Peering 101
and the Peering Simulation Game

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Executive Director, DrPeering

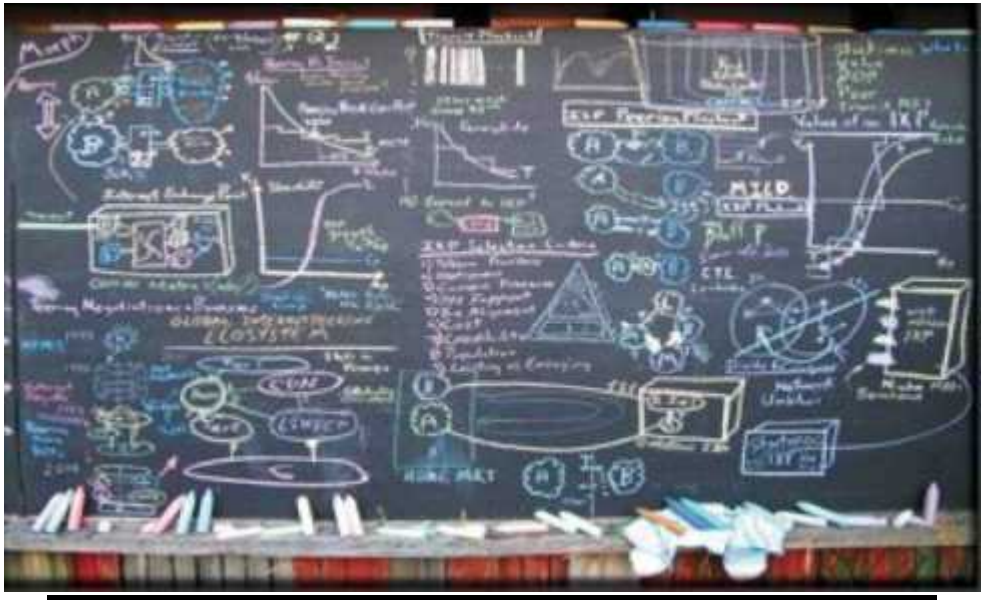
Excerpts from The Internet Peering Playbook: Connecting to the Core of the Internet

AfPIF **2**
Accra, Ghana
August 8, 2001

The

New Book

Playbook



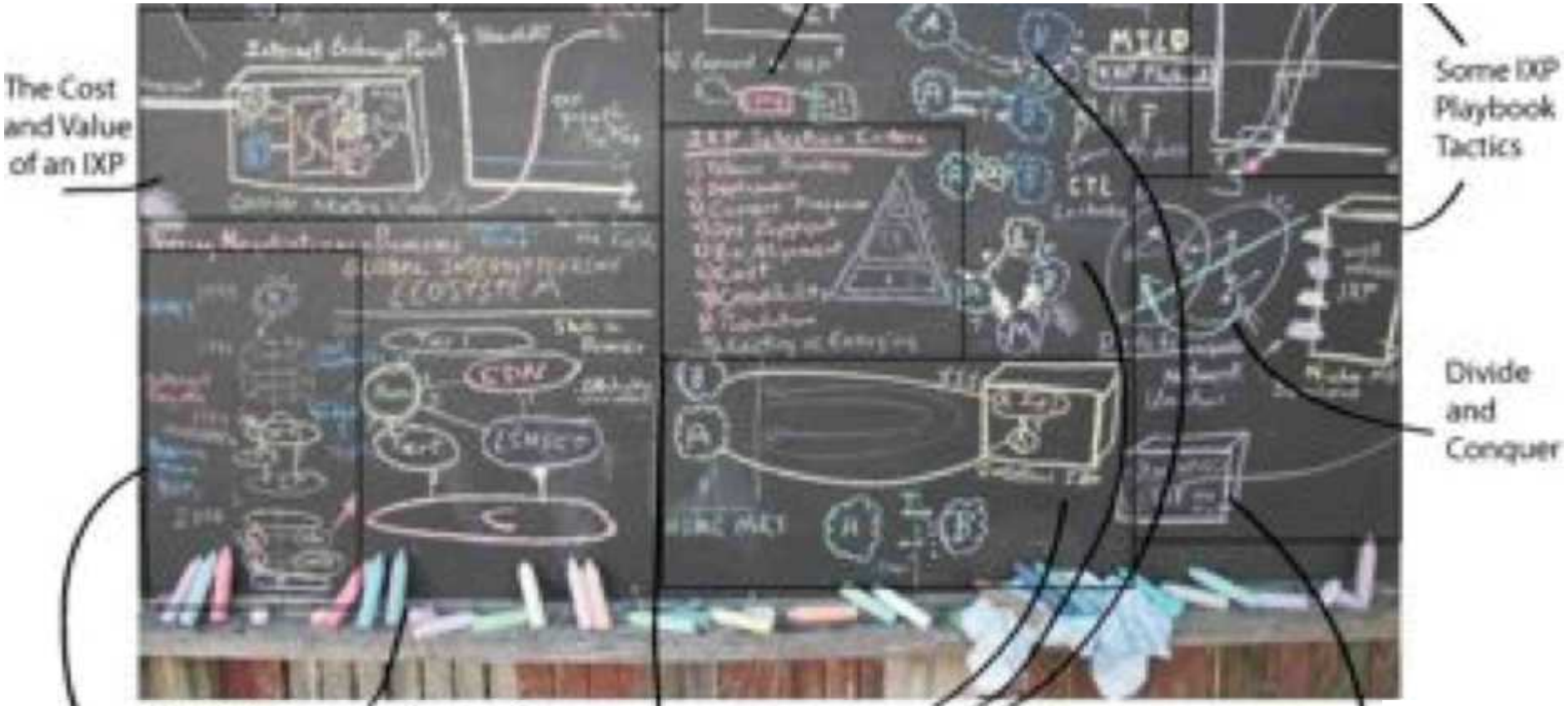
Connecting to the Core of the Internet

The Emerging Ecosystem feor

Cloud Computin

the Author of the Internet Peering White Papers

10 yrs in the making
$500K Travel
500K freq flyer miles
Every continent
Every Internet Ops Forum
What is your working definition
    Of Internet Peering?
    Of Internet Transit?
What are the motivations to peer or not?
What are the peering processes?
Who do you peer with?
Who are the players?
What are the Peering Tactics?
WHEN DOES PEERING MAKE SENSE?
After White Paper walkthroughs
Resources to share back to the community


The Cost and Value of an IXP
Some IXP Playbook Tactics
Divide and Conquer
The Global 'Internet Peering 'Ecosystem'
Some ISP Peering Playbook Tactics
E volution of Internet Peering
How ISPs choose an Internet Exchange Point
Internet Transit with Bluff Issues
Traffic Manipulation
Migration

DrPeering.net Peering Resources

Internet Service Providers and Peering

A Business Case for Peering

About the White Paper Process

The Art of Peering - The Peering Playbook

The Art of Peering - The IX Playbook

Chief Technical Liaison

Ecosystems: 95th Percentile Measurement for Internet Transit

Asia Pacific Peering Guidebook

Evolution of the U.S. Peering

Emerging Video Internet Ecosystems

European vs US Internet Exchange Points

Internet DataCenter Build vs Buy Decision

Internet Service Providers and Peering

Internet Transit Pricing Historical and Projections

Modeling the value of an Internet Exchange Point

NANOG History

Peering: Motivations to Peer

A Study of 28 Peering Policies

Peering Simulation Game

Peering: Top 10 Ways to Contact Peering Coordinators

Peering: Top 10 Reasons NOT to peer

Public vs Private Peering - the Great Debate

The Folly of Peering Ratios

Top 9 IX Selection Criteria

Video Internet - The Next Wave of Massive Disruption to the U.S. Peering Ecosystem

All freely available

Peering 101

Connecting to the Edge of the Internet (aka Internet Transit)

Connecting to the Core of the Internet (aka Internet Peering)

