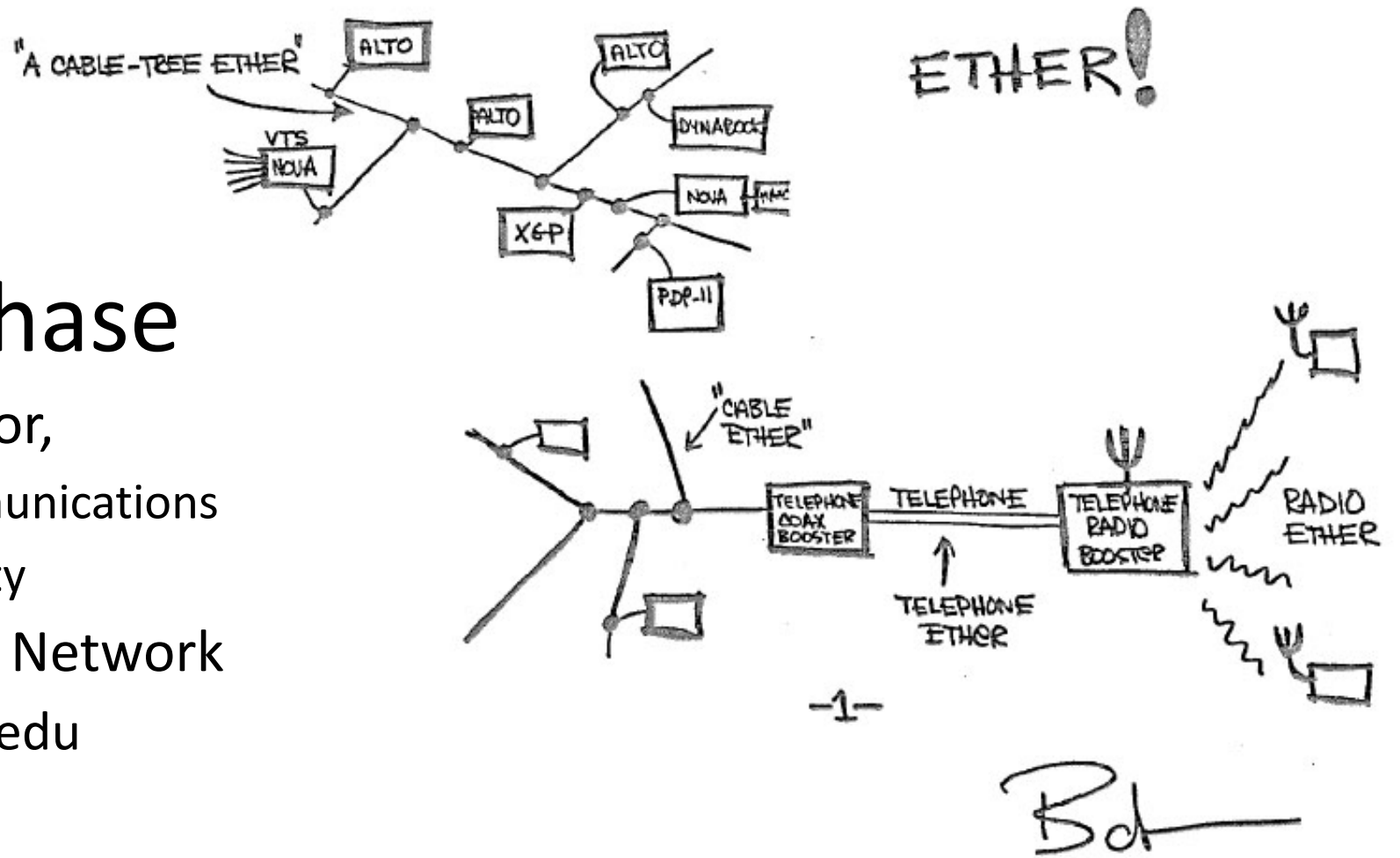


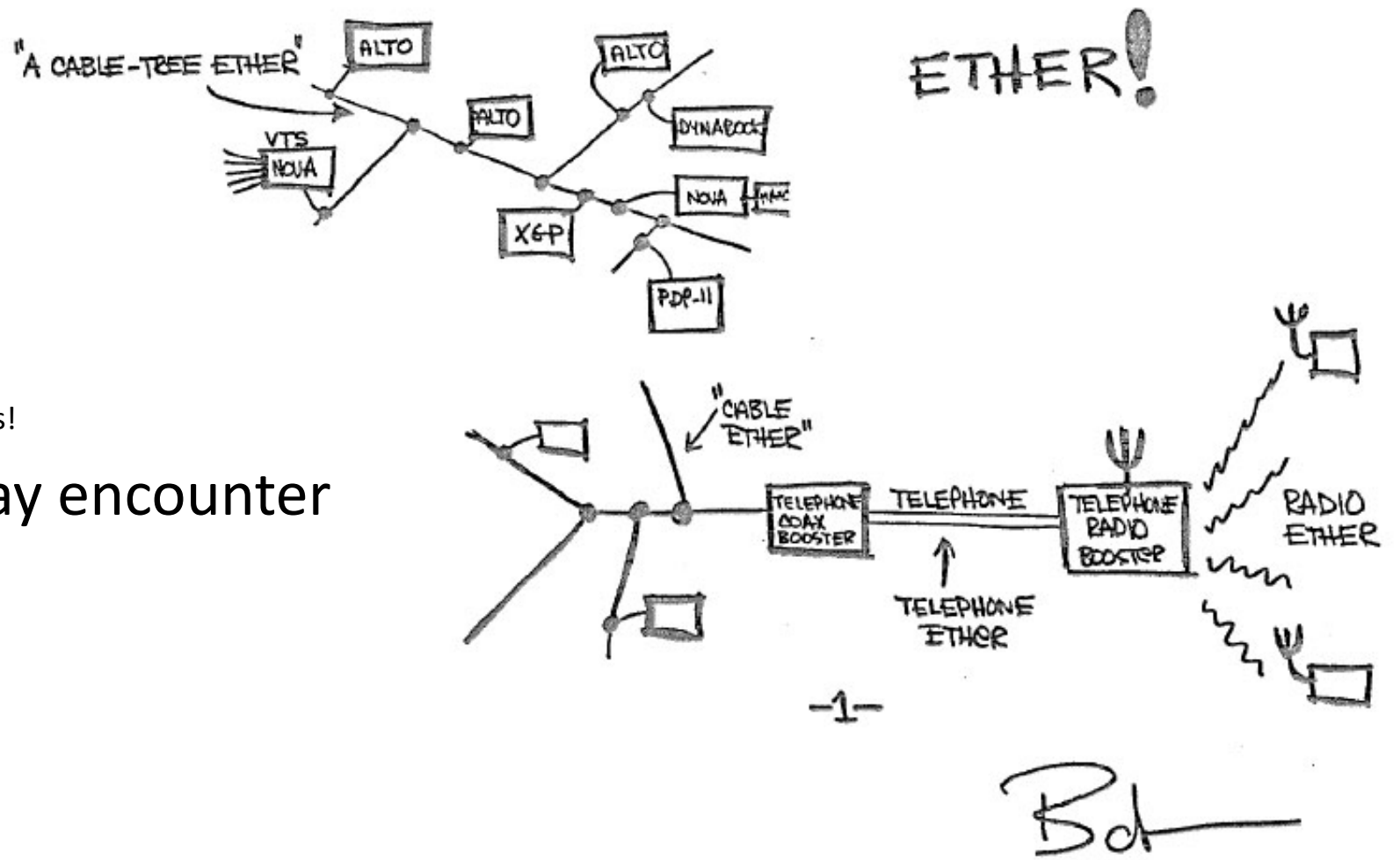
Networking for research support

Wallace A. Chase

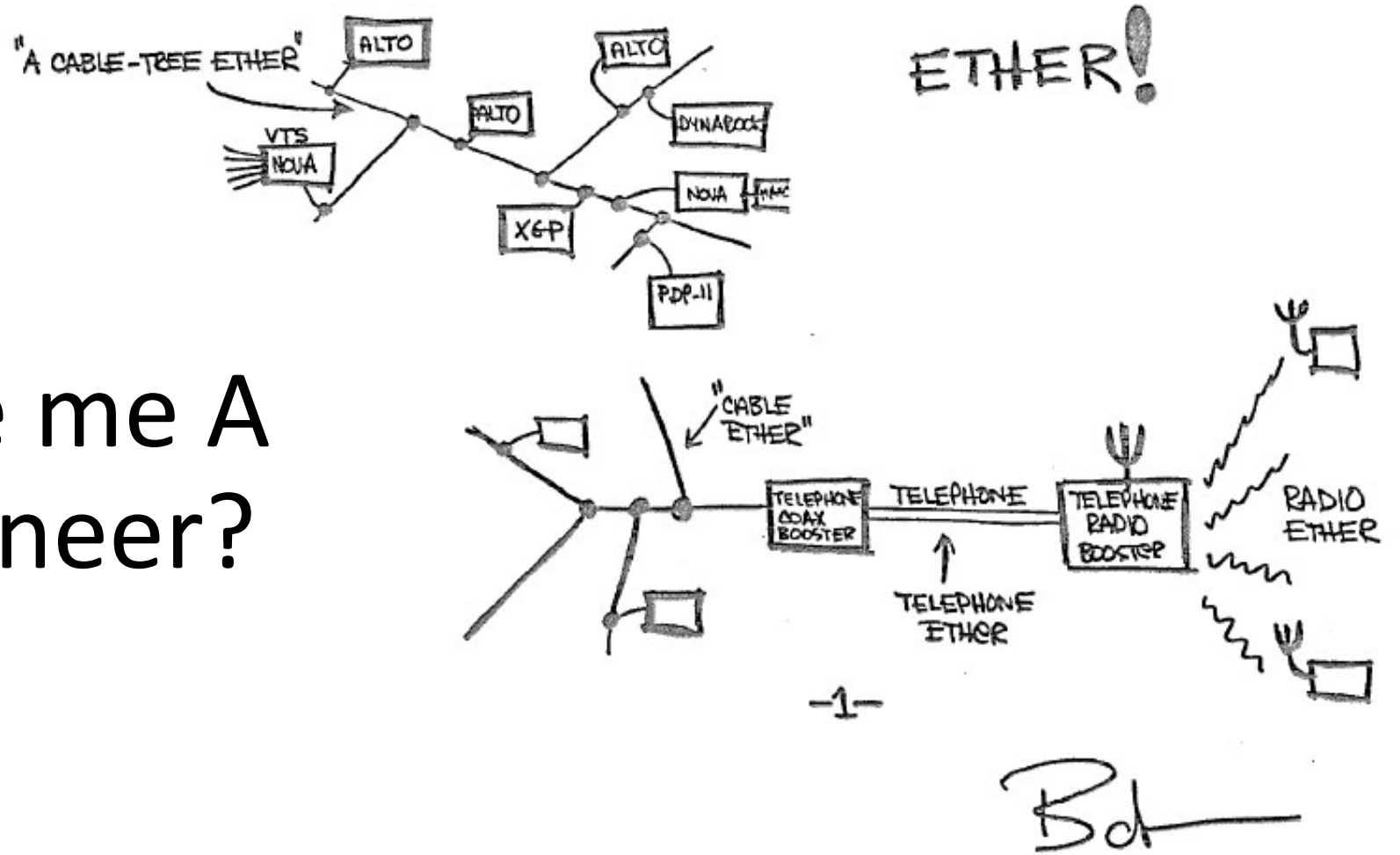
Executive Director,
Networking and Telecommunications
Clemson University
CEO, Carolina Light Rail Network
wchase@clemson.edu



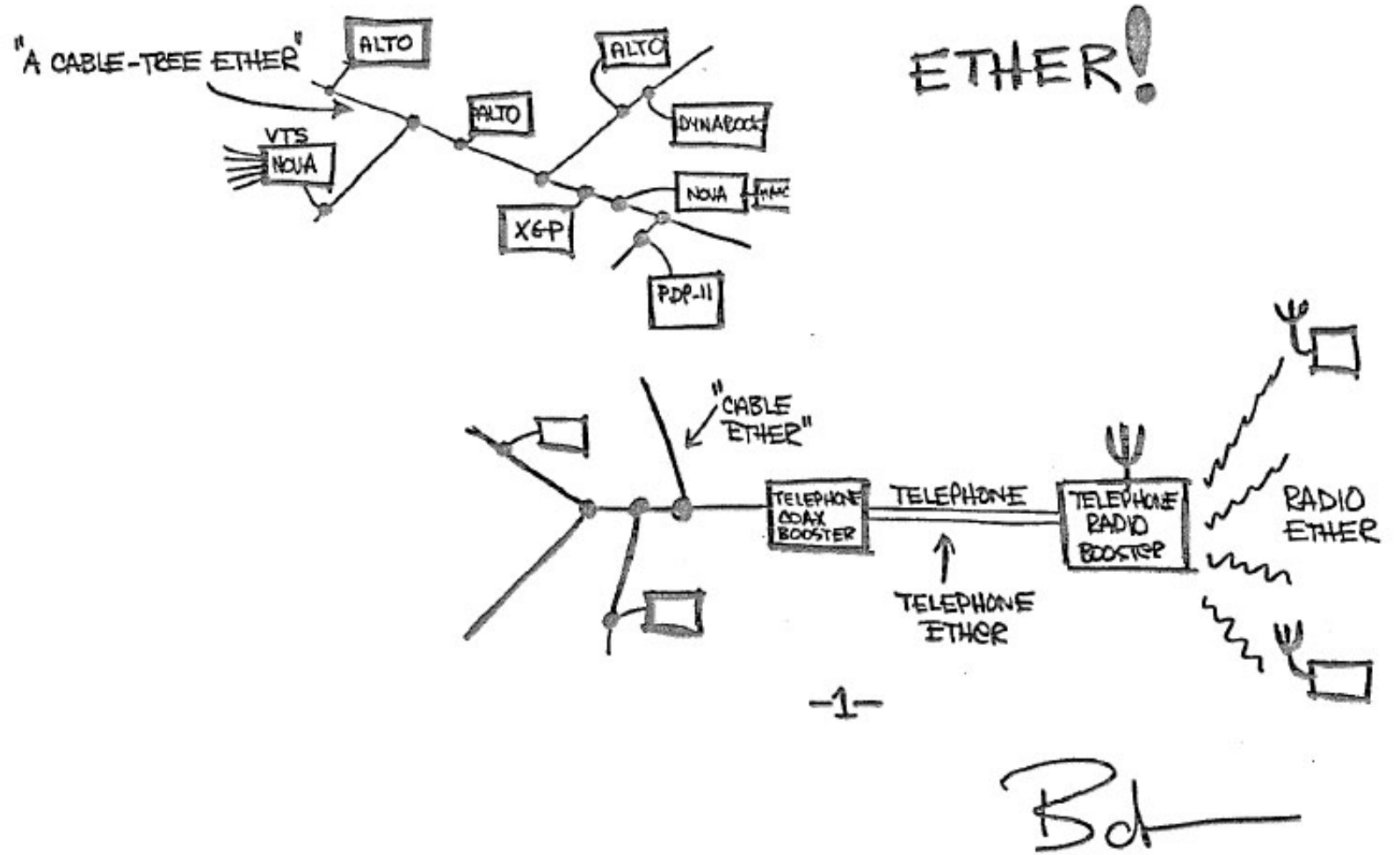
- Why so many networks?
 - Returning by popular demand – velociraptors!
- Types of networks you may encounter
- DTNs
- Build yourself a picture



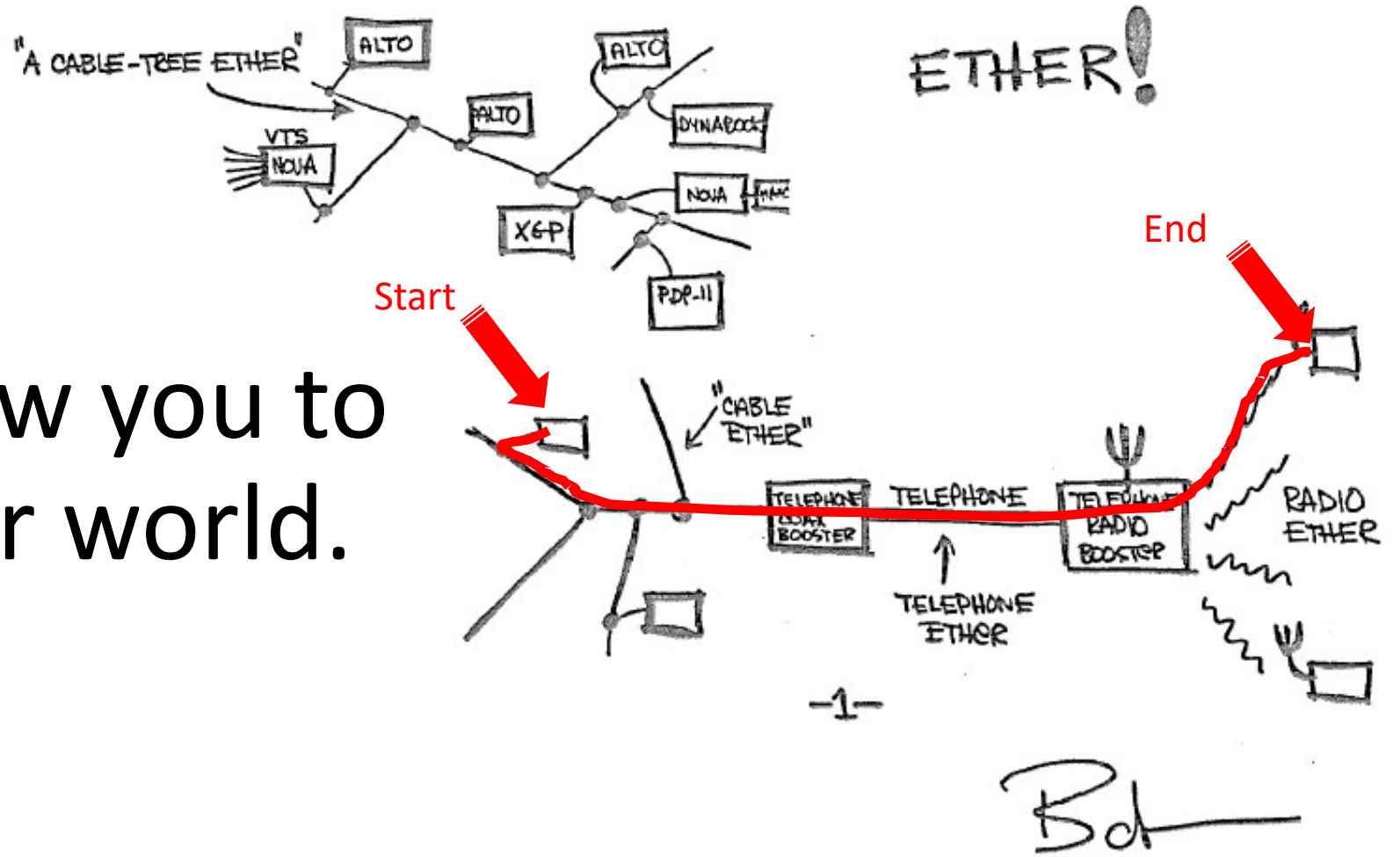
Will this make me A Network Engineer?



