

# Access Power Peering

A historical perspective on  
The Evolution of the Internet Peering Ecosystem

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The 2<sup>nd</sup> Workshop on Internet Economics (WIE'11)  
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The Cooperative Association for Internet Data Analysis

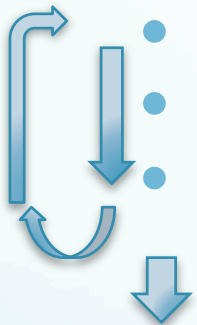
**DR PEERING**  
INTERNATIONAL

# William B. Norton

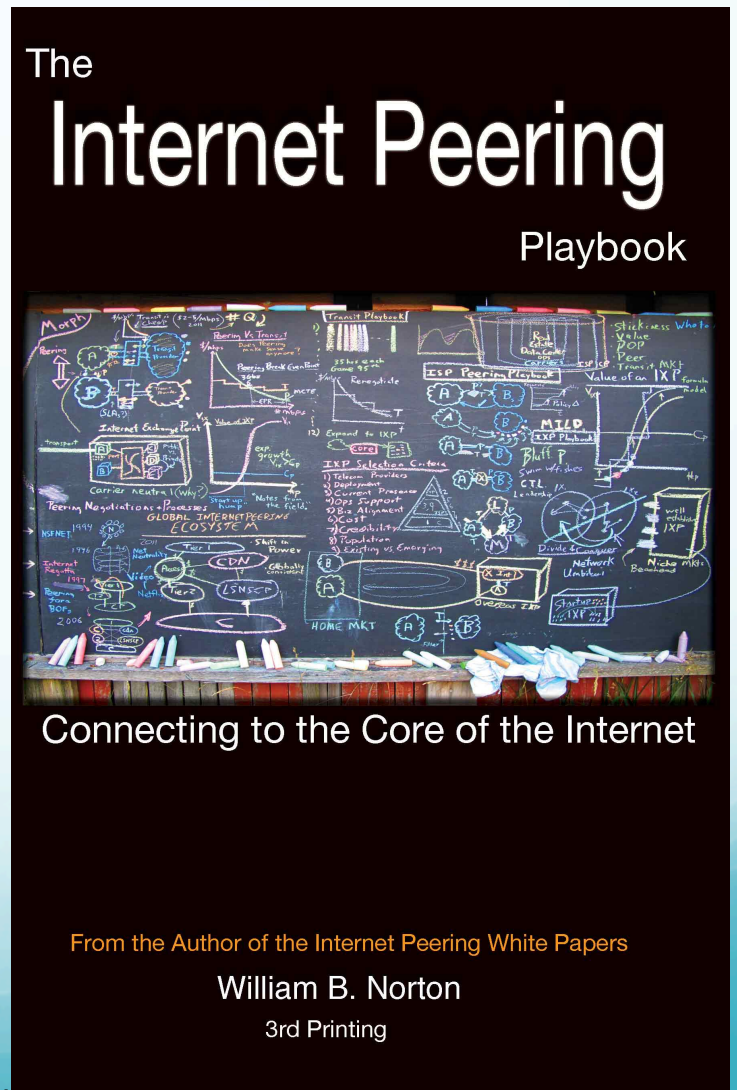
- 1987 NSFNET / 1995-1998 NANOG Chair
- Equinix, 1998-2008, Co-Founder & Chief Technical Liaison
- DrPeering, Executive Director – Keep info public
  - Ask.DrPeering.net – DECIX Newsletter
  - Consulting – GLG Expert Network, Peering Workshops
  - Work with mostly (private) clients – teams up-to-speed
  - Peering White Papers (public)

# The Peering White Papers

- 10 years of Process = 1000's of conversations
  - Assimilate mindset of the Peering Community
    - Collect data. Walkthroughs.
    - Share at Conferences
    - *Refine Primary Research & feed back*
- Results
  - White Papers
  - Web Pages
  - Book-excerpts used in this preso



Unexpected audiences...



# Financial Book review

*“This book is fantastic!”* – Industry analyst

fantastic |fan'tastik| adjective

**1** imaginative or fanciful; remote from reality: *novels are capable of mixing fantastic and realistic elements.*

- of extraordinary size or degree: *the prices were fantastic, far higher than elsewhere.*

- (of a shape or design) bizarre or exotic; seeming more appropriate to a fairy tale than to reality or practical use: *visions of a fantastic, mazelike building.*

**2** informal extraordinarily good or attractive: *your support has been fantastic.*

# The Evolving Internet Peering Ecosystem

All about Context

Why should we care about context?

# My Airplane Story

- NWA Flight DTW-LAX Delay → Cancel
- Rebook, go to gate 34 (short walk)
- On plane. Boarding disgruntles
- Flight attendant: “sit anywhere”
- Delayed... Palpable Anger

What happened?

# What happened?

- Back at gate
- Flight was Cancelled
- “Room for 15-20 passengers”
- “Proceed in orderly fashion”
- “Will handle as many as we can”
- 154 frantic people hauled ass
- Line → special case override → Mob Scene
- Get the yellors out of the line
- Aggression, pushing, shoving, Detroit cops called in

# Who is responsible for riot?

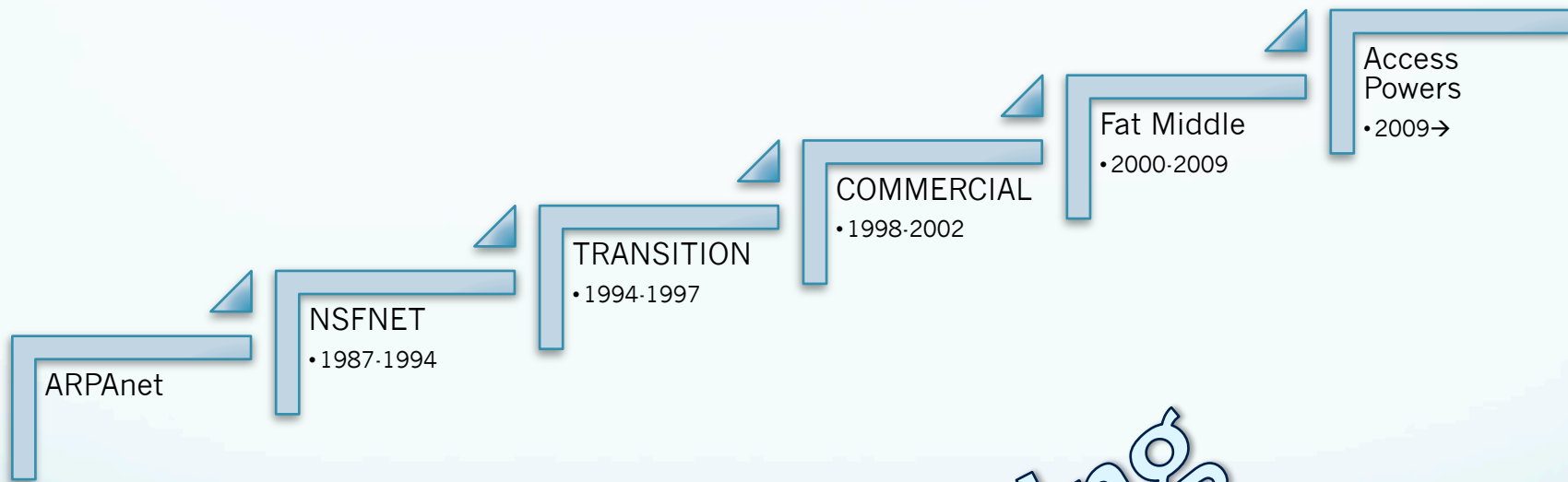
- Airline vs. Passengers
- Show of hands
  - \_\_\_ Airline 100% Passengers 0% responsible
  - \_\_\_ Airline 90% Passengers 10% responsible
  - \_\_\_ Airline 80% Passengers 20% responsible
  - \_\_\_ Airline 70% Passengers 30% responsible
  - :
  - \_\_\_ Airline 0% Passengers 100% responsible



