

# GENI Networking Demos



Clemson University, Georgia Tech, Indiana University at Bloomington, Kansas State, Princeton University, Rutgers, University of Wisconsin at Madison, University of Washington, Stanford University, NLR and BBN

Photo Credit: kptyson (Flickr), David Underhill, Rob Sherwood, Guido Appenzeller



“A virtual laboratory for exploring future internets at scale”



Control



PCs



Network

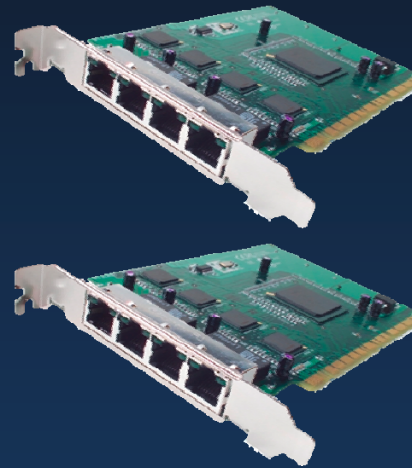
How do we build a Network for  
Internet-Scale experiments?

# Software Router



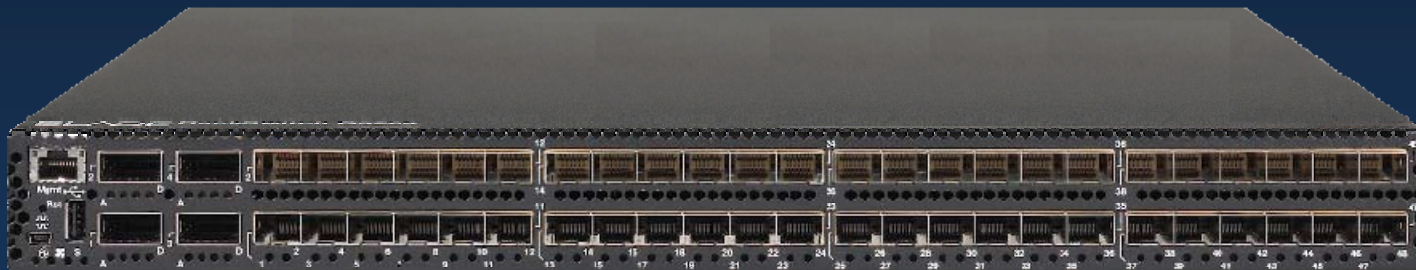
PC

+

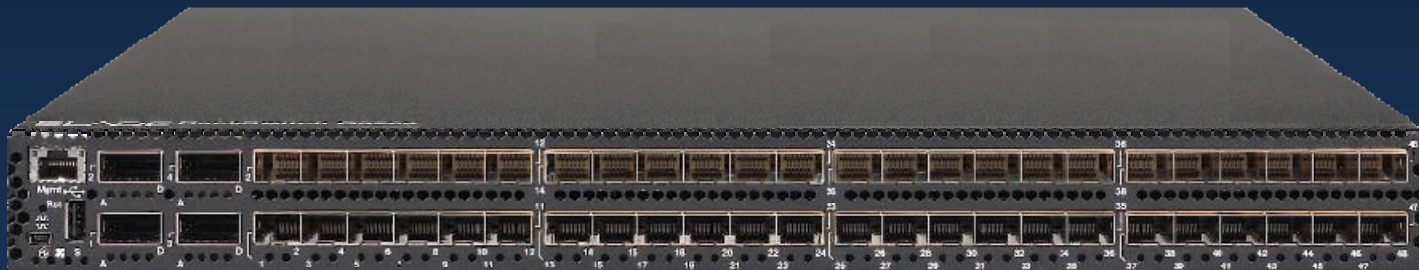


Multi-Port NIC

# HD 10 Gb/s Switch



# HD 10 Gb/s Switch

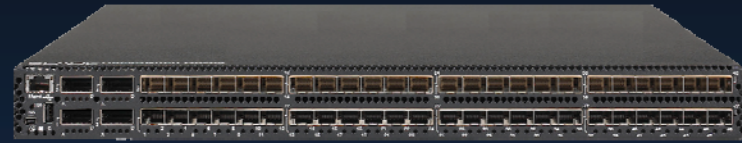


# Software Router



5 Gb/s

# 10 Gbs Switch



480 Gb/s



2 mph



190 mph



# Custom Hardware

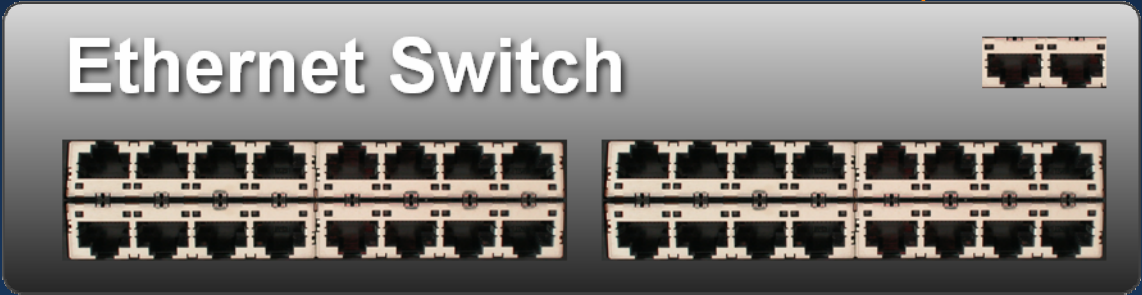
- Difficult to develop, always behind industry
- Difficult to program, constrained environment
- Too expensive

