Looking Beyond the Internet

The Rise of Software Defined Infrastructure

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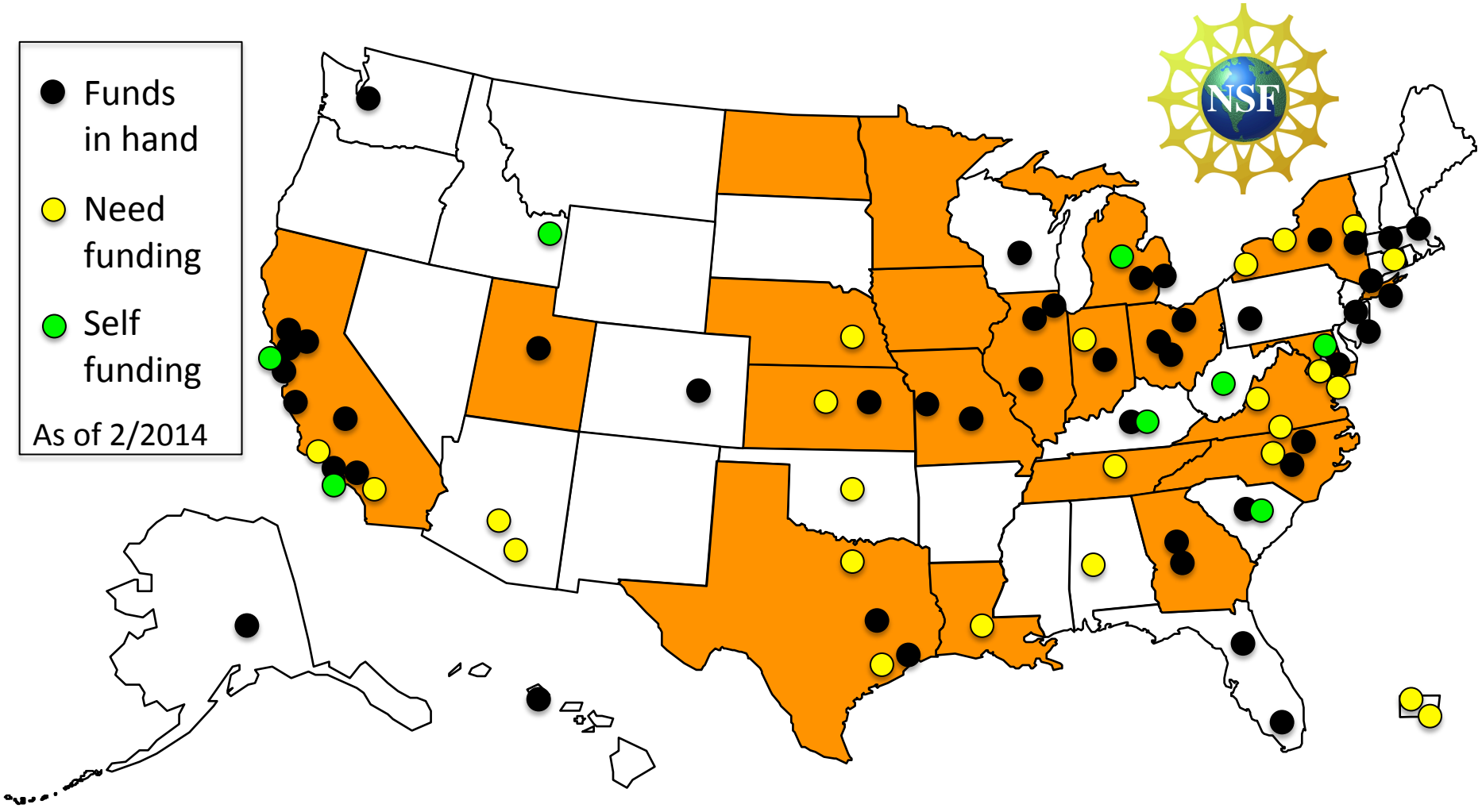
My thesis

- SDN is just an opening act
- A major transformation of the Internet has begun
- We can now catch glimpses of what lies beyond
- We can get there by a series of step by step actions

