



The Post-NSFNET Commercial Internet
structure 1998-2000

The

Global Internet Peering Ecosystem



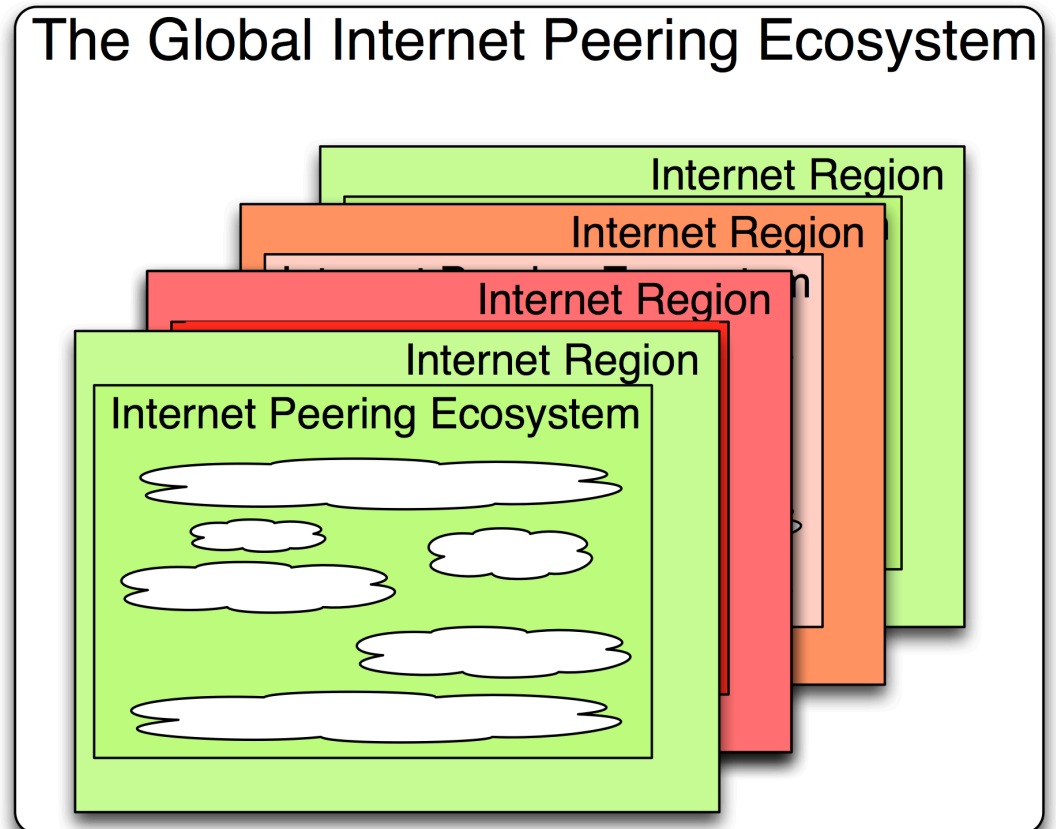
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Modeling the Internet

- Abstraction and containment models
- Identify the underlying structure of this network-of-networks
- Understand the relationships between the players and their corresponding motivations
- Perhaps predict their behavior
- Simplifying assumptions, rule generation, hypothesis and test, *calm* discussions.
- Many ways to model– this is but one.

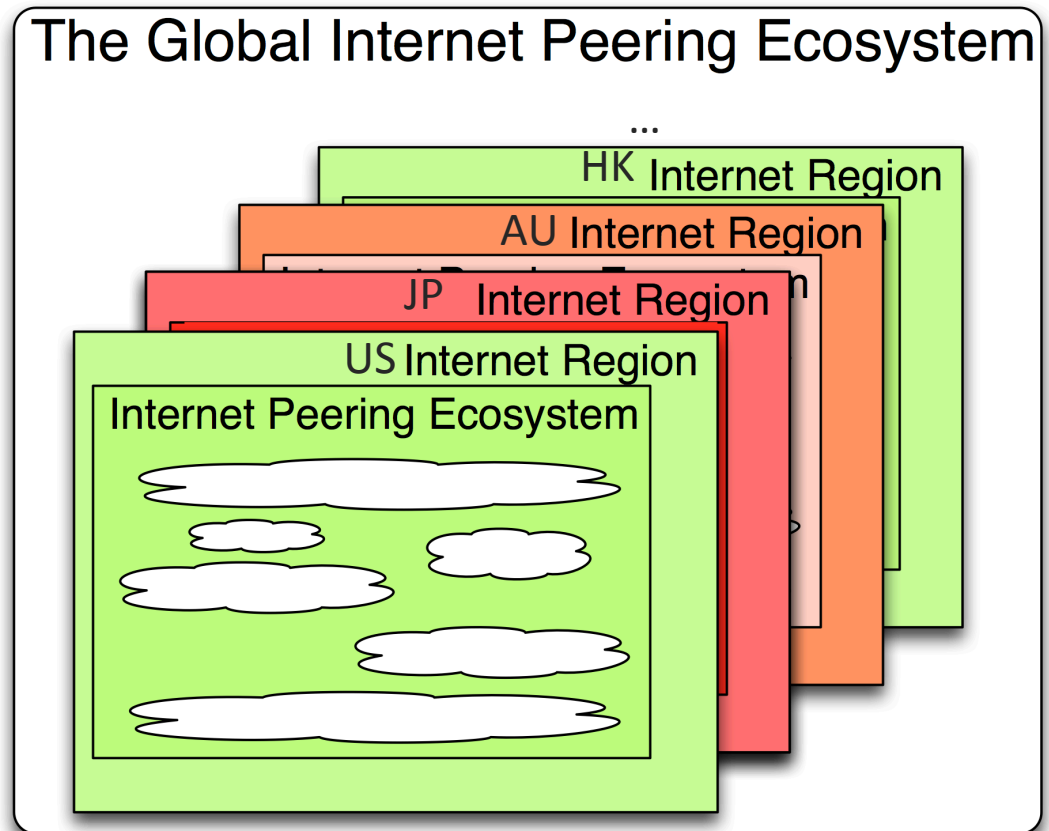
The Global Internet Peering Ecosystem

- **Definition:** The **Global Internet Peering Ecosystem** is a set of loosely coupled Internet Regions.



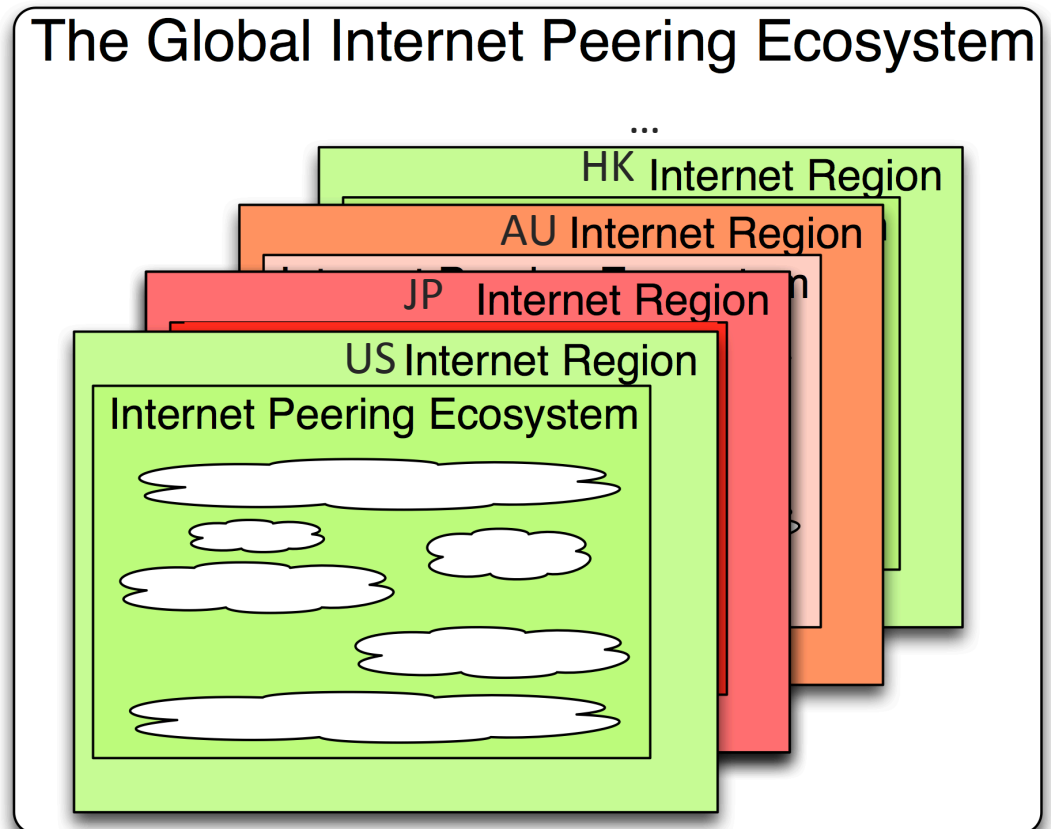
Internet Regions

- **Definition:** An **Internet Region** is the portion of the Internet contained within the boundaries of a country.
- Each Internet Region contains an Internet Peering Ecosystem.



