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Case Study – Bioinformatics Research and Education at Arcadia University

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ARCADIA
UNIVERSITY
FOUNDED 1853

Arcadia University & CSMA

Arcadia

- 4,000 students
- Study abroad program
  - A few buildings in Europe
- Colocation in Valley Forge
- Limited SAN
- 5G with Cogent (burstable to 10G)
  - It was 1G just a few weeks ago
  - 10G with KINBER incoming
- Data Science programs in progress

CSMA

• Math majors:	100
• Computer science majors:	100
• Full-time faculty:	10
• Research-oriented faculty:	8
• Clusters/HPC:	none

- Labs: 3 rooms, ~20 PC/Mac each

Bioinformatics

- Interdisciplinary minor
  - Co-taught by three faculty (2 CS and 1 Biology)
- Students are mostly from CS, Math, or Biology
- Some of the core courses
  - Bioinformatics, Intro to Data Mining, Computer & Scientific Ethics, Probability, Elementary Statistics, Biology, Programming I
- Some of the electives
  - Biochemistry
  - Artificial Intelligence
  - Advanced Data Mining
  - Intermediate Statistics

Bioinformatics: Education

- Genomics Education Partnership (GEP, ~60 schools)
- Data from National Center for Biotechnology Information (NCBI)
- Public Galaxy server
- Tools: Basic Local Alignment Search Tool, Python, Anaconda, BIoPython, Jupyter, GenScan, Tuxedo Suite of Tools, etc.

Bioinformatics: Research

- Illumina Miniseq + just purchased another sequencer
- Undergraduate projects
  - Capstone
  - Research
  - Bioinformatics course

Bioinformatics: Project Examples

- Projects using NCBI and GEP resources
  - DNA of species
  - SNPS in human genome
  - Hormonal response elements in the genome
  - Palindrome occurrences in virus’ RNA
    - RNA viral info

Bioinformatics: Challenges

- Public Galaxy server is slow
- Lab machines cannot do it either
  - 3M RNA to analyze :: 2 days :: 15 GB data => resource exhaustion
- Arcadia
  - Little-to-no storage capacity for genomics data
    - Existing storage does not segregate/limit users, no security
  - No computing capacity to process on premise
  - No ScienceDMZ to transfer big data
  - Multiple single points of failure (authentication, network)
  - Other researchers transfer data using their personal hard drives

Bioinformatics: Solutions

- NSF CC* Network Design Grant (July 9, 2018)
  - ScienceDMZ (DTN + SAN + perfSONAR + Globus)
  - KINBER -> Regional Networks + Internet2 + Cloud

