# WELCOME TO THE SPRING 2012 MAX ALL HANDS MEETING

May 22th, 2012

Mid-Atlantic Crossroads

# Agenda

- 8:15am – 9:00am   Breakfast

- 9:00am – 9:15am   Welcome

- 9:15am – 10:00am  MAX Updates (Administrative, Production, and Research)

- 10:00am – 10:15am  Coffee Break

- 10:15am – 11:15am  Society 3.0, The Future of Society, Work and Education by Dr. Tracey Wilen-Daugenti of the Apollo Research Institute and Stanford University

- *Society 3.0 is a call to action for educators and industry leaders to recognize trends that are revolutionizing 21st century households, learning environments, and workplaces.*

- 11:15am – 12:00pm  Future MAX Services by Dr. Jaroslav 'Jarda' Flidr, MAX's Director of Services

- 12:00pm – 1:00pm   Lunch

- 1:00pm – 2:00pm   Optical networks with ODIN in smart data centers by Dr. Casimer DeCusatis of IBM

- *Advantages of optical networking for highly virtualized data centers including lower power, improved scalability and port density, and tighter I/O integration with processors. Use cases include enterprise infrastructure underlying software-defined networking, supercomputing, and multi-site backup applications.*

- 2:00pm – 3:00pm   Open Discussion

# Talks

**Society 3.0, The Future of Society, Work and Education by Dr. Tracey Wilen-Daugenti of The Apollo Institute, Stanford**

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**Optical networks with ODIN in smart data centers by Dr. Casimer DeCusatis of IBM**

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# MAX Updates - Admin

- MAX office move
  - Space build out - $235k
  - reused existing furniture
  - Engineers transported lab hardware from 8400

# MAX Updates - Admin

- What's new for FY13 Budget
  - 25% of operating cost
  - Proposed Projects
    - Kiosk
    - Shady Grove PoP
    - Federal PoP
  - New Services
  - Pricing Restructure

# MAX Updates - Admin

- Research Grants
  - JHU collaborative grant – 100G
  - BBN Technologies
  - NOAA – Nwave
  - NSF- 100G

  - NSF collaborative proposals being finalized

# MAX Updates - Admin

- Workshops

What workshops would you like to see offered by MAX?

- MAX Website:   www.maxgigapop.net

Would you like to be featured in a member spotlight section?

E-mail:  thurd@maxgigapop.net

# Production

- BALT PoP
- SHADY GROVE PoP
- NIH PoP Proposal
- McLean WIX
- DYNES
- SC12

# BALT PoP Project

- Location is UMB space, 7th Floor 300 West Lexington
- DWDM ring between College Park, 300 West Lexington, and 6 St Paul
- We will migrate services picked up at 660 Redwood over to 300WL
- Expecting redundant fiber down to College Park by end of June
- MoU between MAX and UMB for space and power ready for signature
- **Will be operational this summer**

# SHADY GROVE PoP  Project

- 2 sites in considerations
  - UMD (IBBR) and JHU
- Discussions with JHU for space underway
- Strong Interest from several organizations
  - JHU, UMD, NCI, Open Health Systems Laboratory
- Next step is building the fiber loop
- Time-line : Operational by end of 2012 ?

# NIH PoP – Proposal

- There is a need for more bandwidth at NIH
  - 2x10G for NLM **now** and 100G in the future
- MAX first Federal PoP – needs to be done right
- Partnership with NLM/NIH
  - Use current NLM fibers for the ring
  - NLM will provide Rack space and Power
  - MAX will  provide ROADM equipment at NIH and CLPK
- Time-line : fiber is already in place – fast deployment
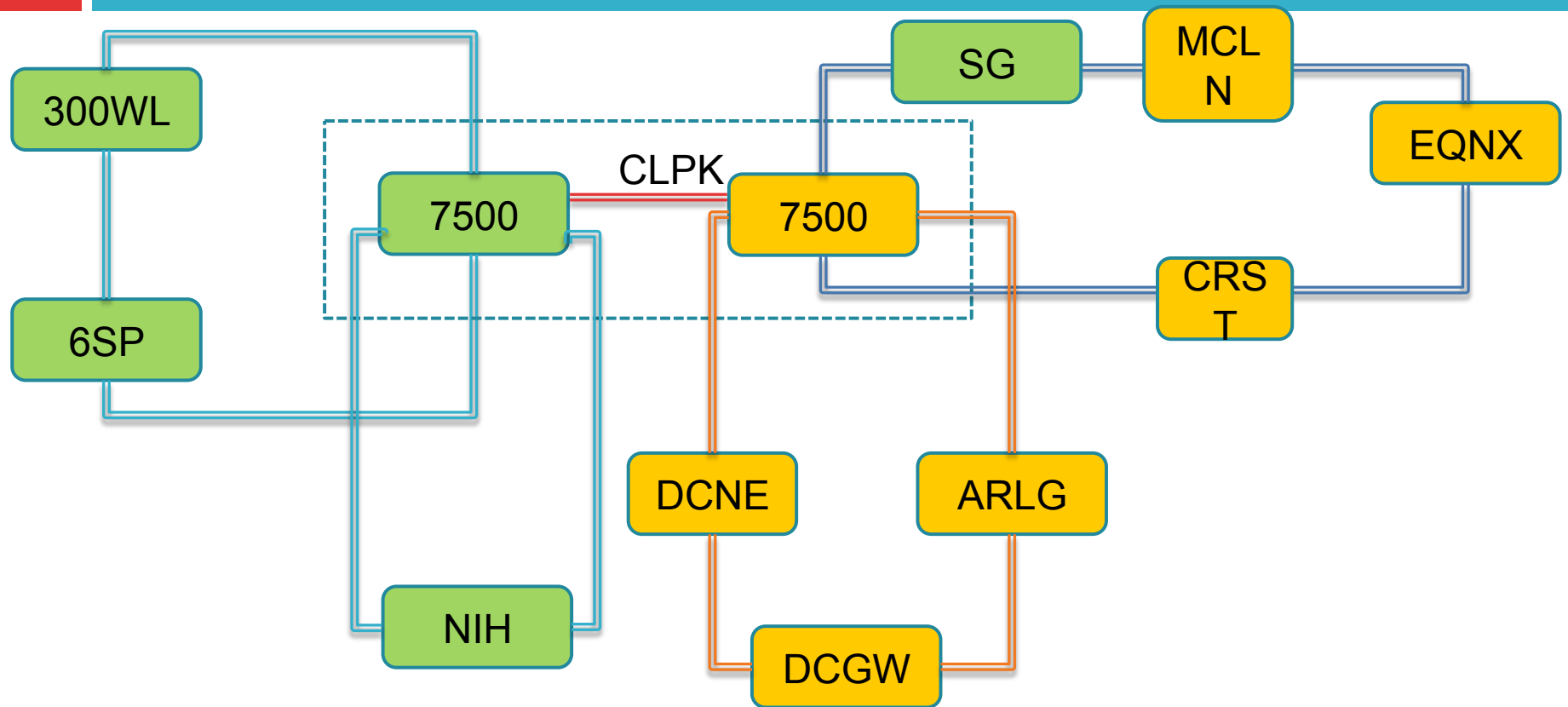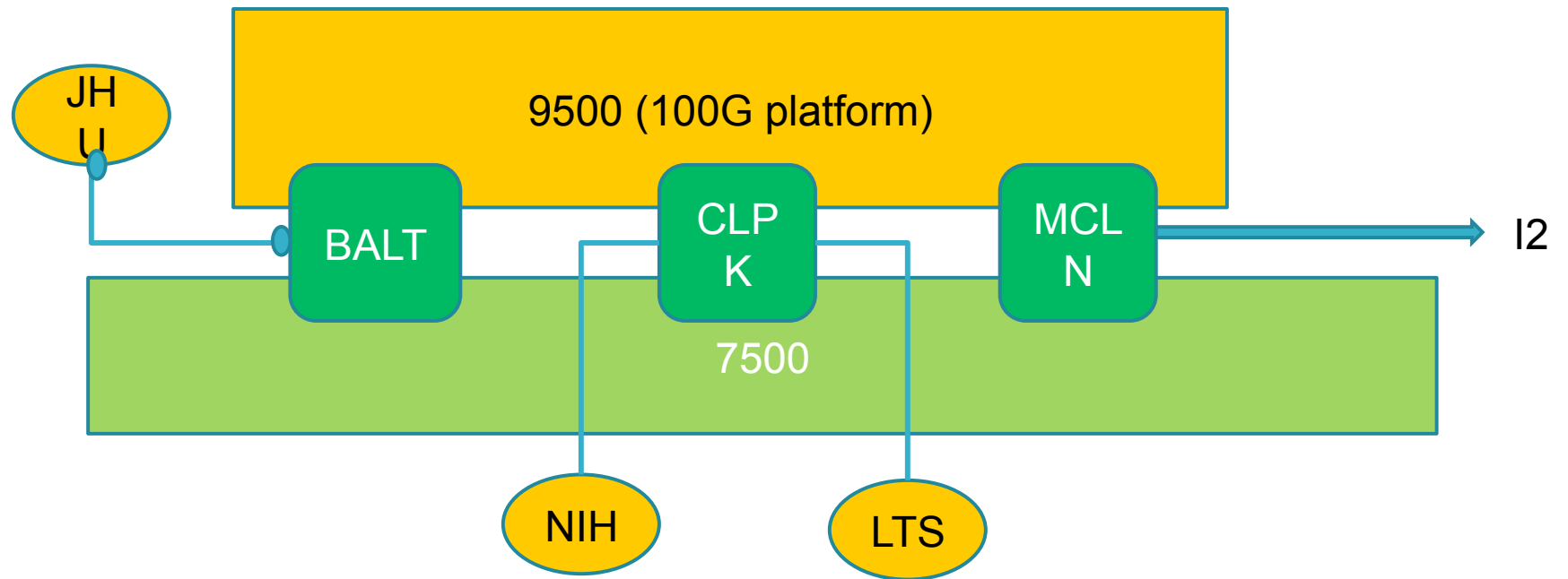
# NIH PoP

