Dynamic Circuit Network
An Introduction

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Dynamic Circuit Networks in context

- Phone network
  - Connect to CO
- Computer connections
  - Switched or static - through CO
- IP networking
  - Local Network
  - ISPs, Exchange Points
  - IP switching
- Dynamic circuits
  - Switched
  - Typically IP over PtP

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Reasons for DCN

- IP network is now ubiquitous - but
- Some applications need dedicated circuits - continuous very high bw or performance
  - E.g. LHC Tier0 - Tier1
- Some applications need dedicated circuits for limited time.
  - E.g. LHC Tier1 - Tier2
  - Community of users that can share connections with each other
- Some applications are (perhaps) on the cusp of what can be provided by IP network
  - E.g. Tier3

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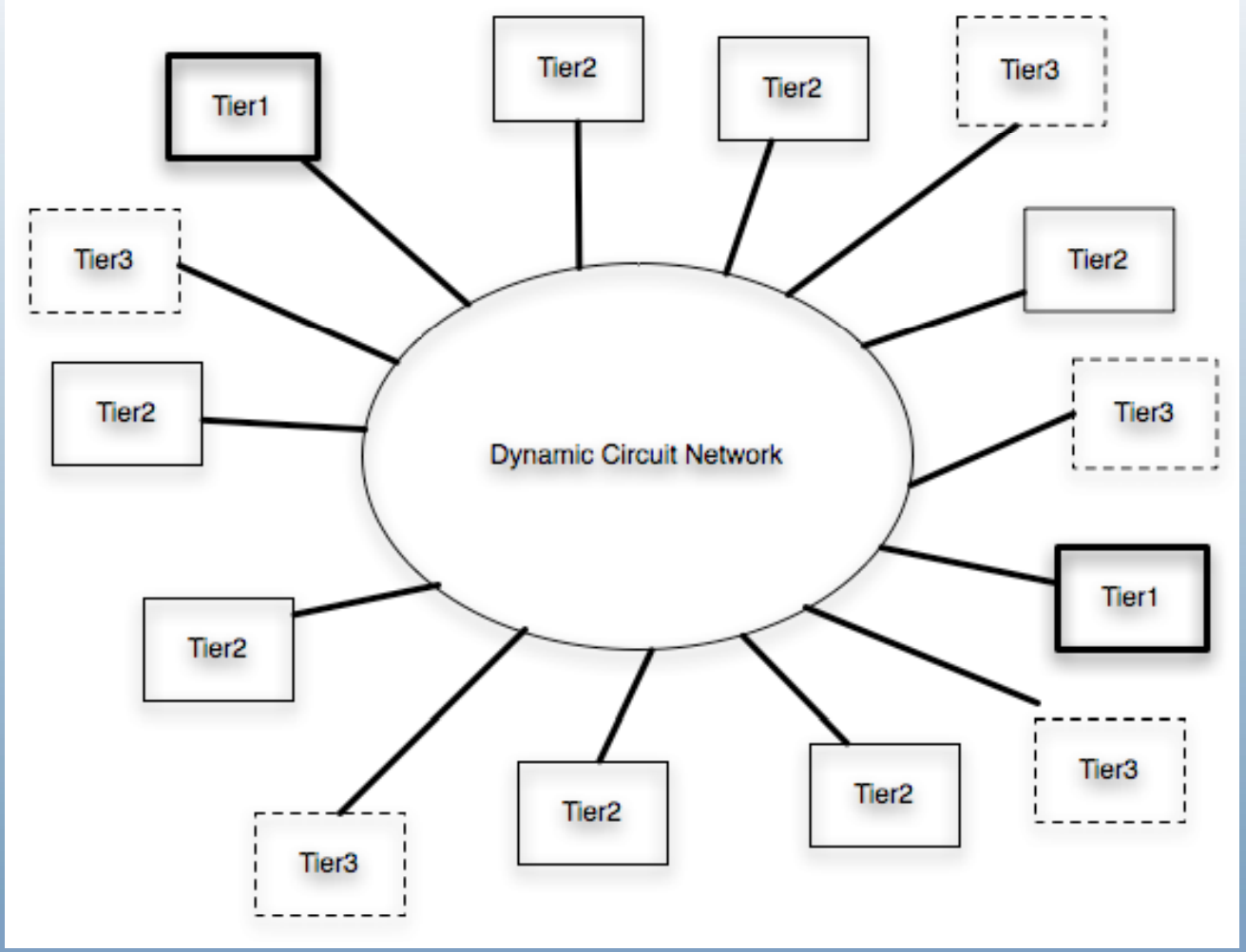
A Community of DCN Users



Uses of DCN

- IP Bypass
  - Users connect to Local Intermediary
  - Intermediary chooses routes
    - IP/ MPLS/ DCN
    - Sets IP routing to work appropriately
  - Examples - TeraPaths, LambdaStation
- User connects directly to DCN
  - Make connection via browser interface
  - Or, via script
  - Or write own program
  - Connection may use IP or some other protocol

