COLOMBIAN NATIONAL GRID INITIATIVE
GRID COLOMBIA
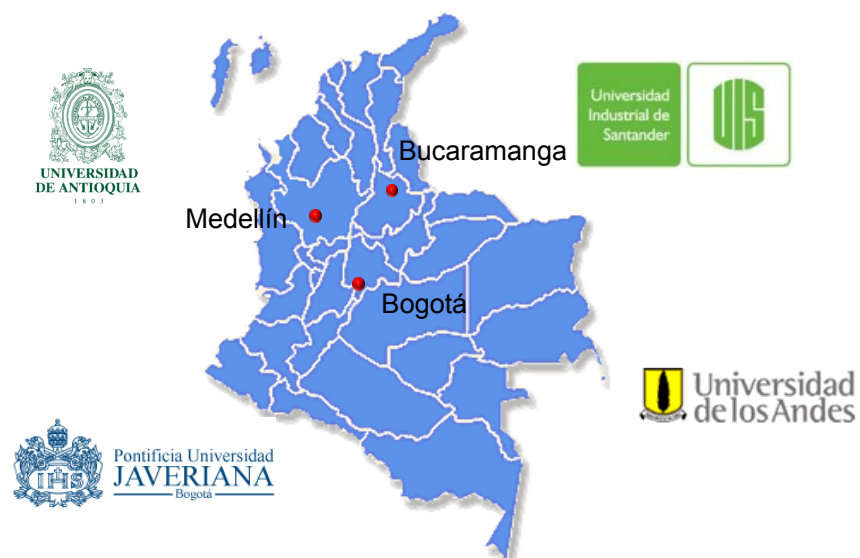
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ANL, December 2007

Outline

□ Introduction
□ Goals
□ Participants
□ Infrastructure
□ Achievements
□ Strategic Applications Areas
□ HPC and Grid Computing in Colombia
□ Challenges

Who are we?

Publication index

Rankin	Institution	Index	Student
1	Universidad Nacional de Bogotá	1405	26500
2	**Universidad de Antioquia**	**1226**	**31600**
3	Universidad del Valle	1225	27247
4	Centro Agricultura Tropical	824	
5	**Universidad de los Andes**	**785**	**13200**
6	**Pontificia Universidad**	**519**	**23100**
7	**Universidad Industrial de Santander**	**337**	**18500**

Iberoamerican Publication Ranking

Legend:
- Spain
- Brazil
- Argentina
- Mexico
- Chile
- Venezuela
- Colombia
- Others
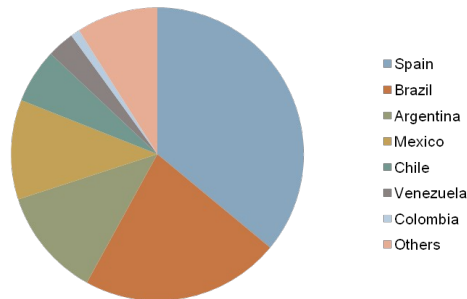
Population 45M (4th)   GDP $400B (5th)

R&D budget: 0.37% GDP

Grid Colombia

GRID Colombia

□ Goals

- Build a national grid system connecting the universities and institutions of the RENATA network.

