



From HPC to High Performance Knowledge...

Carlos Jaime Barrios Hernández, PhD.

Director

[@carlosjaimebh](#)

High Performance and Scientific Computing

Guatiguará Technology Park

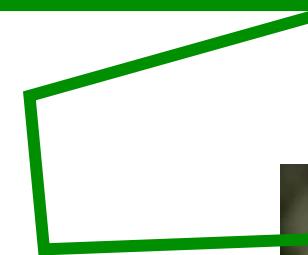
Universidad Industrial de Santander, Bucaramanga, Colombia

[@sc3uis](#)



From Supercomputing to Advanced Computing for Relevance

« Quien no
computa, no
compite »



Science and Advanced Technology for All

$$E_x = E_0 \sin\left(\frac{\pi V}{b}\right) \sin\left(\frac{\pi c}{c}\right)$$
$$H_y = \frac{jbE_0}{\eta\sqrt{b^2 + c^2}} \sin\left(\frac{\pi V}{b}\right) \sin\left(\frac{\pi c}{c}\right)$$
$$H_z = -\frac{jcE_0}{\eta\sqrt{b^2 + c^2}} \cos\left(\frac{\pi V}{b}\right) \sin\left(\frac{\pi c}{c}\right)$$

"HE DOESN'T KNOW ZILCH . BUT HE MAKES THE BEST COFFEE IN THE BUSINESS."

Theory
(Models)

Data

Experimentation

oh, uh, I thought
(Golden Boy)
was here.

Supercomputing

Technology - Infrastructure

Experts- Scientists
(Biologists, Architects, Physicians)

Experts Scientists – Computer and Informatics
Informatic, Math Applied

Technology - Infrastructure

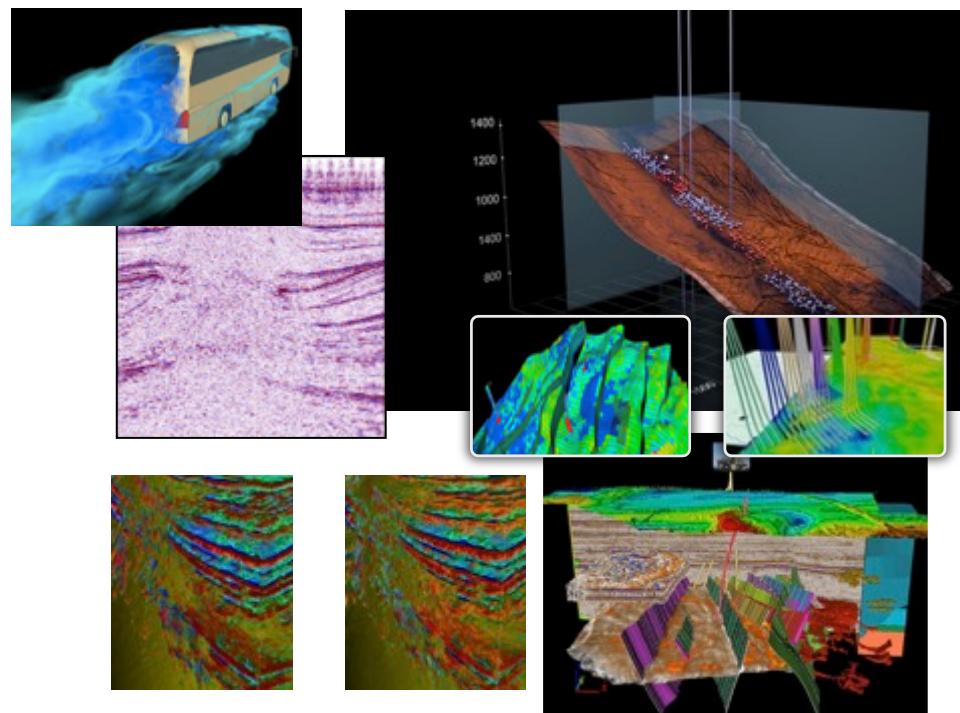


Decision Takers



Citizens, All

Why?



- Large Data Sets
- Complex Mathematics
- Complex Models
- Real Time
- Interaction and Confrontation
- Large Scale Visualization
- High Resolution
- High Performance and Capacity
 - VR Needs
 - Big Data and Deep Learning



¿What is SC3UIS?

R+D+i
National
Strategic
Areas

.com
and **.org**

.gov
and **.co**

International
R+D+i

.edu



Application
Deployment



Scientific Software
Development



SCI- IT Management and
Support



Strategic Mediation
and Training



Research and
Innovation

¿Where is SC3UIS?





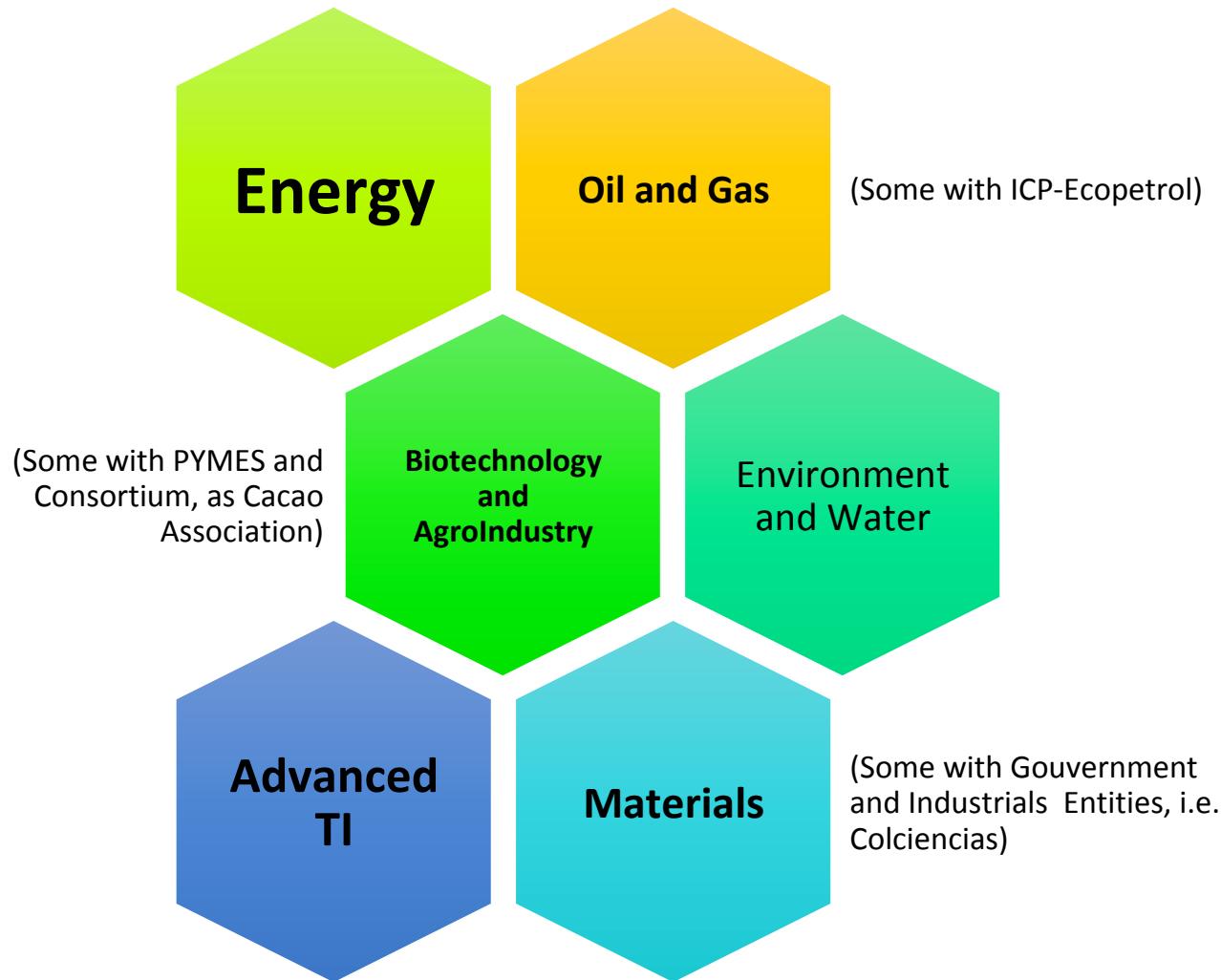
SC3UIS at UIS (@UIS) and Guatiguará Technology Park (@PTGuatiguará)

