## 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

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.

#### 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.

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

#### What's new for FY13 Budget

- 25% of operating cost
- Proposed Projects
  - Kiosk
  - Shady Grove PoP
  - Federal PoP
- New Services
- Pricing Restructure

- Research Grants
  JHU collaborative grant 100G
  BBN Technologies
  NOAA Nwave
  NSF- 100G
  - NSF collaborative proposals being finalized

Workshops What workshops would you like to see offered by MAX?

MAX Website: <u>www.maxgigapop.net</u> 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, 7<sup>th</sup> 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







### **MAX Production Network**



## Production 100G



# WIX – Wash. DC International eXchange

- 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**



# 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 <u>Third Sloan Digital Sky Survey (SDSS-III)</u> 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 Cr

Abdella Battou Executive Director

2012 Date

INTERNE H. Dave Lambert President and CEO

#### 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