Where I am coming from - GENI

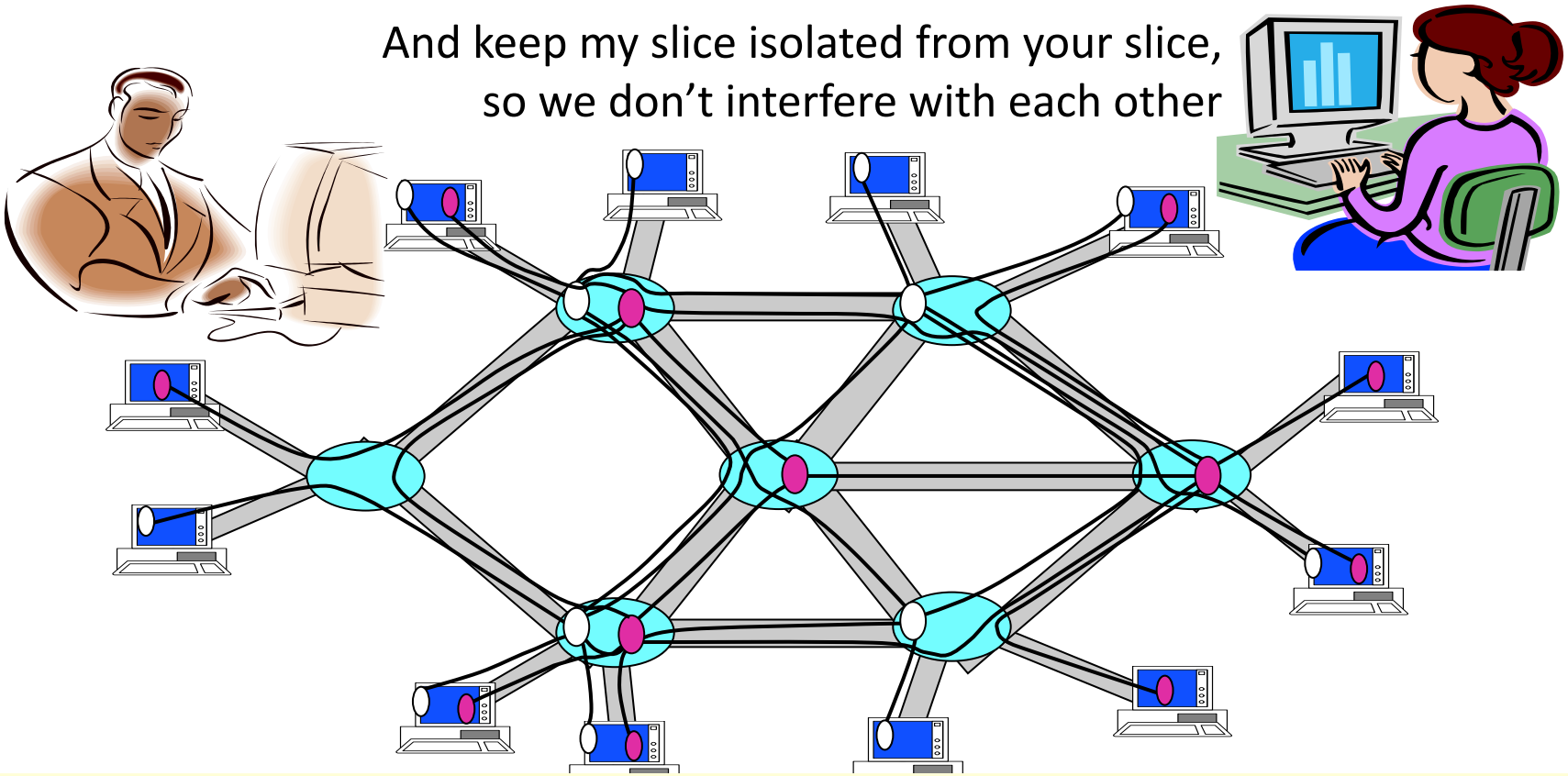


We're building out GENI through universities across the US

Slices and deep programmability

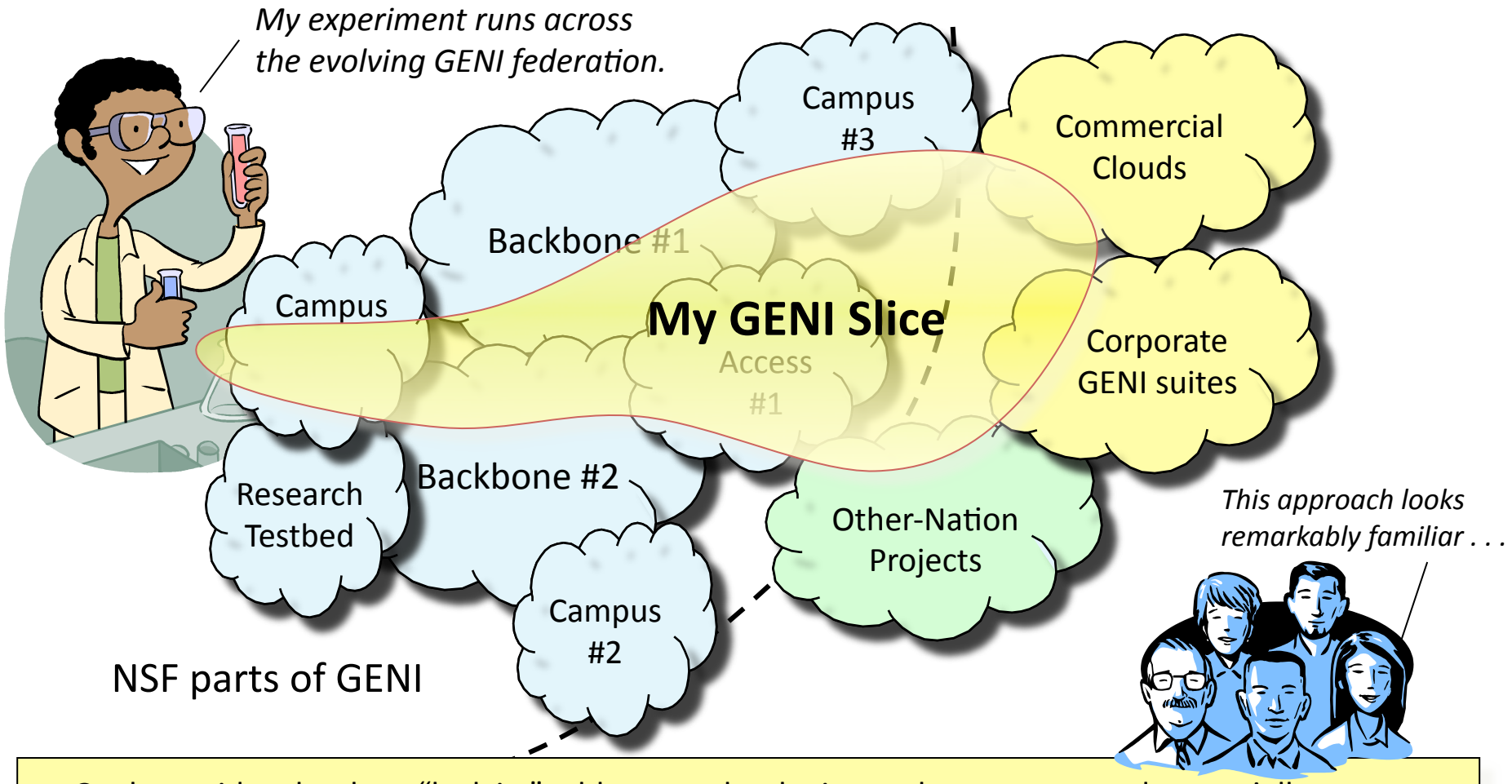
Install the software I want *throughout* my network slice
(into firewalls, routers, clouds, …)

