific information and increasing the scientific research.
- Improved understanding of very large and complex mathematical models at higher resolutions, and the development of new scientific applications.
- Lower times for solving simulation problems.
- Decreased response time to complex problems and simulations.
- Access to the scientific community who provide some free computer applications in certain areas.
- Stimulate electronic exchange of information.
- Accelerate the exchange of information between the partners and reduce administrative activities in scientific collaboration.
- Ability to participate in national and European projects.

The GENIUS Campus – PRO-DD Data Center

- Incidents occurring in the power supply

Disturbance category	Wave form	Effects	Possible causes	Possible solutions
1. Transient				
Impulsive		Loss of data, possible damage, system halts	Lightning, ESD, switching impulses, utility fault clearing	TVSS, maintain humidity between 35 – 50%
Oscillatory		Loss of data, possible damage	Switching of inductive/capacitive loads	TVSS, UPS, reactors/ chokes, zero crossing switch
2. Interruptions				
Interruption		Loss of data possible, damage shutdown	Switching, utility faults, circuit breaker tripping, component failures	UPS
3. Sag / undervoltage				
Sag		System halts, loss of data, shutdown	Startup loads, faults	Power conditioner, UPS
Undervoltage		System halts, loss of data, shutdown	Utility faults, load changes	Power conditioner, UPS
4. Swell / overvoltage				
Swell		Nuisance tripping, equipment dam-age/reduced life	Load changes, utility faults	Power conditioner, UPS, ferroresonant "control" transformers
Overvoltage		Equipment dam-age/reduced life	Load changes, utility faults	Power conditioner, UPS, ferroresonant "control" transformers

The GENIUS Campus – PRO-DD Data Center

5. Waveform distortion				
DC offset		Transformers heated, ground fault current, nuisance tripping	Faulty rectifiers, power supplies	Troubleshoot and replace defective equipment
Harmonics		Transformers heated, system halts	Electronic loads (non-linear loads)	Reconfigure distribution, install k-factor transformers, use PFC power supplies
Interharmonics		Light flicker, heating, communication interference	Control signals, faulty equipment, cycloconverters, frequency converters, induction motors, arcing devices	Power conditioner, filters, UPS
Notching		System halts, data loss	Variable speed drives, arc welders, light dimmers	Reconfigure distribution, relocate sensitive loads, install filters, UPS
Noise		System halts, data loss	Transmitters (radio), faulty equipment, ineffective grounding, proximity to EMI/RFI source	Remove transmitters, reconfigure grounding, moving away from EMI/RFI source, increase shielding filters, isolation transformer
Voltage fluctuations		System halts, data loss	Transmitters (radio), faulty equipment, ineffective grounding, proximity to EMI/RFI source	Reconfigure distribution, relocate sensitive loads, power conditioner, UPS
Power frequency variations		System halts, light flicker	Intermittent operation of load equipment	Reconfigure distribution, relocate sensitive loads, power conditioner, UPS

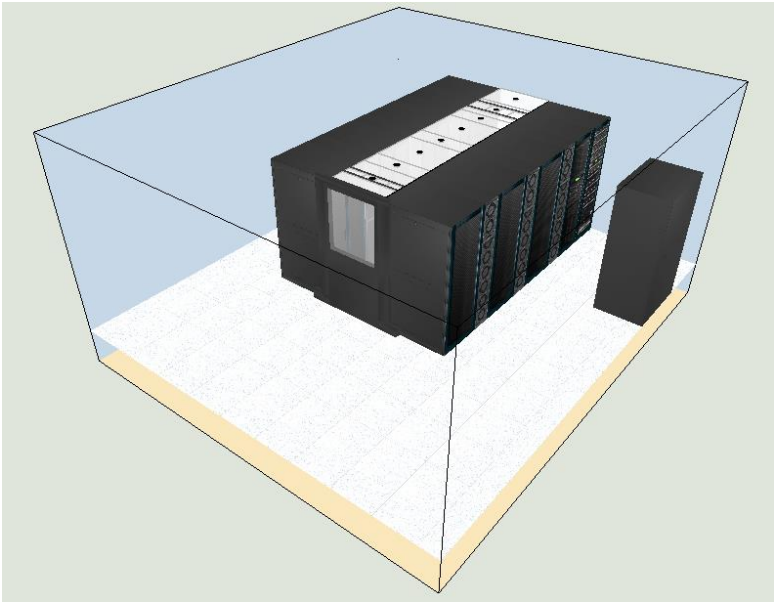
- Required to be used at least one UPS, an air filter and a power distribution unit

The GENIUS Campus – PRO-DD Data Center

- **Incidents that occur due to the environment**
- Optimum temperature: 22-240 C. If too low, too high or temperature variations occur:
  - Data corruption
  - System shutting down
- Optimum relative humidity: 30-50% (R.H.). To keep humidity between these limits is necessary a continuous air humidification (can not do this with a comfort system), which leads to a higher energy consumption
  - If it is too large: corrosion, condensation, gold, silver migration
  - If it is too small: electrostatic discharge
- The volume of air flow into the room: > 160 CFM per kW to maintain a uniform temperature into the room (at lower rates, as is the case with comfort systems, in the room appear warmer areas, and air is not clean enough).
- Required to be used at least one precision cooling unit (not enough a comfort system type)

The GENIUS Campus – PRO-DD Data Center

- **Server room cooling solution:**
- Solution is based on Hot Air Containment System (HACS).
- It involves closing the hot air passage between two rows of racks with a transparent ceiling and a door access to hot aisle.
- In this way you can install racks with high power, up to 20 KW / rack.