# The Peering Problematic

- Just as context drives behavior in the airline story, context drives behavior in the peering ecosystem
- Evolving *Internet Peering* context
  - Positional power
  - Predictable Behavior
- This is a talk about the future of peering
  - Trajectory from the past
- Discussion chapters in *The Internet Peering Playbook*

# History of Internet Peering Contexts

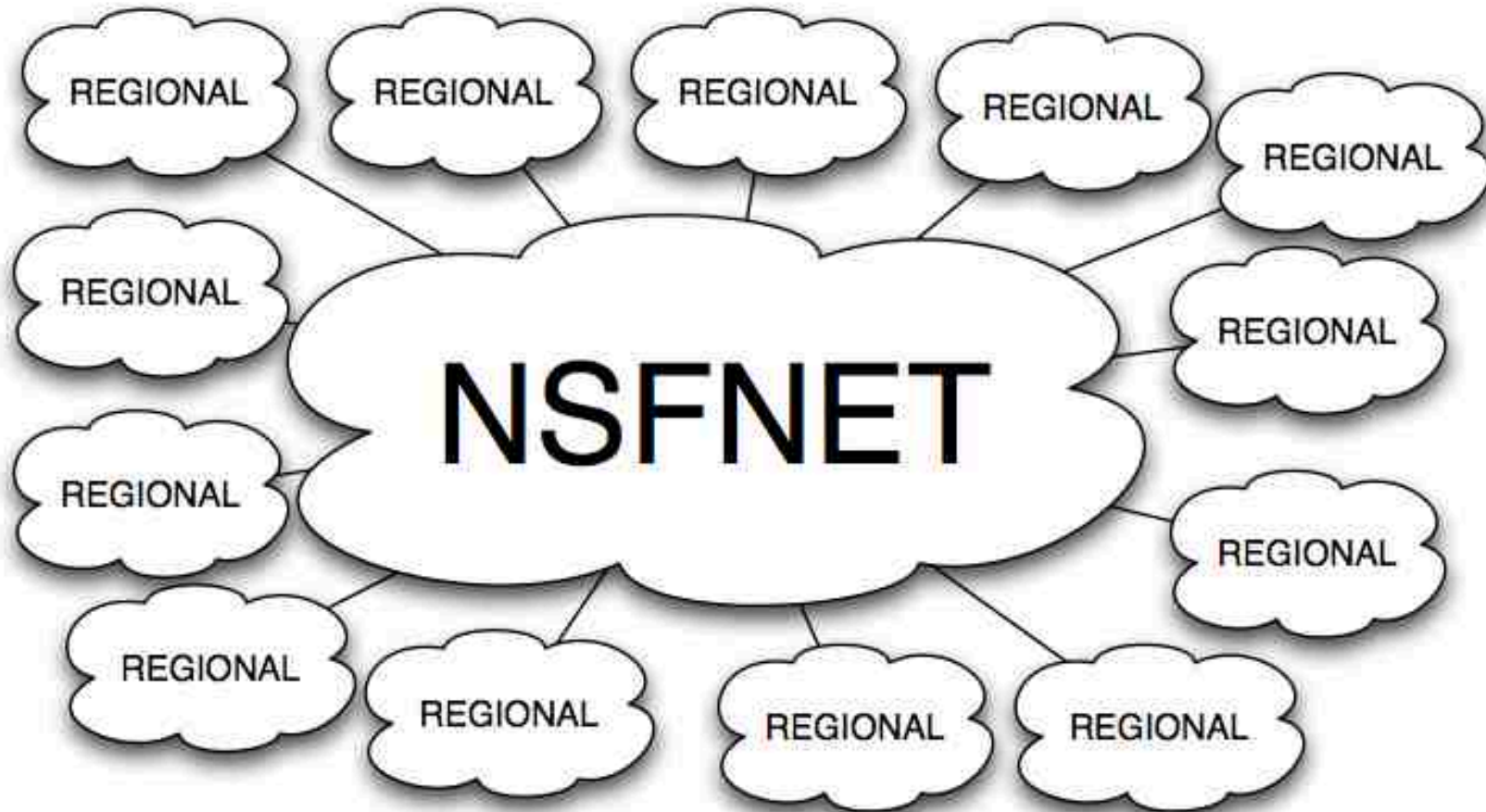
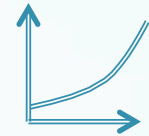


Morphing

# 1<sup>st</sup> Peering: ARPANET 80's

- USENET/BITNET/X.25 could not connect
- ARPAnet limited to gov't & contractors
- CSNet-NSF project to connect all CS depts
- Spotlighted AUP problem
- Bureaucratic complexity
  - Settlement of financial, admin, contract etc.
- Peering is “interconnection without explicit accounting or settlement”