And keep my slice isolated from your slice,
so we don't interfere with each other



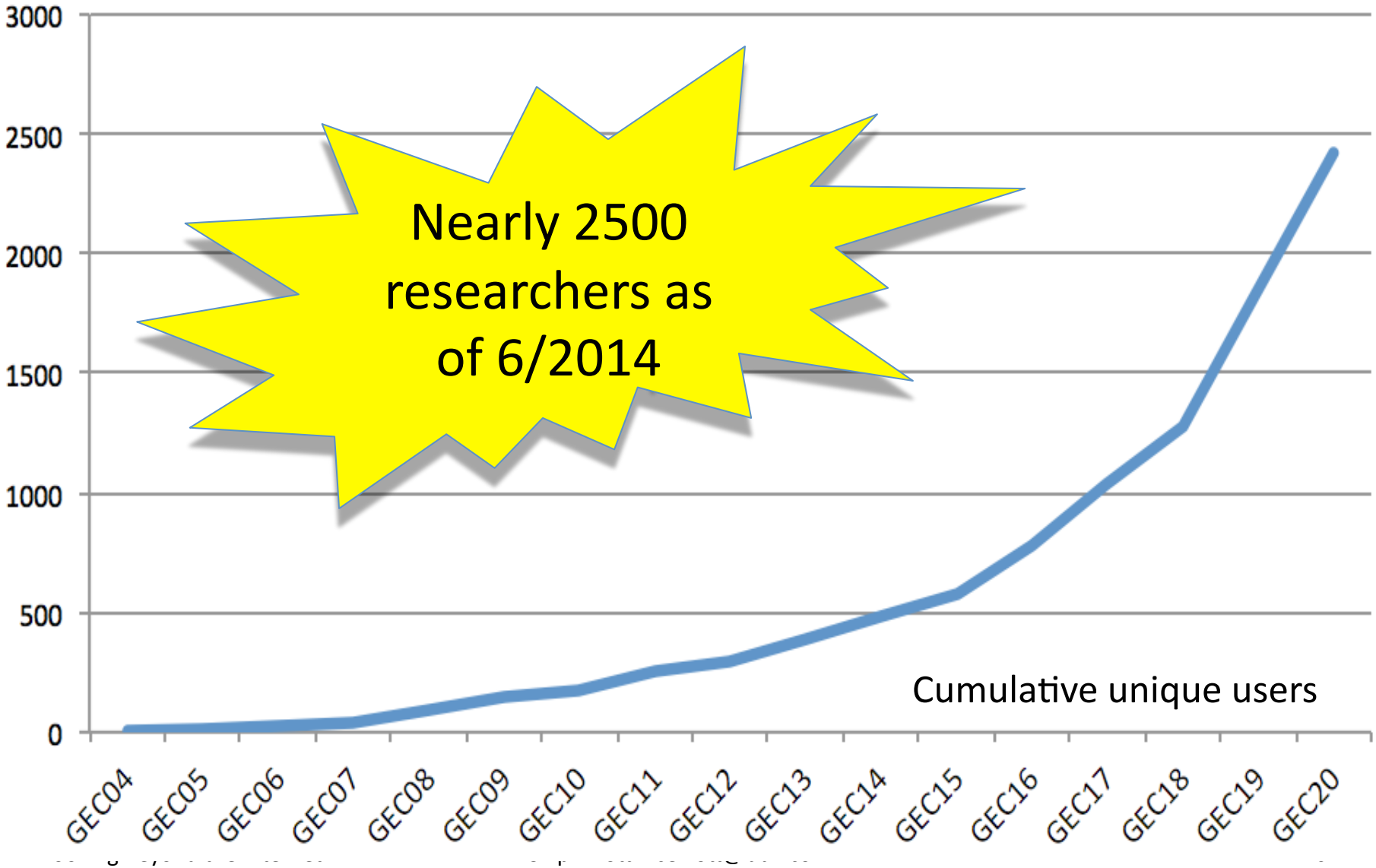
We can run many different "future internets" in parallel

