GRAND DUCHY OF LUXEMBOURG
Ministry of Foreign Affairs

Directorate for Development Cooperation

Peering and Interconnection Economics

Introduction to Internet Transit and Peering

1

Connecting to the Edge of the Internet

INTERNET TRANSIT

2

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

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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.

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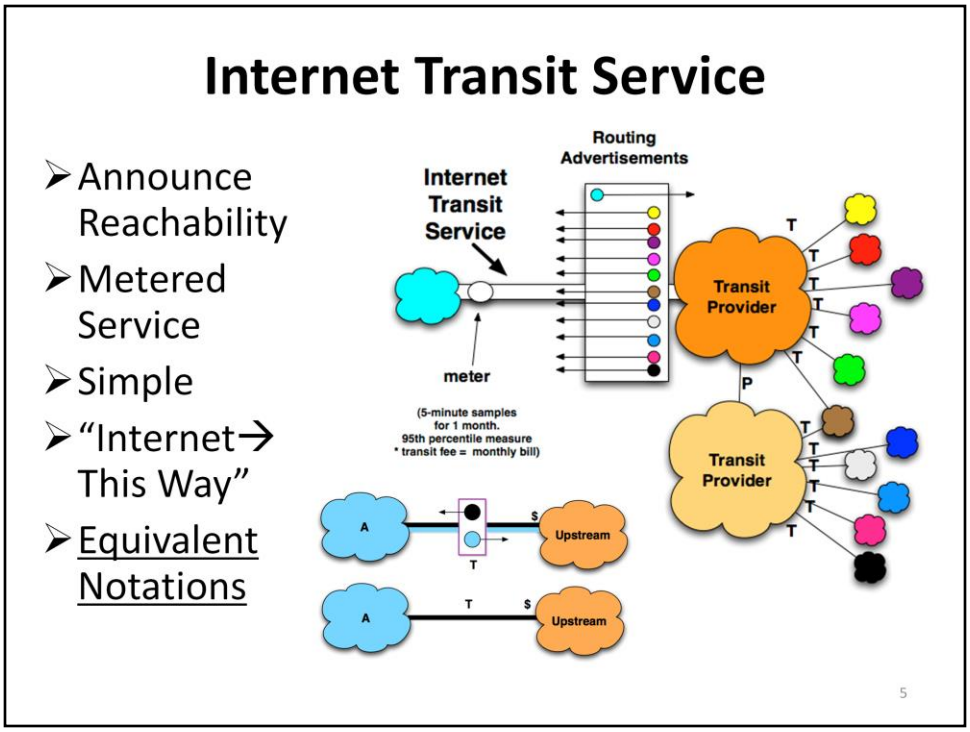
From a high level perspective, Internet Transit can be thought of as a pipe in the wall that says "**Internet this way**". The customer connects its network to the Internet Transit Provider and the Transit Provider does the rest.



The Internet Transit service is shown in the diagram below provides access to the global Internet by:

announcing the customer route across the Internet so any network on the Internet knows how to reach the customer network, and

announcing to the customer the information necessary to be able to send traffic to any destination in the Internet.

In this mini ecosystem, we see the Cyan ISP purchasing transit from the Orange Transit Provider. The Orange ISP announces to the Cyan ISP reachability to the entire Internet (shown as many colored networks to the right of the Transit Providers). The Transit Providers propagate the Cyan route (shown as a cyan circle) across the Internet so that all networks know how to reach the Cyan ISP.

With this reciprocal Internet Transit service, all Internet attachments know how to reach the Cyan ISP, and the Cyan ISP knows how to reach all Internet destinations.