# NSFNET – '87-'94



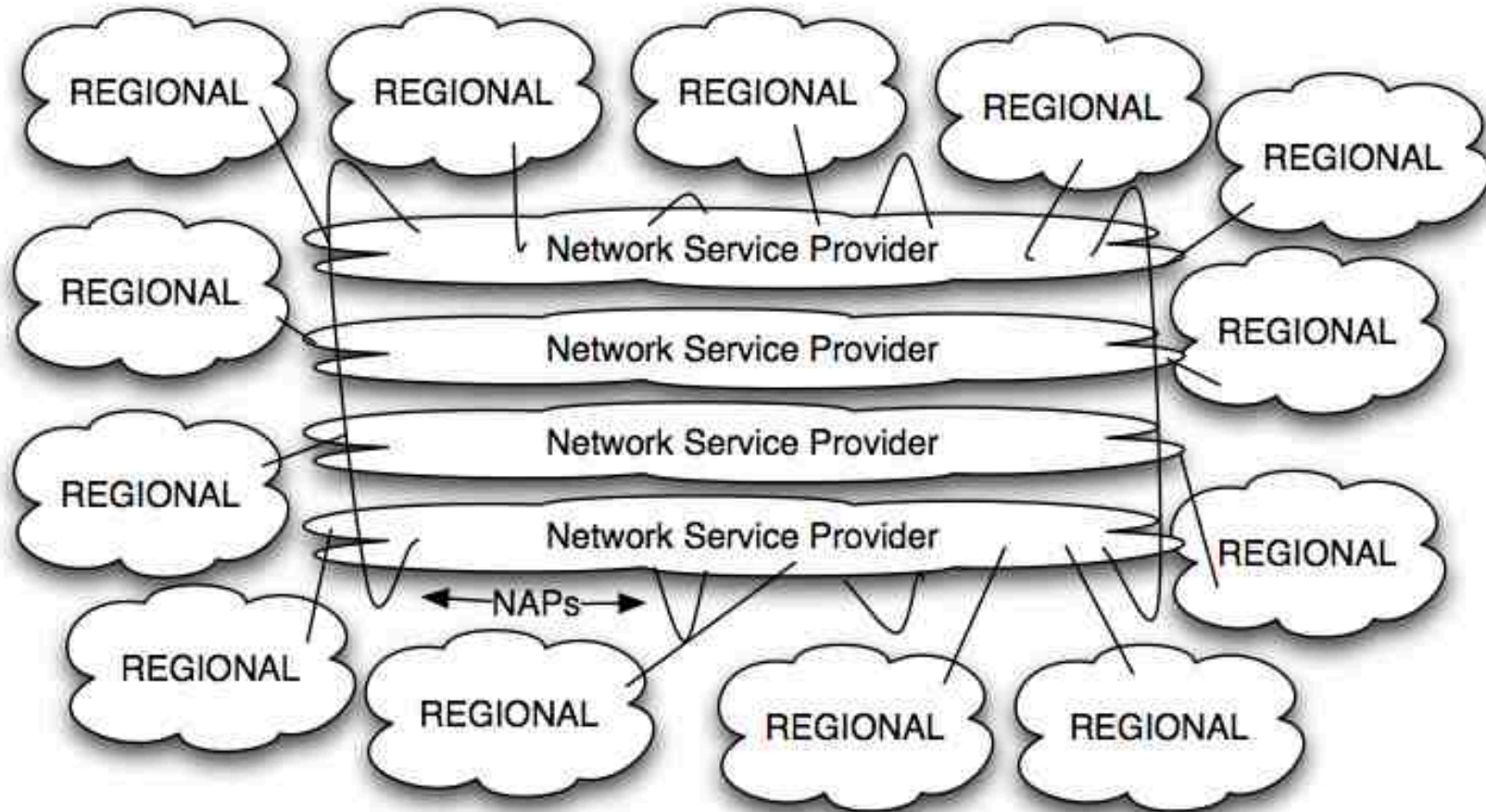
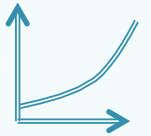
Core

Open Regional Techs

NSF

Growth → Time to privatize

# NSFNET Transition – '94-'96



Strong NANOG Chair model

Chair & commercial interests

PacBell NAP

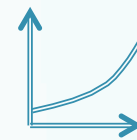
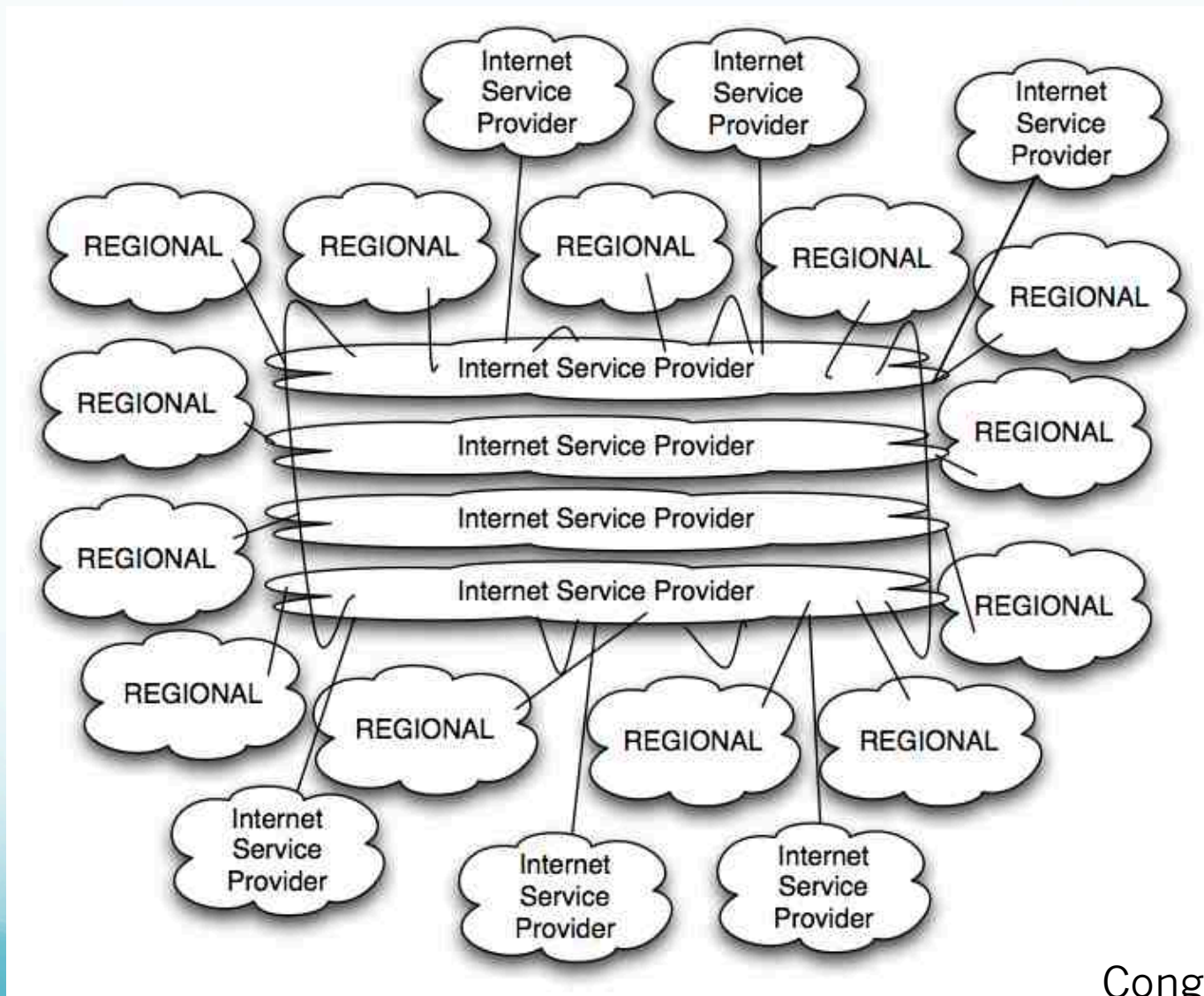
AADS NAP

