geni
Exploring Networks of the Future

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www.geni.net

Sponsored by the National Science Foundation

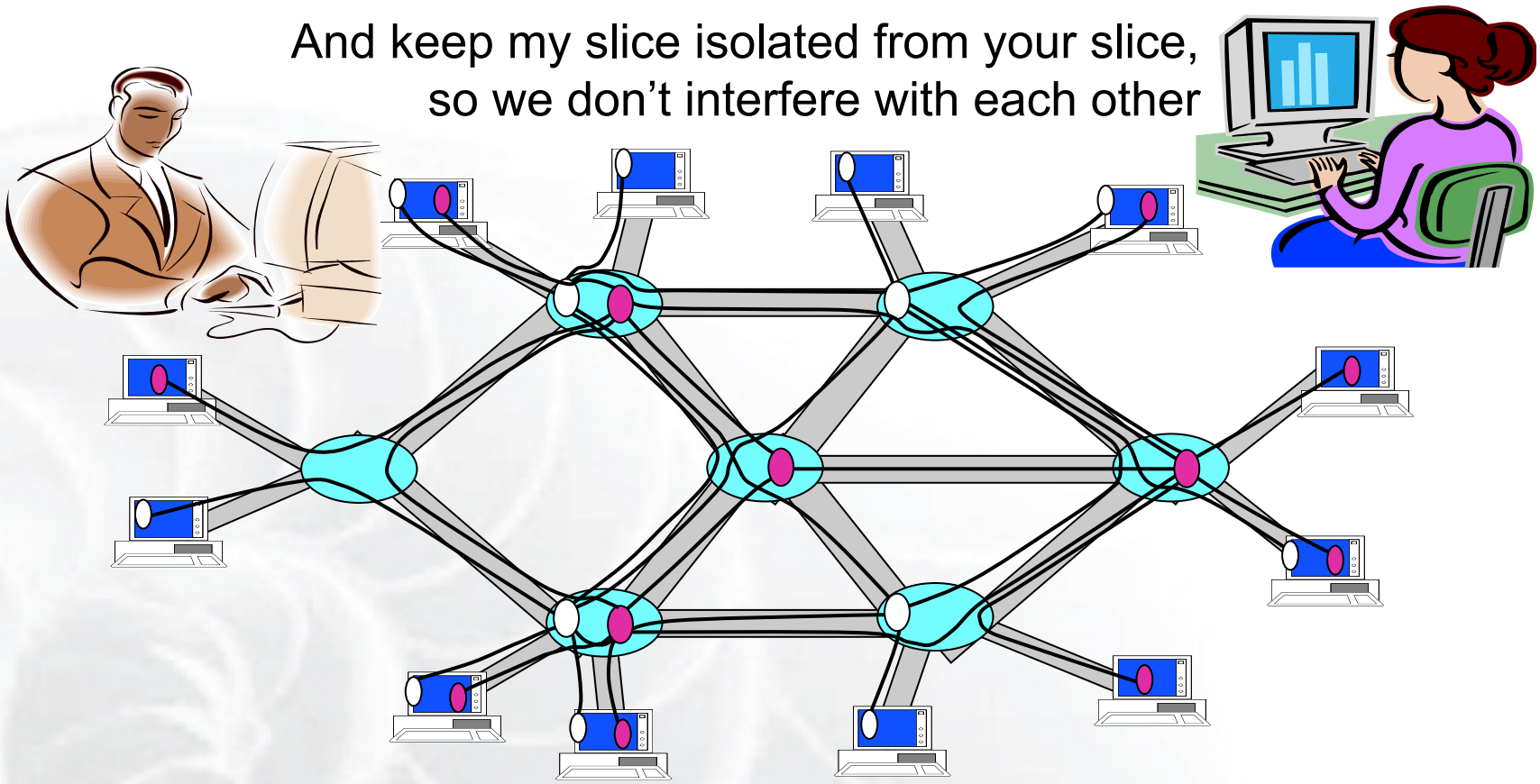
What is GENI?

