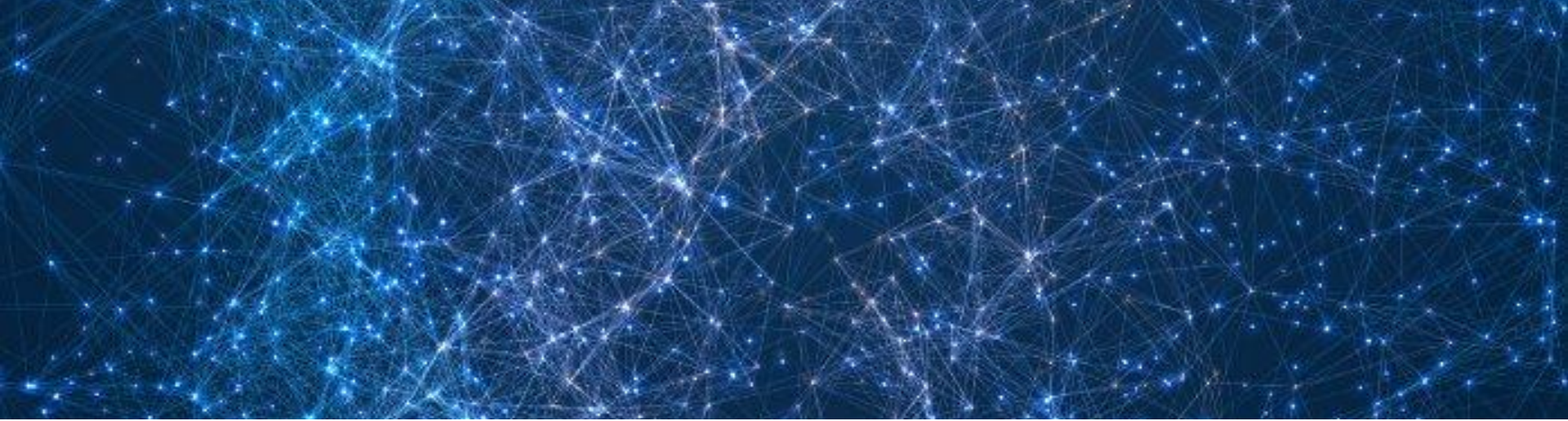


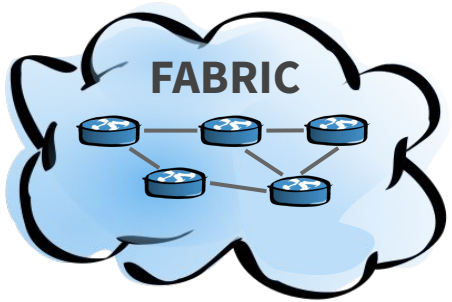
Interdomain routing control for FABRIC experiments with PEERING

Ítalo Cunha

Columbia University

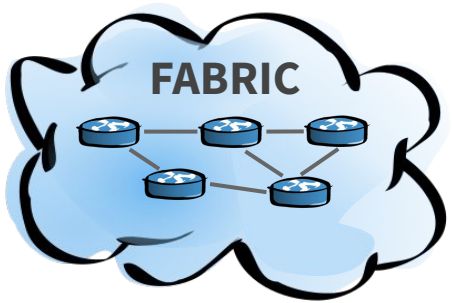
UFMG

Optimizing Intradomain Routes for a Service



Connecting FABRIC Experiments to the Internet

Users

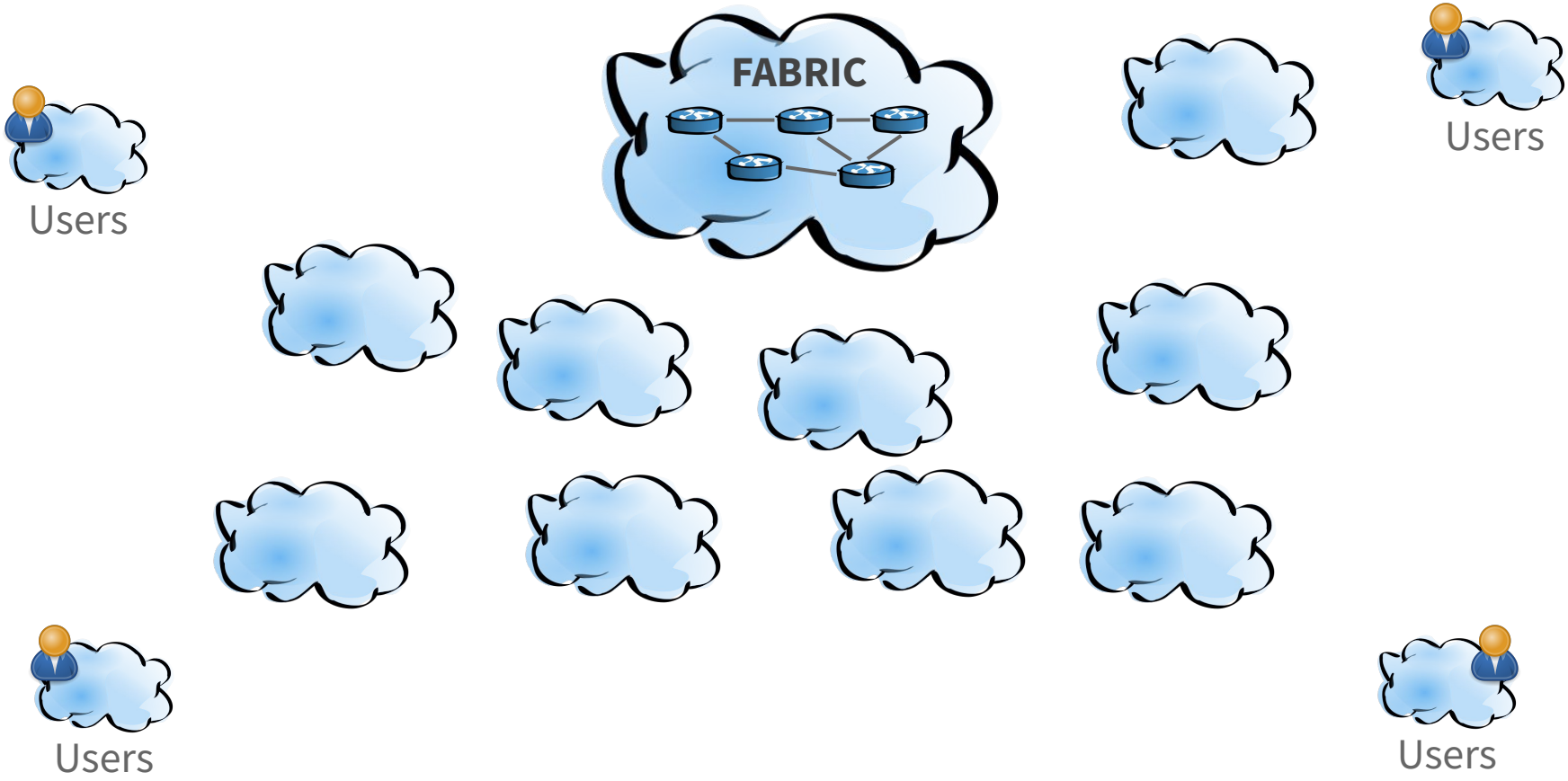


Users

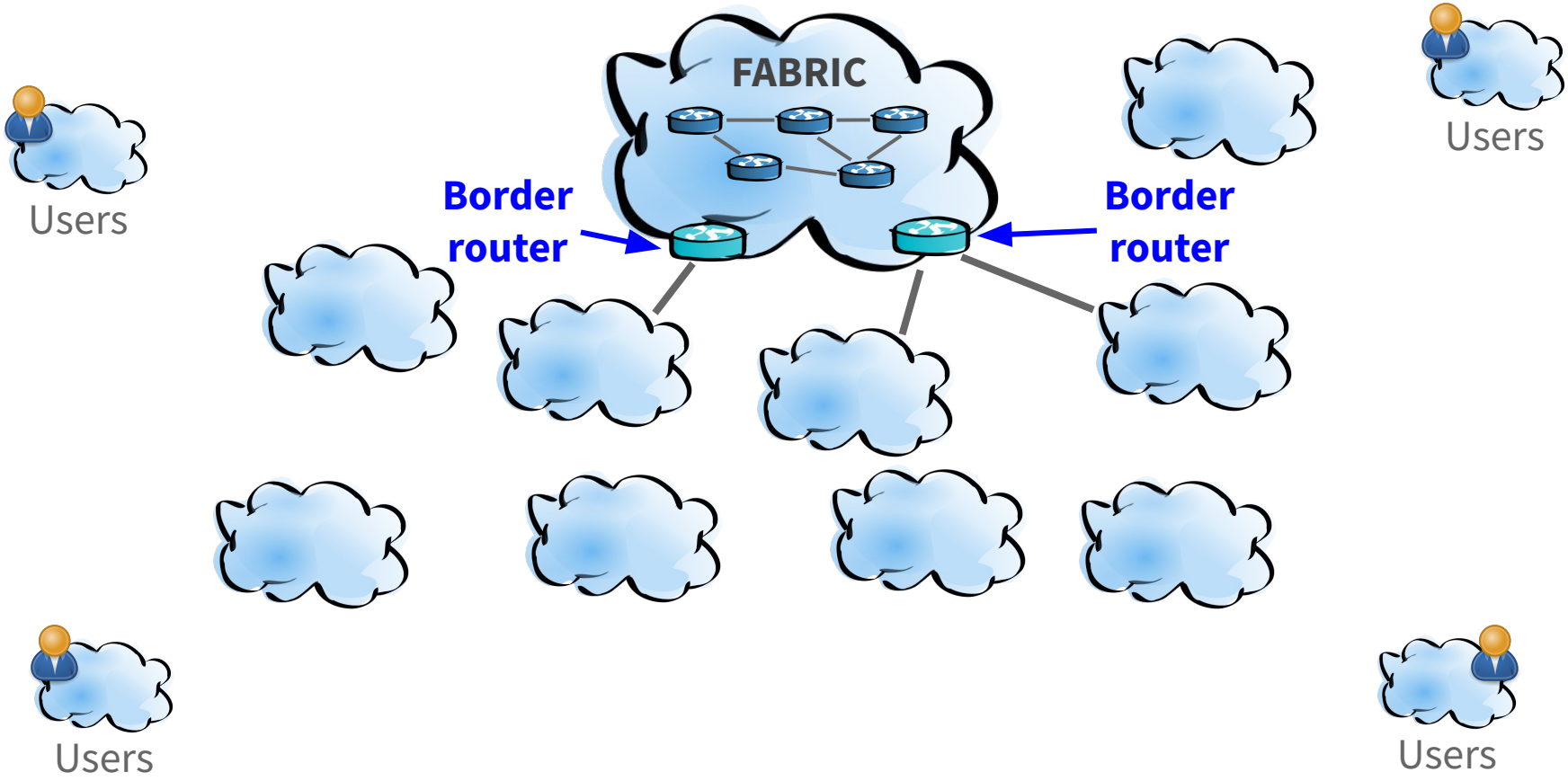
Users

Users

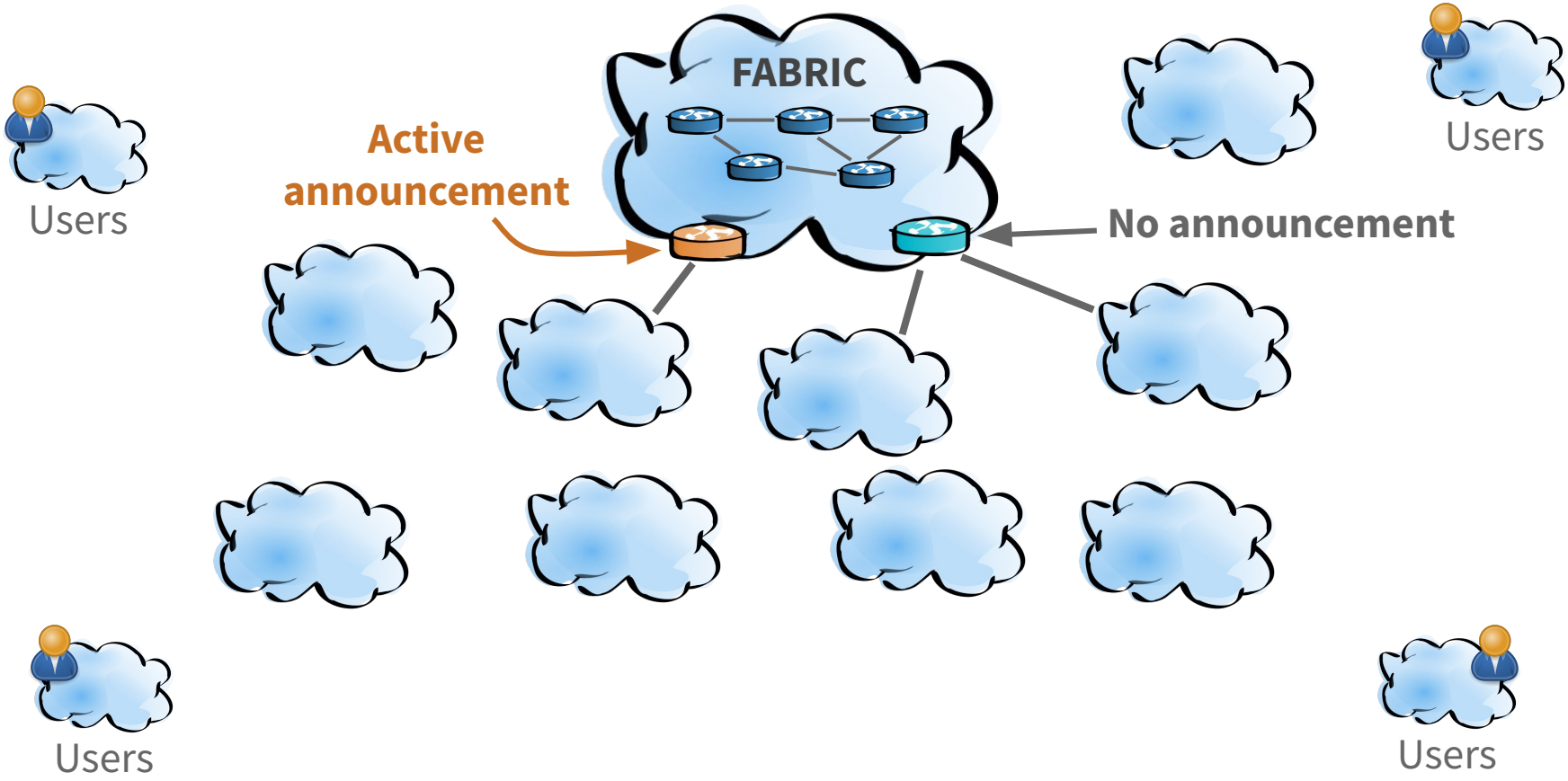
Connecting FABRIC Experiments to the Internet



