

Partnerships for Advanced Global Networking: GENI, iGENI, and the International Network Research Community

Joe Mambretti, Director, (j-mambretti@northwestern.edu)

**International Center for Advanced Internet Research (www.icaair.org)
Northwestern University**

Director, Metropolitan Research and Education Network (www.mren.org)

Co-Director, StarLight, PI-iGENI, PI-OMNINet (www.startap.net/starlight)

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CERN, Switzerland

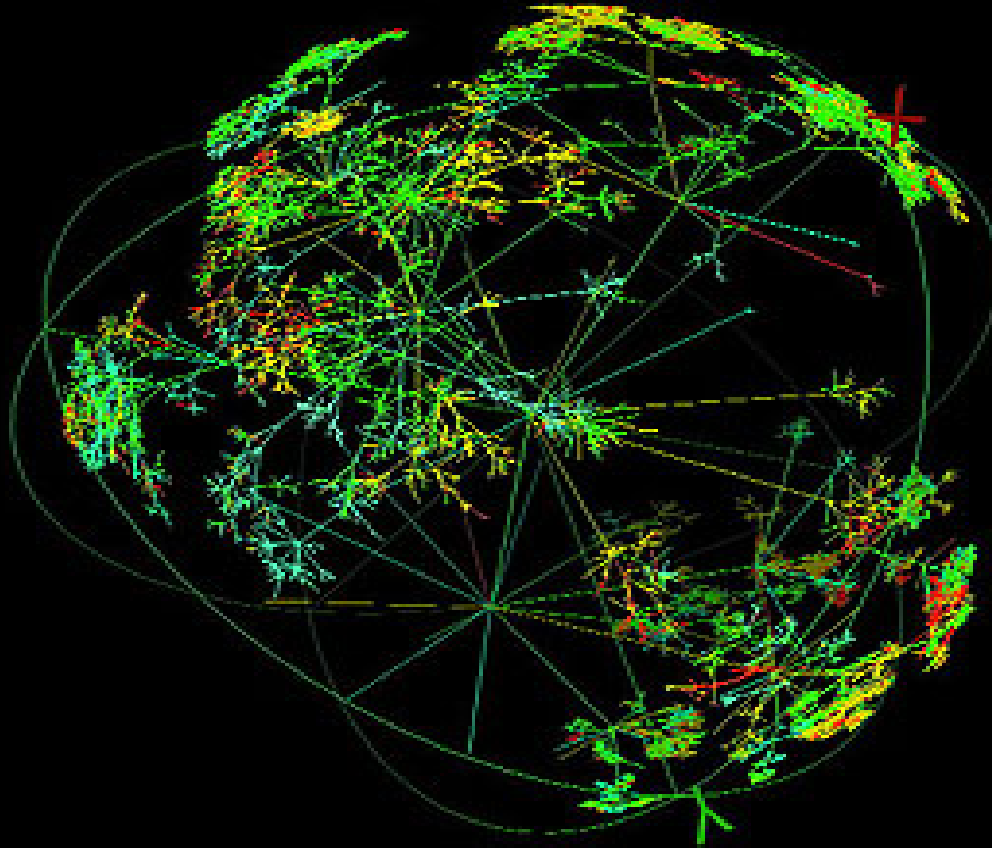


Global Environment for Network Innovations (GENI)

- **GENI Is a Virtual Laboratory For Exploring Future Internets At Scale – Consequently It Must Be Global (NB: “GLOBAL” Environment...)**
- **GENI Is Similar To Instruments Used By Other Science Disciplines, e.g., Astronomers – Telescopes, HEP – Synchrotrons**
- **All Of These Types of Major Facilities Require Global Collaboration and International Partnerships for Success**
- **GENI Creates Major Opportunities To Understand, Innovate and Transform Global Networks and Their Interactions with Society – World-Wide.**
- **International Partnerships Significantly Enhance Those Opportunities and Enable Many Additional Valuable Research Perspectives and Contributions**



iGENI: Creating Next Generation Networks In Partnership With the Global Research Community



iGENI: International Global Environment for Network Innovations

Joe Mambretti, Director, (j-mambretti@northwestern.edu)
International Center for Advanced Internet Research (www.icaair.org)
Northwestern University
Director, Metropolitan Research and Education Network (www.mren.org)
Partner, StarLight/STAR TAP, PI-OMNINet (www.icaair.org/omninet)

Maxine Brown, Associate Director (maxine@uic.edu)
Electronic Visualization Laboratory (www.evl.uic.edu)
University of Illinois at Chicago

Tom DeFanti, Research Scientist (tdefanti@ucsd.edu)
California Institute for Telecommunications and Information Technology
(www.calit2.net),
University of California, San Diego



iGENI: The International GENI

- The iGENI Initiative Is Designing, Developing, Implementing, and Operating a Major New National and International Distributed Infrastructure.
- iGENI Is Placing the “G” in GENI Making GENI Truly Global.
- iGENI Is Creating a Unique Distributed Infrastructure To Support GLOBAL Research and Development for Next-Generation Network Communication Services and Technologies.
- This Infrastructure Is Being Integrated With Current and Planned GENI Resources.
- iGENI Infrastructure Is Interconnecting Its Resources With Current GENI National Backbone Transport Resources, With Current and Planned GENI Regional Transport Resources, and With International Research Networks and Projects
- iGENI Is Highly Leveraging Existing International Advanced Networking Facilities



