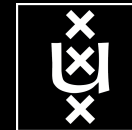
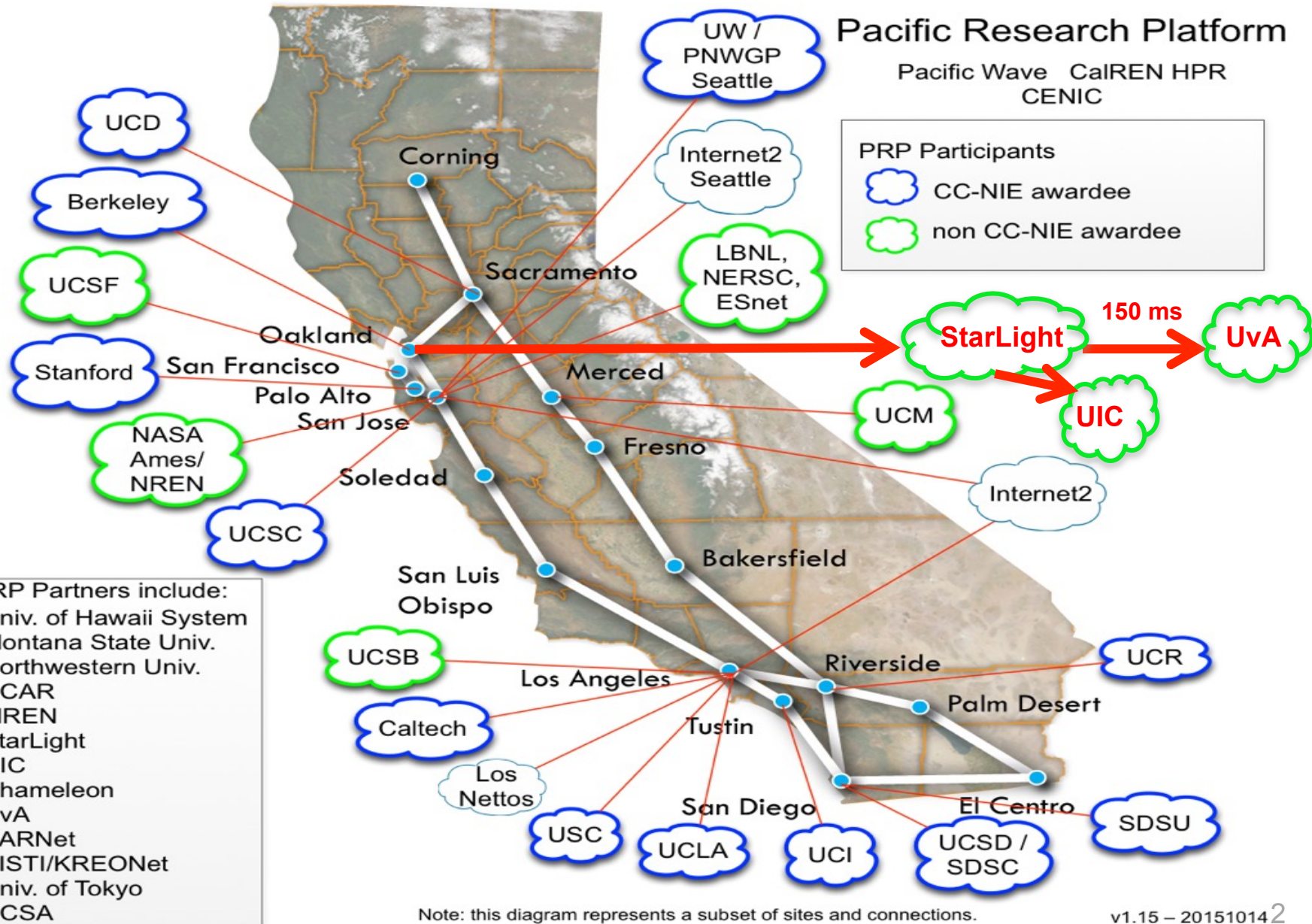


# SARNET: Security Autonomous Response with programmable NETWORKS

Cees de Laat  
System and Network Engineering



# Pacific Research Platform: A Regional Science DMZ





# CdL Sabbaticals in spring 2015



## 1 - Berkeley - San Diego

### All Photos sabb-1



## 2 - Washington - Chicago - Ottawa

### All Photos sabb-2



# Why me?



### Activity

work **leisure**

### Purpose

This personal website contains logs of my sabbatical activities in the spring of 2015. I went on these sabbaticals to be able to engage the community based on content the more and more managerial stuff I was sucked into at UvA. Also my participation in the SURF scientific advisory board made it necessary to study future directions in infrastructure. Apart from those I always keep on my toes if the research questions we as a group at UvA are studying, are still novel and valid. Directions change very particular field of study in System and Network Engineering.

### Goals

- Discuss with peers the 5 and 10 year outlook for Cyber Infrastructure. Budgets are shrinking, networks become mature, Supercomputing and High Throughput computing is now also done with huge commercial cloud centers, so what is the position of specific mission resources in this wild ocean of public capabilities science community need to do ourselves and what can we just buy in the future from the (cloud) market. What do and what do we not need to do on leadership supercomputing. How do we relate to public cloud. We also do not have scientific water. What do we need to do on data at the central level? Do we need a national service including data stewardship, etc.
- Next year we are chairing the eIRG speakers.
- Reflection on our own research questions.