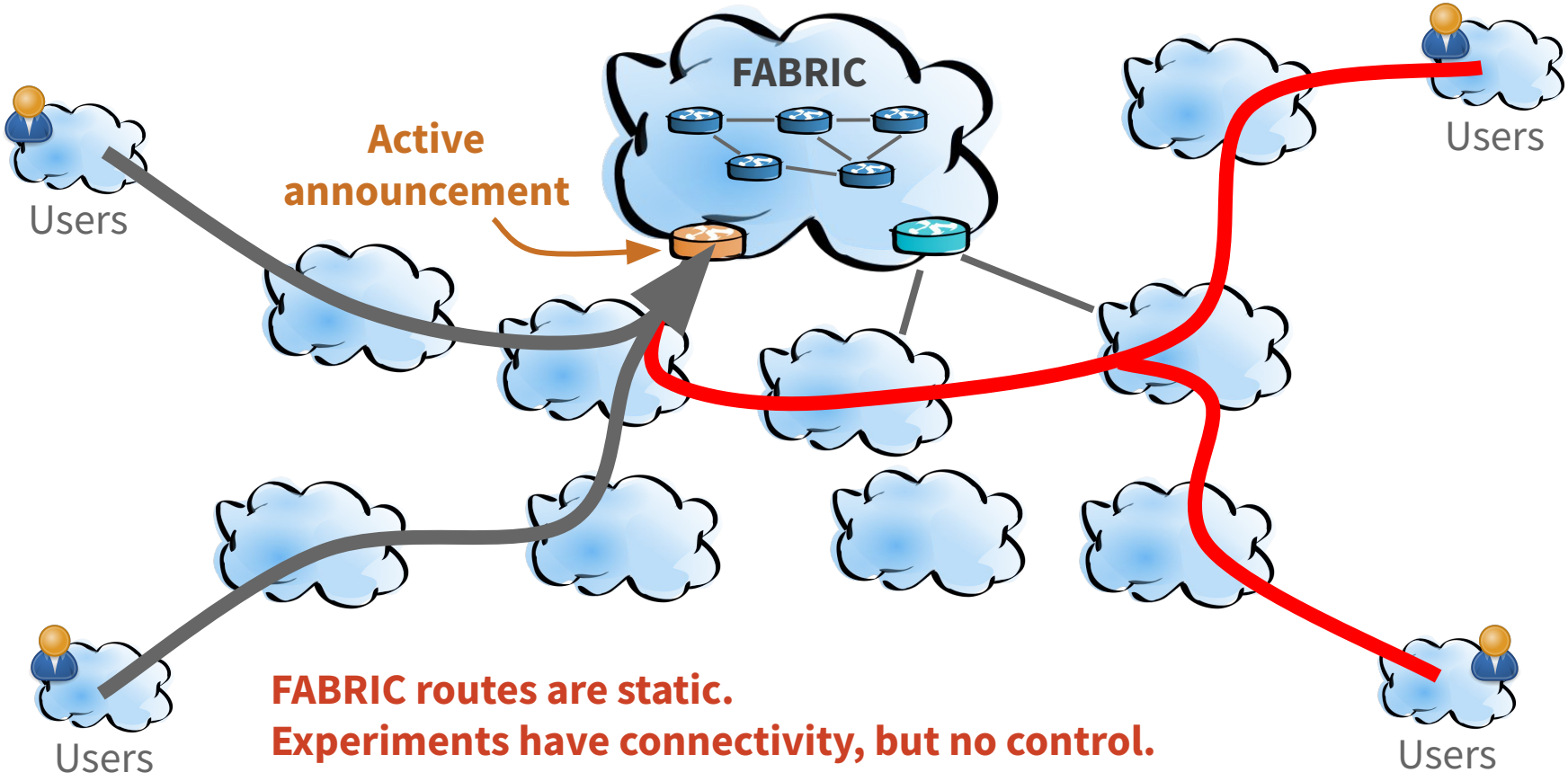
Connecting FABRIC Experiments to the Internet



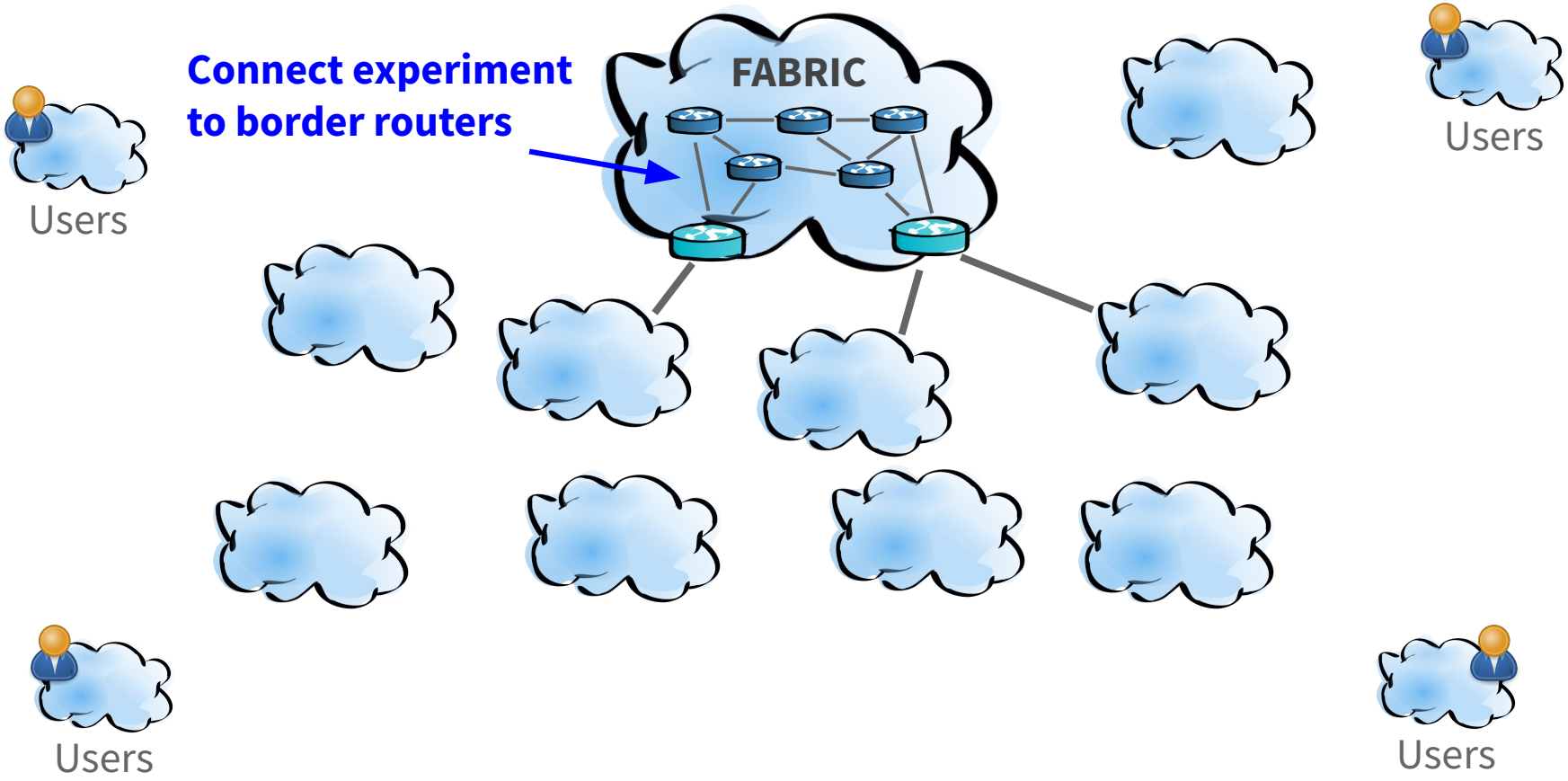
Connecting FABRIC Experiments to the Internet



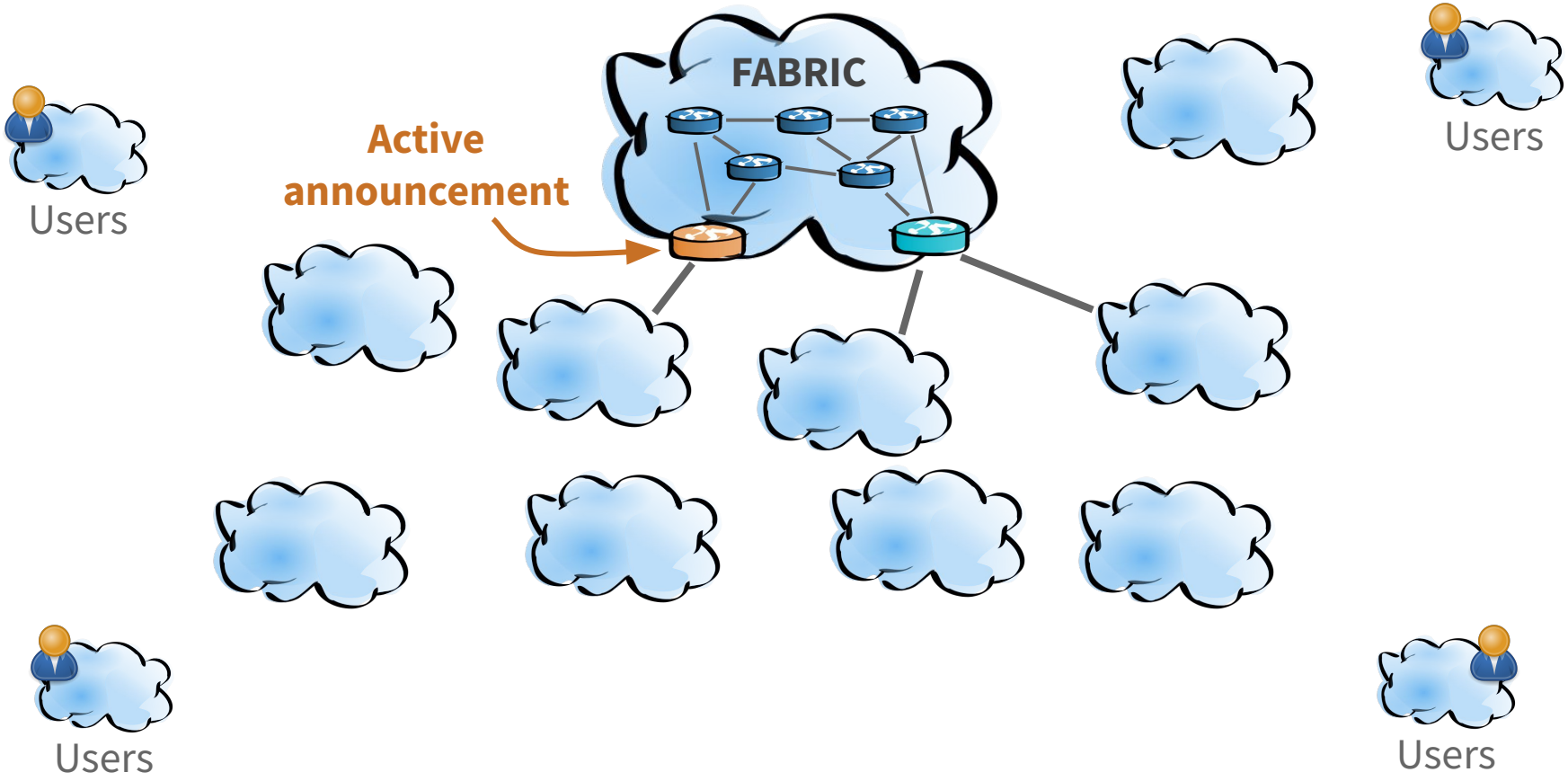
Connecting FABRIC Experiments to the Internet



