Washington International Exchange (WIX) as a Software Defined Exchange (SDX)

Global Experimentation for Future Internet (GEFI)

Session 2: Federation, Software Defined Infrastructure, Testbeds and Connectivity

April 18, 2016
Brussels, Belgium

Tom Lehman
University of Maryland
Mid-Atlantic Crossroads (MAX)

UNIVERSITY OF MARYLAND

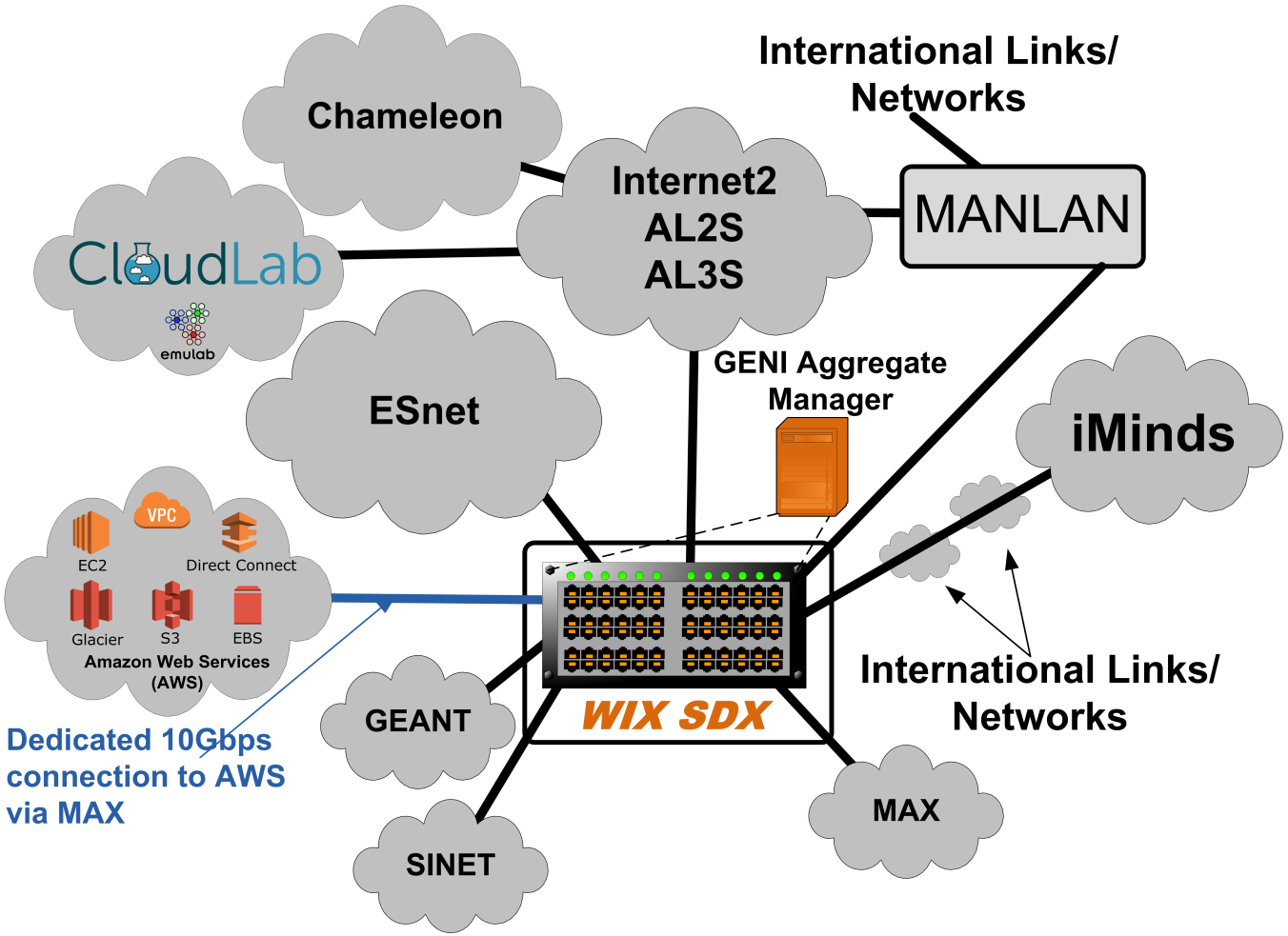
MAX MID-ATLANTIC CROSSROADS

Mid-Atlantic Crossroads (MAX)

