ACI REF

Introduction to OpenFlow
and Why it Matters to You

https://github.com/downloads/mininet/mininet/mininet-2.0.0-113012-amd64-ovf.zip

ACI REF

Introduction to OpenFlow and Why it Matters to You

Goals of the Presentation

- Arm you with a basic understanding of computer networks so that you can provide justification for your “unique” requirements to your fellow IT staff.
- Provide you with a common set of nomenclature that you can use when conversing with research peers regarding data exchange.

Overview

- The Evolution of the Science DMZ
- Software Defined Networking and its Components
- OpenFlow and Why it Matters

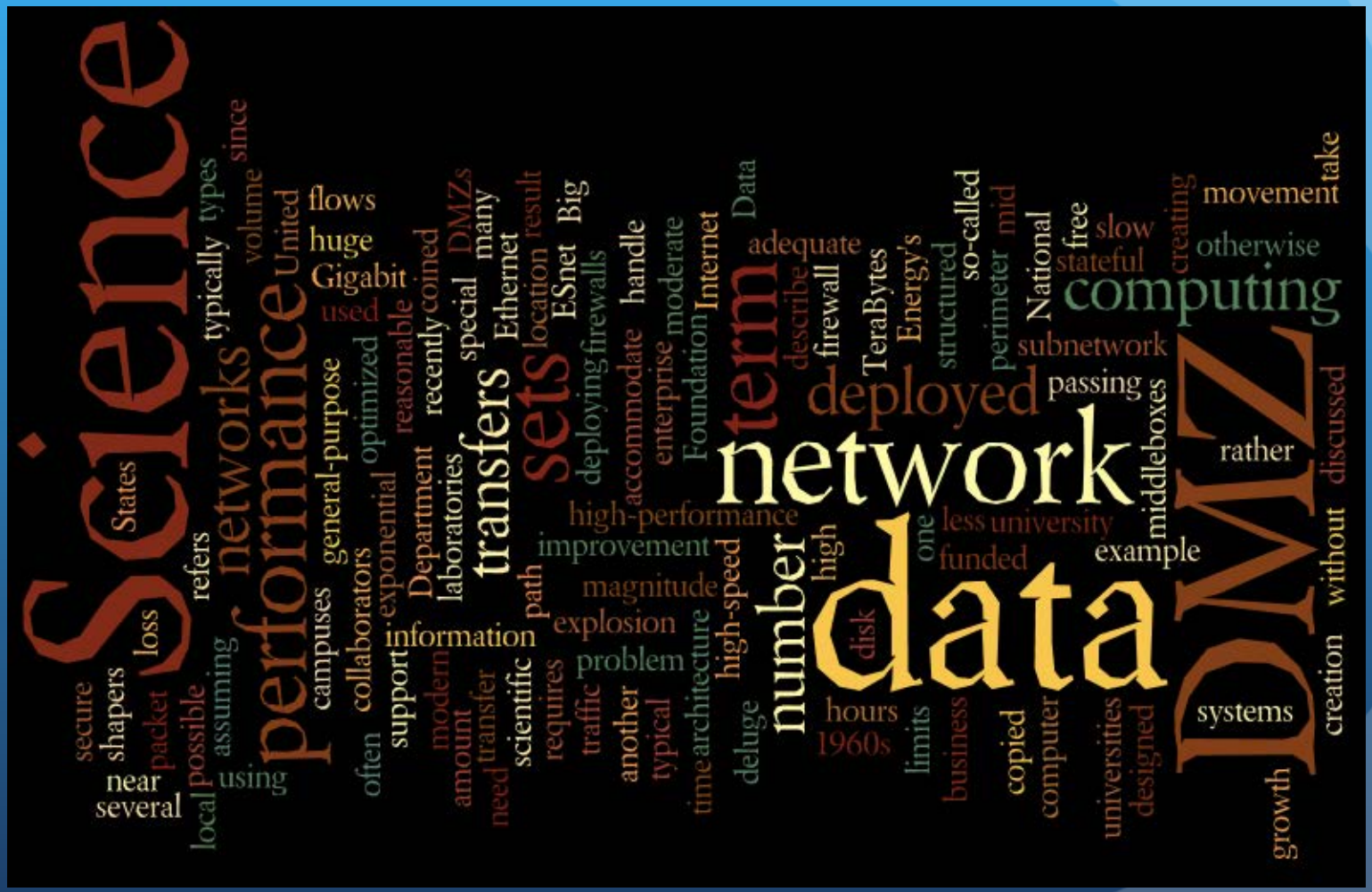
The Definition of Science DMZ

Wikipedia Definition:

"The term Science DMZ refers to a computer subnetwork that is structured to be secure, but without the performance limits that would otherwise result from passing data through a stateful firewall. The Science DMZ is designed to handle high volume data transfers, typical with scientific and high-performance computing, by creating a special DMZ to accommodate those transfers. It is typically deployed at or near the local network perimeter, and is optimized for a moderate number of high-speed flows, rather than for general-purpose business systems or enterprise computing."

http://en.wikipedia.org/wiki/Science_DMZ_Network_Architecture

The “Wordly” of Science DMZ



The Evolution of Science DMZ

Corporate Environment:

Offer Goods and Services

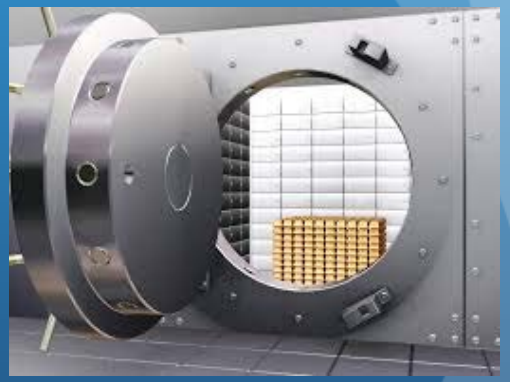
The Evolution of Science DMZ (cont.)

Corporate Environment:

Lock them away in an “online” experience.

The Evolution of Science DMZ (cont.)

Corporate Environment:



And make them available when someone is willing to pay…

The Evolution of Science DMZ (cont.)

Corporate Environment:

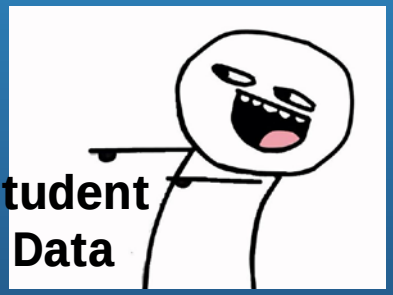
"It's just good business…"

The Evolution of Science DMZ (cont.)

Academic Environment:

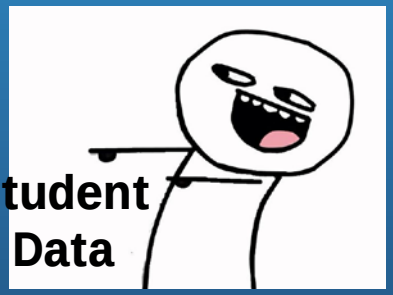
The Evolution of Science DMZ (cont.)

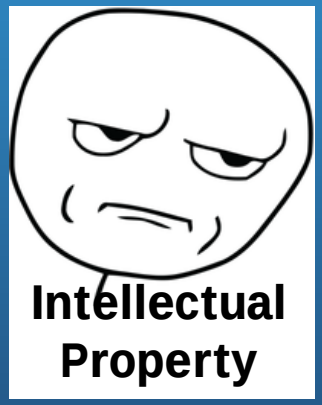
Academic Environment: A stark contrast…



The Evolution of Science DMZ (cont.)

Academic Environment: A stark contrast…





The Evolution of Science DMZ (cont.)

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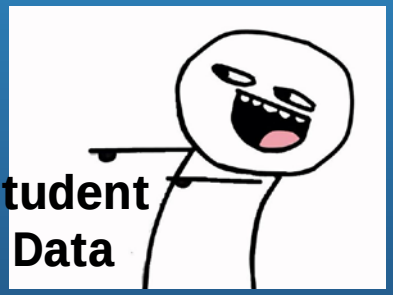

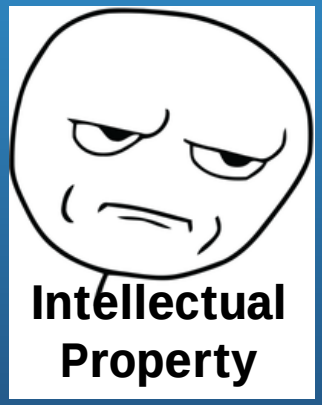

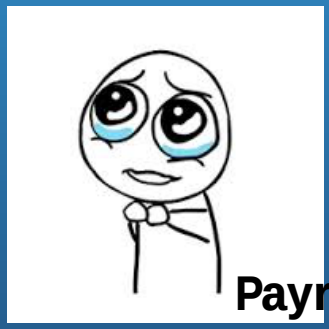

The Evolution of Science DMZ (cont.)

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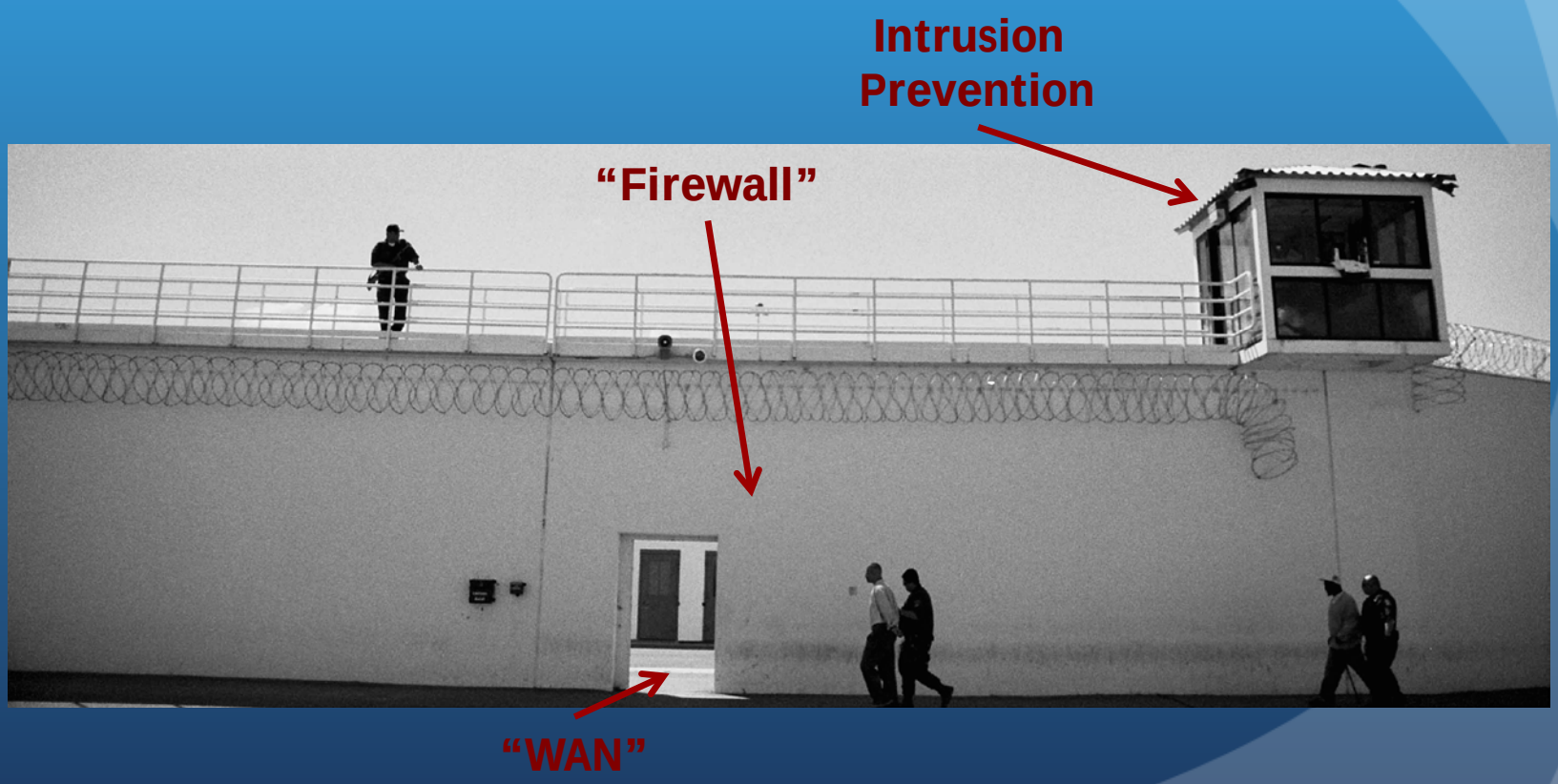
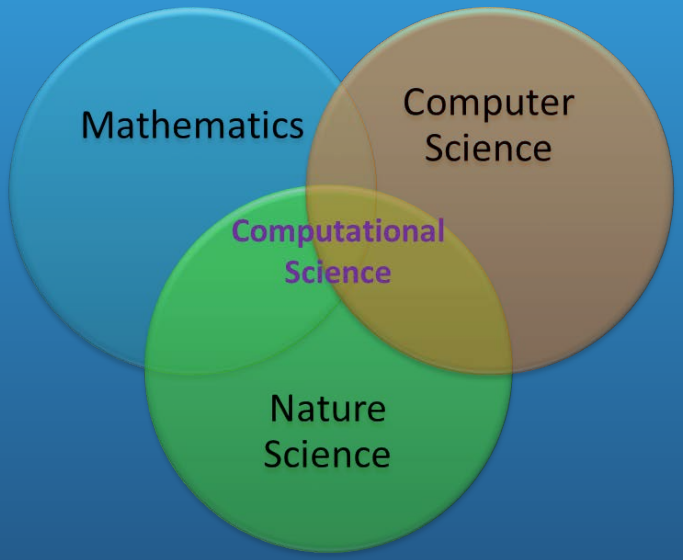


The Evolution of Science DMZ (cont.)

