

# Adding Traffic Control to your GENI Slice with BGP Mux

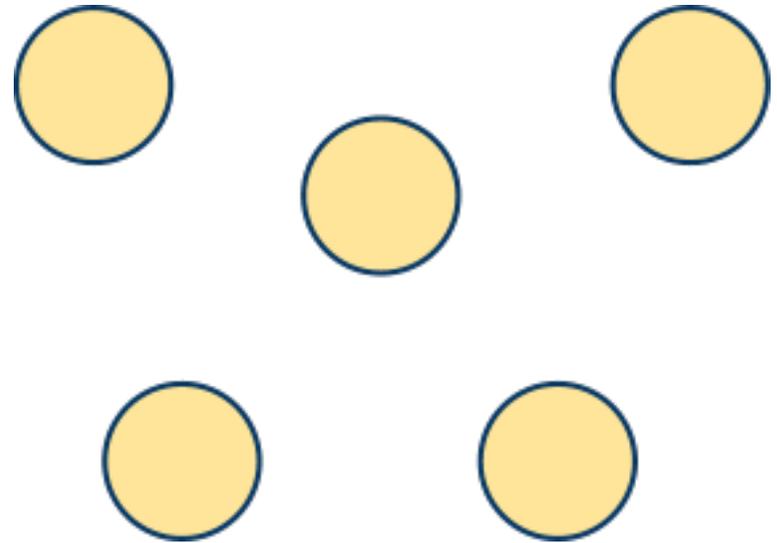
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Vytautas Valancius, Ethan Katz-Bassett,  
Nick Feamster, and Jennifer Rexford

# Your GENI Experiment

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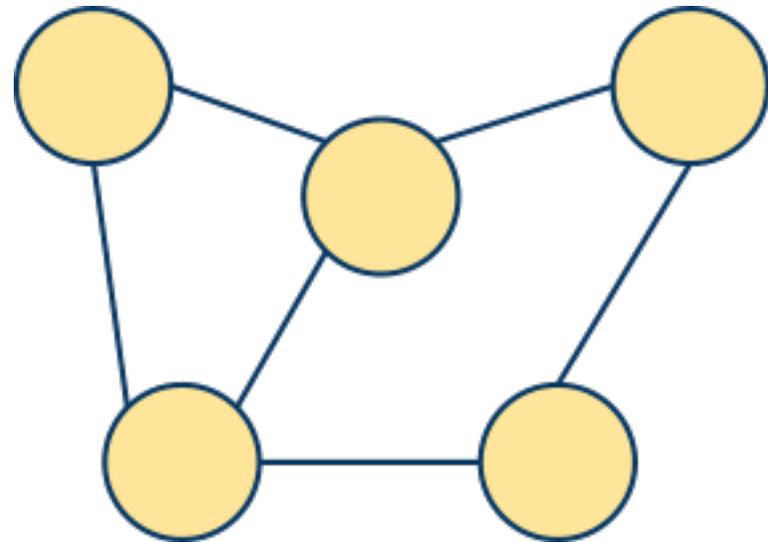
- Nodes
  - Virtual and physical
  - Generic and custom hardware



# Your GENI Experiment

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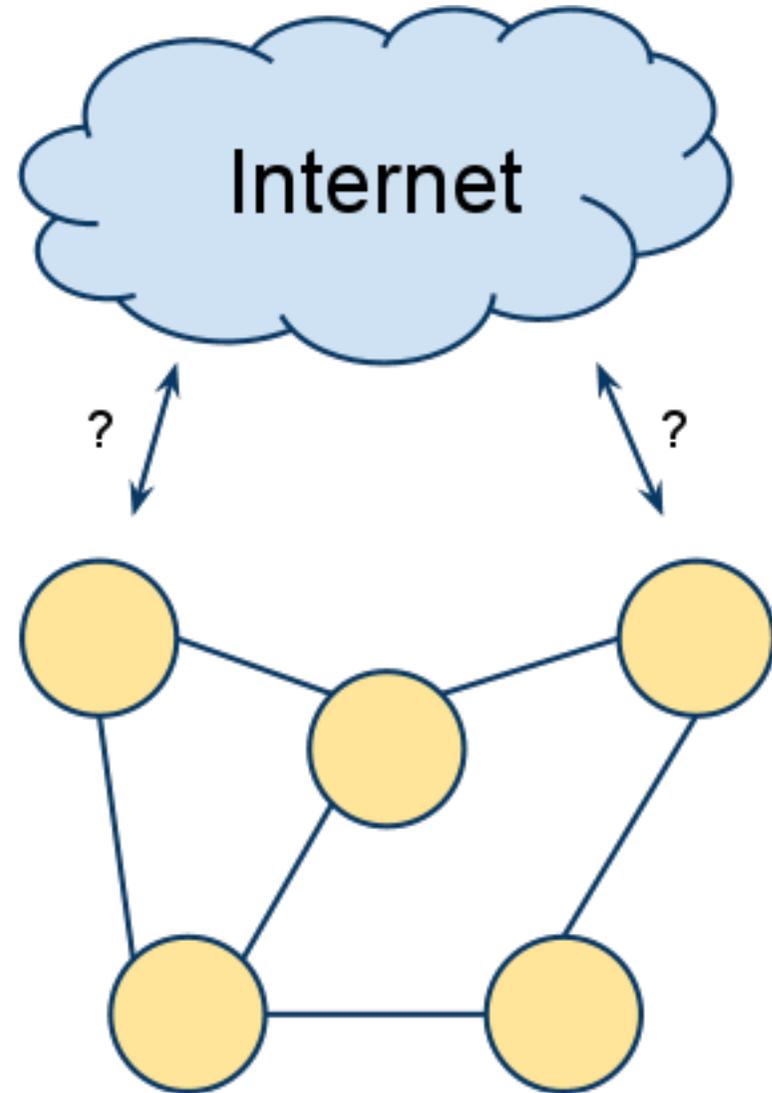
- Nodes
  - Virtual and physical
  - Generic and custom hardware
- Network connecting the nodes
  - VLAN connections
  - Internet2/LambdaRail circuits
  - Overlay connections