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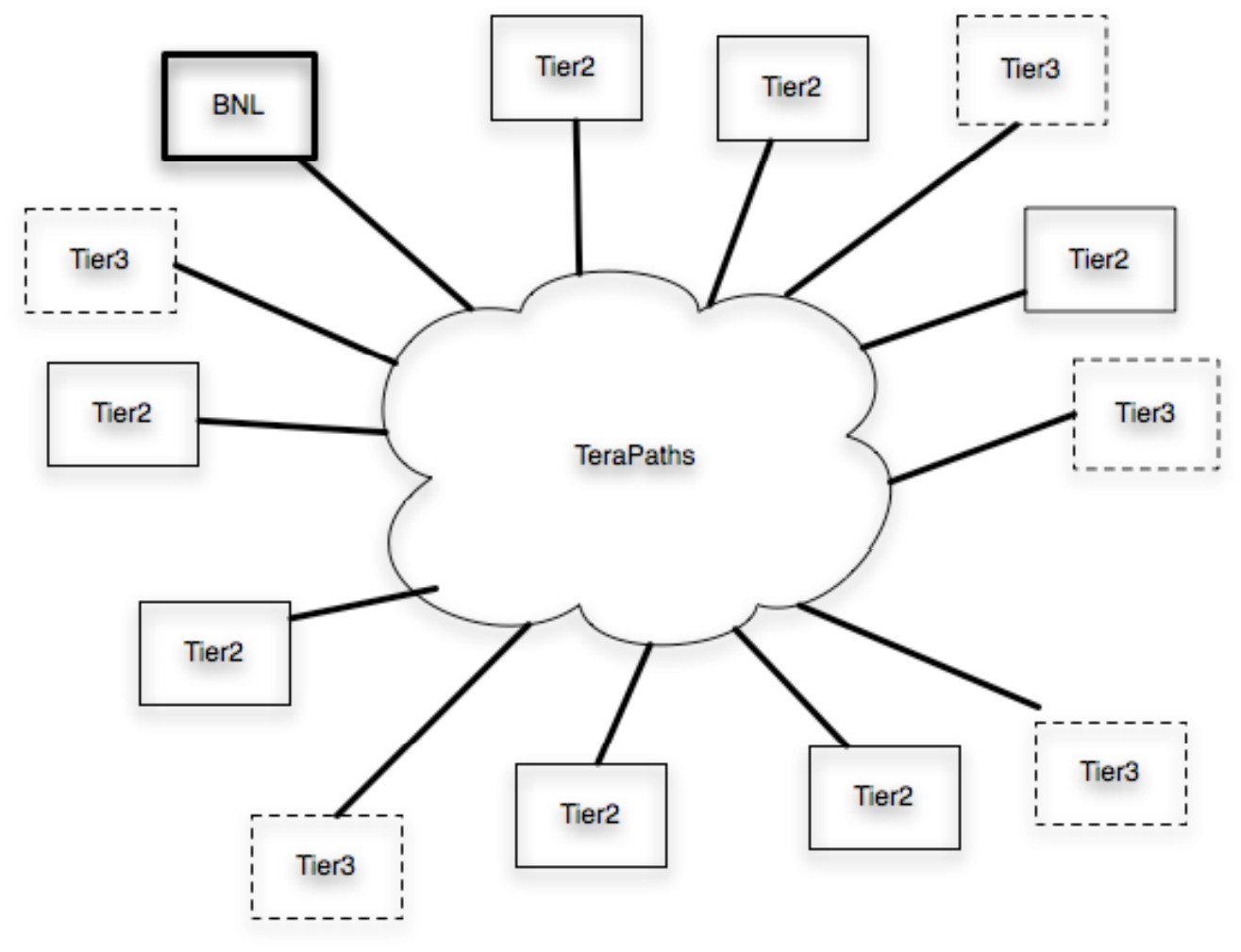
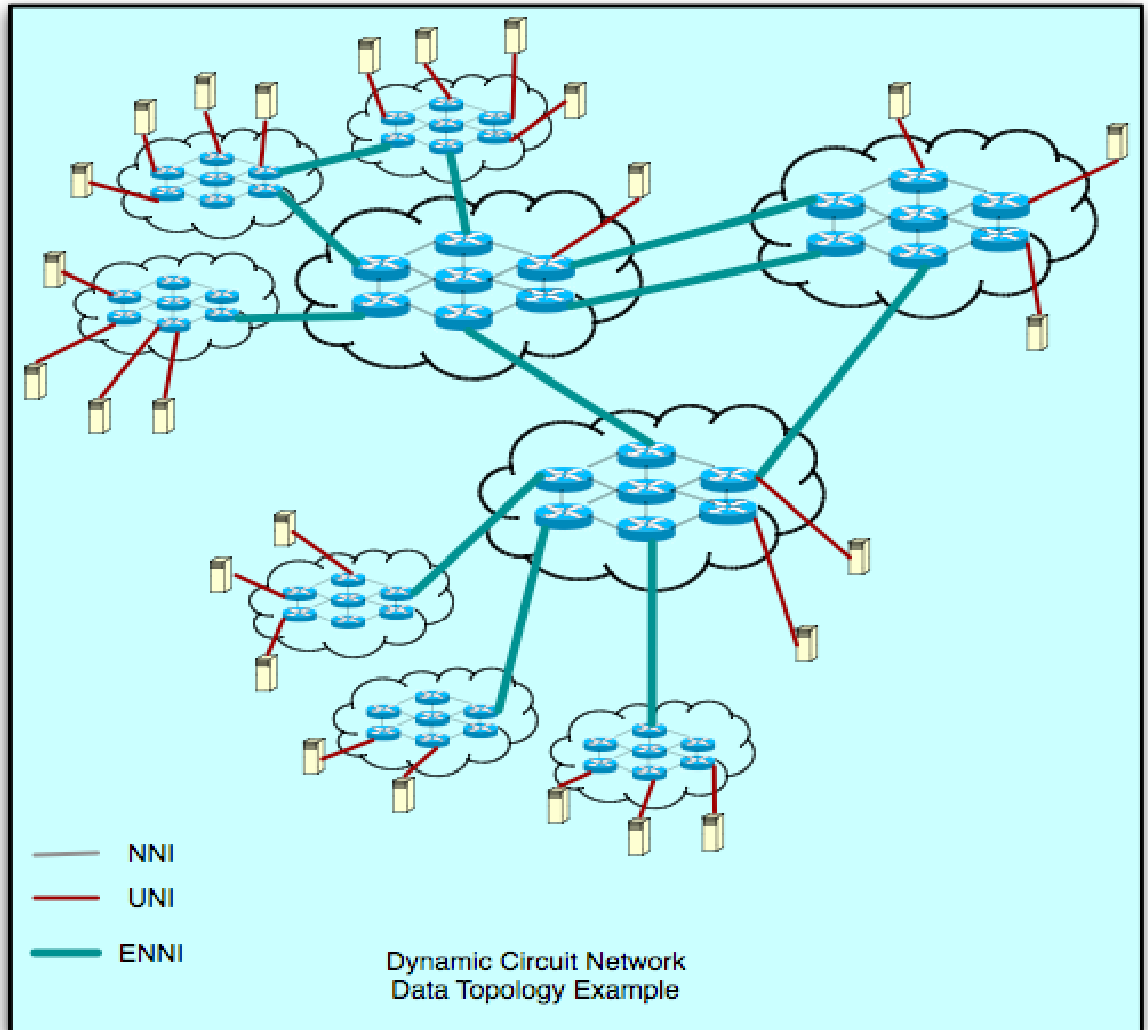
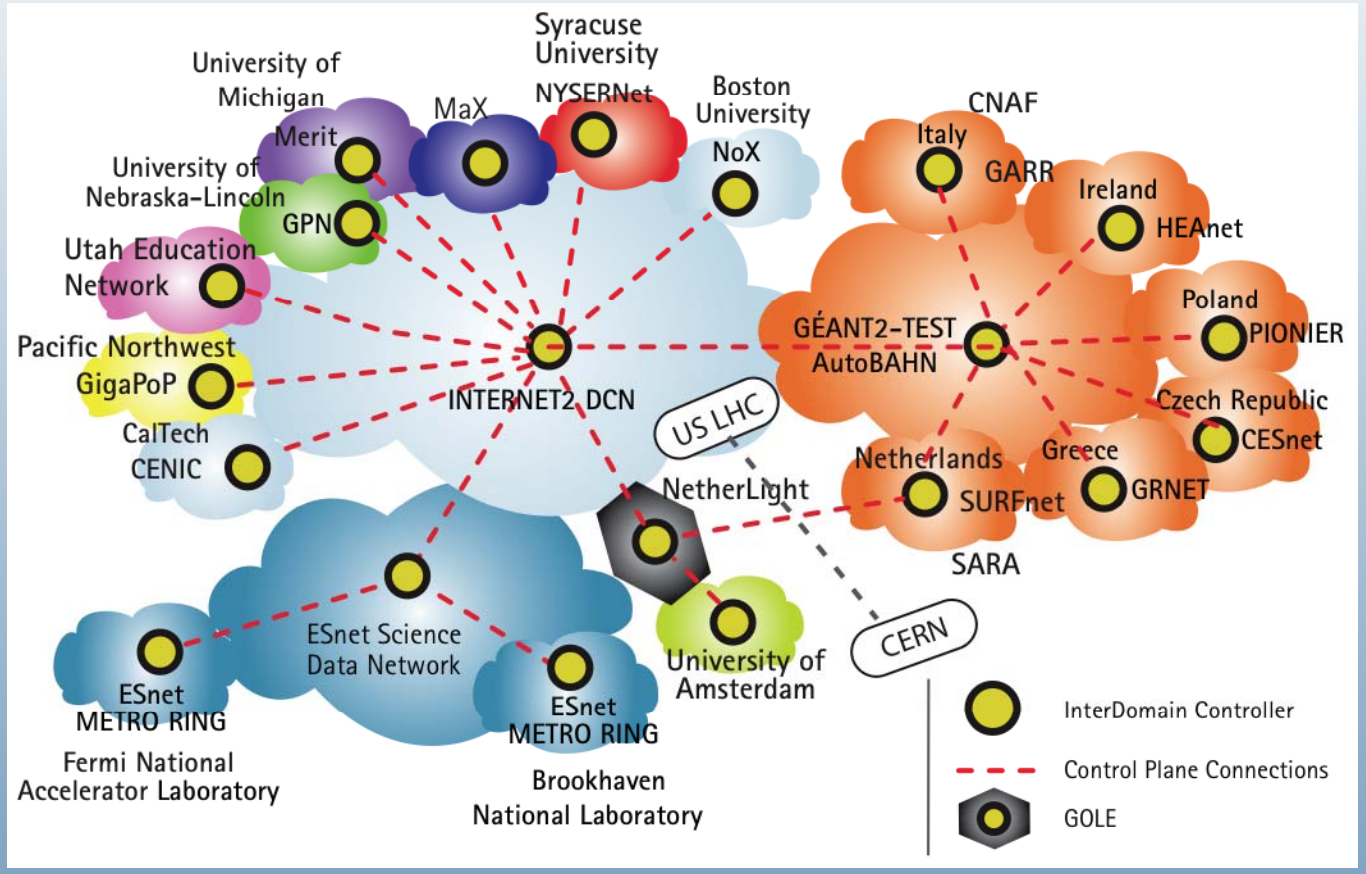
TeraPaths as Intermediary