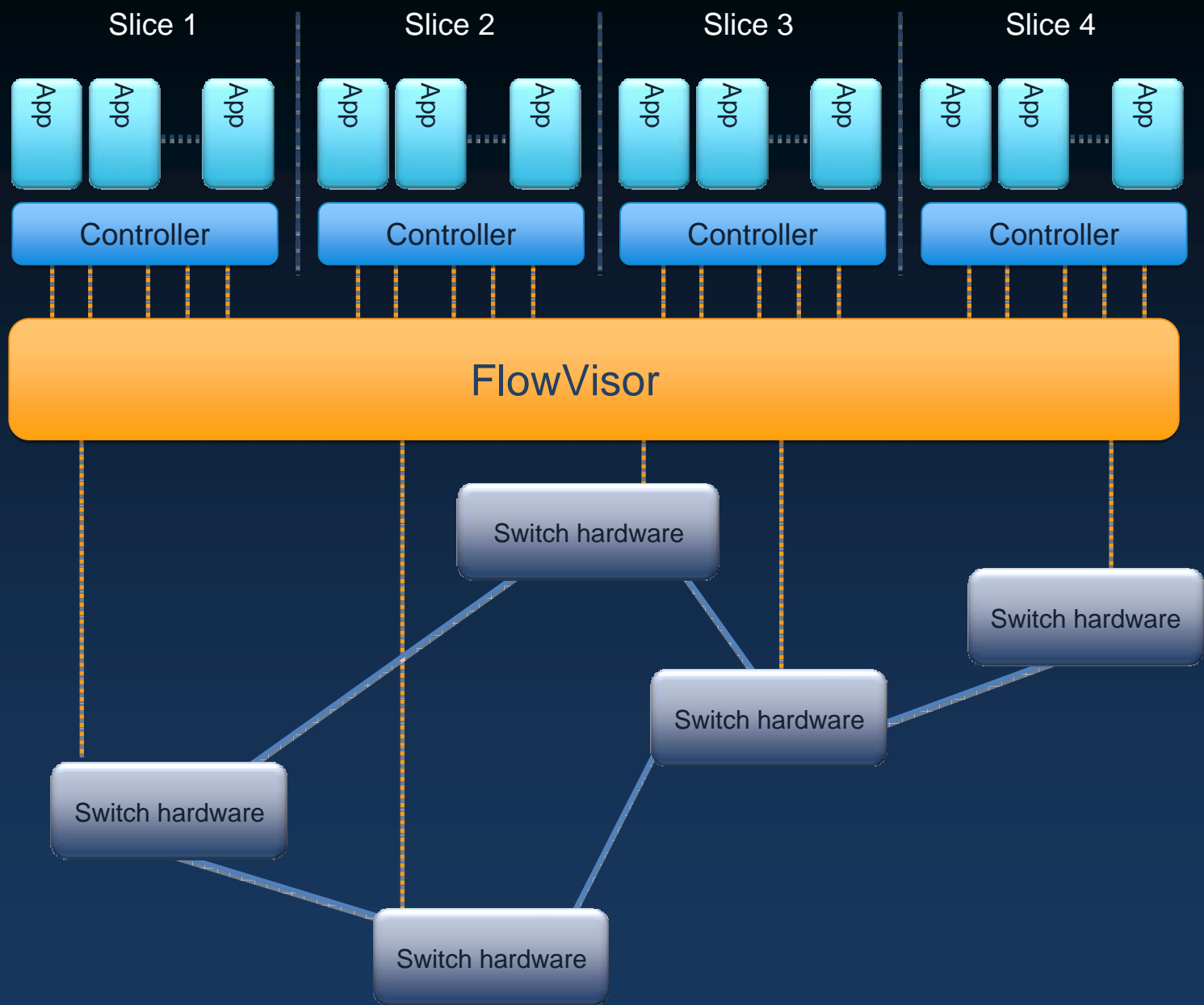


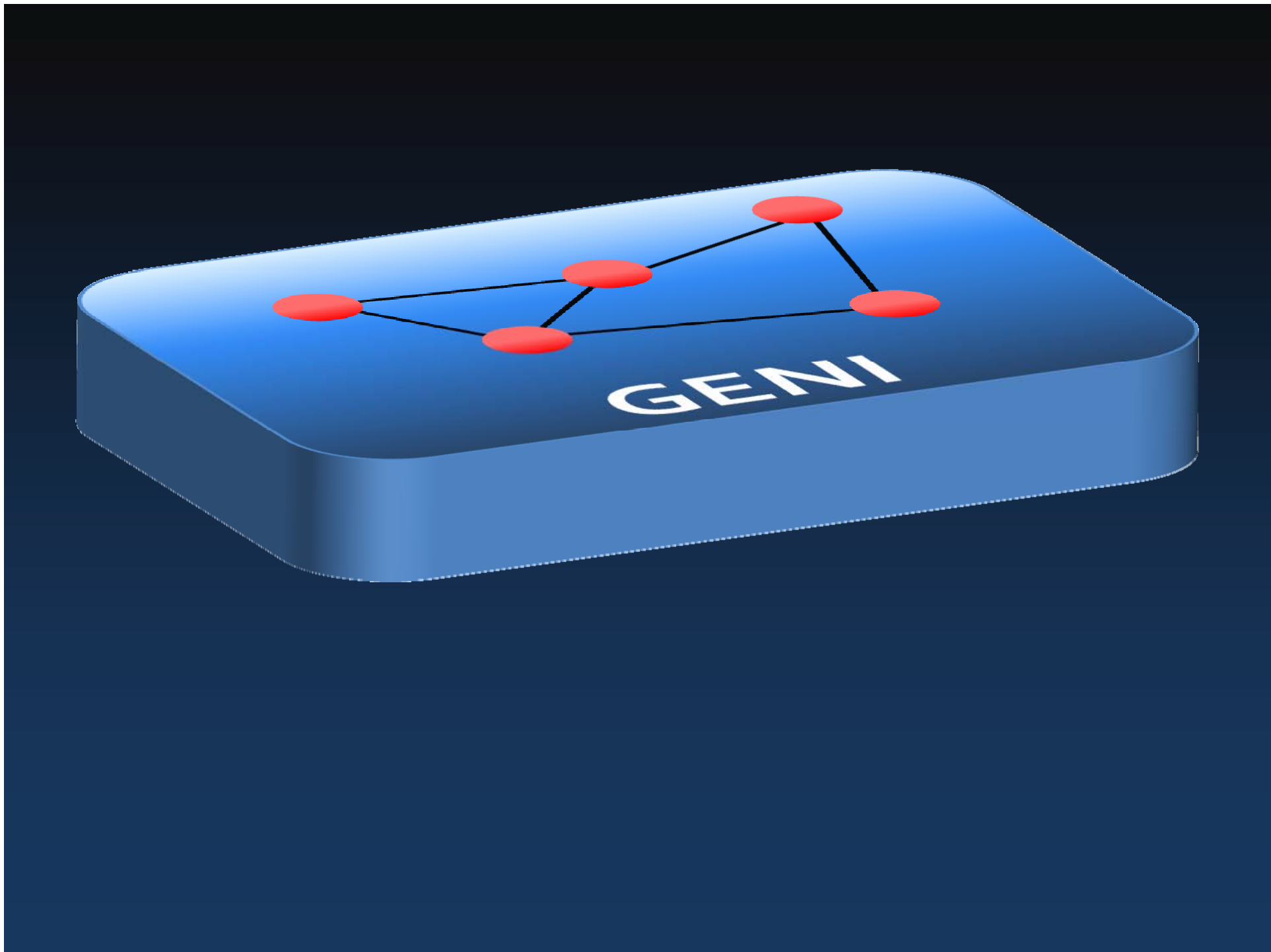
The only test network large enough to evaluate future internet technologies at scale, is the internet itself.

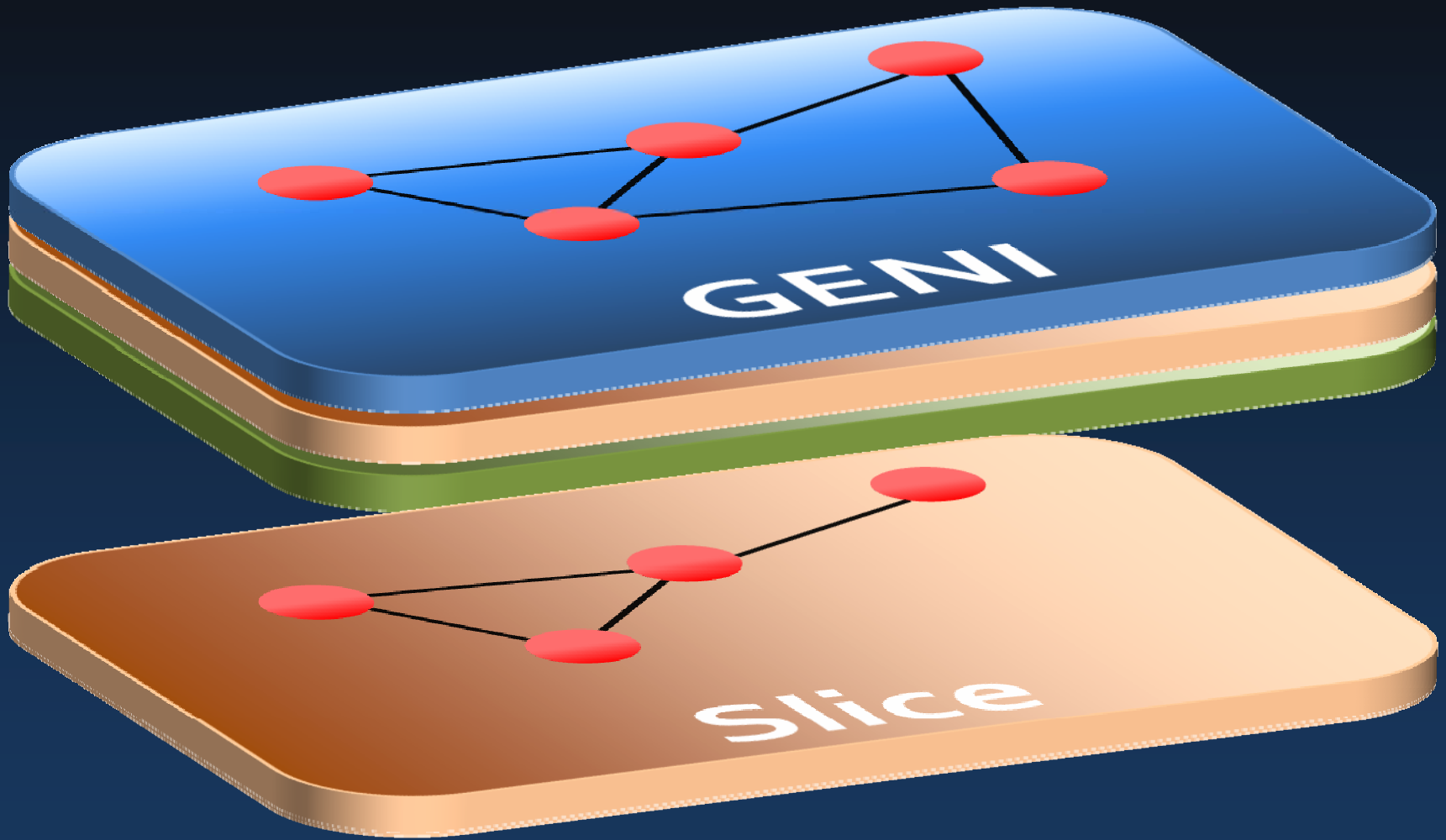


OpenFlow Protocol







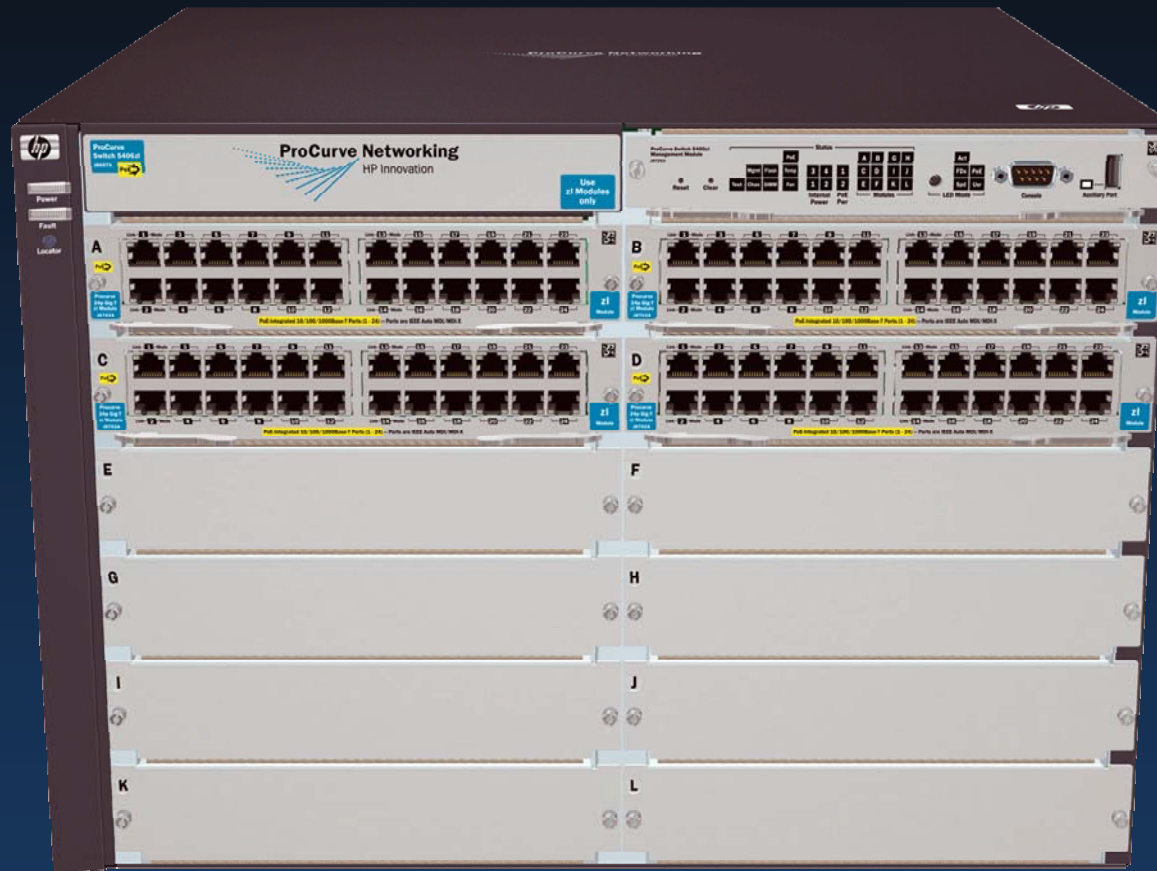




# OpenFlow Switches



# HP Procurve



# NEC



# Pronto/Indigo



# Netgear



# Deployments



Demo 1: Aster\*x:

Load balancing as a network primitive

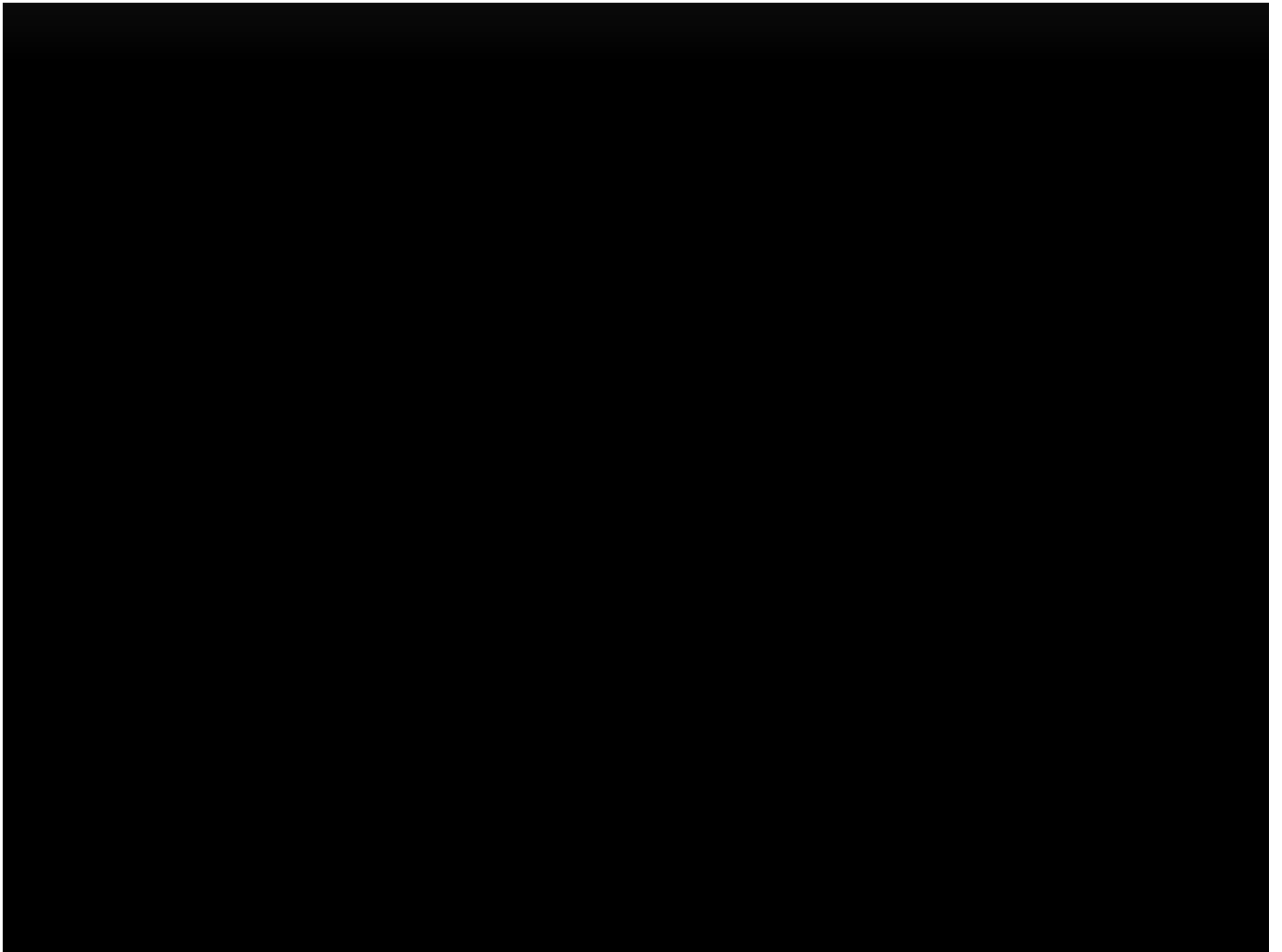
Demo II: Wireless

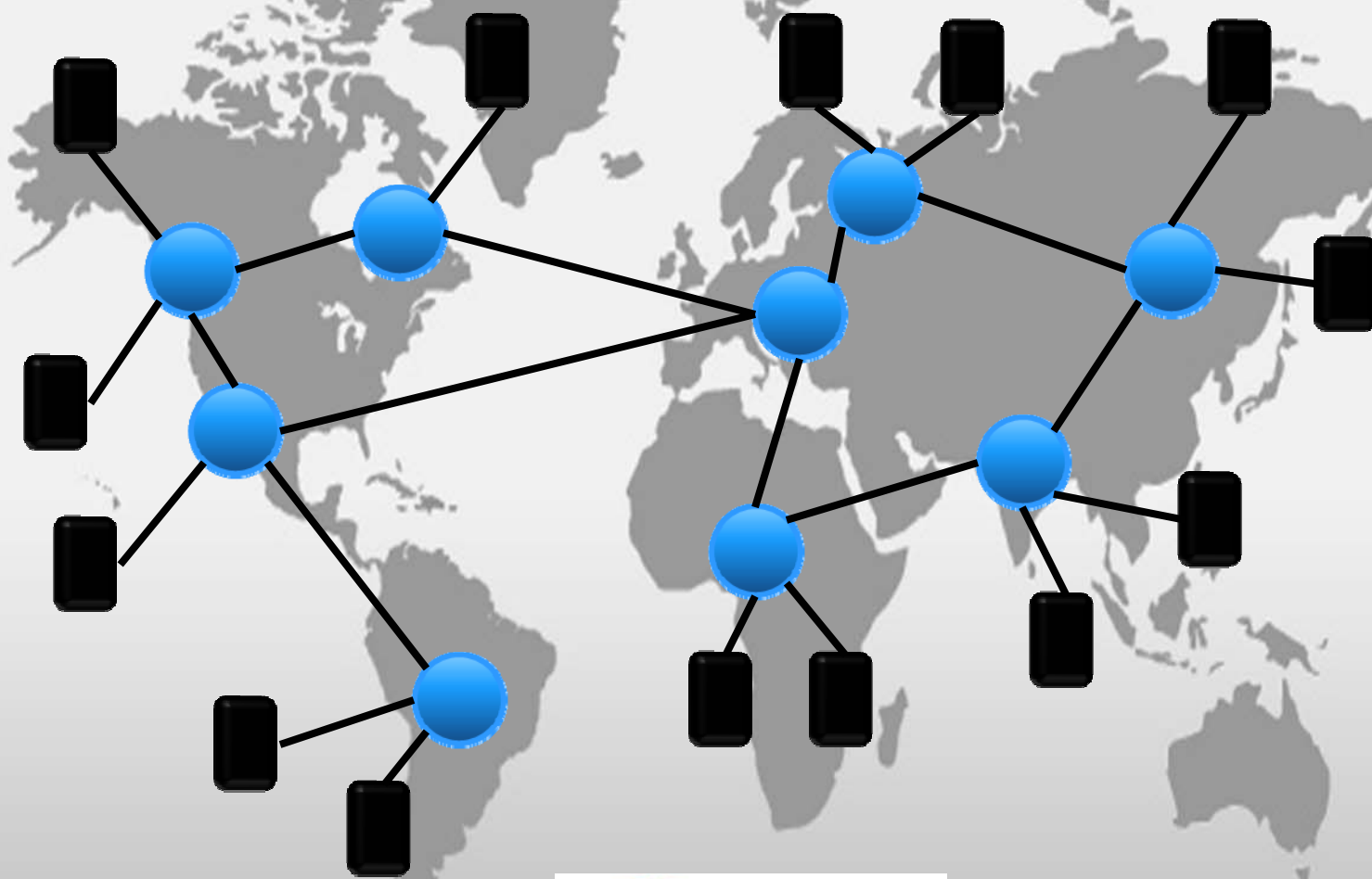
Can I use all the diverse wireless capacity around me?

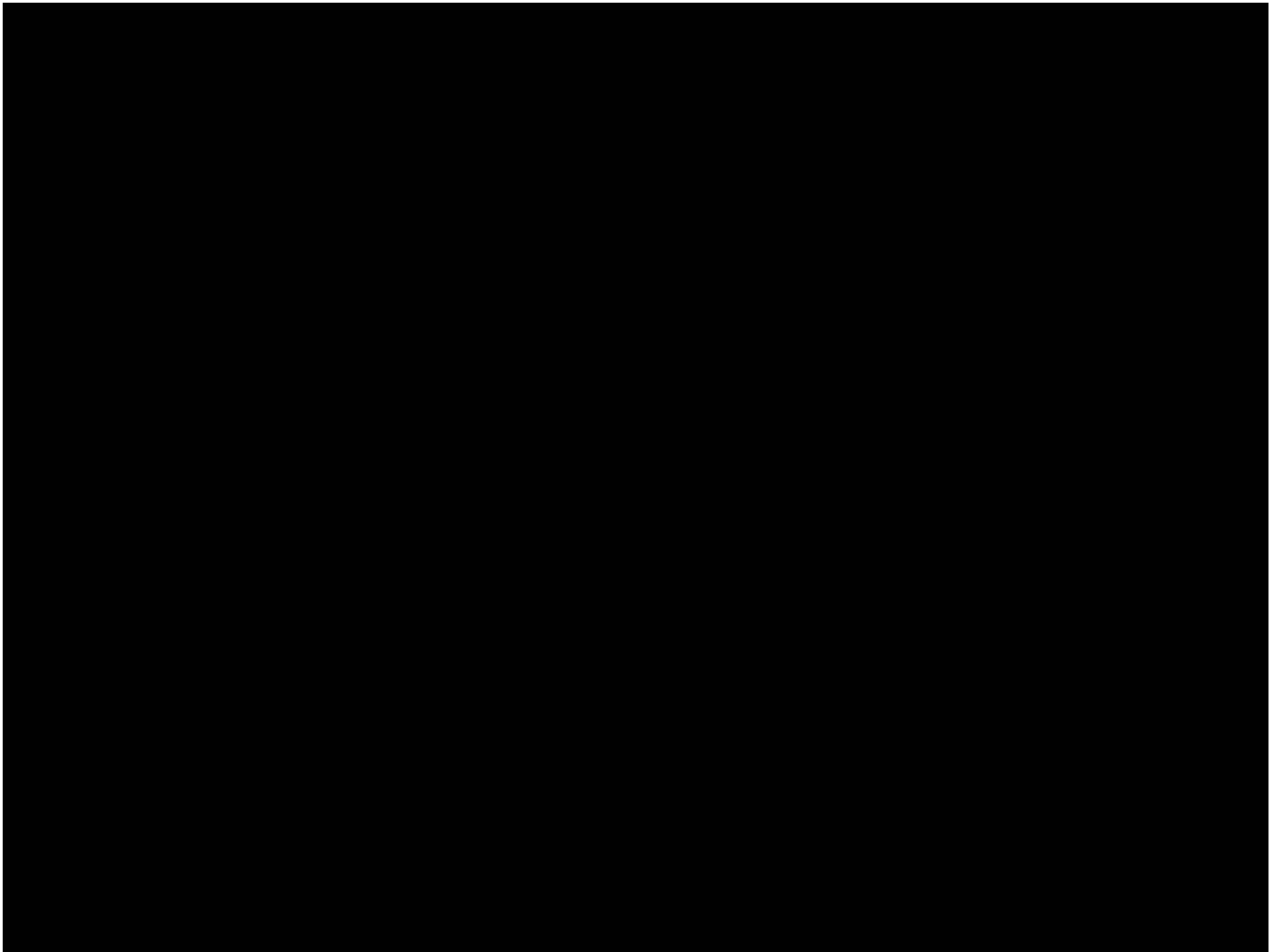
# Aster\*x: Load-Balancing as a Network Primitive