No.



But it will allow you to navigate their world.

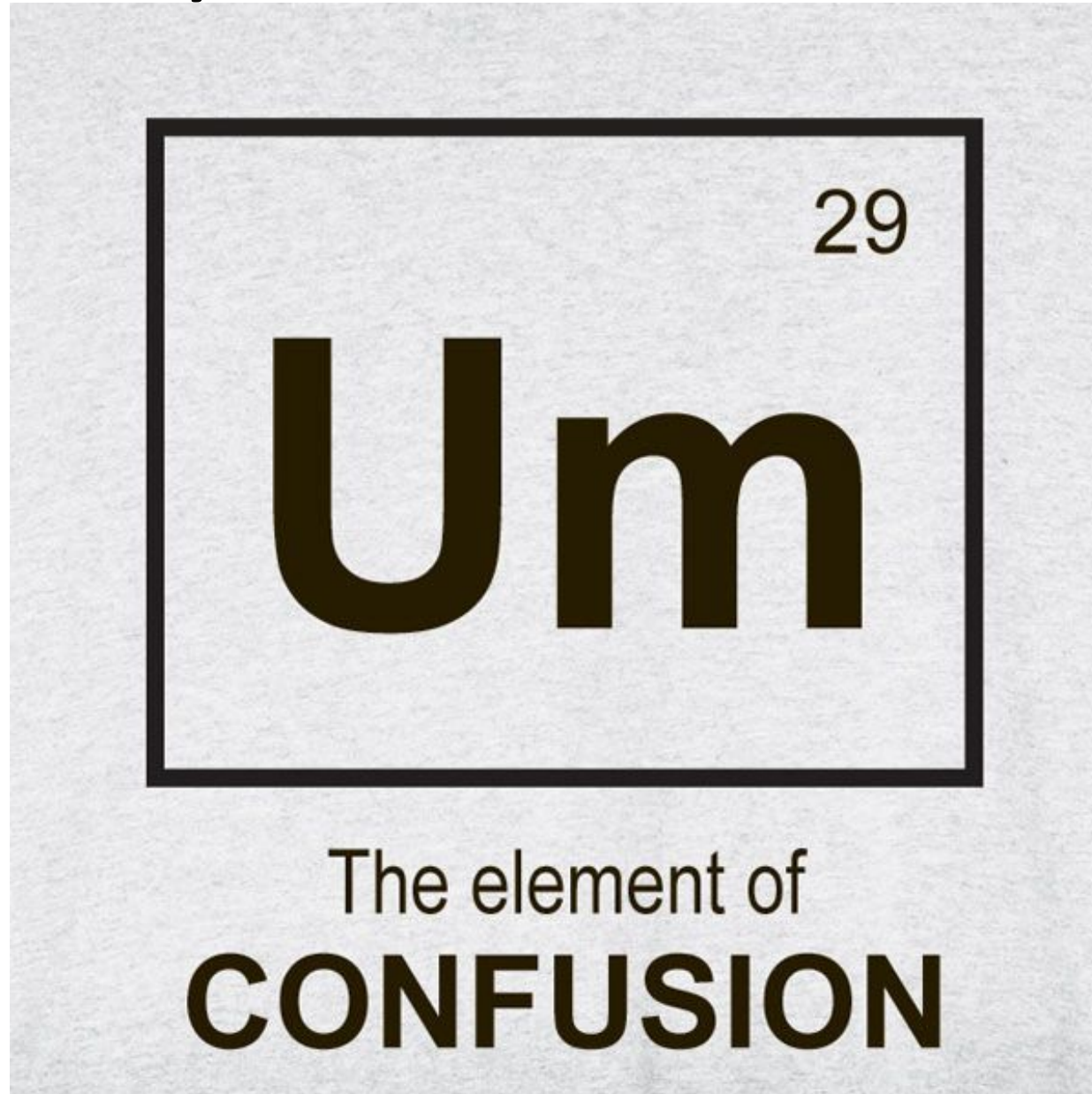


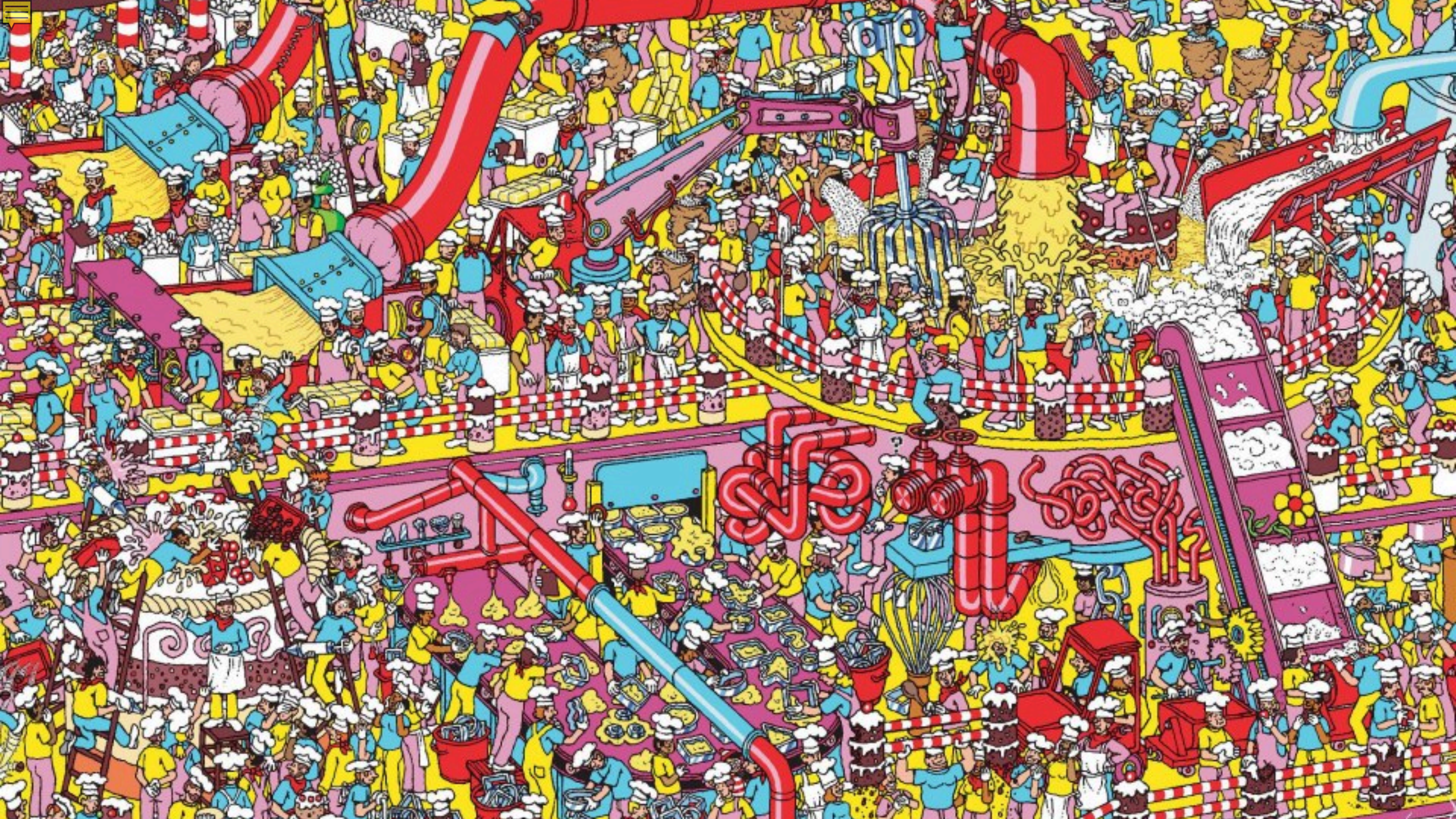
But it will allow you to
navigate their world.

Maybe even understand
them...



But why do I need to know this?





So what makes this so complex anyway?





“Commodity” Networks

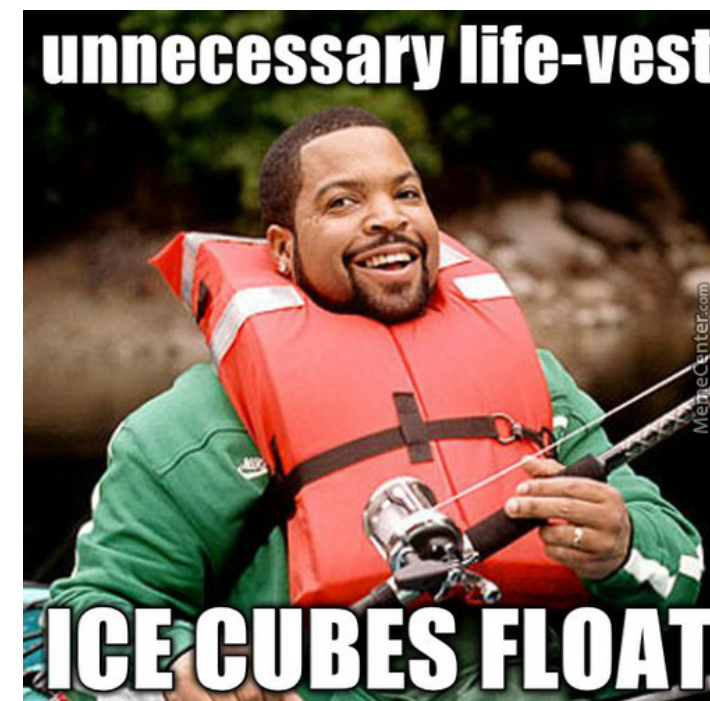
“Commodity” Networks





“Commodity” Networks

Works great for traffic such as



“Commodity” Networks



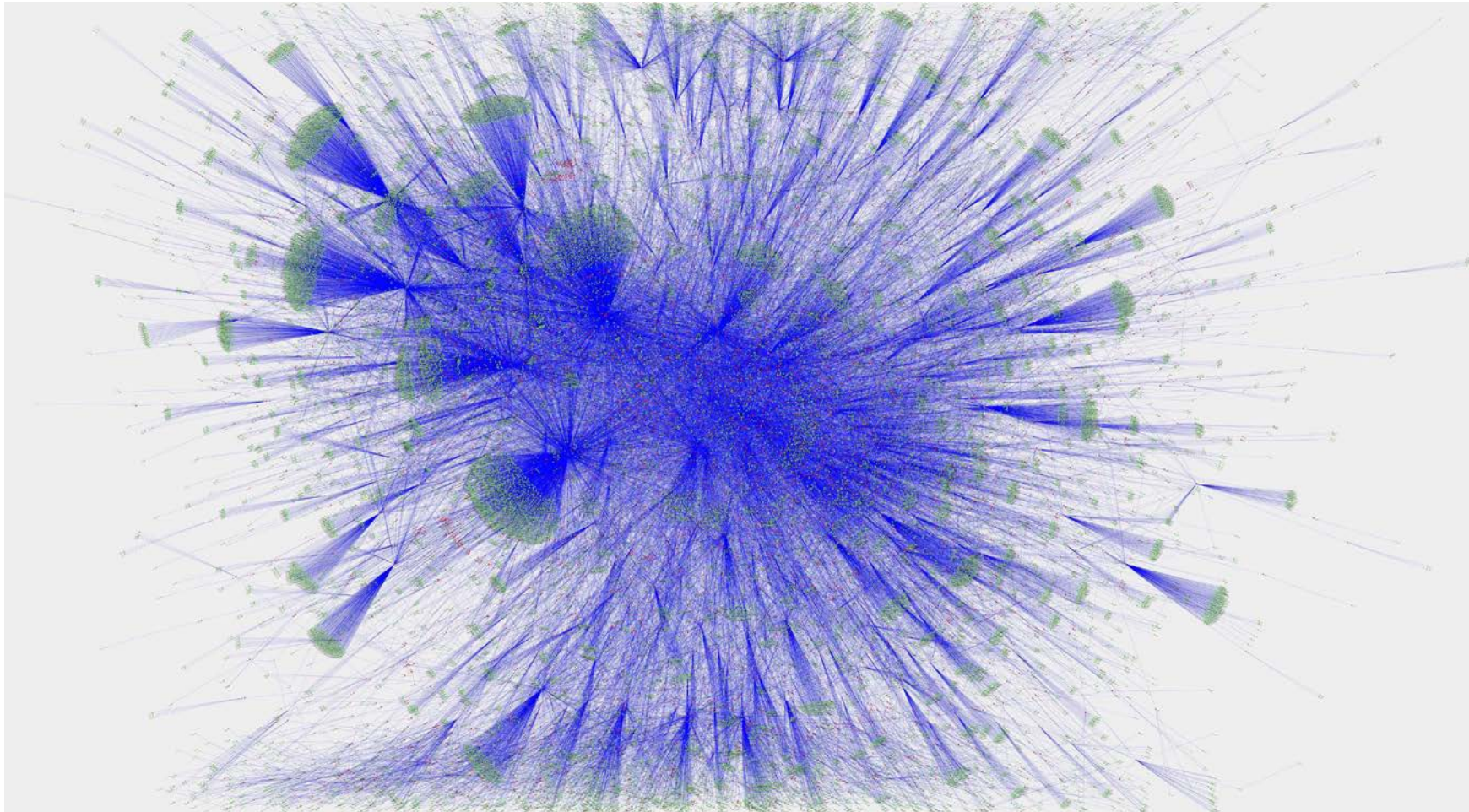
 tastefullyoffensive

Further proof that cats are liquid. (via [jabbathechav](#))

“Commodity” Networks



“Commodity” Networks





Commodity networks

The good

- Great for “normal” traffic
- Resilient by design
- Can move lots of “small” things moving around
- Great if what you are doing is accessing and on a CDN (Content Delivery Network)
- Available almost everywhere

The not so good

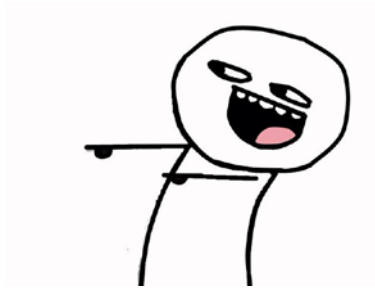
- Not at all optimized for large flows
- Can be very expensive at scale
- **Often sub optimal routing and peering for point to point research traffic**
- Throttling , queuing, traffic shaping destroy throughput (and they don't care)
- Commodity networks assume, and are designed for, “lots of small stuff”
- High speeds are not always available, or cost effective (10G, 40G, 100G)
- **If you have issues, good luck getting help**

Lets take a smaller network and use as an example of this issue...

The academic network

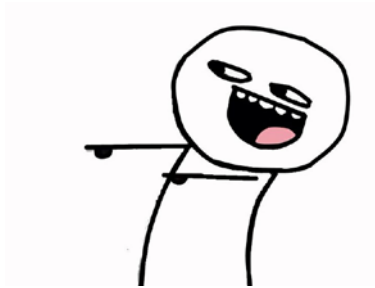


What makes up an academic network?



Student
access

What makes up an academic network?

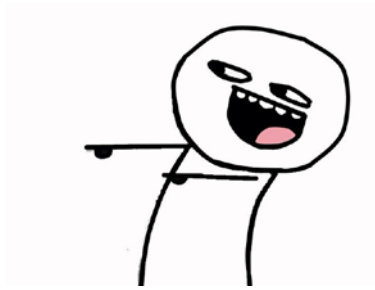


Student
access

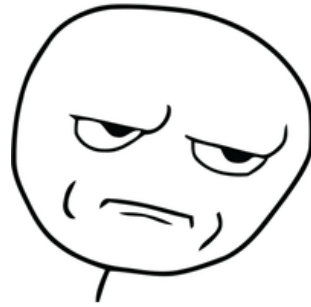


Intellectual
Property

What makes up an academic network?



Student
access

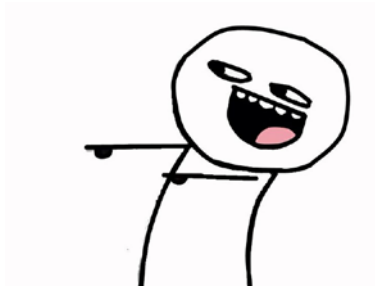


Intellectual
Property

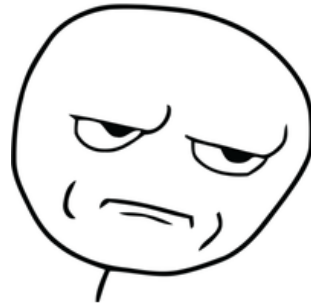


Payroll &
Accounting

What makes up an academic network?