- Promote the use and development of grid applications that contribute to the solution of relevant problems in the Colombian context.
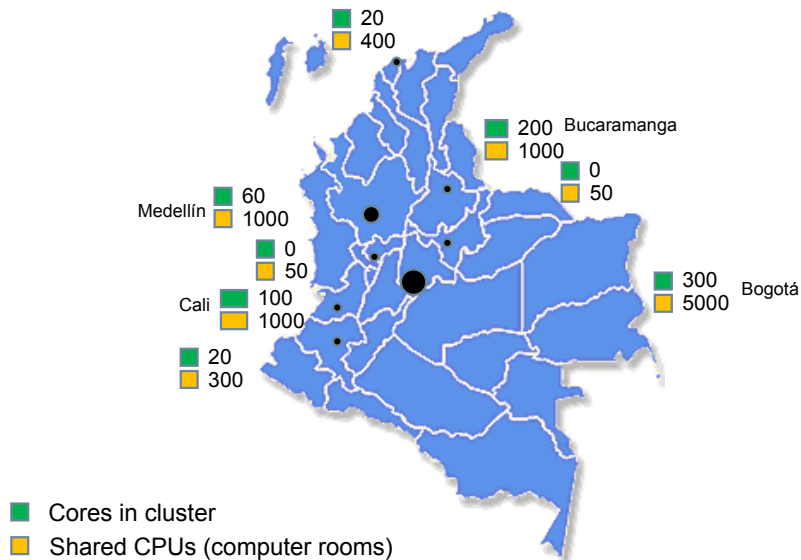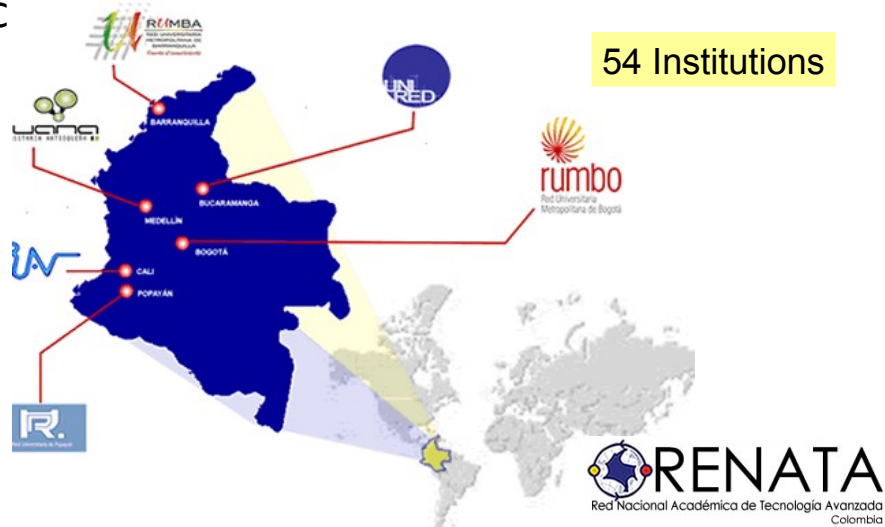
Grid Colombia

Grid Colombia

Grid Colombia

20
400

200 Bucaramanga
1000

0
50

Medellín
60
1000

0
50

Cali
100
1000

20
300

300 Bogotá
5000

- ■ Cores in cluster
- ■ Shared CPUs (computer rooms)

RENATA: Colombian NREN

- National Network of Advanced Technology

54 Institutions

CLARA

How did we start?

- July 2006: first contacts
  - UdeA, UPB, UMB, Uniandes, PUJ
  - Cluster census
  - Colombian Connectivity Agenda: RENATA
- August – November 2006
  - RF Proposals
- November 2006: 1st videoconference on RENATA
  - Both Ministry of Education and Communications were present
  - 12 universities presented their work on HPC
  - Grid Colombia is officially launched

Grid Colombia Initiative

- Organization
  - Infrastructure task force
    - Technical development and connectivity
  - Dissemination/Promotion task force
    - Potential application census
    - Government and Institutions involvement
    - International relationships and support
  - Administrative task force
    - Financial and policy issues
  - Joint Research Unit (JRU) constitution
    - Colciencias and RENATA endorsement

What have we done?

- 2007
  - Consolidation of local clusters
    - UIS, UdeA, Javeriana, Uniandes
  - International contacts
    - Grid Venezuela
    - CL-Grid
    - Grid Costa Rica
    - EELA
    - ANL
  - Training
    - International EELA Seminar on GC at Uniandes (March)
    - Summer school at Uniandes (Borja Sotomayor and French professors – Grid 5000)
    - Summer school at UIS (French professors)

What else have we done?