Academic Environment: A stark contrast…

The Evolution of Science DMZ (cont.)

Academic Environment: Enter Computational Research…



The Evolution of Science DMZ (cont.)

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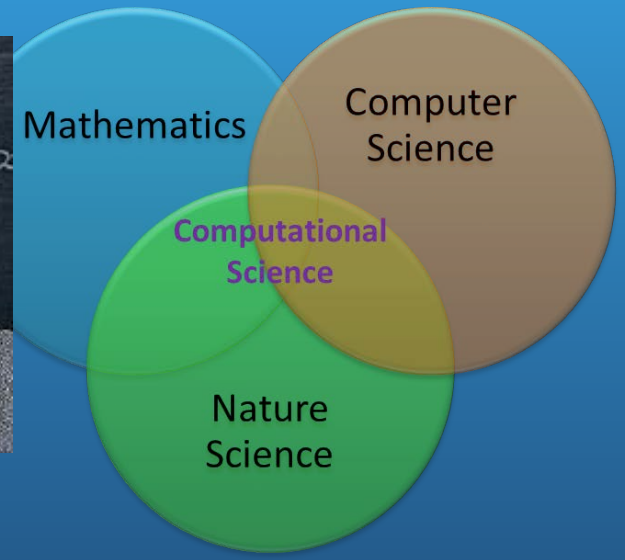

The Evolution of Science DMZ (cont.)

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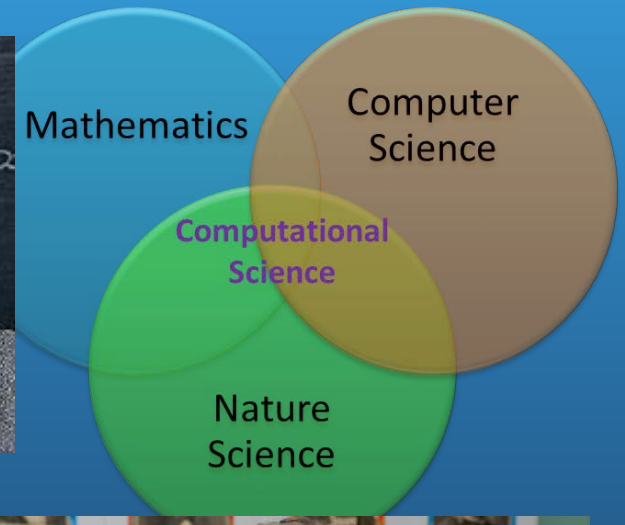

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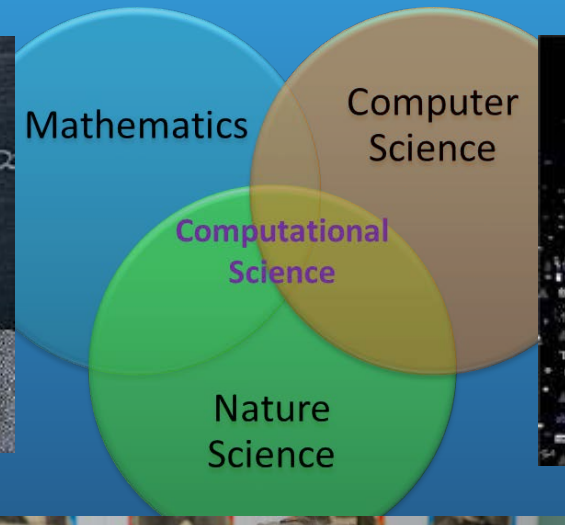

The Evolution of Science DMZ (cont.)

The Evolution of Science DMZ (cont.)

Computational Research and an Analogy…

Computational Research

The Evolution of Science DMZ (cont.)

Computational Research and an Analogy…

Computational Research

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The Evolution of Science DMZ (cont.)

Computational Research and an Analogy…

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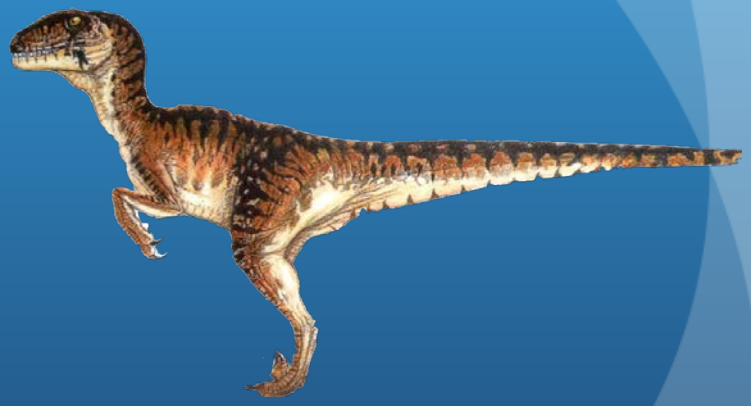

Velociraptor

The Evolution of Science DMZ (cont.)

Computational Research and an Analogy…

Computational Research

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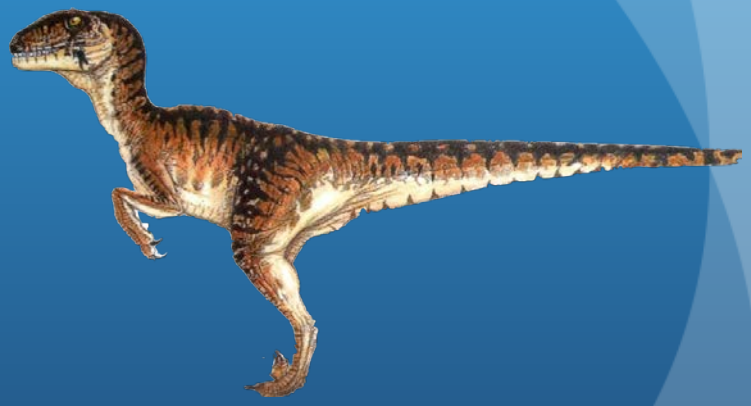


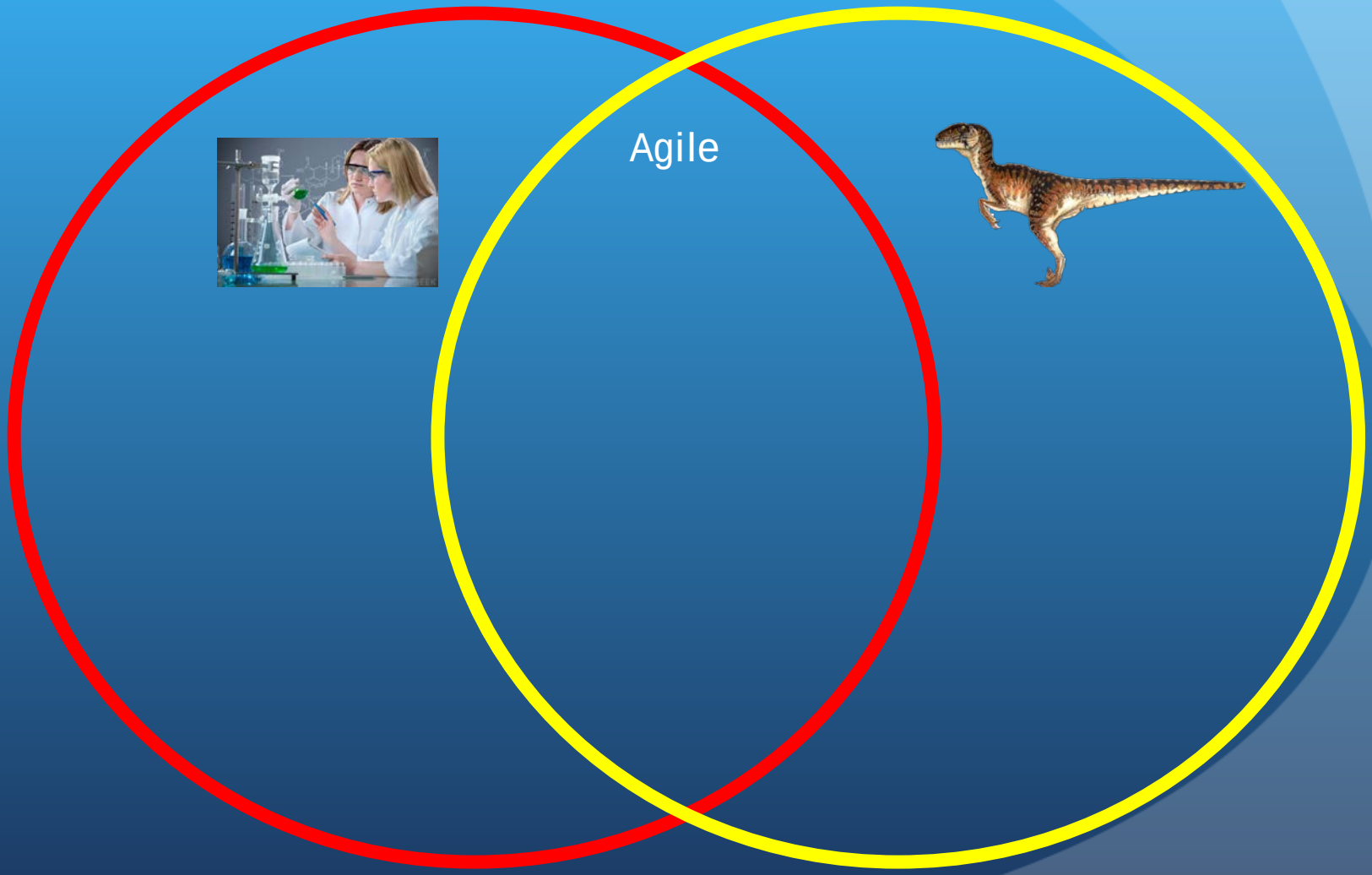
Velociraptor

The Evolution of Science DMZ (cont.)

Proof that the analogy is valid…

The Evolution of Science DMZ (cont.)

The Evolution of Science DMZ (cont.)



The Evolution of Science DMZ (cont.)

Agile

Moves Rapidly

The Evolution of Science DMZ (cont.)

Agile

Moves Rapidly

More Effective
In Groups

The Evolution of Science DMZ (cont.)

Agile

Moves Rapidly

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Consumes All
Available Resources

The Evolution of Science DMZ (cont.)

Agile

Moves Rapidly

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Cool!

The Evolution of Science DMZ (cont.)

Is not reptile

Agile

Moves Rapidly

More Effective
In Groups

Consumes All
Available Resources

Cool!

Is reptile

The Evolution of Science DMZ (cont.)

When Computational Science Meets Traditional Networks

The Evolution of Science DMZ (cont.)

When Computational Science Meets Traditional Networks

The Evolution of Science DMZ (cont.)

When Computational Science Meets Traditional Networks

The Evolution of Science DMZ (cont.)

When Computational Science Meets Traditional Networks

The Evolution of Science DMZ (cont.)

…that is highly important to myself, the educational community, and all of mankind as a whole. It is imperative that this data be ***reasonably secured***; yet, ***available*** to my research peers. The ***datasets are rather large***, as they have been collected over a number of years.

The Evolution of Science DMZ (cont.)

Would it be possible to place this in a ***secure, reliable, flexible, accessible***, as well as ***high performing*** infrastructure?

The Evolution of Science DMZ (cont.)