### Personal

- Take some holiday
- Have Emelie joining me for a couple
- Drive the HWY1
- Visit the desert
- Go to Chicago theatre, music bars, etc



# Was here on sabbatical in march 😊



I want to



“Show **Big Bug Bunny** in **4K** on my **Tiled Display** using **green** Infrastructure”

- **Big Bugs Bunny** can be on multiple servers on the Internet.
  - Movie may need processing / recoding to get to **4K** for **Tiled Display**.
  - Needs deterministic **Green** infrastructure for Quality of Experience.
  - Consumer / Scientist does not want to know the underlying details.
- His refrigerator also just works!



# Yesterday's Media Transport Method!

8 TByte



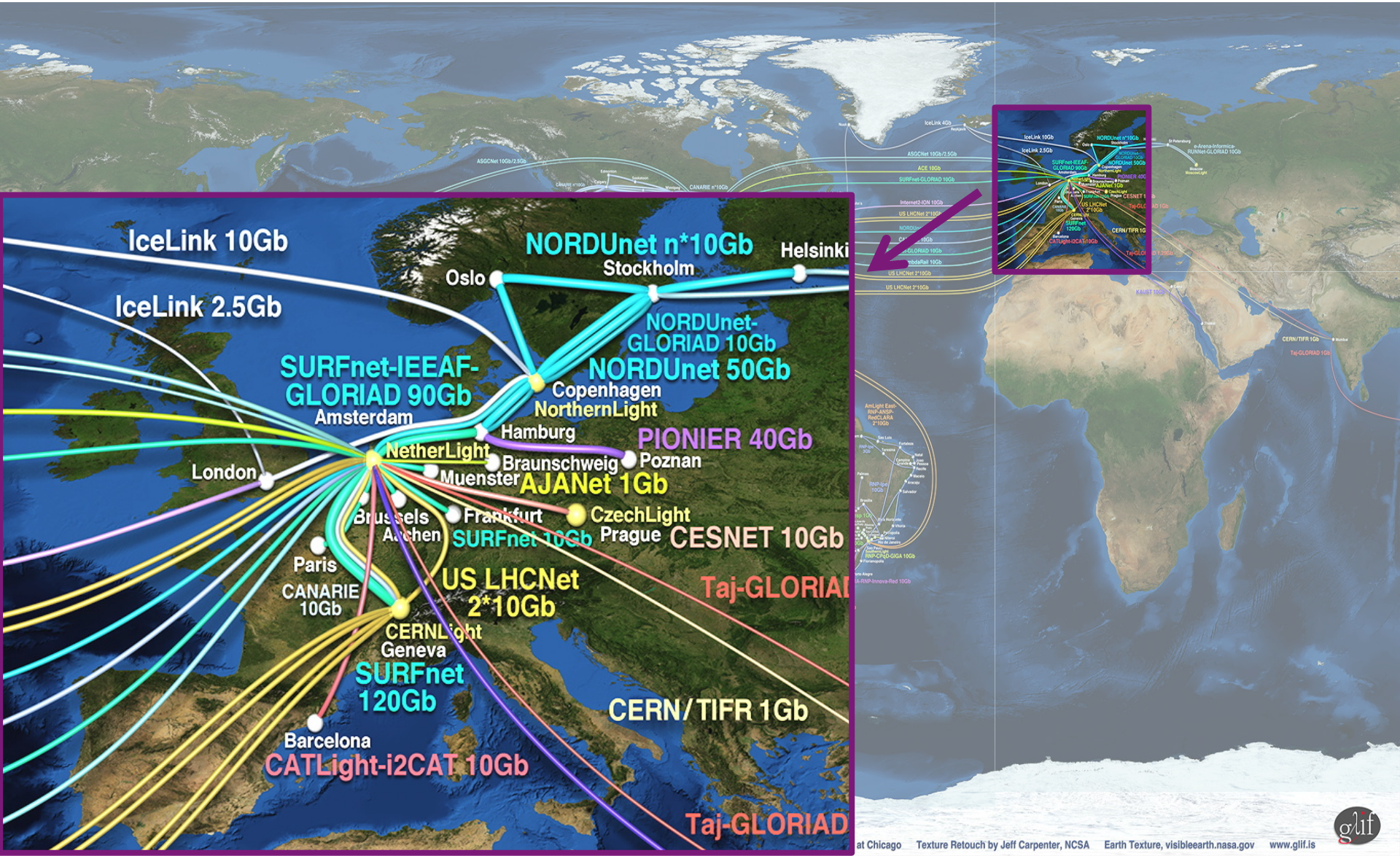


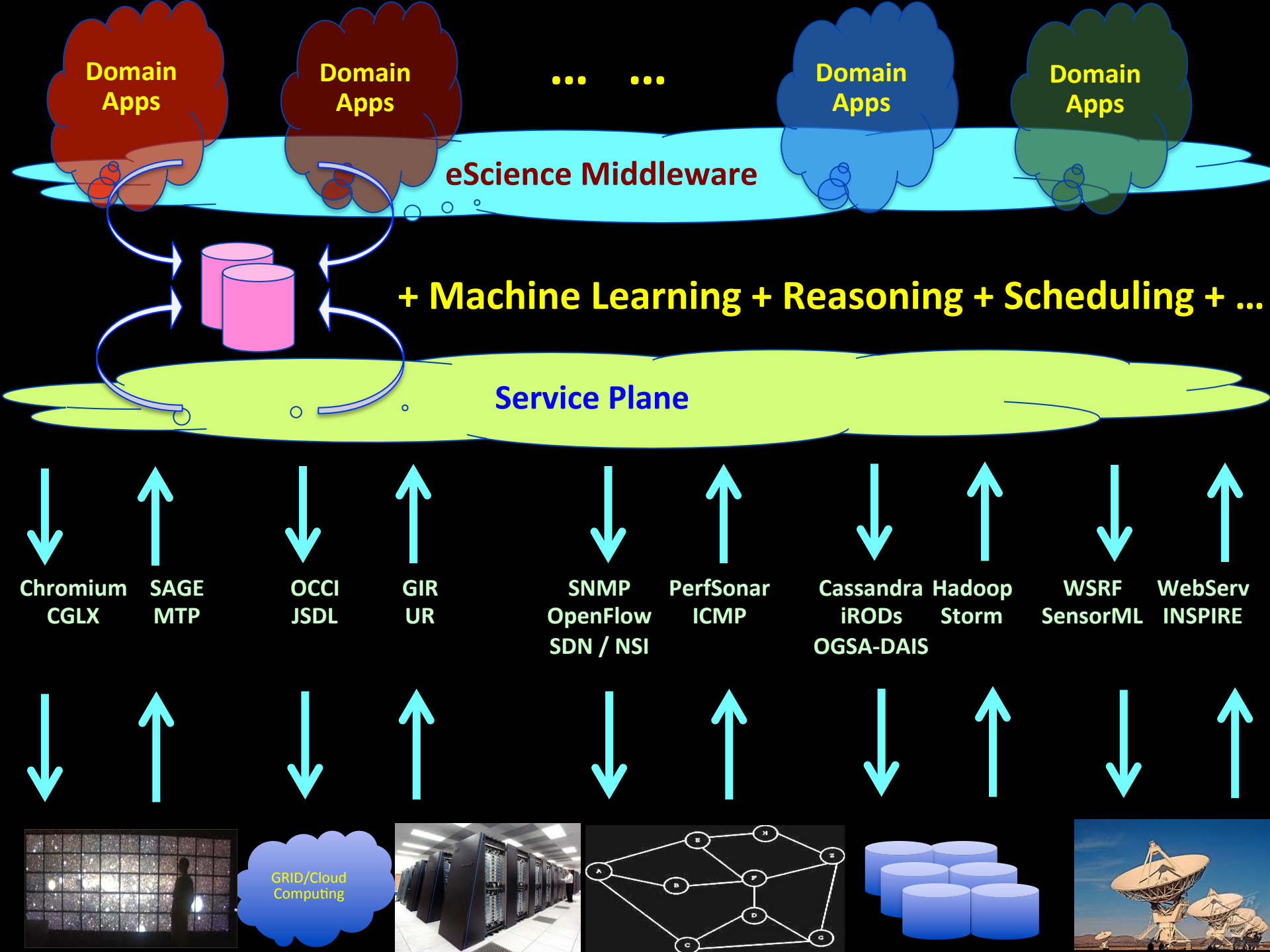




