

# DCN/ION in GpENI Investigation Report

## Contents

- 1 Authors
- 2 Dynamic Circuit Network (DCN)/Interoperable On-demand Network(ION)
  - 2.1 Overview:
  - 2.2 DCN/ION in Internet2
    - 2.2.1 Stage 1
    - 2.2.2 Stage 2
- 3 DCN in GpENI
  - 3.1 Current GpENI Network Configuration
  - 3.2 Option 1: GpENI Network Connectivity with DCN (using GPN switch)
  - 3.3 Option 2: GpENI Network Connectivity with DCN (using GpENI switch)
- 4 Reference

## 1 Authors

**Pragatheeswaran Angu**, University of Nebraska-Lincoln  
**Dr. Byrav Ramamurthy**, University of Nebraska-Lincoln

## 2 Dynamic Circuit Network (DCN)/Interoperable On-demand Network (ION)

### 2.1 Overview:

DCN is a switching service that creates short-term circuits between end-users that require dedicated bandwidth, including reliable connections lasting from minutes to days. DCN provides flexible bandwidth for the most demanding applications. This is particularly useful for the projects such as Large Hadron Collider and other big-science efforts that can stress out the campus backbone for short but schedulable periods.

Seamlessly setting-up optical circuits across independently operated networks requires the coordination of multiple administrative domains. This is achieved through control plane software enabling provisioning across domain boundaries with the appropriate authentication and authorization. Control plane software is developed through several projects, including the NSF-funded DRAGON project, the ESnet OSCARS program, and the GEANT2 Au-toBAHN project. Other participants include the University of Southern California/Information Sciences Institute East (USC/ISI-East), Mid-Atlantic Crossroads (MAX), the University of Amsterdam, Nortel, and other regional and national networks. There is also active collaboration on developing the interdomain protocol within GLIF and a working group is forming at OGF to consider standardizing Dynamic Circuit control protocols.

ION(Interoperable On-demand Network) is a new name to DCN after it went in to production this fall(2009). It leverages the existing control plane work with a simplified web application to instantiate circuits on the Internet2 dynamic circuit fabric. In this document we use the term DCN/ION as both refer to the same service.

## 2.2 DCN/ION in Internet2

The DCN in Internet2 enables users to create point-to-point circuits across the Internet2 infrastructure using control plane software that automates the set up and tear down of the circuits. The Internet2 DCN currently uses an open source version of DCN Control Software which has been called the DCN Software Suite. This suite includes the DRAGON-developed control plane software as well as the ESnet/Internet2 OSCARS software. This software is used to control the Internet2 DCN and is also available as open source to other institutions to use in creating their own DCN.

An Internet2 member connects to the DCN through an Internet2 Connector. Connection to the DCN provides dynamic circuits across the Internet2 infrastructure to regional optical network that are Internet2 Connectors, and to other national and global research networks like ESnet in United States or GEANT2 in Europe.

A Connector, setting up the ability to use the Internet2 DCN may use several approaches. One scenario is a two-step approach in which the Connector first makes a data connection to DCN and uses it to configure static connections from its users to DCN. The second step is for the Connector to implement its own DCN domain. The connector then dynamically switches different users to the Internet2 DCN. These examples provide basic descriptions of these stages

### 2.2.1 Stage 1

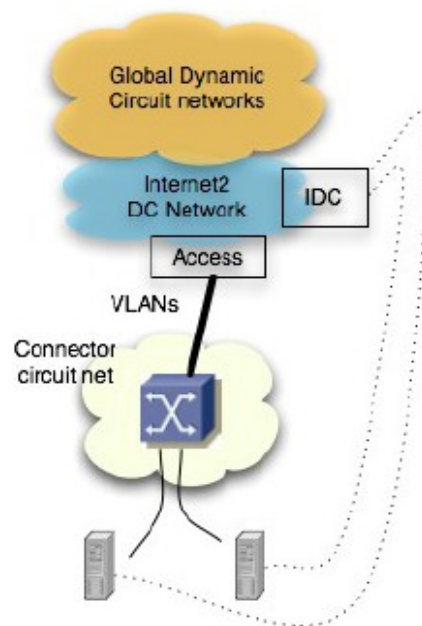


Figure 1: Stage 1 of DCN in Internet2

In Stage 1, Connectors must generally have an Ethernet switch that connects to the Internet2 dynamic switching platform, in the Internet2 Point of Presence (PoP). The Ethernet switch is used by the Connector to create a Virtual Local Area Network (VLAN) connection from the user on campus to the Internet2 DCN interface. The user requests dynamic circuits from the Internet2 DCN, the dynamic circuit starts at the edge of the Internet2 network. As demand on campus or additional campuses for the DCN service grows, the Connector adds users by establishing additional VLAN connections through the Ethernet switch from each user to DCN. These additional sites also use the Internet2 IDC to enable the service.