Slices span many organizational boundaries

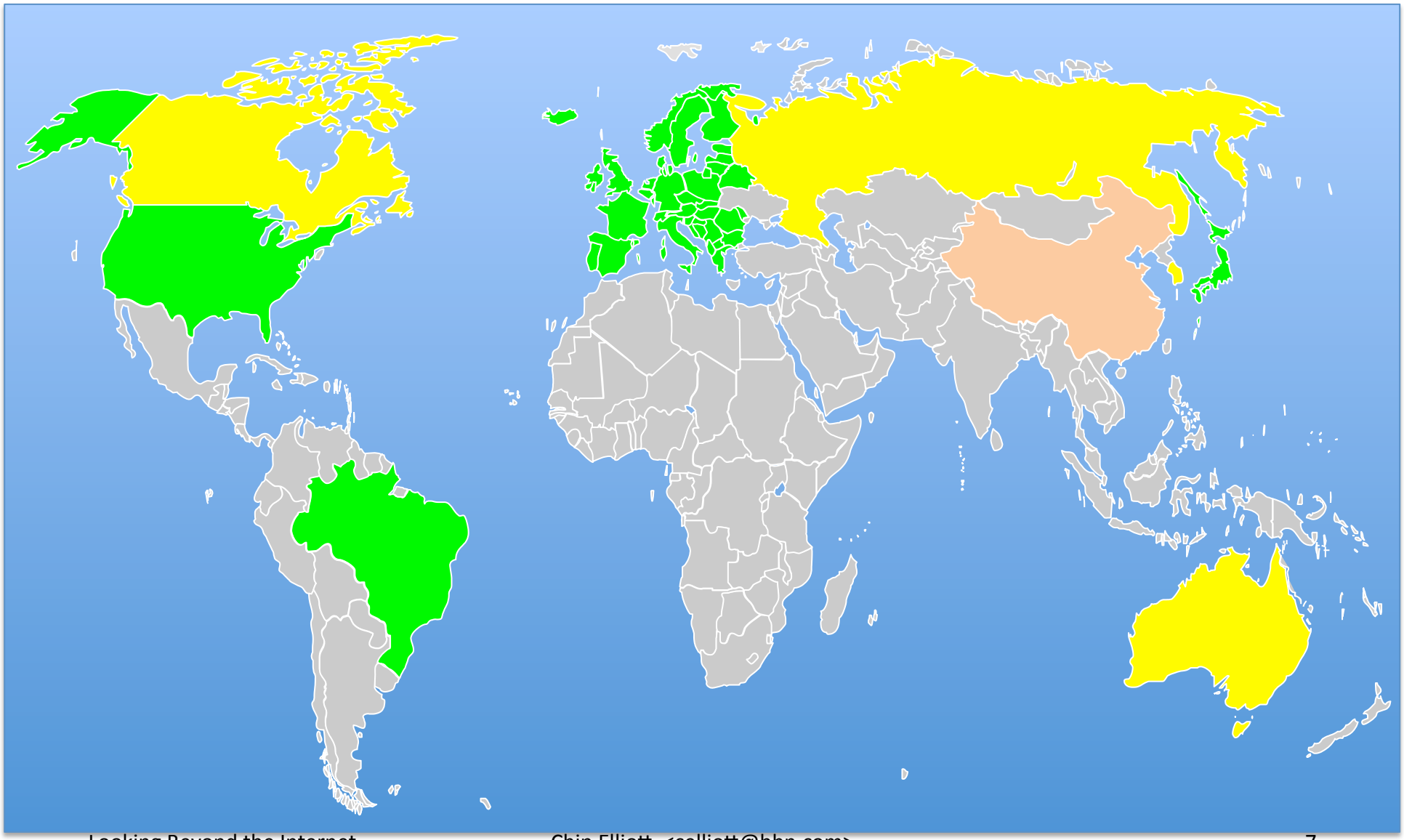


Goals: avoid technology "lock in," add new technologies as they mature, and potentially grow quickly by incorporating existing infrastructure into the overall "GENI ecosystem"

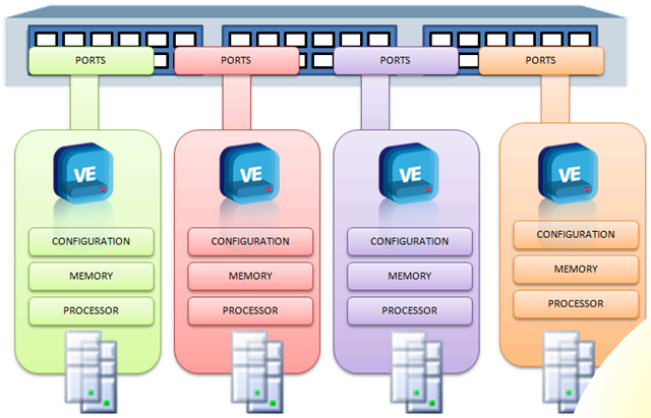
And it works! GENI is seeing heavy use



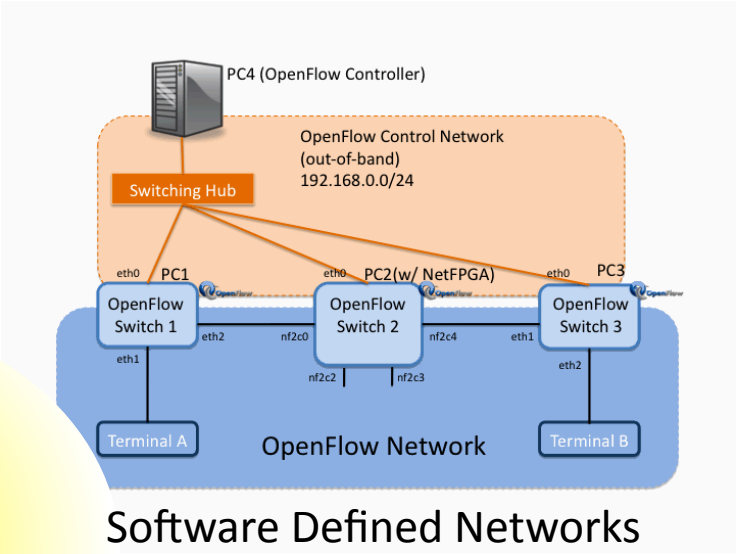
Macro-scale: the Rise of Global Interoperability