- GENI is a nationwide suite of infrastructure for **"at scale"** experiments in networking, distributed systems, security, and novel applications.
- GENI opens up huge new opportunities
  - **Leading-edge research** in next-generation internets
  - **Rapid innovation** in novel, large-scale applications
- Key GENI concept: slices & deep programmability
  - Internet: open innovation in application programs
  - GENI: open innovation deep into the network

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

Opt-In Users

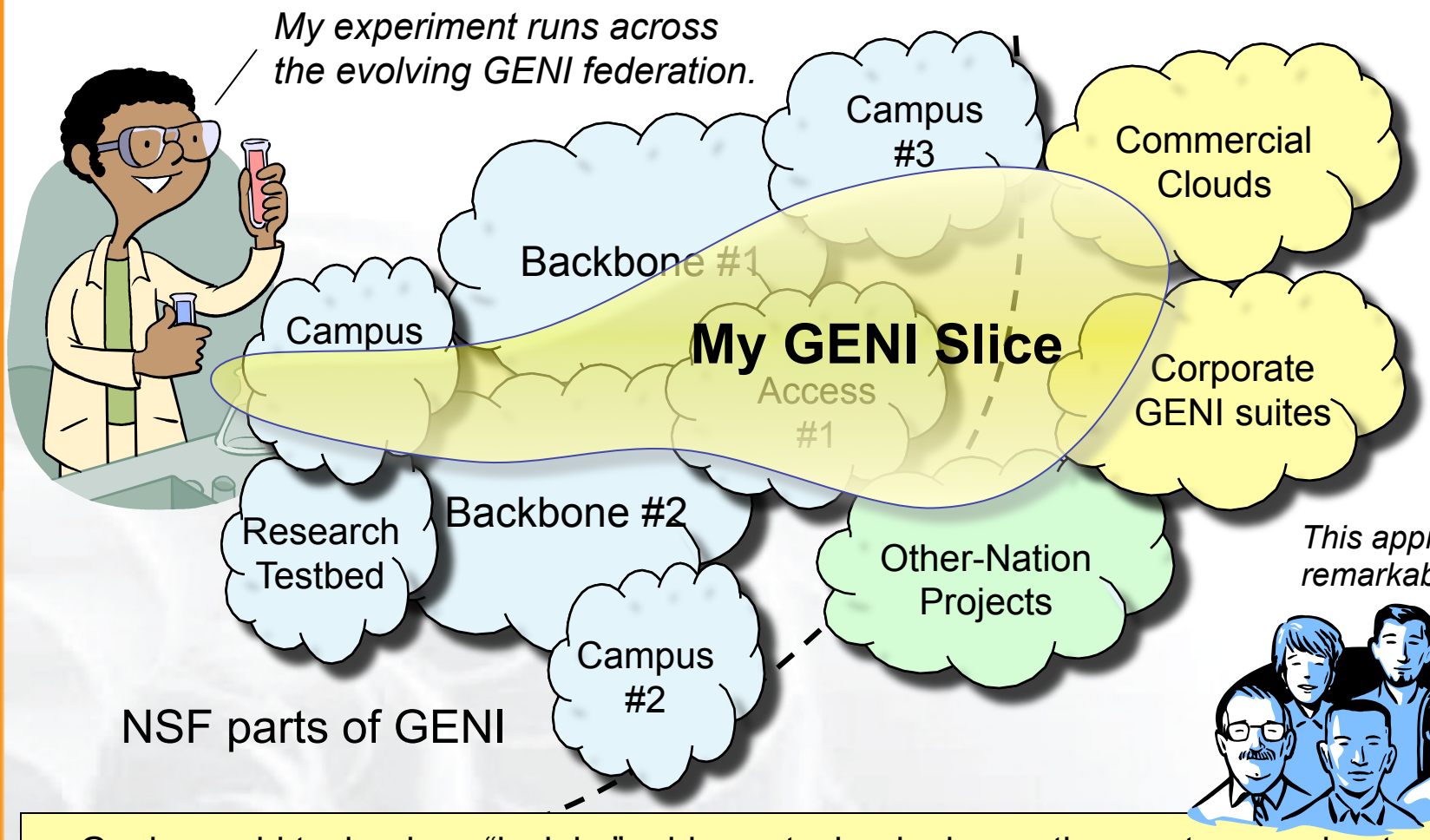
- People signed up to participate in a GENI experiment or use a GENI service
  - They may not even be aware the experimental service they are using is running on GENI
- Experimenters using opt-in users are responsible for determining if they need IRB approval

GENI is Meant to Enable…

- **At-scale experiments**, which may or may not be compatible with today's Internet
- **Both repeatable and "in the wild" experiments**
- '**Opt in' for real users** into long-running experiments
- Excellent **instrumentation and measurement** tools
- **Large-scale growth for successful experiments**, so good ideas can be shaken down at scale