When Computational Science Meets Traditional Networks

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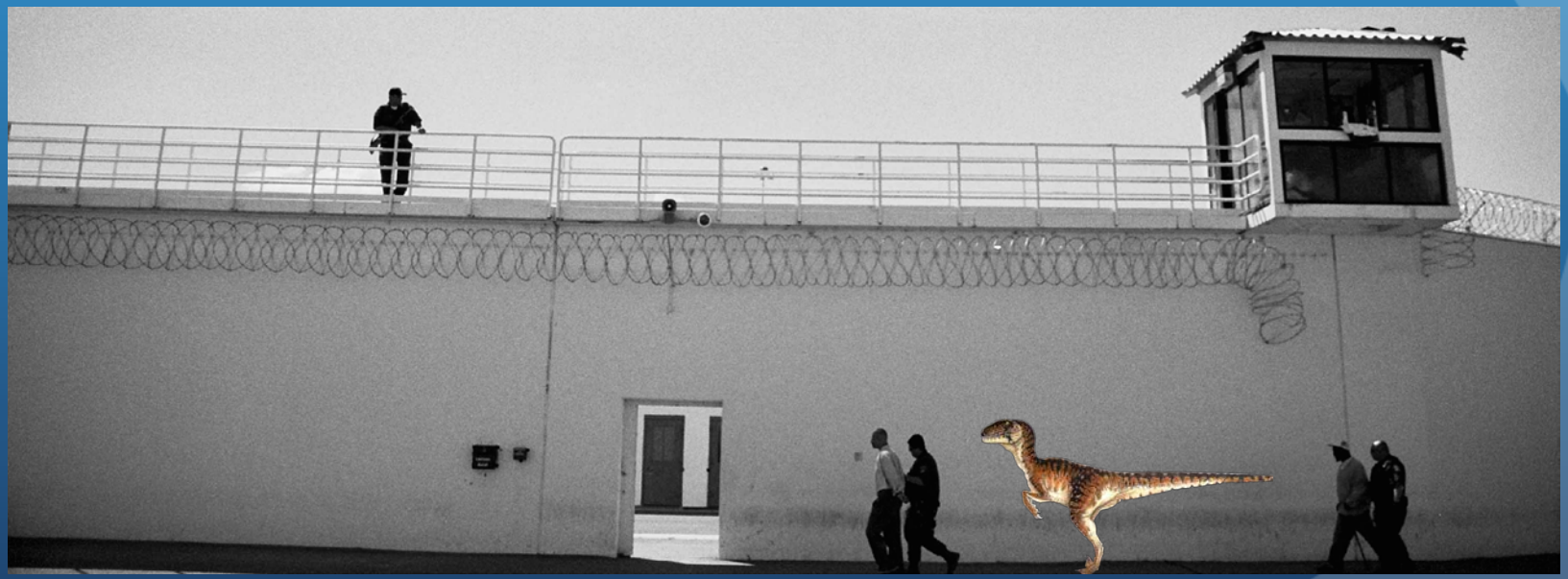

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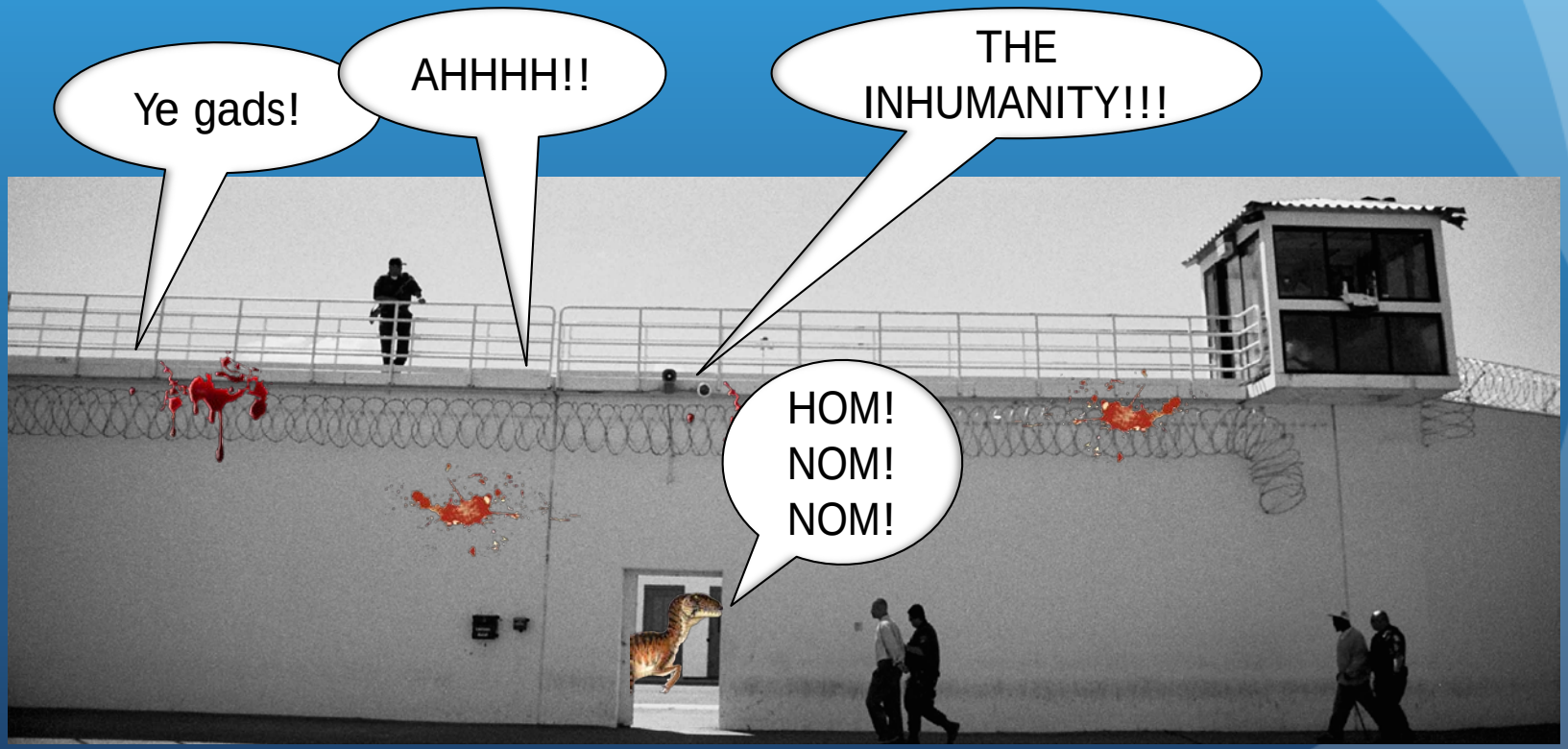
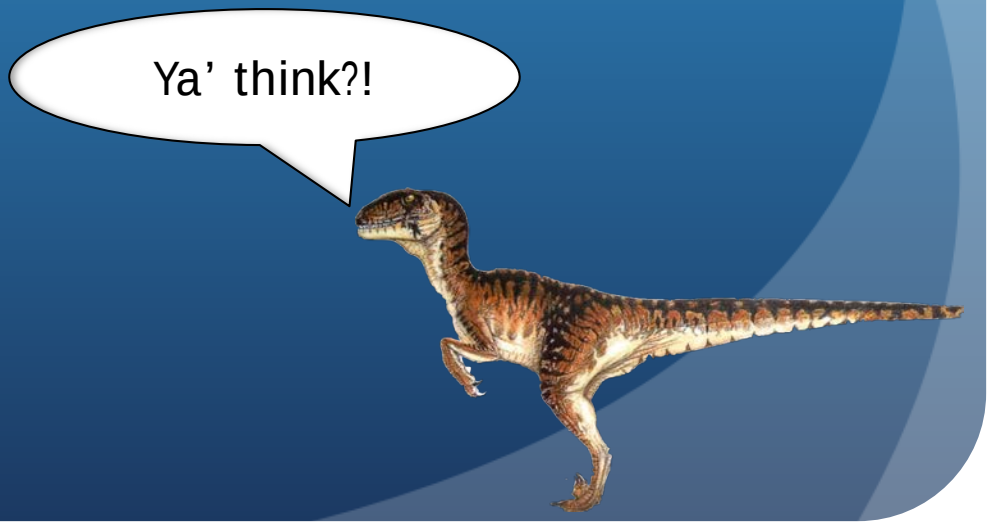


The Evolution of Science DMZ (cont.)

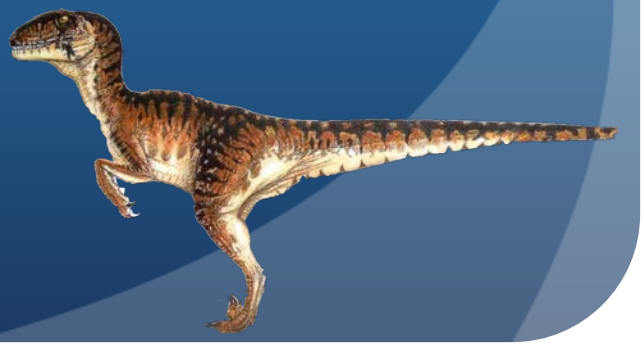
OBSERVATION: The requirements of the computational researcher and the capabilities of the traditional campus computer network do not always align!



The Evolution of Science DMZ (cont.)

This can result in adverse consequences:

- Poor network performance for production systems
- Poor security performance for the campus as a whole
- Bandwidth congestion
- Overutilization of available resources
- Increased Help Desk calls
- General grumbling and complaining



The Evolution of Science DMZ (cont.)

This can result in adverse consequences:

- Poor network performance for production systems
- Poor secu… …mpus as a whole
- Bar…
- Overt…
- Increased Help Desk calls
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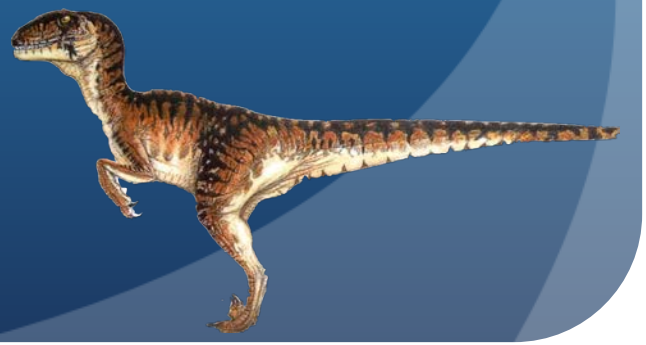
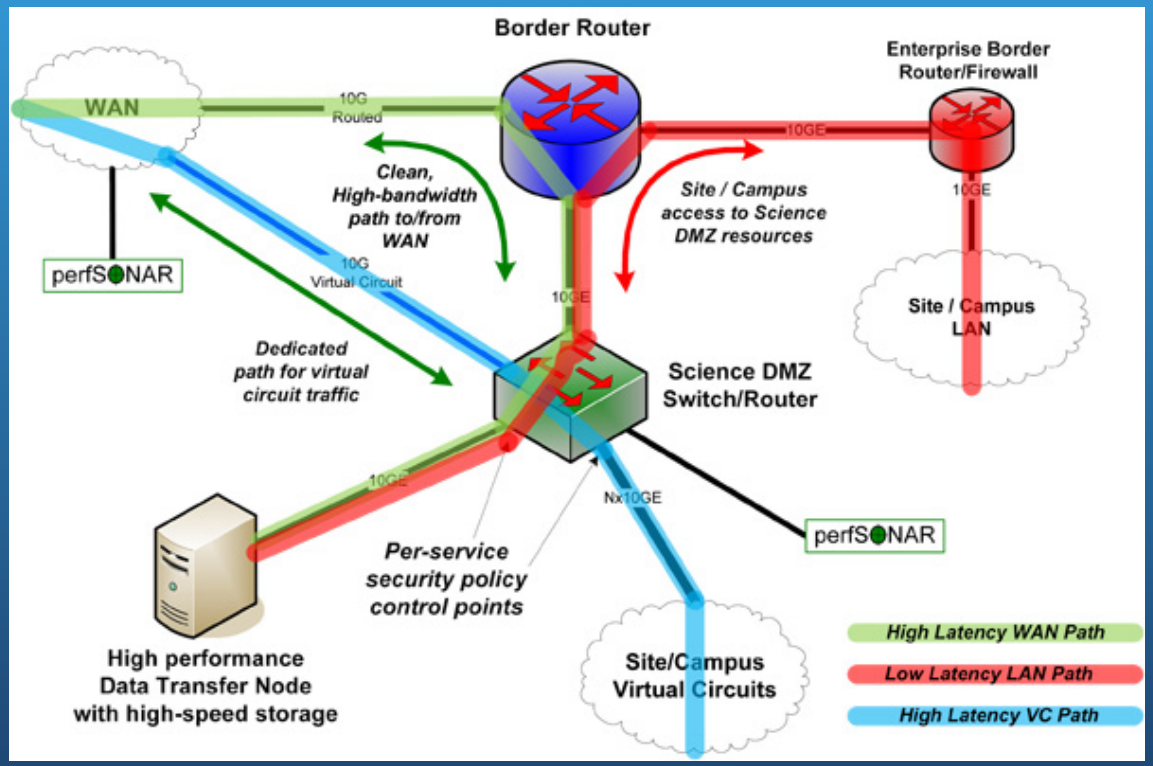
But how do we overcome this? ***I can't stop my research*** just because **the network can't keep up**!



The Evolution of Science DMZ (cont.)

- Enter the Science DMZ!



https://fasterdata.es.net/science-dmz/science-dmz-architecture/

The Evolution of Science DMZ (cont.)

- What makes the Science DMZ important
  - Dedicated Data Transfer Node to ship datasets
  - Dedicated network resources outside of the campus
  - Dedicated, high-speed capacity (typically 10-Gig)
  - Dedicated “circuits” between research sites
  - “Programmable”

The Evolution of Science DMZ (cont.)

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The Evolution of Science DMZ (cont.)