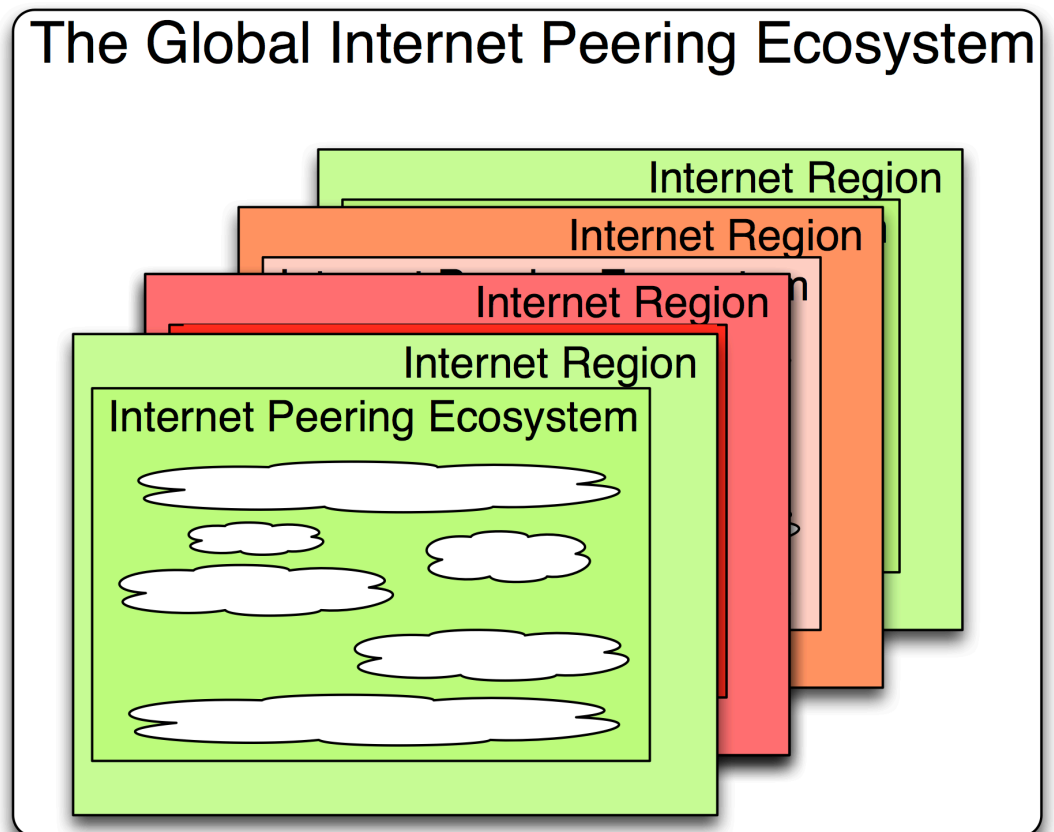
Internet Regions

- **Each Internet Region has a different set of**
 - ISPs
 - Internet Services
 - IXPs
 - Transport options
 - Point of Presence options
 - Business Contexts
 - Regulatory Environment
 - Interconnection region(s)
 - :



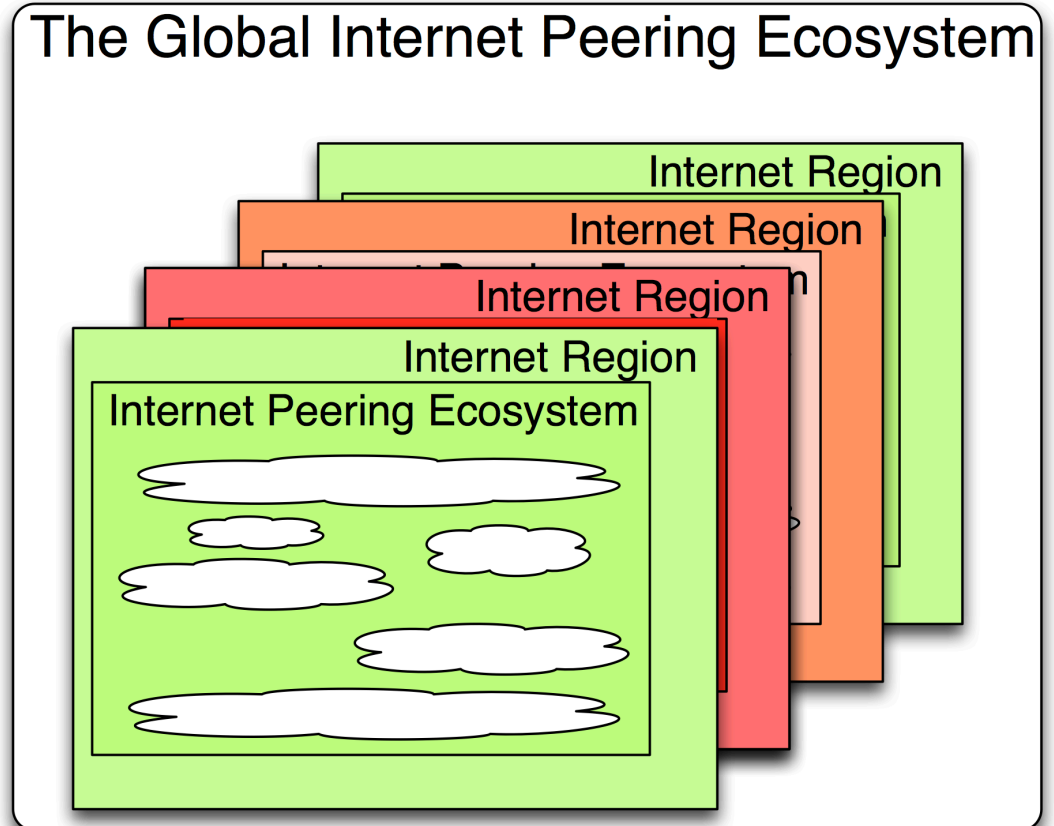
Internet Peering Ecosystem

- **Definition:** The **Internet Peering Ecosystem** is a community of network service providers that interconnect their networks in various business relationships within an Internet Region.
- Transit and Peering



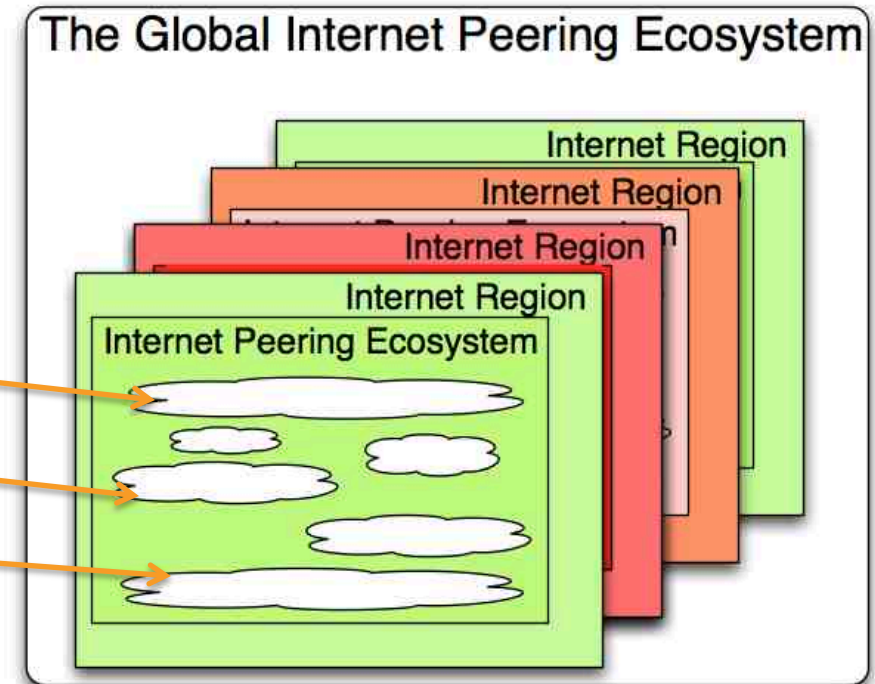
Internet Peering Ecosystem

- **Each Internet Peering Ecosystem has**
 - Categories of players
 - Aka “Species”
 - Interconnected using Transit and Peering relationships



Commercial Internet

- All Internet Peering Ecosystems are composed of at least 3 categories of players:
- Tier 1 ISPs
- Tier 2 ISPs
- Content Providers
- Interconnected using Transit and Peering
- Organically grew into this structure



We will introduce them, define them, provide a litmus test, describe behaviors observed in the wild.

