Creating a Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis (CAMERA) —Taking Metagenomics to Light Speed

Invited Talk

ONR Review

Scripps Institution of Oceanography, UCSD

June 27, 2006

Dr. Larry Smarr

Director, California Institute for Telecommunications and Information Technologies

Harry E. Gruber Professor,

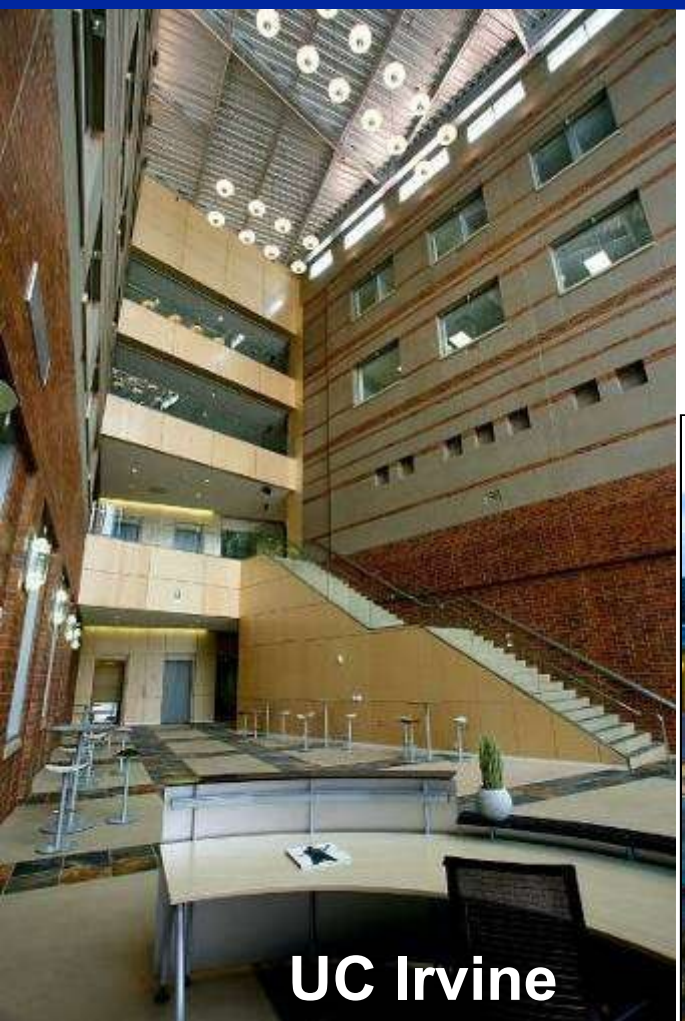
Dept. of Computer Science and Engineering

Jacobs School of Engineering, UCSD

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Marine Microbial Ecology

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Two New Calit2 Buildings Provide New Laboratories for "Living in the Future"



- **Over 1000 Researchers in Two Buildings**
  - Linked via Dedicated Optical Networks
  - International Conferences and Testbeds
- **New Laboratories**
  - Nanotechnology
  - Virtual Reality, Digital Cinema



www.calit2.net

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Preparing for a World in Which Distance is Eliminated…

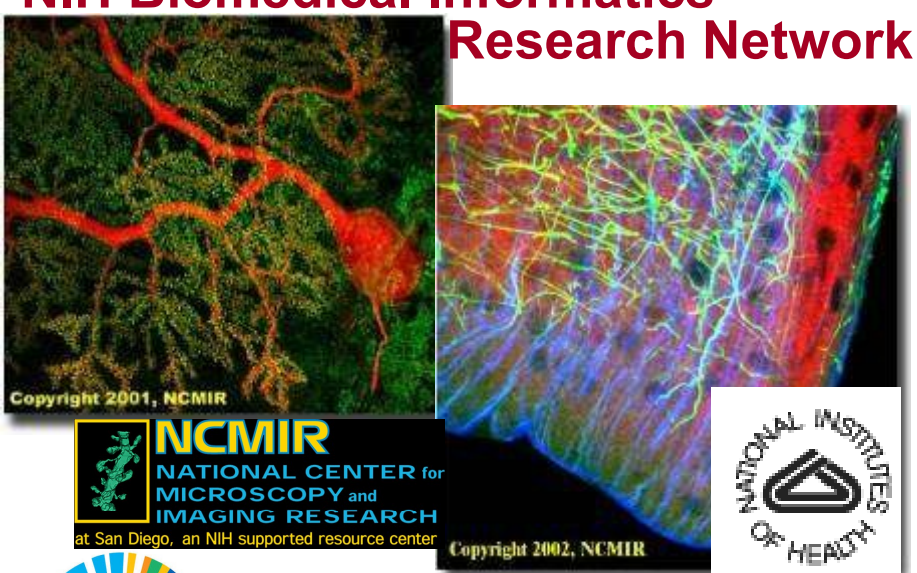
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The OptIPuter Project – Creating High Resolution Portals Over Dedicated Optical Channels to Global Science Data

- **NSF Large Information Technology Research Proposal**
  - Calit2 (UCSD, UCI) and UIC Lead Campuses—Larry Smarr PI
  - Partnering Campuses: SDSC, USC, SDSU, NCSA, NW, TA&M, UvA, SARA, NASA Goddard, KISTI, AIST, CRC(Canada), CICESE (Mexico)
- **Industrial Partners**
  - IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Lucent
- **$13.5 Million Over Five Years—Now In the Fourth Year**

NSF

NIH Biomedical Informatics Research Network

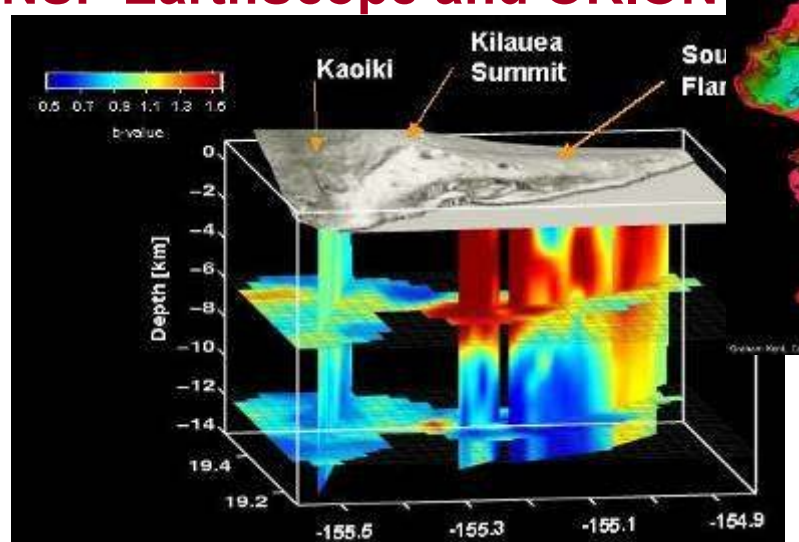


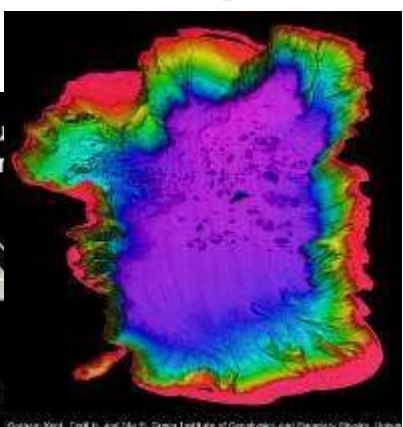
NCMIR
NATIONAL CENTER for MICROSCOPY and IMAGING RESEARCH
at San Diego, an NIH supported resource center