# Your GENI Experiment

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- Nodes
  - Virtual and physical
  - Generic and custom hardware
- Network connecting the nodes
  - VLAN connections
  - Internet2/LambdaRail circuits
  - Overlay connections
- Just basic Internet connectivity
  - No route control
  - No IP address mobility



# GENI Experiment Examples

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- Secure and fault-tolerant routing architectures
- **Security** and **reliability** inside a new architecture
  - Connectivity to **legacy networks**
  - A need for control of the Internet routes
    - Avoiding rogue networks
    - Enabling multi-path routing
    - Improving routing reliability and performance

# GENI Experiment Examples

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- Secure and fault-tolerant routing architectures
  - **Security** and **reliability** inside a new architecture
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      - Avoiding rogue networks
      - Enabling multi-path routing
      - Improving routing reliability and performance
- Mobility-enabling routing architectures
  - **Mobility** primitives inside a new architecture
  - Need for legacy address mobility in the Internet
    - As users move across the network, legacy addresses must move with them

# Adding Internet Control to GENI

- Enabling route control and address mobility:
  - Obtain an **Autonomous System** (AS) number to participate in routing
  - Obtain **IP addresses** to announce
  - Establish forwarding and control **sessions** with other networks
- **Time consuming and sometimes infeasible!**

# BGP-Mux for Internet Control

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- A substrate connecting GENI experiments to the Internet with route control
- Transparent connectivity to upstream networks
  - **Illusion** of direct data and control link to experiment
  - **Stable** session for upstream ISPs
- Internet numbered resources to GENI experiments
  - AS numbers
  - IP addresses

# Outline

- Motivation
- Background on Internet Routing
- BGP Mux Technology
- BGP Mux Deployment
- BGP Mux Uses
- Demo