- Founded in 1948 (Following the German /French Polytechnic Model)
- Public State University
- 8 Campus in the Department
 - 4 at Metropolitan Zone of Bucaramanga
 - 4 in Other Regional Cities (Barrancabermeja, Socorro, Malaga, Barbosa)
- 25000 Students (2300 Postgraduate Students)
- 530 Faculty (4 at SC3UIS)
- Support and R+D+I and General Training of SC3UIS



- Guatiguará Site was created in 1989 (New Foundation at 2007 as Technology Park)
- 8 Industrial Corporations
- 3 National Labs
- National Core Repository and ANR Site
- 5 Centers
- High Performance Computing Data Center
 - GUANE-1 and CHAMAN are here!
- R+D+I and Specialized Training Site of SC3UIS

R+D+i Axes (@PTGuatiguará)



2017 Important Numbers

4 Patents

5 Spin Off in Incubation Process

(Potentially for 2018 more than 10)

3 Big International Collaborations (more than 5M USD)

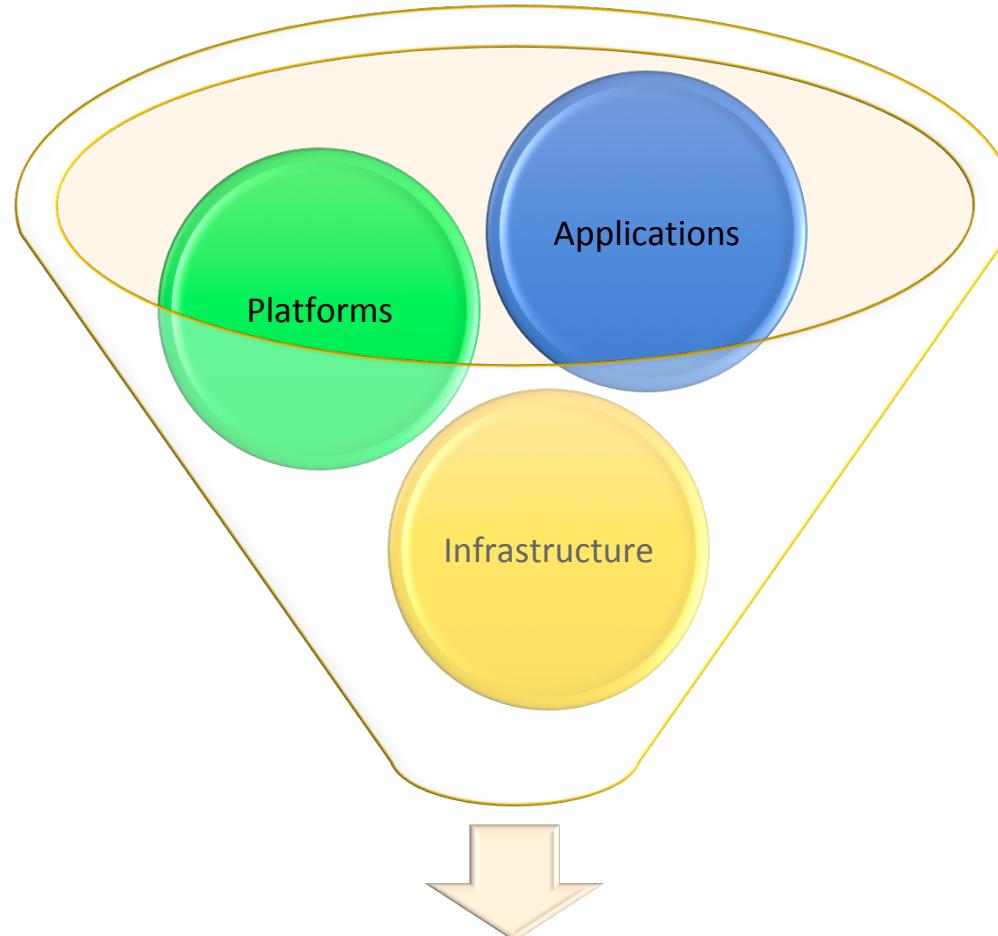
2018 New Axes:

Healthcare

New Generation of Automotive Motors

Human and Social Development

Big Problems, Smart Solutions



High Performance
(Computing) Knowledge

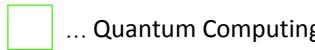
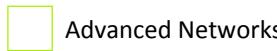
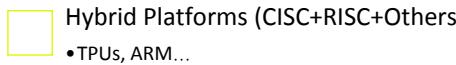
Infrastructure Platform Applications



- Post Moore Era Architectures
 - Parallel Balancing, I/O, Memory Challenges



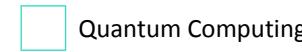
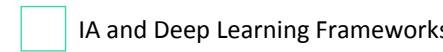
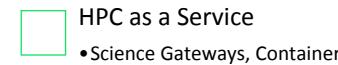
- Exascale
 - Computer Efficiency (Processing/Energy Consumption)



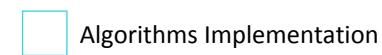
- Programmability
 - New Languages and Compilers



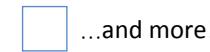
- Data Movement and Processing (In Situ, In Transit, Workflows)



