Advanced Programmable Networks: A Demonstration of Software Defined Networks, OpenFlow, and Current GENI Capabilities

For the Advanced Programmable Networks Team: Northwestern University, National Center for High Performance Computing, Communications Research Center, SARA, University of Amsterdam, GENI, NLR, StarLight Consortium, Metropolitan Research and Education Network, GLIF

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Introduction – Programmable Networks

- Programmable Networks = Instant New and Enhanced Services vs Legacy Multi-Year Schedule of Design, Development, and Deployment
  - Joint Project With Many Partners: iCAIR, iGENI, SARA, GENI, NCHC, CRC, StarLight, MREN, NLR, etc
  - iGENI Optimizes Programmable Dynamic Private Networks Consisting of Highly Distributed Resources

Context 1: Legacy Networking

- 1 Year To Define Service
- 1 Year To Define Architecture
- 1 Year To Define Technology
- 1 Year To Deploy
- N Years of Static Unchanged Implementation
- Minimal Enhancements
- Minimal Opportunities for Service Upgrades

Context 2: Advanced Programmable Networking

- Advanced =
  - Dynamic vs Static
  - Highly Customizable, Including At Edge
  - High Level of Abstractions, Including APIs
  - Flexible Middleware Processes That Can Be Dynamically Provisioned
  - Highly Distributed Processes vs Centralized Command and Control
  - Etc
- Programmable =
  - All Resource Elements As Objects
  - Discoverable/Integrateable
  - Programmability Extending To Hardware Components
  - Rich Semantics for Resource Discovery and Integration