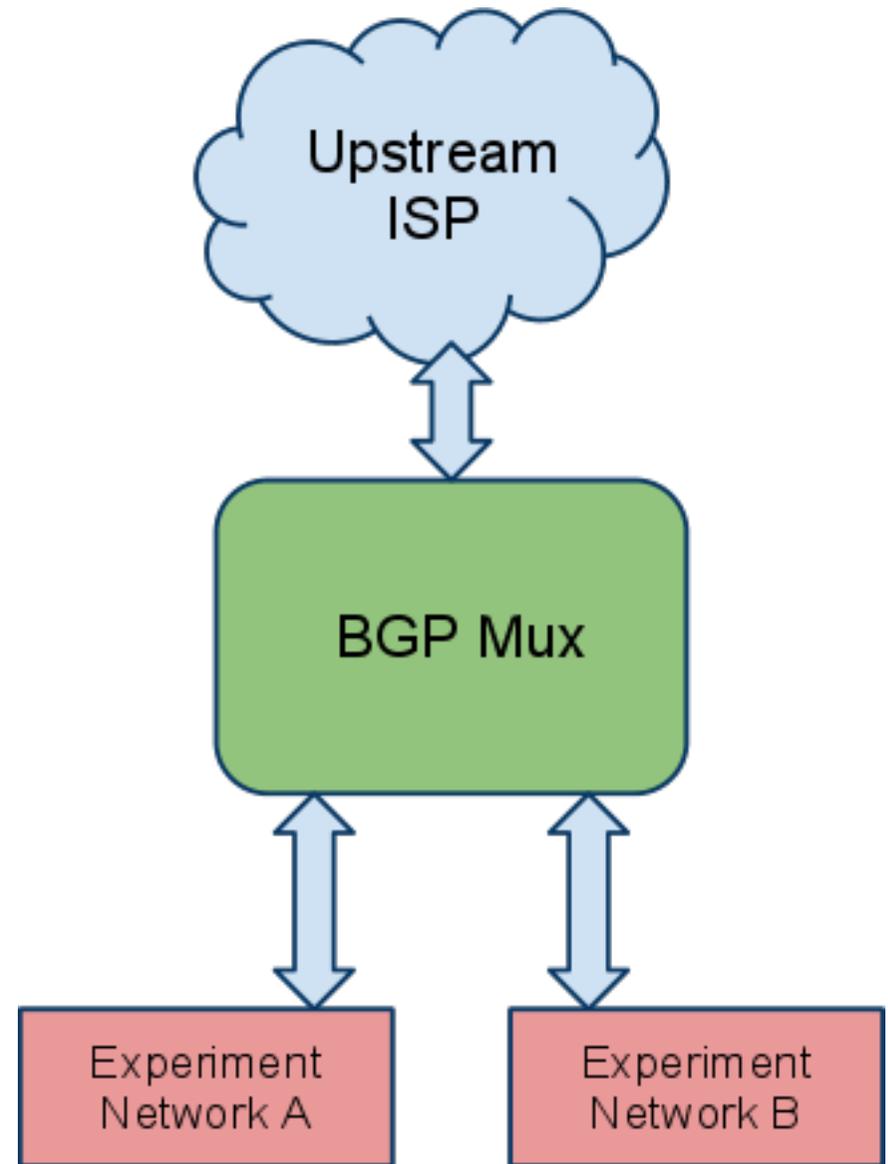
# Background on Internet Routing

- 30,000+ networks
- Border Gateway Protocol (BGP) for route control
- Upstream providers require direct data plane connectivity
- BGP control sessions are based on contracts and trust
- BGP Mux takes care of connectivity, contracts, and trust

# BGP Mux Technology

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- BGP Mux: a custom router with connections to upstream providers
- Connection to upstream providers
  - A **stable** data and control plane session
- Connection to GENI experiment
  - Illusion of **direct connectivity**
  - Variety of data-plane connectivity options
- Monitoring and control system



# BGP Mux Deployment



**We need more volunteers to deploy BGP Mux!**

# BGP Mux Experiment

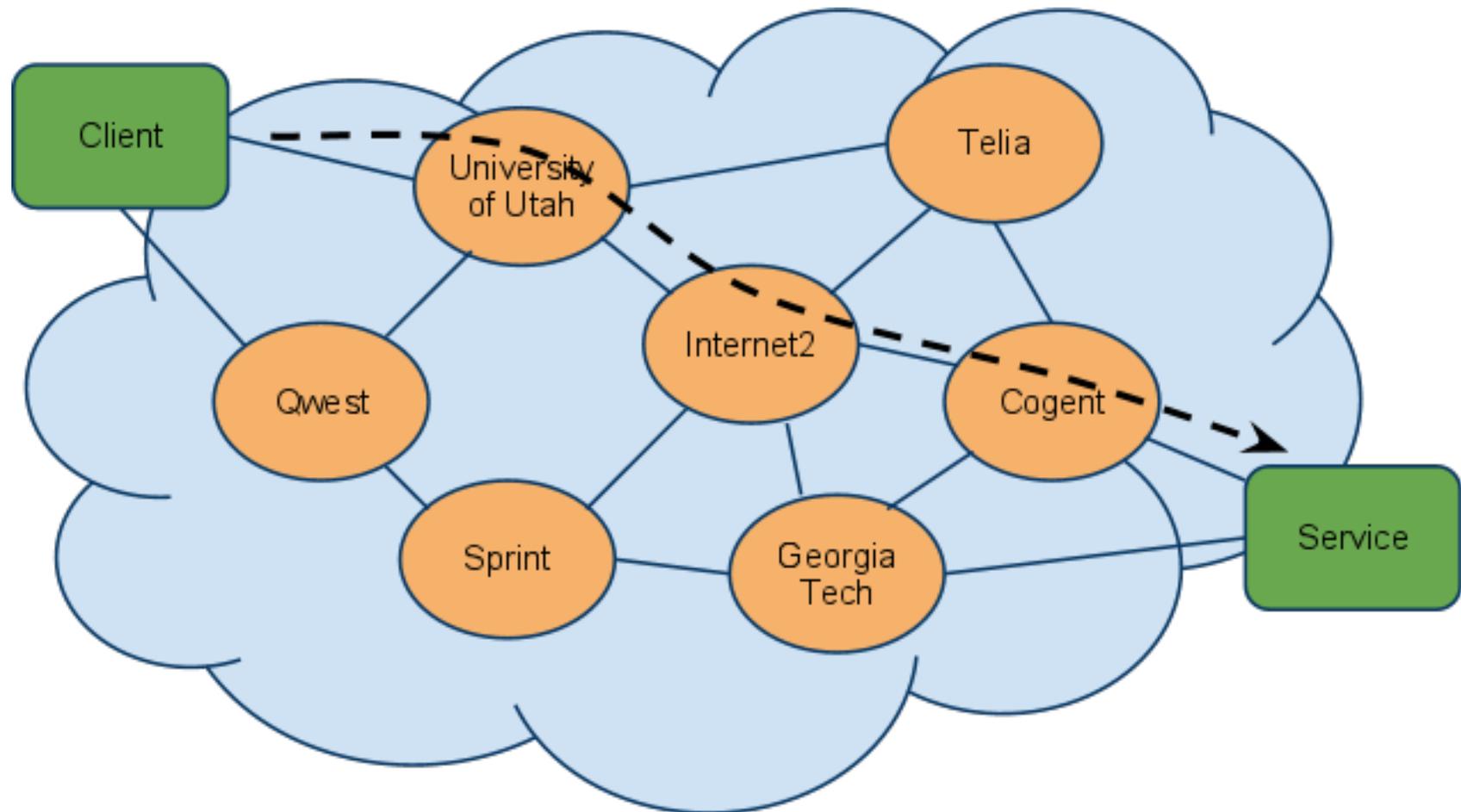
- Some data plane failures are invisible to the control plane\*
  - Packets are lost in the remote network
  - BGP state does not change despite the loss
- Service operator has to detect and route around such failures
- Outgoing traffic: choose routes that avoid troubled network
- Incoming traffic: use BGP poisoning to force others to route around troubled network
  - Question: How effective is such approach?