MAE-East\*

Sprint NAP

Interconnect a private matter

# Commercial Internet – '96-'98

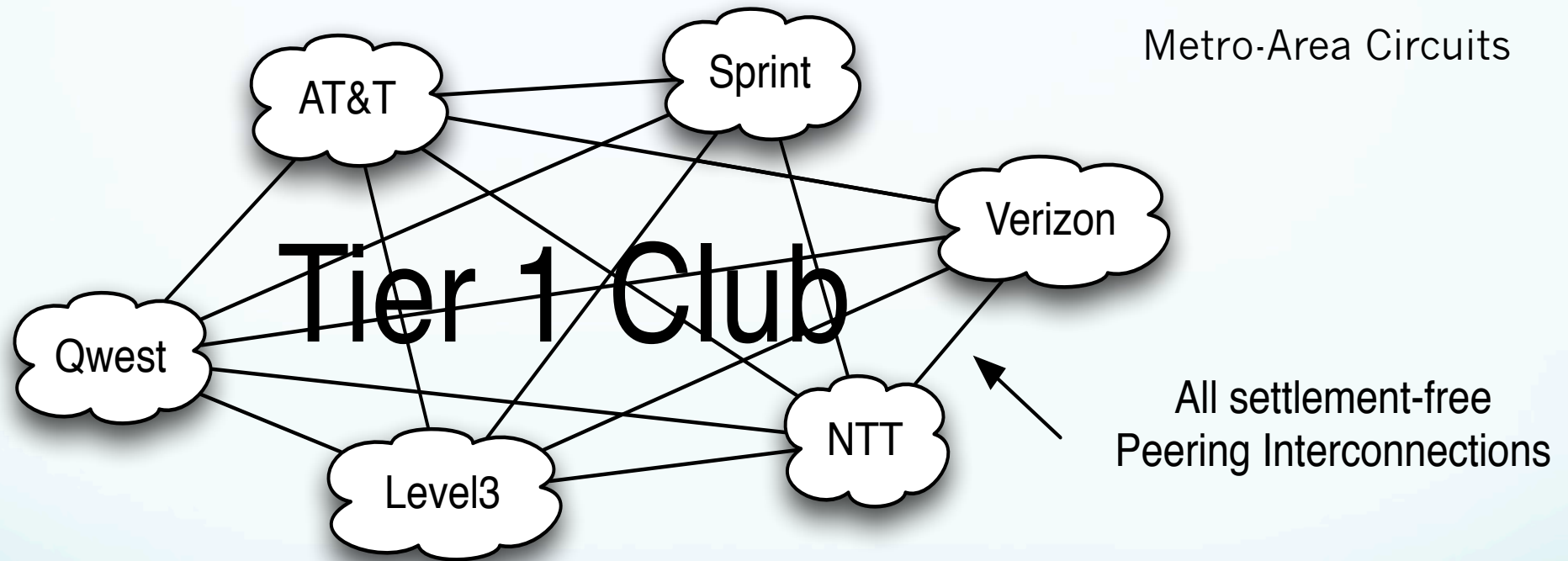


Resale & Growth

Little visibility/sharing

Congestion Points  
→ Private Peering

# Tier 1 Club *Private Peering* Migration



Tier 1 ISPs abandon NAPs

Congestion at NAPs

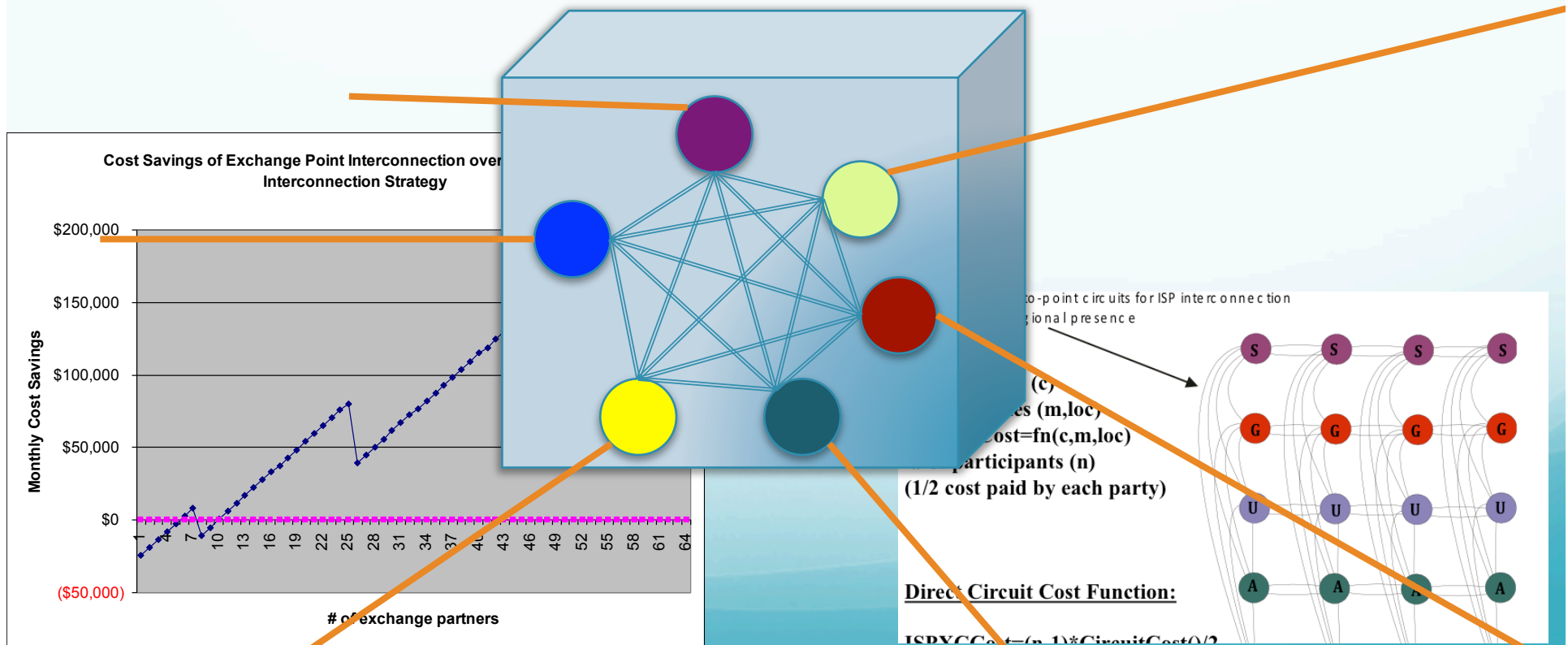
NAPs run by competitors

Reduce complexity – fiber breaks less often than active electronics

Full Mesh in each of 8 interconnect regions across the U.S.