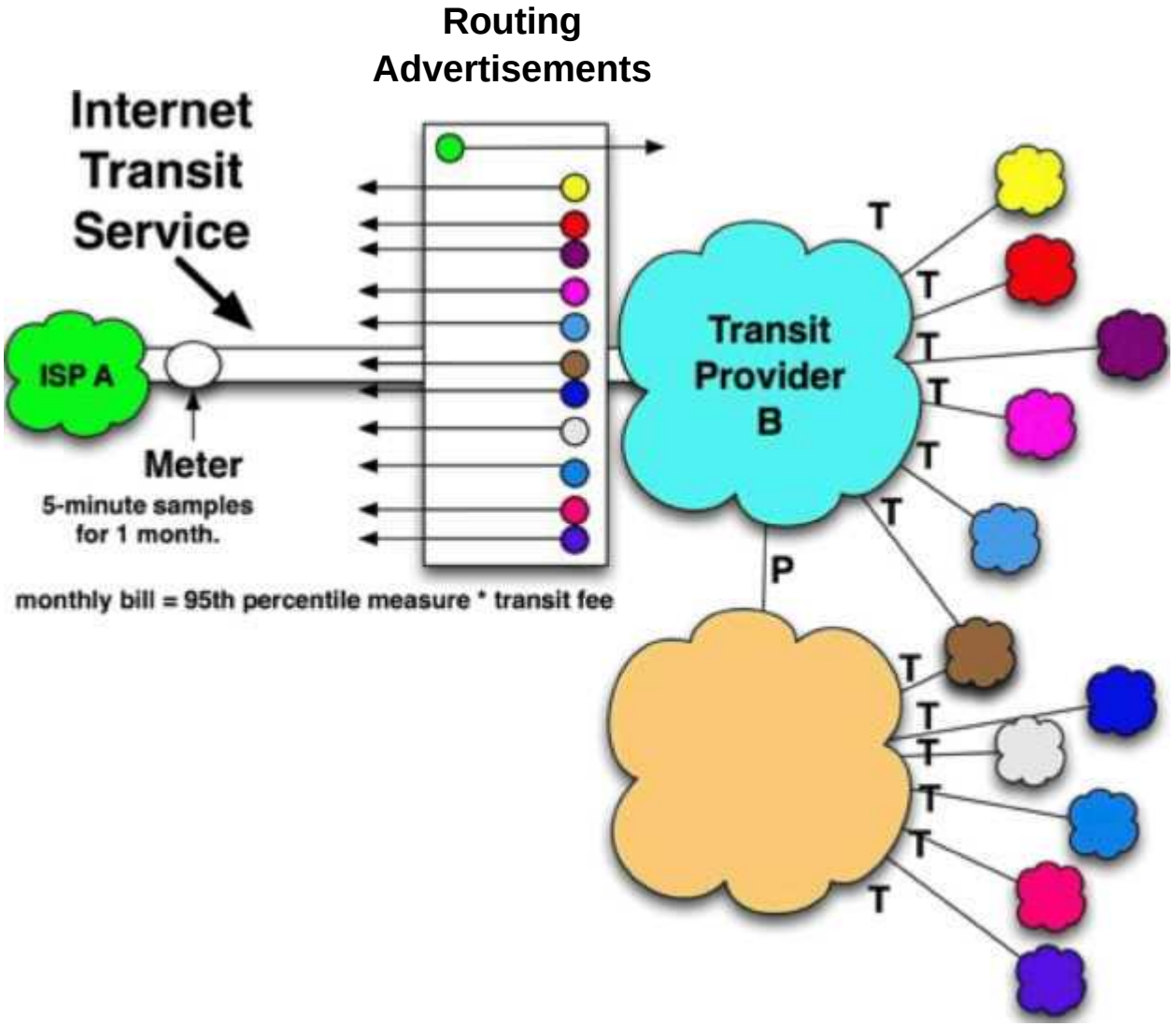
The Economic Benefits of Peering

IXP Operators - Let's talk off-line - lots of material to share

Connecting to the Edge of the Internet

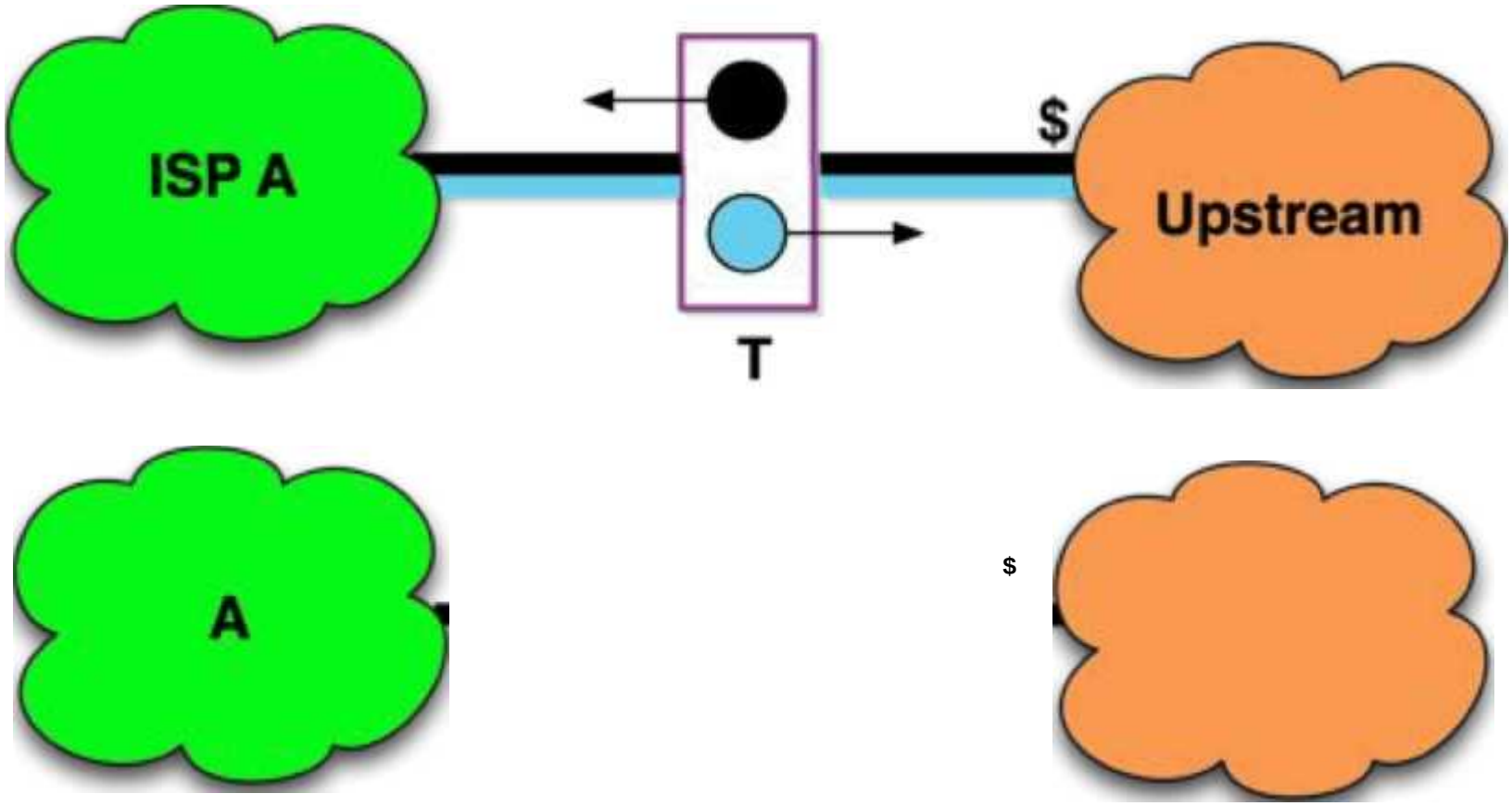
- **Definition: *Internet Transit*** is the business relationship whereby an Internet Service Provider provides (usually sells) access to the global Internet.
- **Definition: An *Internet Service Provider (ISP),*** also called a "Transit Provider/' is an entity that provides (usually sells) access to the Internet.

nternet Transit Service Mode



Graphical notation

Equivalent Notation for Transit



Internet Transit Billing Calculation (95th Percentile Measurement)

Metered Internet Transit Service

Upstream (Transit) Provider

5-minute samples

to

End Of Month Sort

highest

95th Percentile Sample (Mbps)

lowest

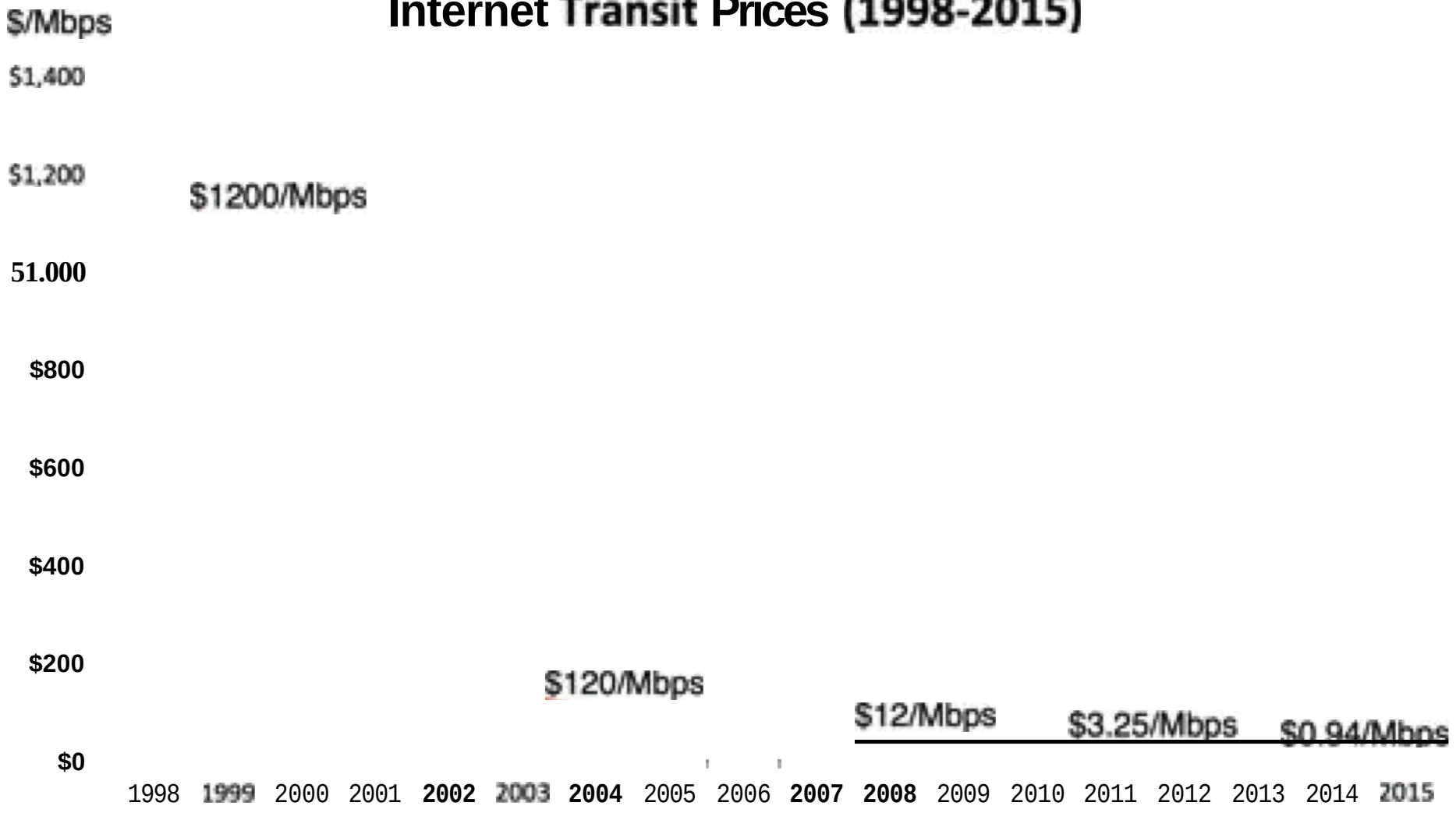
* Internet Transit Price ($/Mbps)

= Monthly Cost of Internet Transit

Trends: Transit Price Drops

Source: DrPeering.net

Internet Transit Prices (1998-2015)