*\*Studying Black Holes in the Internet with Hubble*, E. Katz-Bassett *et al*

# Incoming Traffic Control with Poisoning

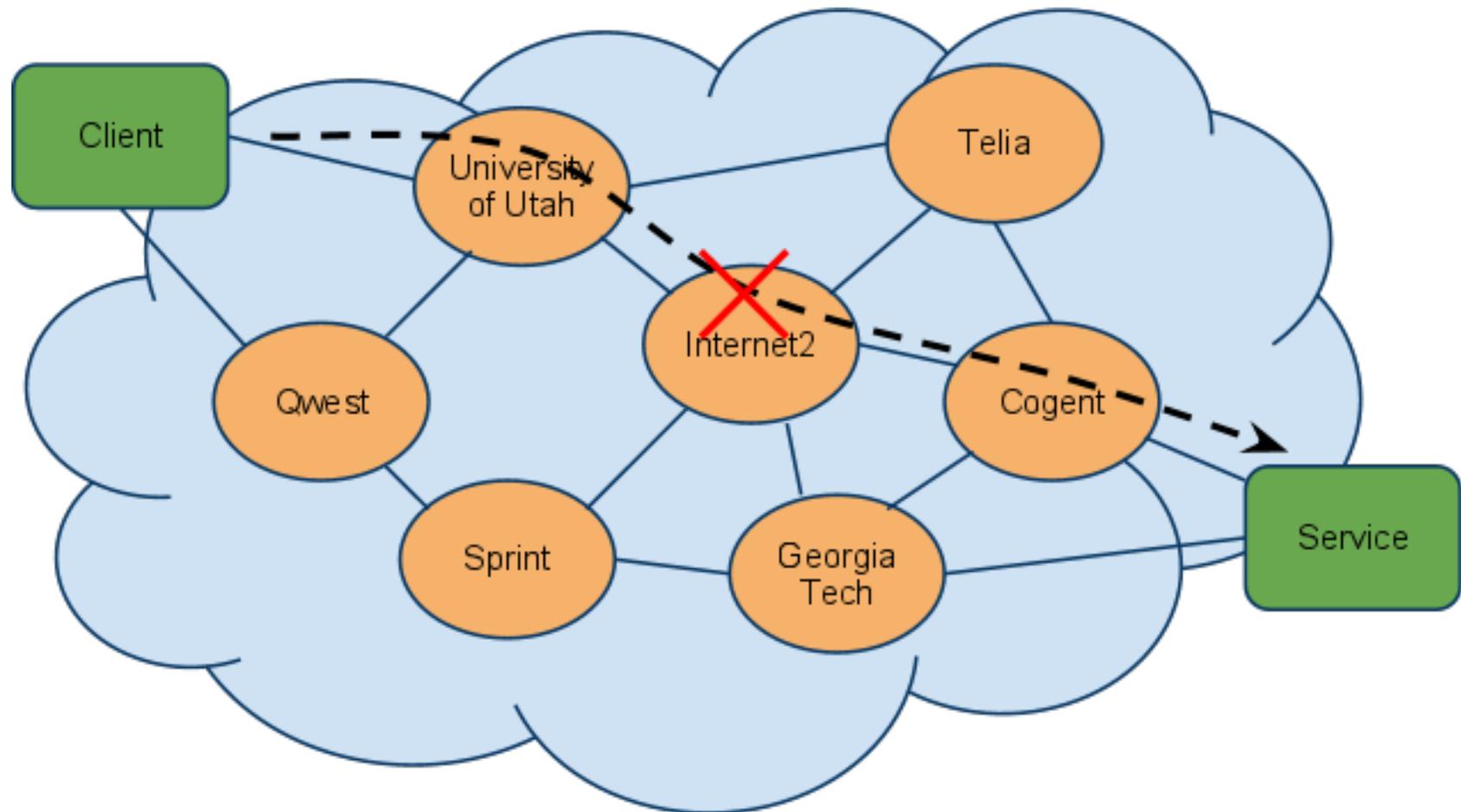
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1. Client network chooses shortest Internet path