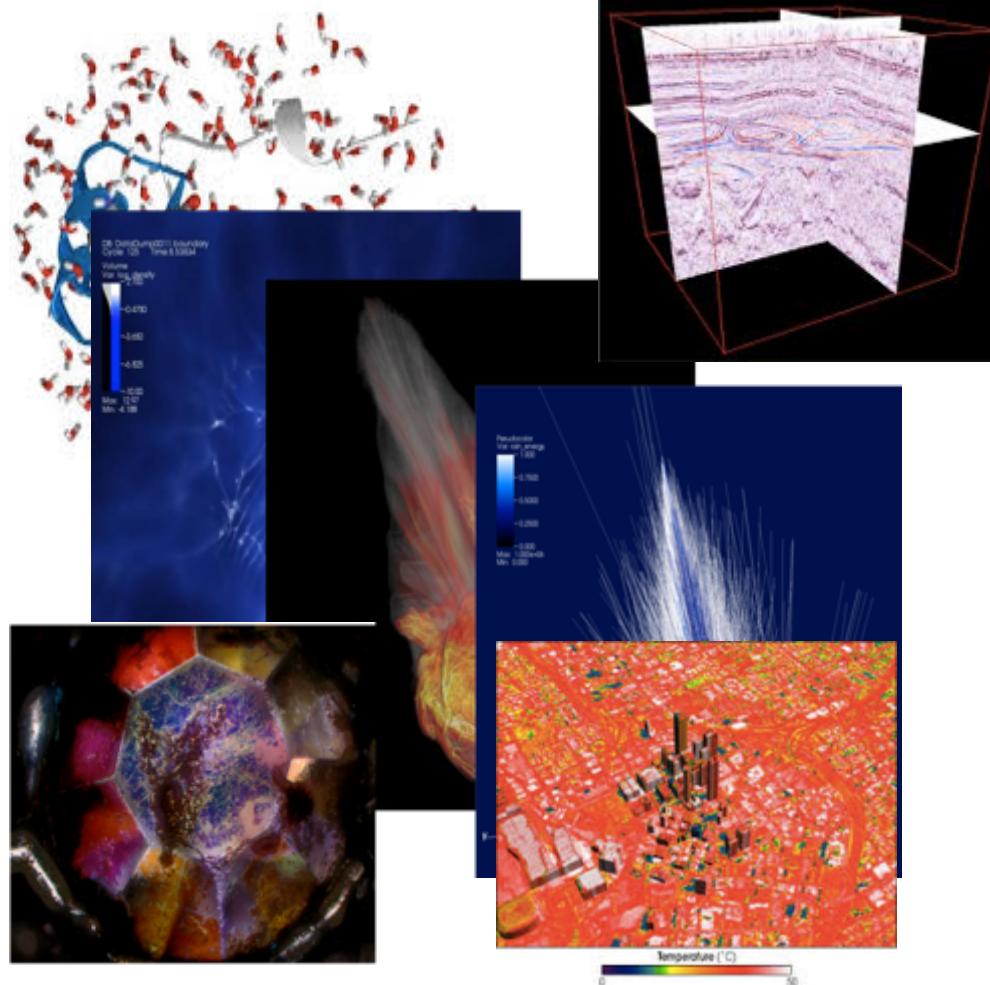
- IA and Deep Learning



- Use of Interpretors (as Python)



Some In House Examples



HPC Hybrid Systems (HPC@Pocket)

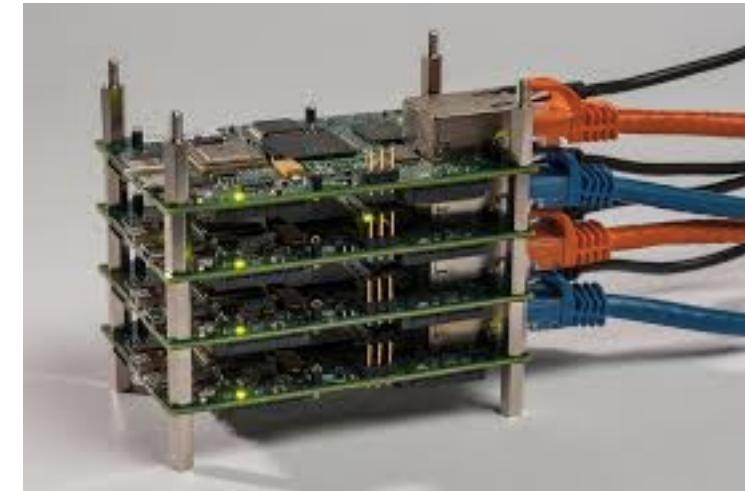
- High Performance Capabilities
 - Multiple Cores (i.e. more than 192 cores in Jetson)
- Co-Design Architecture
 - Allowing multiple networks and protocols
 - Software Implementation Mechanisms (Now, very known, i.e. CUDA, OpenCL... same Python)
 - Low Power
- Low Cost
 - Depending of the device... (≈ 1 € per core)
- However, Integration/interaction demands efficiency



nVidia® Jetson TK1/TX1

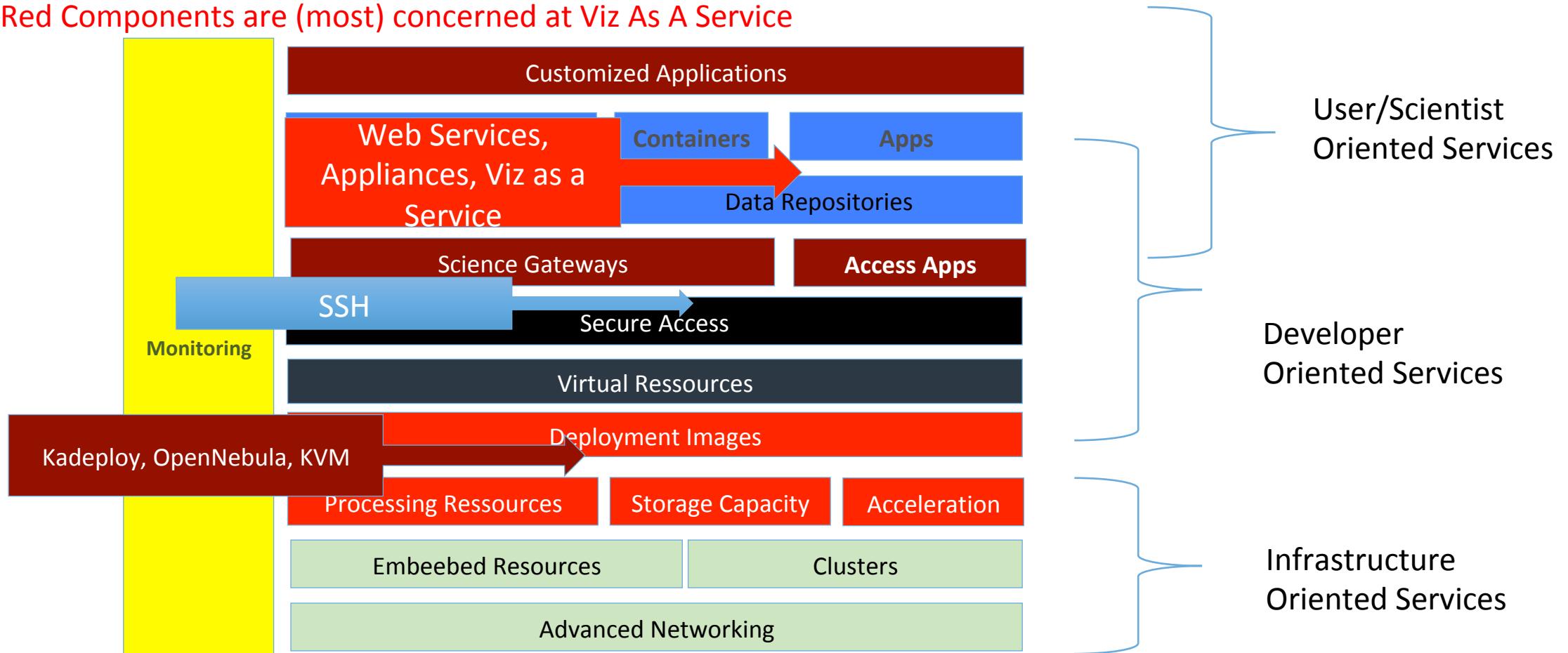
(BIG and Pocket) HPC Heterogeneous Platforms