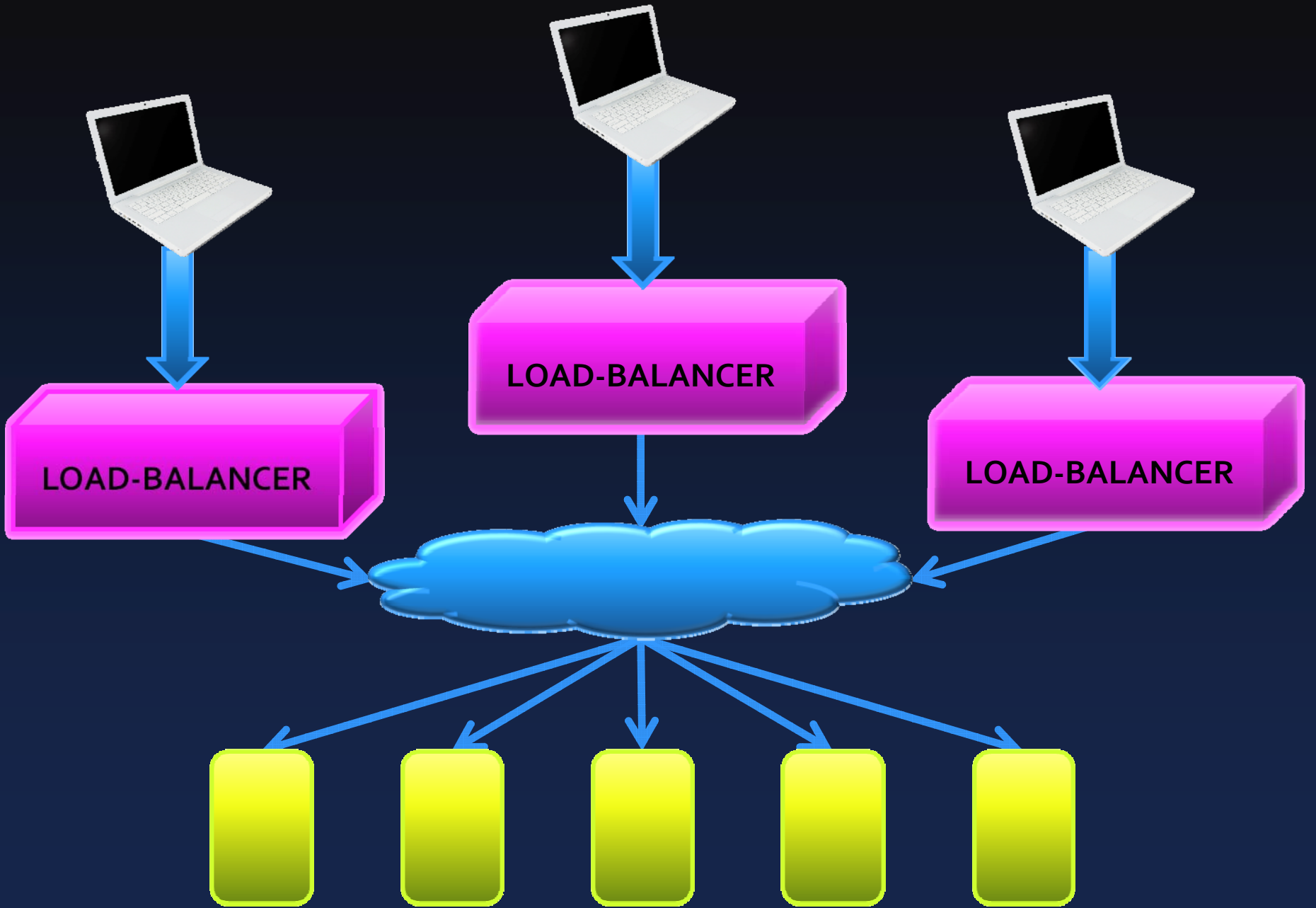
Clemson University, Georgia Tech, Indiana University at Bloomington, Kansas State University, Princeton University, University of Wisconsin at Madison, University of Washington, Stanford University and BBN