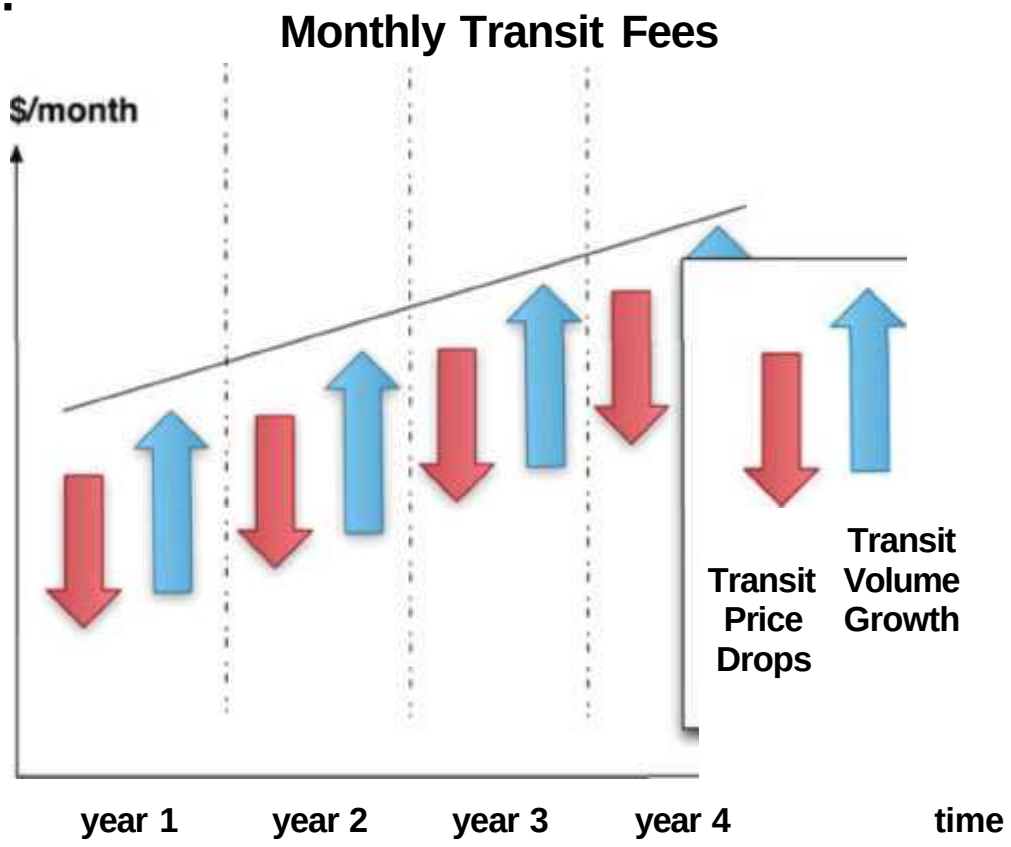


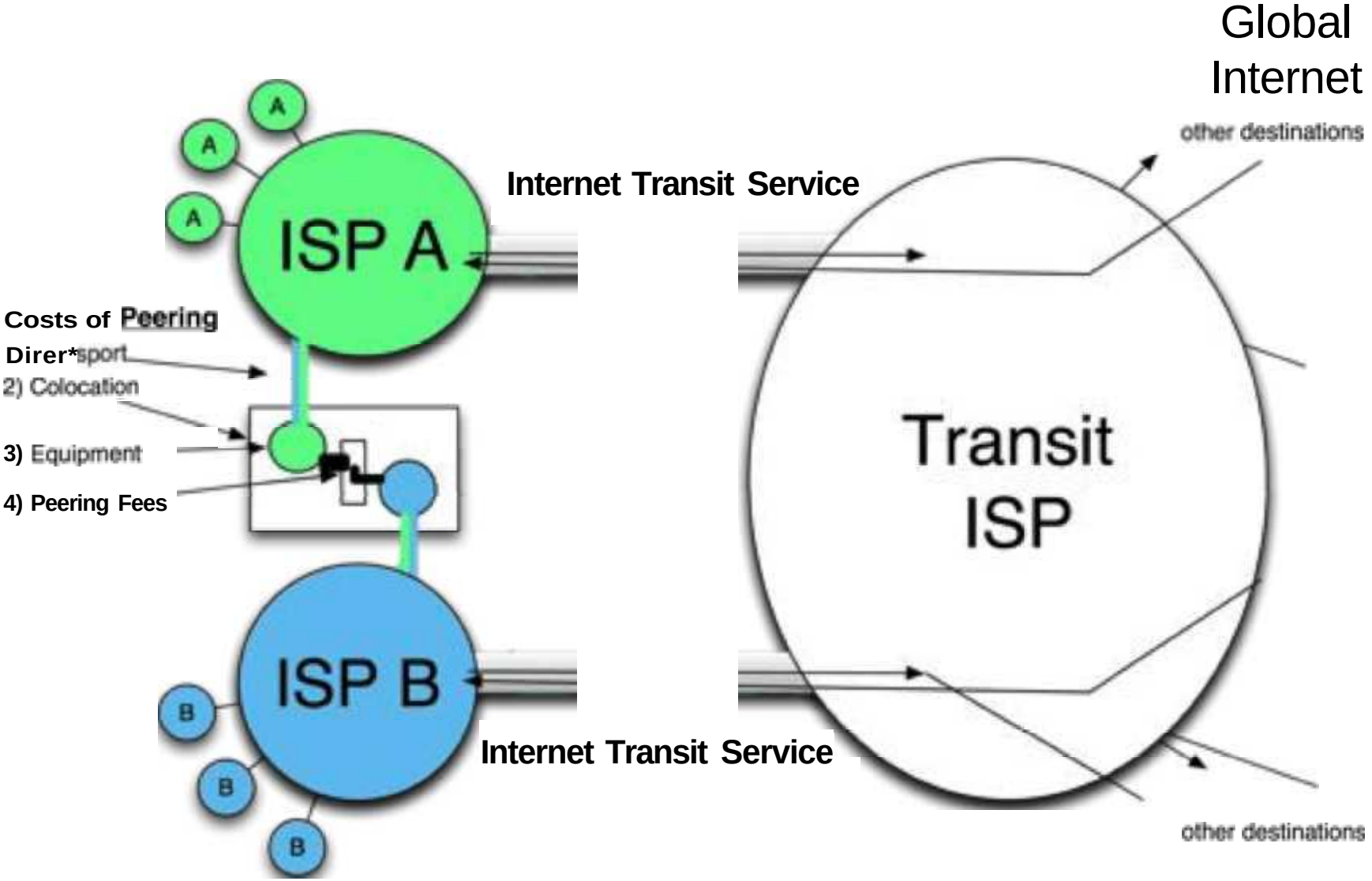
Connecting to the Core of the nternet

Internet Peering

Why Peering?

"Internet Transit is so inexpensive, why do we need anything else?"

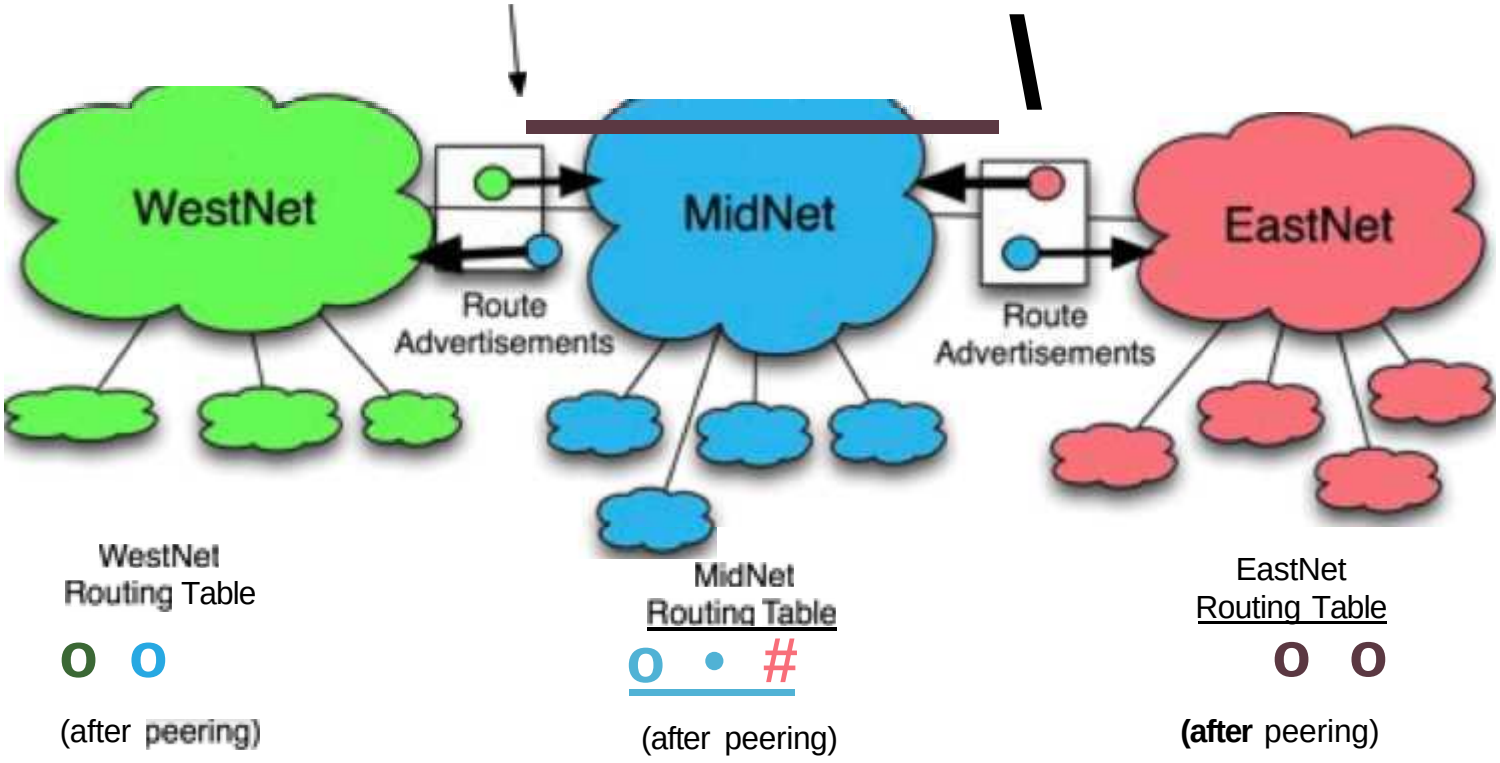




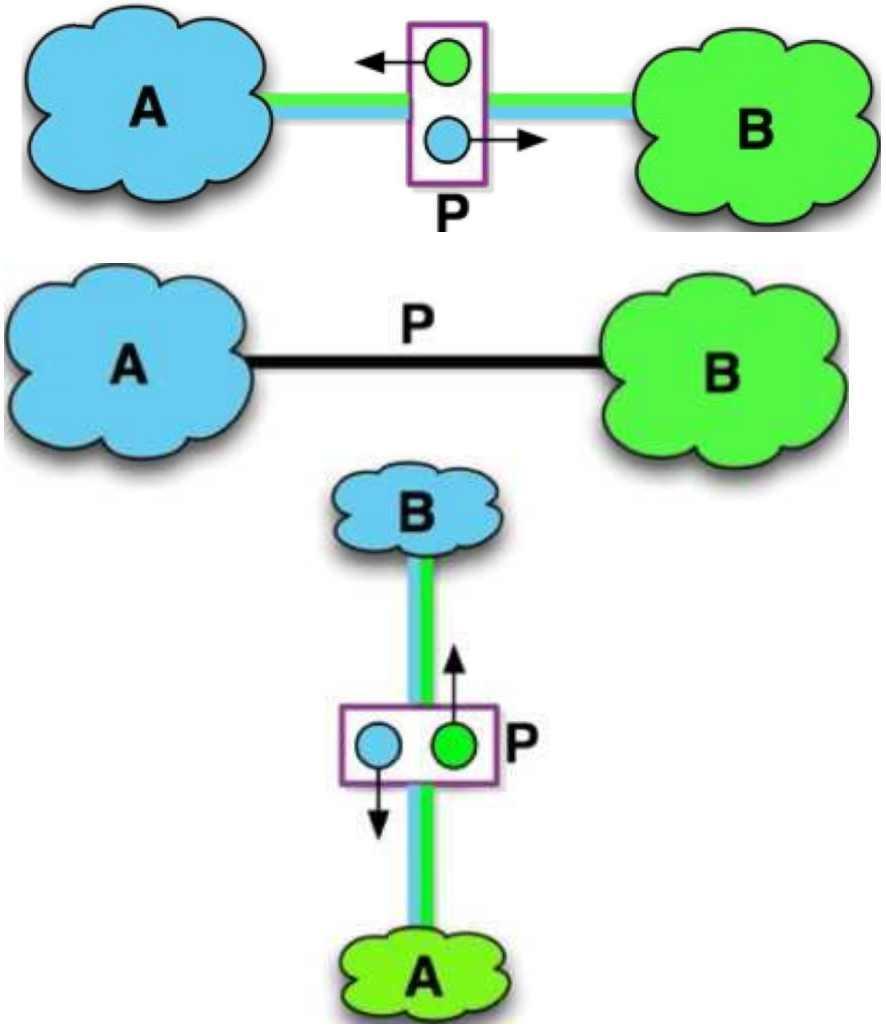
Direct interconnect=peering

nternet Peering Definition

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



nternet Peering notation

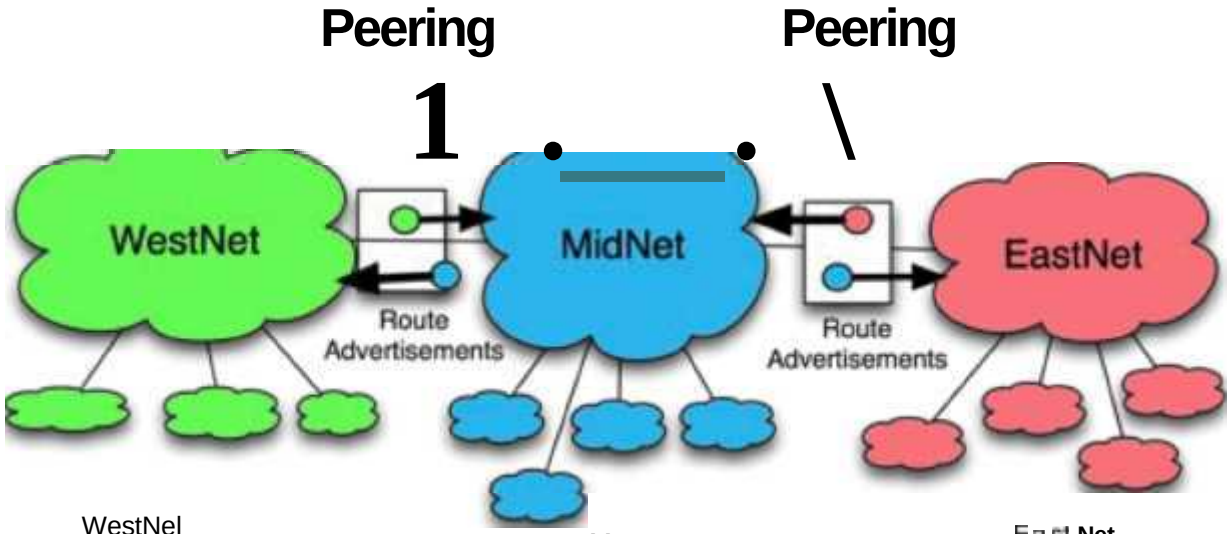


3 Key points about Internet Peering

1) Internet Peering is not a transitive relationship

2) Internet Peering is not a perfect substitute for nternet Transit

3) Internet Peering is typically settlement-free



WestNel
Routing Table

o

(after peering)