# The GLIF – LightPaths around the World

F Dijkstra, J van der Ham, P Grosso, C de Laat, "A path finding implementation for multi-layer networks", Future Generation Computer Systems 25 (2), 142-146.







# Layers

Doing Science

ICT to enable Science

Wis  
dom

Ta  
da

Knowledge  
to act

Schedulers  
to act

Information

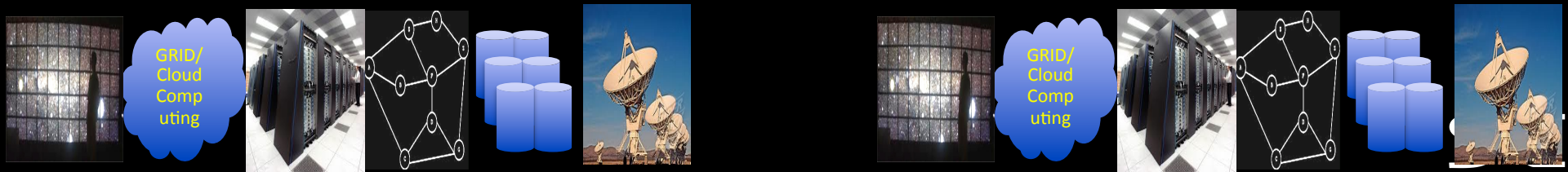


OWL

Data



XML, RDF, rSpec,  
text, Java based, etc.



GRID/  
Cloud  
Comp  
uting

GRID/  
Cloud  
Comp  
uting

# The Big Data Challenge

Doing Science

ICT to enable Science

Wisdom

Tada

Knowledge

Schedulers

MAGIC DATA CARPET

curation – description – security – policy – integrity - storage

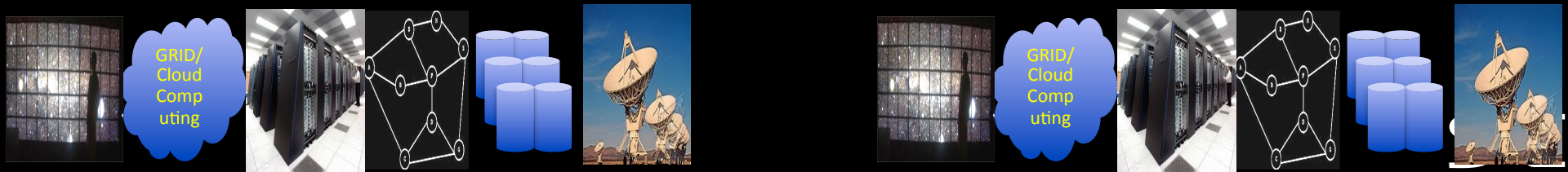
Information

IT

Data



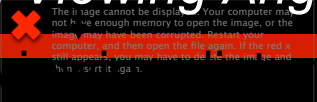
XML, RDF, rSpec,  
text, Java based, etc.