Initial iGENI Consortium

- **Consortium Partners Include Several Major Network Research Organizations:**
 - International Center for Advanced Internet Research (iCAIR) at Northwestern University,
 - Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago
 - The California Institute for Telecommunications and Information Technology (Calit2) at the University of California, San Diego
 - Cisco Systems, Inc. Research
 - BBN Technologies GENI Program Office (GPO).
 - The StarLight Consortium
 - RENCI and North Carolina University Partners, e.g. Duke, North Carolina State
 - Other Cluster D Participants (Univ of Mass - Amherst, Columbia, Ohio State, Wayne State, Univ of Houston, Rice, Texas A&M, UT Austin, Oklahoma State)
 - **iGENI Initiatives Also Extend To Activities In Other GENI Clusters**
 - ***iGENI Research Initiatives Have Multiple International Partners***

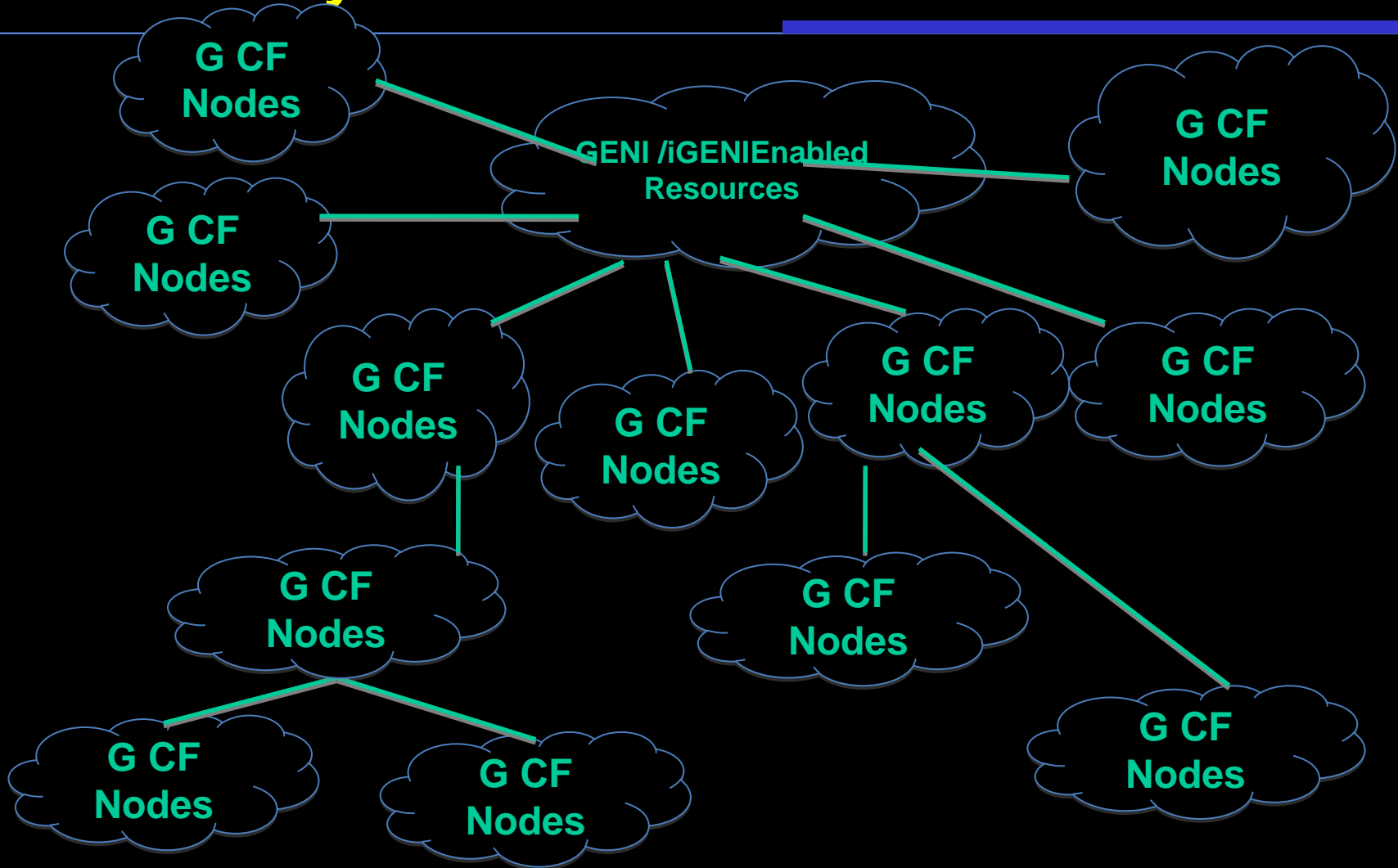


Building On Existing Partnerships, Current & Future International Partners Include Researchers From Many Countries

- Australia
- Brazil
- Canada
- China
- Egypt
- Germany
- India
- Japan
- Korea
- Taiwan
- Spain
- Singapore
- Netherlands
- Spain
- New Zealand
- Sweden
- UK
- Et Al
- All Are Welcome To Participate!