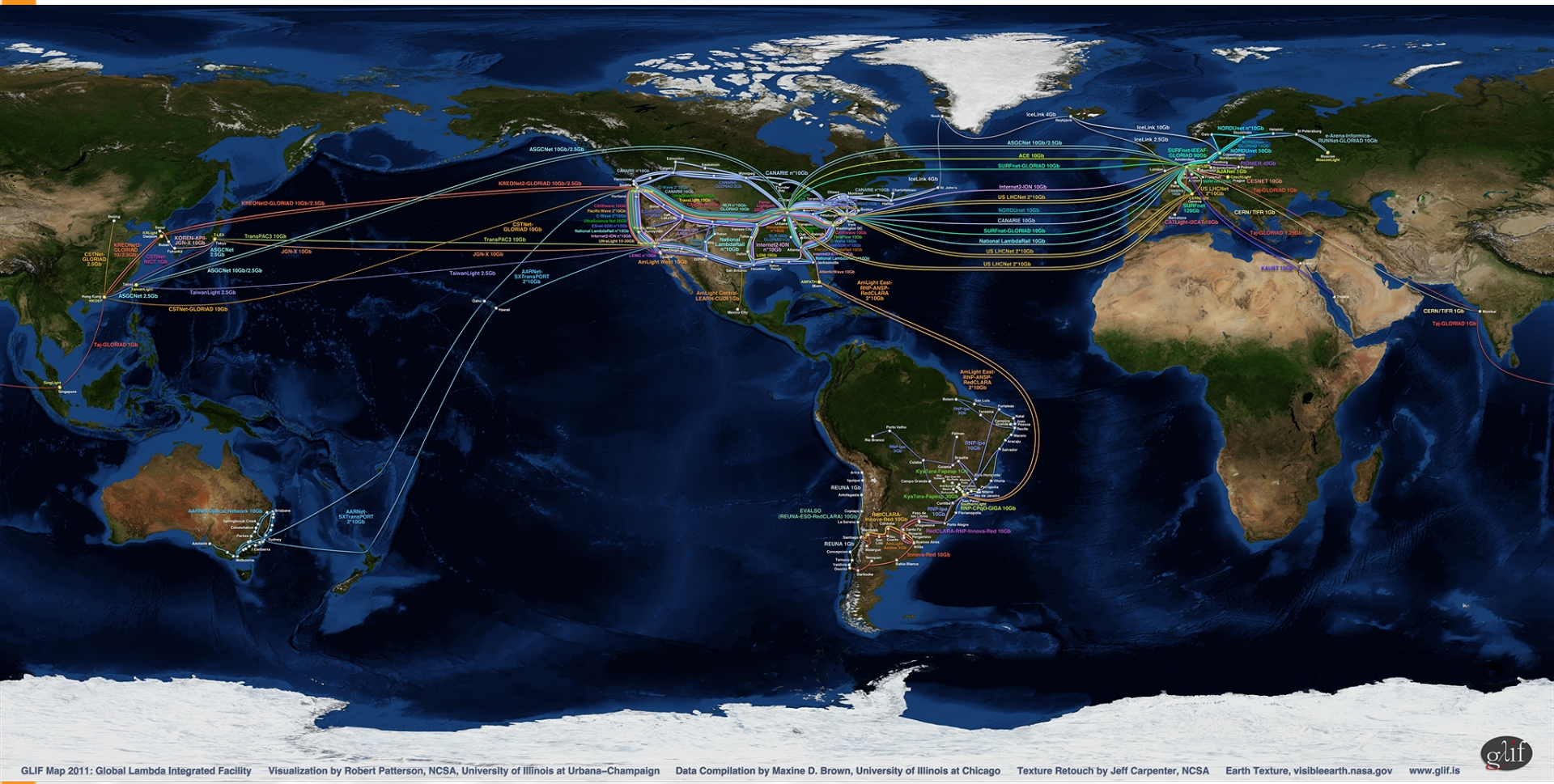
Context 3: Use Case

- Use Case: Ad Hoc Specialized Networks
- Legacy Approach: Try To Find a Provider To Create a New Communications Service (!)
- APN Approach: Create Private Network (Ref: TransCloud)
  - Private Optical Fiber/Lambdas/L2 VLANs
  - All Control Planes
  - All Management Planes
- Leverage
  - IaaS/NaaS
  - PaaS
  - SaaS
  - OaaS
  - XaaS
- More Leverage
  - Dynamic Clouds Closely Integrated With Dynamic Networks (Ref TransCloud, Note Demo At GEC10)