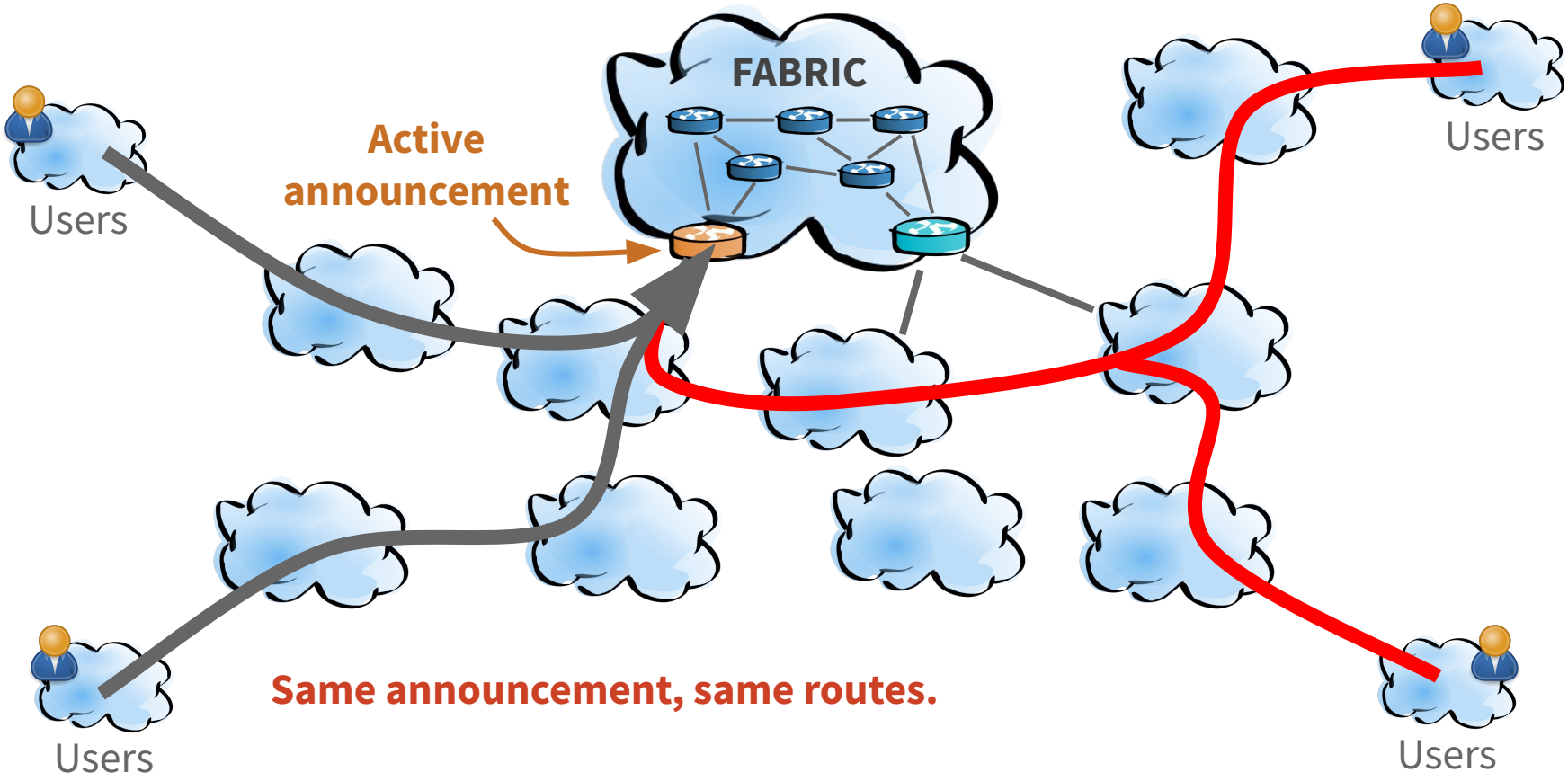
Control Announcements to Steer Traffic



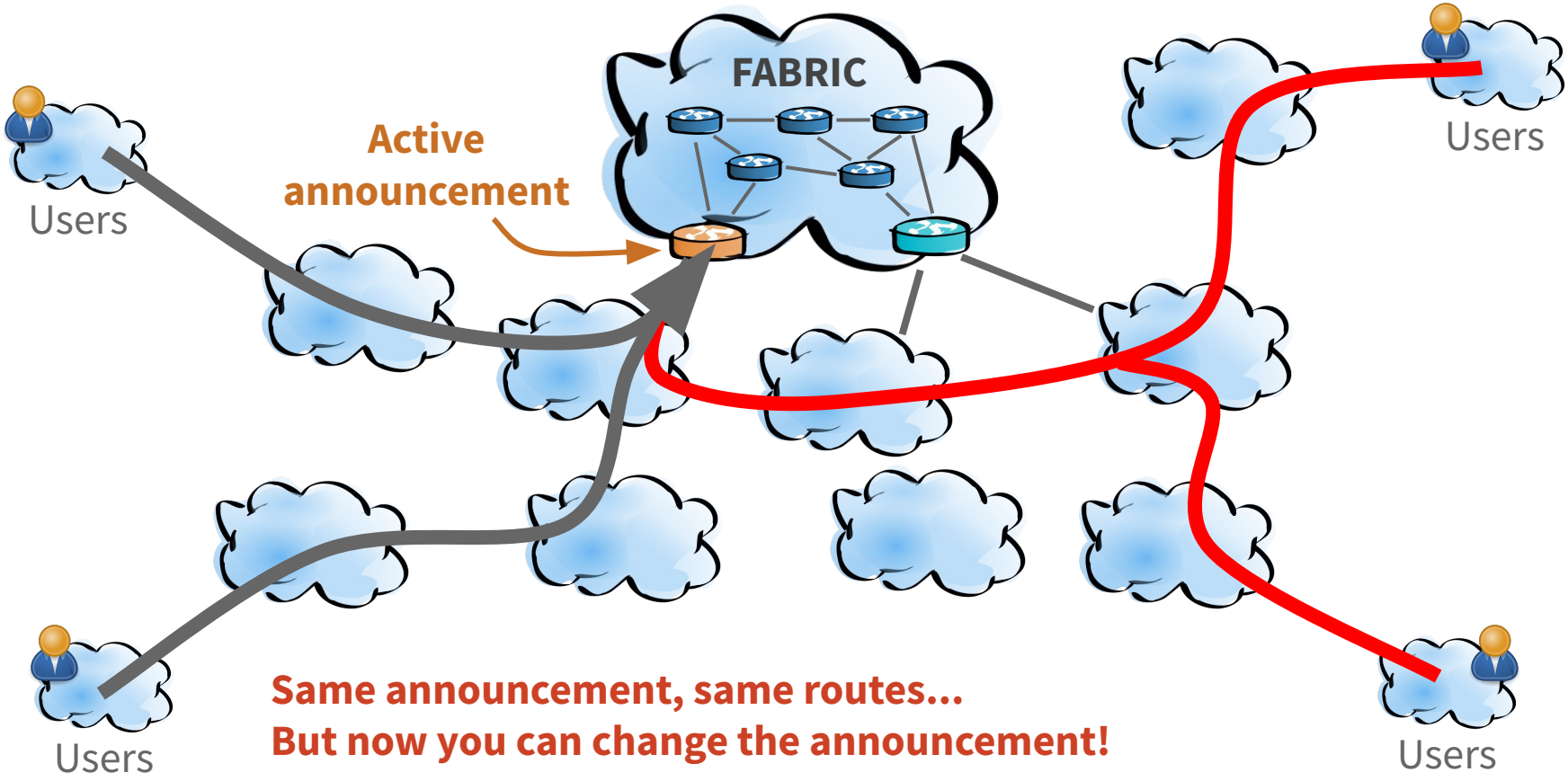
Optimize Interdomain Routes for a Service



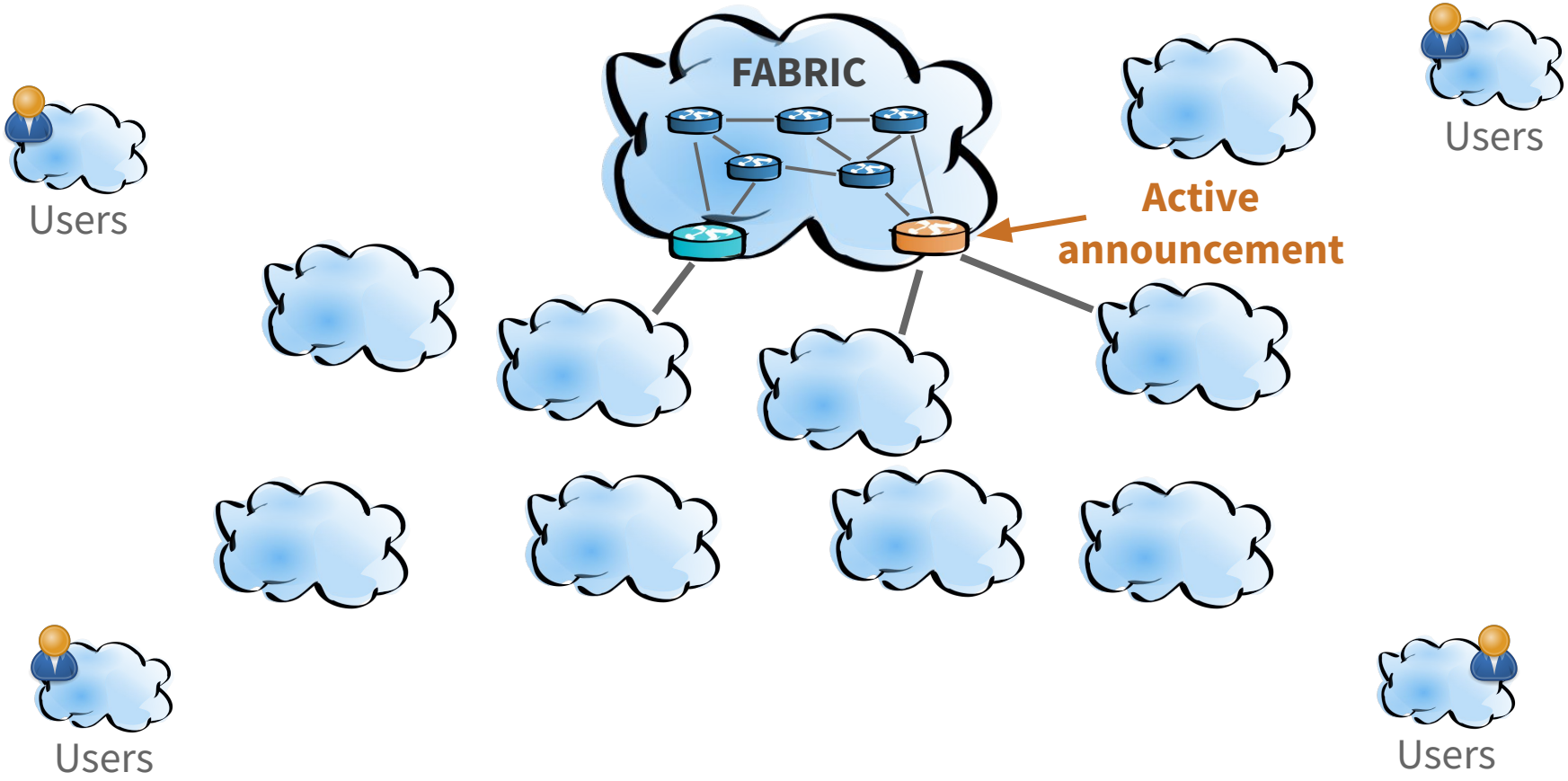
Optimize Interdomain Routes for a Service



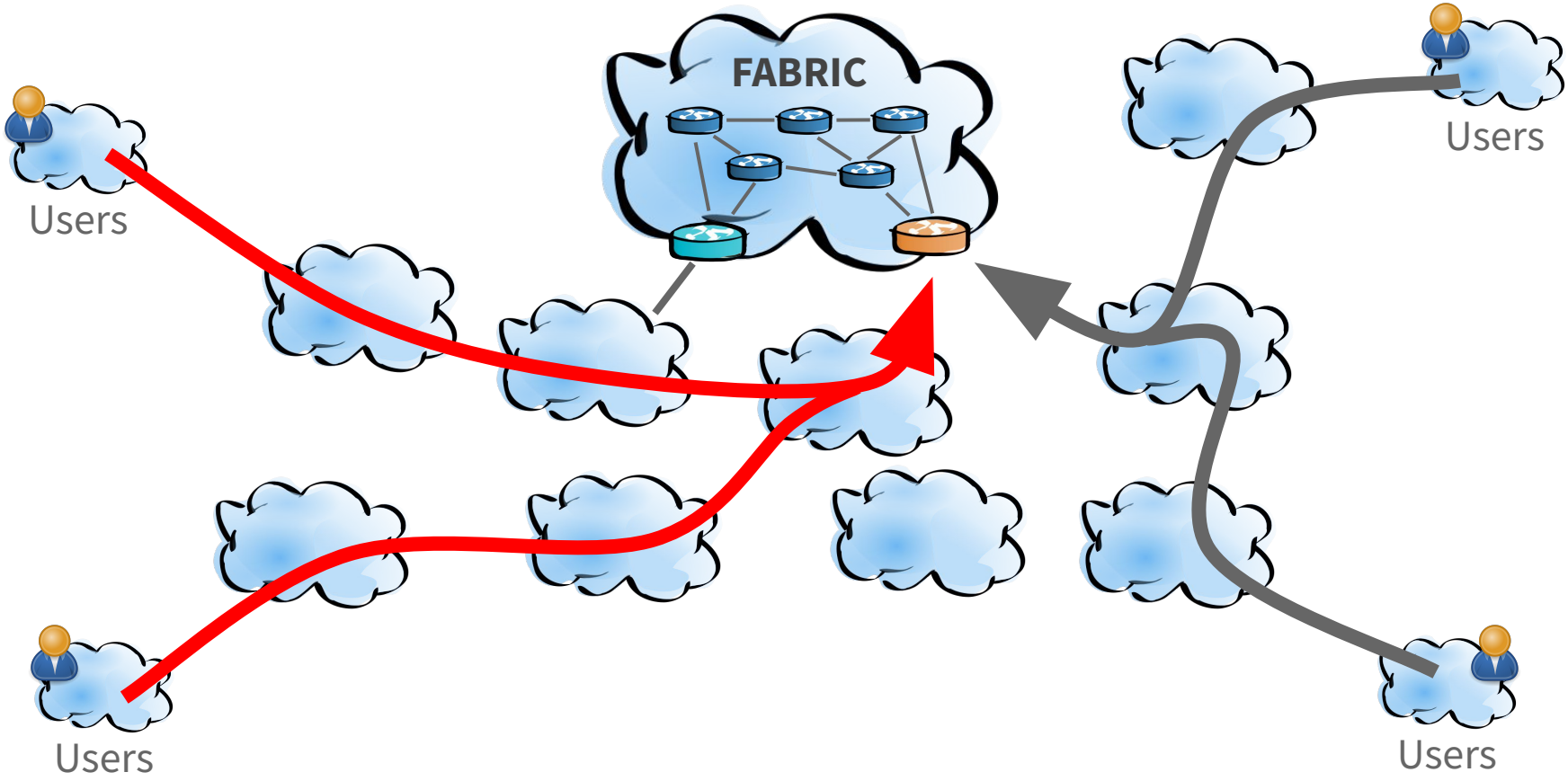
Optimize Interdomain Routes for a Service