# Why is more resolution is better?

- 1. More Resolution Allows Closer Viewing of Larger Image
- 2. Closer Viewing of Larger Image Increases Viewing Angle
- 3. Increased Viewing Angle Produces Stronger Emotional Response



UHDTV(8K)

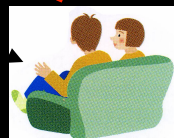
7680



4320

0.75 x Picture Height

100°



HDTV (2K)

1080

1920



30°

3.0 x Picture Height



UHDTV(4K)

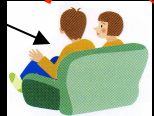
3840



2160

60°

1.5 x Picture Height



# Moving Big Data Objects Globally

## ❑ Digital Motion Picture for Audio Post-Production

- 1 TV Episode Dubbing Reference ~ 1 GB
- 1 Theatrical 5.1 Final Mix ~ 8 GB
- 1 Theatrical Feature Dubbing reference ~ 30 GB

## ❑ Digital Motion Picture Acquisition

- 4K RGB x 24 FPS x 10bit/color: ~ 48MB/Frame uncompressed (*ideal*)
- 6:1 ~ 20:1 shooting ratios => 48TB ~ 160TB digital camera originals

## ❑ Digital Dailies

- HD compressed MPEG-2 @ 25 ~ 50 Mb/s

## ❑ Digital Post-production and Visual Effects

- Gigabytes - Terabytes to Select Sites Depending on Project

## ❑ Digital Motion Picture Distribution

- Film Printing in Regions
  - ❑ Features ~ 8TB
  - ❑ Trailers ~ 200GB
- Digital Cinema Package to Theatres
  - ❑ Features ~ 100 - 300GB per DCP
  - ❑ Trailers ~ 2 - 4GB per DCP



# John Graham's Network Results

## Moving the CineGrid Exchange 30TB

Source: 10.19.21.50 - 10.19.21.50  
Capacity: Unknown MTU: Unknown

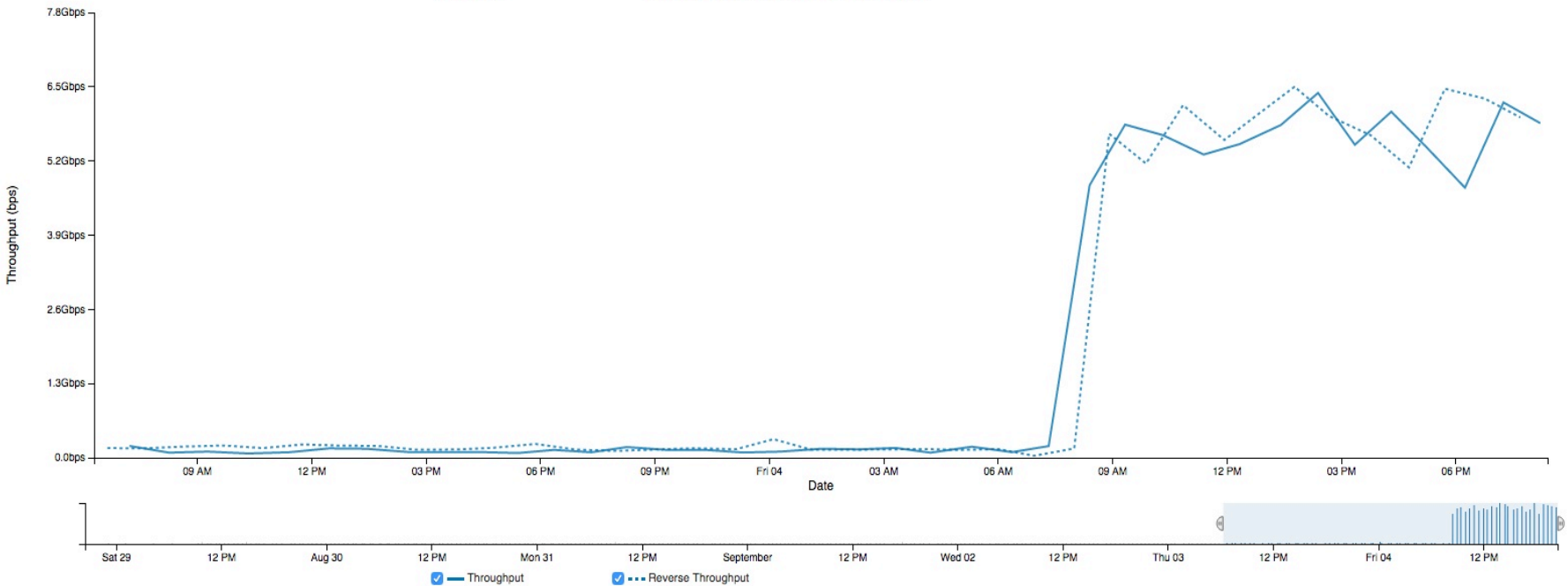
Destination: 10.19.21.51 - 10.19.21.51  
Capacity: Unknown MTU: Unknown

