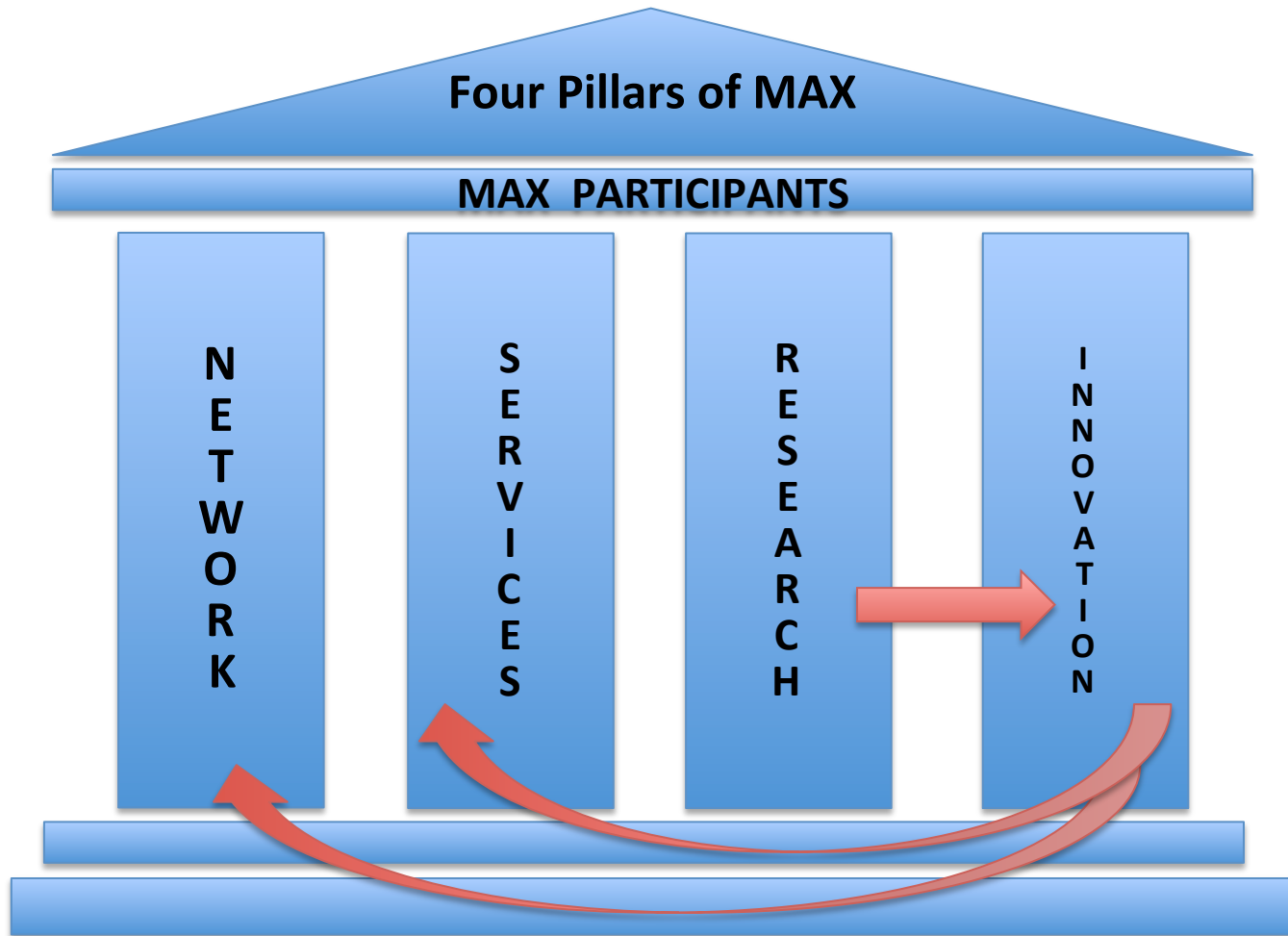




2018 MAX PARTICIPANTS MEETING

TRIPTI SINHA
APRIL 25, 2018



MAX Focus on Thematic Activities

Network Infrastructure and Service Expansion

- Meeting the needs of the MAX community by expanding infrastructure footprint and capabilities

Advanced CI and Security Services

- Continue to research and define advanced and security services (Cloud access, HPC, TICAP, DDoS, ...)

Software Defined Resources and Services Strategy

- More focus on software defined intelligent resource orchestration and automation

Strategic Partnerships

- Establishing strategic and synergistic partnerships



The diagram is a stylized classical building with four pillars. The roof is a blue triangle containing the text 'Four Pillars of MAX'. Below the roof is a blue horizontal bar with the text 'MAX PARTICIPANTS'. The four pillars are blue rectangles, each with a vertical label: 'NETWORK' (with an orange-to-blue gradient), 'SERVICES', 'RESEARCH', and 'INNOVATION'. The pillars sit on a two-tiered blue base.