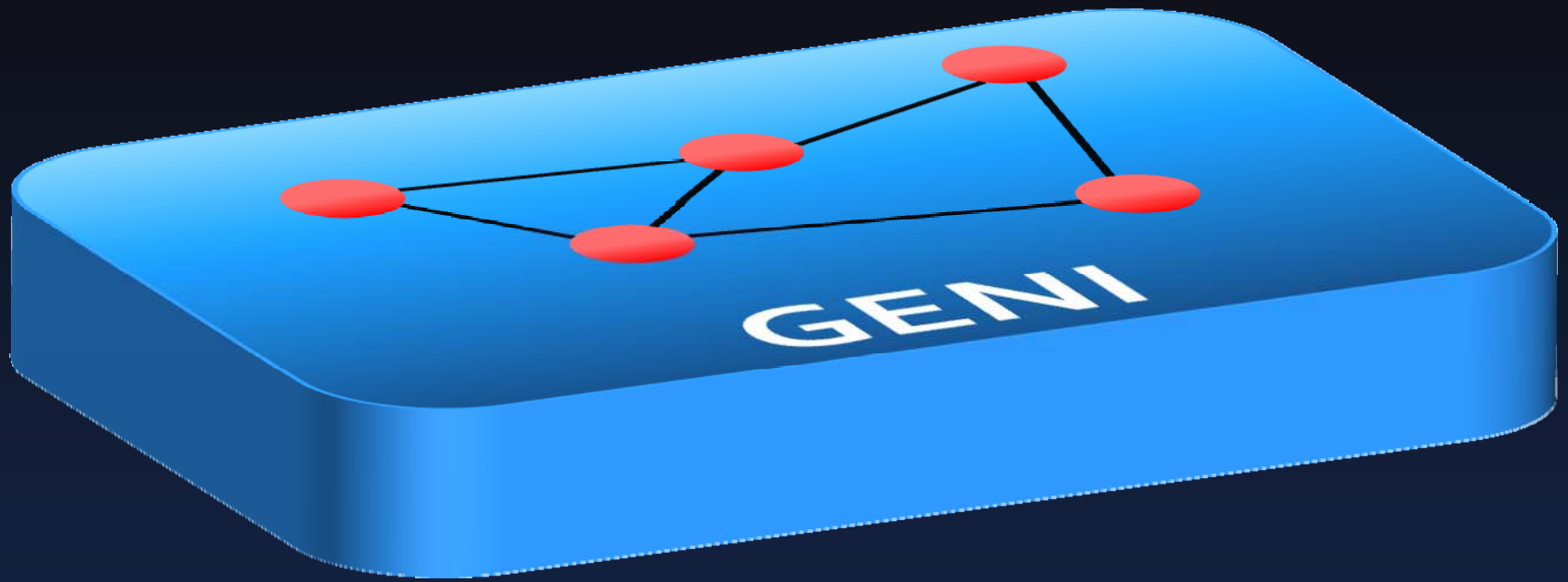


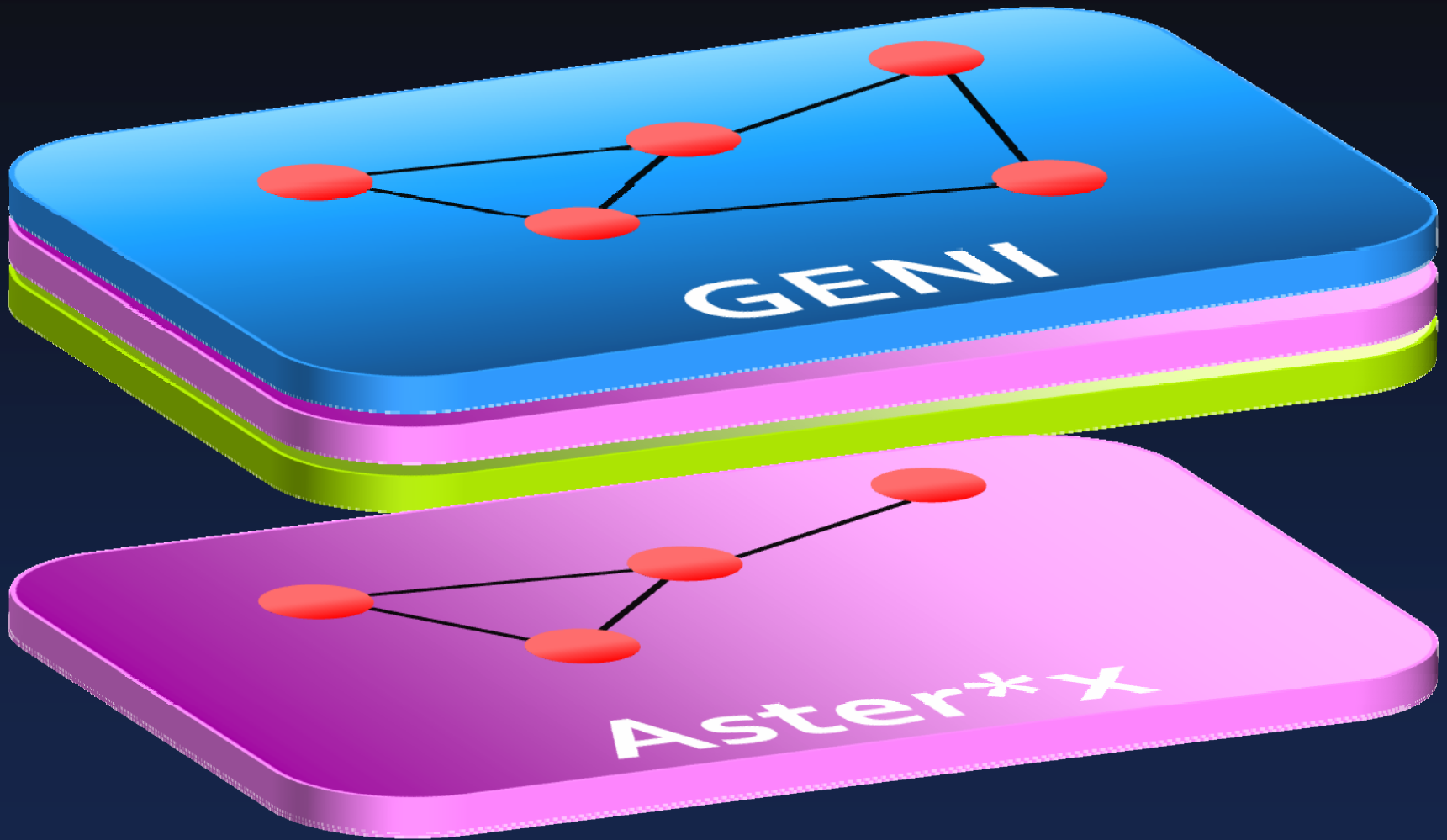




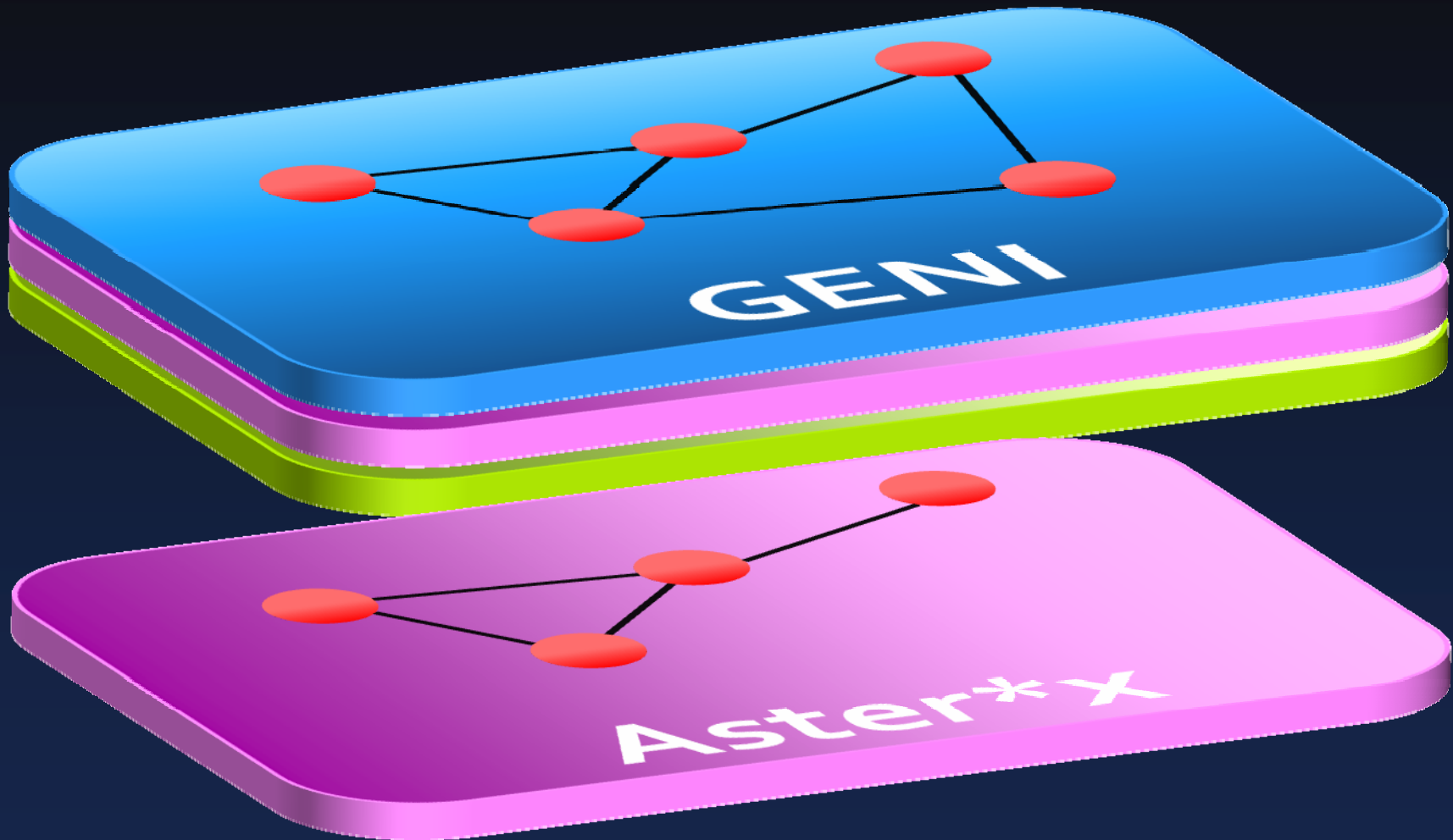
**Load Balancing is just  
Smart Routing**

**Load Balancing should be  
a Network Primitive**











UW



WISC



INDIANA



BBN



PRINCETON



NLR



STANFORD



CLEMSON



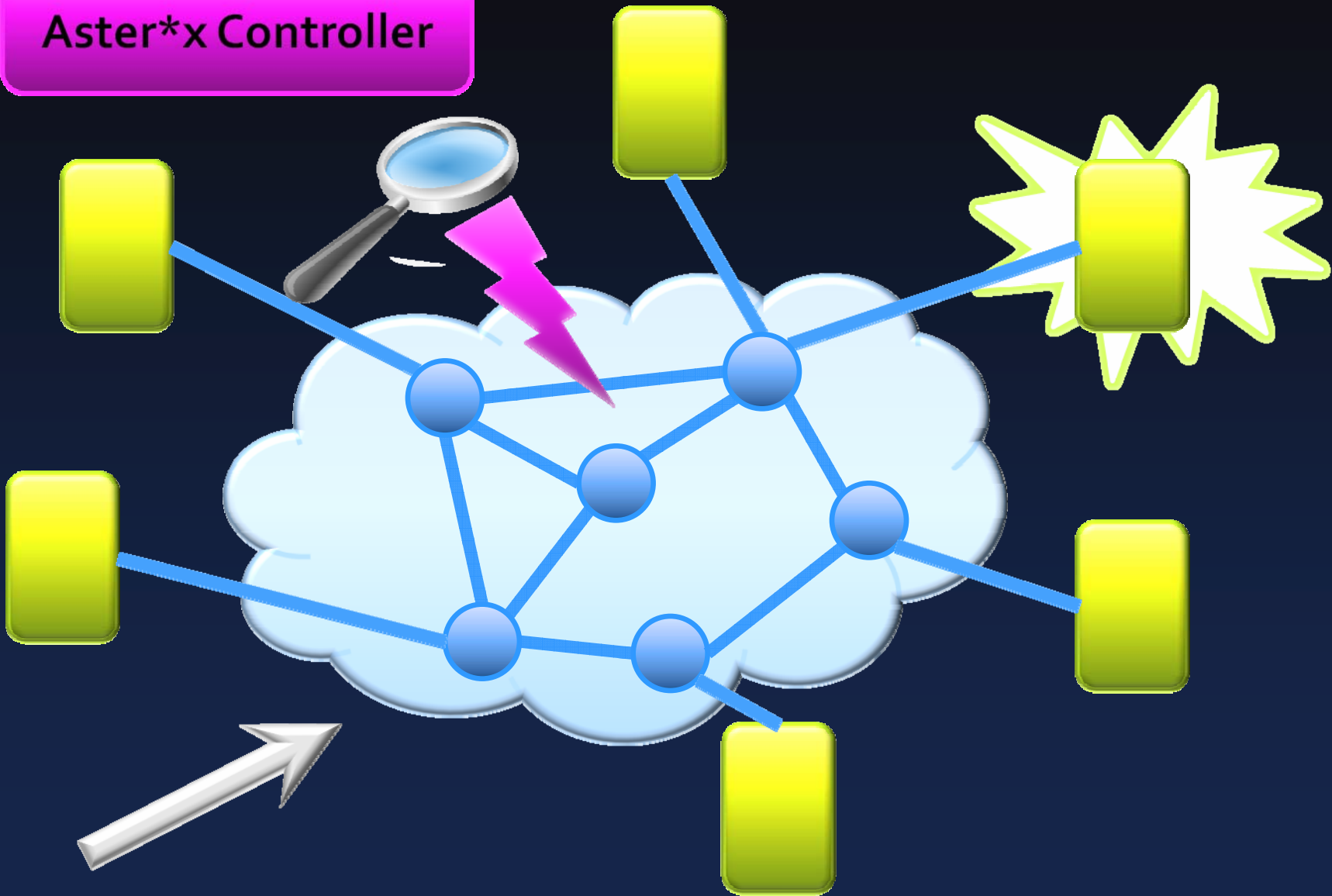
KANSAS STATE



GEORGIA TECH



Aster\*x Controller



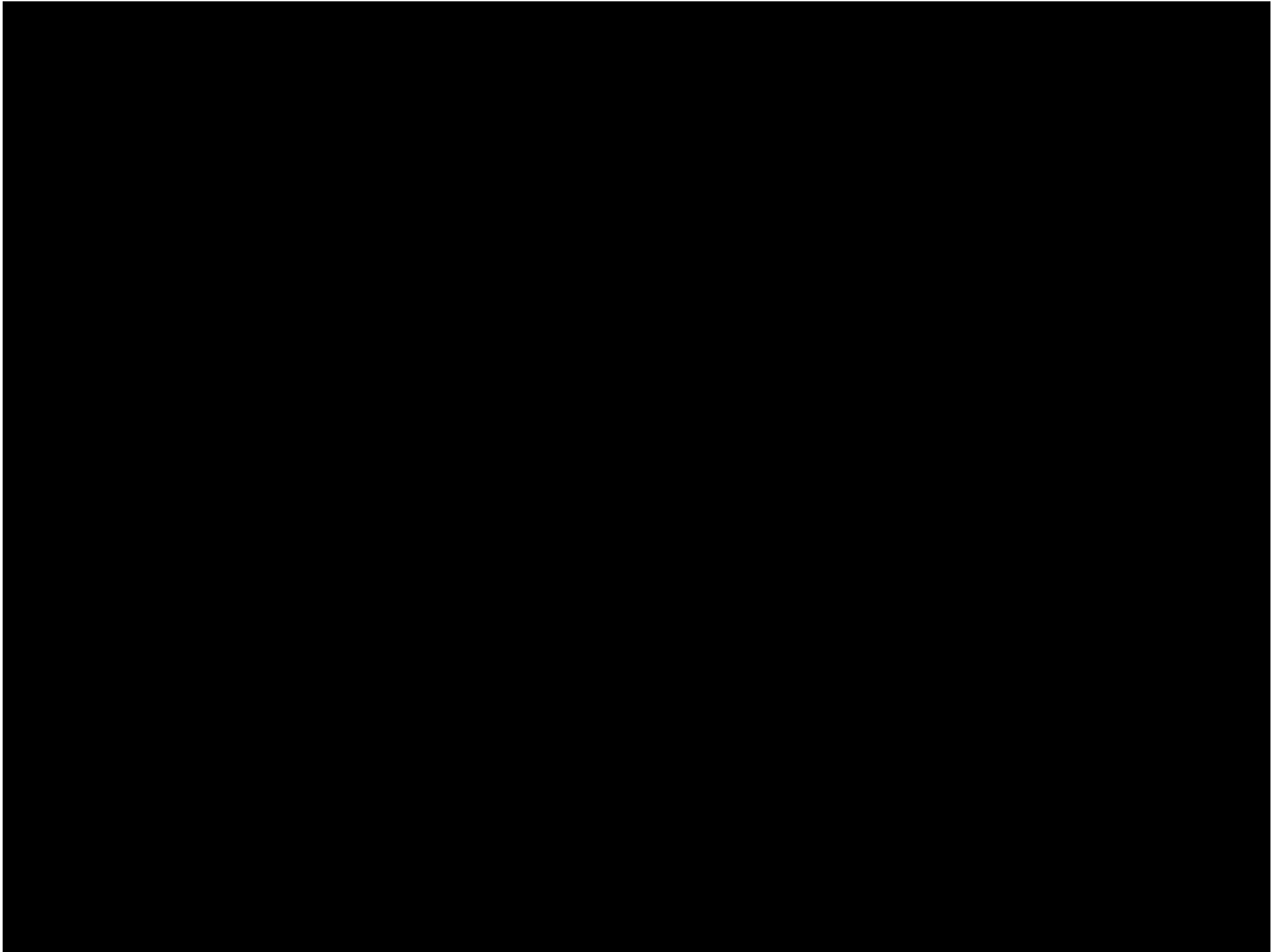
Can I use all the  
wireless networks  
around me?