[Link to this chart](#)

Zoom: 1d 3d 1w 1m 1y

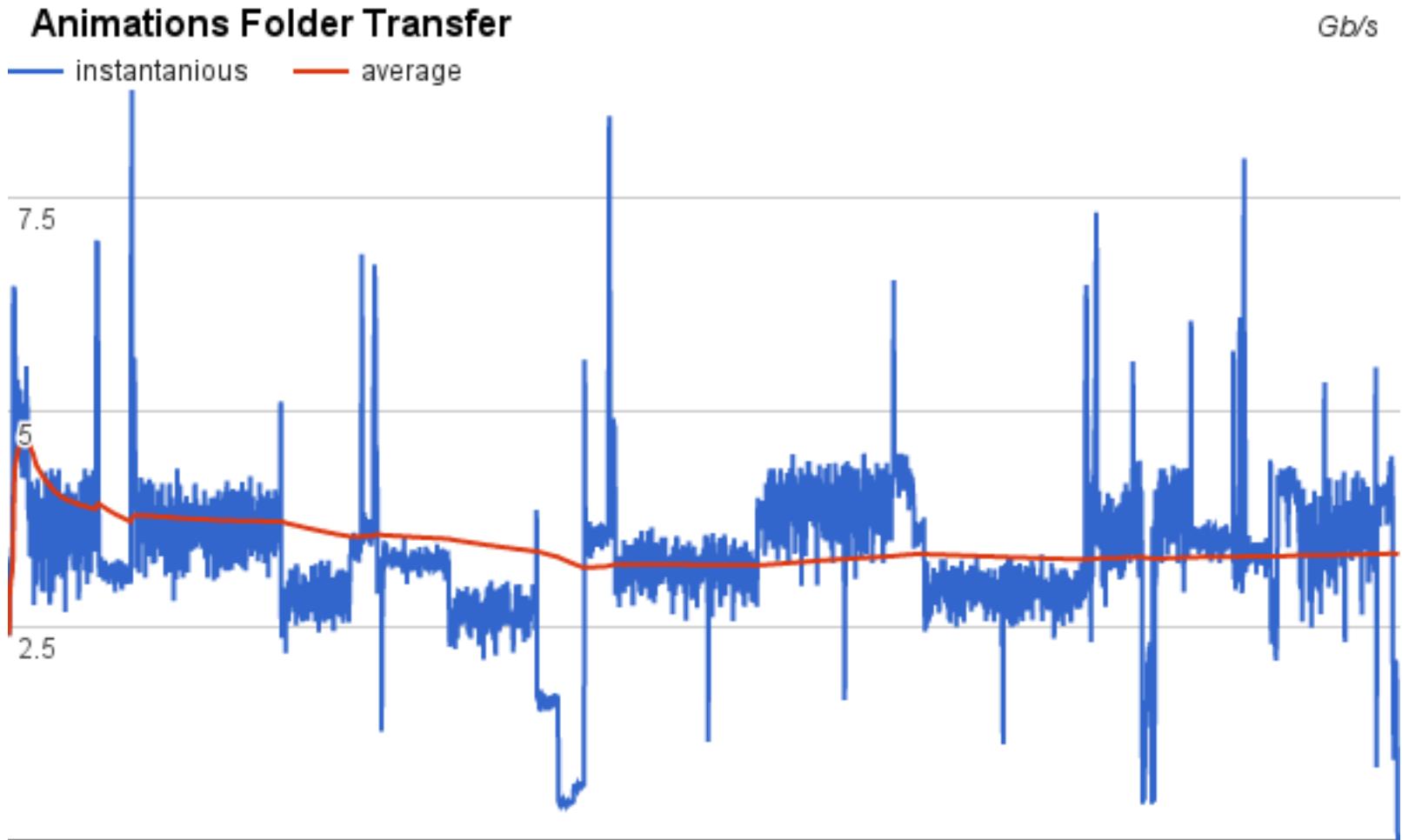
Previous 1w

Fri Aug 28 20:25:26 2015 -- Fri Sep 4 20:25:26 2015

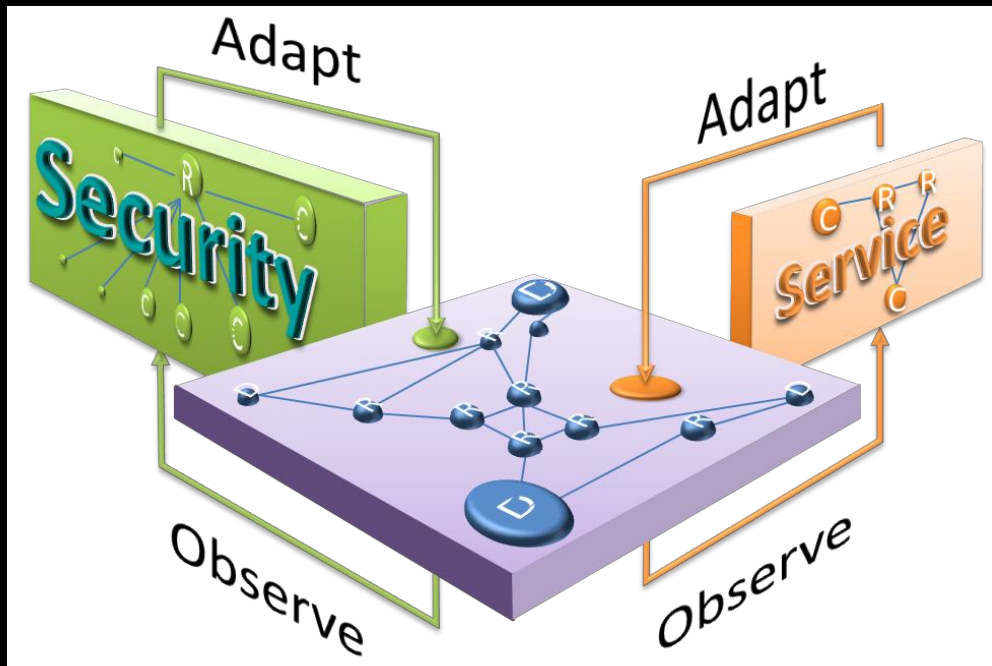


# UCSD < -- > UvA

Iperf3 mem to mem : 32 Gbps



Limited by many 25 Mbyte 4k frame files, file system, ZFS, sata interfaces, etc.



# SARNET

Security Autonomous Response  
with programmable NETworks

Cyber Security program

PI: CdL

Co-Pi's: RM, LG, RW

- 400 + 285 + 300 kEuro:
- 3 PhD's
- Prog & Eng manpower

- Network virtualizations and SDN
- Reasoning
- Risk evaluation
- Trust groups
- Execute response & adaptation



[delaat.net/sarnet](http://delaat.net/sarnet)



# Line of research

- 1997: Need for authorization framework for combination of resources across domains
