Peering Tutorial

APRICOT 2012 Peering Forum
Jan 28, 2012
New Delhi, India

William B Norton,
Executive Director, DrPeering.net
http://DrPeering.net

Overview

- Start assuming no knowledge of Internet Interconnection

1. Internet Transit
2. Internet Peering
3. The Business Case for Peering
4. The ISP Peering Playbook (selections)
5. The IX Playbook (if there is time, how IX builds critical mass)
6. The Peering Simulation Game

- Finish with an understanding of how the core of the Internet is interconnected

Internet Transit – Interconnection at the edge

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Overview of this section

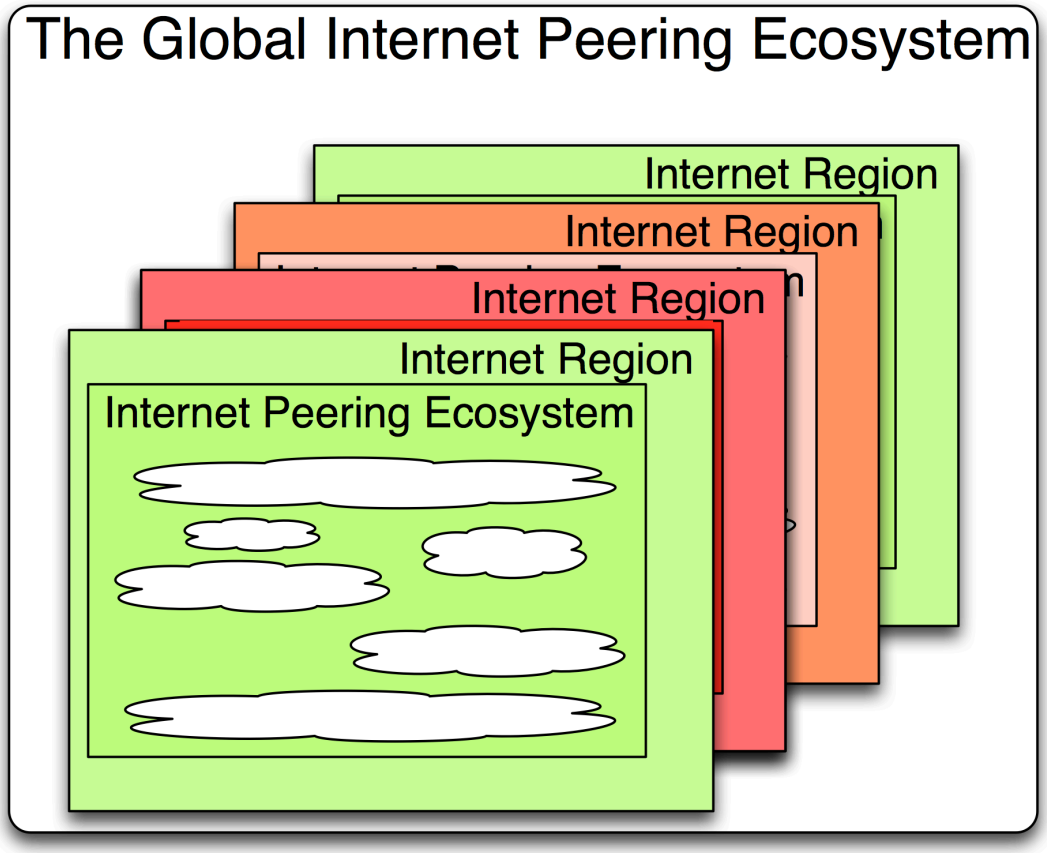
- Start assuming no knowledge
  - I know… many of you are very knowledgeable in this stuff
  - See how I explain things
  - These build effectively
- Introduce the Global Internet Peering Ecosystem
- In this context, metered Internet transit service
- Measurement and pricing models
- The Internet Transit Playbook

The Internet

- Network of Networks
- Organic from ARPANET, NSFNET
- Commercialization 1994
  - Planned economy
- Corporate interests 1997 onward
  - Limited information sharing
- Evolution: "Global Internet Peering Ecosystem"

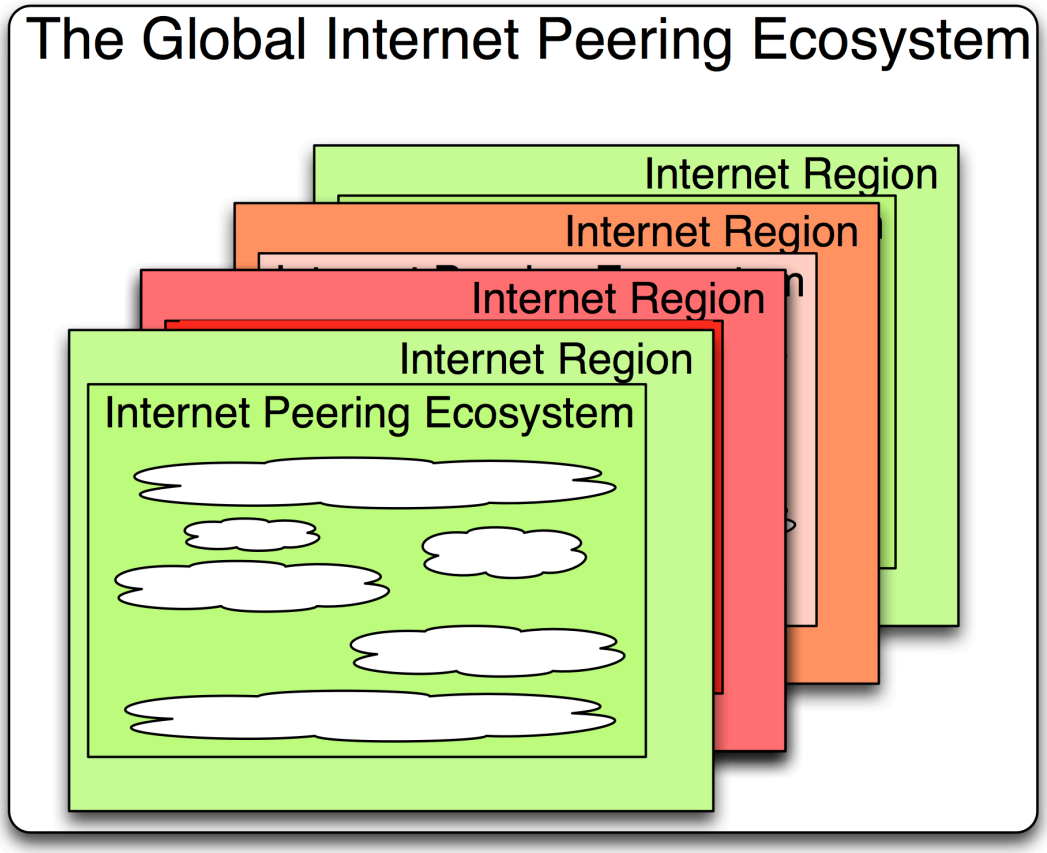
The Global Internet Peering Ecosystem

- **Definition**: The **Global Internet Peering Ecosystem** models the internal structure of the Internet as a set of Internet Regions (typically bound by country borders), each with its own Internet Peering Ecosystem.



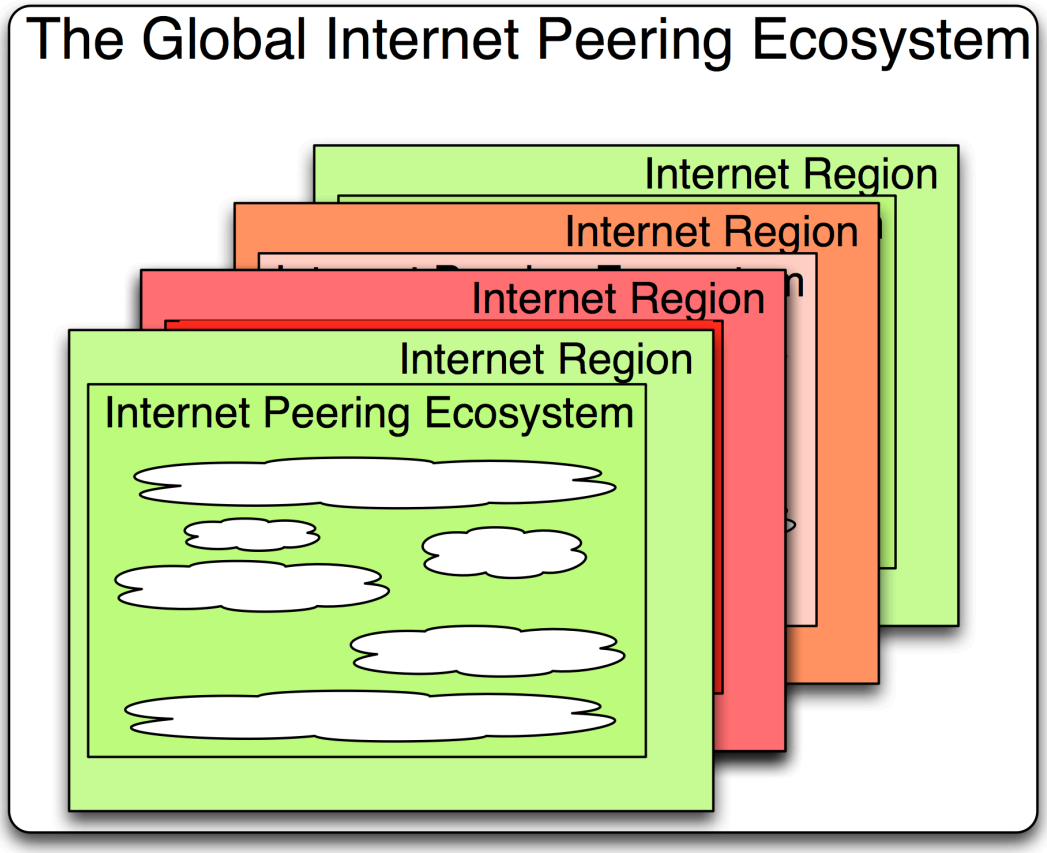
The Global Internet Peering Ecosystem

- **Definition:** An **Internet Region** is a portion of the Internet, usually defined by geographical boundaries (country or continent borders), in which an Internet Peering ecosystem is contained.



The Global 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



Internet Transit

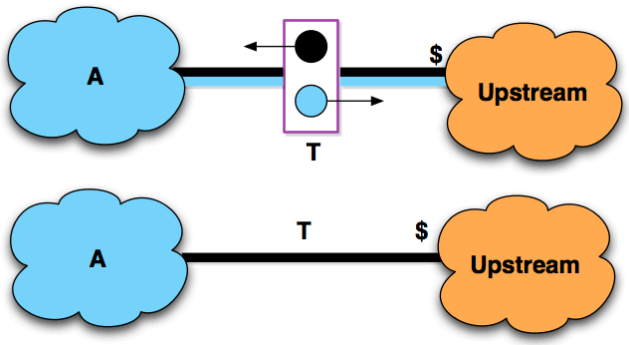
- **Definition**: **Internet Transit** is the business relationship whereby an entity provides (usually sells) access to the Internet.

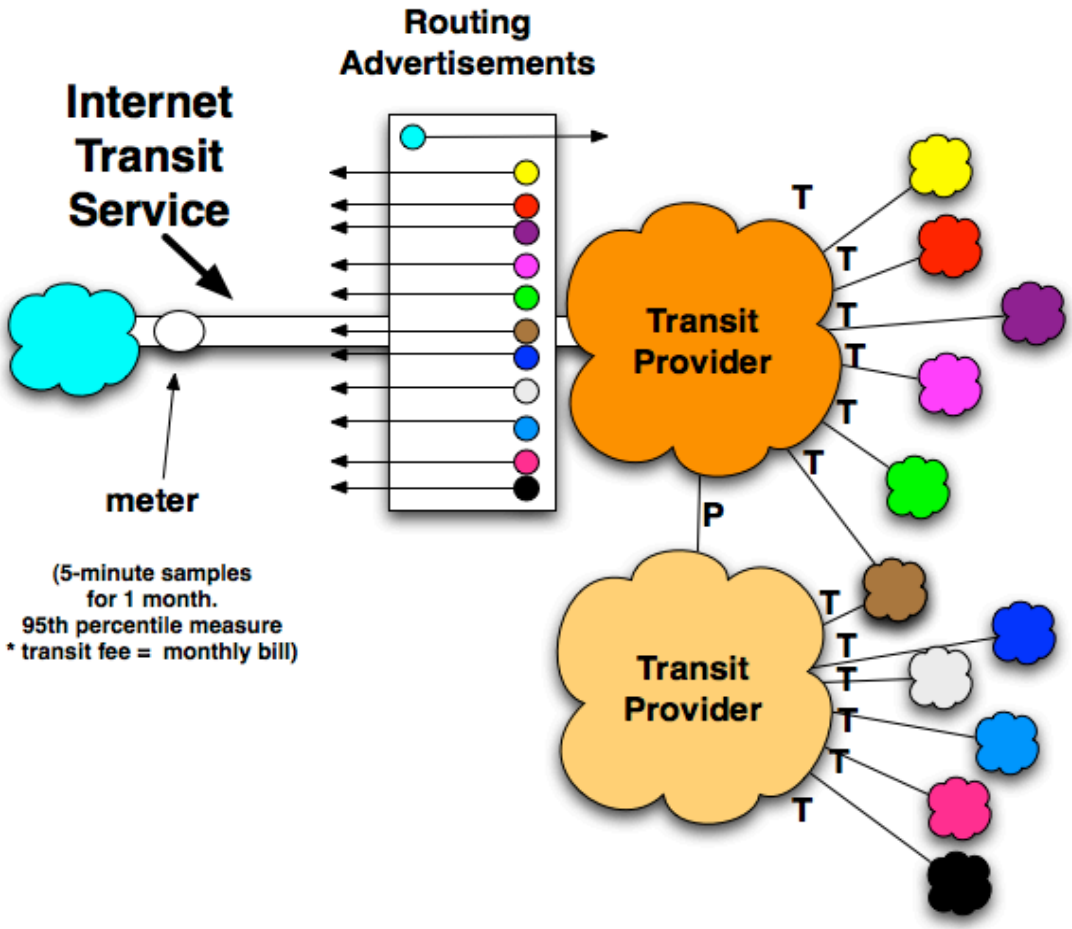
"**Internet → this way**"

- **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





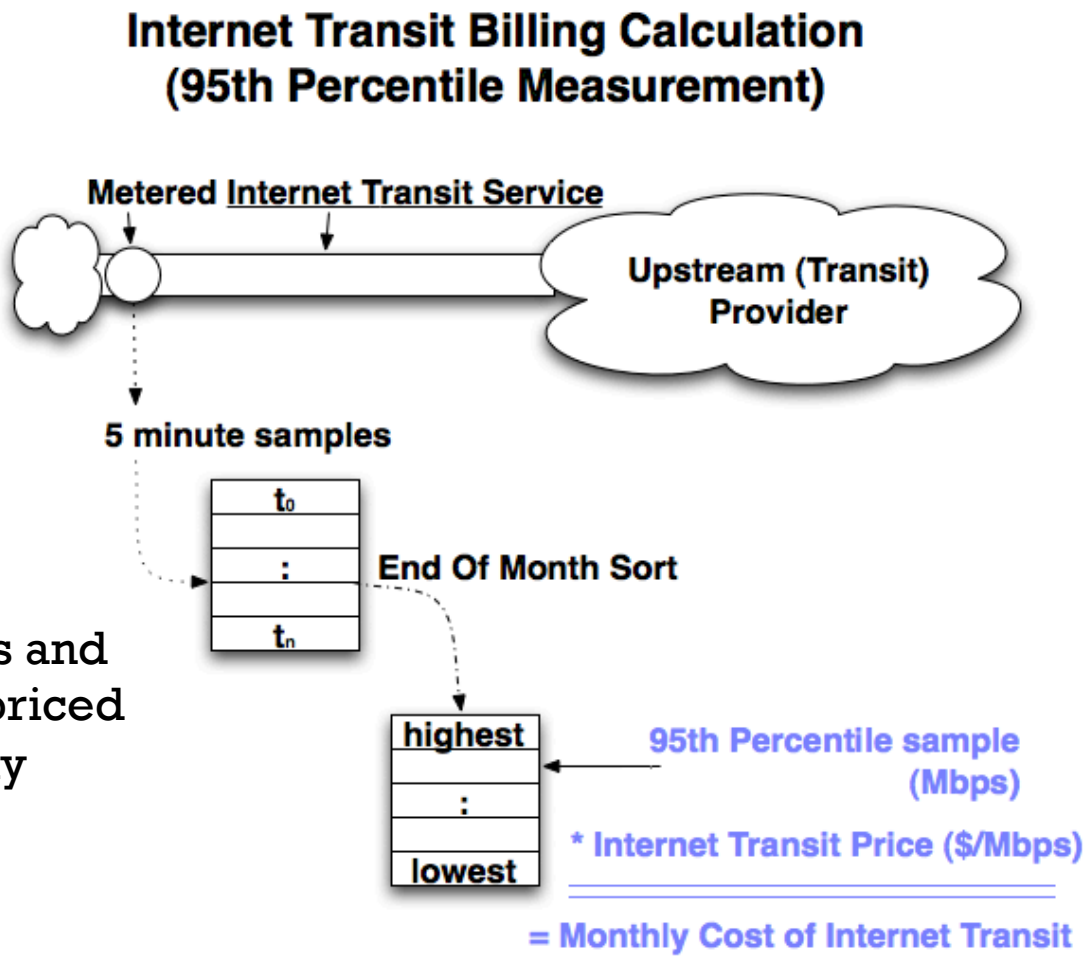
Internet Transit Pricing Model

- **Typically metered**
- **$/Mbps**
- **Volume measured at 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.

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

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

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

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

$$where$$

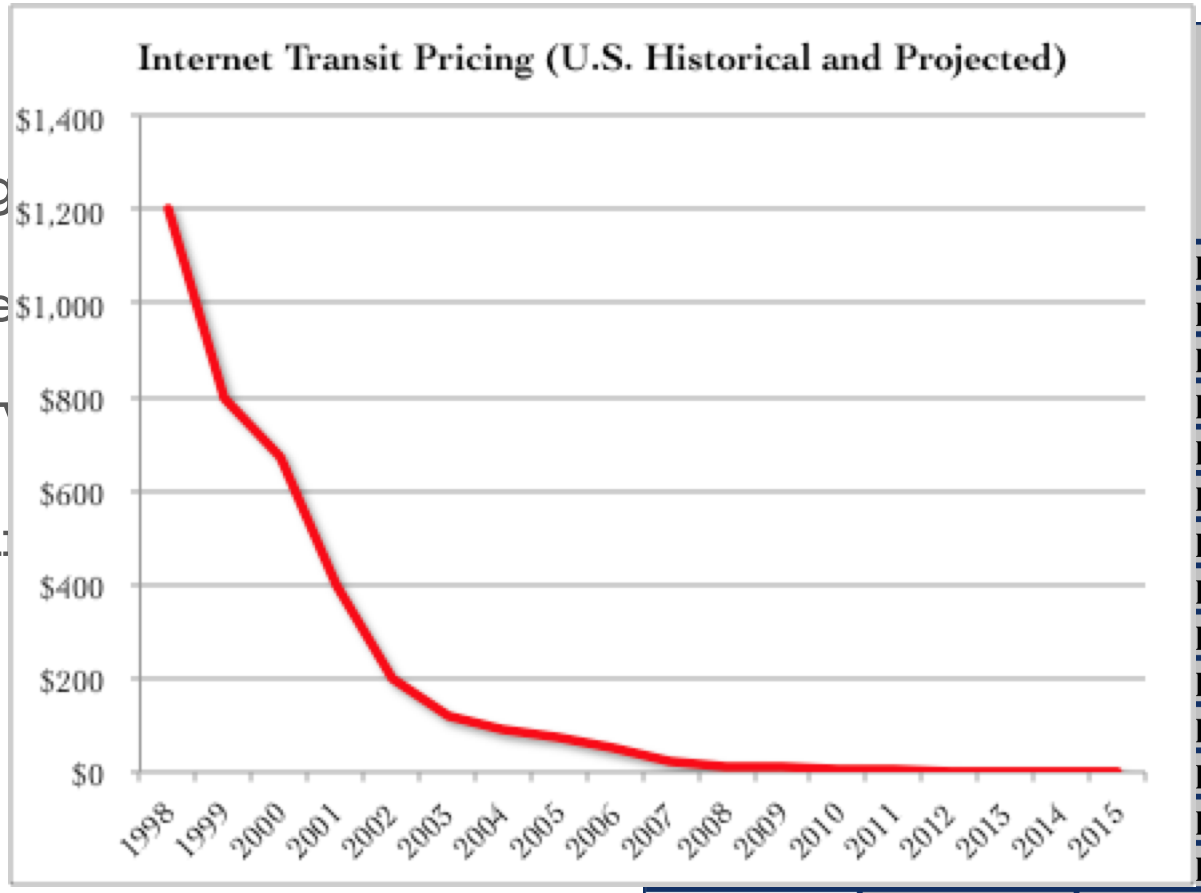
$$T_v = transitVolume\_in\_Mbps$$

$$C = commitLevel\_in\_Mbps$$

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

Internet Price Declines (U.S.)