MidNet
Routing Table

(after peering)

East Net
Routing Table

(alter peering)

Top Five Motivations for Peering

Reduce Transit Costs

Better End-User Experience

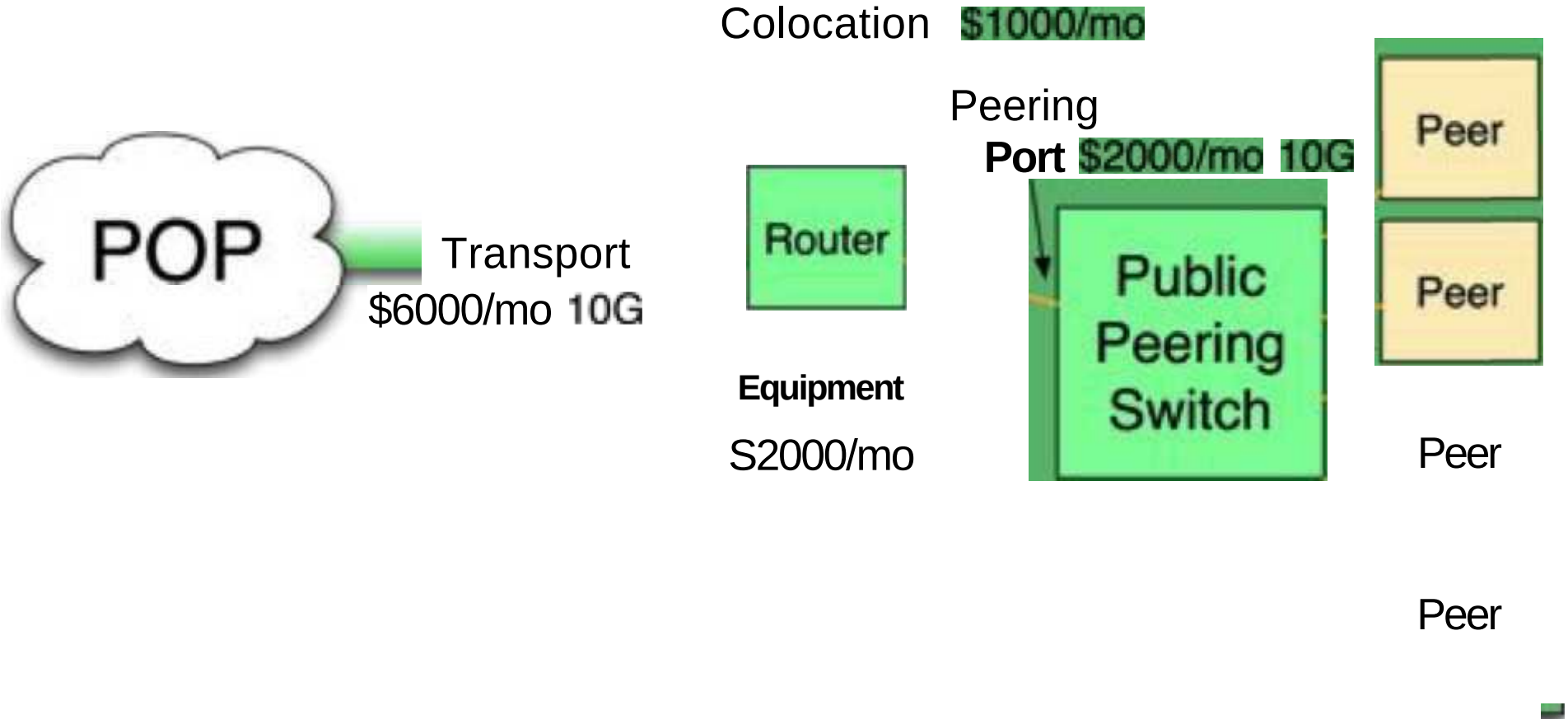
Control Over Routing

Make more $$ - Usage Based Billing

Marketing Benefits of Peering

Comes down to business: Let's talk $$$ motivation

The Business Case for Peering



Source: 2010 DE-CIX Member Meeting discussions

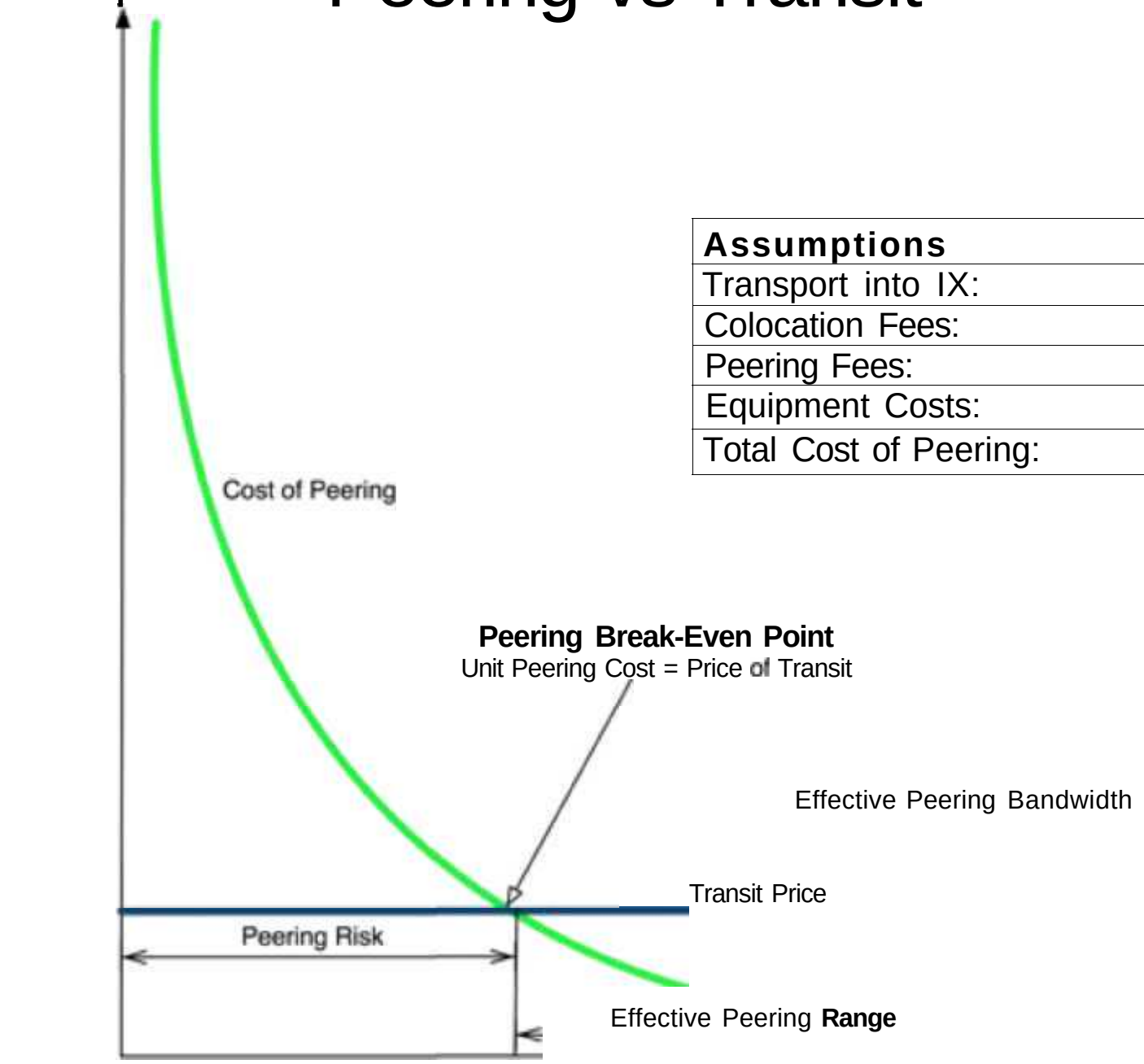
Cost of Peering

Mbps	Peering Cost	
100	$110.00	per Mbps
200	$55.00	per Mbps
300	$36.67	per Mbps
400	$27.50	per Mbps
500	$22.00	per Mbps
600	$18.33	per Mbps
700	$15.71	per Mbps
800	$13.75	per Mbps
900	$12.22	per Mbps
1000	$11.00	per Mbps
1100	$10.00	per Mbps
1200	$9.17	per Mbps
1300	$8.46	per Mbps
1400	$7.86	per Mbps
1500	$7.33	per Mbps
1600	$6.88	per Mbps
1700	$6.47	per Mbps
1800	$6.11	per Mbps
1900	$5.79	per Mbps
2000	$5.50	per Mbps
2100	$5.24	per Mbps

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

"If you can peer 1000Mbps for free, but it costs You $11,000 per month to build into the Internet Exchange Point, the cost of peering is $11,000/1000Mbs=$10/Mbps."

Peering vs Transit



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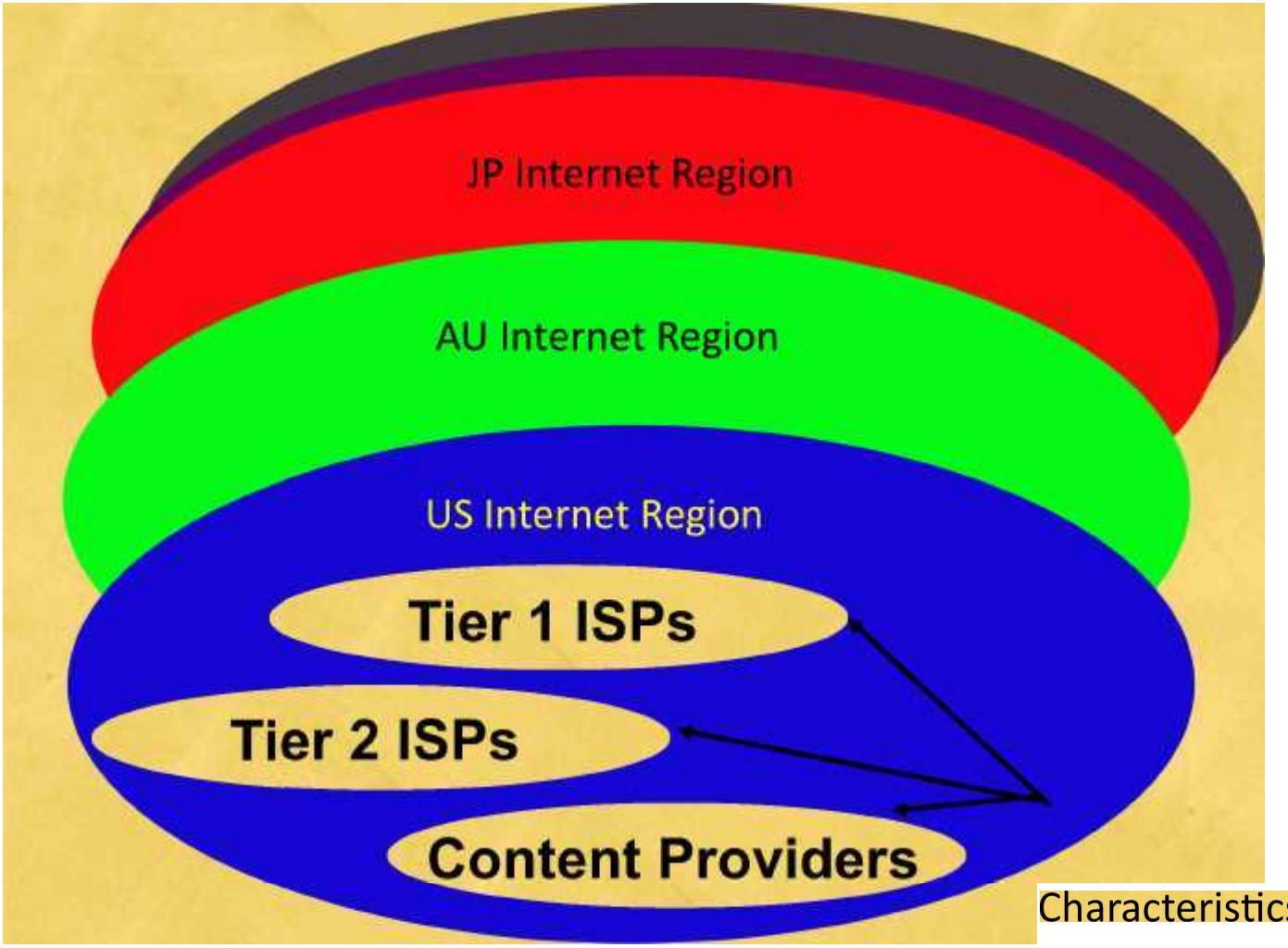
Some context :
The Internet Peering Ecosystem