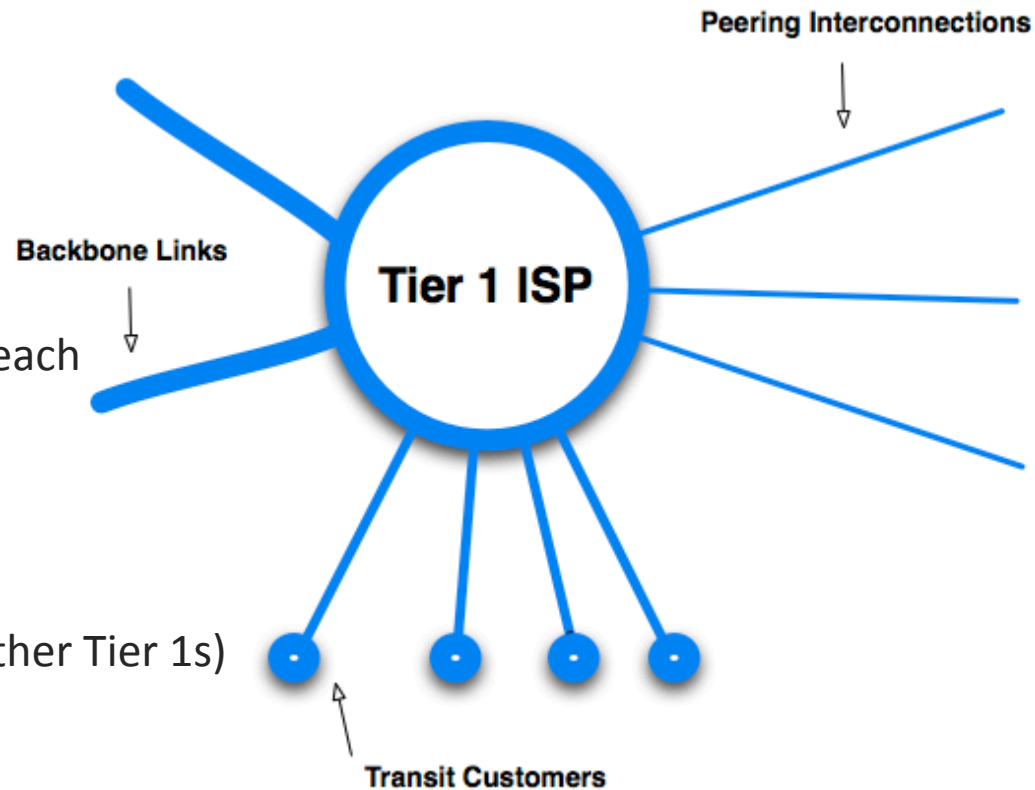
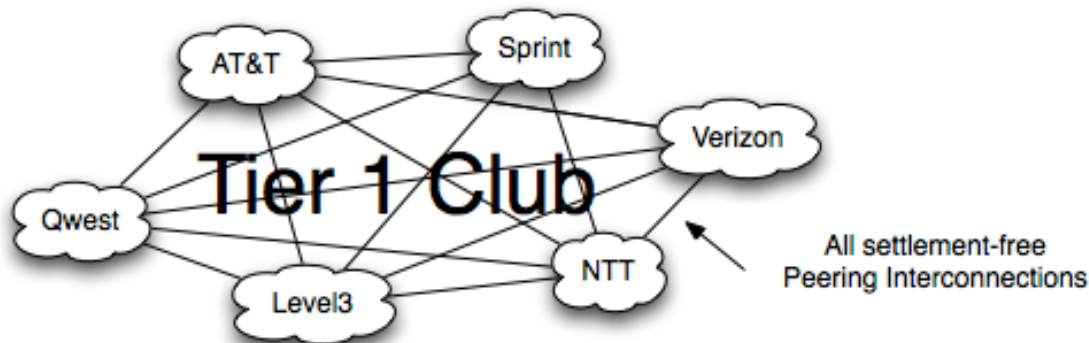
Introducing the “Tier 1 ISP”

Definition: A **Tier 1 ISP** is an ISP that has access to the entire Internet Region routing table solely through its (free) Peering relationships.

Litmus test: If they have to pay anyone to reach any destination within the Internet Region, then they are NOT a Tier 1 ISP

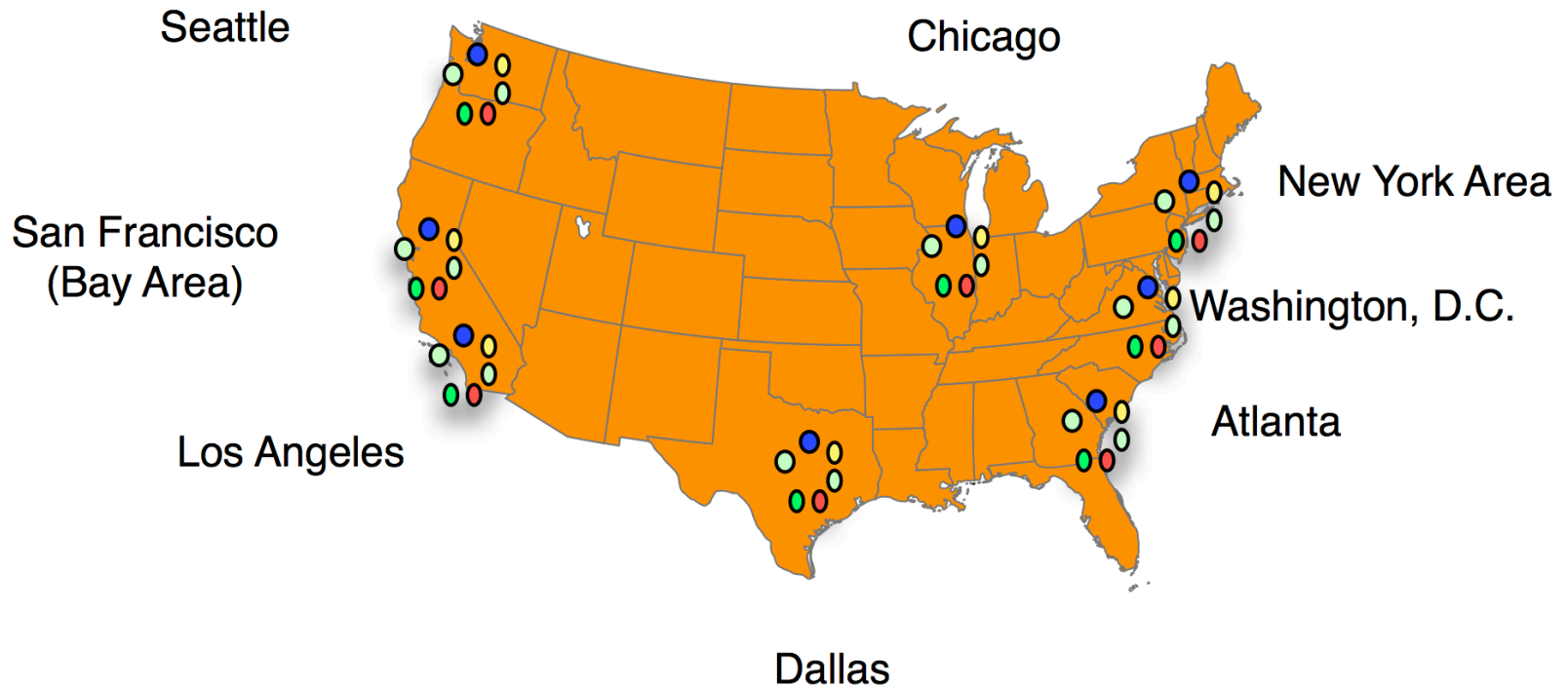
Interconnect Regime

Full Mesh Settlement Free Peering (with other Tier 1s)
Interconnect Region(s)...



The Tier 1 ISP Model

The 8 U.S. Interconnection Regions



Spread the load, more paths to destination, better performance for customers.

Behavior: Peering Inclinations and Policies

- **Definition:** A **Peering Inclination** is a predisposition towards or against peering as demonstrated by Peering behavior in a Peering Ecosystem.
- **Definition:** A **Peering Policy** is an articulation of the Peering Inclination; it documents and defines the prerequisites to peering.