Wireless capacity is  
**NOT** scarce

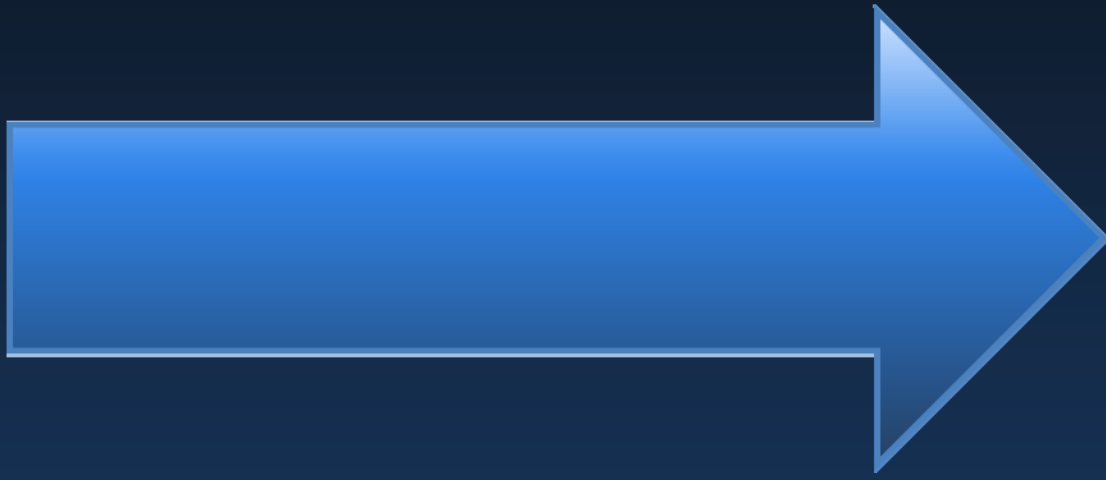
# Contracts

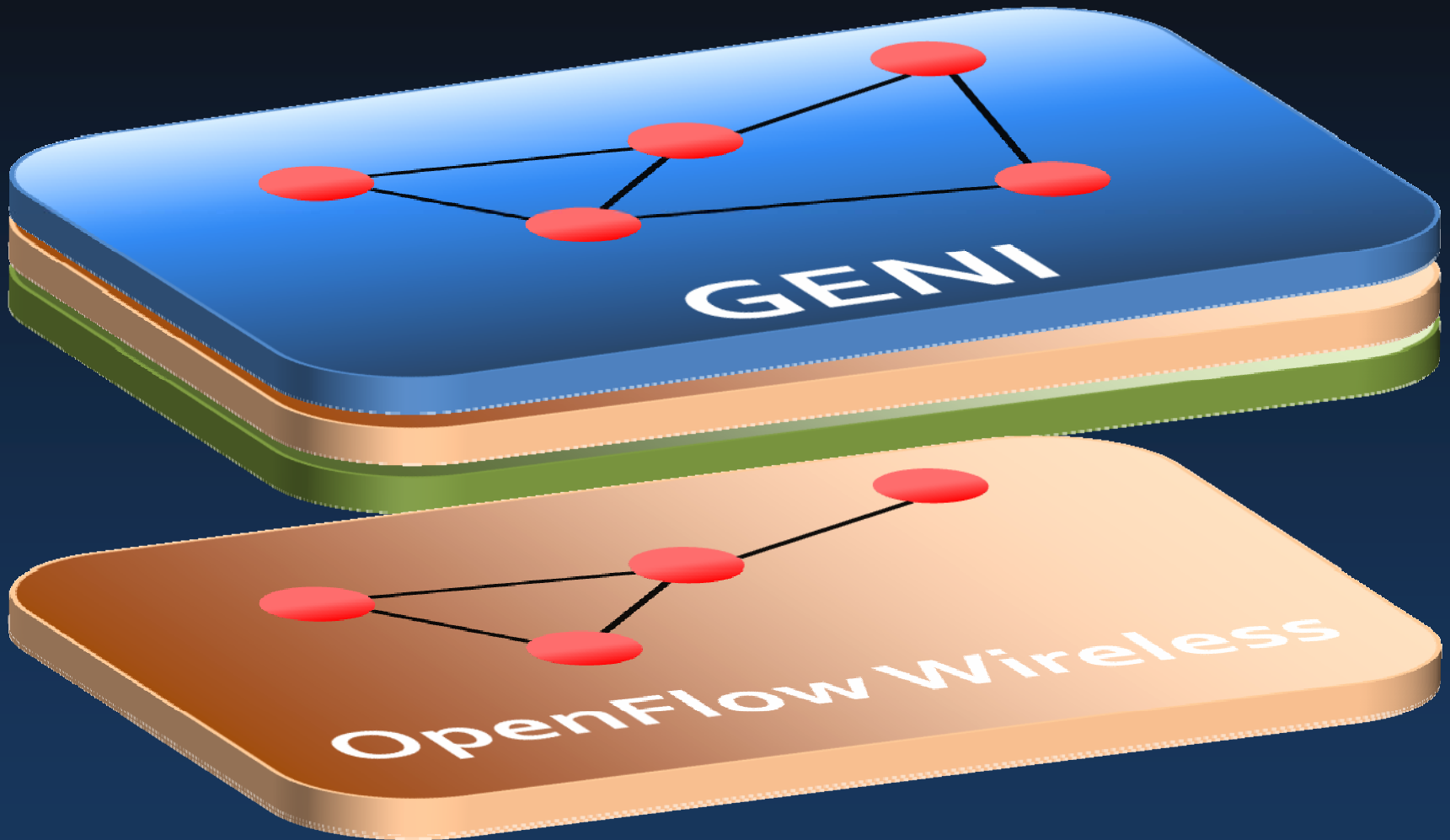
**WPA**











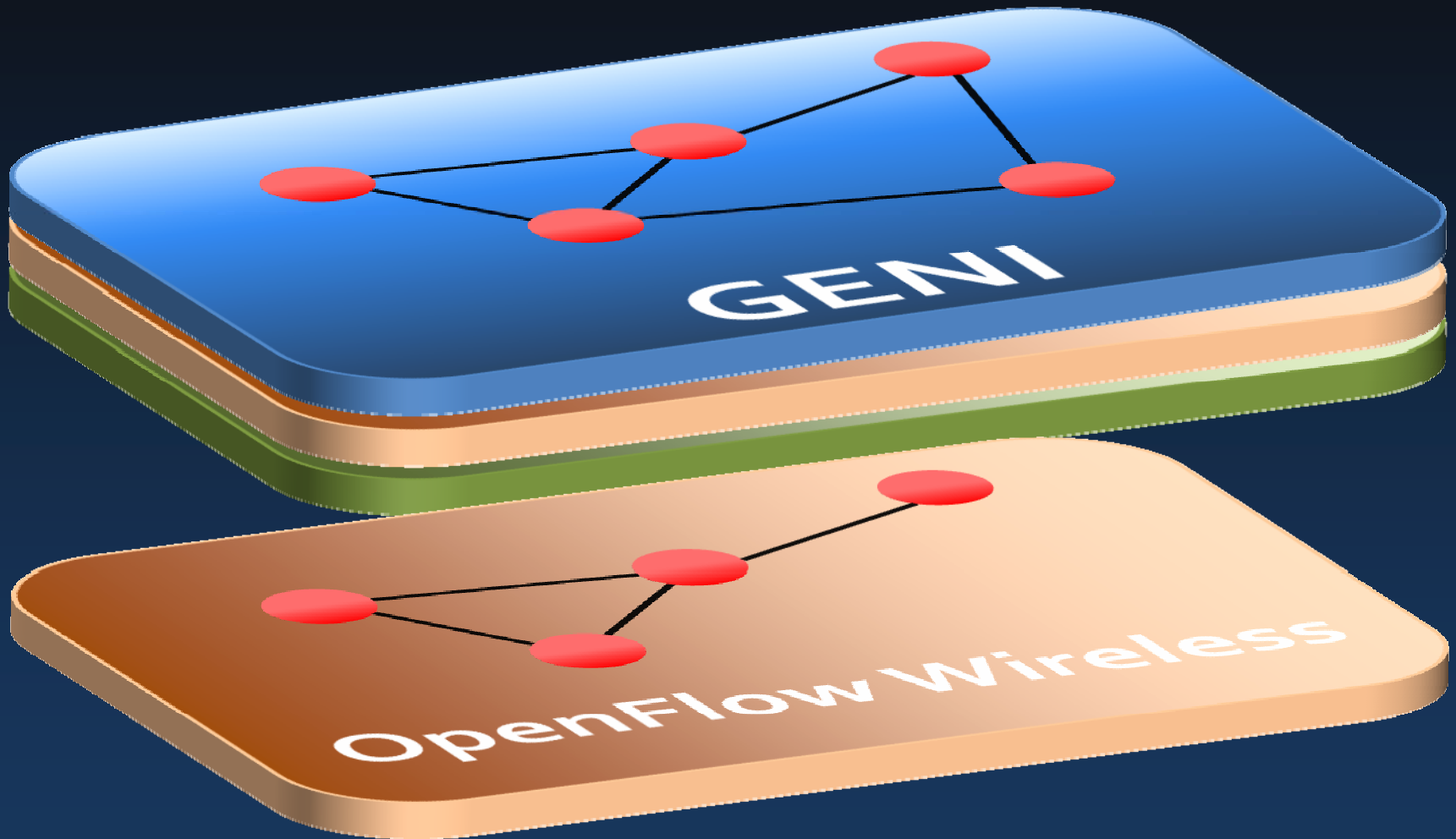
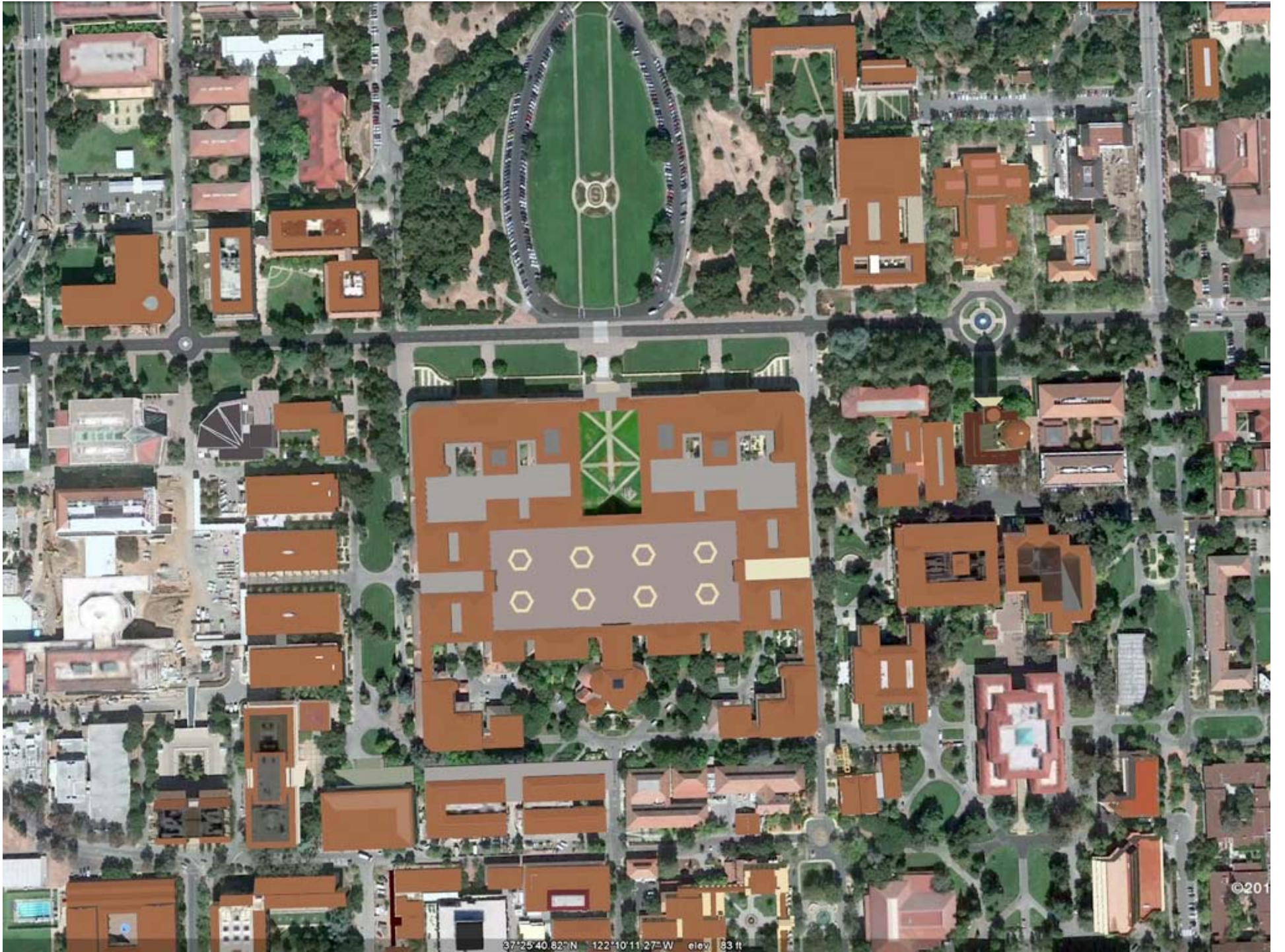