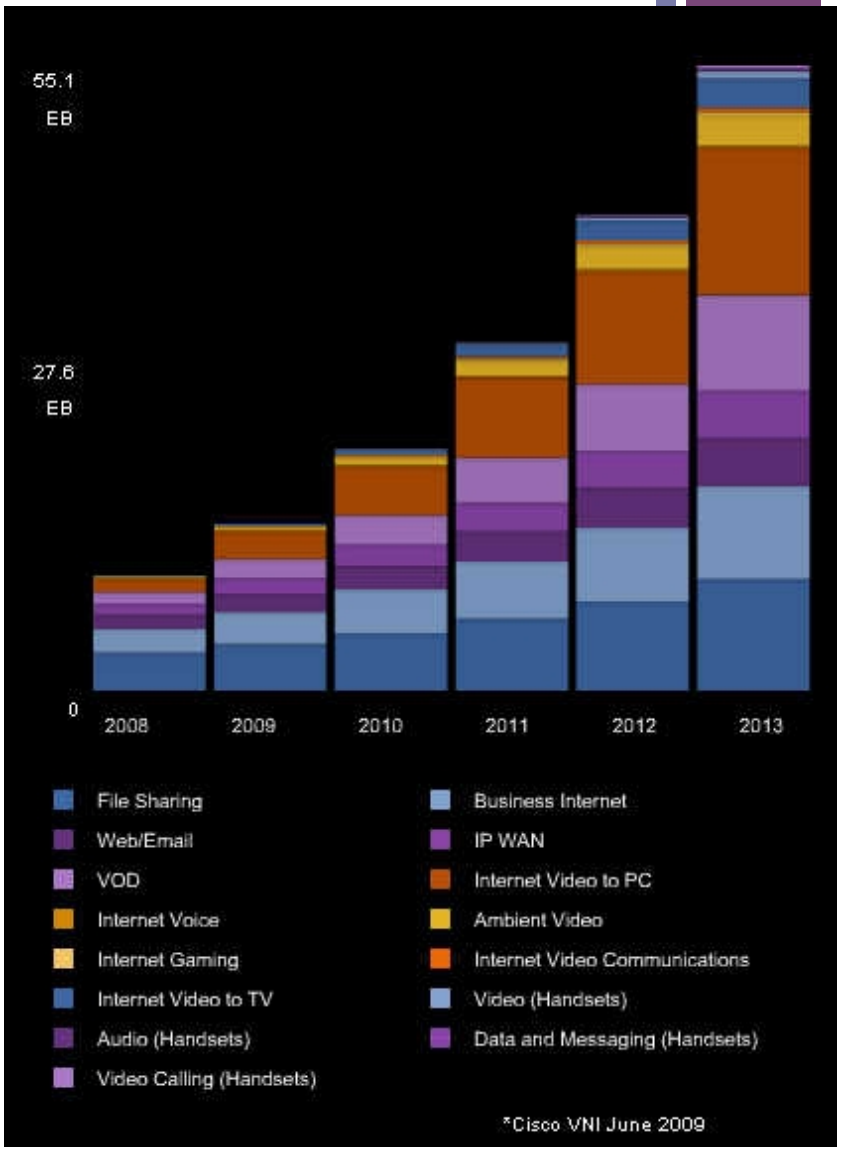
- "Can't g
- "No one
- Pricing
- Trend u



			% Decline
		ps	
		ps	33%
		ps	16%
		ps	40%
		ps	50%
		ps	40%
		ps	25%
		ps	17%
		ps	33%
		ps	50%
		ps	52%
		ps	25%
		ps	44%
		ps	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%



Implementation of Internet Transit

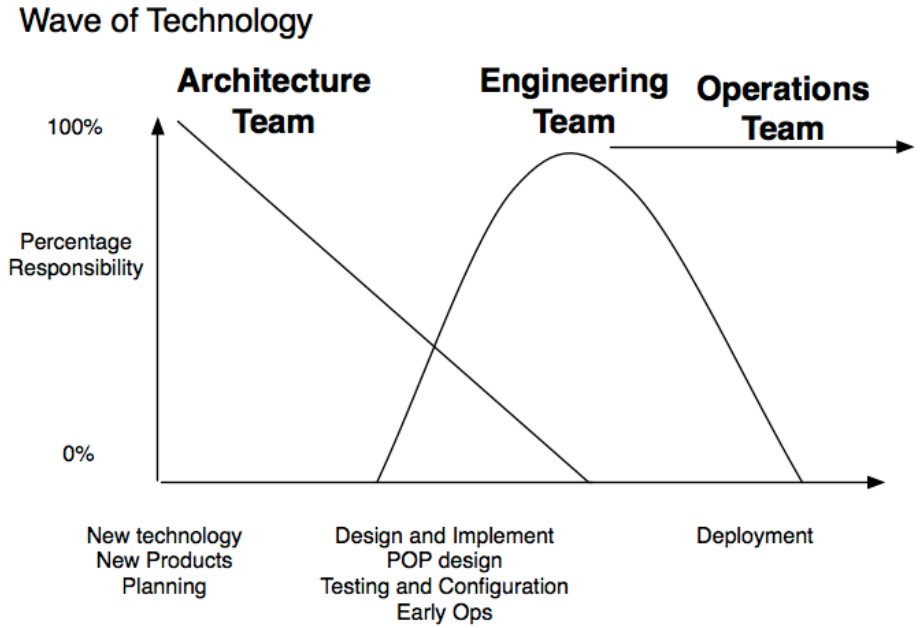
Architecture evaluates technology and designs a solution Product Mgmt and capacity planning involved

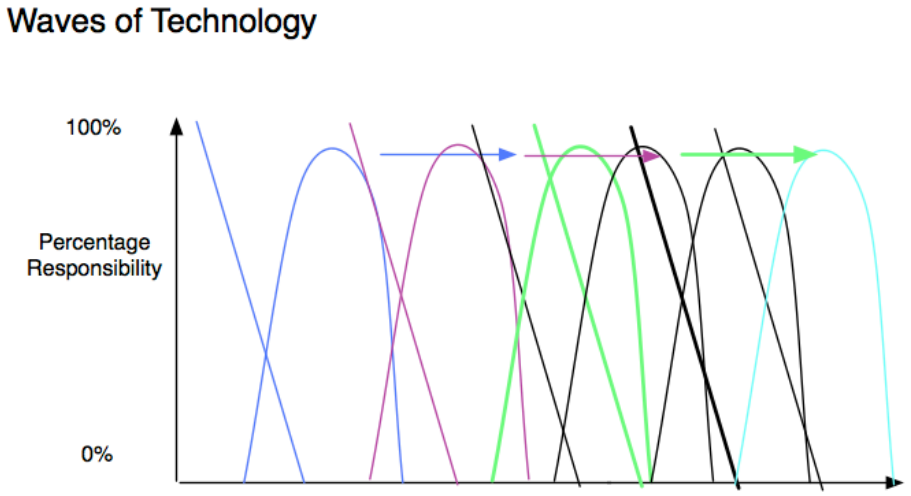
Engineering takes over implementation and early ops

Operations phases transition

Feedback throughout

Always a new wave





Observations: Internet Transit

- Simple Service
- Metered Service
- Transit Commits and Discounts
- Contract Terms
- Is a Commodity
- Customer-Supplier Relationship
- 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 95th percentile. What is my monthly bill?

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?

Internet Peering – Peering at the Core of the Internet

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Overview of this section

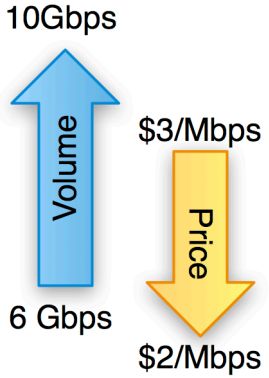
- introduce Internet Peering
- 3 key ways *Internet Peering* is different from *Internet Transit*
- top five motivations ISPs gave for peering
- the Internet Peering Process

Introduction to Internet Peering

- Why bother with Peering?
- Transit is cheap ($1-$3/Mbps)
- Transit is getting cheaper
- “Does Peering make sense anymore?”

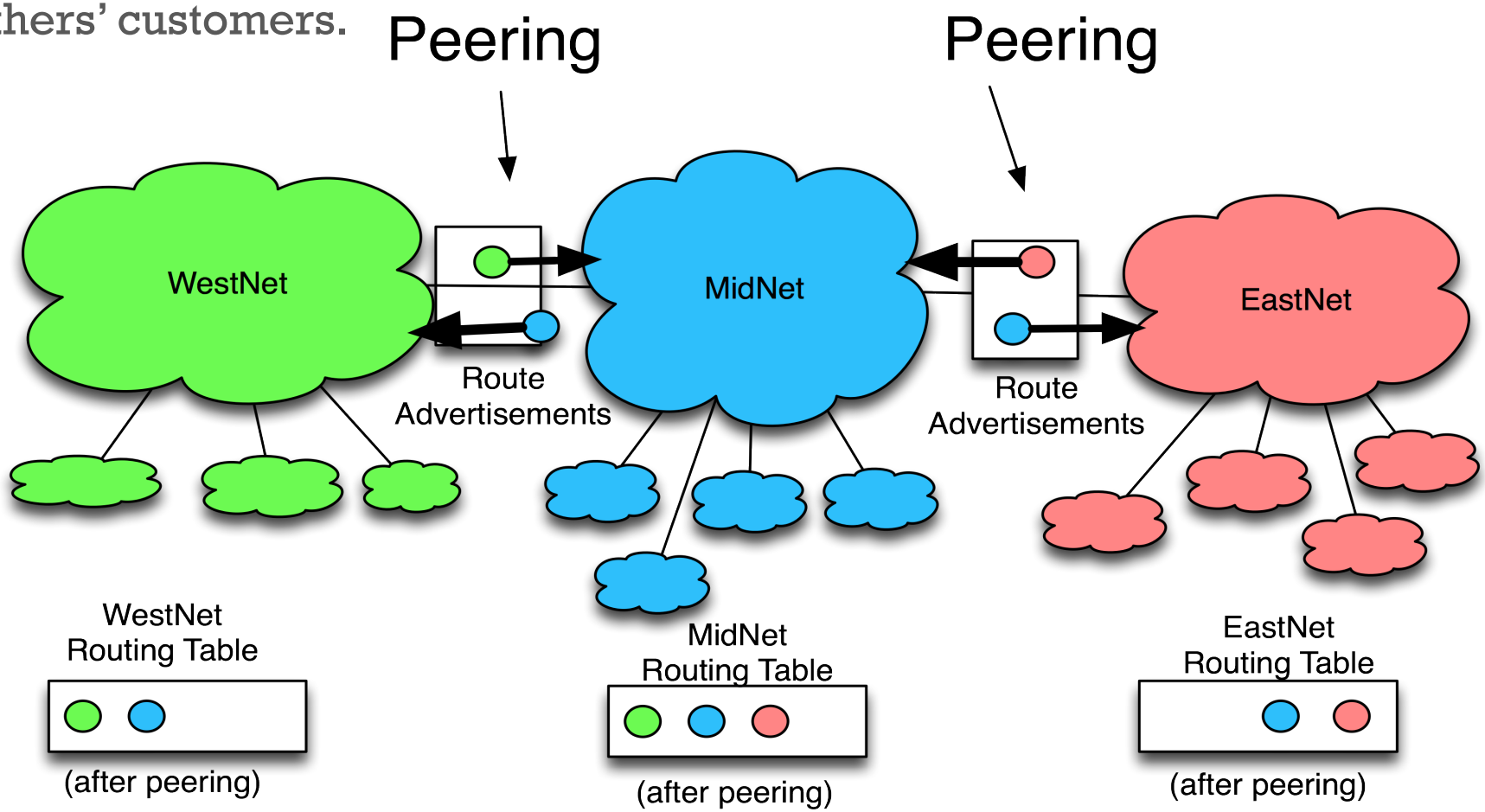
Does Peering Make sense anymore?

- #1 Question in ISP Peering Coordinator Community
- EVERY……YEAR
- Price drops 30%, volume increases 60%
- Transit Bill rising