- **Washington D.C. and Baltimore metropolitan area regional network**
- **Multi-ring dark fiber, 14 node DWDM Switched Network**
- **100Gbps services at Layer 1, 2, 3**
- **Providing local services and connections to the national R&E Infrastructure (i.e. Internet2 and ESnet) and Public Clouds**

WIX

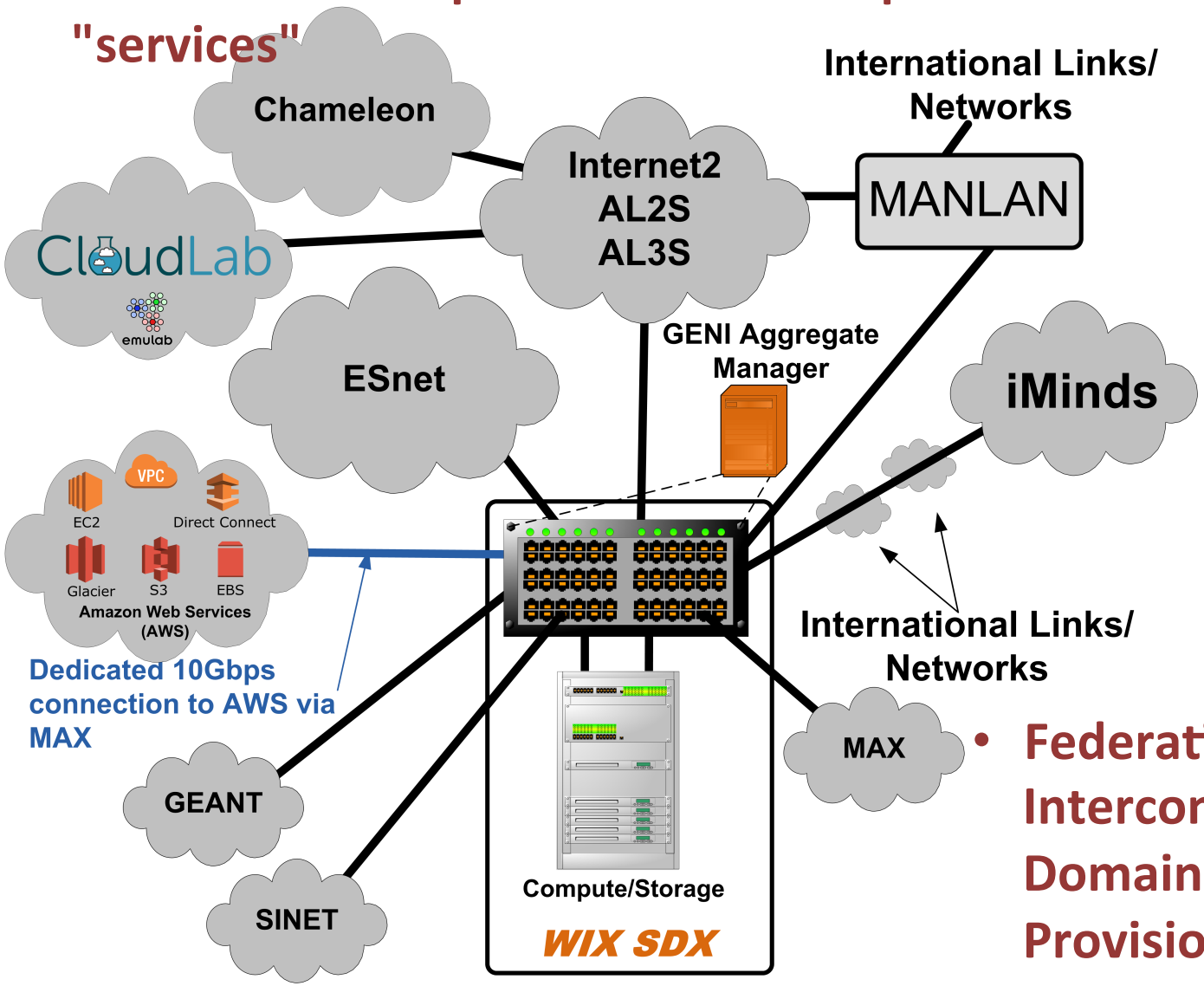
- WIX is a production Exchange Point in McLean, Virginia
- Jointly run by Internet2 and MAX

