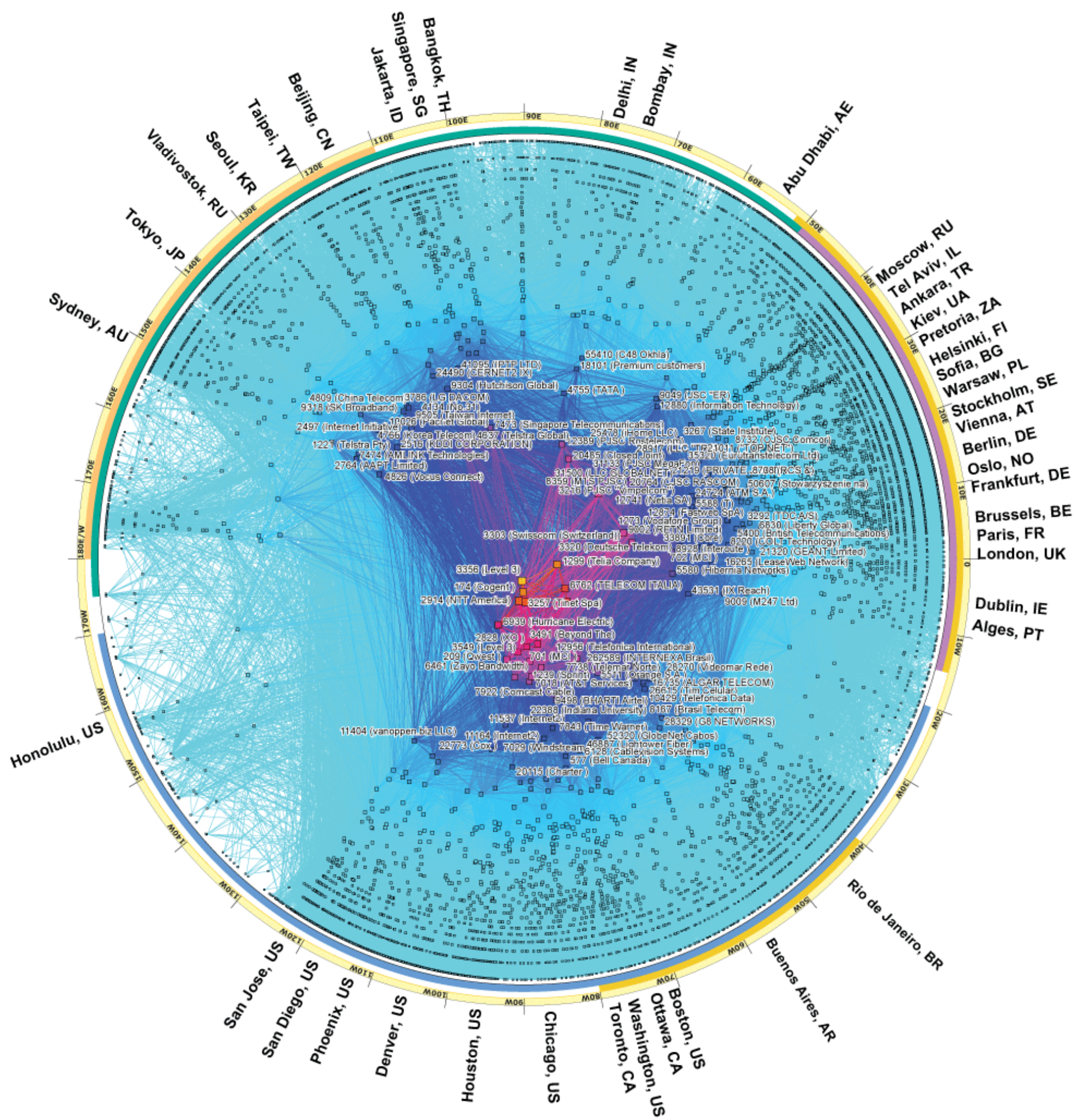


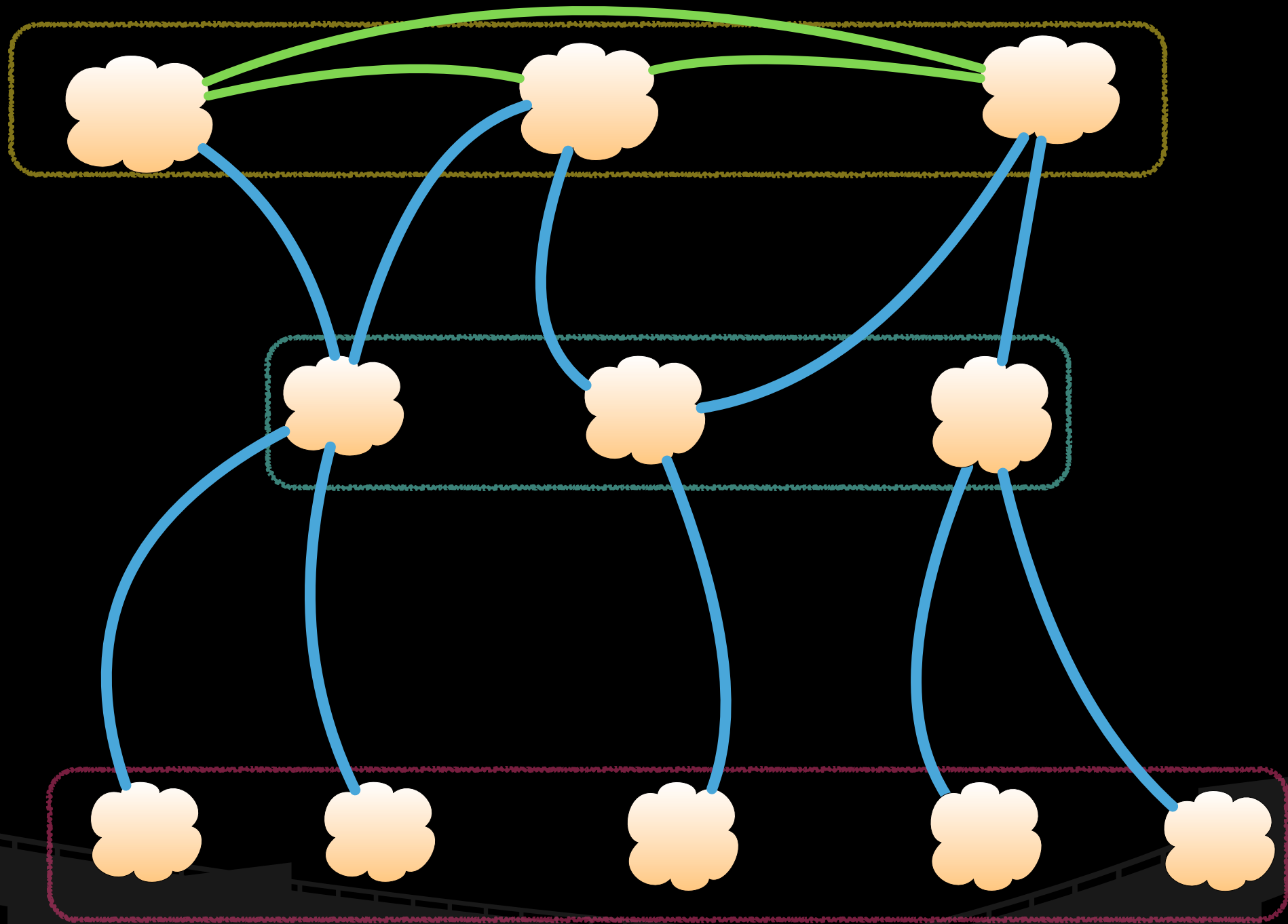
Why Peering Matters

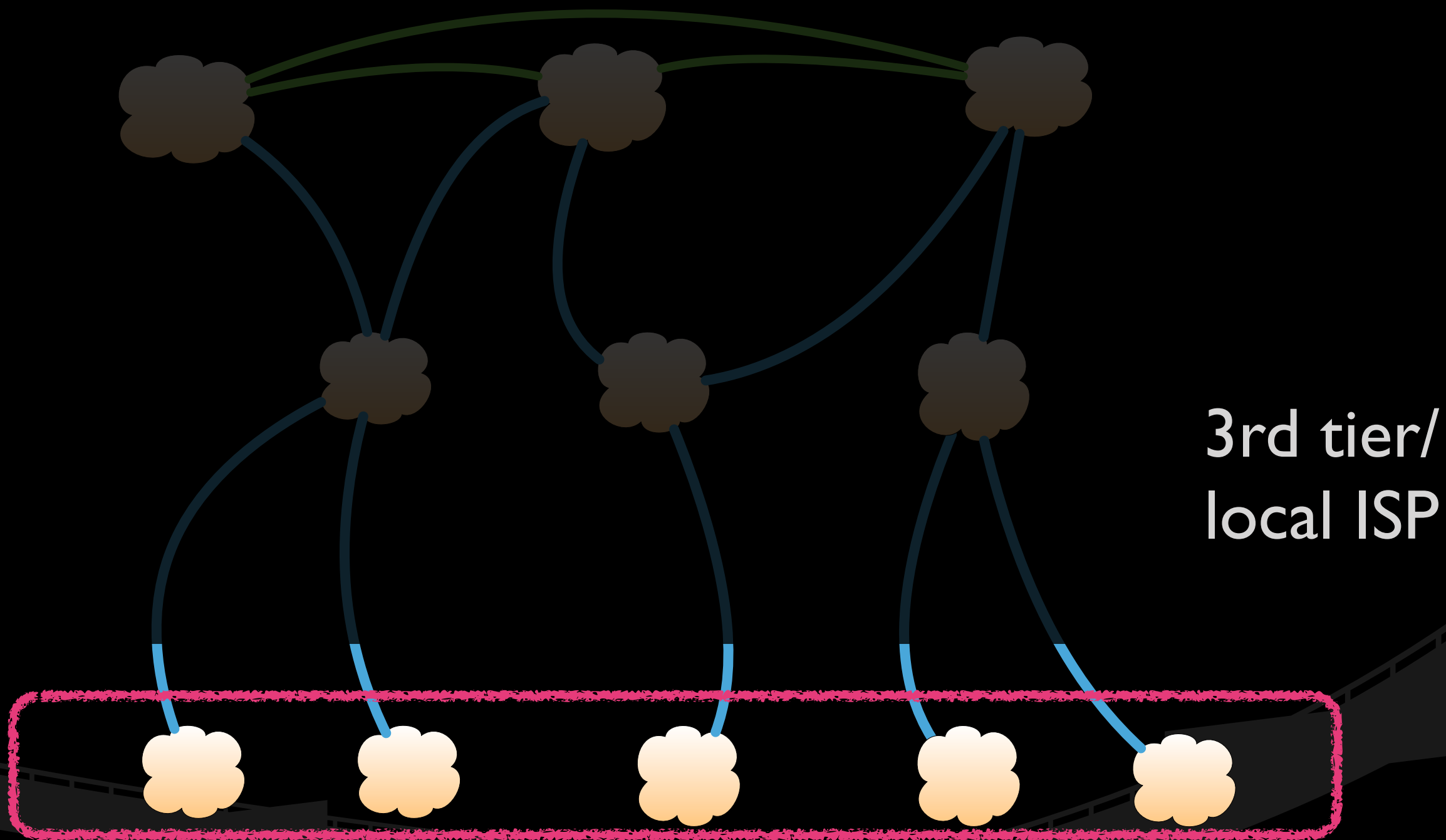
Nishal Goburdhan
Packet Clearing House
www.pch.net

Hello from PCH !

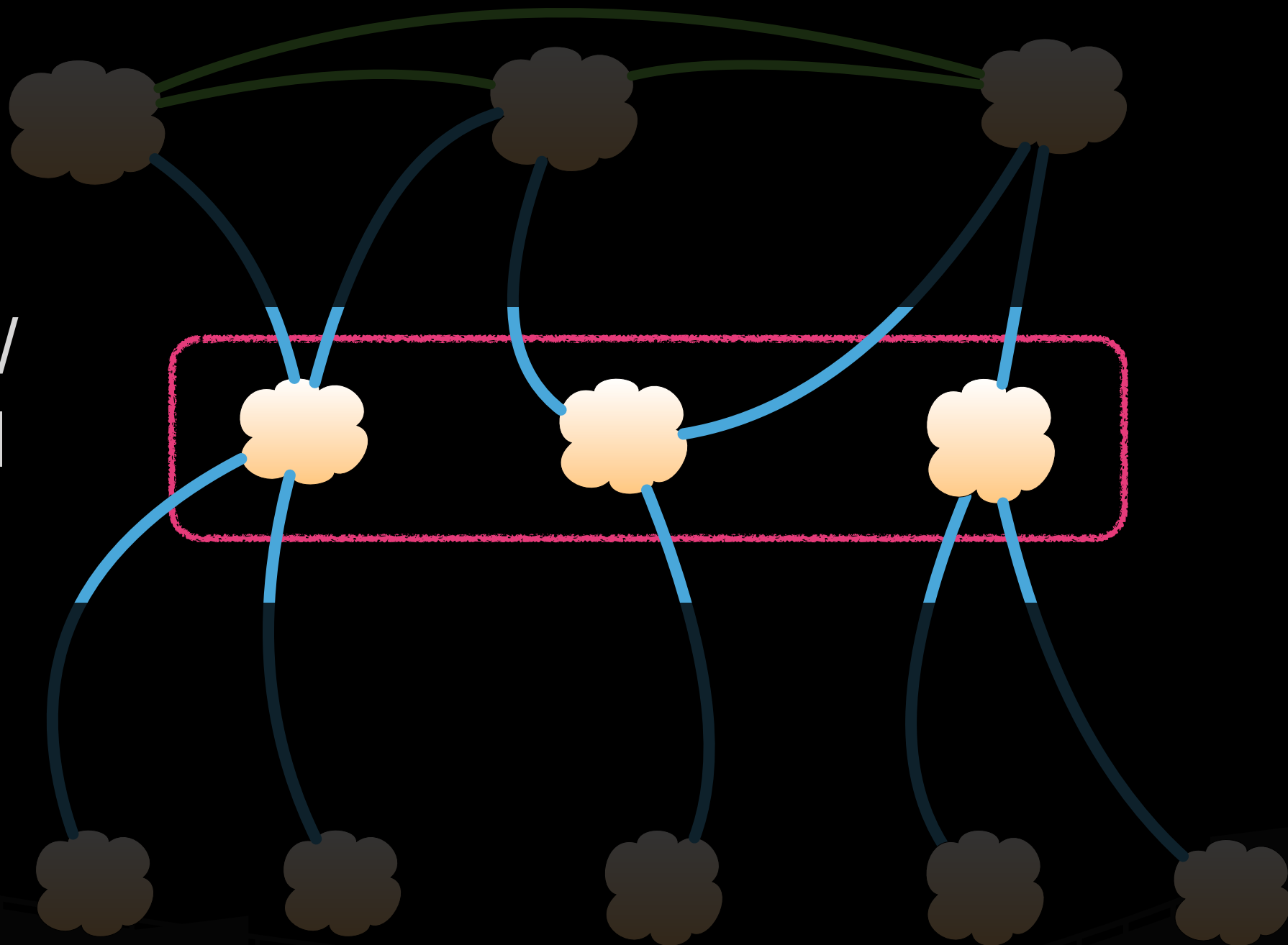
- Global non-profit providing operational support and security to critical Internet infrastructure, including IXPs and the core of the DNS
- Funded by grants, service provision fees from Internet operations industry, and specialised consultancies
- Global footprint with offices in SFO, PAR, KTM and JNB. De-centralised staff in other cities.