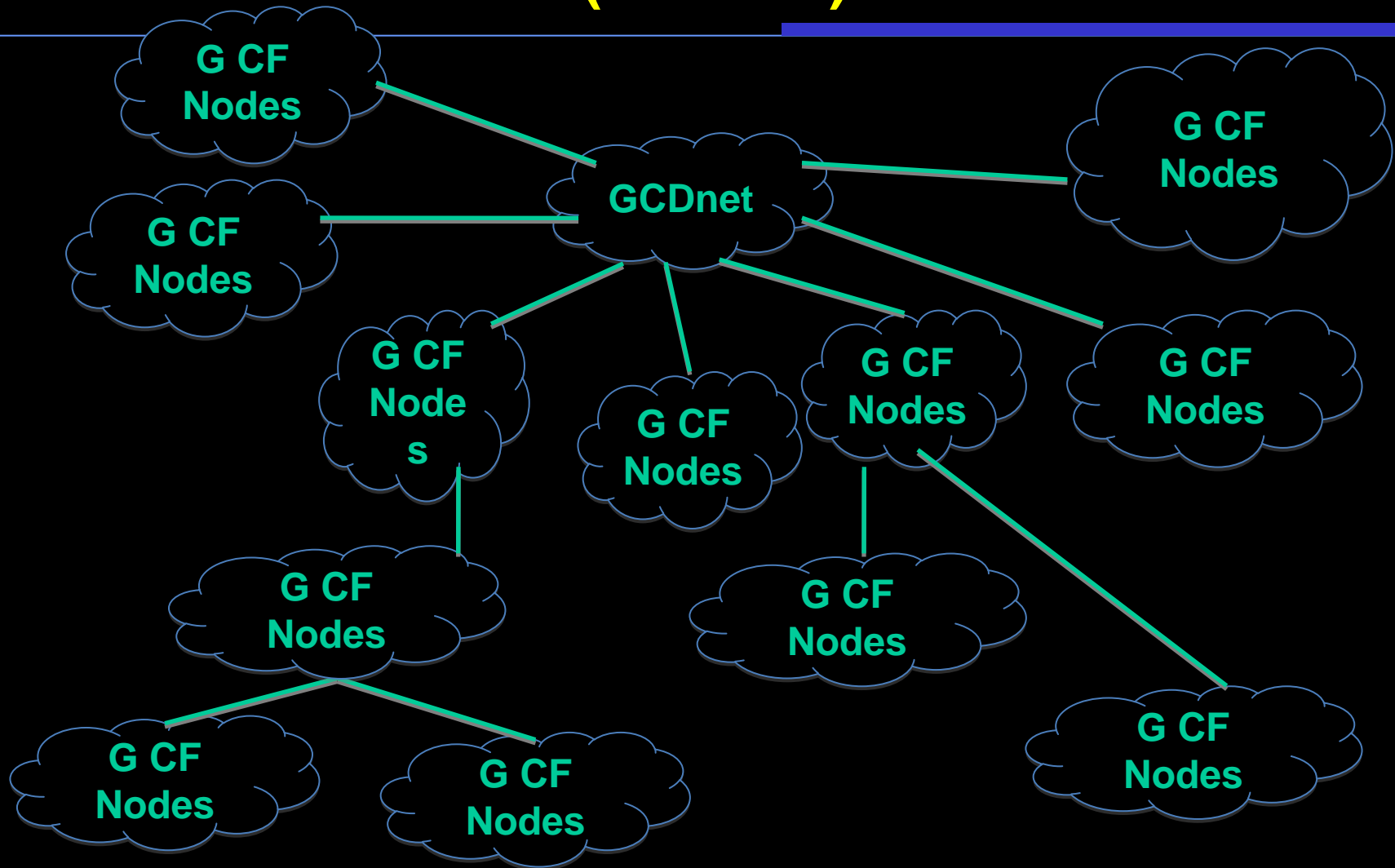


iGENI & Partners Are Providing Paths Managed By a GENI Control Framework



CF Nodes = Core Resources Dedicated To iGENI ~~CF~~ **STARRIGHT** Functions SM

An Initial Prototype: GENI Cluster-D Network (GCDnet)