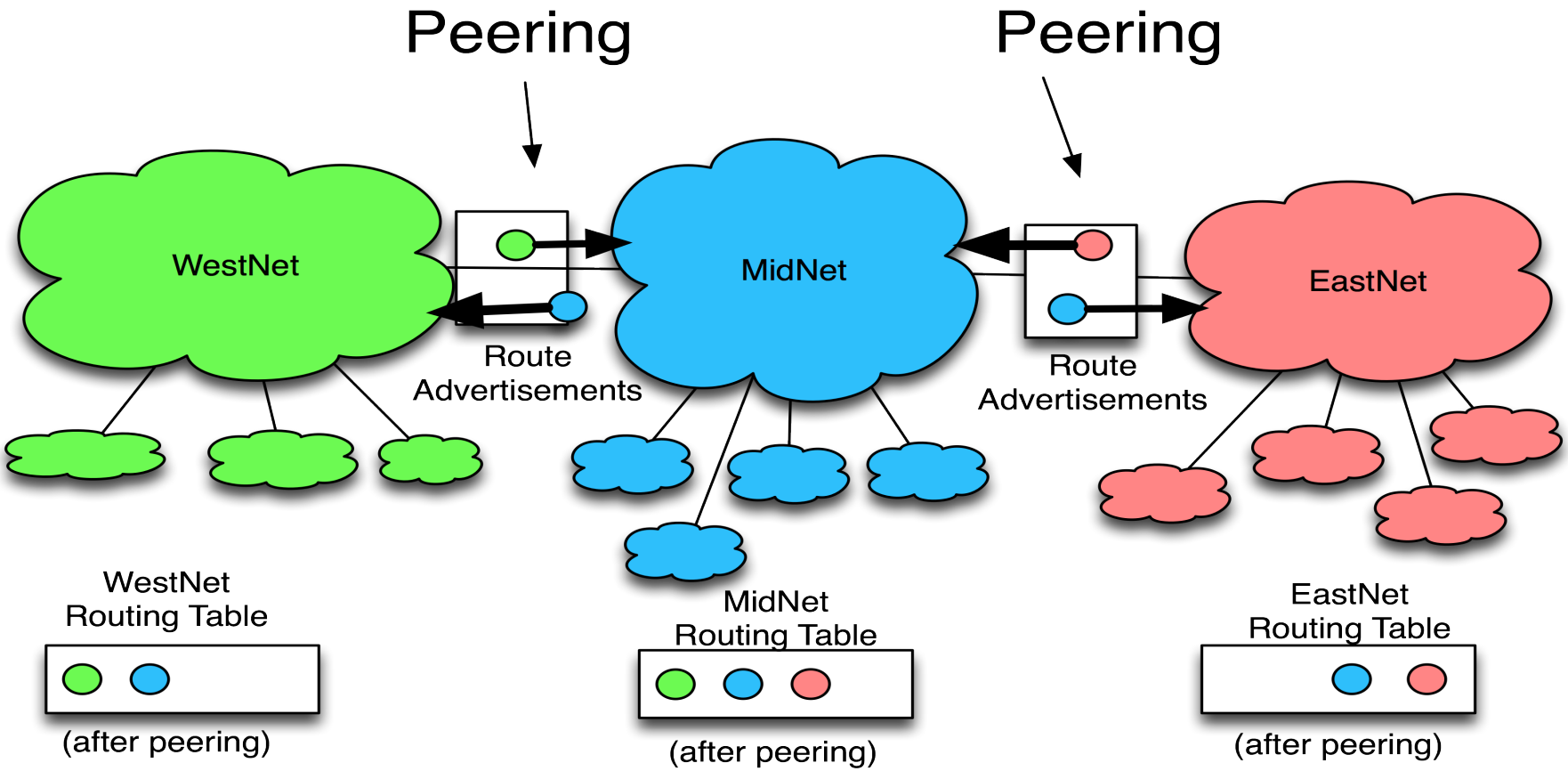
Internet Peering

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

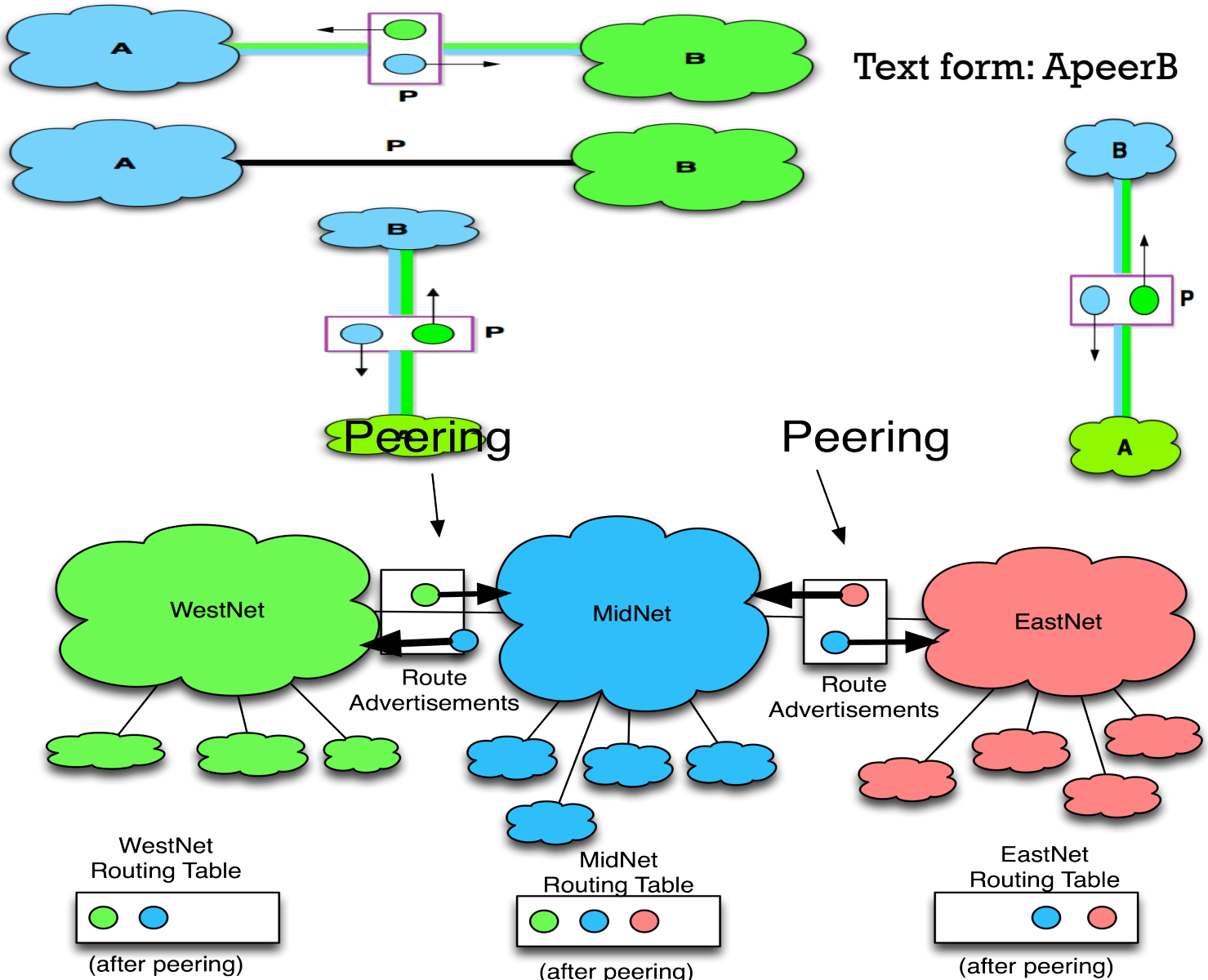


Internet Peering

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

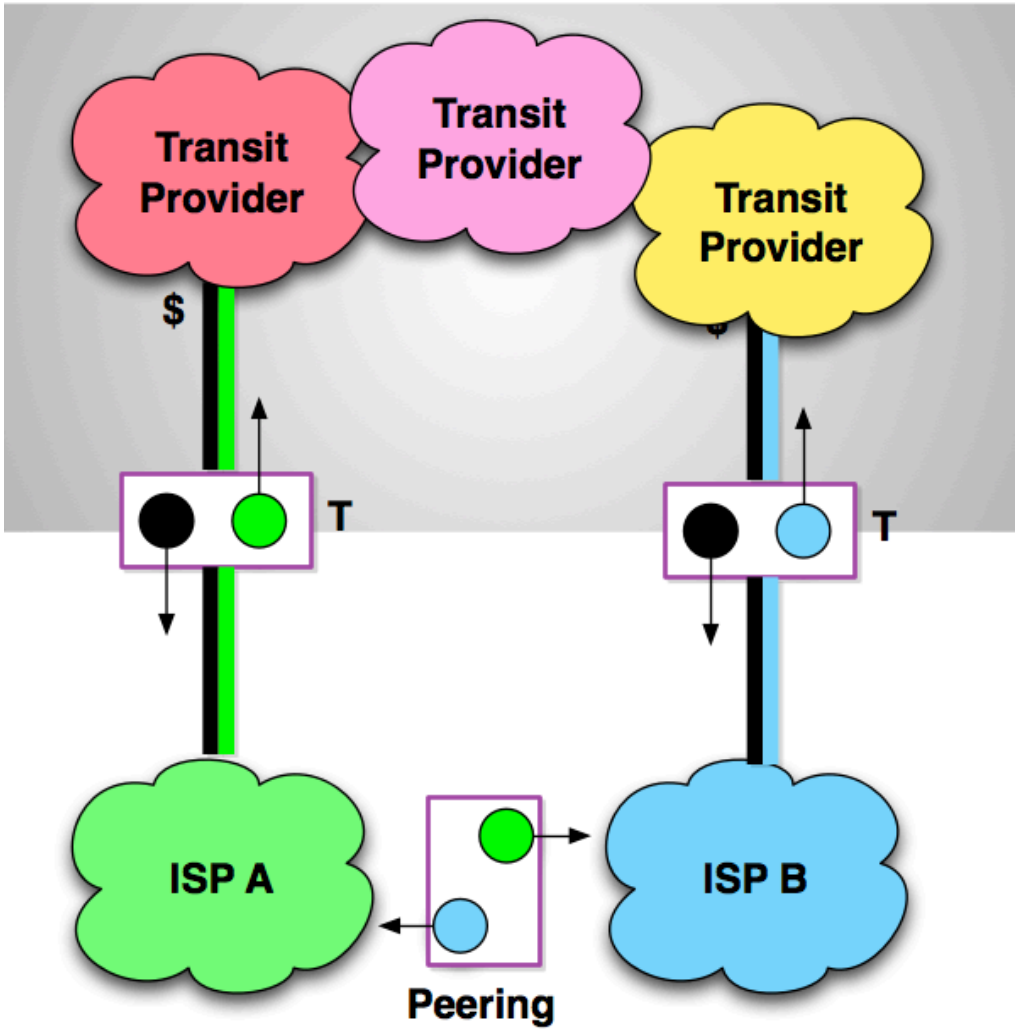


Equivalent Notation



Create network diagrams

Notation shorthand to simply describe business relationships



Top 5 motivations for peering

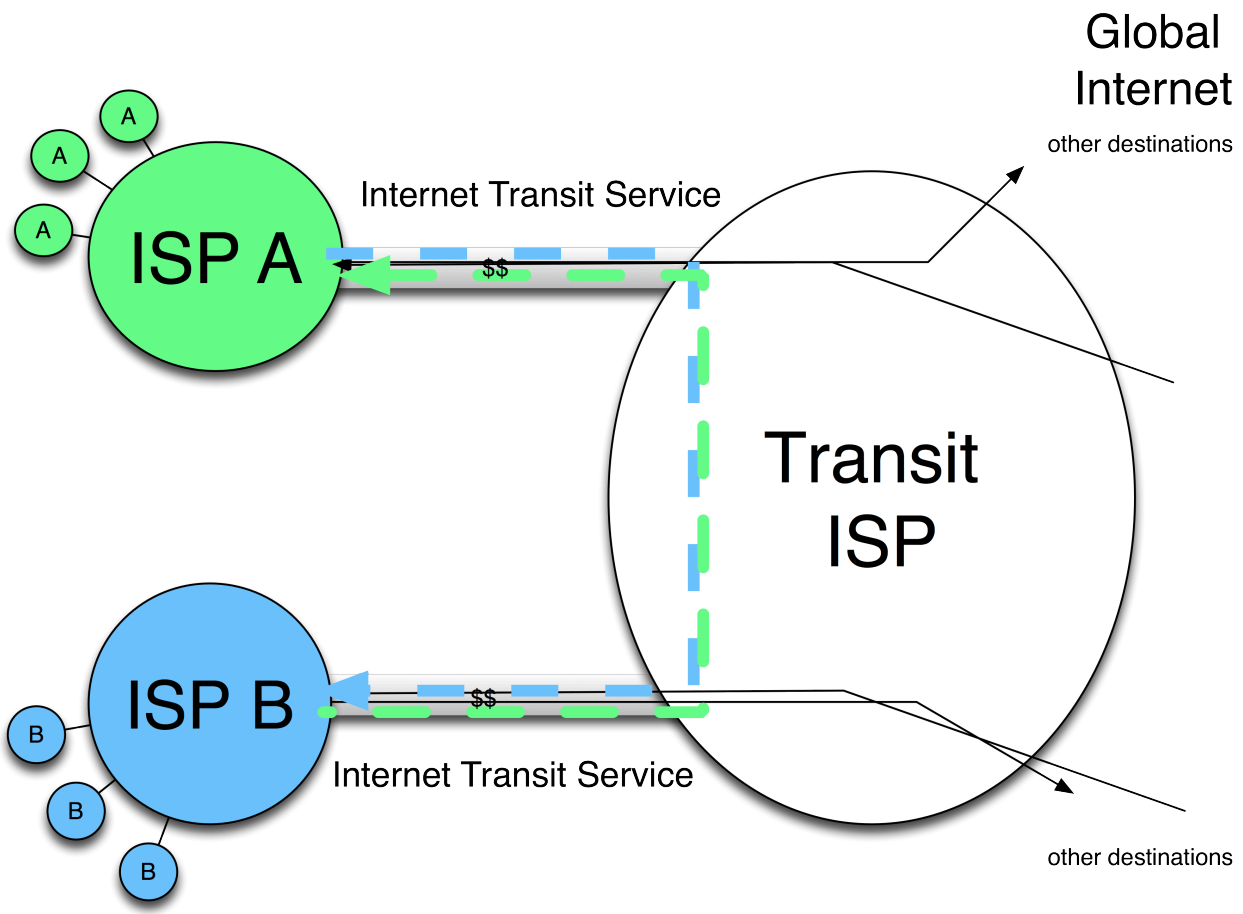
Motivations to Peer

1. Lower Transit Costs
   (#1 from Tier 2 ISP motivation)
2. Improve end user experience
   (#1 from Content companies)
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 3 Phases of the Internet Peering Process

Phase 1 – Identification of Target Peers

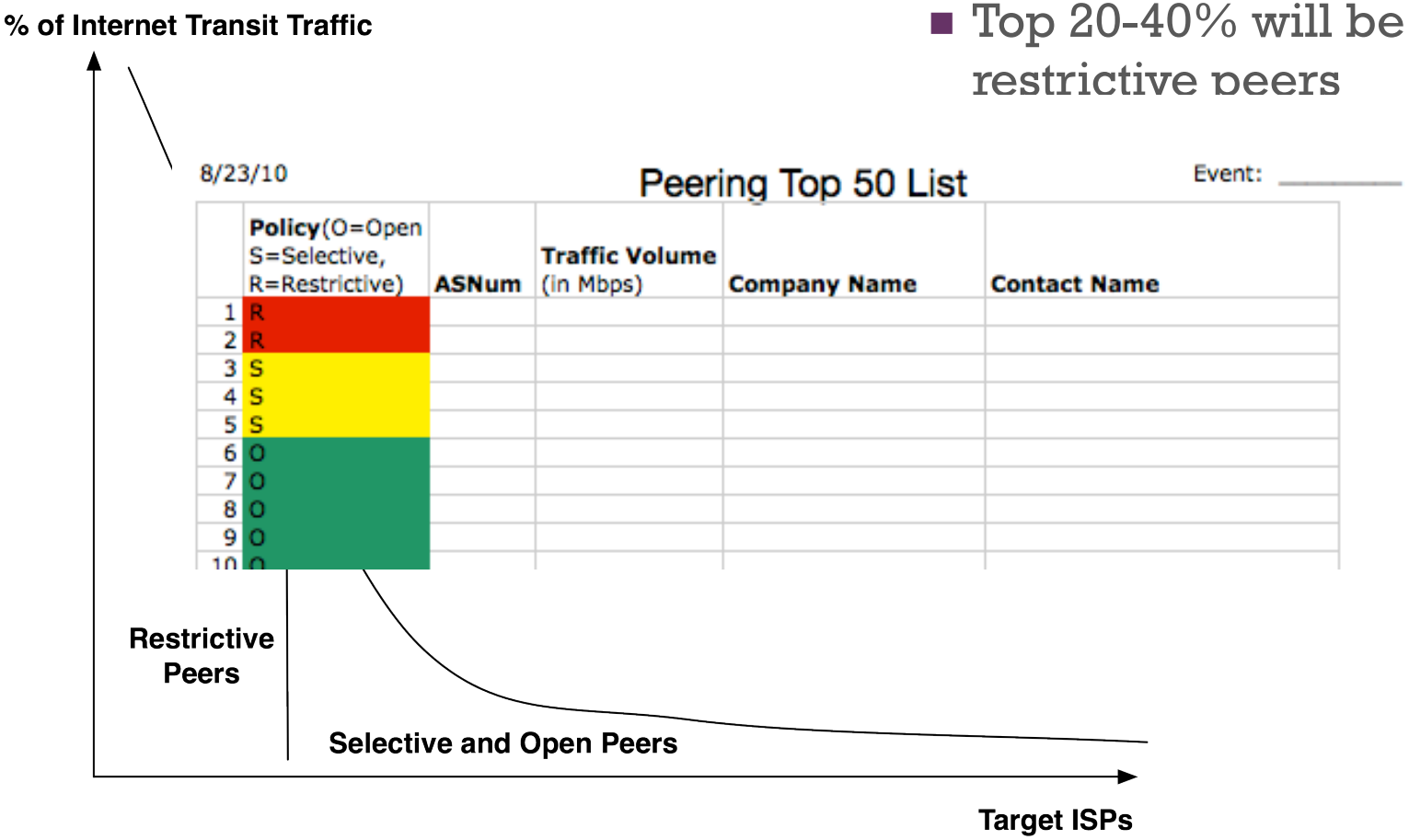
- NetFlow
- others



Cautionary Note

Top Internet Transit Traffic Destinations

- Top 20-40% will be restrictive peers



Phase 2 – Initial Contact & Qualification

- Peering Steering Committee
- Finding the right person is a challenge (See The Peering Playbook)
- Here are the top 10 ways seasoned peering people use to establish contact

Top 10 ways seasoned Peering Coordinators 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 Commercial Peering Forums like Global Peering Forum (you must be a customer of one of the sponsoring Ixes)
3. face-to-face at IX 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 seasoned Peering Coordinators 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.

A Bad peering email

Hello kind sir,

misspellings, poor grammar generally

It has recently been purchsased to my attention that at this moment in time both of our companies are present at the LINX in London England and that we do not at this moment in time have an agreement between our companies such that we may interchange the traffics of our people and customers over this LINX in London England but that we exchanges our traffics in other manors that are detriment to our combined interests.

Please may it be that you are in reply to my email which I write with great satisfication that we are to be setting the configuration up of the peerings at LINX in London England.

Please be in reply to this email if you are in agreement.

I am available of the email address peering@internetserviceprovidings.in

Peering Department

Internet Service Providings India

What problems do you see with this peering request?

<u>Missing Information</u>

AS Number?

Traffic Volume?

Peering Requirements (if any?)

Other Peering Locations?

URL to backbone maps, website?

Send Chat Attach Address Fonts Colors Save As Draft Photo Browser Show Statio

To: peering@as123.net

Cc: wbn@DrPeering.net

Bcc:

Subject: Peering Request from Norton Associates(192.62.198.22,AS5555,AS-NORTON-123) at EQIX-ASH in Ashburn, VA, US

From: William Norton <wbn@drpeering.net> Signature: DrPeering

lello,

lorton Associates (666) is connected to the EQIX-ASH and is interested in establishing a peering session with AS7007.

Ve have a Selective peering policy and ARE willing to sign contracts.

urrently we exchange 1900Mbps of traffic at EQIX-ASH

ur details are as follows:

: 192.62.198.22
S: 666
S-MACRO: AS-NORTON-666
terface: gigE
refixes announced: 2
D5 password: YES
eering email: peering@nortonassoc.com
eering coordinator phone: DrPeering
eering coordinator fax: 800-123-2121
OC email: noc@nortonassoc.com
OC phone: 800-123-4567
OC fax: 800-123-4567
OC mail address: PO Box 1, Ann Arbor, MI 48103
eering agreement: http://www.nortonassoc.com/peering/

dditional information about our network:

Ve carry over 30Gbps of transit.

Ve are present at the following IXPs:

QIX-ASH: 192.62.192.22

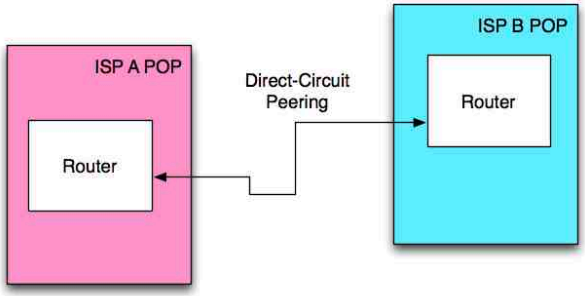
Phase 2 – Initial Discussion

- NDAs may be signed
- BLPAs examined
- Discussion of prerequisites and policies
- Exchange of backbone maps

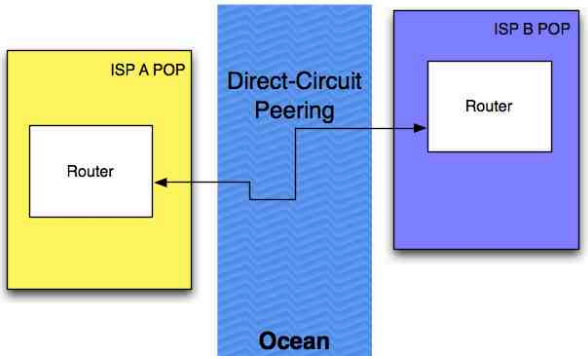
Phase 3 – Implementation Discussion

- Direct Circuit

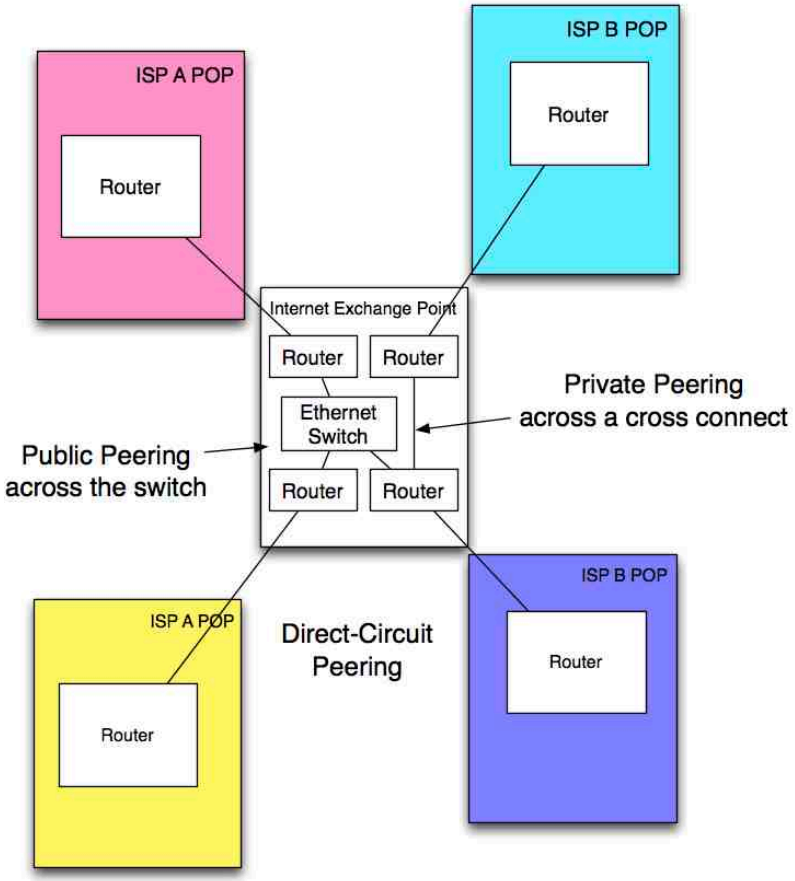
Metro Area Direct Circuit Peering



Transoceanic Half-Circuits



- Exchange Point

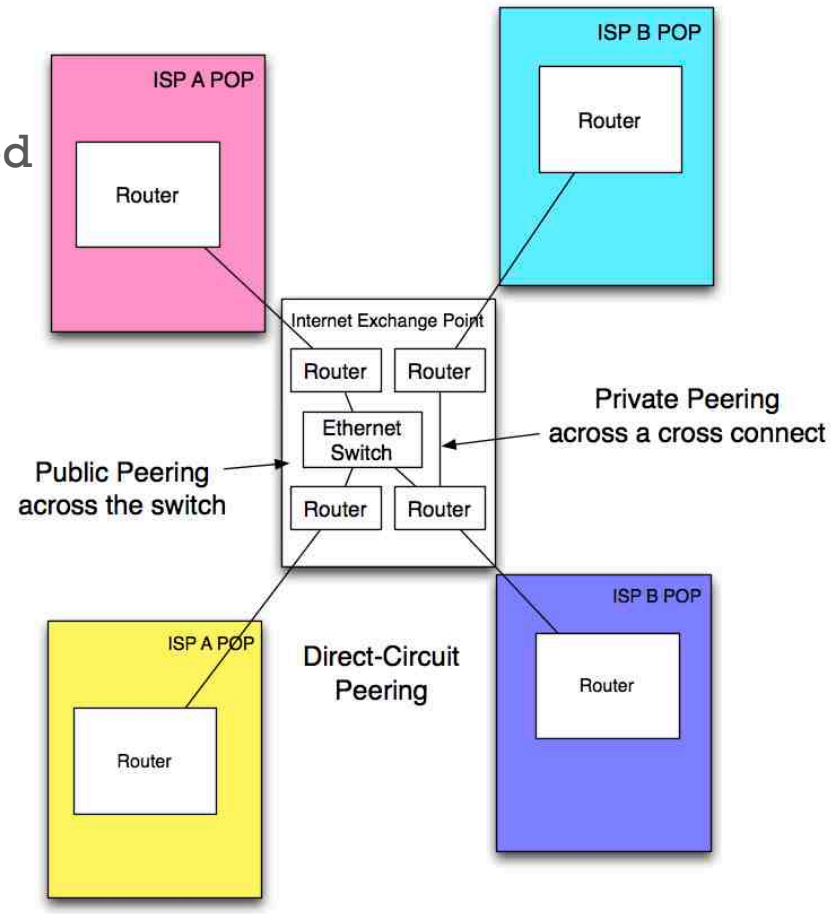


Direct Circuit Approach

- Exactly two parties connected
- Cost: circuit cost

IX Approach

- Many parties connected across peering fabric
- Cost: Transport, router, colo, peering port



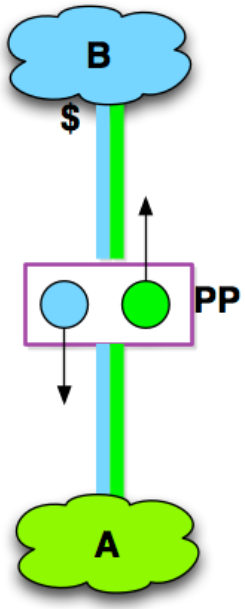
Paid Peering Aside

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

Metered: $/Mbps

Or Barter for services

~ Asymmetric allocation of costs of peering relationships

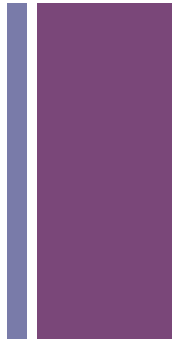


Paid Peering notation

Challenges

1. "If I peer with A, B, and C, won't my peers start sending their traffic to each other through my network? (A→C, A→B)"
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?

Questions?



The Business Case for Peering

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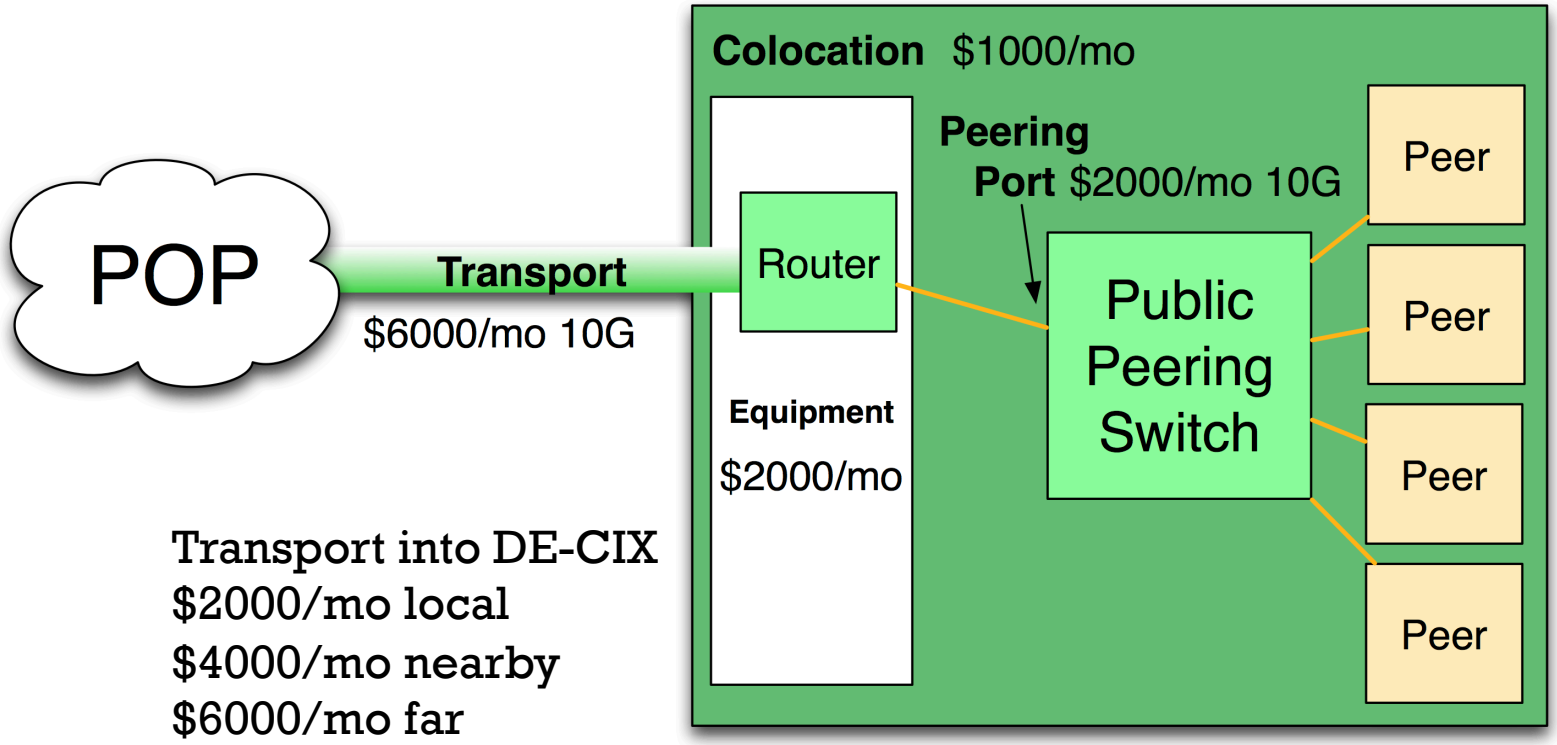
Overview of this section

- "For the CFO, keep it simple"
- When does peering make sense financially?
- Don't convince, prove.
- "Tell me again why I should burn a port for free peering when I could make revenue off of it?"
- Bryan Garrett (BellSouth) story
  - Used internally
  - Reviewed quarterly
  - External experise

The Cost of Peering in 2010

Assumptions	Far	
Transport into IX:	$6,000	per month
Colocation Fees:	$1,000	per month
Peering Fees:	$2,000	per month
Equipment Costs:	$2,000	per month
Total Cost of Peering:	$11,000	per month



Transport into DE-CIX
$2000/mo local
$4000/mo nearby
$6000/mo far

Cost of Internet Peering

Assumptions	Far	
Transport into IX:	$6,000	per month
Colocation Fees:	$1,000	per month
Peering Fees:	$2,000	per month
Equipment Costs:	$2,000	per month
Total Cost of Peering:	$11,000	per month

Cost of Peering allocated across the amount of traffic peered for free.

