



Condor in Networked Clouds

A brief presentation for Condor Week 2012

Presenter: Jonathan Mills

*Ilia Baldine, Yufeng Xin,, Anirban Mandal,
Chris Heermann, Paul Ruth, Jeffery L. Tilson*

RENCI, UNC-CH

*Jeff Chase, Victor J. Orlikowski, Aydan
Yumerefendi, Prateek Jaipuria*

Duke University

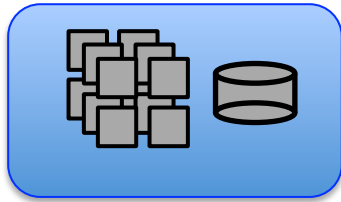
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RESEARCH \ ENGAGEMENT \ INNOVATION

Networked Clouds

IaaS: Clouds and Network Virtualization

Virtual Compute and Storage Infrastructure



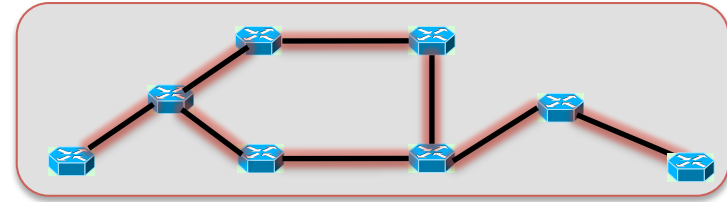
Cloud APIs (Amazon EC2 ..)



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Cloud Providers

Virtual Network Infrastructure

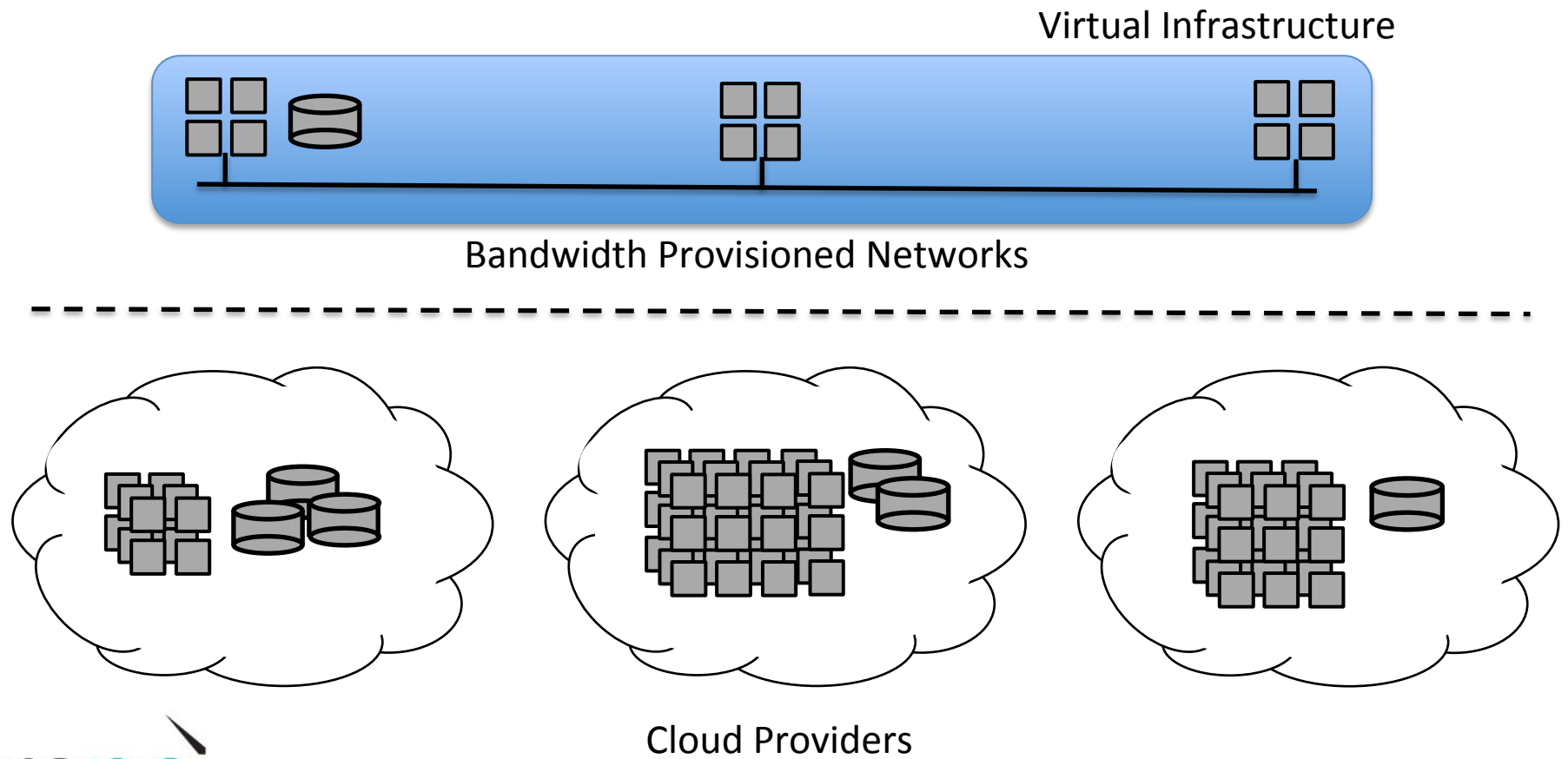


Network Provisioning APIs (NLR Sherpa, DOE OSCARS, Internet2 DRAGON, OGF NSI ...)



