



GRAND DUCHY OF LUXEMBOURG  
Ministry of Foreign Affairs

Directorate for Development Cooperation



European Union Africa  
Infrastructure Trust Fund

# Regional Interconnection Strategy for Africa

## Regional Peering and Interconnection Economics



# 1

Connecting to the Edge of the Internet

## **INTERNET TRANSIT**

# Overview of Internet Transit

- ❑ Start assuming no knowledge
- ❑ Assume the Internet exists
- ❑ To get connected, connect to someone who is already connected
- ❑ Internet Transit service
  - Measurement and pricing models
- ❑ Exercise these definitions with
  - The Internet Transit Playbook

# Internet Transit

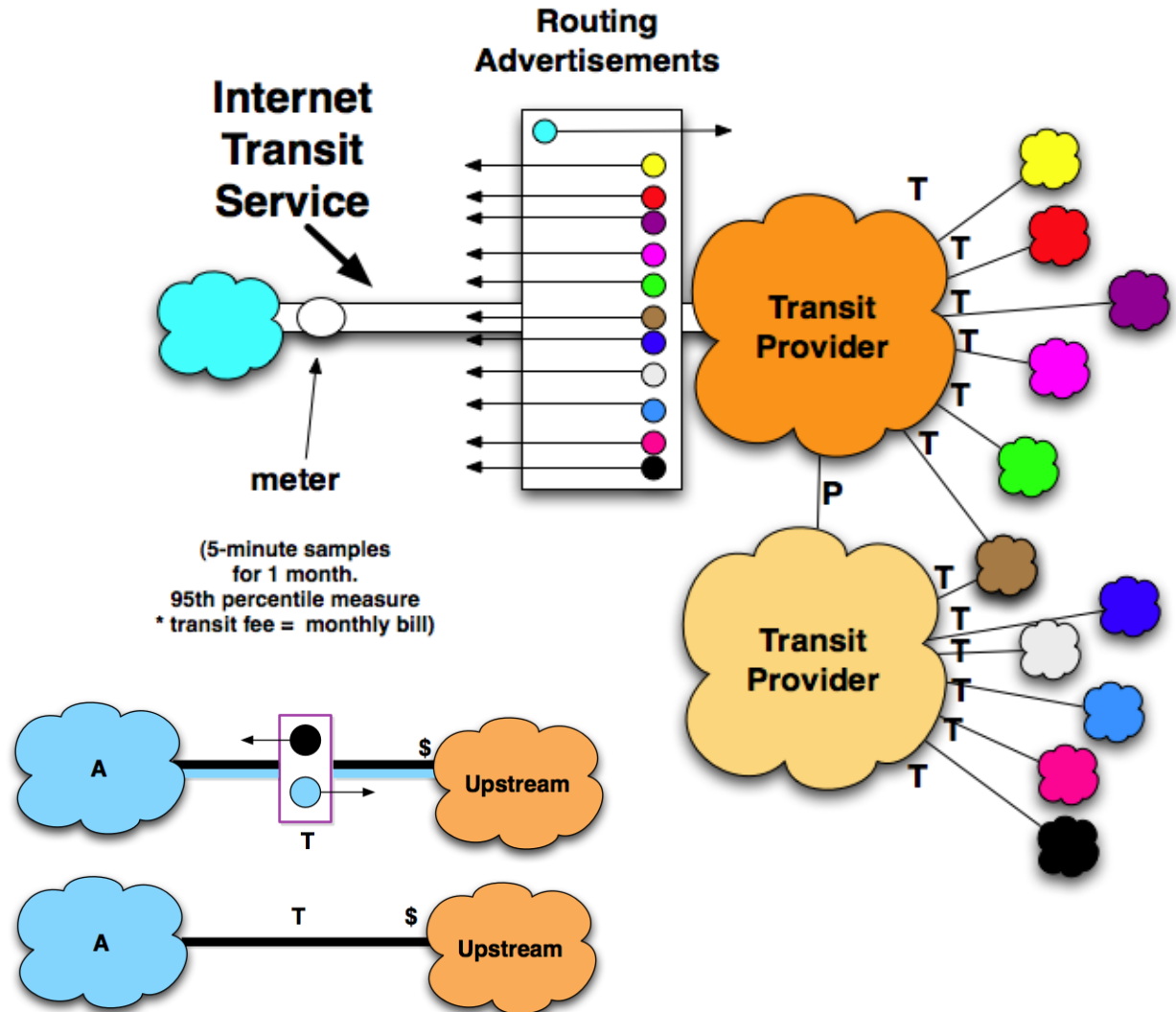
- **Definition: Internet Transit** is the business relationship whereby an entity provides (usually sells) access to the Internet.

**"Internet → this way"**

- **Definition: An Internet Service Providers (ISP)**, also called a “Transit Provider”, is an entity that sells access to the Internet.

# Internet Transit Service

- Announce Reachability
- Metered Service
- Simple
- “Internet → This Way”
- Equivalent Notations



# Internet Transit Pricing Model

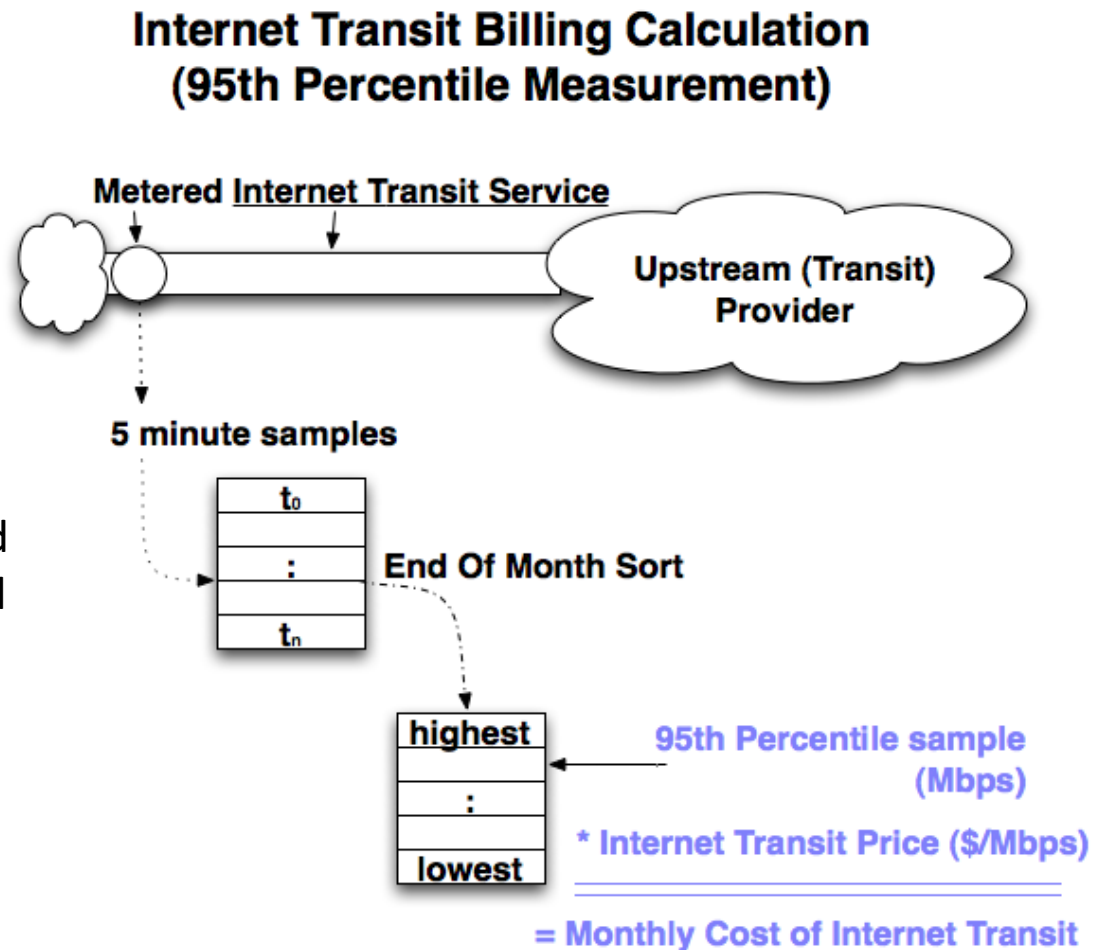
- Typically metered
- \$/Mbps
- Volume measured at 95<sup>th</sup> percentile
- **Definition:** The **95th Percentile Measurement Method** (also called 95/5) uses a single measurement (the 95<sup>th</sup> percentile 5 minute sample for the month) to determine the transit service volume for monthly transit fee calculation.

