



---

# GPO Top-Down Context: End to End Slicing

Global Environment for Network Innovations

GENI Engineering Conference (GEC) 3

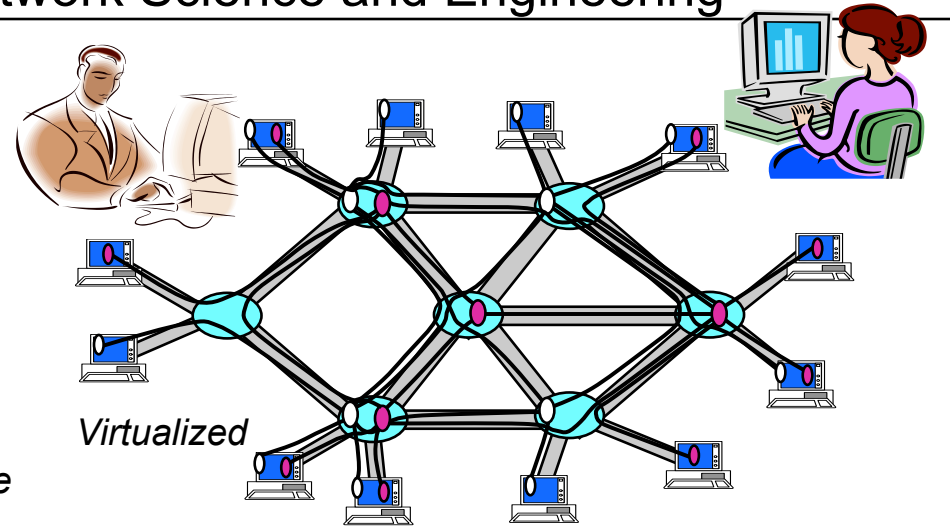
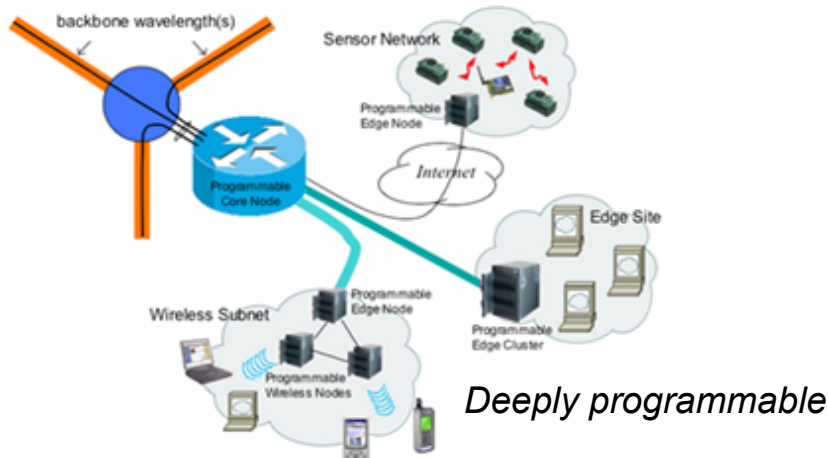
**[www.geni.net](http://www.geni.net)**