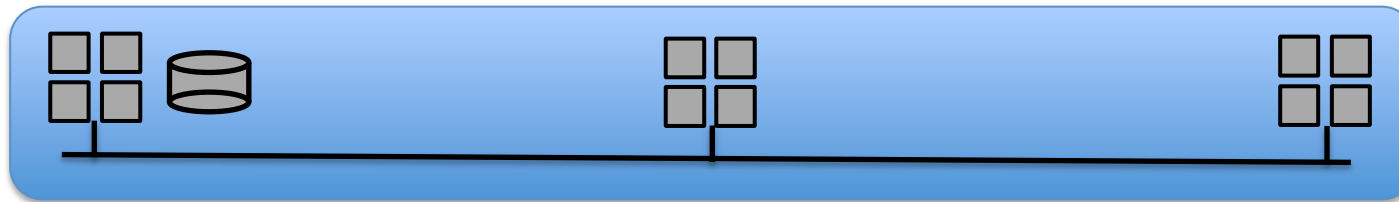
Network Transit Providers

Networked Clouds



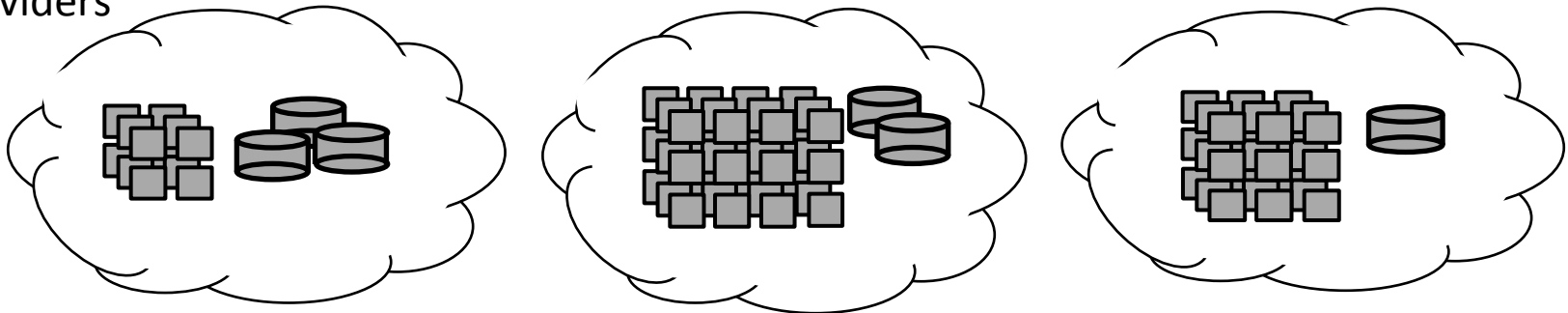
Networked Clouds

Virtual Infrastructure

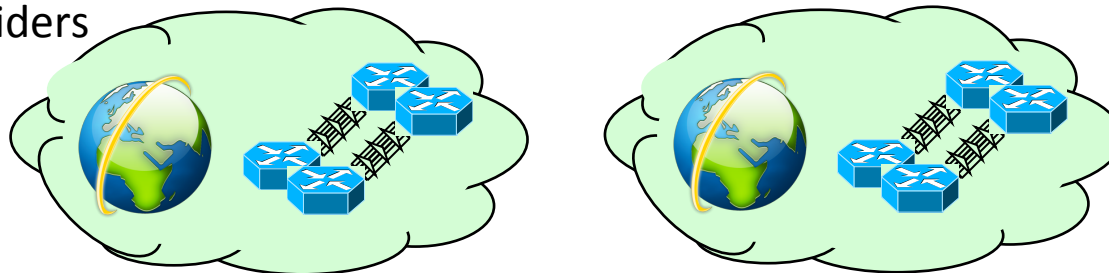


Bandwidth Provisioned Networks

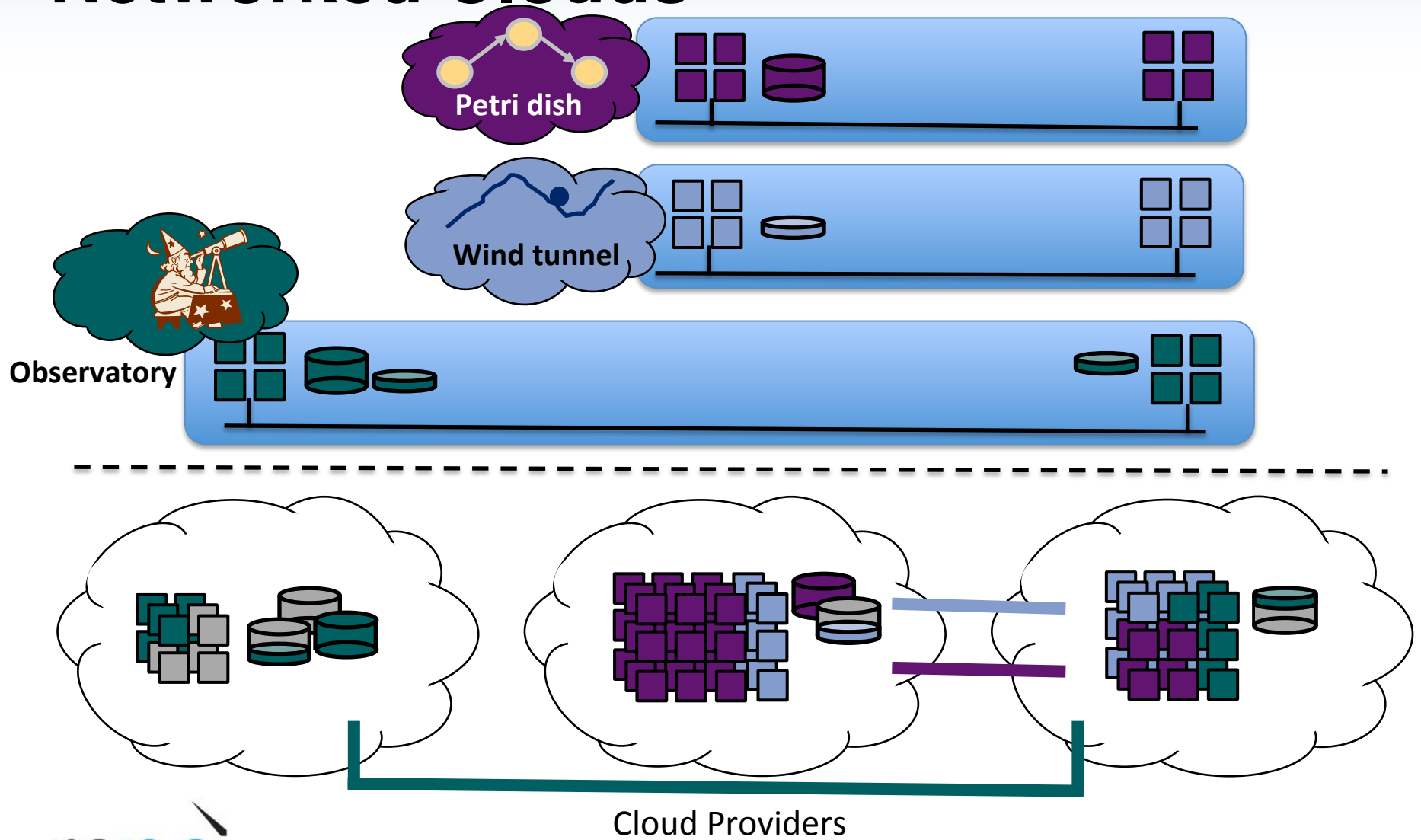
Cloud Providers



Network Transit Providers



Networked Clouds



GENI is an IaaS

- Each slice is infrastructure purpose-built to serve an application
- May require
 - Specific topology (e.g. “I need a mesh with specific average node degree”)
 - Specific connectivity (e.g. “I need to connect resources A, B and C”)
- A number of heterogeneous resources need to be co-scheduled
- Principal focus on
 - Repeatability of experiments
 - Measurements (performance, packet capture, physical layer)
- Also well-suited to science applications (computation- and data- intensive)
 - Performance guarantees
 - Simpler deployment of heterogeneous pieces
 - Batch scheduling
 - Map-reduce
 - Highly-parallel
 - Specialized (GPGPUs)
 - Native resource interfaces

ORCA: Open Resource Control Architecture

ORCA

Open Resource Control Architecture



- ORCA is a “wrapper” for off-the-shelf cloud and circuit networks etc., enabling federated orchestration:

- + Resource brokering
- + VM image distribution
- + Topology embedding
- + Stitching
- + Authorization