Major trends are converging

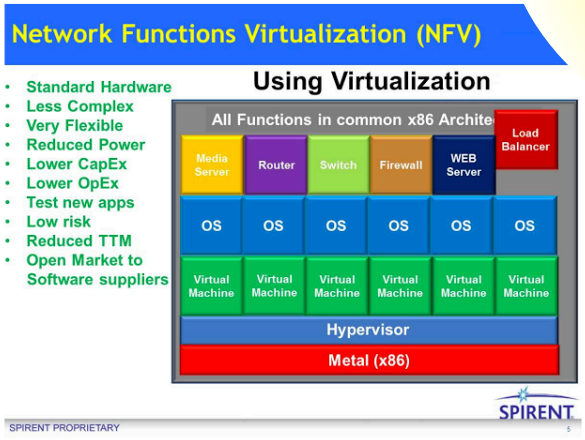


Multi-tenant Datacenters

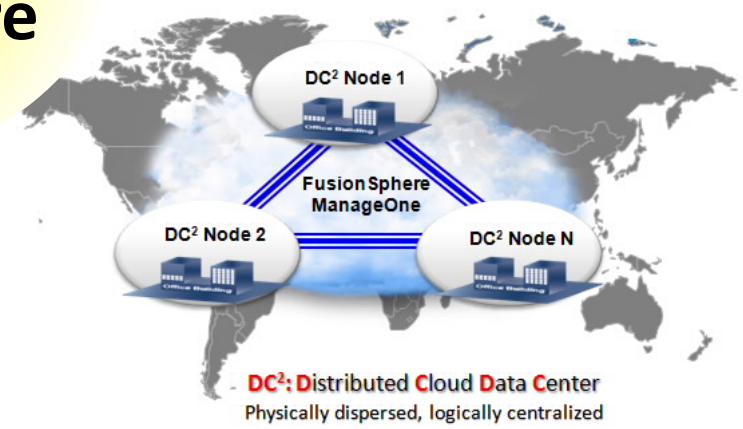


Software Defined Networks

Software Defined Infrastructure



Network Functions Virtualization (NFV)



Distributed Datacenters

Driving the transformation - A radical change in "router" economics

Economics now favor pervasive computation and storage

ARPANET Imp (1969)

1 core, clock ~ 1.1 MHz
64 Kbytes RAM
No disk

Today's cost: ~ $650,000

Commodity GENI rack

Each 1U=
32 cores, 2.1 GHz
16 Gbyte, 4 Tbyte

Today's cost: $200,000
for full rack (50 x 1U)

Disk + controller (IBM 1302)
Today's cost: ~ $2,545,000

Disks were too expensive in 1969

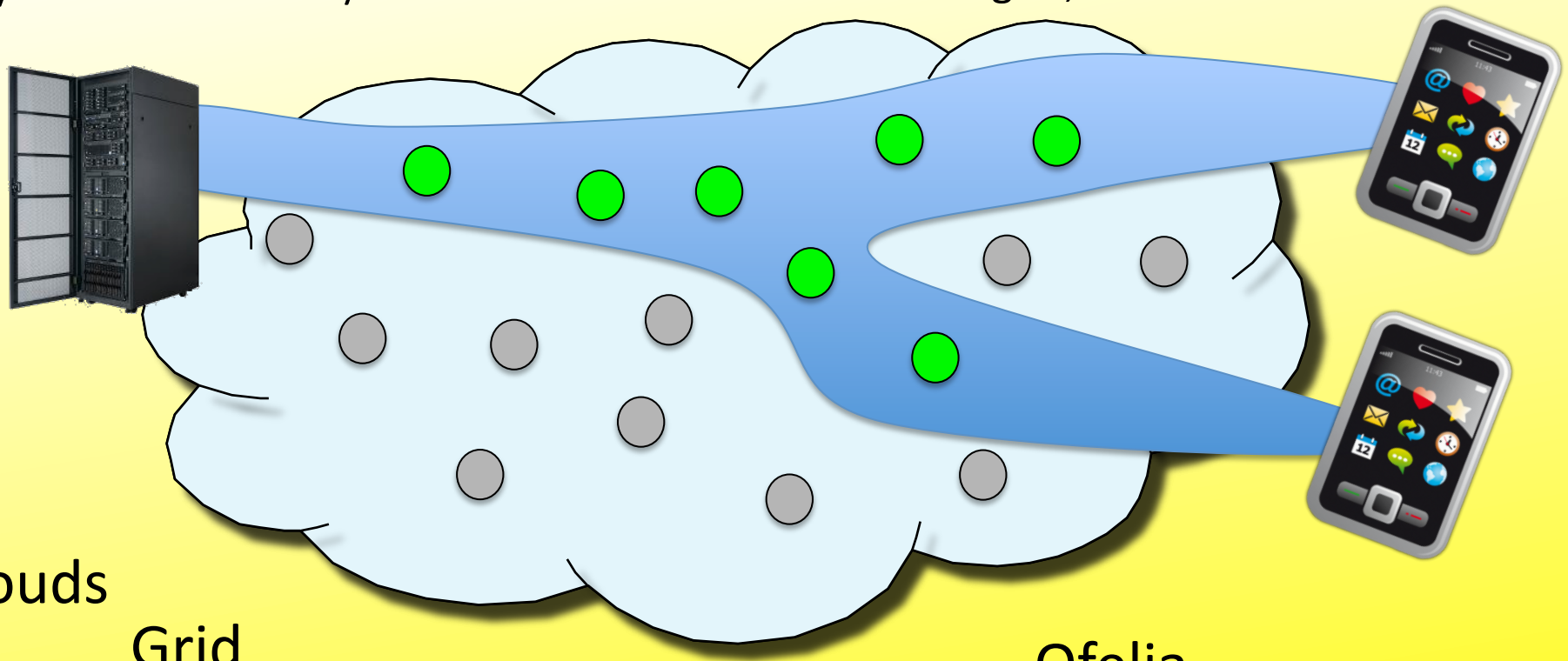
1/3 the IMP's price, but with 1500 cores and 200 Tbytes of local storage