Add BW as needed

2x10G

1x100G

NIH

CLPK

MAX
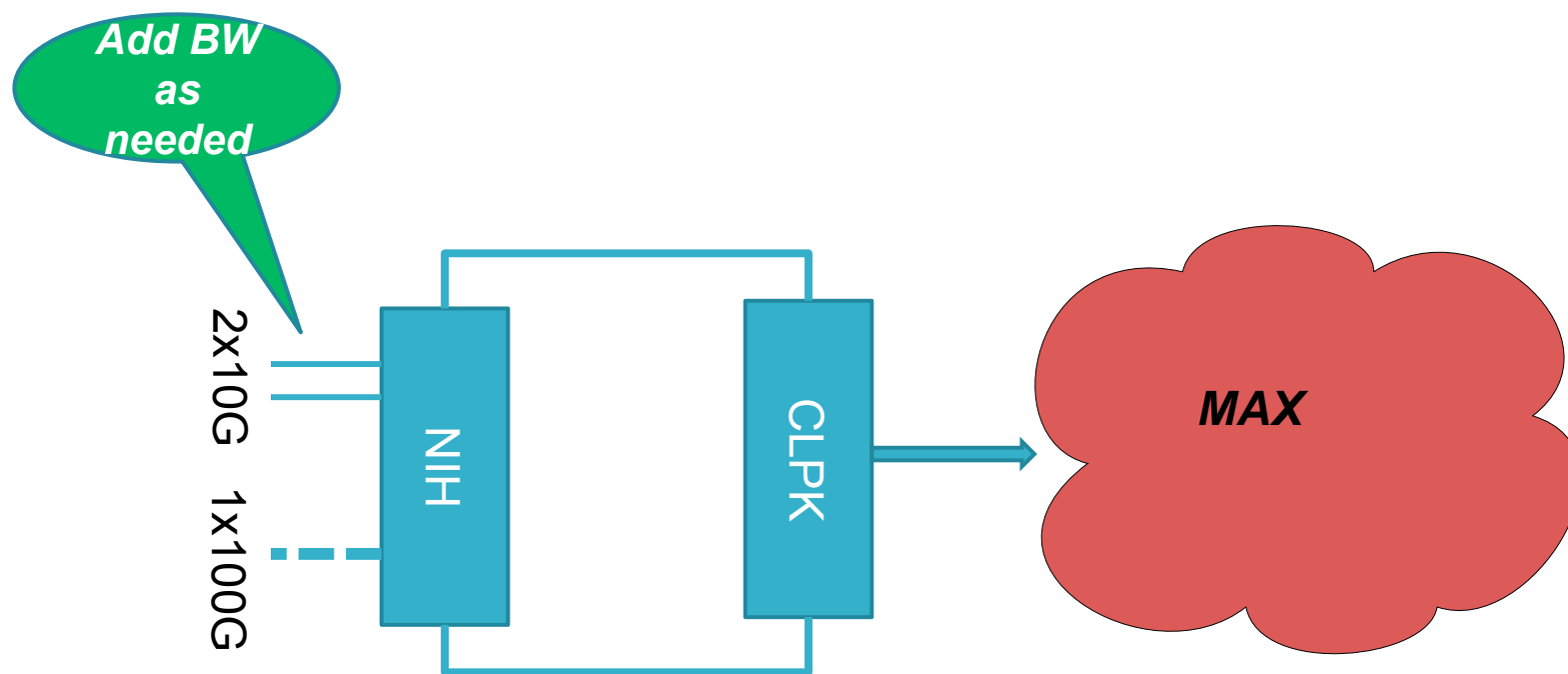
# Today
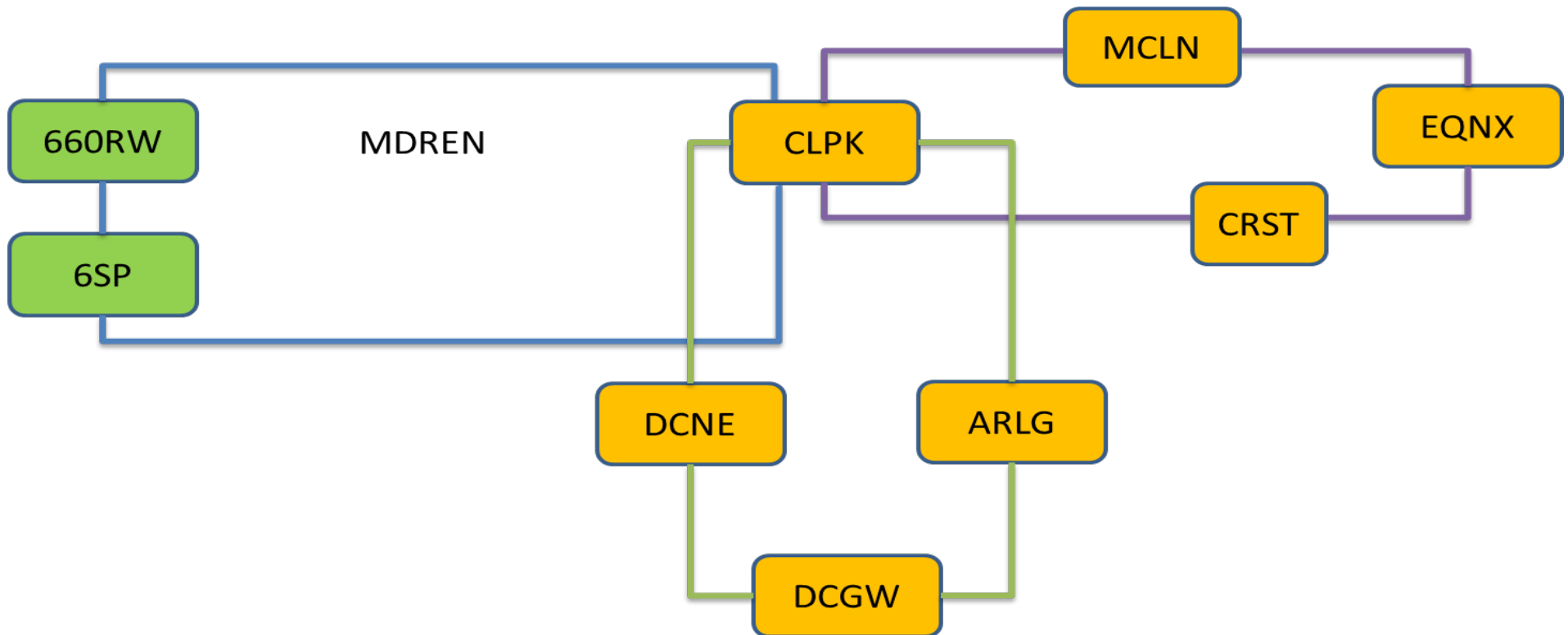
# MAX Production Network