- 1998: AAA-ARCHitecture research in IRTF
- 2000: RFC 2903-2906, 3334
- 2005: open versus not so open exchanges
- 2006: start of trust research (also in rfc 2904)
- 2012: I2-spring session presenting line of research
- 2014: PhD defense of research plus publication
- 2015: Here we are.

# Cyber security program

- Research goal is to obtain the knowledge to create ICT systems that:
  - model their state (situation)
  - discover by observations and reasoning if and how an attack is developing and calculate the associated risks
  - have the knowledge to calculate the effect of counter measures on states and their risks
  - choose and execute one.

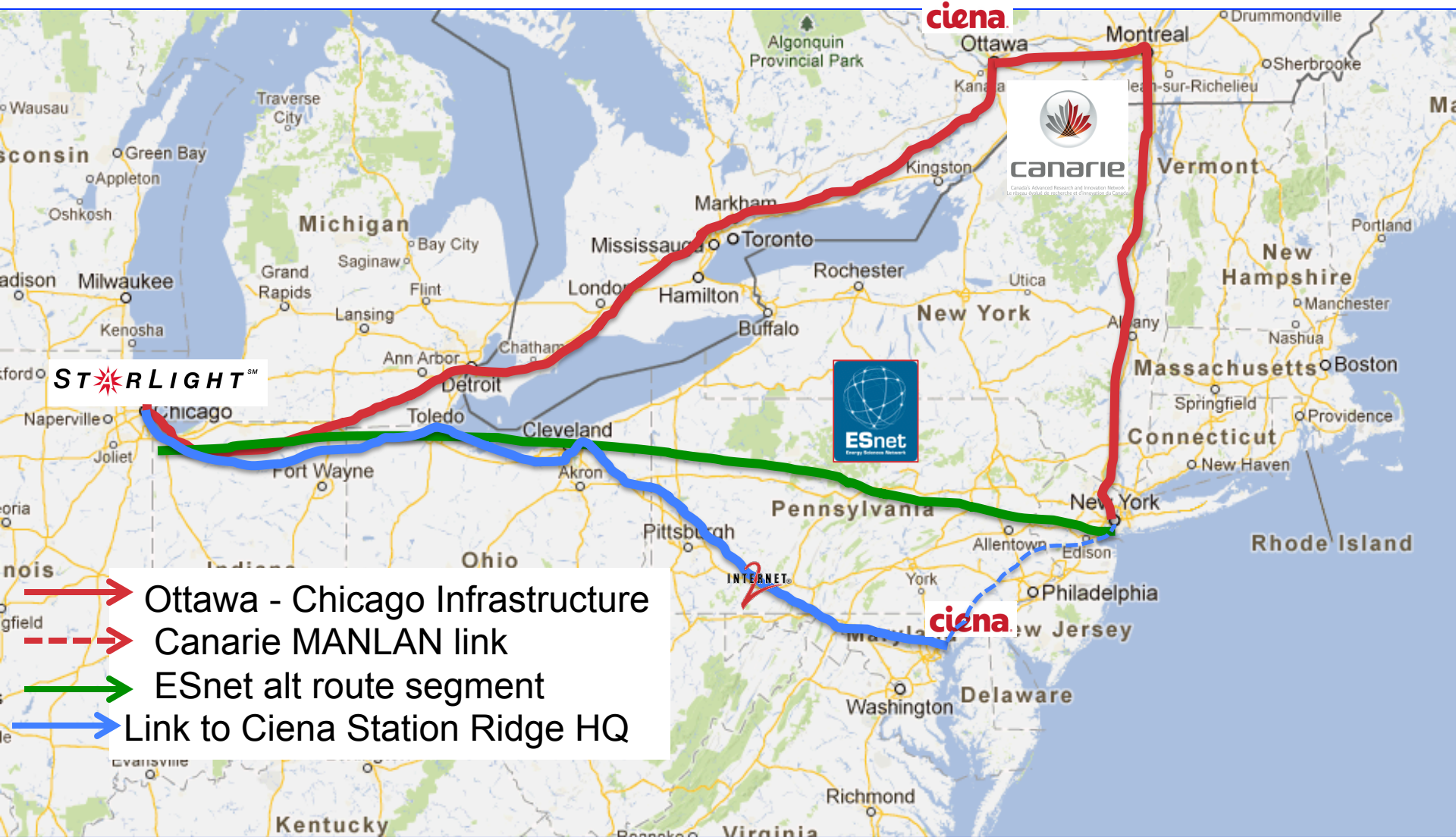
In short, a we research the concept of networked computer infrastructures exhibiting SAR: Security Autonomous Response.