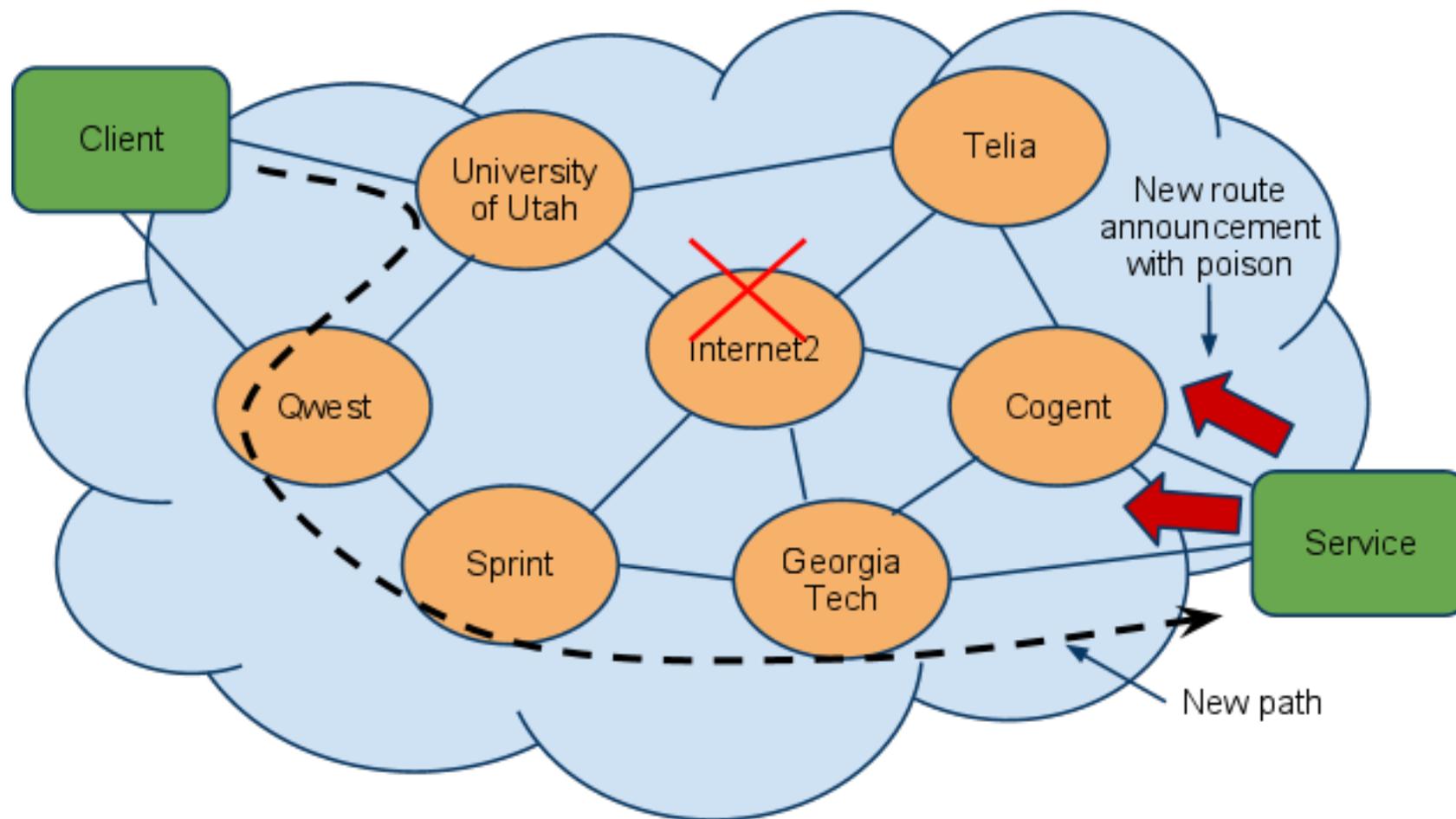
# Incoming Traffic Control with Poisoning