## 2.2.2 Stage 2

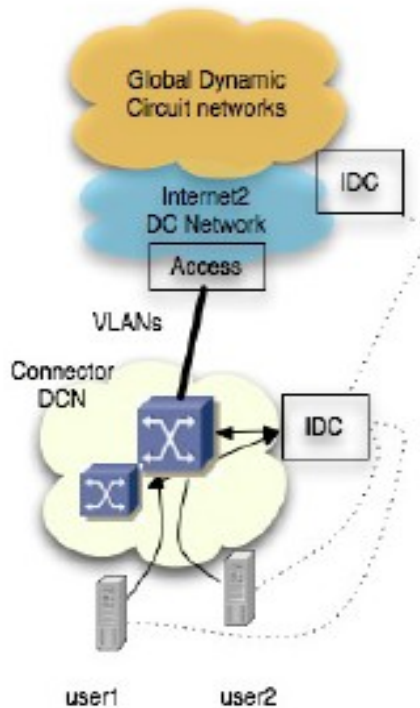


Figure 2: Stage 2 of DCN in Internet2

In stage 2, as the population in a single region or campus expands, regional networks or campuses may consider establishing local or regional dynamic circuit networks. The DCN Software Suite provides the necessary tools to initiate this process. The stage 2 figure shows a Connector that has created its own DCN and is a full participant in the Global Dynamic Circuit community. In this case the data connections are the same as in stage1, but now the user requests dynamic circuits from the Connector IDC rather than the Internet2 IDC.

## 3 DCN in GpENI

The Ciena CoreDirector Optical Switch in Kansas City PoP is connected to the Internet2 network infrastructure and hence this can act as a gateway for GpENI to connect to the Internet2 infrastructure. This document just focuses on establishing the local or regional dynamic circuit domain in GpENI as mentioned in the stage 2 above. Later on it can further proceed to use the Ciena CoreDirector in Kansas City PoP to

establish DCN circuit from GpENI to several sites in the Internet2. In the following document we first explain the current network infrastructure of the GpENI and the changes needed in the current infrastructure to establish DCN across GpENI.