Four Pillars of MAX

MAX PARTICIPANTS

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Geography

MARYLAND

VIRGINIA

Baltimore, MD #2

Baltimore, MD #1

Rockville, MD #1

Rockville, MD #2

Silver Spring, MD

Ashburn, VA

Reston, VA

McLean, VA

Arlington, VA #1

Arlington, VA #2

DC

College Park, MD #1

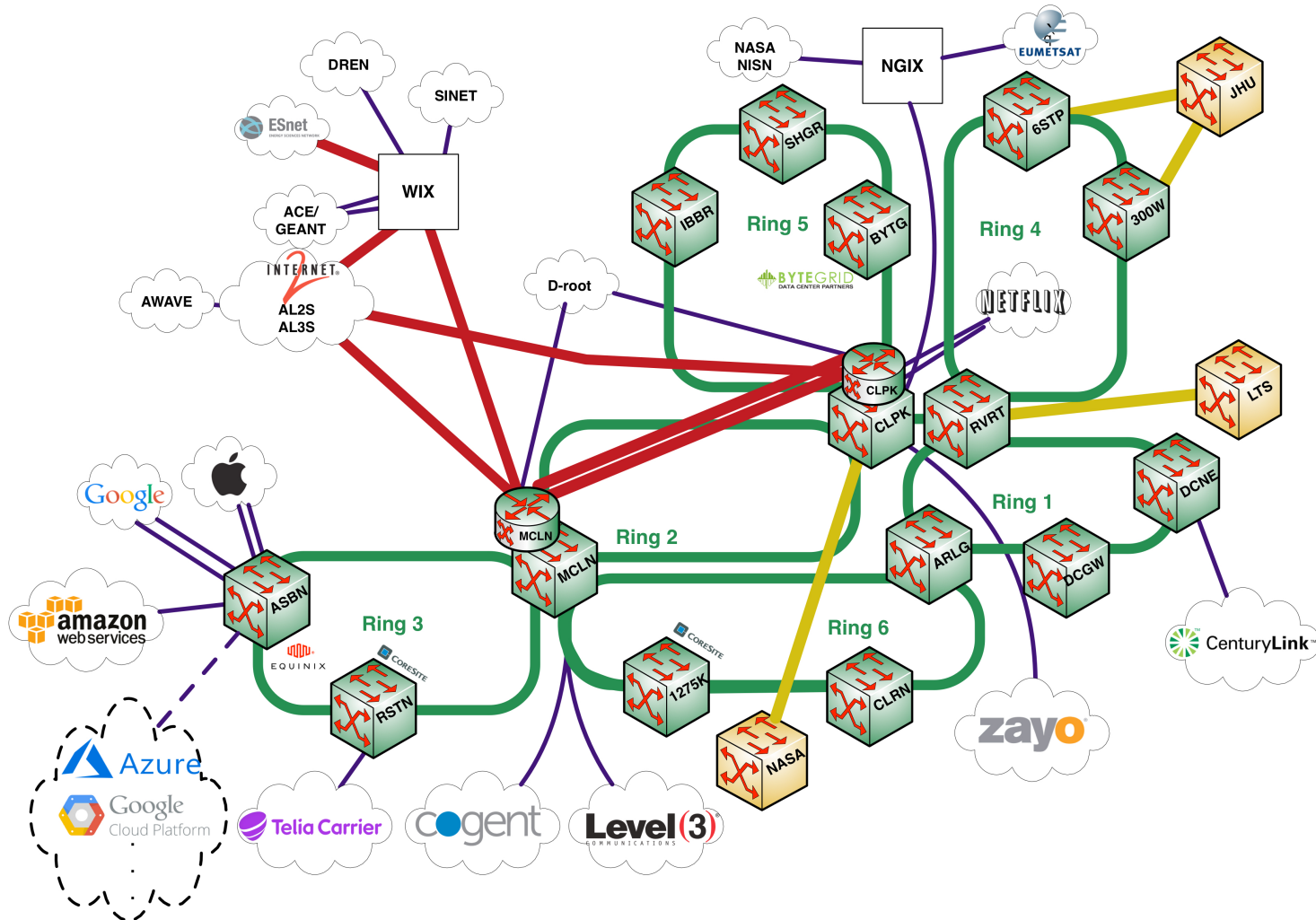
College Park, MD #2

Washington, DC - NE

Washington, DC - NW #1

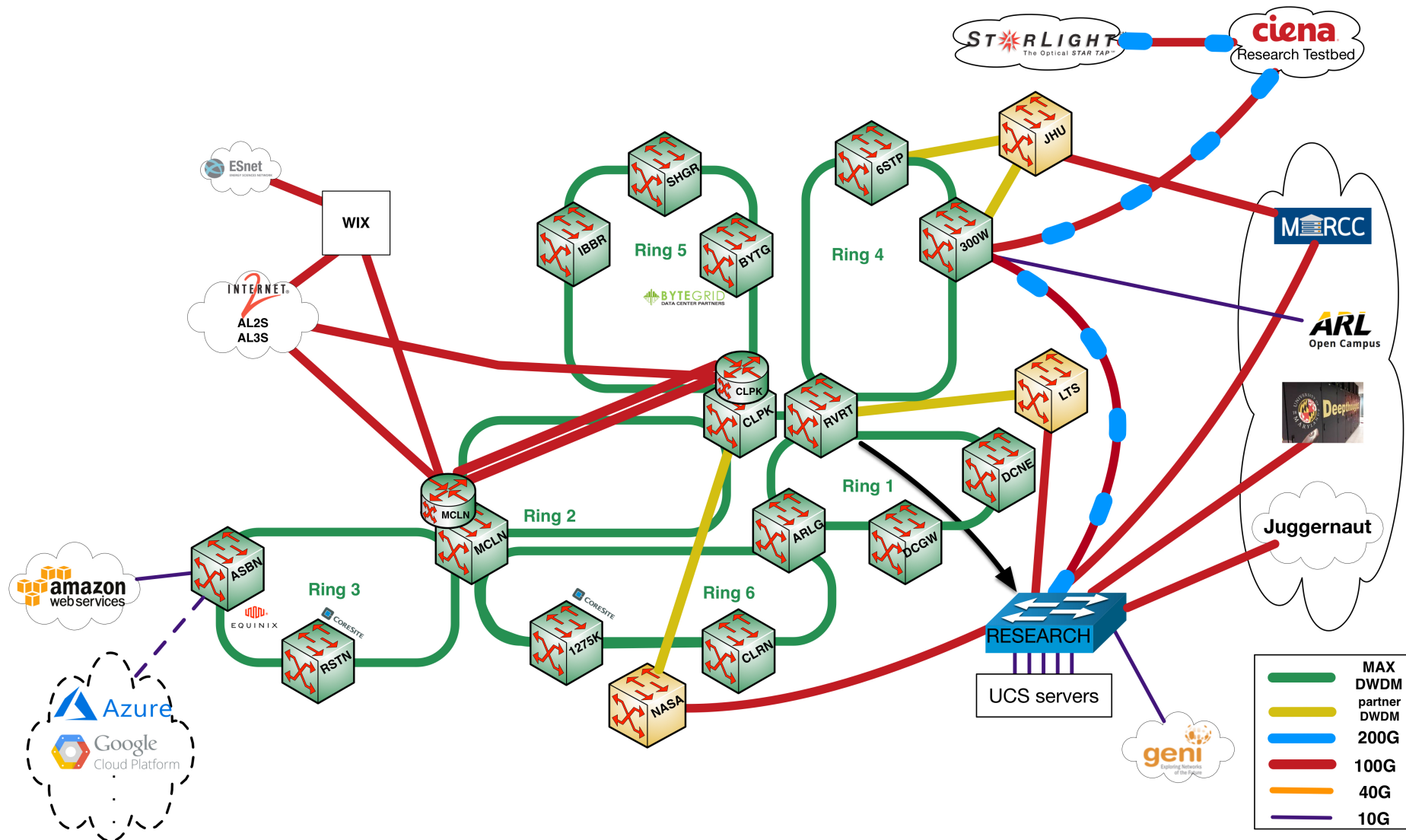
Washington, DC - NW #2

MAX Network Topology

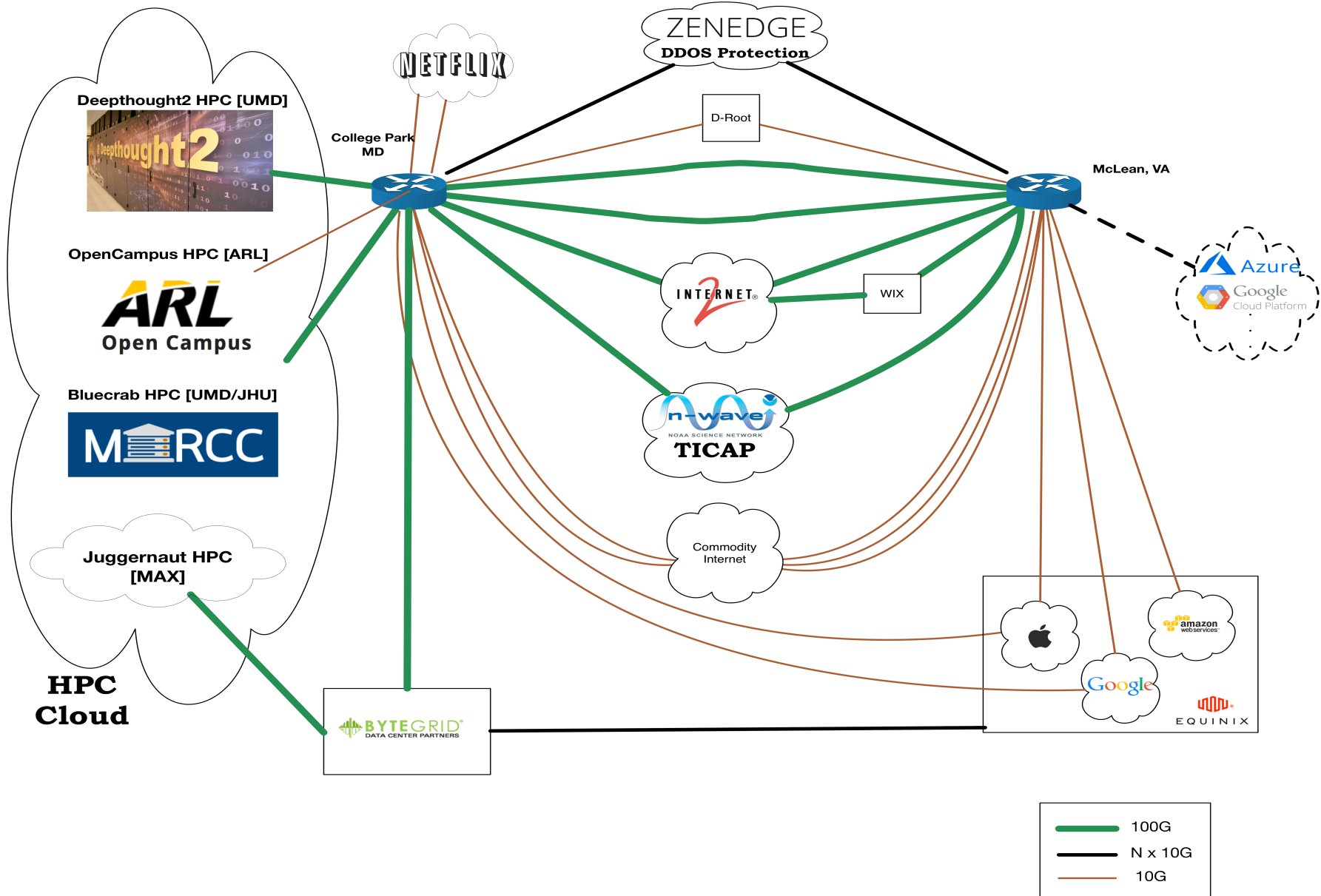


MAX DWDM	MAX DWDM
partner DWDM	partner DWDM
200G	200G
100G	100G
40G	40G
10G	10G

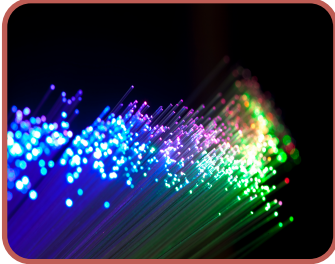
MAX Research Network Topology



MAX Service Panel

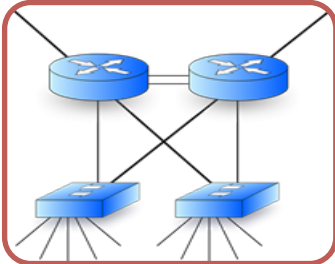


MAX Cyberinfrastructure Platform by the Numbers



MAX optical (DWDM) network

- Current capacity: 88 lambdas (Each lambda can be 10G or 100G in speed)
- Current deployed 100G lambdas: 12 plus two additional for SC17 = 14 total
- Current deployed 10G lambdas: 25



MAX routed network

- Backbone Capacity: 200 Gbps
- Normal traffic: 35 Gbps
- Peak traffic: 65 Gbps