1. Client network chooses shortest Internet path
2. Service detects data-plane failure in the Internet2 network



# Incoming Traffic Control with Poisoning

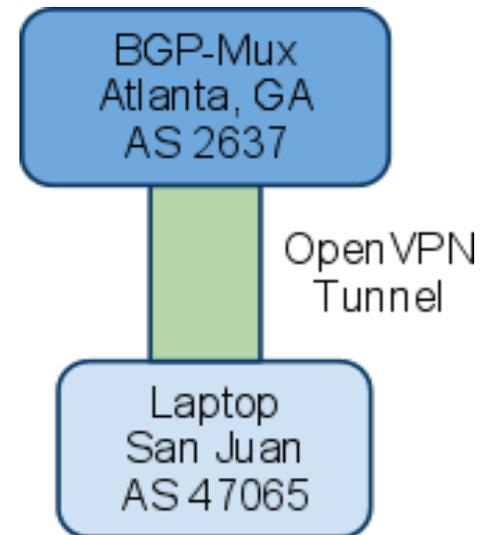
1. Client network chooses shortest Internet path
2. Service detects data-plane failure in the Internet2 network
3. Service poisons advertisements to force others to route around failure



# Demo

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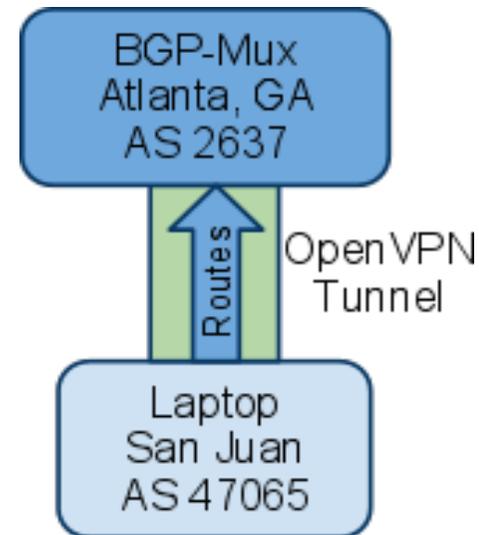
- Establishing data-plane connection to BGP-Mux