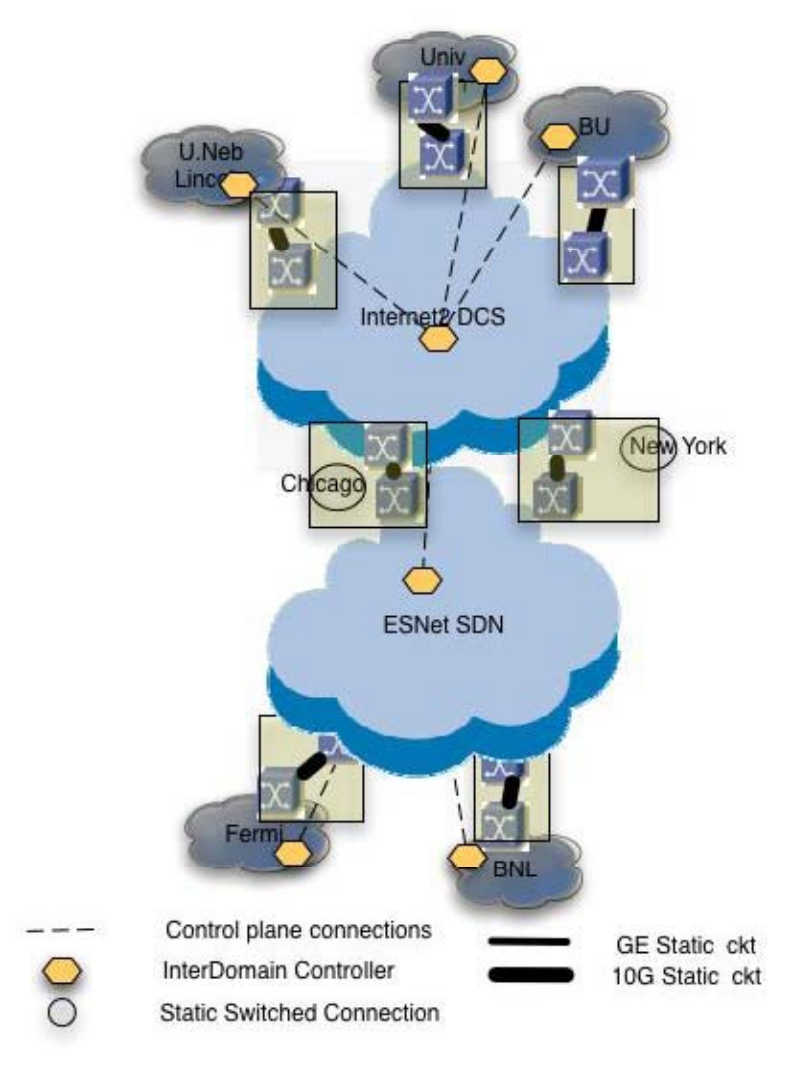
DCN - User connections



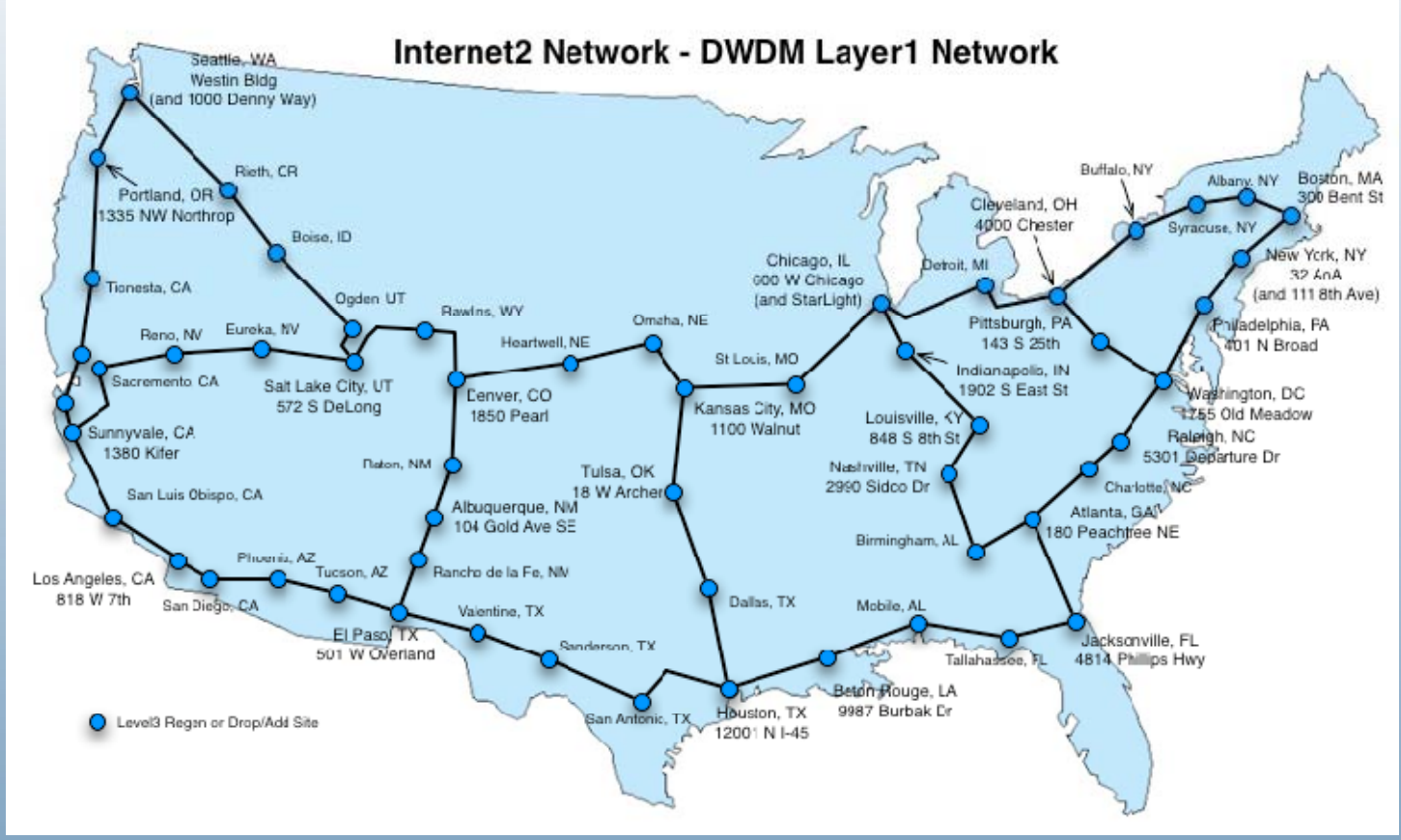
DCN Around the World

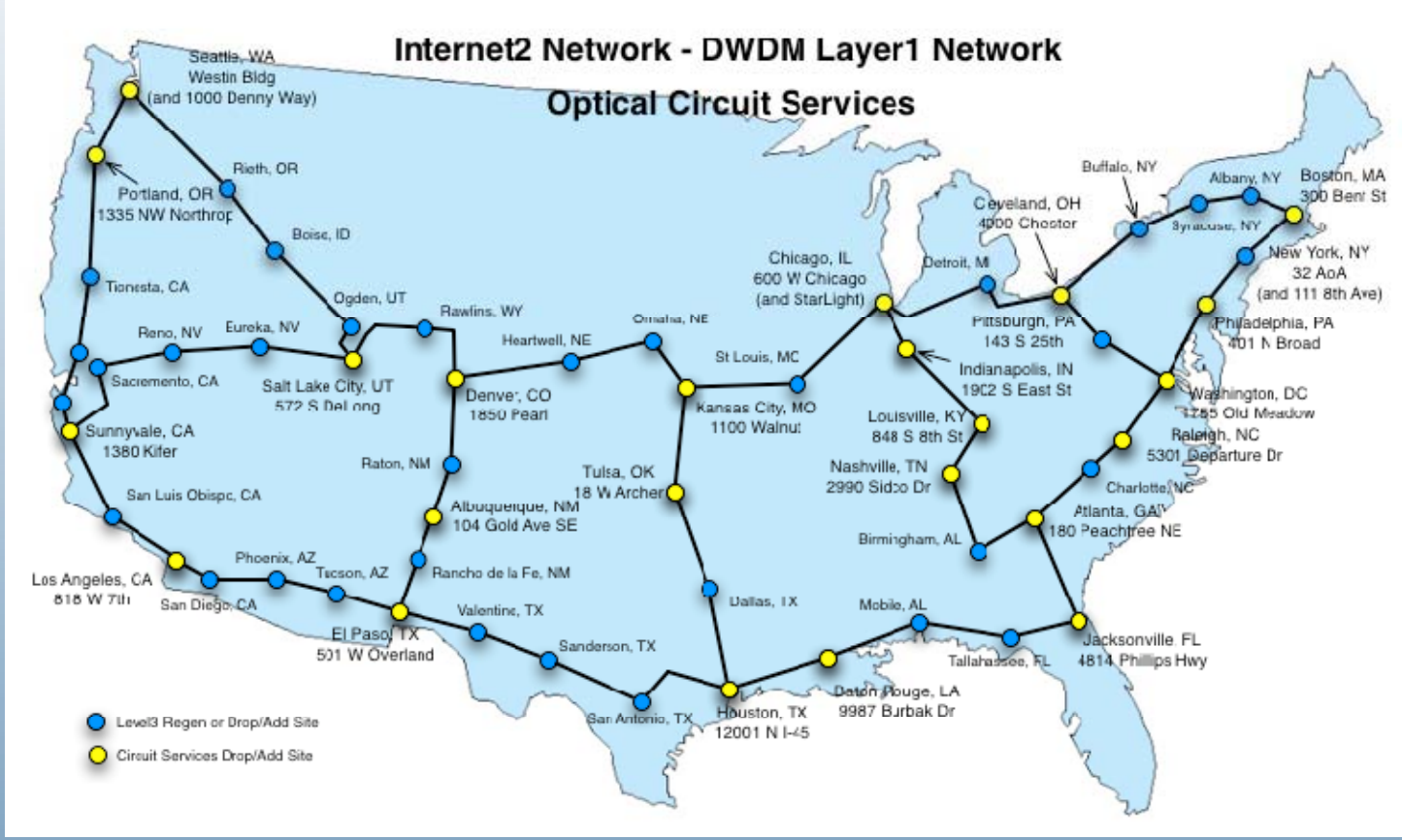


Internet2 - ESNet interoperations for LHC



Internet2 Layer 1
Infinera




Internet2 Network - DWDM Layer1 Network
Optical Circuit Services
Seattle, WA
Westin Bldg
(and 1000 Denny Way)
Portland, OR
1335 NW Northrop
Rieth, OR
Boise, ID
Ogden, UT
Tionesta, CA
Reno, NV
Eureka, NV
Sacramento, CA
Salt Lake City, UT
572 S Del ong
Sunnyvale, CA
1380 Kifer
San Luis Obispo, CA
Los Angeles, CA
818 W 7th
San Diego, CA
Phoenix, AZ
Tucson, AZ
El Paso, TX
501 W Overland
Rawlins, WY
Heartwell, NE
Omaha, NE
Denver, CO
1850 Pearl
Raton, NM
Albuquerque, NM
104 Gold Ave SE
Rancho de la Fe, NM
Valentine, TX
Sanderson, TX
San Antonio, TX
Houston, TX
12001 N I-45
Dallas, TX
Tulsa, OK
18 W Archer
Kansas City, MO
1100 Walnut
St Louis, MO
Chicago, IL
600 W Chicago
(and StarLight)
Detroit, MI
Cleveland, OH
4000 Chester
Buffalo, NY
Pittsburgh, PA
143 S 25th
Indianapolis, IN
1902 S East St
Louisville, KY
848 S 8th St
Nashville, TN
2990 Sidco Dr
Birmingham, AL
Mobile, AL
Tallahassee, FL
Baton Rouge, LA
9987 Burbak Dr
Albany, NY
Syracuse, NY
Boston, MA
300 Bent St
New York, NY
32 AoA
(and 111 8th Ave)
Philadelphia, PA
401 N Broad
Washington, DC
1755 Old Meadow
Raleigh, NC
5301 Departure Dr
Charlotte, NC
Atlanta, GA
180 Peachtree NE
Jacksonville, FL
4814 Phillips Hwy
Level3 Regen or Drop/Add Site
Circuit Services Drop/Add Site