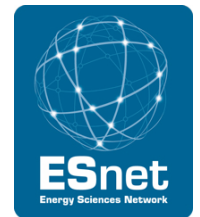
- GENI, DOE, NSF SDCI+TC

- <http://networkedclouds.org>
- <http://geni-orca.renci.org>

EUCALYPTUS

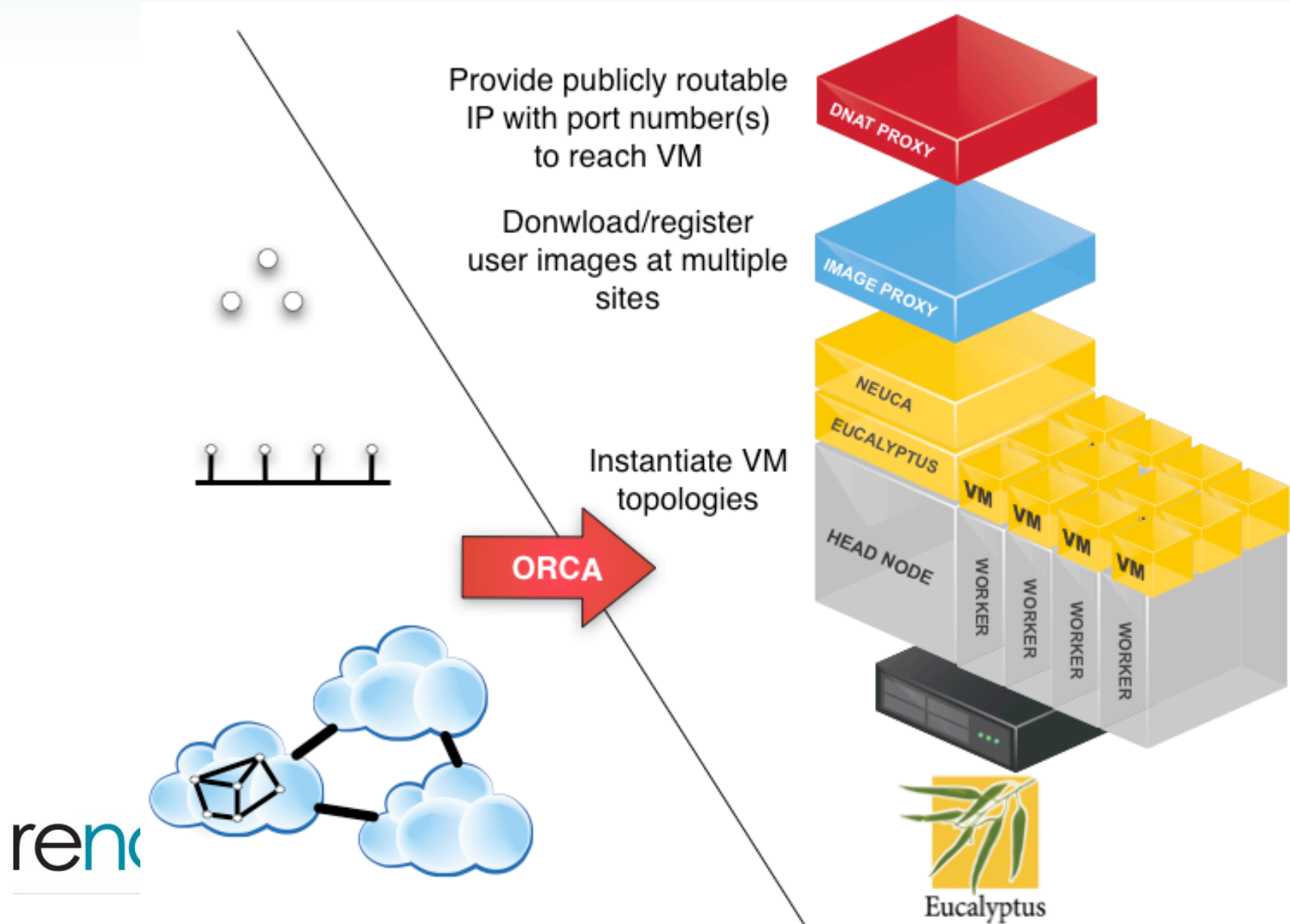


XCAI

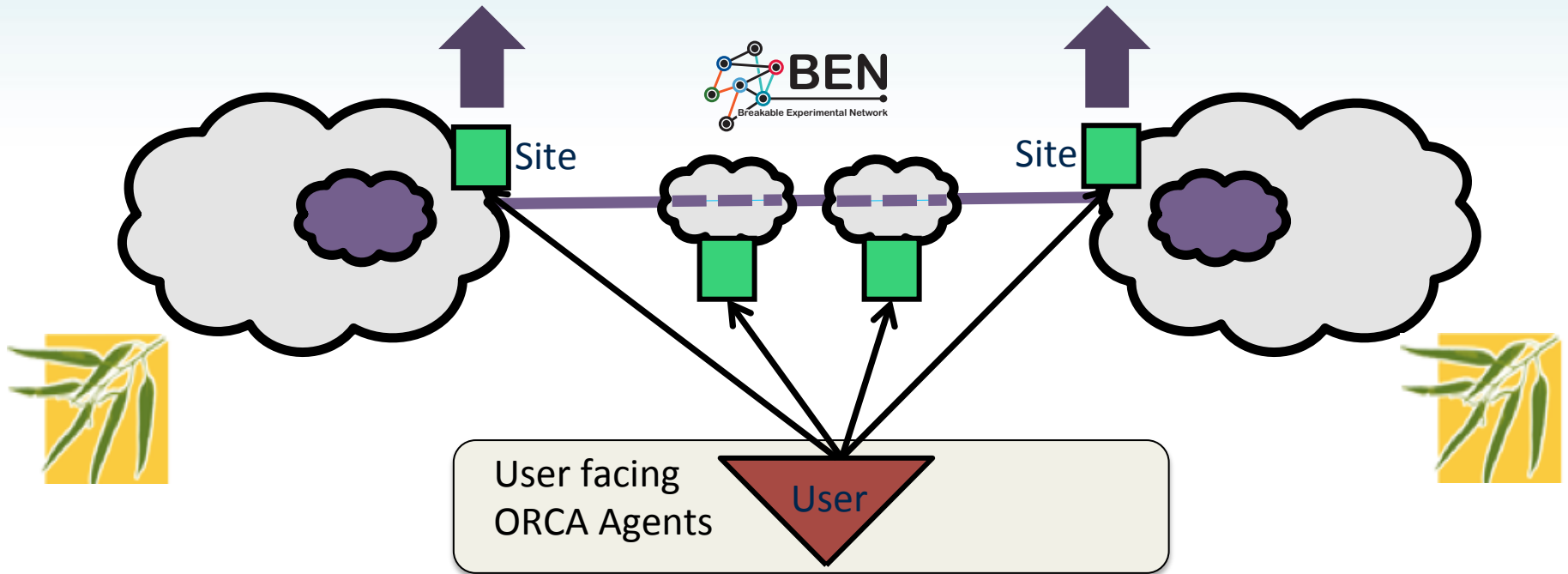


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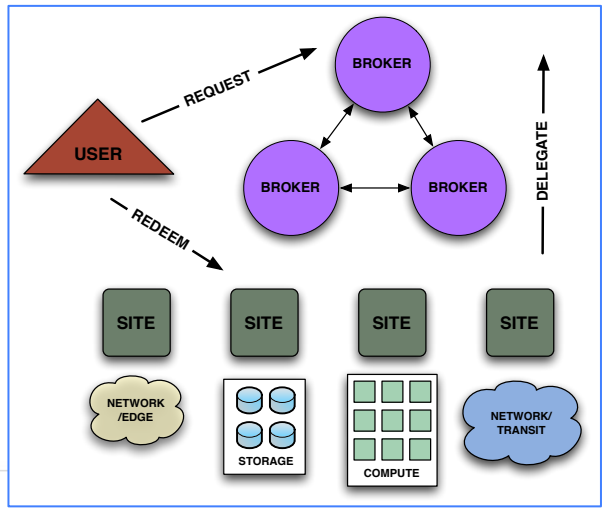
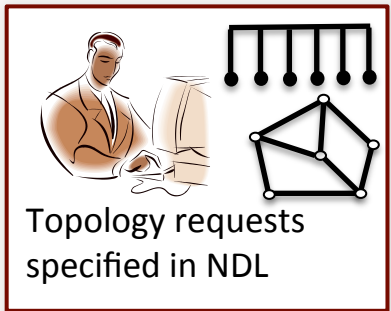
Overview