NATIONAL INSTITUTES OF HEALTH

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NSF EarthScope and ORION

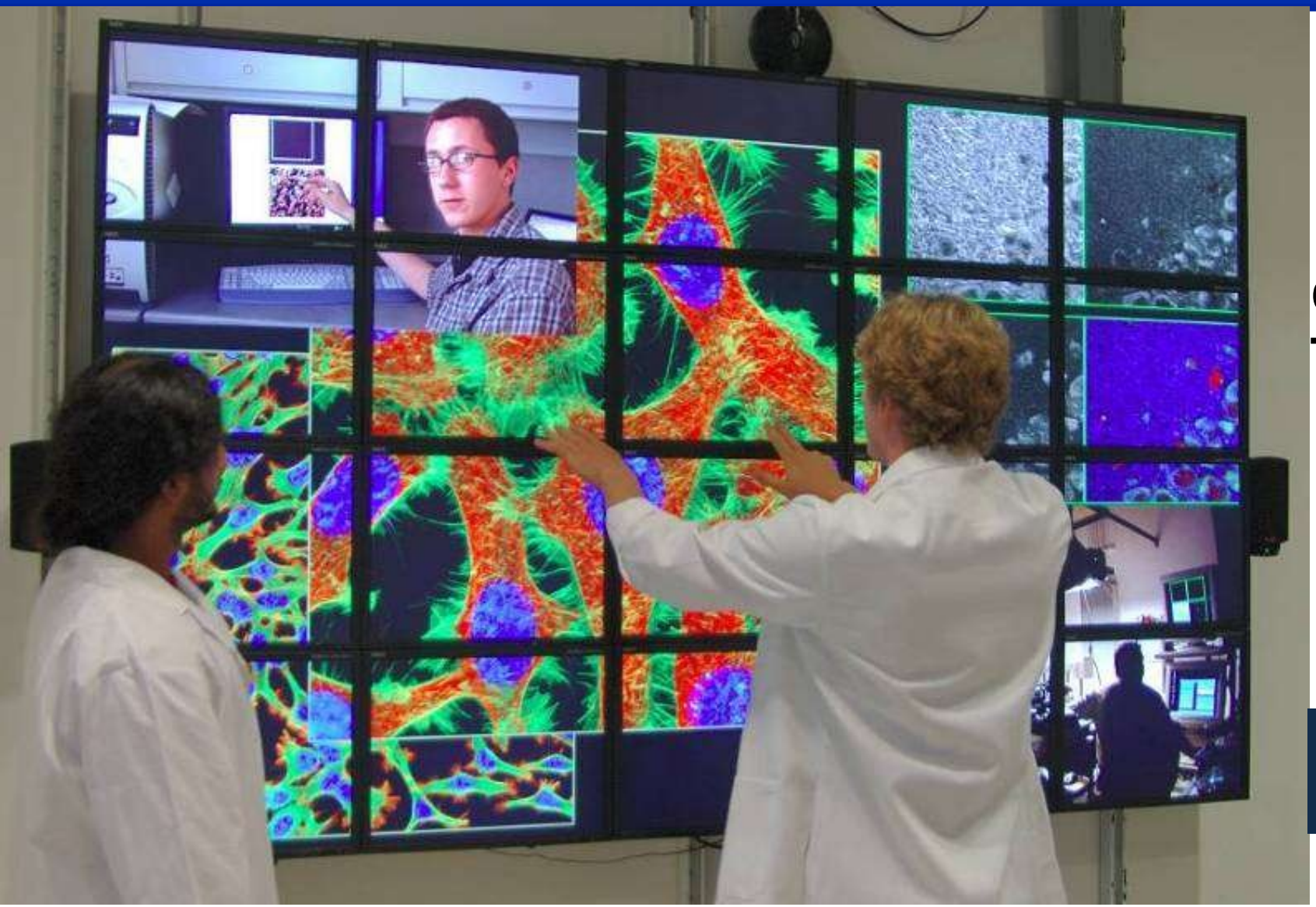




SCRIPPS INSTITUTION OF OCEANOGRAPHY

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OptIPuter Scalable Adaptive Graphics Environment (SAGE) Allows Integration of HD Streams



OptIPortal– Termination Device for the OptIPuter Global Backplane

Powered by Rocks

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evl electronic visualization laboratory

Photo: David Lee, NCMIR, UCSD

NCMIR NATIONAL CENTER for MICROSCOPY and IMAGING RESEARCH at San Diego, an NIH supported resource center

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CAMERA: Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis

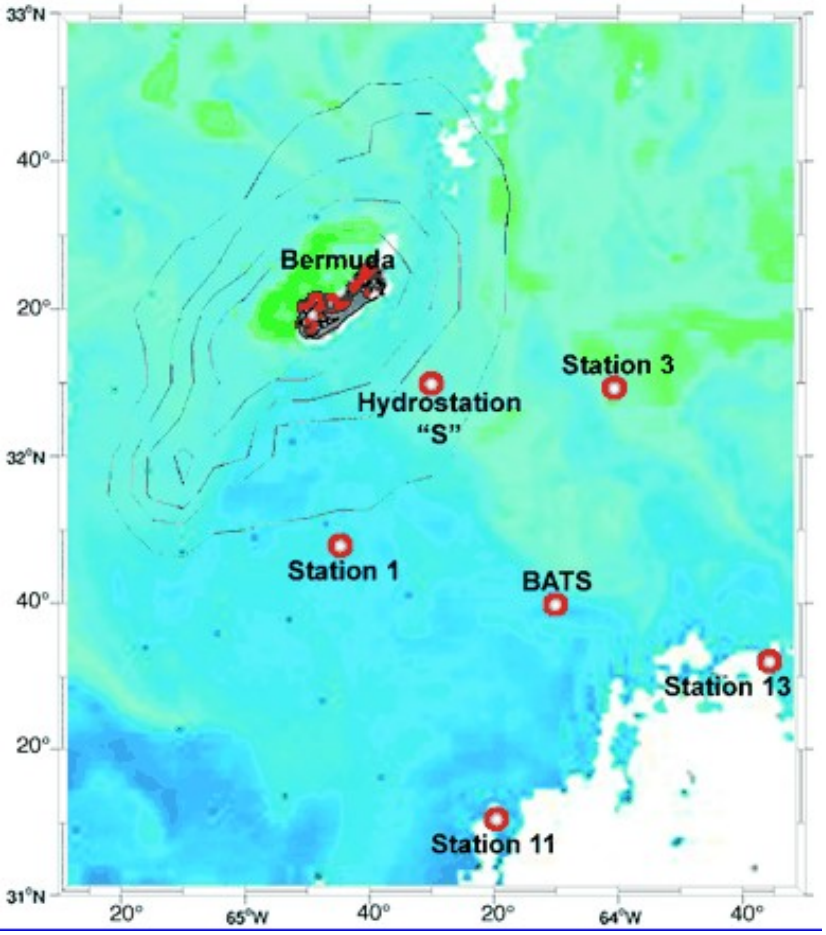
National LambdaRail
Direct Connect
Computation and Storage Complex