Student
access



Intellectual
Property

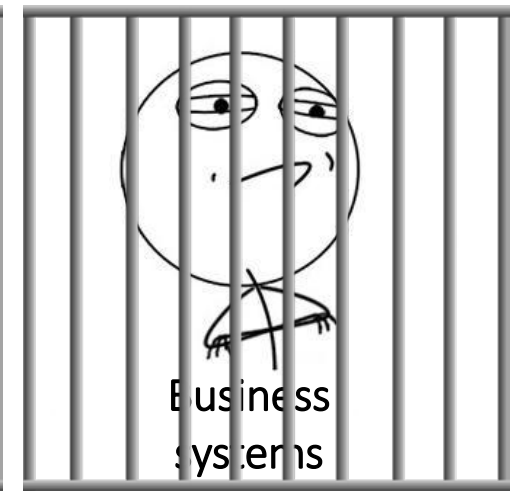


Payroll &
Accounting



Business
systems

What makes up an academic network?



The academic network...





The academic network...



"WAN"



The academic network...

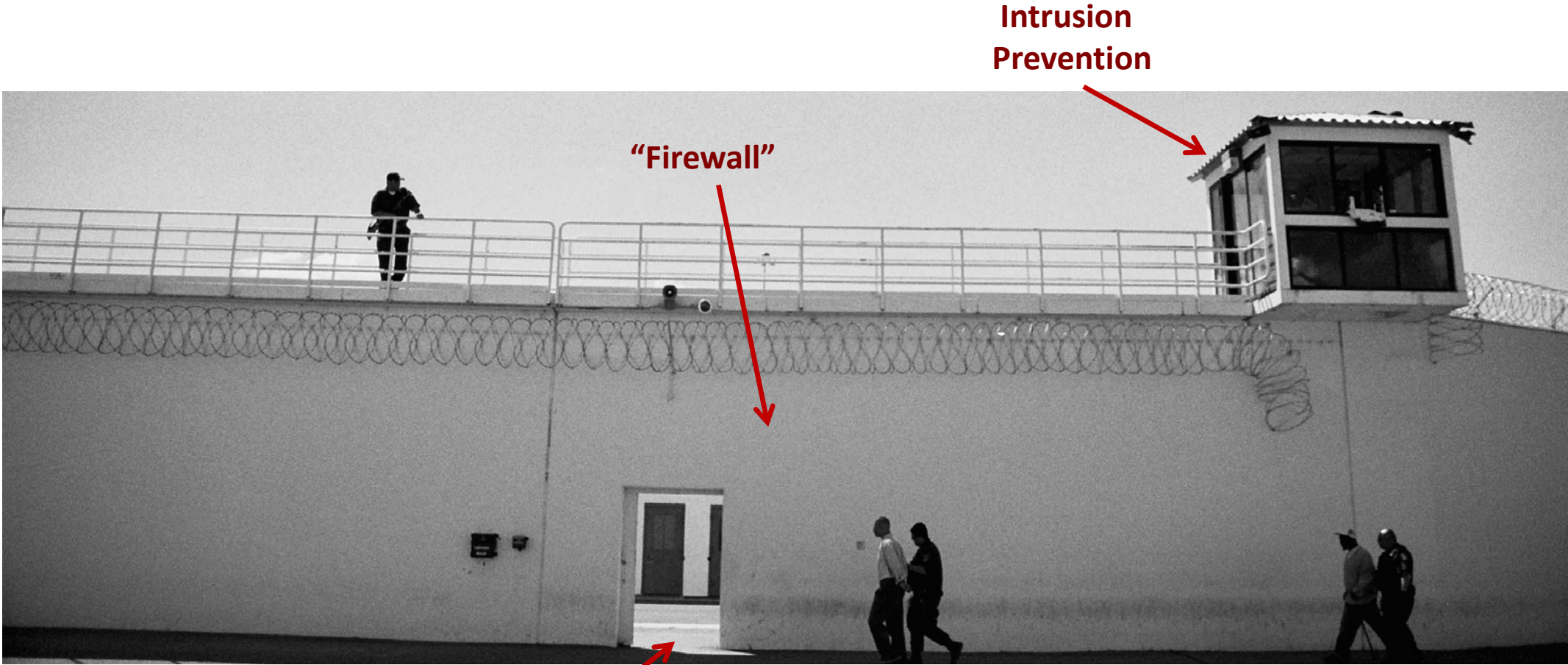


“Firewall”

“WAN”



The academic network...



"WAN"

"Firewall"

Intrusion
Prevention



The academic network...

**Bureaucracy
(aka "Paperwork")**

**Intrusion
Prevention**



"Firewall"

"WAN"

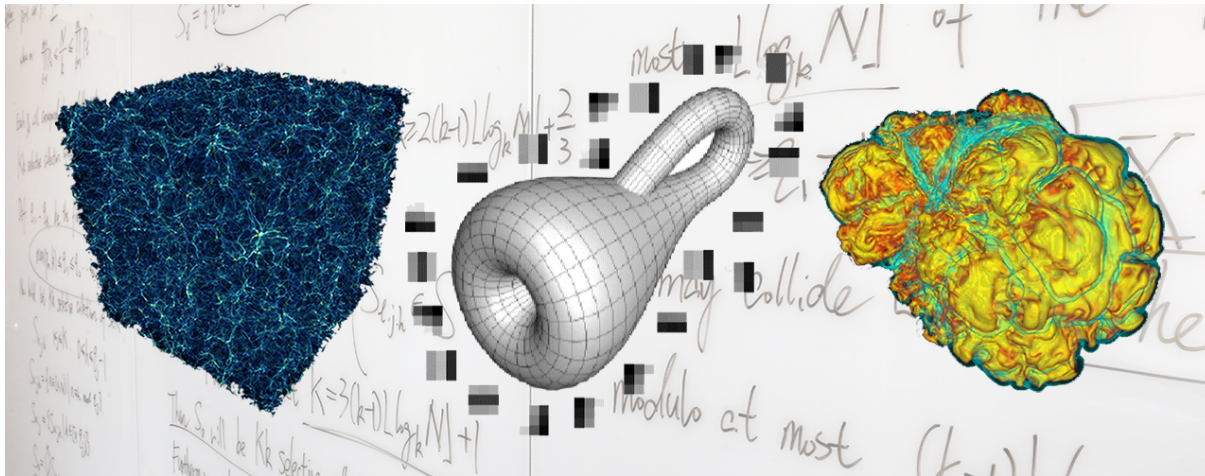
CAUTION

ANALOGIES AHEAD

PROTECTIVE HEADGEAR MUST BE WORN IN THIS AREA

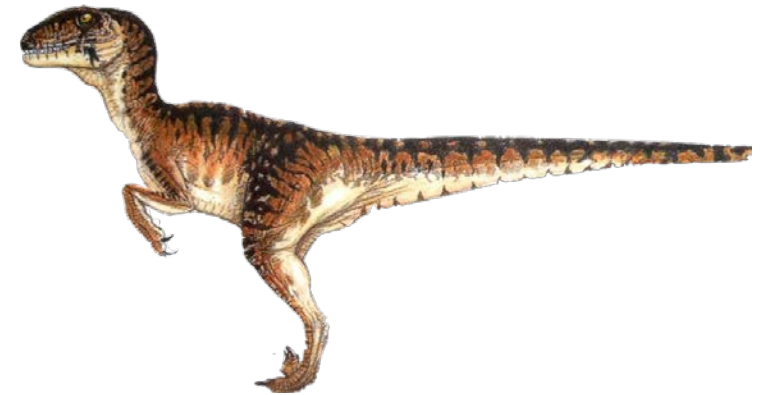


Computational Research, an analogy...



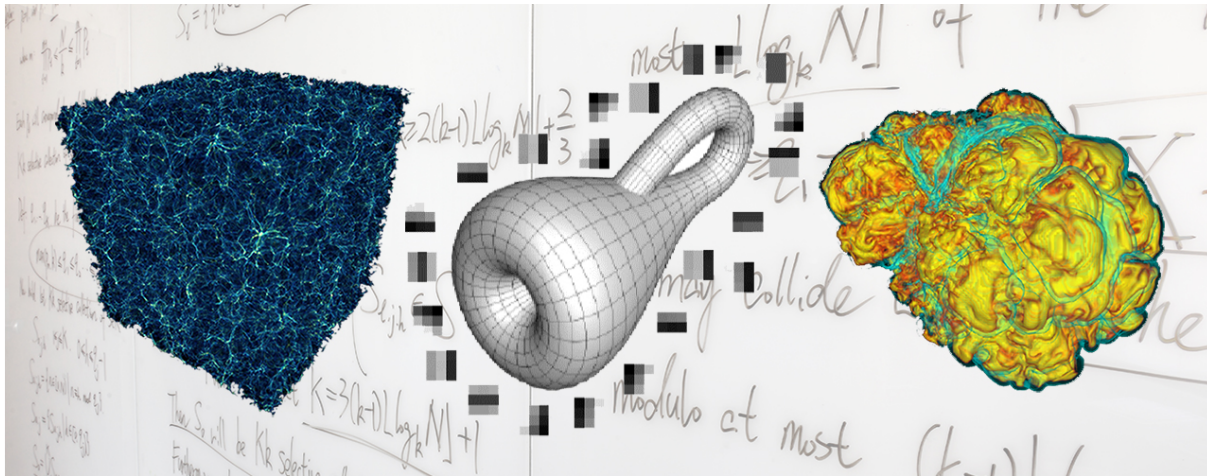
Computational Research

=



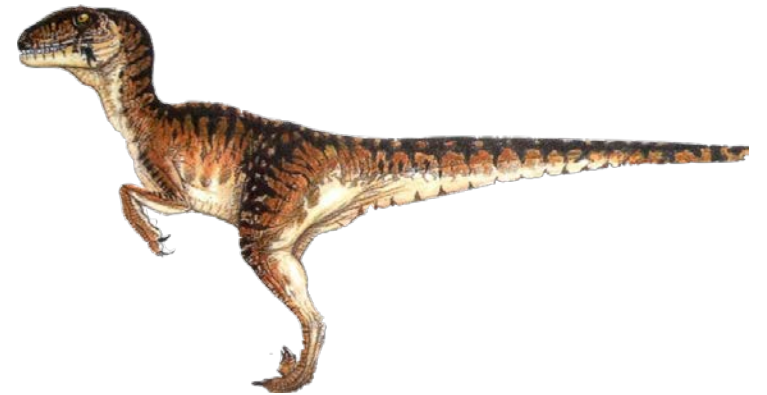
Velociraptor

Computational Research, an analogy...



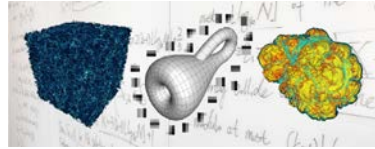
Computational Research

|||



Velociraptor

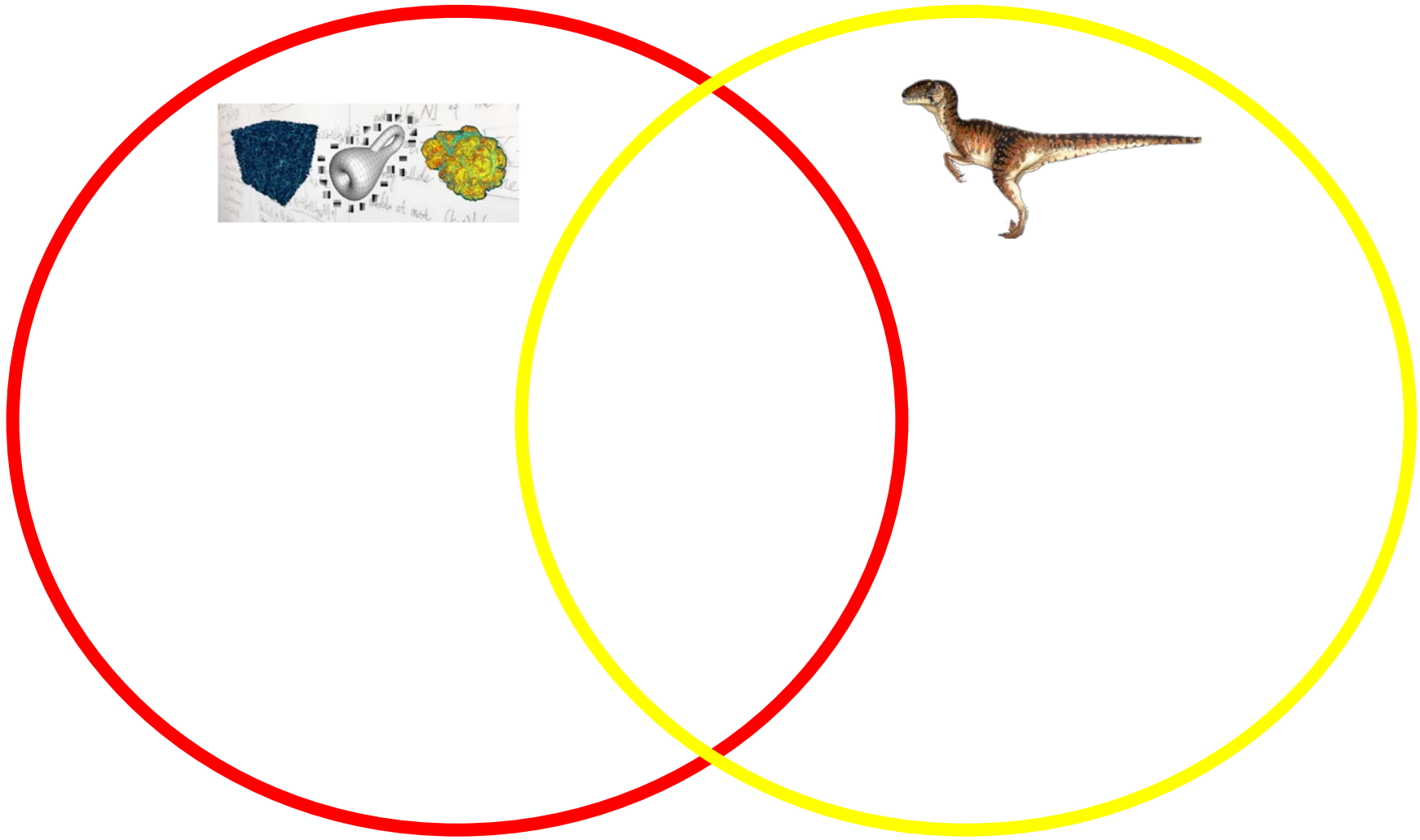
Computational Research, an analogy...



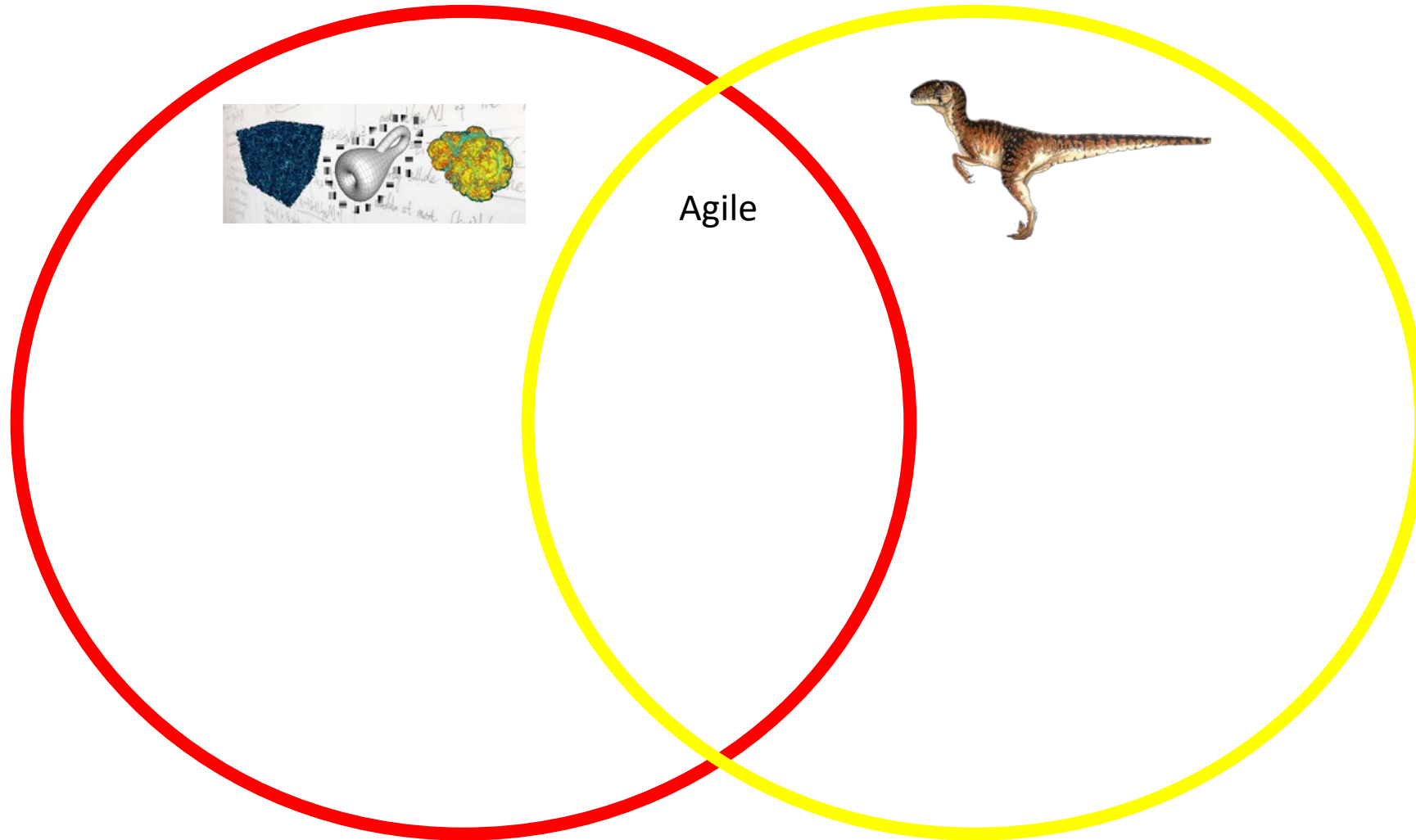
Irrefutable proof the analogy is valid...