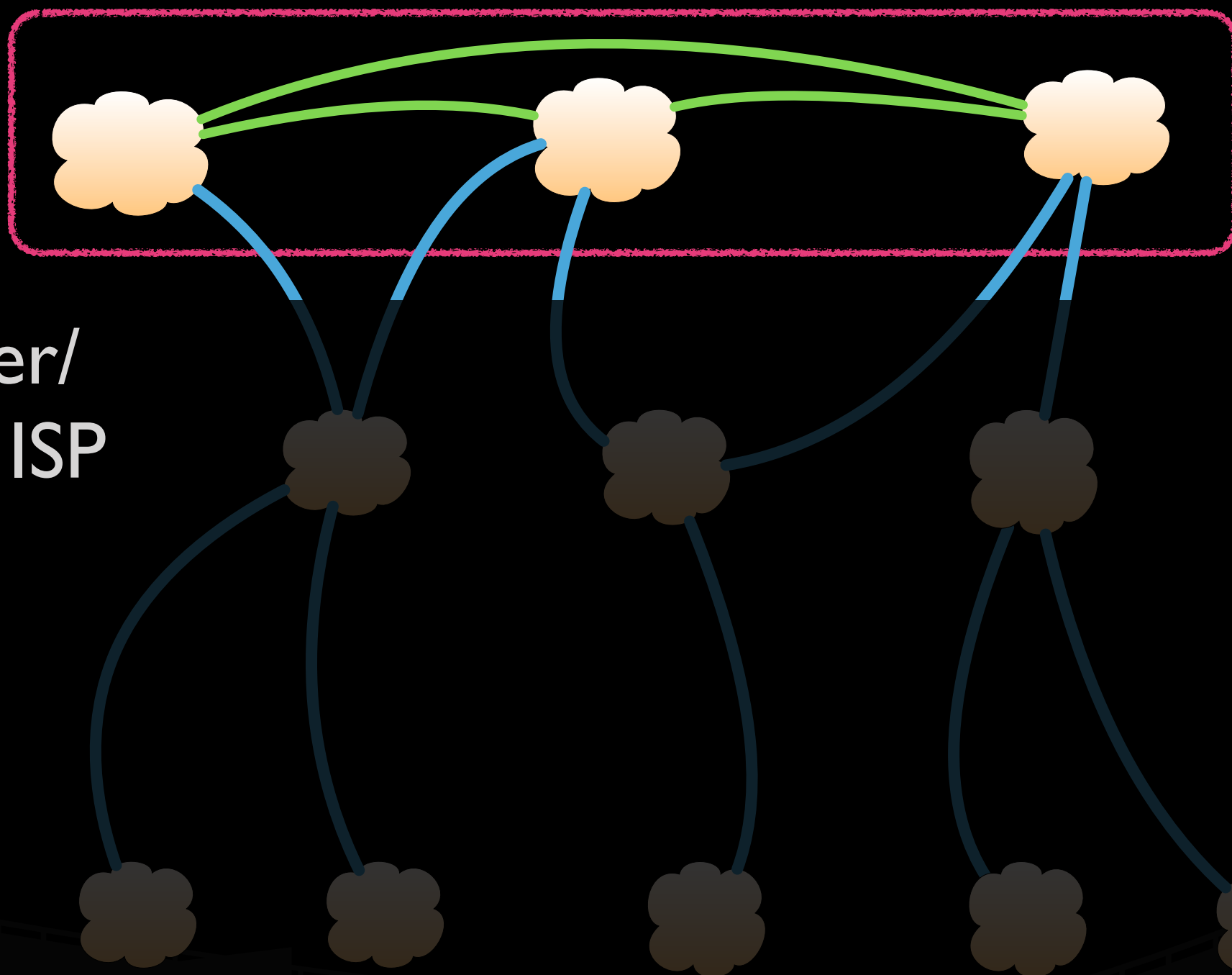


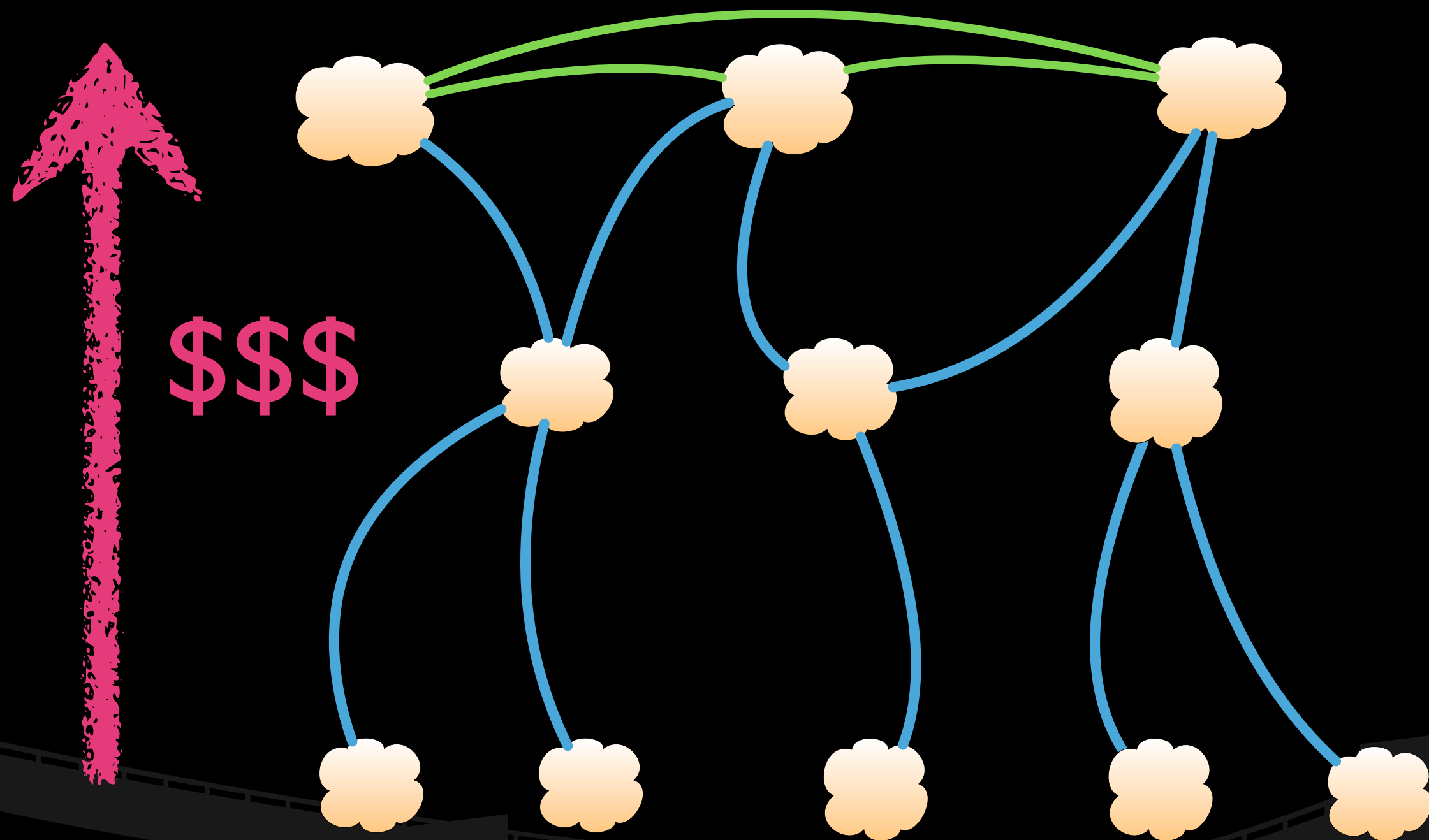


2nd tier/
regional
ISP

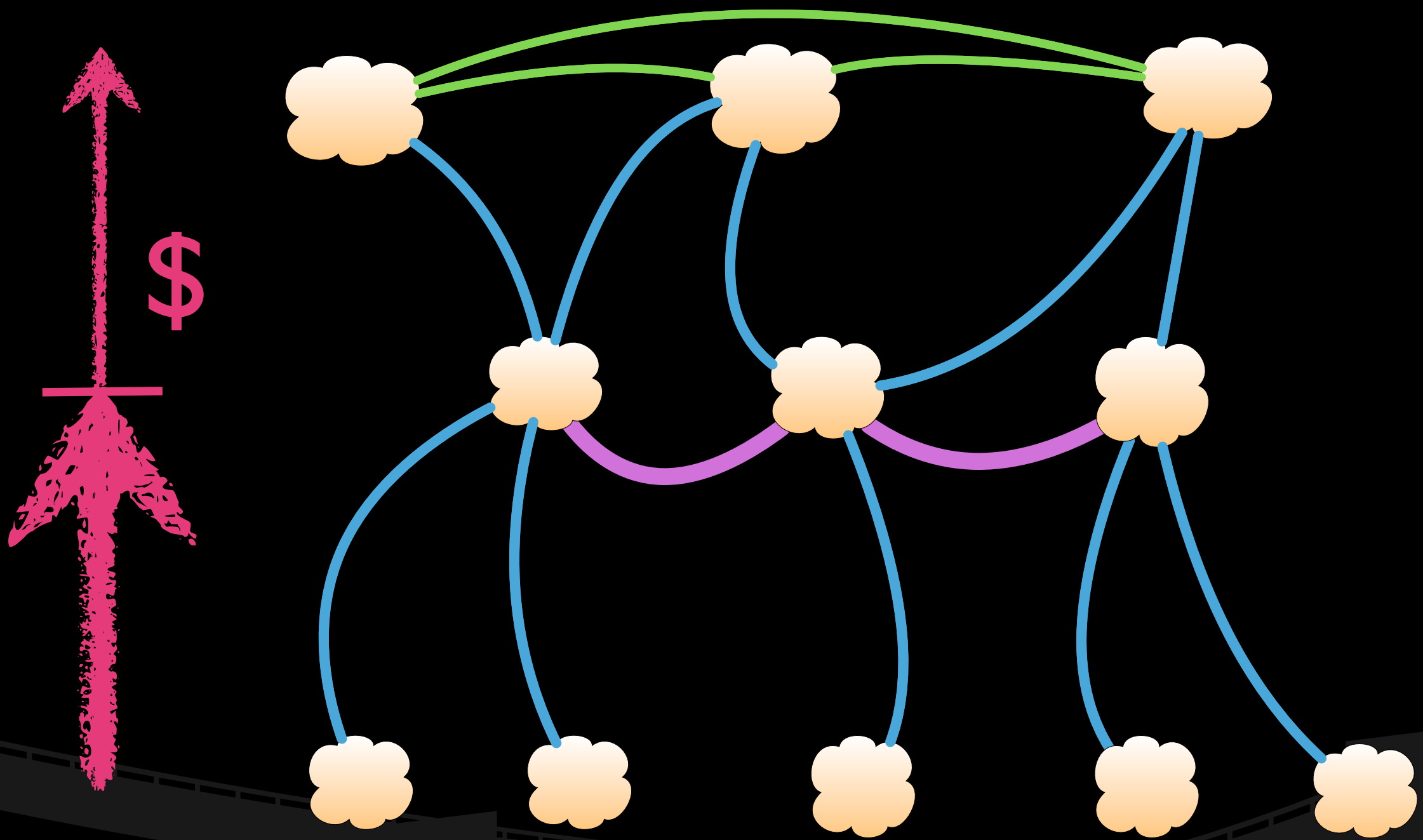


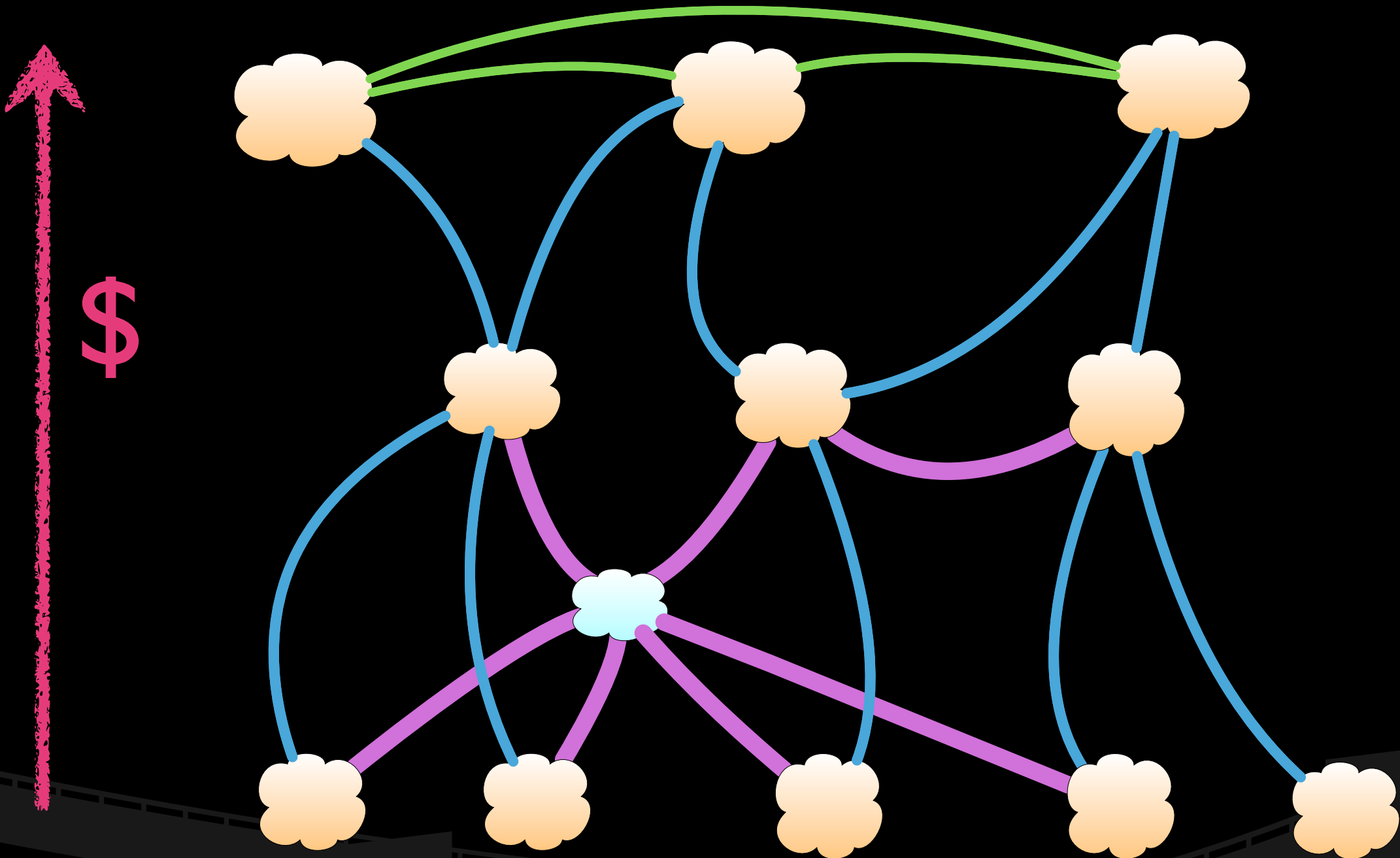
1st tier/
global ISP





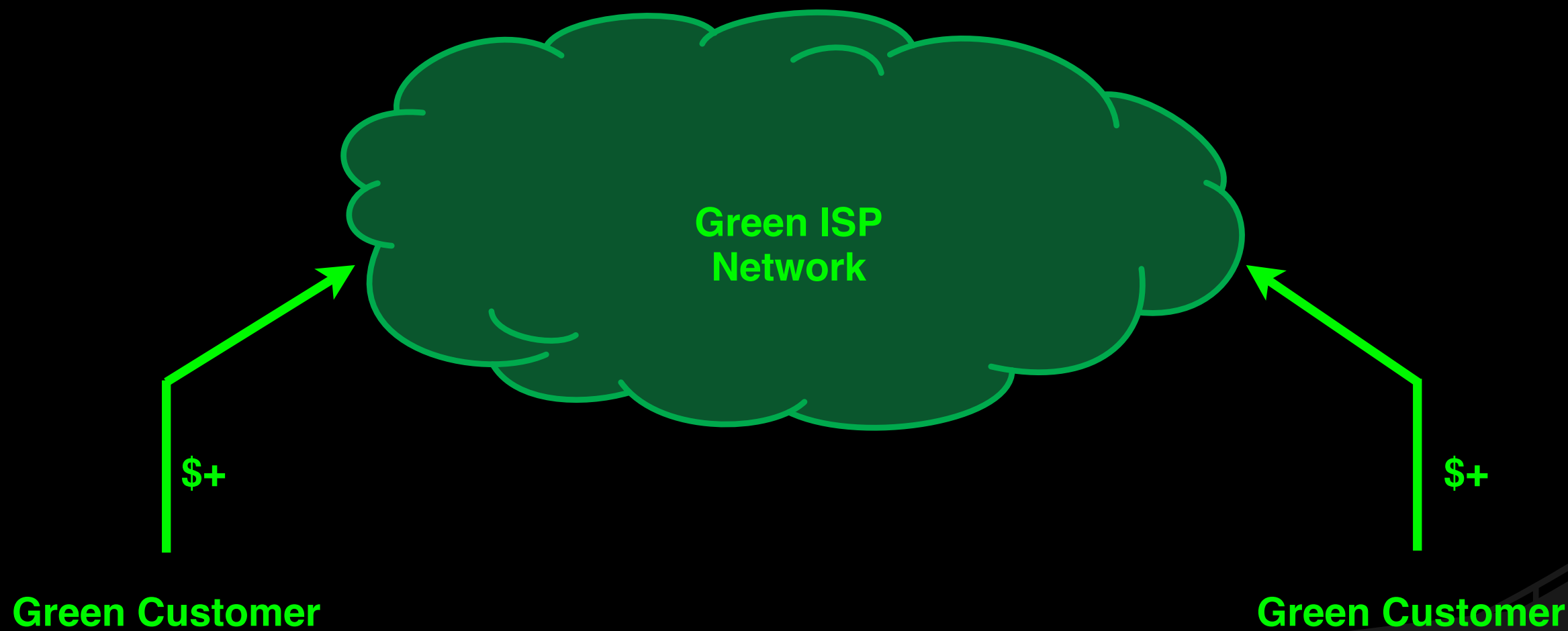
Transit



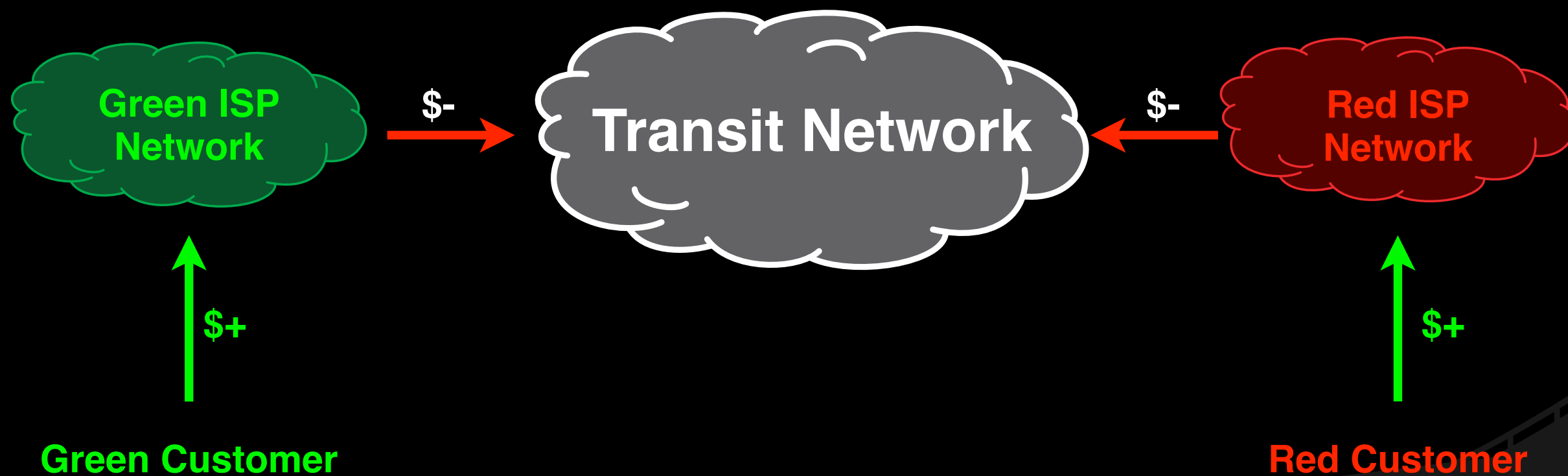


Transit and Peering

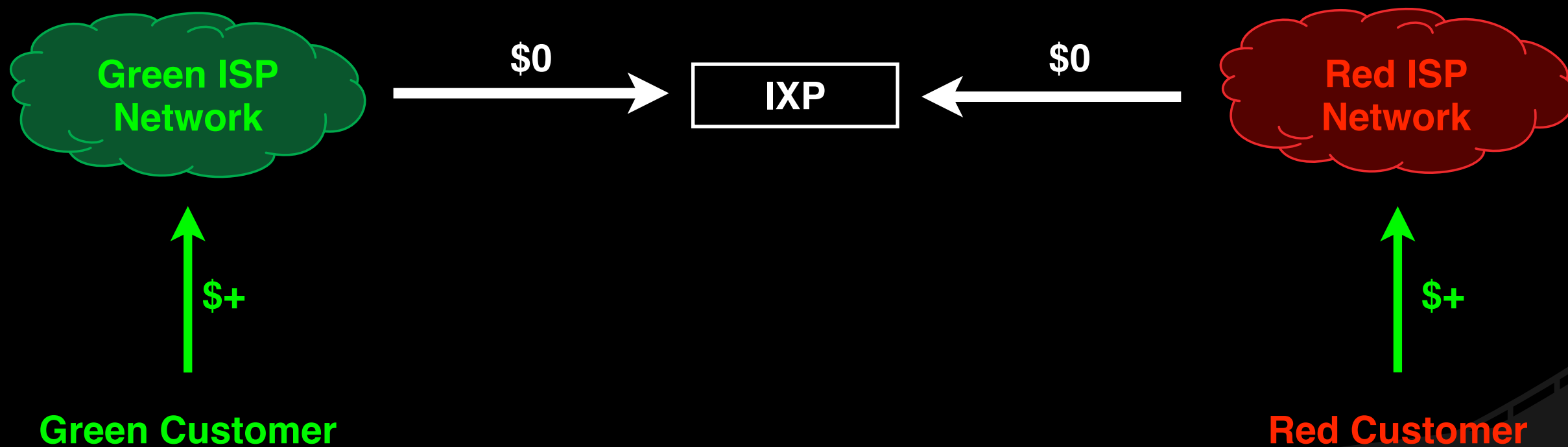
- **Transit agreements** are commercial contracts in which a customer pays a service provider for access to the entire Internet. Transit agreements are most common at the edges of the Internet.
 - Example: a corporate customer of a local ISP that provides Internet connectivity and managed ICT services.
- **Peering agreements** are the carrier interconnection agreements that allow carriers to exchange traffic bound for one another's customers; they are most common in the core of the Internet and are the true creators of value of the Internet.
 - Example: networks at an IXP with a free-settlement peering agreement



Earnings: 2

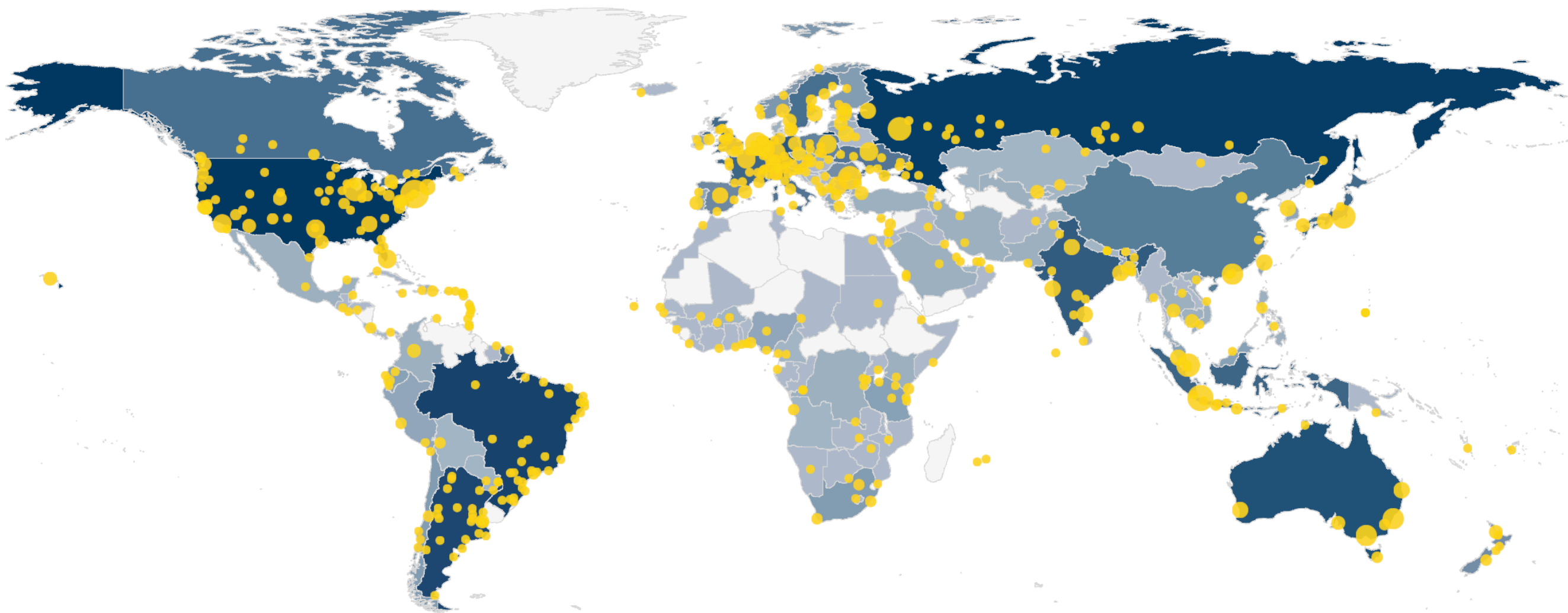


Earnings: 1-x



Any rational network
operator will always seek to