Clearing house for all GENI news and documents

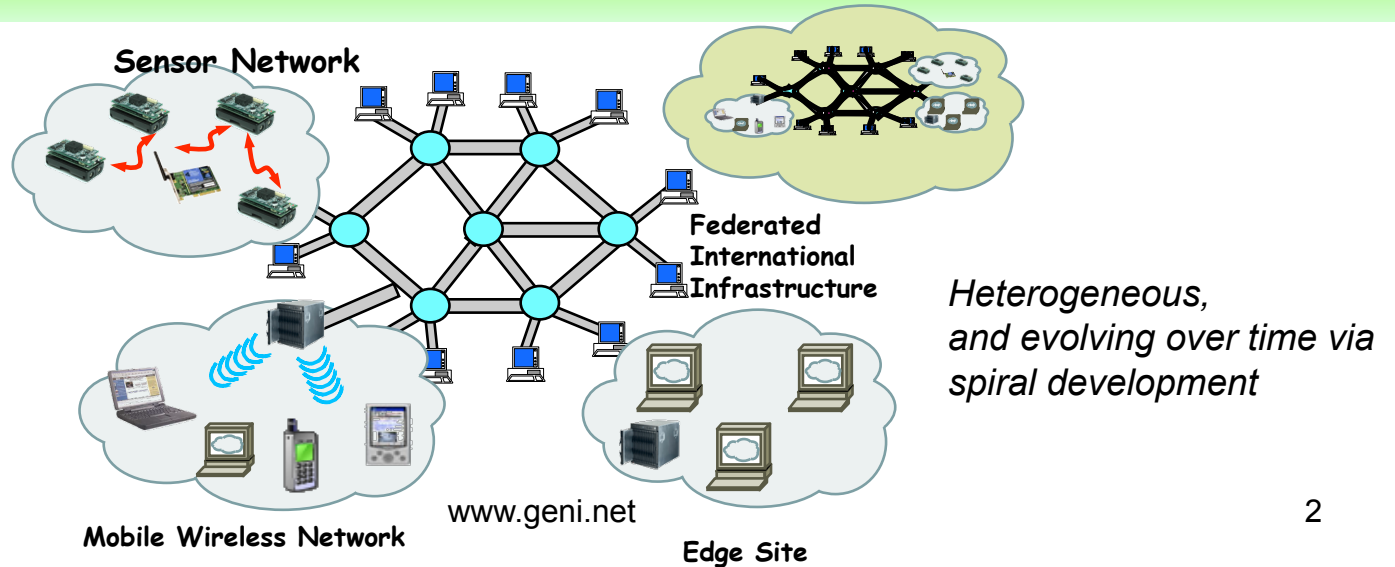


# The GENI Vision

A national-scale suite of infrastructure for long-running, realistic experiments in Network Science and Engineering



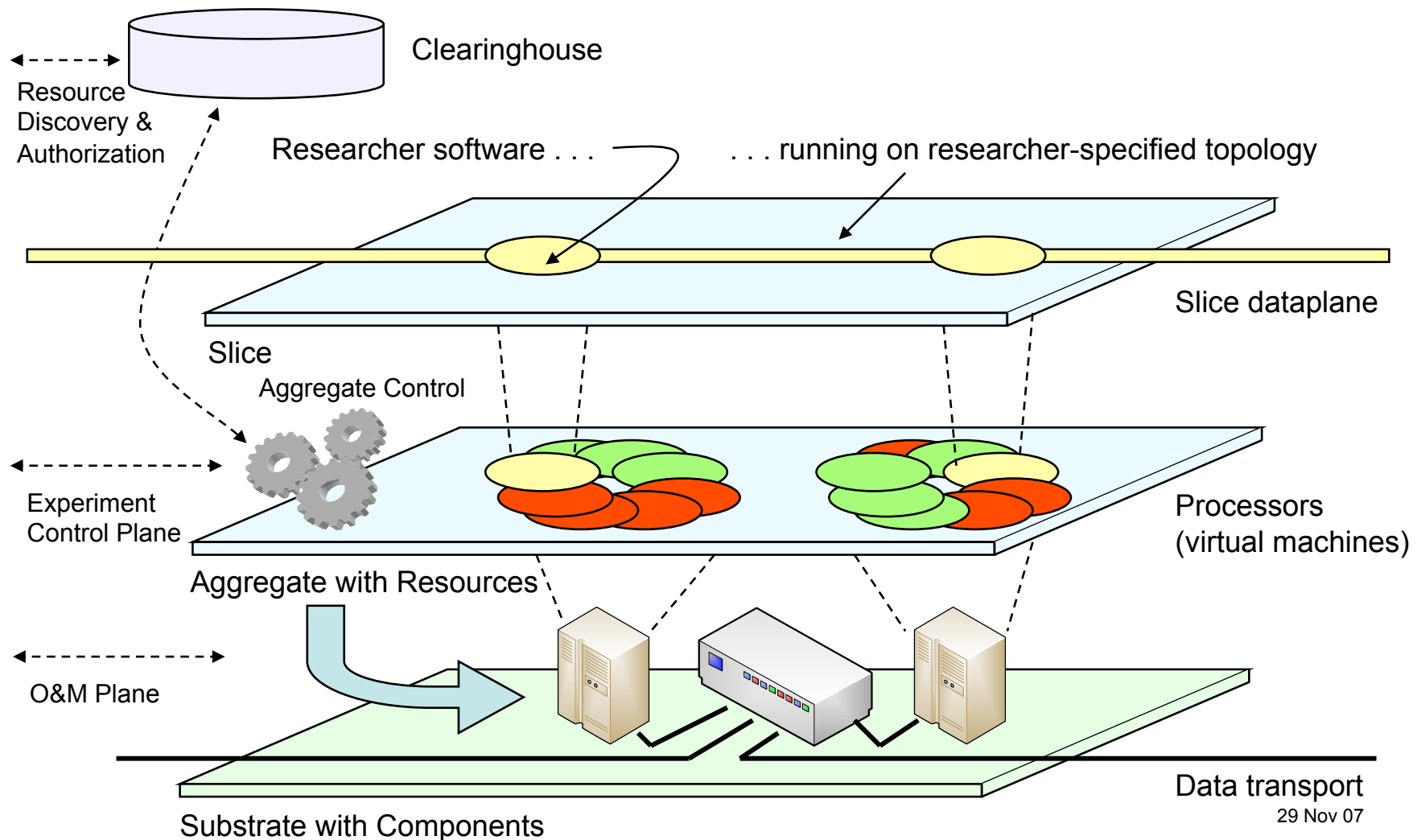
***Programmable & federated, with end-to-end virtualized "slices"***