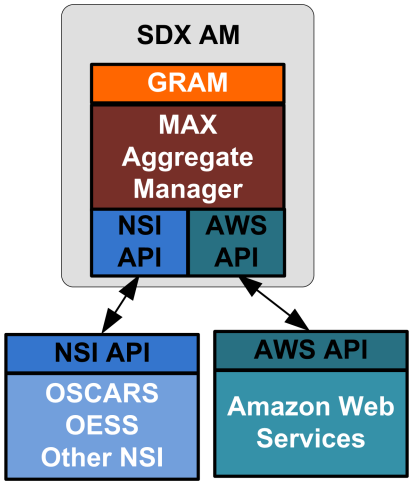


- Deployed WIX GENI Aggregate Manager
- MAX provided AWS "Direct Connect" service available at WIX
- GENI users can create topologies which include the proper WIX SDX port to gain access to AWS resources
- This has converted WIX into prototype SDX

WIX

- Would also like to add compute and storage resources to SDX
- Facilitate development of a marketplace where others can offer "services"



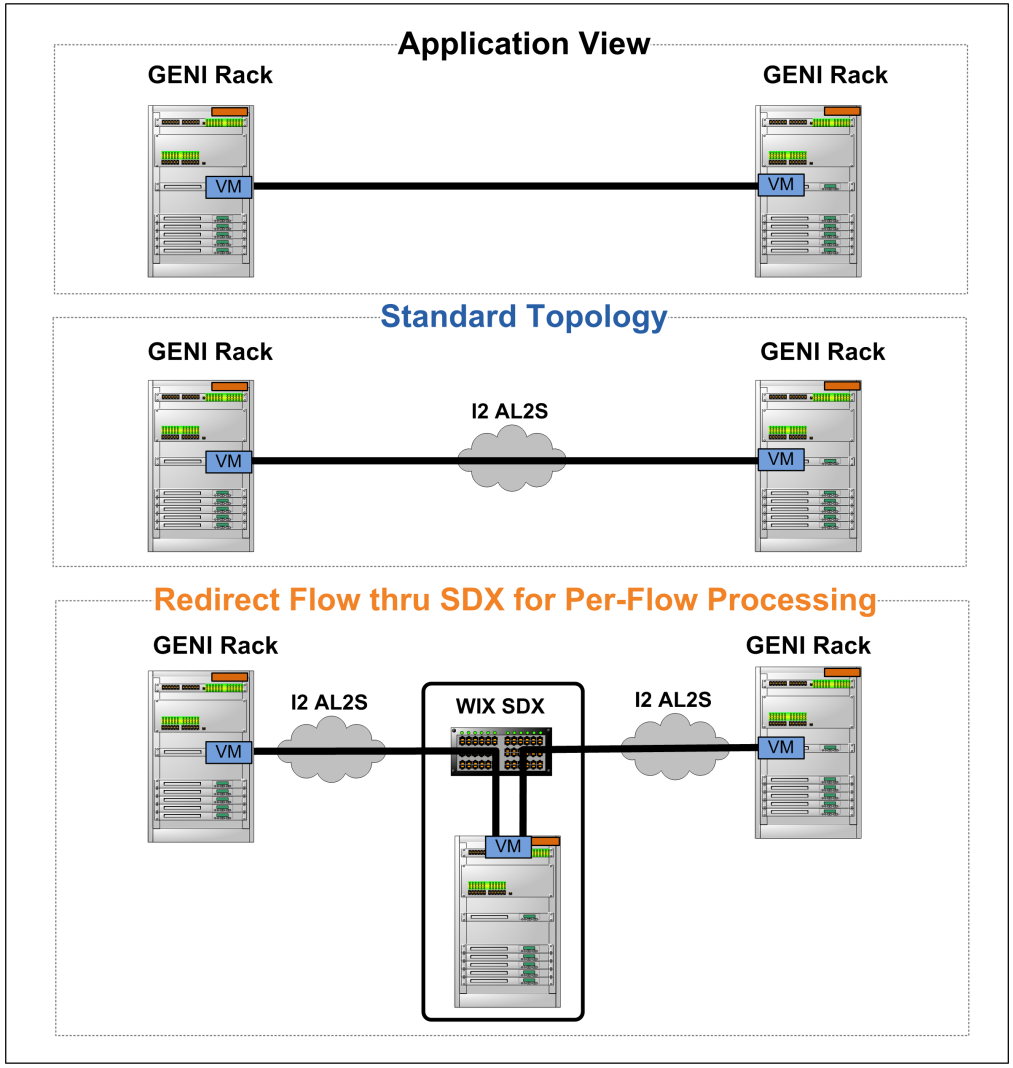


- Federation, Robust Interconnection, and Multi-Domain Service Provisioning needed