Mbps Exchanged	Peering Cost
100 Mbps	$110.00 per Mbps
200 Mbps	$55.00 per Mbps
300 Mbps	$36.67 per Mbps
400 Mbps	$27.50 per Mbps
500 Mbps	$22.00 per Mbps
600 Mbps	$18.33 per Mbps
700 Mbps	$15.71 per Mbps
800 Mbps	$13.75 per Mbps
900 Mbps	$12.22 per Mbps
1000 Mbps	$11.00 per Mbps
1100 Mbps	$10.00 per Mbps
1200 Mbps	$9.17 per Mbps
1300 Mbps	$8.46 per Mbps
1400 Mbps	$7.86 per Mbps
1500 Mbps	$7.33 per Mbps

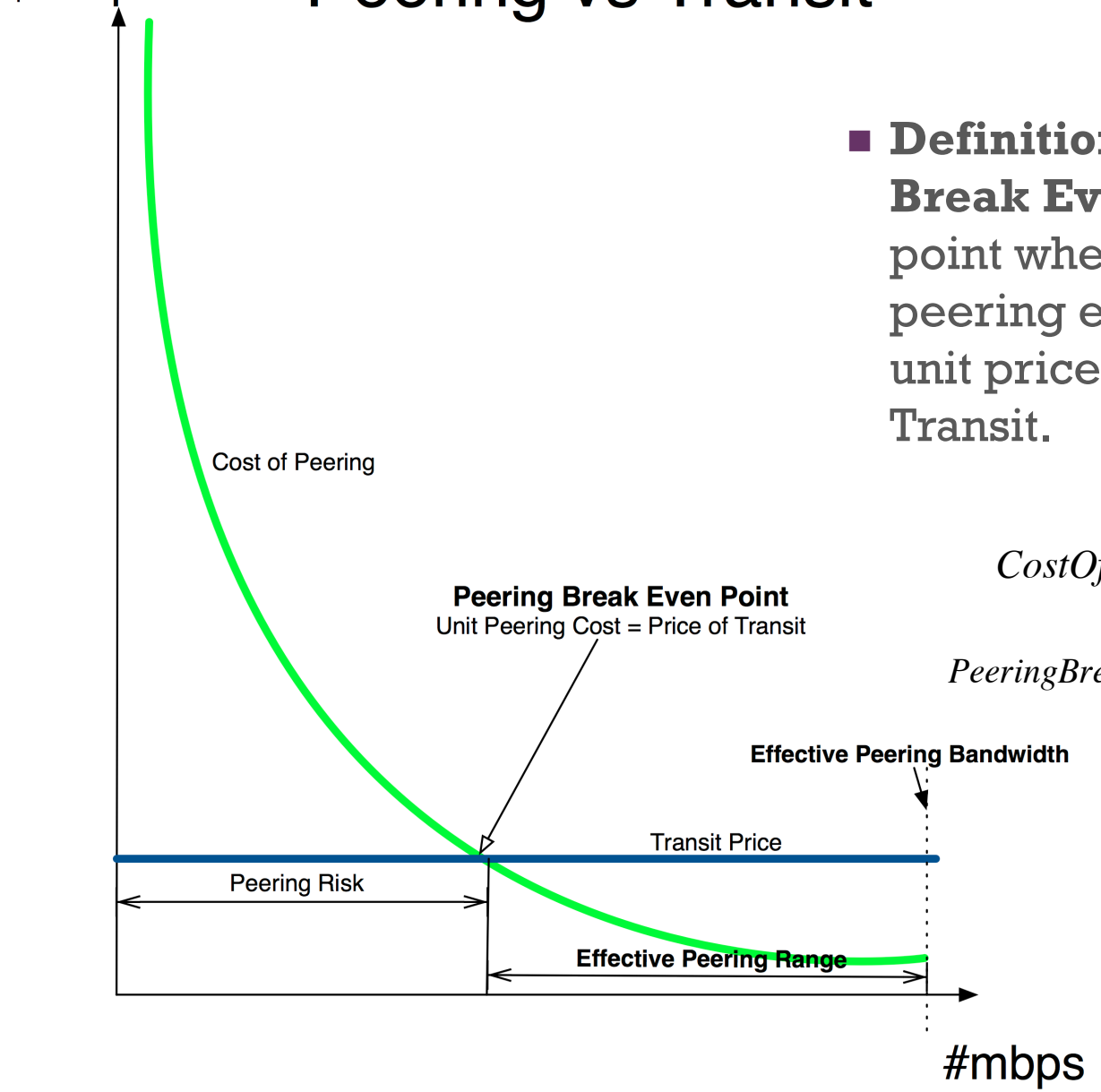
4 Internet Peering Metrics

- All of these metrics are variants of **Does Peering make sense?**

1. How much traffic do I have to peer for free to save enough money to cover the cost of peering?
2. When I max out peering, what will be the best case scenario cost of peering?
3. What is the maximum amount of traffic I can realistically push through peering infrastructure?
4. Where is the peering sweet spot, when peering proves financially rational?

Peering vs Transit

PvT



- **Definition:** The **Peering Break Even Point** is the point where the unit cost of peering exactly equals the unit price of Internet Transit.

$$CostOfPeering = \frac{MonthlyCostOfPeering}{\#\ MbpsExchanged}$$

$$PeeringBreakEvenPoint = \frac{MonthlyCostOfPeering}{UnitPriceOfTransit}$$

Application of Peering Breakeven Point

- "If you can peer 3143Mbps I can prove to you it makes sense to build in"

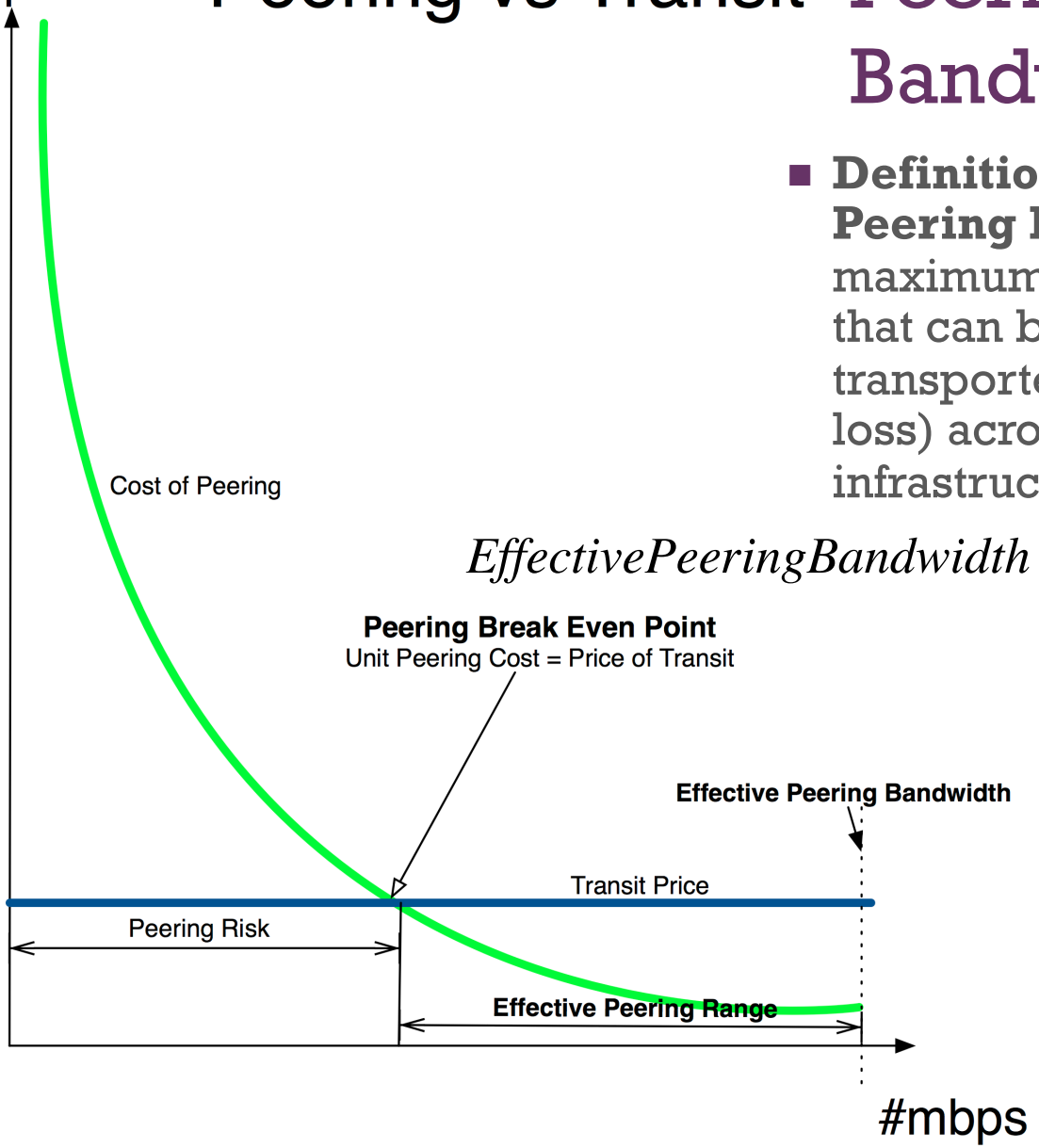
Assumptions	**Far**		**Near**		**Local**	
Transport into IX:	$6,000	per month	$4,000	per month	$2,000	per month
Colocation Fees:	$1,000	per month	$1,000	per month	$1,000	per month
Peering Fees:	$2,000	per month	$2,000	per month	$2,000	per month
Equipment Costs:	$2,000	per month	$2,000	per month	$2,000	per month
Total Cost of Peering:	$11,000	per month	$9,000	per month	$7,000	per month
market price at origin	$3.50	per Mbps	$3.50	per Mbps	$3.50	per Mbps
market price at dest	$2.00	per Mbps	$2.00	per Mbps	$2.00	per Mbps
peeringBreakEven (Mbps)	3143	Mbps	2571	Mbps	2000	Mbps
minCostOfTraffic ($/Mbps)	$1.57		$1.29		$1.00	

Peering vs Transit

Effective Peering Bandwidth

- **Definition: The Effective Peering Bandwidth** is the maximum amount of traffic that can be safely transported (without packet loss) across peering infrastructure.

$$EffectivePeeringBandwidth = 70\% * 10Gbps = 7000Mbps$$

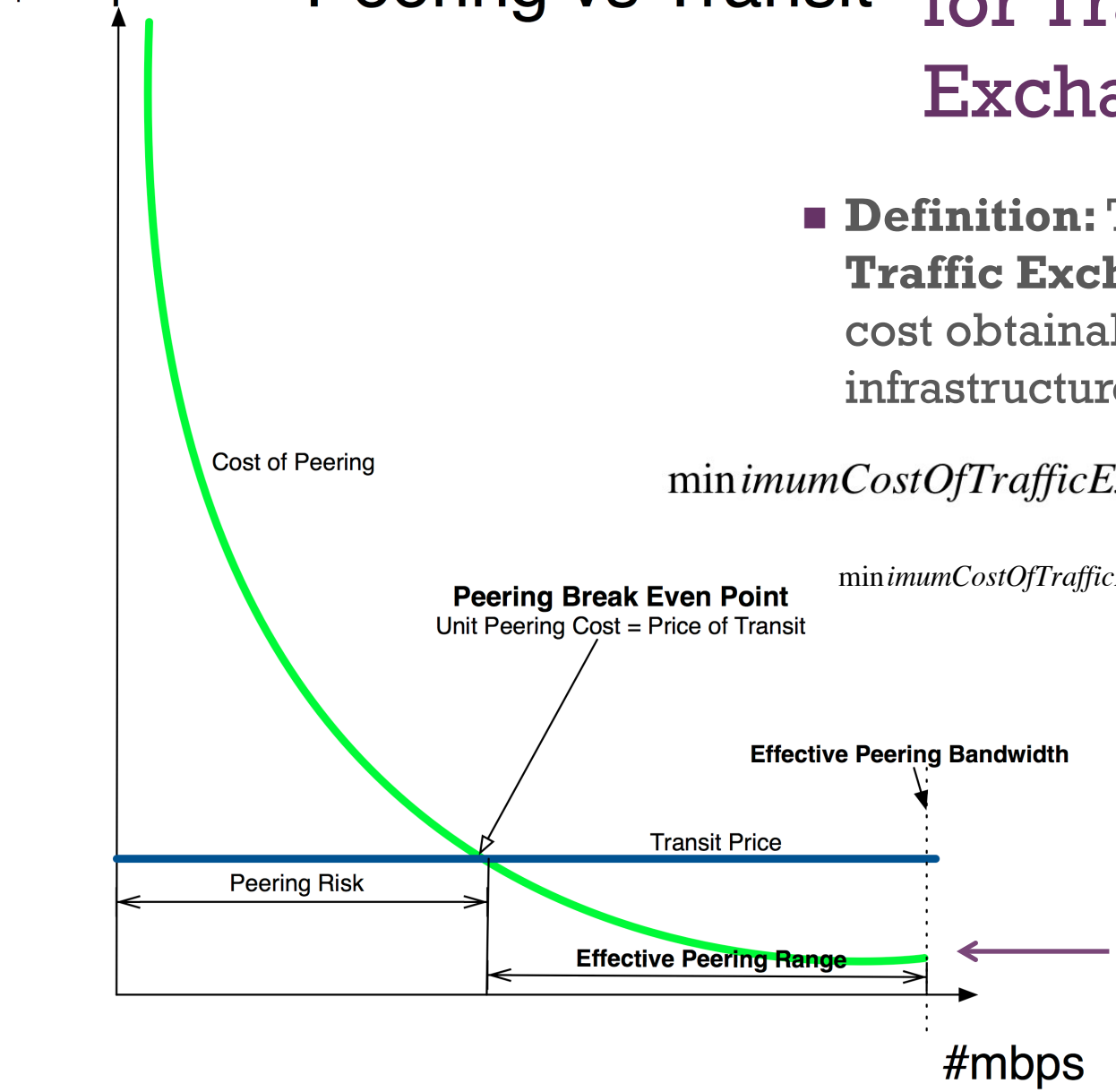


Minimum Cost for Traffic Exchange

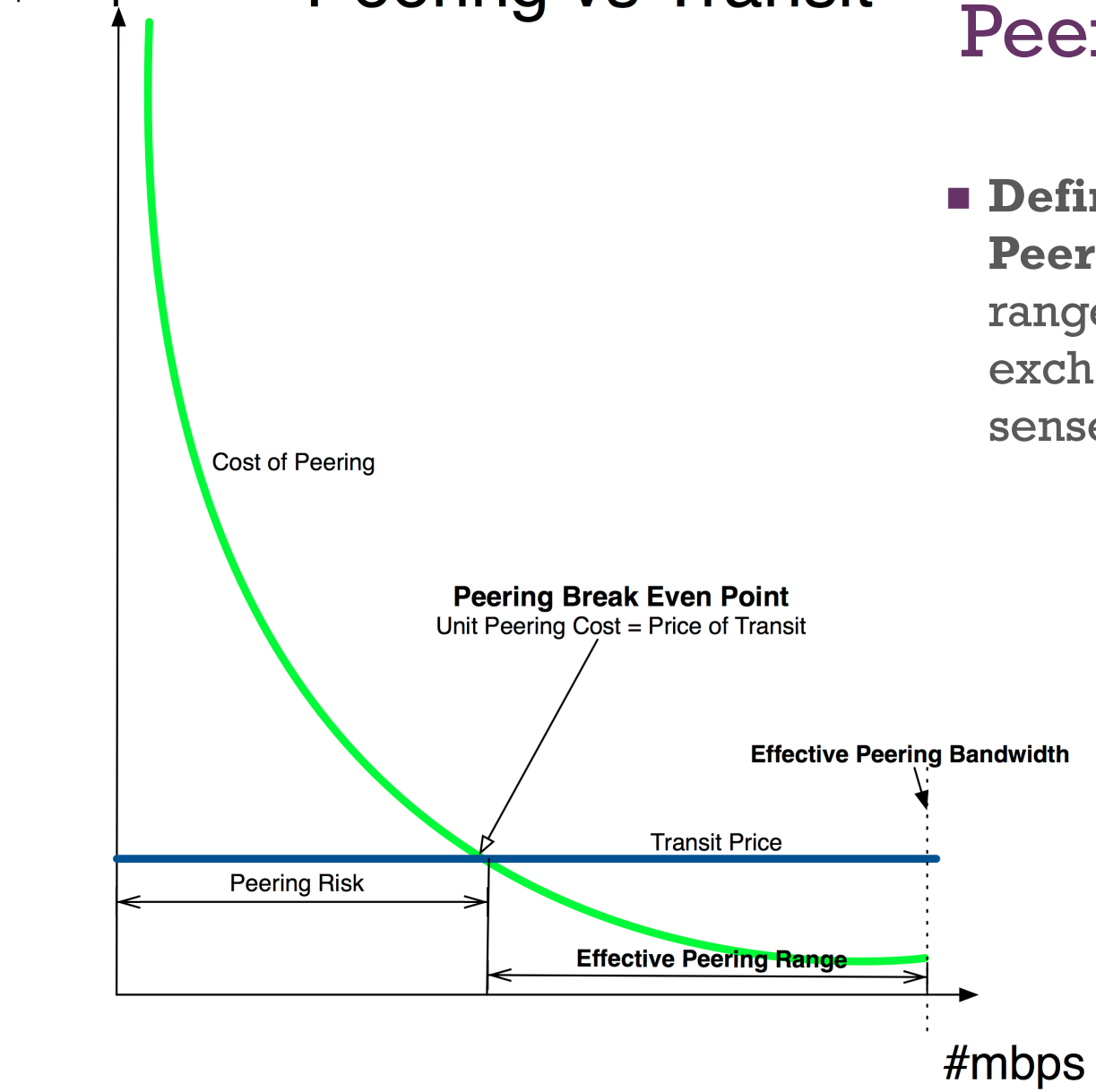
- **Definition:** The **Minimum Cost for Traffic Exchange** is the lowest unit cost obtainable in a peering infrastructure deployment.

$$\min imumCostOfTrafficExchange = \frac{\cos tOfPeering}{effectivePeeringBW}$$

$$\min imumCostOfTrafficExchange = \frac{\$11{,}000\,perMonth}{7000\,Mbps} = \$1.57\,perMbps$$



Peering vs Transit



Effective Peering Range

- **Definition:** The **Effective Peering Range** is the range of peering traffic exchange that makes sense financially.

Non-Financial Motivations for Peering

- Low Latency
- Control Over Routing
- Redundancy
- Aggregation benefits w/peering and Transit at IX
- Make more money with lower latency and loss

Non-Financial Motivations for Peering

- ISP relationships
- Marketing benefits
- Network reliability

Challenges with Peering

- Network Expertise Required
- Admin startup costs
- Peering not always granted
- Greater operational overhead
- Peering process may be slow
- Peering may not be granted
  - Hence the Peering Playbook

Challenges

- Challenges: Build into an IX?

1. What is the monthly bill if you buy 1.5Gbps of transit at $2/Mbps and peer 1Gbps at an IX with a monthly peering cost of $5000/month?

2. You have 5 Gbps of video traffic to push and your price of transit is $2 per Mbps with a 2G commit. Does it make sense to build into Sandeep's Internet Exchange if the circuit in costs $3000/mo, colo costs $1000/mo, the 10Gbps peering port costs $3000/mo and you think you can peer away 2Gbps for free at the IX?

3. You have 6 Gbps of video traffic to push and the price of transit is $2 per Mbps with a 2G commit. Does it make sense to build into Manning's Internet Exchange if you can peer 2Gbps with the only cost being port costs $2000/mo for a 10 gig port.