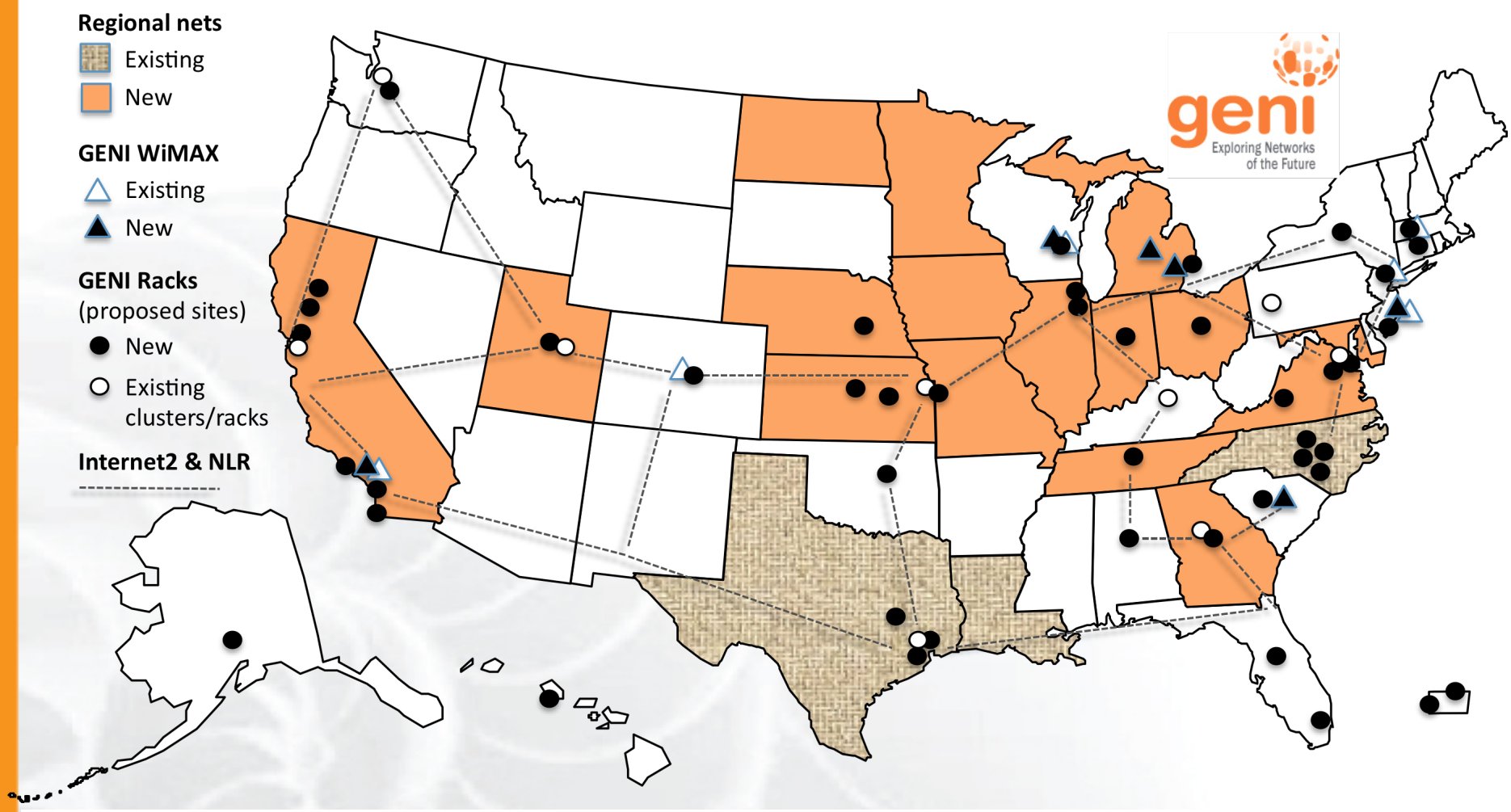
Federation

GENI grows by "GENI-enabling" heterogeneous infrastructure



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

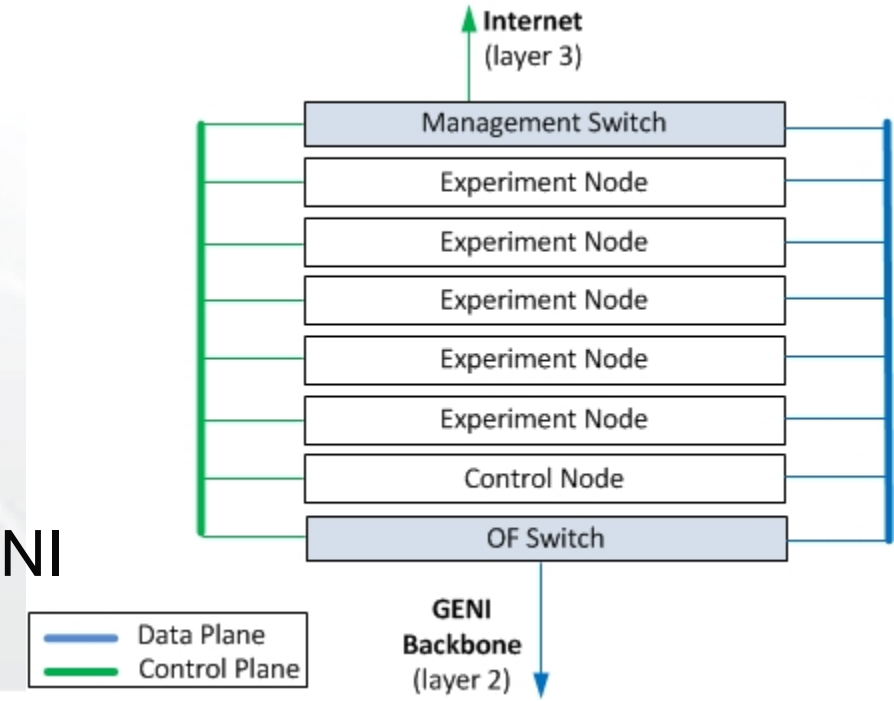
Growing GENI's footprint



(as proposed; actual footprint to be engineered)

Current efforts in GENI buildout

- More **WiMAX base stations** with Android handsets
- GENI-enable 5-6 **regional networks**