Open – “Yes”

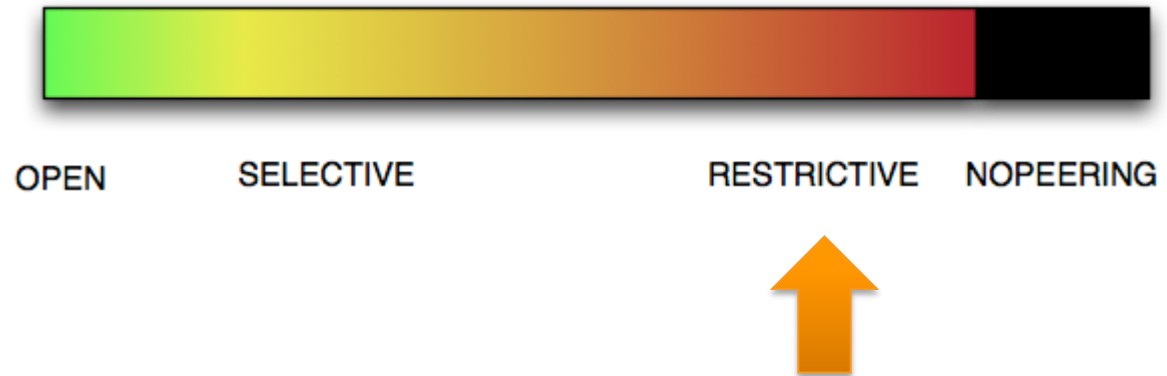
Selective – “Yes” but some preconditions

Restrictive – “No” we have all the peering we need

NOPEERING – We do not peer

Tier 1 ISP Motivations and Behaviors

- **RESTRICTIVE**



“We don’t need anymore peering;
we have all of the peering that we need” – Waqar Khan, Qwest

(Almost) Every other Tier 1 ISP in every peering ecosystem
we studied had the same attitude.

Restrictive Peering Policy

- **Definition:** A **Restrictive Peering Policy** is an articulation of an inclination not to peer with any more entities.
- Tier 1 ISPs have restrictive peering inclinations
 - May or may not have public posted peering policy
- The ‘MILD’ Peering Tactic illustrates
 - Peering “restricted to networks of similar scale and scope”
 - Comindico builds out BW for every kangaroo
 - Meetings, new meetings, new lawyers,
 - Years later bankruptcy

Criticism of the Tier 1 ISP model

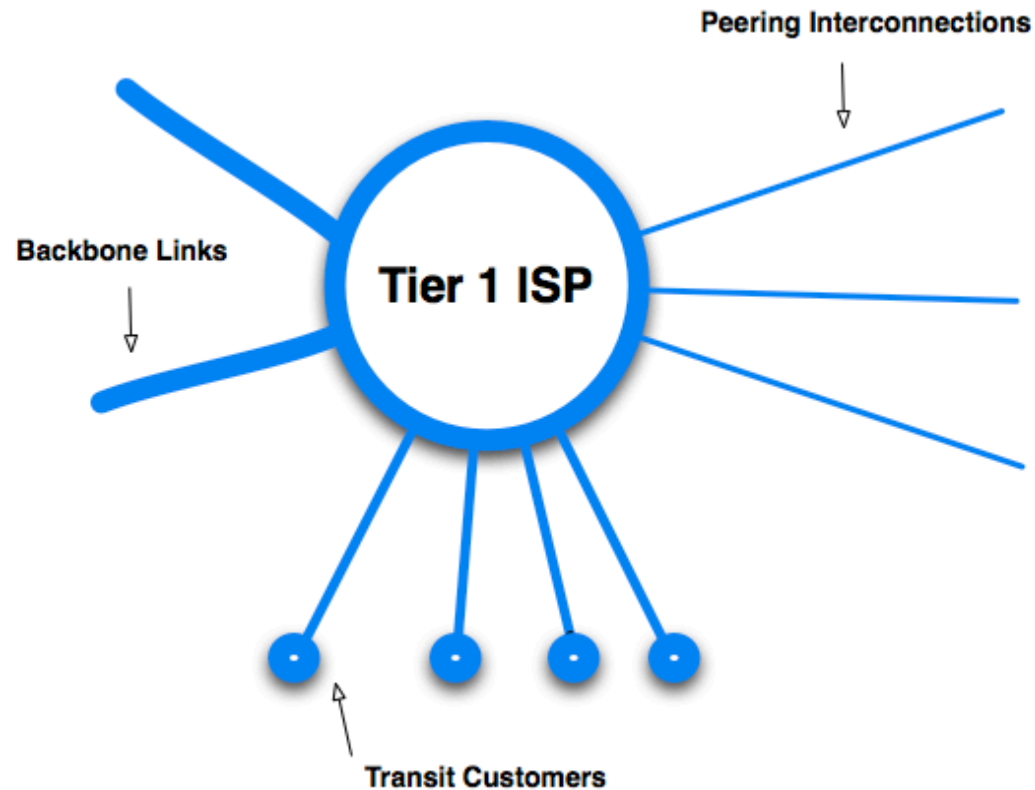
“I am a Tier 1 ISP in my house.

Internet Region is not necessarily bound by country boundaries.”

True – You are a Tier 1 in your home, and you deserve all corresponding respect.

Definition: A **Tier 1 ISP** is an ISP that has access to the entire Internet Region routing table solely through its (free) Peering relationships.

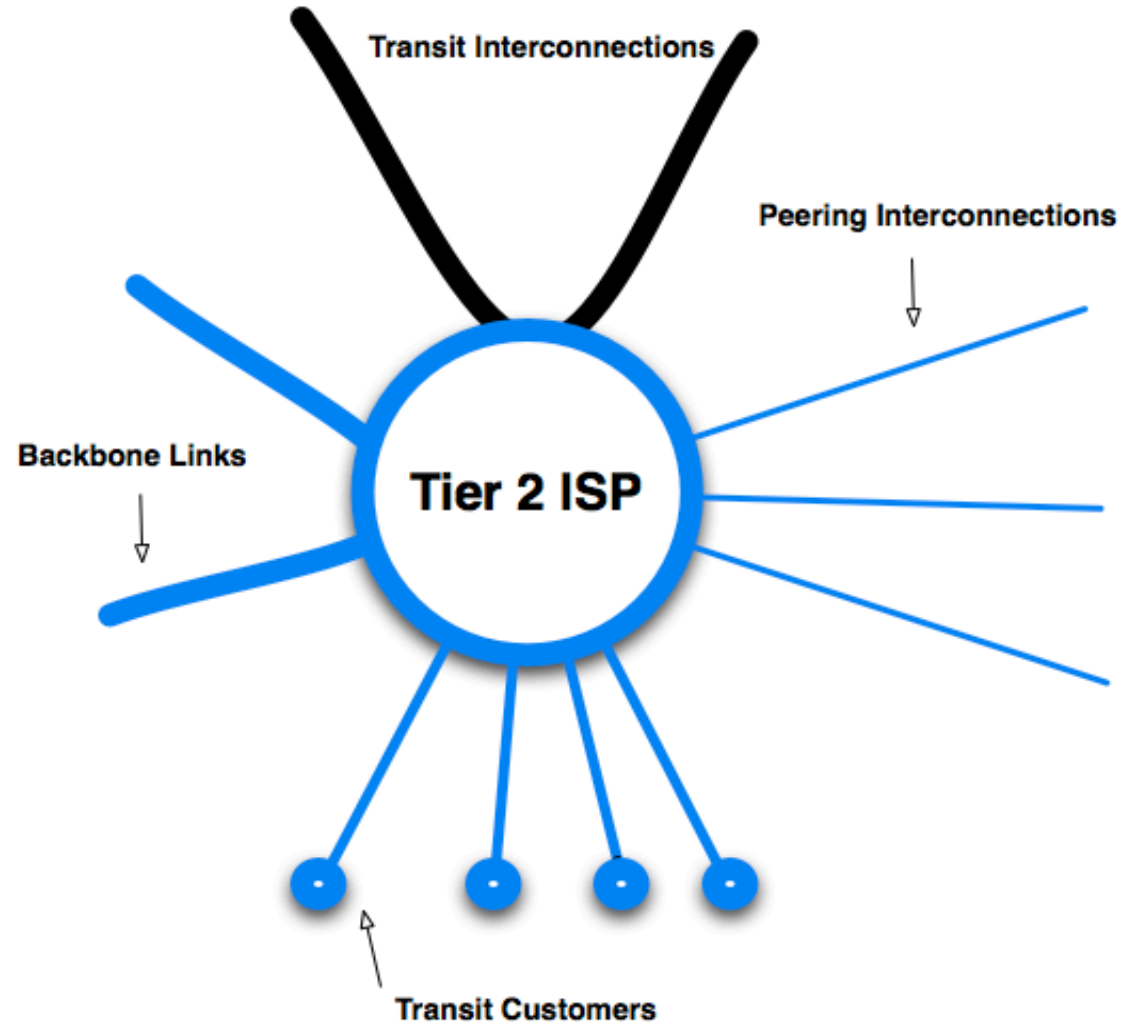
Litmus test: If they have to pay anyone to reach any destination within the Internet Region, then they are NOT a Tier 1 ISP