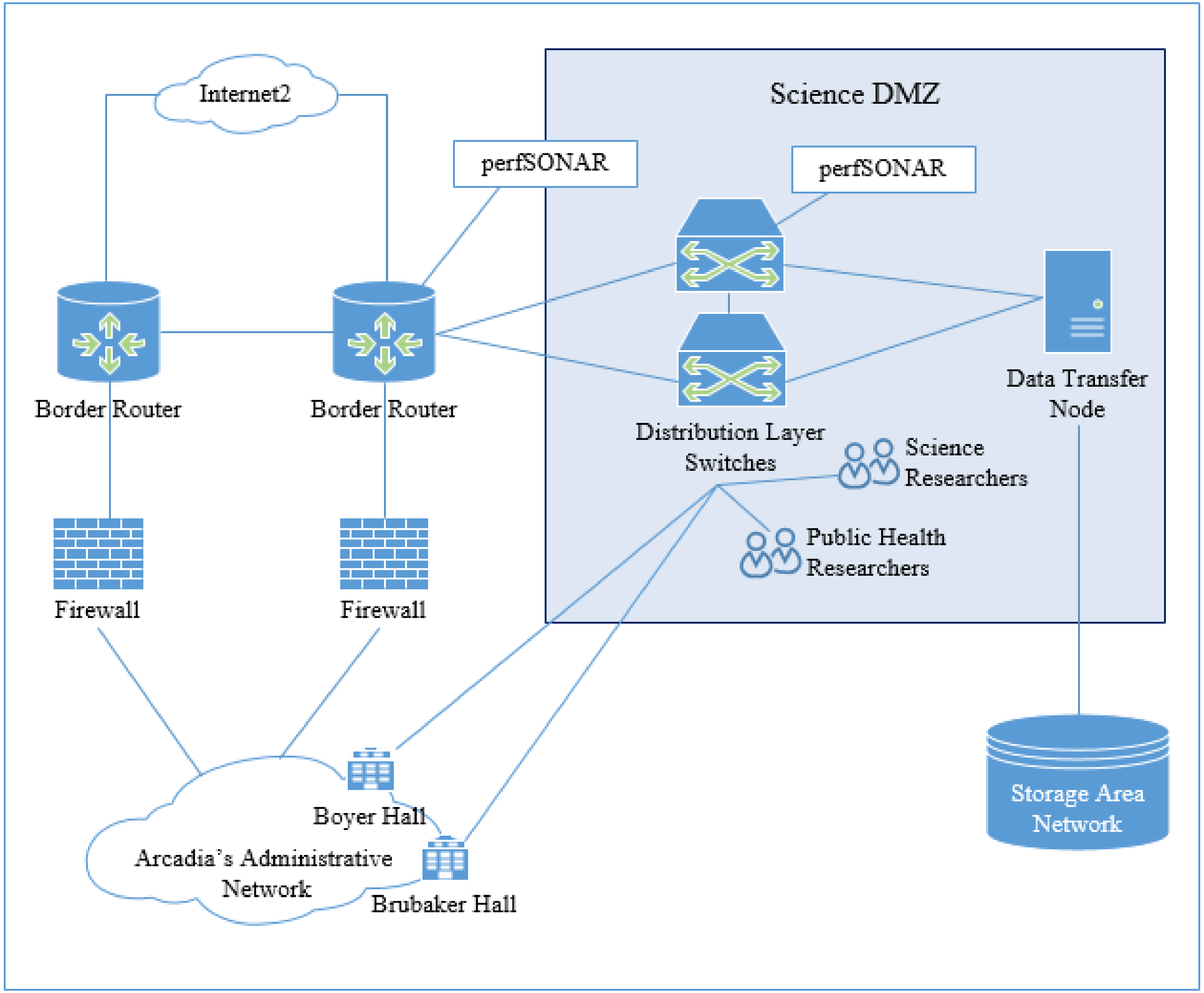
- In progress: administration buy-in into the IT development

NSF CC* Network Design: Arcadia Team

- PI: Leslie Margolis Interim CIO
- Co-PI: Vitaly Ford Assistant Professor
- Science Advisory Committee
    - Associate Provost
    - College of Arts and Sciences Dean
    - College of Health Sciences Dean
- John Zottola, Director of Infrastructure Management
- Office of Sponsored Research and Programs

NSF CC* Network Design Grant

- Science Drivers
  - Bioinformatics
  - Computer Science
  - Chemistry/Physics
- Broader Impacts
  - Communications & Media
  - Physical Therapy (video recordings)
  - Health Science (Fox Chase/Temple Health, UMD, several more)


Internet2
perfSONAR
Science DMZ
perfSONAR
Border Router
Border Router
Data Transfer Node
Distribution Layer Switches
Science Researchers
Public Health Researchers
Firewall
Firewall
Boyer Hall
Arcadia's Administrative Network
Brubaker Hall
Storage Area Network

Back to the Future: 2-5+ years

- Cogent (5-10G) + KINBER (10G) redundant connectivity
- No single point of failure
- AWS (CloudLab, and other) for short-term computing
  - Individual Galaxy servers on AWS per student
- XSEDE/ERN?/VDC? resources
- HPC on premise for long-term computing

Back to the Future: Research Opportunities

- Sequencing and storage on premise
- Secure storage
- Bioinformatics projects that work
- Frictionless connection / data sharing with collaborators
- Publications based on the data generated by the sequencers
- Cloud computing and local storage after computation is done

Future Challenges (2+ years)

- Faculty awareness that ScienceDMZ exists
- Faculty training on Globus, Cloud, etc.
- Faculty one-on-one meetings

Suggestions? Solutions?

Questions?