- Inject more **OpenFlow switches** into Internet2 and NLR
- Add **GENI Racks** to 40+locations within campuses, regionals, and backbone networks
  - Two types of racks: ExoGENI and InstaGENI

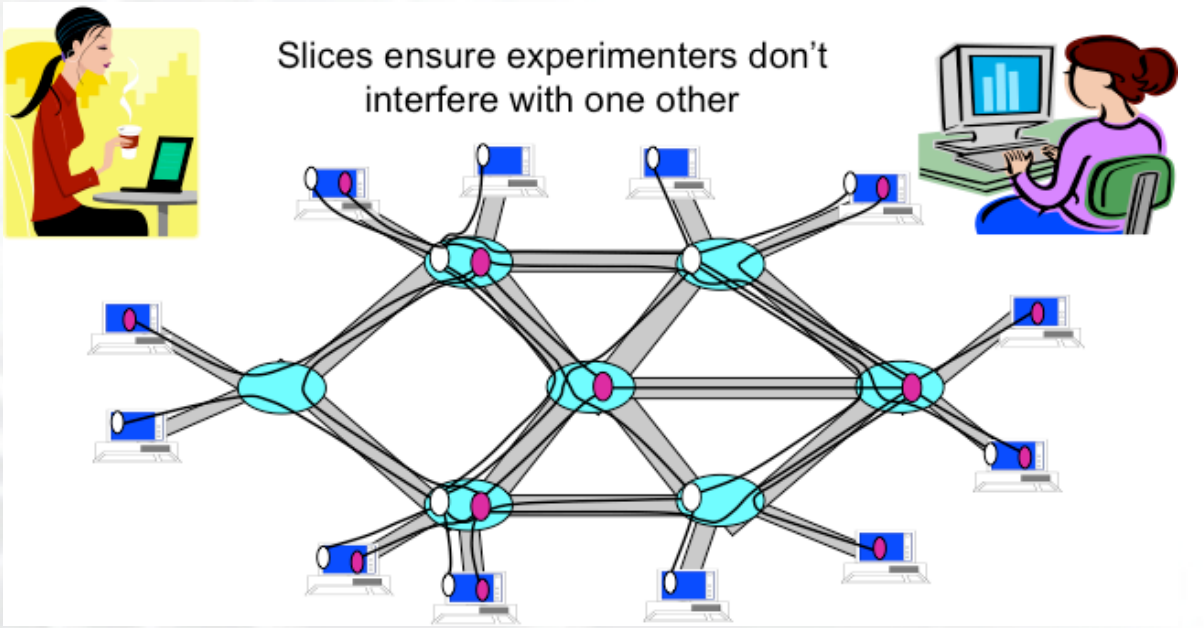


GENI Instrumentation & Measurement

- Two large I&M system development projects underway
  - GEMINI & GIMI
- Both systems support active and passive measurements