- Same Technology
 - RISC/CISC
 - GPUs, Hybrid ARM/FPGAs, Accelerators, CPUS....
- Same Data
 - However scale capabilities changes
 - In-Situ and In-Transit Problem
- Same Schedulers, O.S. and Package Management
 - However, it is important to observe the architecture
- Same Exascale constrains
 - Computer Efficiency (Energy Consumption / Energy Aware)

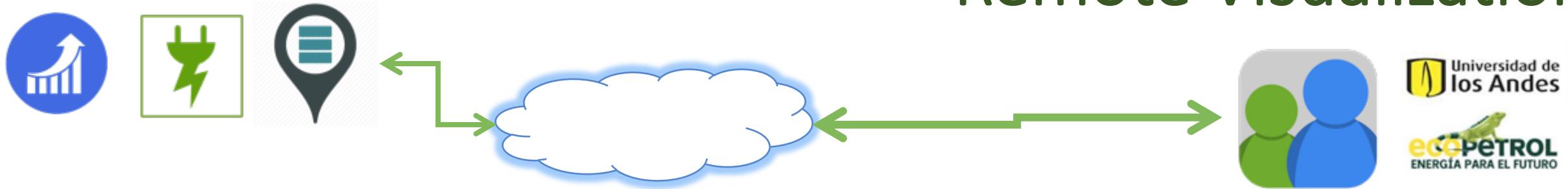


HPC as A Service Model

* Red Components are (most) concerned at Viz As A Service



In Situ HPC Processing* and Remote Visualization



- Technical Challenges
 - HPC “Cloud” Specific Service (VizAsS)
 - Quality of Service is Important (Speedup (Processing and Network), Security, LSAs, Support...)
 - Special Hardware (NGRID...)
 - Special Software (RCUDA, FAST...)
 - Special User Requirements

- User Constraints:
 - Users Needs Visualization and Large Scale Data Analysis
 - Quality of Service is Important (Speedup (Processing and Network), Security, LSAs, Support...)
 - HPC is Expensive (Energy, Space, Hardware, Software, Management)

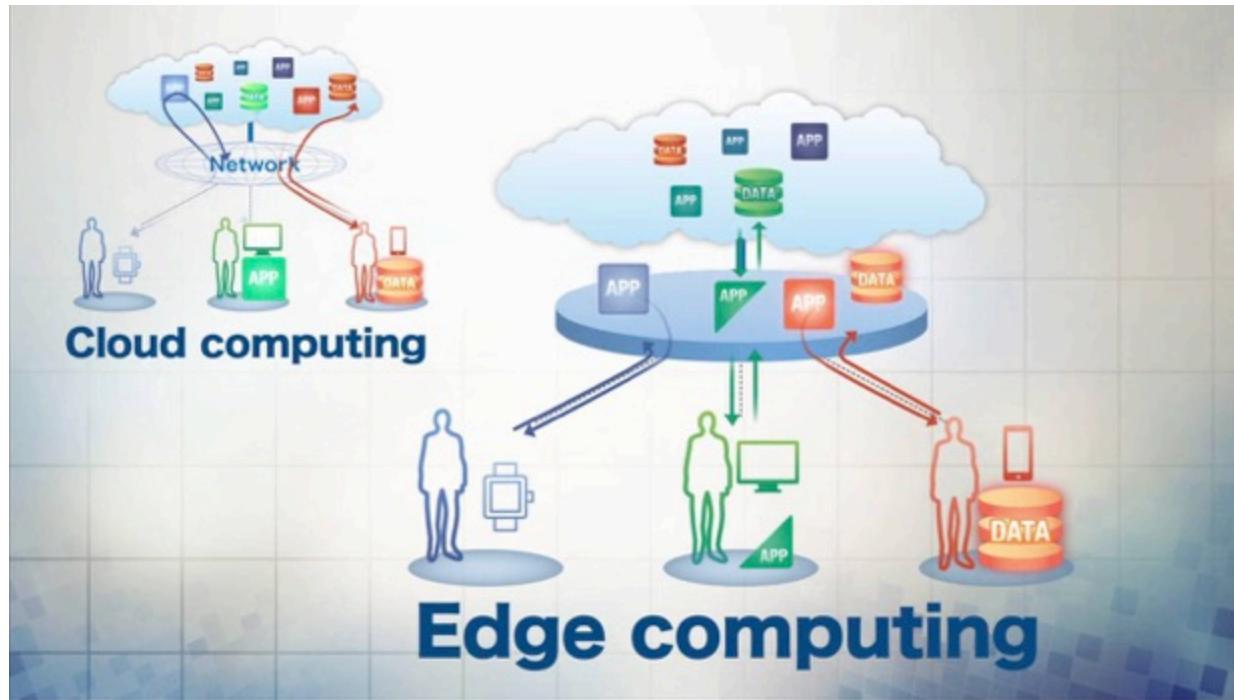
* *In Situ Processing is not show in this presentation*