Use Case: Implication

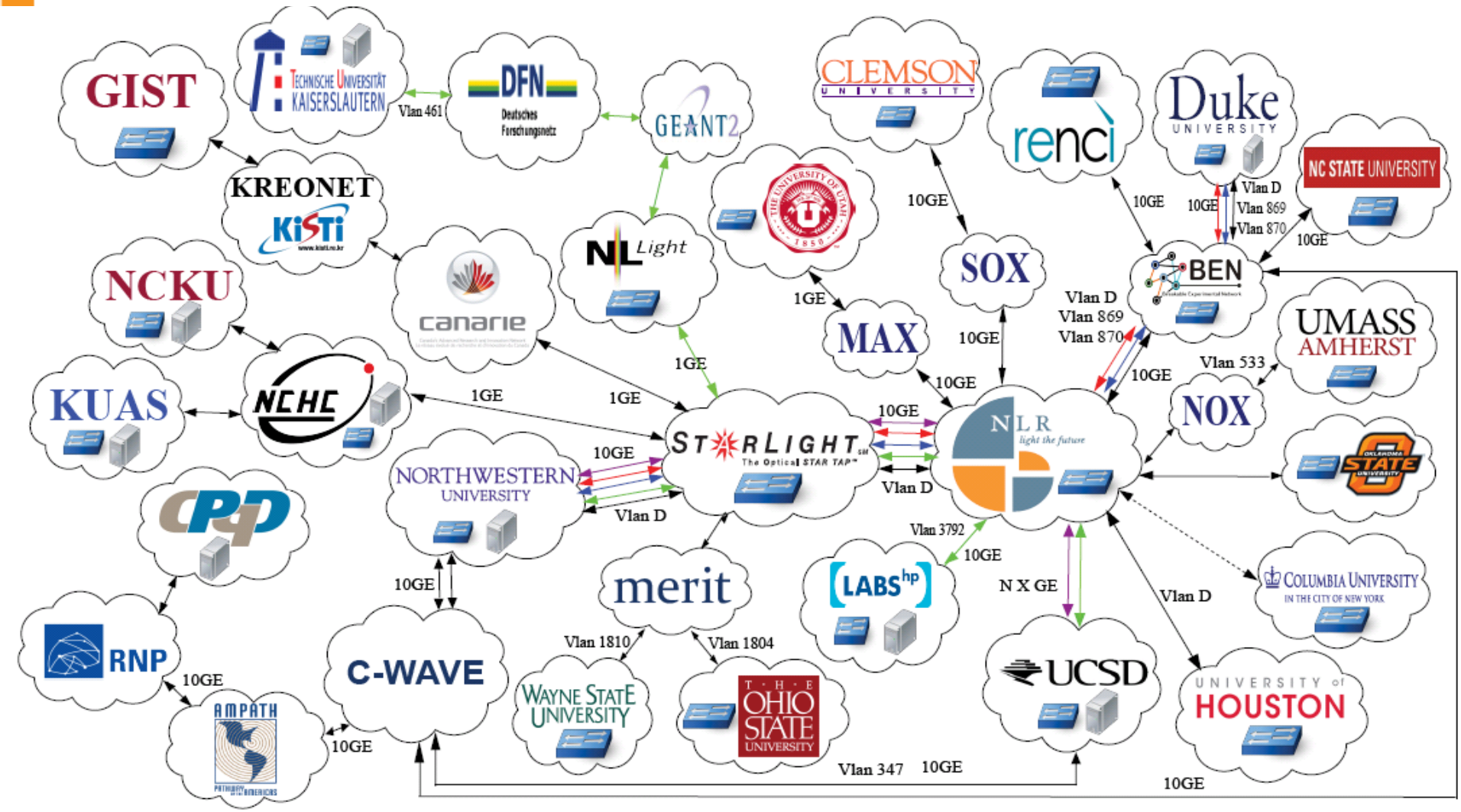
- Ad Hoc Specialized Networks Can Lead To:
  - Personal Global Networks
  - Individualized Communication Services
  - Historic Note Progression From Monolithic To Individualized
    - Personal Computer vs Mainframe
    - Smart Phone vs Personal Computer
    - Intelligent Device vs Smart Phone
    - Etc.