Internet Transit Pricing Model

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

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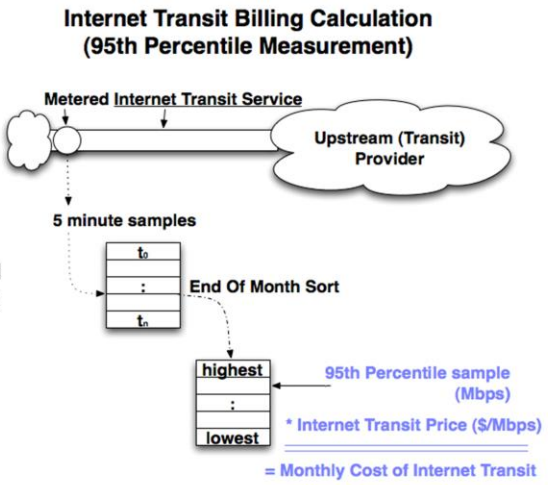
Let´s walk through the 95th percentile measure

95th Percentile Billing Calculation

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

Question: at 95th 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



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Why did the 95th percentile come into existence? In the early Internet days, Internet traffic was charged on a circuit capacity basis. But if you didn't use very much of this capacity, you were still paying as if you did. This made Internet Transit tough to sell so the usage-based (metered) model began. Initially some ISPs charged on average use, which ended up being skewed by the occasional burstiness associated with a spot event. To address this, one ISP adopted the 95th percentile measure that was primarily introduced to not overly punish a customer for the occasional spike in traffic volume, and still allow the ISP to bill based the load placed on its network. This approach seemed palatable and sold. The rest of the industry followed suit and 95-5 was born.

Origin of the 95th Percentile

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

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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

$$T_v = transitVolume\_in\_Mbps$$

$$C = commitLevel\_in\_Mbps$$

$$P_c = unit\,\mathrm{Pr}ice\_at\_commitLevel\_in\_\$\_per\_Mbps$$

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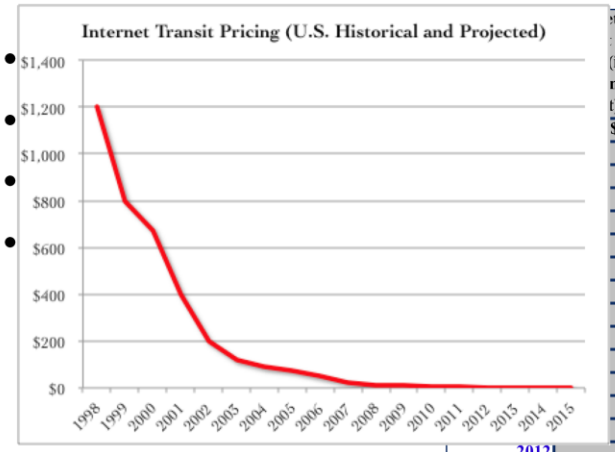
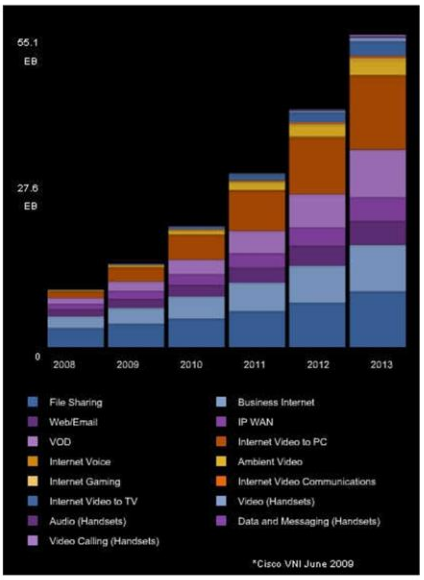
Internet Price Declines (U.S.)



	$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%



As customers expand their use of innovative and high-bandwidth services such as over-the-top streaming and download of video broadcasts, and as large volume download services go viral, Internet Transit customers see larger and larger monthly transit fees. To manage this, some of the larger scale Internet Service Providers and Content Distributors monitor their transit traffic flows to determine where their transit traffic is sent to and coming from. With this data, some of the more clever companies explore optimizations including

Internet Peering (explored next chapter) and

Clever Internet Transit Tactics (described next in the Internet Transit Playbook).