Funded by: Gordon and Betty Moore Foundation

Joint Partnership of:

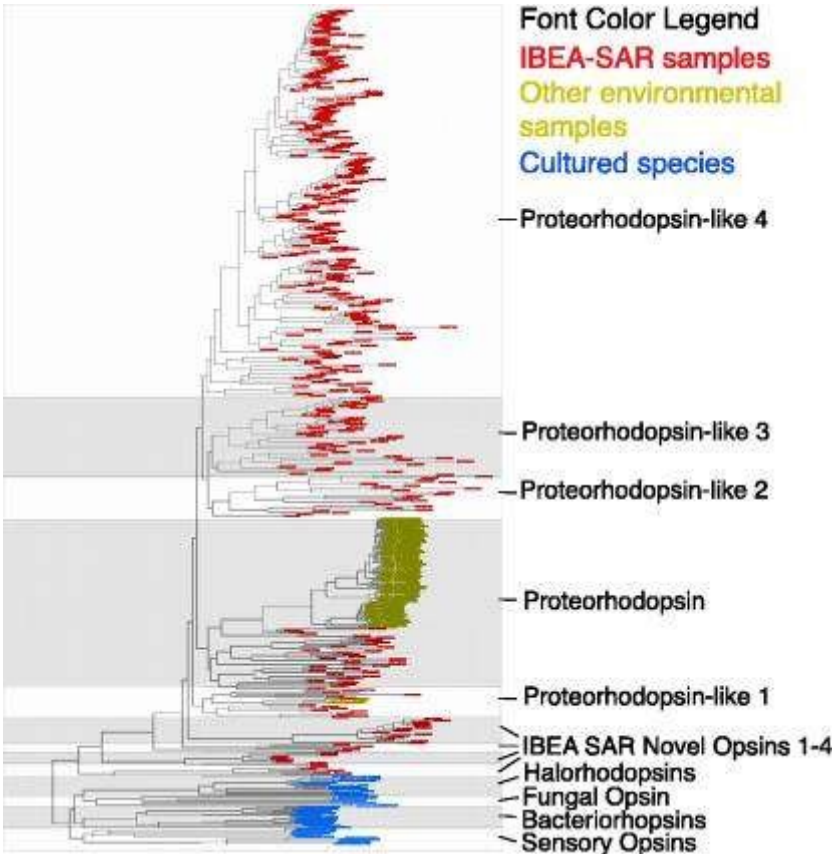
PI Larry Smarr

The Sargasso Sea Experiment
The Power of Environmental Metagenomics



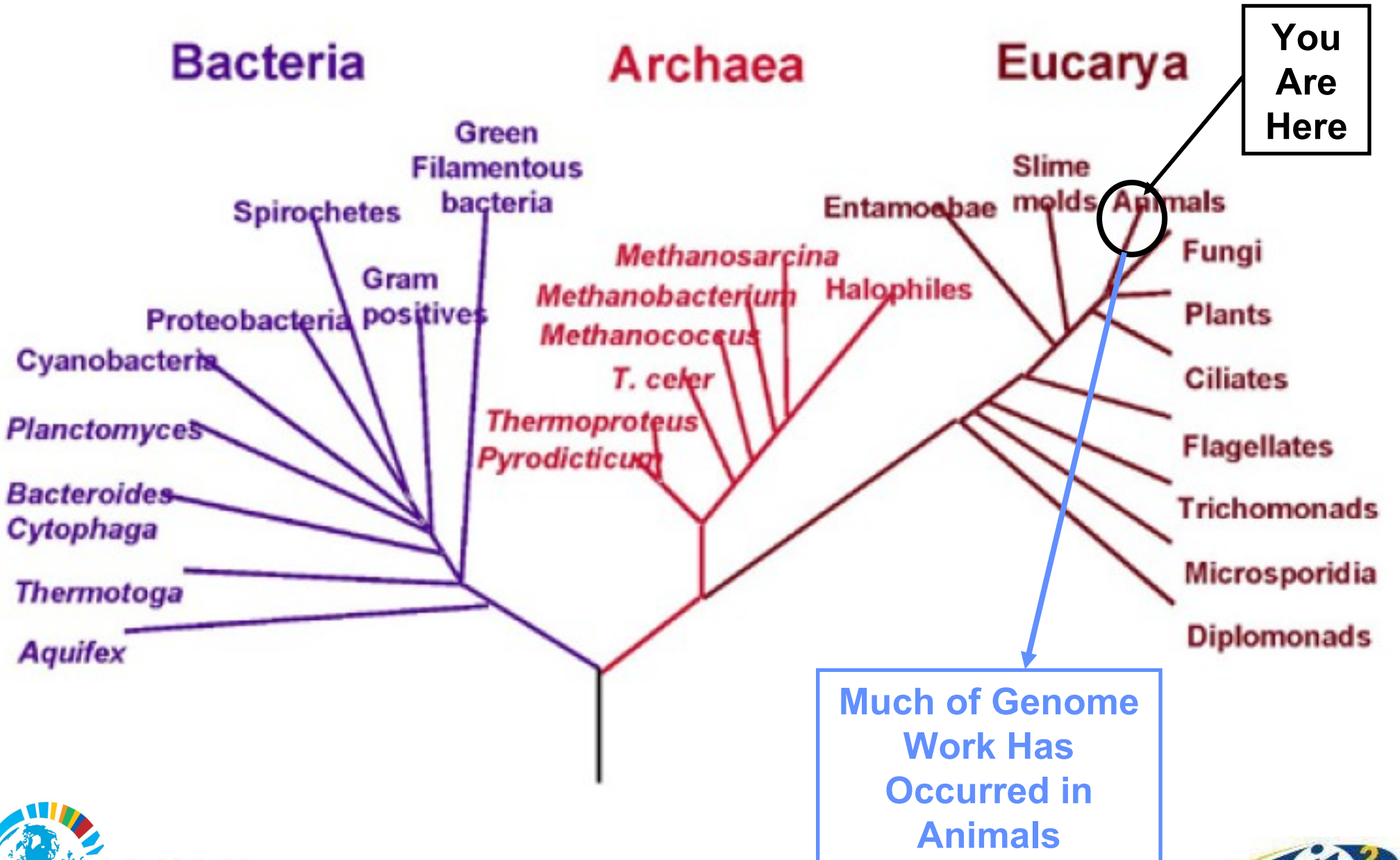
MODIS-Aqua satellite image of ocean chlorophyll in the Sargasso Sea grid about the BATS site from 22 February 2003