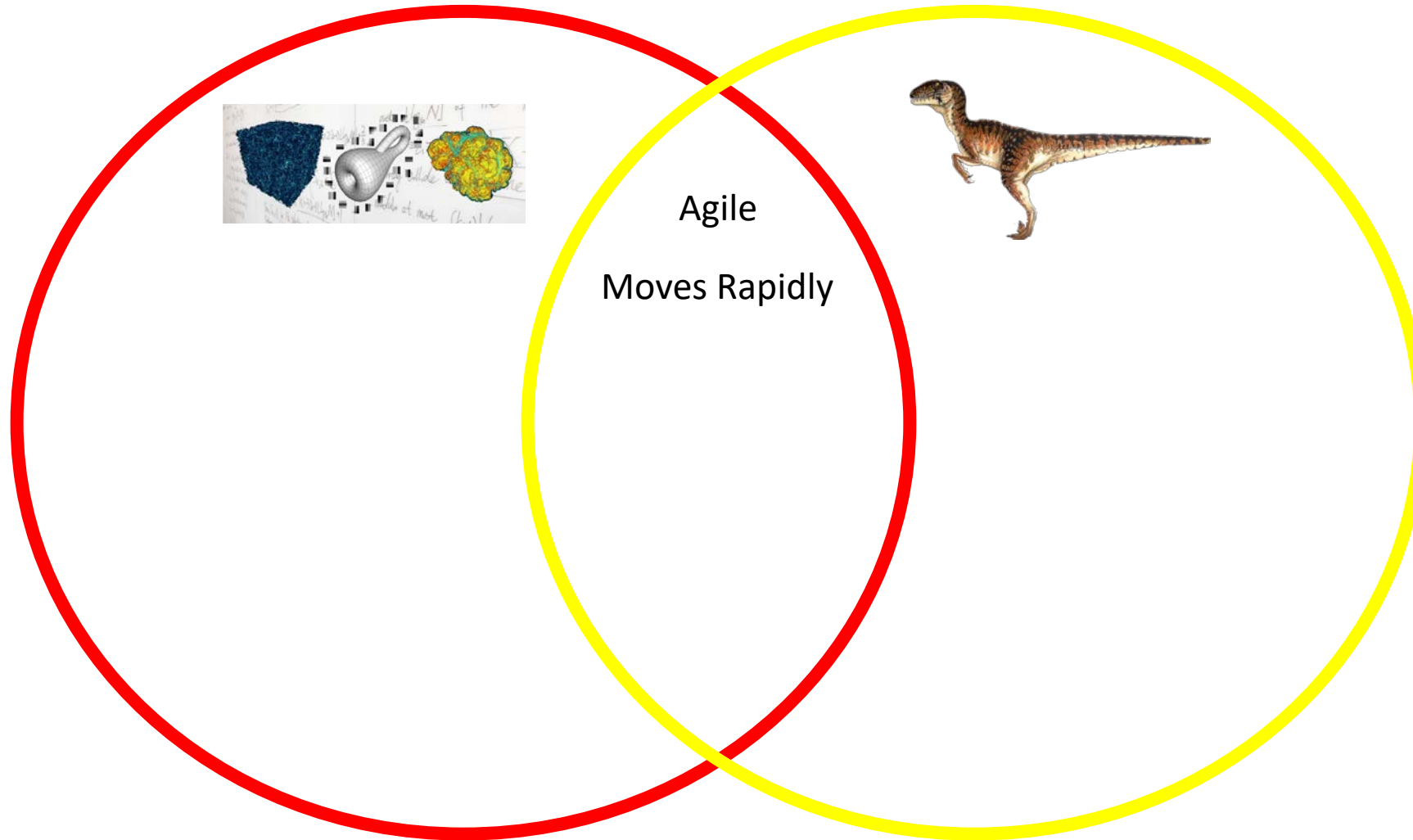
Computational Research, an analogy...



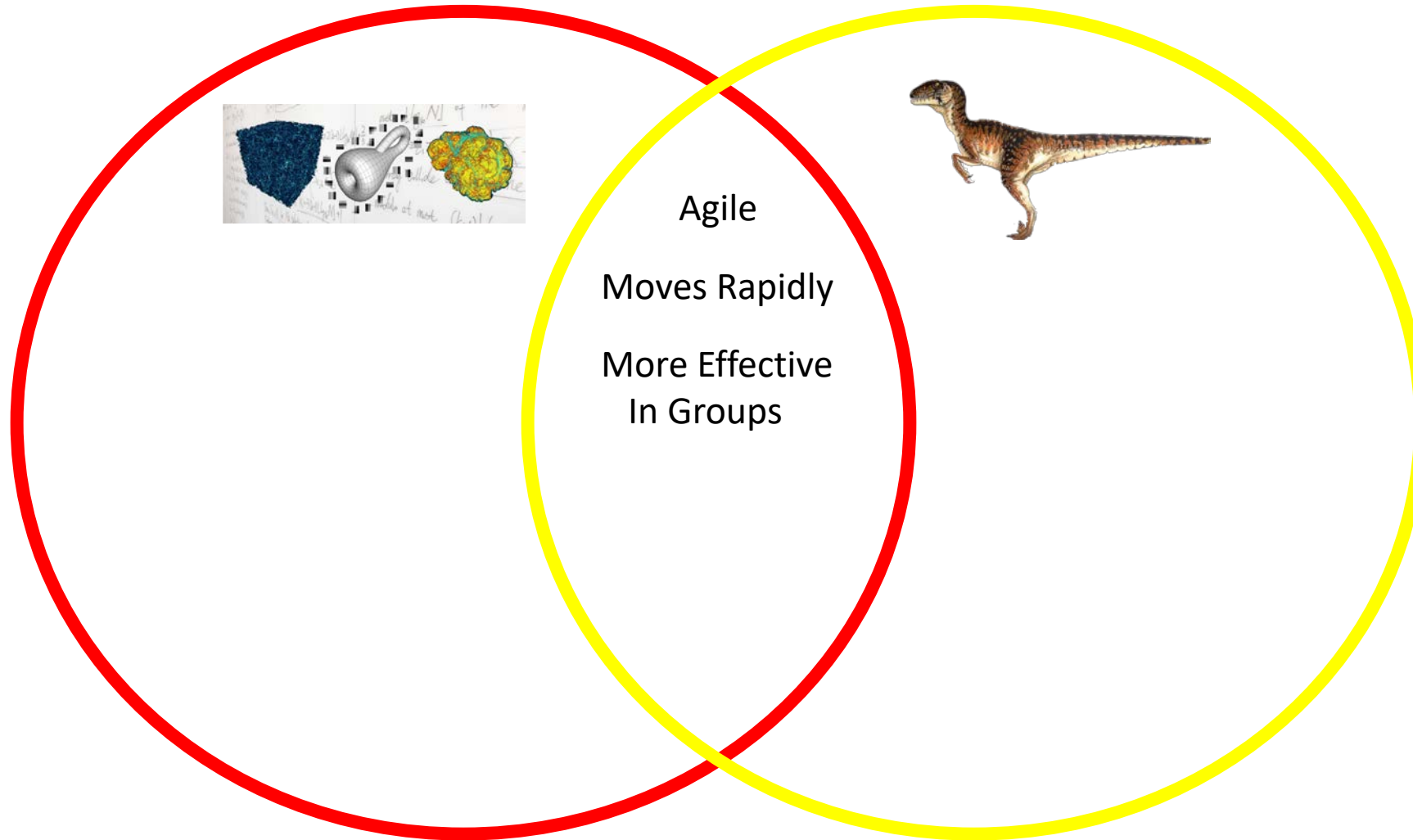
Computational Research, an analogy...



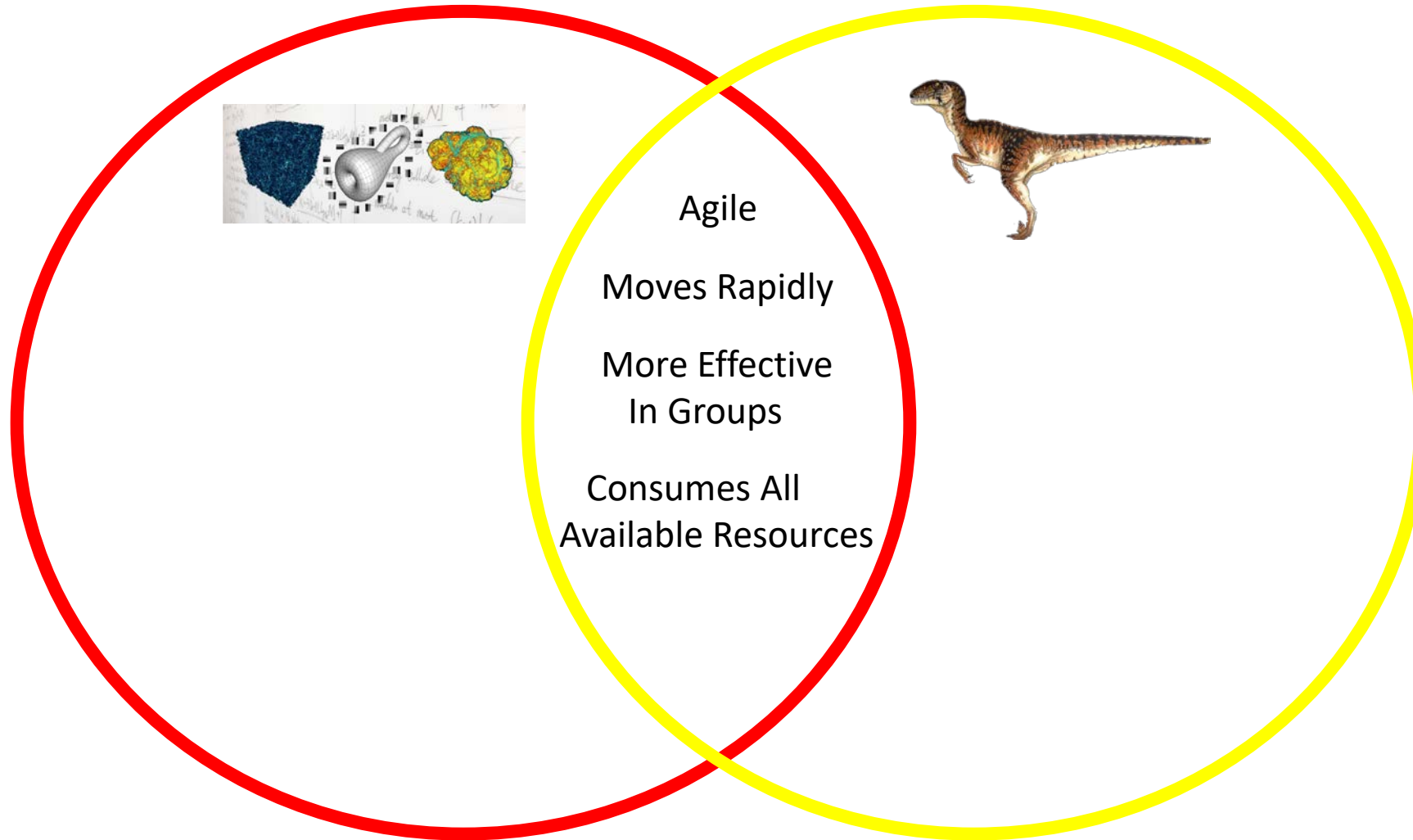
Computational Research, an analogy...



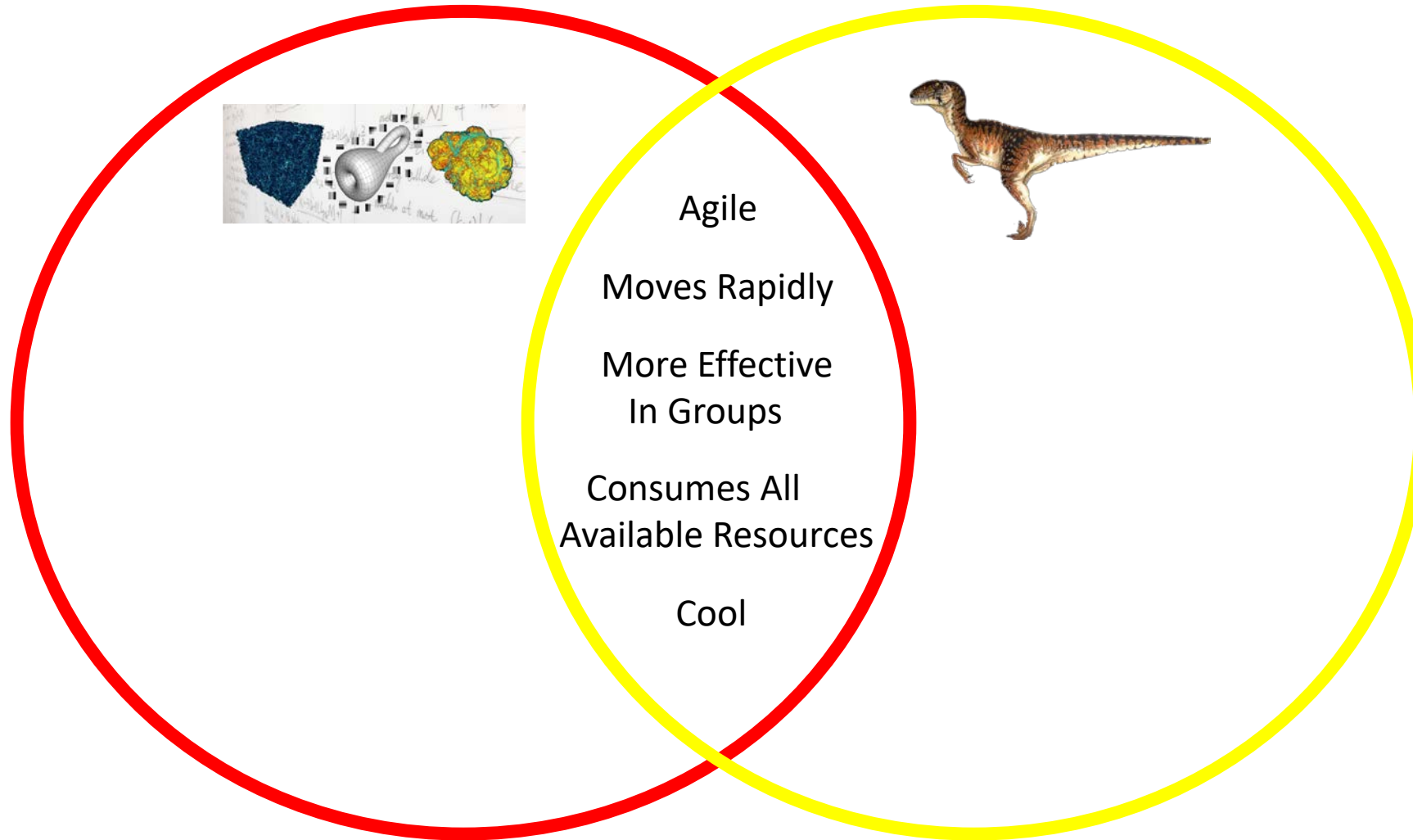
Computational Research, an analogy...



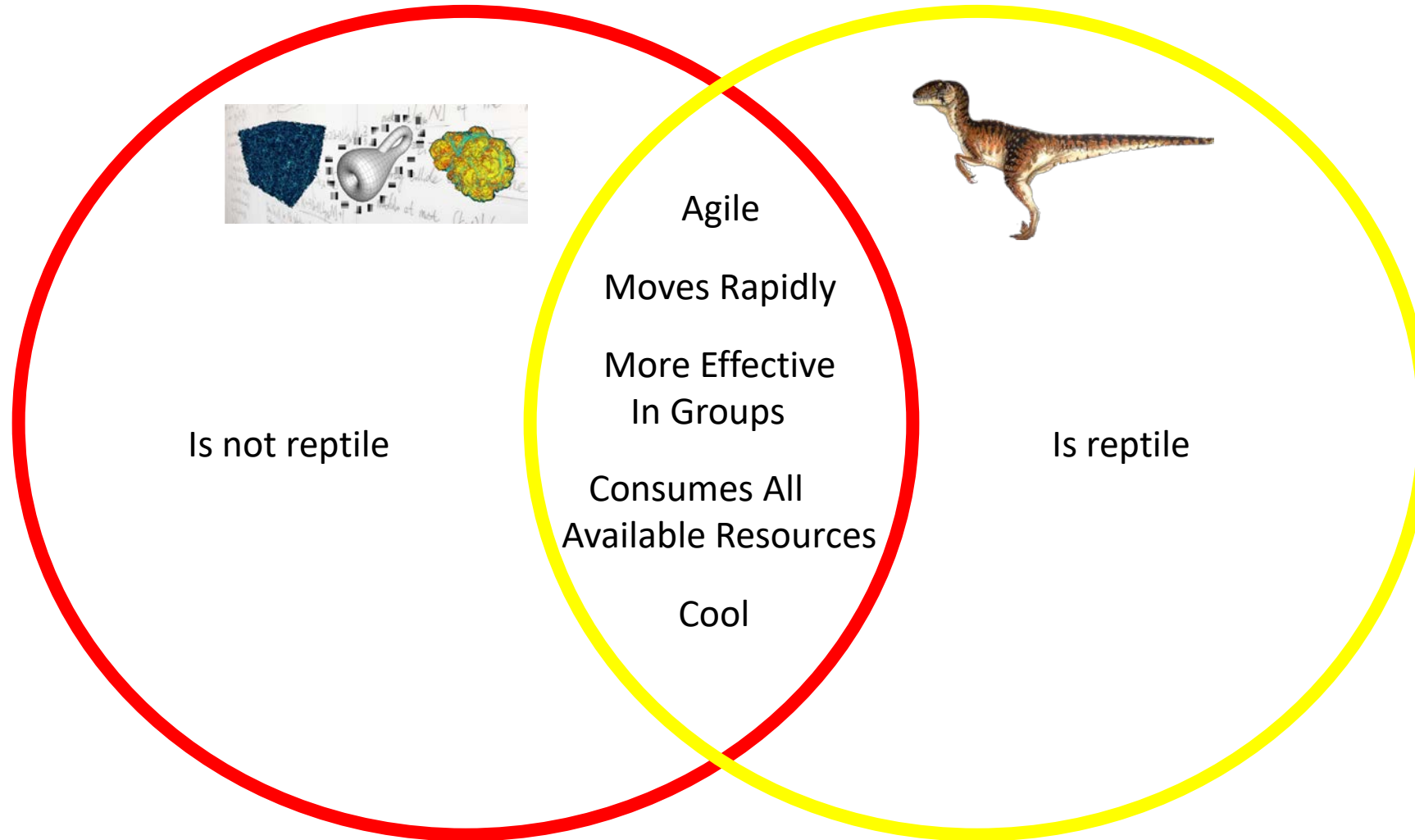
Computational Research, an analogy...