### 3.1 Current GpENI Network Configuration

#### GpENI: Great Plains Environment for Network Innovation

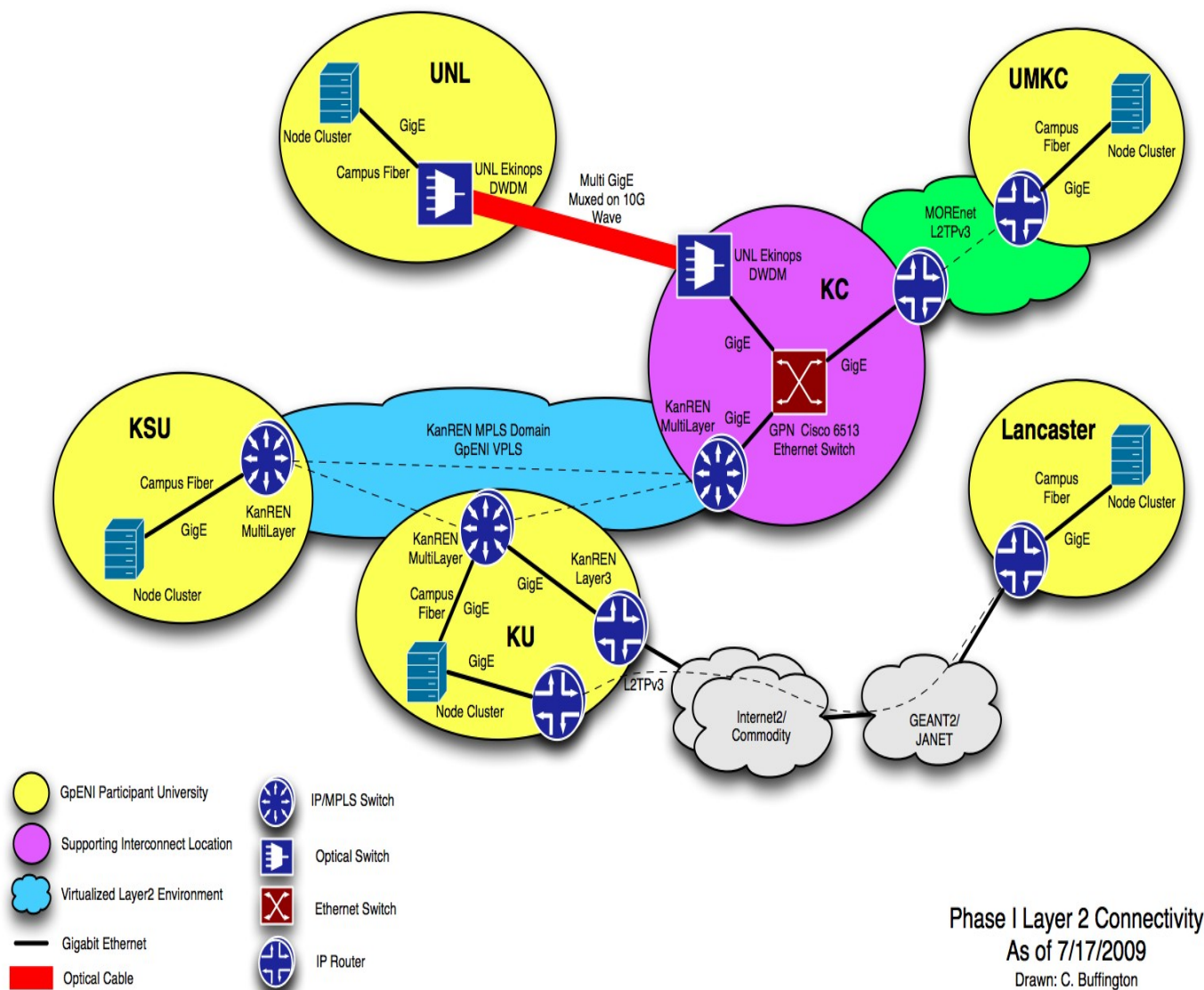


Figure 3: GpENI Current Network Connectivity

GpENI's basic connectivity currently is designed as a single Ethernet broadcast domain capable of transporting arbitrary VLANs. All the four GpENI universities (UNL, KSU, KU, UMKC) are connected to their own interface in GPN Cisco 6509 Ethernet switch (GPN Switch) in Kansas City POP and all these interfaces are configured to the same VLAN number 125. UNL has direct fiber connection of capacity 1GigE to the GPN switch transported through Ekinops DWDM equipment. UMKC connects to the GPN switch using L2TP tunneling through MOREnet infrastructure. KSU and KU form a single MPLS domain in the KanREN

network infrastructure and are connected to the GPN switch through VPLS. The CoreDirector CI switch connects to Internet2 is also connected to the GPN switch using a 10GigE link.

Each university has a Netgear GSM7224 switch and a node cluster connected to the switch. We have modified the DCN software suite to support the Netgear GSM7224 switch. Hence we can create dynamic circuits between the universities with DCN software running over these switches if the infrastructure in Kansas City PoP supports it. The limitation is that, as these Netgear switches do not have per vlan bandwidth policing feature, they do not have the capability to create circuits of specific bandwidth as requested by the user.