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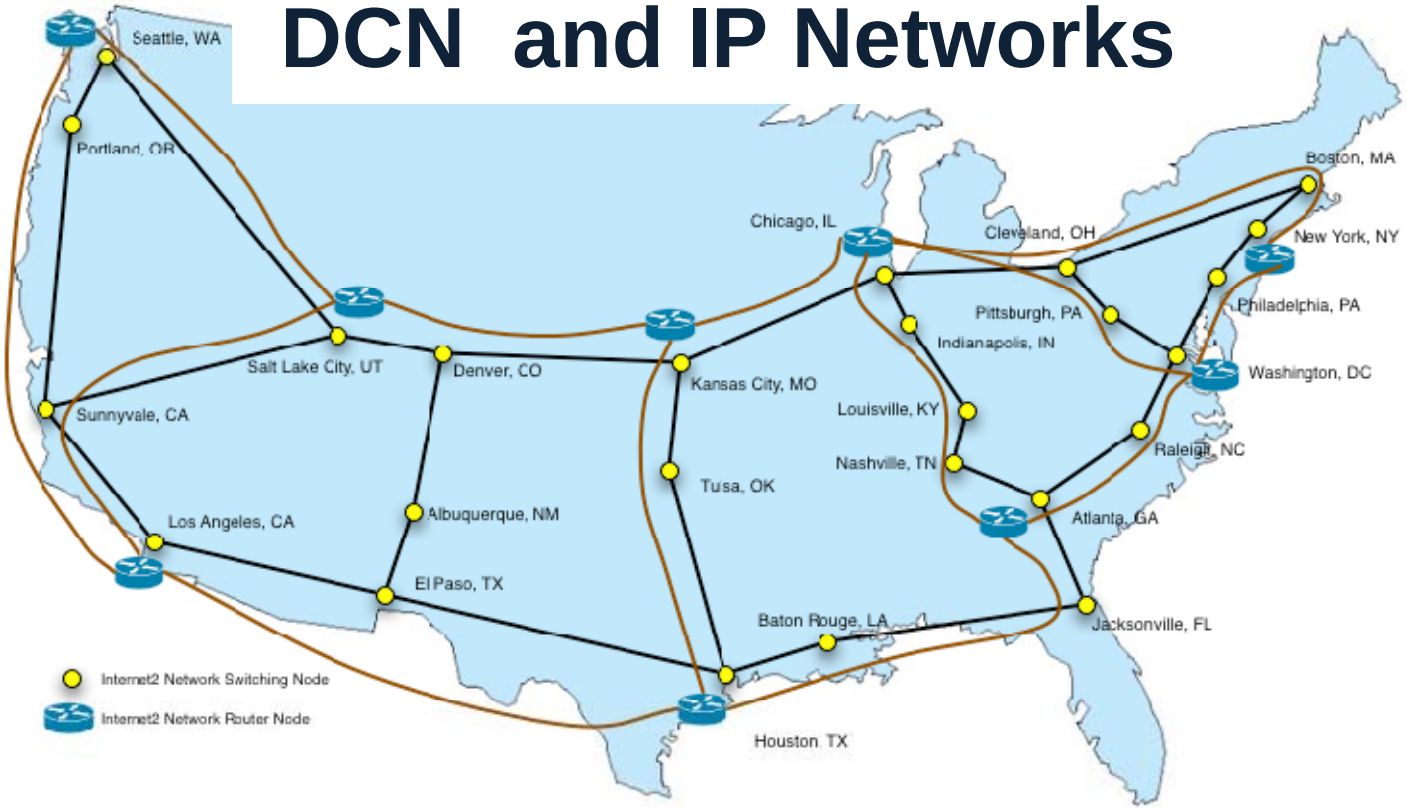
Internet2
DCN and IP Networks



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DCN Functionality

- End-user or application requests point-to-point circuit
- DCN creates circuit
  - Control plane software automates the set up and tear down of circuits
  - Multi-domain circuits coordinate between each other-using internationally developed protocol

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What is DCN? – Control Plane

- Interdomain Controller (IDC)
  - Accepts circuit requests
  - Coordinates requests with other domains
- Domain Controller (DC)
  - Manages local resources
  - Set-up/tear-down circuits in local domain

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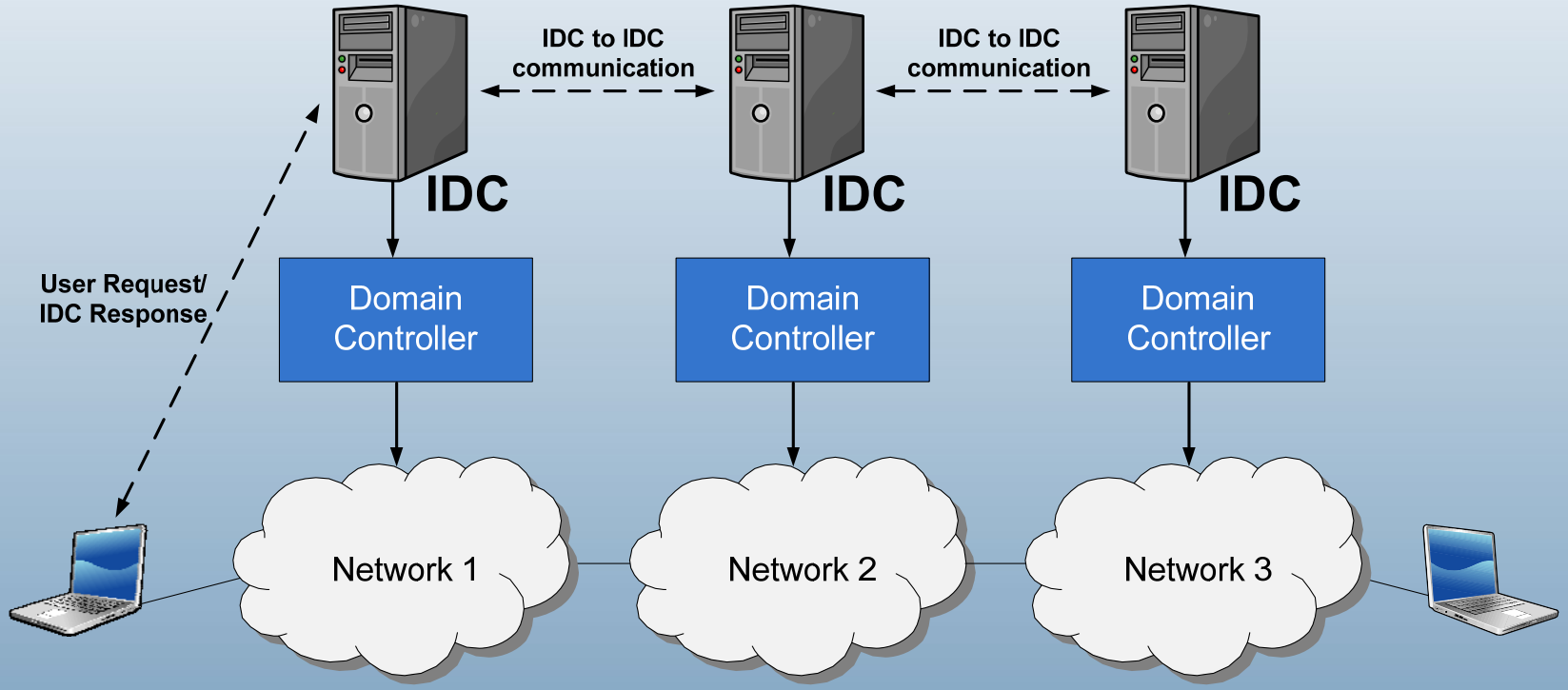
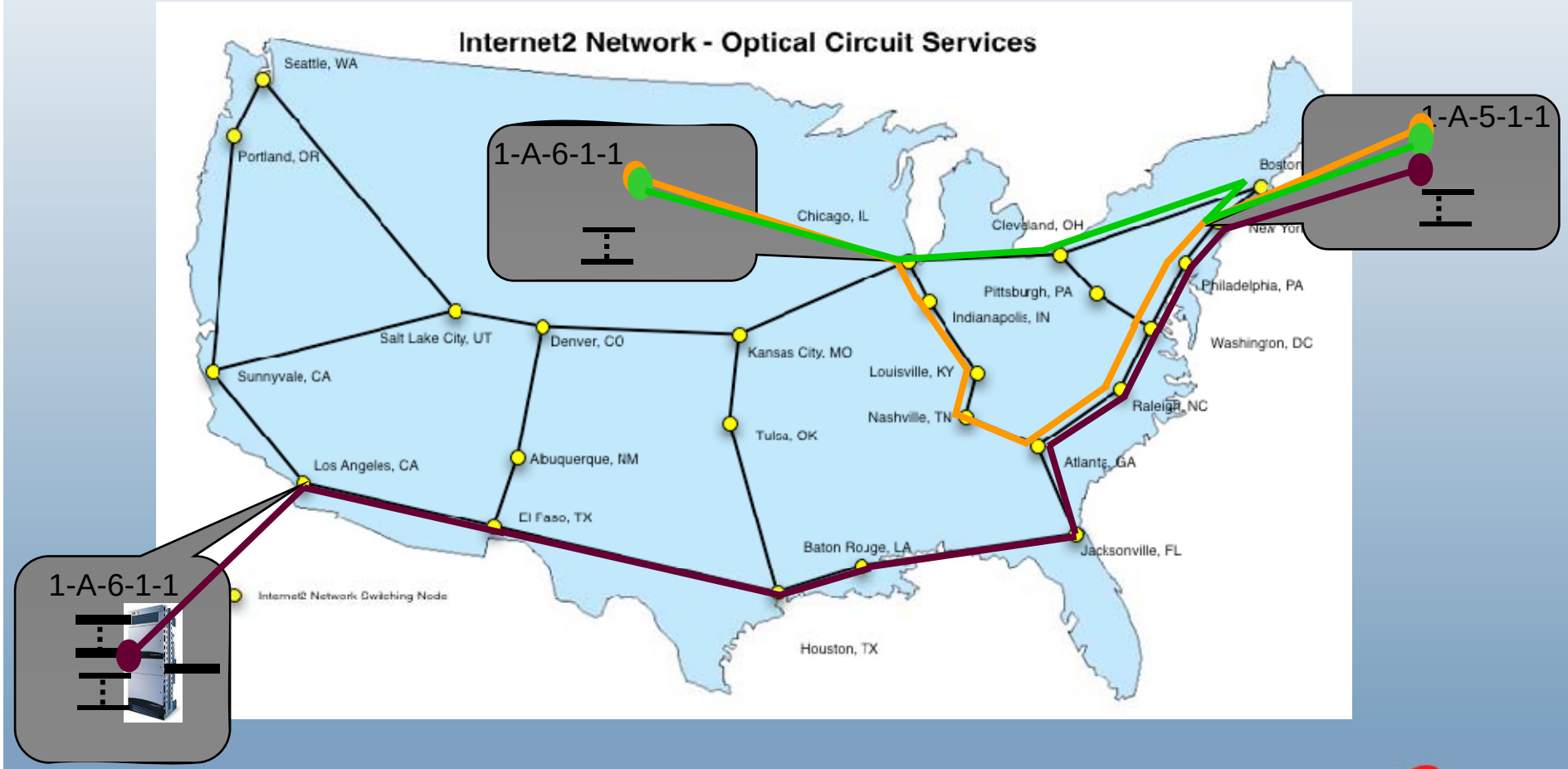
What is DCN? – Control Plane