CF Nodes = Core Resources Dedicated To iGENI Controlled By G
STARLIGHTSM
CF

ORCA Control Framework

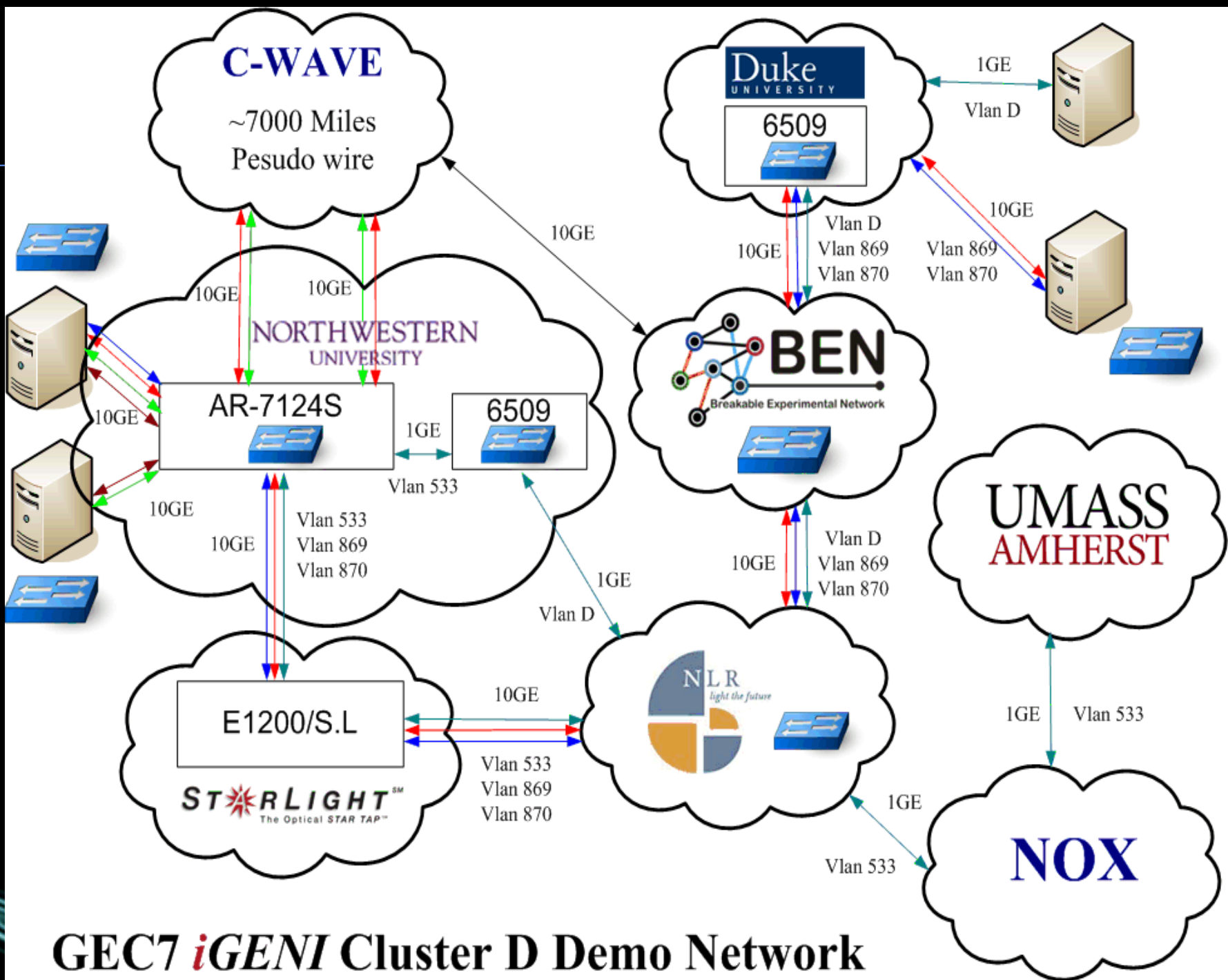
- **The iGENI Consortium Has Integrated Its Initial Infrastructure With the Open Resource Control Architecture (ORCA) Control Framework**
- **ORCA Was Developed by GENI-funded Colleagues at RENCI (Renaissance Computing Institute) and Duke University,**
- **ORCA Enables iGENI Researchers to Dynamically Control International Network Services, Associated Transport Resources and GENI Aggregates.**
- **ORCA Is Being Continually Enhanced**
- **Note That A Project Has Been Established To Integrate OpenFlow and ORCA**