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)

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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 95th 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 1G commit transit product at a price of $3/Mbps. I still expect to send 500 Mbps and receive 800Mbps at the 95th percentile. Should I commit to 1G?

Problem Sets

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(C) Max(500Mbps,800Mbps)*$5/Mbps=$4000/month

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YES – Commit early
Max(500Mbps,800Mbps)*$5/Mbps=$4000/month
Vs.
1000Mbps*$3/Mbps=$3000/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

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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

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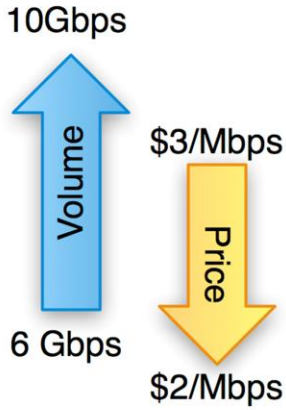
Does Peering Make sense anymore?

A: Price drops 30%, volume increases 60%

→Transit Bill rises



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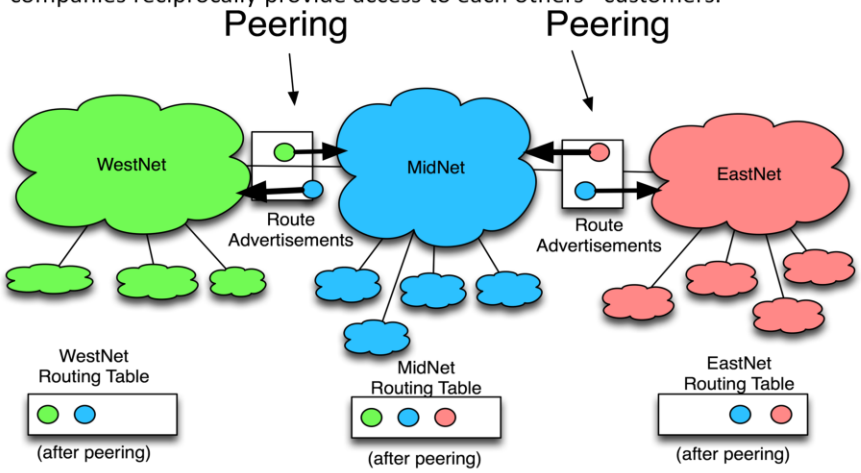
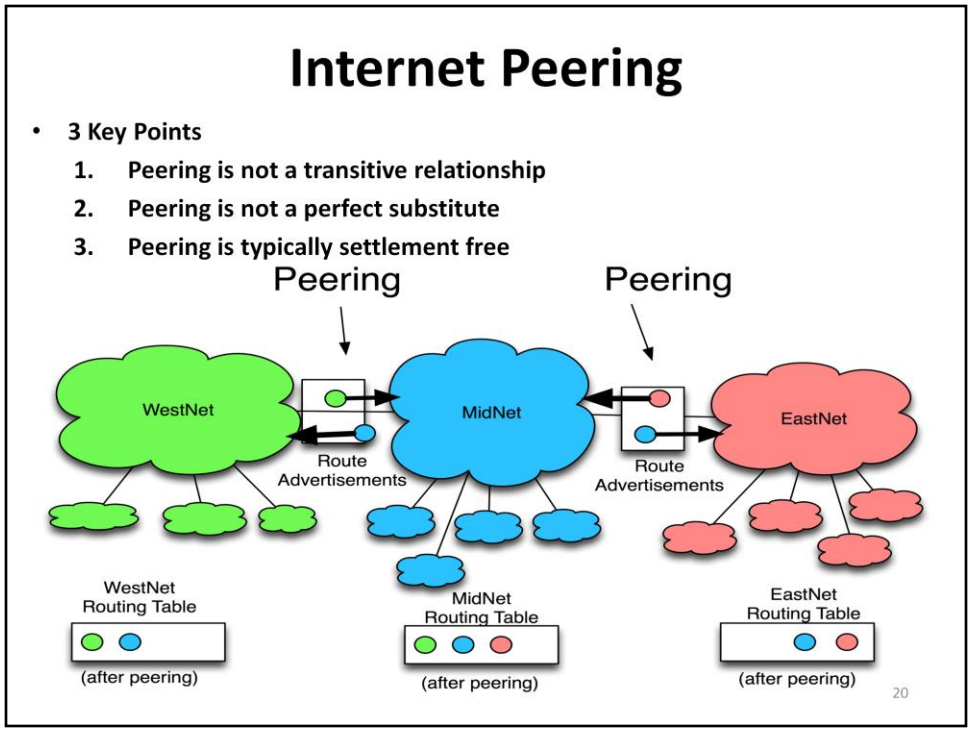
What is Internet Peering?