DCN Services



How do I request a circuit? - Users

- Personal Initiation question
  - OSCARS Web Page
  - Simple command-line tools
- Program-initiated
  - LambdaStation, Terapaths
  - Phoebus
  - Custom applications/scripts you build!
- Requests all use Web Services

Dynamic Circuit - what do I get

- EtE connection
  - Must supply IP addresses if needed
- For requested time period
  - Can request for time in the future
- With certain characteristics
  - Bandwidth

- Questions for the future
  - Pre-emption by priority
  - Scavanger circuits
  - Allocation by priority
  - Others - need input on what is important

How do I request a circuit? - Requests

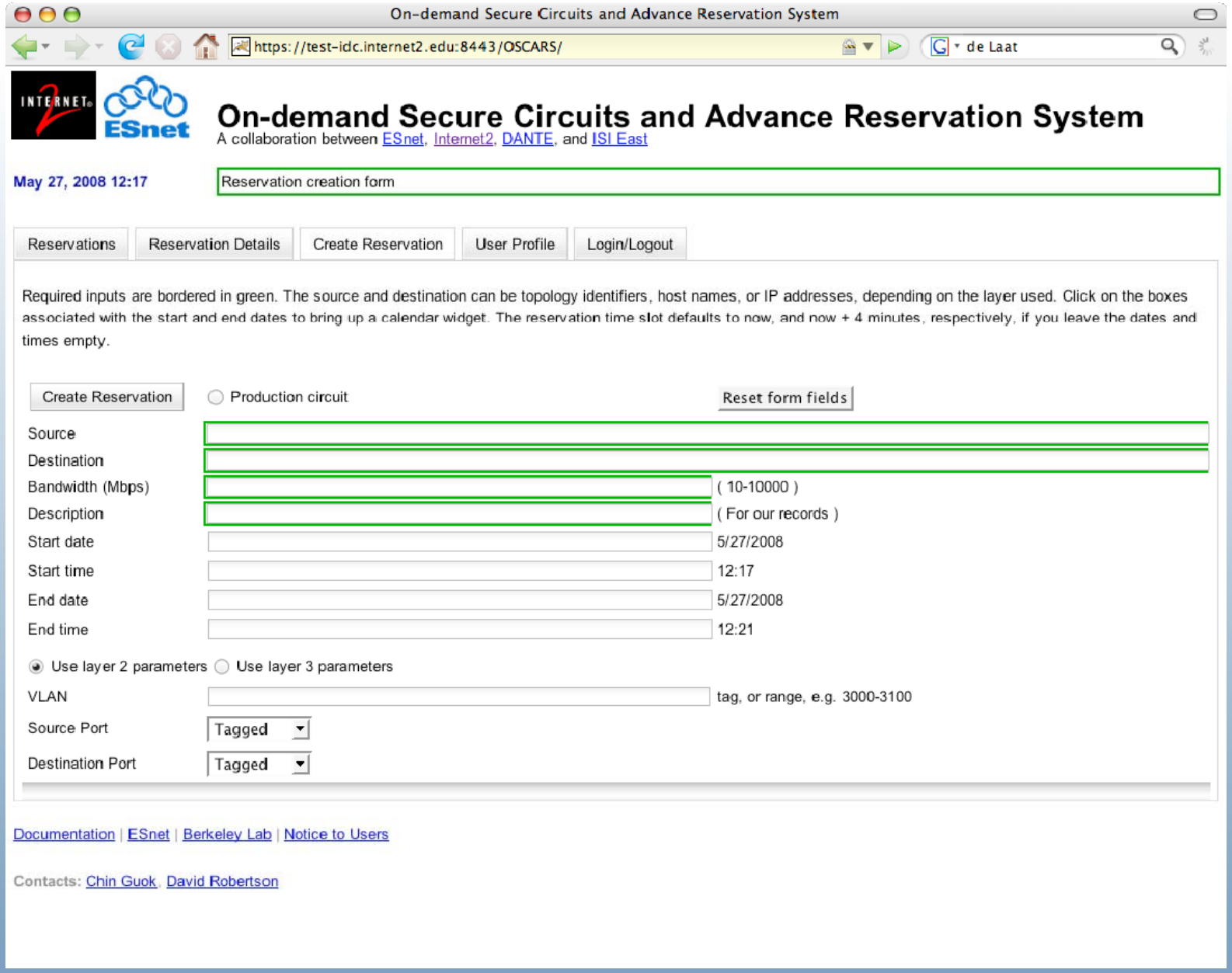
- Minimum set of required information
  - User Id and credentials
  - Source and Destination
  - Start and End Time
  - Bandwidth
  - Description
- Additional fields available
  - VLAN range
  - Path
  - -- other

How do I request a circuit? - Interfaces

- Web User Interface (WBUI)
  - Java servlet interface used by OSCARS web page
  - Not intended for use by other applications
- Web Service API
  - XML-based API intended for use by applications
    - E.g. Phoebus, LambdaStation, TeraPaths

How do I request a circuit? - WBUI

- You may test the WBUI on Internet2's test IDC
  - Go to http://test-idc.internet2.edu
  - Login with guest/guest
  - Click "Create Reservations" and enter:
    - Source: test-newy.dcn.internet2.edu
    - Destination: test-chic.dcn.internet2.edu
    - Bandwidth: 100
    - Purpose of Reservation: [your name] testing
    - VLAN: any