Computational Research, an analogy...



Computational Research, an analogy...



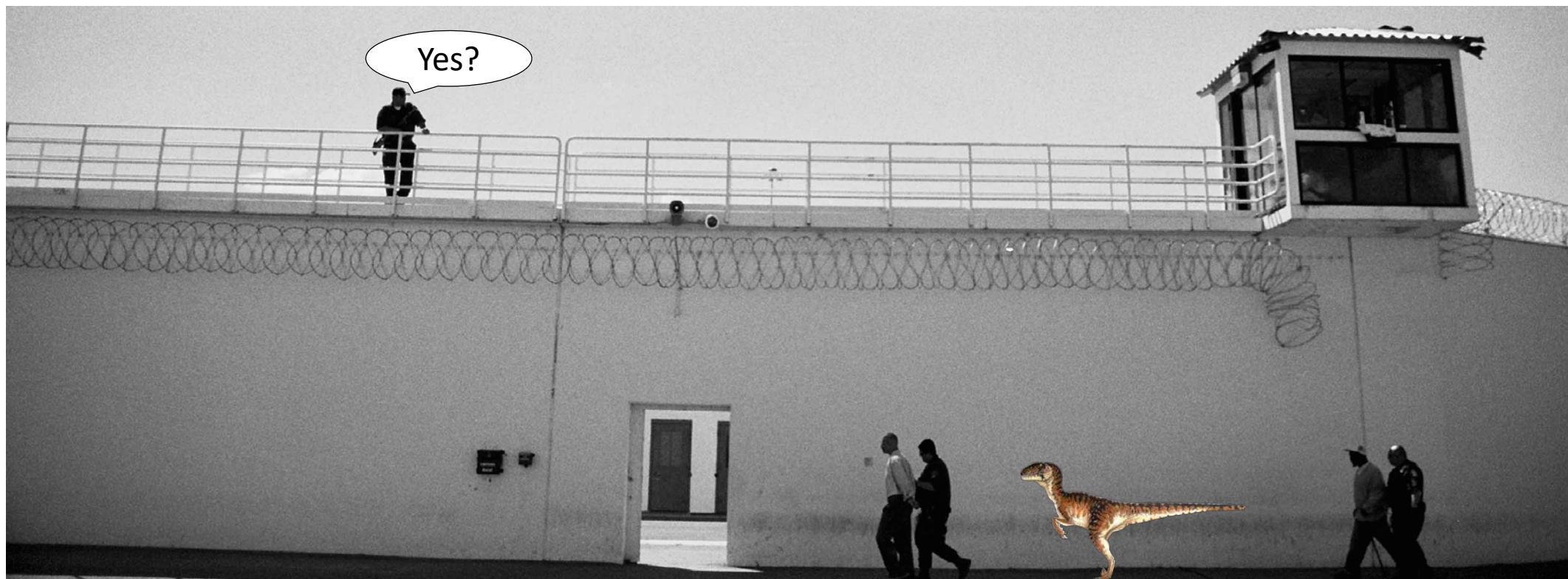
When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks

...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*, and they may need to be shared across institutions.



When Computational Science Meets Traditional Networks

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



When Computational Science Meets Traditional Networks



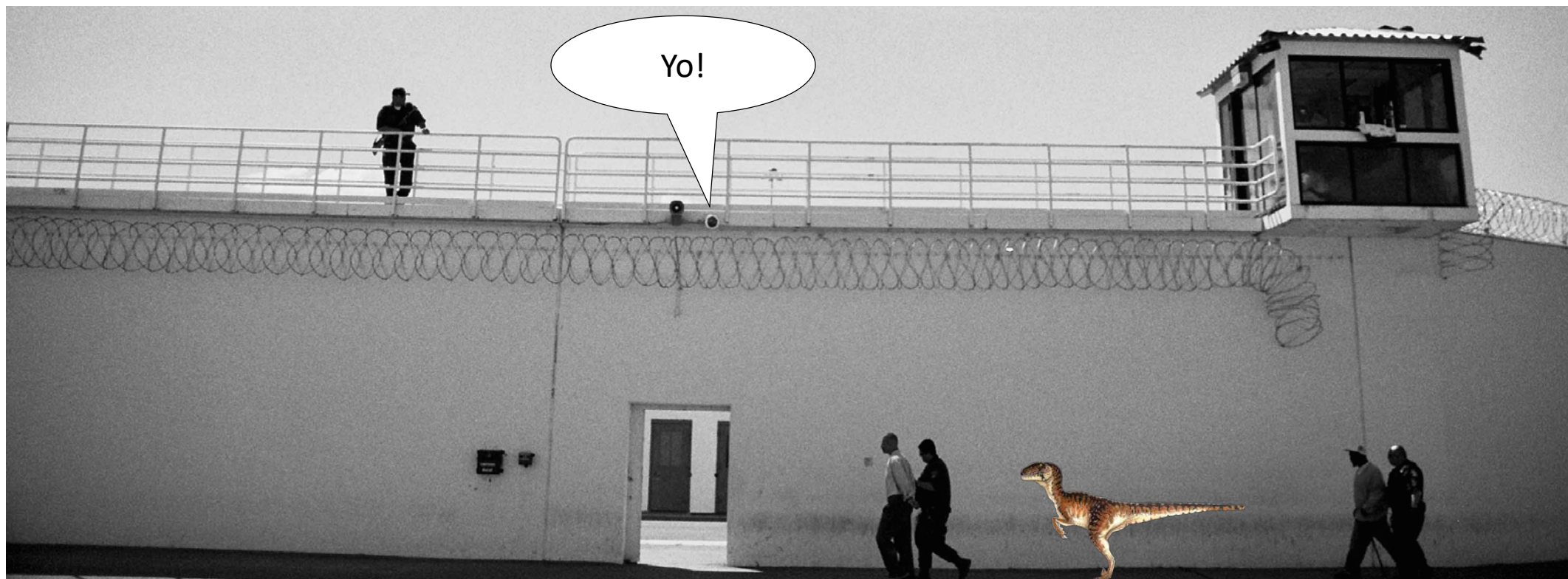
When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks

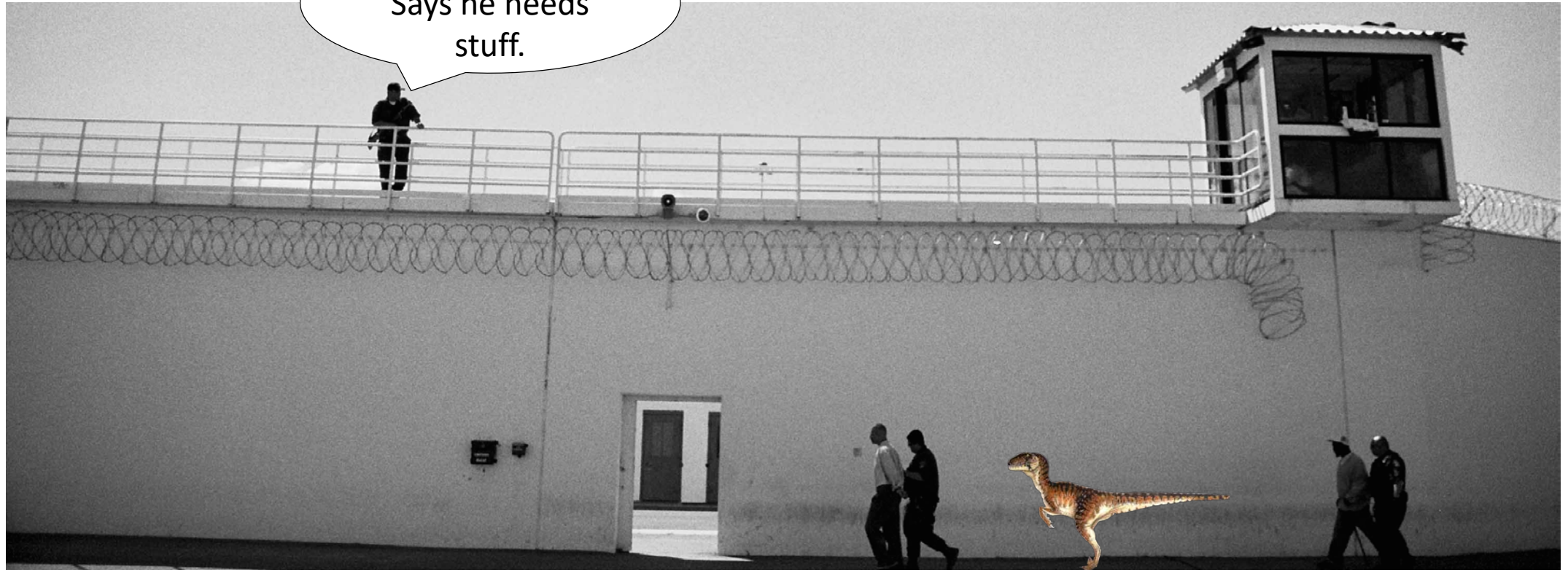


When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks

Gotta guy here.
Says he needs
stuff.



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks

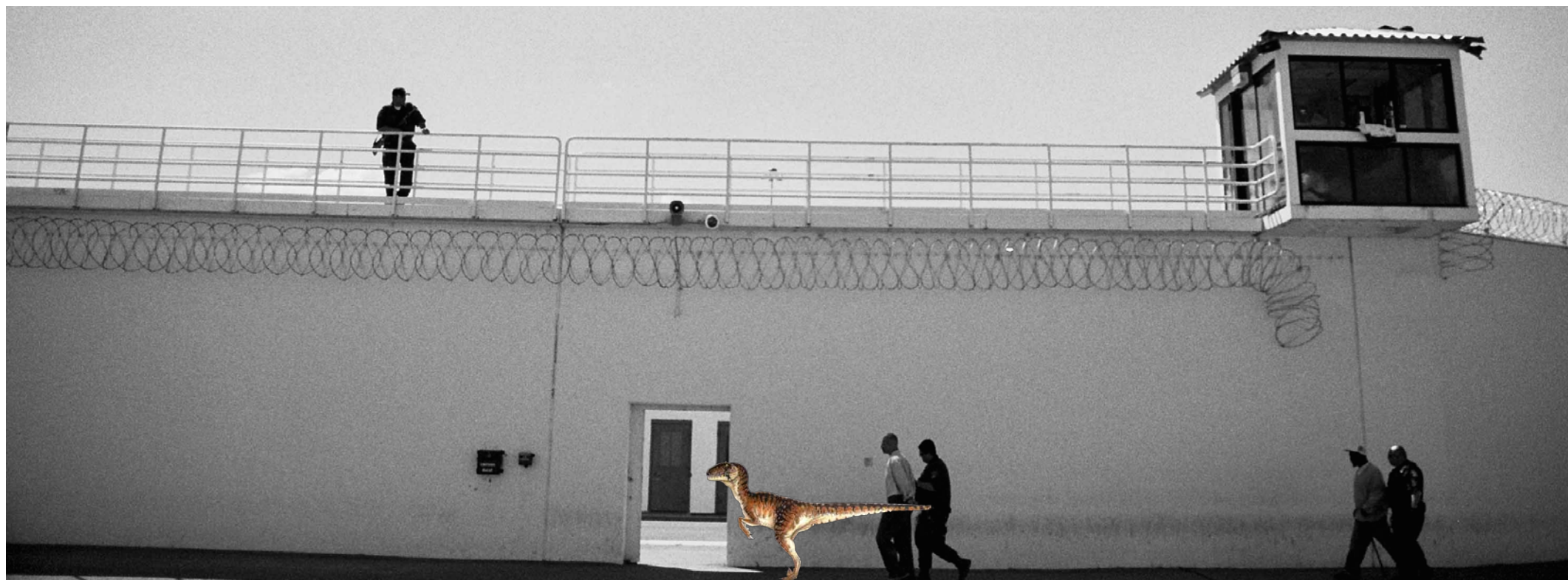
Something about
security and
connectivity (maybe).



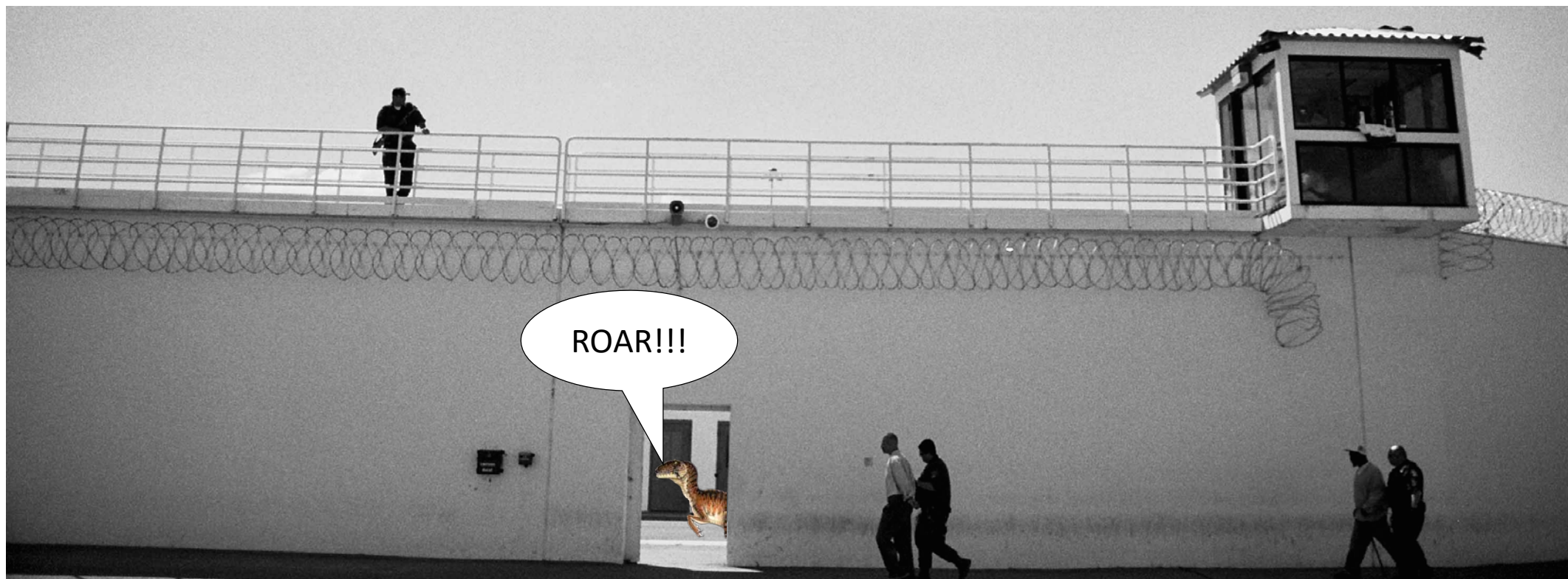
When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



When Computational Science Meets Traditional Networks



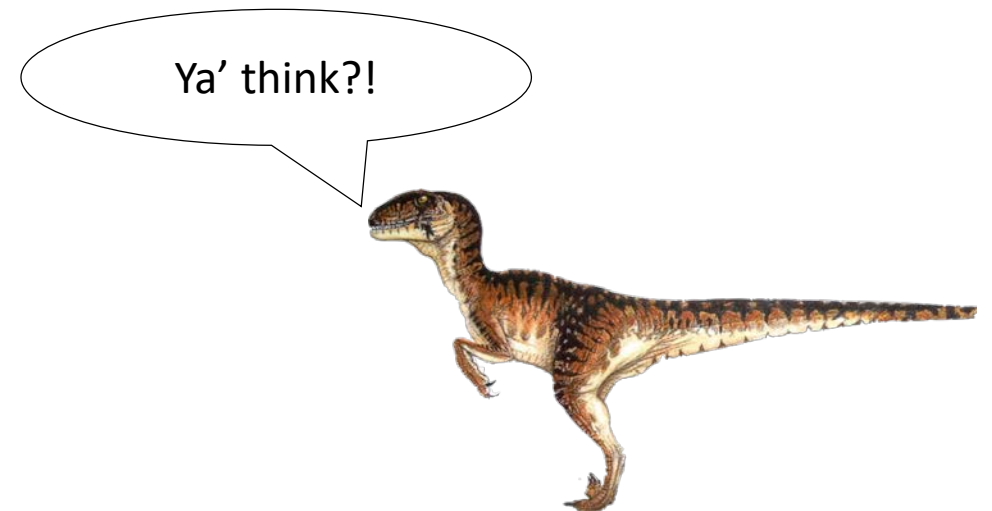
When Computational Science Meets Traditional Networks