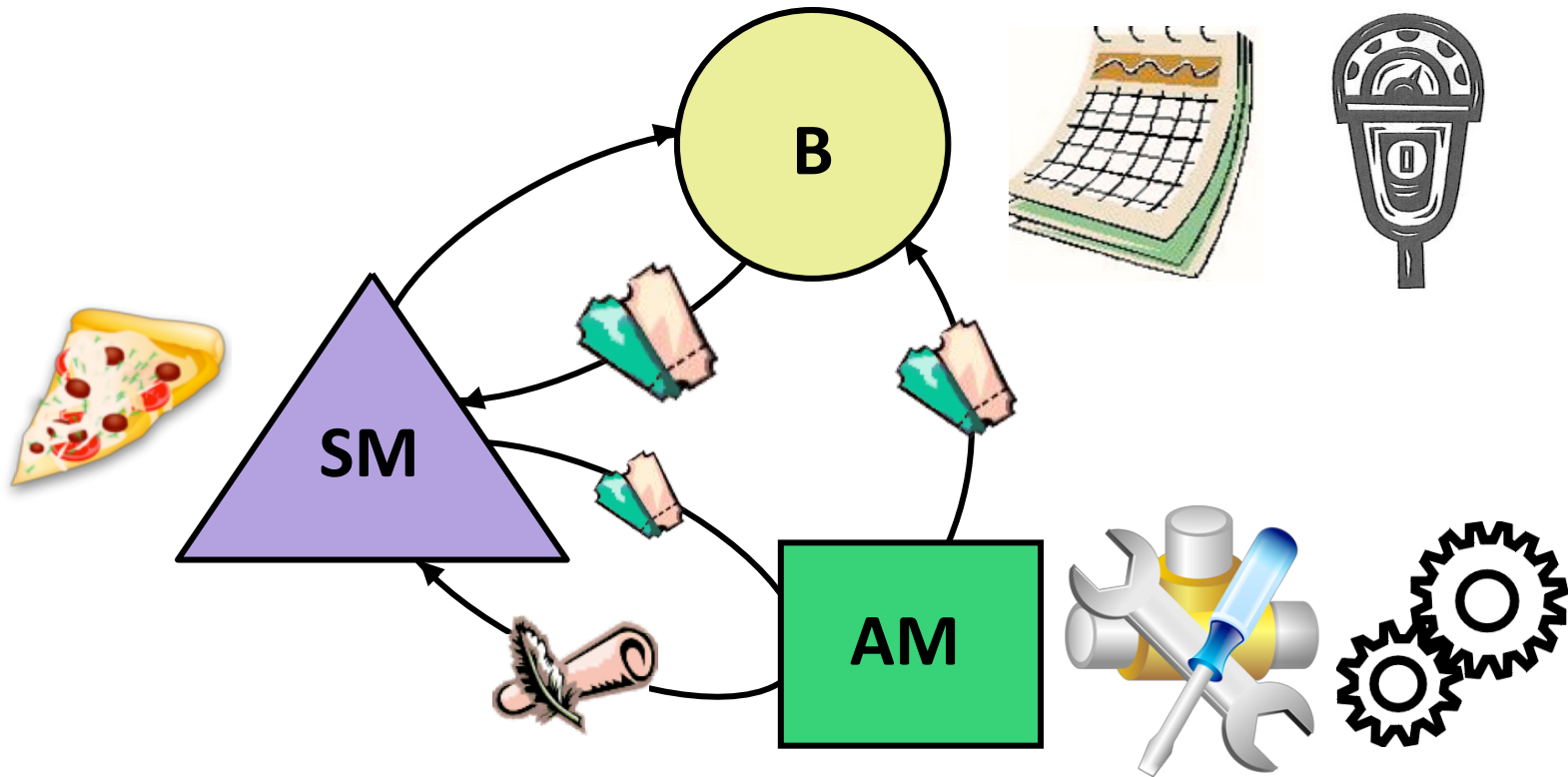
Brokering Services



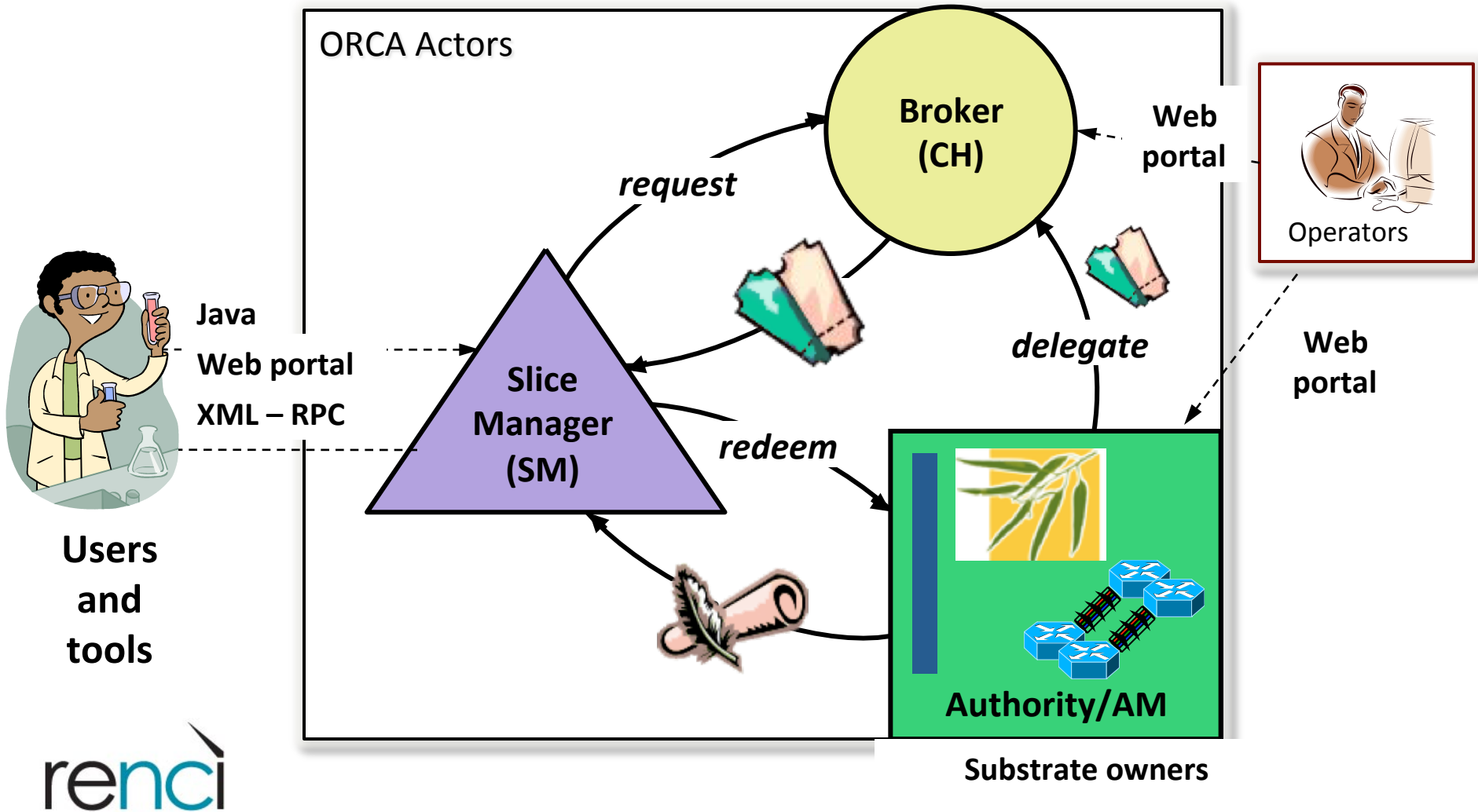
1. Provision a dynamic slice of networked virtual infrastructure from multiple providers, built to order for a guest application.
2. Stitch slice into an end-to-end execution environment.
3. Deploy Workflow into the slice.



ORCA



User/application access





Current Selections

» slice: none

Inventory

- » View Inventory
- » View Inventory Slices
- » Create Inventory Slice
- » Claim Resources

Clients

- » View Clients
- » Register Client

Ticketed Slices

- » View Slices
- » Create Slice
- » View Reservations

Brokers

- » Current Broker
- » View Brokers

Inventory

Select: All None Action:

No	Slice	Type	Units [R]	Units [A]	Start	End	Broker	Site	State	
<input type="checkbox"/>	1 broker	DUKE NET VLAN	4	4	03/15/2010 16:15	04/01/2010 16:55	duke-net-site	duke-net-site	Ticketed	manage
<input type="checkbox"/>	2 broker	BEN VLAN	100	100	03/15/2010 16:15	04/01/2010 16:55	ben-site	ben-site	Ticketed	manage
<input type="checkbox"/>	3 broker	NLR VLAN	100	100	03/15/2010 16:15	04/01/2010 16:55	nlr-site	nlr-site	Ticketed	manage
<input type="checkbox"/>	4 broker	Starlight VLAN	10	10	03/15/2010 16:15	04/01/2010 16:55	starlight-site	starlight-site	Ticketed	manage
<input type="checkbox"/>	5 broker	Eucalyptus Virtual Machine (DUKE)	10	10	03/15/2010 16:14	04/01/2010 16:54	duke-vm-site	duke-vm-site	Ticketed	manage
<input type="checkbox"/>	6 broker	ViSE Testbed	1	1	03/14/2010 14:56	03/31/2010 15:36	vise-site	vise-site	Ticketed	manage
<input type="checkbox"/>	7 broker	Eucalyptus Virtual Machine (RENCI)	10	10	03/15/2010 16:22	04/01/2010 17:02	renci-vm-site	renci-vm-site	Ticketed	manage
<input type="checkbox"/>	8 broker	RENCI NET VLAN	10	10	03/15/2010 16:22	04/01/2010 17:02	renci-net-site	renci-net-site	Ticketed	manage

Select: All None Action:

Operator portal interface to RENCi Clearinghouse (CH), listing AMs with substrate registered for brokering.