On-demand Secure Circuits and Advance Reservation System
https://test-idc.internet2.edu:8443/OSCARS/
de Laat
On-demand Secure Circuits and Advance Reservation System
A collaboration between ESnet, Internet2, DANTE, and ISI East
May 27, 2008 12:17
Reservation creation form
Reservations
Reservation Details
Create Reservation
User Profile
Login/Logout
Required inputs are bordered in green. The source and destination can be topology identifiers, host names, or IP addresses, depending on the layer used. Click on the boxes associated with the start and end dates to bring up a calendar widget. The reservation time slot defaults to now, and now + 4 minutes, respectively, if you leave the dates and times empty.
Create Reservation
Production circuit
Reset form fields
Source
Destination
Bandwidth (Mbps)
(10-10000)
Description
(For our records)
Start date
5/27/2008
Start time
12:17
End date
5/27/2008
End time
12:21
Use layer 2 parameters
Use layer 3 parameters
VLAN
tag, or range, e.g. 3000-3100
Source Port
Tagged
Destination Port
Tagged
Documentation | ESnet | Berkeley Lab | Notice to Users
Contacts: Chin Guok, David Robertson

How do I request a circuit? – WS API

- Used by applications to contact IDC
- Authenticate using an X.509 certificate
  - Generate with command-line tools
  - Have CA sign (Internet2 has test CA)
- Message format defined in DICE Control Plane group
- Custom applications should use this interface

How do I write my own DCN application?

- Java library for making DCN calls
- Can call simple command-line client directly from application
- Google Summer of Code students will be developing PERL, C, and Python libraries

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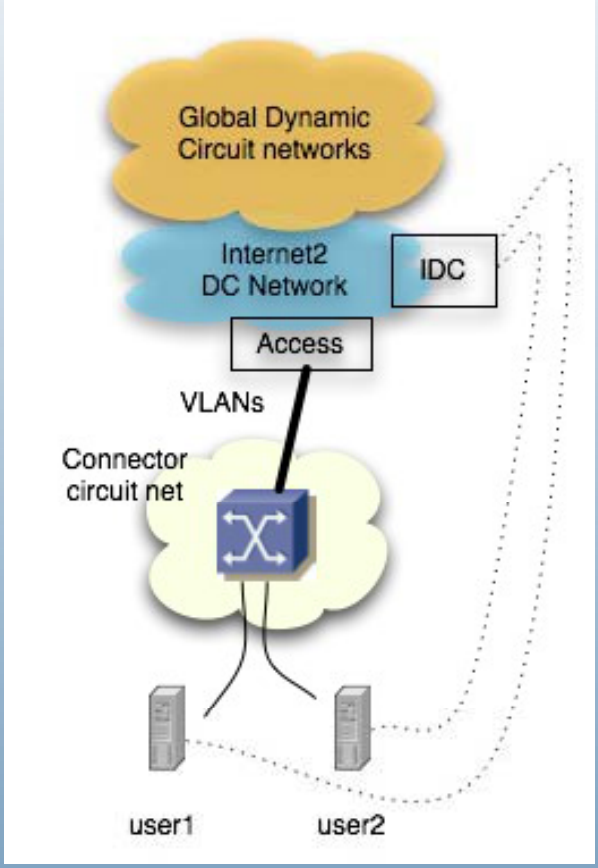
Connecting to DCN
Enabling DCN

1. Physical connection
   - Internet2 Connectors connect to Internet2 DCN
   - Universities and campuses connect to Internet2 Connector
2. Access to control plane software
   - Either -static connect to Dynamic Network
   - Or - install IDC and do dynamic networks

How to Connect
Static connection to DCN

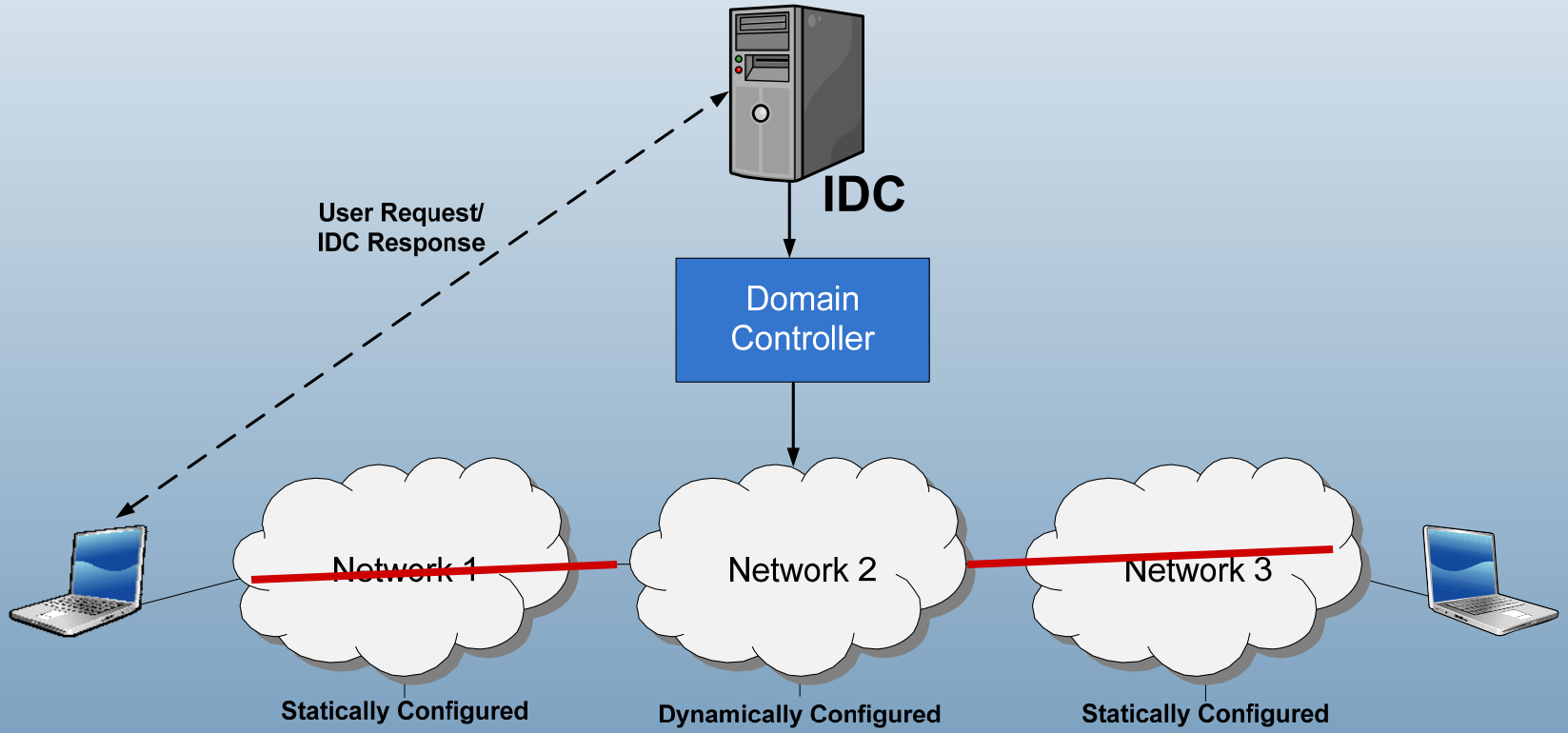
- **Option 1: No local IDC**
  - Statically connect user to Dynamic network - [Internet2 or other ckt net]
  - Applications/Users request circuits IDC of net to which they are statically connected

    [note Requests use IP net]