# 95<sup>th</sup> Percentile Billing Calculation

- 5 minute samples
- Month of deltas
- 95<sup>th</sup> percentile
- Max(in,out)
- Origin of 95<sup>th</sup>?

Question: at 95<sup>th</sup> I send 500Mbps and receive 800Mbps. My transit is priced at \$10/Mbps. What is my monthly Internet transit bill?

- a) \$5,000
- b) \$8,000
- c) \$13,000
- d) None of the above



# Origin of the 95<sup>th</sup> Percentile

- Charged based on pipe capacity
- T1 Internet Service pricey
- Paid as if you filled it up 24/7
- Peak usage – bursty penalties
- 95<sup>th</sup> allows for 5% bursts
- Market adopted it



# Transit Pricing with Commits

➤ Volume discounts

➤ Contracts with terms and duration

Commit	Unit Price	MinSpend
10 Mbps	\$12 per Mbps	\$120 /month
100 Mbps	\$5 per Mbps	\$500 /month
1 Gbps	\$3.50 per Mbps	\$3,500 /month
10 Gbps	\$1.20 per Mbps	\$12,000 /month
100 Gbps	\$0.70 per Mbps	\$70,000 /month

$$monthlyBill = \max(T_v * P_c, C * P_c)$$

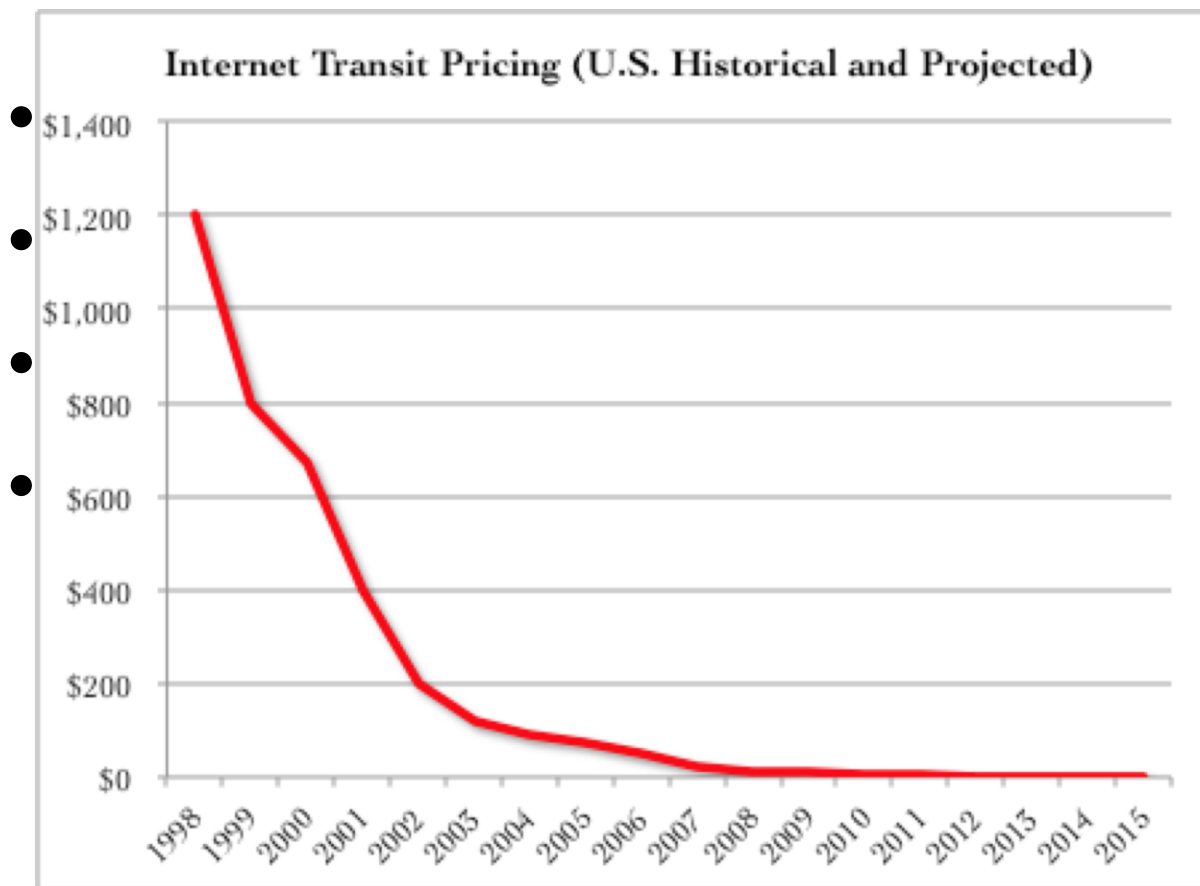
where

$T_v$  = transitVolume\_in\_Mbps

$C$  = commitLevel\_in\_Mbps

$P_c$  = unitPrice\_at\_commitLevel\_in\_\$\_per\_Mbps

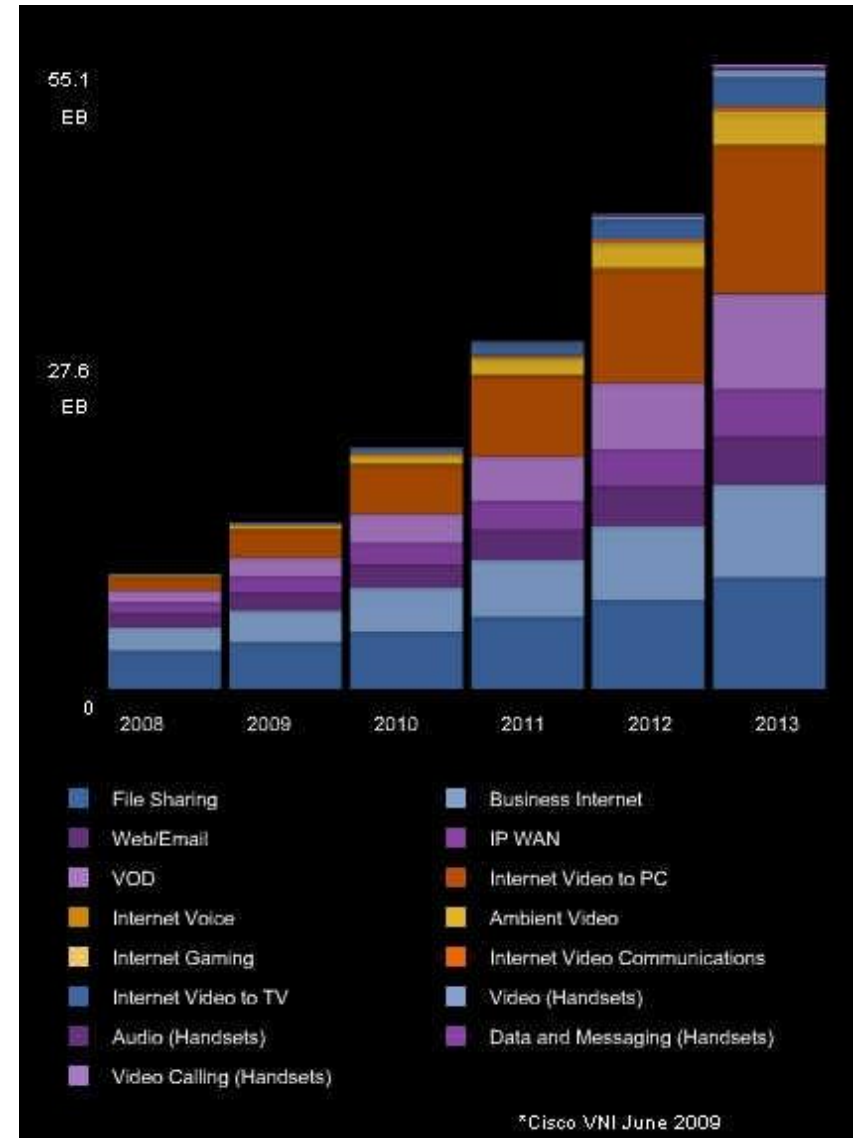
# Internet Price Declines (U.S.)



Price (in min t)		% Decline
\$1,200	per Mbps	
\$800	per Mbps	33%
\$675	per Mbps	16%
\$400	per Mbps	40%
\$200	per Mbps	50%
\$120	per Mbps	40%
\$90	per Mbps	25%
\$75	per Mbps	17%
\$50	per Mbps	33%
\$25	per Mbps	50%
\$12	per Mbps	52%
\$9.00	per Mbps	25%
\$5.00	per Mbps	44%
\$3.25	per Mbps	35%
2012	\$2.34 per Mbps	28%
2013	\$1.57 per Mbps	33%
2014	\$0.94 per Mbps	40%
2015	\$0.63 per Mbps	33%

# Internet Transit Growth

- Massive growth in Video
- Price Decline at 30%
- Volume grows at 60%



# 7 Observations About Internet Transit

1. Simple Service