maximise their peering ...

Internet Exchange Directory



Why do we peer?

Cost reduction

Economic tool

Performance

National security

Knowledge Economy



The Internet Lifecycle (from an ISP's perspective)

**But first ... How many of you
run / want to run a “Cloud”
business?**

Central African CFA Franc BEAC to US Dollar Exchange Rate Chart

Xe Historical Currency Exchange Rates Chart

Convert

Send

Charts

Alerts

From

XPF

XAF – Central African CFA Franc BEAC



To



USD – US Dollar



We use midmarket rates ⓘ

Track currency

View transfer quote

XAF to USD Chart -15.26% (10Y)

Central African CFA Franc BEAC to US Dollar

1 XAF = 0.00166934 USD Apr 4, 2023 at 16:27 UTC

12H

1D

1W

1M

1Y

2Y

5Y

10Y



Apr 7, 2013 at 00:00 UTC - Apr 4, 2023 at 16:27 UTC

XAF/USD close: 0.00166934 low: 0.00146291 high: 0.00212366

South African Rand to US Dollar Exchange Rate Chart

Xe Historical Currency Exchange Rates Chart

Convert

Send

Charts

Alerts

From



ZAR – South African Rand



To



USD – US Dollar



We use midmarket rates ⓘ

Track currency

View transfer quote

ZAR to USD Chart -48.45% (10Y)