# Production 100G

# WIX – **W**ash. DC **I**nternational e**X**change

- It is developed by MAX and Internet2 and will be transferred to MAX once in operation.
- It is a state-of-the-art international peering exchange facility, located at the Level 3 POP in McLean VA, designed to serve research and education networks.
- It is architected to meet the diverse needs of different networks.
- Initially the facility will hold 4 racks, expandable to 12 racks as needed.
- The Global Research NOC at IU will provide 24x7 monitoring
- WIX is operational today

# Direct Connect Amazon

- 10G pipe between MAX and Amazon AWS at Equinix
- MAX will pick up the recurring costs for the physical pipe
- Traffic to AWS travels over individual VLANs from a MAX member port out to AWS
- Working on recovering costs for the pipe/DWDM/vlans ?
- Traffic in a VLAN is billed directly by AMZ to the member
- AMZ costs: $0.02/GB outbound (versus "over the internet" costs of $0.12/GB)

# MAX Research Areas

- Regional network primer
  - End-to-end connectivity
  - Engaging researchers
- Regionals as innovators
  - Workshops
  - Outreach and Dissemination
  - Campus coordination
- Technology Trends
  - Big Data
  - SDN
  - Control Plane and national collaboration

# Regionals as innovators

**Technology Innovator**

**Network Primer**

End-to-end connectivity
Engage researchers

Big data
SDN
Control Plane
National collaboration

Workshops, outreach
Dissemination and camp
coordination
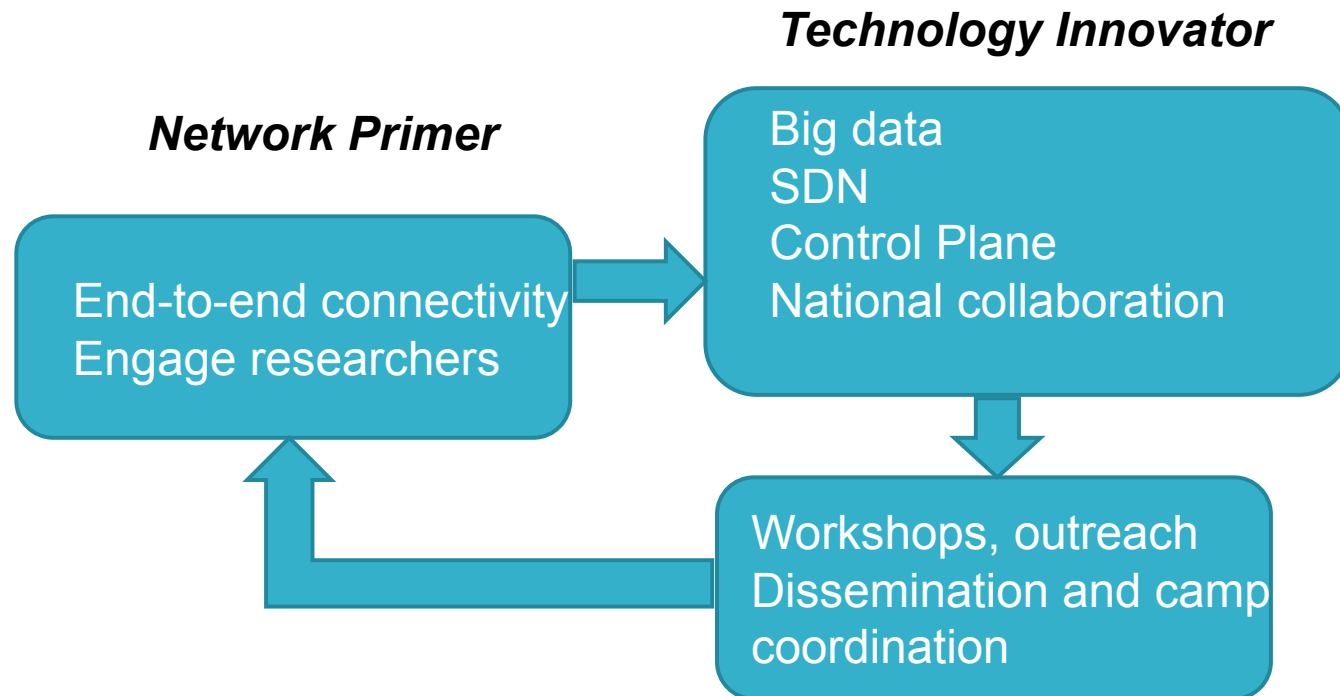
# DYNES PROJECT

- NSF Funded Project led by Internet2, Caltech, University of Michigan, Vanderbilt University
    - www.internet2.edu/dynes
- Deployment of a nationwide 'cyber-instrument' spanning about 40 US universities and 11 Internet2 connectors
- DYNES provides standardized hardware and software deployments for access to schedulable, dedicated, data transfer paths via the wide area Dynamic Circuit Network
- MAX is a DYNES connected regional network. JHU campus is DYNES participant.
    - Any MAX participants may also join