2. Metered Service
3. Transit Commits and Discounts
4. Contract Terms
5. Is a Commodity
6. Customer-Supplier Relationship
7. May have SLAs (joke)

# Problem Sets

1. I am purchasing Internet Transit from ISP A for \$5 per Mbps with no commits. At the end of the month I send 500 Mbps and receive 800Mbps at the 95<sup>th</sup> percentile. What is my monthly bill for Internet Transit?  
A)\$5/month B) \$2500/month C) \$4000/month d) \$6500/month
2. I am purchasing Internet Transit from ISP B for \$5 per Mbps but I am considering buying their 1Gbps commit transit product at a price of \$3/Mbps. I still expect to send 500 Mbps and receive 800Mbps at the 95<sup>th</sup> percentile. Should I commit to 1Gbps?

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(C)  $\text{Max}(500\text{Mbps}, 800\text{Mbps}) * \$5/\text{Mbps} = \$4000/\text{month}$

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YES – Commit early

$\text{Max}(500\text{Mbps}, 800\text{Mbps}) * \$5/\text{Mbps} = \$4000/\text{month}$

Vs.

$1000\text{Mbps} * \$3/\text{Mbps} = \$3000/\text{month}$

# 2

Connecting to the Core of the Internet

## **INTERNET PEERING**

# Overview of Internet Peering

- ❑ Introduce Internet Peering
- ❑ List 3 key points about how *Internet Peering* is different from *Internet Transit*
- ❑ List top five motivations ISPs gave for peering
- ❑ Understand the Internet Peering Process



# The most common question at Peering Forums

Q: “Internet Transit is so cheap, why do we need anything else?”

- “Why bother with Peering?”
- “Transit is so cheap (\$1-\$3/Mbps)”
- “and Transit keeps getting cheaper”

➤ “Does Peering make sense anymore?”

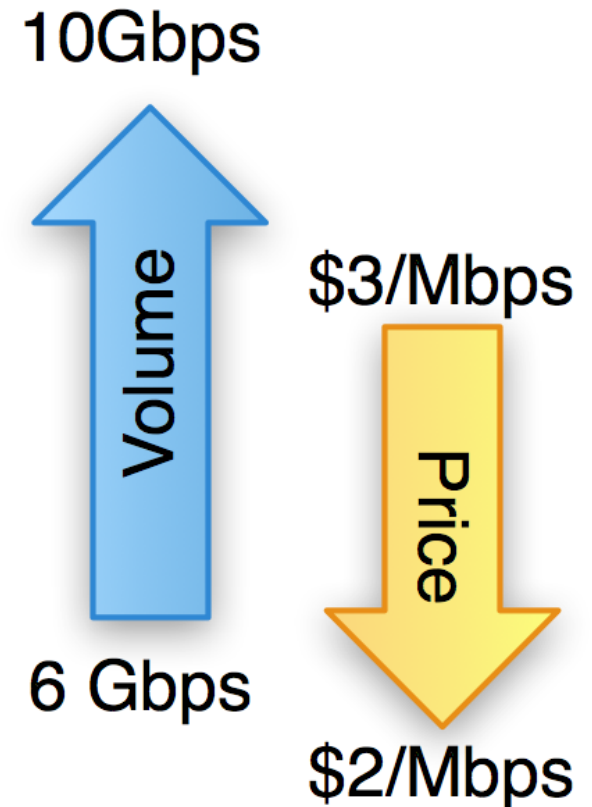
➤ #1 Question in ISP Peering Coordinator Community