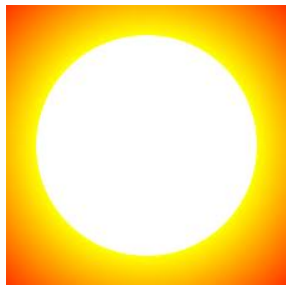
Solar fuels workflow

Solar Fuels: Creation of storable fuels using solar energy and catalysis

The Science

- Research in Solar Fuels and Photovoltaics will integrate light absorption and electron transfer driven catalysis
- Molecular assemblies to create efficient devices for solar energy conversion through artificial photosynthesis

– T Meyer, J Papanikolas, C Heyer, *Catalysis Letters* 141 (2011) 1-7.



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A Theoretical Framework

- Co-design strategy for creation of new scalable codes
- Incorporation of workflow technologies to coordinate, launch, and enhance resilience of the design pipeline
- Apply the developed codes to solve complex problems in electronic structure, kinetics, and synthesis

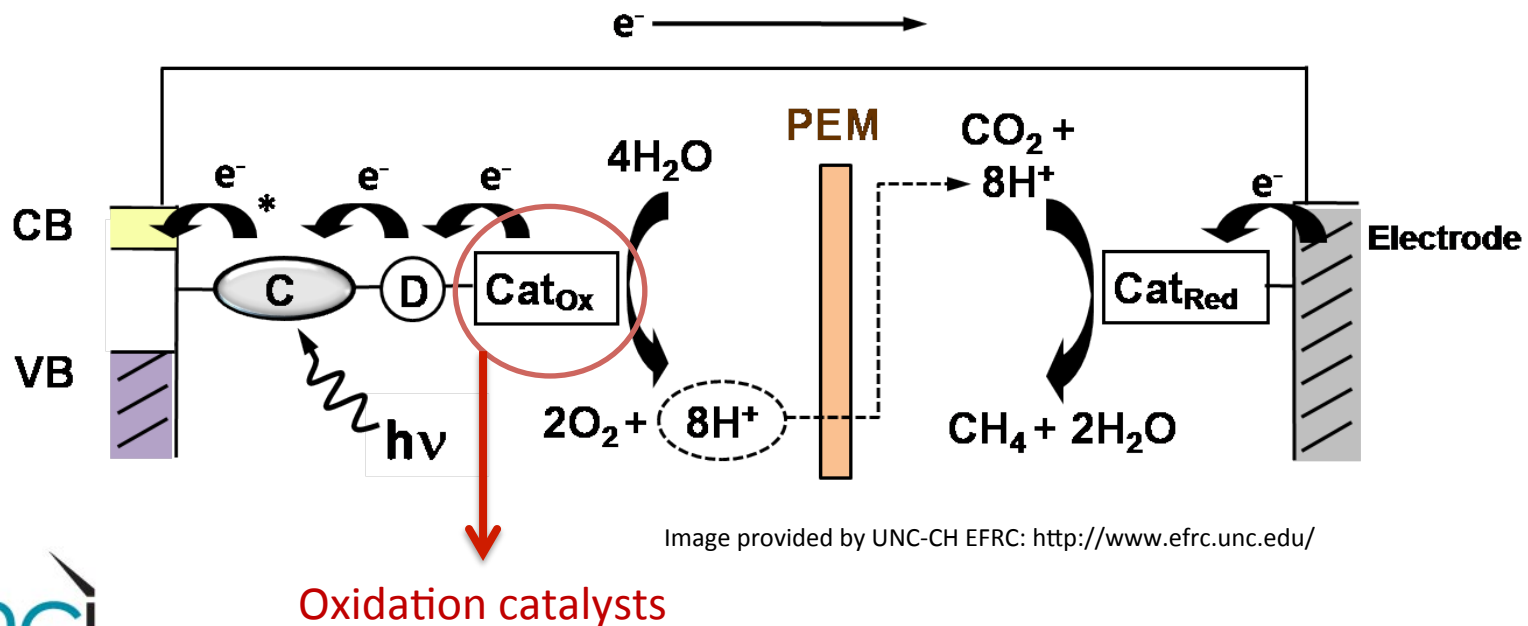
Collaborations - Working directly with

- Experimentalists (UNC-CH)
- Model and methods developers (Duke, UNC-CH)

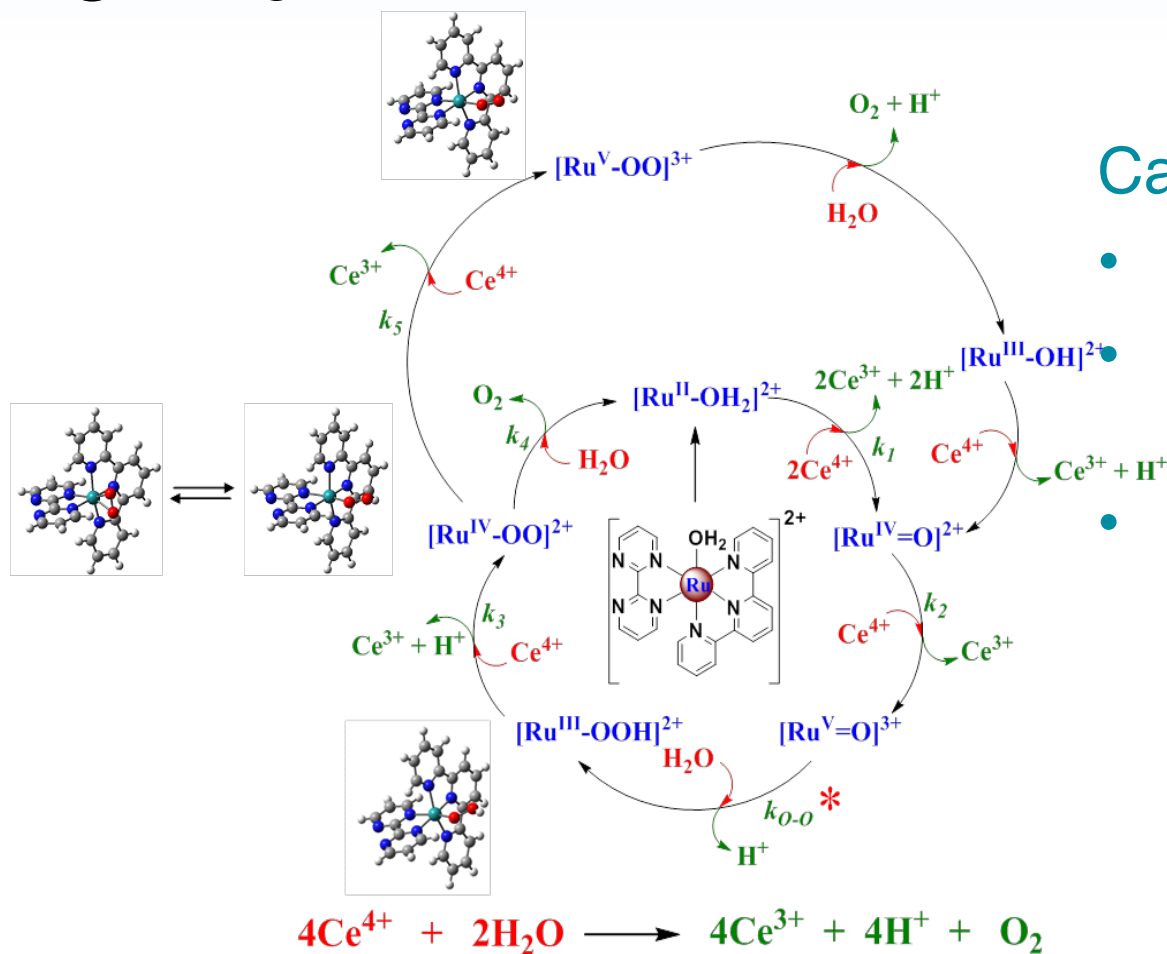
A multistep process for sustainable fuel creation

Dye Sensitized Photoelectrosynthesis Cell (DSPEC)

- Solar \rightarrow Catalysts + abundant materials \rightarrow Liquid Fuel
- Each step a significant research project
 - Focus on Oxidation catalyst