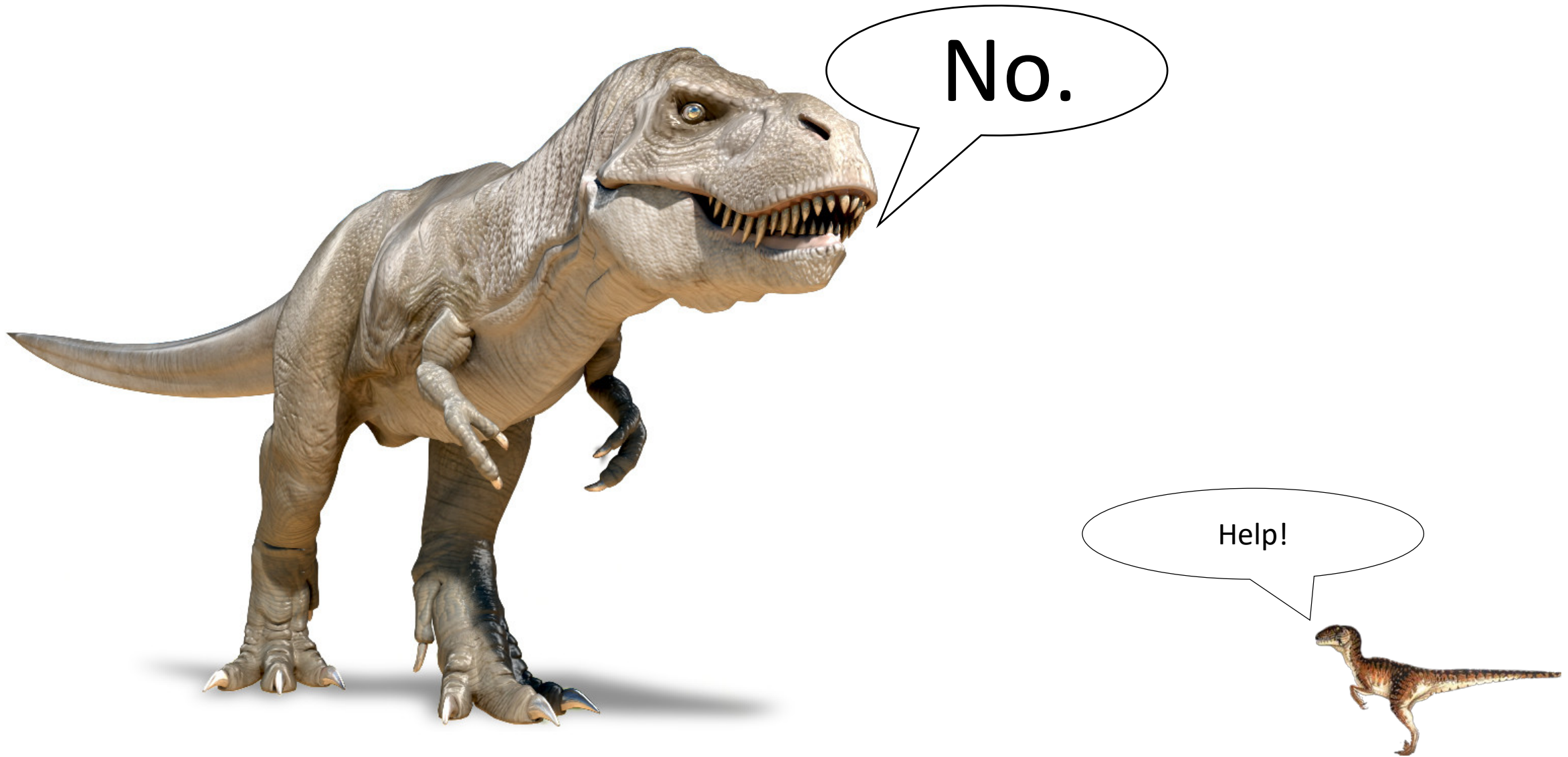
When Computational Science Meets Traditional Networks

OBSERVATION: The **requirements** of the computational researcher and the **service profile** of the traditional campus computer network (or other "commodity" networks) do not always align!





When Computational Science Meets Commercial Commodity Networks





When Computational Science Meets Commercial Commodity Networks



On second thought,
how much money yah gots?

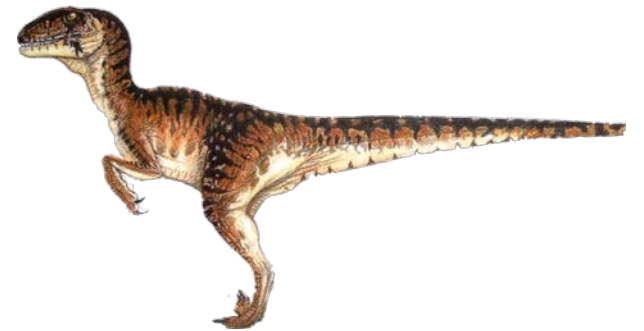
Eek... Umm...



When Computational Science Meets Traditional Networks

This can result in adverse consequences:

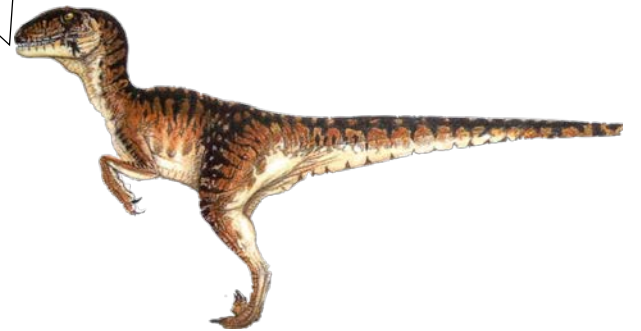
- Network performance issues for the researcher
- Network performance issues for everyone else
- Frustration for the researcher
- Frustration for IT staff



When Computational Science Meets Traditional Networks

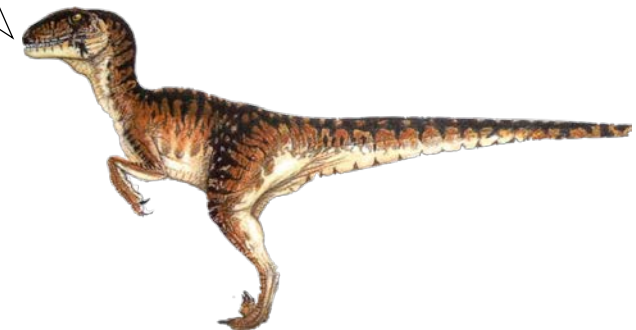


Sigh. I guess cancer cures can wait.



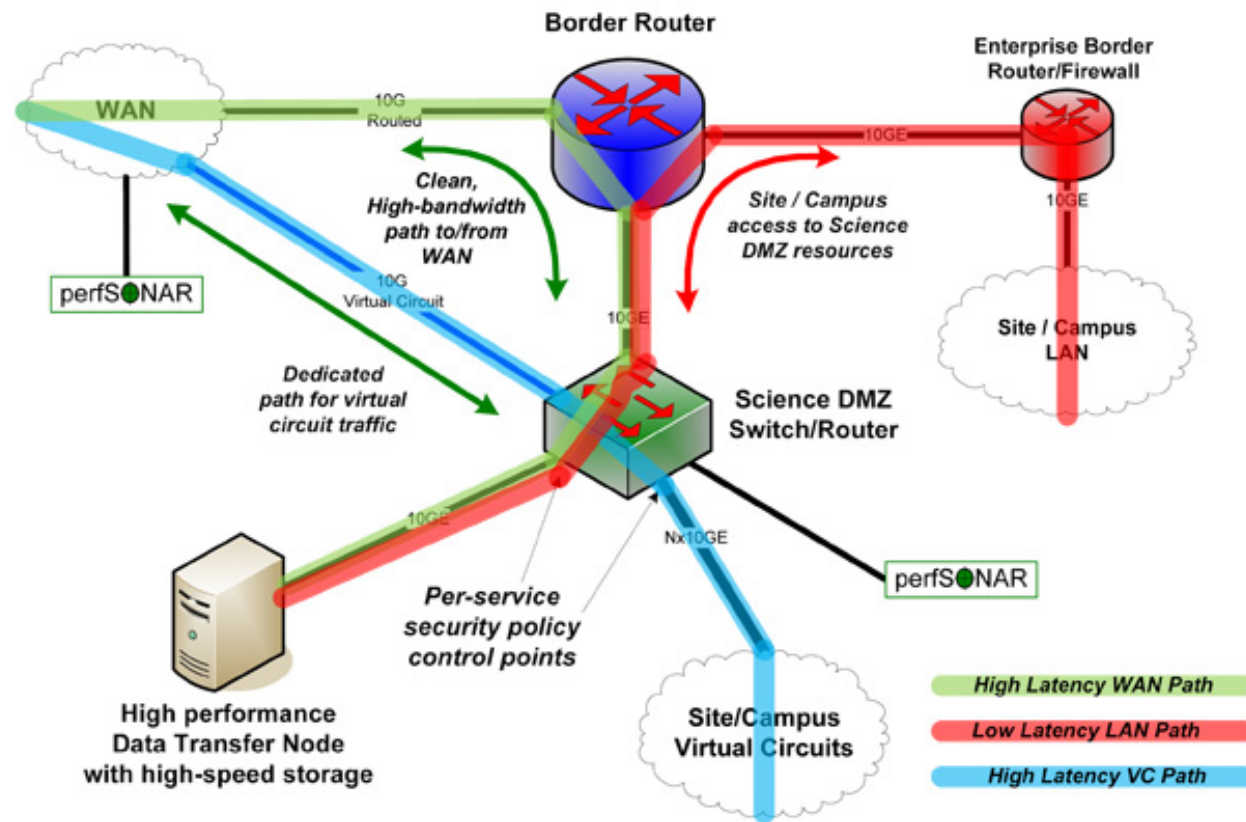
When Computational Science Meets Traditional Networks

But how do we overcome this? *I can't stop my research* just because **the network can't keep up!** Being able to collaborate is the next step!



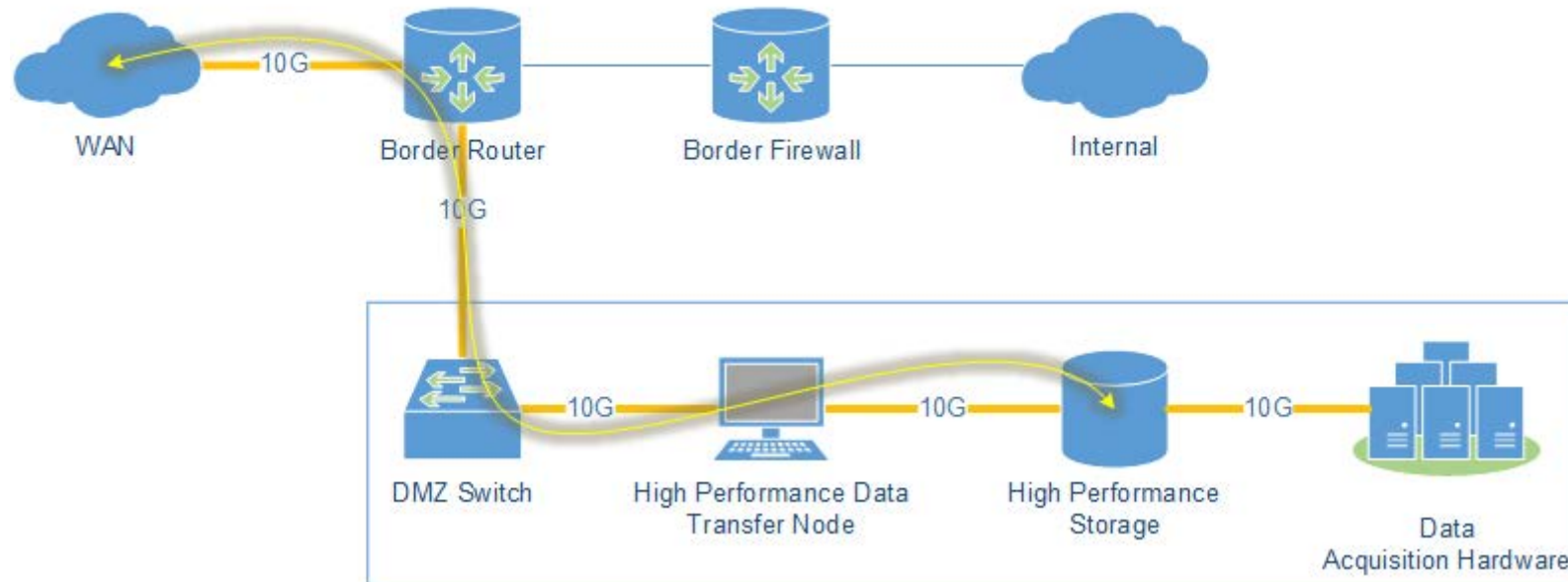
Specialty networks to the rescue!

- Both internally to your organization and externally
- Science DMZ is an example of a specialty network

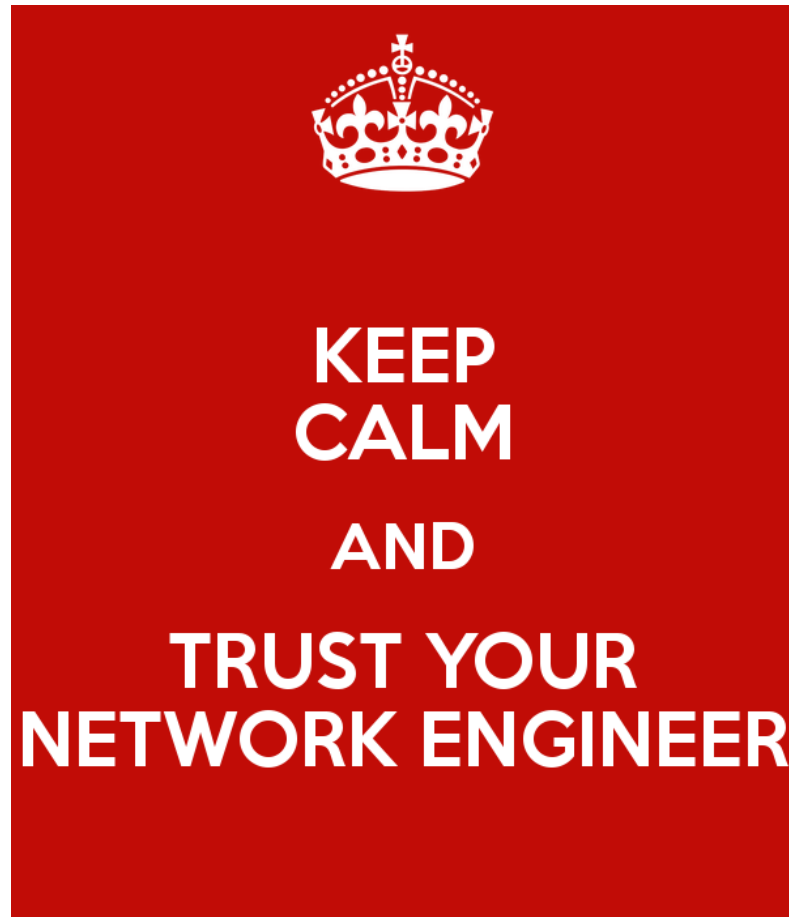


Data Transfer Nodes (DTN)

- Simply put, a DTN is a server that is specially designed to move data from disk to a network at speed.



So what should I do?
I'm not a network engineer!



You don't need to be.

The skills and knowledge of how to move your data probably already exists within your reach.

Now you need to discover it.



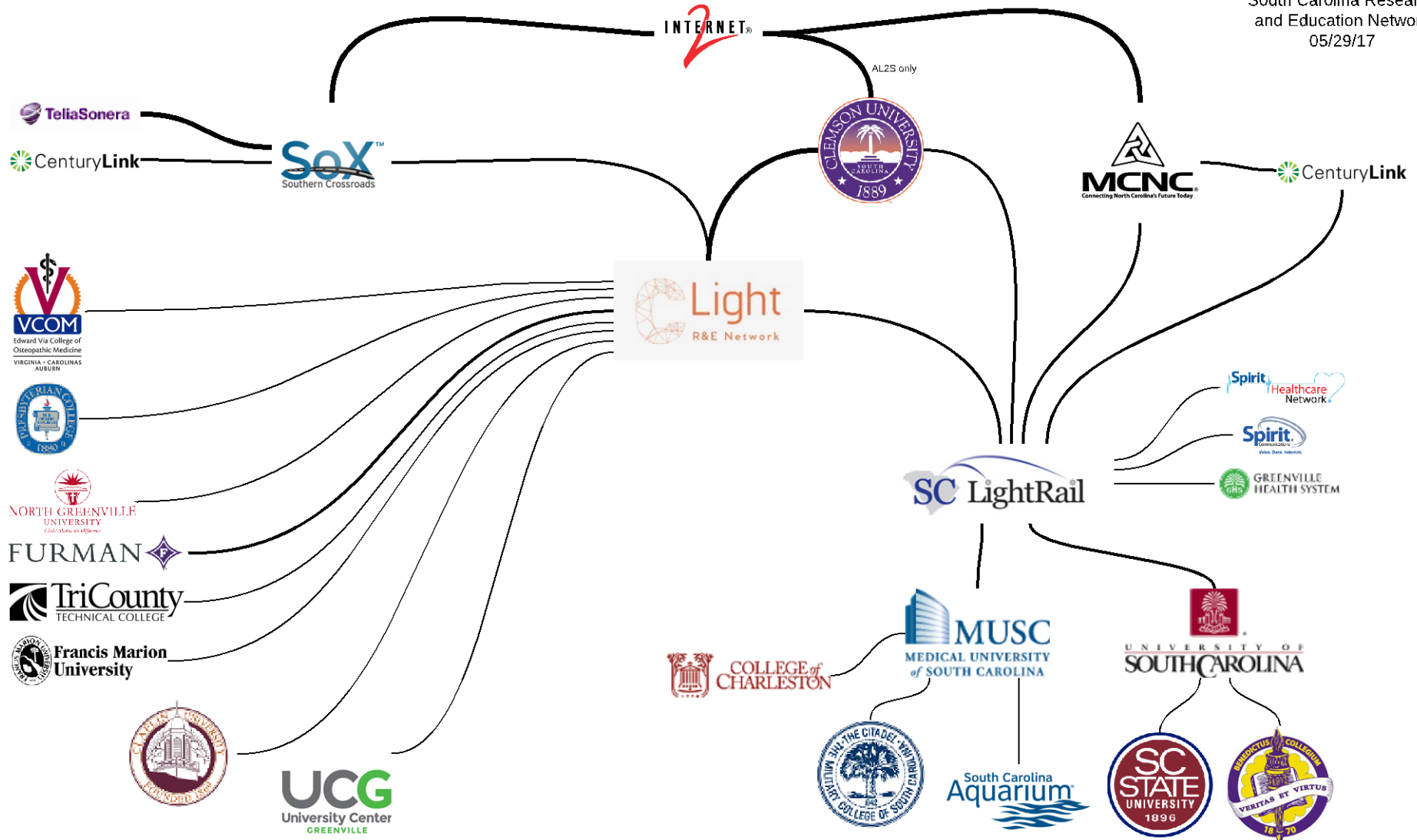
Build a relationship diagram

- Start at a high level
- Get more detailed over time
- Don't attempt to boil the frog all at once