➤ EVERY.....YEAR

# Does Peering Make sense anymore?

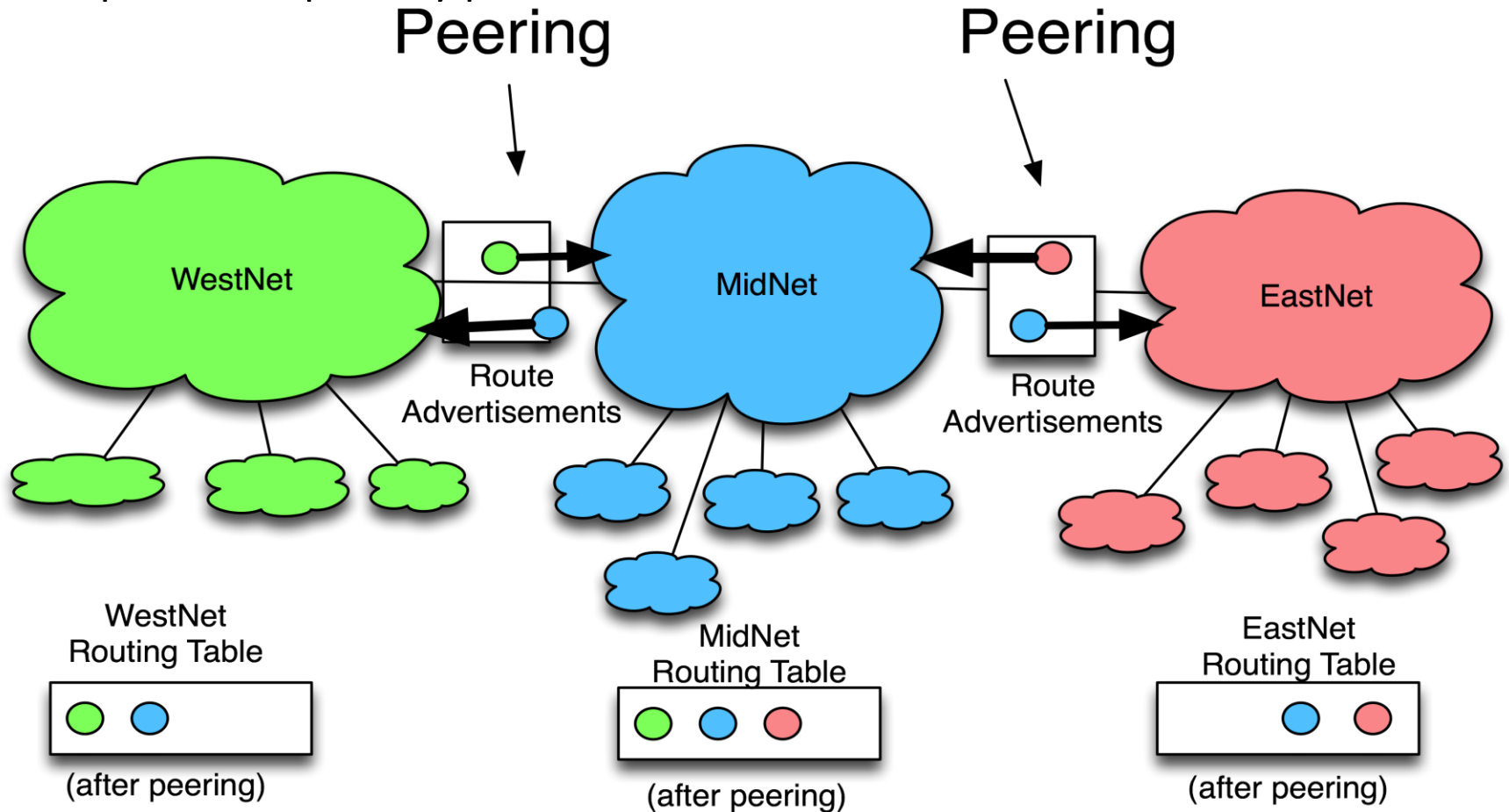
A: Price drops 30%, volume increases 60%

→ Transit Bill rises



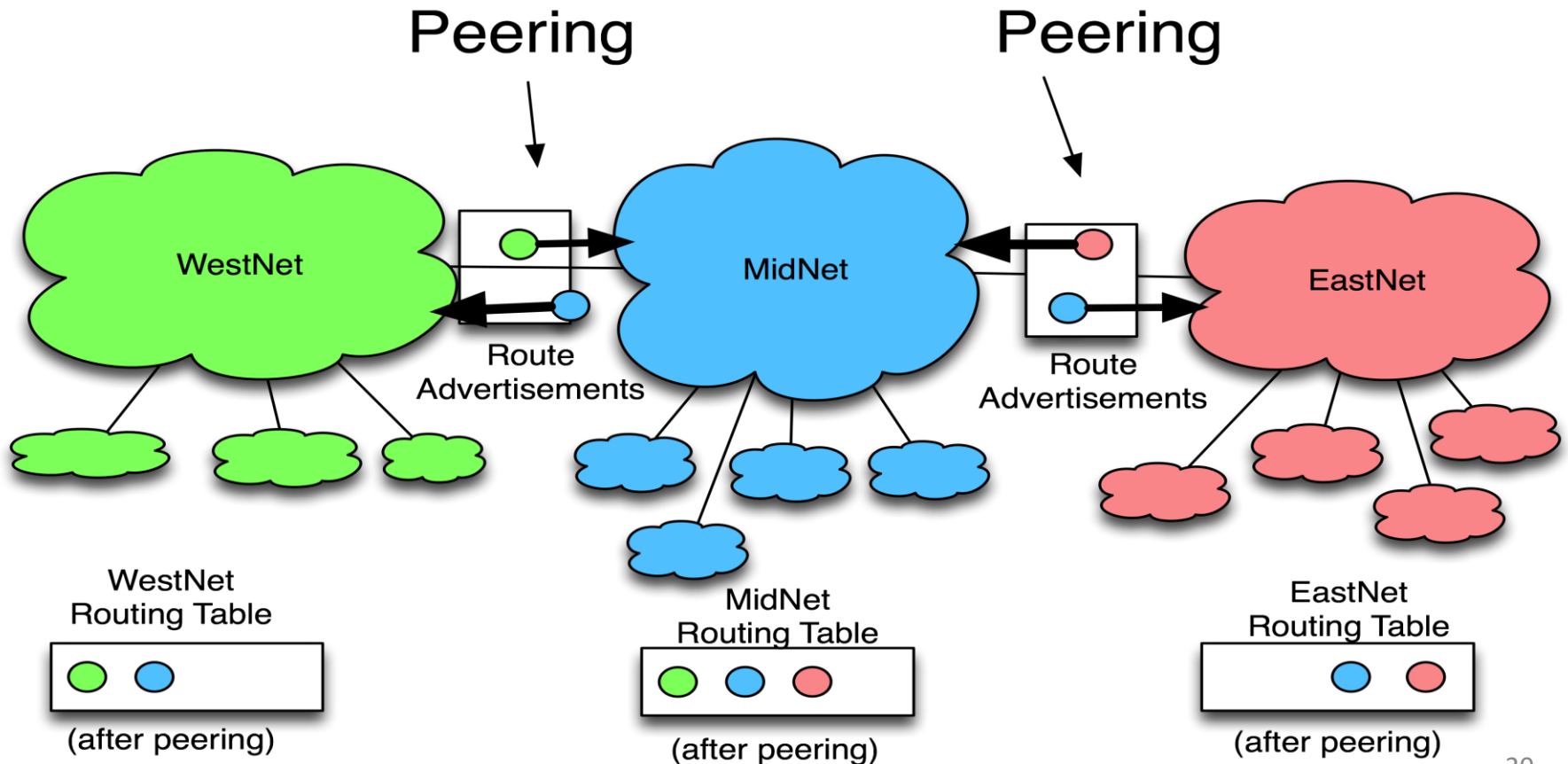
# What is Internet Peering?