Image © 2010 TerraMetrics  
Image IBCAO  
Image © 2010 DigitalGlobe  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

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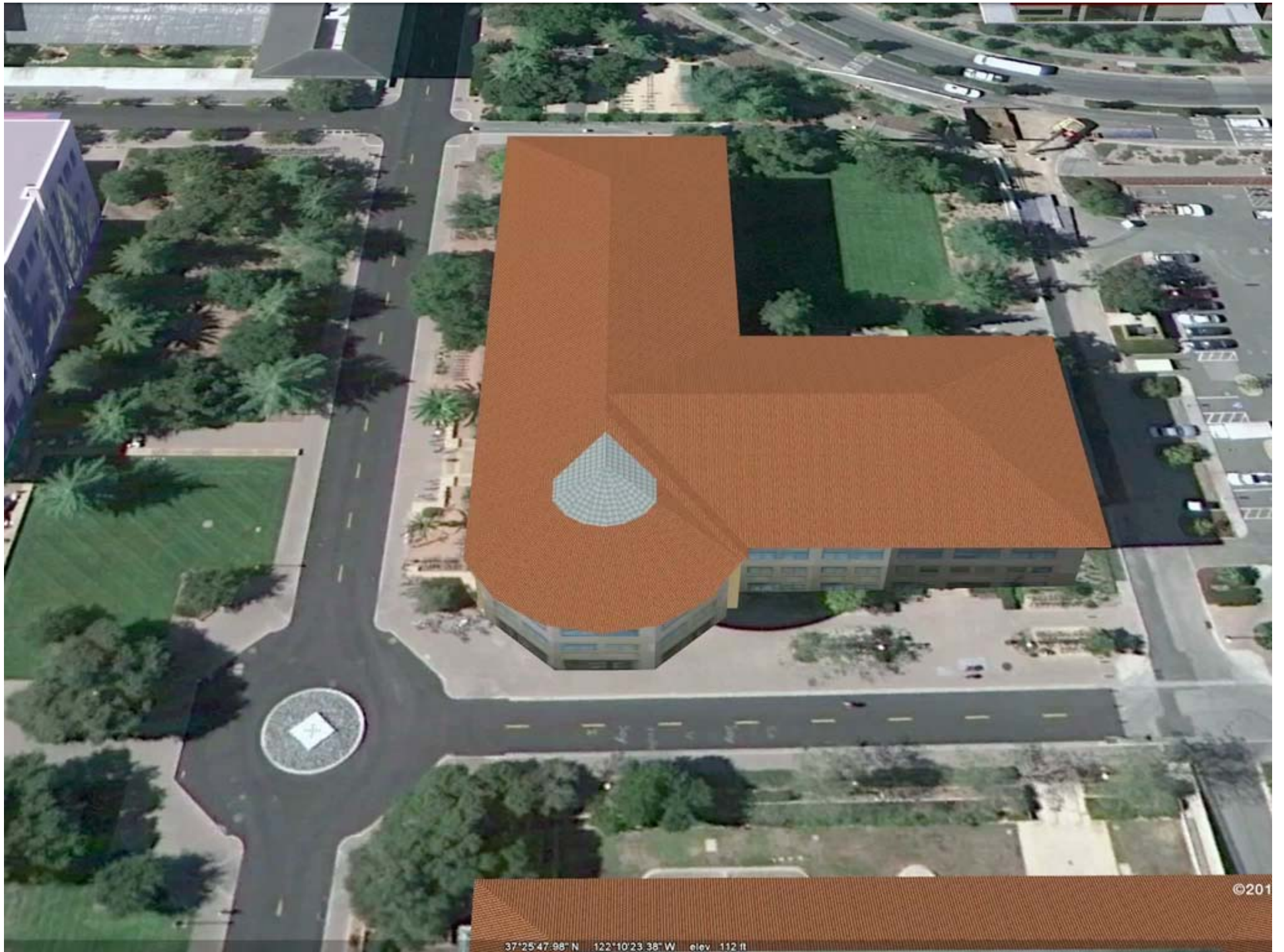
37°25'40.82"N 122°10'11.27"W elev 83 ft

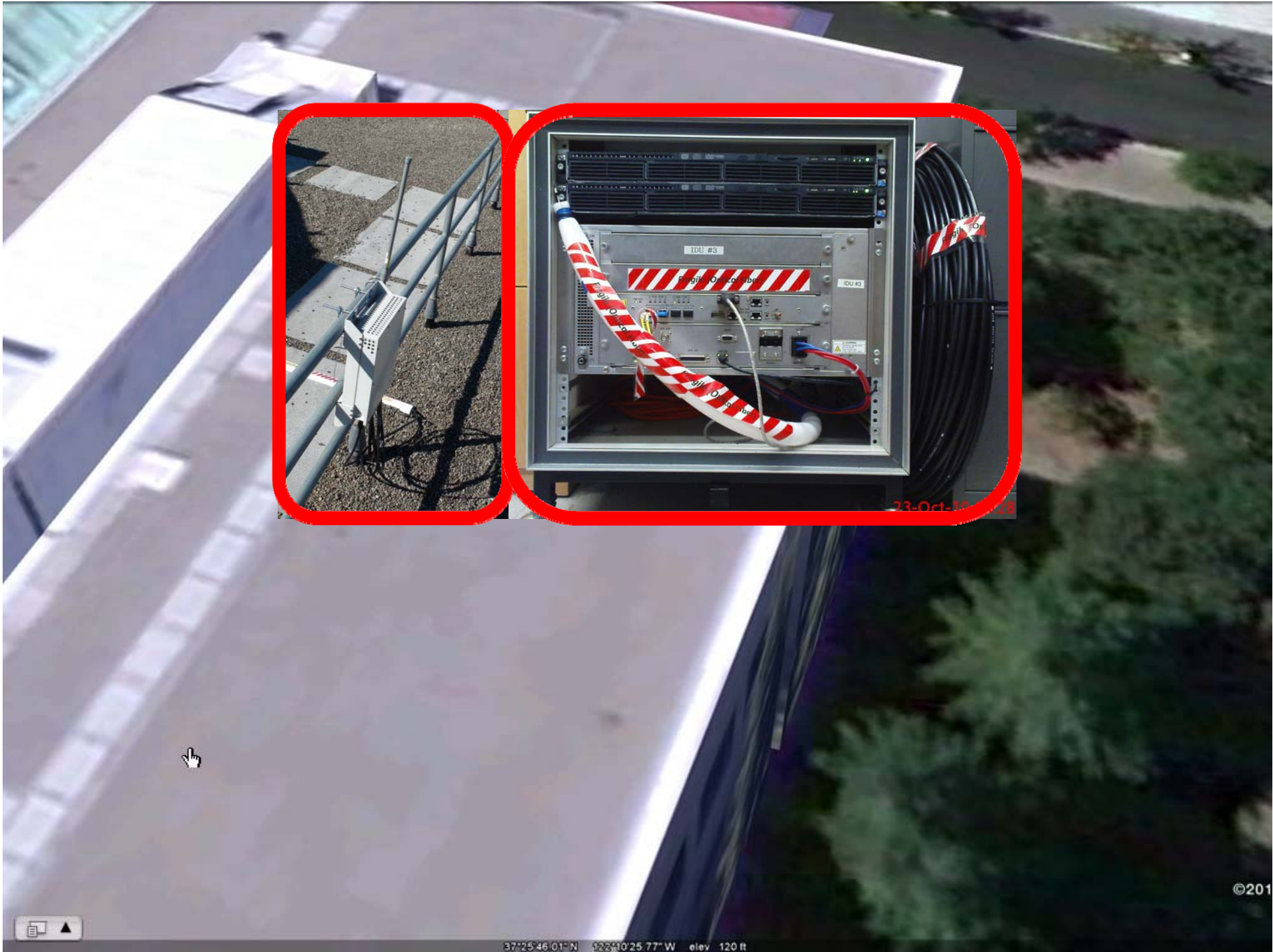
©201



EE

CS

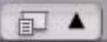




23-Oct-16 11:28

©201

37°25'46.01"N 122°10'25.77"W elev. 120 ft

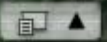






©201

37:25:46.01"N 122:10:25.77"W elev 120 ft





37°25'48.70" N 122°10'23.26" W elev. 110 ft

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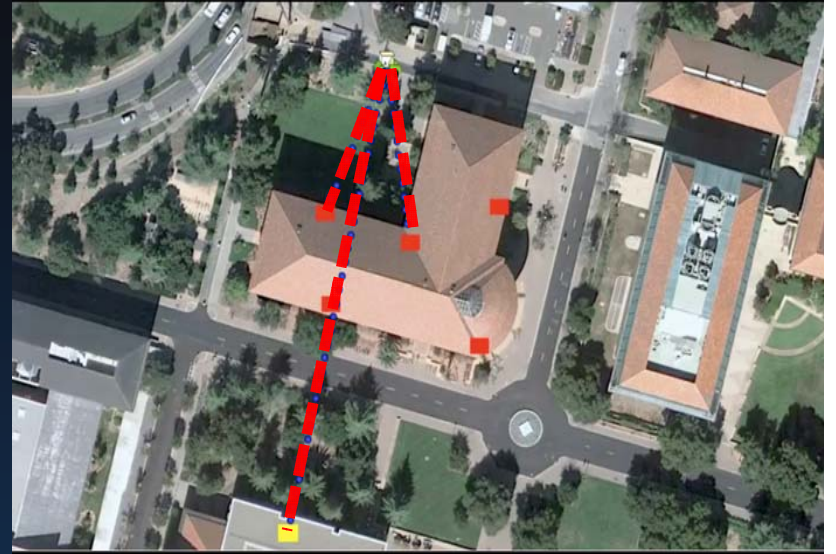
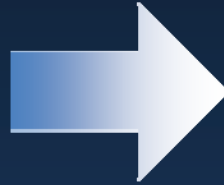
37°25'48.70" N 122°10'23.26" W elev. 110 ft

©201

# Demonstration

- Round 1
  - Using only WiFi network
- Round 2
  - Uses all networks around
  - WiFi + WiMAX