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





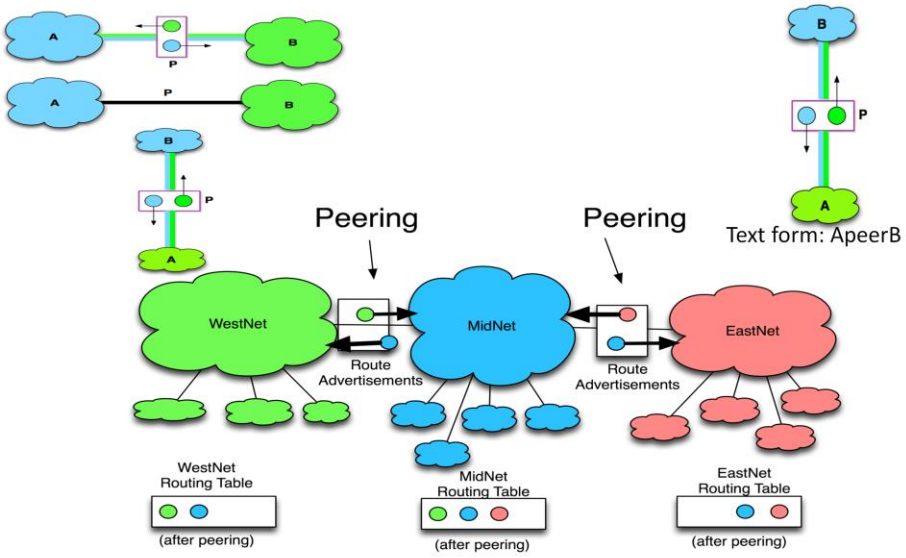
WestNet is an ISP with green customers, MidNet is an ISP with blue customers, and EastNet is an ISP with red customers.

WestNet is in a Peering relationship with MidNet in which WestNet learns how to reach MidNet's blue customers, and MidNet reciprocally learns how to reach WestNet's green customers.

EastNet is in a Peering relationship with MidNet in which EastNet learns how to reach MidNet's blue customers, and MidNet reciprocally learns how to reach EastNet's red customers.

After these two peering sessions are established, the routing tables are in place as shown in the boxes beneath the ISP clouds. Since MidNet peers with both EastNet and WestNet, MidNet customers can reach both EastNet and WestNet customers.

Equivalent Notations



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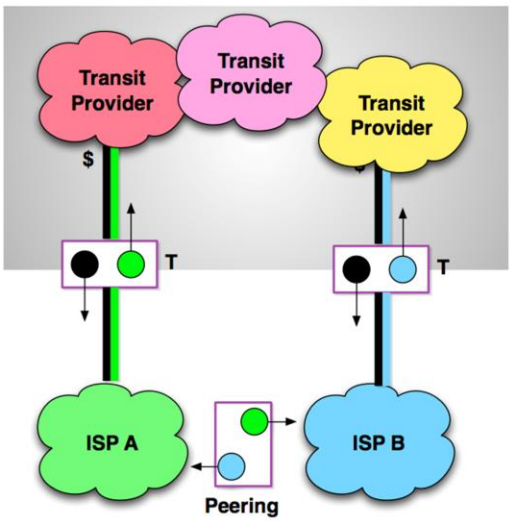
Transit and Peering Relationship