# Demo

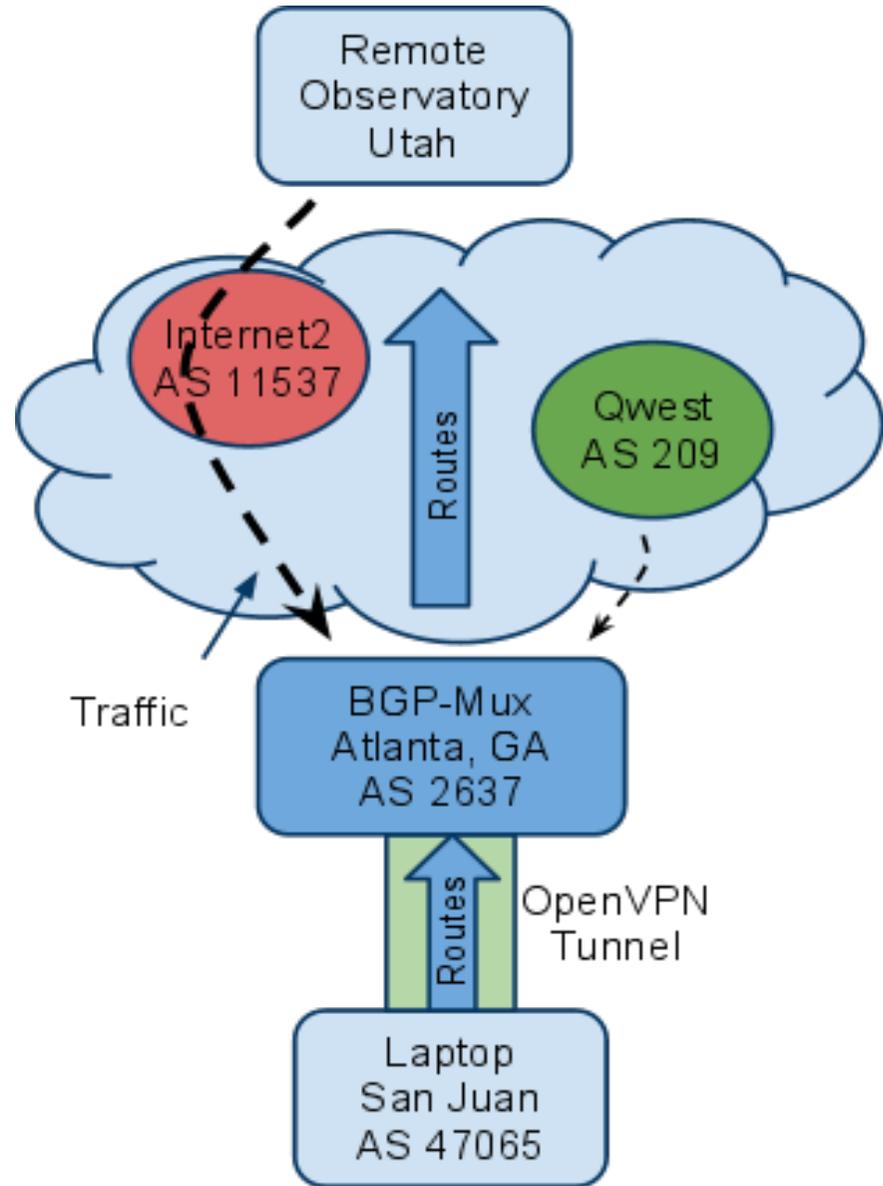
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- Establishing data-plane connection to BGP-Mux
- Establishing route control session to BGP-Mux