- External traffic off-load capacity: 430 Gbps
- Normal traffic: 75 Gbps
- Peak traffic: 160 Gbps

MAX Network Peering

National Mission Networks

- DREN (DoD) • ESnet (DOE) • Internet2 (I2) • NASA–NISN • N-Wave (NOAA)

International Networks at WIX

- ACE/GEANT (European R&E network) • SINET (Japanese R&E network)

Higher Education and State Networks

- MDREN • Network Maryland

Cloud and CDN Networks

- Apple • Amazon/AWS • Google • Netflix • [Azure, GCP]

Commodity Networks and Datacenters on-net

- CenturyLink • Cogent • Level3 • Telia Sonera • Zayo
- ByteGrid • Coresite • Centurylink • Equinix • Level3

Trusted Internet Connection (TIC)

- In partnership with NOAA, MAX hosts a TIC and offers TICAP services



The diagram is a stylized representation of a classical building with four pillars. At the top is a blue triangular pediment containing the title 'Four Pillars of MAX'. Below the pediment is a horizontal blue bar labeled 'MAX PARTICIPANTS'. The four pillars are blue rectangles, each with a vertical label: 'NETWORK', 'SERVICES' (which has an orange-to-blue gradient), 'RESEARCH', and 'INNOVATION'. The pillars rest on a two-tiered blue base.