The Tier 1 ISP Model

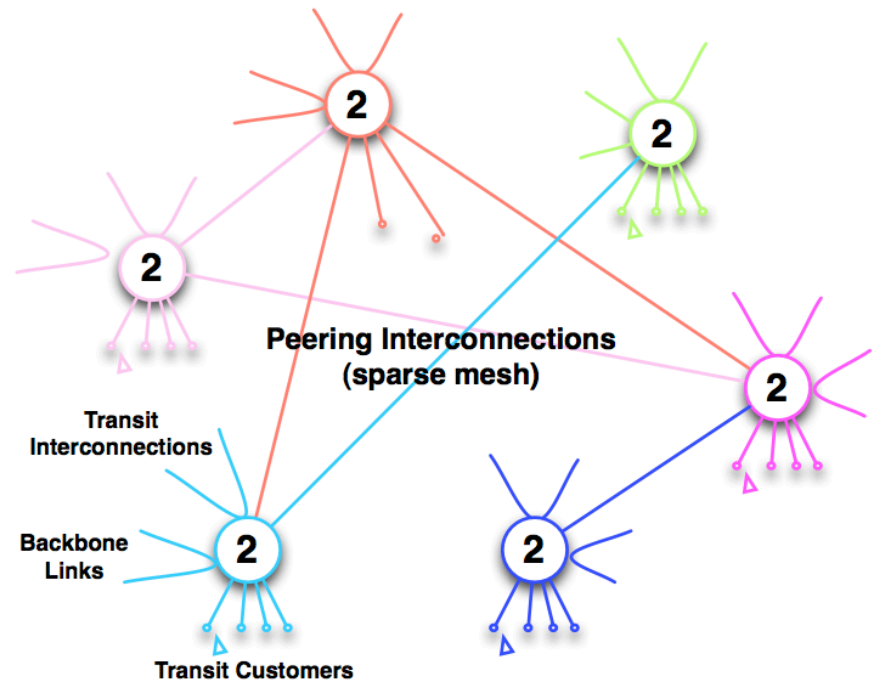
Introducing the “Tier 2 ISP” = “everyone else”

- **Definition:** A **Tier 2 ISP** is an Internet Service Provider that purchases transit to reach some destination(s) within an Internet Region.
- **Definition:** An **Open Peering Policy** is an articulation of an inclination to peer with anyone.
 - “Pulse Peering”
 - “Peering Sluts”
- **Definition:** A **Selective Peering Policy** is an articulation of an inclination to peer, but with some conditions.



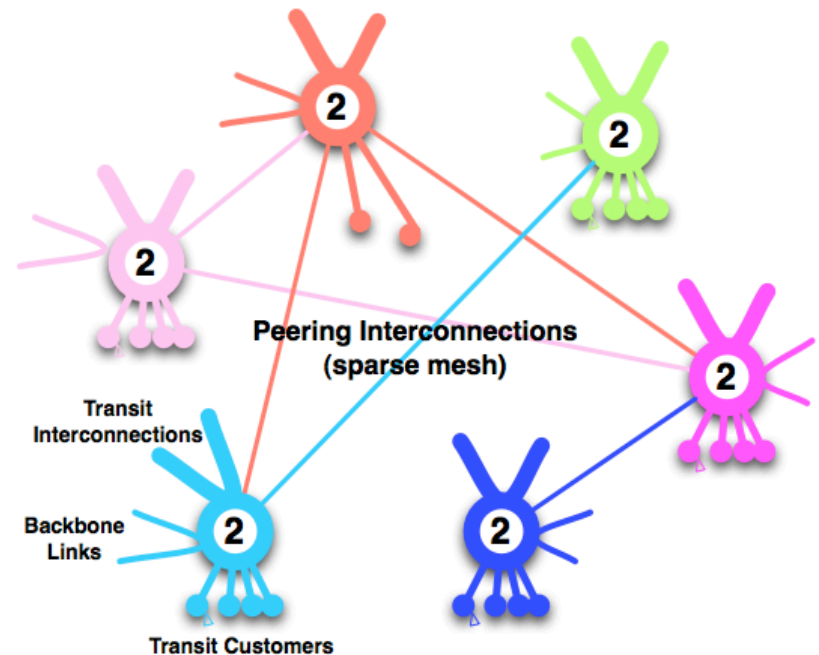
Tier 2 ISPs Behaviors

- They are a social species
- Open or Selective Peering Policy
- Motivation –reduce transit fees
- Build community
- Value of peering grows with traffic over time
- Improved performance
- Greater control over routing
- Marketing benefits



Tier 2 ISP Interconnections

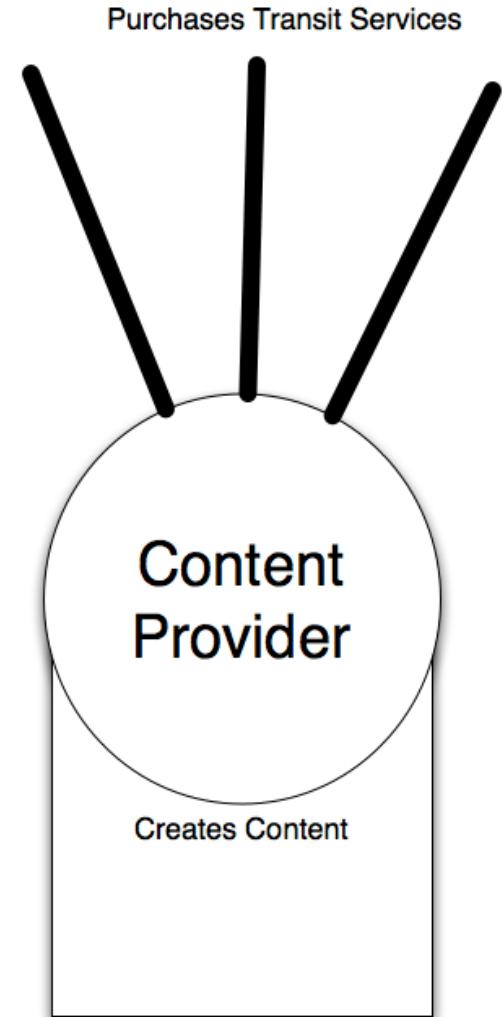
- Wholesale Transit purchase(s)
- Sparse (not full) peering
 - Open Peering Policy
 - Selective Peering Policy
- Sell transit
- Help Evangelize peering
- Support exchange points



Introducing the Content Providers

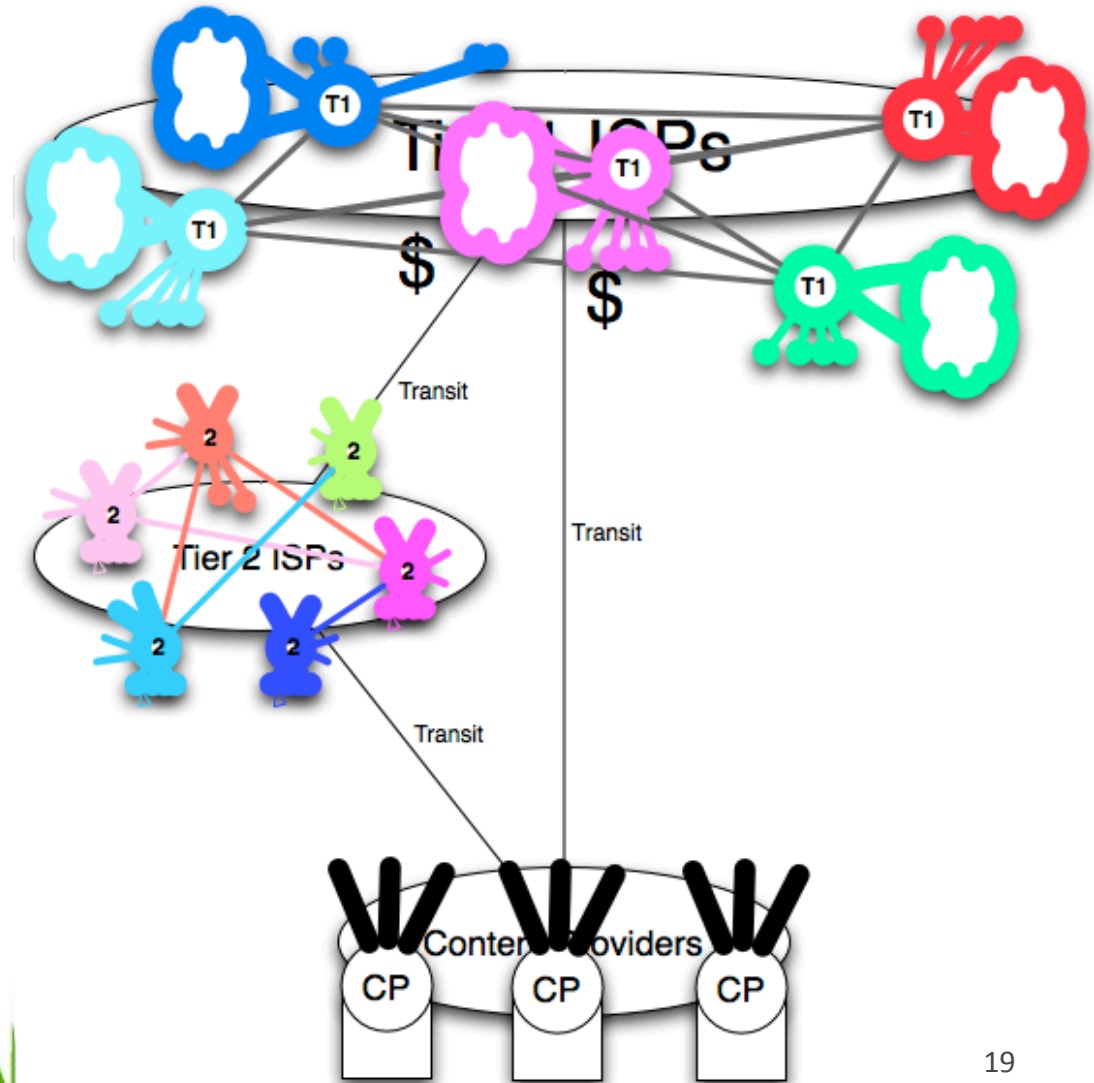
- **Definition: Content Providers** are all companies that operate an Internet Service but do not sell transit within the Internet Peering Ecosystem.