South African Rand to US Dollar

1 ZAR = 0.0560813 USD Mar 30, 2023 at 19:37 UTC

12H

1D

1W

1M

1Y

2Y

5Y

10Y

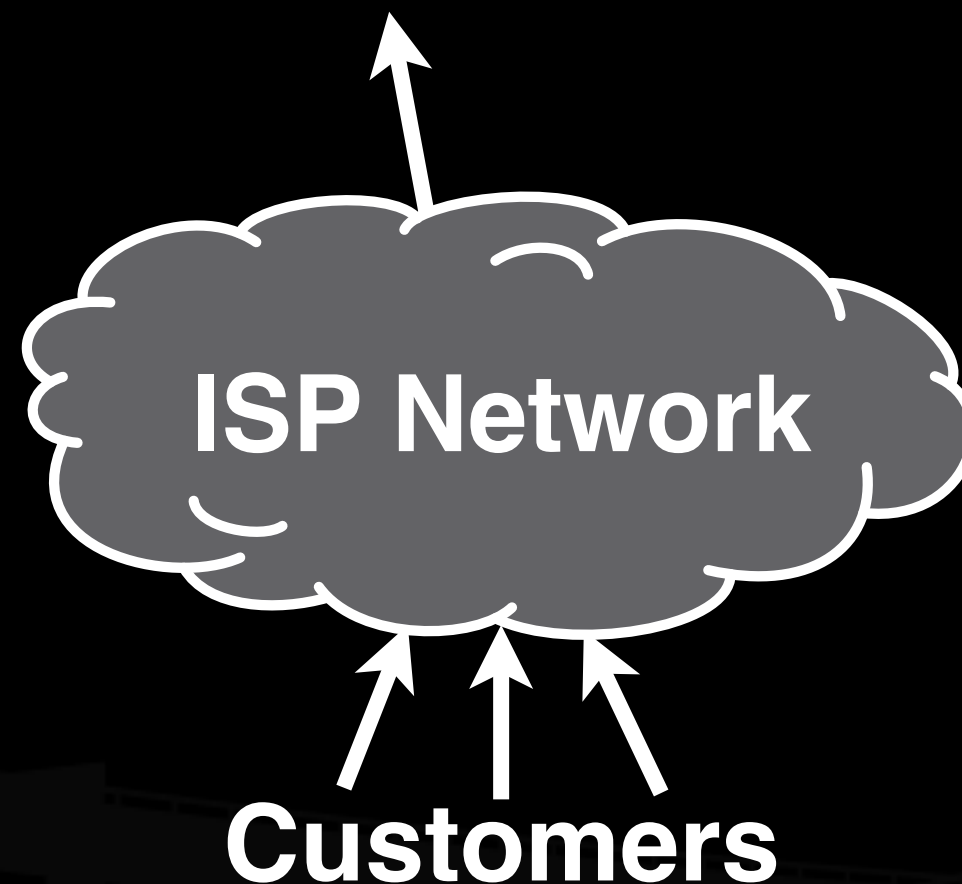


Apr 2, 2013 at 00:00 UTC - Mar 30, 2023 at 19:38 UTC

ZAR/USD close: 0.0560813 low: 0.0519112 high: 0.112342

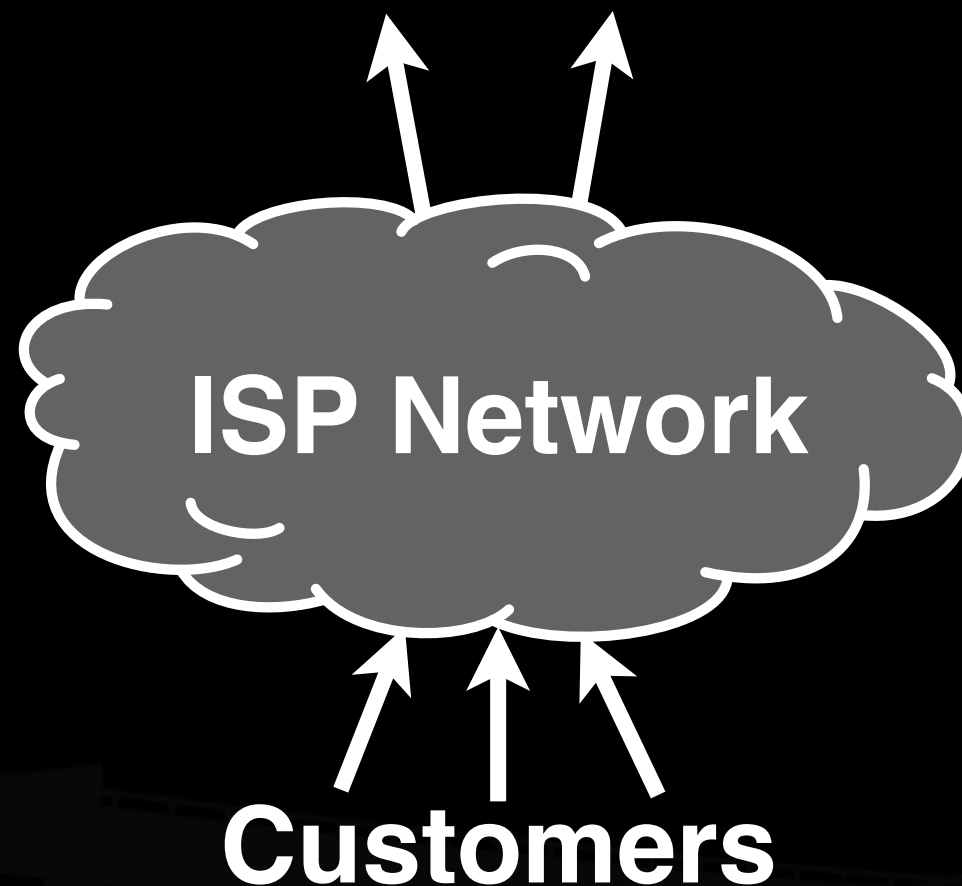
ISP Lifecycle: Simple Aggregator

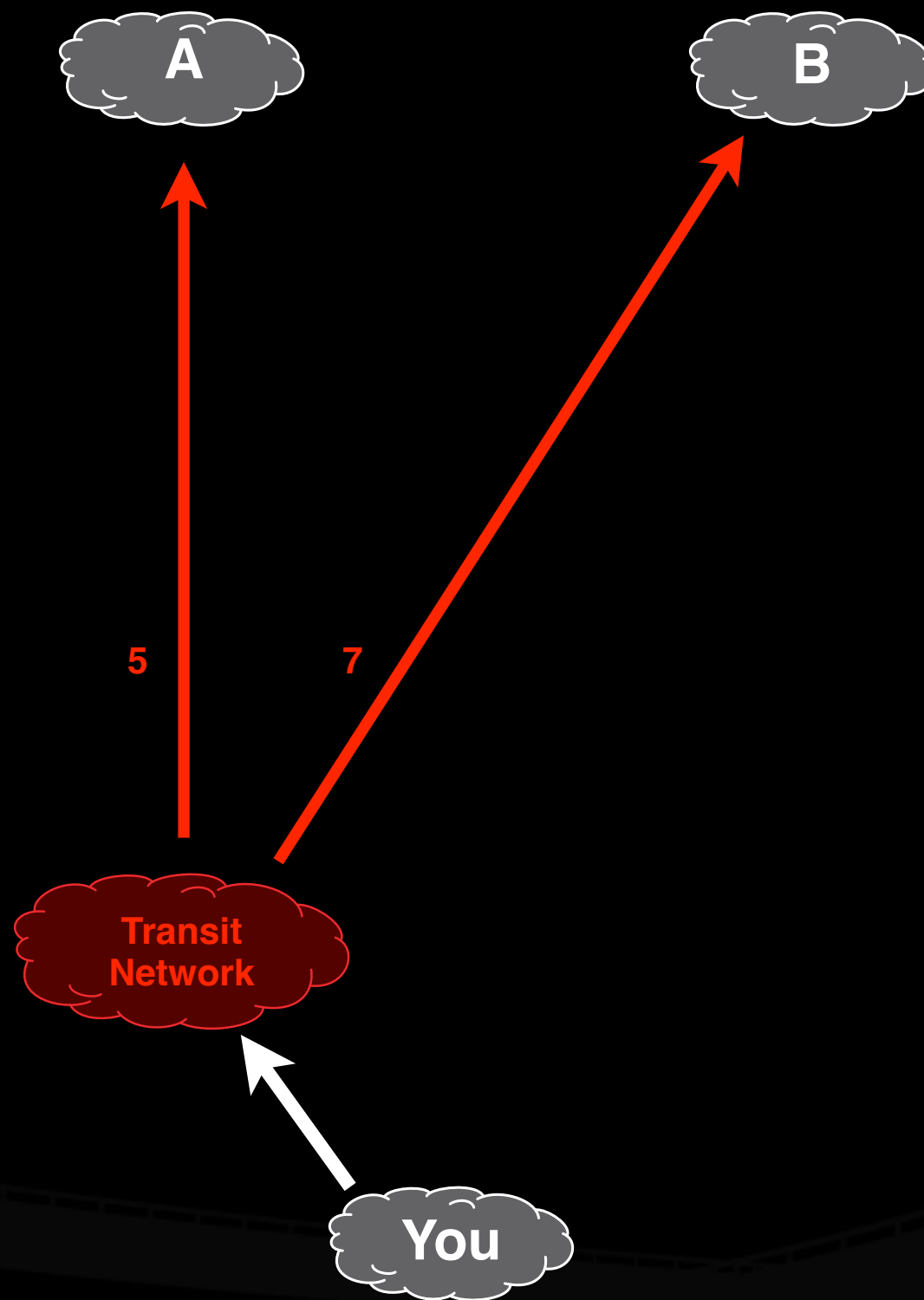
Single Transit Provider ——— IXPs



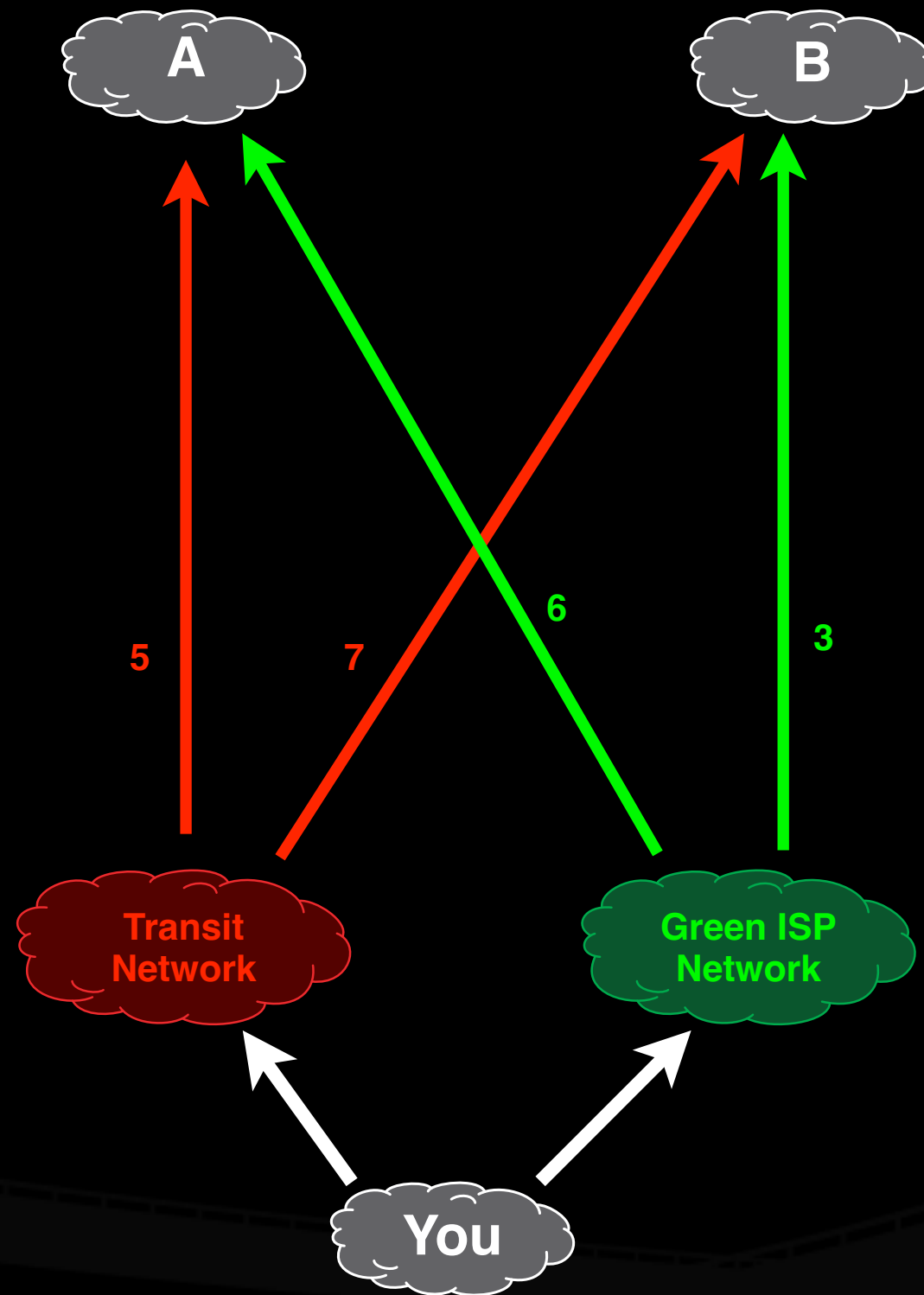
ISP Lifecycle: Redundancy and LCR

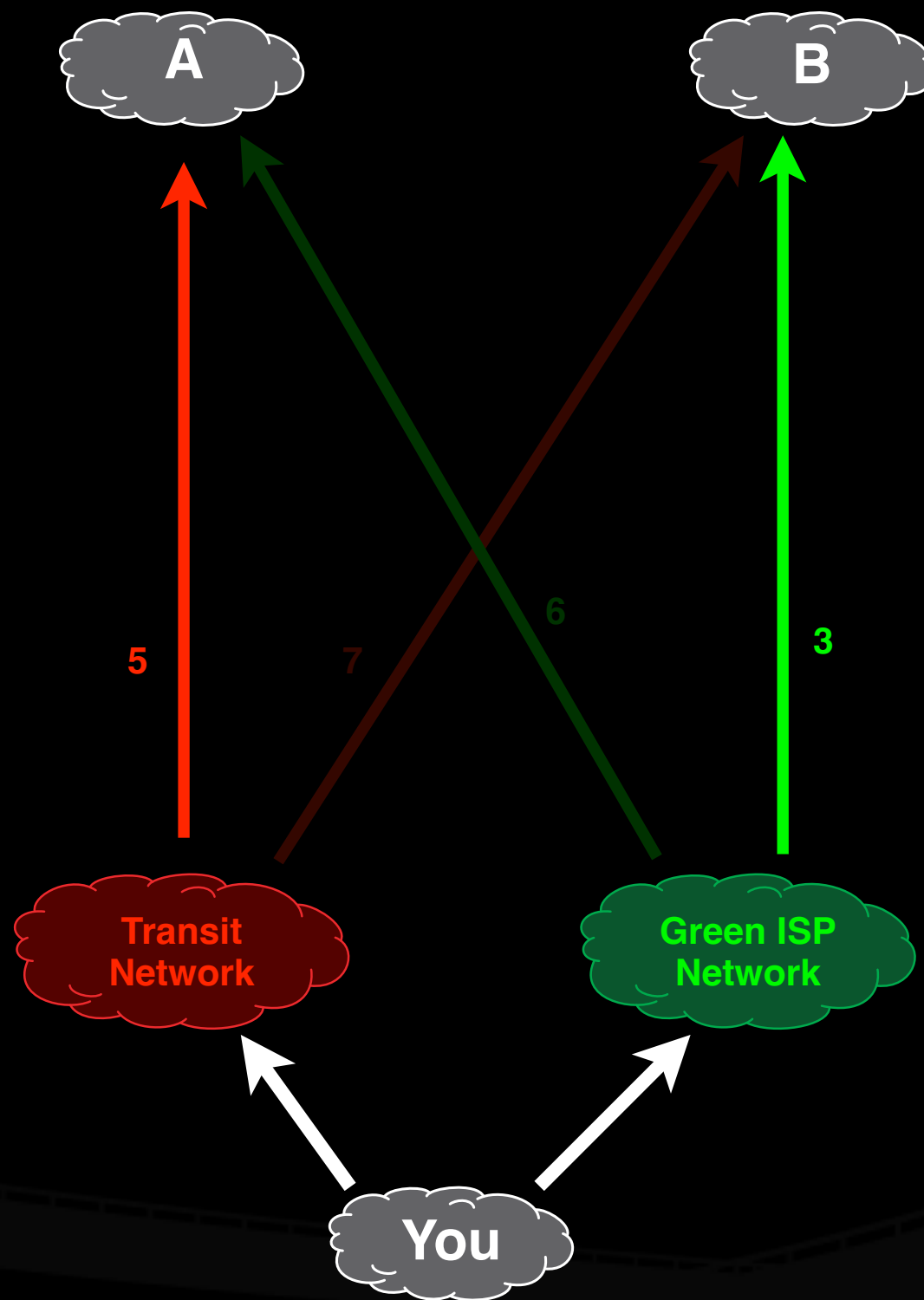
Redundant Transit Providers — IXPs





Ave Length = 6

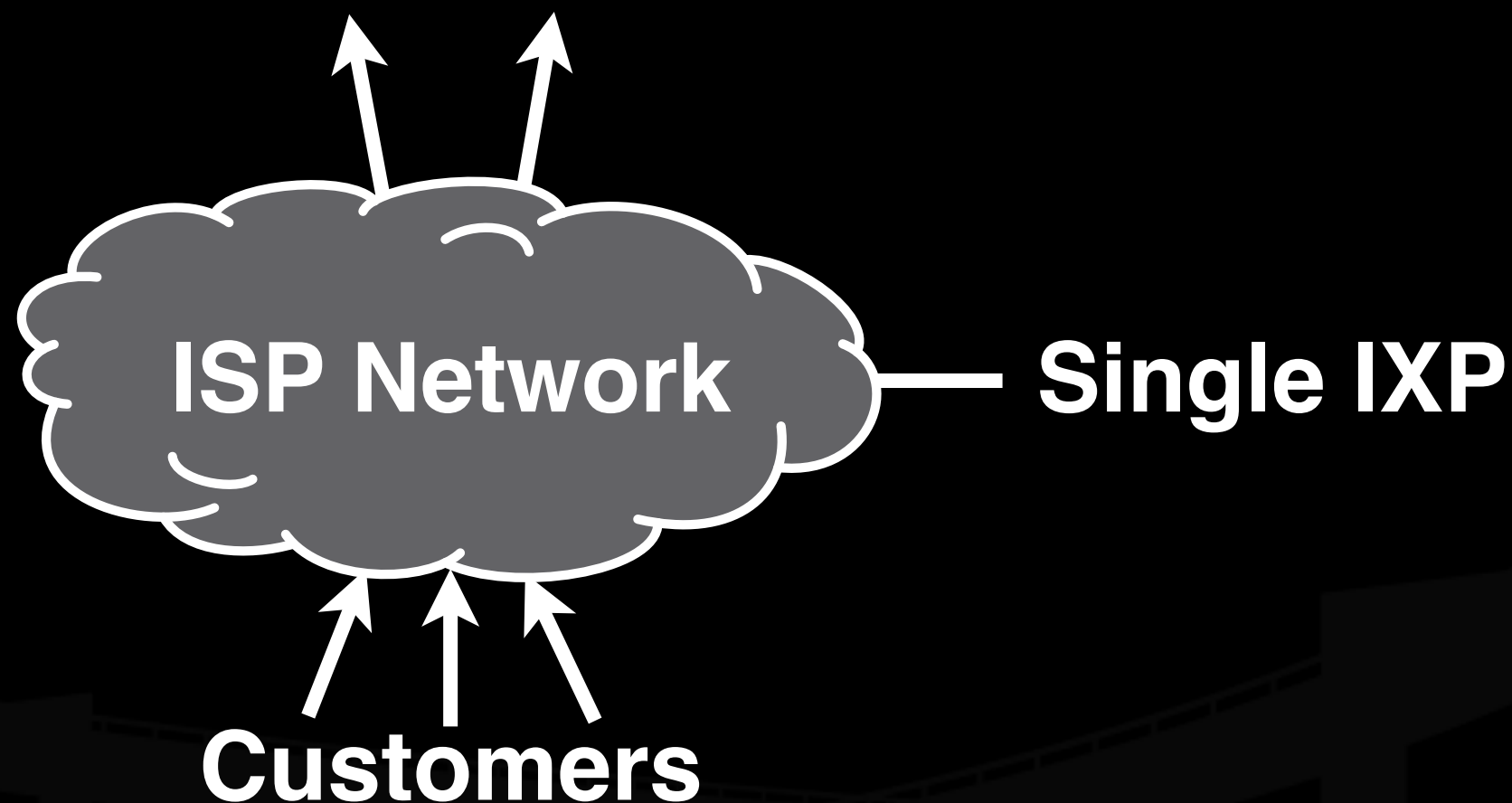




Ave Length = 4

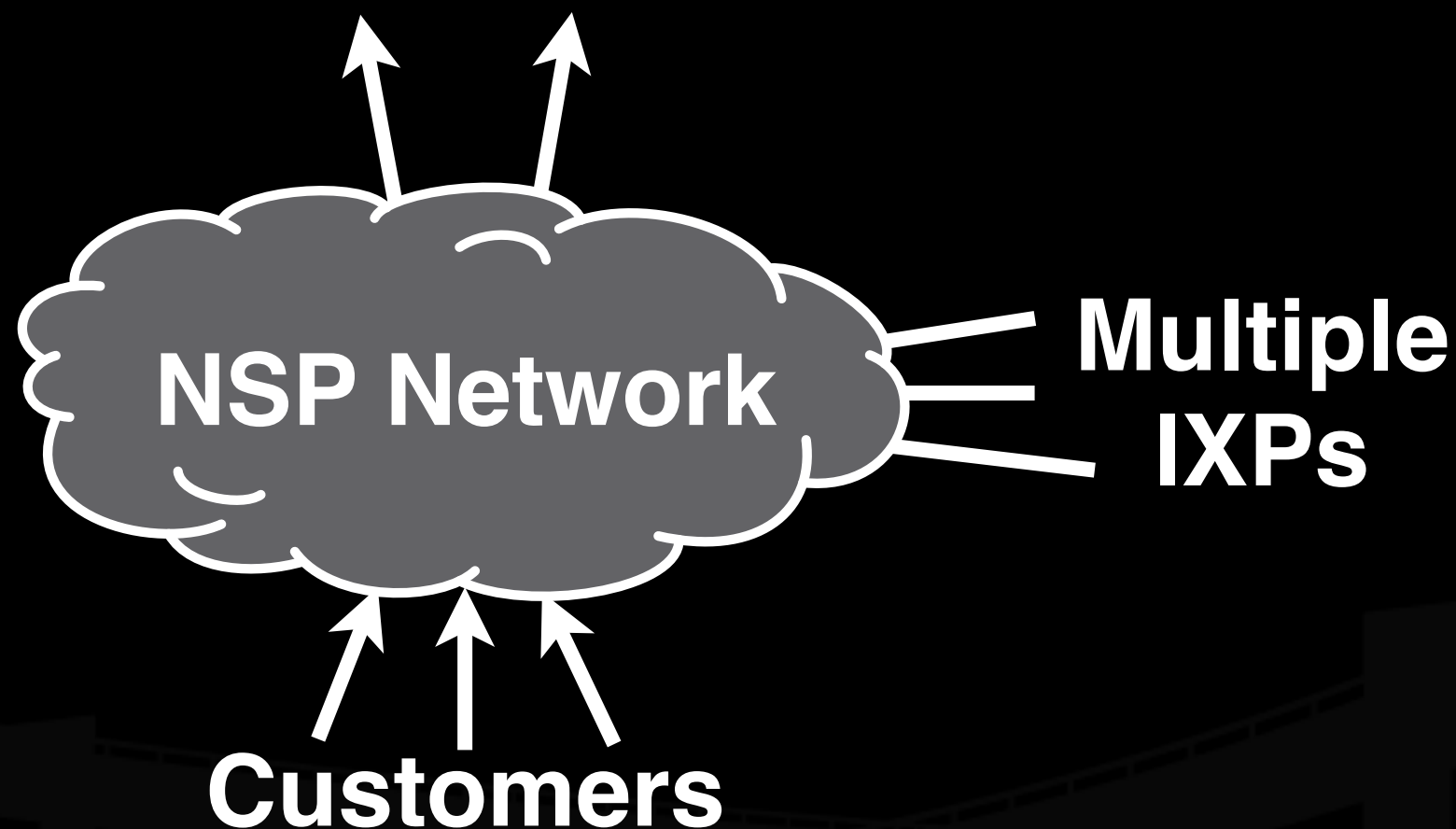
ISP Lifecycle: Local Peer

Redundant Transit Providers — IXPs