- **Definition: Internet Peering** is the business relationship whereby two companies reciprocally provide access to each others' customers.

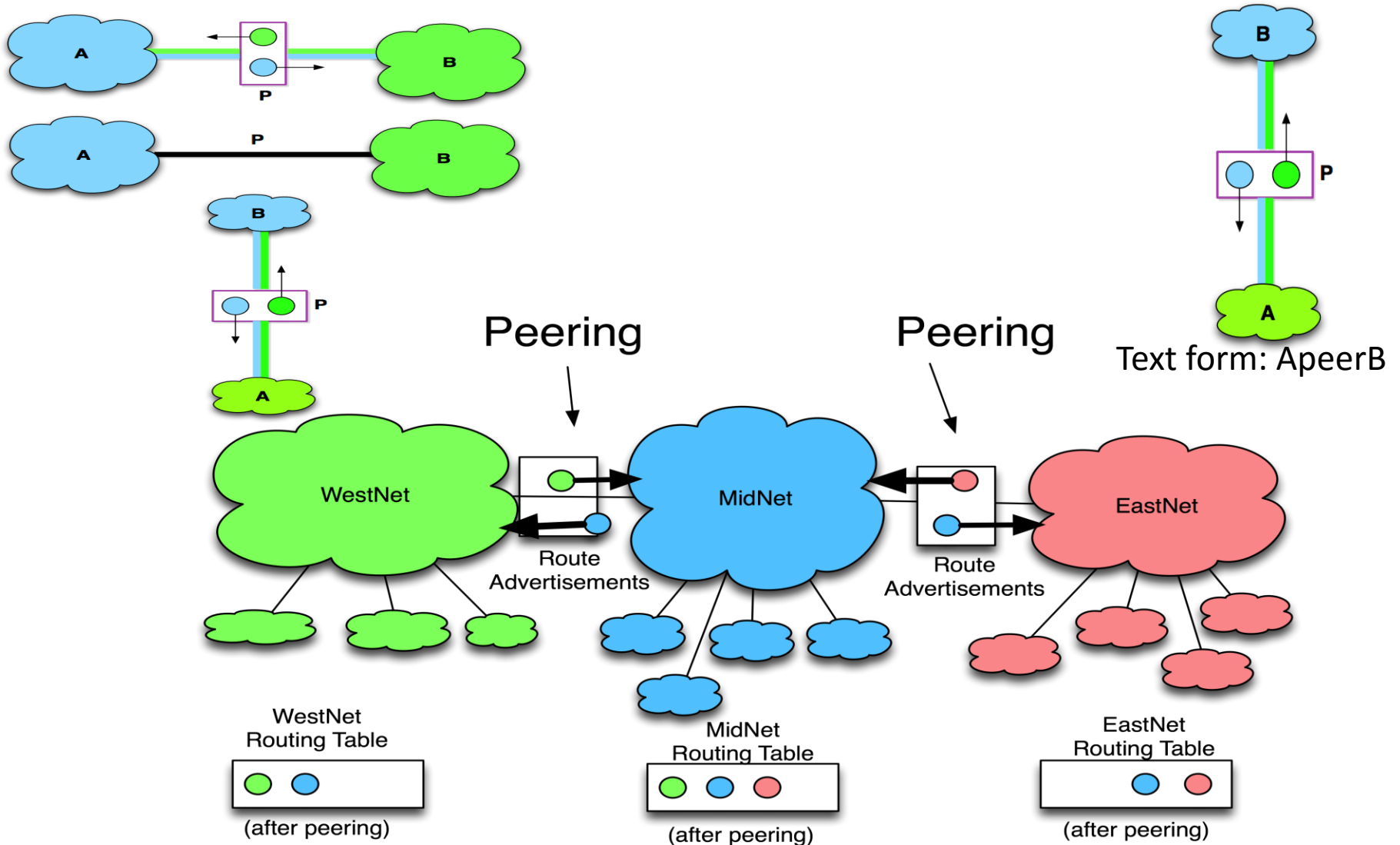


# Internet Peering

- 3 Key Points
  1. Peering is not a transitive relationship
  2. Peering is not a perfect substitute
  3. Peering is typically settlement free