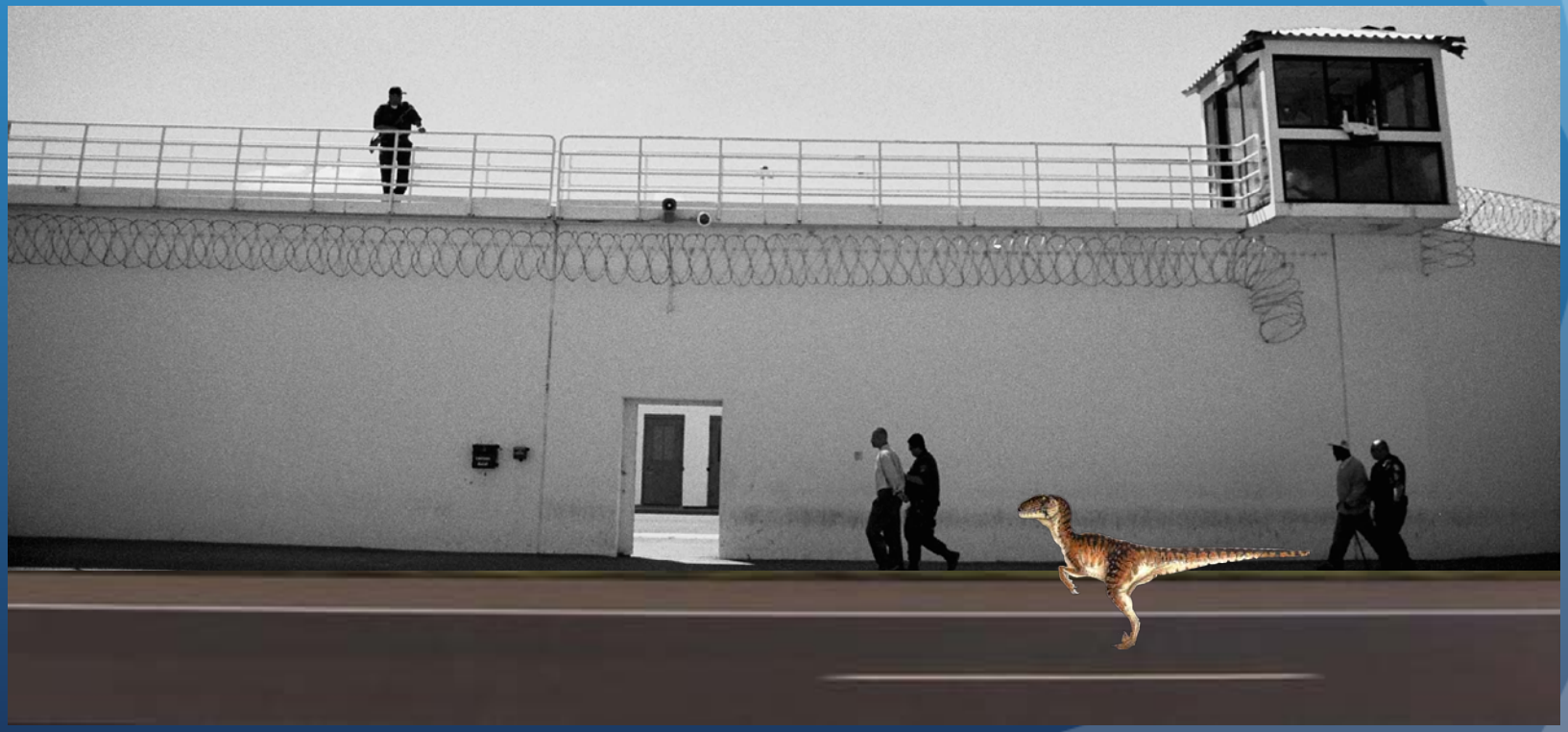
- Sort of like an Interstate highway… no stop lights, and dedicated on and off ramps:

The Evolution of Science DMZ (cont.)

Science DMZ and the Campus Network…

The Evolution of Science DMZ (cont.)

Science DMZ and the Campus Network…



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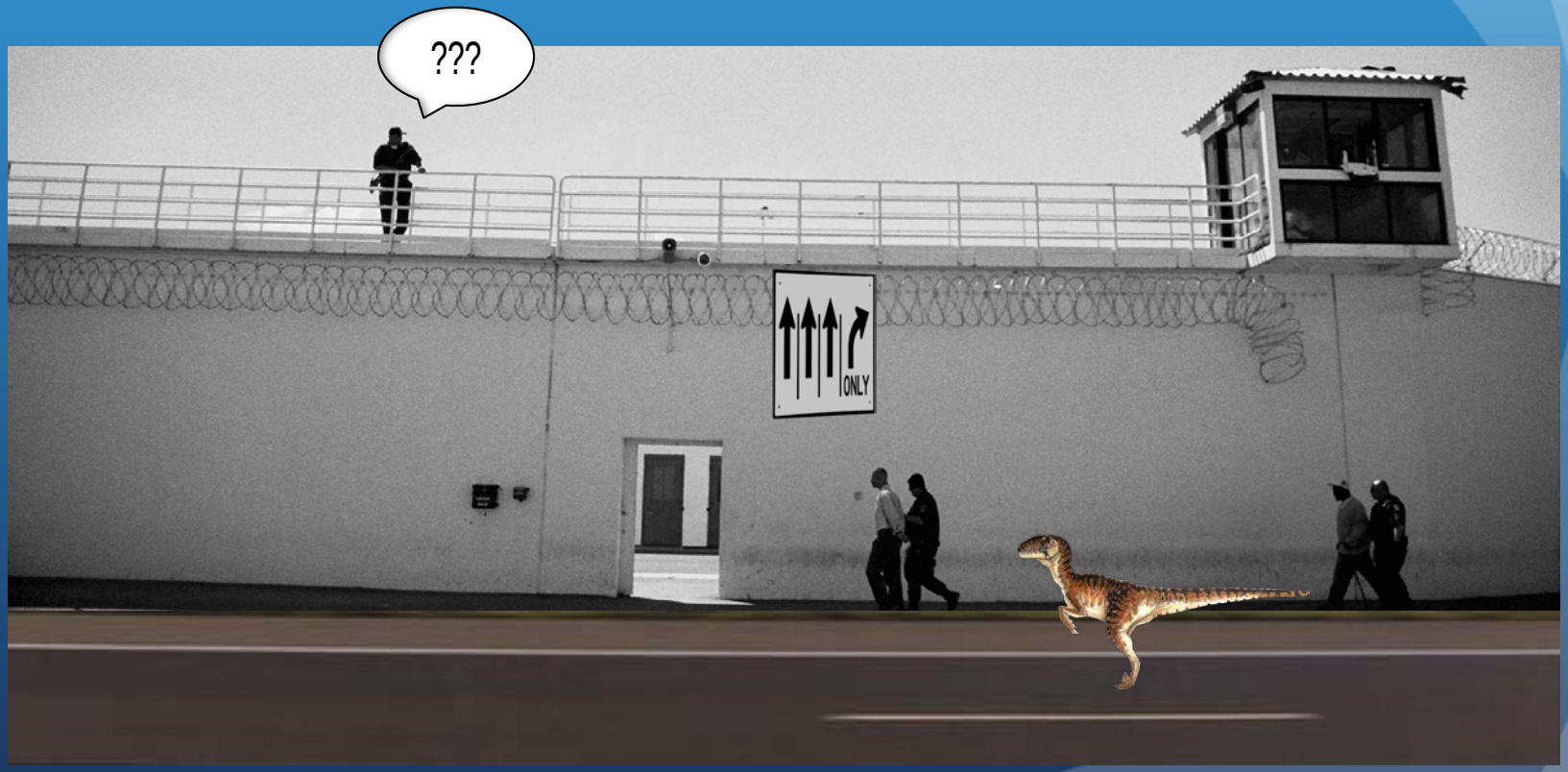
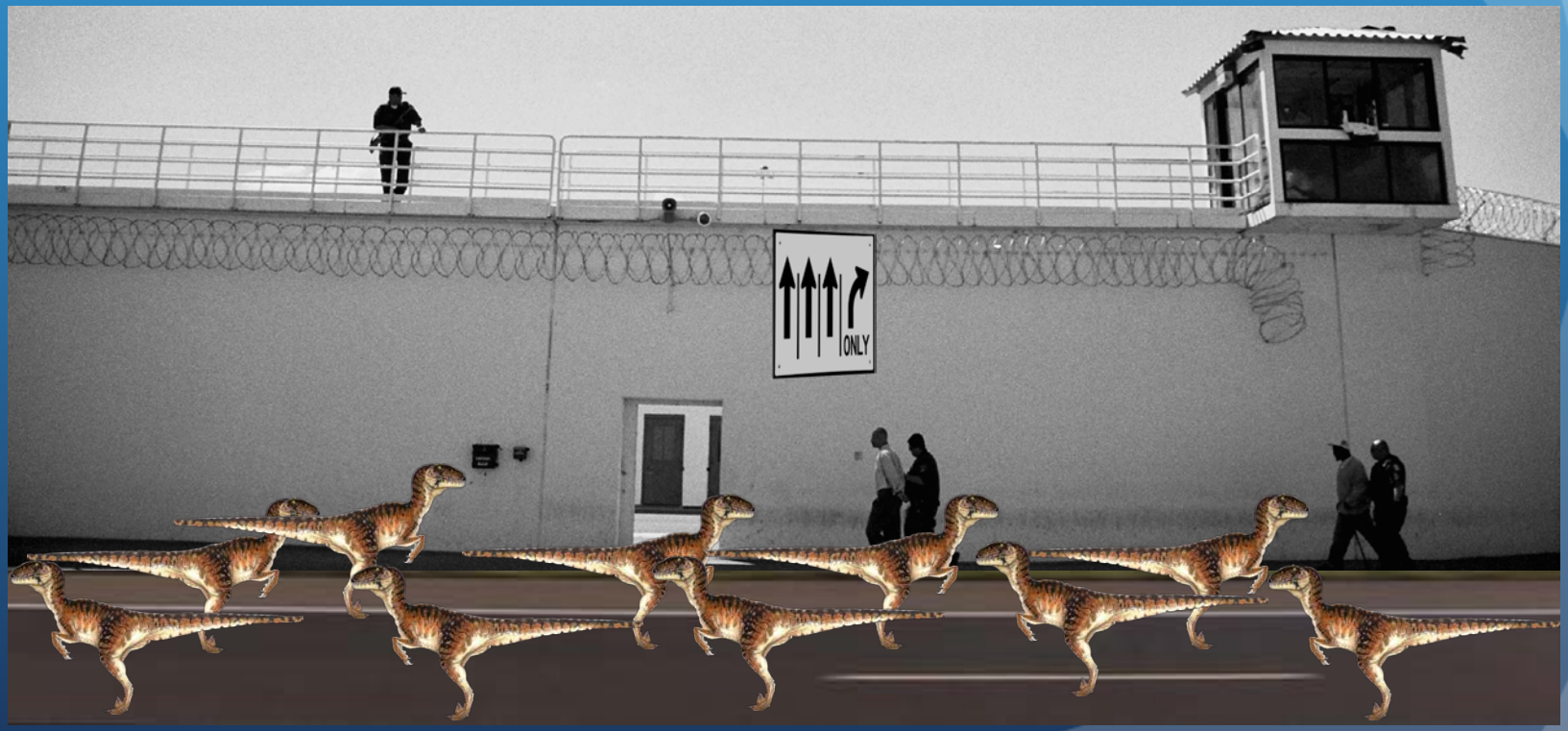
Science DMZ and the Campus Network…



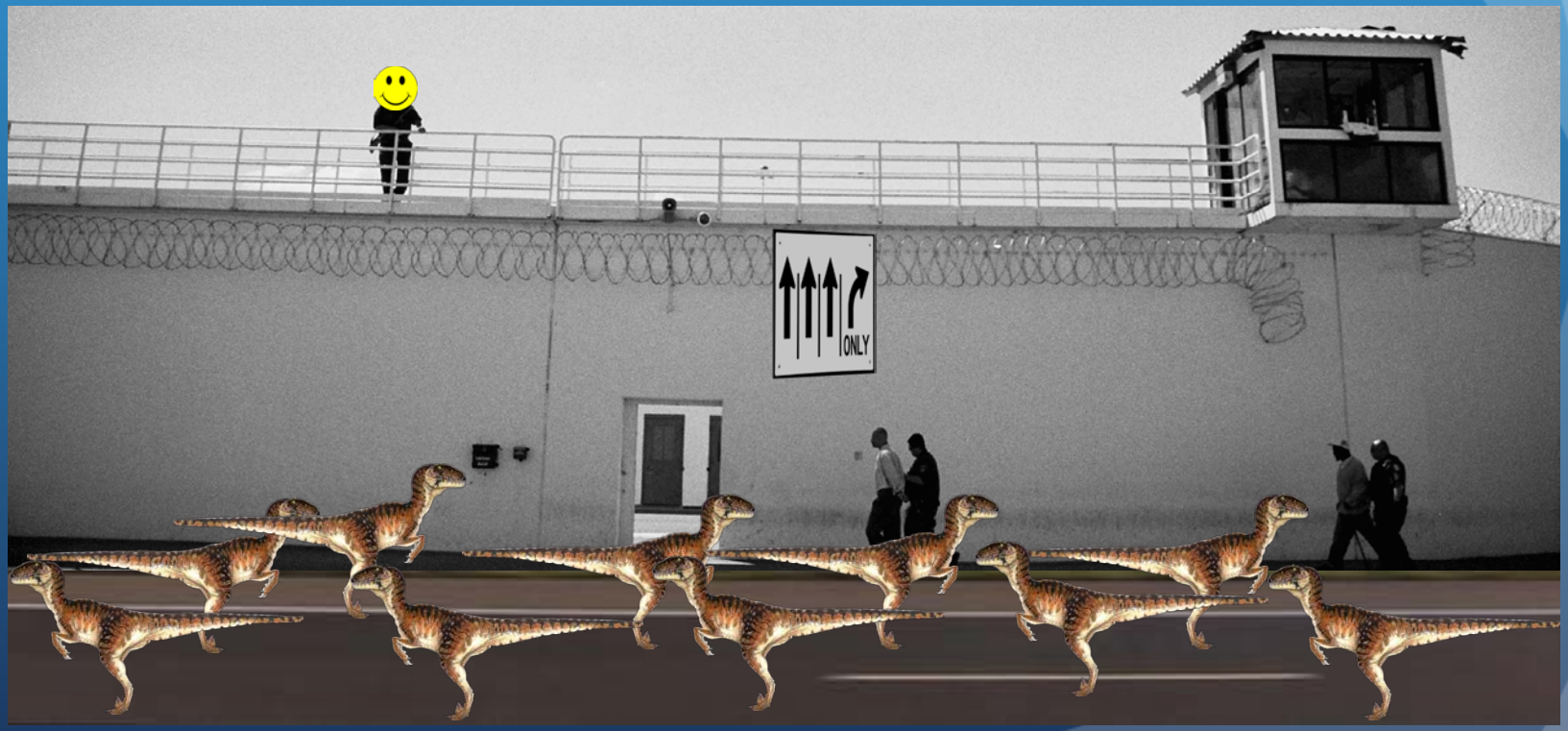
The Evolution of Science DMZ (cont.)