- 2007
  - Call for proposals based on RENATA
    - Submission from the different Grid Colombia task forces
  - Dissemination
    - CLCAR: 1st Latin-American Conference on HPC
    - Presentations in different contexts
      - Networking congress in Cartagena
      - Science week in Bogota
      - Physics Lab in Barranquilla
      - Expociencia in Bogota
  - Call for proposals on research
    - Articulated proposal
    - EELA 2

Strategic Application Areas

- Environment
  - Climate
  - Pollution
  - Natural disasters
- Biodiversity
  - Bioinformatics
- Health Science
  - Tropical diseases
  - Image based diagnosis
- Natural resources
  - Oil exploration
  - Minerals exploitation

Bio*: potato blight

Phytophthora infestans
Solanaceae

Potatoes
Annual production: $ 9,750 M
Production costs: $ 420 M
Phytophthora control: $ 42 M
Direct jobs: 70,000

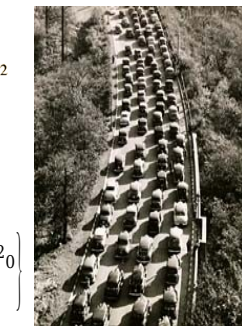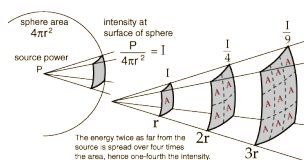# Noise and Air Pollution

Gaussian Pollution Model

Sound Intensity

$$I_0 = 10^{-12} watts / m^2 = 10^{-16} watts / cm^2$$
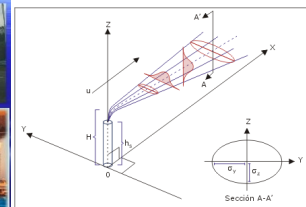
$$I(dB) = 10 \log_{10}\left[\frac{I}{I_0}\right]$$

Continuous Noise Level

$$L_{eq} = 10 \log_{10}\left\{\left[(1/T)\int_{t1}^{t2} p^2 A(t)dt\right]/p^2_0\right\}$$

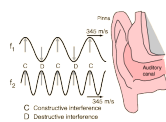**Inverse Square Law of Sound**

$$\chi = \frac{Q}{2\pi \sigma_y \sigma_z u}\ e^{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}\left\{e^{-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2} + e^{-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2}\right\}$$

sphere area
$4\pi r^2$

intensity at
surface of sphere

source power
P

$\frac{P}{4\pi r^2} = I$

$\frac{I}{4}$

$\frac{I}{9}$

I

r   2r   3r

The energy twice as far from the
source is spread over four times
the area, hence one-fourth the intensity.

C Constructive interference
D Destructive interference

Oil Production

Largest Colombian Company
Fourth in Latin America

What they do
Exploring
Producing
Refining
Transporting
RESEARCH-ICP

ecoPETROL
ENERGÍA PARA EL FUTURO

ICP'S RESEARCH PROJECTS
• Modeling Complex Areas
to Reduce Exploration Risks and Costs
• Modeling of Refining Processes

What is our experience?

- Uniandes
  - Intra grid project
  - Participation in European Grid project
  - EELA2 – JRU
- Universidad de Antioquia - UPB
  - Regional Center for Simulation and Advanced Computing (CRESCA)
- Universidad Javeriana PUJ
  - High speed connection between 4 dedicated clusters
  - Testbed on bioinformatics applications
- UIS – Universidad Industrial de Santander
  - Dedicated clusters

Grid projects at Uniandes

□ COMIT (Communication and Information Technology) research group at Uniandes CS department on GC
  - Campus grid Uniandes
    - **Definition and implementation**
      - Local models for accounting and interfaces
    - **Based on a central facility**
    - **Enhanced with computer rooms dynamically**
      - Big bucks
    - **Connected to the world**
      - EELA (done)
      - OSG?
    - **Pilot for Grid Colombia**
  - ECOS-NORD: Integration of medical information

MAGOS: Middleware Architecture for Grid Oriented Services

□ The main contribution of MAGOS:
  - Abstraction of the development grid complexity
  - Effortless grid use for the SOA developer
  - Declarative description of existing applications and non functional requirements
  - Integrated solutions for cooperation, availability, security, autonomy, usability, reuse