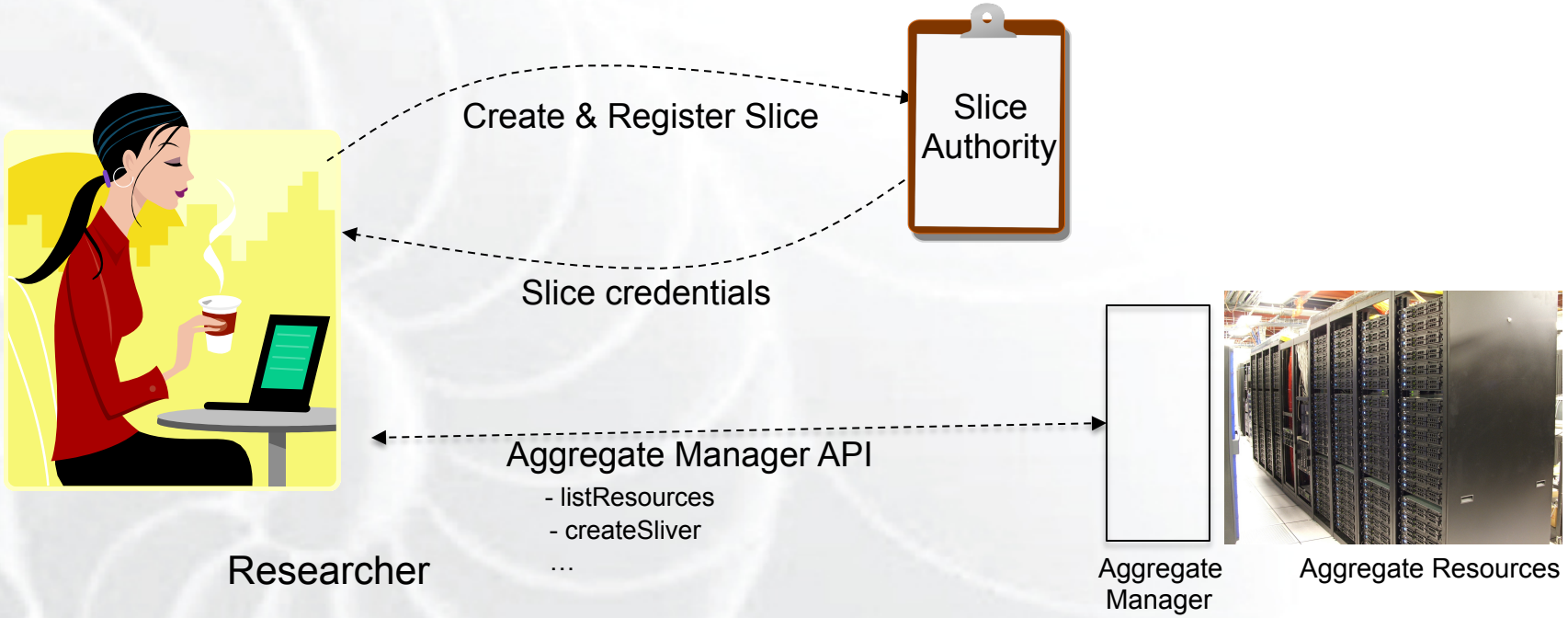
GENI: Terms and Definitions

- Slice: Abstraction for a collection of resources capable of running experiments
  - An experiment uses resources in a slice
  - Slices isolate experiments
  - Experimenters are responsible for their slices