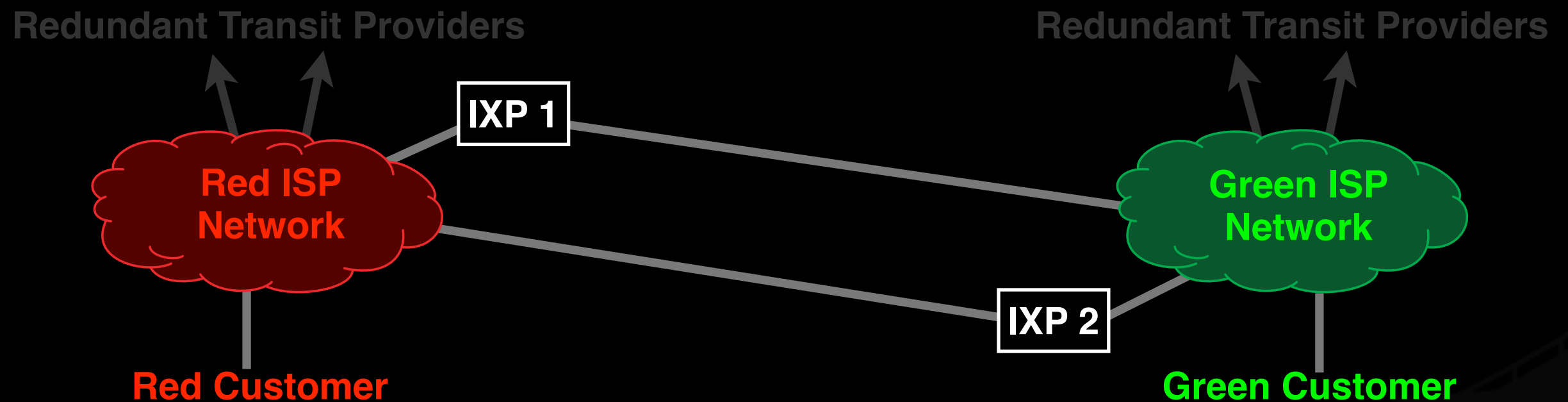


ISP Lifecycle: Backbone Network

Redundant Transit Providers — IXPs

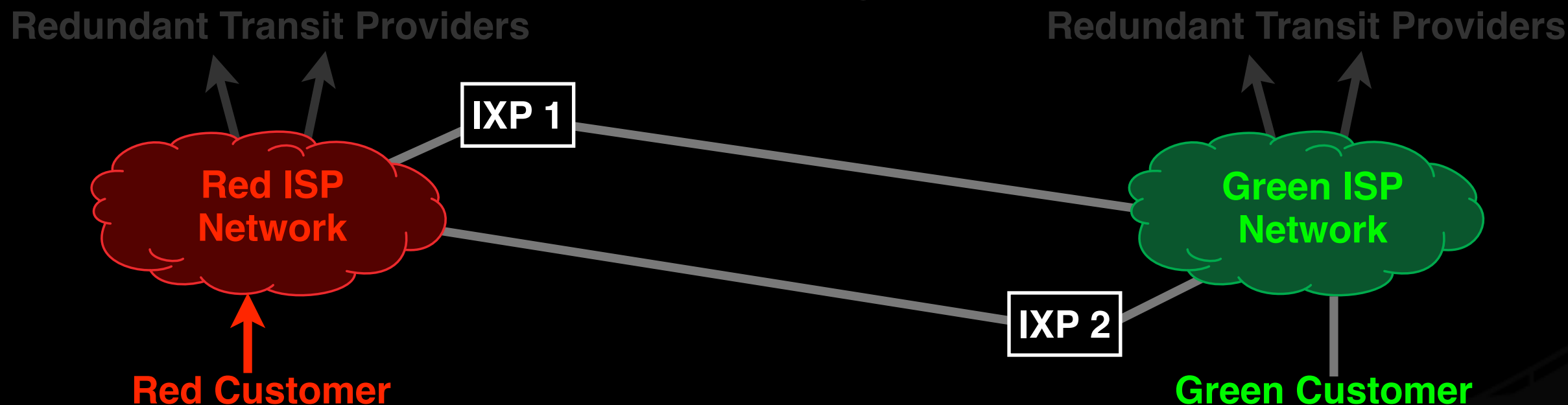


Hot Potato Routing



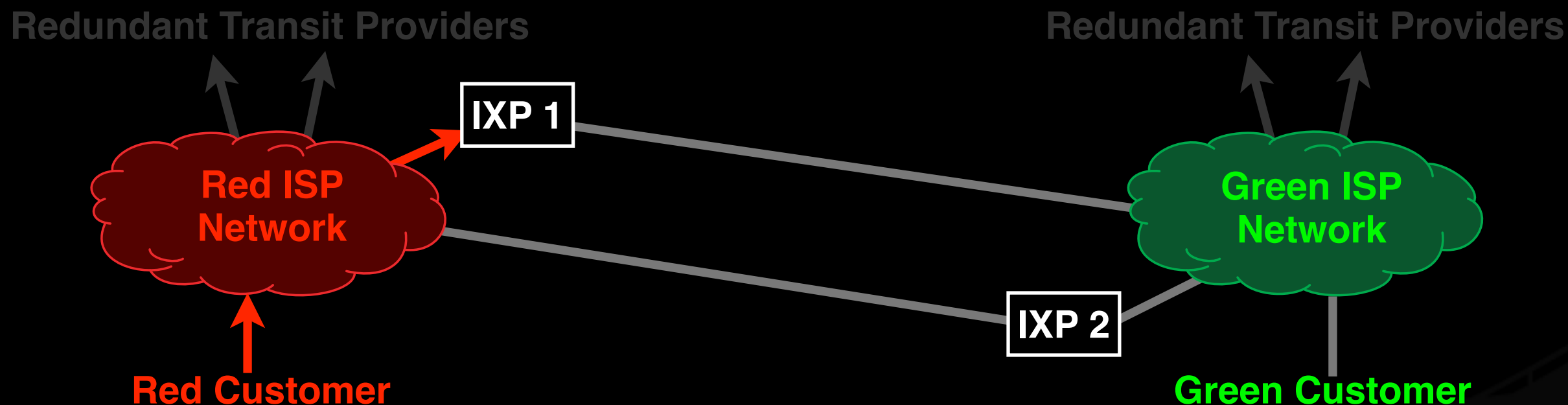
Hot Potato Routing

Red Customer sends to Green Customer via Red ISP



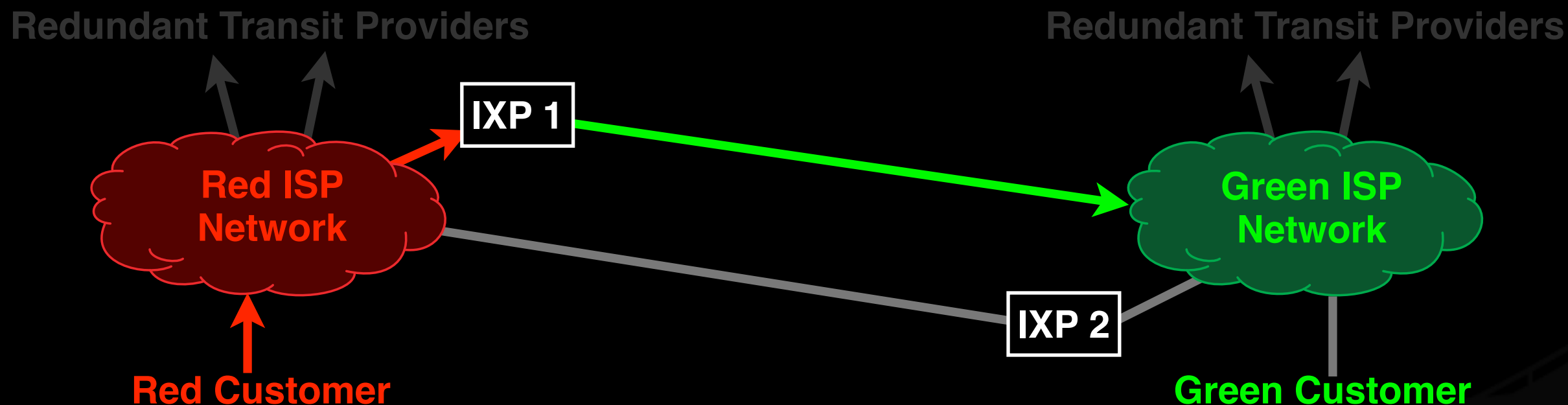
Hot Potato Routing

Red ISP delivers at *nearest* IXP



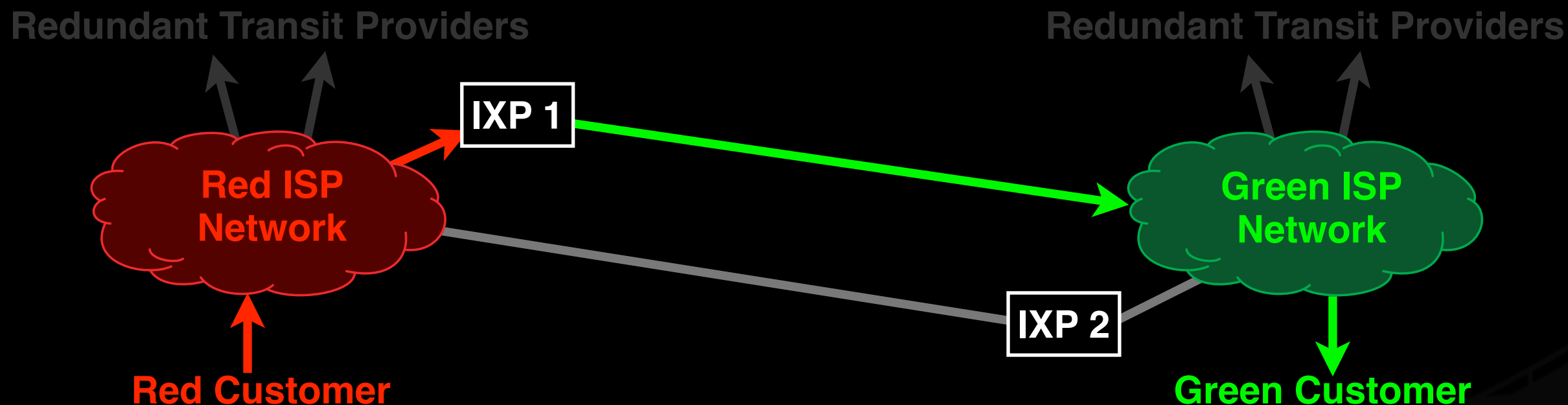
Hot Potato Routing

Green ISP backhauls from distant IXP



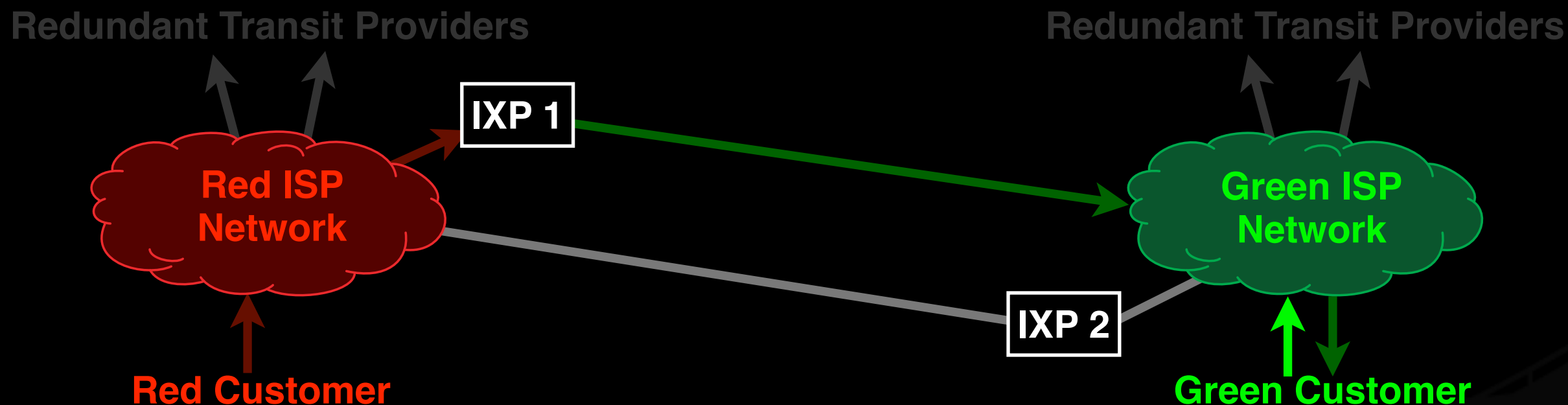
Hot Potato Routing

Green ISP delivers to Green Customer



Hot Potato Routing

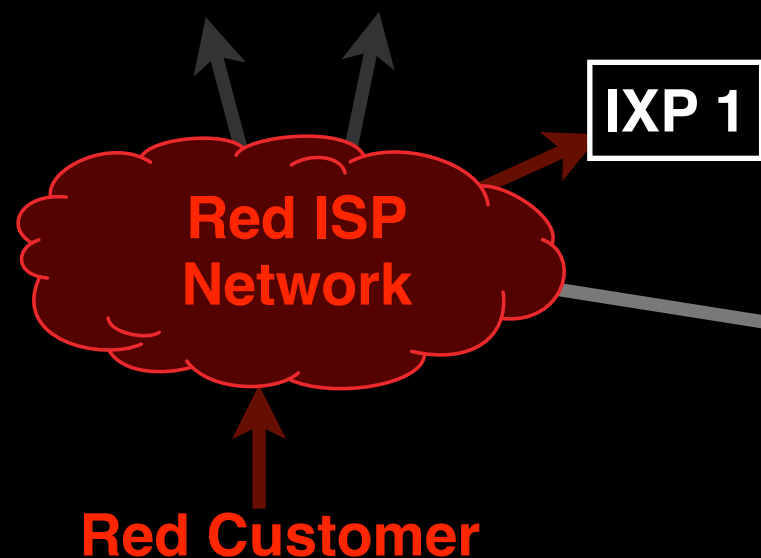
Green Customer replies via Green ISP



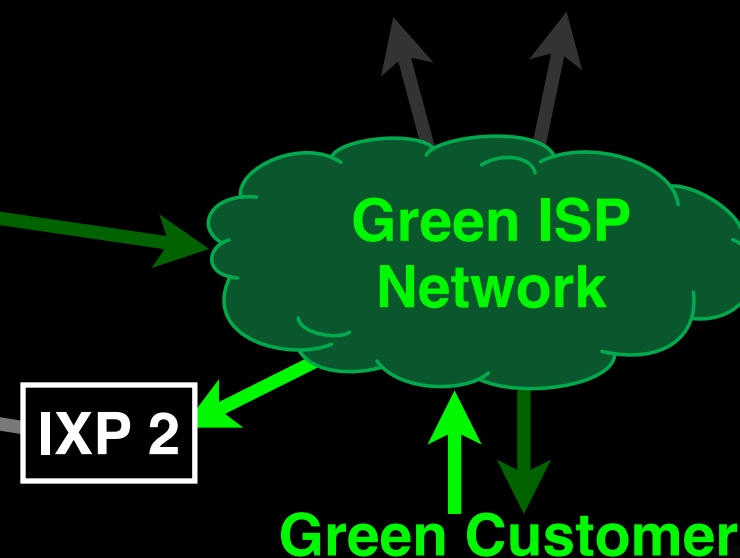
Hot Potato Routing