□ Magos allows workflow execution of business services

□ Applications remain individual, autonomous
  - Cooperation between own or third applications
  - Service composition

□ Non Functional requirements support
  - Replication, authorization, performance, availability, transparence to location and data source access

□ Execution according to actual load of the grid

Current applications at Uniandes

- Java Genetic Algorithm Framework
  - Optimization problems
  - Industrial Engineering Department
- *Bacillus thuringiensis* (to start on 2008)
  - Stochastic kinetic approximation
  - Chemical Engineering Department
- Enhanced videoconferences
  - On-line integration of grid resources to a collaborative session
  - IMAGINE research group at the CS Department

Grid projects at UIS

- CENTIC(Communication and Information Technology) research Center at UIS

  https://www.uis.edu.co/recursos_centic

  - ICT for Education
    - E-learning, ProSPECTI Project
  - Campus grid UIS
    - Design and implementation
      - Clusters, Computer Rooms, Supercomputers
    - Based on a central facility
    - Services in HPC and Distributed Systems
      - e-Science
    - Connected to the regional,national and world initiatives
      - UNIRED,GRID COLOMBIA, EELA, CLARA, and OTHERS
    - Strong involvement with Master and Doctorate programs

Grid projects at UIS

- PARALLEL AND GRID COMPUTING RESEARCH AT UIS
  - Molecular Dynamics
    - 1 dedicated cluster for HPC
  - Sismic and structural Engineering
  - Electromagnetic Fields
  - Astrophysics
  - Energy and Environmental Studies
    - Air and Noise Pollution Modeling
  - Applied Mathematics
    - Numerical Methods applied to Science and Engineering
  - Medical Diagnosis by Image Processing
    - Cancer Diagnosis
  - Microelectronic Devices

Grid projects at UIS

- GIEMA – Energy and Environmental Research Group
  - Infrastructure evolution
    - 3 dedicated clusters for HPC
    - 1 cluster for experimentation and development
  - Research projects
    - Design and Implementation of High Perfomance Supercomputing Service at UIS
    - Parallel Computing with CFD applications
    - Soft Computing applied to Modeling and Simulation of Complex Systems
    - Numerical Methods applied to Science and Engineering
  - Application development
    - Modeling and Simulation of Energy Conversion Systems
    - Air and noise pollution
    - Bioengineering

Grid projects at Javeriana University

- SIDRe – Distributed systems and networks research group
  - Infrastructure evolution
    - 3 dedicated clusters for HPC
    - 1 cluster for experimentation and development
  - Research projects
    - G+ - Agent based Middleware
    - Bioinformatics Testbed – NAMD
    - XEOS – Complex Systems Simulation
 - Application development
    - Molecular dynamics
    - Air and noise pollution
    - Ecological models

Grid projects at Javeriana University

- G+ - Grid Middleware
  - Main Features
    - model based on rational agents
      - incorporate learning skills to adapt the scheduling to the grid dynamics
      - autonomy to discover changes in the grid and act in a proactive way
    - architecture is composed by three type of elements
      - nodes, towns and grids
      - arranged in a flexible hierarchical structure
    - specialized control mechanisms
      - allowing the user to manage the way jobs are processed
      - resource grouping - composite jobs - friend process
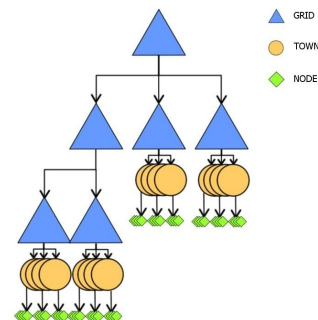
GRID
TOWN
NODE

Current and Future Challenges

- Economical support for projects
  - Government involvement
- Increase network bandwidth
- Personnel training (Grid People)
- Grid applications deployment
- Dissemination activities: hands on tutorials
  - Organization of local/international meetings
  - Social awareness

More information

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  - Jorge Zuluaga jzuluaga@udea.edu.co