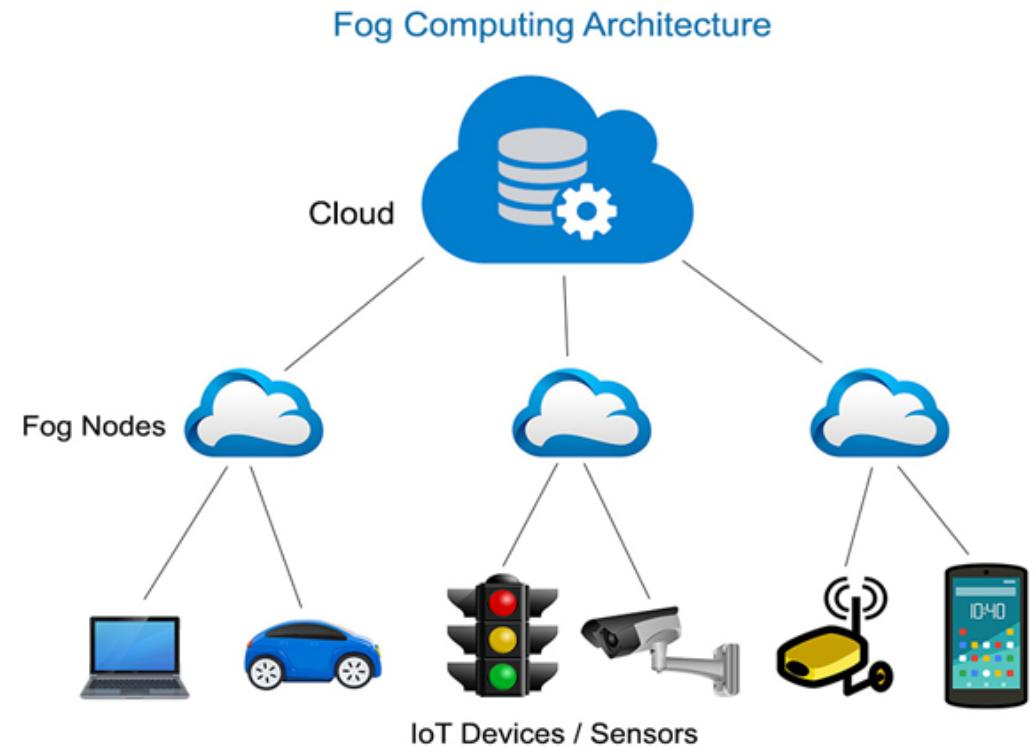
Involved People

- **NVIDIA GRID Development Team (Collaborators)**
 - Jeff Weiss, Jason Southern, Rachel Berry
- **WMWare Development Team (Collaborators)**
 - Matt Coppinger
- **Imagine Team at UniAndes**
 - Jose Tiberio Hernandez, Pablo Figueroa
- **INRIA – HPC and Visualization Team**
 - Bruno Raffin
- **Kaiserslautern – Computer Grafics and HCI Team**
 - Hangs Haguen
- **SC3UIS R+D+i Team**
 - Deyberth Riaño (**UIS Master Student SC3UIS/Imagine**)
 - Carlos Parada (**UIS Undergraduate Student SC3UIS**)
 - John Anderson Garcia (**UIS Former Master Student SC3UIS**)
 - Gilberto Diaz (**SC3UIS CTO**)
 - Gabriel Pedraza (**SC3UIS Faculty**)
 - Carlos J. Barrios H. (**me**)

Why Ultra Scale?



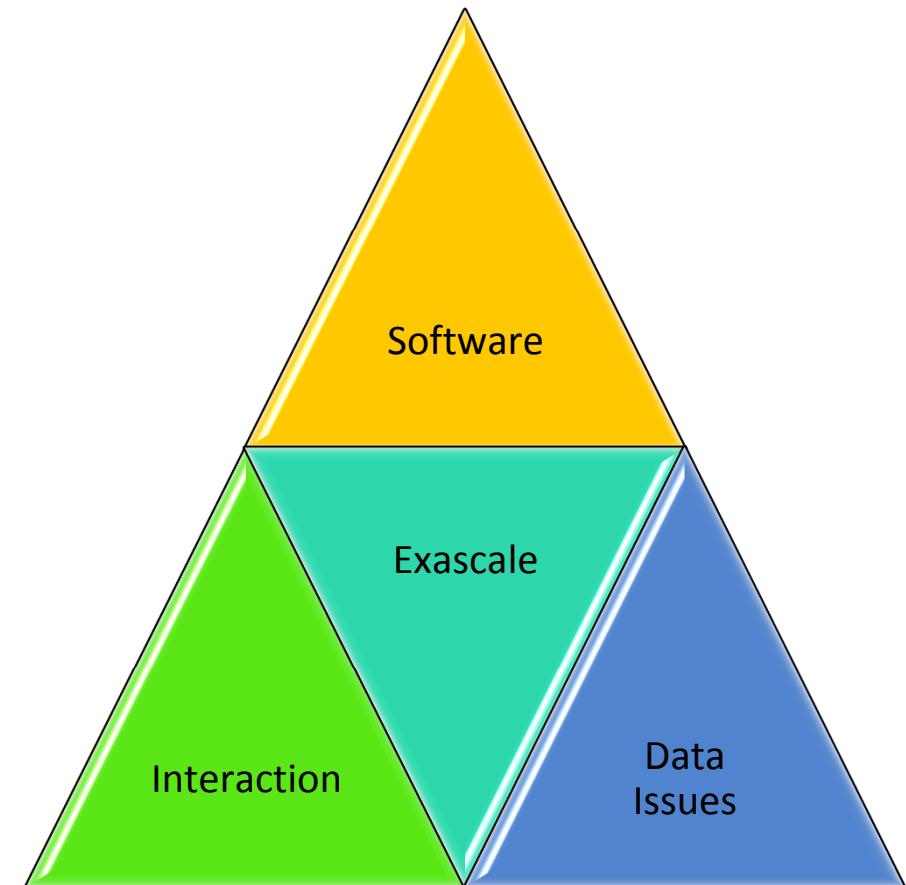
Mesh network of micro data centers that process or locally



Extends Cloud computing and services to the edge of the network

Ultra Scale Systems needs Ultra Scale Software (Almost the concept)

- **Hybrid Systems (Hardware and Software Architecture)**
 - High Performance Capabilities
 - Parallelism
 - Energy Efficiency
- **Large Scale (Scalability)**
 - Latency
 - Distribution
 - Diversity (Networks, Protocols)
 - In Situ and In Transit
- **Software Quality**
 - Compatibility
 - Functionality
 - Reliability
 - Availability
 - Dependability
 - Usability



About the In-situ Production visualization: “Pure Parallelism”

From: Hank Childs

Lawrence Berkeley Lab & UC Davis

Example:
Production visualization with “pure parallelism”: same problems that processing

Pure parallelism emphasizes I/O and memory

High Cost (Efficiency, Performance, Energy)