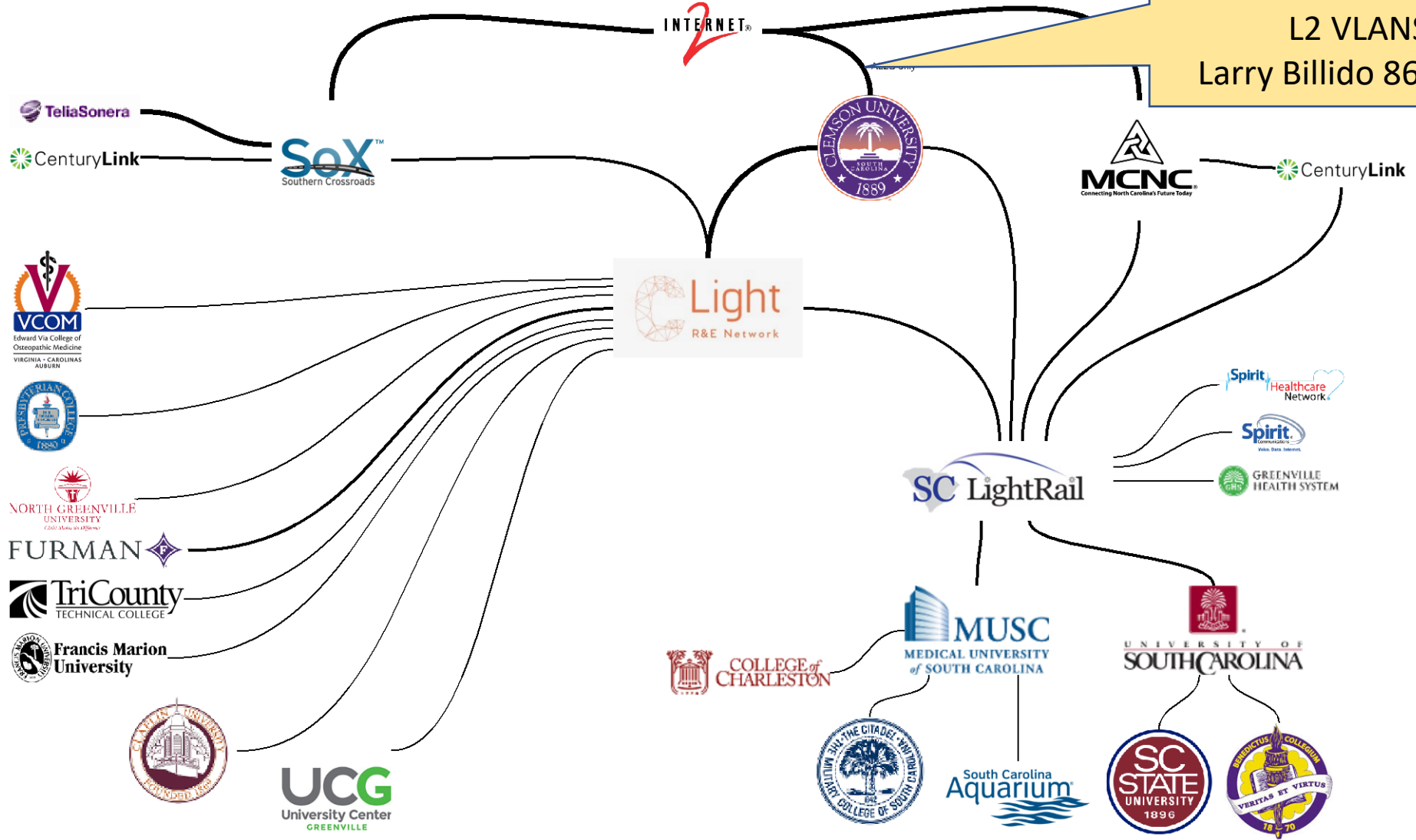
Build a relationship diagram

C-Light
South Carolina Research
and Education Network
05/29/17



Add details as you discover them

AL2S path
100G direct to I2
Connects direct to DMZ router
L2 VLANS only
Larry Billido 863-999-9999



Local networks



HARVARD UNIVERSITY
Information Technology

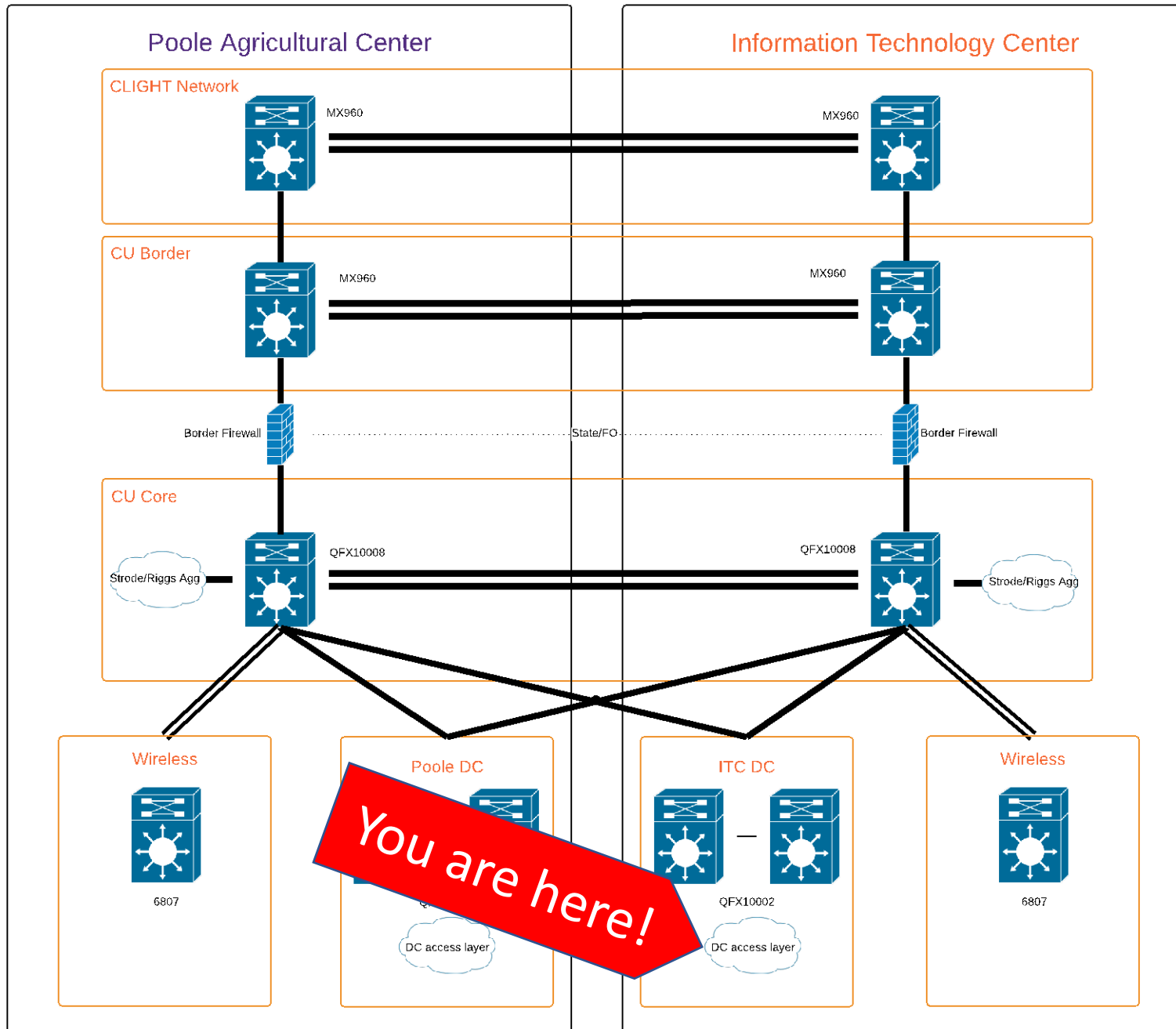


CLEMSON
College of ENGINEERING,
COMPUTING AND APPLIED SCIENCES



INFORMATION TECHNOLOGY
UNIVERSITY *of* WASHINGTON

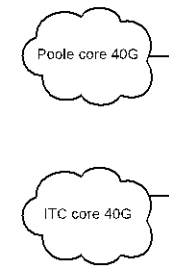
(Insert your logo here)



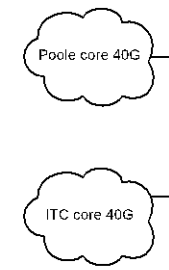
Key

- Dual links
- 100G
- 40G
- 10G
- 1G
- Other

Strode Hall aggregation



Riggs Hall aggregation

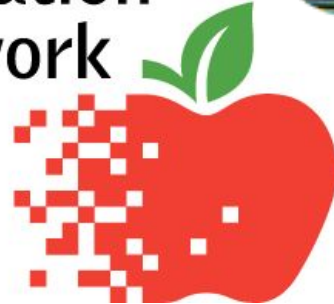


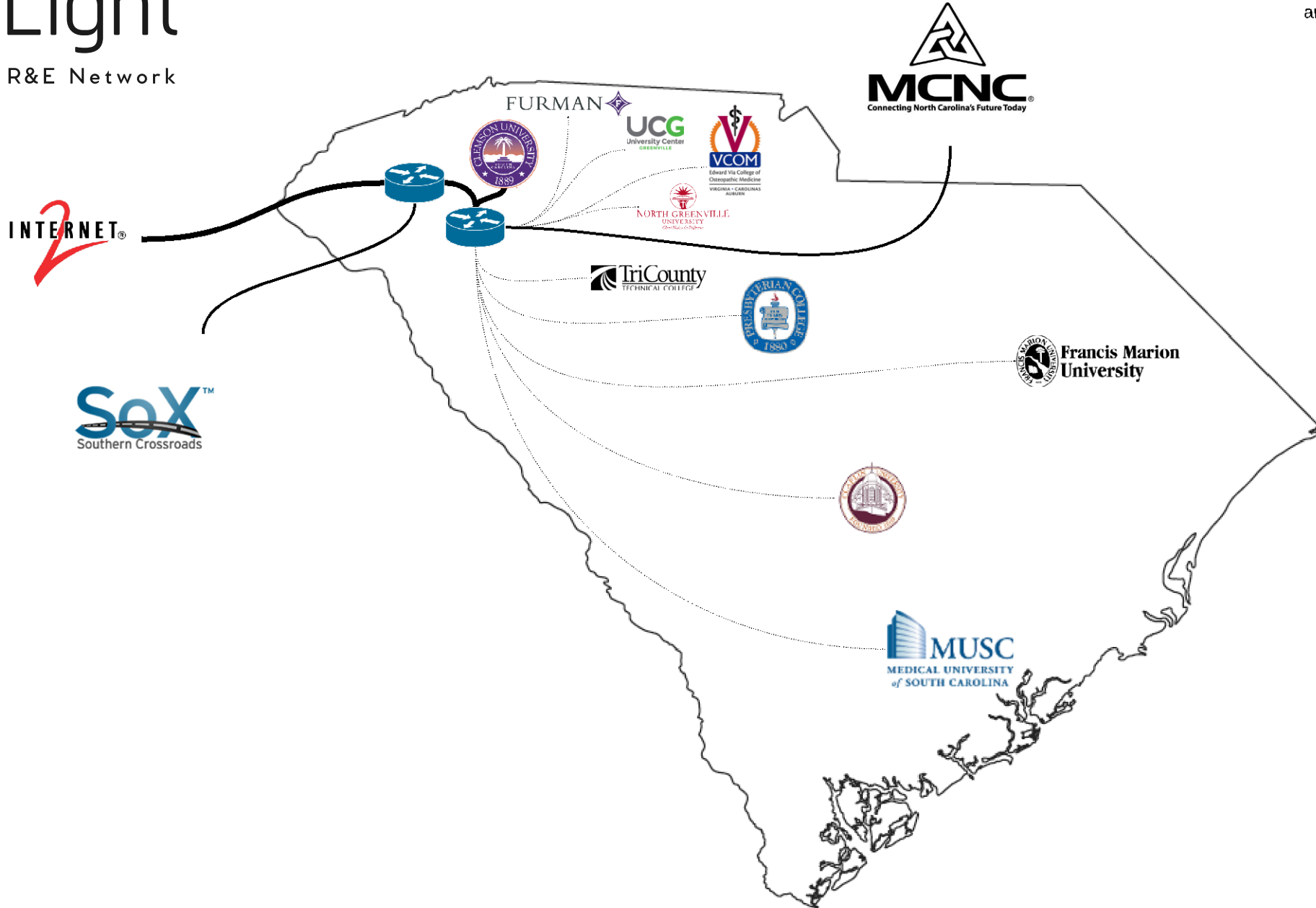


State/regional networks aka "your ISP"



K-20
Education
Network





Exchanges and PoPs



National Networks (US)





INTERNET2 NETWORK ADVANCED LAYER 1 SERVICE

MAY 2017



IN SUPPORT OF
U.S.UCAN

NETWORK PARTNERS

ciena



INDIANA UNIVERSITY

infinera

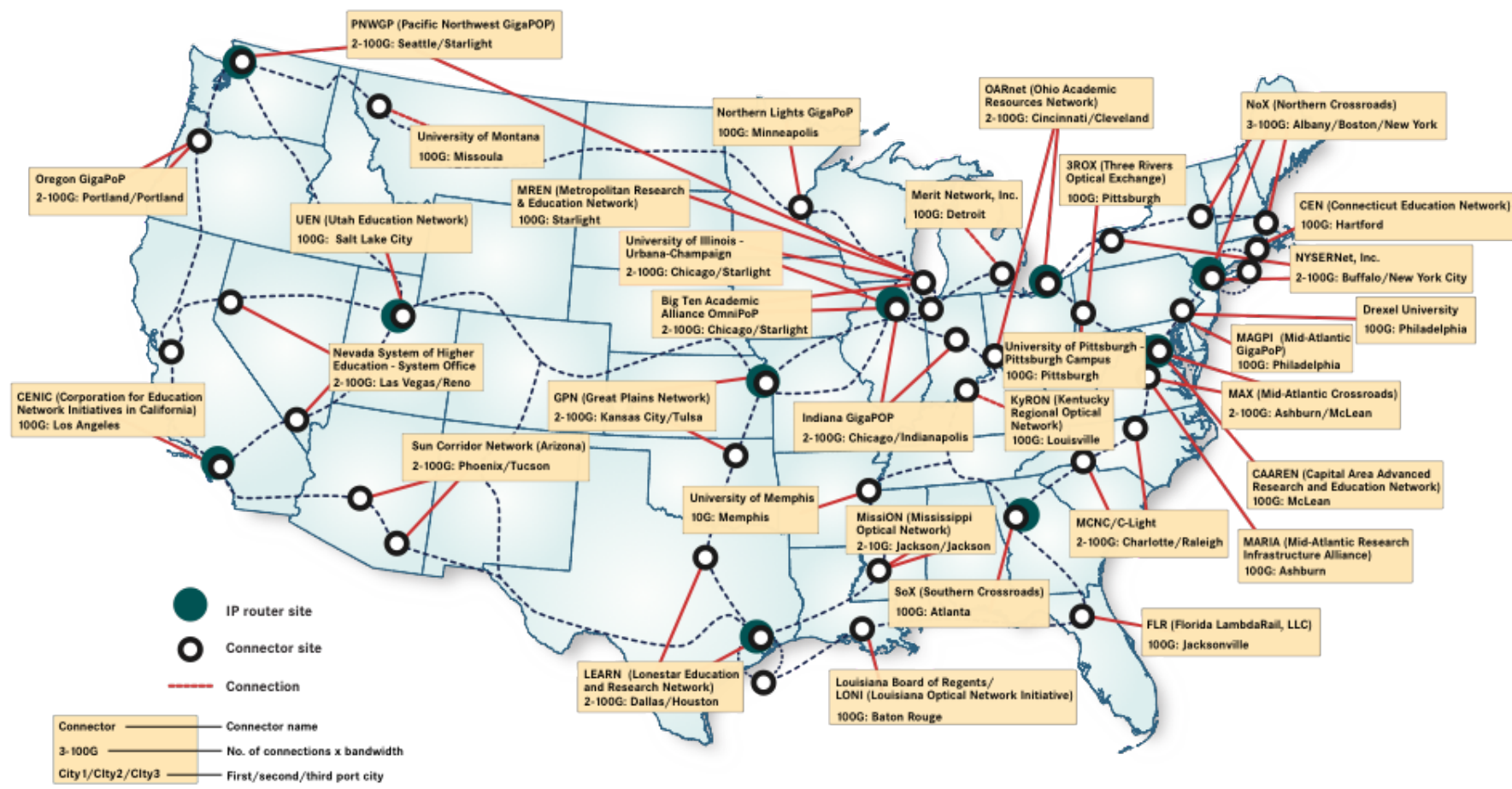
JUNIPER
NETWORKS





INTERNET2 NETWORK CONNECTIONS

WWW.INTERNET2.EDU/CONNECTORS - MARCH OF 2017





INTERNET2 NETWORK ADVANCED LAYER 2 SERVICE

MAY 2017



● Advanced Layer 2 Service
(SDN Ethernet)