Four Pillars of MAX

MAX PARTICIPANTS

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MAX Services

Current Services
Layer 3 – IP Routed (R&E) Service
1G
10G
100G
Layer 2 – Ethernet Transport Service
1G
10G
Layer 1 – DWDM Transport Service
10G
100G
Data Center
Access to on-net data centers

Current Services
IP Commodity Routes
Commercial Providers
TR-CPS
Advanced Services
MAX AWS Direct Connect
Research Network Connection
MAX Platinum Service
Access to multiple services
Other Services
Rack Colocation Space
Machine/Virtual Machine Hosting
Remote Hands

MAX Services

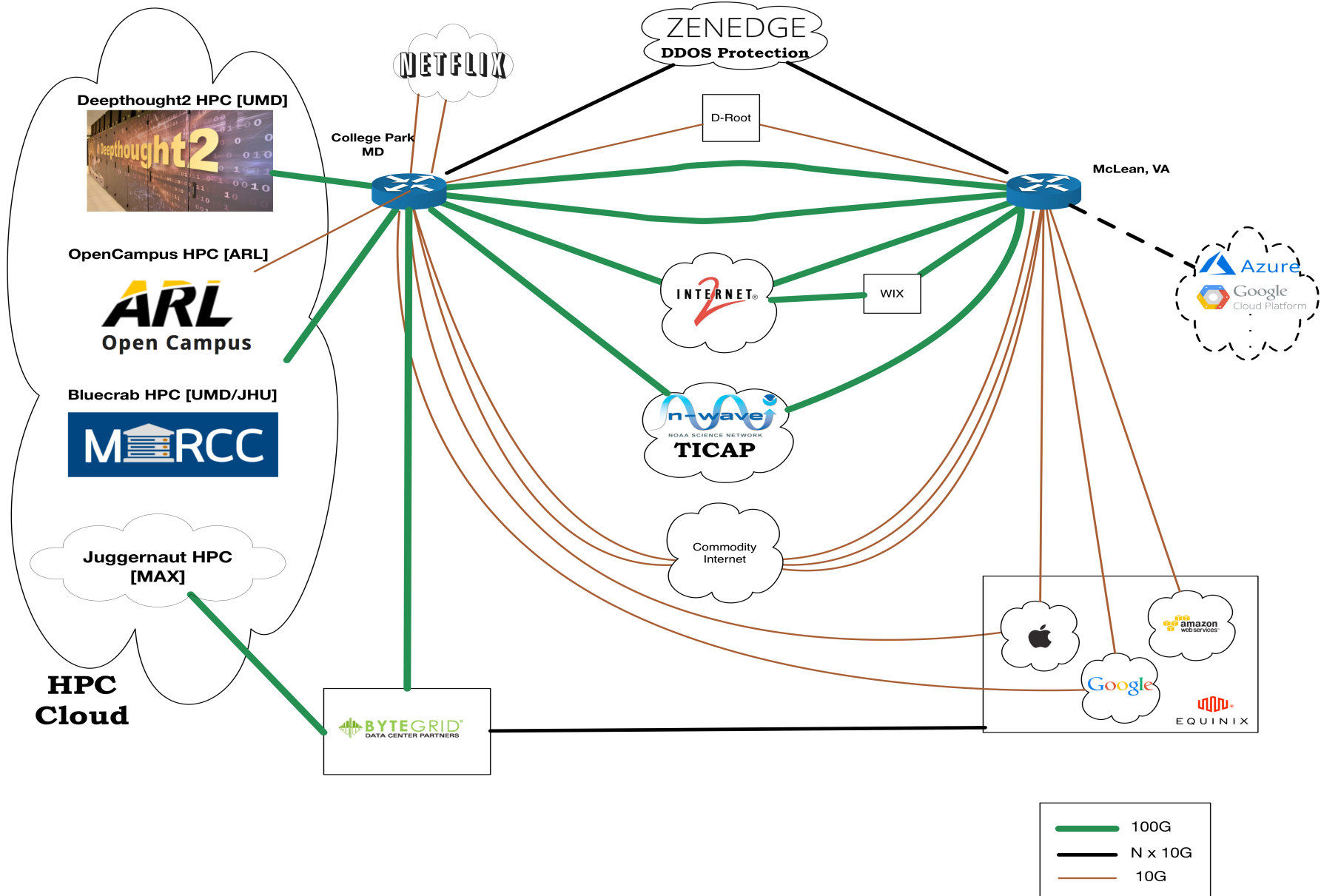
Current Services
Washington International Exchange (WIX)
10G
100G
Next Generation Internet Exchange (NGIX)
1G
10G
100G
HPC Offering
Compute Cloud and Custom Solutions
Security
DDoS
TiCAP

Future Services
Software Defined ScienceDMZ
Advanced Hybrid Cloud Service
Cloud Orchestration
Edge Cloud Connection

