StarLight GOLE Update

10th Annual Global LambdaGrid Workshop

Joe Mambretti, Linda Winkler, Alan Verlo

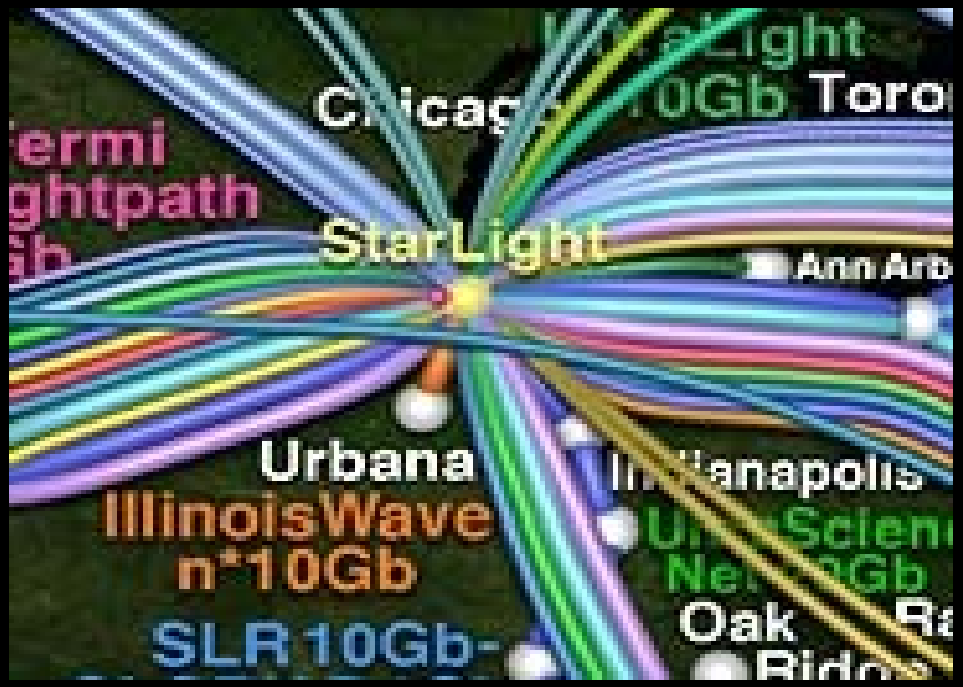
& the StarLight International Consortium

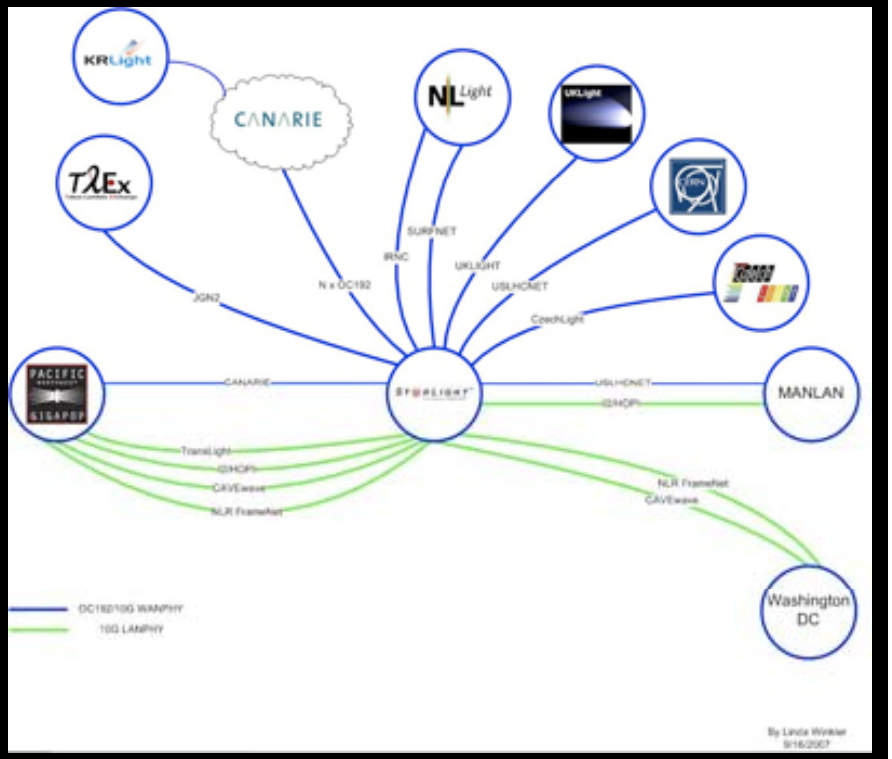
Rio De Janeiro, brazil

12-13 September 2011

Current StarLight Infrastructure

Ciena OME, Calient PXC (L1)
Force10 E1200 (L2/L3)
Many Lambdas & Collaborators





http://wiki.glif.is/index.php/StarLight

Measurement Servers:
bwctl, owamp, ndt/npad, perfSONAR

IRNC:ProNet: TransLight/StarLight

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)

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IRNC TL/SL 3-Year Deliverables

- Continue enabling multi-national application and middleware experiments 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 partnerships (e.g. MSC-CIEC*)
- Serve GLIF, NLR, and I2 as senior leaders, reviewers
- New services, including many with industrial partners
- Create opportunities for all the REUs we can get*

*Currently also funded by various NSF awards to UCSD/UIC/NU

TransLight/StarLight Collaborates with All IRNC/GLIF Initiatives

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

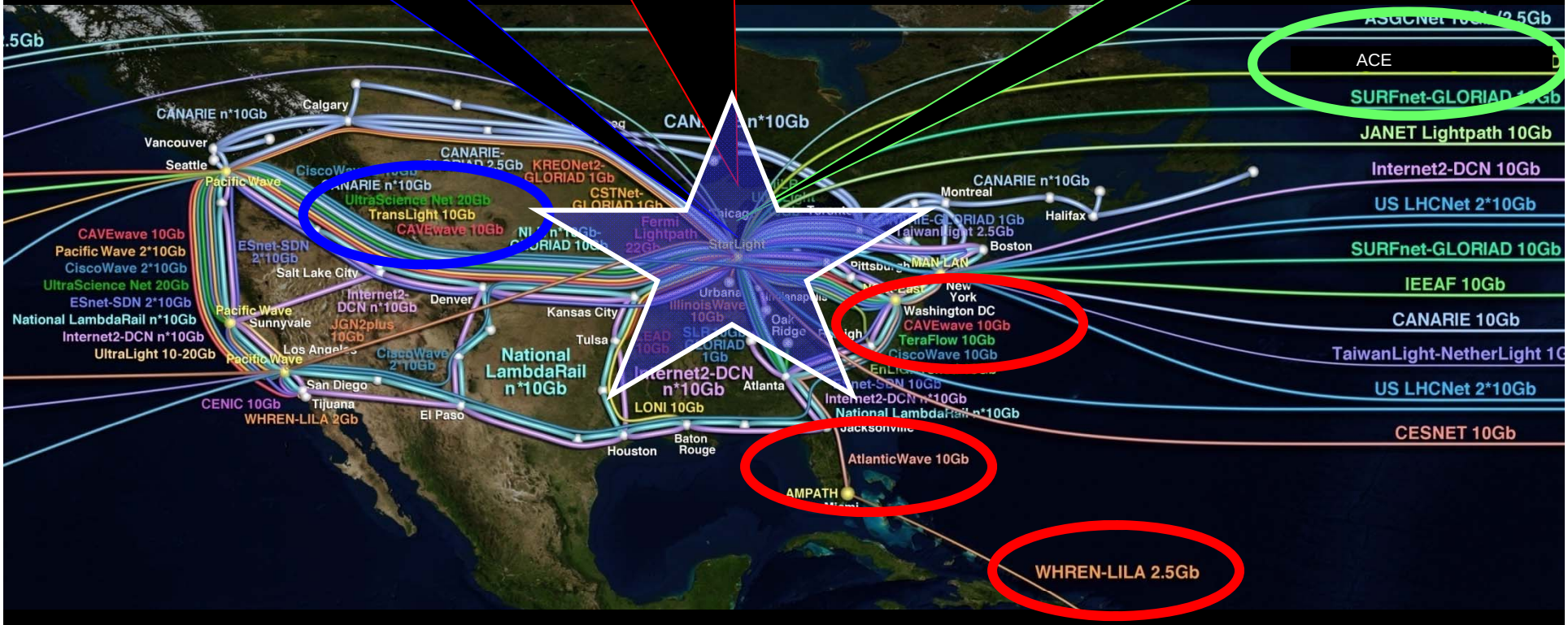
PACIFIC WAVE TRANS LIGHT

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

WHREN

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

GLORIAD



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iGENI: International Global Environment for Network Innovations

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International Center for Advanced Internet Research (www.icair.org)
Northwestern University
Director, Metropolitan Research and Education Network (www.mren.org)
Partner, StarLight/STAR TAP, PI-OMNINet (www.icair.org/omninet)