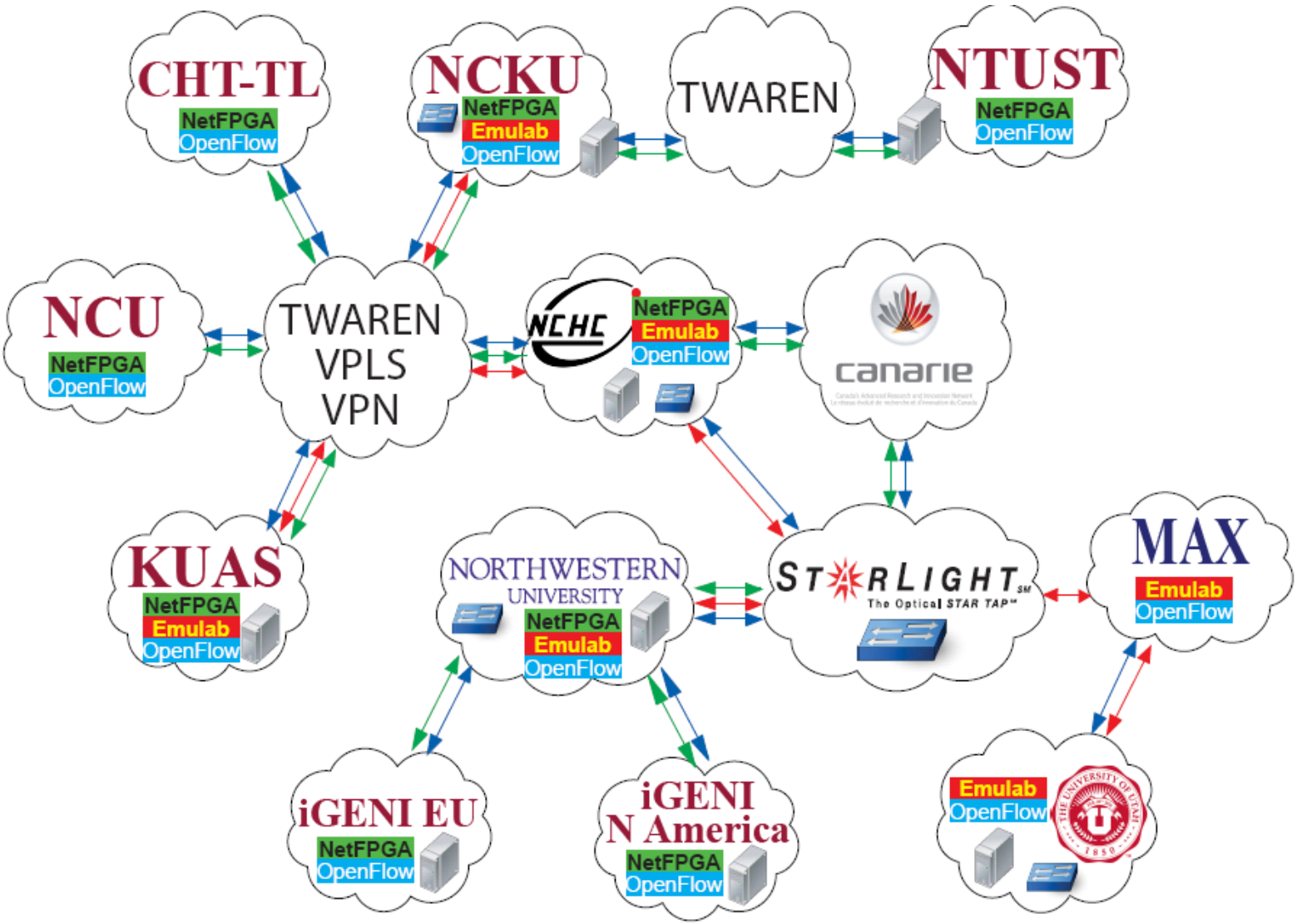
Global Lambda Integrated Facility (GLIF)