# 2000-2001

- Carrier Neutral Internet Exchange Points (PAIX/EQIX)
- Proved financially better if at least 5 Tier 1's build in and do fiber cross connects

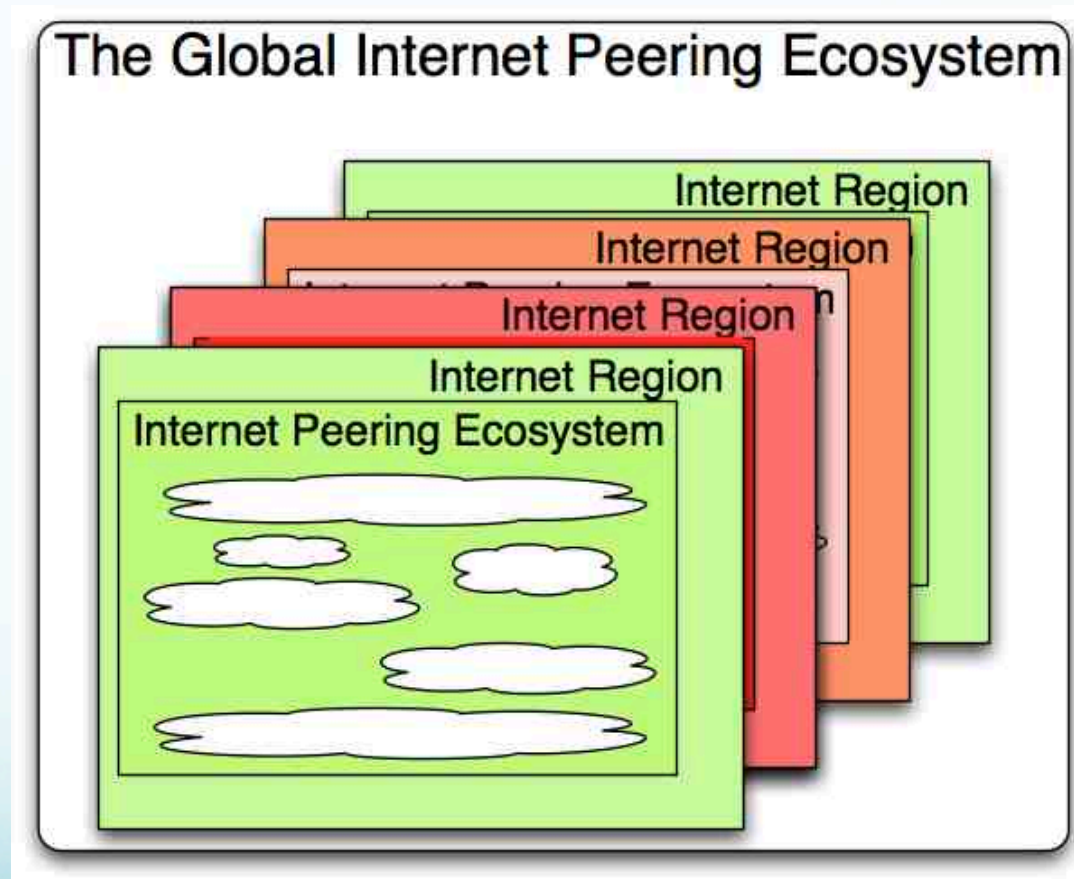




# Commercial Internet

Internet Growth

Organic  
With Structure:



# Basic Internet Peering Ecosystem

**Tier 1 ISPs** have access to The entire Internet Region routing Table solely via their free peering Interconnects.

They **do not pay transit fees** to reach any destination in their Internet Region.

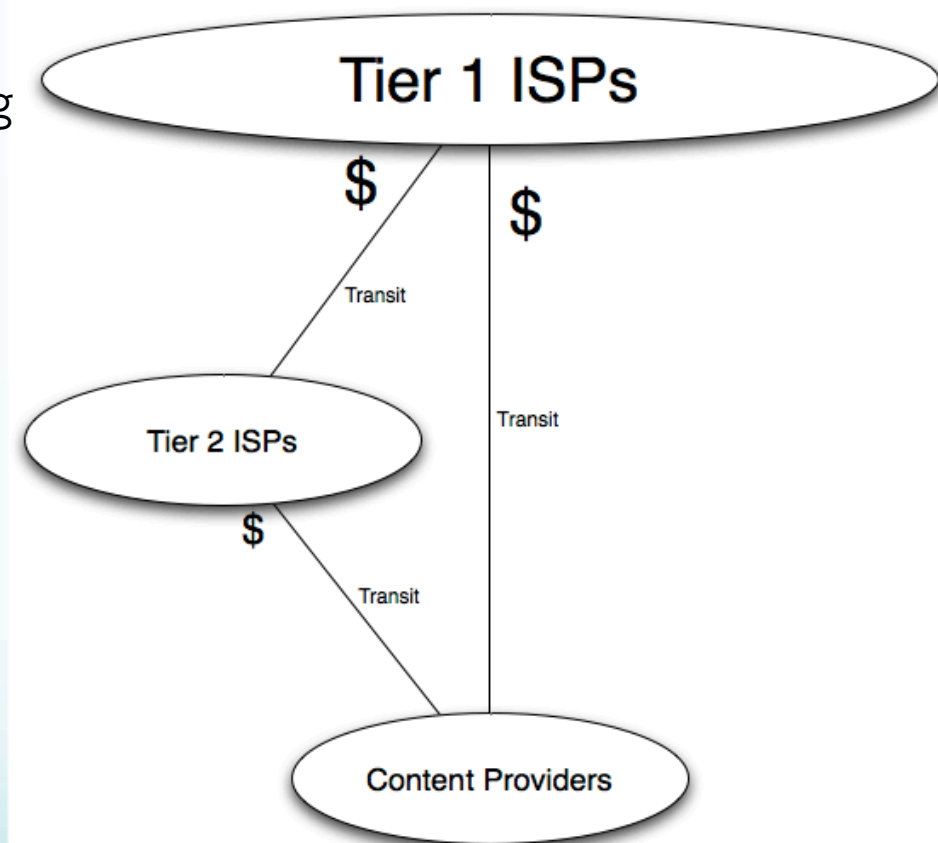
Revenue and traffic flows to T1s.

**Tier 2 ISPs** are everyone else.

Pay transit fees.

Interested in peering around transit providers.