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



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Differs depending on category of Network Services Company

TOP 5 MOTIVATIONS FOR PEERING

The Top 5 Motivations to Peer

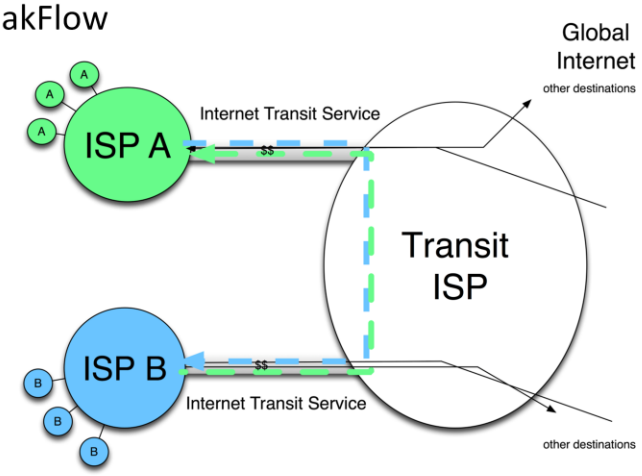
1. Lower Transit Costs
   (#1 motive of ISPs)
2. Improve end user experience
   (#1 motive of Content Heavy network service providers)
3. Better control over routing-strategic
   (#1 from Yahoo!, NetFlix 2008)
4. Usage based billing – make more money by peering
   (#1 from AboveNet)
5. Sell more underlying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



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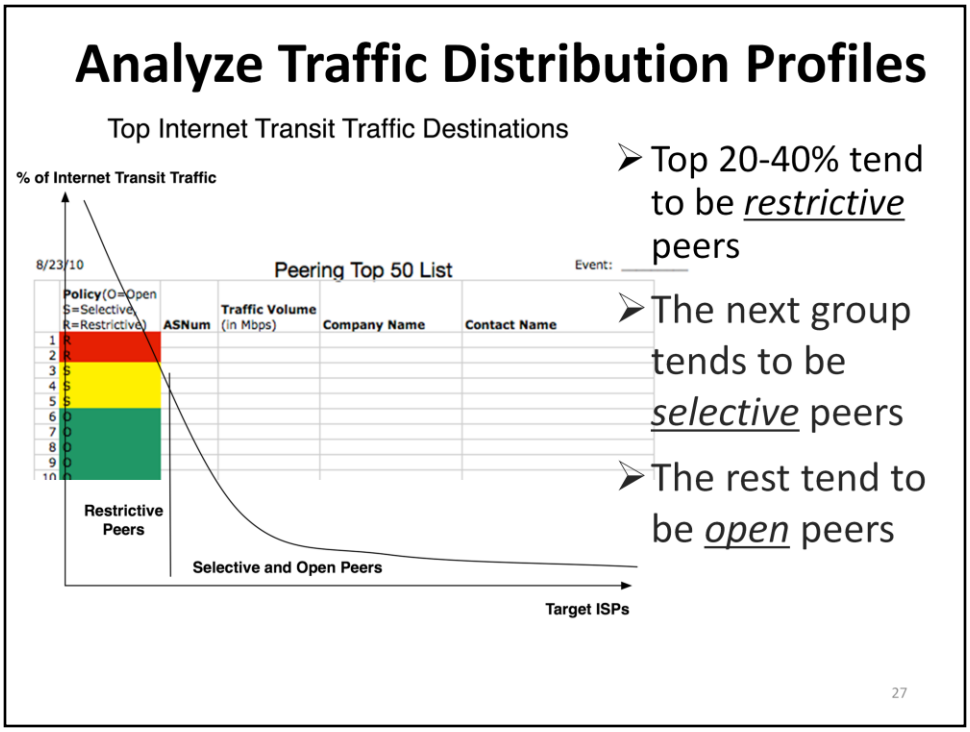
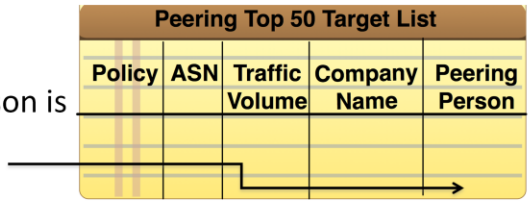