- **Yielded a Total of Over 1 billion Base Pairs of Non-Redundant Sequence**
- **Displayed the Gene Content, Diversity, & Relative Abundance of the Organisms**
- **Sequences from at Least 1800 Genomic Species, including 148 Previously Unknown**
- **Identified over 1.2 Million Unknown Genes**



J. Craig Venter, et al. Science 2 April 2004: Vol. 304. pp. 66 - 74

Evolution is the Principle of Biological Systems: Most of Evolutionary Time Was in the Microbial World



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Source: Carl Woese, et al

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Marine Genome Sequencing Project
Measuring the Genetic Diversity of Ocean Microbes



CAMERA will include
All Sorcerer II Metagenomic Data

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MARINE MICROBIOLOGY INITIATIVE

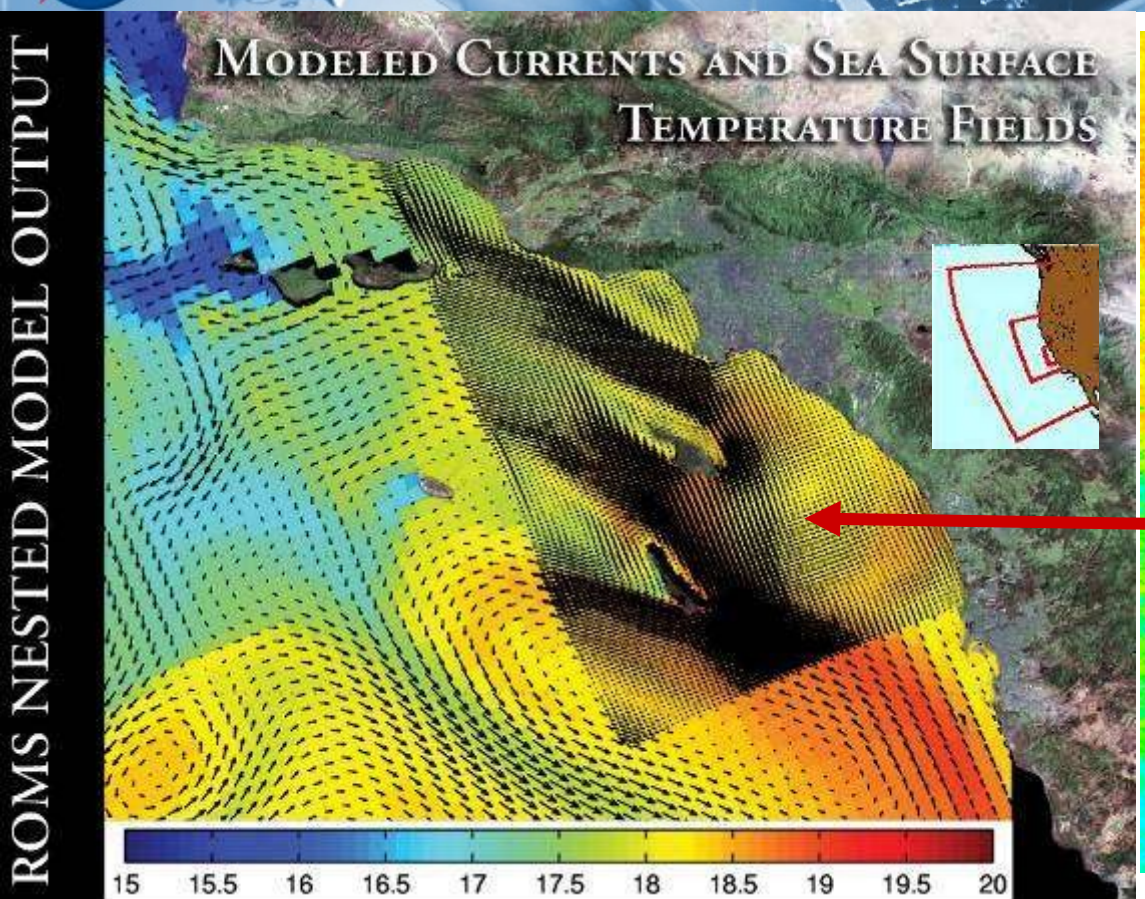
Gordon and Betty MOORE FOUNDATION

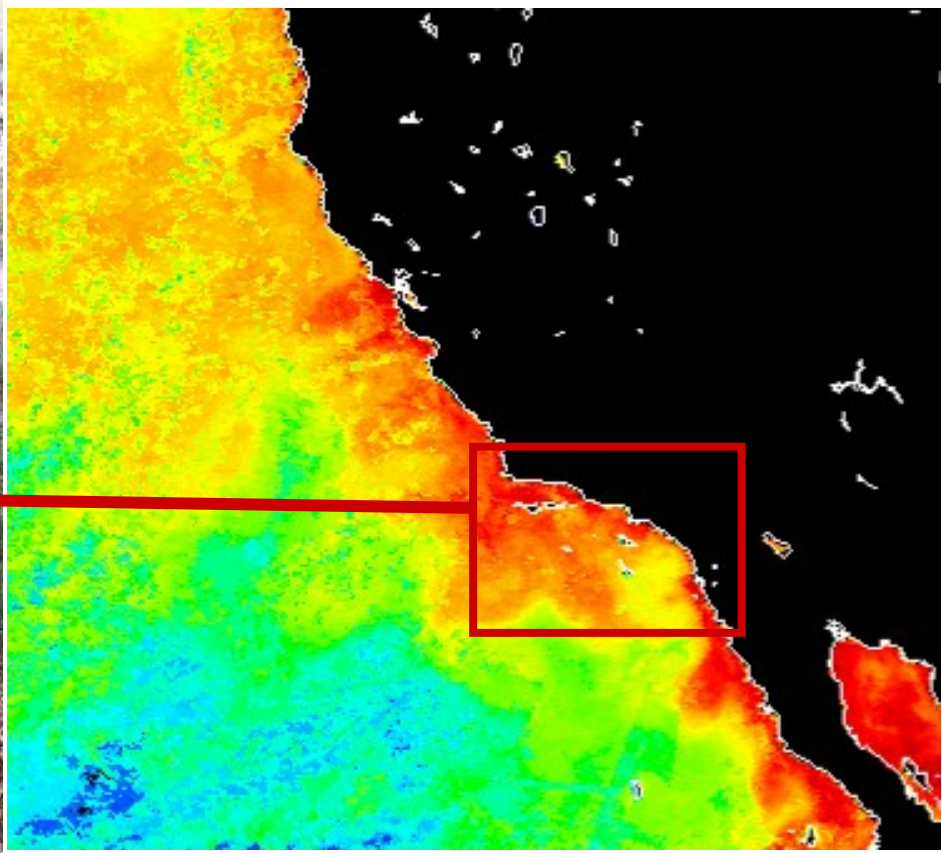
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Using the OptIPuter to Couple Data Assimilation Models to Remote Data Sources Including Biology