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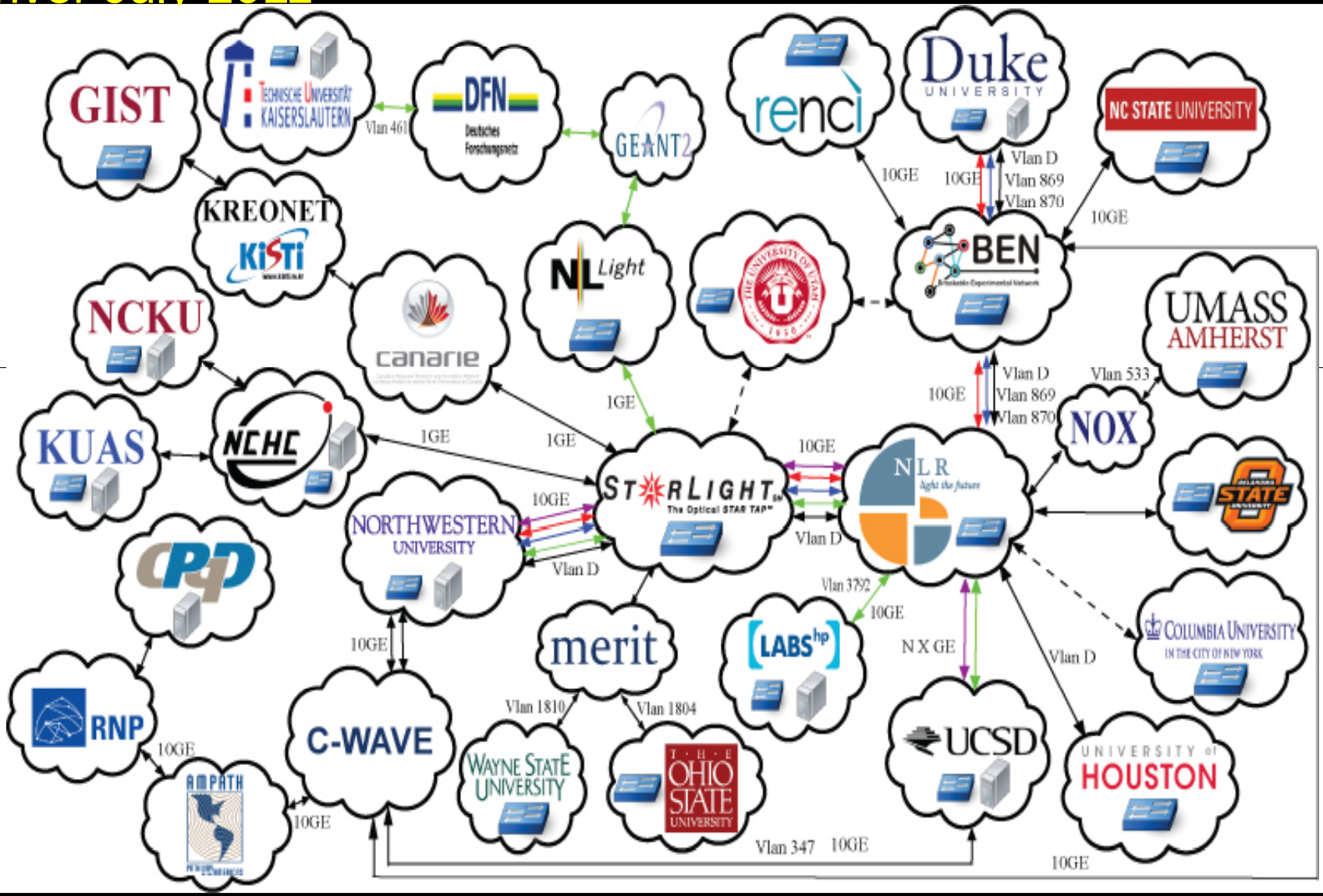
University of Illinois at Chicago

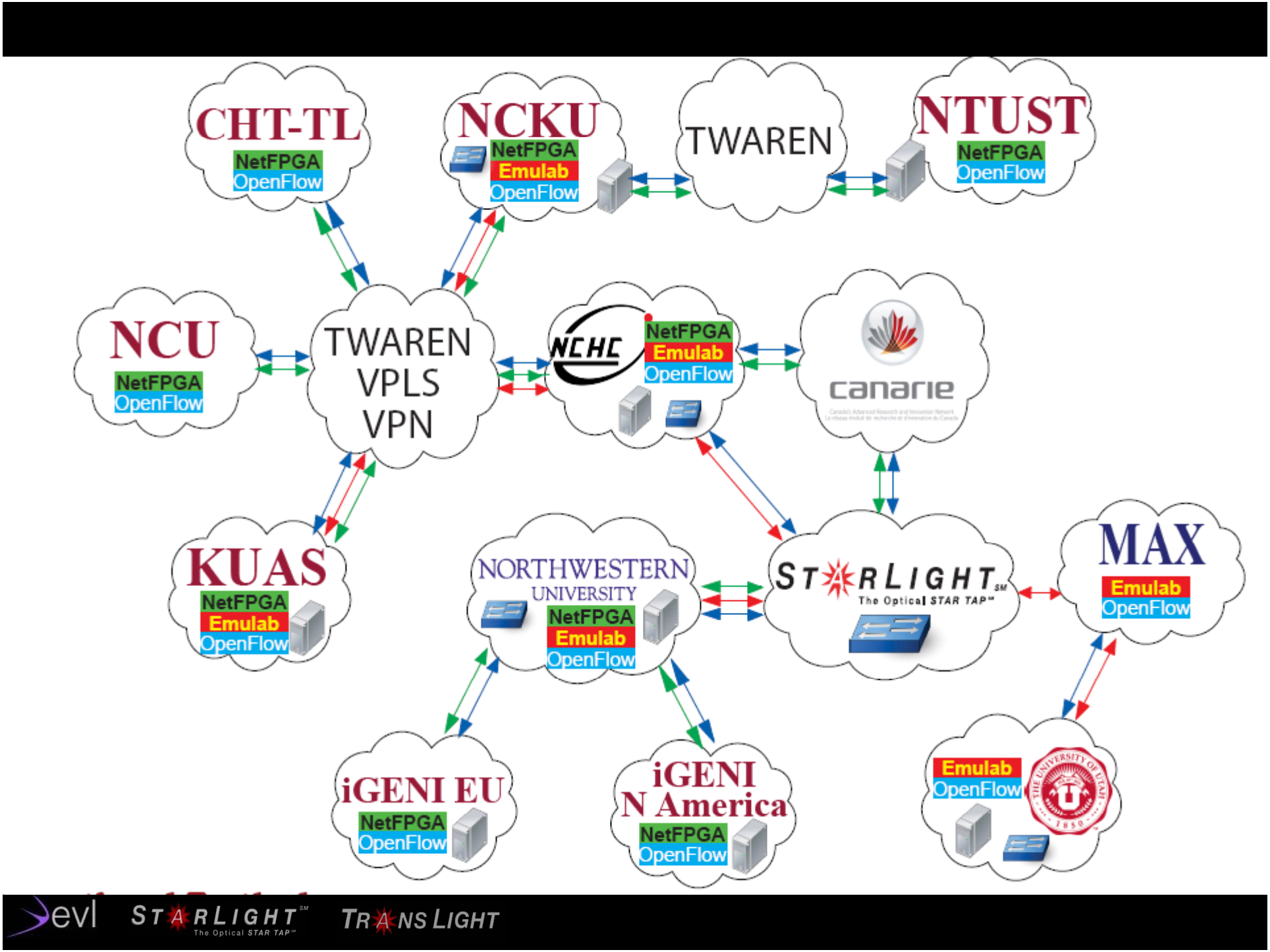
Tom DeFanti, Research Scientist (tdefanti@ucsd.edu)
California Institute for Telecommunications and Information Technology (www.calit2.net),
University of California, San Diego

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

GENI Engineering Conferences 10/11 Puerto Rico Mar 2011, Denver July 2011




CHT-TL
NetFPGA
OpenFlow
NCKU
NetFPGA
Emulab
OpenFlow
TWAREN
NTUST
NetFPGA
OpenFlow
NCU
NetFPGA
OpenFlow
TWAREN
VPLS
VPN
NCHC
NetFPGA
Emulab
OpenFlow
canarie
KUAS
NetFPGA
Emulab
OpenFlow
NORTHWESTERN
UNIVERSITY
NetFPGA
Emulab
OpenFlow
STARLIGHT
The Optical STAR TAP
MAX
Emulab
OpenFlow
iGENI EU
NetFPGA
OpenFlow
iGENI
N America
NetFPGA
OpenFlow
Emulab
OpenFlow

Experiments Planned For S3 = Many Ref For Example -- TransCloud

Alvin AuYoung, Andy Bavier, Jessica Blaine, Jim Chen, Yvonne Coady, Paul Muller, Joe Mambretti,Chris Matthews, Rick McGeer, Chris Pearson, Alex Snoeren, Fei Yeh, Marco Yuen

TransCloud Today

TransCloud: Based on iGENI and GENICloud

- Transcontinental Federation of Cloud Systems
- Slice-Based Federation Architecture for sign on and trans-cluster slice management
- SFA cluster manager at each site
  - Currently, enhanced Eucalyptus
- Private 10 Gb/s transcontinental network linking sites
  - Thanks to GLIF, NLR, NetherLight, CAVEWave, StarLight, DFN

Roadmap

- Accept experimenters ***now***
- Federation expansion
  - TU Amsterdam immediately
  - Brazil, Asia by July
  - All interested parties at any time
- Full integration with PlanetLab Control Framework (July)
- High-level programming environment based on RePy and NaCl
- High-level distributed query environment

Example of working in the TransCloud

[1] Build trans-continental applications spanning clouds:

- Distributed query application based on Hadoop/Pig
- Store archived Network trace data using HDFS
- Query data using Pig over Hadoop clusters

[2] Perform distributed query on TransCloud, which currently spans the following sites:

- HP OpenCirrus
- Northwestern OpenCloud
- UC San Diego
- Kaiserslautern

- Use By Outside Researchers? Yes
  - Use Involving Multiple Aggregates? Yes
  - Use for Research Experiments? Yes

Also Ref: Experiments in High Perf Transport at GEC 7

Demo: http://tcdemo.dyndns.org/

Digital Media TransCoding Demonstration GEC 10 San Juan Puerto Rico, March 2011

- TransCloud: Advanced Distributed Global Environment Enables Dynamic Creation of Communication Services, Including Those Based on Rapid Migration of Virtual Network and Cloud Resources
- TransCloud: Set of Protocols, Standards, Management Software Enables Interoperation of Distinct Cloud and Network Resources
- Example: Dynamic Cloud+Dynamic Network for Digital Media Transcoding Using Single Platform vs Multiple Infrastructures

Transcoding Cloud 1

Transcoding Cloud 2

Video Sources

OpenFlow Switches

Transcoding Cloud 3

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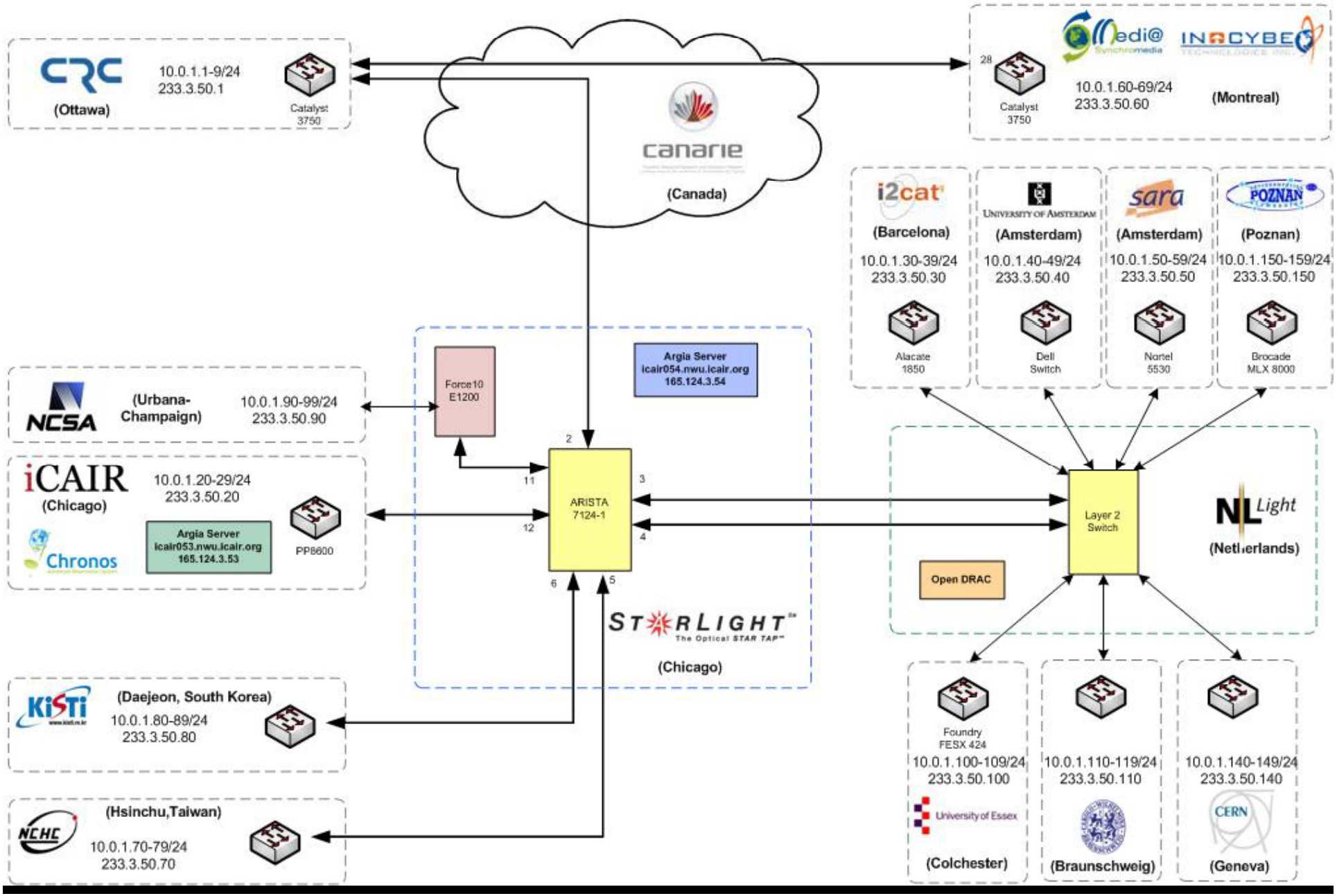
Multiple Network Research Testbeds

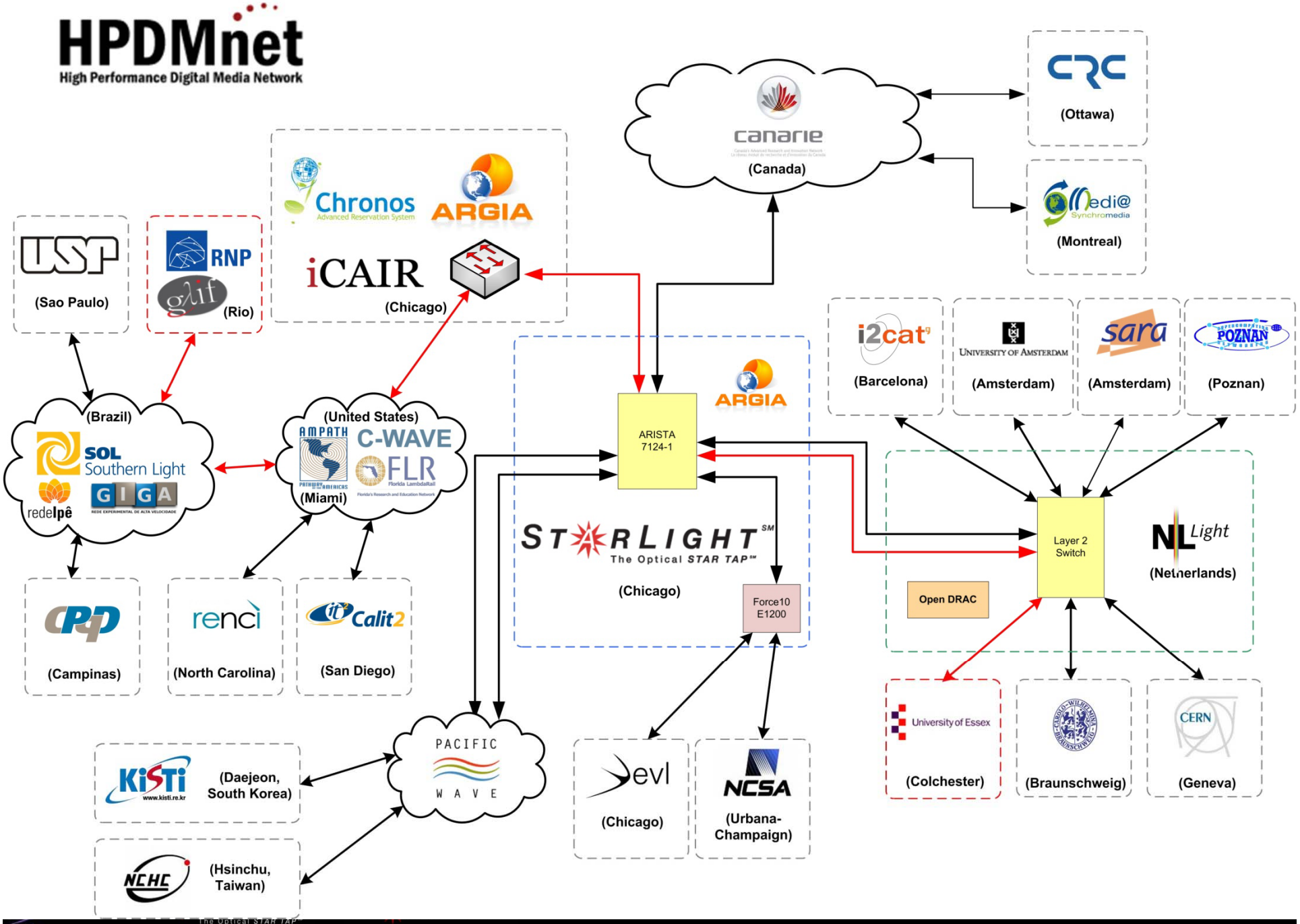
- Multiple Large Scale Network Research Testbeds
  - International
  - National
  - Regional
  - State-Wide
  - Metro
  - Local