# Equivalent Notations



# Transit and Peering Relationship

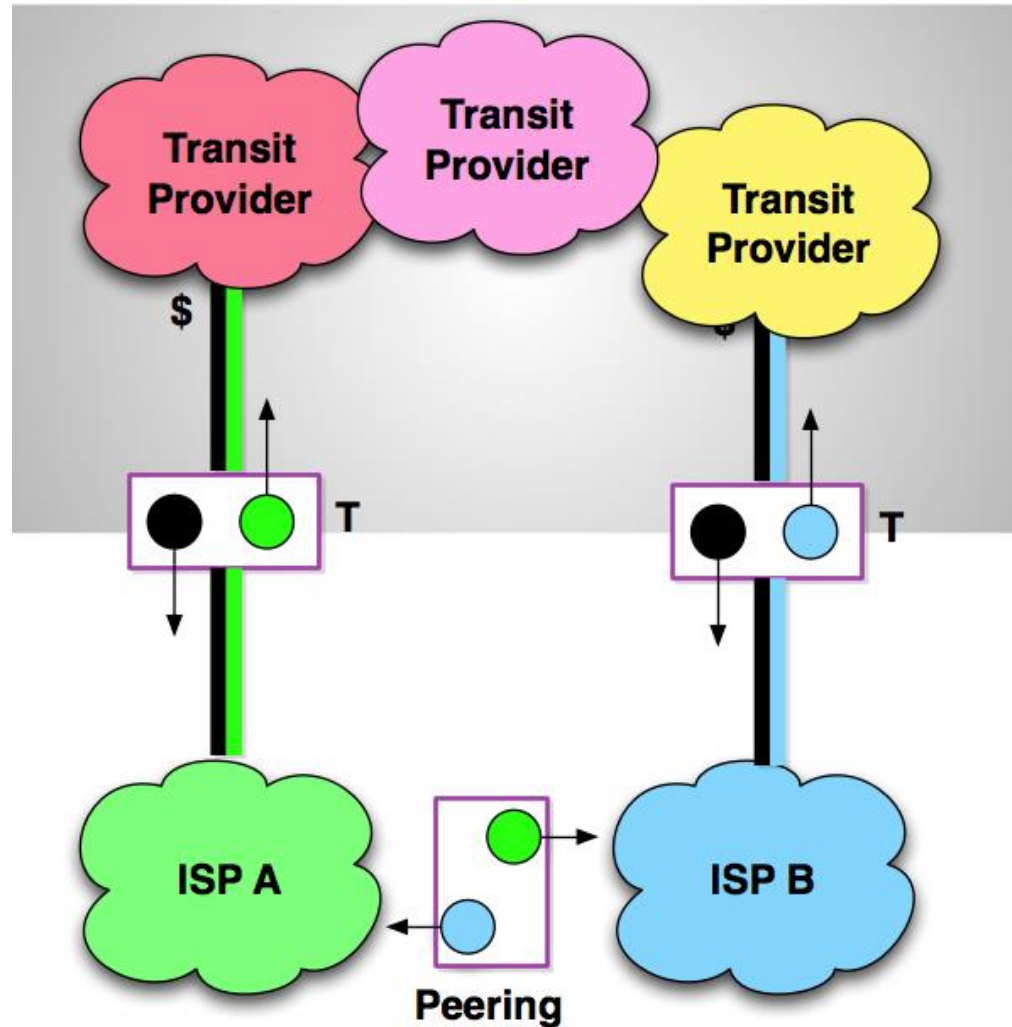
This is a simplified peering and transit business relationships

The relationships are important in developing interconnection strategies of Where to buy, sell and peer.

\$T = Transit

P = Peering

\$PP = Paid Peering



Differs depending on category of Network Services Company

# **TOP 5 MOTIVATIONS FOR PEERING**

# The Top 5 Motivations to Peer

1. Lower Transit Costs  
(#1 motive of ISPs)
2. Improve end user experience  
(#1 motive of Content Heavy network service providers)
3. Better control over routing-strategic  
(#1 from Yahoo!, NetFlix 2008)
4. Usage based billing – make more money by peering  
(#1 from AboveNet)
5. Sell more underlying transport capacity  
(#1 from Telecom Italia)