Green ISP delivers at nearest IXP

Redundant Transit Providers

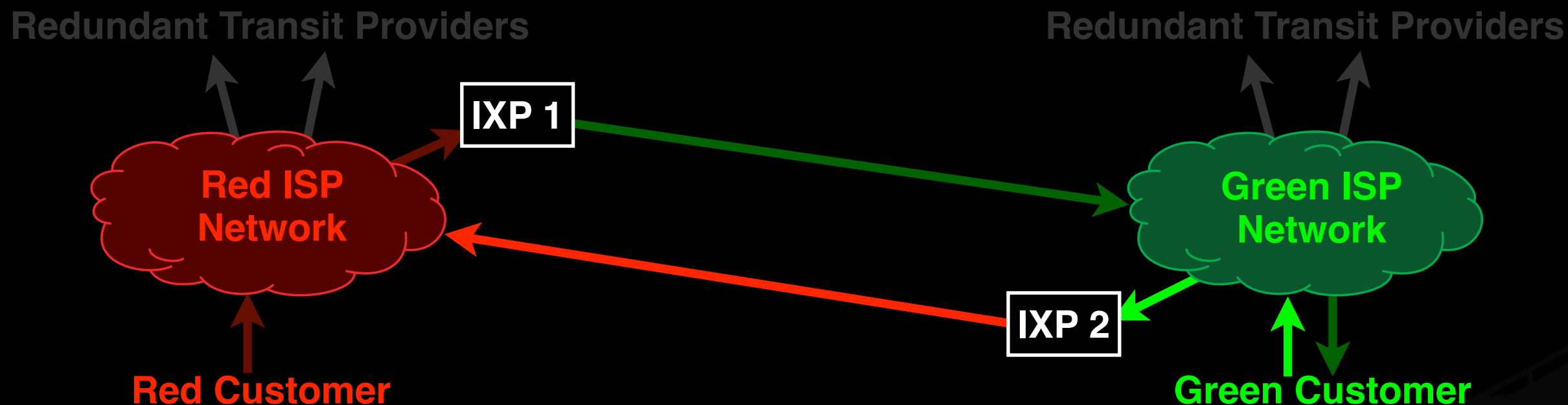


Redundant Transit Providers



Hot Potato Routing

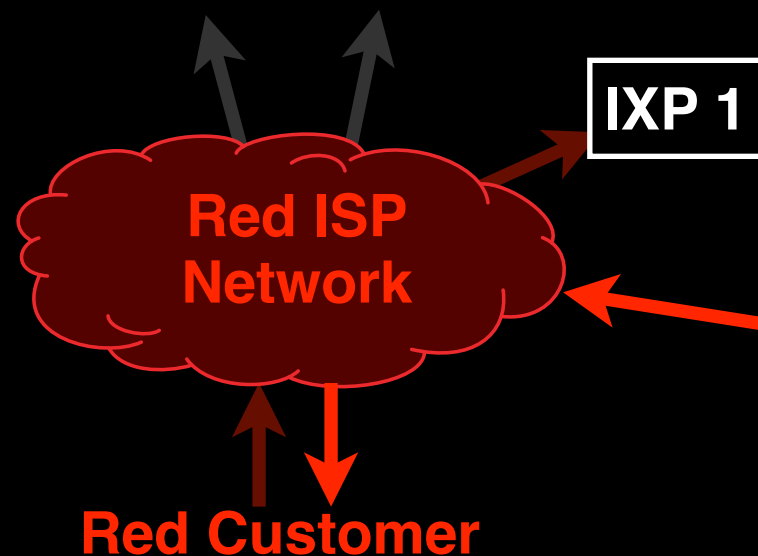
Red ISP backhauls from distant IXP



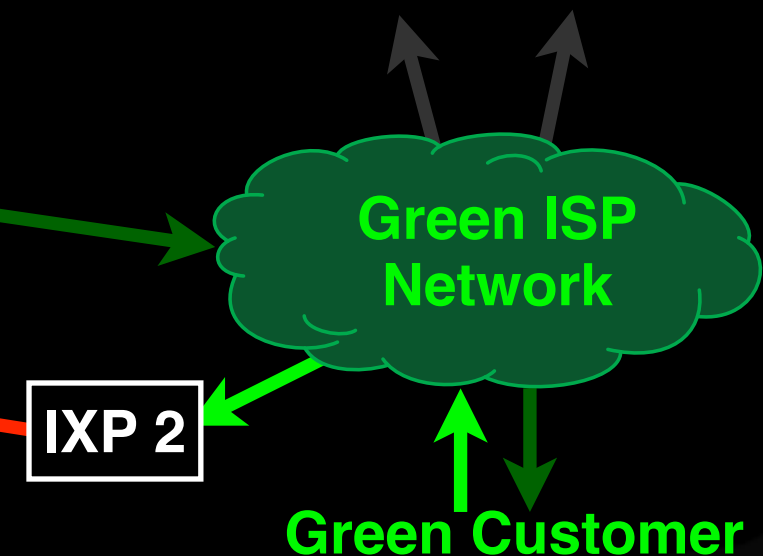
Hot Potato Routing

Red ISP delivers to Red Customer

Redundant Transit Providers



Redundant Transit Providers

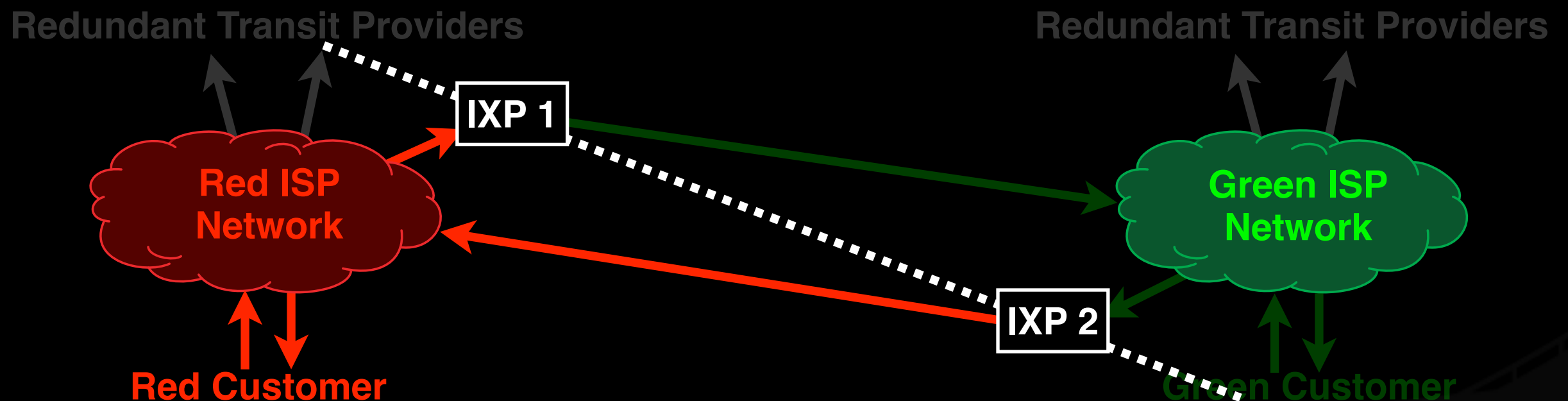


IXP 1

IXP 2

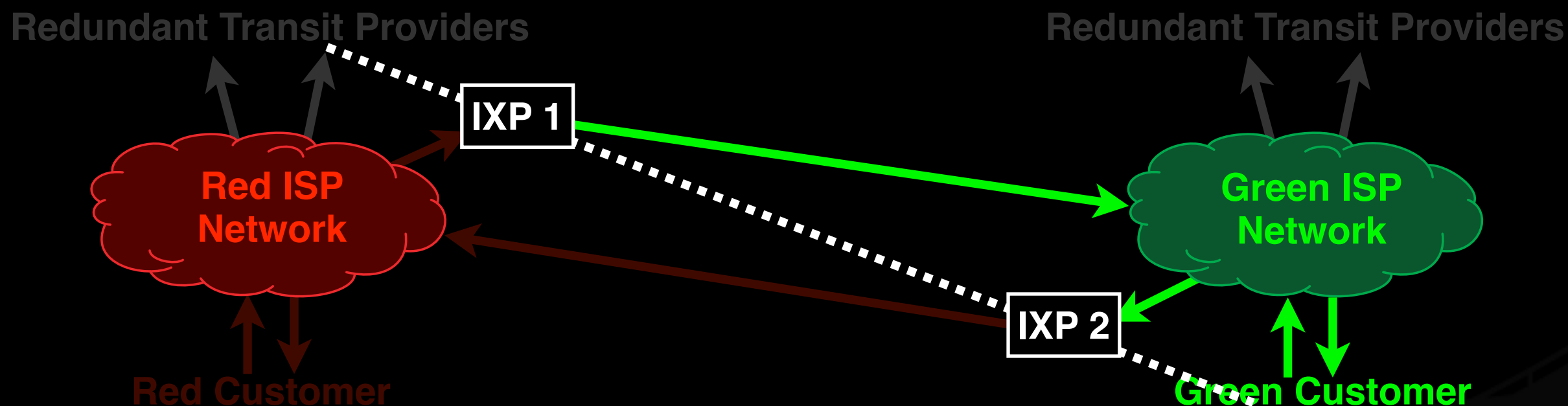
Hot Potato Routing

Red Network is responsible for its own costs



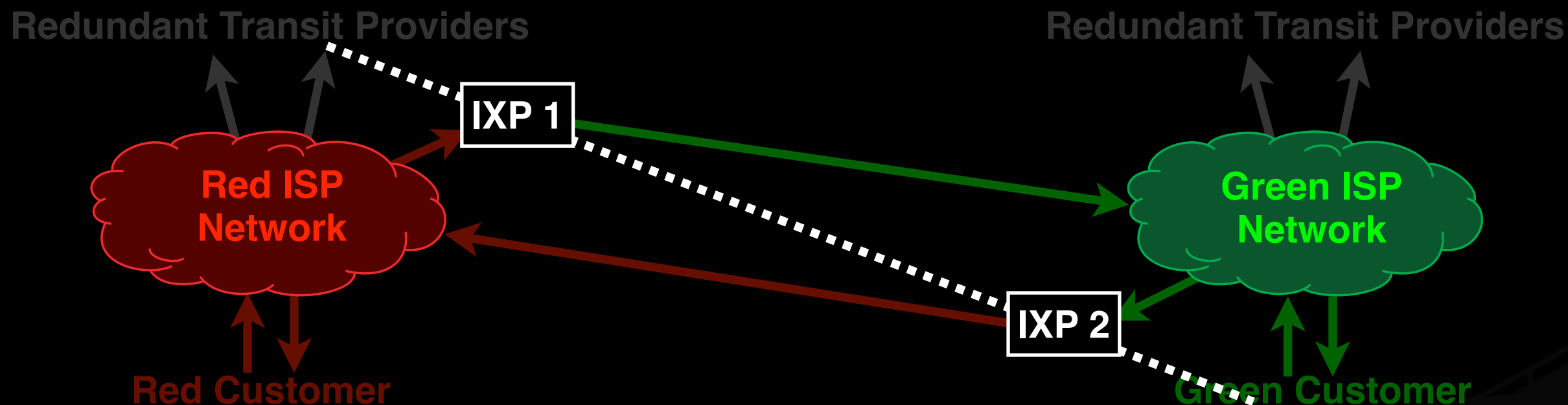
Hot Potato Routing

Green Network is responsible for its own costs



Hot Potato Routing

Symmetry: Fair sharing of costs