Difficult to programming and use

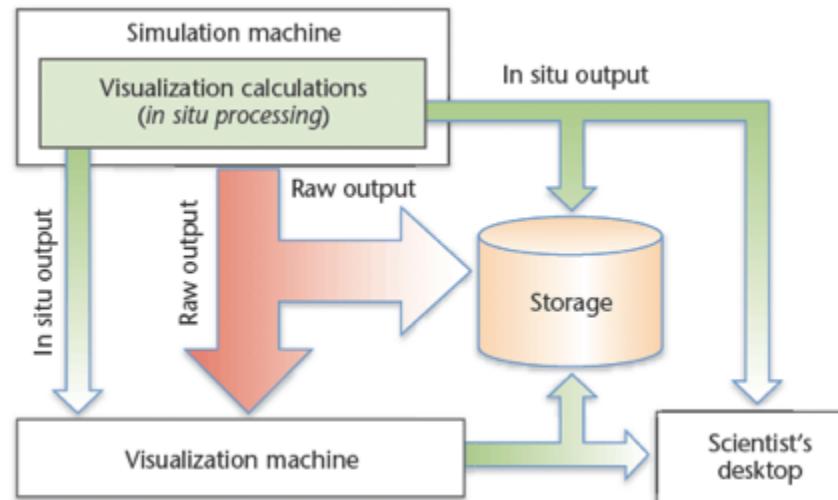
Hardware Disruption

Accelerators (GPUs, ARM, Xeon Phi)

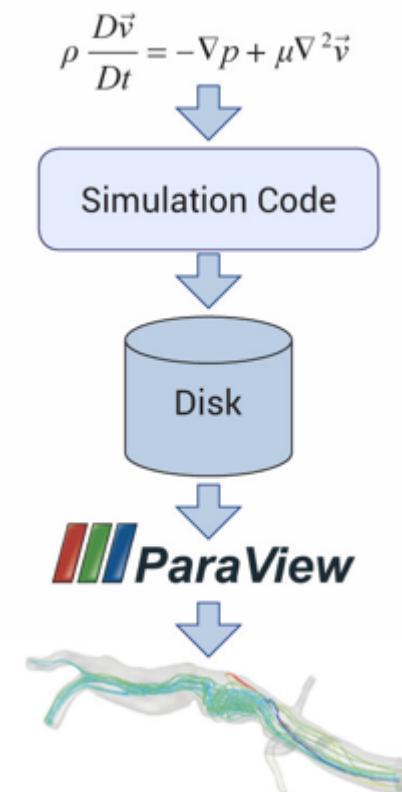
Specific Issues (i.e. TPUs, 3D Memory)

What about in-situ?

- In situ operation is one that occurs without interrupting the normal state of a system, with the data close to the processing unit.
- in situ data would mean bringing the computation to where data is located, rather than the other way, then, In- situ needs extra memory allocation or special memory.

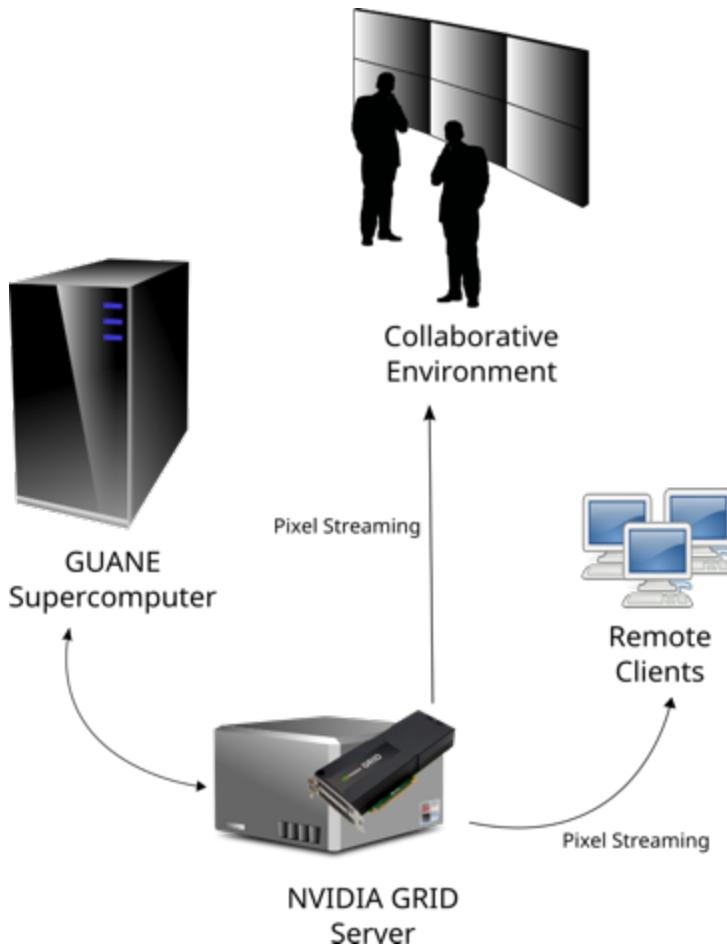


An Example: Paraview



In Situ Strategies:

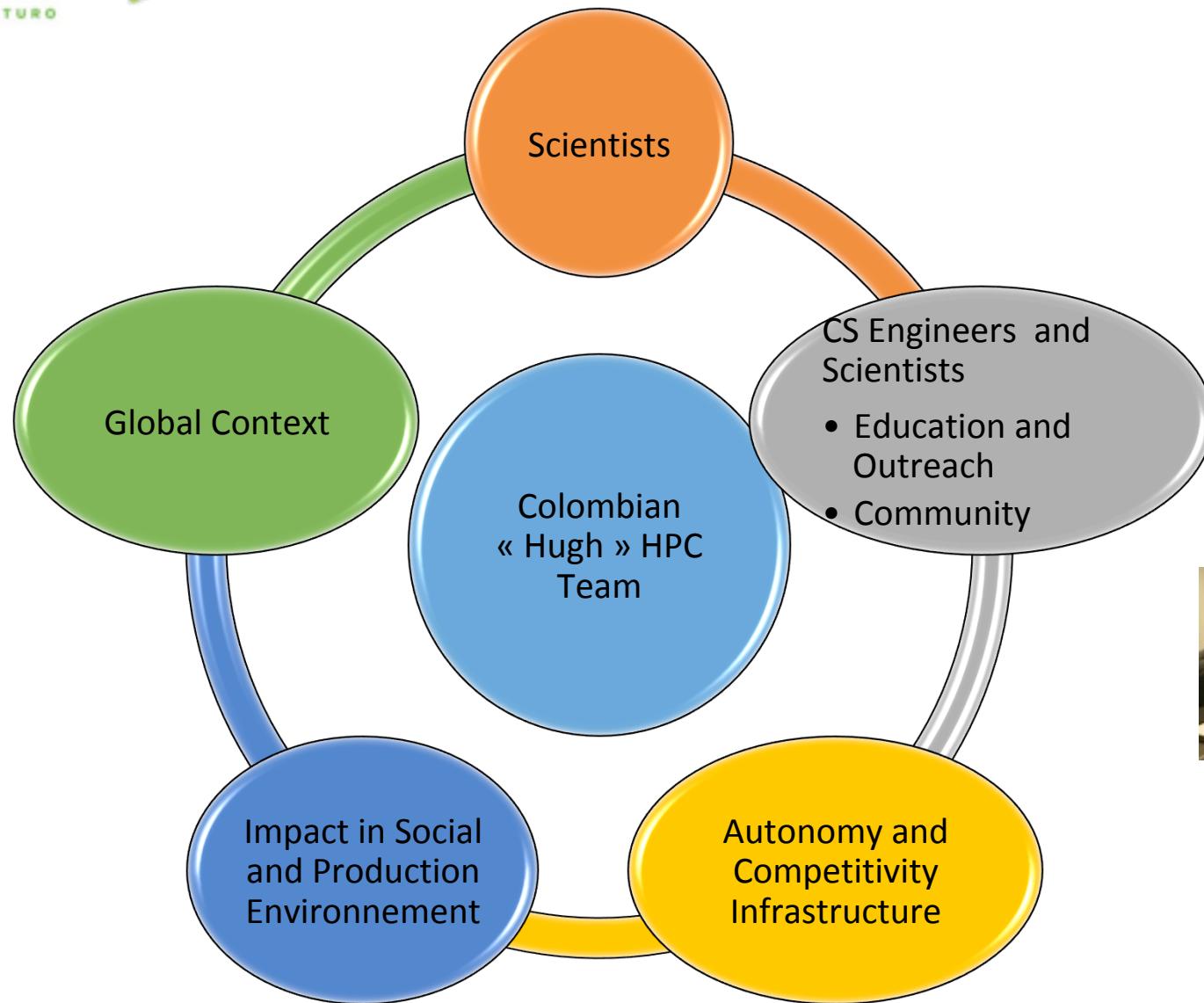
In Situ Strategy	Description	Negative Aspects
Loosely coupled	Visualization and analysis run on concurrent resources and access data over network	<ul style="list-style-type: none">1) Data movement costs2) Requires separate resources
Tightly coupled	Visualization and analysis have direct access to memory of simulation code	<ul style="list-style-type: none">1) Very memory constrained2) Large potential impact (performance, crashes)
Hybrid	Data is reduced in a tightly coupled setting and sent to a concurrent resource	<ul style="list-style-type: none">1) Complex2) Shares negative aspects (to a lesser extent) of others