Software Defined Infrastructure

We're all heading to the same place

Rapidly create entire "sliced" cyberinfrastructure / networks on demand

Fast spin new protocols, switching strategies, virtual machines



Clouds

Grid

Network functions virtualization

Software defined networks

Distributed Clouds

Vnode

Wivi

Ofelia

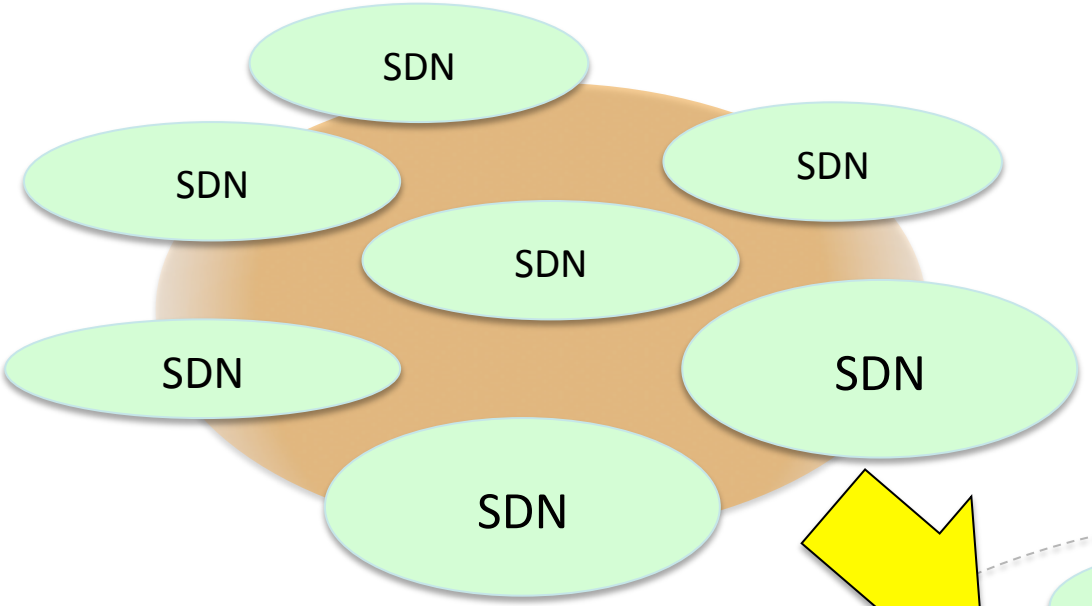
FLARE

US Ignite

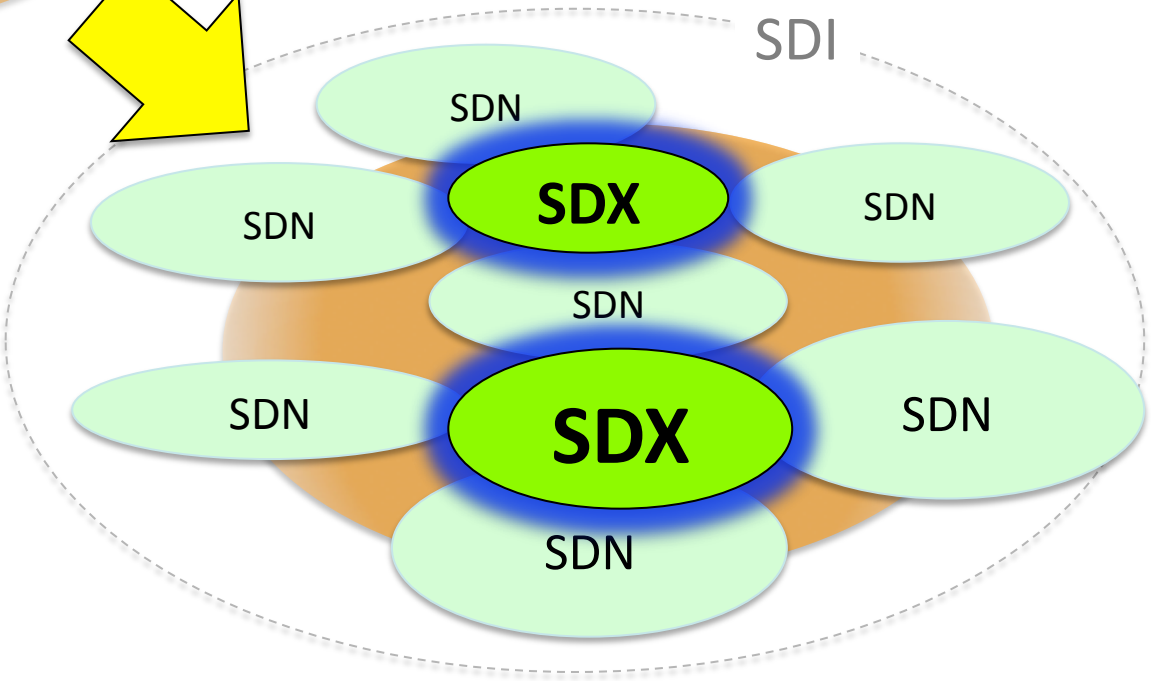
GENI

Taking the next step

Software Define Exchanges (SDXs)