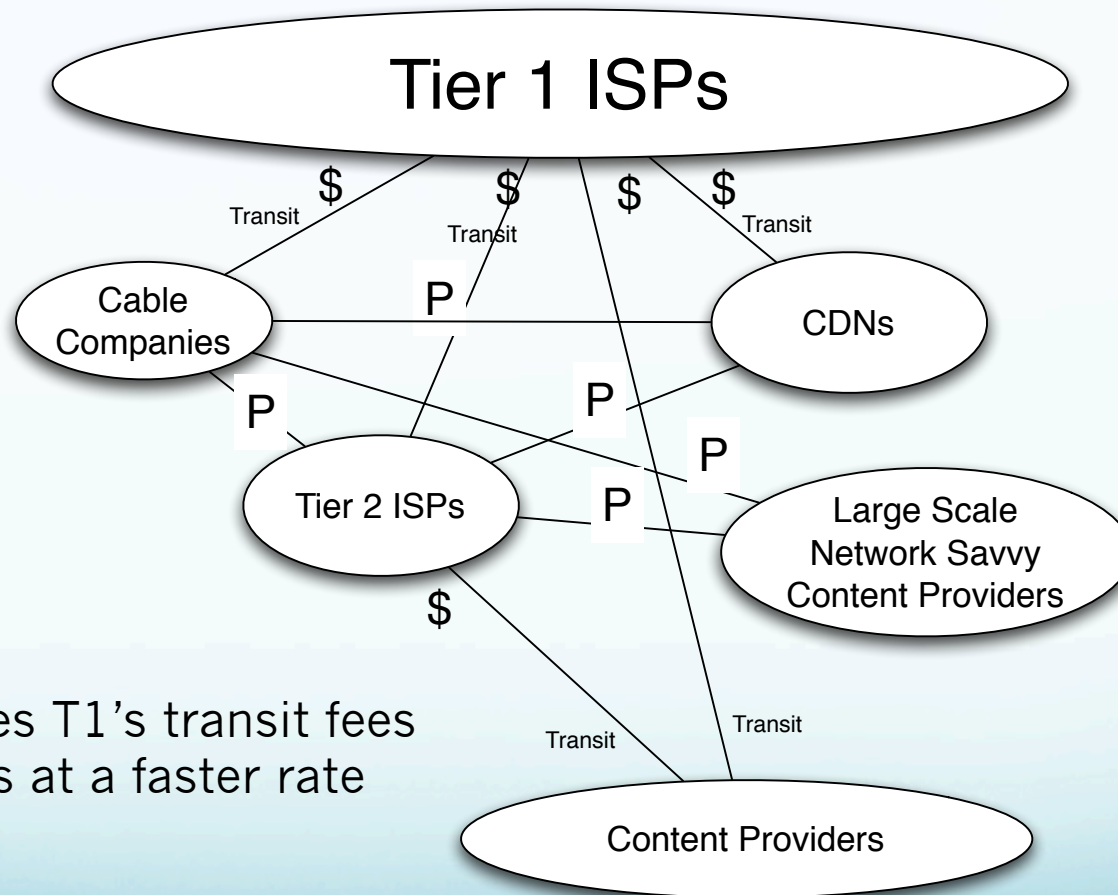
Attend Peering Fora



# Fat Middle Peering '98- today

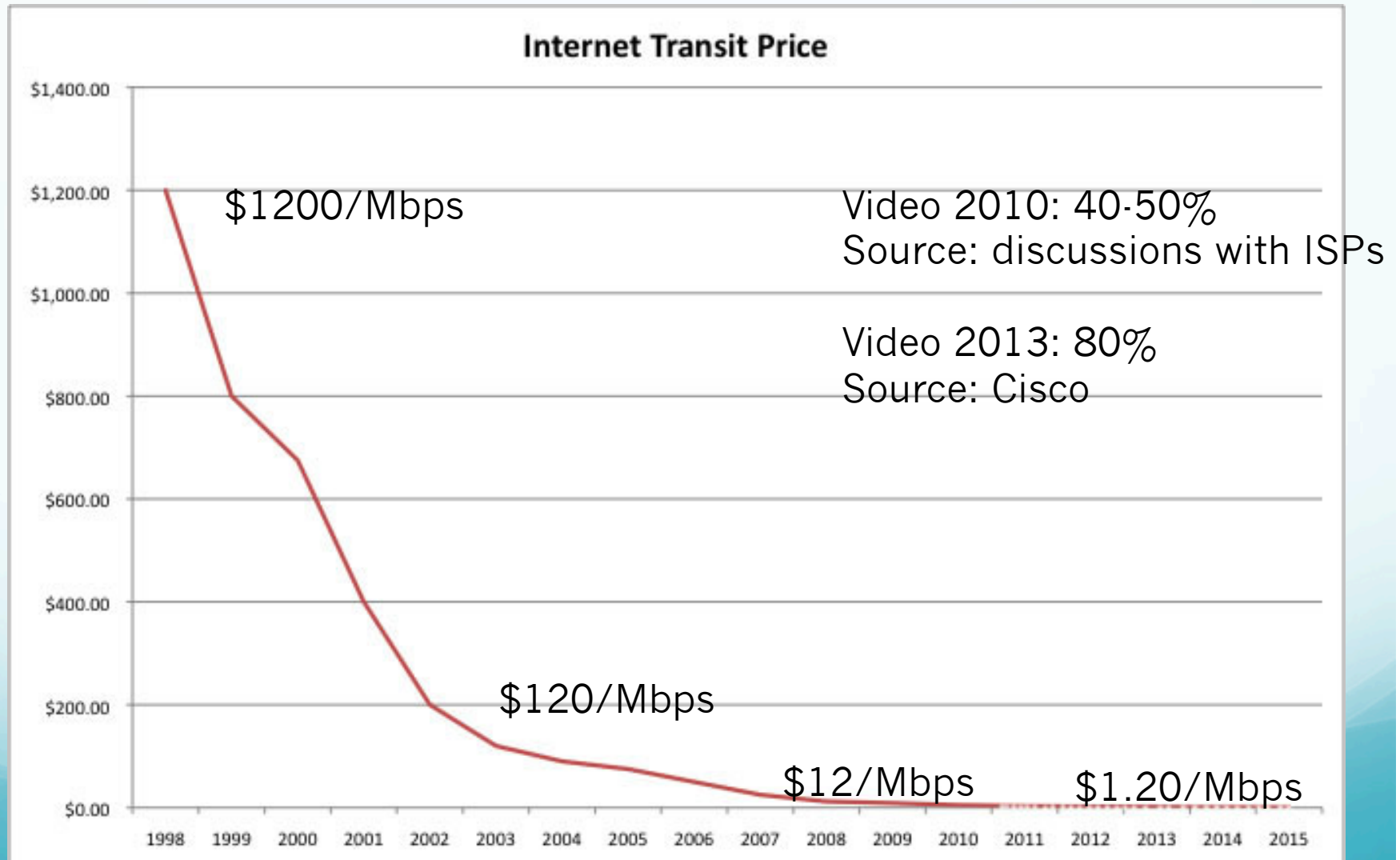
New Players  
@home bankrupt  
CDNs  
LSNSCP

“Open” Peers  
:  
“Selective Peers”