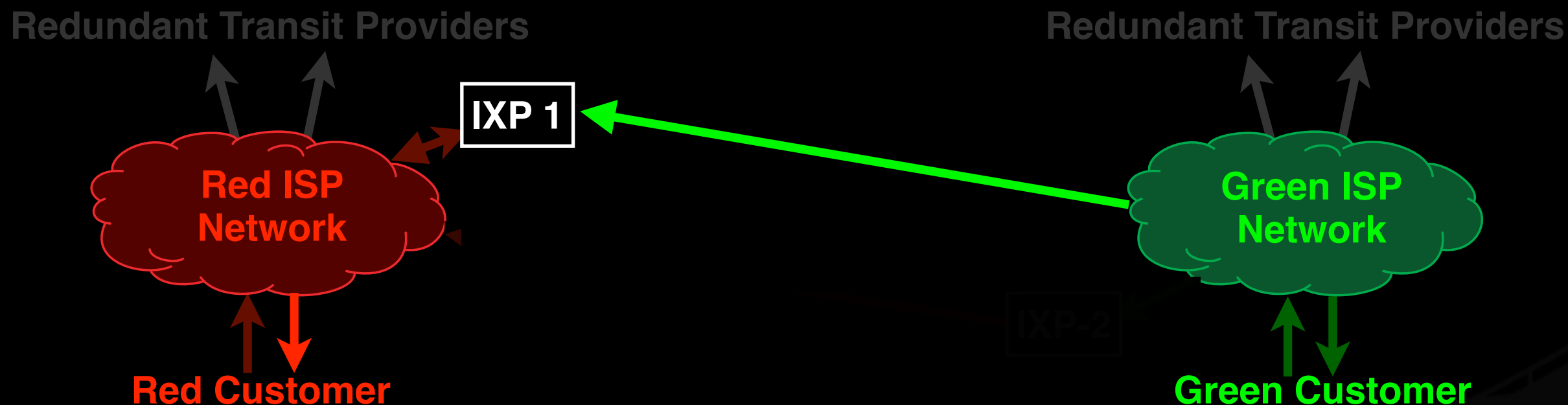
The efficiency of the Internet depends upon this principle:

For any two parties who wish to exchange traffic equitably, there must be a pair of exchanges, one near each party.

The Corollary:

Cities / countries / economies that have not yet built Internet Exchange Points disadvantage themselves, and export capital to cities / countries / economies that already have.

When there's no domestic IX...



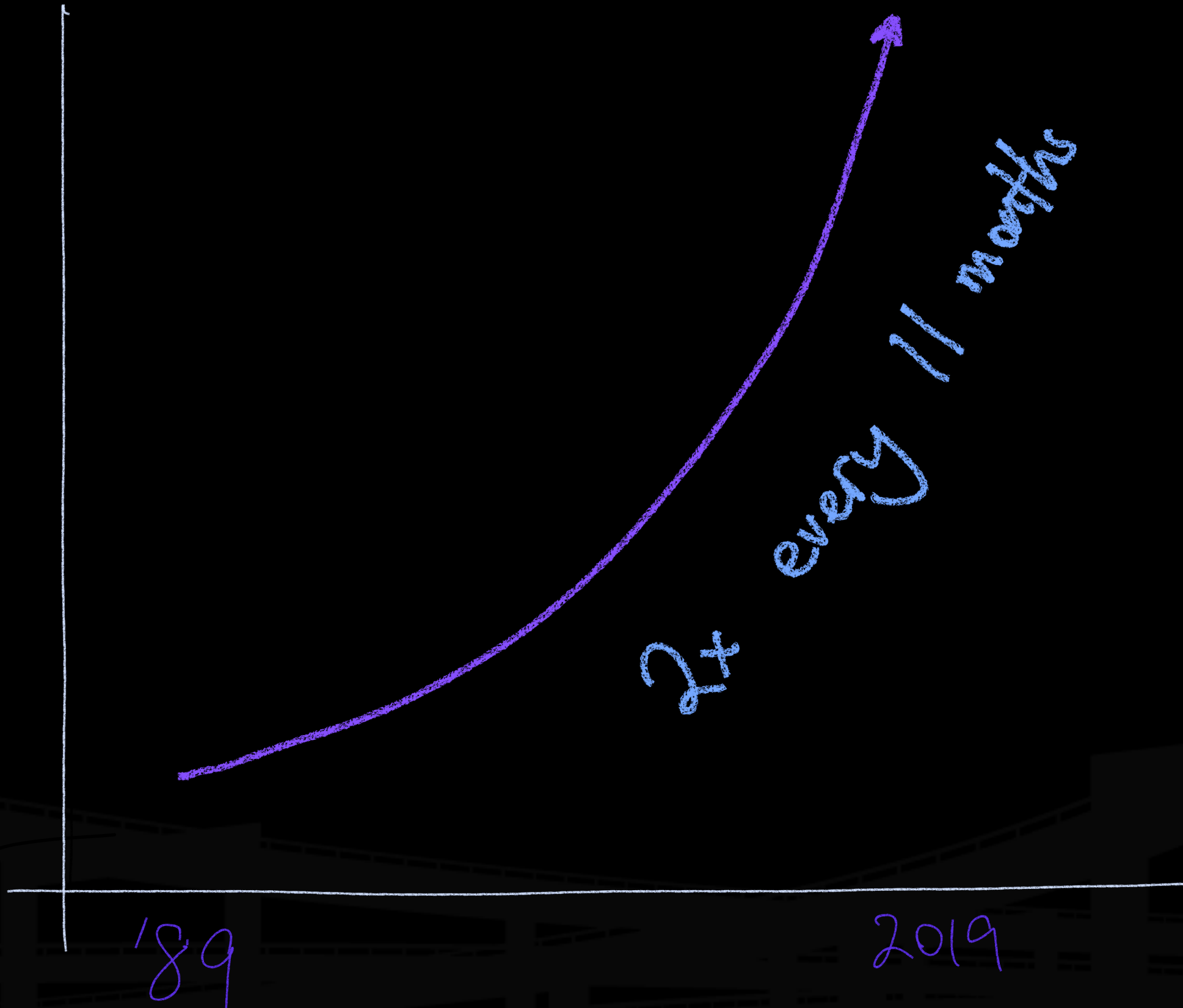
...you are always on the “long” path!

speed * distance = cost

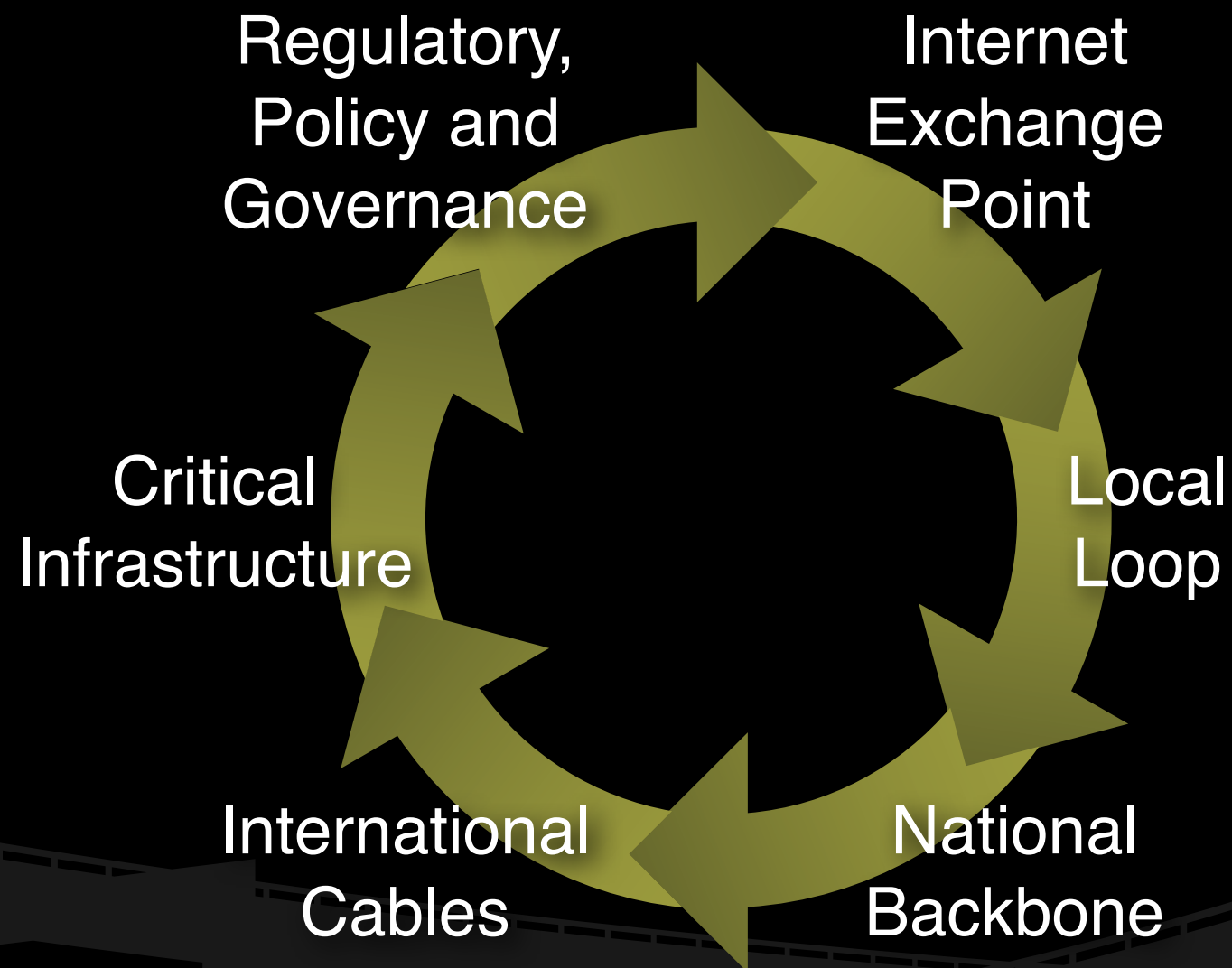
Q2. Growing a domestic ecosystem

How do we:

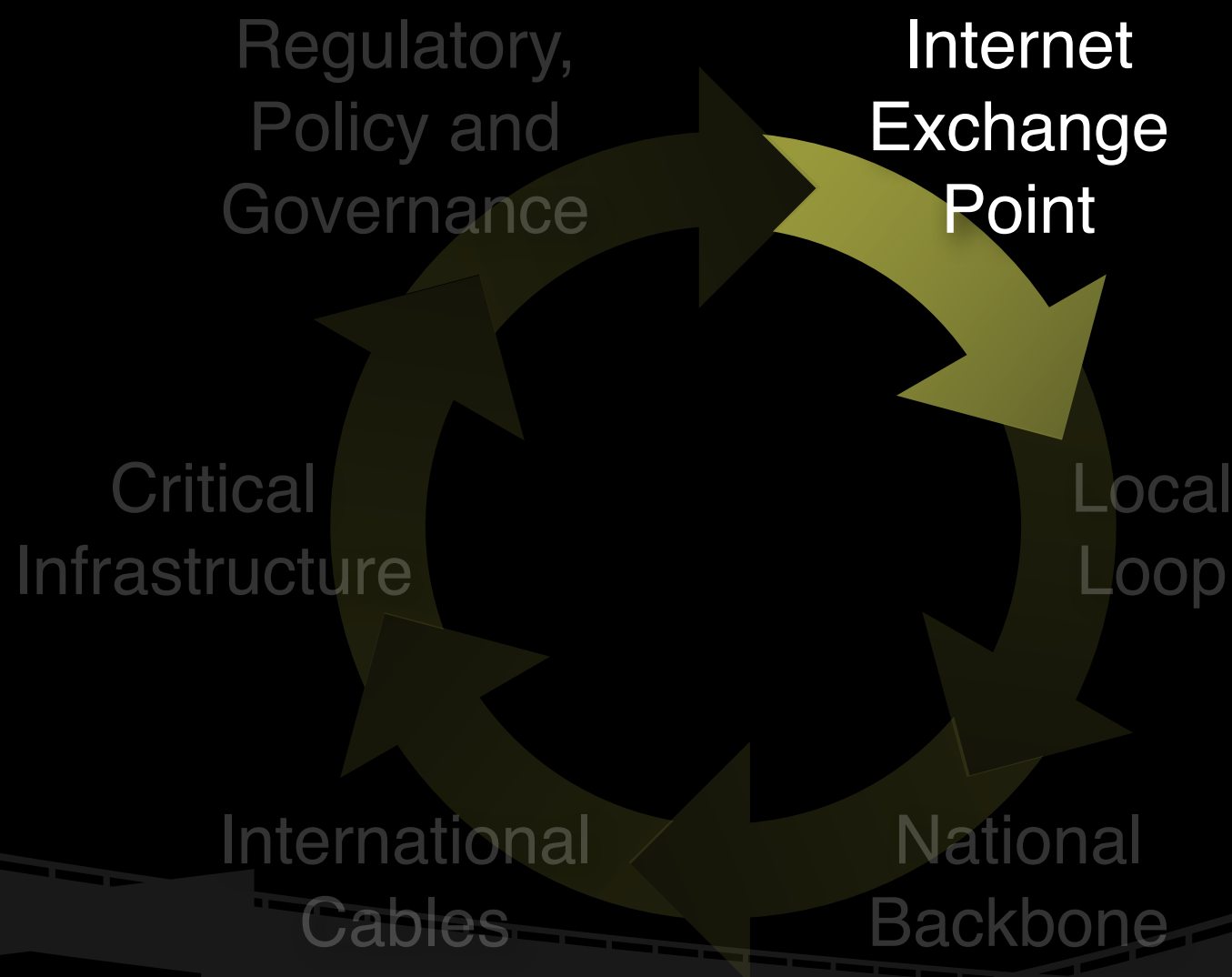
- Build/drive domestic content
- Attract foreign participants
- Drive down cost to peer