Last Updated: September 16, 2010

HPDMnet
High Performance Digital Media Network

Layer 2 Topology




HPDMnet
High Performance Digital Media Network
canarie
(Canada)
CRC
(Ottawa)
Medi@ Synchromedia
(Montreal)
Chronos
Advanced Reservation System
ARGIA
iCAIR
(Chicago)
USP
(Sao Paulo)
RNP
glif
(Rio)
i2cat
(Barcelona)
University of Amsterdam
(Amsterdam)
sara
(Amsterdam)
POZNAN
(Poznan)
ARGIA
ARISTA
7124-1
(Brazil)
SOL
Southern Light
GIGA
redeIpê
(United States)
AMPATH
C-WAVE
FLR
Florida LambdaRail
(Miami)
STARLIGHT SM
The Optical STAR TAP SM
(Chicago)
Force10
E1200
Layer 2
Switch
Open DRAC
NL Light
(Netherlands)
CPqD
(Campinas)
renci
(North Carolina)
Calit2
(San Diego)
University of Essex
(Colchester)
(Braunschweig)
CERN
(Geneva)
PACIFIC
WAVE
KISTI
www.kisti.re.kr
(Daejeon,
South Korea)
NCHC
(Hsinchu,
Taiwan)
evl
(Chicago)
NCSA
(Urbana-
Champaign)
The Optical STAR TAP

8k Media Experiments At the Univ of Essex

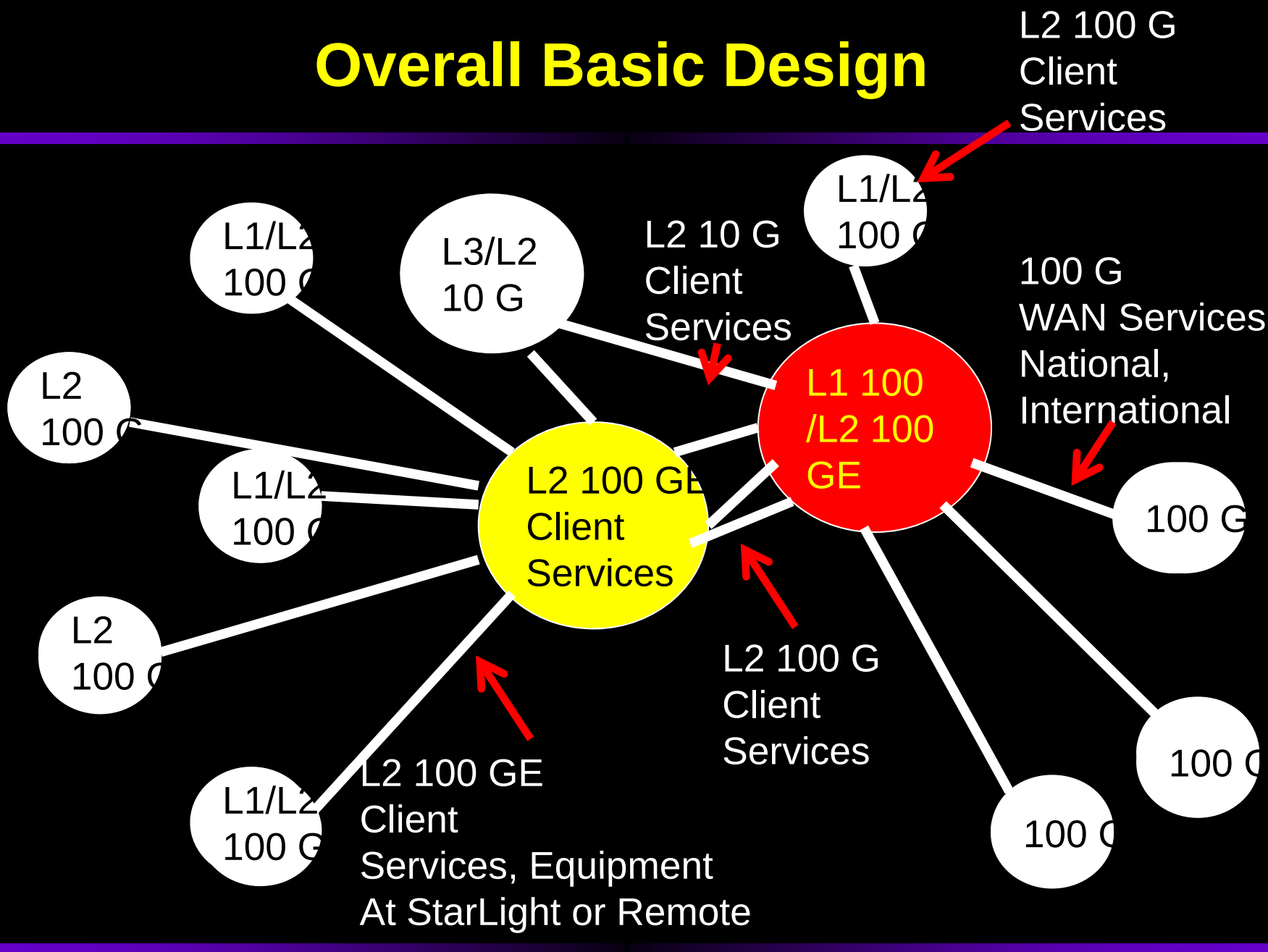
StarLight 100 Gbps/Tbps Initiatives

- StarLight Has Established Several Initiatives That Are Directed At Creating Networking Services, Architecture, Technology, and Networks Based on 100 Gbps and Higher Service, Including Tbps
- Foundation Research Is Based On Earlier Experience With Dynamic Lightpath Technologies
- 100 Gbps = More Than Capacity (e.g., Dynamic Control Over Channel Segments, Customization)
- StarWave: New NSF Award To Create a New 100 Gbps Exchange at the StarLight Facility for Data Intensive Science
- StarWave Will Be Implemented in Q4 2011

StarWave: A Multi-100 Gbps Facility

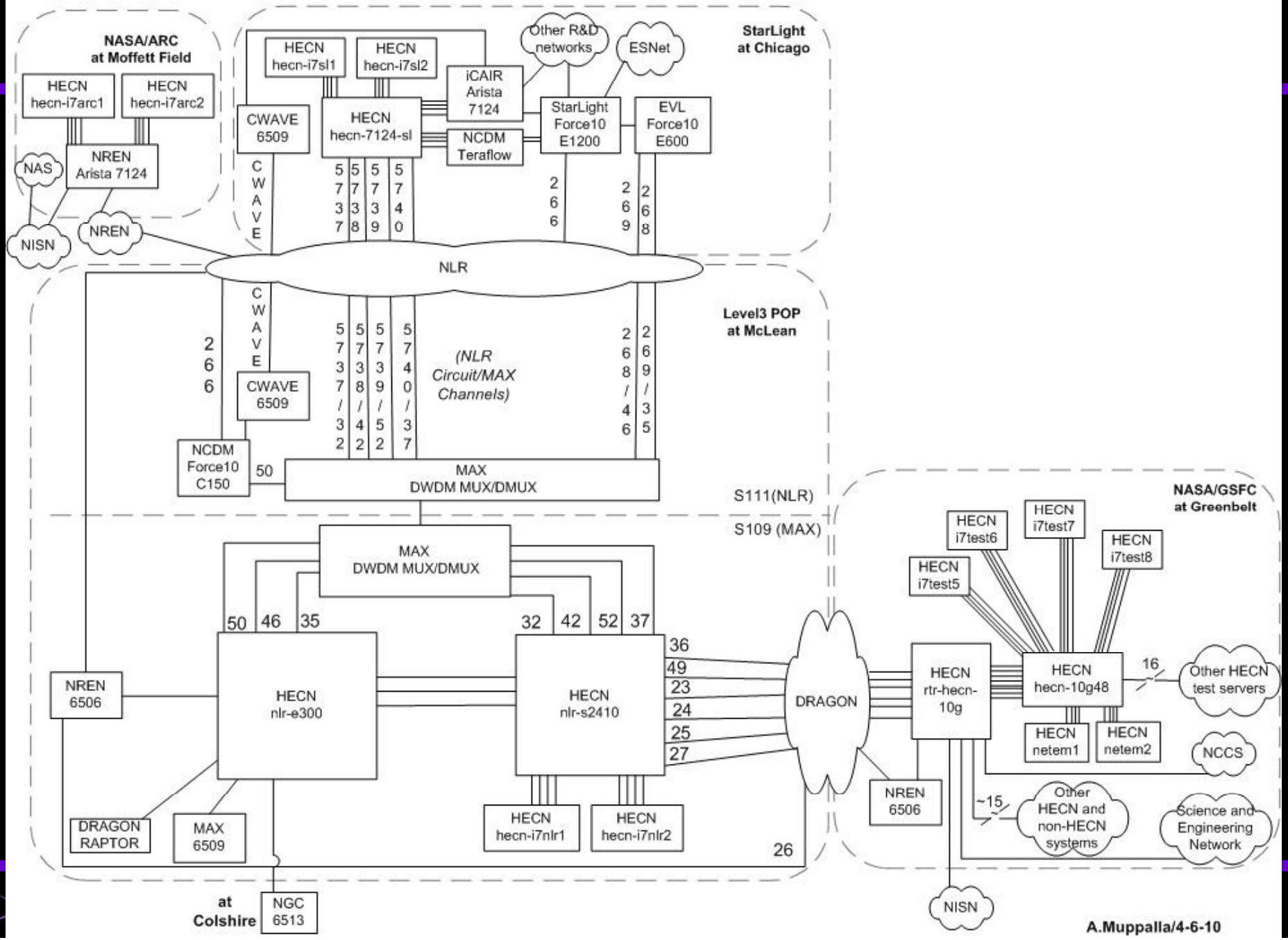
- StarWave, A New Advanced Multi-100 Gbps Facility and Services Will Be Implemented Within the StarLight International/National Communications Exchange Facility
- StarWave Is Being Funded To Provide Services To Support Large Scale Data Intensive Science Research Initiatives
- Facilities Components Will Include:
  - An ITU G. 709 v3 Standards Based Optical Switch for WAN Services, Supporting Multiple 100 G Connections
  - An IEEE 802.3ba Standards Based Client Side Switch, Supporting Multiple 100 G Connections, Multiple 10 G Connections
  - Multiple Other Components (e.g., Optical Fiber Interfaces, Measurement Servers, Test Servers