The GENIUS Campus – PRO-DD Data Center

- Data center location (yellow rectangle in the picture)

Automation, Electronics and Computer Science Dept.

- **Department of the *Electrical Engineering and Computer Science* faculty**
- **Coordinated study programs:**
  - **1st cycle:**
    - **Automation**
    - **Information Technology**
  - **2nd cycle:**
    - **Advanced system in Automation and Information Technology**
  - **3rd cycle:**
    - **PhD domains:**
      - **Electrical engineering**
      - **Control engineering**
      - **Information technology**
    - **Post-doc programs**

Participation in international IBM projects

- **"IBM Faculty Award" program:**
  - **project "DB2IMS - An Information Management System increasing Reliability in Data Transfer Using XML Technology" (proposed in 2005)**
  - **project "DB2REL- A Database Management System Increasing Reliability in Data Transfer with XML Technology " (2005-2006, 10000 USD, director: prof. Ph.D. eng. Francisc Sisak)**
  - **project "ELMSET- Using Eclipse to Develop a Learning Management System and a SCO Editor " (2006-2007, 10000 USD, director: conf. Ph.D. eng. Liviu Perniu)**

- **"IBM University Research" program**
  - **WEEGEN- Smarter Buildings: Intelligent Distributed Workspace for Energy Efficiency in the GENIUS Campus, international IBM grant (2010-2012, 90000 USD, director: prof. Ph.D. eng. Sorin Moraru)**

University Awards

IBM Faculty Awards

Related links
- IBM Academic Initiative
- IBM Student Portal
- IBM developerWorks
- alphaWorks (emerging technologies)

Overview | Ph.D. Fellowship | Innovation | Faculty | Shared Univ Research
About the program | Eligibility | Nomination process

The IBM Faculty Awards is a worldwide competitive program. Nominations for these awards must be initiated by someone within IBM.

About the program

The IBM Faculty Awards is a competitive worldwide program intended to:

- Foster collaboration between researchers at leading universities worldwide and those in IBM research, development and services organizations; and
- Promote courseware and curriculum innovation to stimulate growth in disciplines and geographies that are strategic to IBM.

Find out more
→ John W. Backus Awards
→ Frequently asked questions

Award recipients
2011 Faculty Award recipients (43KB)
2010 Faculty Award recipients (38KB)
2009 John W. Backus Award recipients (49KB)
2009 Faculty Award recipients (67KB)
2008 Faculty Award recipients (118KB)
2007 Faculty Award recipients (179KB)
2006 Faculty Award recipients (162KB)

Cloud computing

- **Can significantly reduce IT costs and complexity, while increasing the workload optimization and service delivery**
- **Allows a very high degree of scalability**
- **Offers superior user experience**
- **Allows companies to achieve tremendous computing power via the Internet, without being forced to invest in infrastructure**
- **Is based on new economic principles that rely on the Internet**
- **Companies can reduce IT costs by 30-40%**

Cloud computing

- **Global *cloud computing* market was around 68 billion dollars in 2011 and will reach about 150 billion dollars in 2014 (Gartner)**
- **For Romania 40% is the estimated annual growth for this segment between 2011 and 2015 (Eugen Schwab-Chesaru, general manager for Eastern Europe research company Pierre Audoin Consultants - PAC) - one of the elements that could help develop cloud computing in Romania is the high speed internet connection (Romania is one of the countries with the highest internet speed)**
- **The European Commission made the first steps towards formulating an European strategy regarding cloud computing, considering that, in Europe, cloud computing is expected to produce 35 billion Euros until 2014**

Cloud computing

- **"Academics, through higher education institutions and research institutes focused on both basic and applied research. Government environment, in turn, is part of the research and innovation, through their research institutes and departments, and participate, while also adapting legislation to the requirements of new technologies, such as *cloud computing*. However, the governmental and private beneficiaries trained human resources in academia and should provide its feedback on university curricula in order to adapt it to new technological concepts, such as cloud computing, grid computing, programming languages."**
(*Mihai-Răzvan Ungureanu*, Director of Foreign Intelligence Service and former Prime-Minister of Romania)