NASA MODIS Mean Primary Productivity for April 2001 in California Current System

JPL · ONR · MBARI · California Institute of Technology

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Regional Ocean Modeling System (ROMS)

http://ourocean.jpl.nasa.gov/

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Building On Centers of Excellence and Achievement









Powered by Rocks









The Scripps Genome Center

Supported by:











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Announced January 17, 2006

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Calit2's Direct Access Core Architecture Will Create Next Generation Metagenomics Server

Sargasso Sea Data

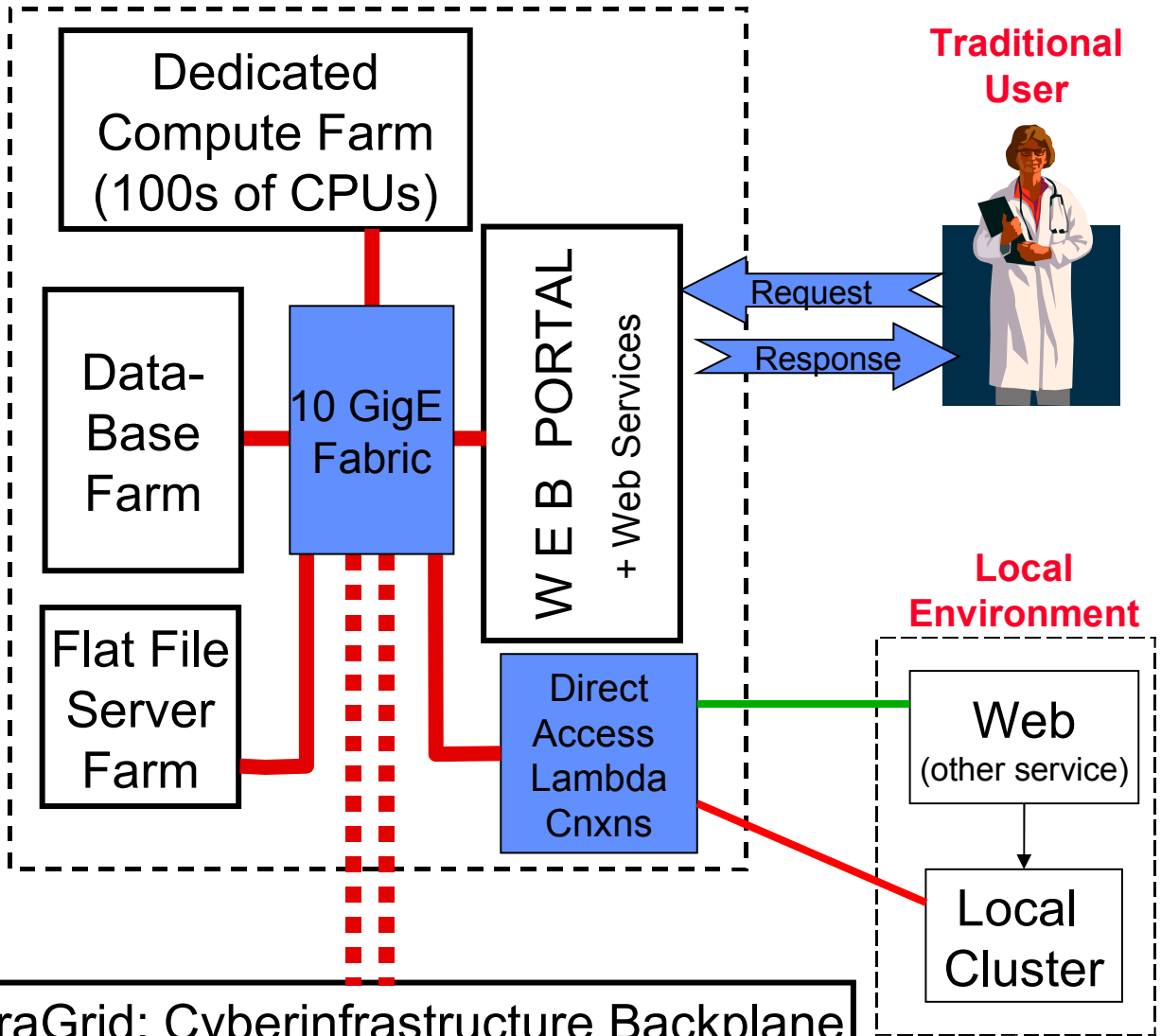
Sorcerer II Expedition (GOS)