Internet viewed as a Global Internet Peering Ecosystem

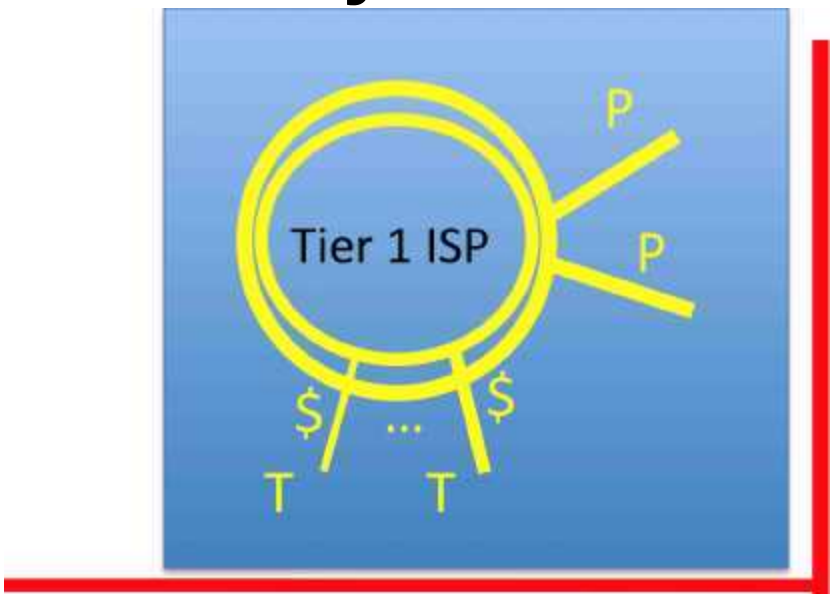
Def: Global Internet Peering Ecosystem consists of a set of interconnected internet regions (countries).

Global Internet Peering Ecosystem



Characteristics of these Ecosystem Organisms?

Ecosystem Member: Tier 1 ISP

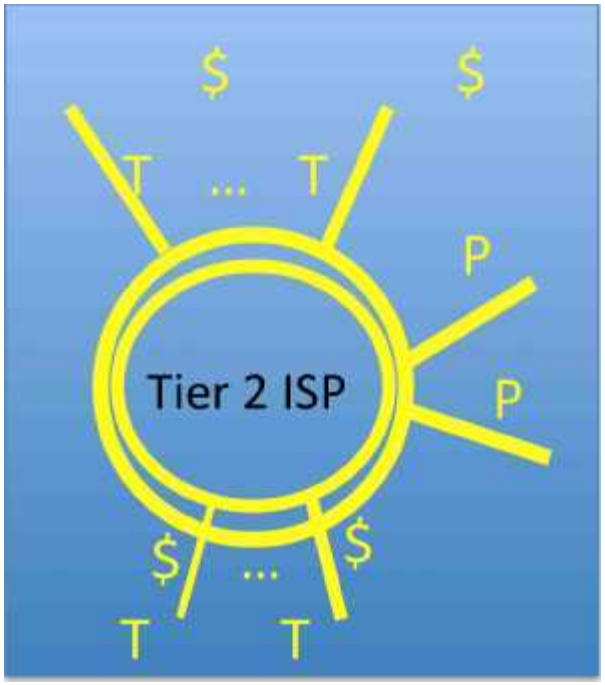


Def: A Tier 1 ISP is an ISP that has access to the ENTIRE Internet Region Routing Table solely via Free Peering Relationships

(Doesn't buy transit from anyone to reach any destination in the Internet Region.)

Motivation: Is NOT motivated to Peer in region to reduce transit fees, Is NOT motivated to peer with anybody else.

Behavior: "Restrictive" Peering *def: Policy

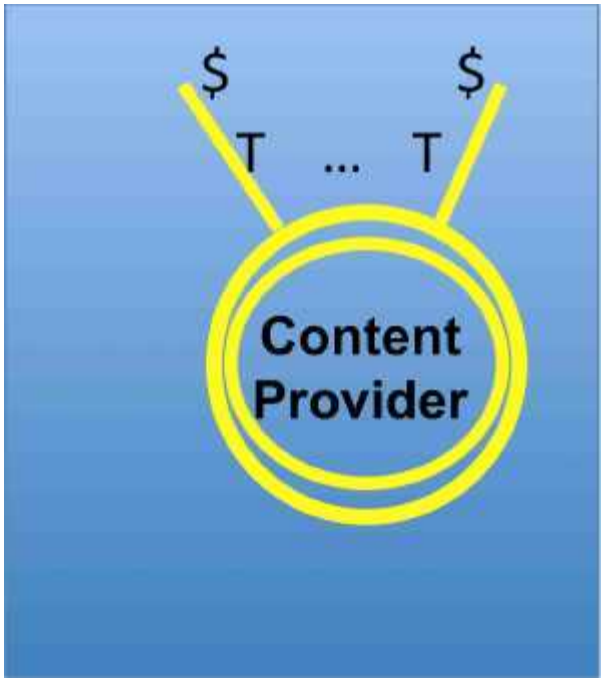


Ecosystem Member: Tier 2 ISP

Def: A Tier 2 ISP is an ISP that has to purchase Transit to access some part of the Internet Region.

Motivation: Is motivated to Peer in region to reduce transit fees.

Behavior: "Open" Peering or "Selective" Peering Policy Active in Peering Forums



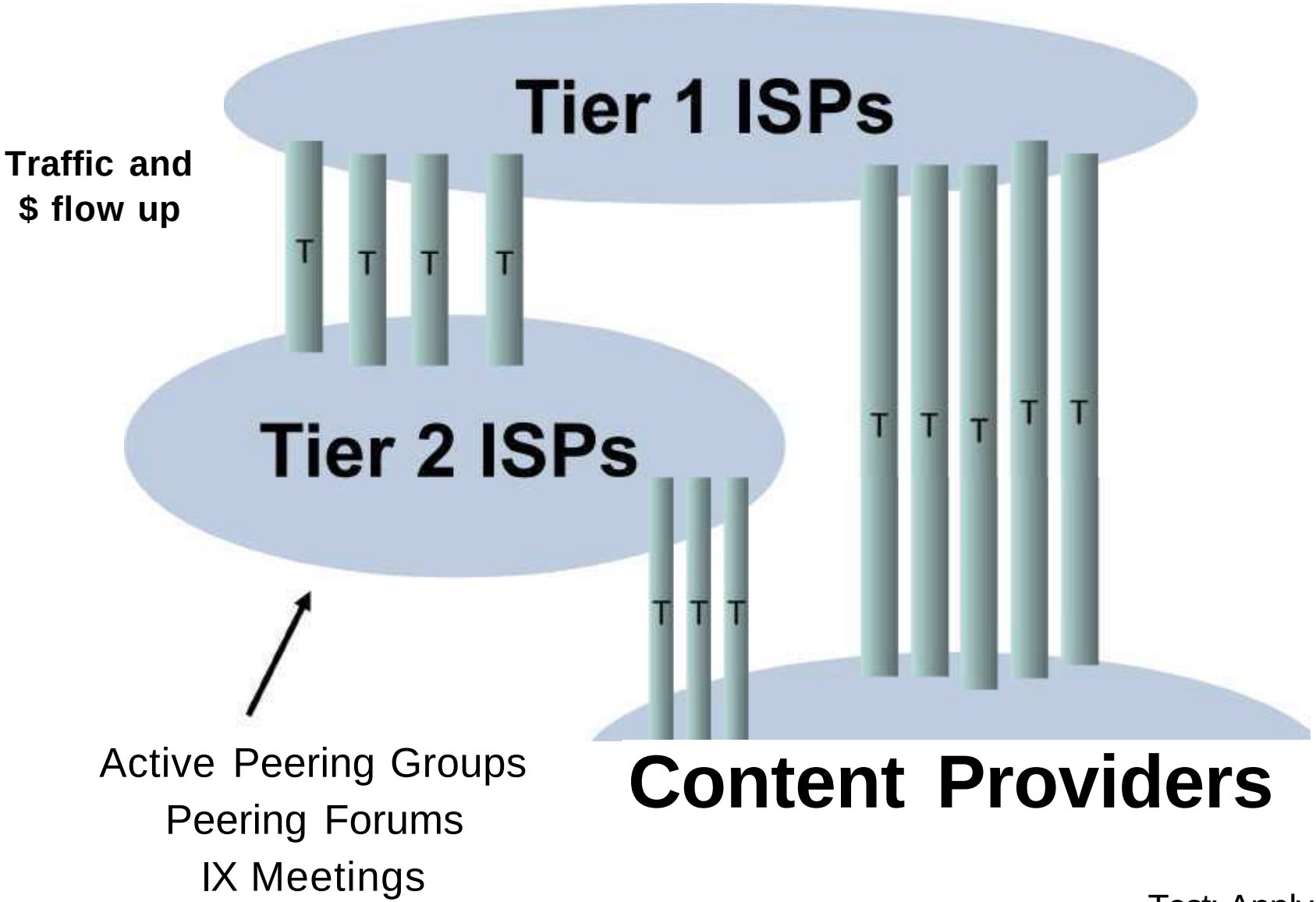
Content Providers

Def: A Content Provider focuses on content development and does not sell access to the Internet.