Science DMZ and the Campus Network…



The Evolution of Science DMZ (cont.)

Science DMZ and the Campus Network…



ANALOGY RECAP…

Corporate Network

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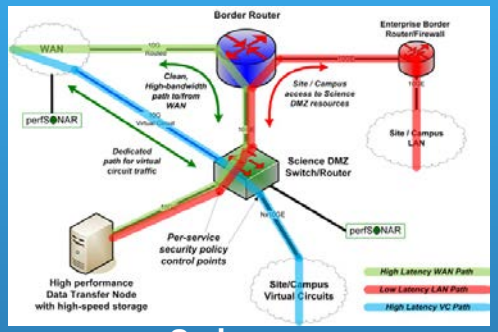
Sealed Vault

Campus Network

≈

Prison

ANALOGY RECAP…



Science DMZ

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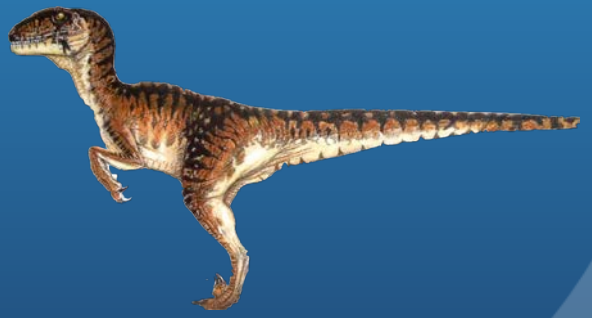
Interstate

Computational Research

≈



Velociraptor

Remember that “Programmable” Aspect of Science DMZ?

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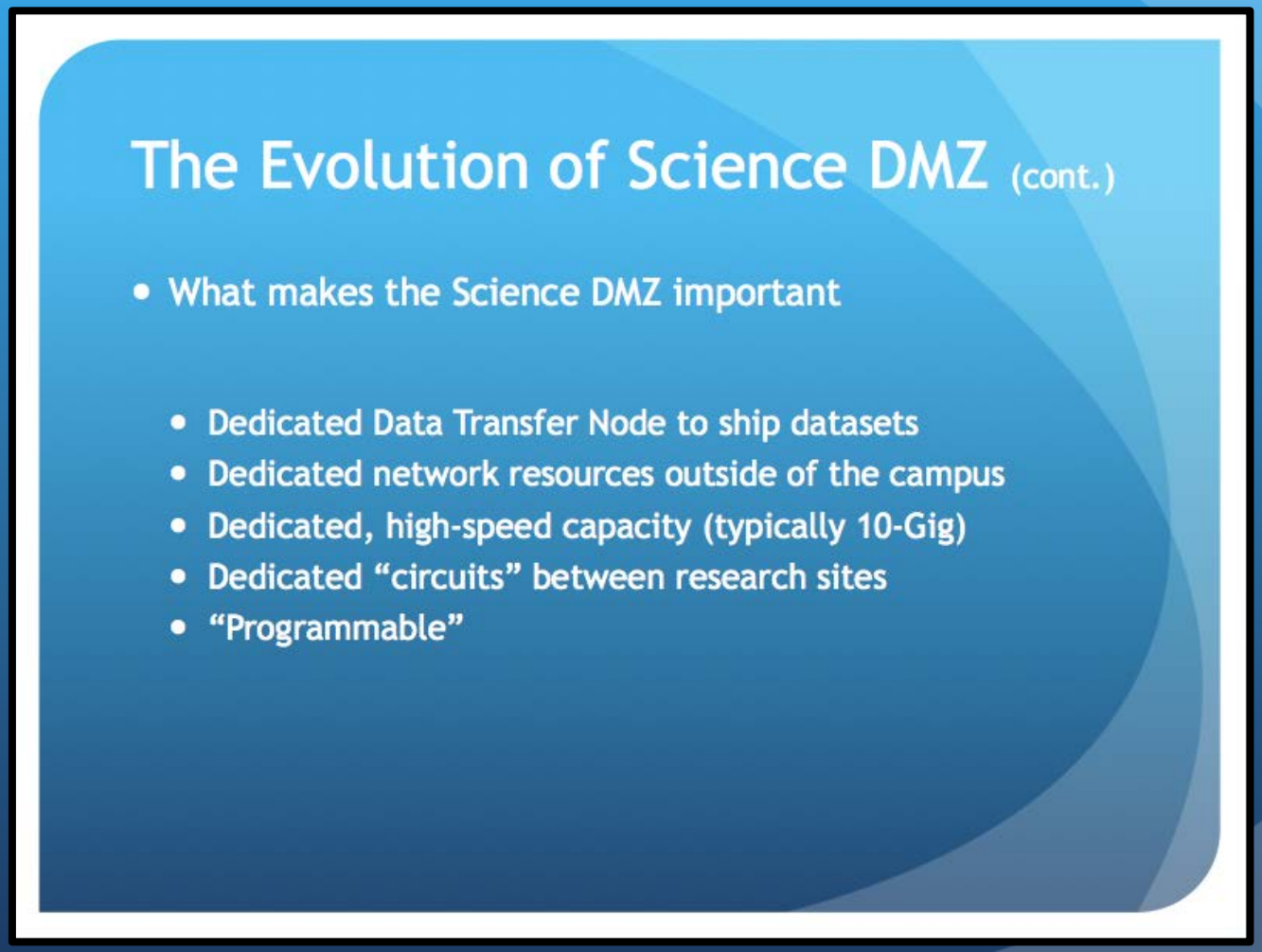

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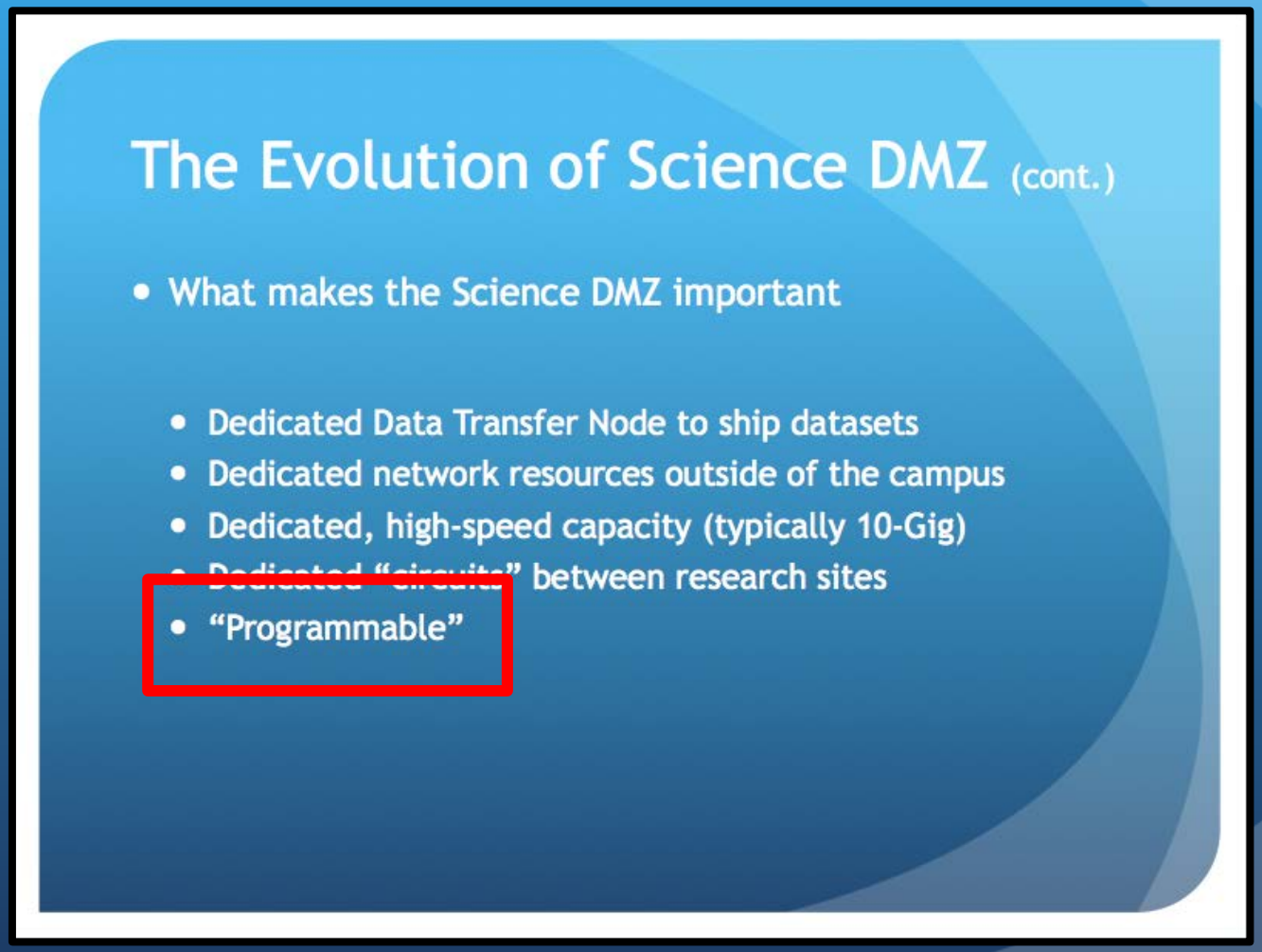