JGI Community Sequencing Project

Moore Marine Microbial Project

NASA Goddard Satellite Data

Community Microbial Metagenomics Data



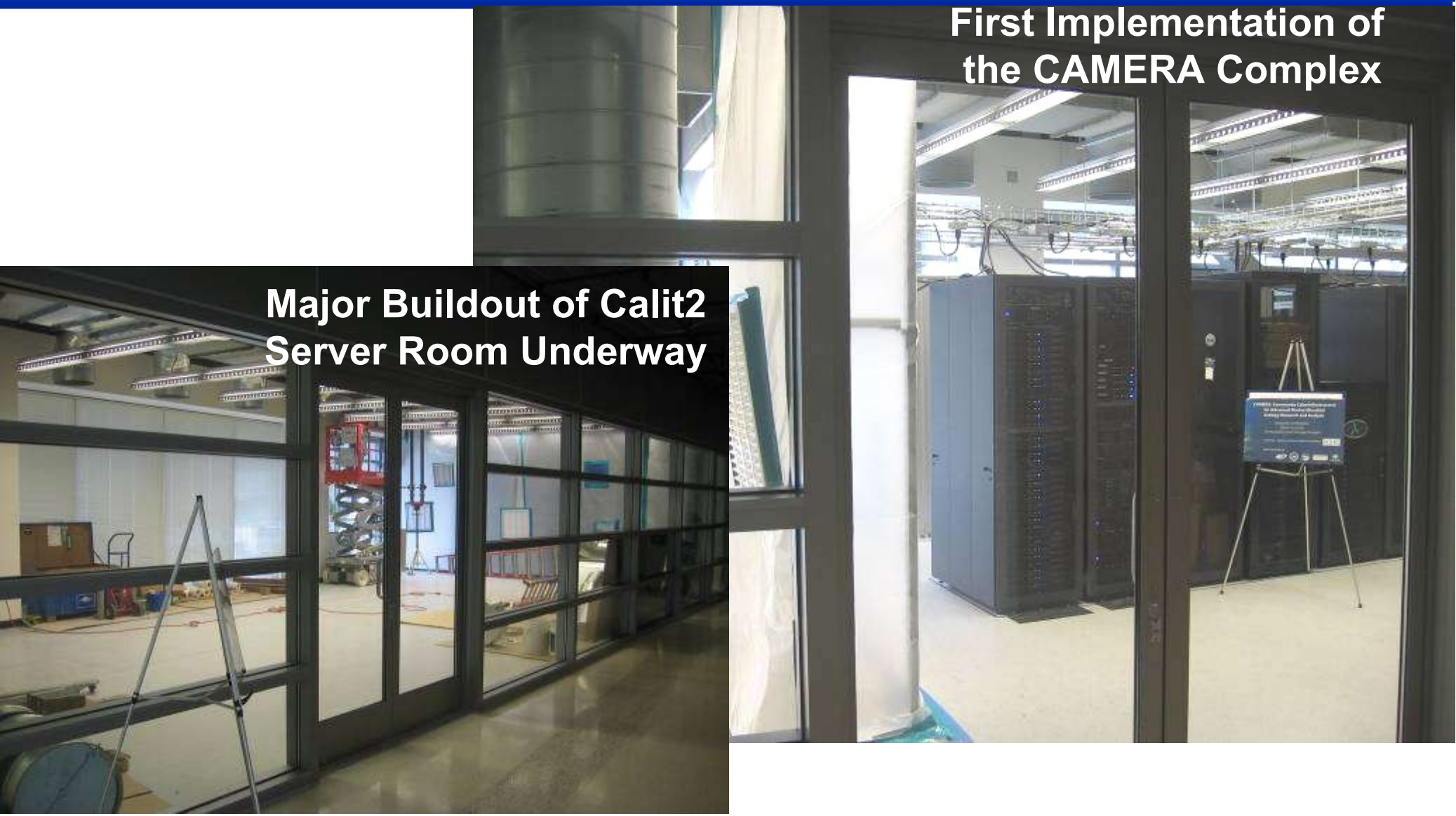
Source: Phil Papadopoulos, SDSC, Calit2

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SDSC SAN DIEGO SUPERCOMPUTER CENTER

The Future Home of the Moore Foundation Funded Marine Microbial Ecology Metagenomics Complex



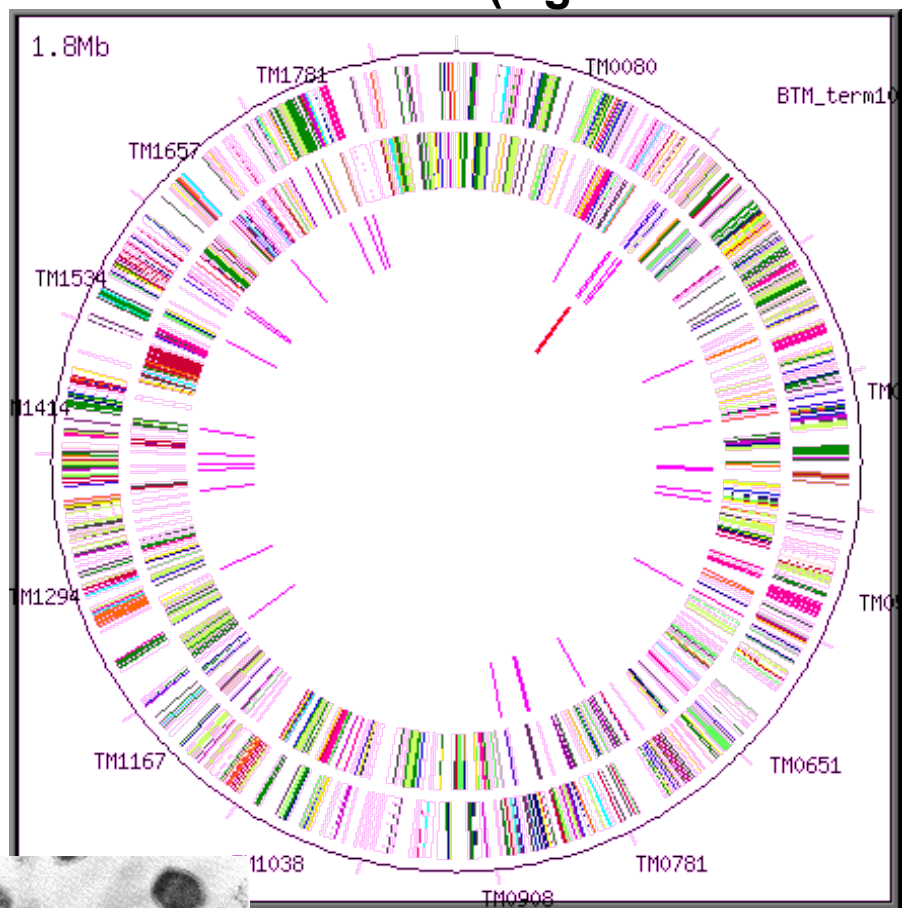
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Photo Courtesy Joe Keefe, Calit2