# System overview (straw man)

Based on very large-scale, end-to-end virtualization



29 Nov 07



## End-to-End Slicing in GENI Spiral 1: Why?

---

- Gain experience with prototype clearinghouses and aggregates in GENI end-to-end networks to better understand requirements and design
- Support some network experiments that don't use IP
- The 29 teams in 5 clusters need working prototype data, control, and experiment plane(s) in **6-12 months** – focus on end-to-end connections *within* control clusters.
- Spiral 1 end-to-end prototypes are *not* the final GENI solution — they will change as GENI evolves and we learn more about how researchers use end-to-end slicing in a live network. These slides show discussion straw men.
- Don't panic! Projects can start with existing IP connections and add in "native GENI" connections as they become available. Some projects may never need "native GENI" end to end.



## End-to-End Slicing in GENI Spiral 1: How?

---

- Clearinghouses for each framework facilitate GENI resource slicing ("vertical" slices)
- End-to-End slicing connects resources in each slice via the experimental plane ("horizontal" slices)
- Ideally experiment plane supports programmability, virtual topologies and isolation of resources allocated to each slice ("native GENI")
- Spiral 1 data plane that supports experimental plane will usually combine GENI-programmable and more static procedure-based steps for creating experimental plane connections



## End-to-End Slicing in GENI Spiral 1—IP protocol connections

---

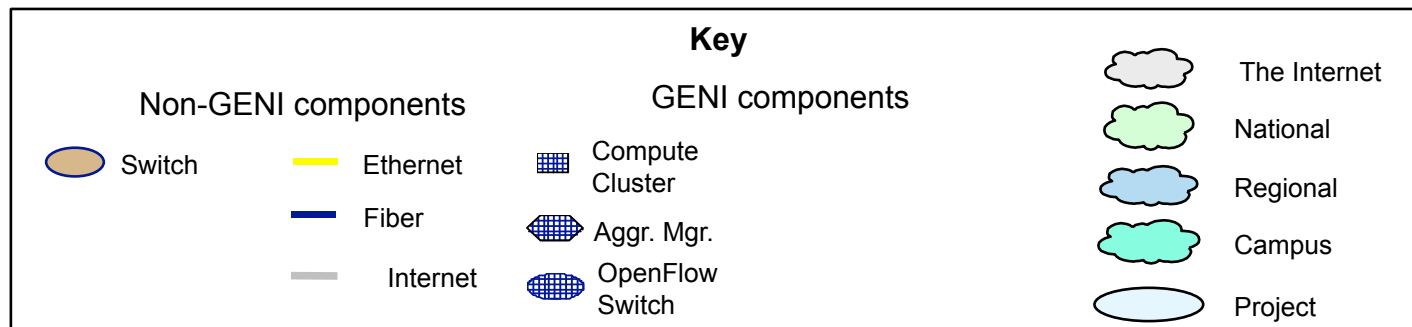
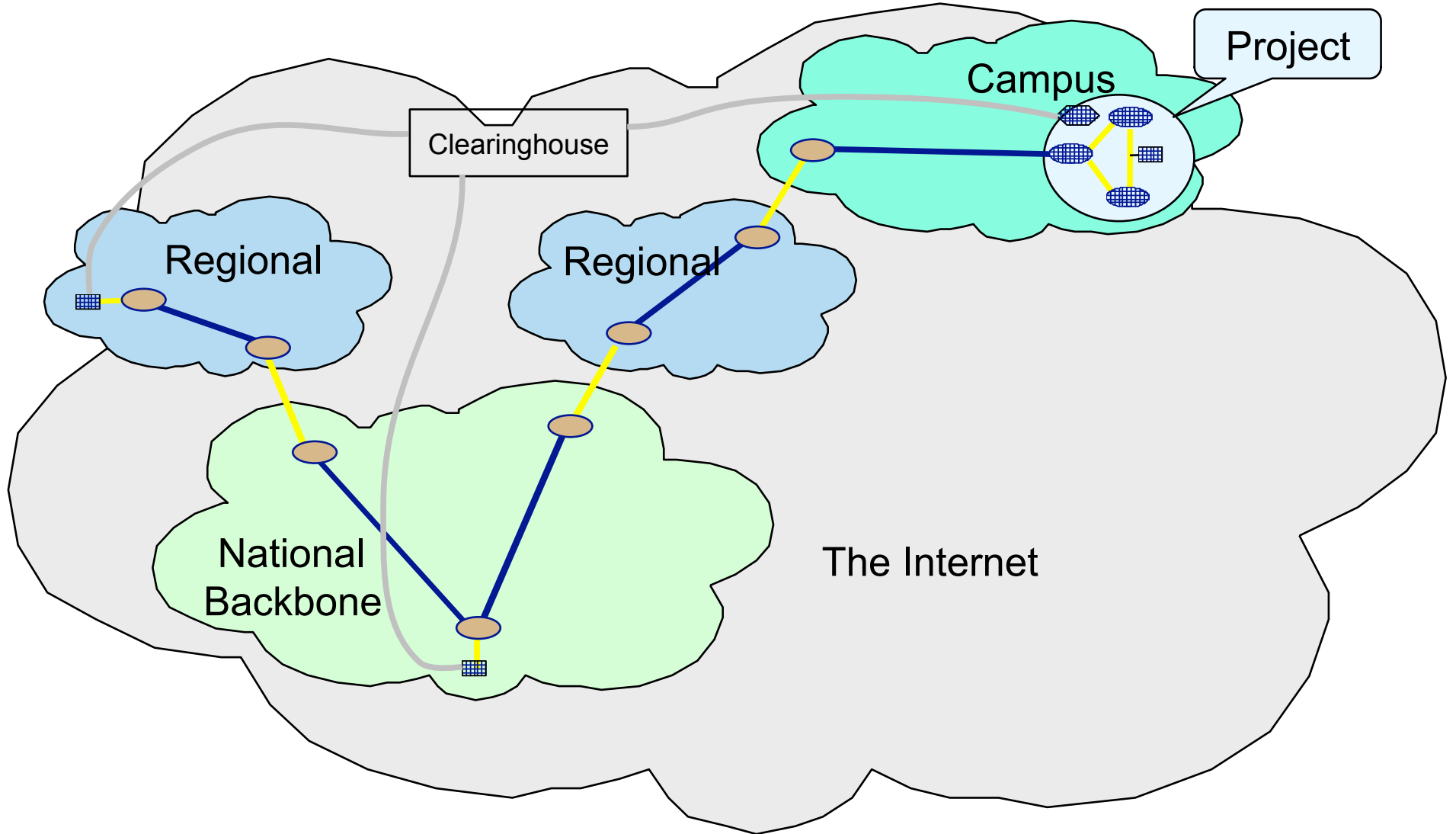
- Used for all control plane connections
- Used by some experiments or parts of experiments in both short and long term. (example: Vehicular Mobile Net)
- Allows early cluster connections and debugging (e.g. component manager interface to clearinghouse) (example: CMU Testbeds)
- May require careful engineering of routes and peering for some prototypes (GPO system engineers and projects working jointly on this.)
- Campus/enterprise, regional, and national backbone network and security engineers cooperating on prototypes
- Engineers will use GENI wiki/TRAC tickets to keep GENI community informed