Why Do We Want WIX to be an SDX?

- Would like be able control Exchange Point resource utilization, in an automated fashion:
  - at the Federation (Clearinghouse) level, Virtual Organization (Project) Level, Slice Level, and User Level
  - also need to be able to adjust authorizations and access polices in near-real time
- Example use case: MAX AWS Direct Connect Access
  - MAX AWS Direct Connect is available by stitching to a specific WIX Interface/VLAN combination
  - Would like to make this available to GENI Users, but need to be able to control that access in flexible ways

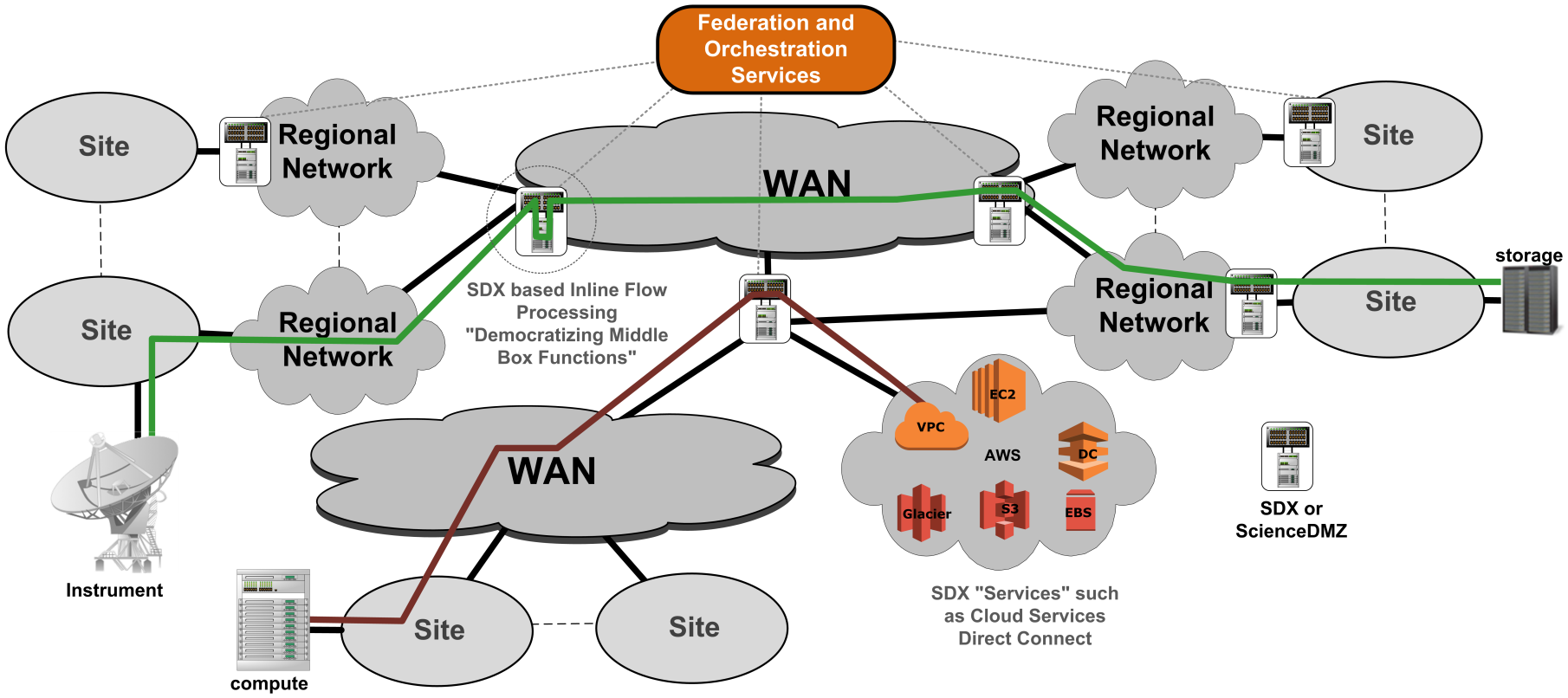
SDX Enabled Flow Based Services



- GENI mechanisms can be utilized to “redirect” flow thru an exchange point where “value added” processing can be accomplished
- With a distributed infrastructure of SDXs this can be done in much more dynamic and open manner then what is possible today.
- This type of capability can be used for single flow focus, or to build specialized service topologies

SDX and ScienceDMZ Ecosystem

- Imagining a distributed ecosystem of SDXs and ScienceDMZs which can be orchestrated to add control of end-to-end flows
- Distributed service infrastructure to allow application owners to develop their own middle box functions



What are the big issues and needs?

- The R&E infrastructure and interconnections are fairly extensive and capable. The weak areas are in automated control and Federation.
- We need Federation systems which have more:
  - Granularity in user, virtual organization (project), and resource (slice) level authorization and control
  - Realtime creation and adjustment of Virtual Organizations across Federations
- We need more SDN/SDX/SDI infrastructure available as the basis for advanced Cyberinfrastructure and to build new services for the research community
- Service level abstractions which can be implemented in various ways by different resource owners
- One example or vision is “Distributed SDX Orchestrated Control”
  - This "orchestration" function should be a service that the cyberinfrastructure provides. This will eliminate the need for every application workflow agent to recreate this in their own unique way

Thank-you

Extras

SDX Functionality

Current SDX Functionality

- Establish resource quotas on a Clearinghouse, Slice, or User basis
- Resource types are total bandwidth, number of VLANs in use

Future Capabilities Desired

- Additional parameters available for resource access
  - Interfaces, VLAN Ranges