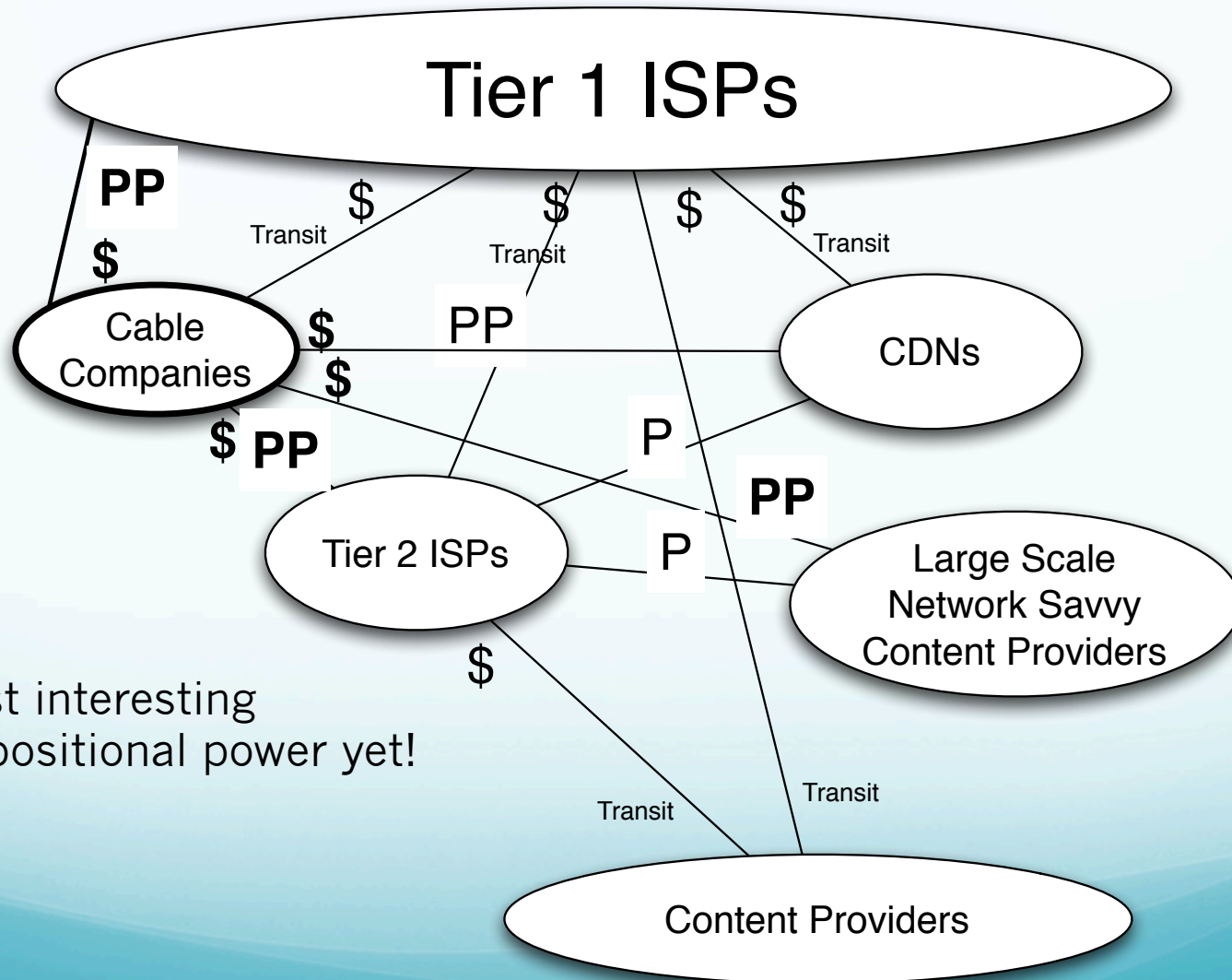


Peering decreases T1's transit fees  
Growth increases at a faster rate

# Transit Prices & Video



# Captive Access Power Peering



The most interesting shift in positional power yet!

Fantastic

Fantastic

# Captive Access Power Peering

Comcast-Level 3

**Disclaimer:** The facts here have not been verified.  
This is for discussion purposes only.

The Comcast-Level 3 – NetFlix situation is used because it is a very public example that illustrates the power positions

Fantastic

Fantastic

# Captive Access Power Peering Example

## Level3 broad business deal

Fiber, transit, free peering (on-net), etc.

## 3 Ways to reach Comcast

- 1) Transit (A→GLBX→Comcast)
- 2) Paid Peering (A→Comcast)
- 3) ~~Peering (A→Comcast) w/vol & <2.5:1~~