# DYNES TOPOLOGY
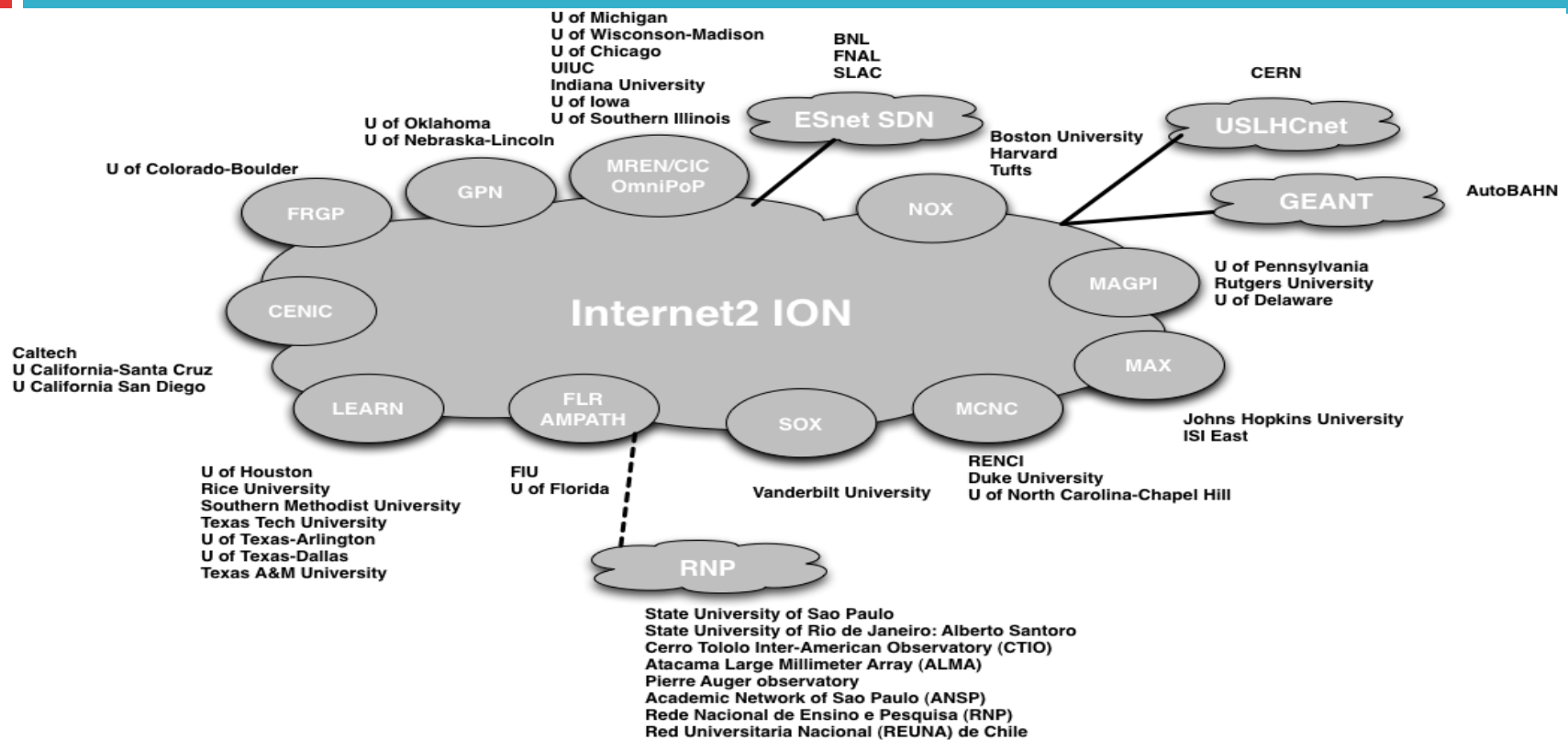
# DYNES – MAX & JHU implementation
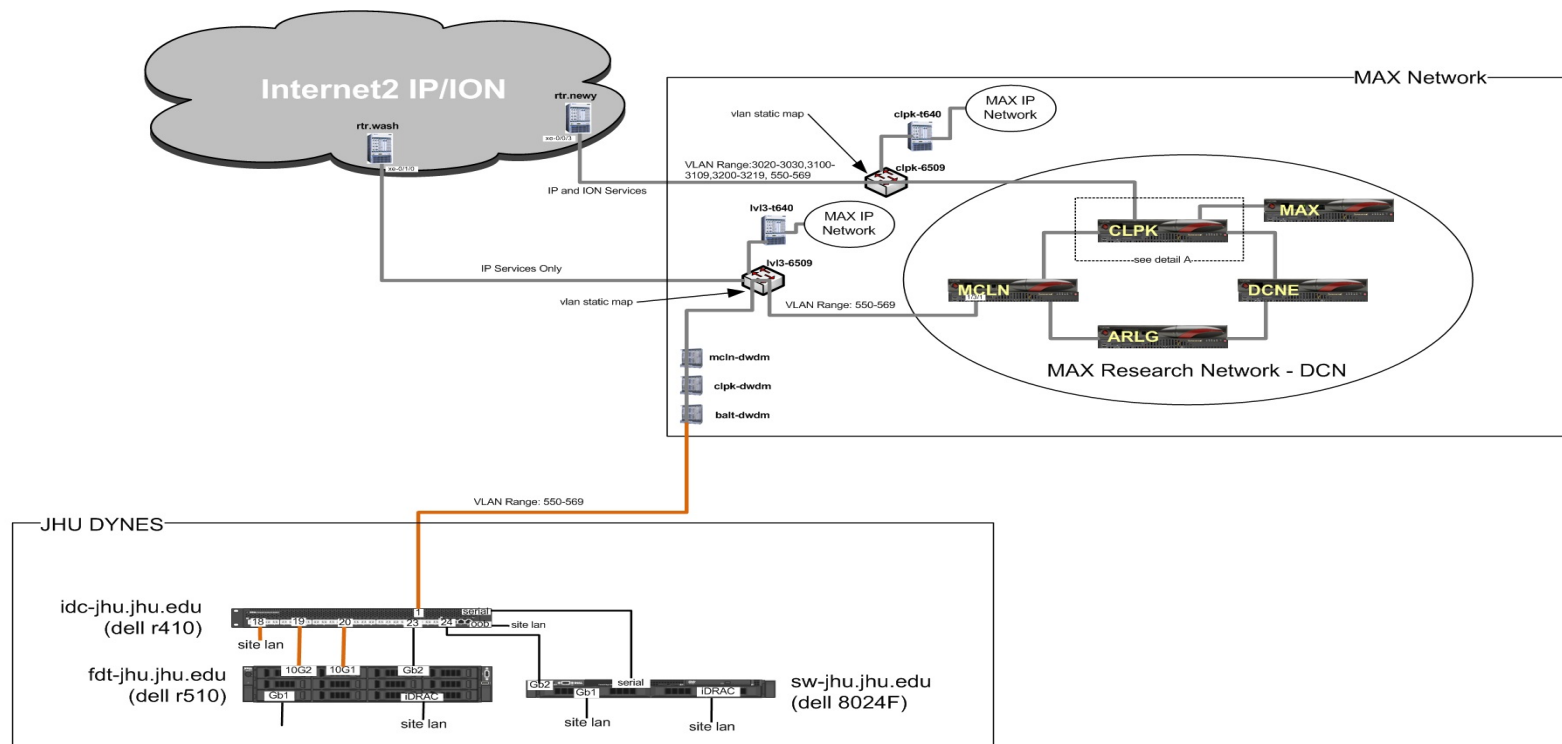
# Medical Surgical Training Event

- Can High Performance Networks enhance medical surgical training among multiple sites ?
- The American Academy of Orthopaedic Surgeons (AAOS) organized a surgical training event on May 4, 2012
- AAOS used a medical training studio at the Simulation Technology and Immersive Training Department of the Center for Advanced Surgical Education, Feinberg School of Medicine at Northwestern University in Chicago.
- Participated in the event :  the Feinberg School of Medicine, Northwestern University**, the surgical training center of Johns Hopkin's University**, and the Surgical Training Facility at the Medical School of the University of California at San Francisco.
- For high quality digital media transmission this event is implementing a private overlay network using the FrameNet service of NLR, with various site connections provided through the Metropolitan Research and Education Network (MREN), the High Performance Digital Media Network (HPDMnet), **the Mid-Atlantic Cross Roads (MAX**), CENIC, the StarLight International/ National Communications Exchange Facility, and the International Center for Advanced Internet Research at Northwestern University .
- Planning is underway to extend this capability for future events to multiple international sites.

# Sloan Digital Sky Survey

- Over 8 years, the Sloan Digital Sky Survey (SDSS) obtained deep, multi-color images covering more than a quarter of the sky and created 3-dimensional maps containing more than 930,000 galaxies and more than 120,000 quasars.

- Data Release 8 includes measurements for nearly 500 million stars and galaxies, and spectra of nearly two million.

- The Third Sloan Digital Sky Survey (SDSS-III) will continue operating and releasing data through 2014.

- SDSS data are used by many scientific communities to support fundamental research across an extraordinary range of astronomical disciplines, e.g.,

  - Properties of galaxies,
  - Structure and stellar populations of the Milky Way,
  - Asteroids and other small bodies in the solar system,
  - Large scale structure and matter and energy contents of the universe;

# JHU Leads Much of the SDSS Research

- Some Research Is Computationally Intensive, Requiring Data Transport To Remote Advanced Facility Sites, Such As The National Center for Computational Sciences At Oak Ridge National Laboratory In Tennessee.

- The NCCS Hosts the Jaguar Computational Facility, the World's Most Powerful Facility Devoted To Computational Science

- **The JHU Group Led By Alex Szalay, Designed An Experiment That Required Sending Large Amounts of Data To the Jaguar, Creating Simulations, and Sending Back Resulting Models.**

- To Accomplish The Goals Of This Research, It Was Necessary To Design and Implement a Customized 10 Gbps Network Established Among **JHU**, **The Mid-Atlantic Crossroads (MAX**), a Computational Science Facility at the University of Illinois At Chicago, the StarLight International/National Communications Exchange Facility in Chicago, the National TeraFlow Testbed Network, the Metropolitan Research and Education Network (MREN), The Illinois Wired/Wireless Infrastructure for Research and Education (I-WIRE), ESnet, the NLR, and the Jaguar Facility at ORNL.