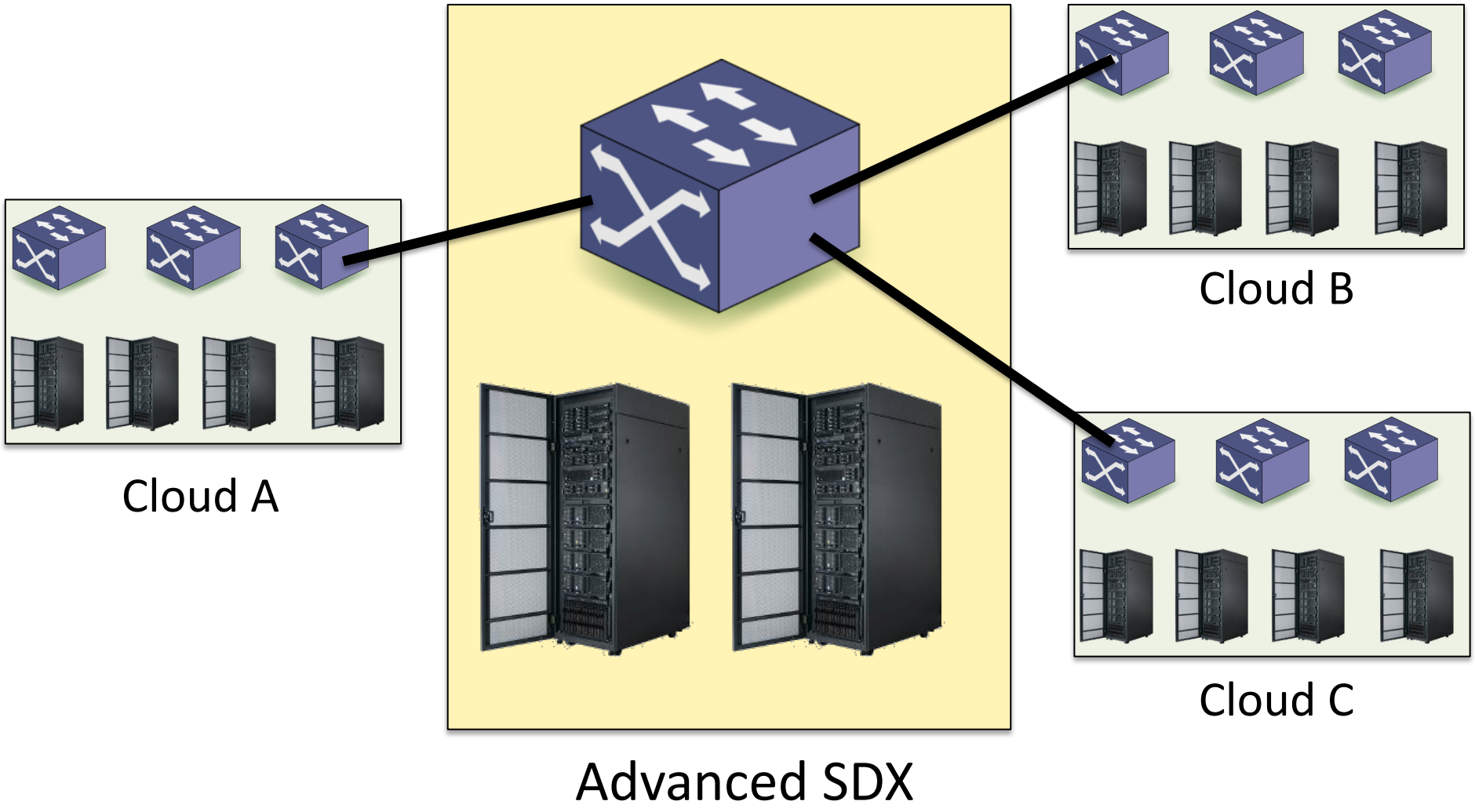


Today: "SDN islands"
GENI slices & VLAN stitching help point the way



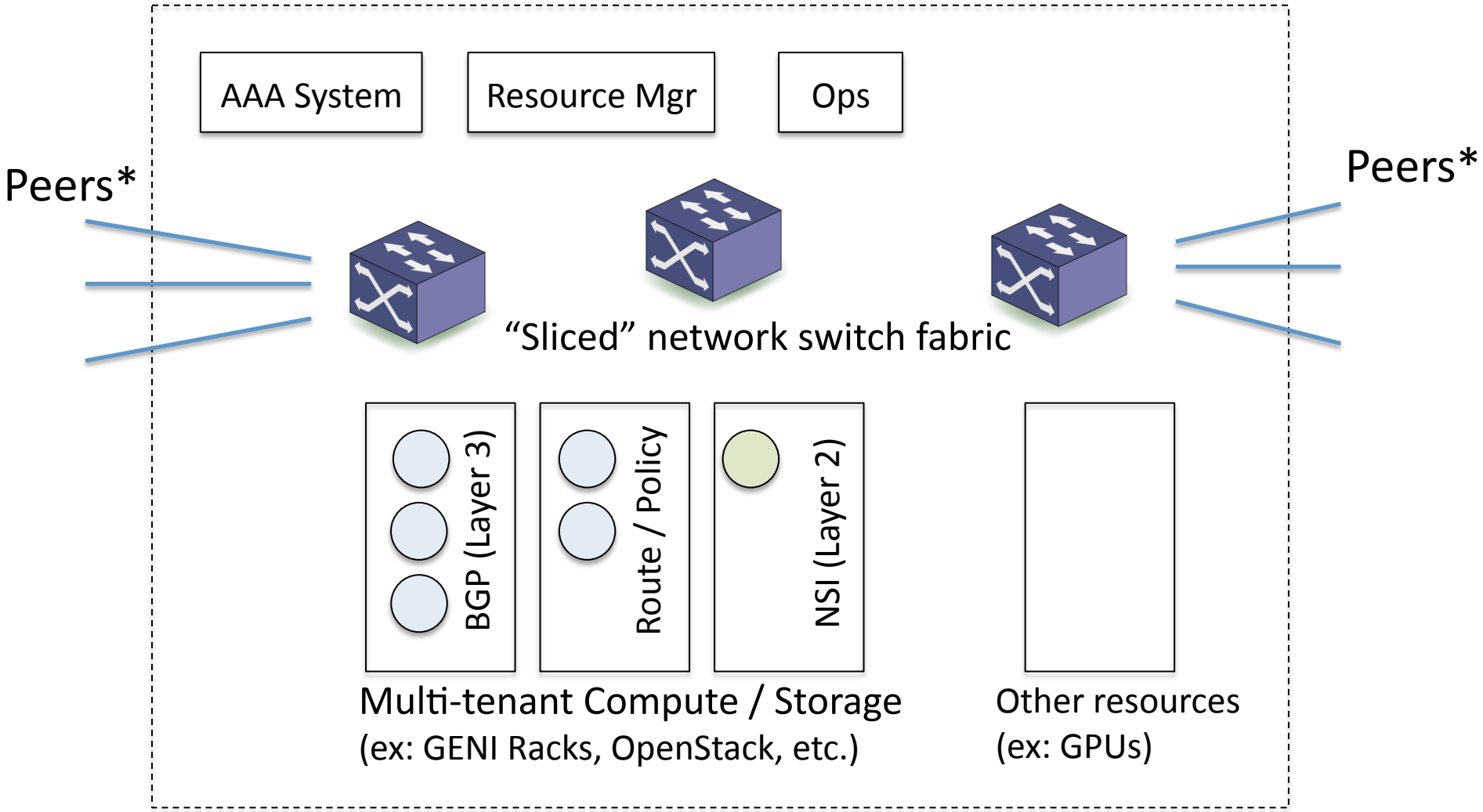
Next Step: Add SDX's
Build a "Rev 0" control plane, run native next-gen apps and scientific instruments **spanning multi-domain SDNs**