From Yaje ... Now Yaje 2!lt Works! (Almost)

- Hardware Elements
 - NVIDIA GRID Infrastructure 😊
 - GUANE-1 HPC Platform (Based In TESLA GPUs) 😊
 - Network (Provided by RENATA 😞)
- Software Components
 - HPC as a Service Model (Developed by SC3UIS and SCALAC)
 - Singularity and NVIDIA Software
 - Open Source Software
 - In House Software
- **And Now with Containers!!**

My Personal Vision for Colombia





**Colombia Advanced
Computing Center**



**Colombia Advanced
Computing Center**

PAIX: Plataforma Avanzada para la Innovación eXascale

*(Plateforme Avancée pour l'Innovation
eXascale)*



HPC/TI Avanzadas:

Innovación para acelerar ciencia, investigación
y desarrollo económico en Colombia



**Centro Colombiano
de Computación Avanzada**



MINTIC



Bull
atos technologies



CATAÏ
Collaboration France-Colombie





Objectives

- The main goal of CACC is to support the generation of knowledge, the technological appropriation and the creation of own technologies to boost the development of Colombia.
- Offer knowledge, infrastructure and High Performance Computing for the needs and perspectives in science, research and development of the country.
- Support the sovereignty of the information, the national security and the decreasing of the dependence on outside technology.



Colombia Advanced
Computing Center

Mission

Colombia Advanced Computer Center (CACC) is the national supercomputing and scientific computing center in Colombia, with the mission to support research and development of knowledge; appropriate and manage technology with advanced computing, high performance computing to boost the progress and development of Colombia.

To reach this mission, CACC drive national interest projects and follows specific objectives.



MINTIC

Colombia Advanced Computing Network (RCCA)



LATINAMERICAN CONFERENCE ON HIGH PERFORMANCE COMPUTING 2018

CARLA

Joint Conference HPCLATAM/CLCAR



Guatiguará Technology Park, Piedecuesta, Santander, Colombia

Workshops and Tutorials: September 21-25 /2018

Conference September 26-28 /2018

@CARLA_Conf



NVIDIA.





The Spirit of #CARLA

After some beers in CLCAR 2013 Conference in Costa Rica ...

CARLA meets people overall...

HPC Infrastructure, HPC Users, HPC Uses, HPC Perspectives, Scientific Computing... in Latin America

2014 – Valparaiso (Chile) hosted by UFSM (*Chair G. Hernández*)

2015 – Petropolis (Brasil) hosted by LNCC (*Chair C. Osthoff*)

2016 – Ciudad de México (México) hosted by ABACUS CINVESTAV-IPN (*Chair I. Gitler*)

2017 – Buenos Aires/Colonia (Argentina- Uruguay) hosted by UBA and UdR (*Chairs: Esteban Mocksos and Sergio Neschmanow*)

**2018 – Bucaramanga/Piedecuesta (Colombia) hosted by CACC
(Chairs: Carlos Barrios and Harold Castro)**

2019 – San José (Costa Rica) hosted by CENAT

2020 - ??

¿Where will be CARLA 2018?



How to come to Bucaramanga?

In Flight to Bogota (El Dorado International Airport (Code BOG))

- More than 70 International Flights from different cities in America (Capitals and secondary cities)
- i.e.: Buenos Aires – Bogota (4 Flights by day), Mexico City – Bogota (6 Flights by day), Sao Pablo –Bogota (2 Flights by day), Rio de Janeiro – Bogota (2 Flights by day), Santiago de Chile – Bogota (4 Flights by day), San José de Costa Rica – Bogota (2 Flights by day)...
- Partnership airlines to publish in March 2018



In Flight to Bucaramanga ((Palonegro International Airport (Code BGA))

- 9 Avianca flights from Bogota by day
- 4 Latam Flights from Bogota by day
- 6 Copa flights from Panama by week (Tuesday, Friday and Sunday)
- 4 Low costs flights from Bogota and Medellin by day.