- Through Cooperative Partnership Among All These Organizations, This Customized Network Was Established In a Few Weeks and Was Successfully Used To Support the JHU/UIC Research

# Research Network – 100G

- Operational today
- Who is on it today ?
  - MAX, NASA, LTS
- Working on adding
  - JHU, Naval Research Lab, NLM
- **MAX has signed to participate in I2 Innovation Platform ➔ access to100G layer 2 connection starting July 1,2012**

May 5th, 2012

H. David Lambert
President and CEO, Internet2
1150 18th Street, NW
Suite 900
Washington, DC 20036

Dear Mr. Lambert:

The Mid-Atlantic Crossroads (MAX) hereby affirms and represents our intent to participate in the Internet2 Innovation Platform Initiative as a Pilot Site. As a Pilot Site, we understand that we are committing to all three components of the Innovation Platform Initiative over the next three years. These components include: a connection to the Internet2 100 GE Advanced Layer 2 Service; implementation and support for software defined networking infrastructure and applications; and, support for a Science DMZ. In addition, we understand we must substantially implement two out of the three Innovation Platform Initiative components by the end of 2012, which is the end of the first pilot year.

As one of the Innovation Platform Initiative Pilot sites, we plan to connect to Internet2's 100 GE Internet2 Advanced Layer 2 Service prior to December 31, 2014 and understand there is a separate agreement, the Internet2 Advanced Layer 2 Service User Agreement for this connection. We understand, that as a pilot site, if we chose to connect by July 1, 2012 the cost for the connection will be $80,000 for the first year (through June 30, 2013) and will increase to $165,000 beginning July 1, 2013.

We further agree to actively collaborate with Internet2 during pilot phase of the Innovation Platform Initiative providing feedback on the development of the platform components as well as ensuring that all parties are working together with a clear understanding of the technical details, implementation schedule and any related requirements.

We trust that this document adequately conveys our intent to participate in the Pilot Phase of the Innovation Platform Initiative.

Sincerely,

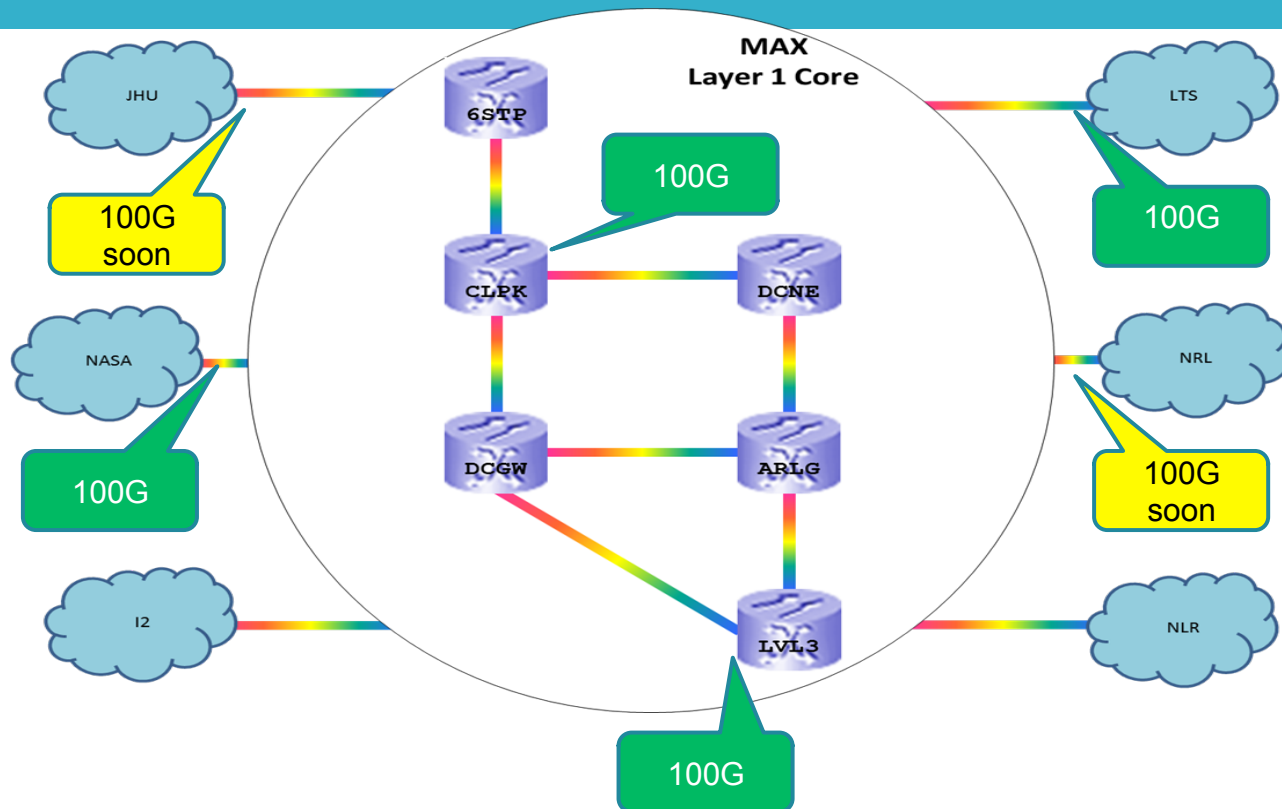Mid-Atlantic Crossroads

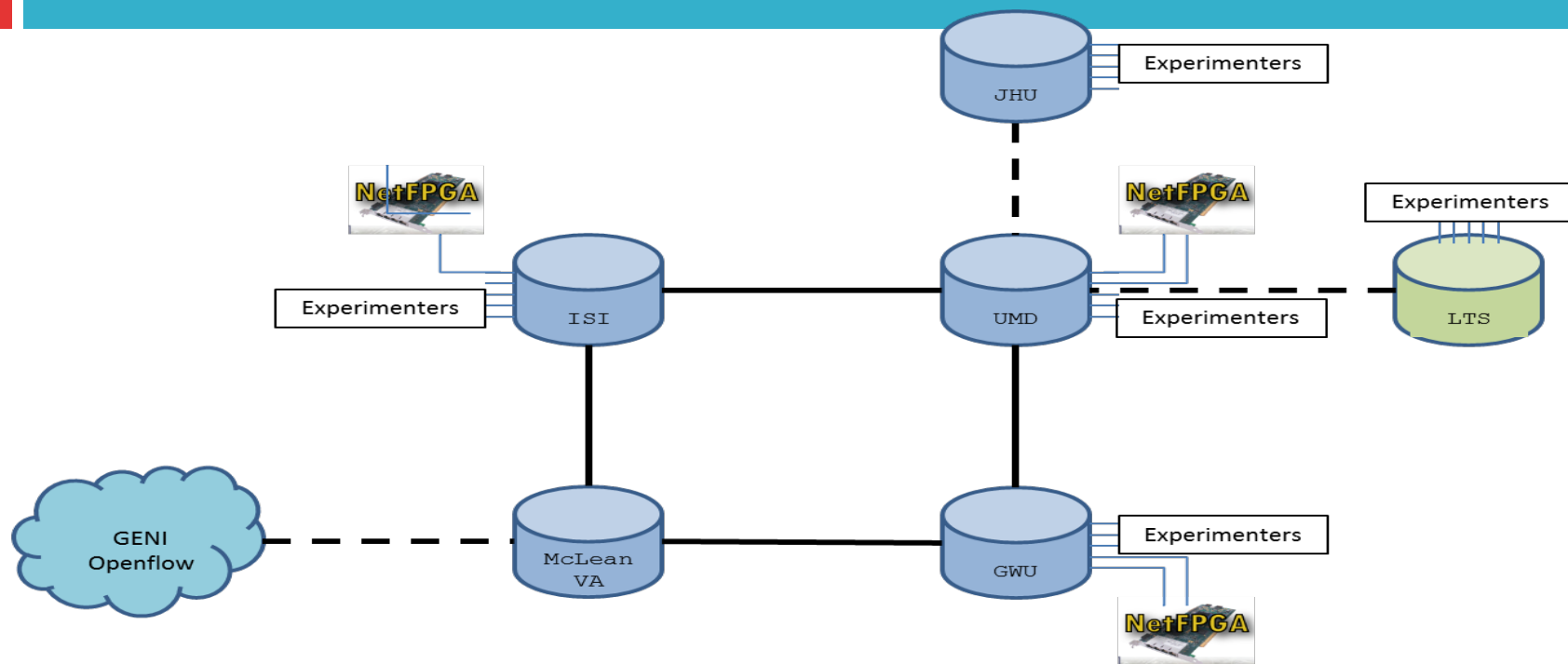**Abdella Battou**
**Executive Director**