<We talk about content companies that do peer later>

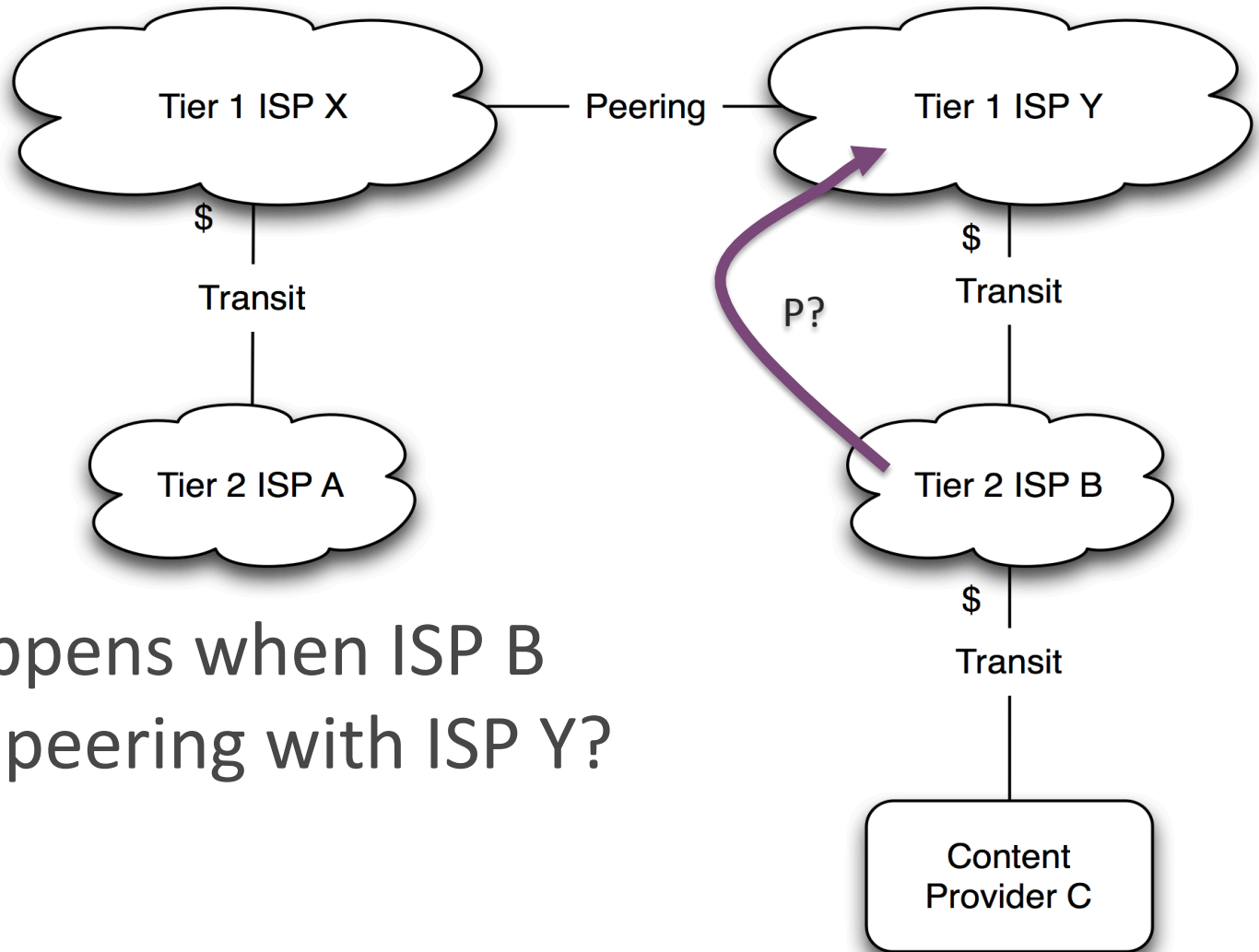


Content Provider Motivation and Behavior

- “We don’t peer”
- Stick to core competence
- No Peering Policy
- **Definition: A No-Peering Policy** is an articulation of an inclination not to peer at all.

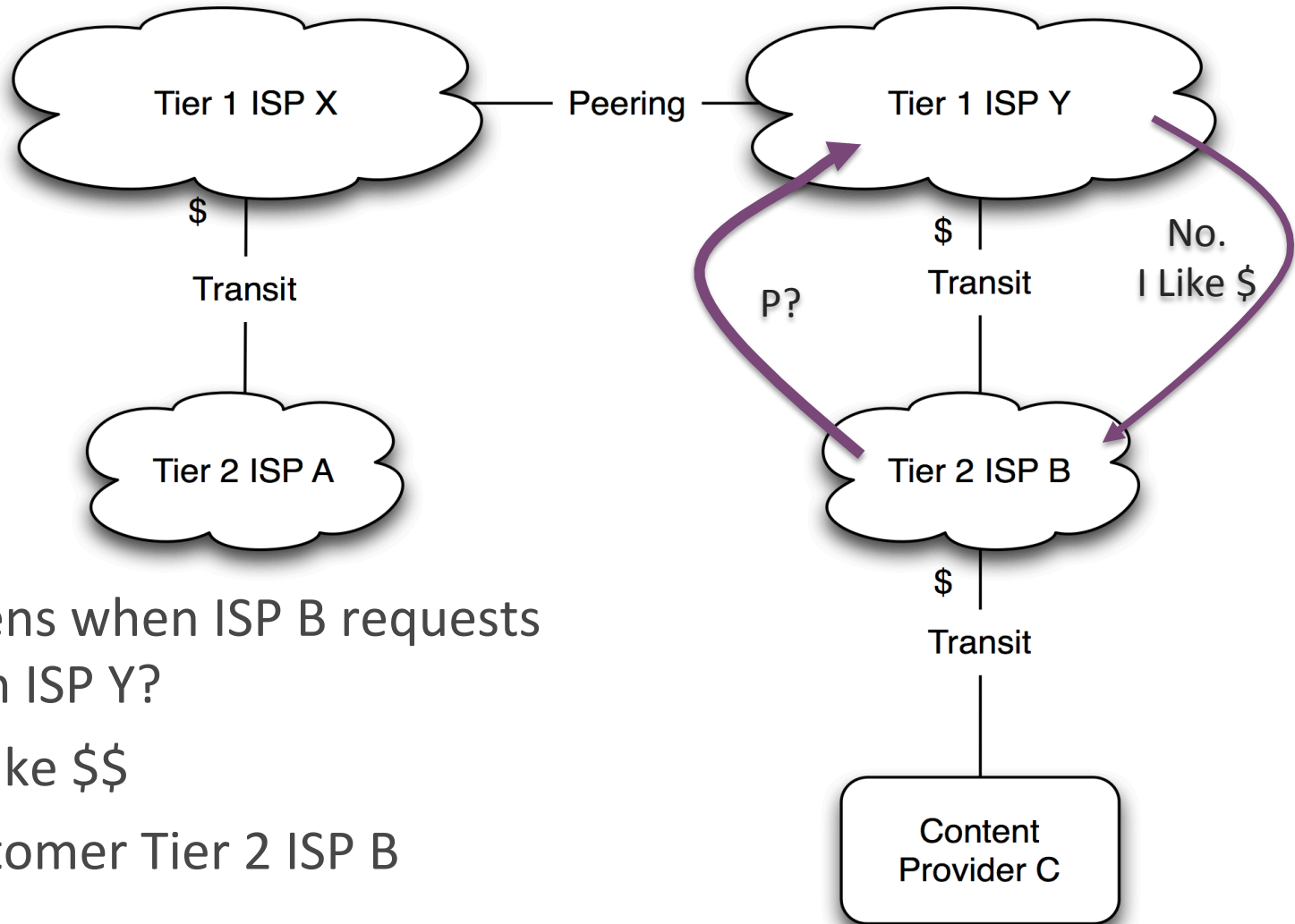


Quiz



- What happens when ISP B requests peering with ISP Y?