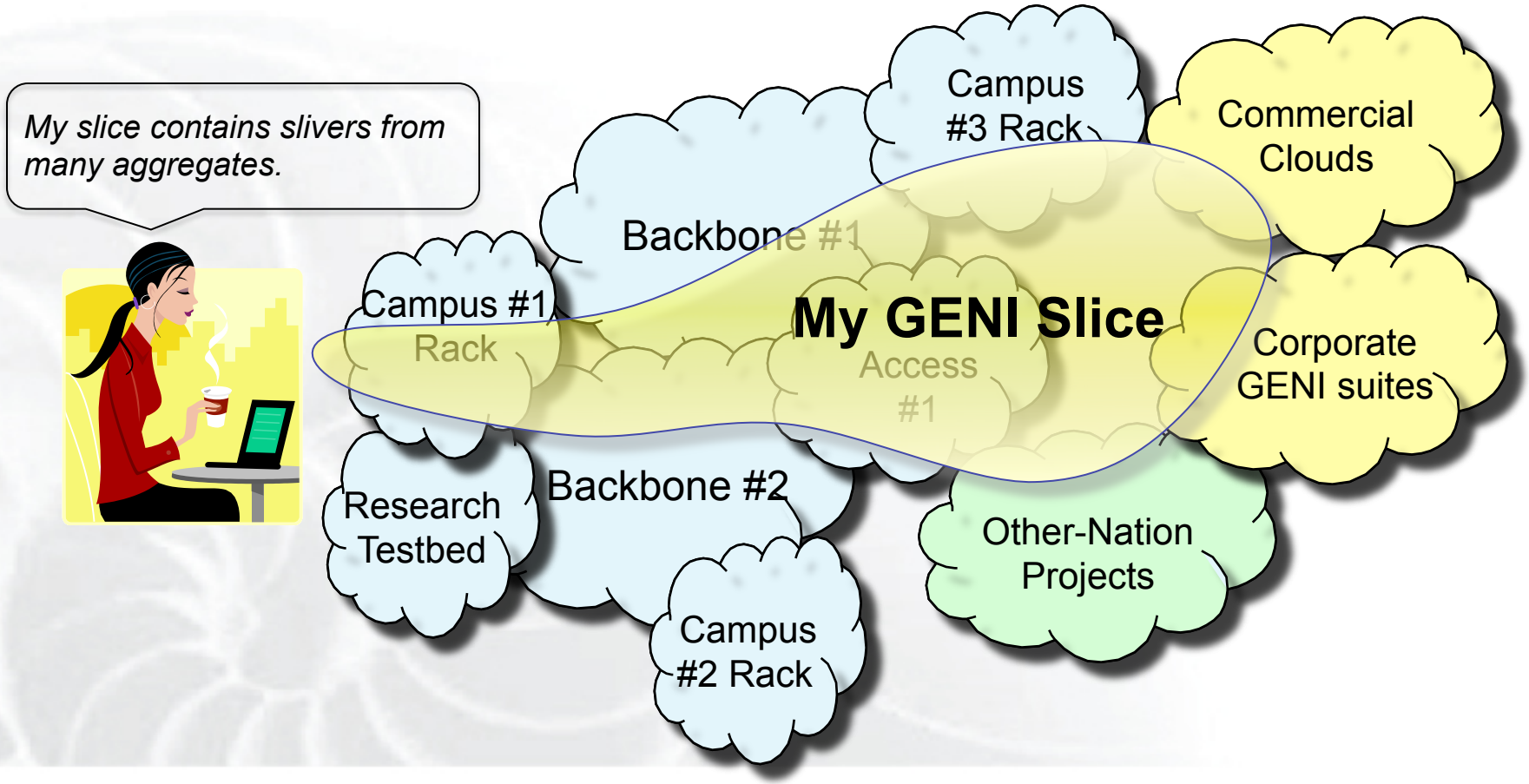
GENI: Terms and Definitions

- Slice authority: Creates and registers slices
  - GENI slice authorities: PlanetLab, ProtoGENI, GPO Lab
- Aggregate: Provides resources to GENI experimenters
  - Typically owned and managed by an organization
  - Examples: PlanetLab, Emulab, GENI Rack on various campuses
  - Aggregates implement the GENI AM API



GENI: Terms and Definitions

- Sliver: One or more resources provided by an aggregate
  - E.g. Bare machines, virtual machines, VLANs