Motivation: SLAs w/well known ISP

Behavior: "No Peering" Policy

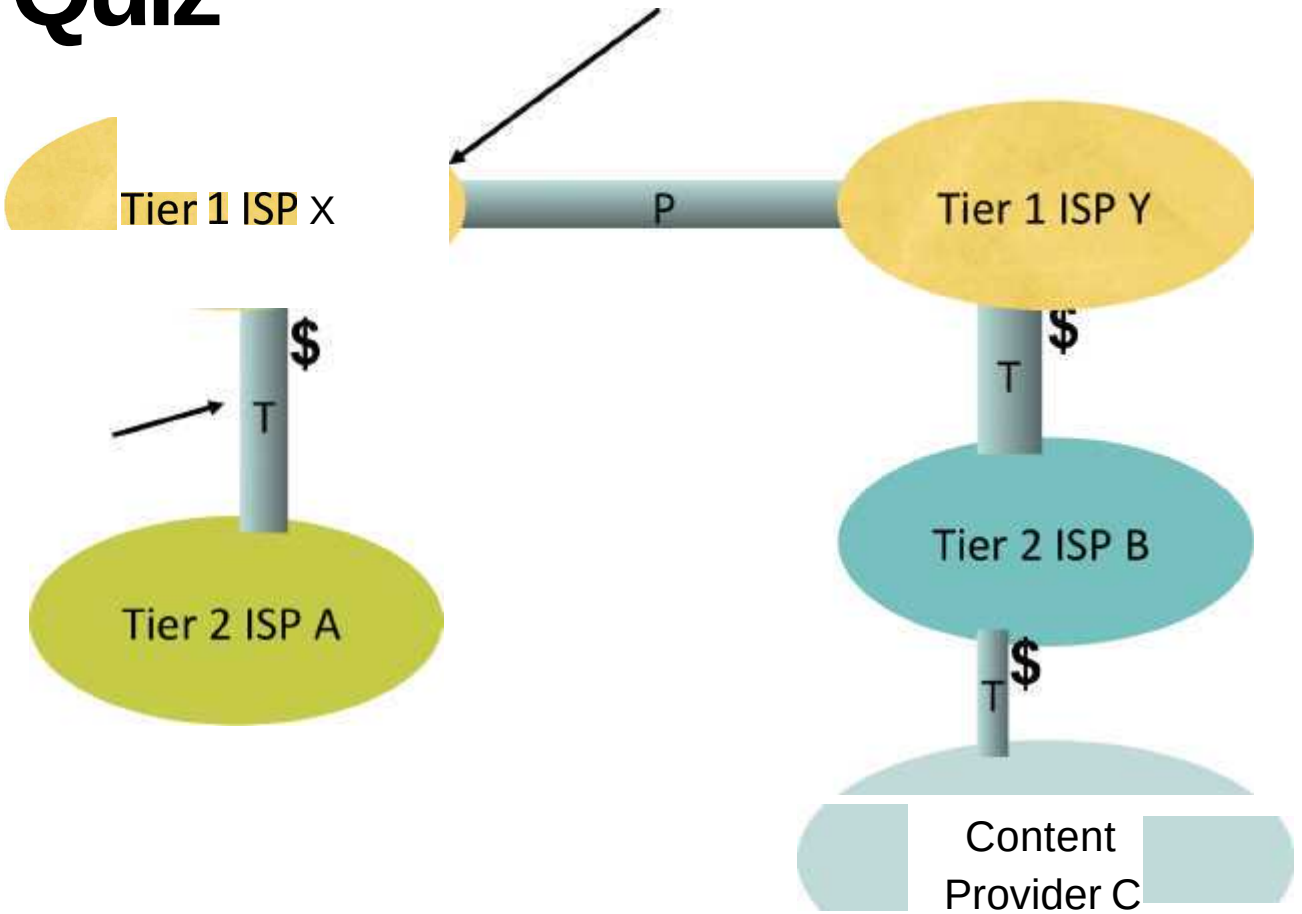
Internet Peering Ecosystem



Test: Apply defs.

Quiz

2) Definition of Peering:



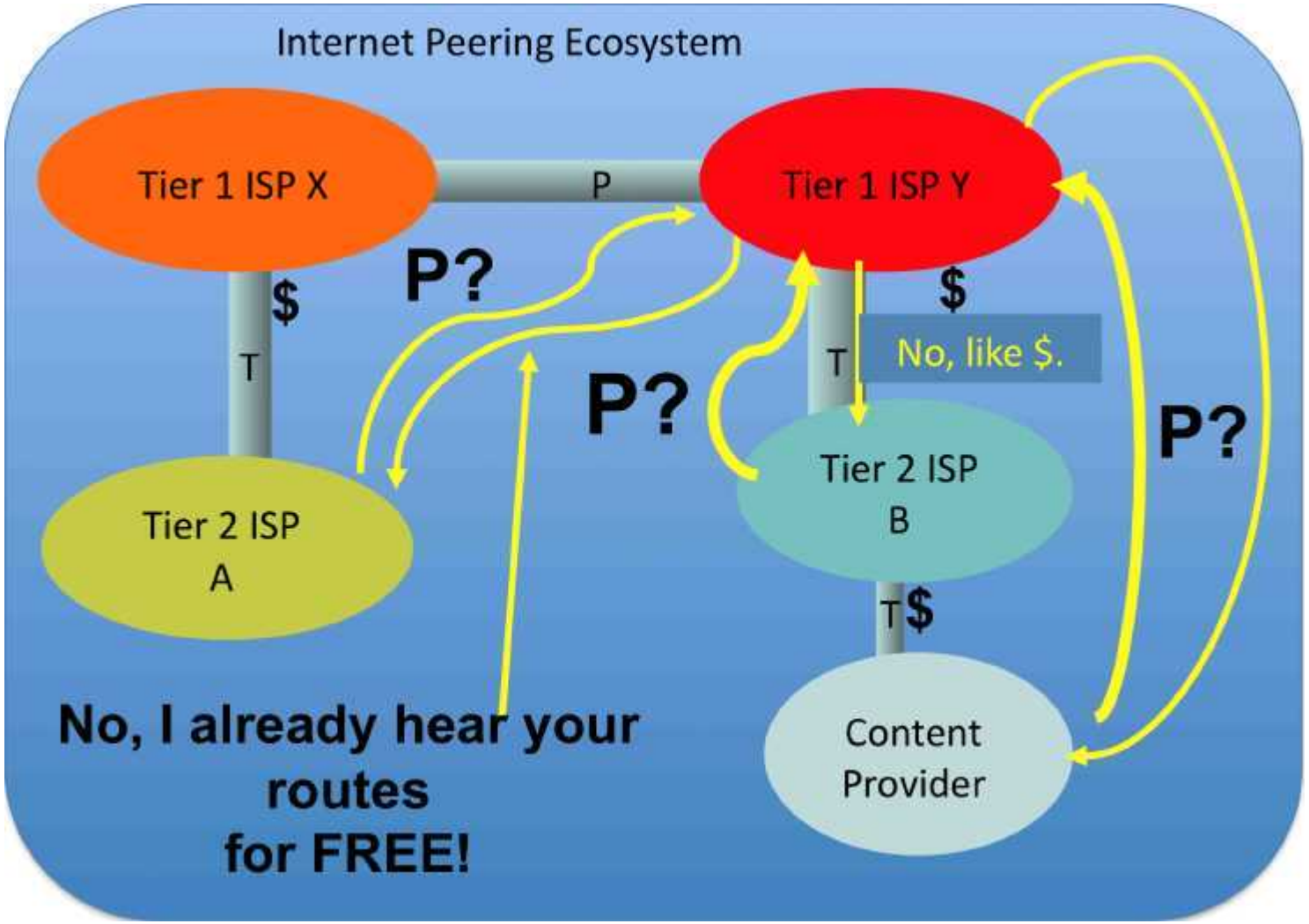
1) Definition of Transit:

3) Definition of an "Open" Peering Policy:

4) Definition of a "Selective" Peering Policy: _

5) Definition of a "Restrictive" Peering Policy:

Apply Defs: Peering Dynamics & Motivations



No, like $,

& I Like customer

B

Synch Point:

You have all the definitions needed to predict behavior in the Peering Ecosystem.