Science DMZ is like…

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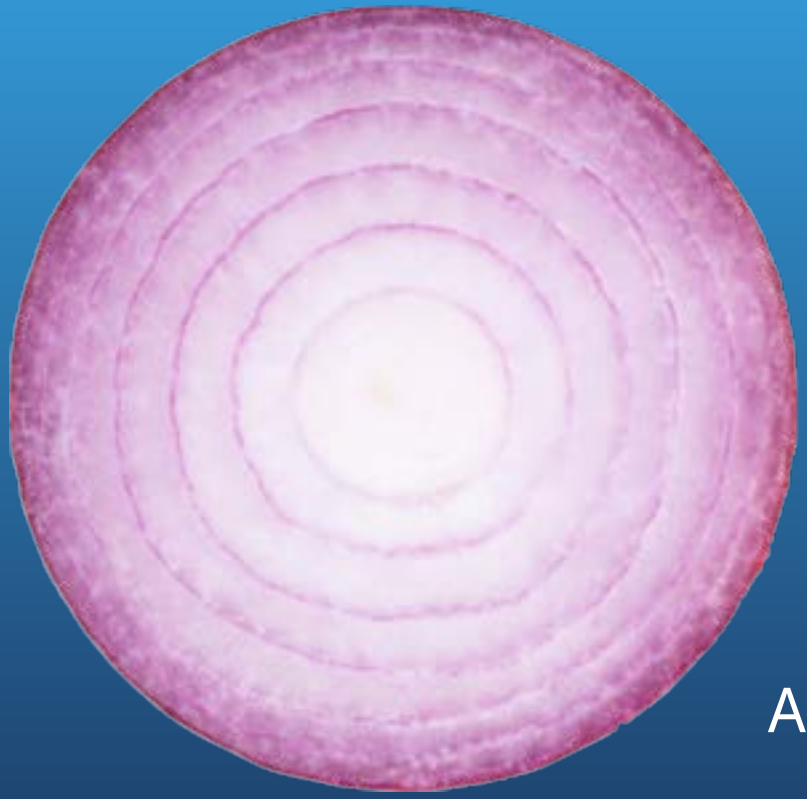
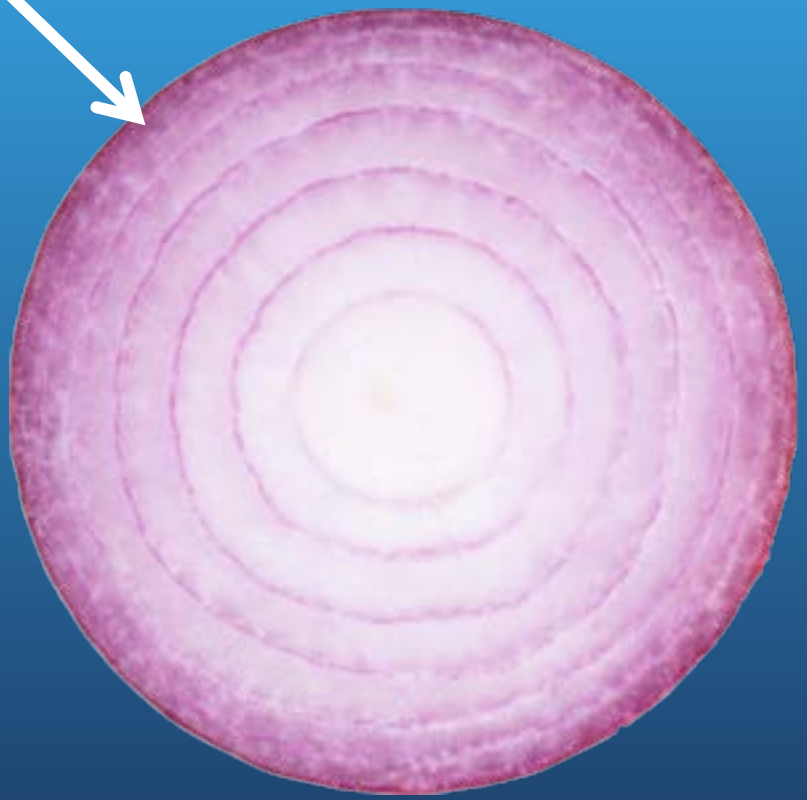


An onion!

Science DMZ Layers

Science DMZ

- Dedicated Paths
- Transfer Nodes
- perfSONAR



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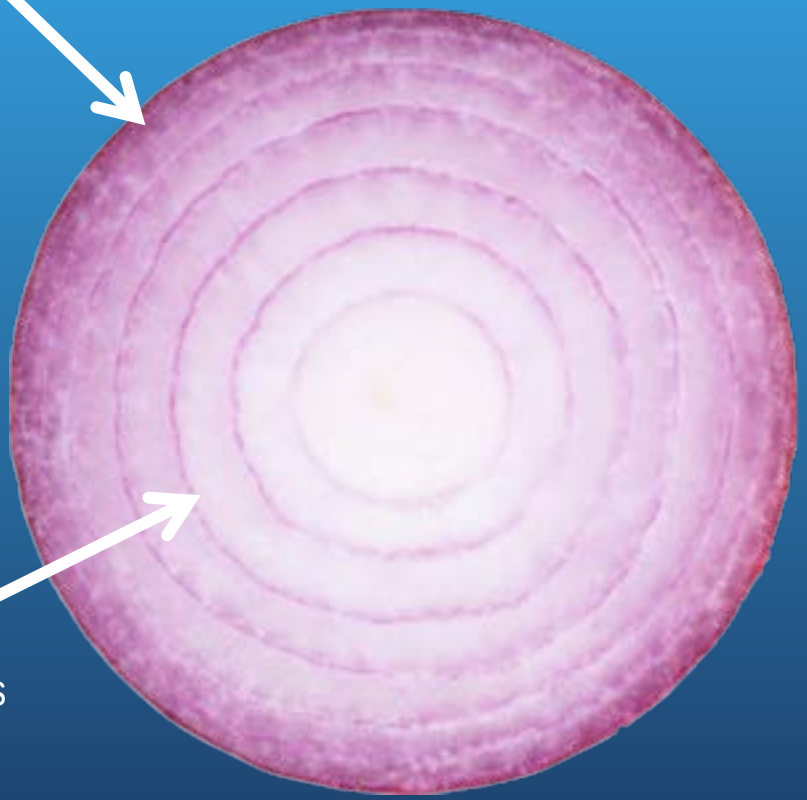

SDN

- Controller
- Network Switches

Science DMZ Layers

Science DMZ
- Dedicated Paths
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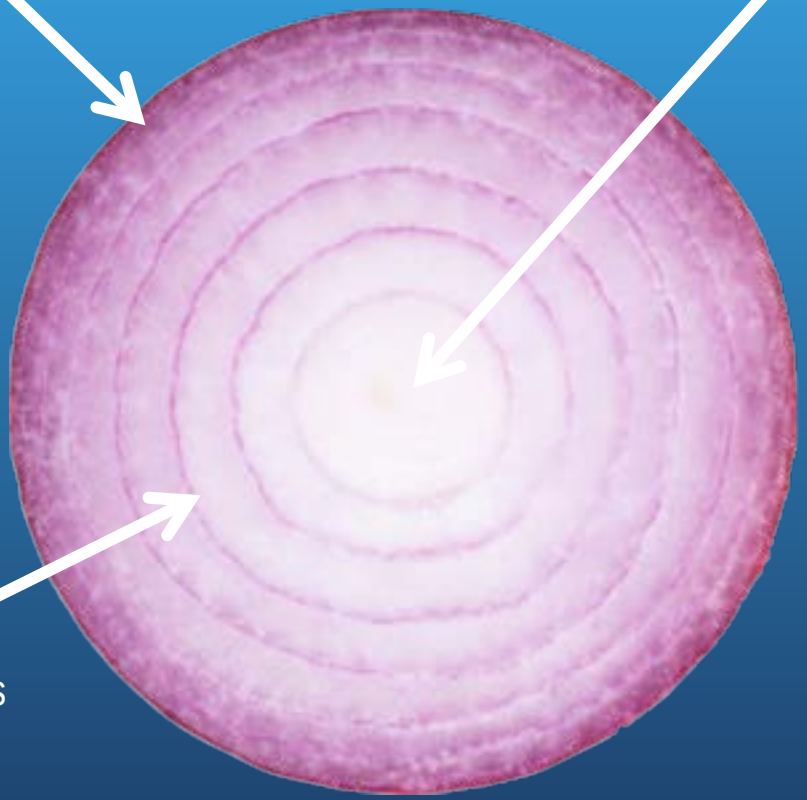
SDN
- OpenFlow
- Northbound APIs
- East-West Monitoring



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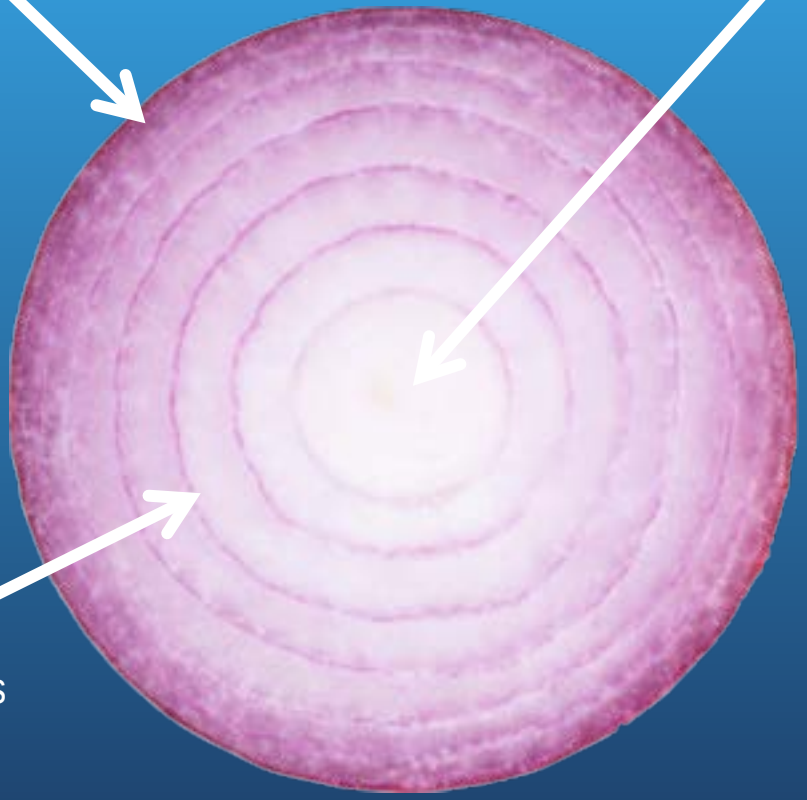
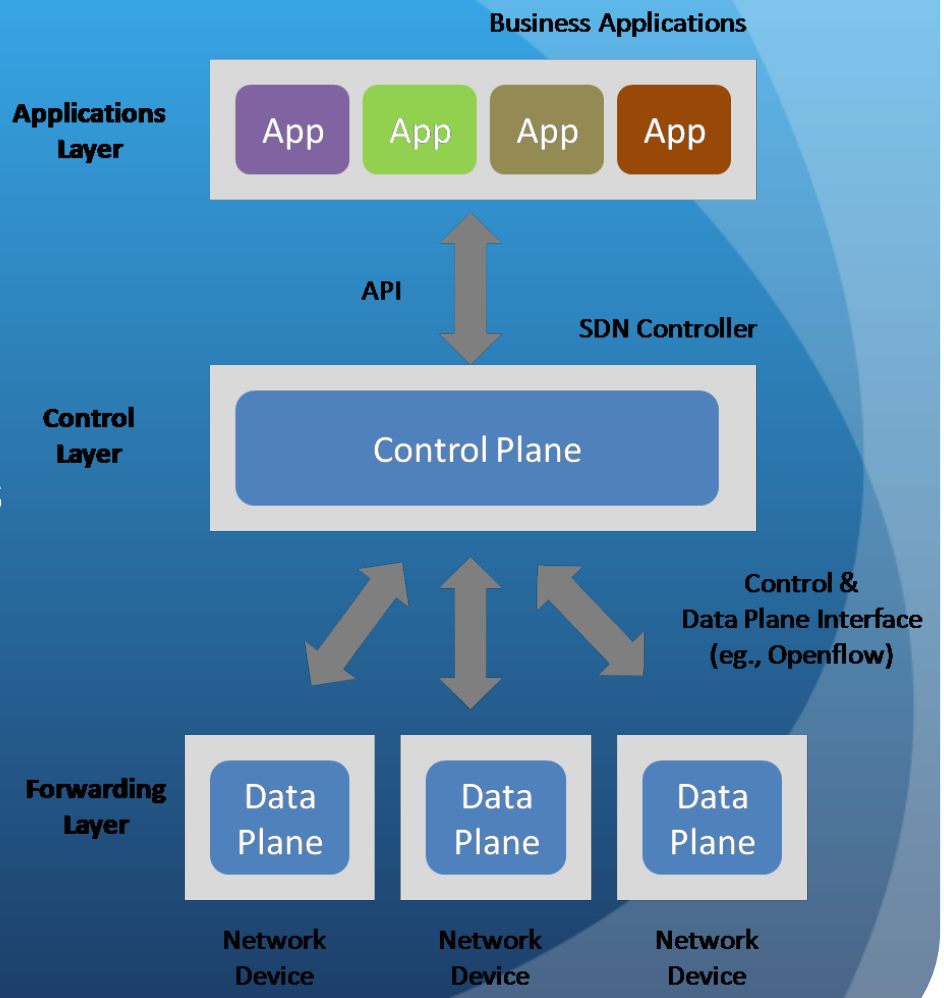


SDN
- Controller
- Network Switches

Campus Network

Software Defined Networks (SDN)

- Components of SDN
  - Controller
  - Devices
  - Northbound APIs
  - East/West monitoring
  - OpenFlow communications

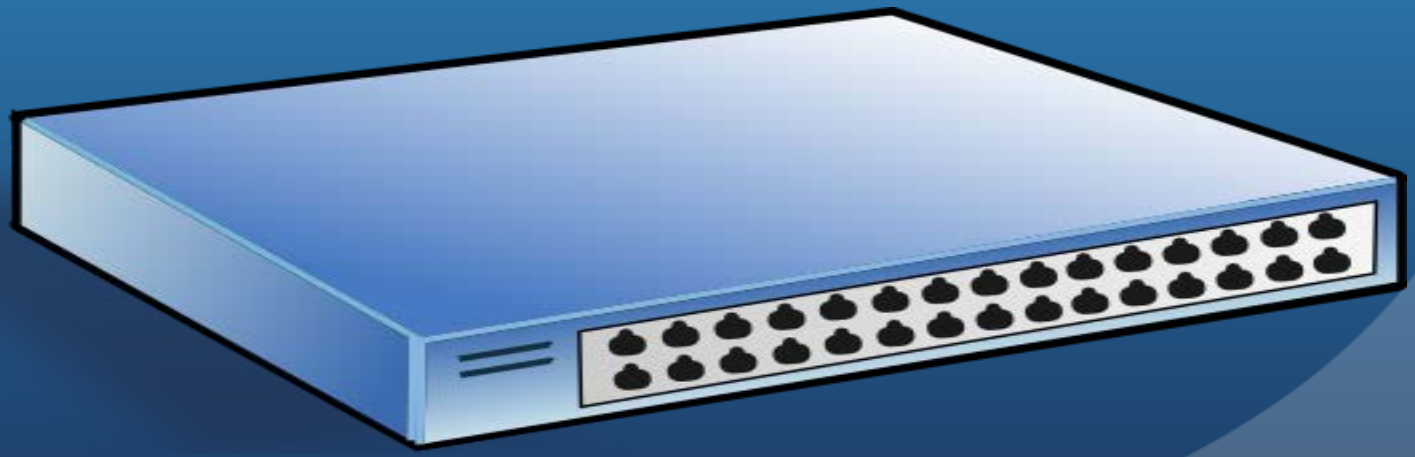


Software Defined Networks (SDN)

- Components of SDN
  - Controller
  - Devices
  - Northbound APIs
  - East/West monitoring
  - OpenFlow communications

For the purpose of this discussion, we will focus on an SDN that involves OpenFlow!