Cluster D Initiatives

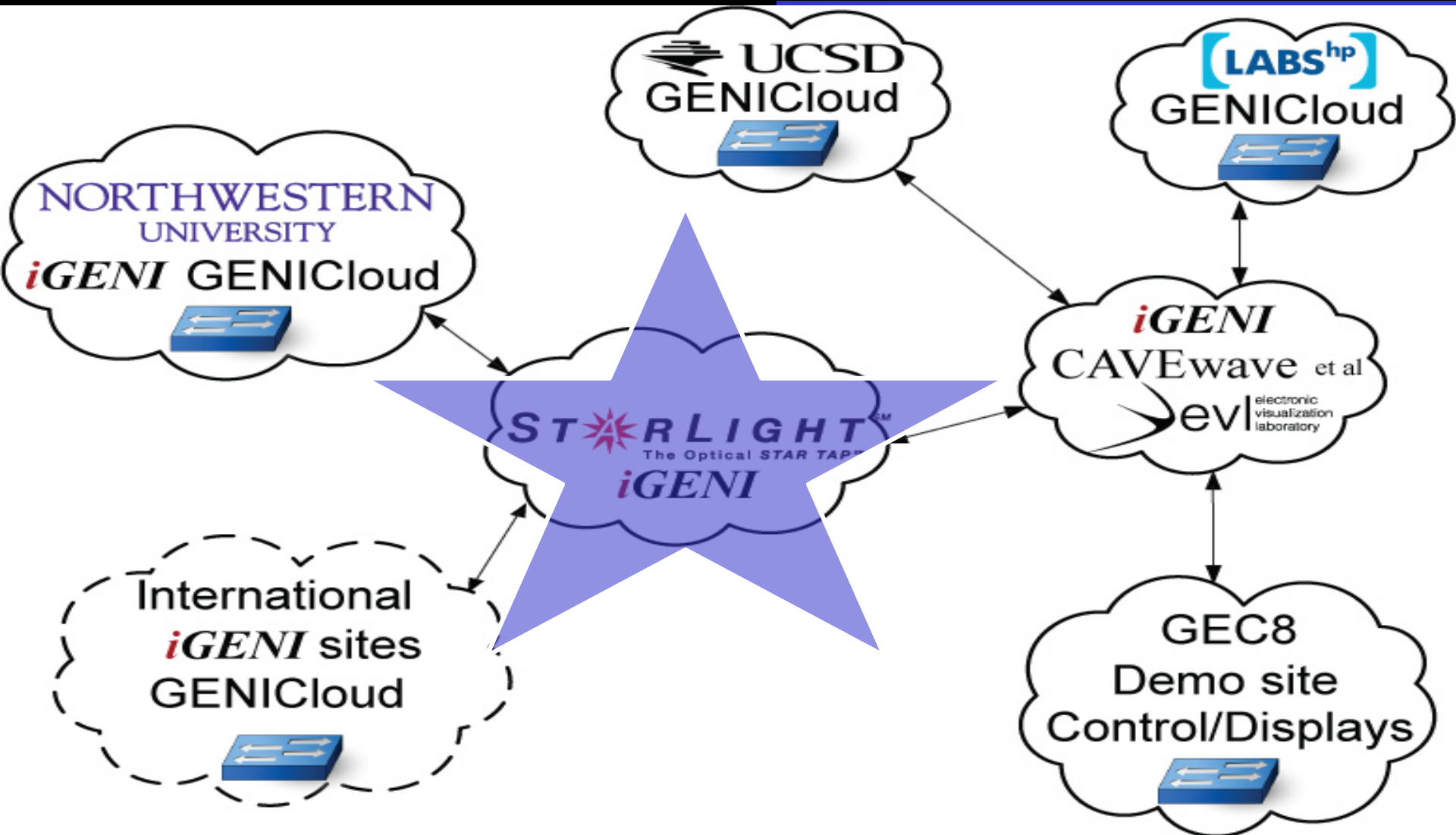
- **ORCA/BEN -- Primary Distinction Among Other Control Frames = A Unique Comprehensive Strategy Cross-Layer Provisioning and Experimentation**
- **DOME -- Diverse Outdoor Mobile Environment**
- **ViSE -- Sensor Virtualization and Slivering in an Outdoor Wide-Area Wireless -- GENI Sensor/Actuator Network Testbed**
- **ERM -- Embedded Real-Time Measurements**
- **KANSAI – KanseiSensorNet**
- **DICLOUD – Data Intensive Cloud Control**
- **OKGEMS – Cyber-Physical System**
- **IMF – Integrated Measurement Network**
- **LEARN – Measurement Handler and Network Integration (Programmable Measurements)**
- **BBN ORCA Xen Cluster**
- **iGENI**