The Peering Simulation Game

APRICOT 2012 Peering Forum
Jan 28, 2012
New Delhi, India

William B Norton,
Executive Director, DrPeering.net
http://DrPeering.net

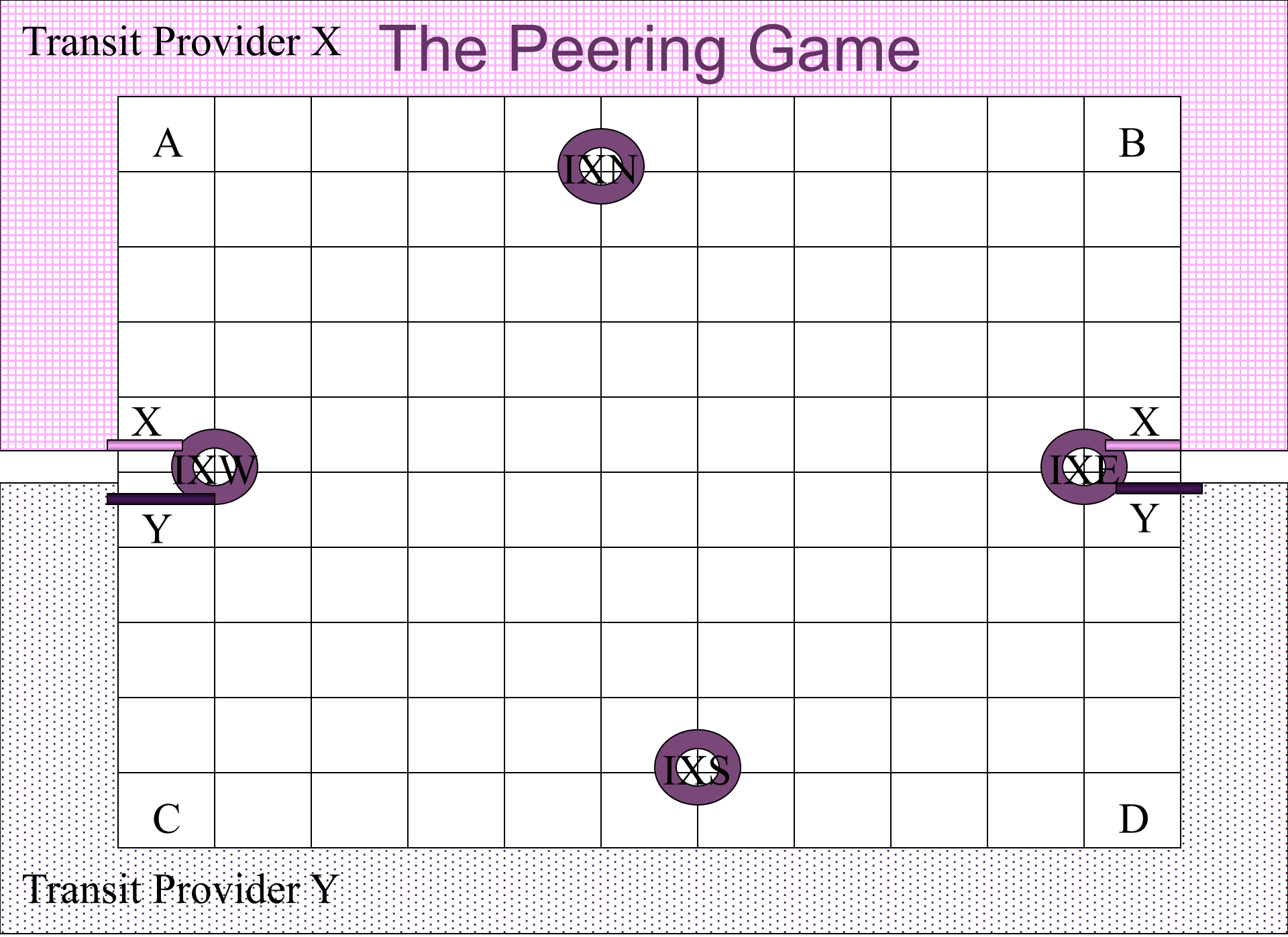
Goals

- Apply the lexicon
- Live the life of a peering coordinator
- Invented@Telephony Conference
- “When I place a call from my browser to Yahoo!, how are the intermediary ISPs compensated for their part of the transaction?”

30 Runs of the Peering Simulation Game

- Across Africa – Train the Trainers
- New Zealand Social
- With Regulators (FCC)
- APRICOT, NANOG, RIPEs, etc.
- Strikingly similar to real life
- Couldn’t be done…Simplifications

The Peering Game



3 Rules

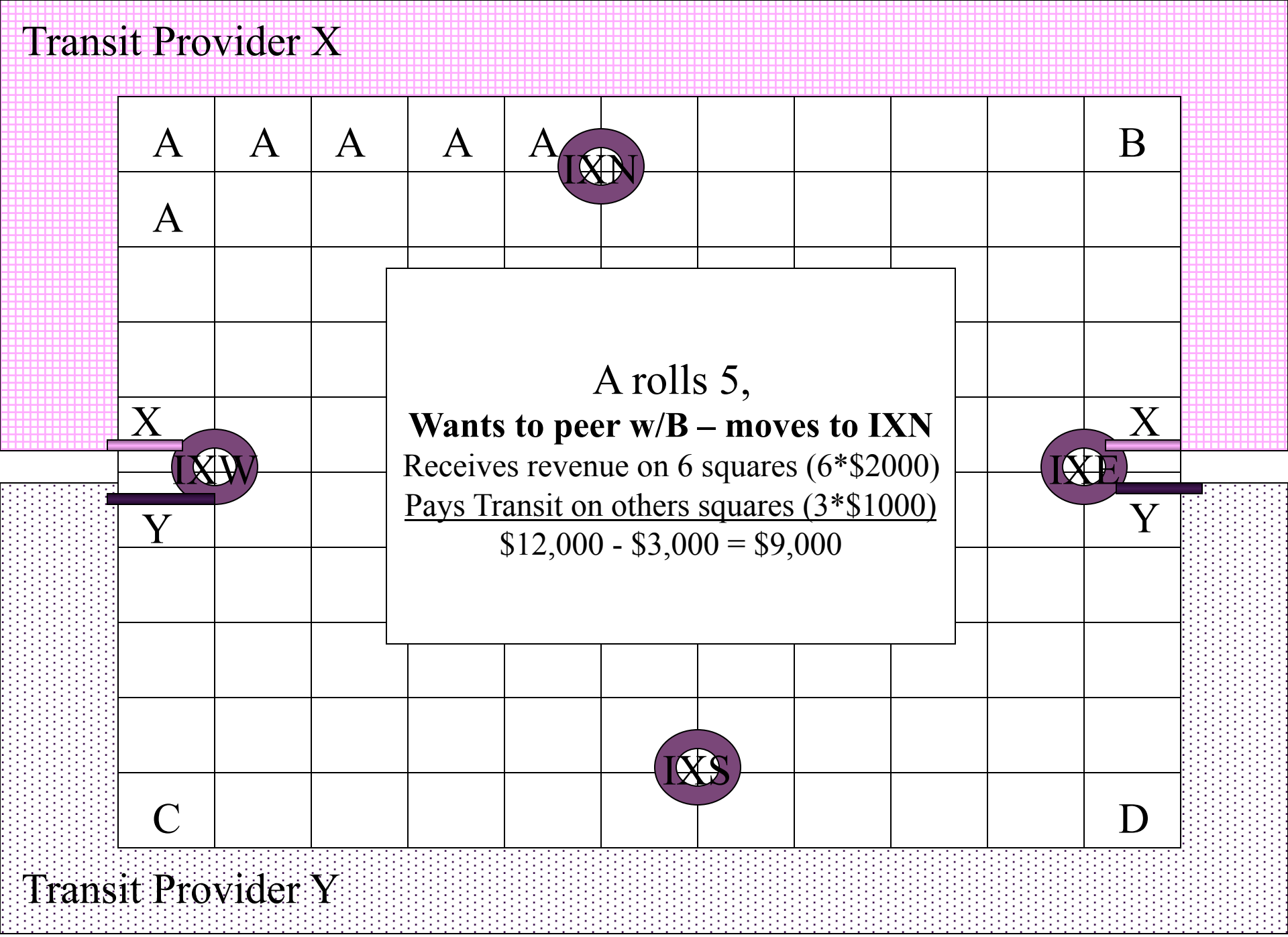
1. Goal: Maximize bank holdings. Make money by acquiring customers and reduce transit costs by peering
2. Play: Roll the dice and expand your network by selecting that many adjacent "squares" of customers

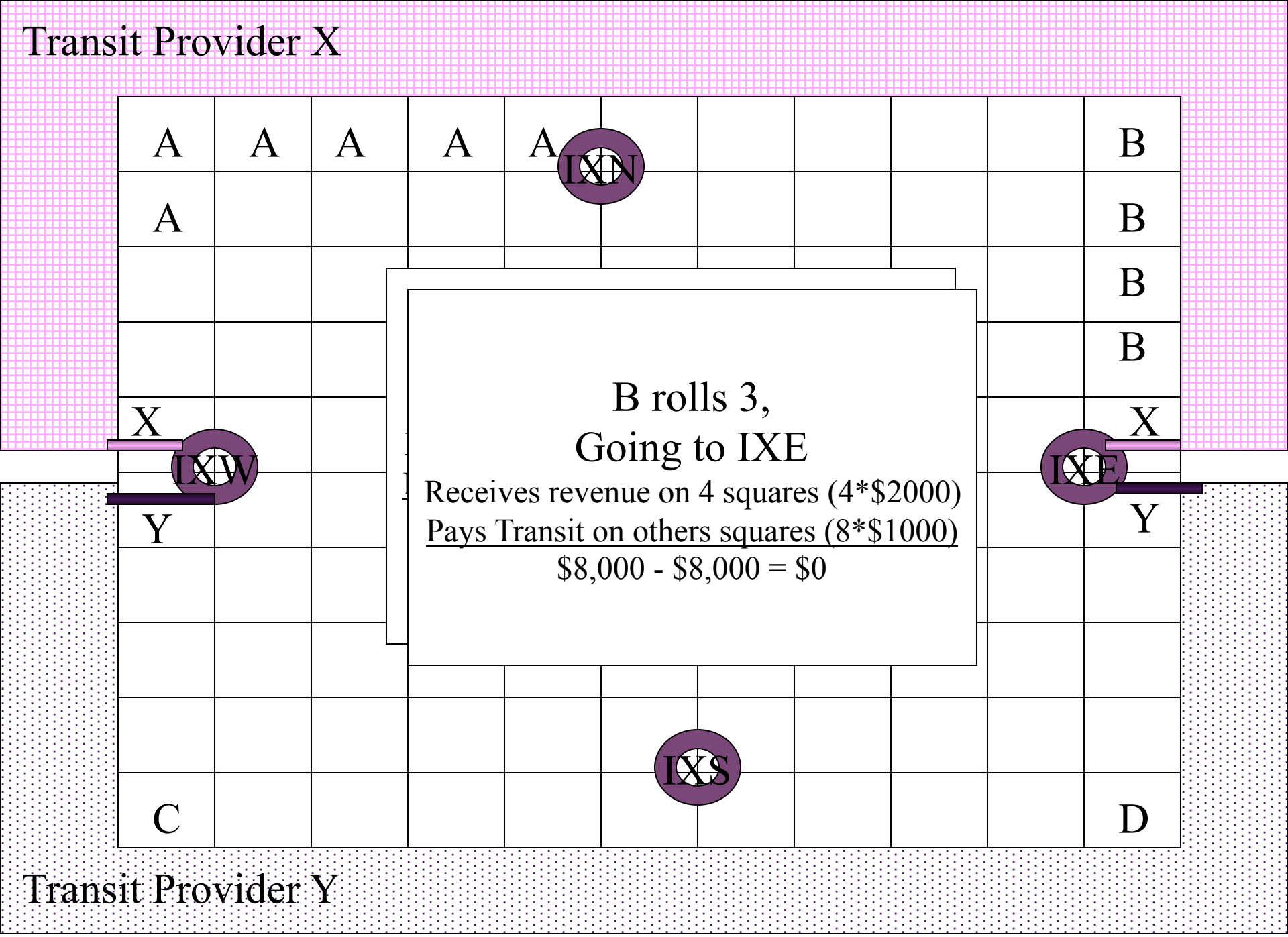
Gain transit revenue of $2000 for each customer square you own

Pay transit fees of $1000 for each square of traffic that other ISPs own

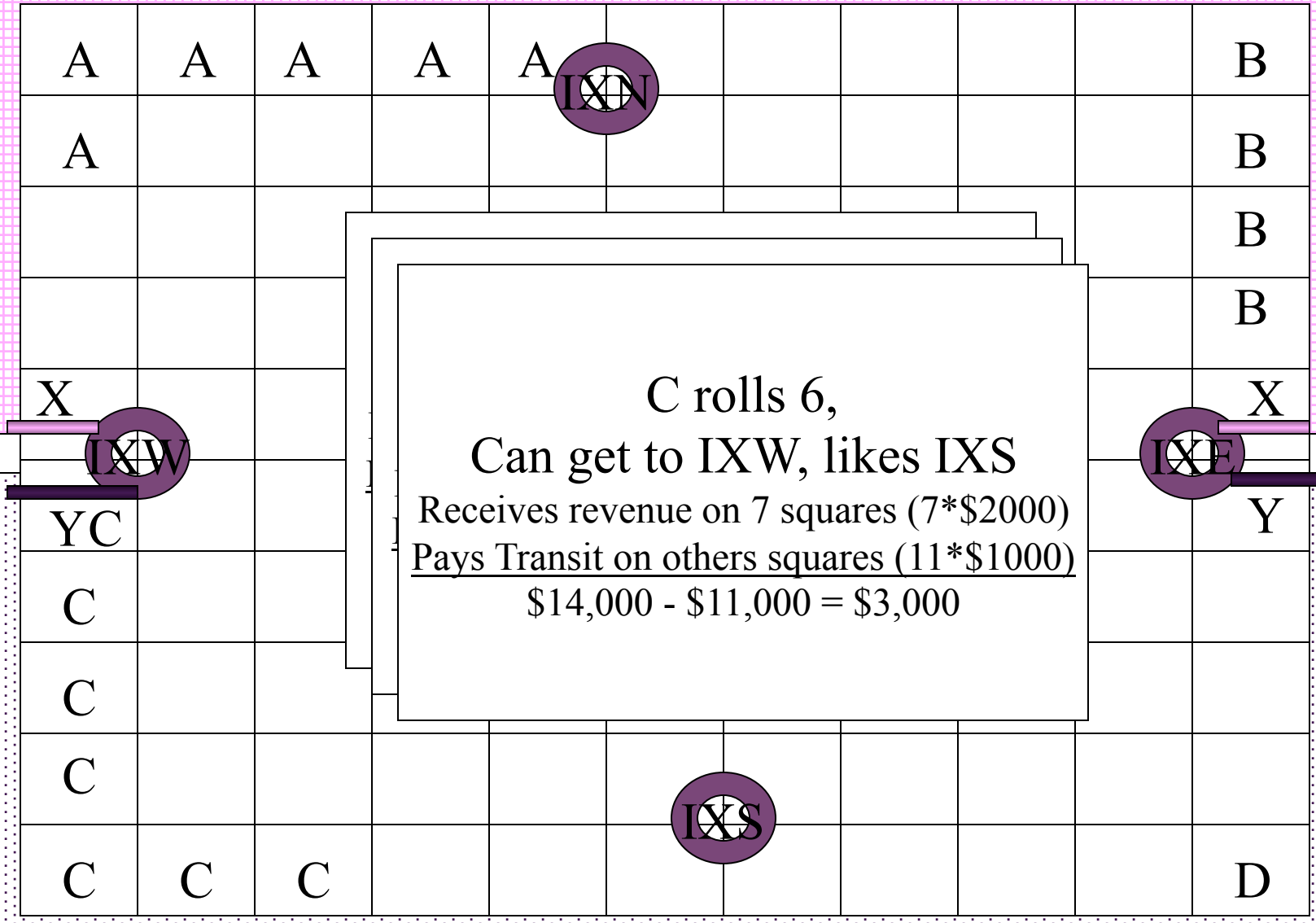
3. If at Exchange Point, two ISPs can negotiate peering:
   - $2000 recurring cost and loss of 2 turns, ISPs negotiates who covers the costs of peering
   - Peering ISPs do not have to pay transit for each others squares starting the next turn

Quick round…


Transit Provider X
A
A
A
A
A
IXN
B
A
X
IXW
Y
A rolls 5,
Wants to peer w/B – moves to IXN
Receives revenue on 6 squares (6*$2000)
Pays Transit on others squares (3*$1000)
$12,000 - $3,000 = $9,000
X
IXE
Y
IXS
C
D
Transit Provider Y

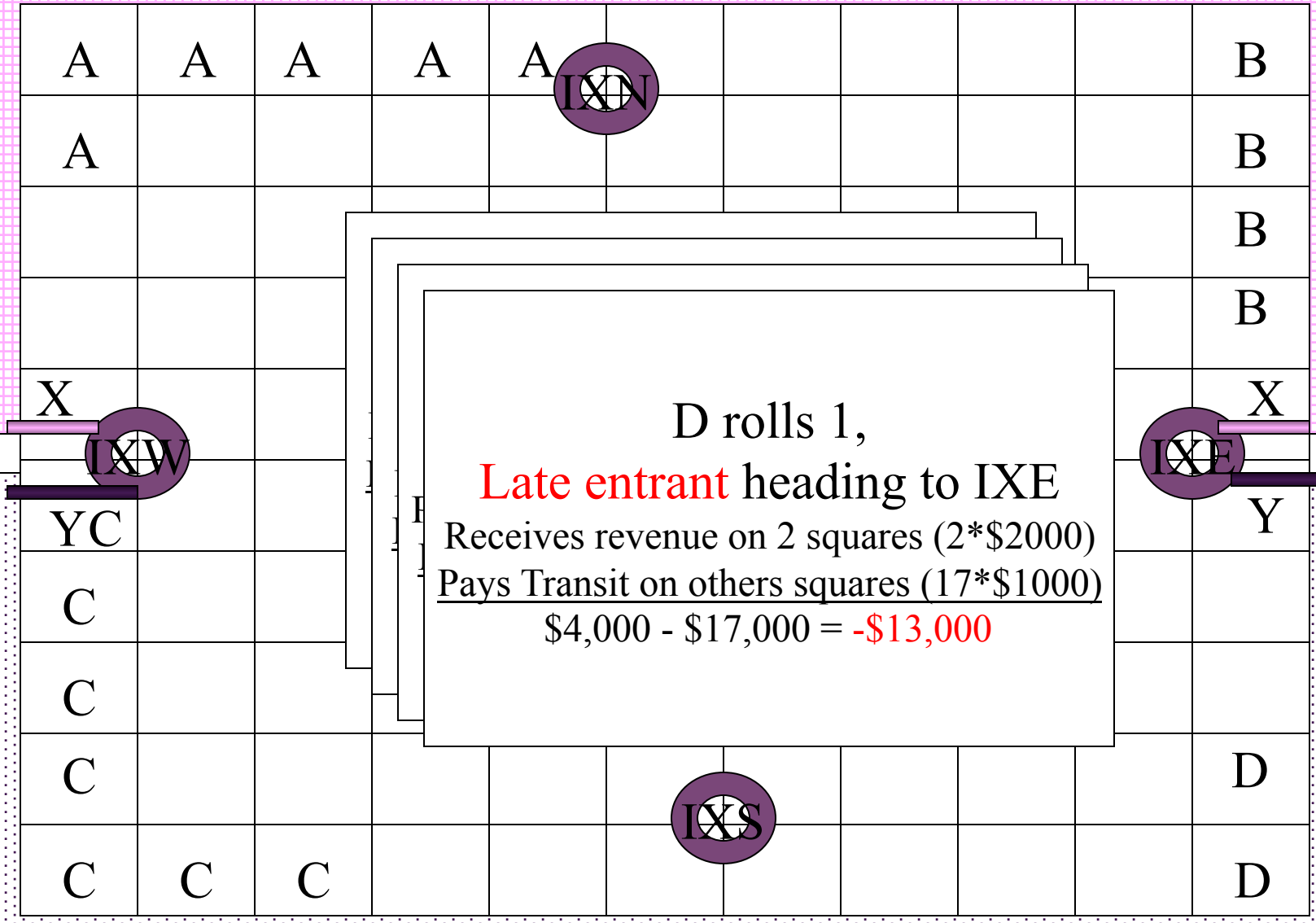

Transit Provider X
A
A
A
A
A
IXN
B
A
B
B
B
X
IXW
IXE
X
Y
Y
B rolls 3,
Going to IXE
Receives revenue on 4 squares (4*$2000)
Pays Transit on others squares (8*$1000)
$8,000 - $8,000 = $0
IXS
C
D
Transit Provider Y