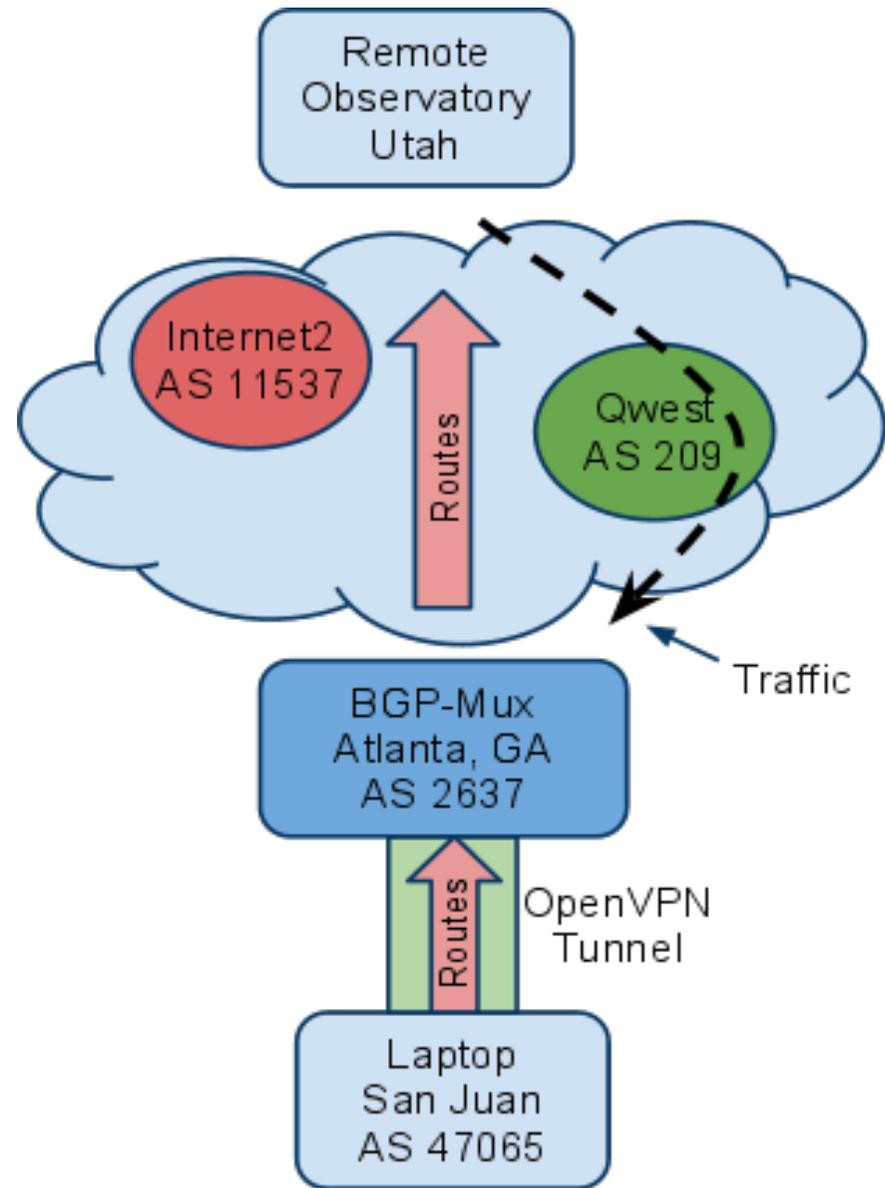
# Demo

- Establishing data-plane connection to BGP-Mux
- Establishing route control session to BGP-Mux
- Announcing routes and testing data-plane path



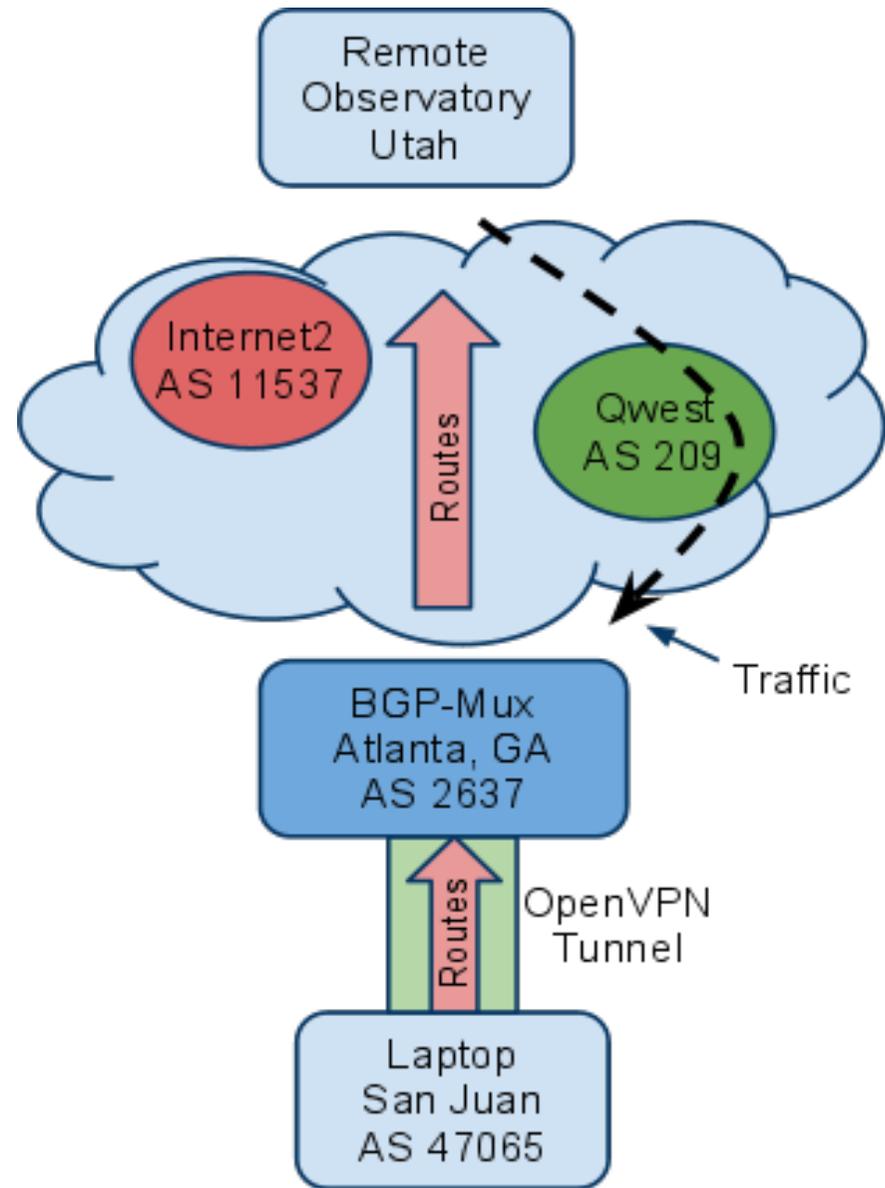
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- Announcing routes and testing data-plane path
- Using AS path poisoning to force remote networks to avoid Internet2



# Demo

- Establishing data-plane connection to BGP-Mux
- Establishing route control session to BGP-Mux
- Announcing routes and testing data-plane path
- Using AS path poisoning to force remote networks to avoid Internet2
- Testing new data plane



# Questions?



**We need more volunteers to deploy BGP Mux!**  
**Contact: [valas@gatech.edu](mailto:valas@gatech.edu)**