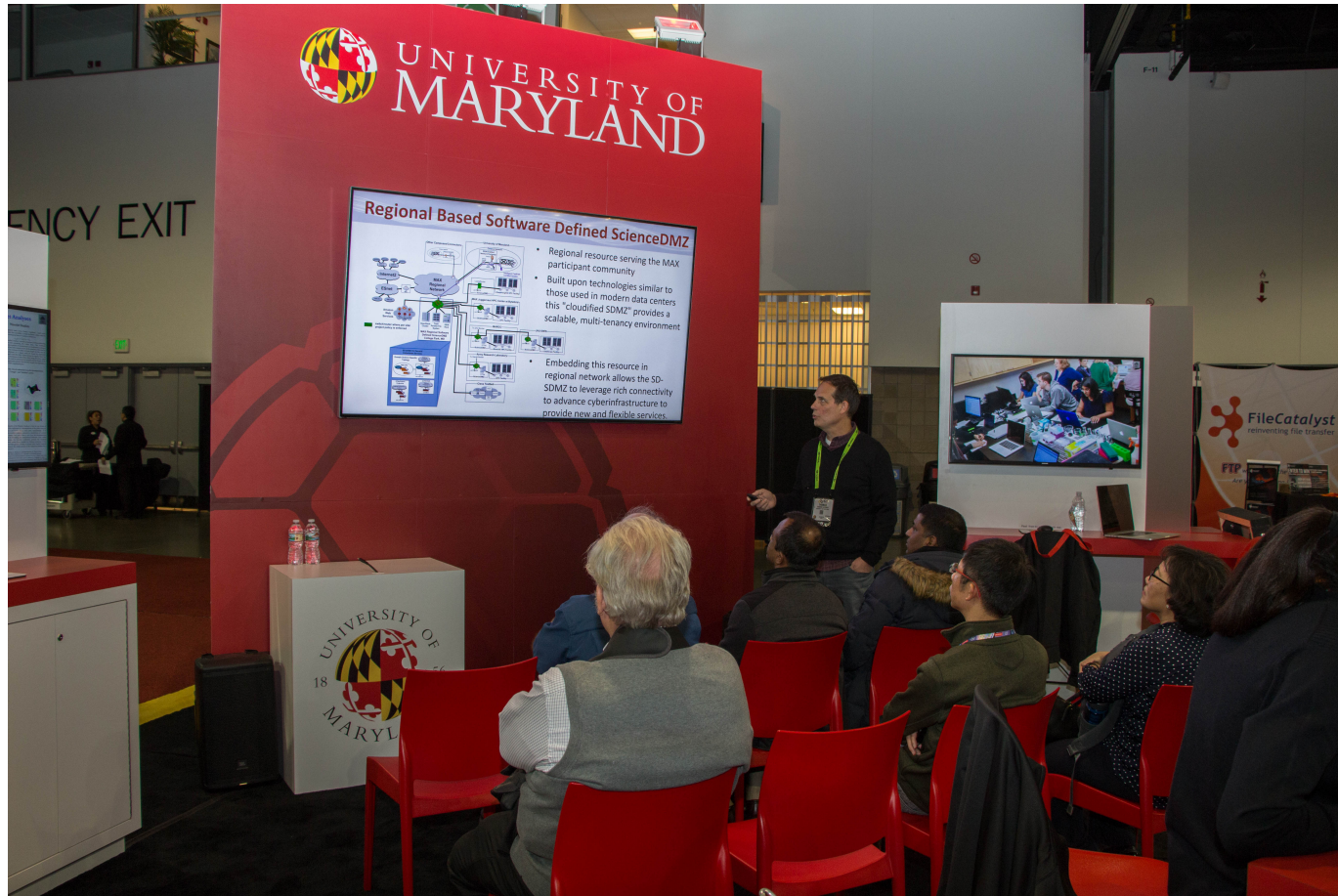


HPC Initiatives

MAX Service Panel



SuperComputing 2017 Denver



SuperComputing 2017 Denver





Global DNS Root Services

Global DNS Root Services

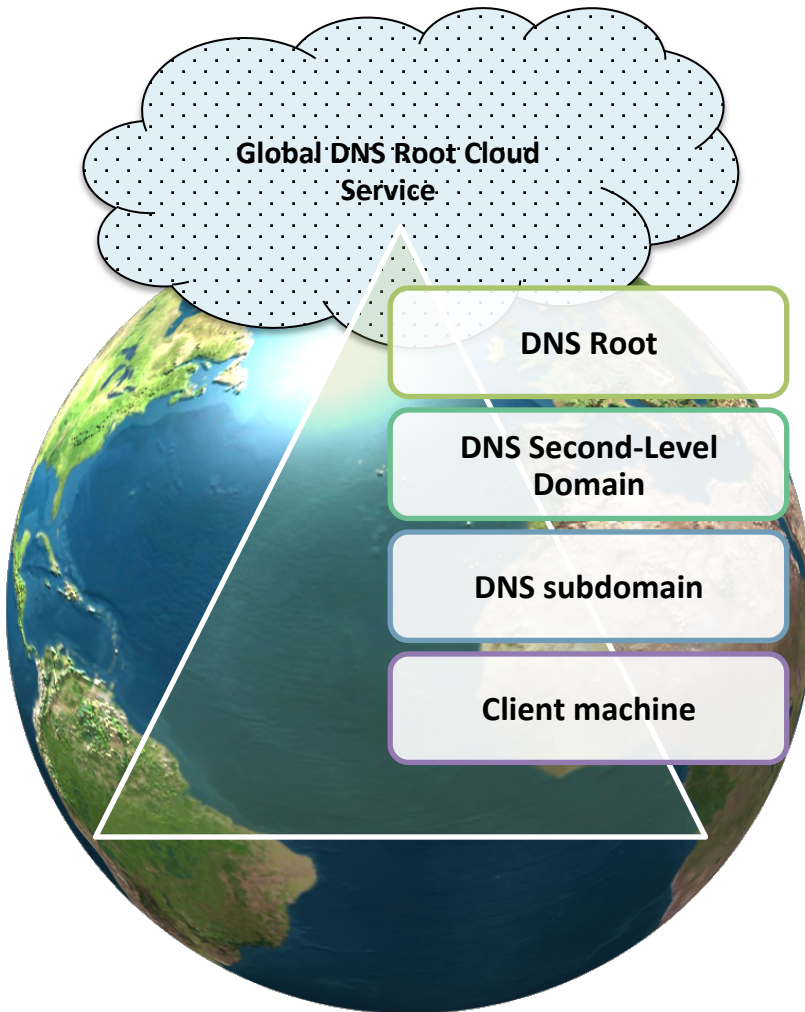
- ❑ UMD operates D-root and has been a steward of this global service since November 18, 1987.
- ❑ One of 12 global organizations that operate 13 root DNS servers
- ❑ 1000+ DNS root server instances in the global DNS root cloud

1. Cogent Communications
2. Internet Corporation for Assigned Names and Numbers (ICANN)
3. Internet Systems Consortium
4. NASA Ames Research Center
5. Netnod
6. Réseaux IP Européens Network Coordination Centre
7. **University of Maryland**
8. University of Southern California
9. U.S. Department of Defense Network Information Center
10. U.S. Army Research Laboratory
11. Verisign
12. WIDE Project and Japan Registry Services