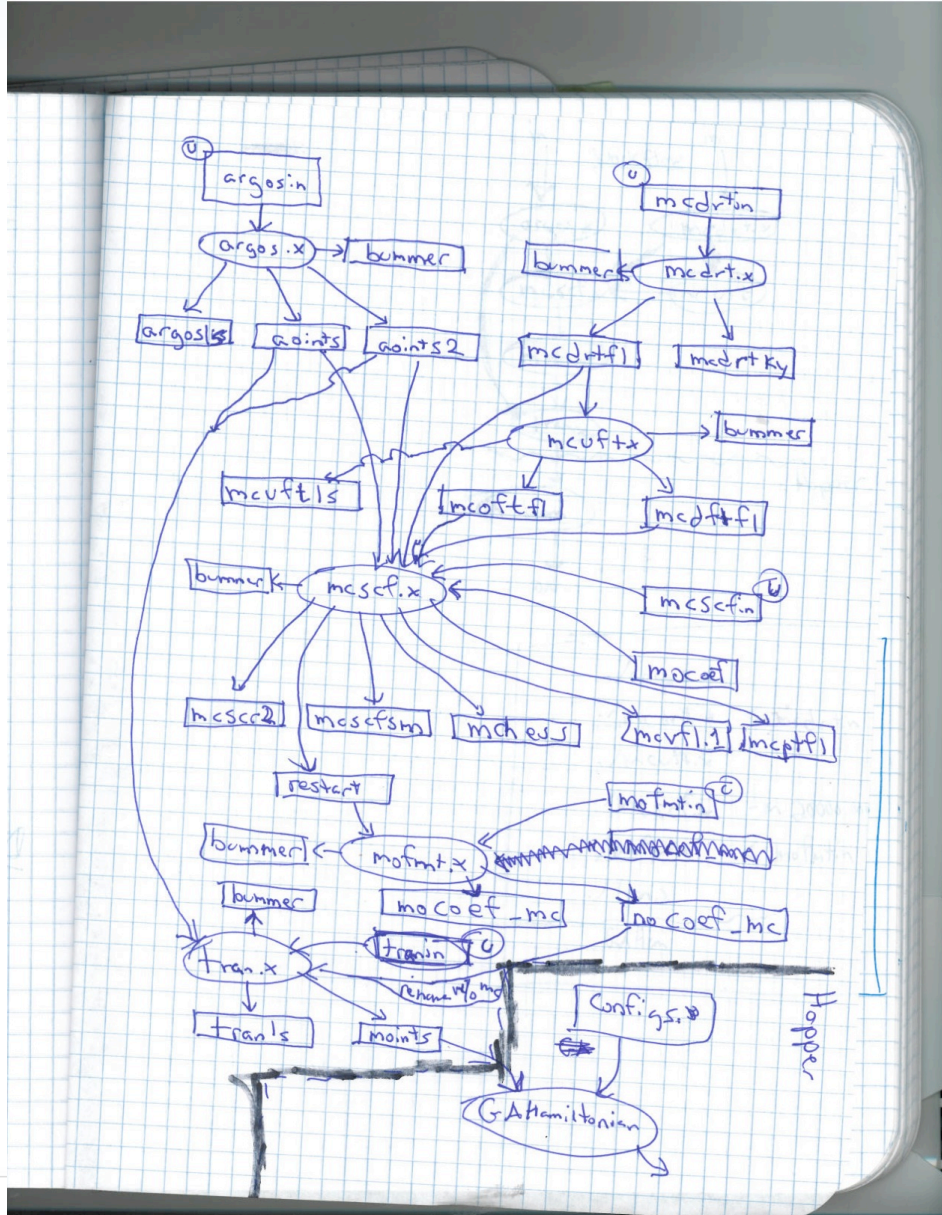
Model Catalyst: Single site system based on Ru



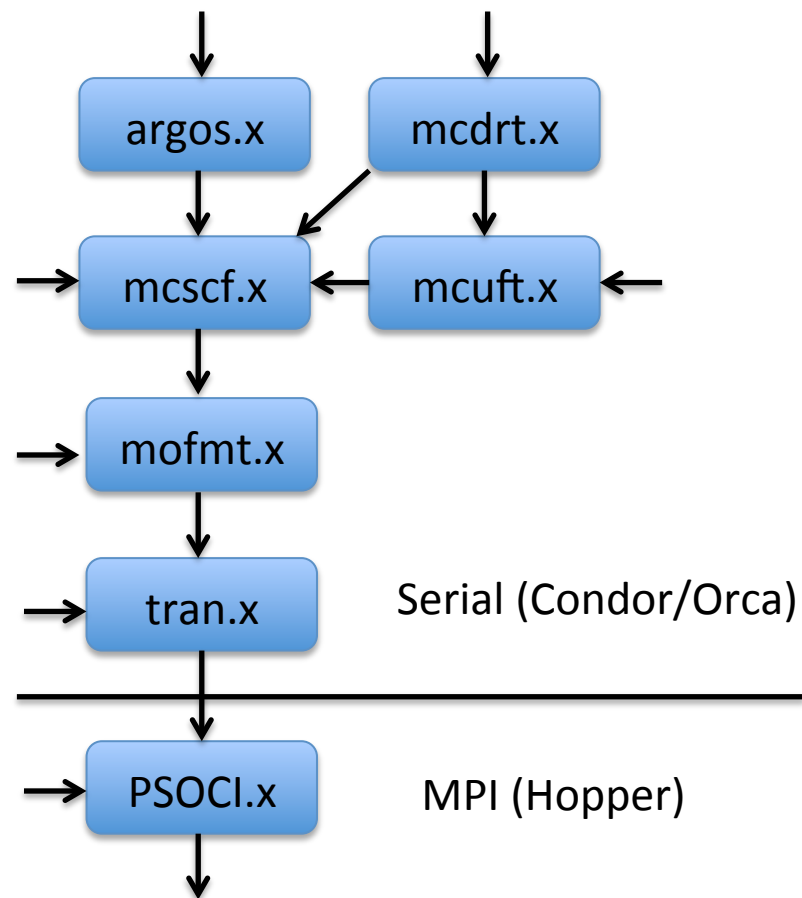
Catalytic oxidation of water

- Multistep cyclic process
- Several steps difficult to analyze experimentally
- Desire to replace expensive Ru with earth abundant materials