Crude SDX picture (net, compute, storage)



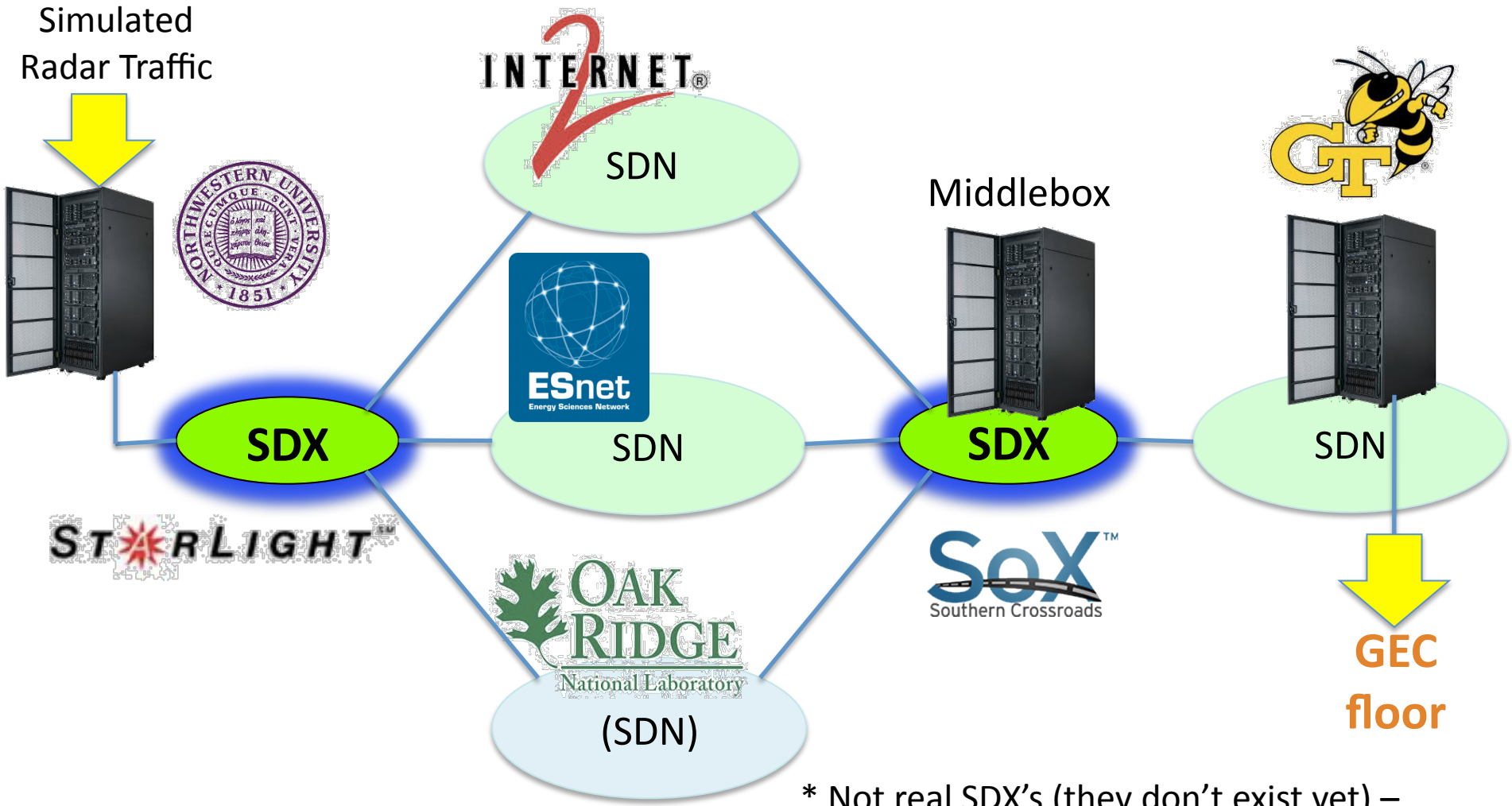
Notional SDX Schematic

Note that the SDX's equipment may be physical, virtual, or a mix



* Examples: Campuses, R&E nets, ISPs, Layer 2 networks, HPC, AWS, new SRPs, etc.

Concept demo* at GEC Atlanta



* Not real SDX's (they don't exist yet) – just illustrating the concept

Software Defined Infrastructure

Looking beyond the Internet

SDI apps

Good old Internet

SDI apps from many players

Sfotware Defined Infra.

Federated, authenticated control plane (software)

Multiple, federated sites with interconnected Software Defined Infrastructure

Conclusions

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