### 3.2 Option 1: GpENI Network Connectivity with DCN (using GPN switch)

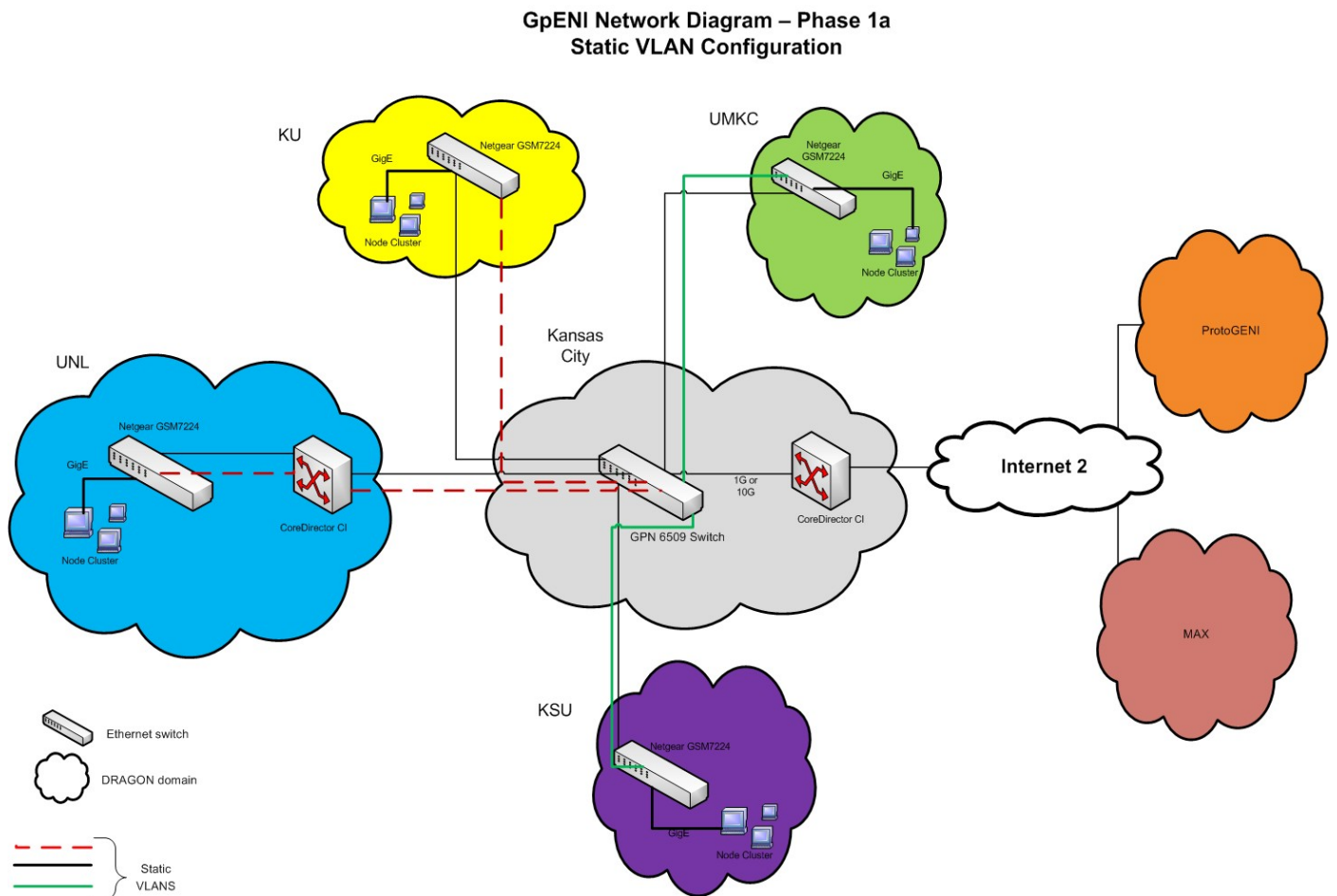


Figure 4: Option 1: DCN in GpENI

The GPN switch is a production switch that carries traffic between the four GpENI universities and is also not supported by the current DCN/ION software suite. This option analyses the possibility of using the GPN switch for creating DCN circuits between GpENI universities. There are two ways in which GPN switch can be configured to enable DCN circuits between GpENI universities.

One way is to configure static VLAN's over the GPN switch so that DCN circuits can be created between universities only with the pre-configured VLAN tags. Hence this involves creating a table of VLAN tags for all possible source and destination of DCN circuits between GpENI universities and configuring them



appropriately in the GPN switch. In this case the IDC and two VLSR's: one for controlling the Ciena CoreDirector CI switch in UNL and another for controlling all the Netgear GSM7224 switches in all the GpENI universities, will be located in the UNL. Hence we will be able to create, delete and modify dynamic circuits over the web interface provided by the DCN/ION software suite between these universities.

Another way is to configure Q-in-Q cloud in the GPN 6509 switch with VLAN 125 so that it acts as a pass through for packets of any VLAN tag generated by any of the GpENI universities. Hence in this case also, the IDC and two VLSR's will be placed in the UNL, but the only difference is that we will be able to create circuits of arbitrary VLAN tags between the GpENI universities. Though the advantage of this method over the previous is the freedom of choice of VLAN tags, the drawback is that, because of the Q-in-Q cloud the packet transmitted by any university will be broadcasted to all the 4 GpENI universities.