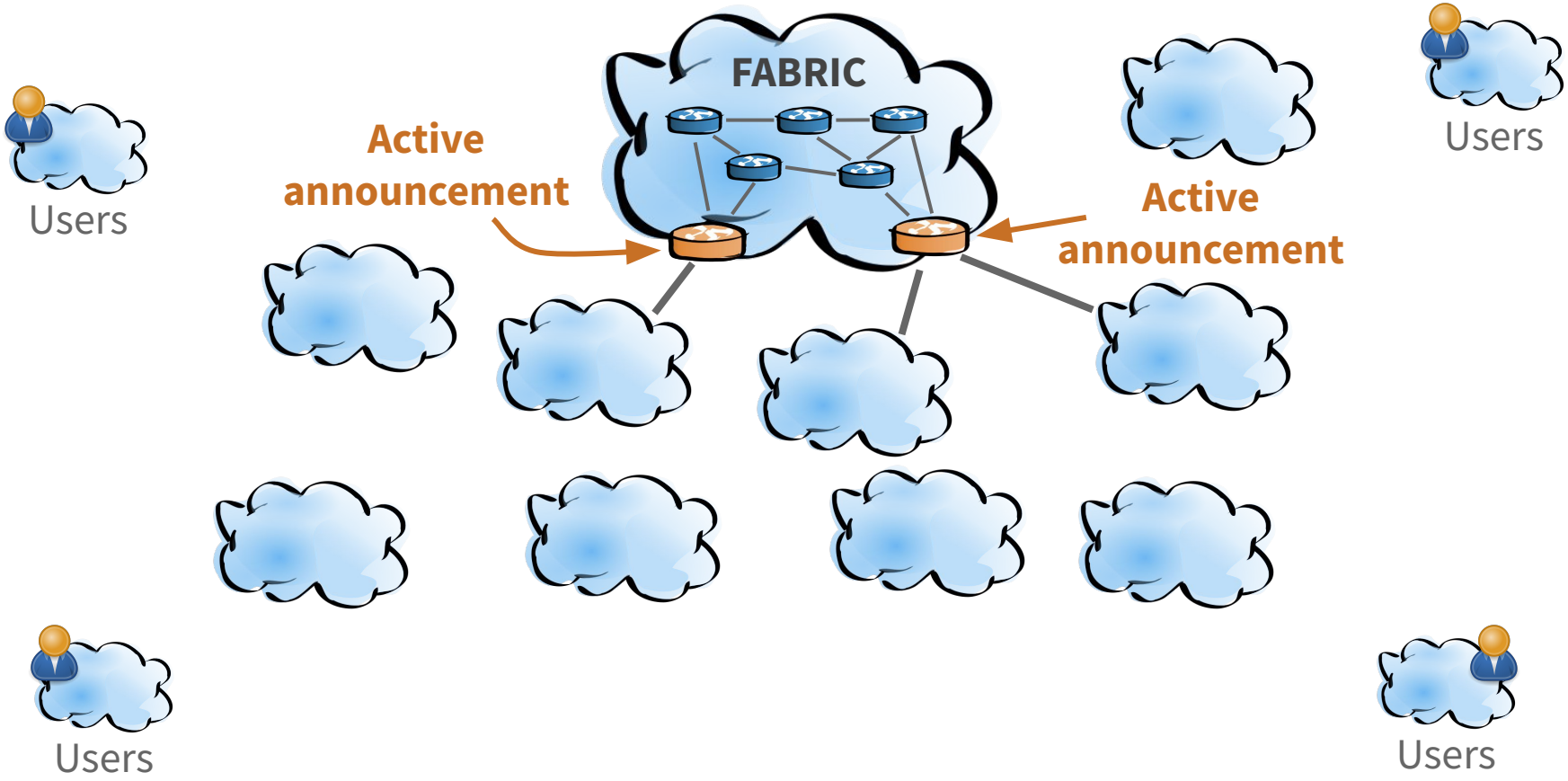
Optimize Interdomain Routes for a Service



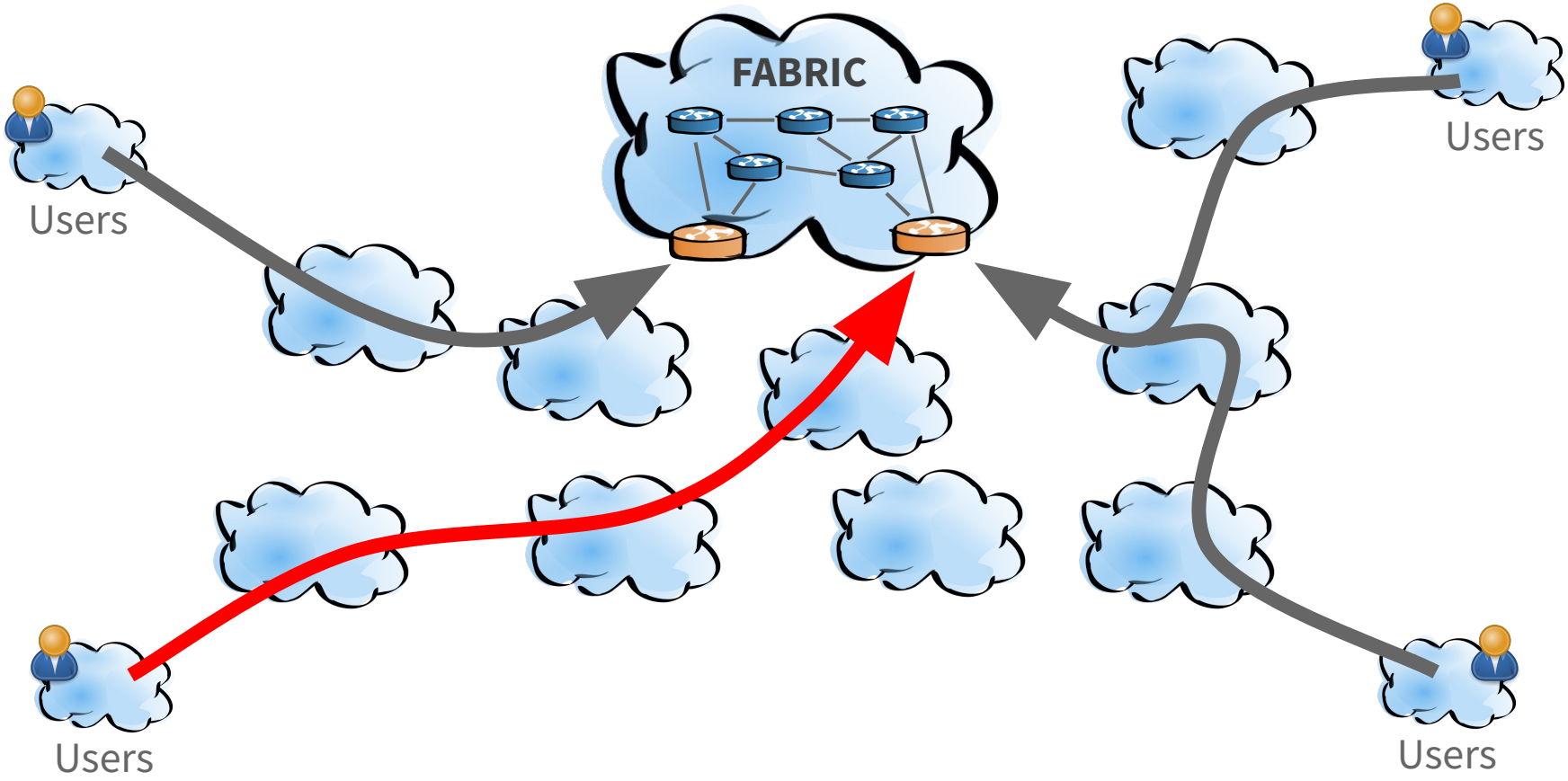
Optimize Interdomain Routes for a Service



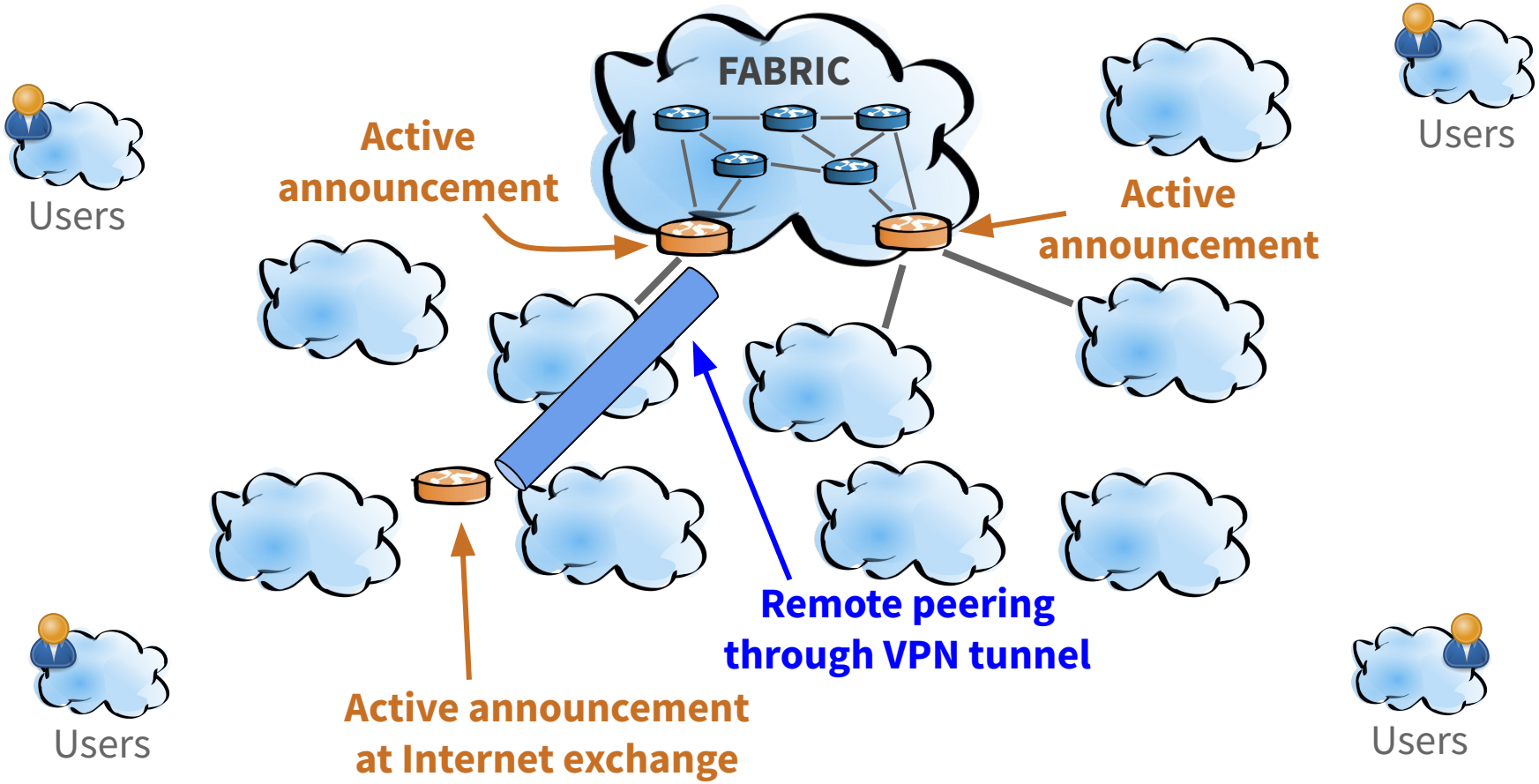
Optimize Interdomain Routes for a Service



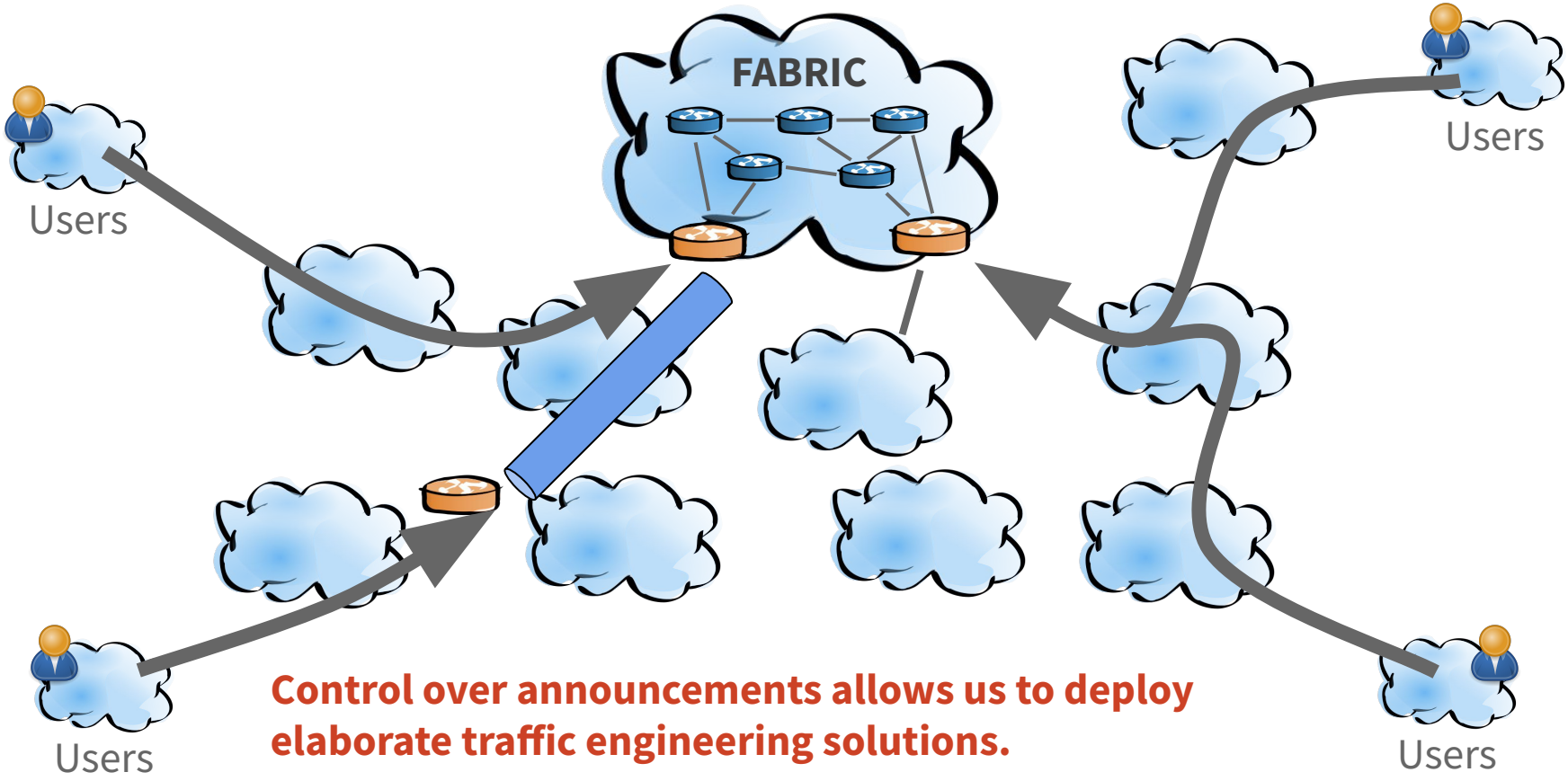
Optimize Interdomain Routes for a Service



Optimize Interdomain Routes for a Service



Optimize Interdomain Routes for a Service



Control over announcements allows us to deploy elaborate traffic engineering solutions.