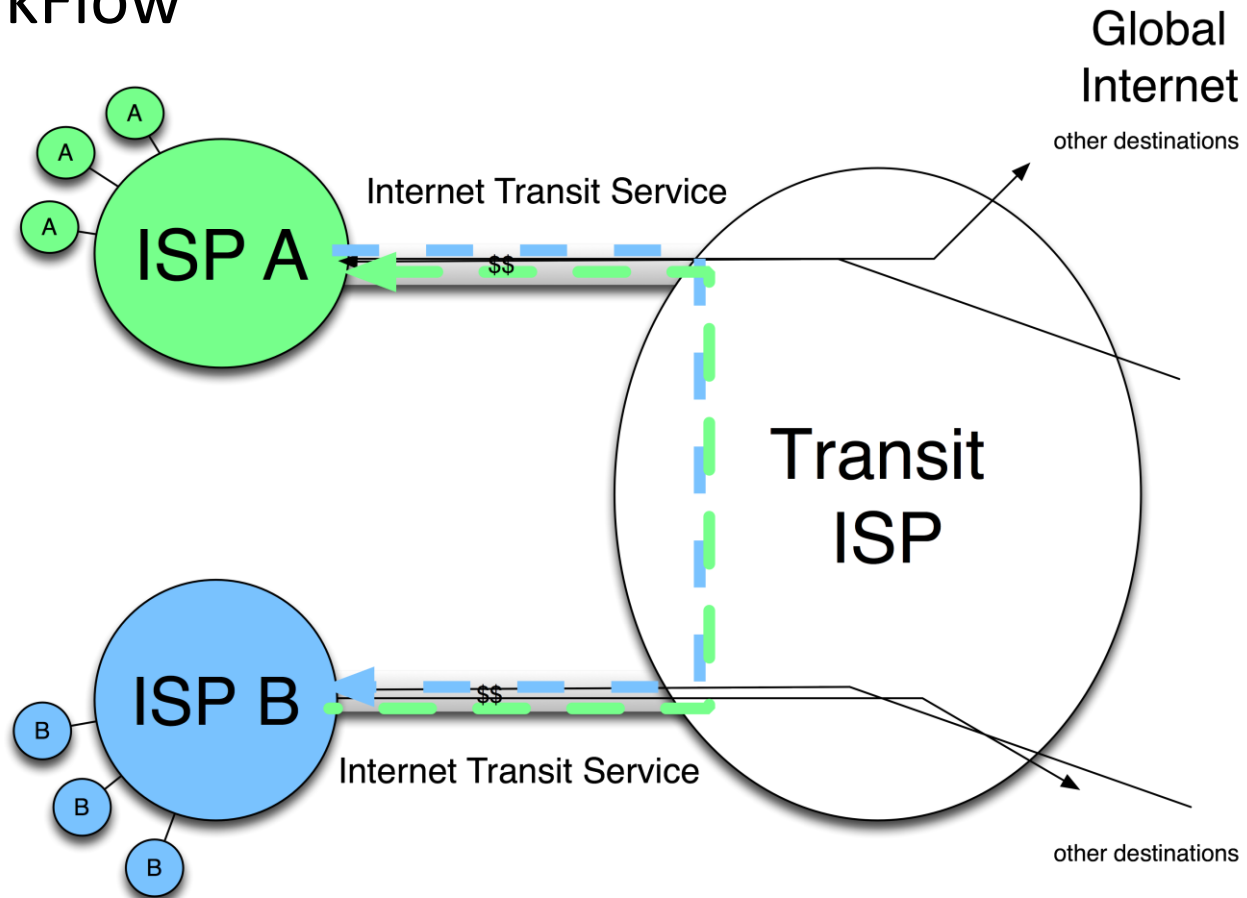


The Peering Process

# **THE 3 PHASES OF PEERING**

# Phase 1 – Identification of Peering Target

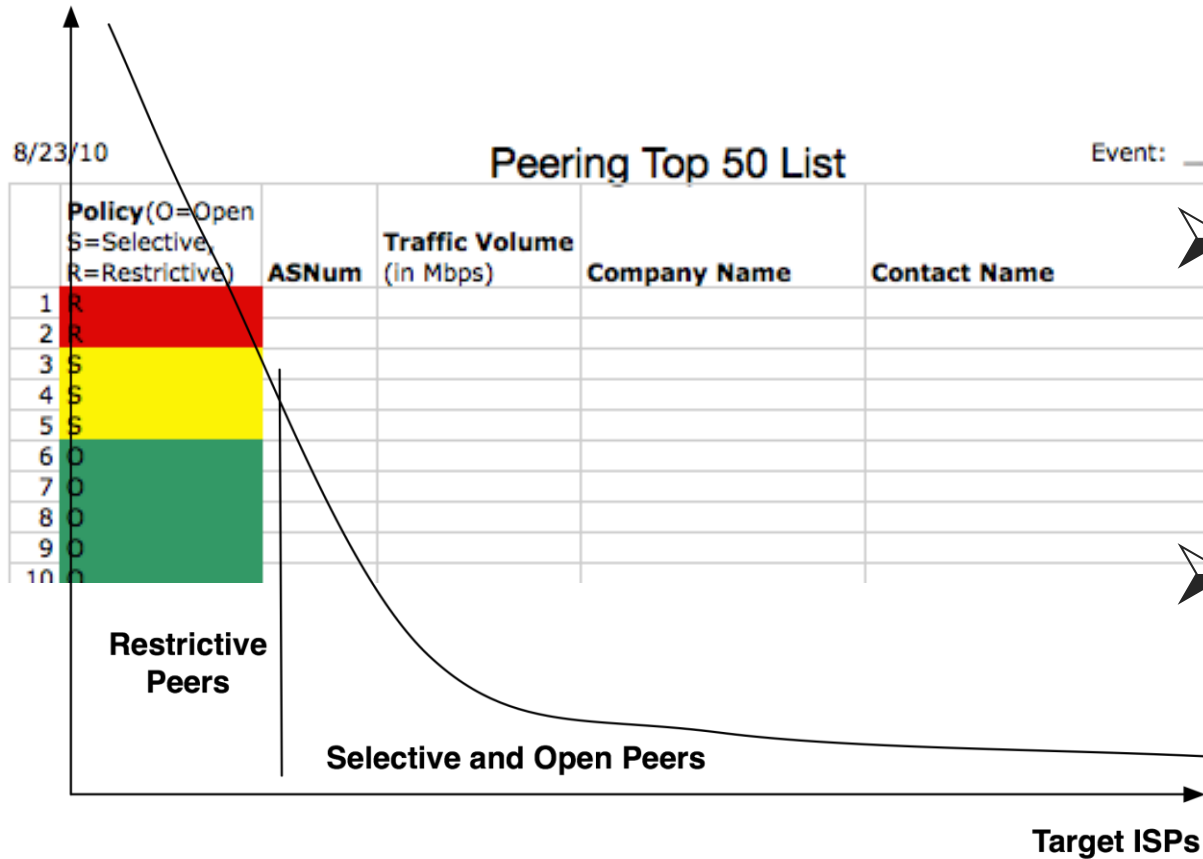
- NetFlow
- Arbor PeakFlow
- [nfsen](#)
- others



# Analyze Traffic Distribution Profiles

## Top Internet Transit Traffic Destinations

% of Internet Transit Traffic



➤ Top 20-40% tend to be restrictive peers

➤ The next group tends to be selective peers

➤ The rest tend to be open peers

# Phase 2 – Initial Contact & Qualification

- “Peering Steering Committee”
- Finding the right person is a challenge
- Traveling, behind on email, too many balls in the air
- Here are the top 10 ways seasoned peering professionals use to establish contact

Peering Top 50 Target List				
Policy	ASN	Traffic Volume	Company Name	Peering Person

# Top 10 Ways the Pros Contact Target ISPs

1. face-to-face at informal meeting in an Internet Operations forum like NANOG, IETF, RIPE, GPF, APNIC, AFNOG, etc.,
2. face-to-face at Peering Forums like Global Peering Forum, European Peering Forum or Africa Peering and Interconnection Forum
3. face-to-face at local IXP Member Meetings like DE-CIX, LINX, or AMS-IX member meetings.
4. introductions through an *IX Chief Technical Liaison* (or a peer) that knows the right contacts

# Top 10 ways the Pros Contact Target ISPs

5. via electronic mail, using the pseudo standard peering@ispdomain.net or a personal contact,
6. from contacts listed on an exchange point participant list, or peeringdb registrations,
7. with tech-c or admin-c from DNS or ASN registries,
8. Google for peering contact \$ASN peering ,
9. from the target ISP sales force, at trade show or as part of sales process,
10. from the target ISP NOC.

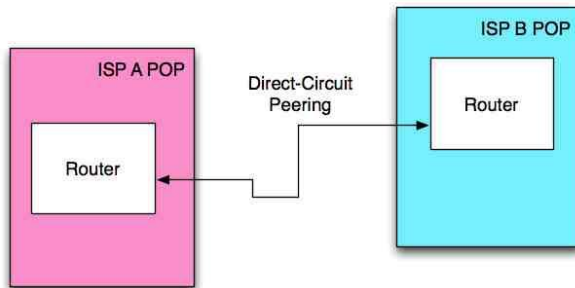
# Phase 2 – Initial Discussion

- NDAs may be signed (Non-Disclosure Agreements)
- BLPAs examined (Bi-Lateral Peering Agreements)
- Discussion of prerequisites and policies
- Exchange of backbone maps
- Like a date, with a chance of long-term happiness from exchanging routes