# Timeline

- 1<sup>th</sup> year
  - Make infrastructure programmable (SD)
  - Observe and measure
  - Model organisations & relationships
- 2<sup>nd</sup> year
  - Multi domain
  - Countermeasure patterns
  - Assign value, cost assessment
- 3<sup>th</sup> year
  - Autonomous response across domains
  - Reasoning
  - Visualisation
  - Performance

# Ciena's CENI topology

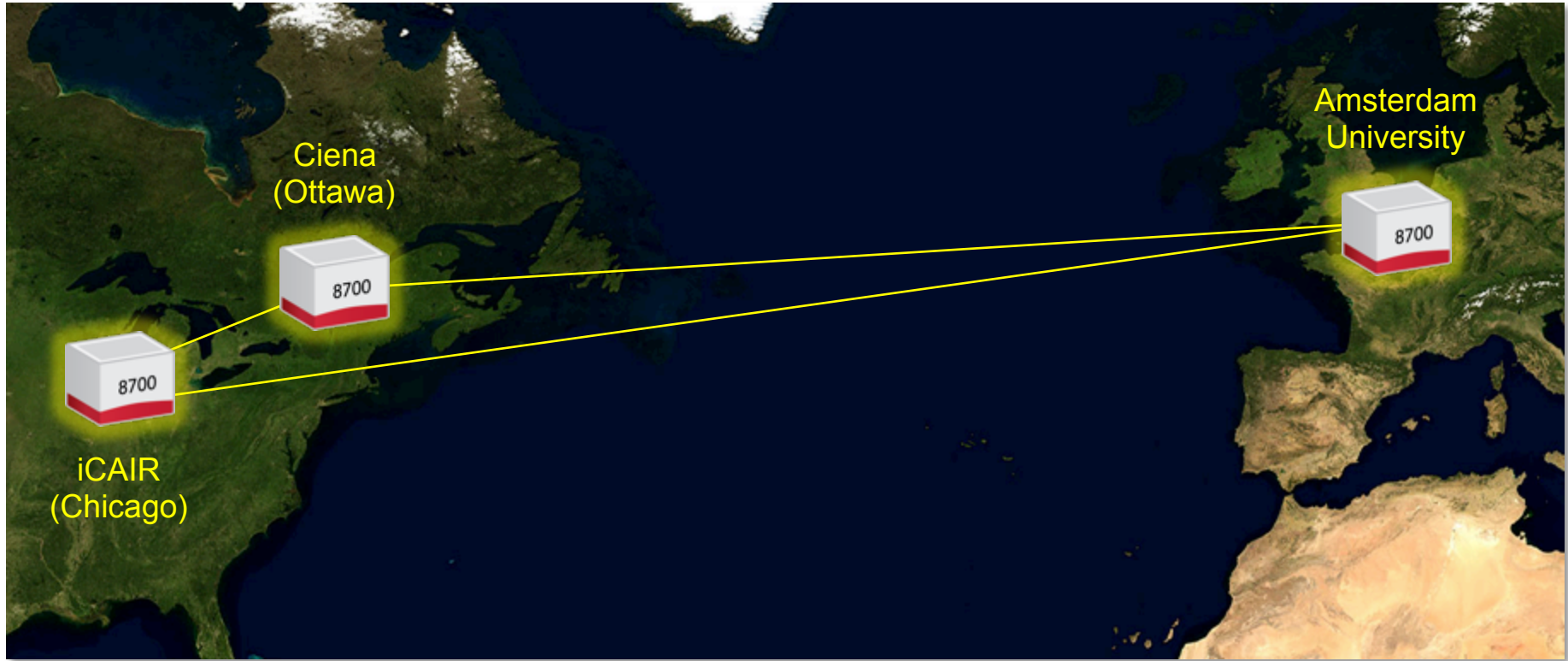


- Ottawa - Chicago Infrastructure
- - - → Canarie MANLAN link
- ESnet alt route segment
- Link to Ciena Station Ridge HQ



# CENI, International extension to University of Amsterdam

Research Triangle Project. Operation Spring of 2015



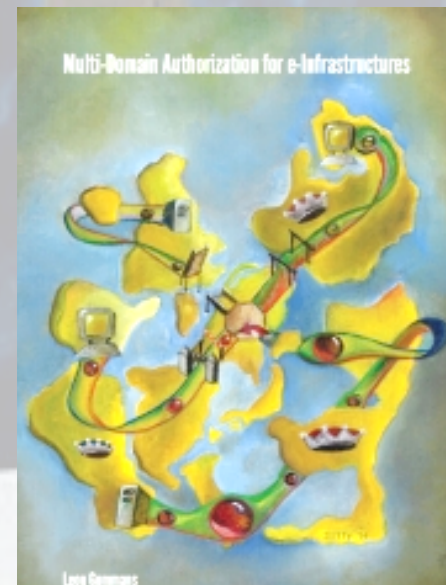
National Science Foundations ExoGENI racks, installed at UvA (Amsterdam), Northwestern University (Chicago) and Ciena's labs (Ottawa), are connected via a high performance 100G research network and trans-Atlantic network facilities using the Ciena 8700 Packetwave platform. This equipment configuration is used to create a computational and storage test bed used in collaborative demonstrations.