Overall Basic Design

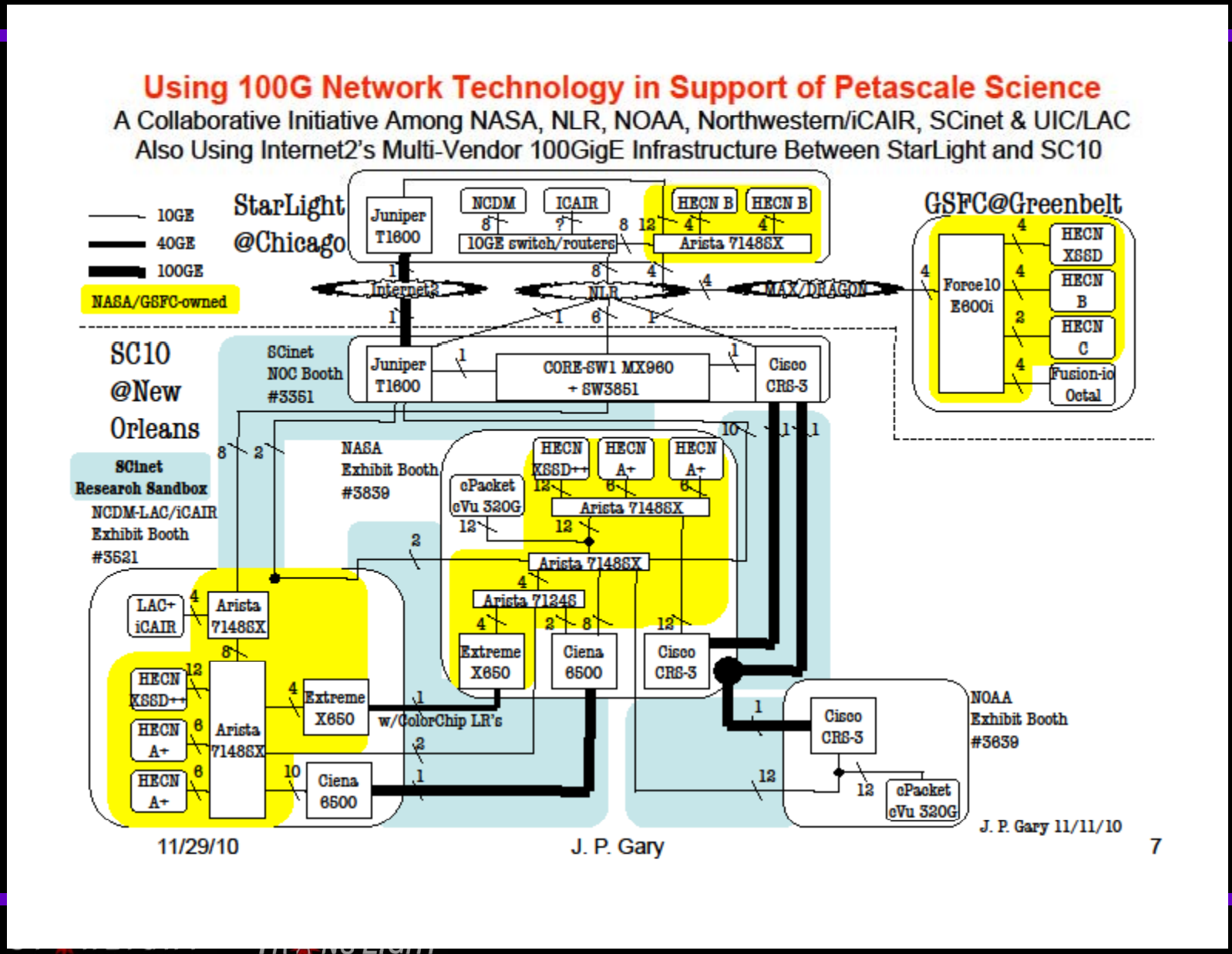


GSFC/High End Computer Network (HECN) and Partners 10GE and 10G Lambda Connections Through McLean

Note: The non-GSFC/HECN systems shown typically have other connections that are not shown in this diagram, as the focus is primarily GSFC/HECN connections



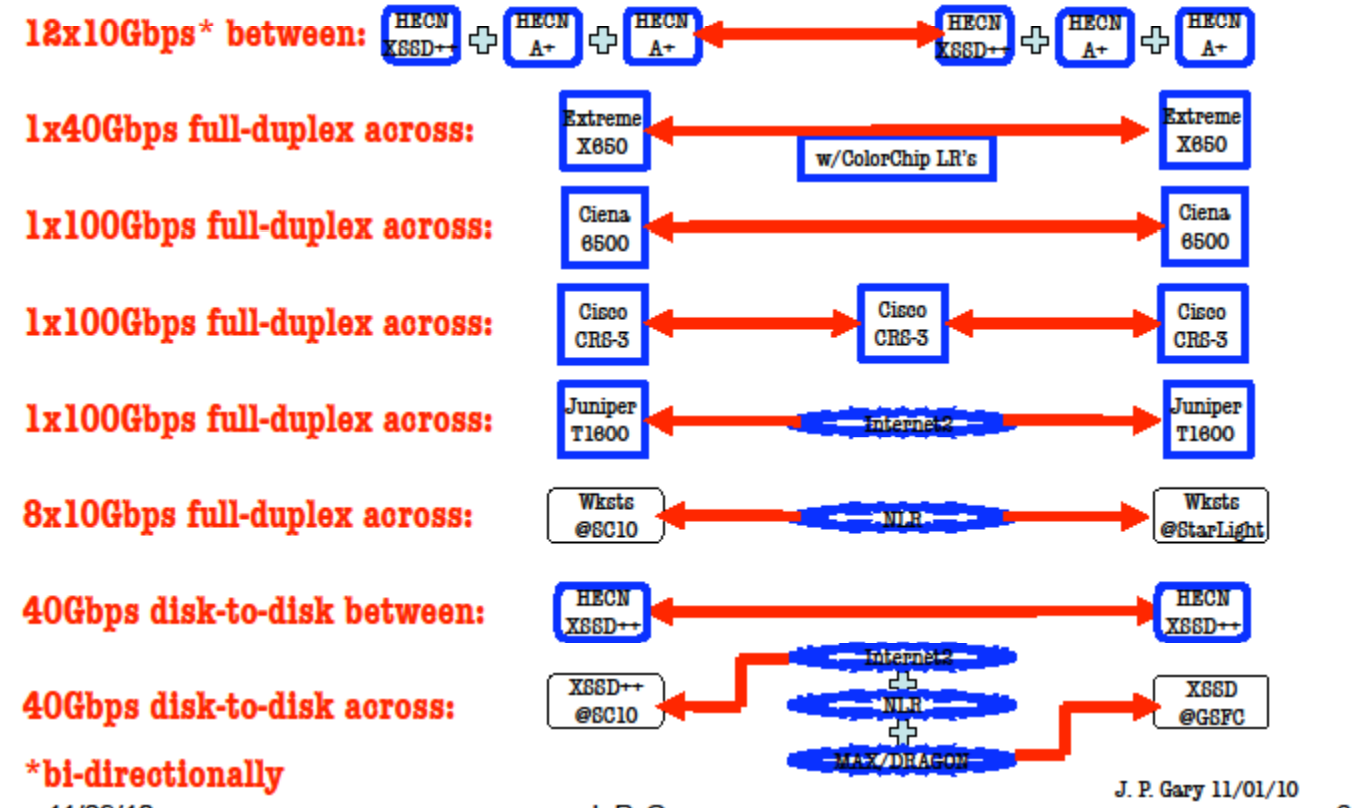
SC10 Demos – Additional Demos Planned for SC11



Using 100G Network Technology in Support of Petascale Science

A Collaborative Initiative Among NASA, NLR, NOAA, Northwestern/iCAIR, SCinet & UIC/LAC
Also Using Internet2's Multi-Vendor 100GigE Infrastructure Between StarLight and SC10