Not a Network – A Global Programmable Facility

GCDnet + iGENI Partner Resources




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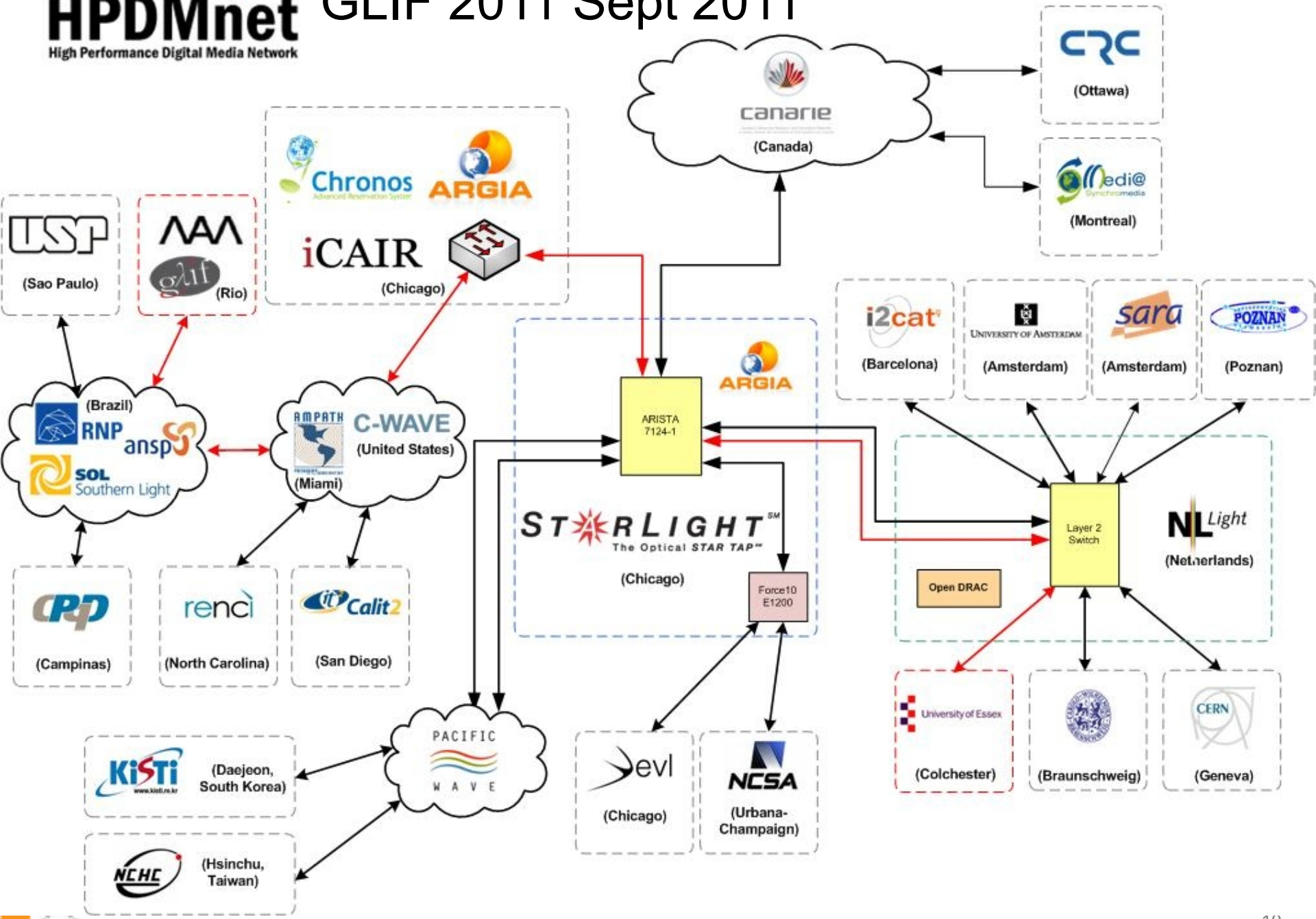
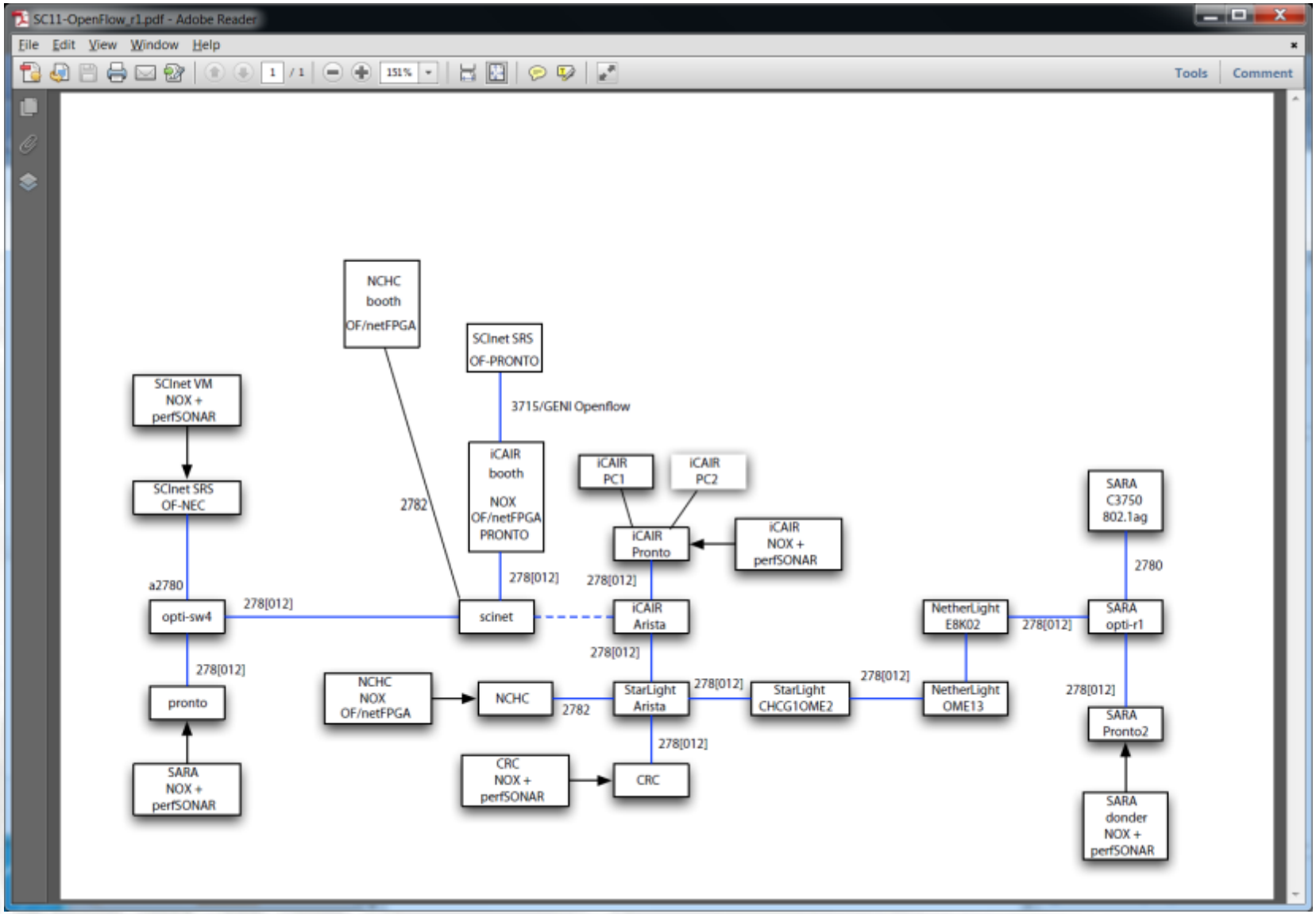
iGENI
N America
NetFPGA
OpenFlow
Emulab
OpenFlow