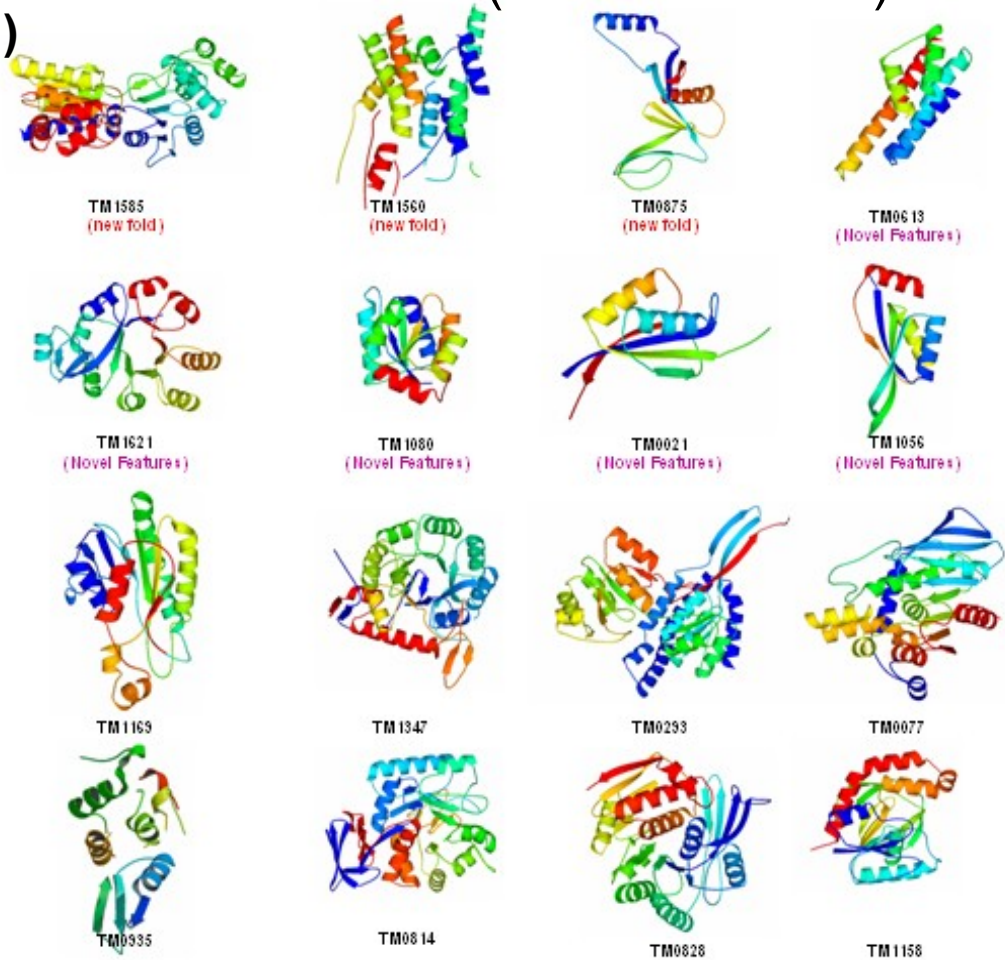
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The Bioinformatics Core of the Joint Center for Structural Genomics will be Housed in the Calit2@UCSD Building

Extremely Thermostable -- Useful for Many Industrial Processes (e.g. Chemical and Food)



173 Structures (122 from JCSG)





- Determining the Protein Structures of the Thermotoga Maritima Genome
- 122 T.M. Structures Solved by JCSG (75 Unique In The PDB)
- Direct Structural Coverage of 25% of the Expressed Soluble Proteins
- Probably Represents the Highest Structural Coverage of Any Organism

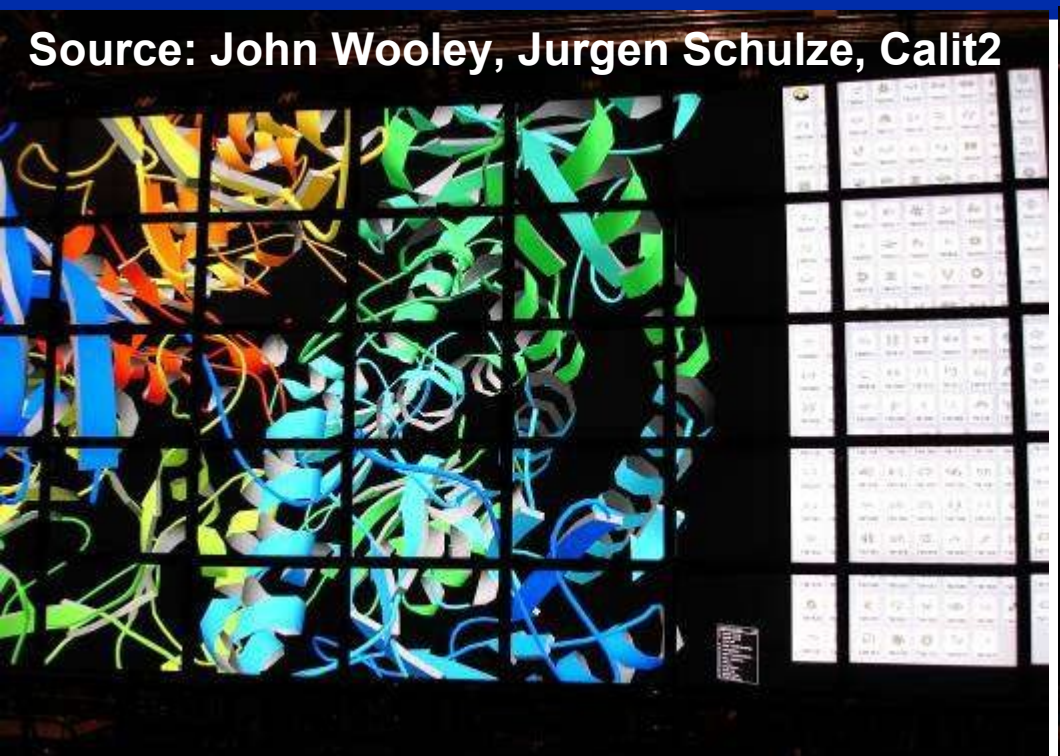
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Source: John Wooley, UCSD

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Interactive Visualization of Thermatoga Proteins at Calit2

Source: John Wooley, Jurgen Schulze, Calit2





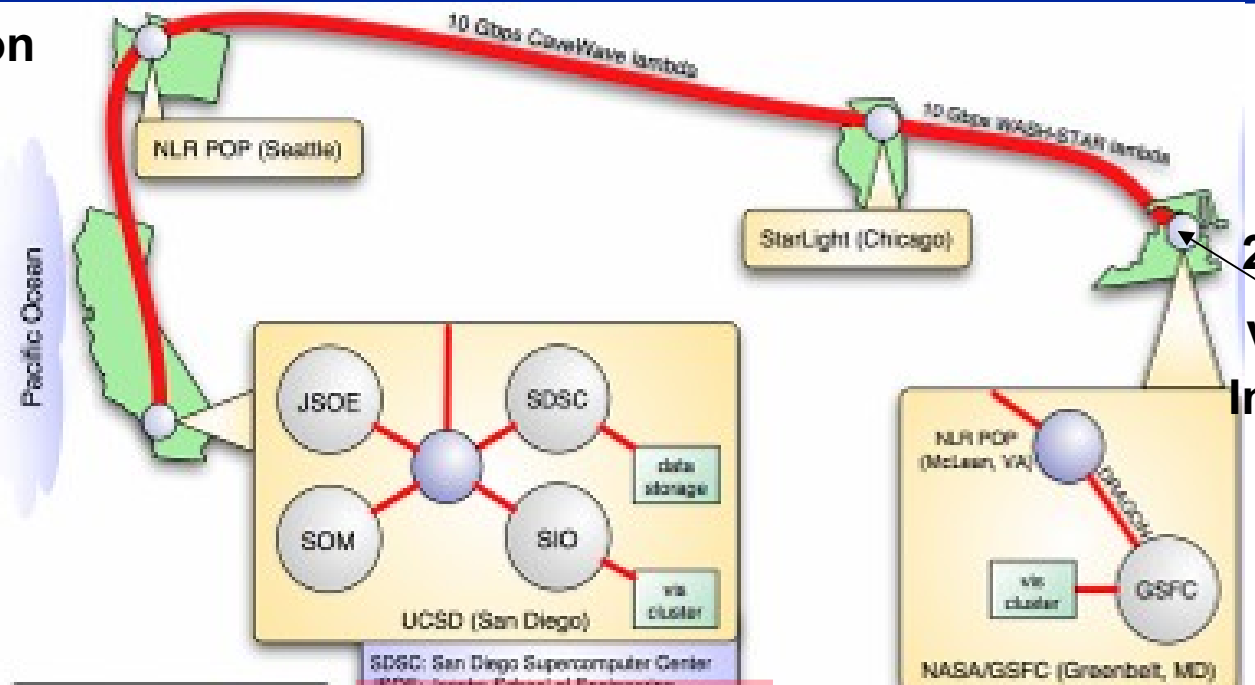




Calit2 and the Venter Institute Will Combine Telepresence with Remote Interactive Analysis