Transit Provider X



Transit Provider Y

Transit Provider X

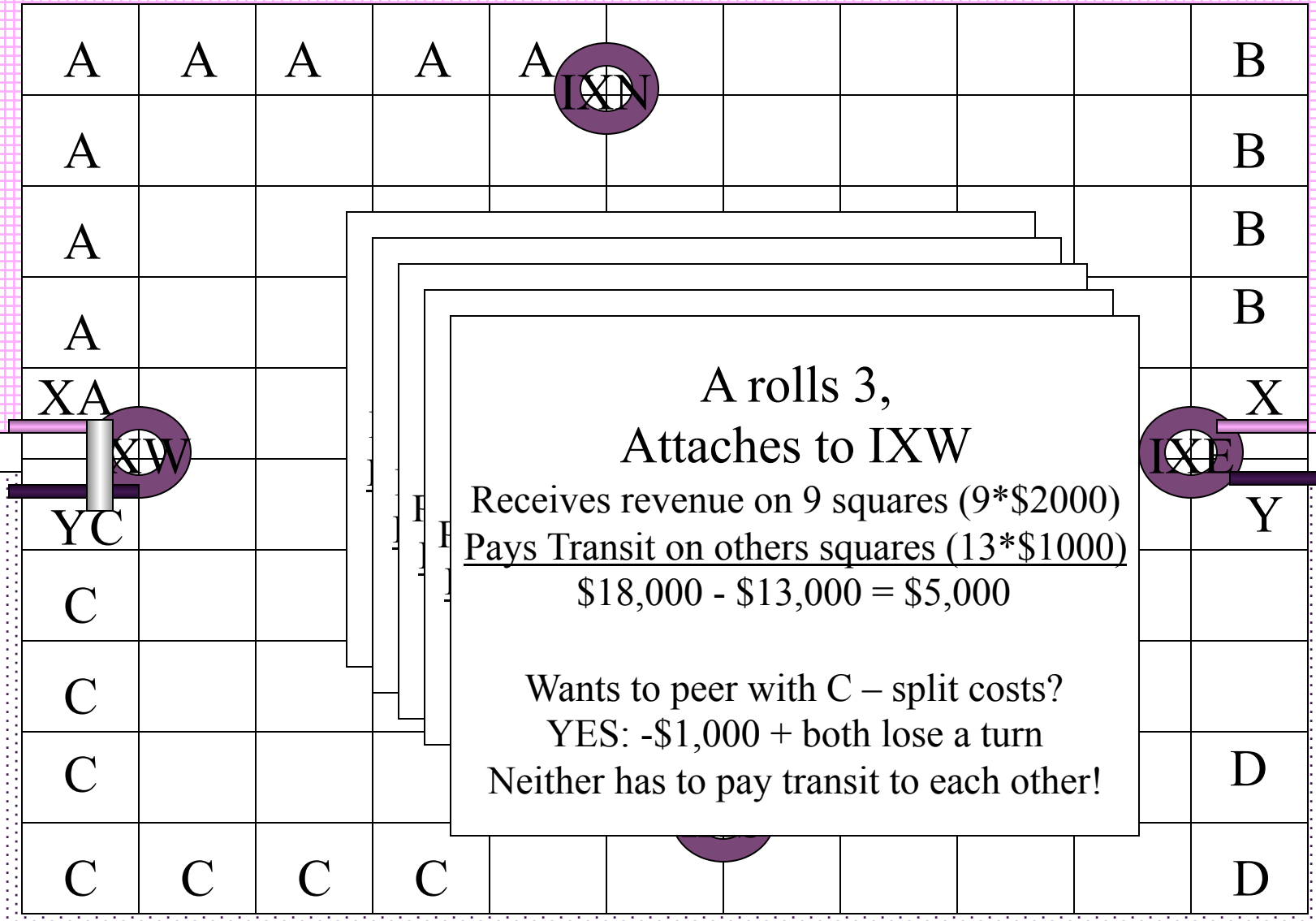


Transit Provider Y

Scoreboard after Round 1

- ISP A: $9,000
- ISP B: $0
- ISPC: $3,000
- ISPD: -$13,000

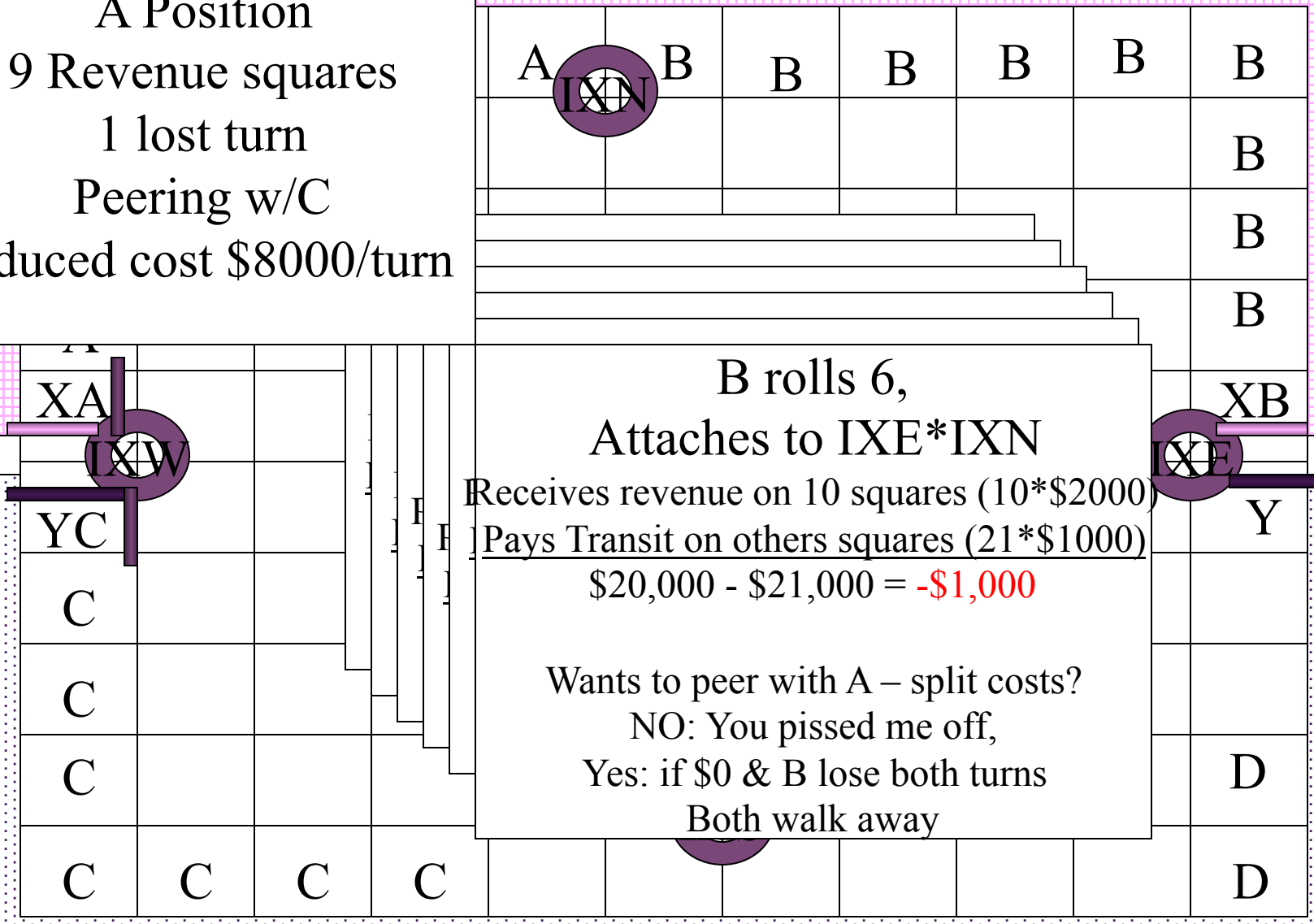
Transit Provider X



Transit Provider Y

Transit Provider X

A Position
9 Revenue squares
1 lost turn
Peering w/C
reduced cost $8000/turn



B rolls 6,
Attaches to IXE*IXN
Receives revenue on 10 squares (10*$2000)
Pays Transit on others squares (21*$1000)
$20,000 - $21,000 = -$1,000

Wants to peer with A – split costs?
NO: You pissed me off,
Yes: if $0 & B lose both turns
Both walk away

Transit Provider Y

Let's play!

WELCOME TO **BILLAND**

4 ISPs that have never played before

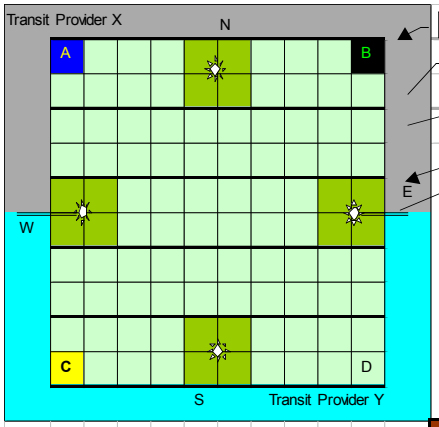
Open Board

$35,000 VC Funding

$25,000 VC Funding – HARD Economic Times

We want to hear your thought process and peering negotiations

Play Game



Internet Service Provider **Starting Point**

Get **$2000 revenue** for each square you own

Pay **$1000 transit fee** to your upstream for each square others own

Internet Exchange Point East

Reduce transit fee by peering with other ISPs at exchange point; **peering costs**
$2000 per round and loss of 2 turns, split how ISPs see fit

Peering Array

Calculate

Notes:

Can only move adjacently and diagonally

Hint: Calculate cost of NOT peering vs. Cost of peering

At end of game we assume all roll a 3 for remaining rolls

Winner is the ISP will the largest bank account at the end

ROUND	PLAYER	Roll	Bonus Content Squares	# Squares Owned	Revenue (Squares * $2000)	#OthersSquares	Transit Cost (*$1000)	Peering Costs	Net	Running Total	XpeerY	PLAYER	Pay for Transit to A?	Pay for Transit to B?	Pay for Transit to C?	Pay for Transit to D?	Sum of Transit $$$$ paid to X	Sum of Transit $$$ Paid to Y	
0	A	##		1	$0	3	$0	$0	$0	$0		A		1	1	1	$ -		
0	B	##		1	$0	3	$0	$0	$0	$0		B	1		1	1	$ -		
0	C	##		1	$0	3	$0	$0	$0	$0		C	1	1		1		$ -	
0	D	##		1	$0	3	$0	$0	$0	$0		D	1	1	1			$ -	
copy	A	##		1	$2,000	3	($3,000)	$0	$25,000	$25,000		A		1	1	1	$ -		
copy	B	##		1	$2,000	3	($3,000)	$0	$25,000	$25,000		B	1		1	1	$ -		
copy	C	##		1	$2,000	3	($3,000)	$0	$25,000	$25,000		C	1	1		1		$ -	
copy	D	##		1	$2,000	3	($3,000)	$0	$25,000	$25,000		D	1	1	1			$ -	
Jan	A	##		1	$2,000	3	($3,000)	$0	($1,000)	$24,000		A		1	1	1	$ 3,000		A
Jan	B	##		1	$2,000	3	($3,000)	$0	($1,000)	$24,000		B	1		1	1	$ 6,000		B
Jan	C	##		1	$2,000	3	($3,000)	$0	($1,000)	$24,000		C	1	1		1		$ 3,000	C
Jan	D	##		1	$2,000	3	($3,000)	$0	($1,000)	$24,000		D	1	1	1			$ 6,000	D
Feb	A	##		1	$2,000	3	($3,000)	$0	($1,000)	$23,000		A		1	1	1	$ 9,000		A
Feb	B	##		1	$2,000	3	($3,000)	$0	($1,000)	$23,000		B	1		1	1	$ 12,000		B
Feb	C	##		1	$2,000	3	($3,000)	$0	($1,000)	$23,000		C	1	1		1		$ 9,000	C
Feb	D	##		1	$2,000	3	($3,000)	$0	($1,000)	$23,000		D	1	1	1			$ 12,000	D
Mar	A	##		1	$2,000	3	($3,000)	$0	($1,000)	$22,000		A		1	1	1	$ 15,000		A
Mar	B	##		1	$2,000	3	($3,000)	$0	($1,000)	$22,000		B	1		1	1	$ 18,000		B
Mar	C	##		1	$2,000	3	($3,000)	$0	($1,000)	$22,000		C	1	1		1		$ 15,000	C
Mar	D	##		1	$2,000	3	($3,000)	$0	($1,000)	$22,000		D	1	1	1			$ 18,000	D
Apr	A	##		1	$2,000	3	($3,000)	$0	($1,000)	$21,000		A		1	1	1	$ 21,000		A
Apr	B	##		1	$2,000	3	($3,000)	$0	($1,000)	$21,000		B	1		1	1	$ 24,000		B
Apr	C	##		1	$2,000	3	($3,000)	$0	($1,000)	$21,000		C	1	1		1		$ 21,000	C
Apr	D	##		1	$2,000	3	($3,000)	$0	($1,000)	$21,000		D	1	1	1			$ 24,000	D
May	A	##		1	$2,000	3	($3,000)	$0	($1,000)	$20,000		A		1	1	1	$ 27,000		A
May	B	##		1	$2,000	3	($3,000)	$0	($1,000)	$20,000		B	1		1	1	$ 30,000		B
May	C	##		1	$2,000	3	($3,000)	$0	($1,000)	$20,000		C	1	1		1		$ 27,000	C
Mayu	D	##		1	$2,000	3	($3,000)	$0	($1,000)	$20,000		D	1	1	1			$ 30,000	D
Jun	A	##		1	$2,000	3	($3,000)	$0	($1,000)	$19,000		A		1	1	1	$ 33,000		A
Jun	B	##		1	$2,000	3	($3,000)	$0	($1,000)	$19,000		B	1		1	1	$ 36,000		B
Jun	C	##		1	$2,000	3	($3,000)	$0	($1,000)	$19,000		C	1	1		1		$ 33,000	C
Jun	D	##		1	$2,000	3	($3,000)	$0	($1,000)	$19,000		D	1	1	1			$ 36,000	D
Jul	A	##		1	$2,000	3	($3,000)	$0	($1,000)	$18,000		A		1	1	1	$ 39,000		A

Observations about the Peering Simulation Game

- Similar to real world
- Personality clashes
- Effective Teaching tool – use the language
  - Kenya - Relationships
  - Kuala Lumpur – Microsoft
  - Audience Engagement
  - Diagonal Strategy
- Sometimes, players don’t do the math.
- Unlimited rolls, peering always makes sense

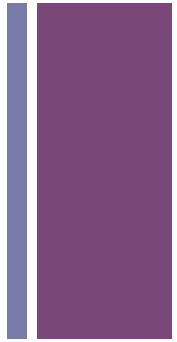
How the game is different from reality

1. The board is veiled allowing for gaming and bluffing during peering negotiations
2. ISPs move serially in the game, while in the real world action is parallel.
3. The meaning of the board squares is severely overloaded to mean regional coverage and corresponding revenue, a quantum of traffic generated, and a quantum of traffic transited to all others. All customers are not equal in revenue, traffic.
4. Customer transit revenue gained does not cause any additional financial load for the ISP in the game.
5. Traffic quantum is a vague notion that ignores the asymmetric nature of traffic today.

How the game is different from reality

6. Shared squares should cause revenue and costs to be divided
7. Everyone starts with the same number of squares.
8. Everyone is financially backed to support infinite periods of financial loss. Well, that may reflect reality for some period of Internet time.
9. If ISPs fail to peer they must pay transit to get access to these squares. In reality, content multi-homes allowing alternative paths to the same content.
10. Business motivations to sell transit instead of peer are an ignored dynamic in the game.

Questions?



The Art of Peering: The Peering Playbook

APRICOT 2012 Peering Forum
Jan 28, 2012
New Delhi, India

If there is time….

William B Norton,
Executive Director, DrPeering.net
http://DrPeering.net

Research "The **Art** of Peering"

- Follow up to the first three white papers.

Q: When e-mail to peering@<ispdomain>.net generates no response, what do Seasoned Peering Coordinators do?

- Smartest Peering Coordinator: "Tricks of the Trade"
- 20 Tactics successfully used to obtain Peering where you otherwise might not be able to.

Disclaimer: These are NOT recommended tactics…I am simply documenting what has been successfully used in the field to obtain peering.

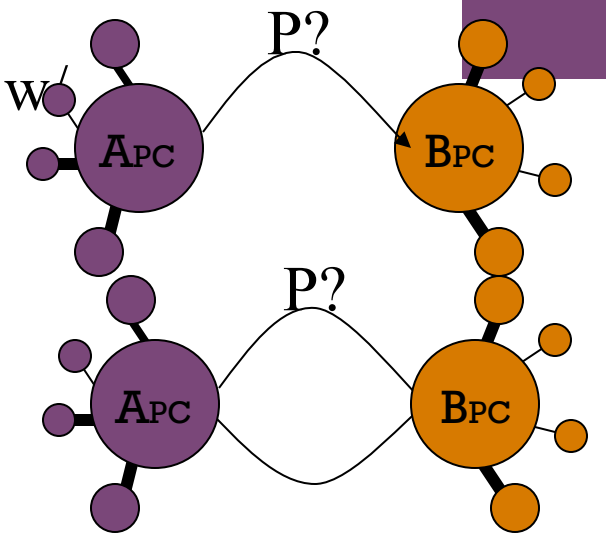
Language.Graphical notation to describe the tactics

Graphical Notation of Tactics

To Portray Peering Plays Pictorially…

ISP Initiator ISP Target

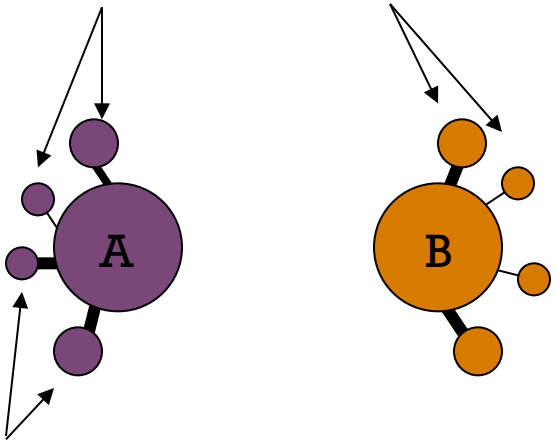
P?=Peering Request w/
Peering Coordinator



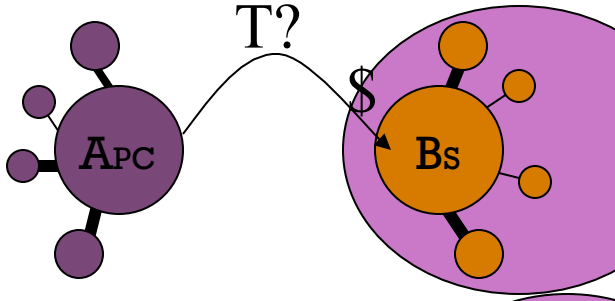
Peering Negotiation

ISP A Customers

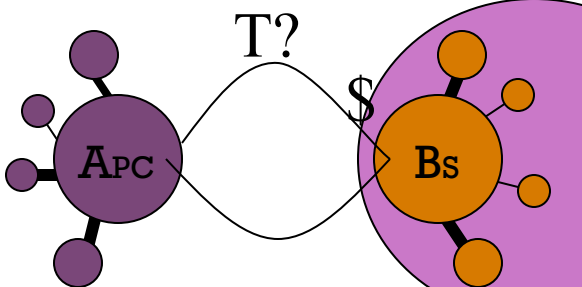
ISP B Customers



T?=Transit Request
To Sales Person



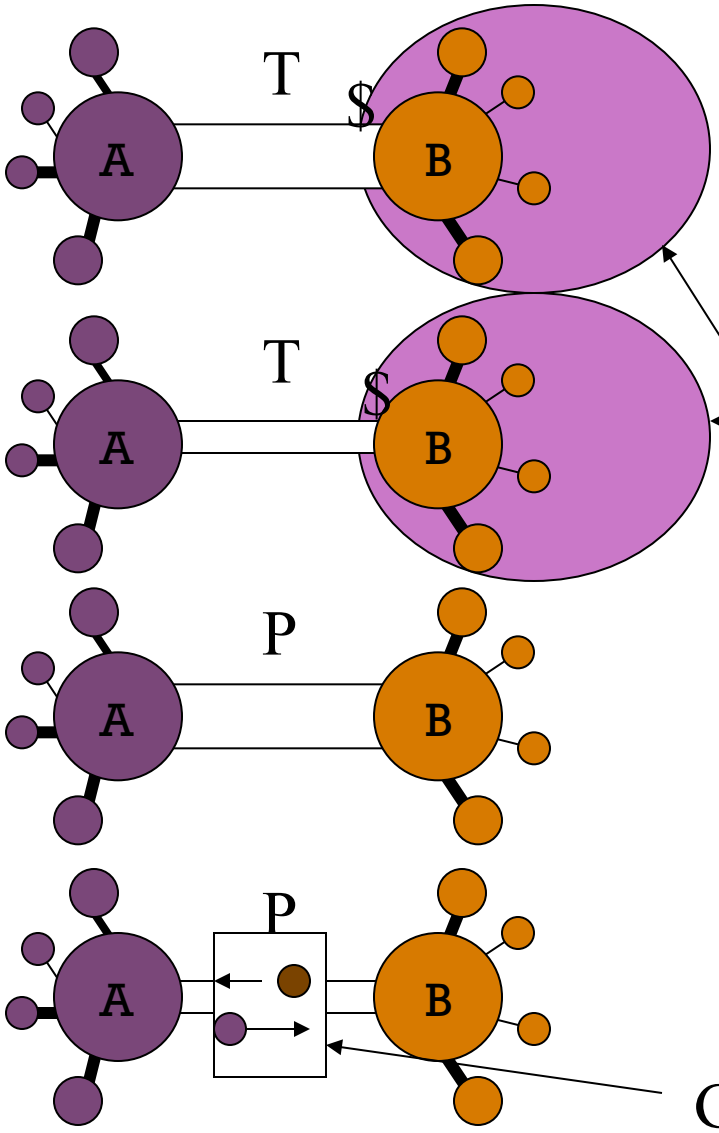
Transit Negotiations



Larger Circle=More Customer Prefixes

Thicker Lines=More Traffic

Transit and Peering **Sessions**



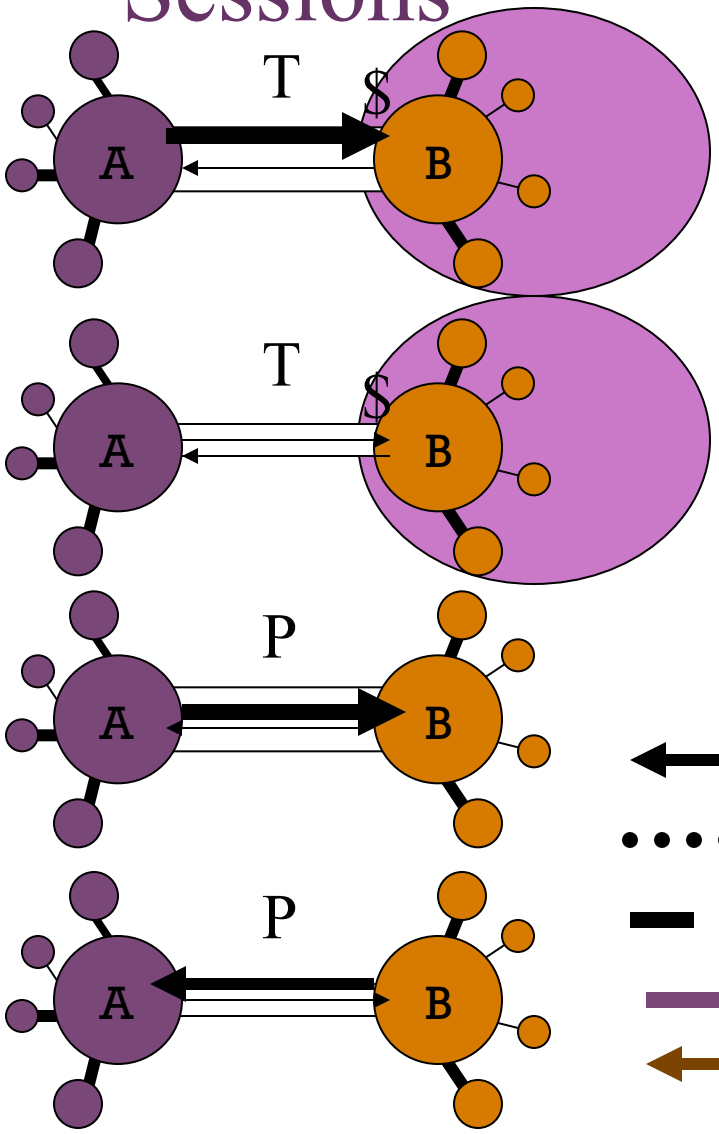
T=Established Transit Session
(Selling Access to entire Internet)
Size indicates effective size of transport
Supporting the session