Demo Summary



J. P. Gary 11/01/10

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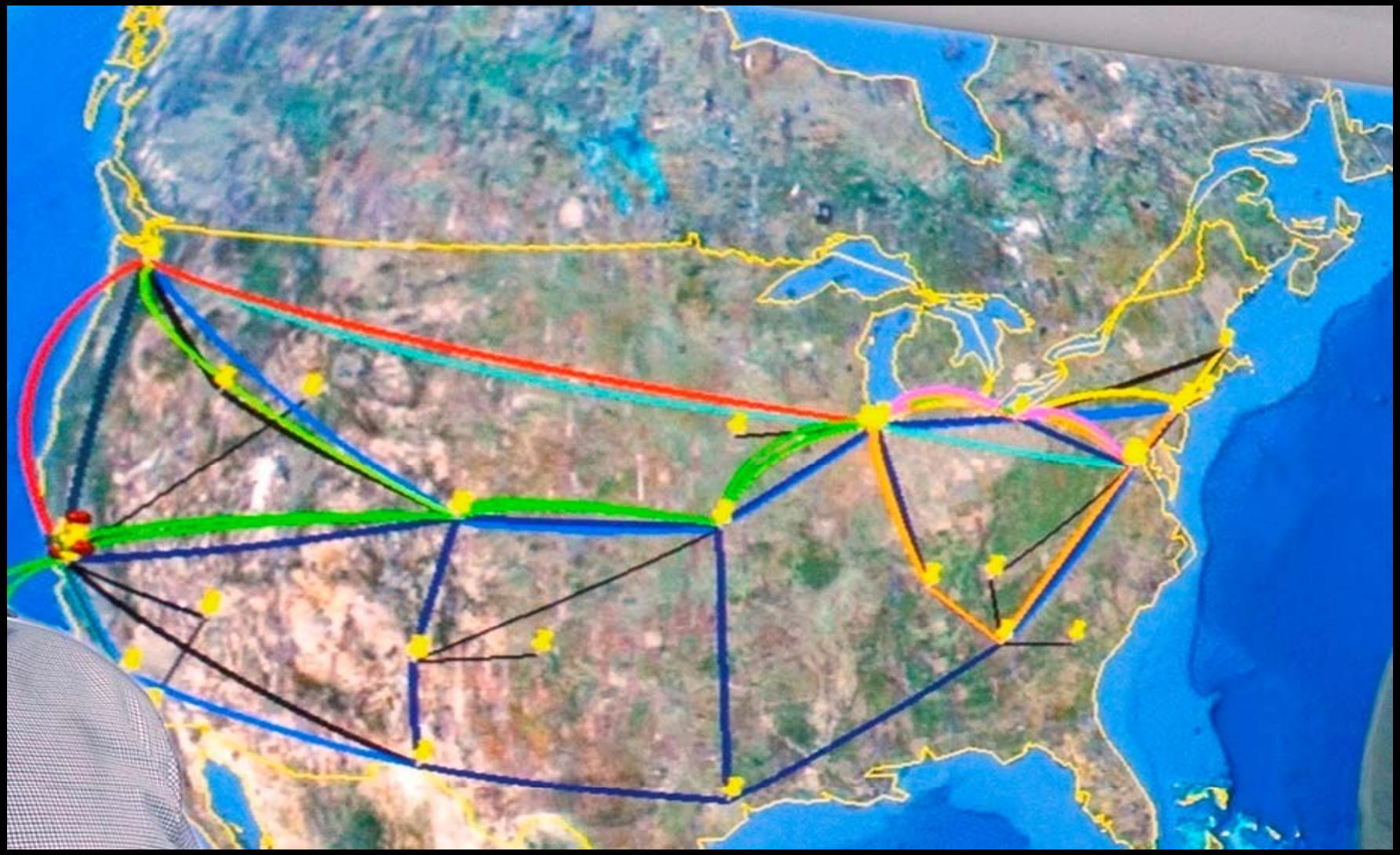
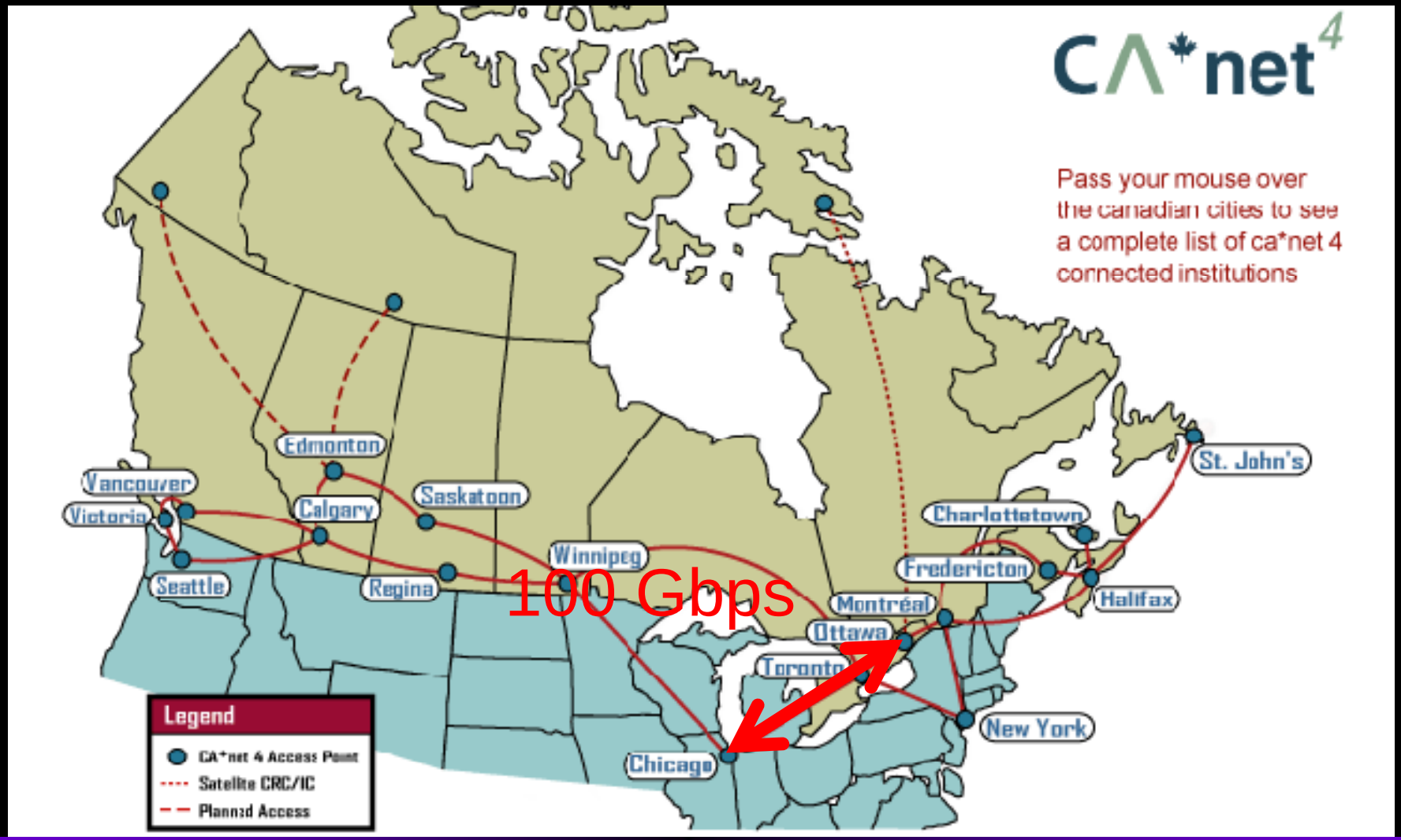
DOE ESnet Advanced Networking Initiative: 100 Gbps