IN SUPPORT OF
U.S.UCAN

NETWORK PARTNERS

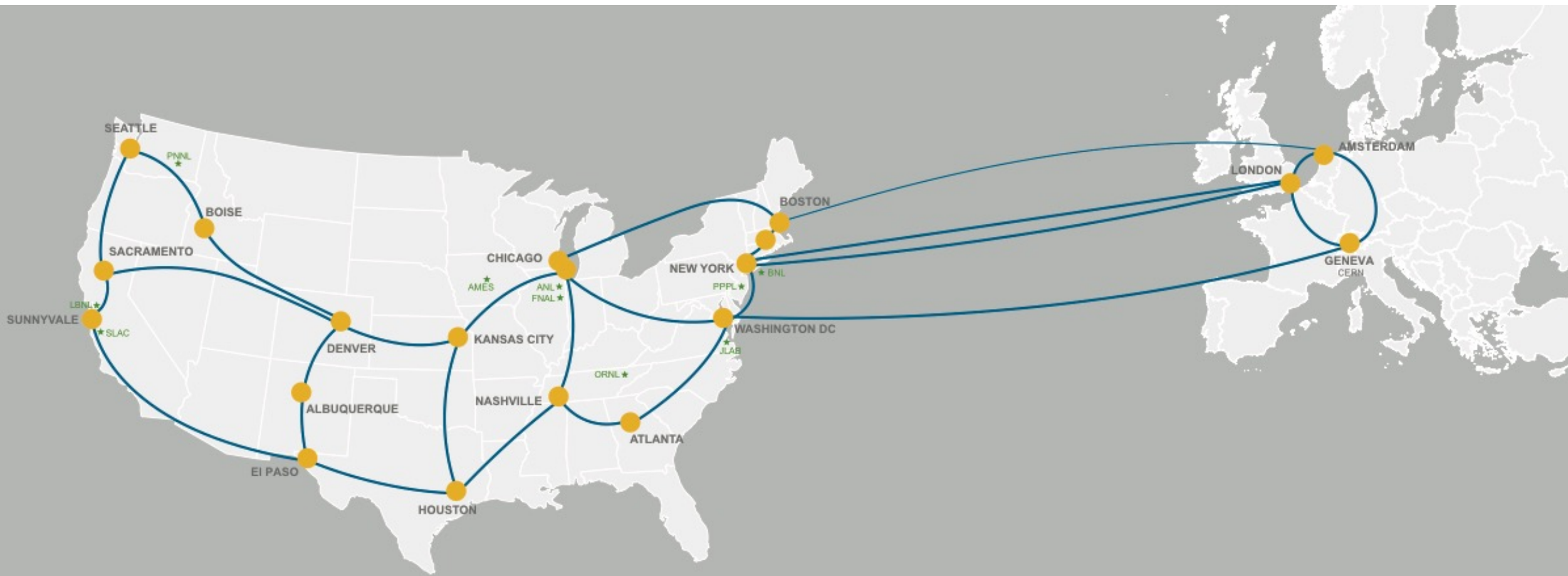
ciena

CISCO

INDIANA UNIVERSITY

Infinera

JUNIPER NETWORKS



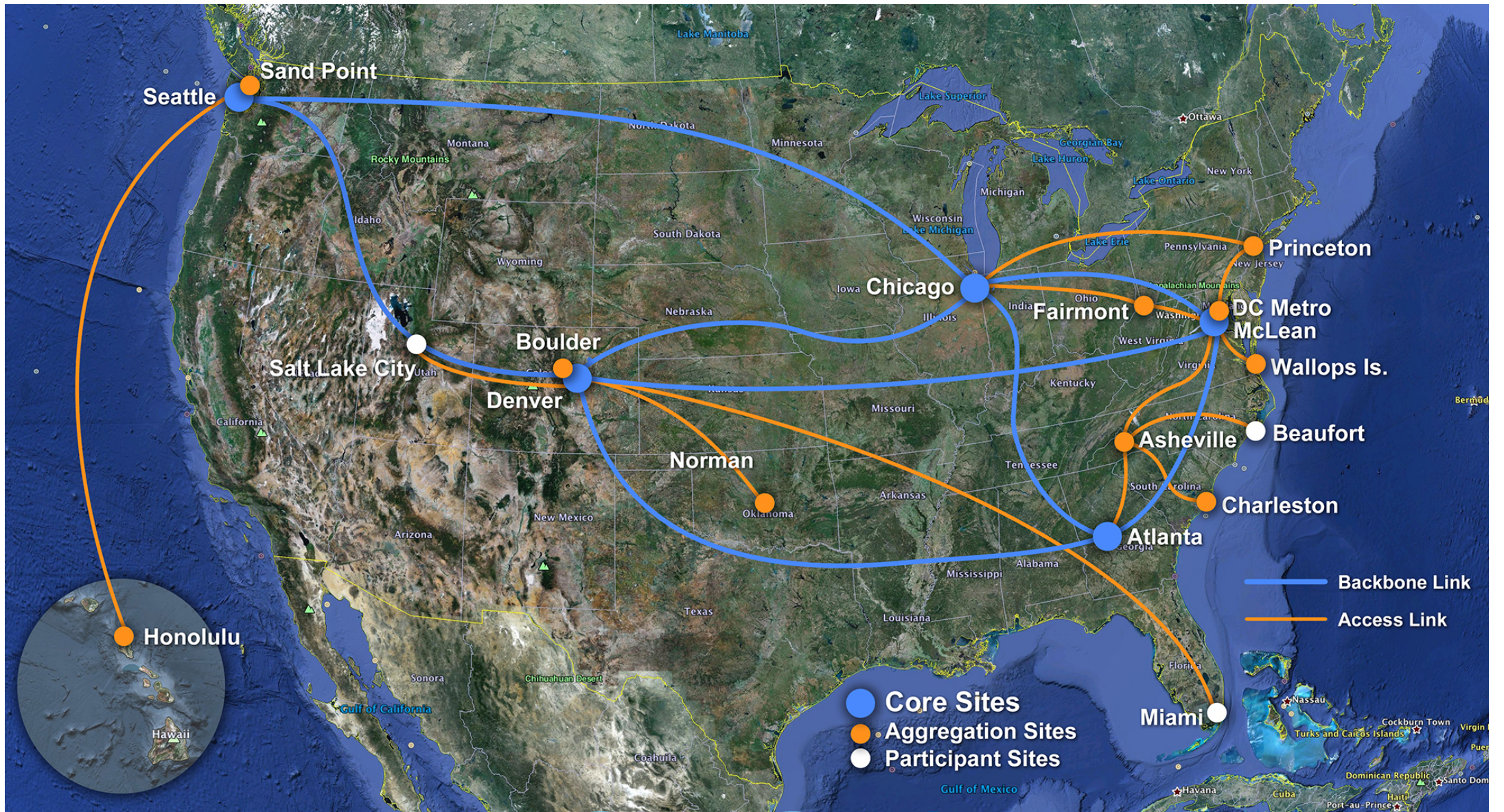
ESnet

ENERGY SCIENCES NETWORK

★ Department of Energy Office of Science National Labs

- Ames** Ames Laboratory (Ames, IA)
- ANL** Argonne National Laboratory (Argonne, IL)
- BNL** Brookhaven National Laboratory (Upton, NY)
- FNAL** Fermi National Accelerator Laboratory (Batavia, IL)
- JLAB** Thomas Jefferson National Accelerator Facility (Newport News, VA)

- LBNL** Lawrence Berkeley National Laboratory (Berkeley, CA)
- ORNL** Oak Ridge National Laboratory (Oak Ridge, TN)
- PNNL** Pacific Northwest National Laboratory (Richland, WA)
- PPPL** Princeton Plasma Physics Laboratory (Princeton, NJ)
- SLAC** SLAC National Accelerator Laboratory (Menlo Park, CA)



International Networks

★
TEIN3


GÉANT
Networks • Services • People


Red CLARA


ERNET
Indian Research & Education Network


SCReN

S
C
R
e
N

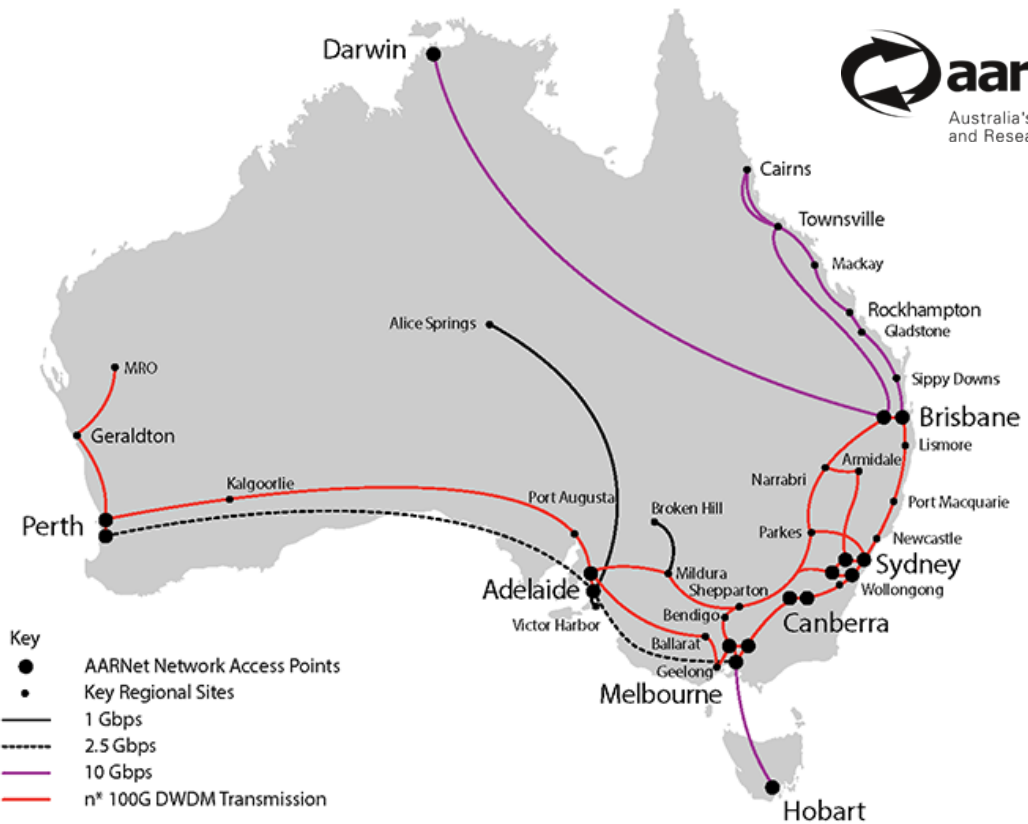

South African National
Research Network

canarie



aarnet

Australia's Academic
and Research Network



So... what does all this mean for me?

- Networks come in many shapes and sizes
- Networks interconnect to make more networks
- Networks get exponentially complex the more connections you have

If your data has to transit it - its “your” network! You need to know who to go to for help!

So... what does all this mean for me?



We as a community know this is too complex

NSF and others are funding multiple proposals dealing with end-to-end or disk-to-disk data flow complexity

- National Research Platform

- <http://prp.ucsd.edu/events/the-first-national-research-platform-workshop>

- Pacific Research Platform

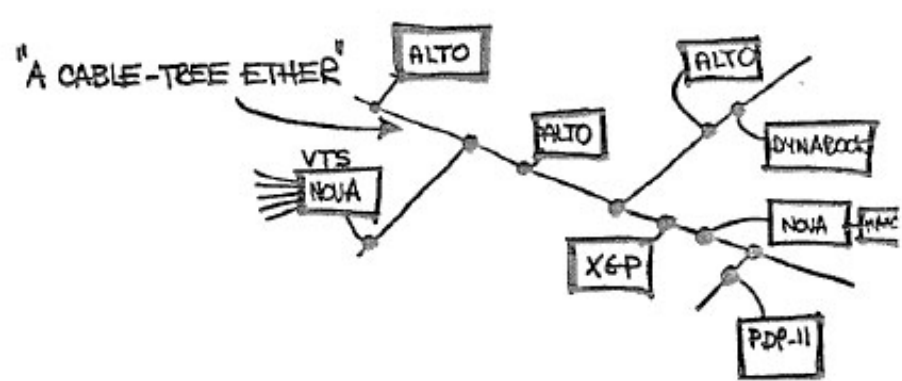
- <http://prp.ucsd.edu>

- SLATEci

- NSF Award Search: Award# 1724821

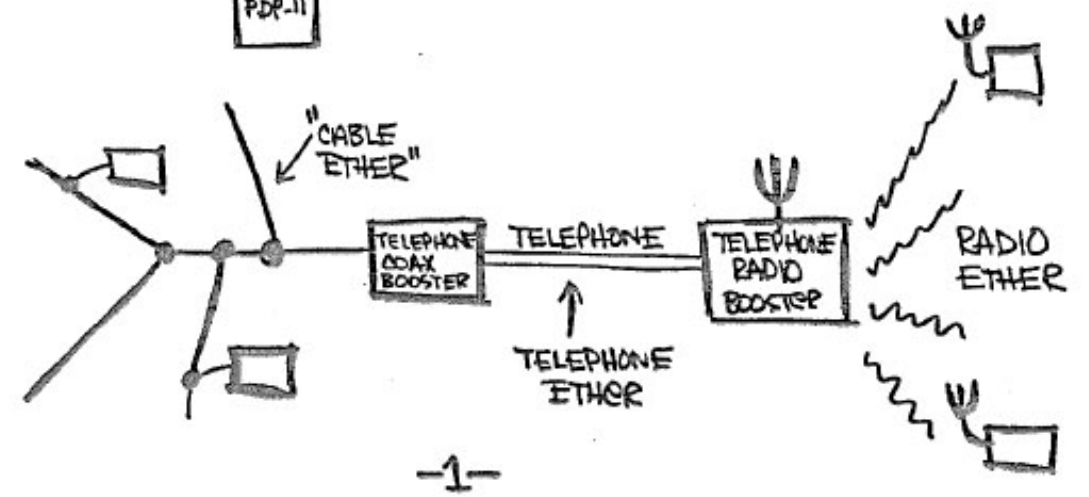
- CI Engineers

- https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504748



ETHER!

- Why so many networks?
 - Not all networks are the same!
- Types of networks you may encounter
 - What ones are relevant to you?
- DTNs
 - A computer with a simple but critical job
- Build yourself a picture
 - What are your resources? Who are your resources?
 - If you don't know, how will your researchers know what the possibilities are?

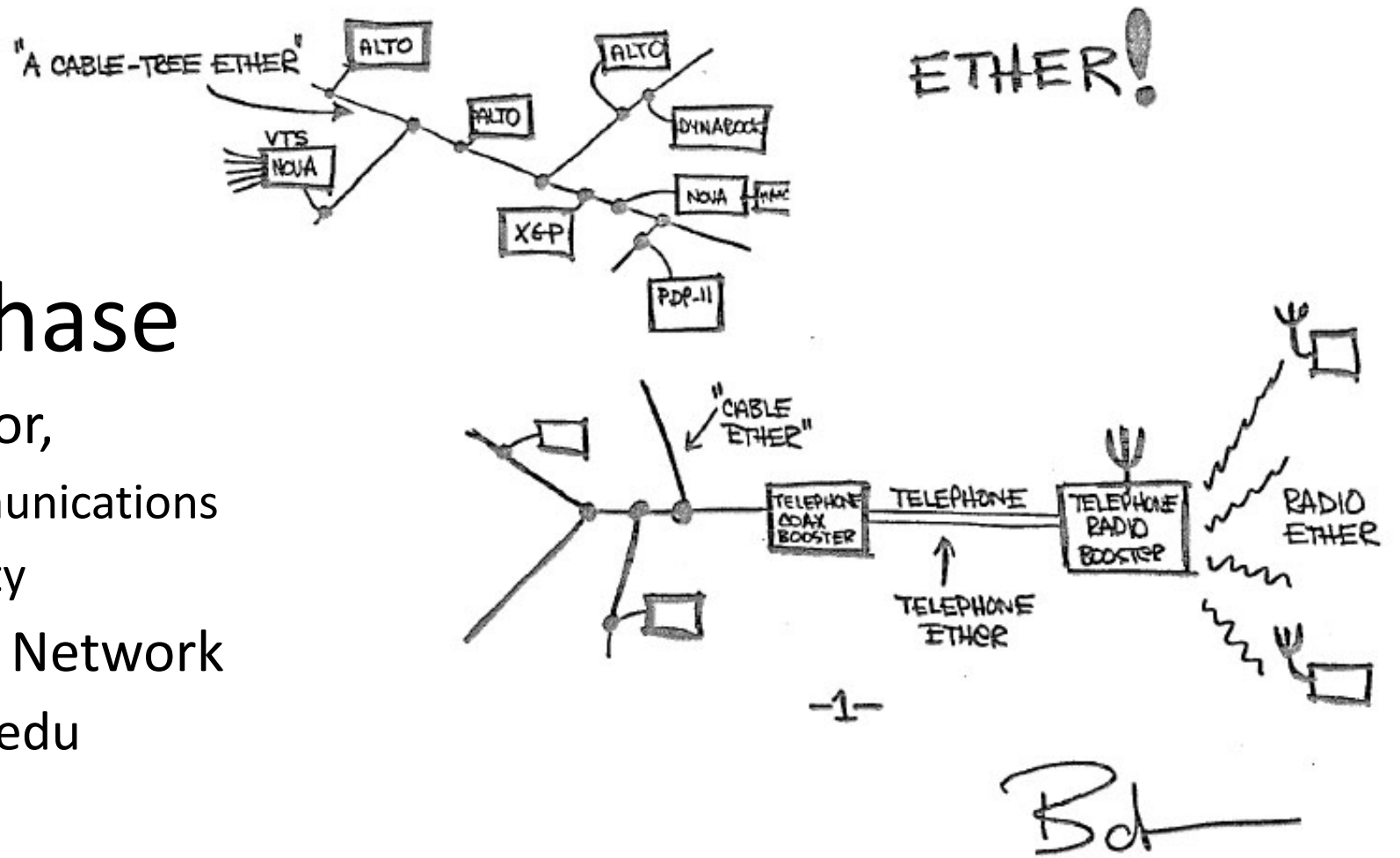


-1-

Bd

XEROX

Wallace A. Chase
Executive Director,
Networking and Telecommunications
Clemson University
CEO, Carolina Light Rail Network
wchase@clemson.edu



A very special thanks to Matt Younkins at OU, as the raptors are on loan from him!