  - at the Federation (Clearinghouse) level, Virtual Organization (Project) Level, Slice Level, and User Level
- Ability for real-time resource utilization adjustments based on user priority and preemption
- SDXs with compute and storage embedded

SDX Functionality

```
Request RSpec with SDX Extension
Main Body
  node
    client_id (="ec2-vpc1-vm1")
    component_manager_id (="wix.internet2.edu")
    sliver name (="aws_ec2")
    client_id (="wix:if0")
      ip_address (="10.20.2.2/24")

SDX Extension
  virtual_cloud
    client_id (="vpc1")
    provider_id (="aws.amazon.com:aws-cloud")
    cidr (="10.0.0.0/16")
    subnet
      client_id (="subnet1")
      cidr (="10.0.0.0/24")
      node (="ec2-vpc1-vm1", public="true")
      route (to="default", from="vpn", next_hop="vpn")
    route (to="default", next_hop="internet")
    gateway
      client_id (="aws_dx1")
      type (="direct_connect")
      to (type="stitch_port, value=\
            "sw.net.wix.internet2.edu:13/1:vlan=1725")
```

GRAM with ABAC like policy features for multiple control levels for SDX utilization and connected resources:

- Federation(Clearinghouse), Virtual Organization (Project), Slice, User
- Realtime authorizations and access policy adjustments needed

What do we want from SDN?

- Fine grained Flow Management
  - flow identification
  - flow steering/modification
- Dynamic Network Services/Topologies
  - network virtualization with hard isolation
  - workflow specific services and topologies (pt-to-pt, mpoint)
- All in support of Advanced Cyberinfrastructure Services
  - integration/orchestration of compute, storage, instruments, and networks

While it is not possible, or desirable, to manage all flows in the network, it should be possible to manage "any" flow in the network.

What are the biggest challenges?

- Multi-Resource, Multi-Domain Orchestration of Services
  - end-to-end, full stack needed to realize full value
- Resources Description, Discovery, and Computation
  - need a common method (model/language) for everyone to describe their resources, services, and what others are permitted to do with them, abstraction is key
  - Multi-resource computation
- Fine Grained, Multi-Domain, Authentication and Authorization
  - user level, flow level, resource level
  - needs allow for dynamic adhoc “mini-federation” formation

The R&E community is uniquely positioned to address these issues. Past experience indicates that commercial efforts may not focus on these due to business considerations.