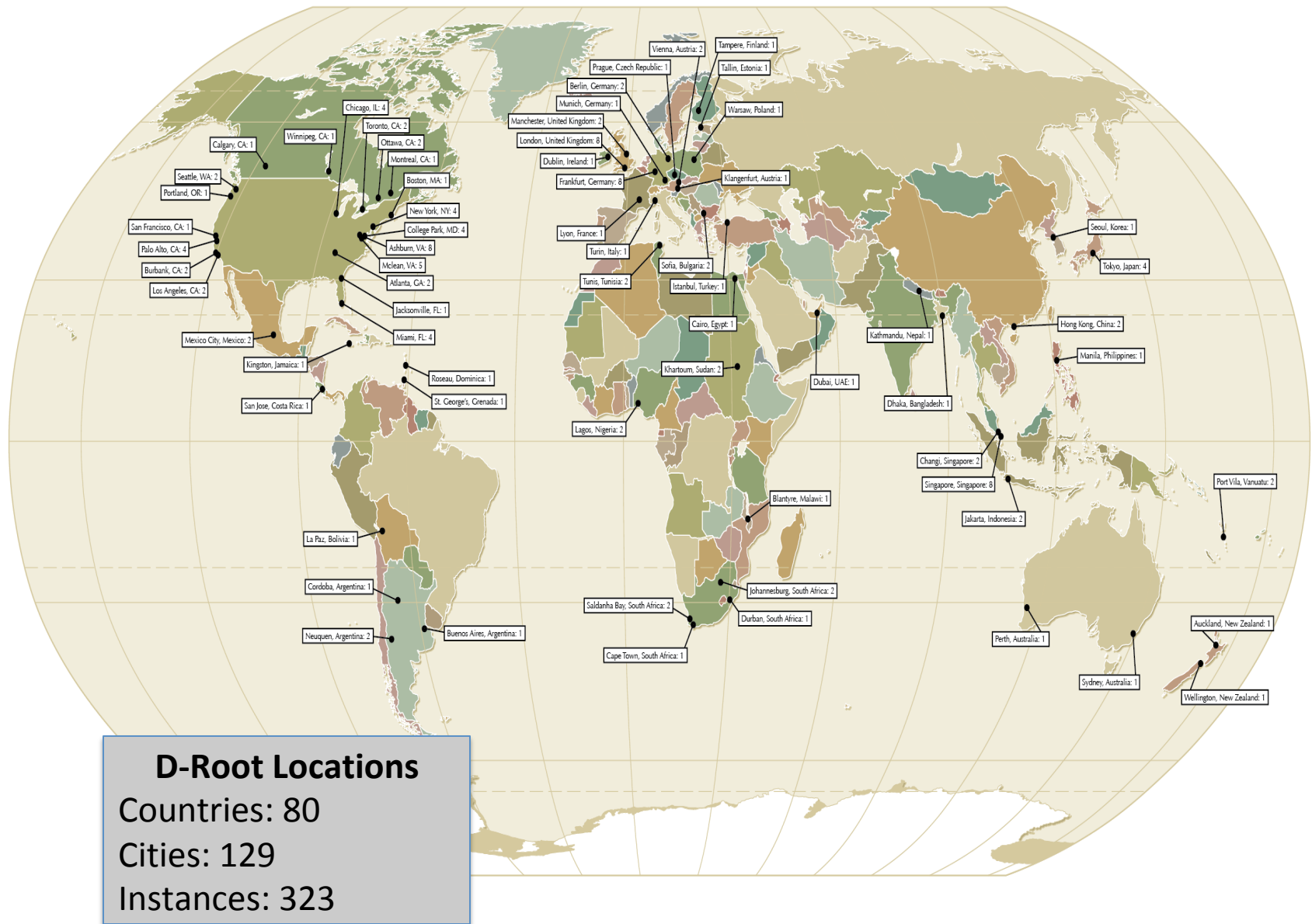
- ❑ UMD and Verisign co-chair the global advisory committee – Root Server System Advisory Committee (RSSAC) – to the ICANN board to advise on matters pertaining to the security and stability of the global DNS root server system.

- ❑ Useful URLs:

- <http://root-servers.org/>
- <http://icann.org/>
- https://en.wikipedia.org/wiki/Root_name_server



DNS Queries to D-Root on April 19, 2018: 4,720,983,991



Happy 30th D-root!



Happy 30th D-root!





The diagram is shaped like a classical building. At the top is a blue triangular pediment containing the title. Below it is a horizontal blue bar. The main body consists of four vertical rectangular pillars. The first two pillars are blue and labeled 'NETWORK' and 'SERVICES'. The last two pillars are orange and labeled 'RESEARCH' and 'INNOVATION'. The text in all pillars is oriented vertically. At the base of the pillars are two horizontal blue bars of increasing width.

Four Pillars of MAX

MAX PARTICIPANTS

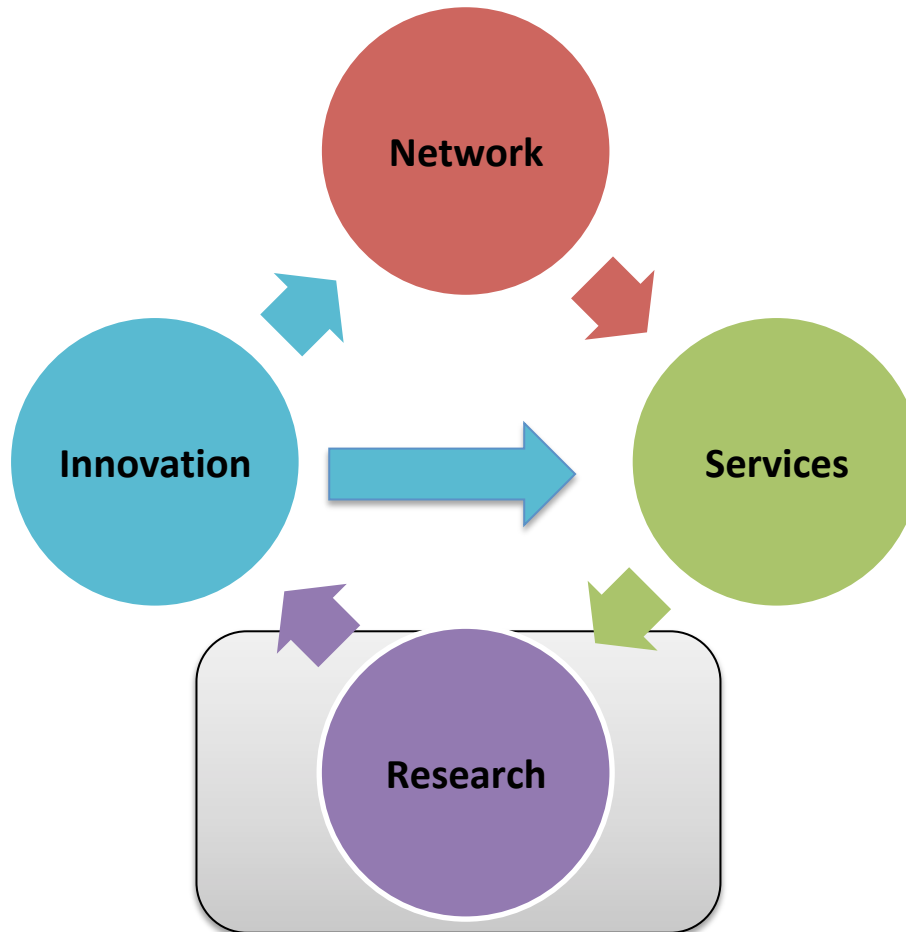
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The cycle of innovation and advanced services



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New MAX Pilot Service Announcements

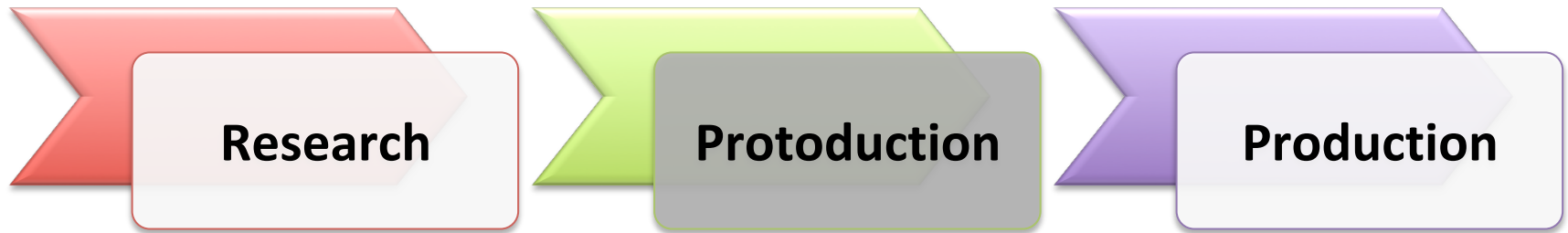
1. Advanced Hybrid Cloud Service

- ☐ Pilot Service on the “Protoduction” MAX Software Defined Science DMZ (SD-SDMZ)