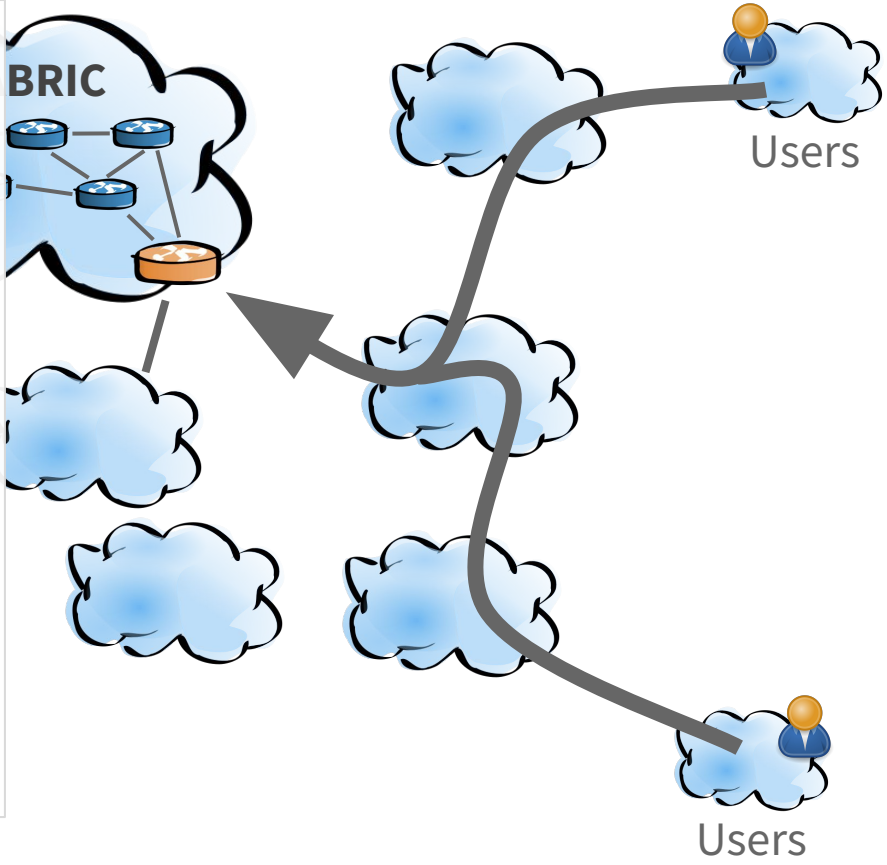
Rich Research Area

Knobs:

- BGP prepending
- BGP communities
- Selective announcements
- Subprefix announcements
- Superprefix announcements

Objectives for traffic engineering:

- Performance
- Static configurations
- Fast failover
- Capacity constraints



Users

Rich Research Area

Knobs:

- BGP prepending
- BGP communities
- Selective announcements
- Subprefix announcements
- Superprefix announcements

Objectives for traffic engineering:

- Performance
- Static configurations
- Fast failover
- Capacity constraints

Other applications:

- Reliability
  - Detouring around failures
  - Avoiding congested paths
- Security
  - Prefix hijacks
  - Denial of service attacks
- Internet characterization
  - Topology discovery
  - Reverse engineering routing policies
-
-
-

Users

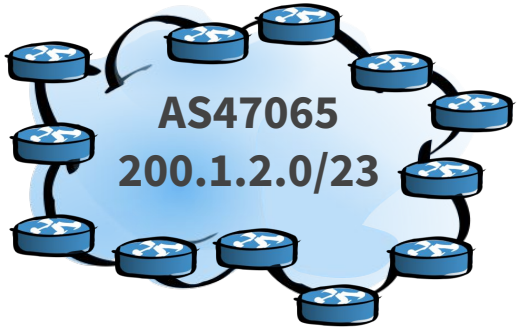
What do we need to run interdomain routing experiments?

Running Traffic Engineering Experiments

Resources:

- AS number
- IP prefix

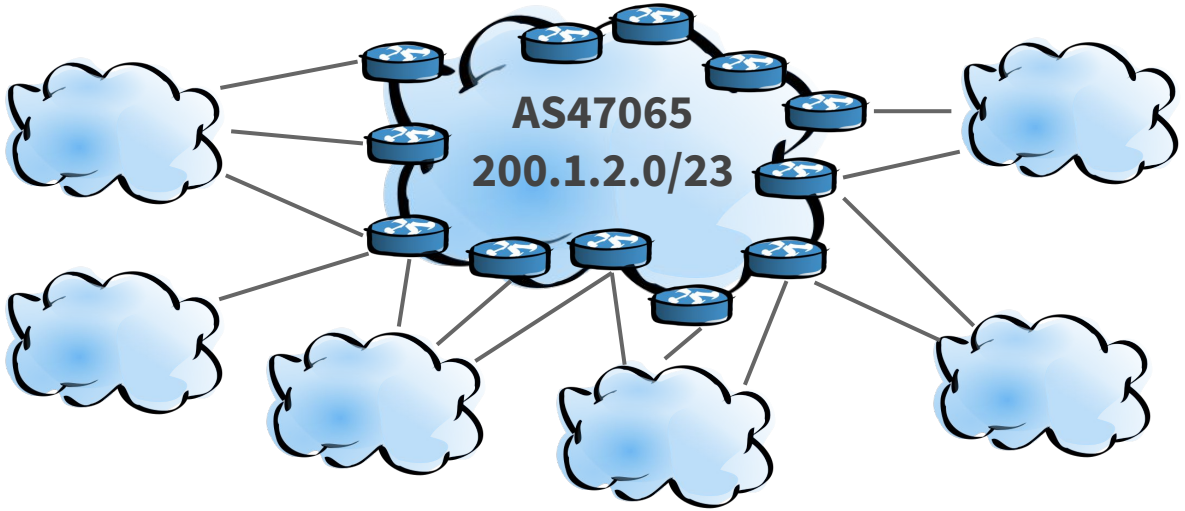
Running Traffic Engineering Experiments



Resources:
- AS number
- IP prefix

Infrastructure:
- Routers around the globe

Running Traffic Engineering Experiments



Resources:

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- IP prefix

Infrastructure:

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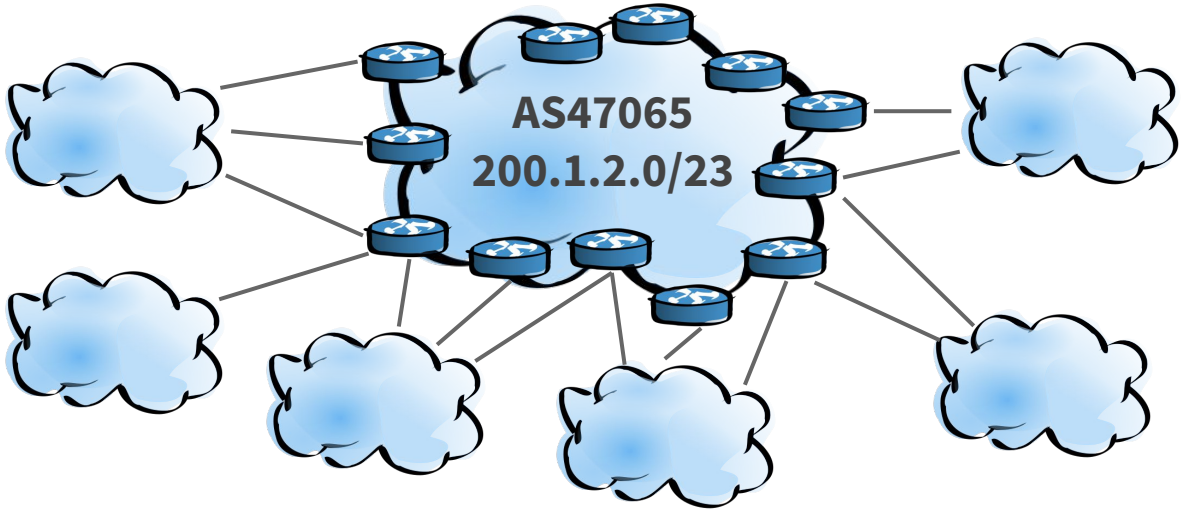
Running Traffic Engineering Experiments



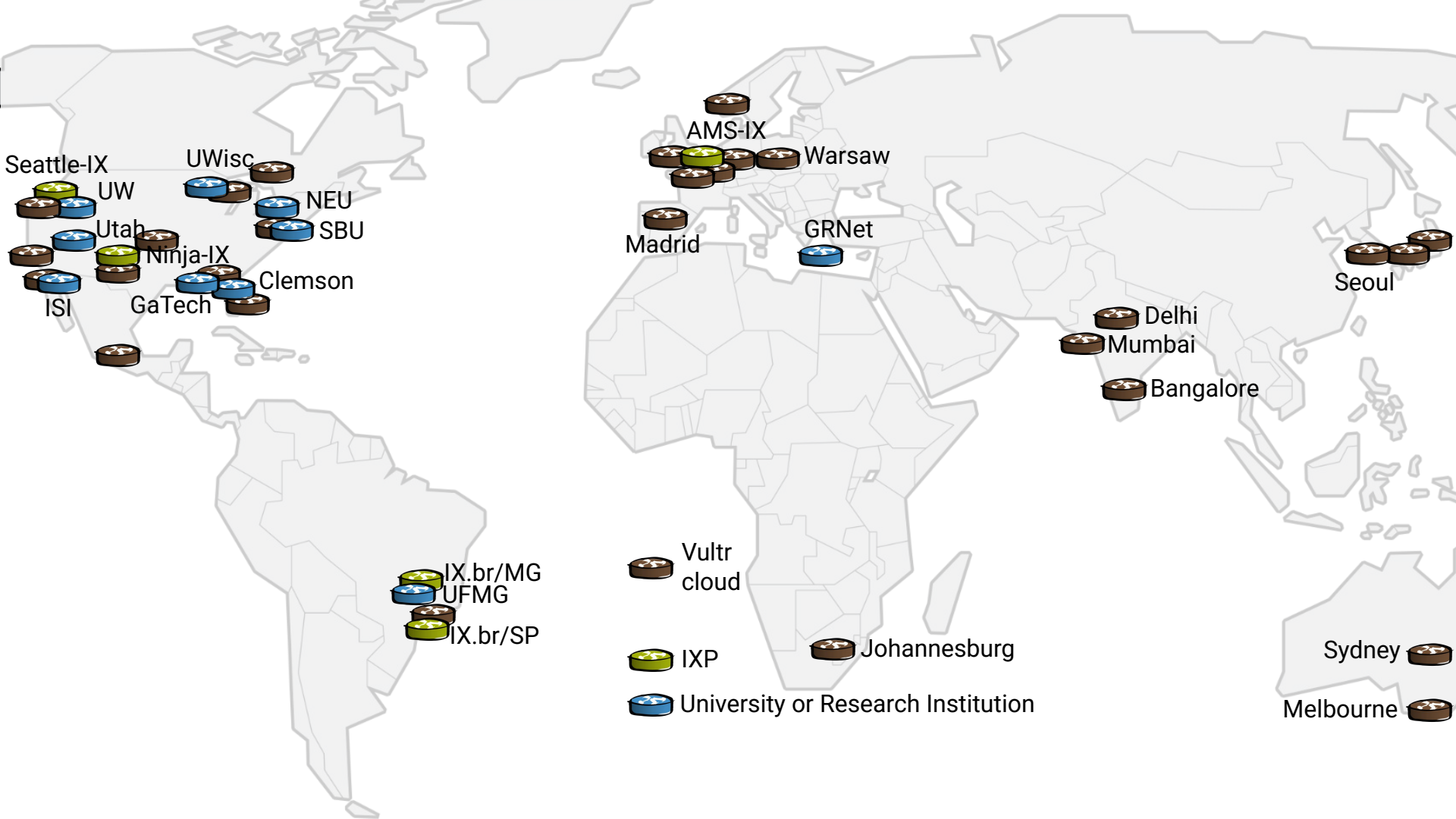
Resources:
- AS number
- IP prefix

Infrastructure:
- Routers around the globe
- Interconnections

Tooling:
- Control announcements
- Ensure safety

PEERING is a routing research testbed

Facilitates executing experiments on the Internet


Seattle-IX
UW
UWisc
NEU
Utah
SBU
Ninja-IX
Clemson
ISI
GaTech
AMS-IX
Warsaw
Madrid
GRNet
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Delhi
Mumbai
Bangalore
IX.br/MG
UFMG
IX.br/SP
Vultr
cloud
Johannesburg
Sydney
Melbourne
IXP
University or Research Institution