INSEED project

- ***IBM Romania*** **and** ***Bucharest Polytechnic University*** **implemented the first cloud computing lab dedicated to universities in Romania.**
- **A consortium of** ***Politehnica University of Bucharest***, ***"Transilvania" University of Brasov***, ***Bucharest Academy of Economic Studies*** **and** ***University of Medicine and Pharmacy "Carol Davila" Bucharest*** **aims at creating a new model of education and academic curriculum in** ***Science Service***, **making available to approximately 12,500 students laboratory and courses based on cloud platform through virtualization.**
- **Platform aims and promote innovation in service science education through an open and continuous model and through a virtualized IT infrastructure resources, which can be accessed as services.**

INSEED project

- **The cloud lab provides a common platform for students and teachers, service sector companies and government agencies that work together in a modern environment based on advanced information technology capabilities to create Science, Management and Engineering Services.**

- **Cloud platform allows for an open space, interactive collaboration between higher education institutions, industry and government agencies dedicated to promoting innovation services through demonstrations, case studies and technology transfer services solutions based on IT systems.**

MHMON project

- ***MHMON* - Using IBM *CloudBurst* and *Rational Application Developer* to develop mobile applications for remote healthcare monitoring with feedback functions**
- **Goals:**
  - **To develop a platform aimed to provide a flexible and interactive environment for improving medical service, focusing on both prevention and rapid intervention for people at risk by designing and implementing a monitoring and alarm system.**
  - **This system can be used, for emergency medical service and for educational purposes, by students from Faculty of Medicine at *Transilvania* University of Brasov.**

MHMON - Objectives

- **Data acquisition from a wide type of modern sensors:**
  - **spirometer, breathing monitor, pulse-oximeter, glucometer, blood-pressure monitor, physical-activity monitor, EKG, ultrasound.**
  - **therapy evolution monitoring of muscles, and exercise assisting.**
- **Data transfer from the sensors to the Cloud using mobile devices. Hardware and software interfacing, wireless communication.**
- **Data storage, analysis and feedback software functions developed and running on the host Cloud and communicating with the mobile devices or other authorized terminals**
- **Defining alarms and feedback for dosing and administering patient medications, to stop activity, or to call for help.**

MHMON - Results

- **Design and development of a microcontroller based hardware for data acquisition and communication having the following functionalities:**
  - **multi-channel input for analogical and digital sensors**
  - **an adapting interface for received signals using RS232, SPI, I2C and so on**
  - **wireless communication between this module and a mobile device**
- **Microcontroller software development for data acquisition and bidirectional communication with the mobile device.**

MHMON - Results

- **Software development for mobile devices for data acquisition from microcontroller board to send data to the Cloud using Internet. Also, additional functionalities will be developed:**
  - **sending patient's id and GPS position using mobile devices internal sensor,**
  - **defining alarms and feedback to inform patient to take his/her medicine, to stop activity or contact emergency services, if necessary**
- **Develop a methodology for maintaining patient security and privacy and the implementation of this methodology.**

MHMON - Results

- **Main software development running on the Cloud (an EAR that is created in Rational Application Developer, publishes the ear, and then deploys the application from within Rational Application Developer) for:**
  - **data acquisition from mobile device using TCP/IP,**
  - **inserting and data storage into a DB2 database,**
  - **analysis (using different tools and methods in order to provide information as detailed patient history) and feedback,**
  - **report generation,**
  - **user and security management to limit data access just for authorized users.**

MHMON - Results

- **Client software development to access Cloud using Internet-based authorized terminal to show archived and real time data about the patient. This service is for family physician, emergency physician, or even for teachers using anonymous medical data for their virtual laboratories.**

MHMON - Targeted groups

- **People at risk:**
  - **elderly people, cardiac patients, asthmatics, diabetics, epileptics, and so on.**
  - **those who are not allowed to lose their consciousness: drivers, plane pilots, flight supervisors, dangerous process supervisors etc.**
- **Emergency health services (providing a better data exchange between emergency physician and family physician)**
- **Ambulatory health services (monitoring without hospitalization)**
- **Students of *Transilvania* University of Brasov, including students involved in continuous education programs: summer courses, postgraduate courses, or training for employees from local or distance corporations.**

Conclusions

- **One of the main goals of our department, *Automation, Electronics and Computer Science* is to improve knowledge and skills based on new concepts and technologies.**
- **In order to develop the existing system we are using some IBM products like *CloudBurst*, *Tivoli*, *Rational*, *WebSphere* and *DB2*.**
- **Our datacenter provides customizable computational resources and virtual machines for our community, to develop complex and flexible applications.**
- **One of our domains of interest is medical monitoring, in which the real-time response is essential.**

Conclusions

- **Involving students from our department, we created a flexible and interactive environment for improving medical service, focusing on both prevention and rapid intervention for people at risk, by designing and implementing a monitoring and alarm system.**
- **This system can be used both in clinical and in educational purposes. The students from the Faculty of Medicine access the virtual laboratory for patient history, remote monitoring, statistics and best practices.**
- **The projects creates the opportunity for collaboration with other similar projects over the world to provide pieces of information to be reused in proper courses.**