How to connect? Static Connection to DCN

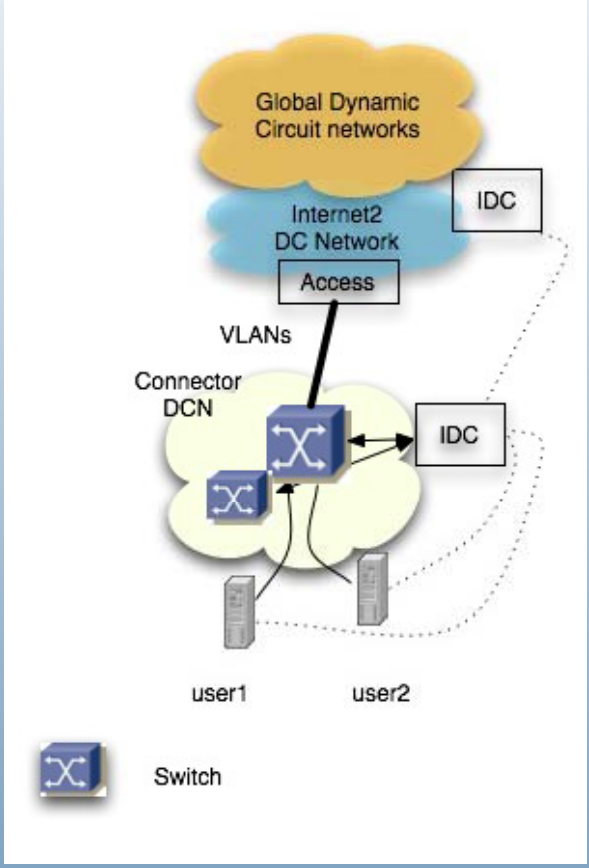
- Option 1: No local IDC



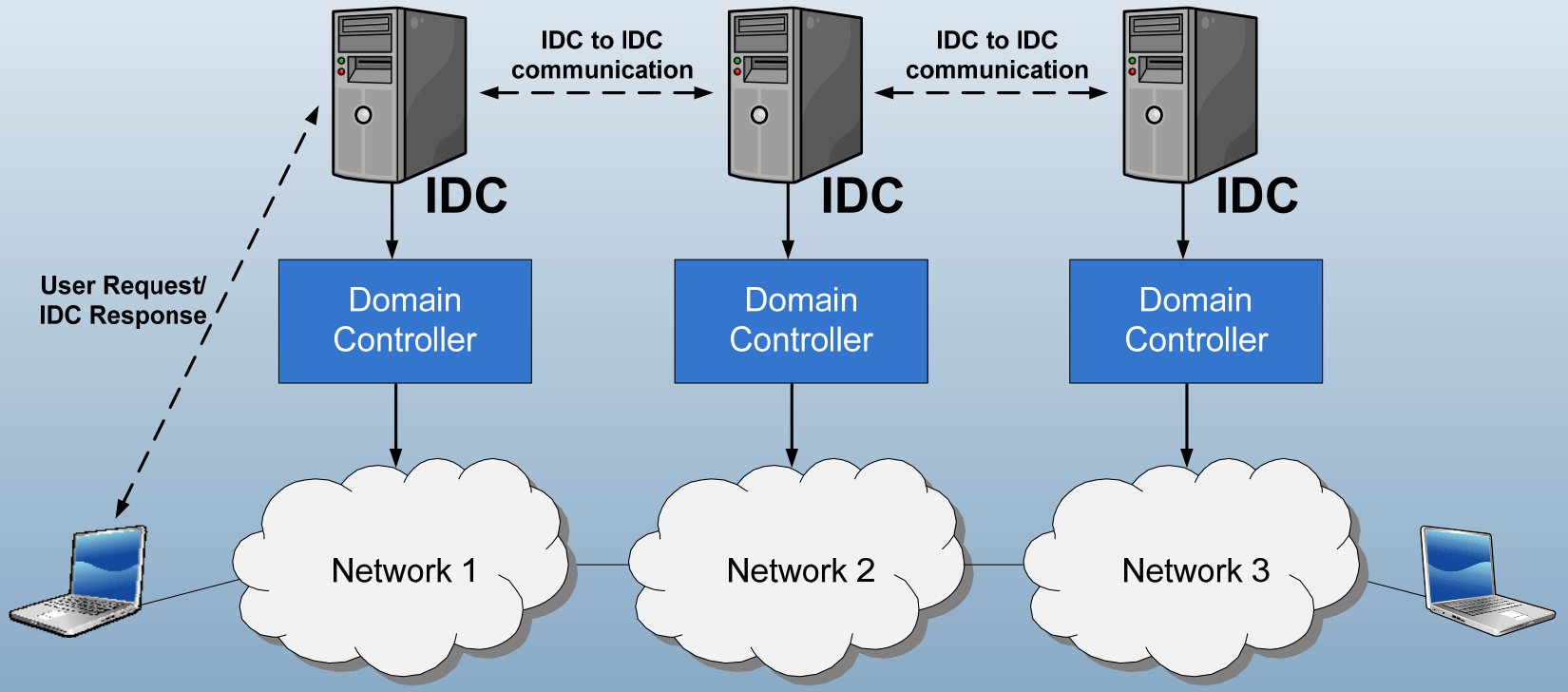
Option 2 DCNs connecting to Global DCN

How to Connect
Dynamic Circuits in
RON and/or Campus

RON and or Campus
participates in
Dynamic Circuit
setup



How do I connect? Create local DCN



What is DCN? – DCN Software Suite

- OSCARS (IDC)
  - Open source project maintained by Internet2 and ESNet
- DRAGON (DC)
  - NSF-funded
  - Open source project maintained by MAX, USC ISI EAST, and George Mason University
- Version 0.3 of DCNSS released April 18, 2008

DCN standards

- IDC development is not the only dynamic circuit capability being developed
- G-Lambda, UCLP, Phosphorous and others are developing similar capabilities
- Working starting with OGF to create long term standards
- Working with GLIF to discuss user requirements and perhaps shorter term interoperation

Summary

- Dynamic Circuits Provide alternative connection mechanism
  - Good for some applications not well fitted to general IP
- Access DCN
  - Via Intermediaries like TeraPaths
  - Or Directly
- Using DCN via request is simple
- Connecting to DCN is more difficult
  - Help from Internet2 and ESNet
- Others are working on ways to provide ckts
  - Standards will evolve

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Summary- Using DCN

- In use by “proto-duction” mode
- Basic user interface is stable
- Need to understand requirements of users
  - What will make this service valuable to you
  - What is support is needed
  - What functions should be added
  - What applications can make use of it
- Hope to collaborate in developing this service
  - With “intermediaries”, with end users
  - And with regional providers

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Questions

InterDomain Controller Protocol Standardization Activities

- Standardization process and increasing community involvement continues
- Optical Grid Forum (OGF)
  - Network Markup Language (NML) Working Group
    - Standardizing topology schemas (perfsonar and control plane)
  - Dynamic Network Resources – InterDomain BoF
    - Expected to become a working group after next OGF
  - Grid High Performance Networking (GHPN) Research Group
  - Network Measurement (NM-WG)
  - Network Measurement Control (NMC-WG)
- GLIF
  - Control Plane Subgroup working on normalizing between various interdomain protocols (IDCP, G-Lambda GNS-WSI, Phosphorus API)
  - Also active in other GLIF subgroups in this and related space (global id format, PerfSonar)

Where can you learn more?

- DCN Software Suite
  - https://wiki.internet2.edu/confluence/display/DCNSS/Home
- Java Client API
  - https://wiki.internet2.edu/confluence/display/CPD/OSCARS+Client+Java+API
- Test IDC Guide
  - https://wiki.internet2.edu/confluence/display/DCNSS/Internet2%27s+Test+IDC
- Obtaining a Test Certificate
  - https://wiki.internet2.edu/confluence/display/CPD/How+to+Request+an+IDC+User+Certificate

www.internet2.edu