### 3.3 Option 2: GpENI Network Connectivity with DCN (using GpENI switch)

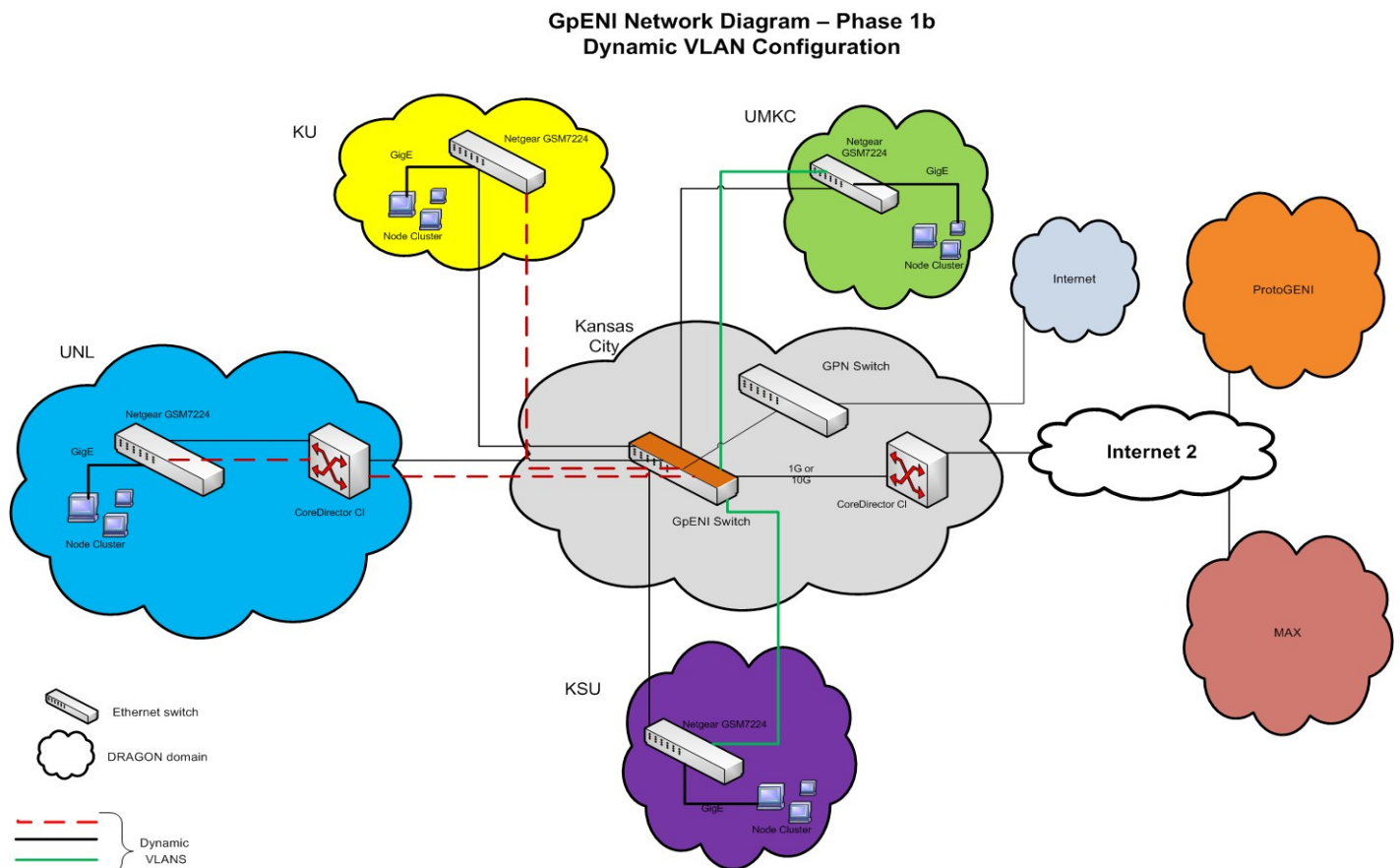


Figure 5: Option 2: DCN in GpENI

This option investigates the option of acquiring a new Ethernet switch(GpENI switch), which is already supported by the DCN/ION software suite and replacing the existing GPN switch with the GpENI switch. Hence this option requires all the 4 GpENI universities to have a layer 2 connectivity to the GpENI switch and one interface of the GpENI switch will be connected to the GPN switch. The dedicated switch at Kansas City for this option could also be a switch placed by the ProtoGENI group at this location. Funds are being sought for the deployment of a GpENI switch at Kansas City

The IDC of the DCN/ION can be placed UNL or Kansas City PoP and two VLSR's: one for controlling the CoreDirector CI and another for controlling the Netgear switches, can be placed in UNL or Kansas City PoP. Hence we will be able to create dynamic circuits of desired bandwidth of arbitrary VLAN tag between any of the GpENI universities with this network infrastructure. The Ciena CoreDirector in Kansas City is shown as connected to the GpENI switch because this will be the Connector for GpENI universities to connect to the Internet2 infrastructure. This is still being investigated and will be explained in detail in our next investigation report about "GpENI connectivity to MAX".

## 4 Reference

<http://www.internet2.edu/network/dc/>

<http://www.internet2.edu/ion/>

[http://en.wikipedia.org/wiki/IEEE\\_802.1Q](http://en.wikipedia.org/wiki/IEEE_802.1Q)