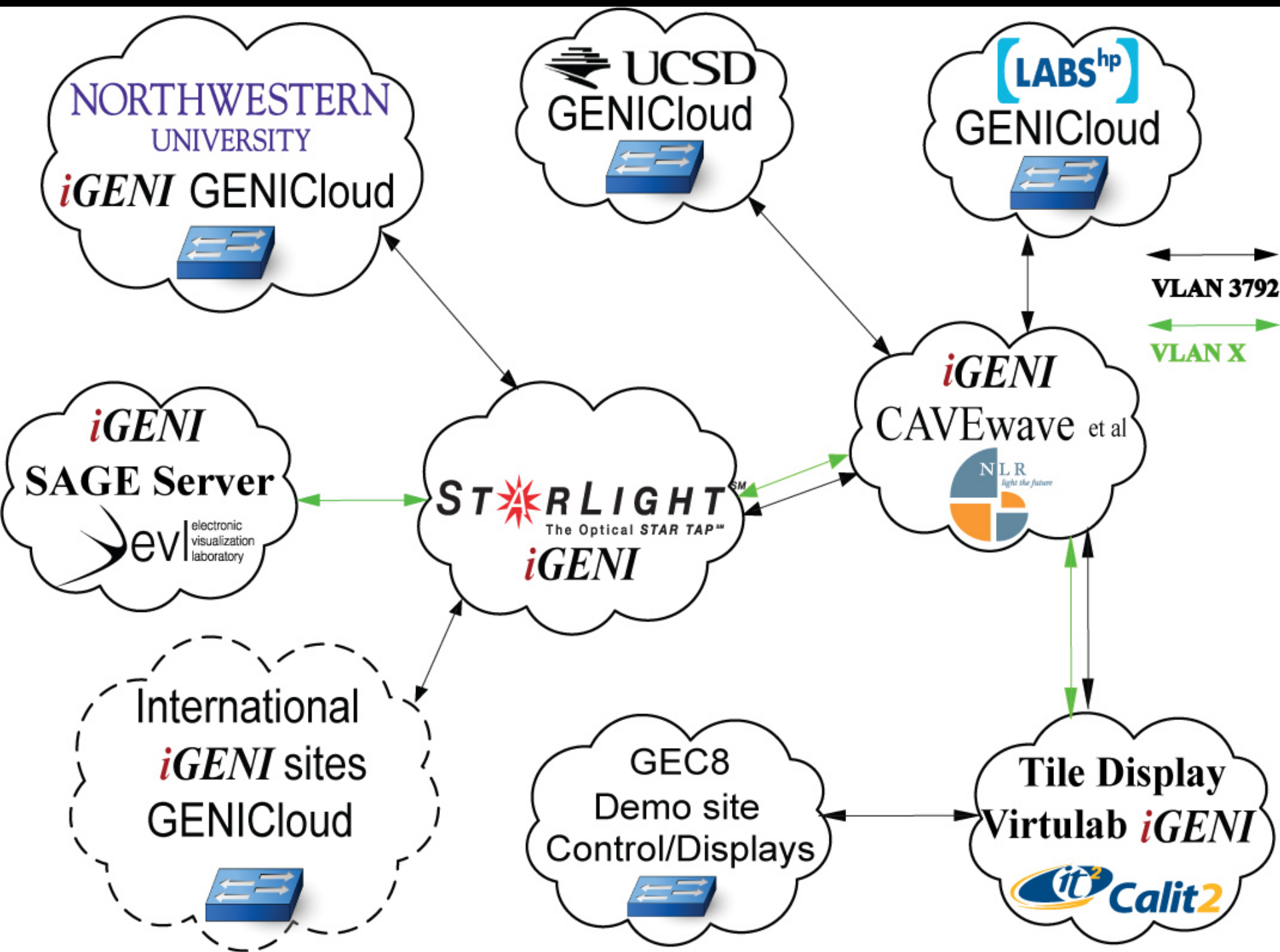


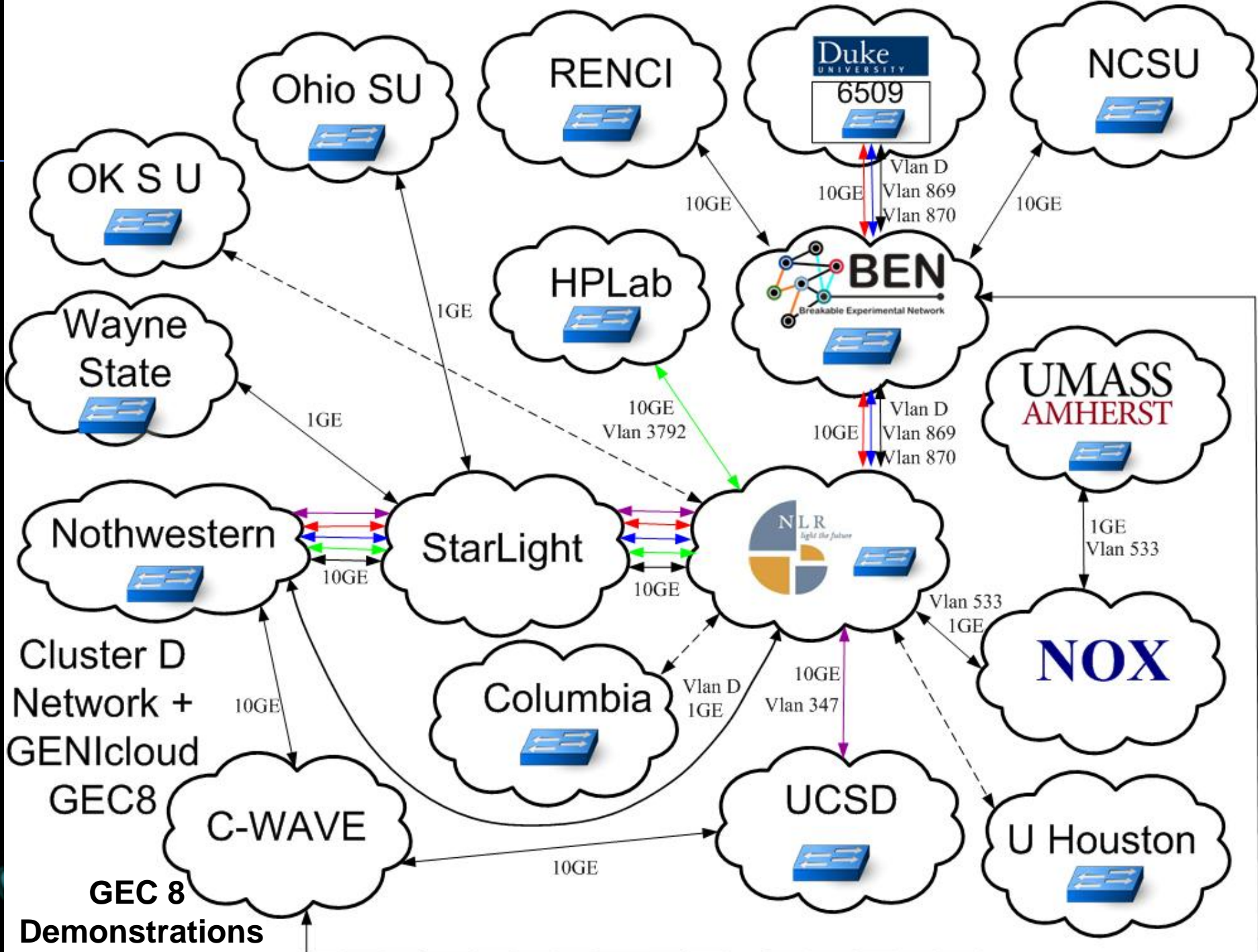


GEC7 *iGENI* Cluster D Demo Network

iGENI Demonstrations at GEC 8





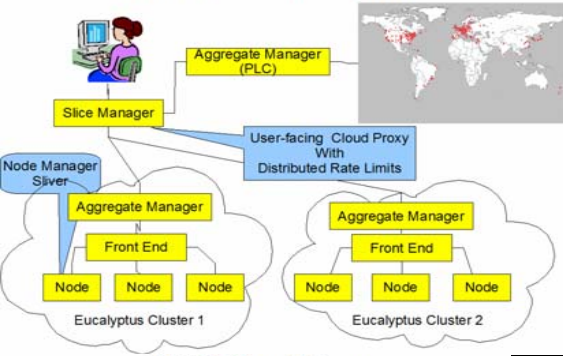


GENICloud



Andy Bavier, Jessica Blaine, Daniel Catrein, Jim Chen, Yvonne Coady, James Kempf, Christian Lottermann, Joe Mambretti, Rick McGeer, Alex Snoeren, Johannes Willig, Marco Yuen, Alvin AuYoung

GENICloud Architecture



GENICloud Demo



- Transcoding on Eucalyptus Clouds at UCSD, HP Labs, iCAIR (Northwestern)
- Transcoding app thanks to Ericsson Research
- For GEC-9:
 - Integration with NLR (CAVEWave)
 - Integrated Distributed Rate Limiting

Status and Accomplishments

- Integrated Eucalyptus and GENI
 - Eucalyptus release supporting the SFA
- Unified API interface to Eucalyptus and SFA
 - GENI tools now work on (our) Clouds
- RSpec for Eucalyptus
- Resource Discovery
 - Kernel/Disk images
 - Instance Types
- Jobs instantiated on multiple Clouds
- Distributed Rate Limiting over multiple Clouds

Roadmap

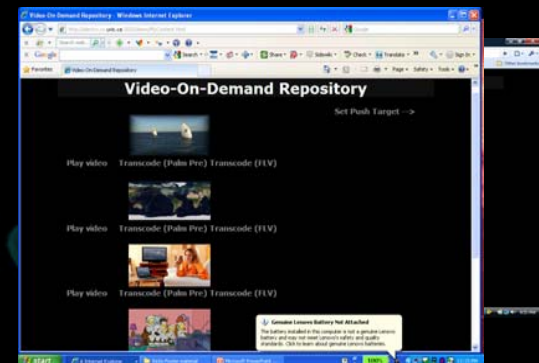
- Full integration of PlanetLab and Eucalyptus
- Complete “Slice Manager” – user-facing multiple-SFA facility controller
- Integrate DRL into cross-facility slices
- New GUI for PlanetLab, Eucalyptus, cross-SFA Facilities

ERICSSON



Transcoding videos at three clouds:

- HP OpenCircus
- Northwestern Univ. OpenCloud
- UCSD



Demo. Transcoding in the Cloud

<http://electro.cs.uvic.ca:2020/demo/MyContent.html>

STARLIGHTSM

VirtuLab Tile Display: Directly Connected To National 10 Gbps Testbed With Core at the StarLight Facility



iGENI and StarLight

- **iGENI Will Integrate Multiple Network Resources, Including:**
 - Resources at the StarLight International Communications Exchange in Chicago - StarLight Currently Supports Over 20 Major Network Research Testbeds, Including National and International Fabrics
 - Segments of National Research and Education Network Infrastructures
 - National Wide-Area Private Networks
 - Components of the International Optical-Networking GLIF Fabric.
- **StarLight Is More Than a Facility – It Is a Major National and International *Community* Dedicated To Designing and Implementing Advanced Networking Services and Technologies**



iGENI and GLIF

- **iGENI Consortium Members Have Partnered with Many Other Participants of the Global Lambda Integrated Facility (GLIF) To Undertake Multiple Experimental Network Research Projects**
- **The iGENI Initiative Will Build On That Experience To Create and Exploring New Prototypes of Innovative Communication Services and Technologies.**