Quiz

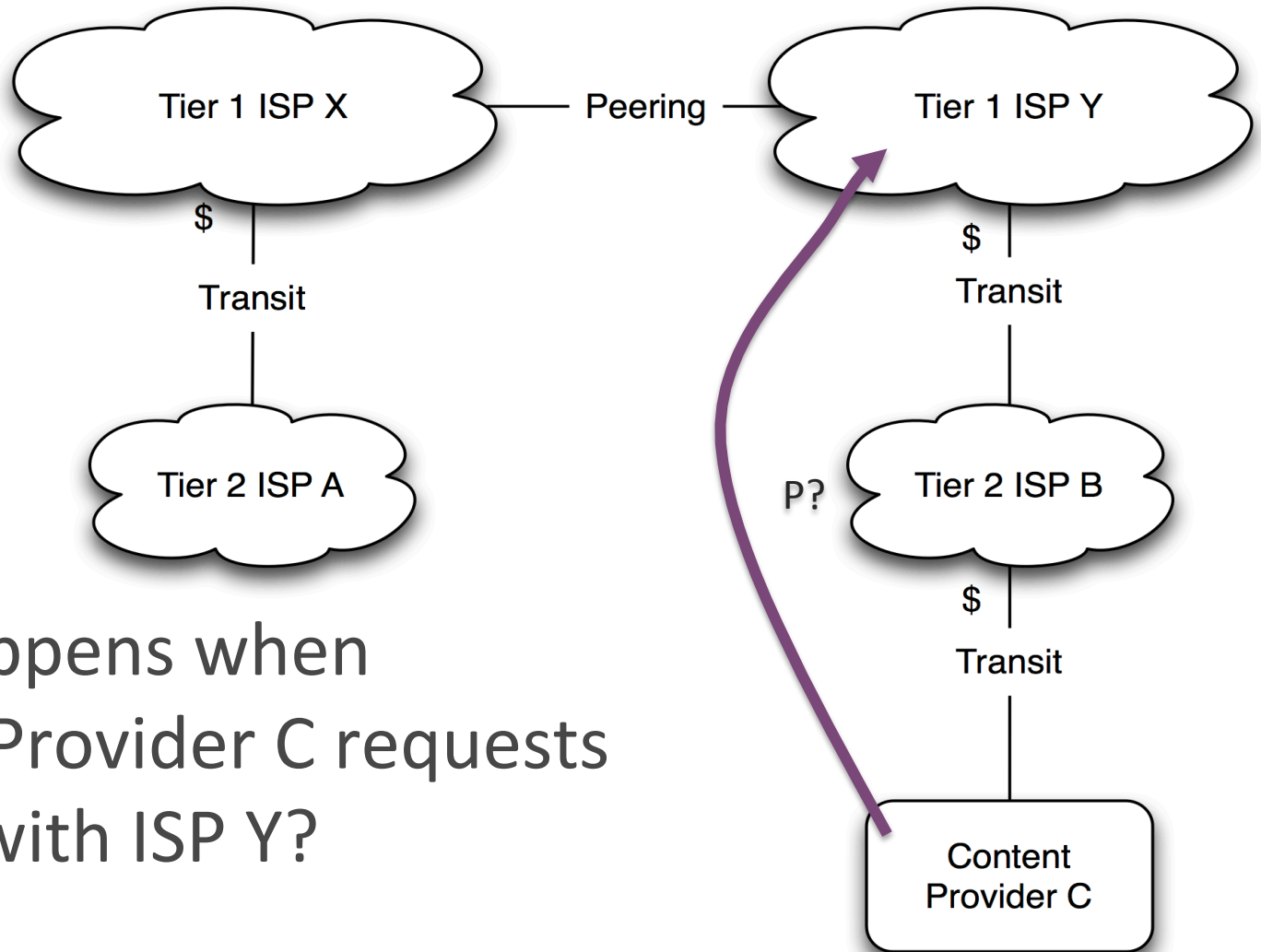


- What happens when ISP B requests peering with ISP Y?