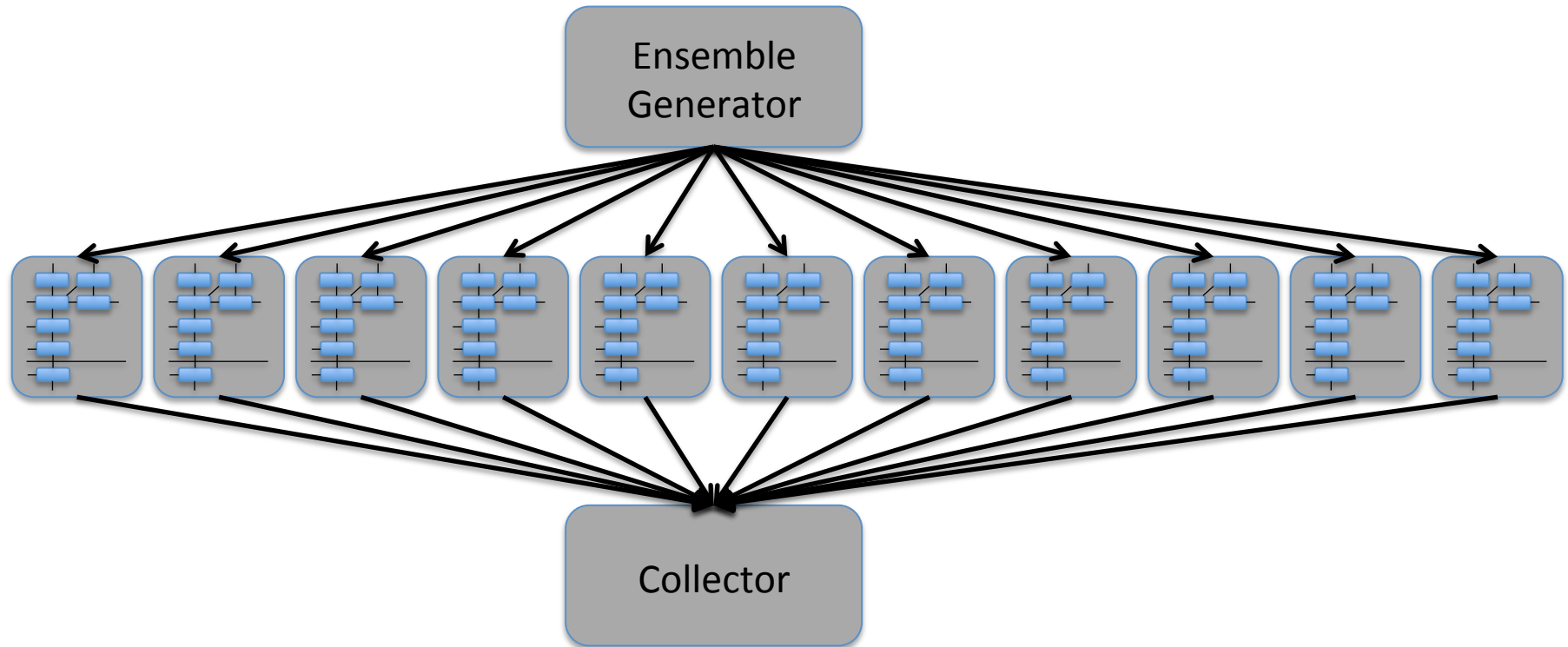
Solar Fuels Workflow



Workflow

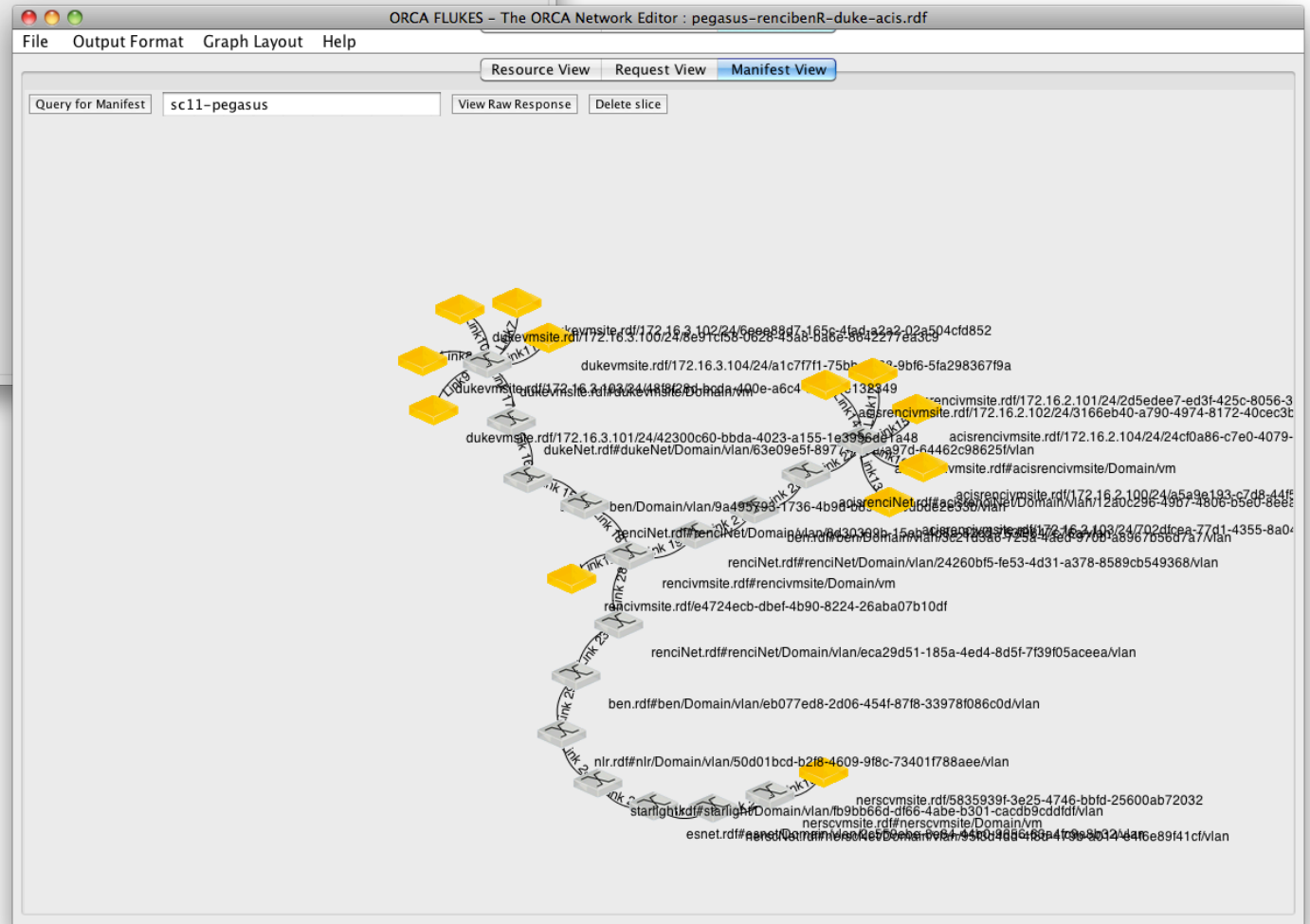
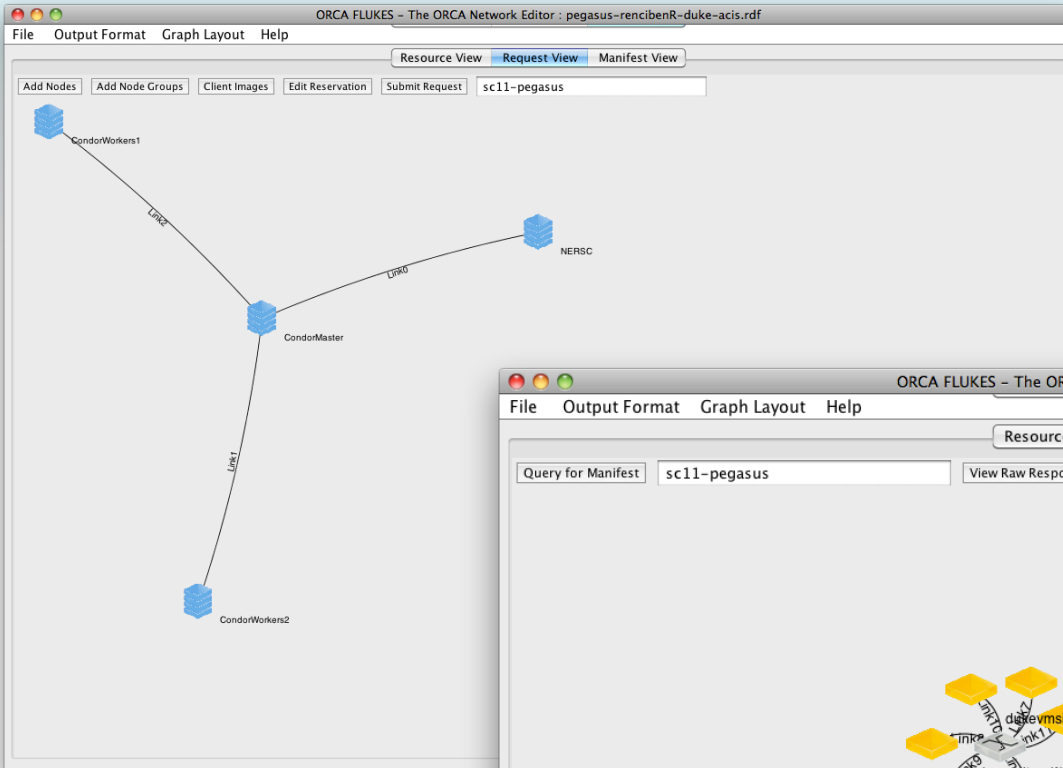