# Service Provider Group framework

*A Service Provider Group (SPG) is an organisation structure providing a defined service only available if its members collaborate.*

*Examples:*

Internet2NET+

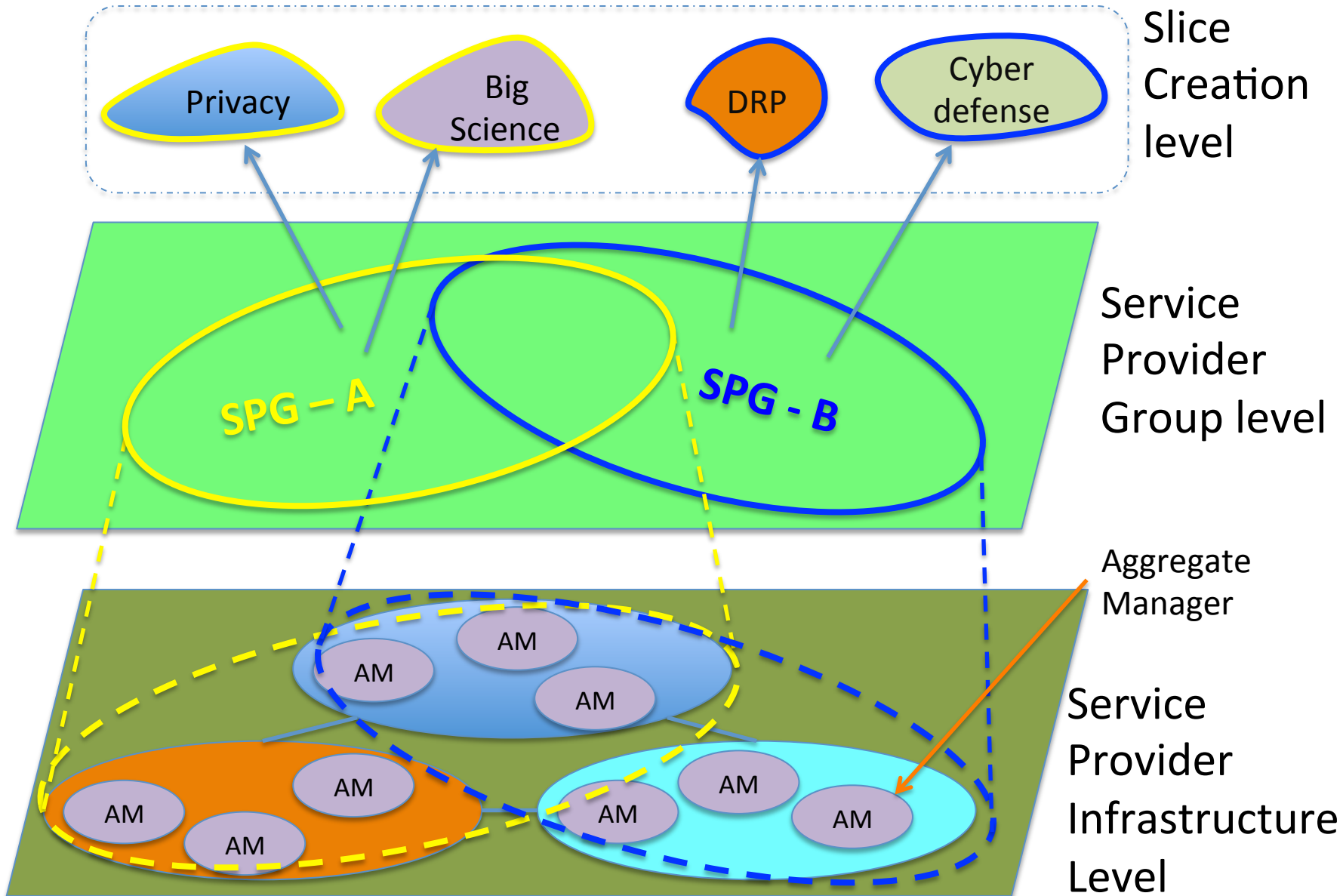




# Service Provider Group Characteristics

- **Autonomous members** acting together on a decision to provide a service none could provide on its own
- Appears as **a single provider** to a customer
- Appears as **a collaborative group** to members with standards, rules and policies that are defined, administered, enforced and judged by the group.
- Autonomy in the group: every member signs an agreement **declaring compliance** with common rules, unless local law determines otherwise.
- Membership rules **organizes trust** amongst members and manage group reputation and viability.

# Envisioned role of the SPG: define slice archetypes?





# More Info

- <http://delaat.net/sarnet>
- Leon Gommans, "Multi-Domain Authorization for e-Infrastructures", UvA, Dec 2014.
  - <http://delaat.net/pubs/2014-t-3.pdf>
- Rudolf Strijkers, "Internet Factories", UvA, Nov 2014.
  - <http://delaat.net/pubs/2014-t-2.pdf>
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