Software Defined Networks (SDN)



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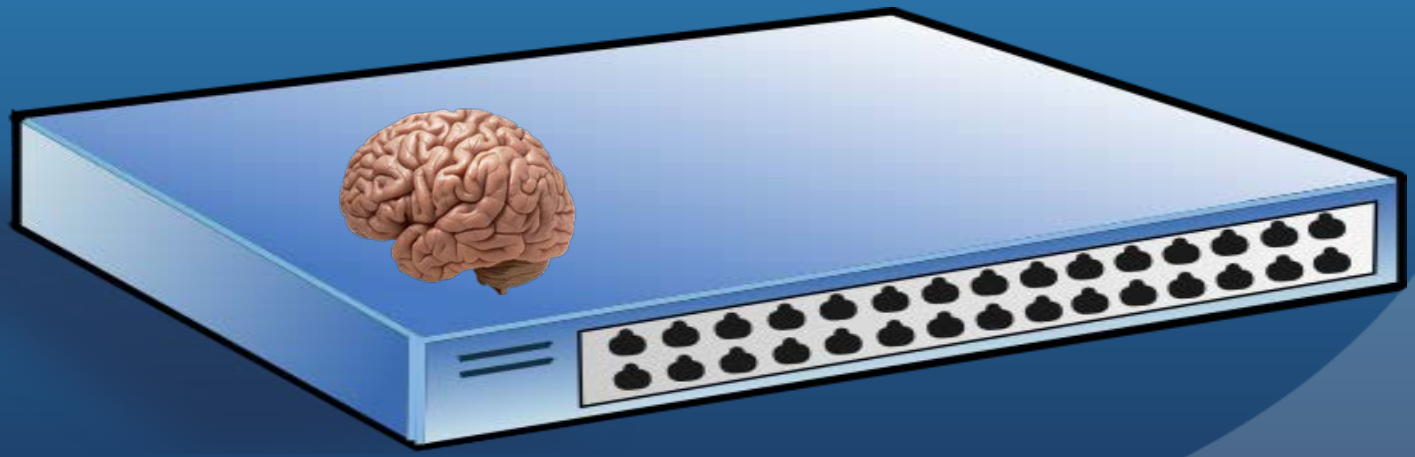

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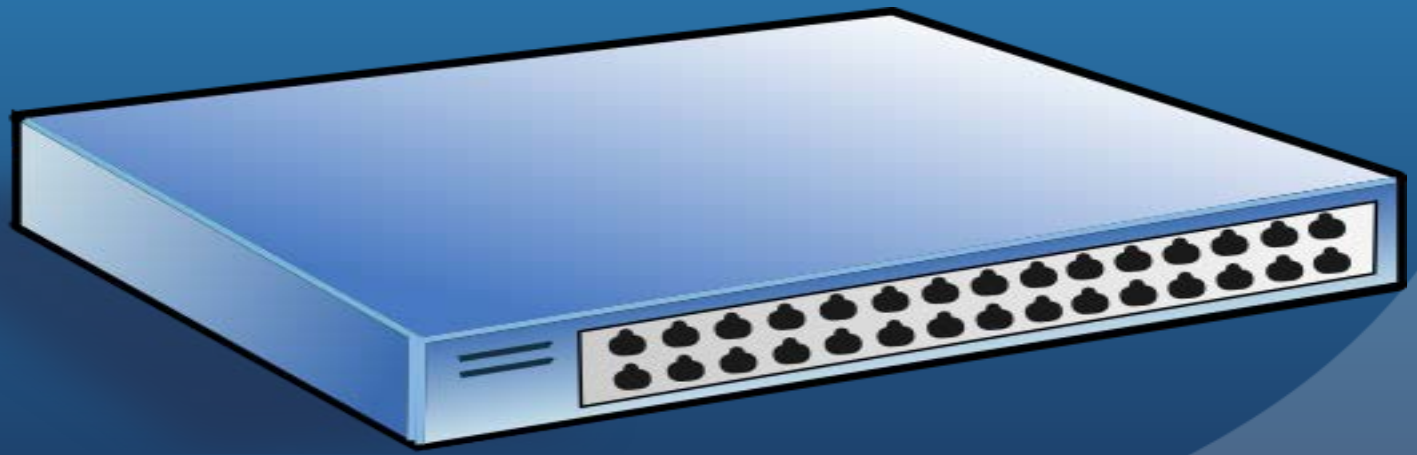

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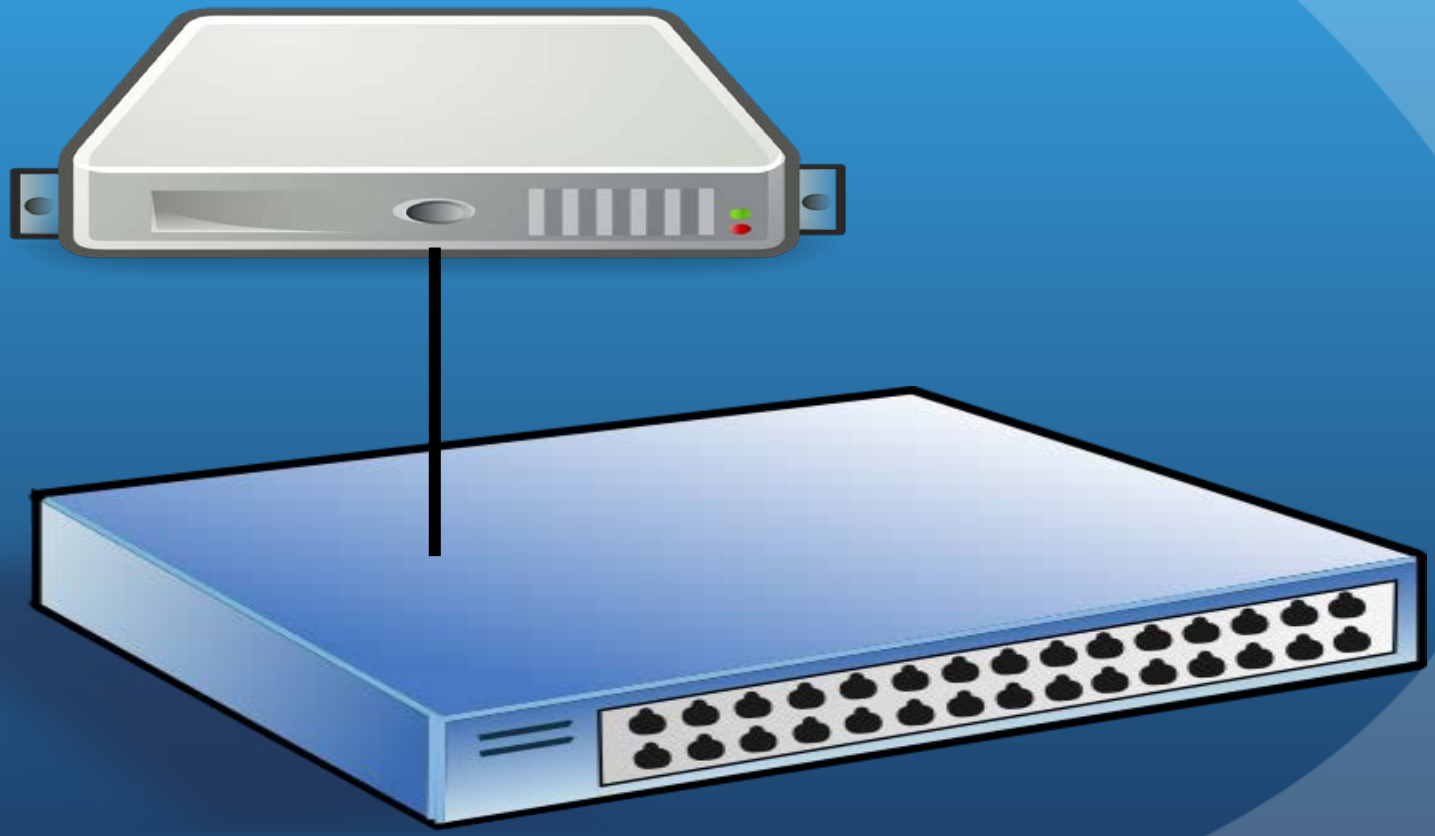

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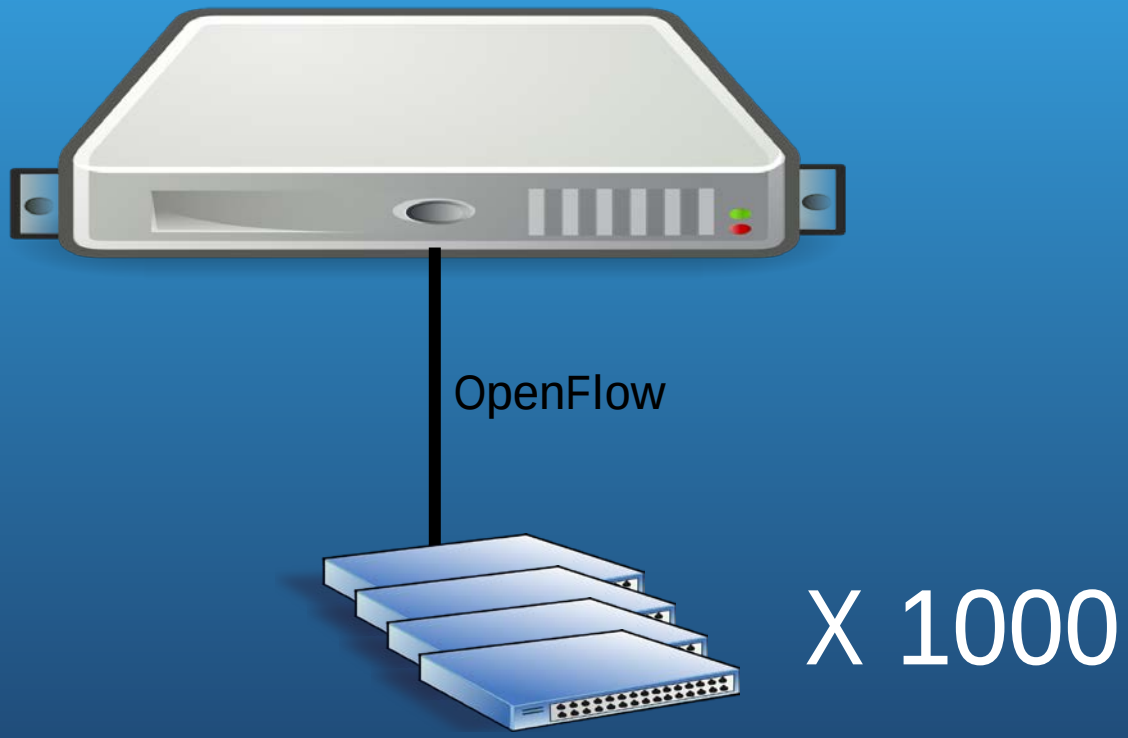