Workflow: Ensemble

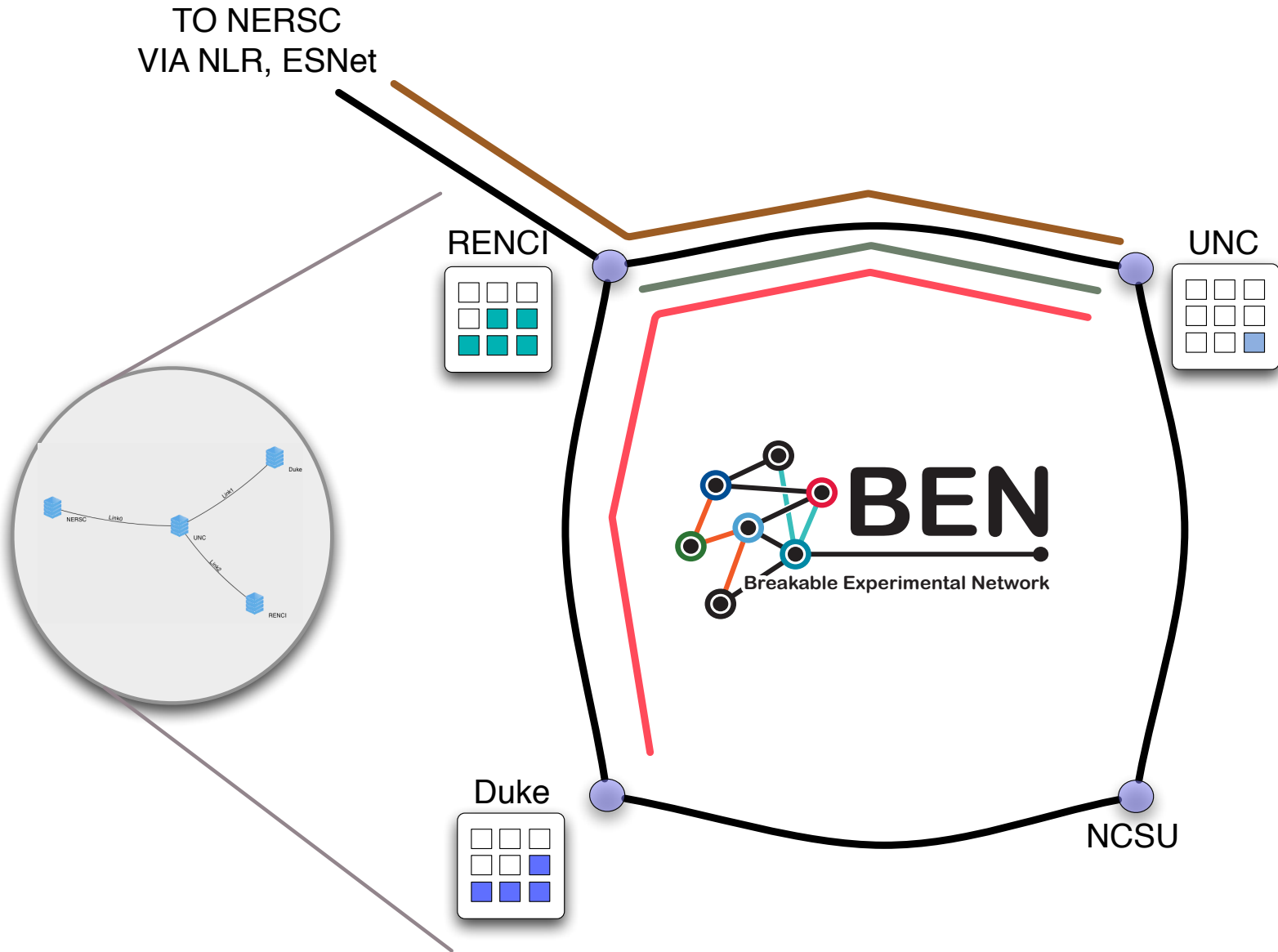


Inter-cloud slice

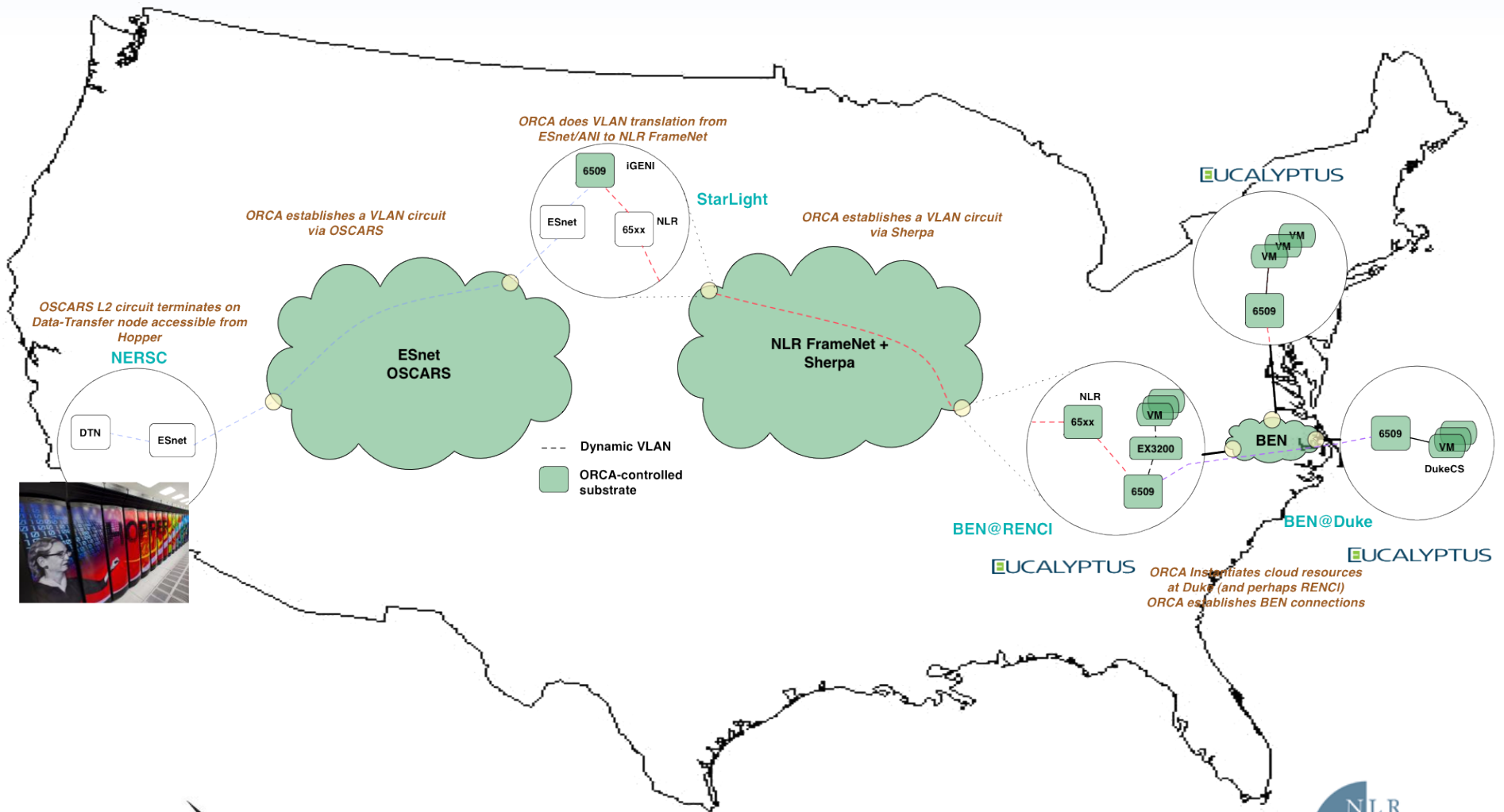
- ORCA negotiates a slice among a multitude of heterogeneous resource providers
- Multiple independent cloud providers
 - RENCI, UNC, Duke
- Multiple network providers
 - ESNet, NLR, BEN
- Inter-provider VLAN stitching
 - VLAN label agreement
- Multi-layered connections in BEN
 - Fiber, DWDM, VLAN/Ethernet layers provisioned in concert with each other



BEN Slice Detail



Resource/substrate providers



Challenges

- Temporary
- Diverse requirements
- Isolation/Security
- Authentication
- Dynamic Applications
- Data Access

Questions?