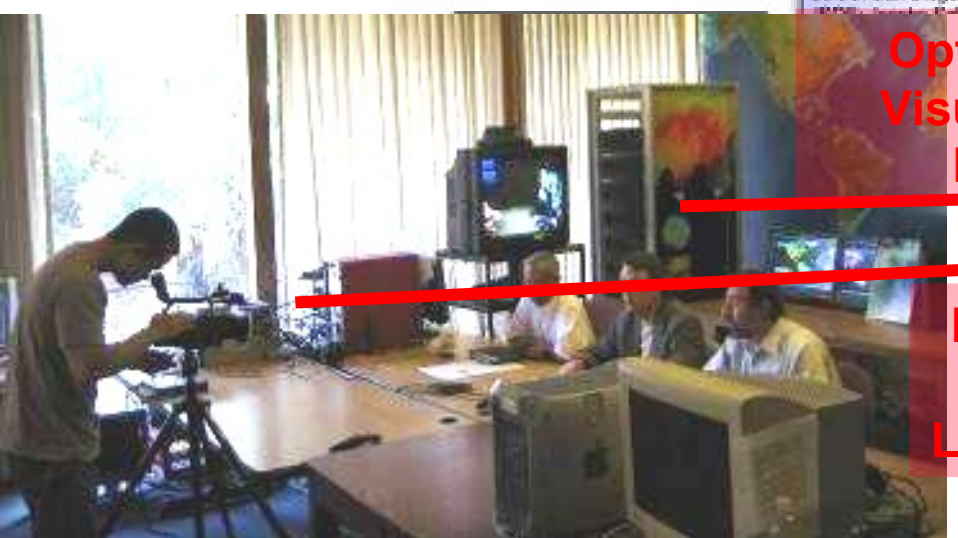
Live Demonstration

of 21st Century National-Scale Team Science



25 Miles

Venter Institute



OptIPuter Visualized Data

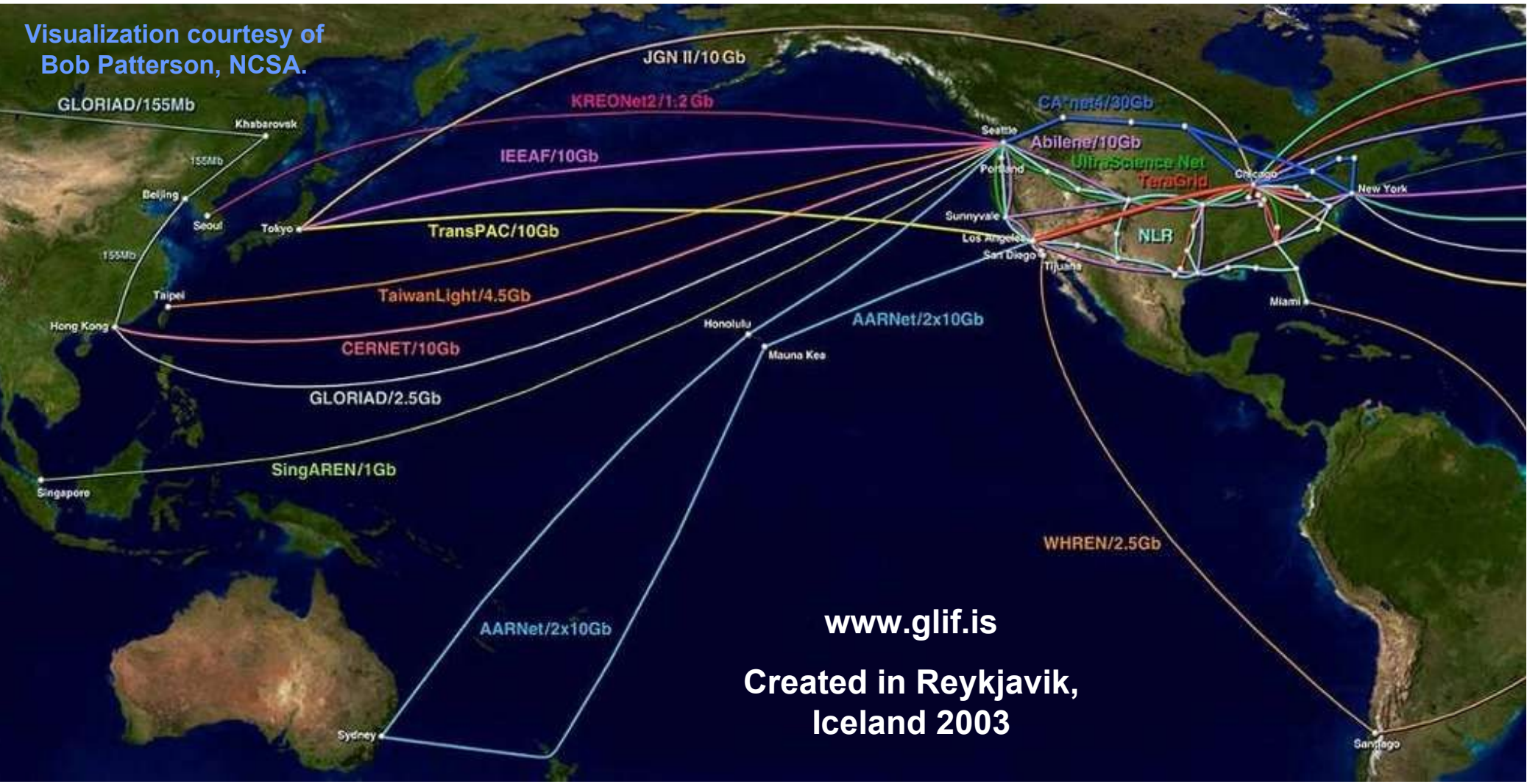
HDTV Over Lambda



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Countries are Aggressively Creating Gigabit Services: Interactive Access to CAMERA Data System



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