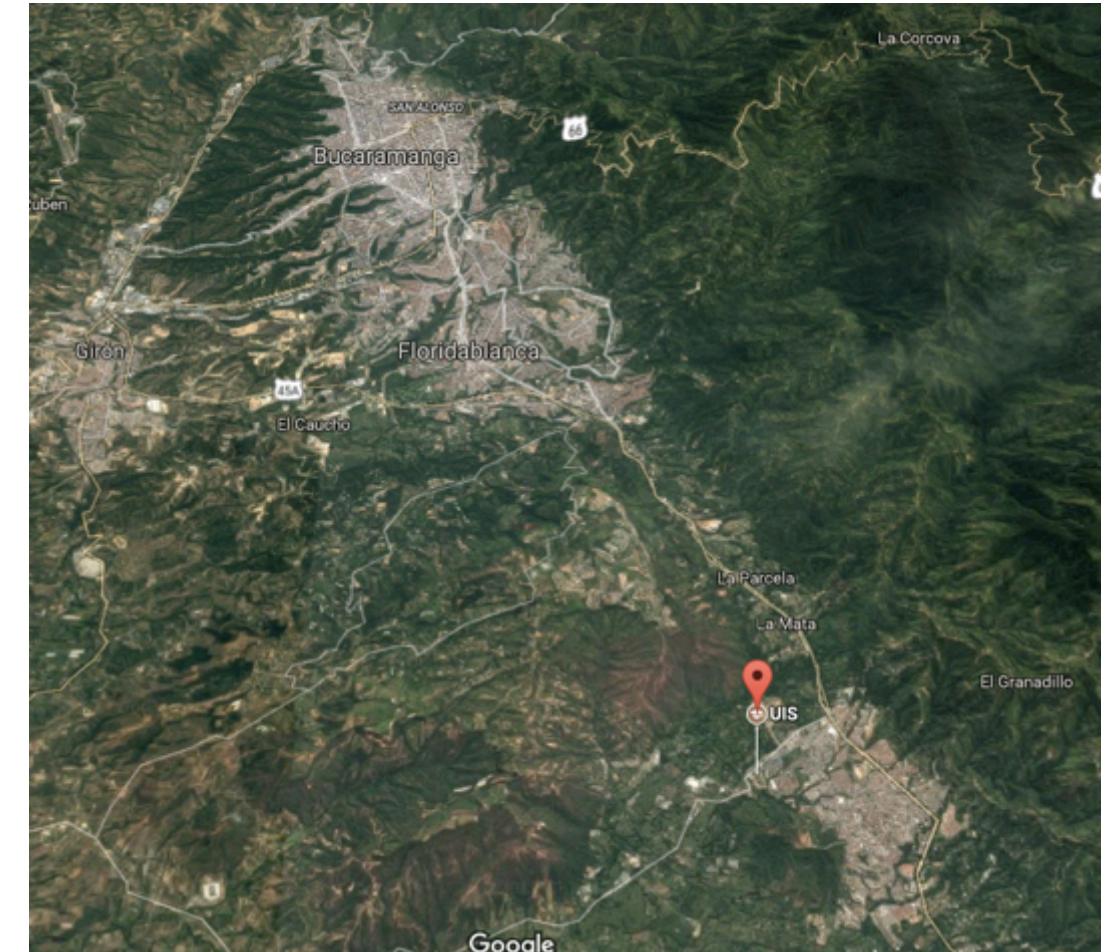
How to host in Bucaramanga?

Close to PTG

- 3 Hotels in Piedecuesta (and 5 hostels) (5min car or bus) - Walking Possible (1 of the hotels in Pie de la Cuesta Shopping Mall) –Piedecuesta Downtown close.
- 4 Hotels in Floridablanca (and 3 hostels) (15min car or bus) - Walking not recommended.

In Bucaramanga

- More than 20 *cheaper* recommended hotels (and 10 hostels) (30min car or bus)
- **Partnership hotels to publish in March 2018**
- Official #CARLA2018 Buses will be available to recover attendees in strategic points.
- 15 Special Lodgment for non-Colombian postgraduate authors)
- A lot of AirBnB offers!
- A Beer in a Bar: U\$ 2.0 /2.5 Dollars
- Taxi from Airport to Bucaramanga: U\$ 12.0 Dollars



About #CARLA2018

- **Conference Dates: 26-28 September (Wednesday to Friday)**
 - General Chairs: *Carlos Jaime Barrios Hernandez (.co) and Harold Castro Barrera (.co)*
 - Publication Chairs: *Esteban Meneses (.cr) and Raul Ramos (.co)*
 - Poster Chairs: *Gabriel Pedraza (.co) and Sergio Neschmanow (.uy)*
 - Industrial Chairs: *Isidoro Gitler (.mx) and Alvaro de la Ossa (.cr)*
 - Tutorial Chairs: *Gilberto Diaz (.ve .co) and Esteban Mocksos (.ar)*
 - Workshops Chair: *Nicolas Wollowick (.ar) and Jorge L. Chacón (.co)*
- *Call for Papers*
- *Closed for Regular Papers*
- *Call for Posters and workshops Open !!*
 - *Deadline Julne 28 2018*

About #CARLA2018 - Meetings, Tutorials and Workshops: 23-24-25 September (Sunday to Tuesday)

- **Tutorials (To confirm and publish in July 2018)**
 - However 3 hands – On NVIDIA !!!
- **Confirmed Meetings:**
 - SCALAC Chair: *Salma Jaliffe (.mx)*
 - RICAP Chair *Rafael Mayo .(es)*
- **Confirmed Workshops:**
 - **Latin American Women on HPC.** Chairs: *Carla Osthoff (.br) and Salma Jaliffe (.mx)*
 - **EAGE HPC for Oil and Gas.** Chairs: *Pedro Cruz (.br), Carlos Barrios.co)*
 - **Graduate Symposium (Master and Doctoral Students).** Chairs: *Yves Denneulin (.fr) and Phillippe Navaux (.br)*
 - **HPC Hackaton.** Chairs: *Juan Guillermo Lalinde (.co) and Robinson Rivas (.ve)*
 - **Visualization Showcase (Sponsored by NVIDIA)** Chair: *Jose Tiberio Hernandez (.co) and Benjamin Hernandez (.mx/.eu)*
 - **BioCARLA Chair:** *Miguel Guevara (.co)*
 - **HPC Management Good Practices** Daniel Gruner (.ca), Gilberto Diaz (.co) and Guilherme Peretti Pezzi (sw)

About #CARLA2018 – Other Activities



Visit to Chicamocha Canon National Park (PANACHI) – Saturday 29th September (organized for #CARLA2018 attendees)

• However for your side:

- You can visit two important dams (Tocomoro (1h car/bus from Bucaramanga) and Sogamoso, (45min car/bus from Bucaramanga)), Villa de los Caballeros San Juan de Girón (UNESCO colonial village (20min in Car/Bus)), Eloy Valenzuela Natural Park (10min Car/Bus) and Santisimo Monument (Our Corcovado...15min car/bus and 10min lift)).
- San Gil and Socorro Tourism Axe (2h half car/bus from Bucaramanga) with Barichara, it is one of the most beautiful colony villages in Colombia).
- Zapatoca Village: First German/Spanish Village in Colombia (Founded in 1743), traditional Santander Culture Village (2h half Car/bus from Bucaramanga)

Special Gifts Now in the Summer School on HPC - Universidad de los Andes/ Universidad del Rosario

- (2) Two Full Inscriptions (Workshops and Conference)* for one assistant that follows the twitter account @CARLA_Conf
 - Visit the site: www.ccarla.org
 - Make a tweet in english with a message with the Hastag #CCARLA2018 and saying: « I want to participate because... from the 1st HPC Summer School
 - Best Twitter selected by chairs of the summer school will be selected





Thanks a lot and see you at Santander...

Follow us: [@sc3uis](https://twitter.com/sc3uis)

Or visit us: www.sc3.uis.edu.co