5/7/2012
Date

INTERNET2

**H. Dave Lambert**
**President and CEO**

5/9/2012
Date

# Research Network – DWDM Core

# Research Network – OpenFlow Testbed

# Joint 100G Research – let's partner

- Make the new 100G research network accessible to researchers at our HighEd member institutions and federal labs

- If you have an Application/Project that needs the 100G capability - *Talk to us we will find a way to help you*

# Research Network – Virtualization

- Lack of standardization
  - ITU Focus Group
  - IRTF NVRG
- Network Virtualization Model
- Done with the optical Layer
- Provisioning Of Virtual Networks
- Management of Virtual networks

# Research Network – SDN

- New area, we are trying to understand
- Major vendors Cisco, Juniper, Brocade, and Google, and Yahoo are in some form of SDN
  - July 17, 2012, 9:50 AM - 10:10 AM
  - Cisco will discuss the new Cisco SDN controller (CSDN), it's capabilities, built-in APIs, and possible applications. Also included will be a live demo of CSDN for the audience.
- OpenFlow is getting momentum in the Data Center area
- Nicira's Distributed Network Virtualization Infrastructure (DNVI)

# Early days we used networks as

- Data pipes

- Application is email

- Main concern :
  - how to get a packet from one point to another
  - Routing was the primary control decision

# Today, networks play a bigger role

- In securing resources
  - block unauthorized access
  - detect attacks
- Ensuring application performance
  - Server load balancing
  - Network differentiated services
- Enhancing application reliability - HA
  - Backup server takeover
- Supporting value added services
  - VPN, Data Centers

# Consequences

- Networks are now more complex ➔ Multiple control functions
- Modular Approach – develop each control in isolation
- Routing : OSPF control and Globally – BGP
- Traffic Blocking – packet filter
- Traffic redirection – load balancer
- Bad Traffic – intrusion detection
- QoS - Traffic Tunneling

# Complexity

- Technology trend is more and more critical functions

- complexity to grow

- Modularity is good, but all control components concurrently modify the underlying shared network state

# Results – we are learning that

- Control components need to communicate their decision to each other

- Their execution schedule must be managed

- Concurrency must be managed

- Control decision must ensure correct network state transition despite failures & transients effects