RSpecs

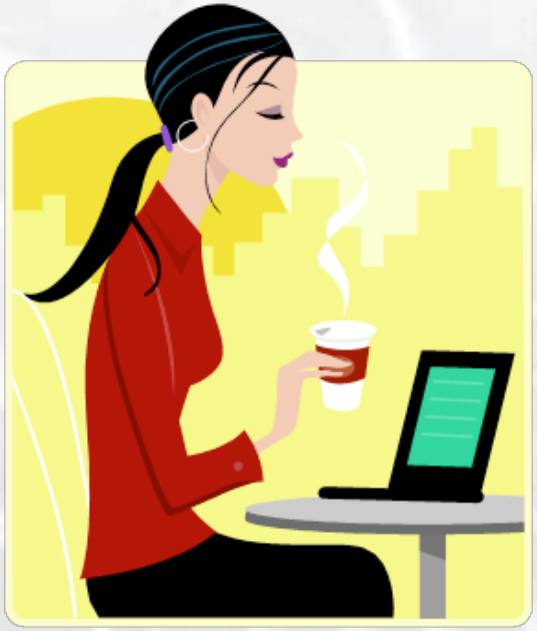
- RSpecs: Lingua franca for describing and requesting resources
  - "Machine language" for negotiating resources between experiment and aggregate
  - Experimenter tools eliminate the need for most experimenters to write or read RSpec

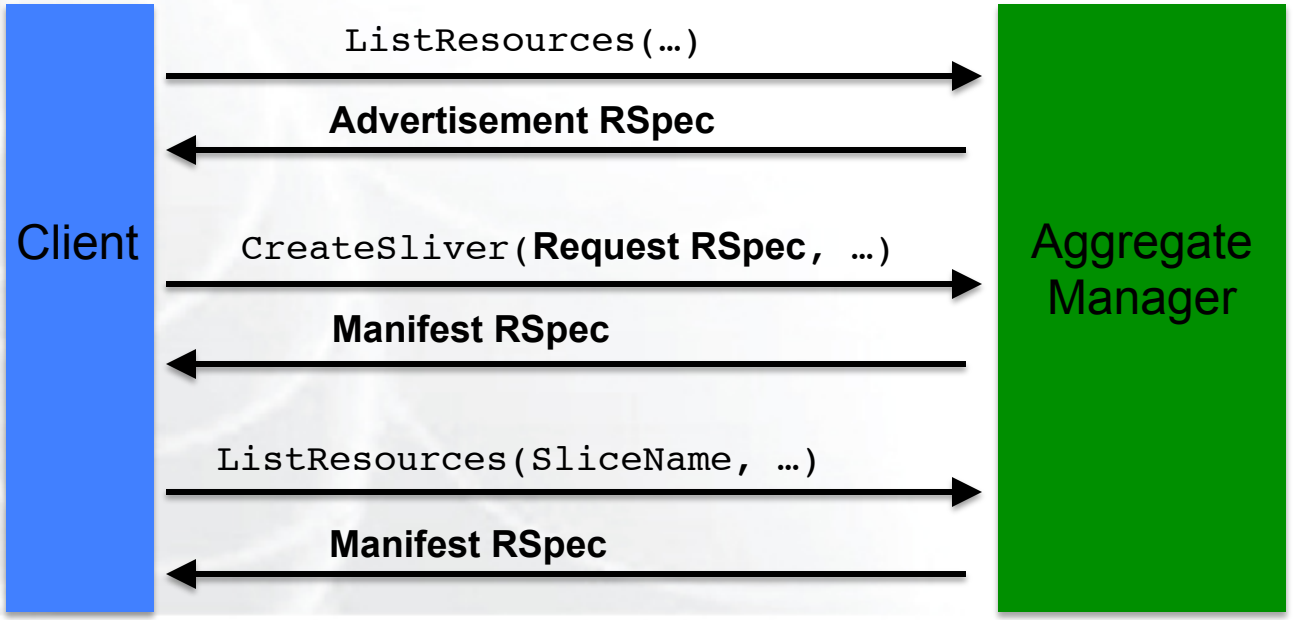
```
<?xml version="1.0" encoding="UTF-8"?>
<rspec xmlns="http://www.protogeni.net/resources/rspec/2"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.protogeni.net/resources/rspec/2
                           http://www.protogeni.net/resources/rspec/2/request.xsd"
       type="request" >
  <node client_id="my-node"
        exclusive="true">
    <sliver_type name="raw-pc" />
  </node>
</rspec>
```

RSpec for requesting a single node

Sliver Creation using Rspecs and the AM API

- Advertisement RSpec: What does an aggregate have?
- Request RSpec: What does the experimenter want?
- Manifest RSpec: What does the experimenter have?





GENI Status

- Most of the the key GENI features are in place and are being used
- There are however issues that need addressing
  - Ease of use
  - Difficulty setting up and keeping alive a large experiment or a long-running experiment
  - Insufficient documentation / training material
  - Contention for resources