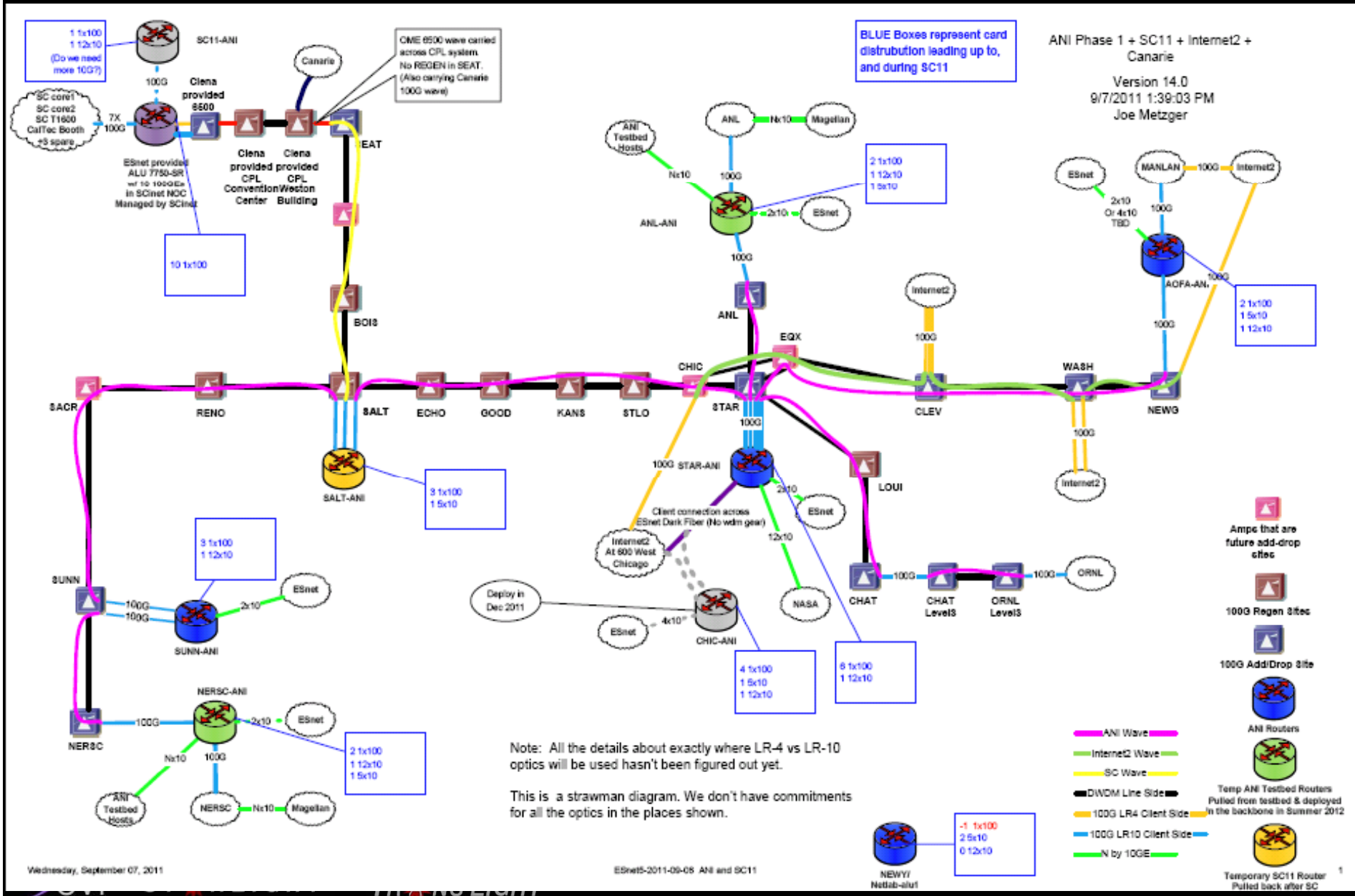
Source : ESnet

CA*net/Ciena/StarLight/iCAIR 100 Gbps Testbed 1st Implemented In Sept 2010, Scheduled Also for Sept-Oct 2011