Represents "the rest of the Internet"

P=Established Peering Session
(Reciprocal Access to each others customers)
Size indicates effective size of transport
Supporting the session

Graphical Display of Routing Announcements

Traffic over Transit and Peering Sessions



Traffic showed as directed lines

Thickness of line indicates amount of Traffic in relevant direction

Other Variations

P->T = Transition of Relationship

P | T = Either Peering or Transit apply

= Traffic destined anywhere

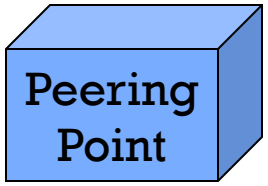
= Fictitious Traffic

= Packet Loss ridden Traffic

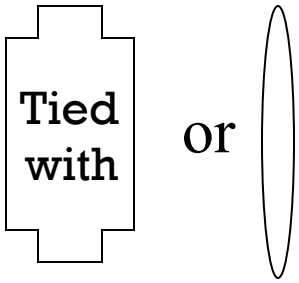
= Traffic destined to green network

= Traffic destined to brown network

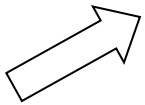
Other Graphical **Symbols**



Exchange Point,
Telco Hotel



Indicates two or more
Elements tied with
relationship



Indicates a ordering:
a sequence to be followed
in the Peering Tactic

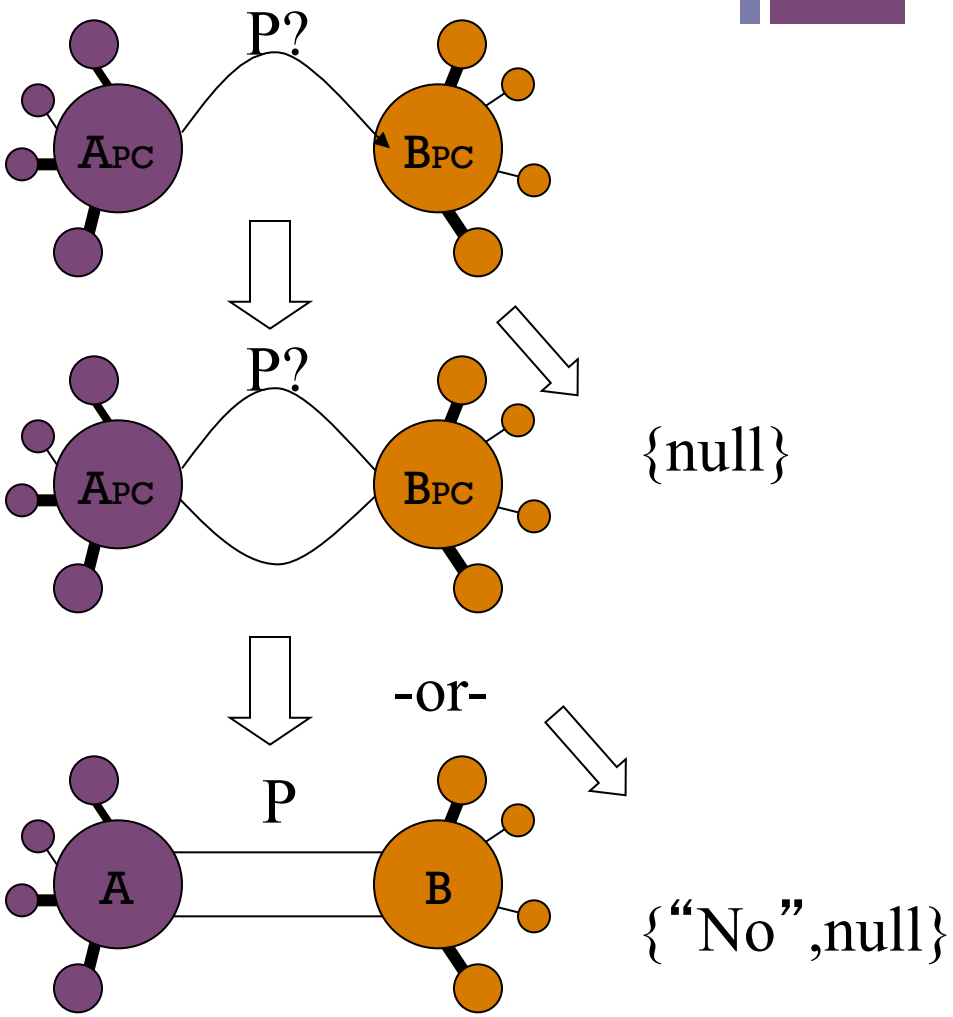
1) The **Direct Approach** uses peering@<ispdomain>.net , phone calls, face to face meetings, or otherwise direct interactions with Peering Coordinators to establish peering.

P?=Peering Request
To Peering Coordinator(s)

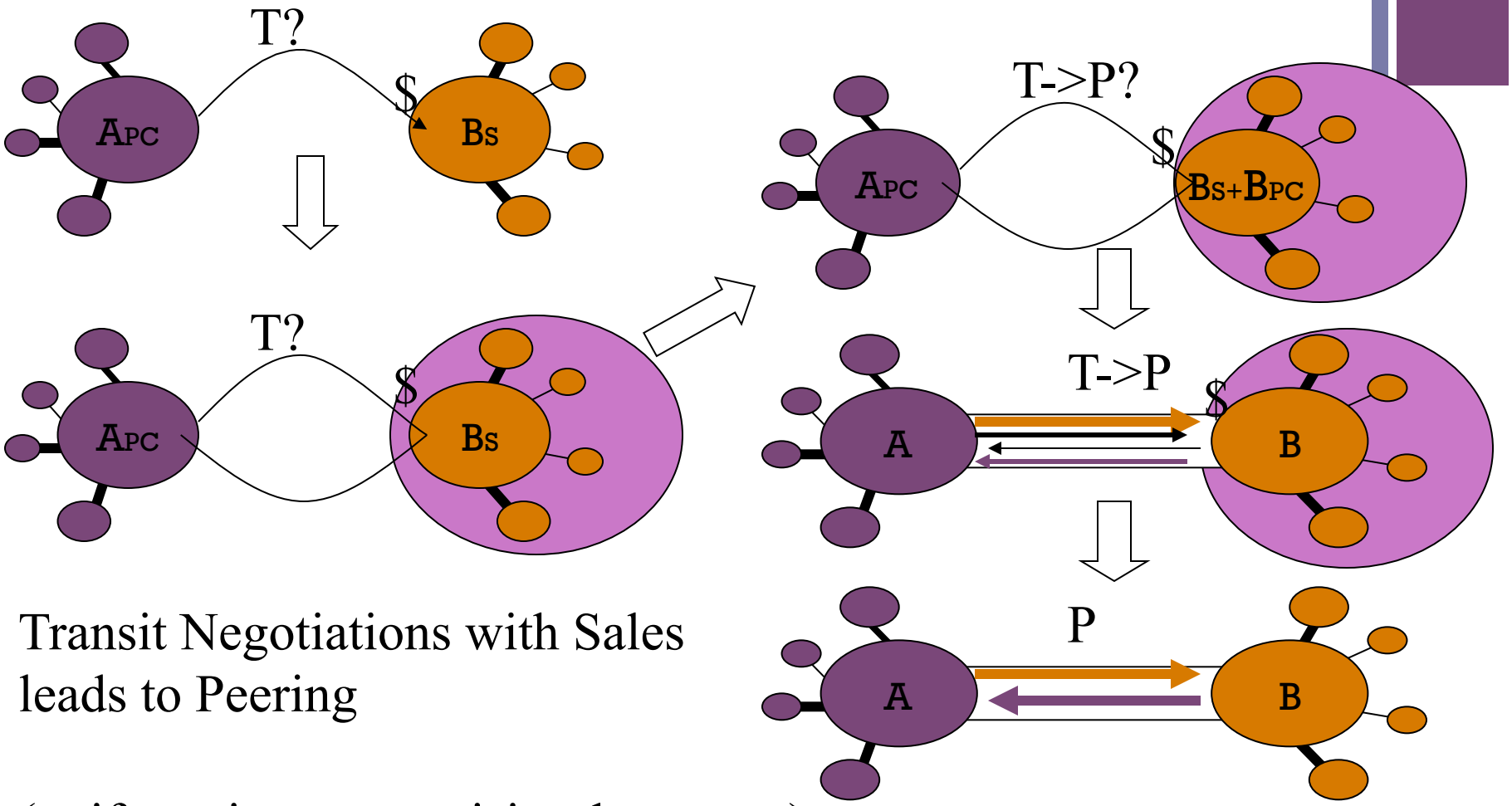
Peering Negotiation

Leading to

Peering Session



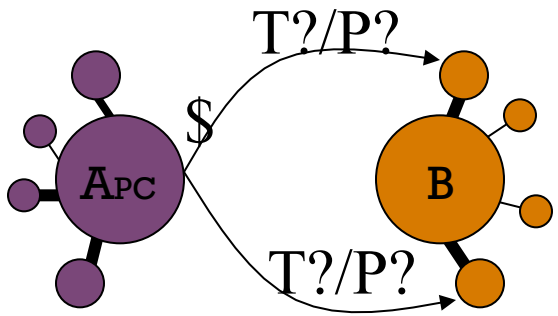
+ 2) The **Transit with Peering Migration** tactic leverages an internal advocate to buy transit with a contractual migration to peering at a later time.



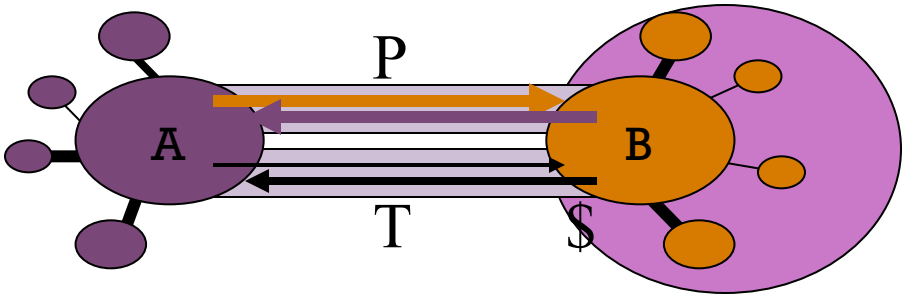
Transit Negotiations with Sales leads to Peering

(…if peering prerequisites be met…)

3) The **End Run Tactic** minimizes the need for transit by enticing a direct relationship with the target ISP's largest traffic volume customers.

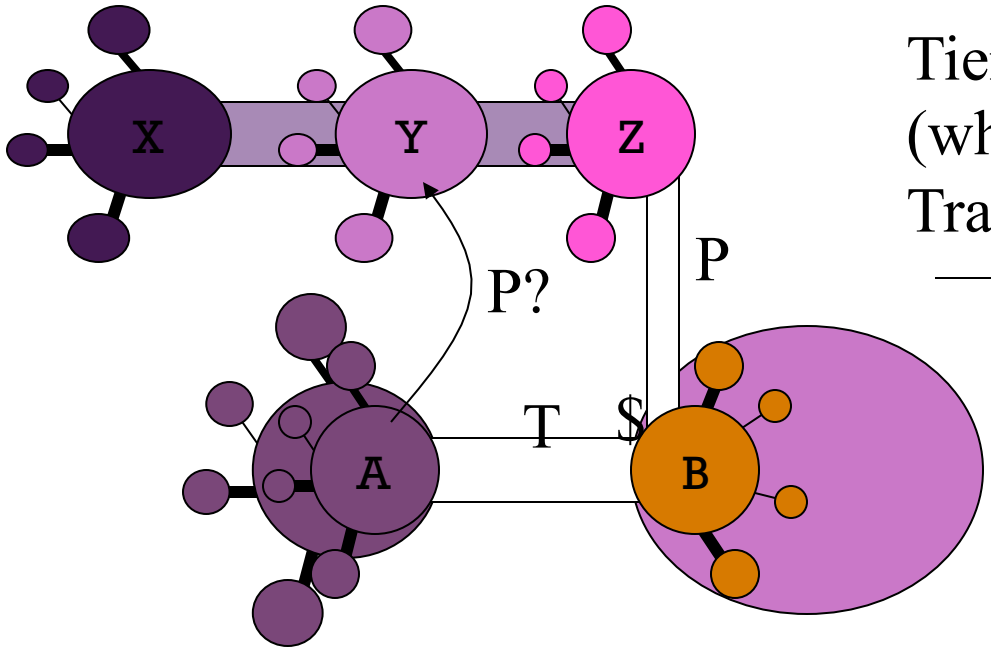


4) In Europe the **Dual Transit/Peering** separates the peering traffic from the transit traffic using separate interface cards and/or routers.



Why do this?
So it appears you are peering with bigger players
Sue "Like paying for a prom date."
Only the two of you know
there is a cash payment at the end of the evening.

5) **Purchasing Transit *Only* from Large Tier 2 ISPs** is an approach to reduce the risk of being a customer of a potential peer on the road to Tier 1 status.

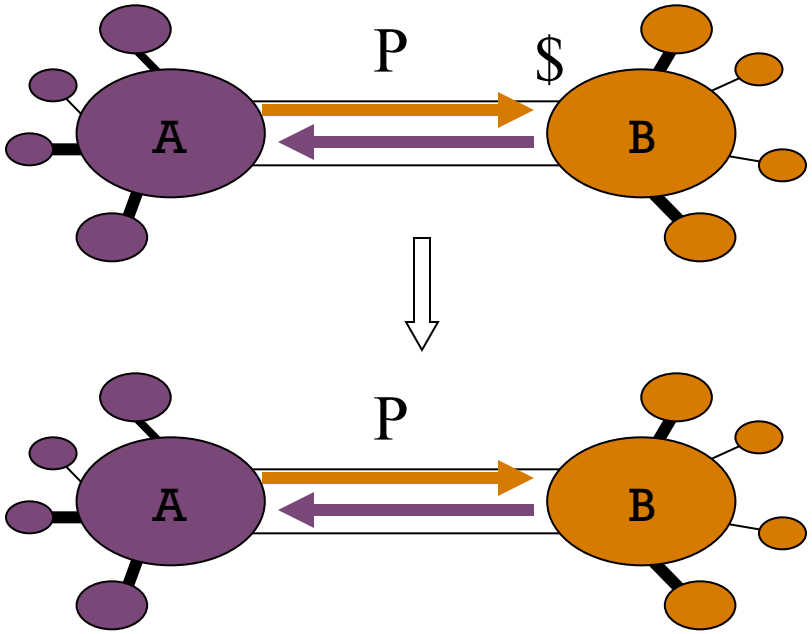


Tier 1 ISPs (who do not buy Transit)

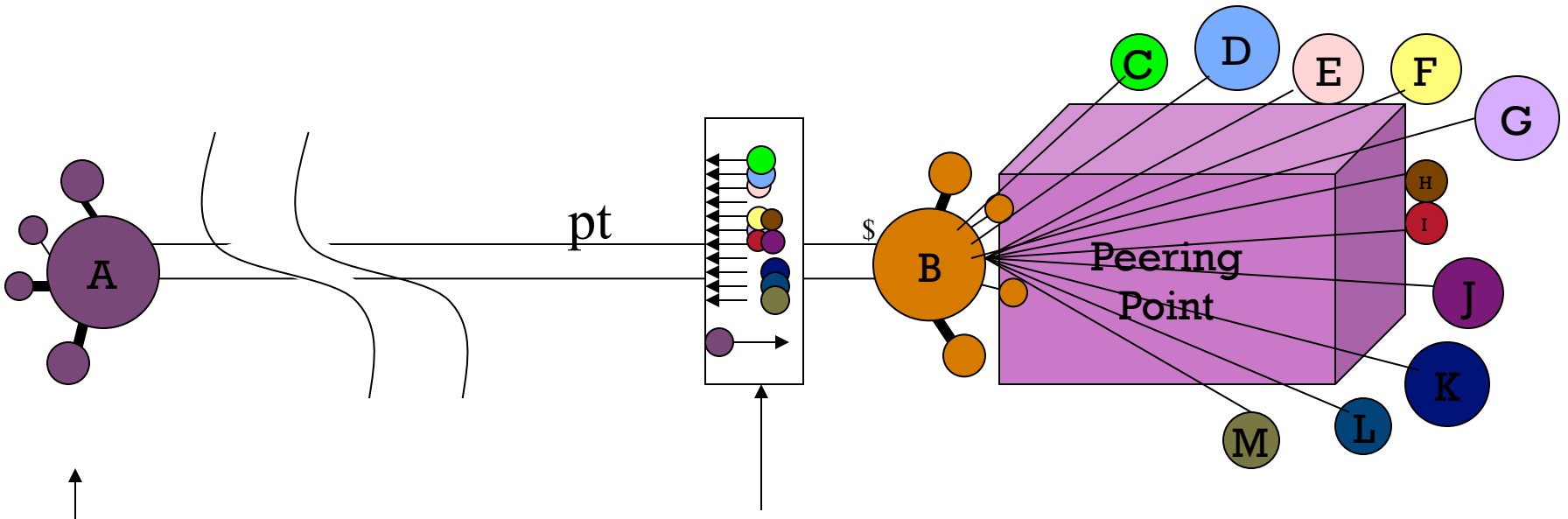
Tier 2 ISPs (who buy Transit)

Since A peering with any Tier 1 won't affect transit revenue with Tier 1s There is no financial consequence to peering.
(One less barrier to overcome during peering negotiations.)

6) **Paid Peering** as a maneuver is positioned by some as a stepping stone to peering for those who don't immediately meet the peering prerequisites.



7) In the **Partial Transit** tactic, the routes learned at an exchange point are exchanged with the peer for a price slightly higher than transport costs.

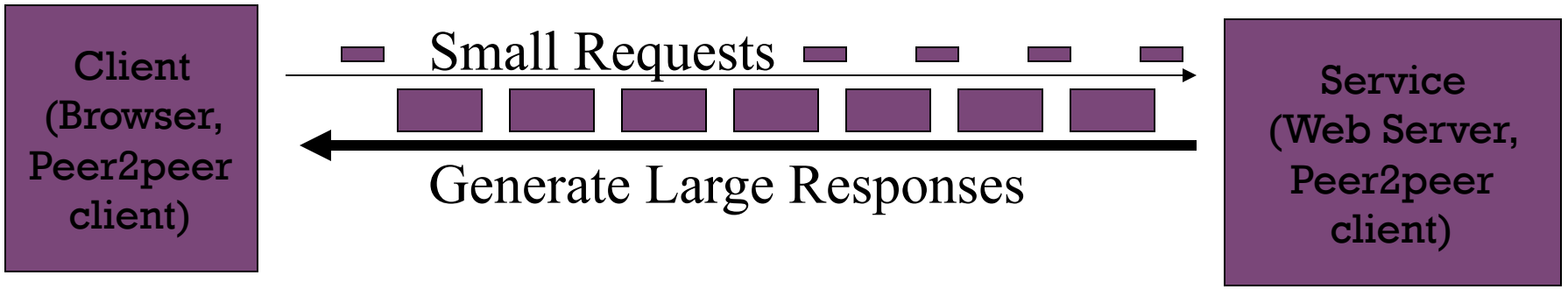


Geographically
Remote Router

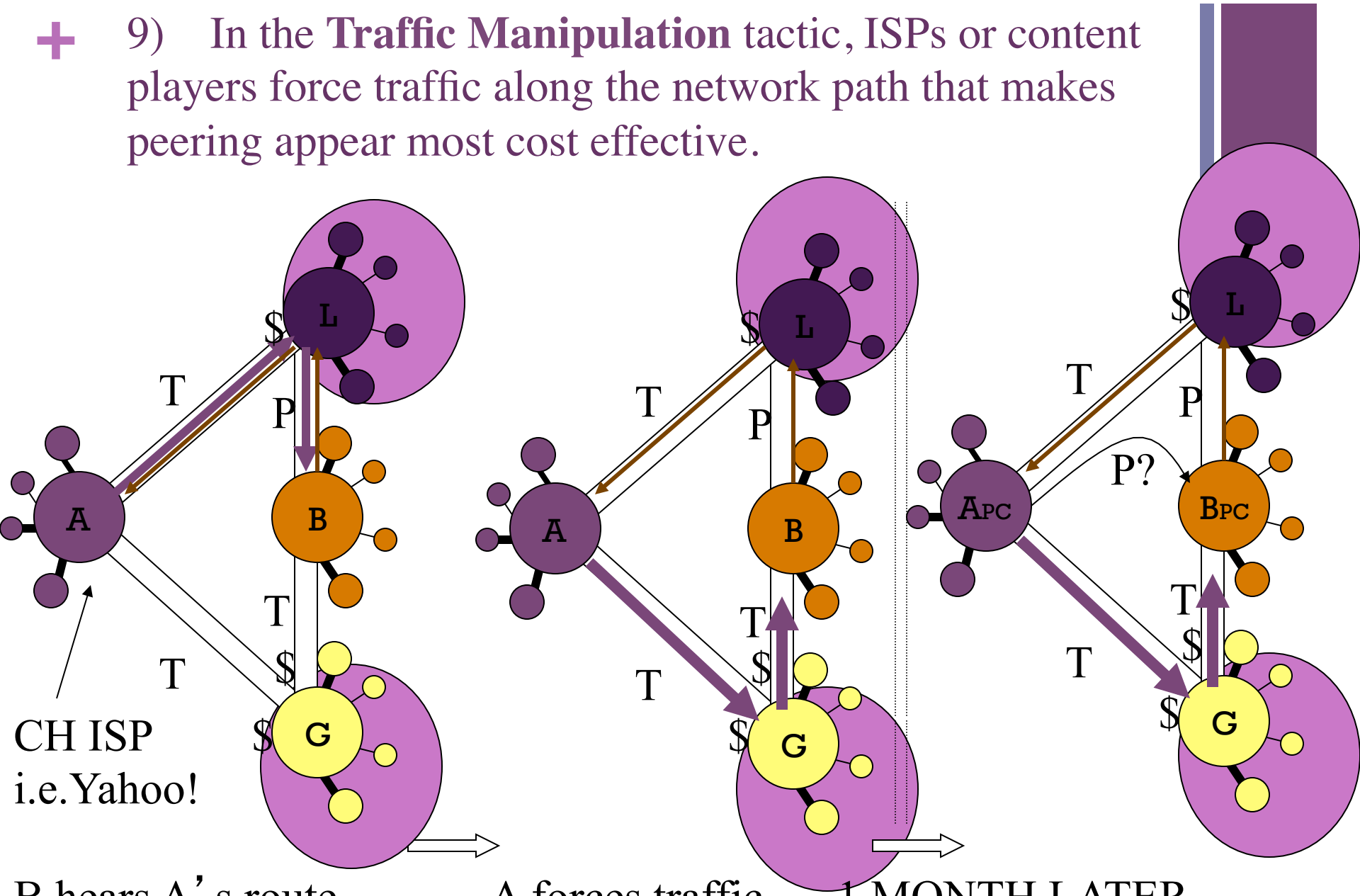
Routing Announcements
Forwarding all customer & Peering Pt Routes
(almost peering – maybe costs less)

The Nature of Web Traffic

- Asymmetric Traffic



9) In the **Traffic Manipulation** tactic, ISPs or content players force traffic along the network path that makes peering appear most cost effective.