It is typical for the top traffic sources or sinks being the large ISPs that do not peer openly. (We will discuss these "restrictive" peers in the section on Internet Peering Inclinations and Policies.) These top destinations often represent a large chunk of traffic that is ultimately not peerable. The remainder of the traffic however is potentially peerable.

Once the top traffic destinations are identified and associated with specific ISPs, these ISPs are targeted for potential peering relationship discussions. Below is a sample "Peering Top 50 list" template – peering coordinators use some form of this to help track their interactions with potential 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



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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

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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

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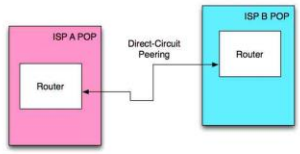
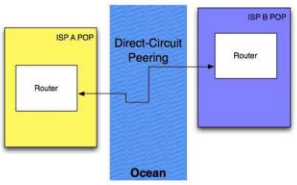
Phase 3 – Implementation Discussion

Direct Circuit

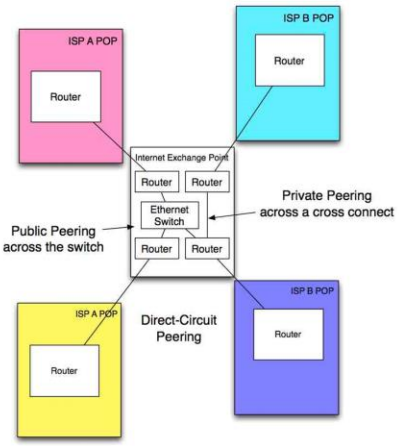
Metro Area Direct Circuit Peering



Transoceanic Half-Circuits



Internet Exchange Point



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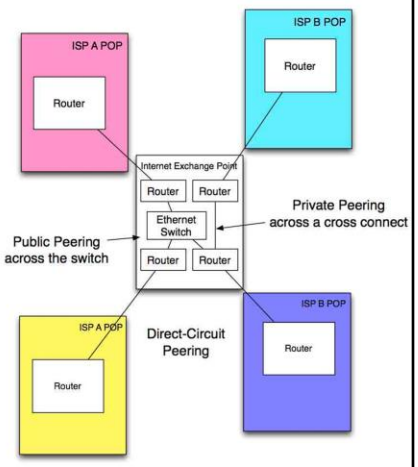
Direct Circuit vs. IXP

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

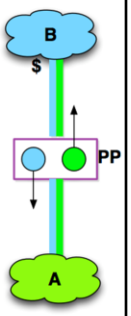
❑**Definition**: A ***Paid Peering*** relationship is a peering relationship but with an exchange of compensation from one party to the other.

<u>Characteristics of a Paid Peering Relationship</u>

Metered: $/Mbps

or Barter for services

~ Asymmetric allocation of costs of peering relationships



Paid Peering notation

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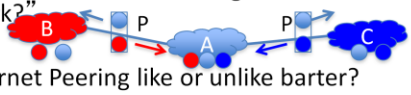
Challenges

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?

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Acknowledgement and Attribution

This presentation contains content and information originally developed and maintained by the following organisation(s) and provided for the African Union AXIS Project

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Infrastructure Trust Fund
END
Internet Society