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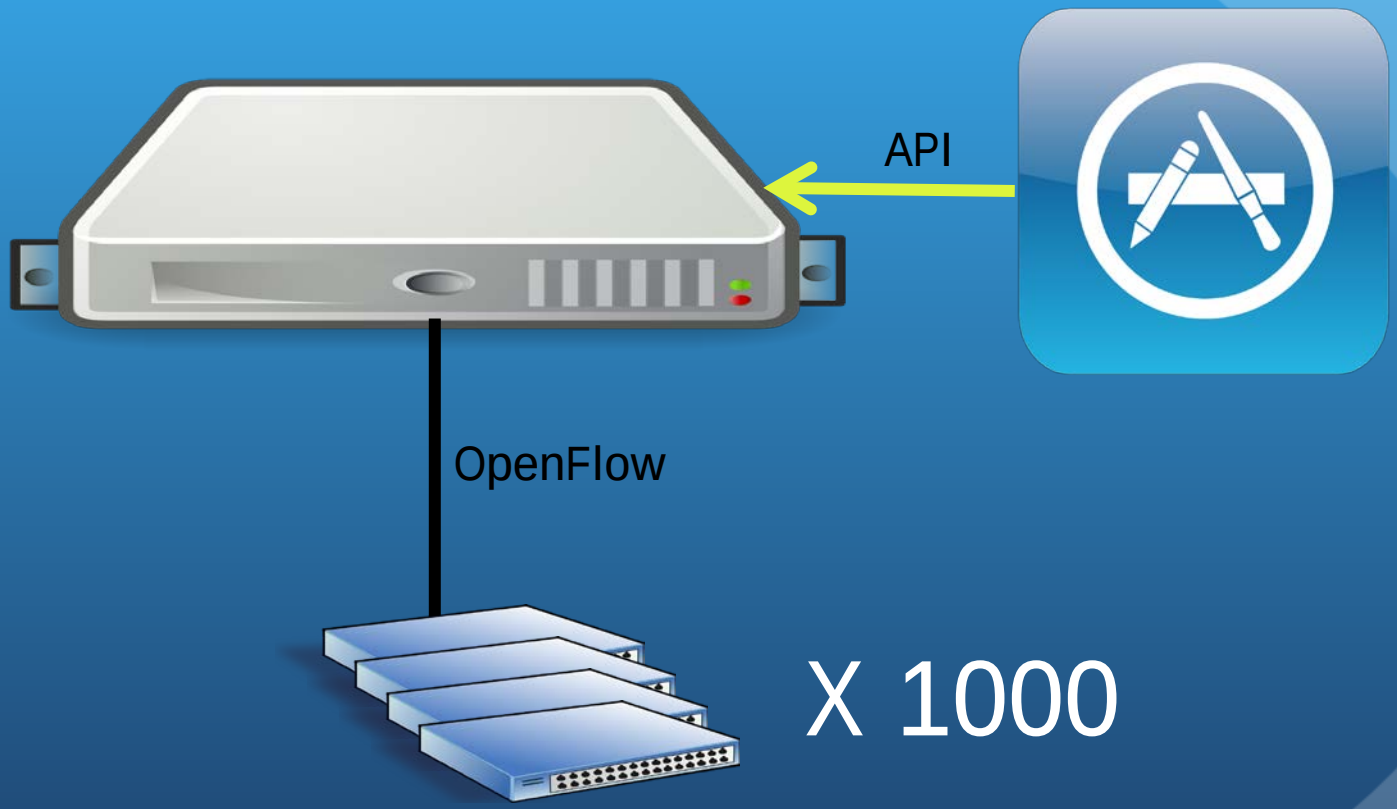
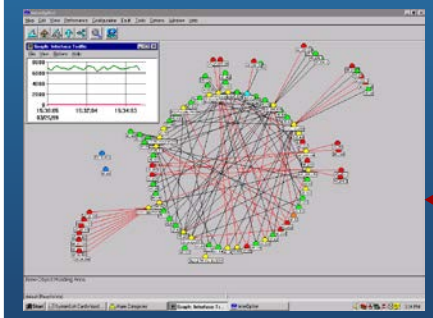


Software Defined Networks (SDN)

API

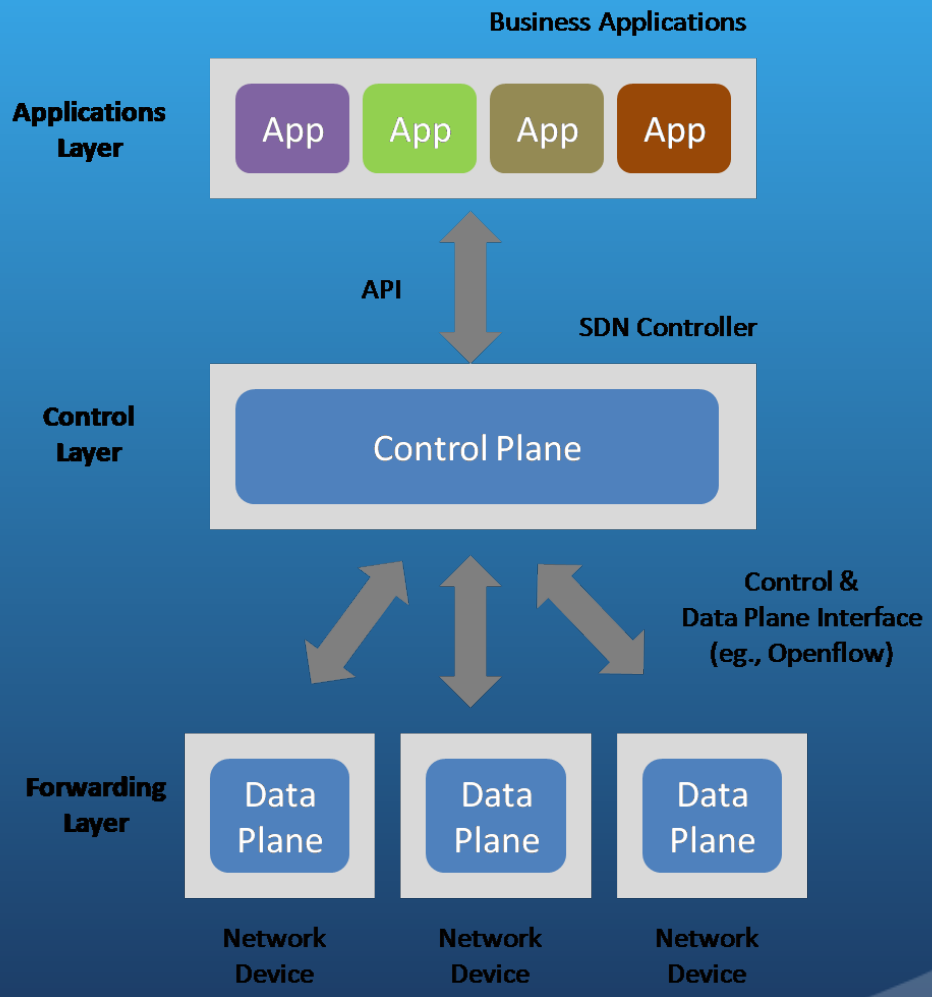
OpenFlow



X 1000

SNMP
Syslog
Flow

Software Defined Networks (SDN)



Why Even Do SDN?

- Orchestration!
- Flexibility
- Self Service
- Agility
- More “holistic”

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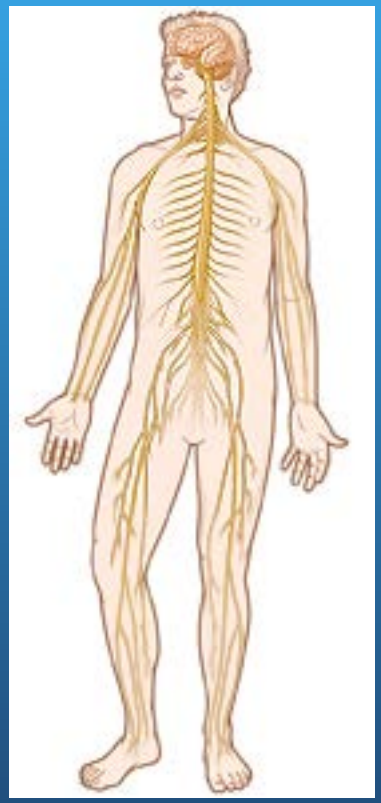
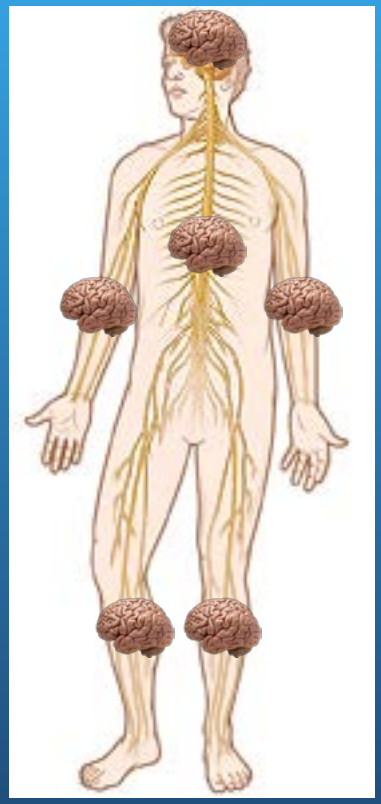


Why Even Do SDN?

Imagine if your brain were distributed throughout your body.

How would you walk? Run? Shop?

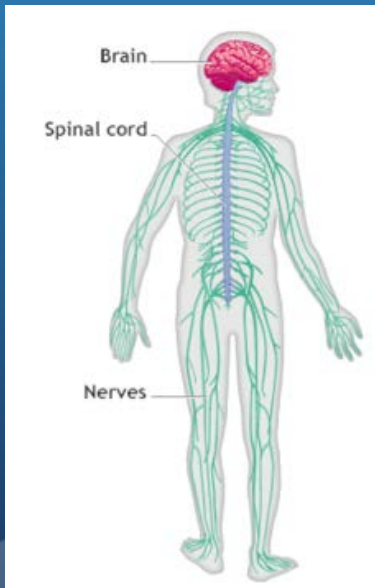
SDN is just a natural evolution of computer networking.



OpenFlow

- OpenFlow is like the “Nerves” of the body
  - Controller (brain)
  - Devices (arms/lets/mouth/tail)
  - Northbound APIs (eyes/ears/tongue/nose)
  - East/West monitoring (pain/soreness/sick)

- Carries messages from the controller to the devices, and vice-versa.



OpenFlow

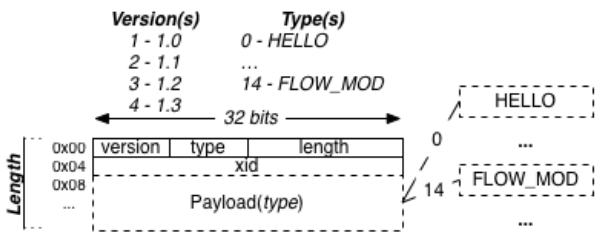
"OpenFlow is an open standard network protocol used to manage traffic between commercial Ethernet switches, routers and wireless access points. OpenFlow enables software-defined networking (SDN) for programmable networks and is based on an Ethernet switch, with an internal flow-table and a standardized interface to add and remove flow entries."

http://www.webopedia.com/TERM/O/openflow.html

OpenFlow: What you need to know…

- Specifications: Located at the Open Network Foundation web site (www.opennetwork.org)
- Leverages TCP for communication
- Port 6653 is most commonly used
- Specification recommends TLS encryption

OpenFlow:
What you need to know… (cont)

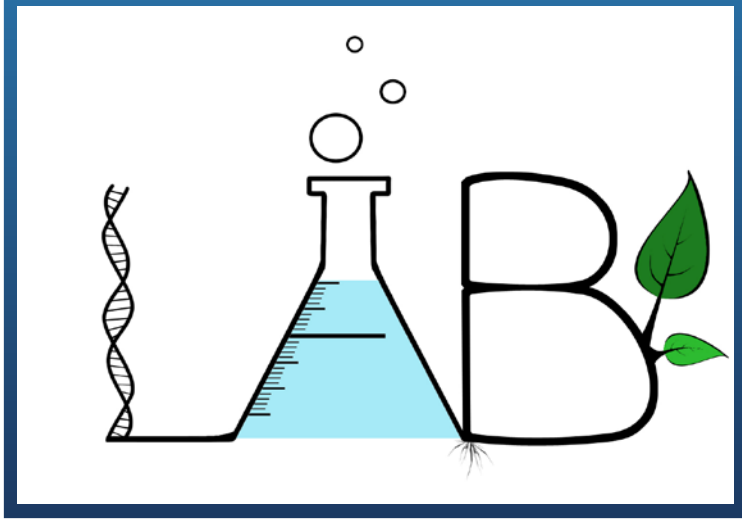


Every OpenFlow message begins with the same header structure. This fixed structure serves three roles that are independent of the version of OpenFlow being used. First, the version field indicates the version of OpenFlow which this message belongs. Second, the length field indicates where this message will end in the byte stream starting from the first byte of the header. Third, the xid, or transaction identifier, is a unique value used to match requests to responses. The type field which indicates what type of message is present and how to interpret the payload, is version dependent.

- OpenFlow Message Types:
  - OpenFlow 1.3 has 30 different message types
  - Details at www.flowgrammable.org
  - Includes things like table requests, table insertions, ports in, ports out, get config, set config, etc.

OpenFlow: Lab this afternoon!

You will have the opportunity to see these messages in real time.



In Summary

When properly equipped…

The computational researcher can use Science DMZ, Software Defined Networks, and OpenFlow communications for more effective data collaboration.

Thank You!

https://www.dropbox.com/sh/h7y0c3z9n0eq15b/AAB97wqUY54MzCIbZsRKA_RAa?dl=0

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Reminder: Lab Prereq's

- Download ***and install*** both VirtualBox and the VirtualBox extension pack:
  https://www.virtualbox.org/wiki/Downloads
- Download the SDN Hub All-in-One App Development Starter virtual machine:
  https://github.com/downloads/mininet/mininet/mininet-2.0.0-113012-amd64-ovf.zip
- ***NEW*** Lab instructions can be downloaded here:
  https://www.dropbox.com/sh/h7y0c3z9n0eq15b/AAB97wqUY54MzCIbZsRKA_RAa?dl=0