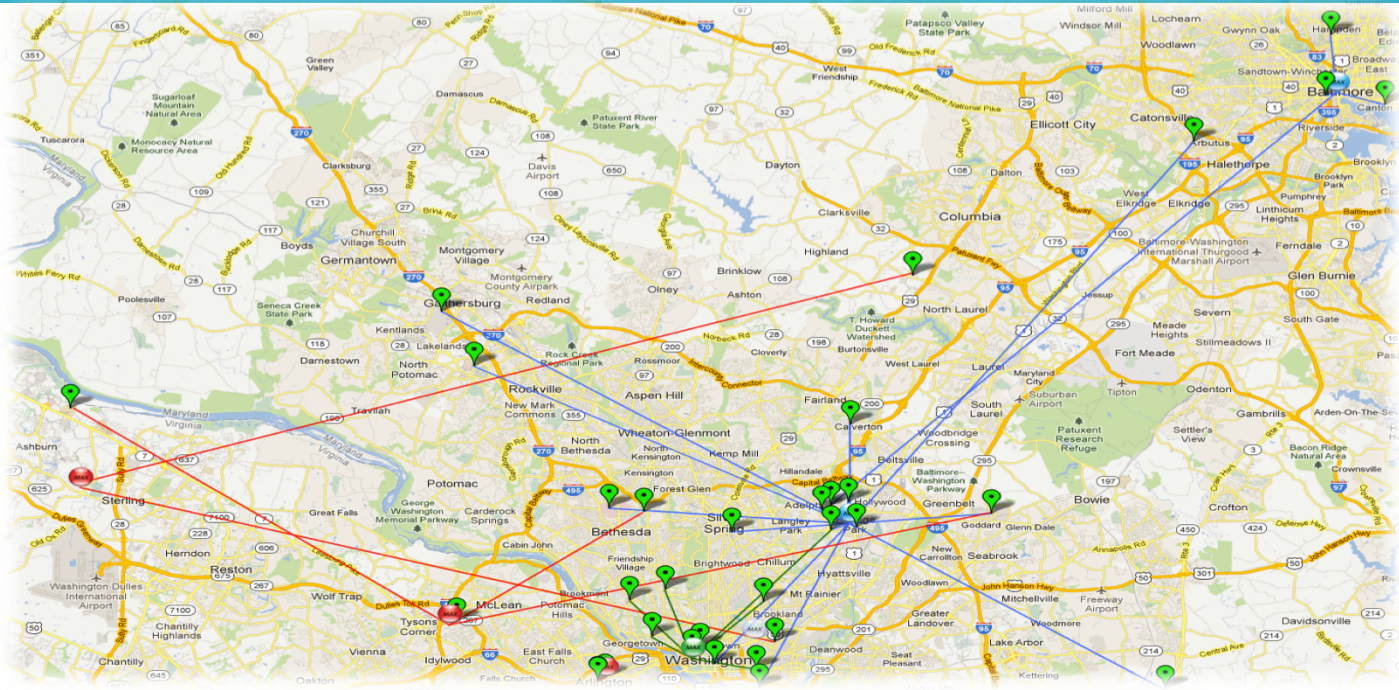# Applications - Network
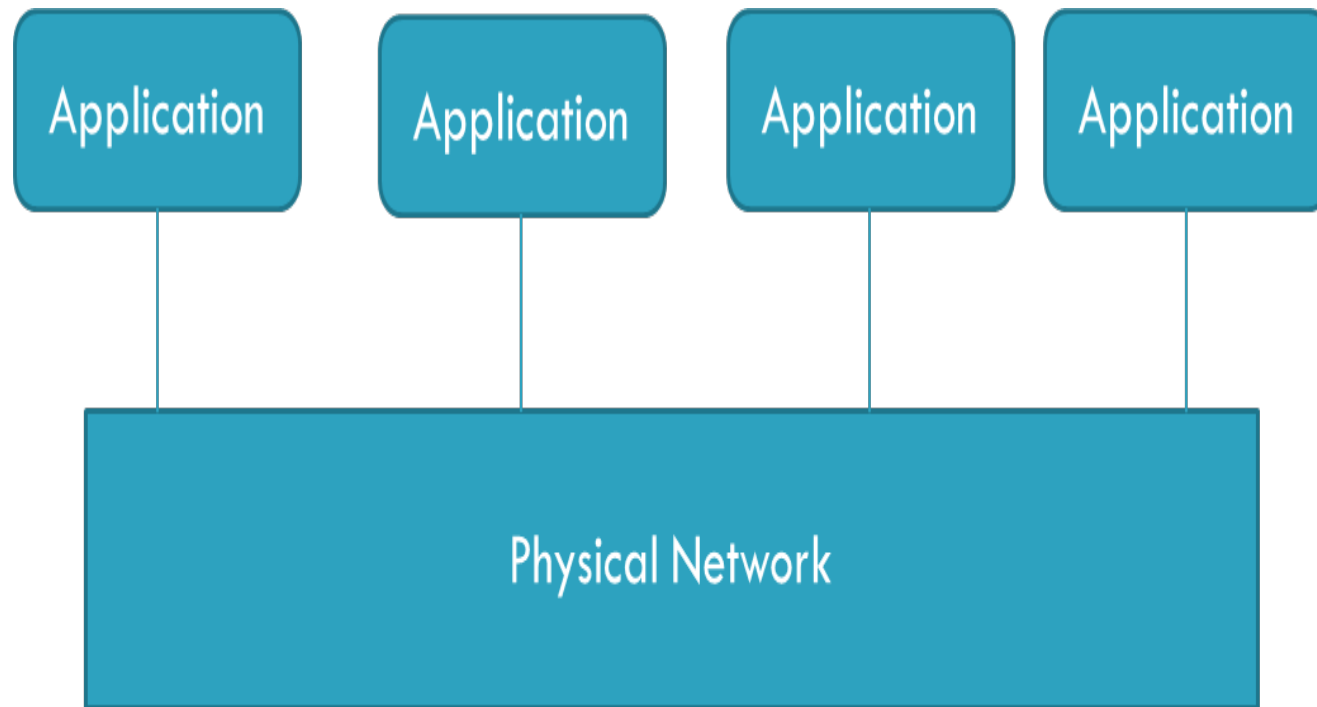
# Application – SDN - Network
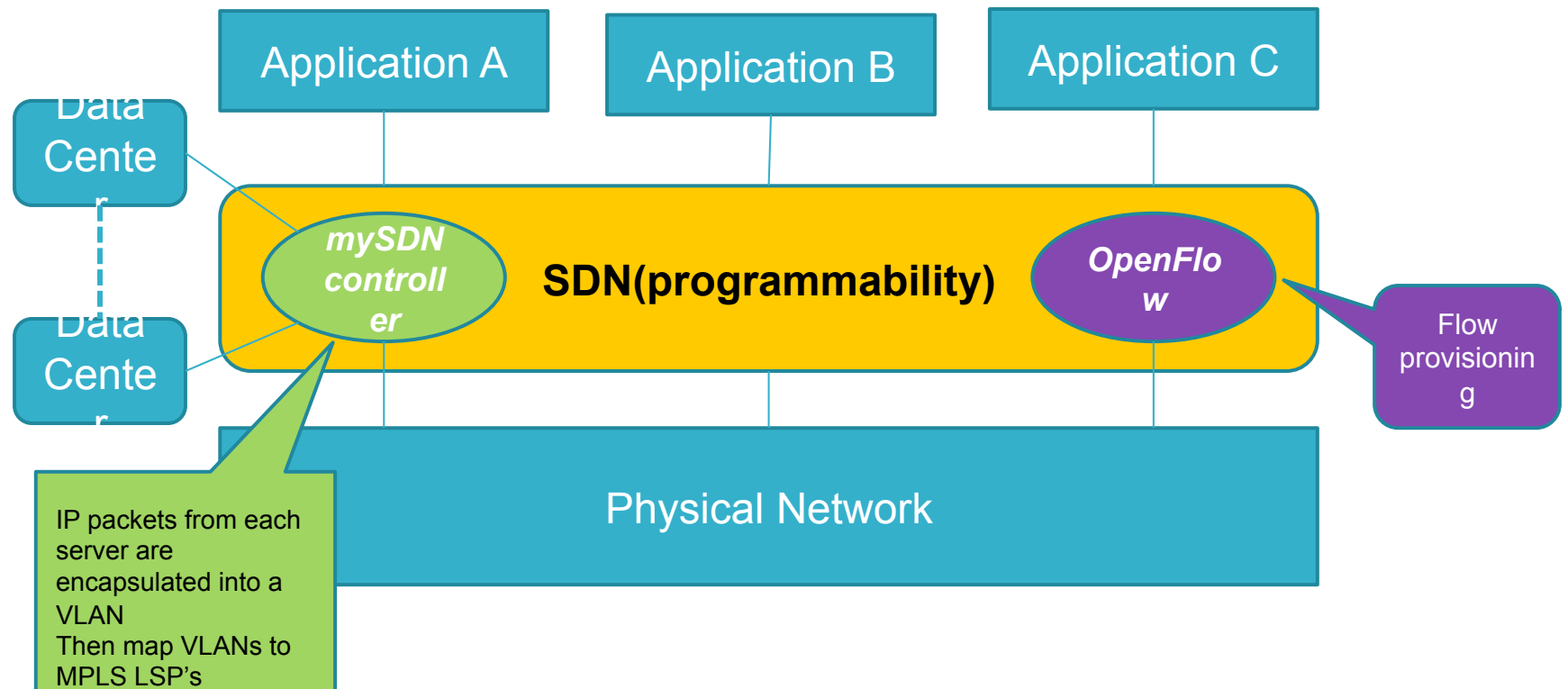
# SERVICES

May 22, 2012

Classic and New

# Current Membership

# Service Categories

- Classic Networking
  - Data Transport
  - Research
  - Connection to the national backbones (Internet2, NLR and beyond …)
- New
  - Specific Destination – jetStream (AWS, XCEDE)
  - Multi-Services Exchange (MSX)
  - Application Integration
  - MARC – Mid-Atlantic Research Cloud

# Production Services

- Layer 3
  - 20Mbps – 10Gbps
- ISP
  - TransitRail
  - Cogent
  - Qwest
- Layer 2
  - VLAN Transport
  - Internet2 ION
  - 1Gbps per VLAN over 10GE channel
  - Regional, national and international reach
- Layer 1
  - Protected
  - Lambda Transport
  - 1Gbps – 100Gbps
- NGIX

# Research Services

- DRAGON
  - Full Layer 2 access within the MAX members
  - Full unlimited access to GENI resources
  - Full unlimited access to OpenFlow resources
  - Full unlimited access to Layer 1 lambda services

# Beyond Data Transport – New Services

- Why
  - Increasingly, networks are seen as integral, system interconnects rather than the plumbing in between
- How
  - Extending services past the traditional notions of the networking domain
  - Awareness of
    - Data flows
    - Specific destinations
      - Tailored solutions
    - Applications
      - Integration

# *JetStream* (AWS Direct Connect) Service

- ☐ What is AWS Direct Connect?
  - ◘ Dedicated Layer 3 peering with AWS Data Center
  - ◘ Up to 10Gbps
  - ◘ Multiple Logical Connections
  - ◘ Bandwidth cost reduction ($.12/GB to $0.02/GB)
- ☐ Why?
  - ◘ AWS is a popular platform
  - ◘ Groups use it as a rendezvous point for data distribution