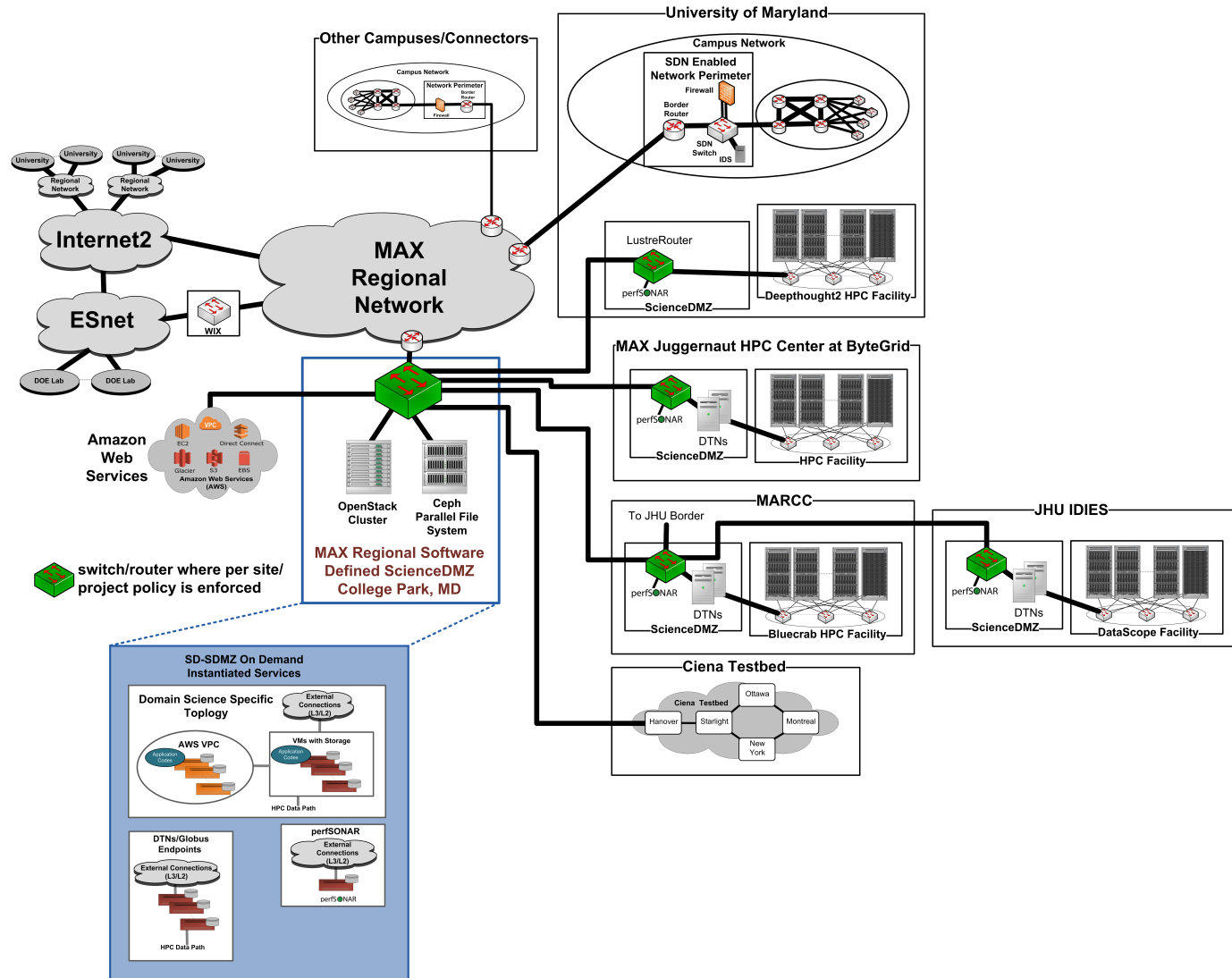
2. EdgeCloud Connection Service

- ☐ Pilot Service across production infrastructures of Internet2 AL2S, Washington International Exchange (WIX), and AWS
- ☐ MAX and Internet2 Collaboration