B hears A's route 'for free' through Peer L

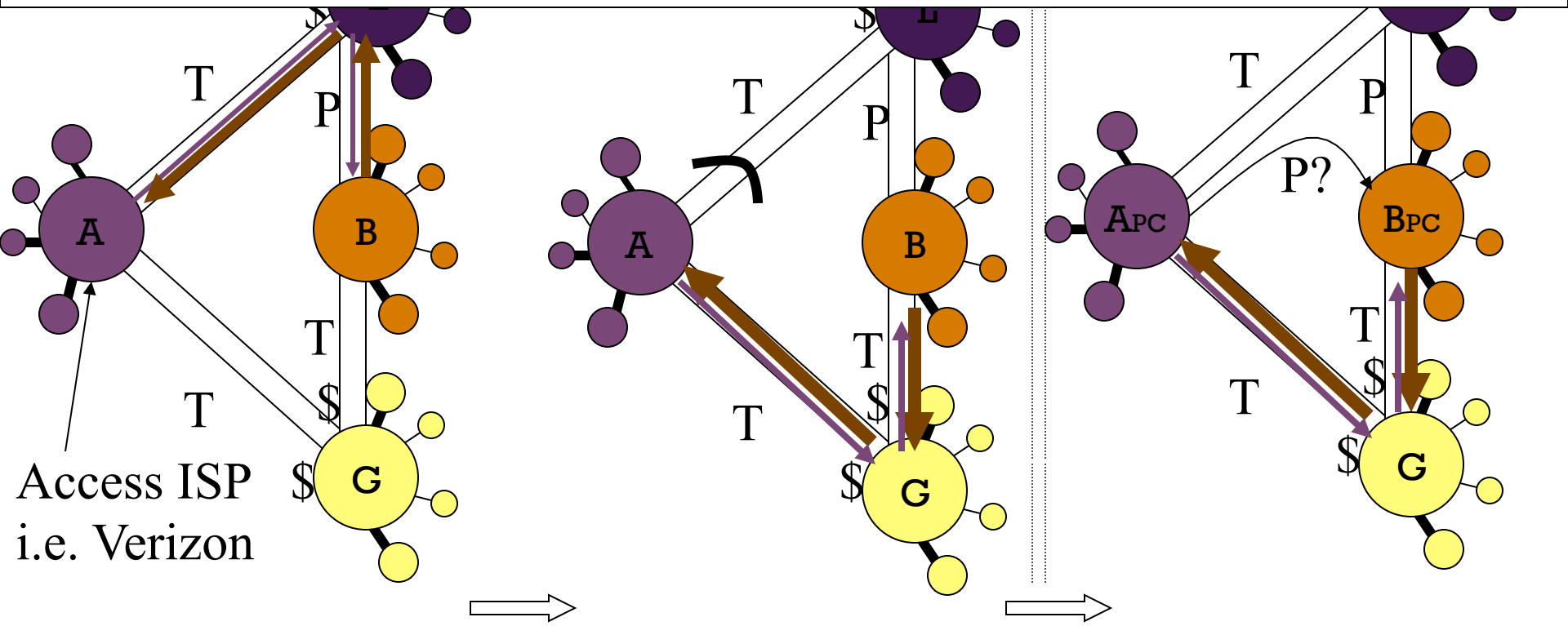
A forces traffic Over B's transit

1 MONTH LATER Contact PC-We should Peer!

9b) For Access Heavy Guys…In the **Traffic Manipulation** tactic, Access ISP

a) stop announcing routes, or

b) insert Target AS# into announcement to trigger BGP Loop Suppression to force traffic along the network path that makes peering appear most cost effective.

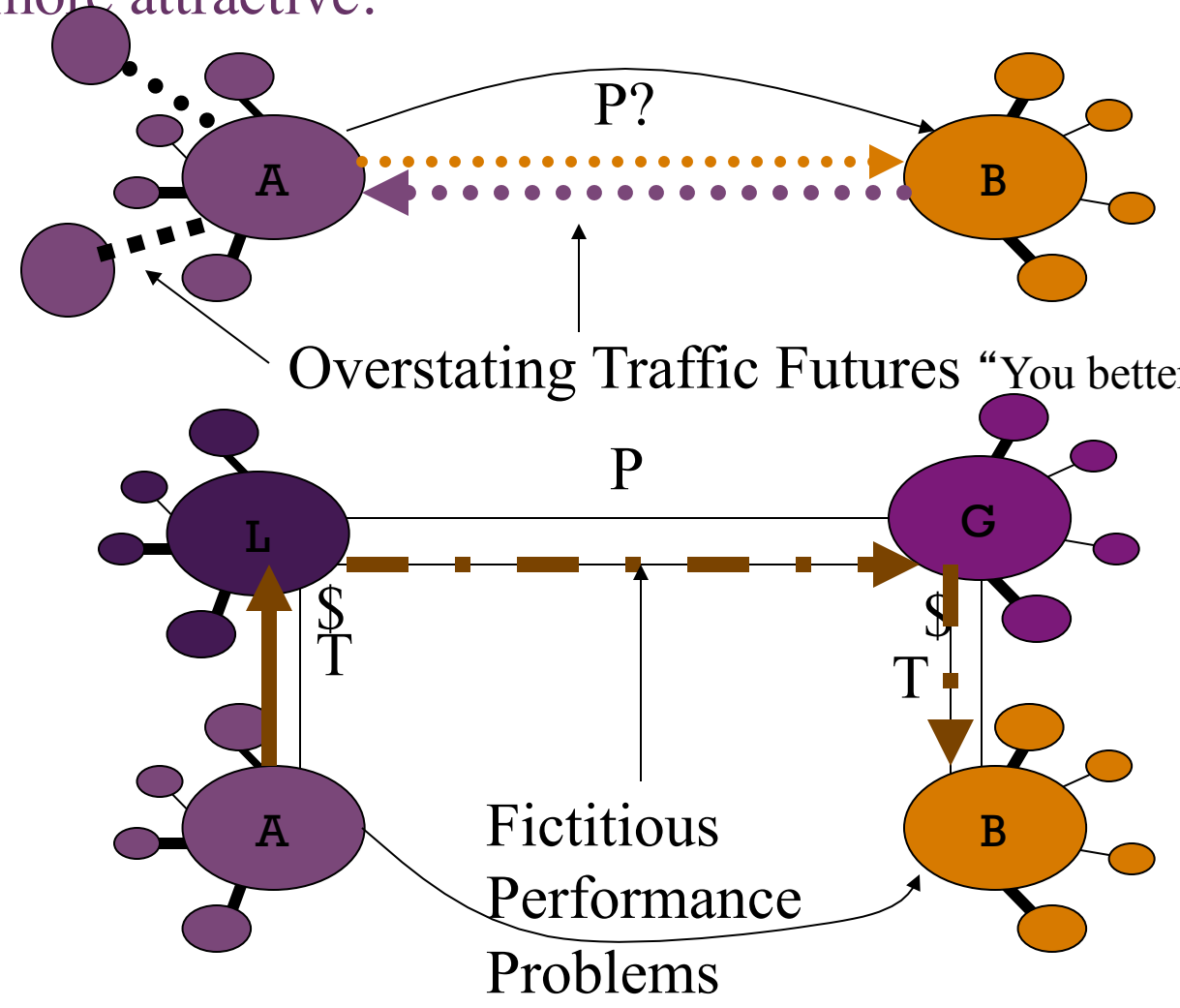


B hears A's route 'for free' through Peer L

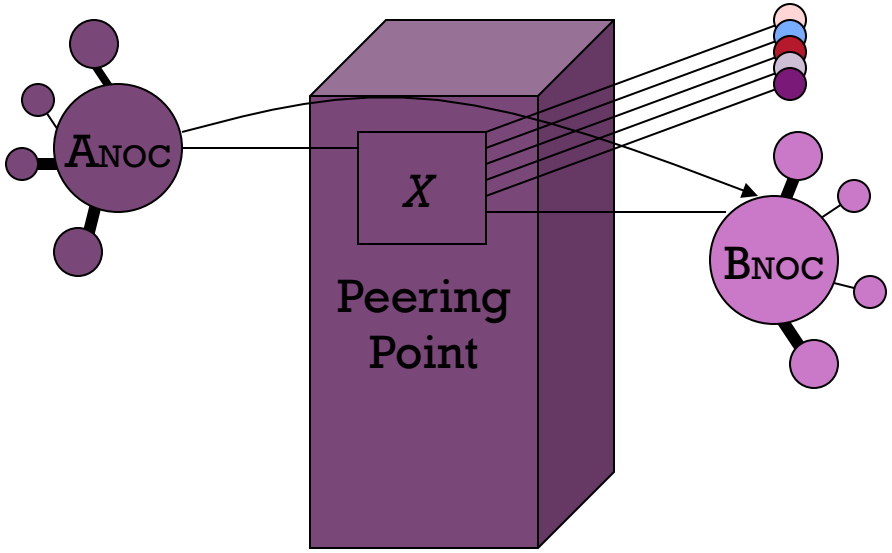
A forces traffic Over B's transit

1 MONTH LATER Contact PC-We should Peer!

10) The **Bluff** maneuver is simply overstating future traffic volumes or performance issues to make peering appear more attractive.

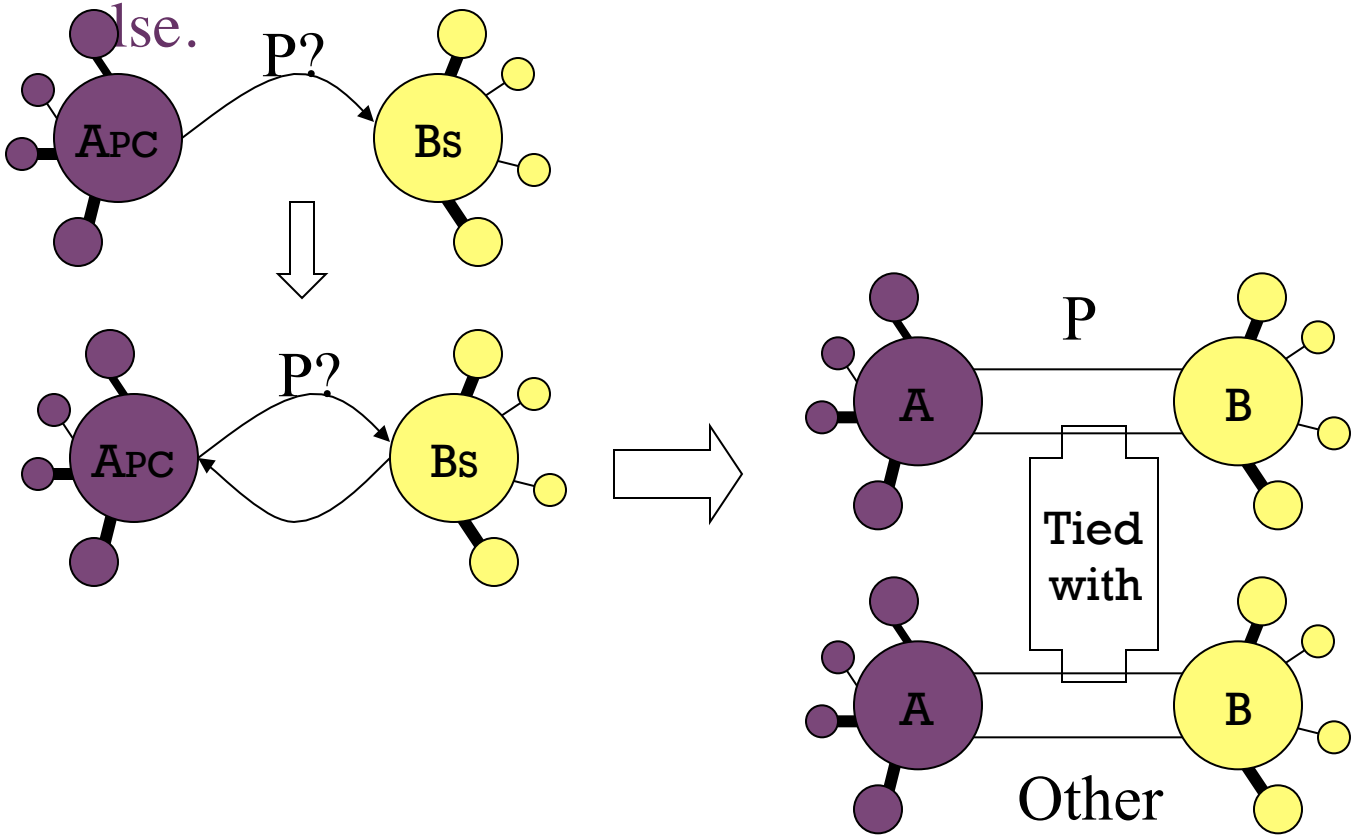


19) The **False Peering Outage** tactic involves deceiving an ill-equipped NOC into believing a non-existing peering session is down.



ANOC: Hey – Emergency!
ANOC: Our Peering Session with you Went Down!
BNOC: Strange. <looks on router> I don't see it configured.
ANOC: It was. Don't make me escalate to <famous person>
BNOC: Ah – I bet is was that last config run that trashed it.
BNOC: Give me a few minutes to fix it on both ends.

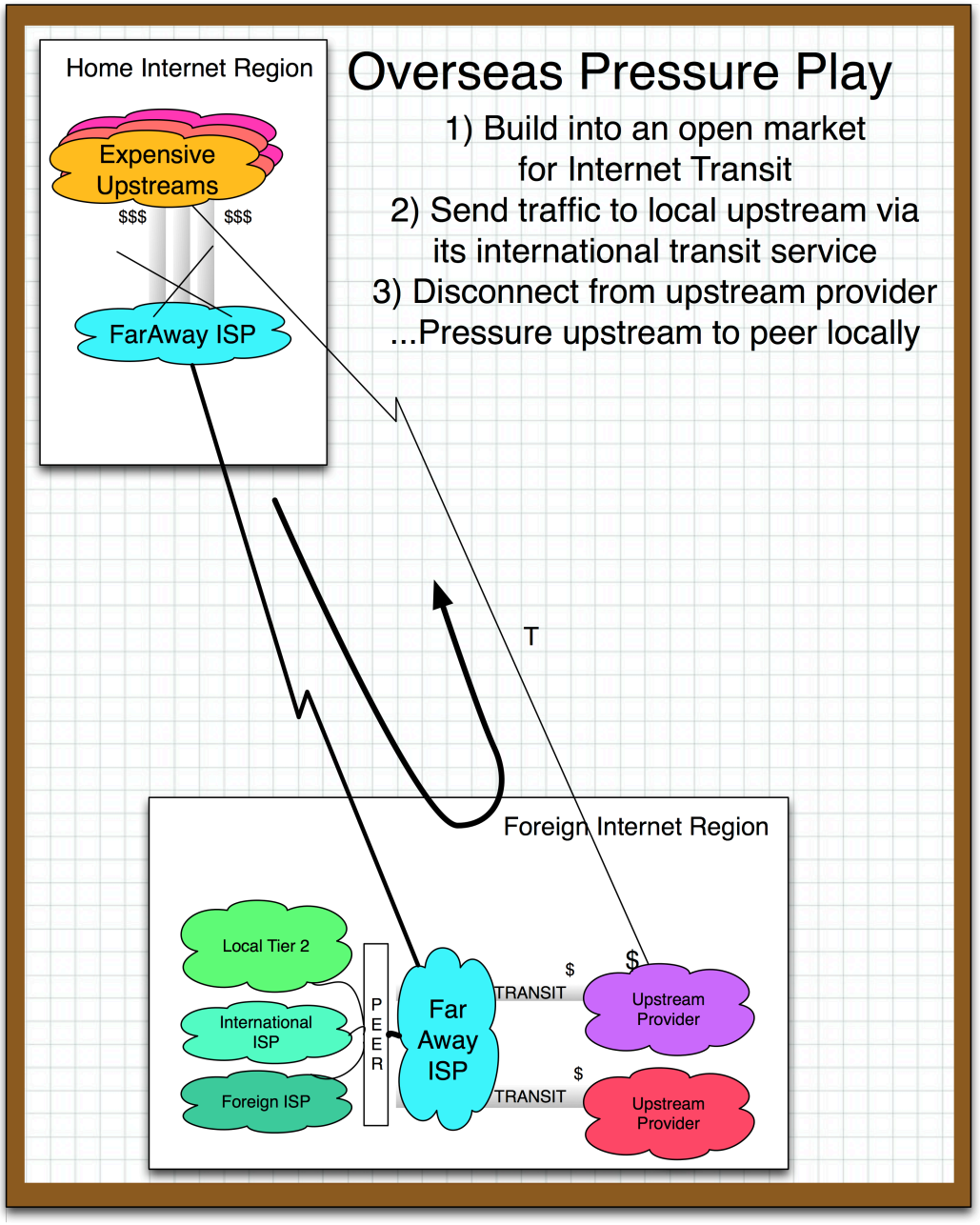
20) The **Leverage Broader Business Arrangement** takes advantage of other aspects of the relationship between two companies to obtain peering in exchange for something else.



Peering Tied with "Other"

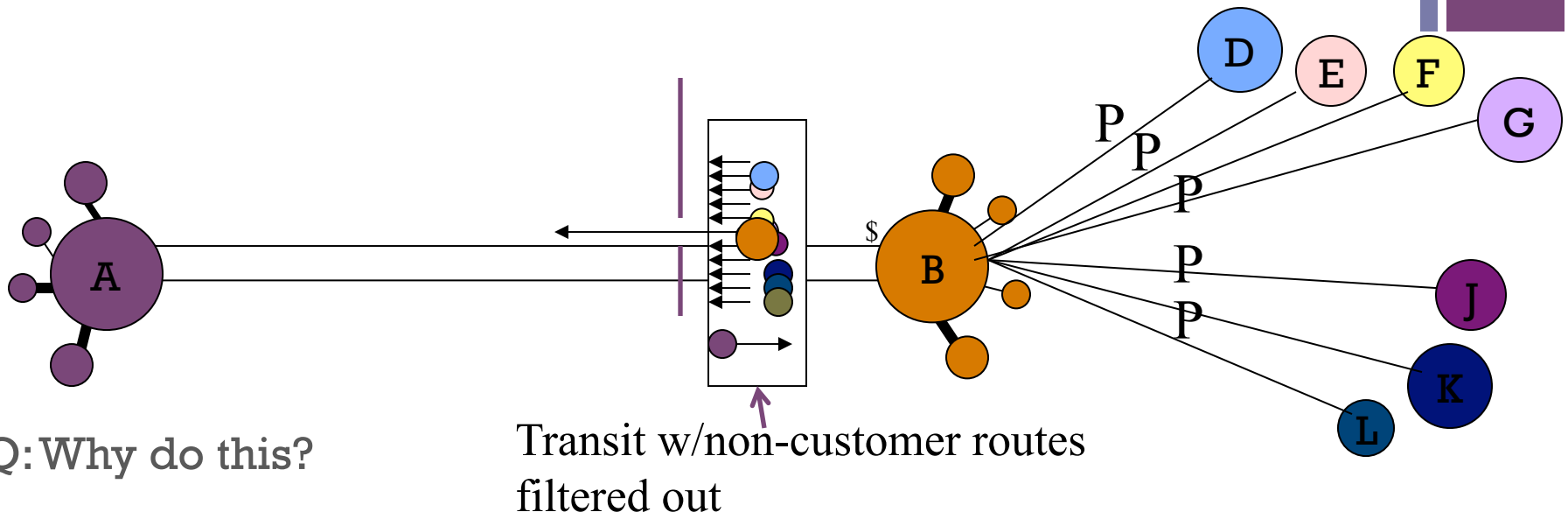
+Fiber deal
+Dial-in deal
+Racks
+Transport
+Strategic deal
:

21 – Overseas Pressure Play



- Video and gaming
- Latency sensitive traffic
- Large volume
- Forced over transit $$$ service

22 – Construct Peering from Transit



Q: Why do this?

A: So it appears you are peering with bigger players

- Sue "Like paying for a prom date."
  - Only the two of you know there is a cash payment at the end of the evening.
- Most ISPs do not have a paid peering product
- Transit is sometimes cheaper than paid peering

Tactics that do not work

- Give content only if you peer at WAIX
- Swagger like you are a Tier 1 in other market
- Threaten litigation
- Public name calling
- Blind request peering of large peers first
- Demonstrate lack of local knowledge
- Refusal to register in route registry

Summary

- These are some of the “Tricks of the Trade”
- Comments/Additions welcome !
- Copies of the “Art of Peering: The Peering Playbook” are freely available
  - Send e-mail to wbn@DrPeering.net or
  - Or <google search “William B. Norton”>

Questions?