## End-to-End Slicing in GENI Spiral 1—non-IP protocol connections via L2 Ethernet

---

- NRL and I2 can both support multiple 1 GbE virtual Ethernets (L2 Ethernets) for GENI in their backbones. Can also support higher bandwidths in many cases. There will be multiple virtual Ethernets (not just one full mesh.) examples: Overlay Hosting and ProtoGENI nodes.
- Spiral 1 projects already access regional networks with fiber and Ethernet switches that could support configured GENI VLANS between campus/enterprise nets and I2 or NLR. There will be multiple virtual Ethernets.
- Enterprises/Campuses already provide static Ethernet connections between regionals and labs "outside" the campus/enterprise production network. Could support configured GENI project VLANS to "outside" labs.
- Enterprises/Campuses that participate in "Enterprise GENI" project (using OpenFlow), could support more dynamic VLAN connections that experiments manage "inside" the campus, while still protecting production networks. (example: Stanford)



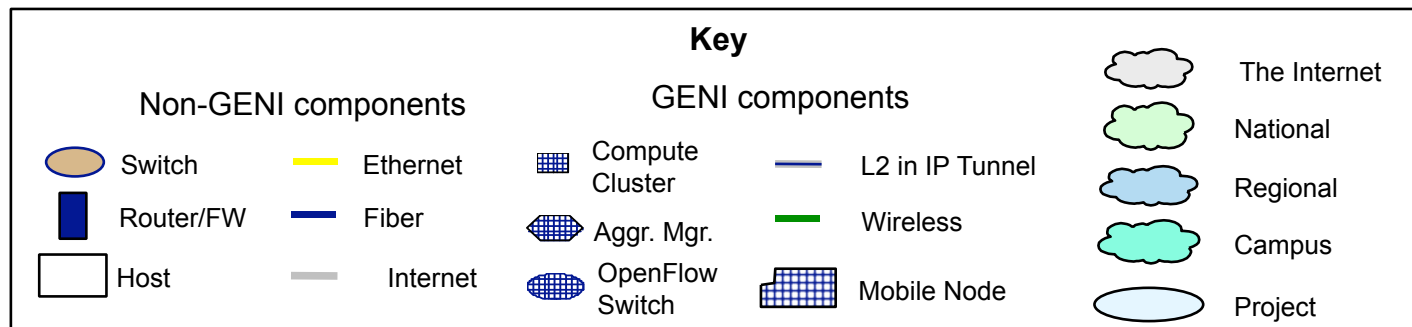
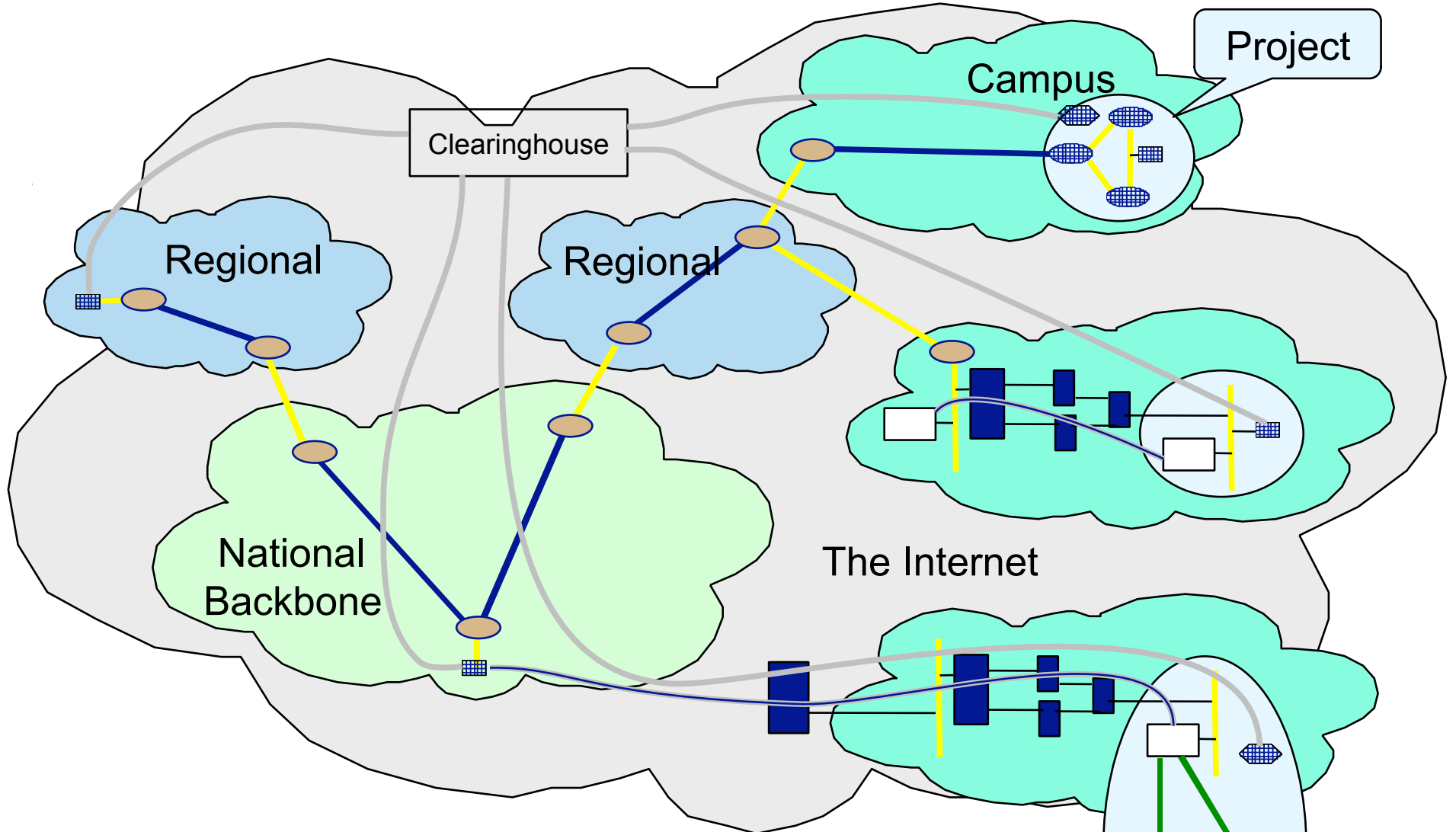




## End-to-End Slicing in GENI Spiral 1—mixed protocol connections

---

- Combine IP and non-IP sections in an end-to-end GENI connection
  - Required for some kinds of long-term experiments (e.g. Internet clients on public Internet accessing GENI resources that aren't using IP)
  - Good for combining early prototypes where end-to-end virtual Ethernets aren't possible or desirable
  - L2 in IP tunnels or IP-in-IP tunnels, many possibilities
  - Wireless, sensor, mobile network possibilities (example: ORCA/BEN)





## End-to-End Slicing: What do I do now?

---

- Discuss your site/equipment connections with your GENI system engineer. (Regionals and backbones are coordinating with system engineers—you can save some time.)
- Discuss specific connections you need for prototype to work with others in your control cluster (bandwidth, endpoints, etc.)
- Keep connections as simple as possible for initial experiments/demonstrations, so they can be provisioned quickly and give you maximum time to integrate with a working end-to-end experiment plane
- Use the Spiral 1 wiki/tickets to record and track your connection requirements, including schedules for when you'd like to start integrating on each type of connection.
- Follow the control and OMIS working group mailing lists.
- Share your results in working groups and at GECs , as the following 4 projects are doing.