Answer – No, like \$\$

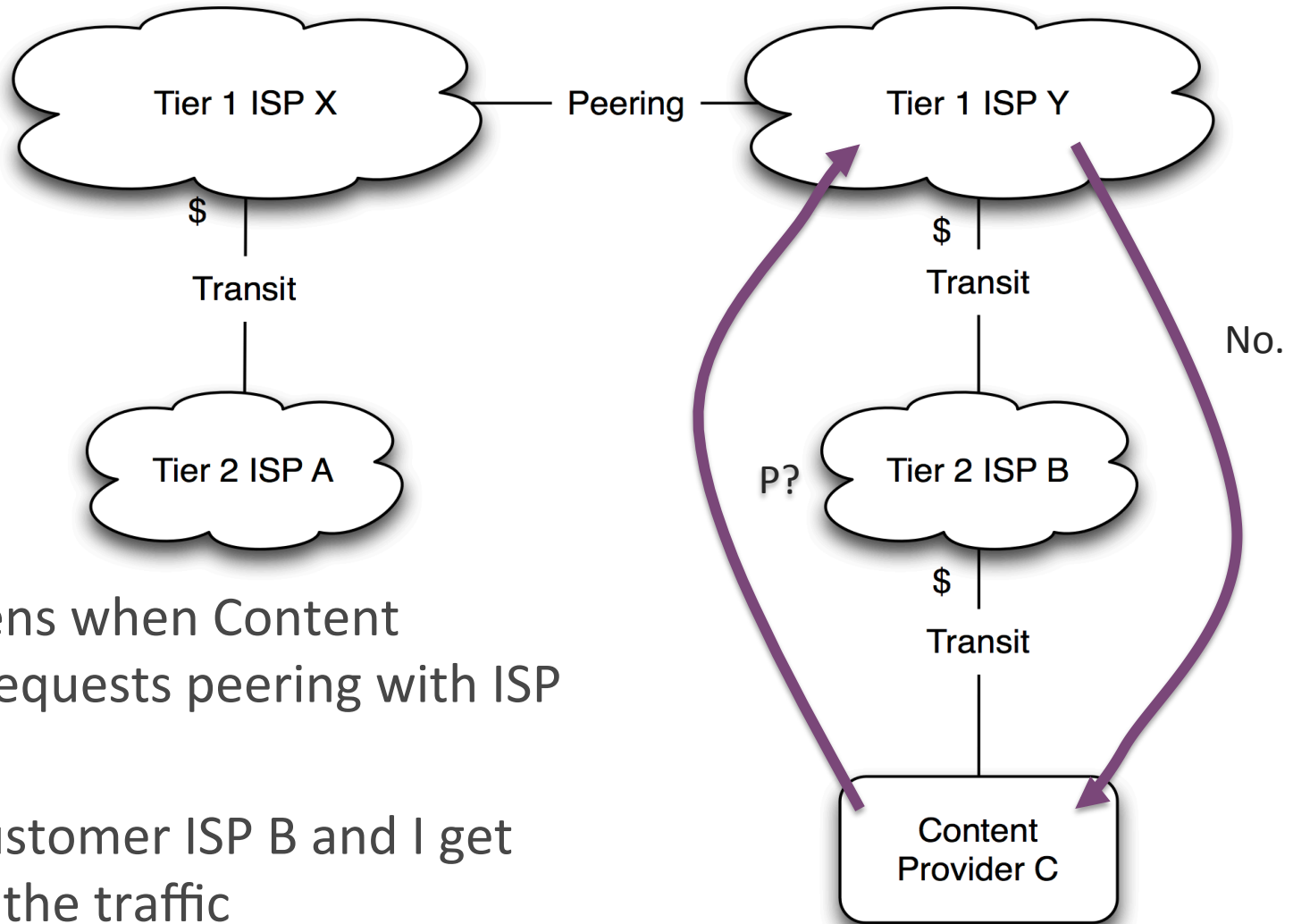
And...I like customer Tier 2 ISP B

Quiz



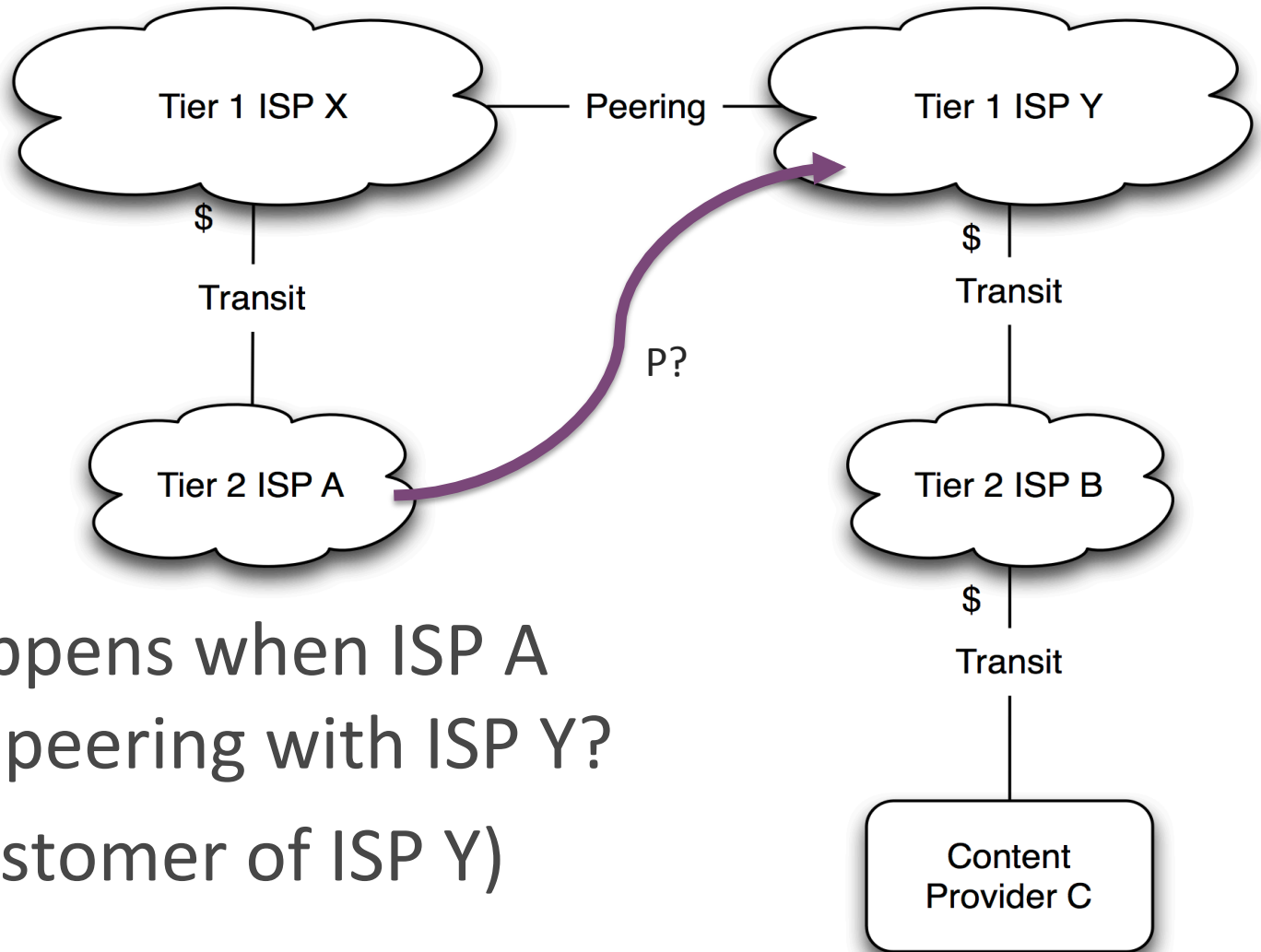
- What happens when Content Provider C requests peering with ISP Y?

Quiz



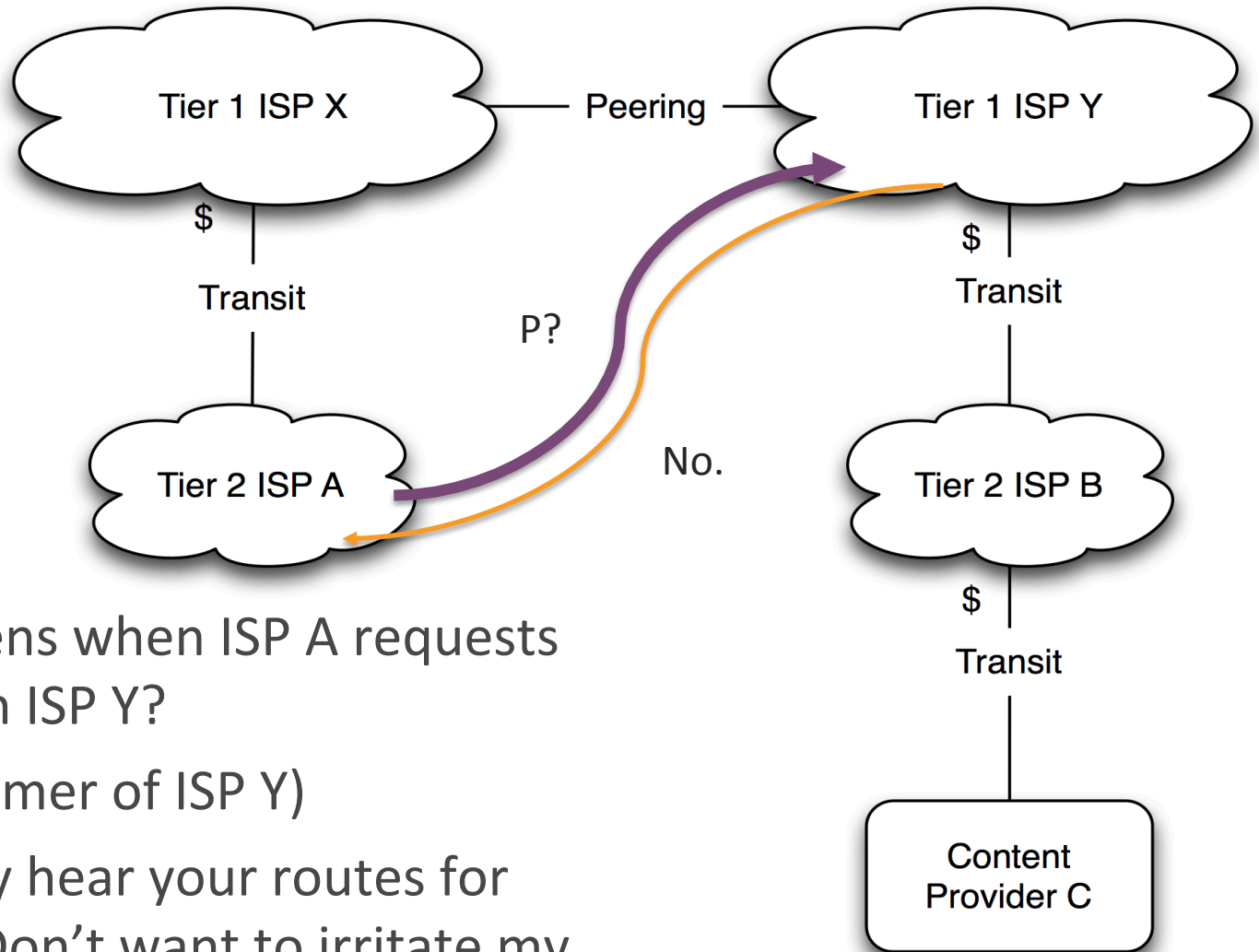
- What happens when Content Provider C requests peering with ISP Y?
- No, I Like Customer ISP B and I get revenue for the traffic

Quiz



- What happens when ISP A requests peering with ISP Y?
- (Not a customer of ISP Y)

Quiz



- What happens when ISP A requests peering with ISP Y?
- (Not a customer of ISP Y)
- No, I already hear your routes for free. And I Don't want to irritate my peer.

Applied to Real Internet Peering Ecosystem

- Why won't Telstra peer with me in Australia?
- Why won't Singapore peer with me in Singapore?
- Why won't Telekom SA peer with me?

Applied to Real Internet Peering Ecosystem

- Why won't Telstra peer with me in Australia?
- Why won't Singapore peer with me in Singapore?
- Why won't Telekom SA peer with me?
- That's right – they don't need to. And they are no different from any other Tier 1 ISP anywhere else in the world.