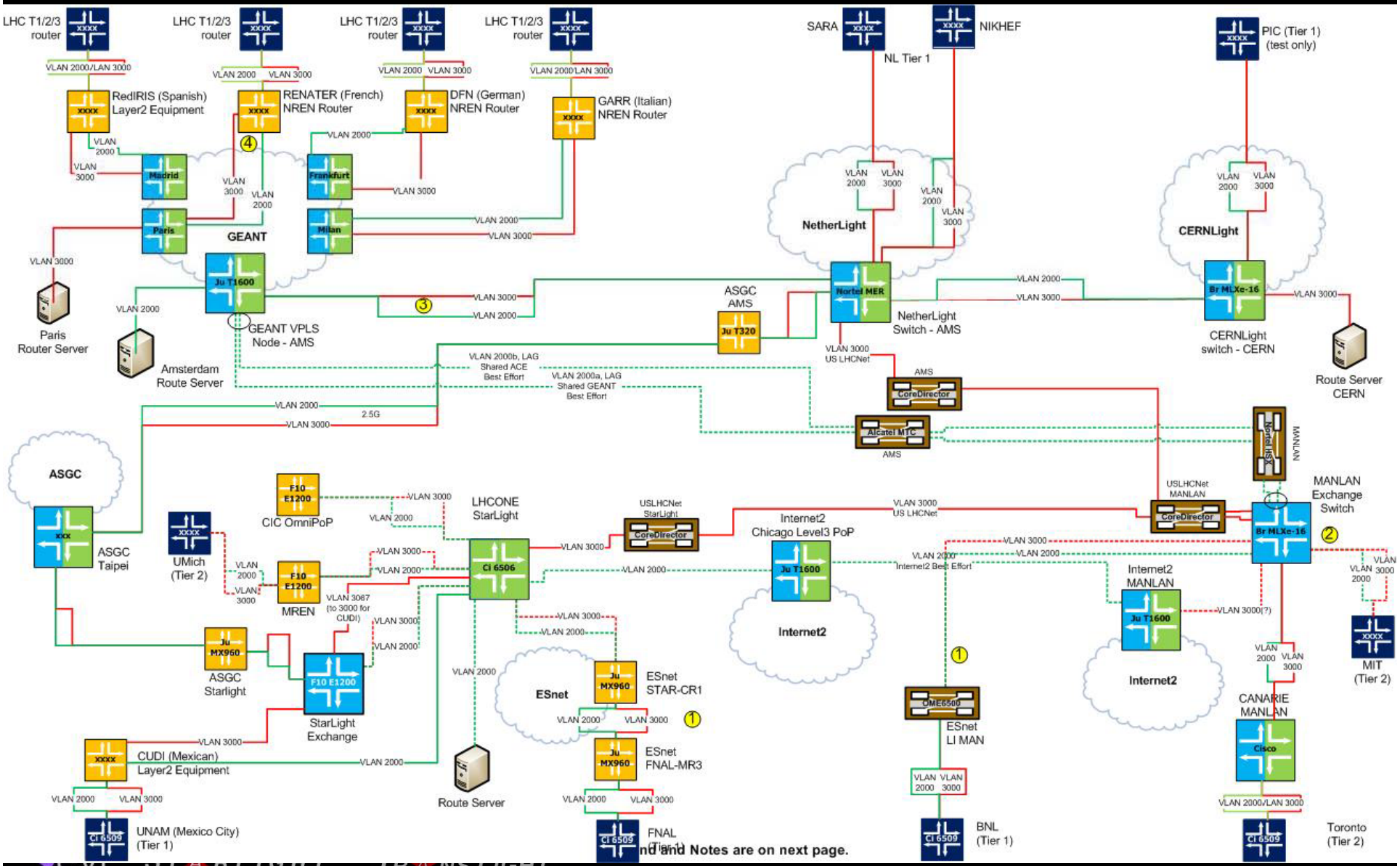


Source: CANARIE

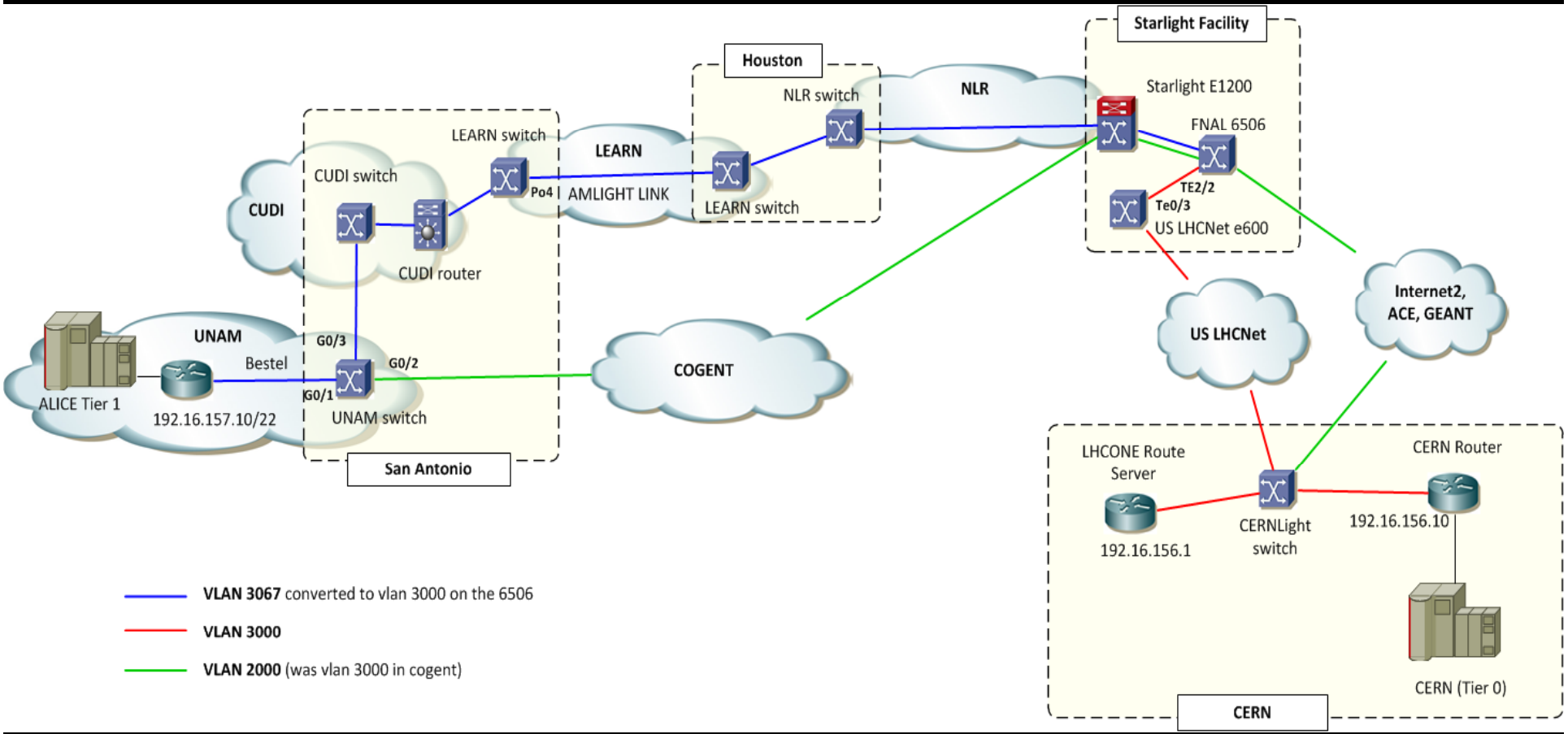
SC11 100 Gbps Demonstration Backbones



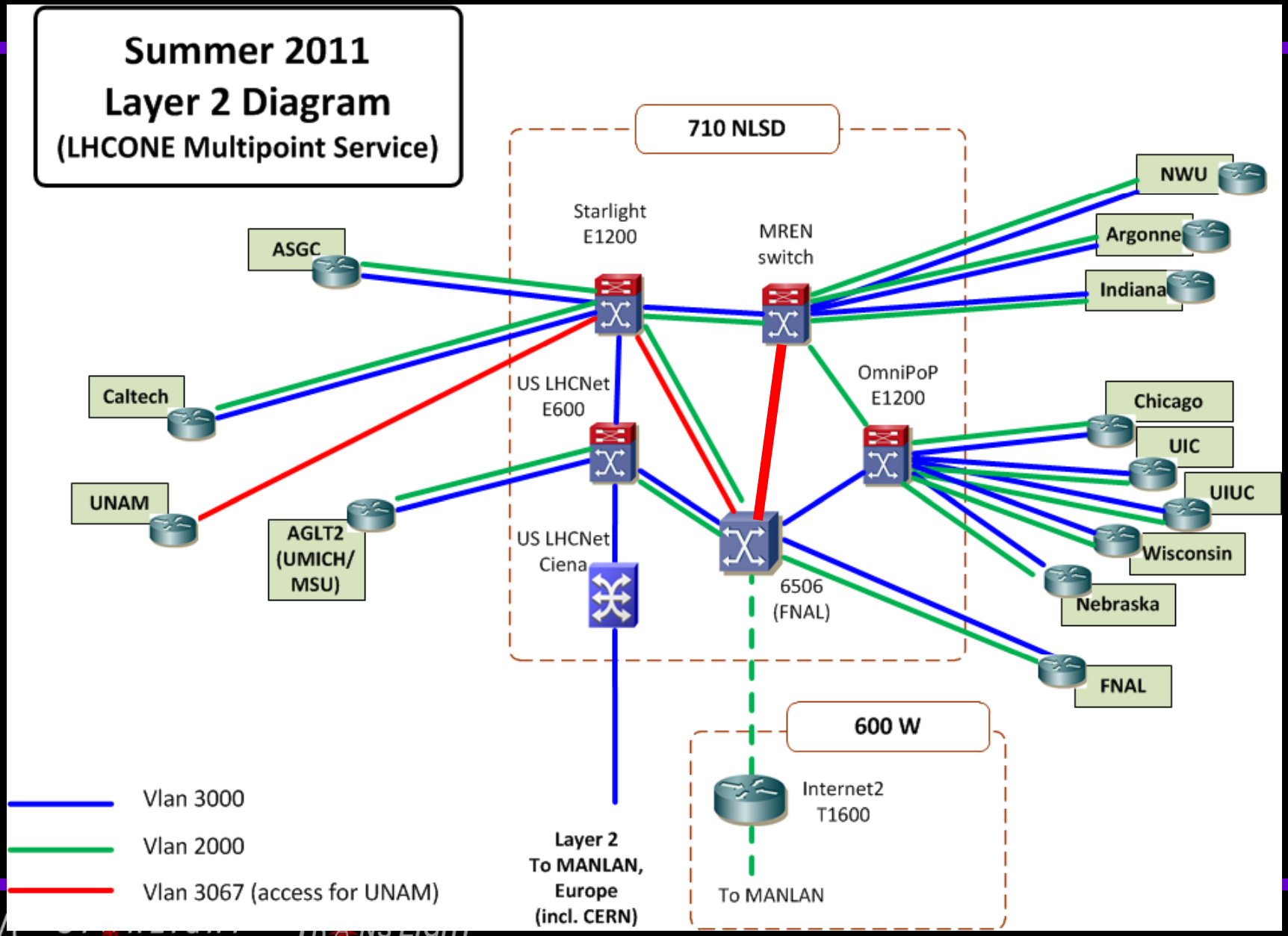
LHCONE


LHC T1/2/3 router
RedIRIS (Spanish) Layer2 Equipment
RENATER (French) NREN Router
DFN (German) NREN Router
GARR (Italian) NREN Router
SARA
NIKHEF
NL Tier 1
PIC (Tier 1) (test only)
NetherLight
CERNLight
GEANT
Madrid
Paris
Frankfurt
Milan
Ju T1600
Paris Router Server
Amsterdam Route Server
GEANT VPLS Node - AMS
ASGC AMS
Ju T320
Nortel MER
NetherLight Switch - AMS
CERNLight switch - CERN
Route Server CERN
VLAN 2000b, LAG Shared ACE Best Effort
VLAN 2000a, LAG Shared GEANT Best Effort
2.5G
US LHCNet
AMS
CoreDirector
Alcatel MTC
Nortel HSX
MANLAN
ASGC
ASGC Taipei
UMich (Tier 2)
F10 E1200
CIC OmniPoP
MREN
LHCONE StarLight
USLHCNet StarLight
Ci 6506
Internet2 Chicago Level3 PoP
Internet2
USLHCNet MANLAN
MANLAN Exchange Switch
Br MLXe-16
Internet2 MANLAN
Internet2 Best Effort
MIT (Tier 2)
VLAN 3067 (to 3000 for CUDI)
Ju MX960
ASGC Starlight
StarLight Exchange
CUDI (Mexican) Layer2 Equipment
UNAM (Mexico City) (Tier 1)
Route Server
ESnet
ESnet STAR-CR1
ESnet FNAL-MR3
FNAL (Tier 1)
OME6500
ESnet LI MAN
BNL (Tier 1)
CANARIE MANLAN
Cisco
Toronto (Tier 2)
Legend and Notes are on next page.

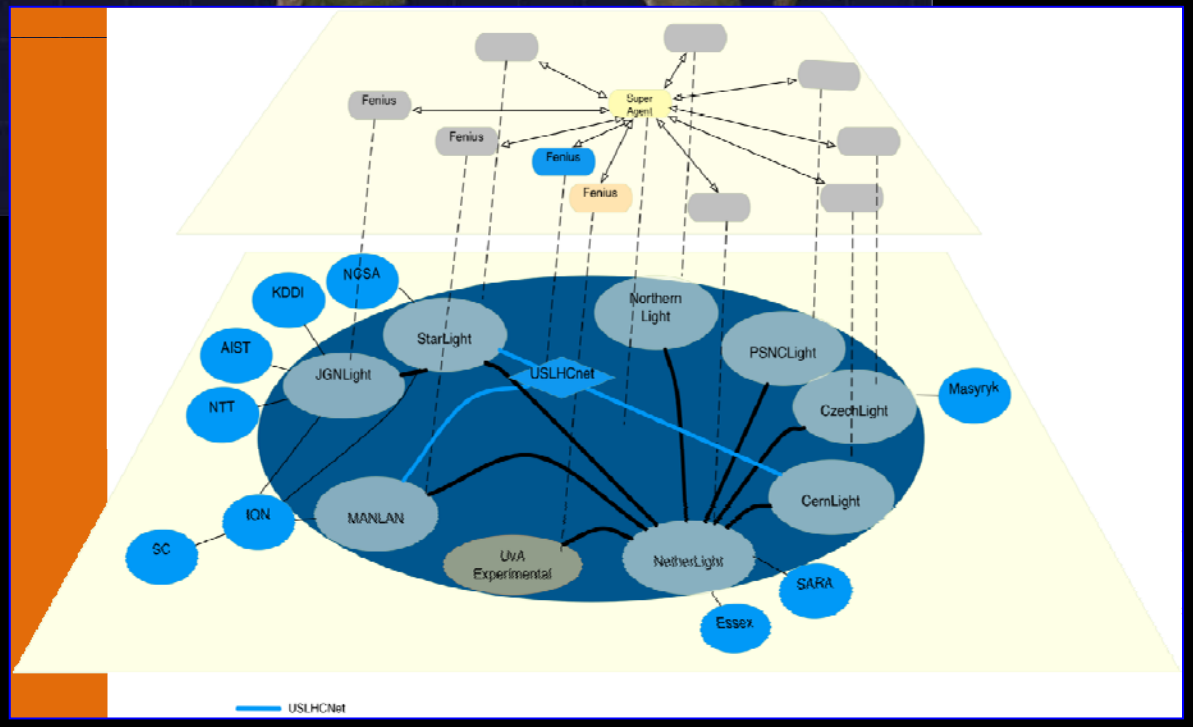
UNAMnet


Starlight Facility
Houston
NLR switch
NLR
Starlight E1200
FNAL 6506
LEARN switch
LEARN
CUDI switch
CUDI
Po4
AMLIGHT LINK
LEARN switch
TE2/2
Te0/3
US LHCNet e600
CUDI router
Internet2,
ACE, GEANT
US LHCNet
UNAM
G0/3
Bestel
G0/2
COGENT
G0/1
ALICE Tier 1
192.16.157.10/22
UNAM switch
San Antonio
LHCONE Route
Server
CERN Router
CERNLight
switch
192.16.156.10
192.16.156.1
CERN (Tier 0)
CERN
VLAN 3067 converted to vlan 3000 on the 6506
VLAN 3000
VLAN 2000 (was vlan 3000 in cogent)

Plans for LHCONE



Fenius GLIF Demonstrations
Global Lambda Grid Workshop SC10
HK GLIF Technical Workshop



Contact Us

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Alan Verlo (EVL/UIC)
Linda Winkler (MCS/ANL)

‘710engineers (at) startap (dot) net’
www.startap.net/starlight