The Peering Simulation Game

Let's exercise these definitions

The Players

Internet Service Provider A

- Peering Coordinator

Internet Service Provider B

- Peering Coordinator

Internet Service Provider C

- Peering Coordinator

Internet Service Provider D

- Peering Coordinator

3 Helpers

Transit Provider X

Transit Provider Y

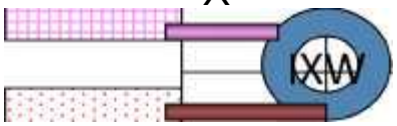
Exchange Point Operator

ran it Provider

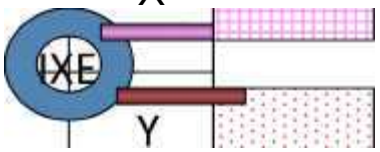
The Peer ng Game

B

X



X



D

Transit Provider Y

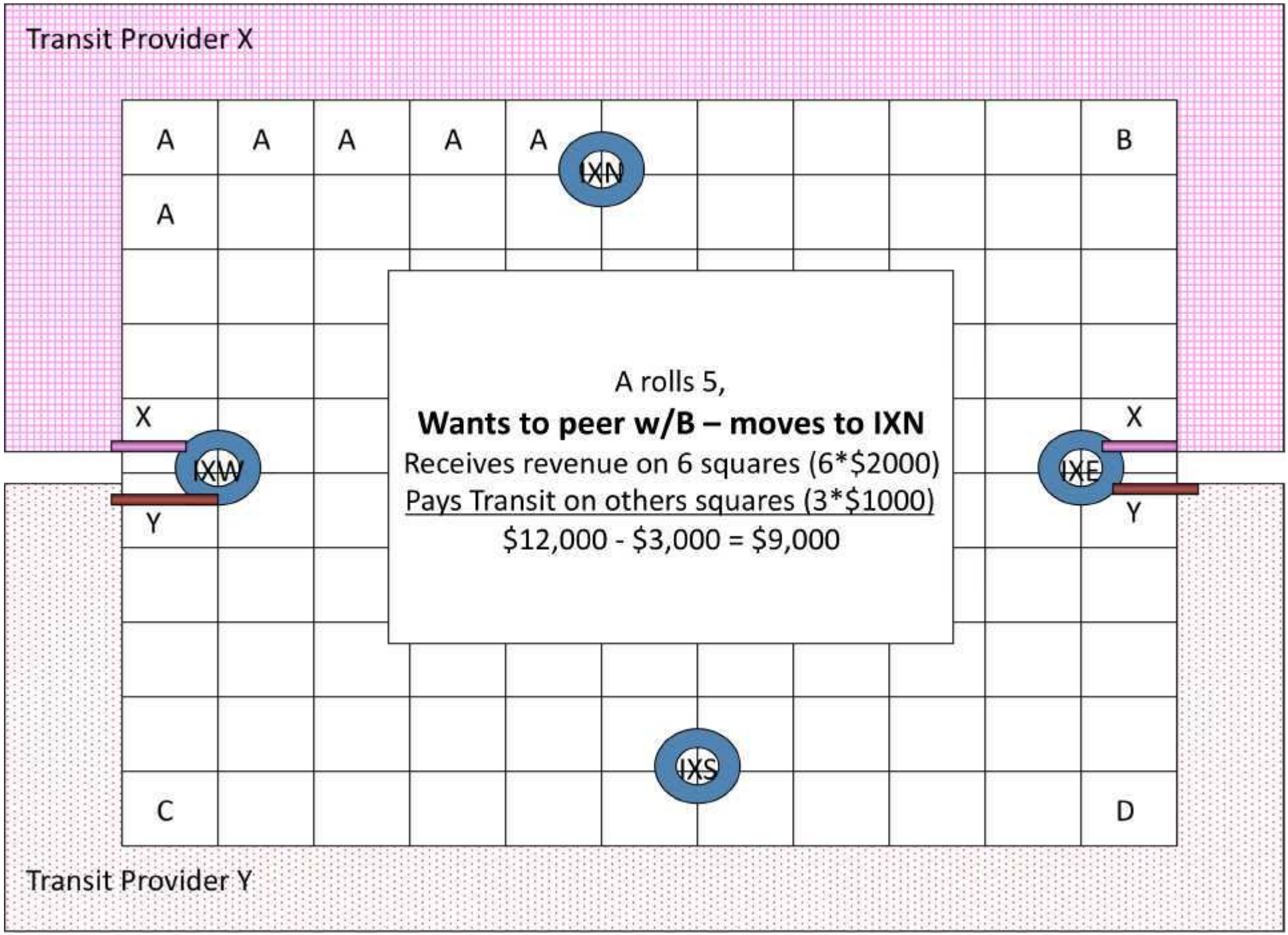
3 Rules

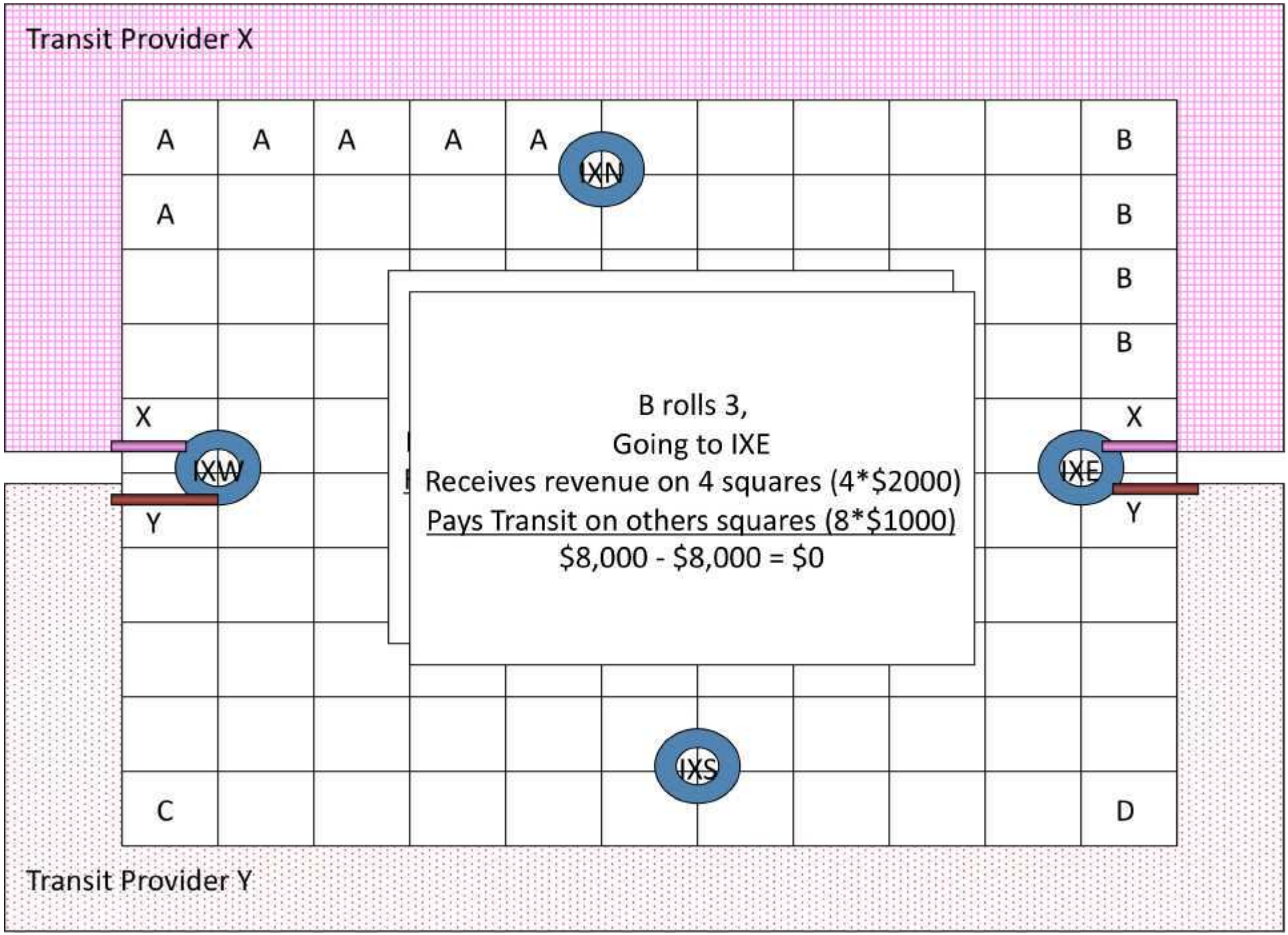
1. Goal: **Maximize bank holdings.** Make money by acquiring customers and reduce transit costs by peering
2. Play: Roll the dice and expand your network by selecting that many adjacent "squares" of customers

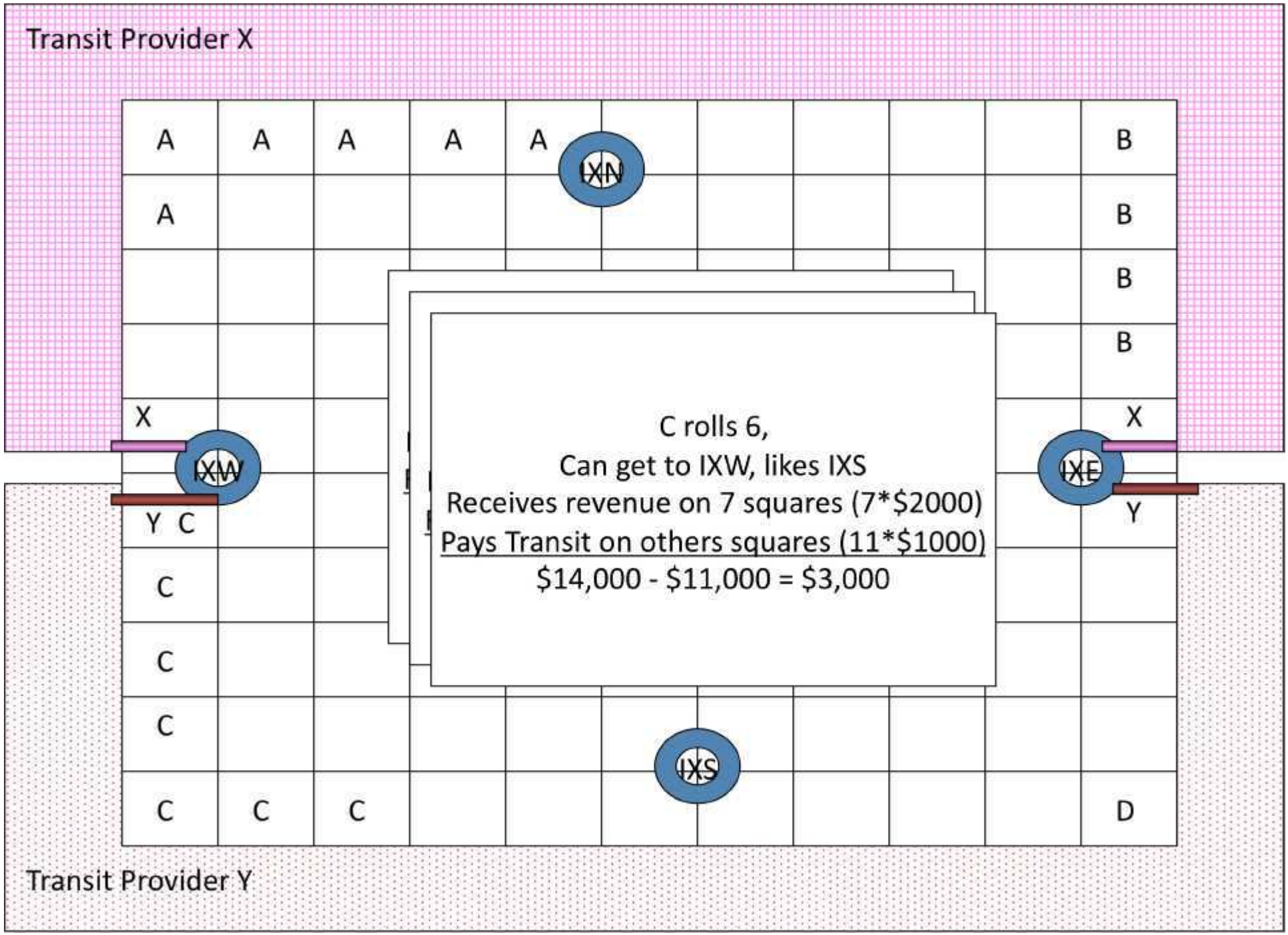
   Gain transit revenue of $200(for each customer square you own

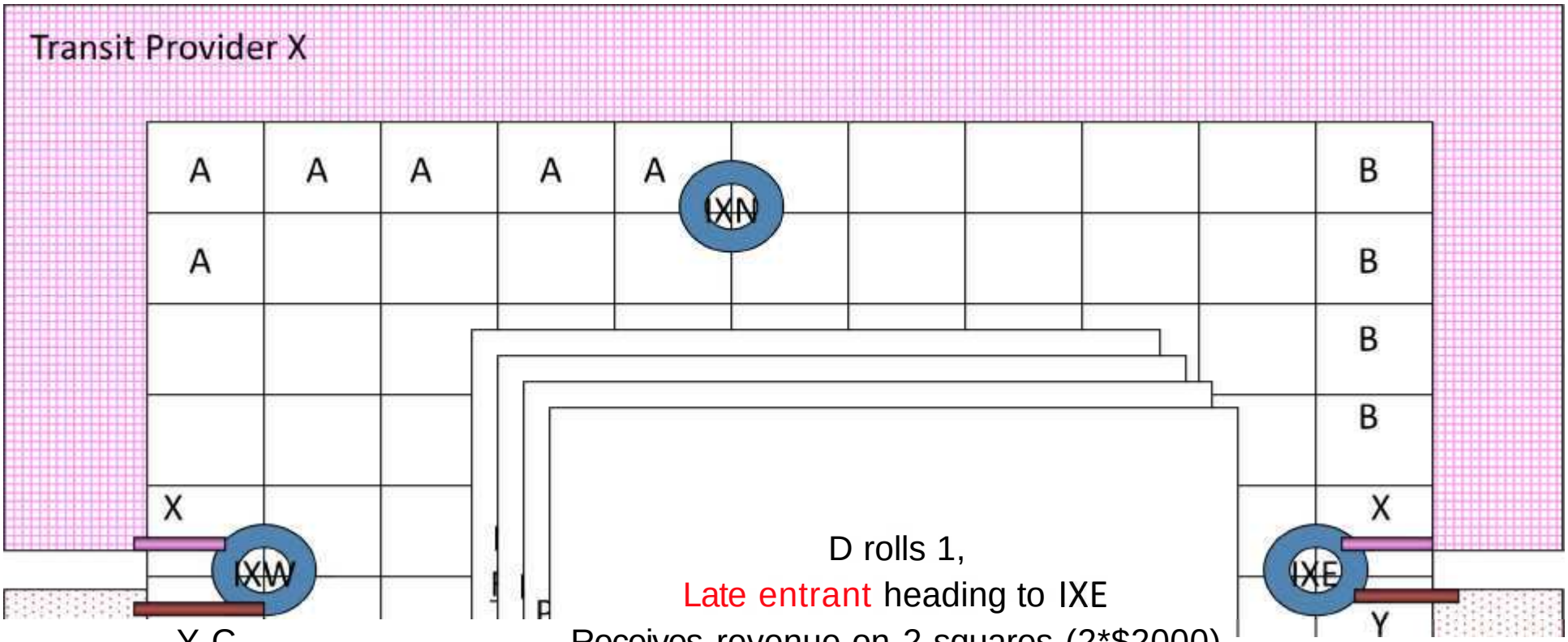
   Pay transit fees of $1000 for each square of traffic that **other** ISPs own
3. If at Exchange Point, two ISPs can **negotiate peering:**
   - $2000 recurring cost and loss of 2 turns, ISPs negotiates who covers the costs of peering
   - Peering ISPs do not have to pay transit for each others squares starting the next turn

Quick round.