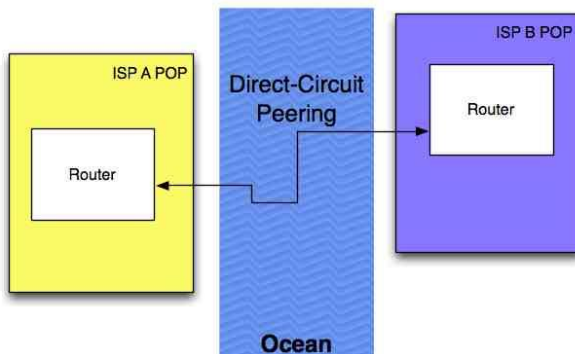
# Phase 3 – Implementation Discussion

## Direct Circuit

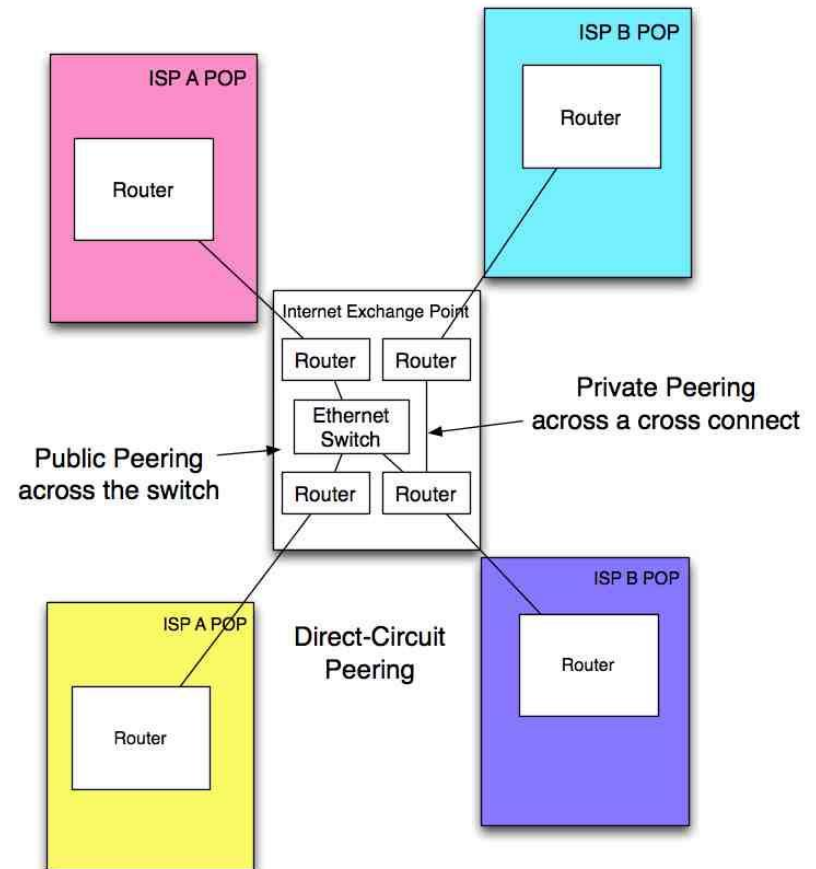
### Metro Area Direct Circuit Peering



### Transoceanic Half-Circuits



## Internet Exchange Point





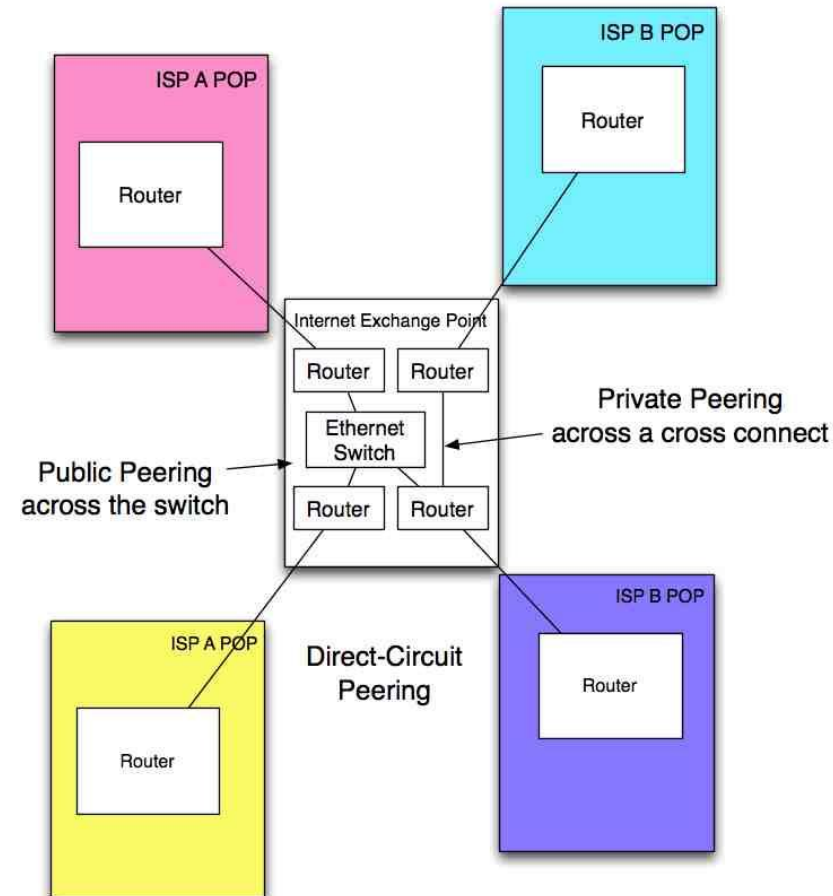
# Direct Circuit vs. IXP

## Direct Circuit Approach

- Exactly two parties connected
- Cost: circuit cost

## IX Approach

- Private peering + Public Peering
- Multiple parties connected to shared peering fabric
- Cost: Transport, router, colo, peering port



# A quick “Paid Peering” Aside

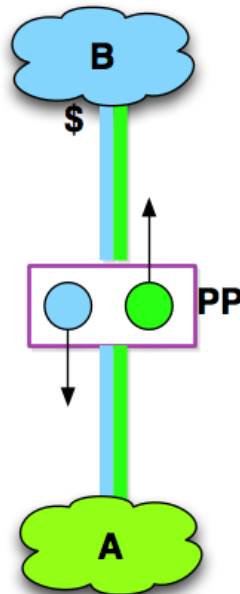
❑ **Definition:** A ***Paid Peering*** relationship is a peering relationship but with an exchange of compensation from one party to the other.

## Characteristics of a Paid Peering Relationship

Metered: \$/Mbps

or Barter for services

~ Asymmetric allocation of costs of peering relationships



Paid Peering notation

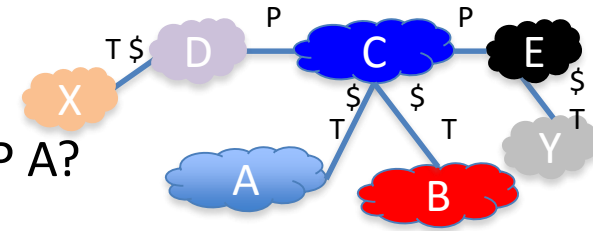
# Challenges

1. “I am ISP A. If I peer with B and C, won’t B and C start sending their traffic to each other through my network?”



2. In Australia we tax barter. . . How is Internet Peering like or unlike barter?

3. Draw the network diagram using the peering and transit notation for the following scenario: ISP A and ISP B purchase transit from ISP C who peers with ISP D and ISP E. ISP D sells transit to ISP X and ISP E sells transit to ISP Y.



4. In #3, would ISP C likely be interested in peering with ISP A?
5. Should paid peering be priced the same as Internet Transit? What is the case for it being priced cheaper than transit, and what is the case for pricing is higher than the price of transit?

# Acknowledgement and Attribution

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<http://www.drpeering.net>



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