GLIF 2011 Sept 2011



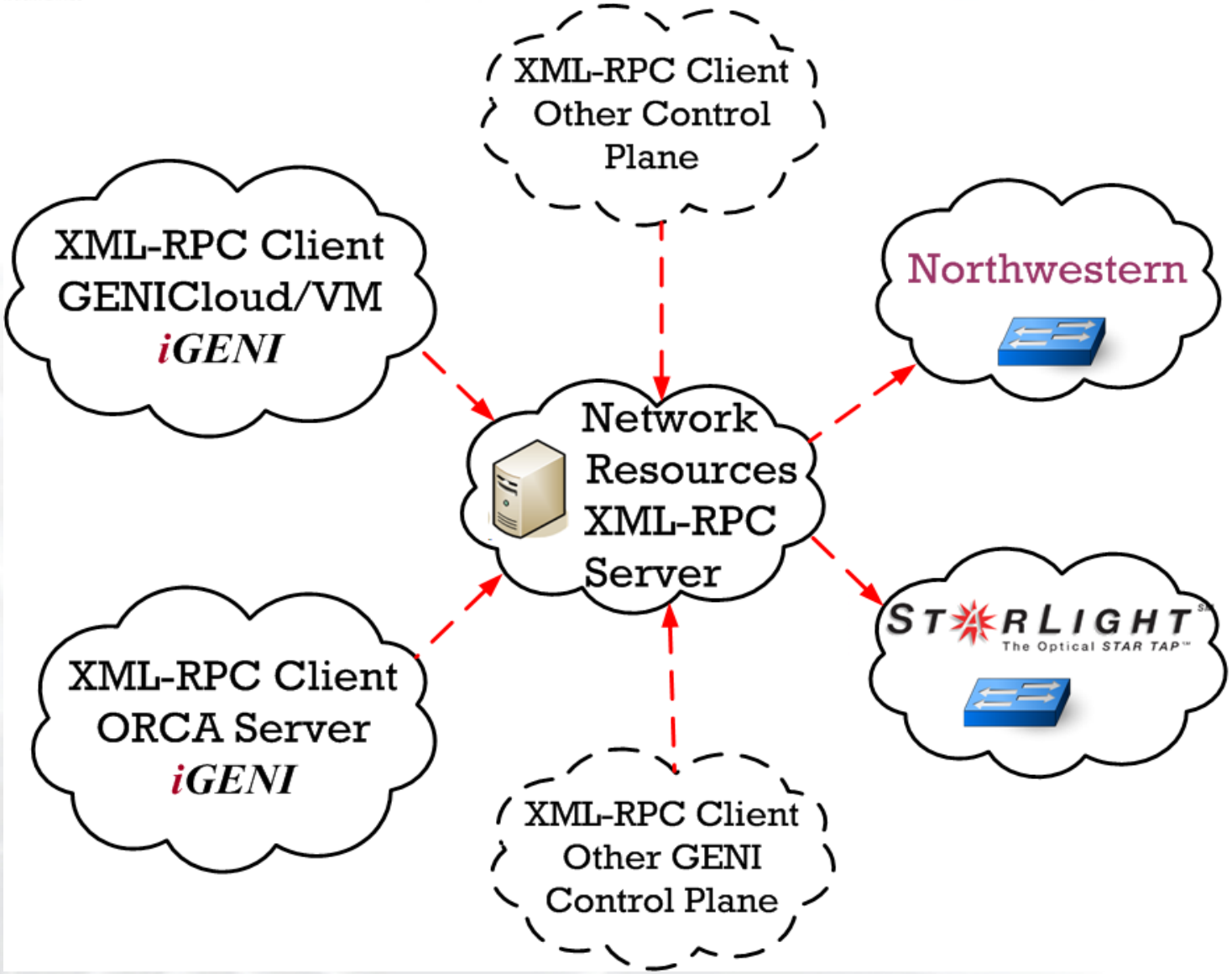
SC11 SRS Openflow Draft Design



Demo

(International Center for Advanced Internet Research, Northwestern Univ, SARA, NCKU, KUAS, NCHC and CRC)

iGENI Dynamic Provisioning



Demo Overview

- 1) Current State - Partial Mesh of Paths
- 2) In Response To Dynamic Change In Requirements, Selection and Implementation of Alternative Paths Directly Via XML-RPC Client Control Over Dynamic Paths
- 3) Personnel Client Direct Control Over Switches With Embed XML-RPC Server.
- 4) Vlans/Flows Control Implementation
- 5) Possible In Band or Out of Band Control
- 6) XML-RPC API For Control Plane Frameworks Or Apps Integration

APN at GEC 12


C:\Users\admin\Deskto
Switch Manager
iGENI
STARLIGHT
The Optical STAR TAP
iCAIR
URL:
port:
submit
server: :
client:Didn't receive 200 OK from remote server. (HTTP 12029)
Create VLAN
Add/delete port from VLAN
Show port
Show VLAN
Show/Add/Delete Flow
Show
Add
Delete
port 1:
port 2:
submit
Connectivity Functions

Summary – APN

- Objective: Advanced Programmable Networks
- Highly Customizable, With Individual Direct Control
- High Level APIs, Signaling, Via Client or API
- A Highly Programmable Environment
- Any Resource Can Be Integrated Into the Environment (Extensible)
- Abstraction Of Resources + Rich Set of Underlying Primitives

APN at GEC 12

- Thanks!
- Questions?