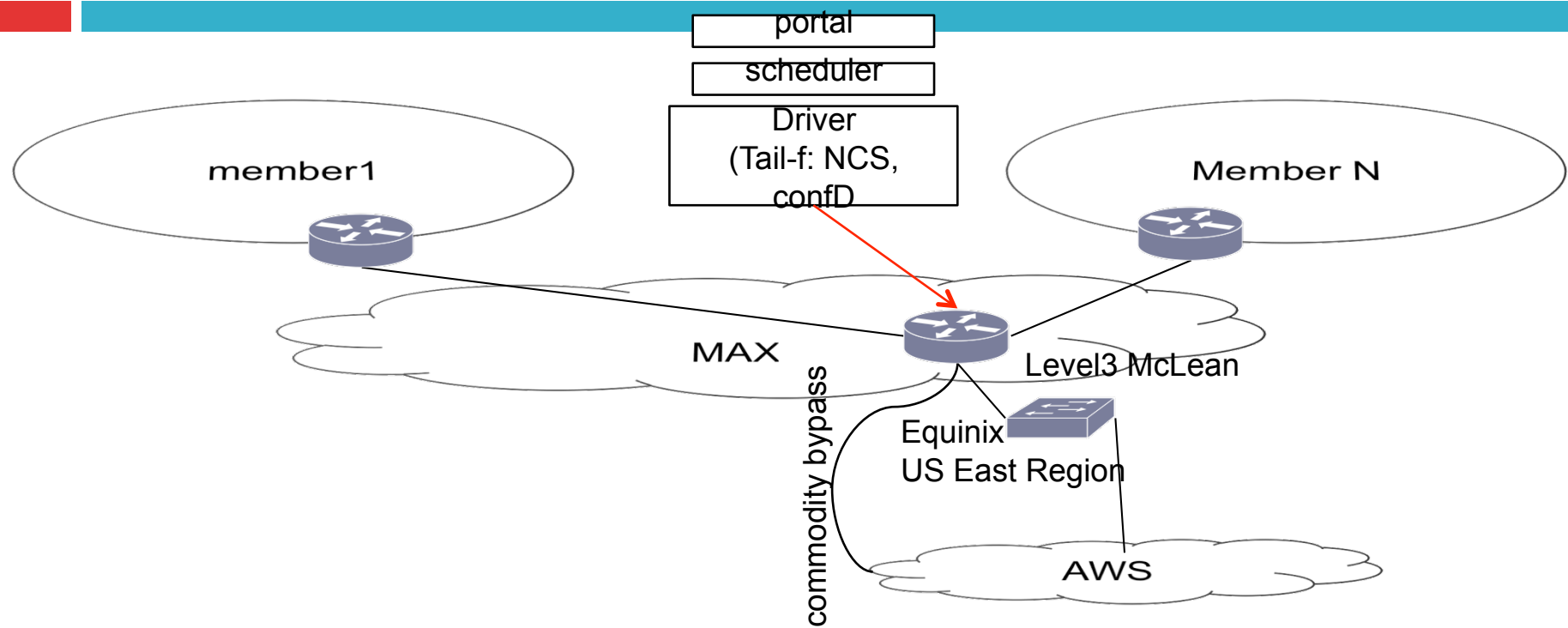# *JetStream* (AWS Direct Connect) Service

- Types
  - Static
    - Permanently provisioned 10GE connection
    - BGP peering with AWS
  - Dynamic
    - Portal Access
    - Single, Scheduled 10GE connection
    - Multiple Logical Connections
    - Dynamic BGP peering

# *JetStream* (AWS Direct Connect) Service

portal

scheduler

Driver
(Tail-f: NCS,
confD

member1

Member N

MAX

Level3 McLean

commodity bypass

Equinix
US East Region

AWS

# (AWS Direct Connect) Service

# *JetStream* (AWS Direct Connect) Service

- Status
  - Agreement
    - Pending, expected soon
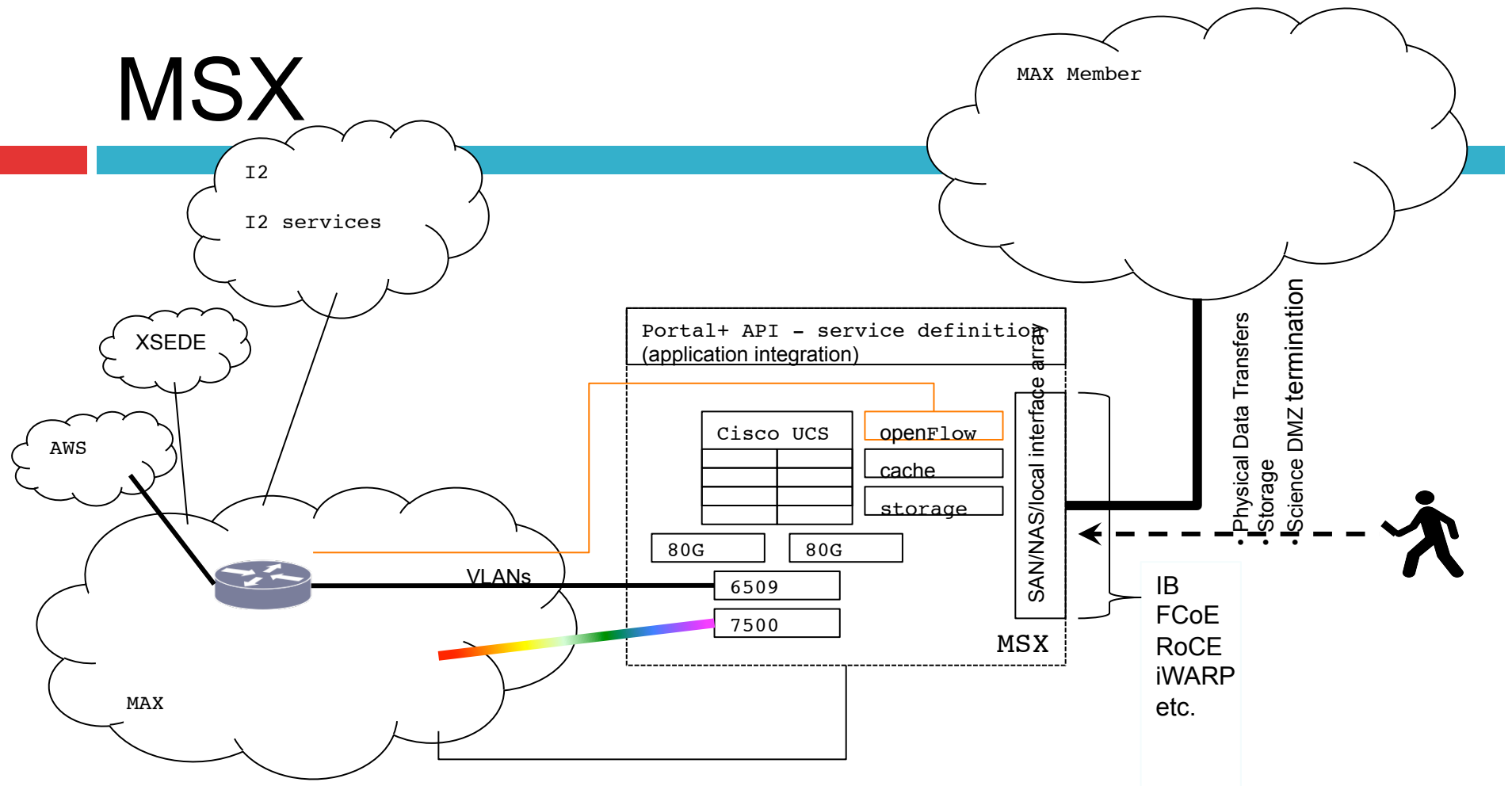  - NDA (optional)
    - Pending, expected soon
- Timeframe
  - ~ 2 months after the documents are signed

# MSX – Multi-Service Exchange

- Original motivation
  - Physically accessible location (initially MAX POPs)
  - On-demand, high-performance data transport
  - Integrated with the *jetStream* portal
  - Pre-defined transfer destinations (AWS, EXCEDE, *etc.*)
- Extended Functionality
  - High-Performance platform for stitching local and wide-area SDN and storage solutions

# MSX

I2

I2 services

XSEDE

AWS

MAX

MAX Member

VLANs

**Portal+ API - service definition**
(application integration)

Cisco UCS

openFlow

cache

storage

80G

80G

6509

7500

SAN/NAS/local interface array

MSX

Physical Data Transfers

Storage

Science DMZ termination

IB
FCoE
RoCE
iWARP
etc.

# MSX – Multi-Service Exchange

- Status
  - Finalizing architecture
  - Obtaining quotes

# SmartHands

- Existing Service
  - Current focus: network engineering/ troubleshooting
- Intended expansion – SmartHeads?
  - Application integration with SDN solutions: openFlow, ION, DYNES

# MARC – Mid-Atlantic Research Cloud

- Modest, Cloud-Computing Offering
  - Cisco UCS Platform
  - UCSM Hardware Manager
  - OpenStack
  - Deployed at MAX POPs and integrated with the network

The End