IRNC ProNet: TransLight/StarLight

Announced: July 13, 2010

Tom DeFanti, Maxine Brown, Joe Mambretti, Tajana Rosing

Calit2, University of California, San Diego

Electronic Visualization Lab, University of Illinois at Chicago

**International Center for Advanced Internet Research, Northwestern
University**

**20 years of NSF-Funded High-Performance
International Networking for
Advanced Applications
(1995-2014)**



IRNC TL/SL Deliverables

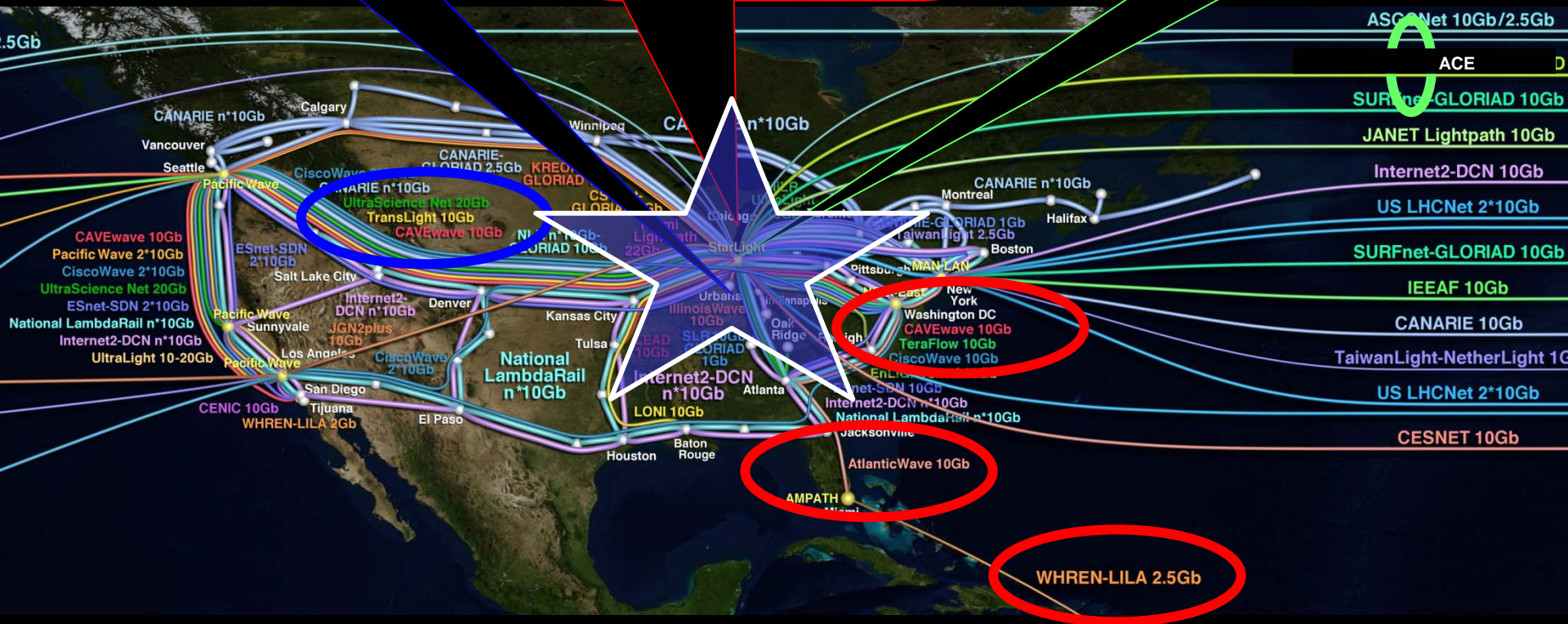
- **Continue Enabling Multi-National Application and Middleware Experiments Through Innovative Services and Technologies On International Networks:**
 - **High-Performance Digital Media Network (HPDMnet)**
 - **iGENI: the GENI-funded international GENI project* ##**
 - **SAGE: connecting people and their data at high-res***
 - **CineGrid: it's all about visual communications**
 - **GreenLight International: less watts/terabyte***
 - **Science Cloud Communication Services Network (SCCSnet)*: the impending disruption**
 - **Build Cooperative National and International Partnerships***
 - **Provide New Services, Including Many with Industrial Partners**
 - **Capitalize On Other Emerging Opportunities***
- ## Now, In Part, A CISE/OCI Partnership!!**

TransLight/StarLight Collaborates with All IRNC/GLIF Initiatives

Connect to
TransLight/PacificWave in Seattle
via TransLight (Cisco Research
Wave deployed on NLR)
TRANS LIGHT

With US HEP/LHC researchers, do
trials to move multi-gigabit traffic
between CERN and Brazil (Geneva to
Amsterdam; via LHCnet to Chicago;
via CAVEwave to DC; via AtlanticWave
to Miami;
via AmLight-East to Brazil)

Provide GLORIAD via StarLight
with services to support multi-
gigabit US traffic to partners in
Russia, Netherlands, Nordic
countries, Asia



www.icair.org, www.startup.net/starlight

**Thanks to: NSF, DOE, NASA, USGS, NIH, DARPA
Universities, National Labs,
International Partners, Commercial Partners
and Other Supporters**



STARLIGHTSM