Video is highly asymmetric up to 30:1

Comcast peering ratio requirement <2.5:1

All paths require Comcast

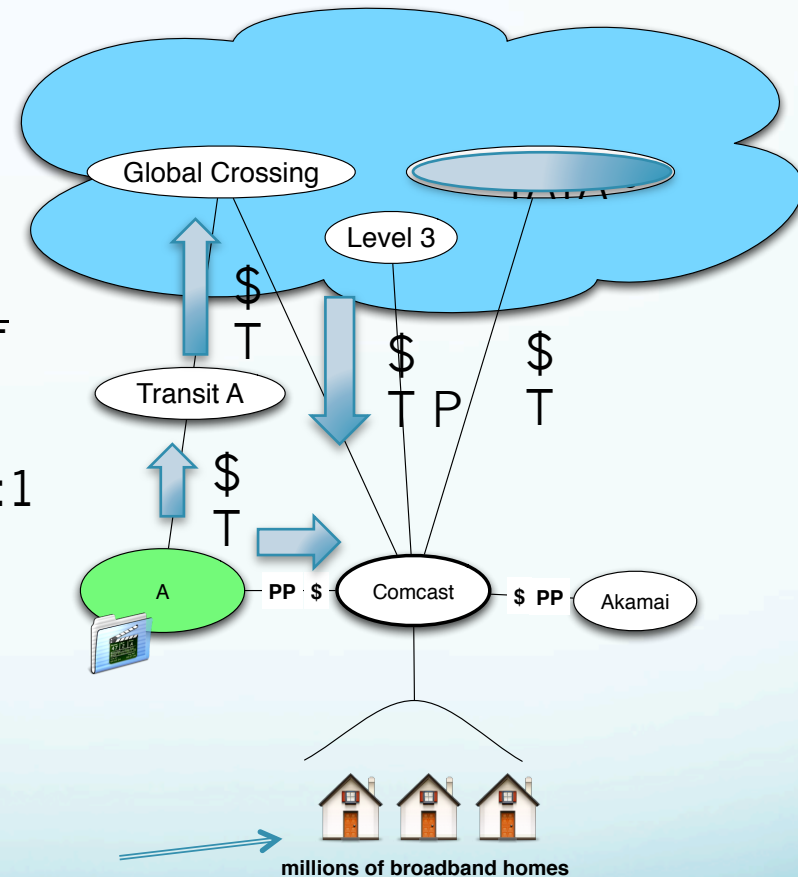
Peering is direct, high performance

Transit is subject to loss/latency

OTT Video requires high performance

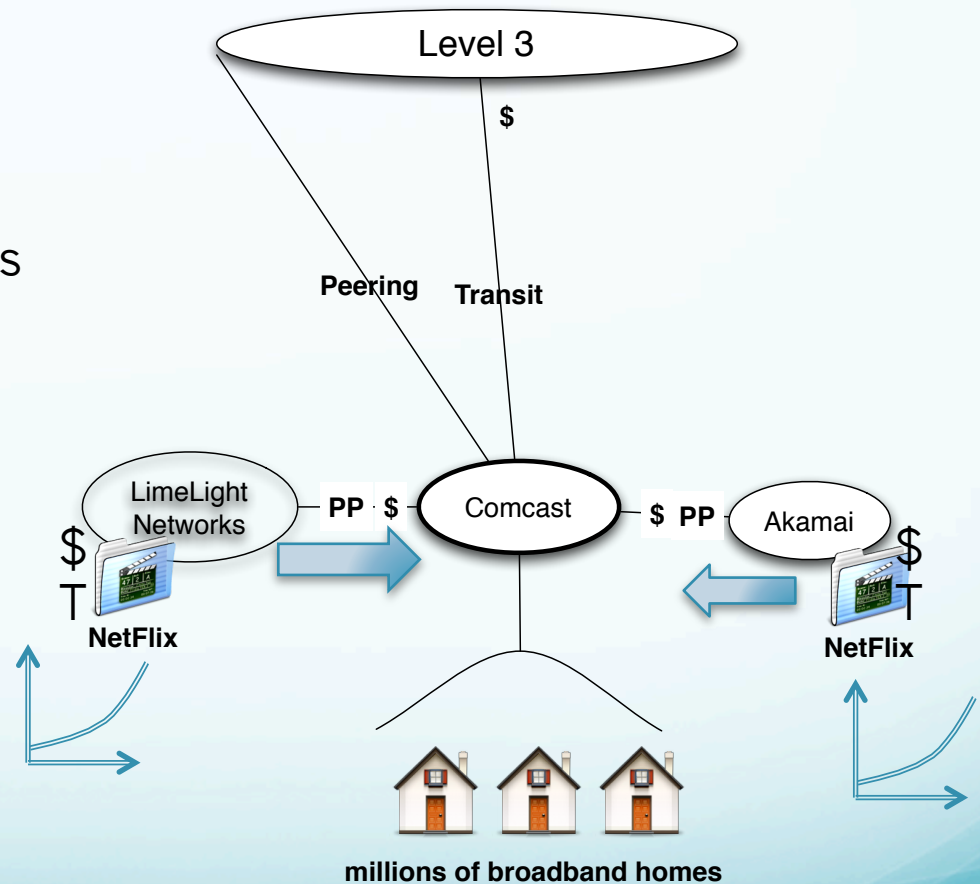
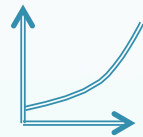
No alternative path to Comcast eyeballs but through Comcast (Captive customers)

If you are in the video distro biz you **must buy paid peering from Comcast**



# 1) NetFlix Application 2010

NetFlix distributes Video via CDNs  
Massive growth  
O(100'sGbps)  
Great Service





## 2) Level3 Bids Cheaper

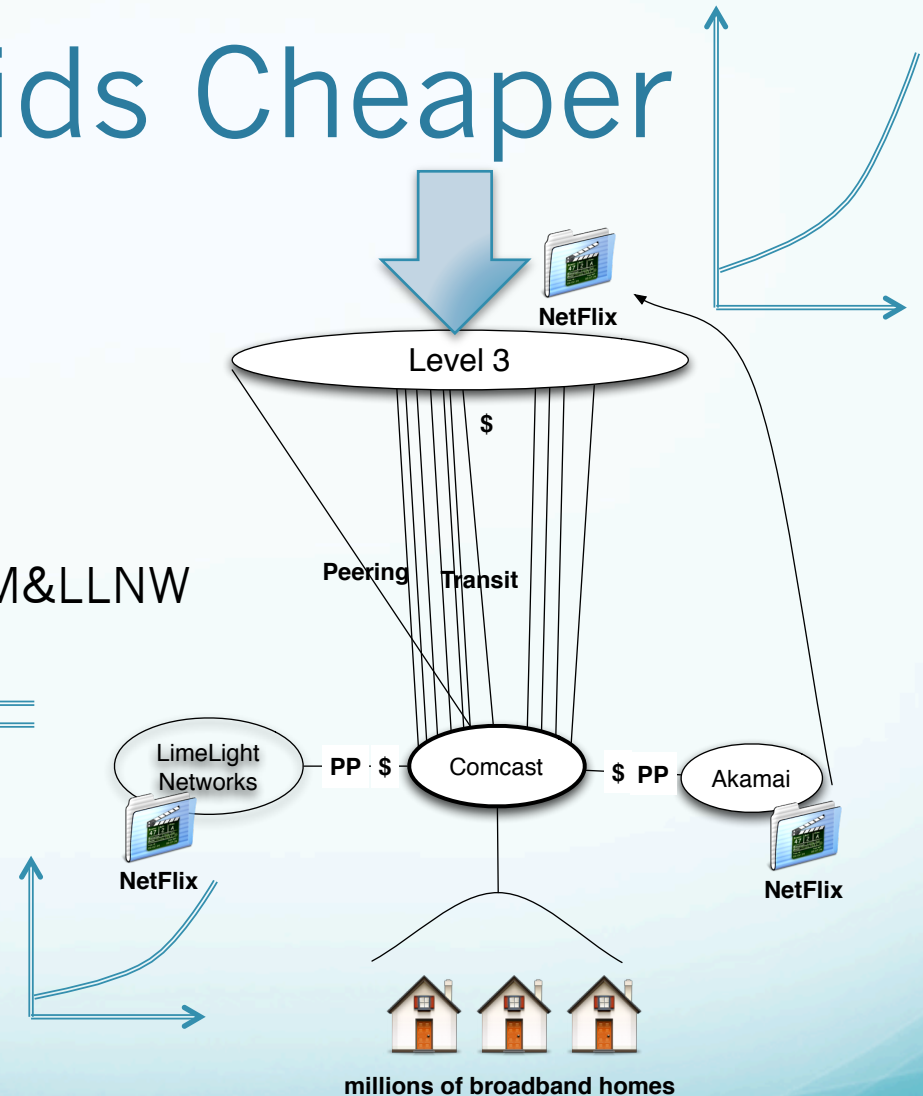
Akamai loses T\$  
Comcast loses PP\$

Level 3 freely peers the traffic  
Level 3 requests more interconnects  
Comcast says No – you pay like AKAM&LLNW  
Level 3 Acquiesces

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### Access Power Peering



Comcast says (in essence) “We have others paying us.  
It wouldn’t be fair not to charge you as well”

# 3) Result & Observation

Comcast leverages peering to get \$\$ from all sides

No alternative to reach Comcast customers

“Captive” Customers

Can't peer around them

Can't choose competitor

Exploiting Market power position: Captive Market

Where is this going?

Is this the right model?