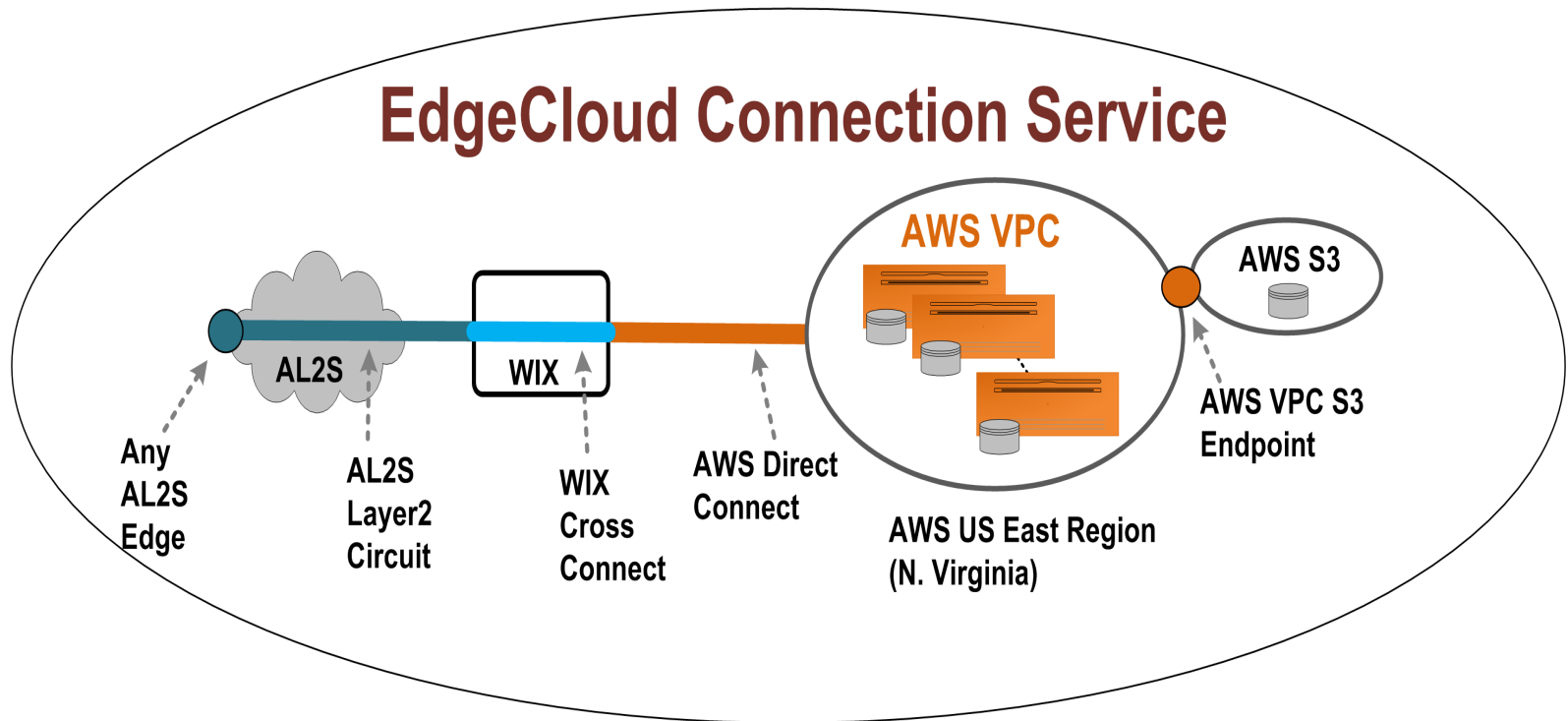
From Innovation to Service



Regional Based Software Defined ScienceDMZ



EdgeCloud Connection Service



- **Connect to AWS US East Region via AWS Direct Connect from any AL2S Edge**
- **Orchestration of AL2S, WIX, and AWS Direct Connect Provisioning**
- **MAX and Internet2 collaboration on Pilot Service**

Global Environment for Network Innovations (GENI)

10-year anniversary!

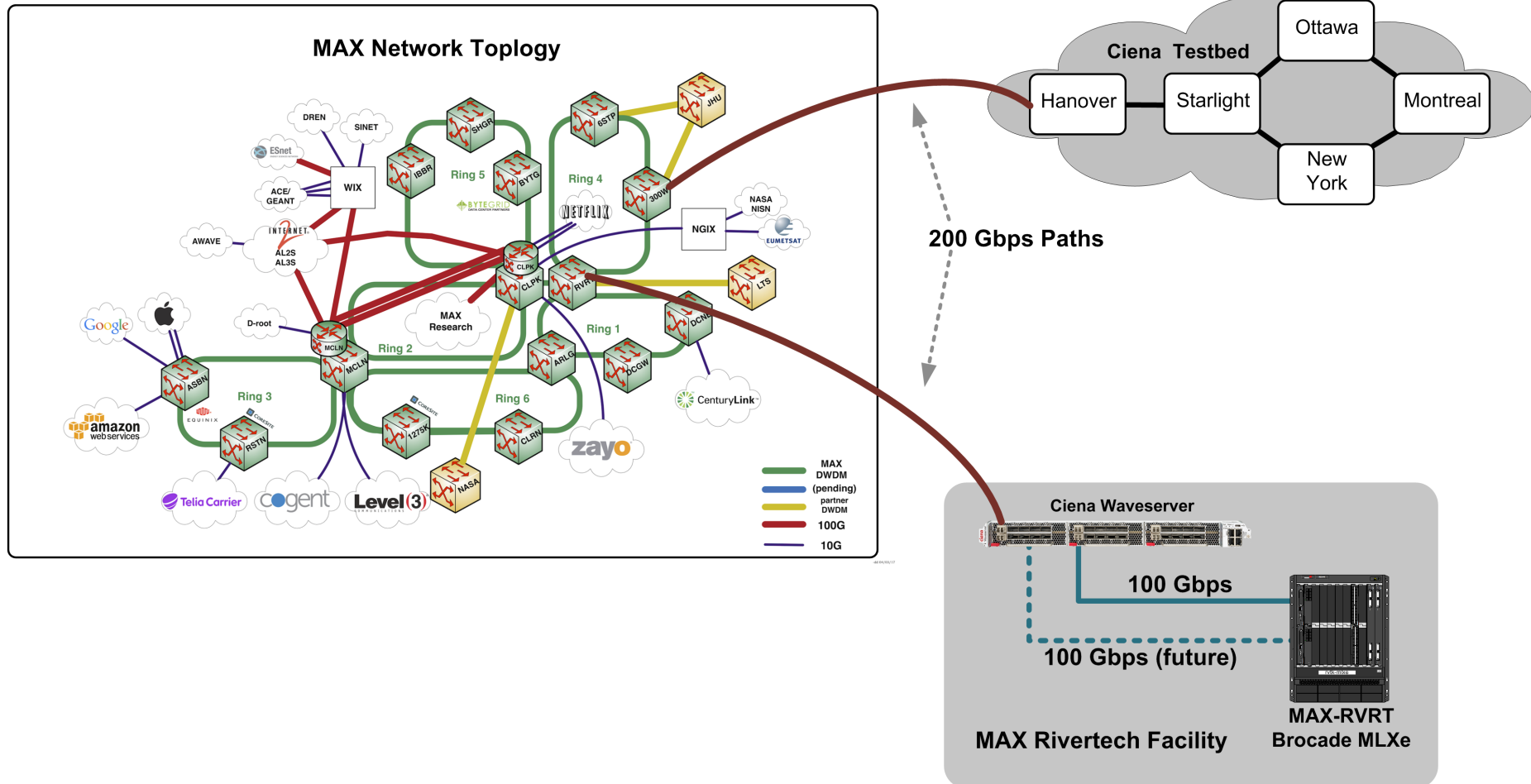


- ❑ virtual laboratory for exploring future internets at scale and their interactions with society (www.geni.net)
- ❑ *A large-scale experiment infrastructure..* GENI Resources deployed at over 60 Universities and other organizations throughout the R&E community.
- MAX hosts an InstaGENI Rack, and is one of the facilities in the Federated GENI Distributed Testbed
- MAX involvement in GENI system development since 2009.
- The MAX team - Tom Lehman and Xi Yang- developed:
 - the **GENI Stitching Architecture and the Stitching Computation Service (SCS)**.
Stitching enables the dynamic establishment of layer2 connections between GENI Racks. There were over 1700 GENI Stitching events across AL2S in 2017.
- MAX is also developing **GENI Aggregate Managers** to cover Software Defined Exchanges (SDX) and Software Defined ScienceDMZs (SD-SDMZ). This includes enabling access to public cloud providers via standard GENI mechanisms.



MAX – Ciena Partnership

MAX – Ciena Partnership





MAX Edge and Cloud Services

Tom Lehman, MAX