Live Demo



# GENI Networking Demos

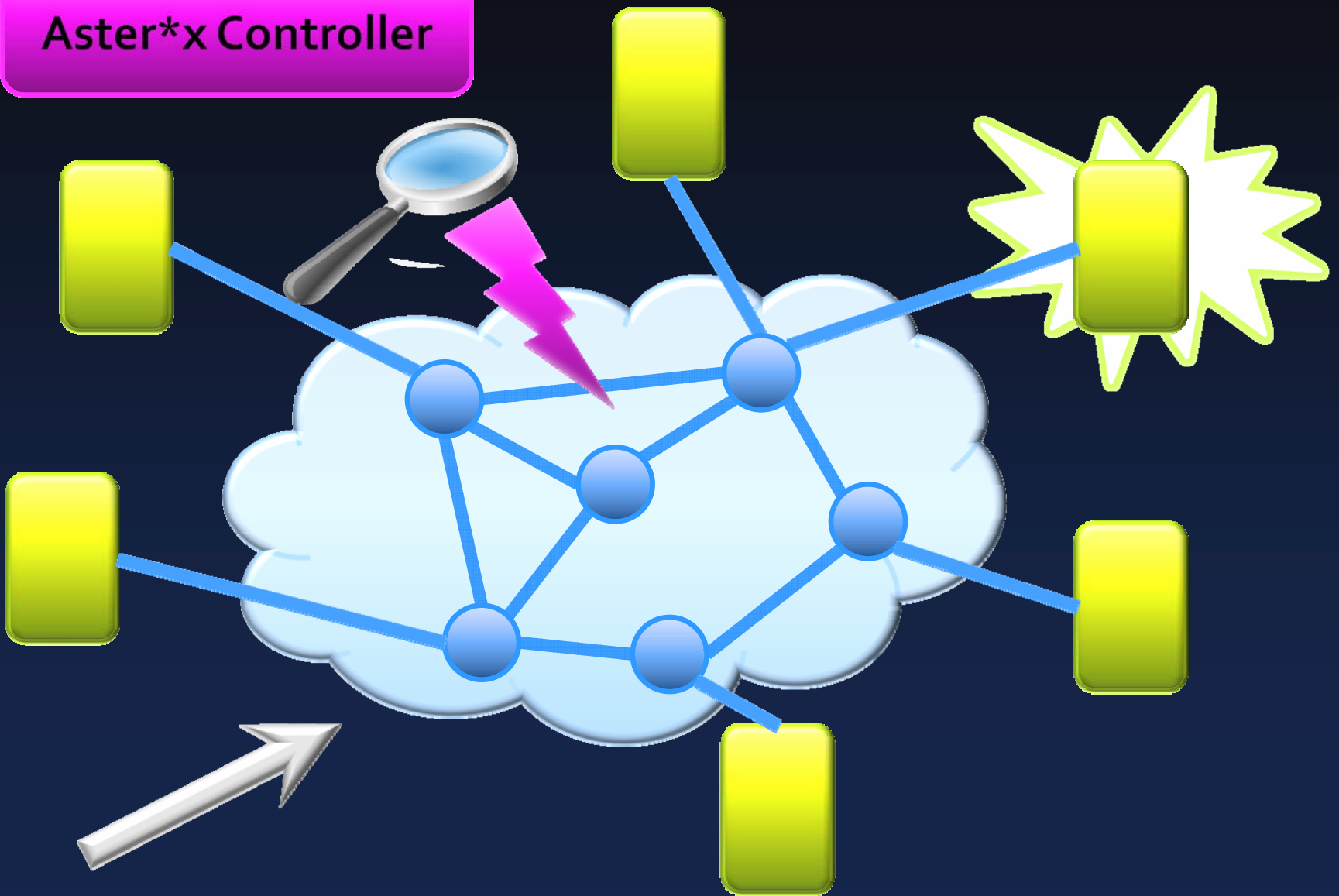
## Closing Thoughts



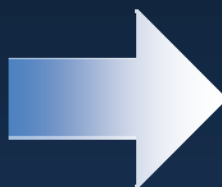
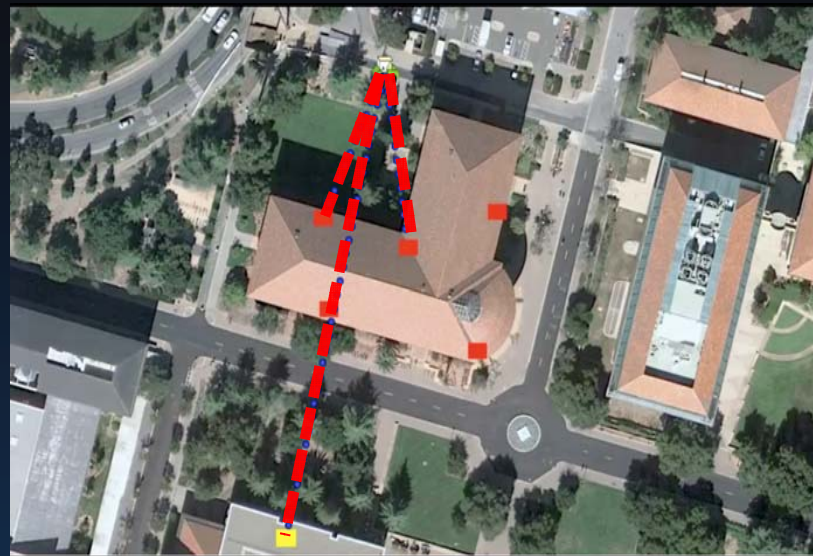
# GENI Enables Exciting Research

# Balancing

Aster\*x Controller



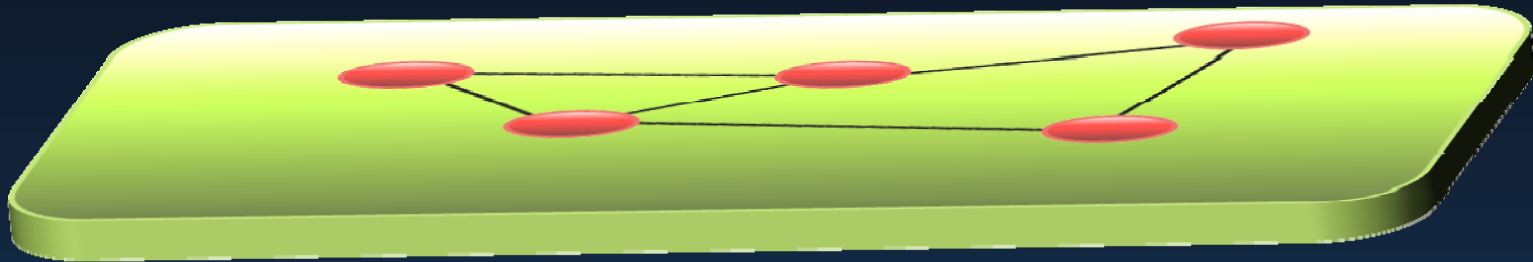
# Nets



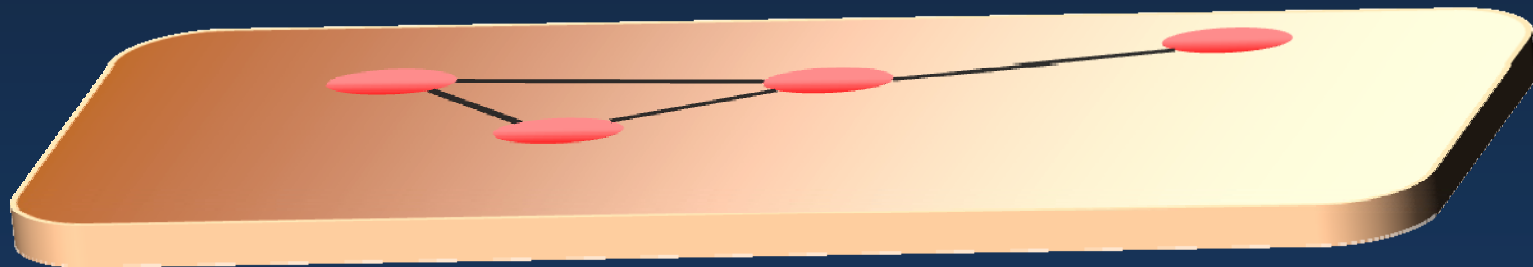
This is just the  
beginning!

# Looking Under the Hood

Computing Substrate



OpenFlow (wired & wireless) Substrate

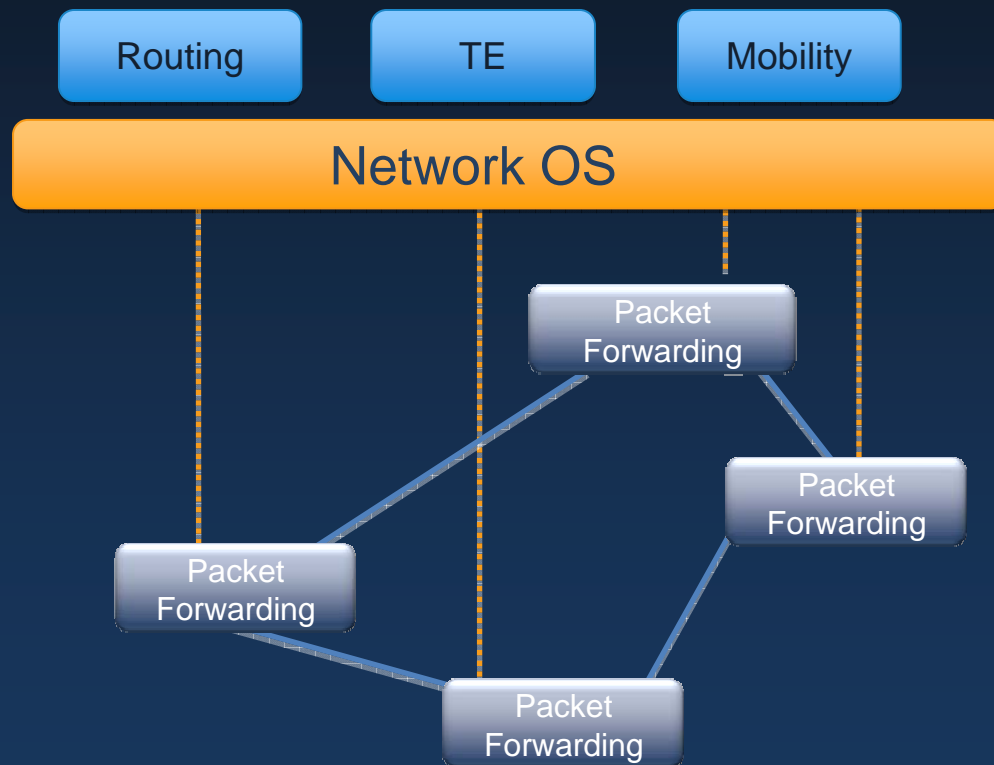


GENI slice



a set of VMs connected by a slice of programmable OpenFlow network

# OpenFlow Network



Logical Map of Network

Control Plane



Data Plane

# OpenFlow Ecosystem ...

Interest from providers/data center operators



Deployments in R&E Networks



Support from vendors



Commitment varies

# Final Takeaways

- GENI is starting to enable great research and lot more to come
- GENI helped create OpenFlow
  - ⇒ Now impacting practice of networking