Transit Provider X
A
A
A
A
A
IXN
B
A
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
IXW
Y
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
A
A
A
A
A
IXN
B
A
B
B
B
X
X
IXW
IXE
Y
Y C
C
C
C
C
C
C
IXS
D
C rolls 6,
Can get to IXW, likes IXS
Receives revenue on 7 squares (7*$2000)
Pays Transit on others squares (11*$1000)
$14,000 - $11,000 = $3,000
Transit Provider Y



D rolls 1,

Late entrant heading to IXE

Receives revenue on 2 squares (2*$2000)

Pays Transit on others squares (17*$1000)

$4,000 - $17,000 = -$13,000

D

D

Transit Provider Y

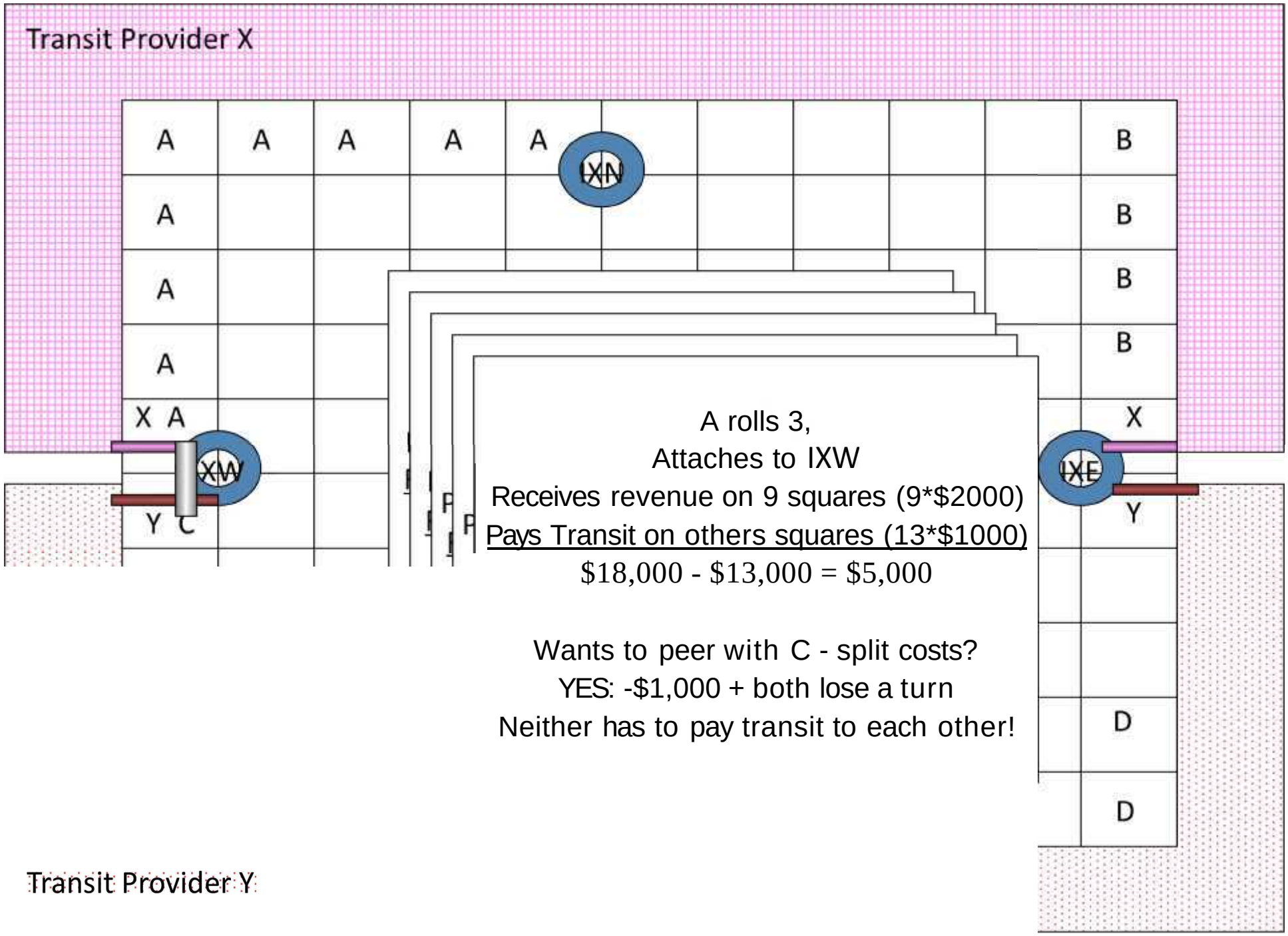
Scoreboard after Round 1

ISP A: $9,000

ISP B: $0

ISPC: $3,000

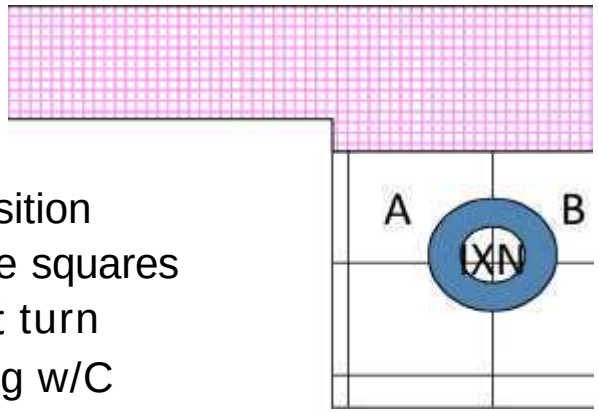
ISPD: -$13,000


Transit Provider X
A
A
A
A
A
IXN
B
B
B
B
X
IXE
Y
D
D
A
A
A
X A
IXW
Y C
A rolls 3,
Attaches to IXW
Receives revenue on 9 squares (9*$2000)
Pays Transit on others squares (13*$1000)
$18,000 - $13,000 = $5,000
Wants to peer with C - split costs?
YES: -$1,000 + both lose a turn
Neither has to pay transit to each other!
Transit Provider Y

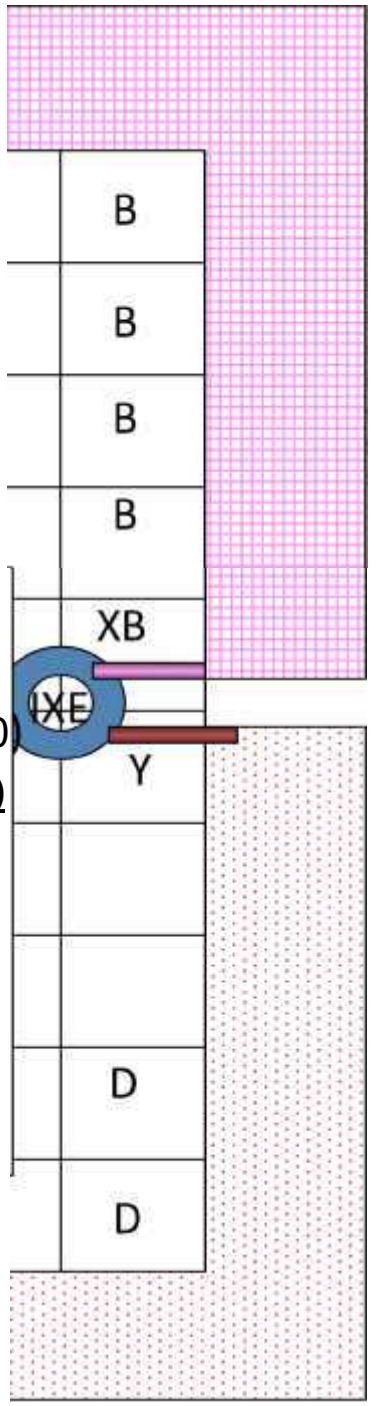
ransit Provider

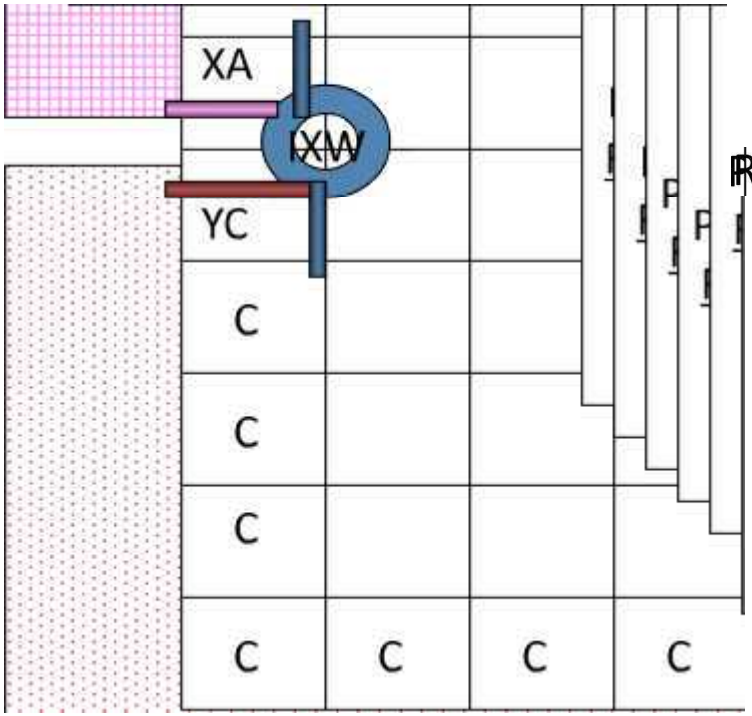
ffffff

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



B B B B





Transit Provider Y

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

Let's play!

WELCOME TO **BILLAND**

4 ISPs that have never played before

Open Board

$35,000 VC Funding

$25,000 VC Funding

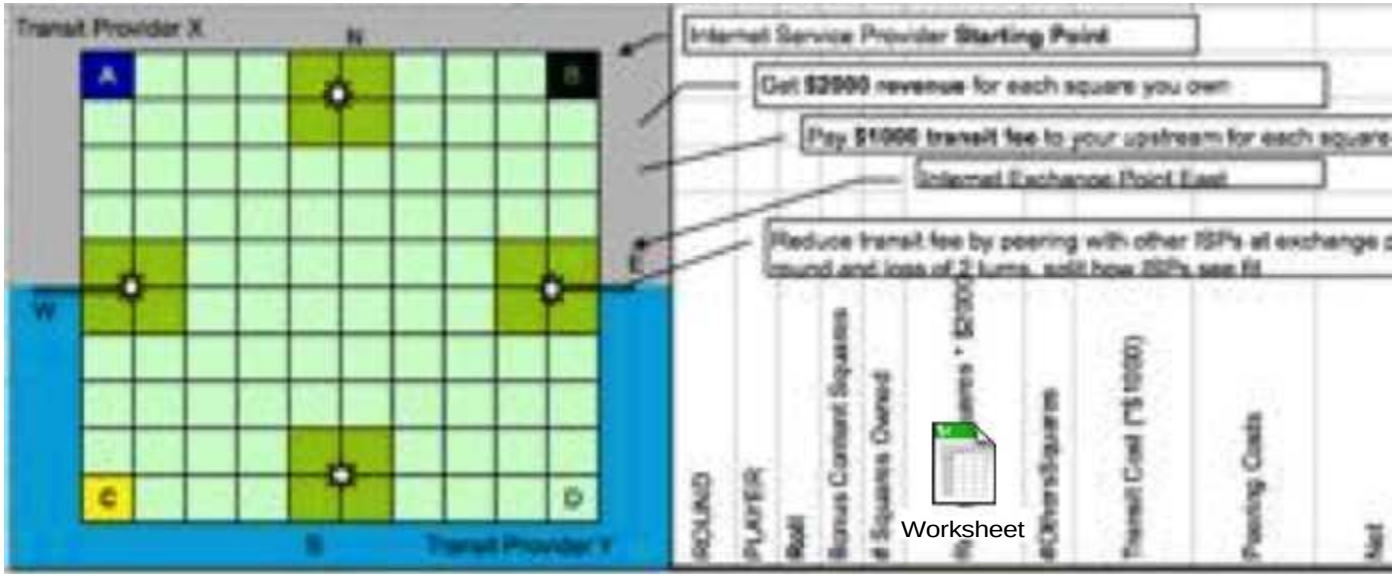
1¥ = $1000

We want to hear your thought process and peering negotiations

Winner- prize

WINNER: At 5:25?PM we will stop and assume that every roll was a "3" from that point on out to 12 rounds..

Play the Peering Simulation Game...



I'M

i

(of NOT) (vs. Cost of)

At end of game we (roll a 3 !

account at the end

Worksheet