Seattle-IX
UW
UWisc
Chic
NEU
Utah
SBU
Ninja-IX
DC
Clemson
ISI
GaTech
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Bangalore
Singapore
IX.br/MG
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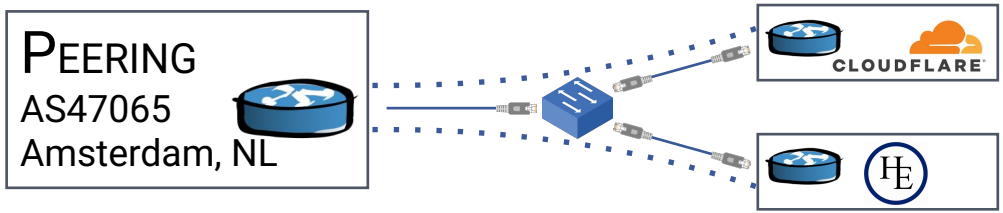
FABRIC
IXP
University or Research Institution
Johannesburg
Sydney
Melbourne

Connecting to PEERING PoPs



BGP Session

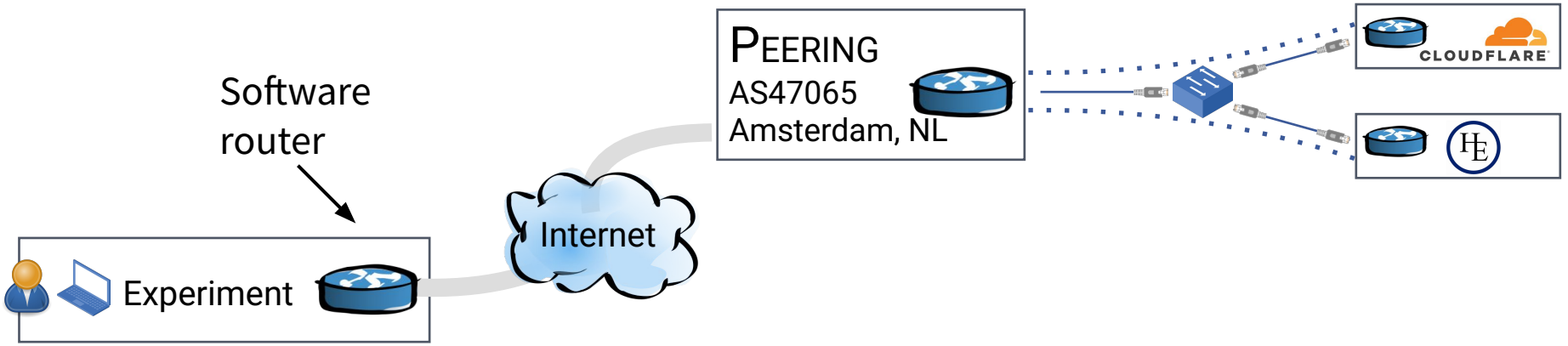
Physical Circuit

Connecting to PEERING PoPs

BGP Session

Physical Circuit

Connecting to PEERING PoPs

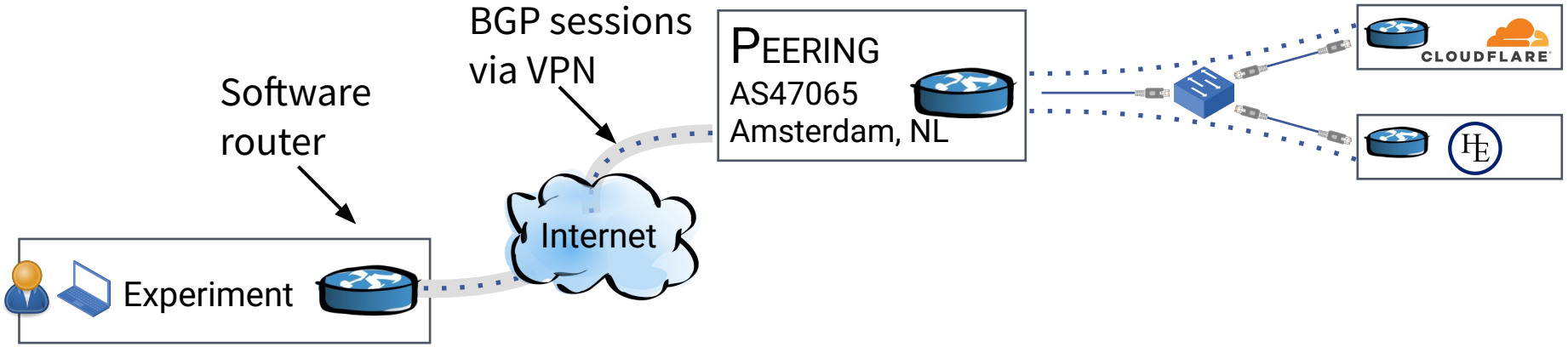


BGP Session

VPN Circuit

Physical Circuit

Connecting to PEERING PoPs

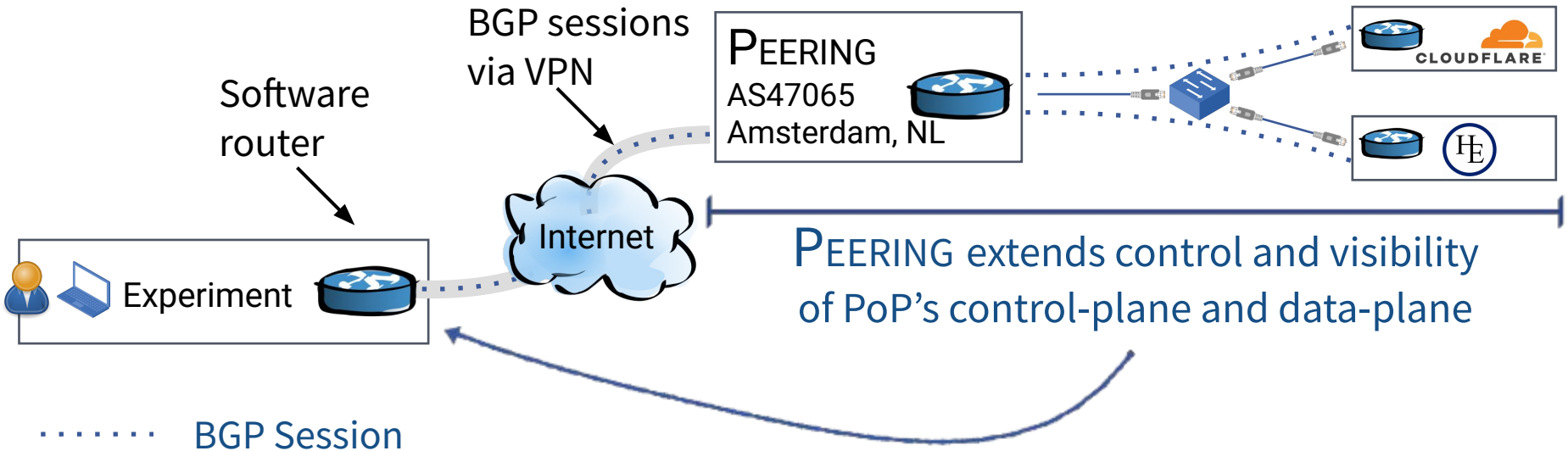


BGP Session

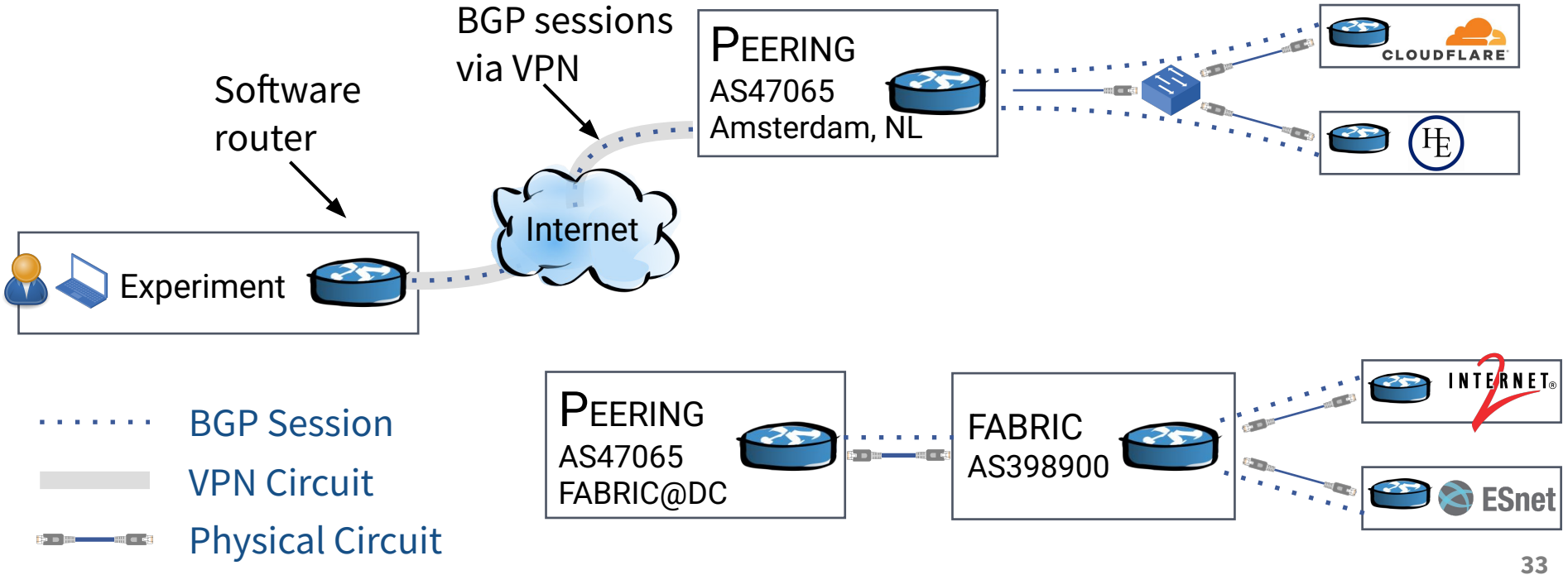
VPN Circuit

Physical Circuit

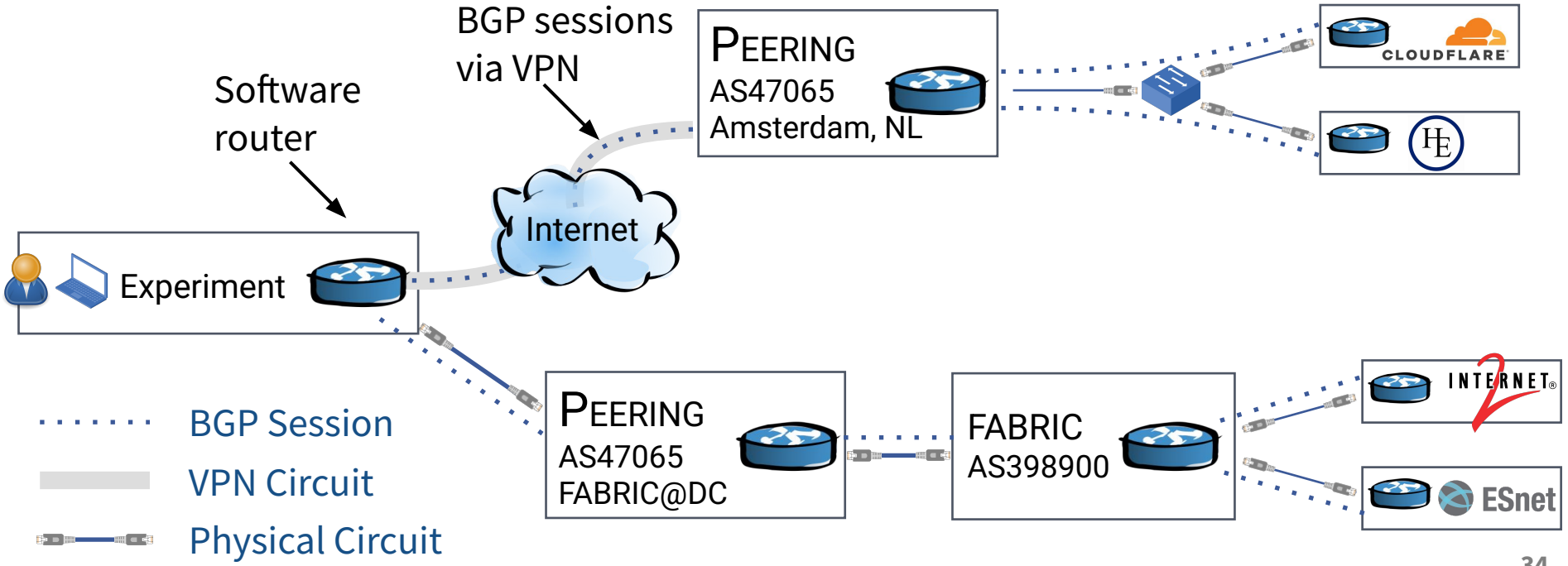
Connecting to PEERING PoPs



Connecting to PEERING PoPs

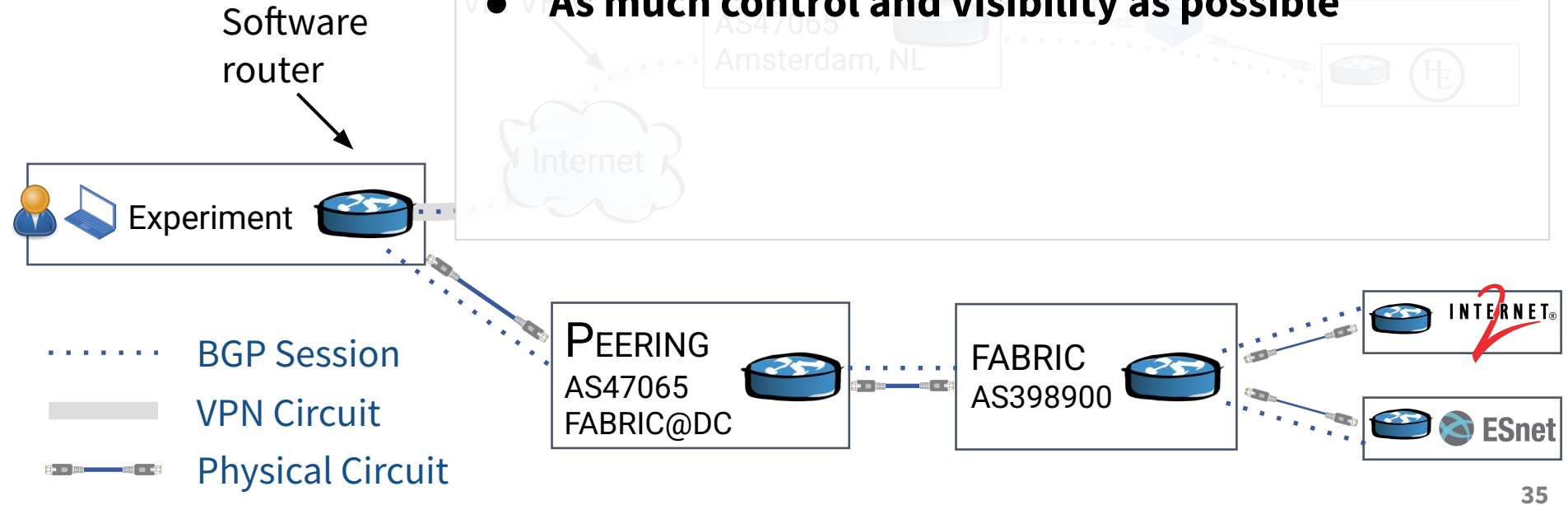


Connecting to PEERING PoPs



Connecting to PEERING PoPs

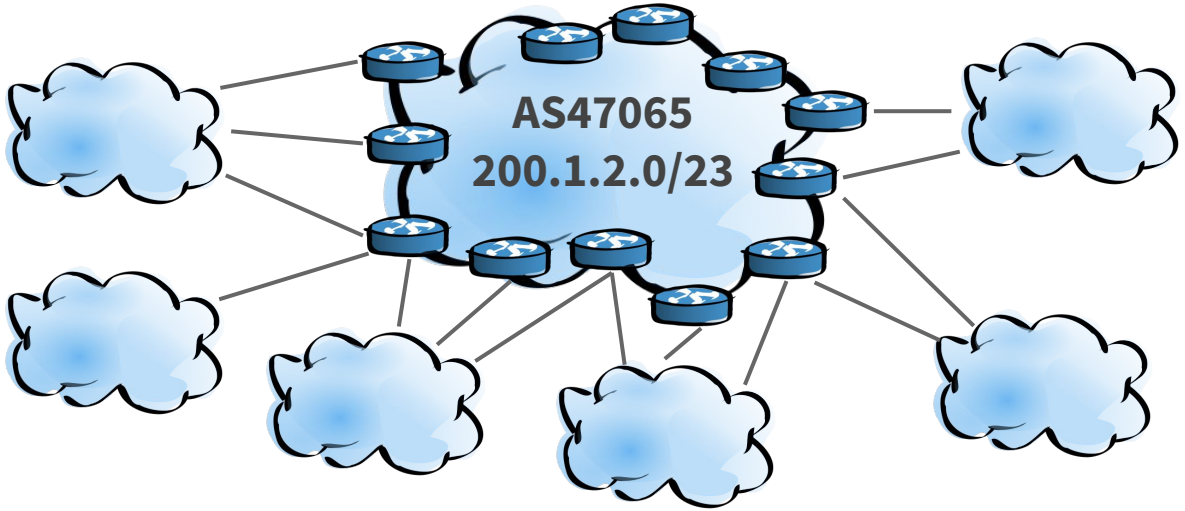
- **Connectivity with thousands of networks**
- **As much control and visibility as possible**



PEERING's Security Framework

Ensure safety

Running Traffic Engineering Experiments



Resources:
- AS number
- IP prefix

Infrastructure:
- Routers around the globe
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Tooling:
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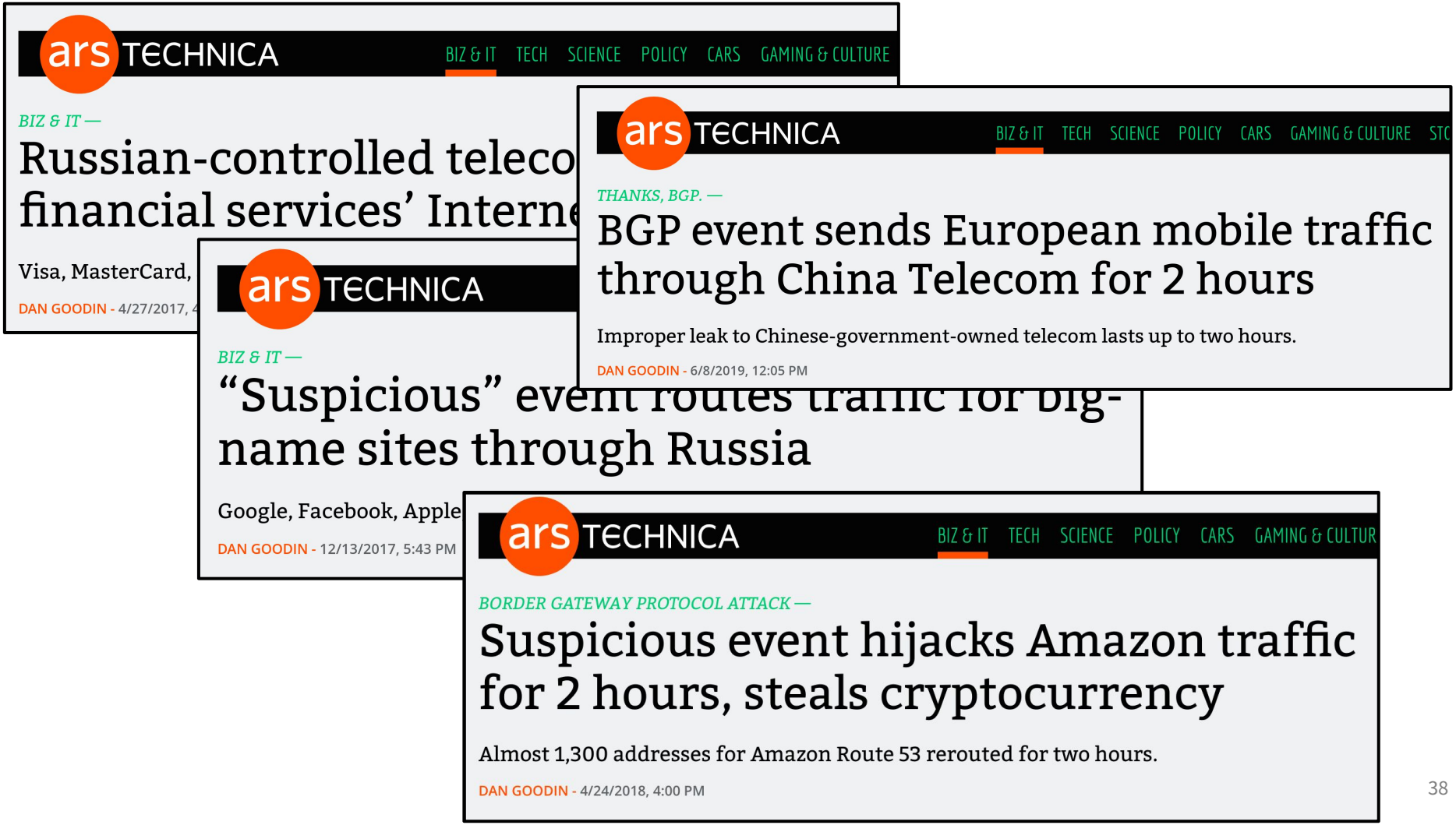
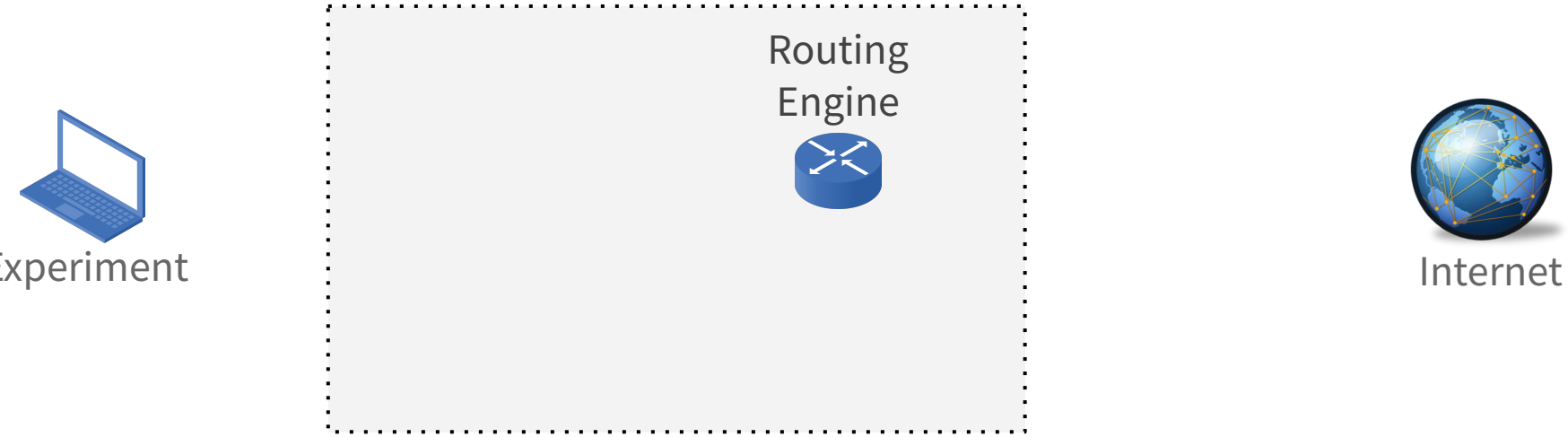

ars TECHNICA
BIZ & IT TECH SCIENCE POLICY CARS GAMING & CULTURE
BIZ & IT —
Russian-controlled teleco
financial services' Interne
Visa, MasterCard,
DAN GOODIN - 4/27/2017,
ars TECHNICA
BIZ & IT —
"Suspicious" event routes traffic for big-
name sites through Russia
Google, Facebook, Apple
DAN GOODIN - 12/13/2017, 5:43 PM
ars TECHNICA
BIZ & IT TECH SCIENCE POLICY CARS GAMING & CULTUR
BORDER GATEWAY PROTOCOL ATTACK —
Suspicious event hijacks Amazon traffic for 2 hours, steals cryptocurrency
Almost 1,300 addresses for Amazon Route 53 rerouted for two hours.
DAN GOODIN - 4/24/2018, 4:00 PM
ars TECHNICA
BIZ & IT TECH SCIENCE POLICY CARS GAMING & CULTURE STC
THANKS, BGP. —
BGP event sends European mobile traffic through China Telecom for 2 hours
Improper leak to Chinese-government-owned telecom lasts up to two hours.
DAN GOODIN - 6/8/2019, 12:05 PM

PEERING's Security Framework

Experiment

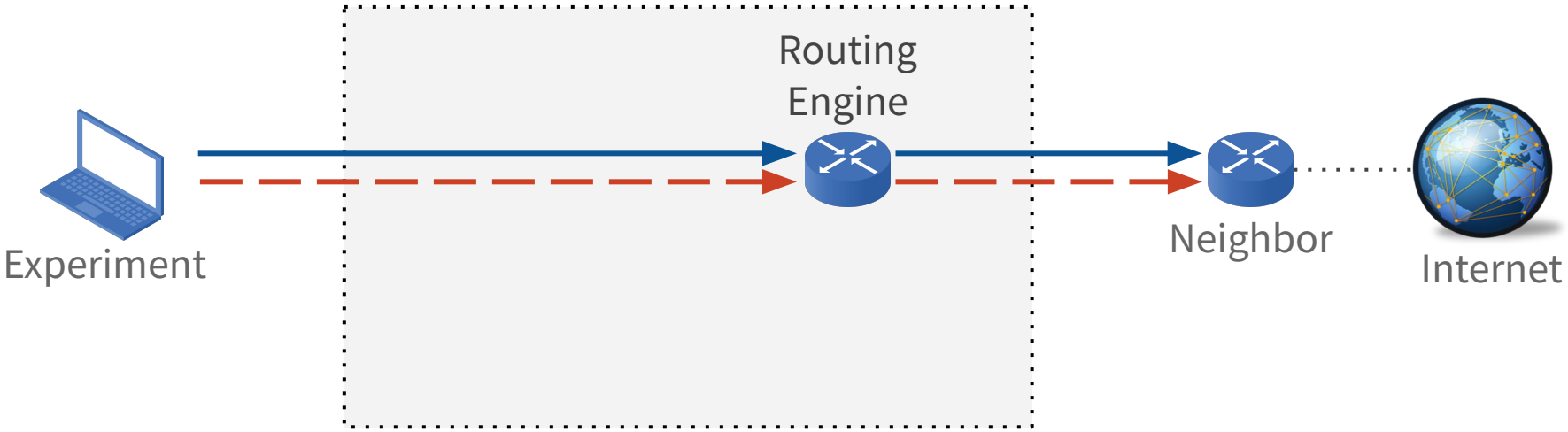
Internet

PEERING's Security Framework



Interpose between experiment and Internet
to enforce security

PEERING's Security Framework

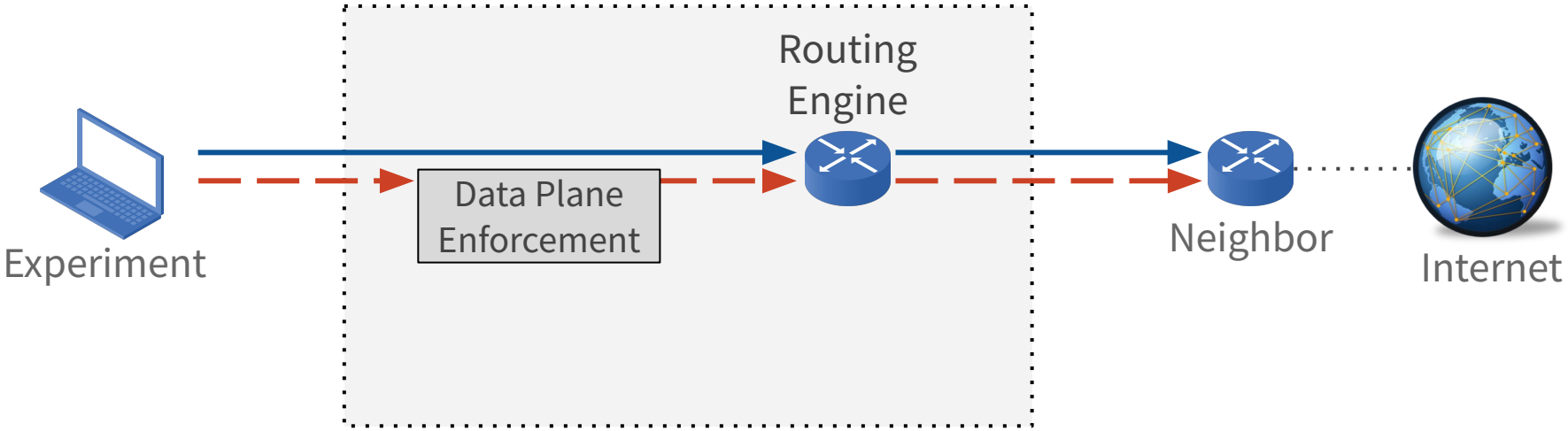


Announcements (control plane) and traffic (data plane) are intercepted and inspected.

Control Plane

Data Plane

PEERING's Security Framework

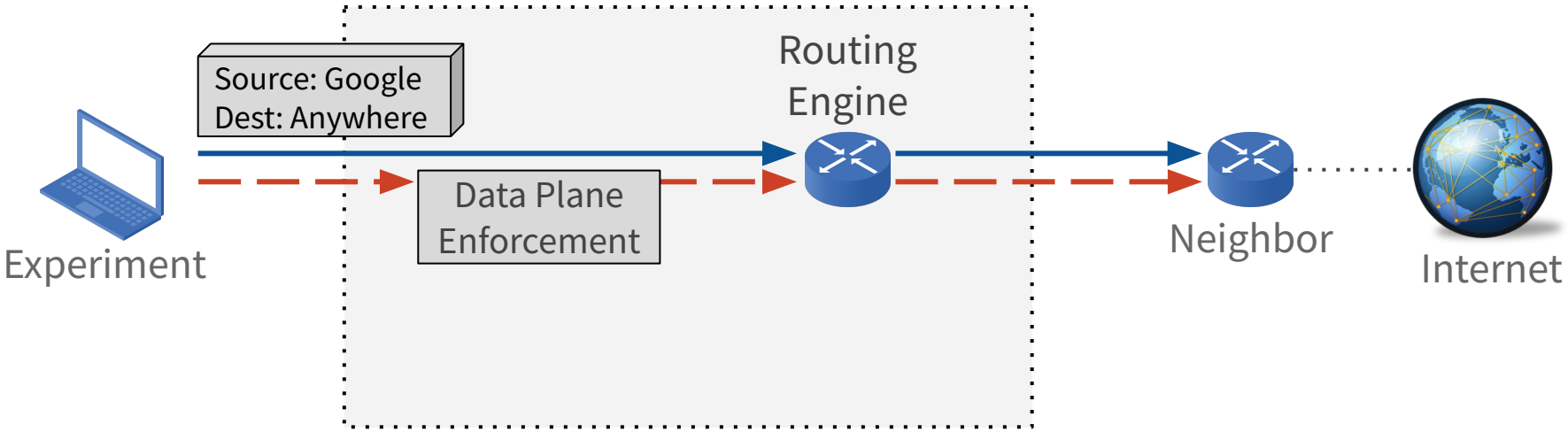


Data plane enforcement limits IP source addresses to experiment allocations and traffic rate

Control Plane

Data Plane

PEERING's Security Framework



Data plane enforcement limits IP source addresses to experiment allocations and traffic rate

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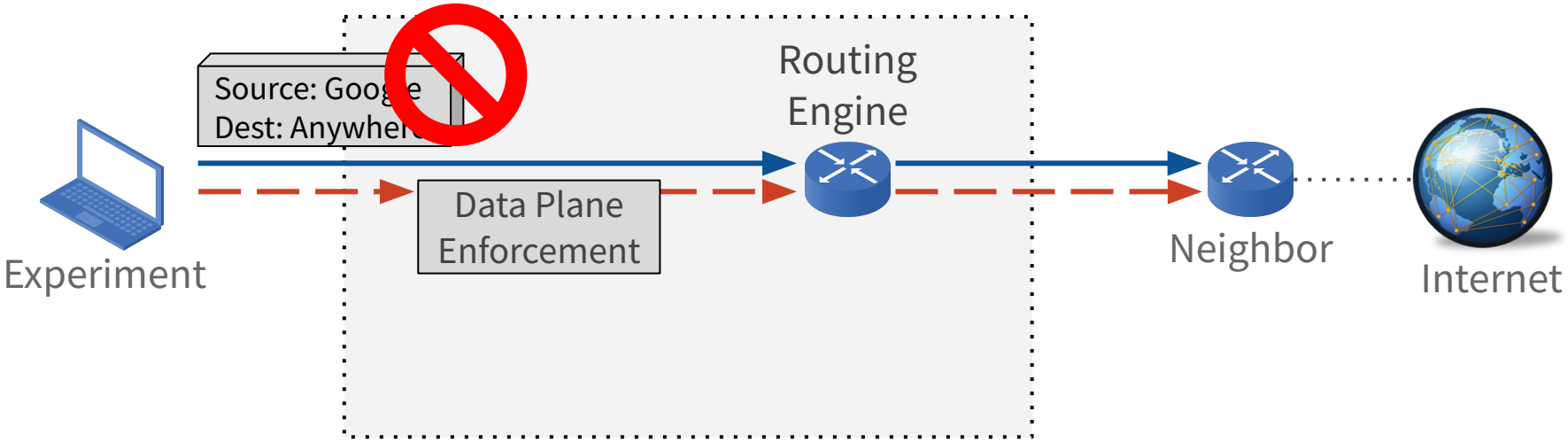
Data Plane

PEERING's Security Framework

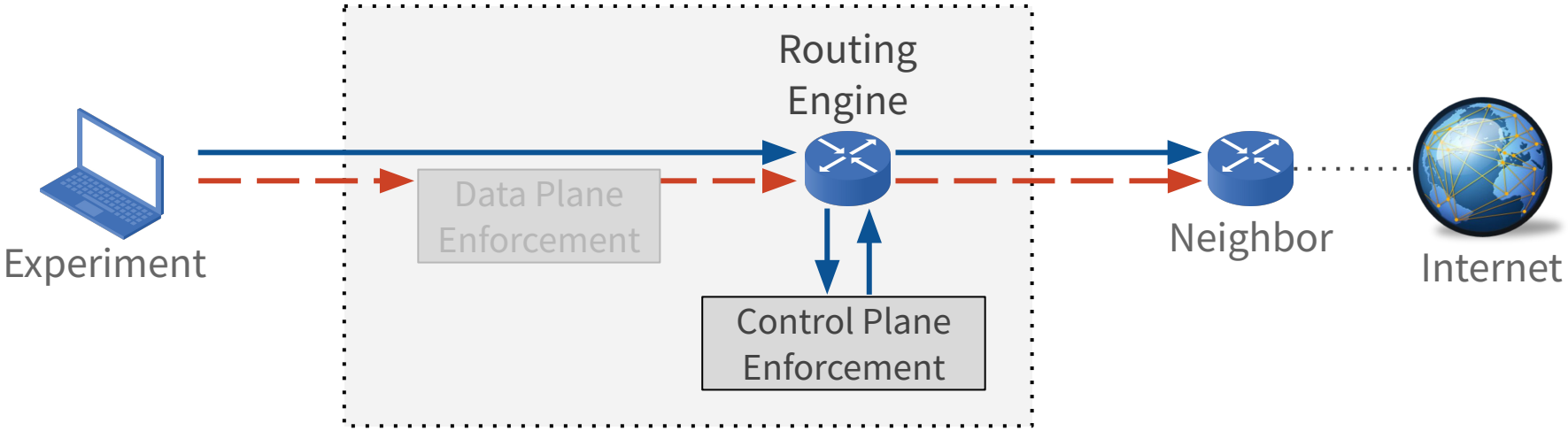


Data plane enforcement limits IP source addresses to experiment allocations and traffic rate

Control Plane

Data Plane

PEERING's Security Framework

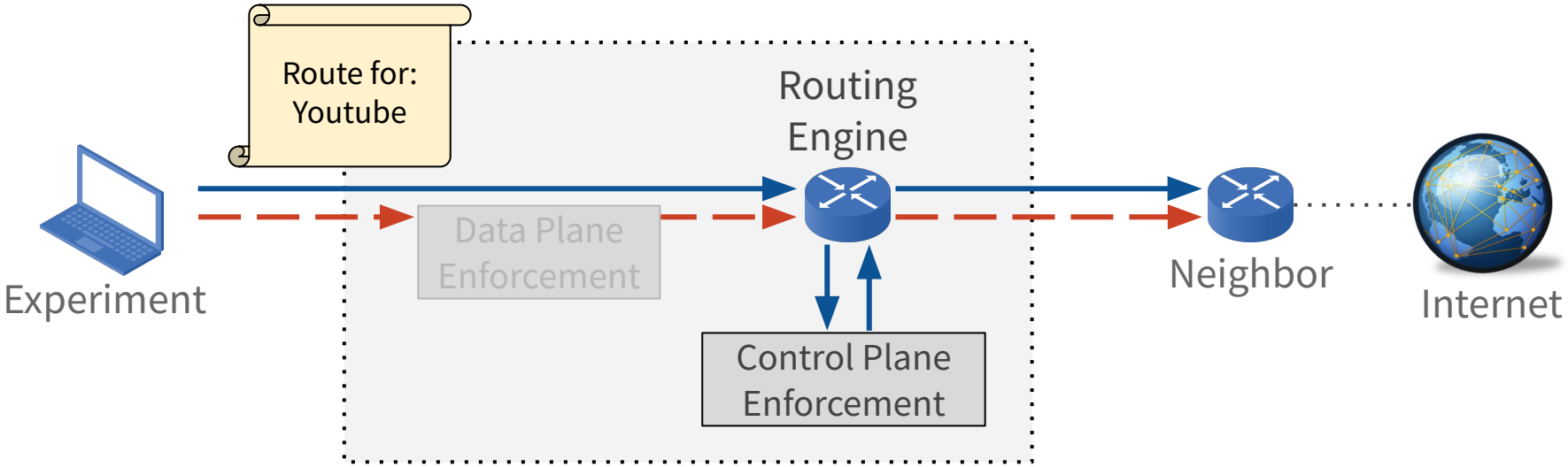


Control plane enforcement checks prefixes and announcement properties

Control Plane

Data Plane

PEERING's Security Framework



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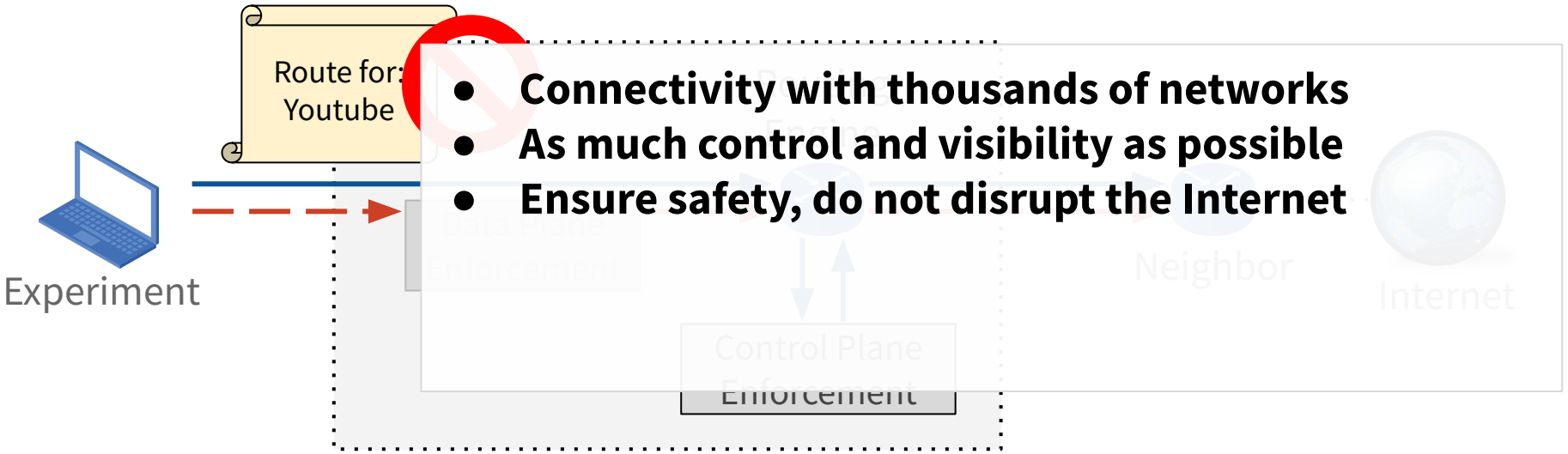

- **Connectivity with thousands of networks**
- **As much control and visibility as possible**
- **Ensure safety, do not disrupt the Internet**

Control plane enforcement checks prefixes and announcement properties

Control Plane

Data Plane

Conclusion

You can control how your FABRIC experiment exchanges traffic with the Internet

Check out PEERING at https://peering.ee.columbia.edu