The Virtuous Cycle of Upgrades

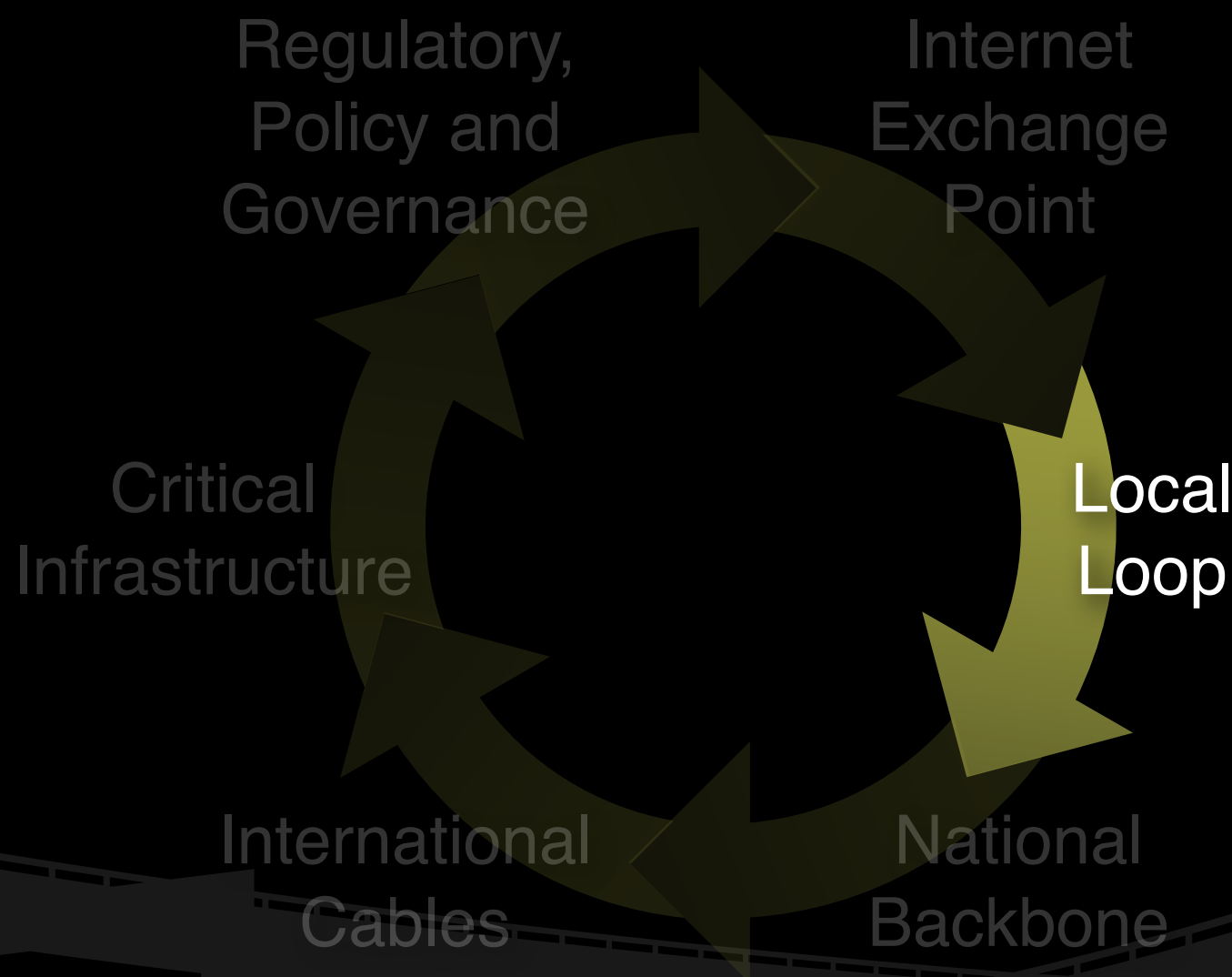


The Virtuous Cycle of Upgrades



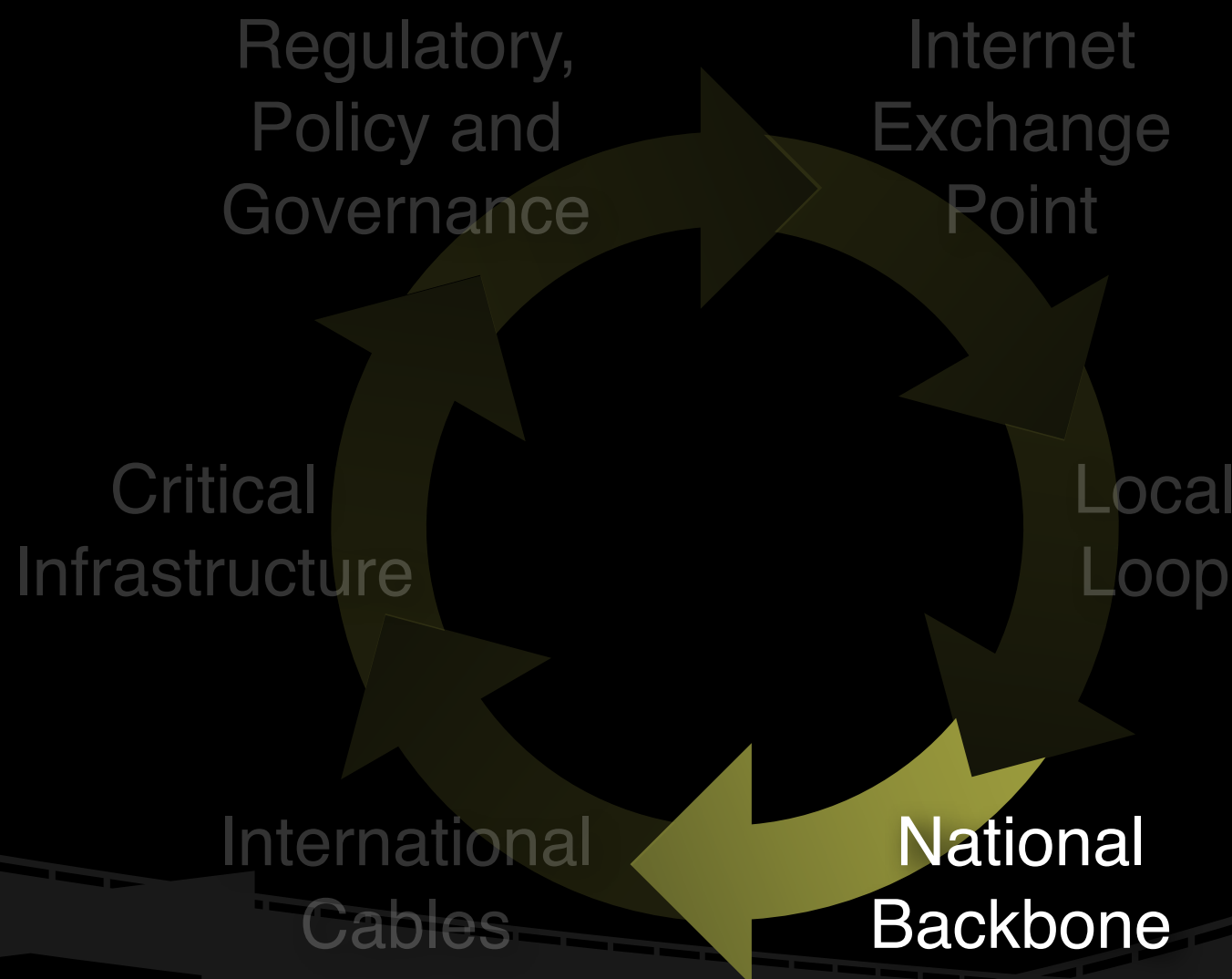
IXPs provide a domestic source of Internet bandwidth that is not dependent on International transit or transport.

The Virtuous Cycle of Upgrades



Local loops (or “last miles” of copper, fiber, or wireless must be available to connect networks to customers and resources like IXPs, critical infrastructure, and international cables.

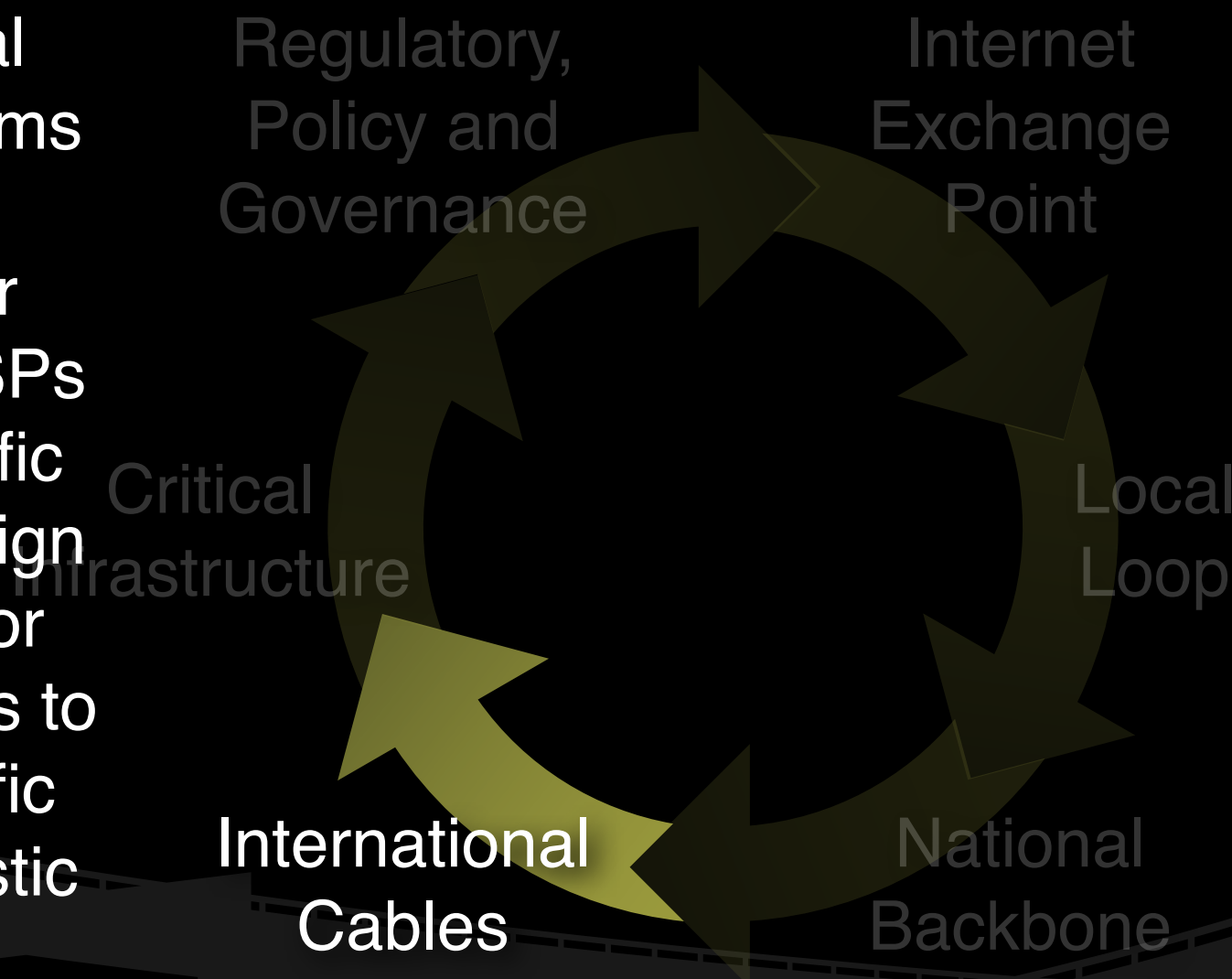
The Virtuous Cycle of Upgrades



Long-haul backbone fiber must be available to interconnect IXPs in one city with customers in another. They form the web of circuits between a country's cities.

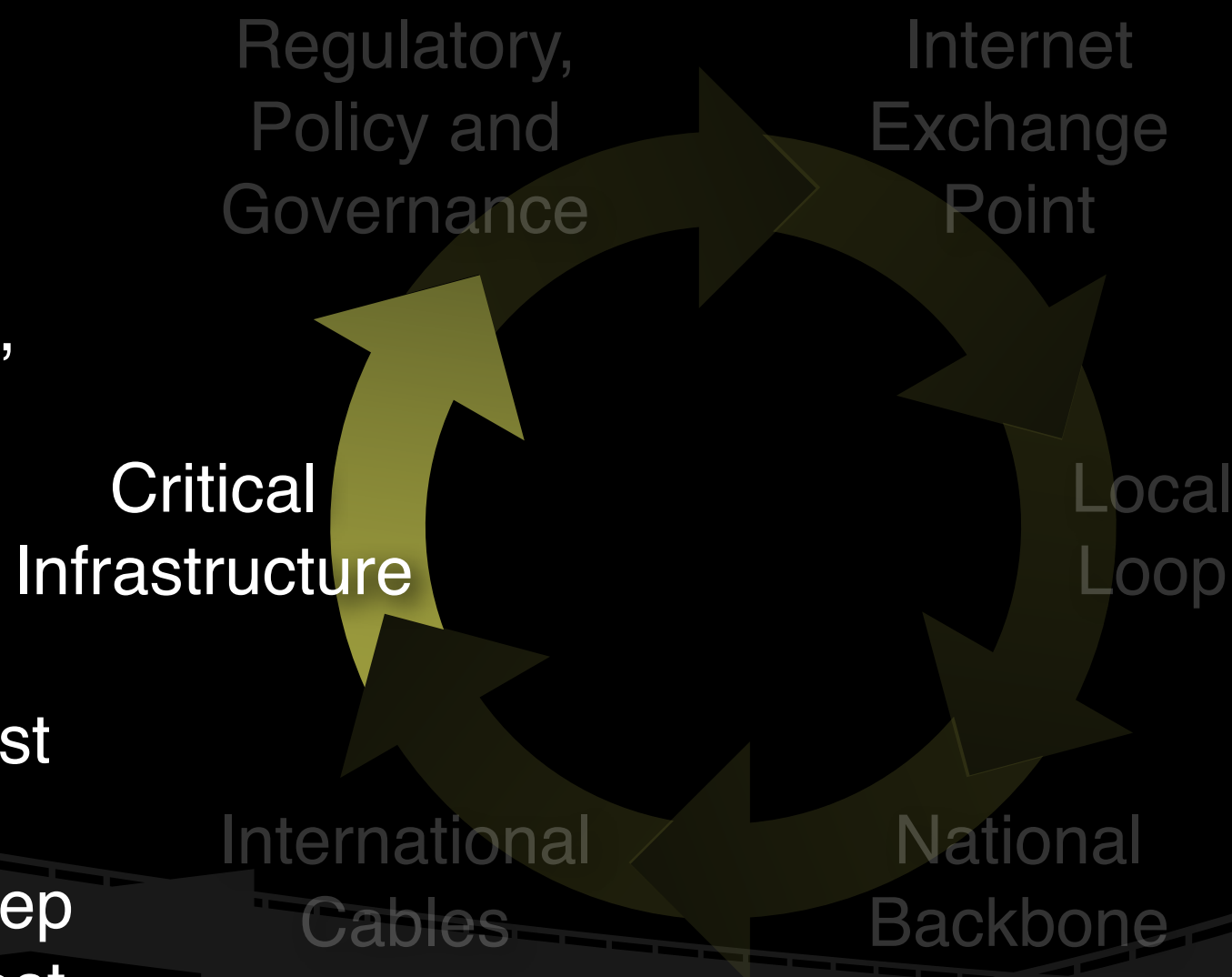
The Virtuous Cycle of Upgrades

International cable systems must be available for domestic ISPs to bring traffic in from foreign IXPs, and for foreign ISPs to receive traffic from domestic IXPs.



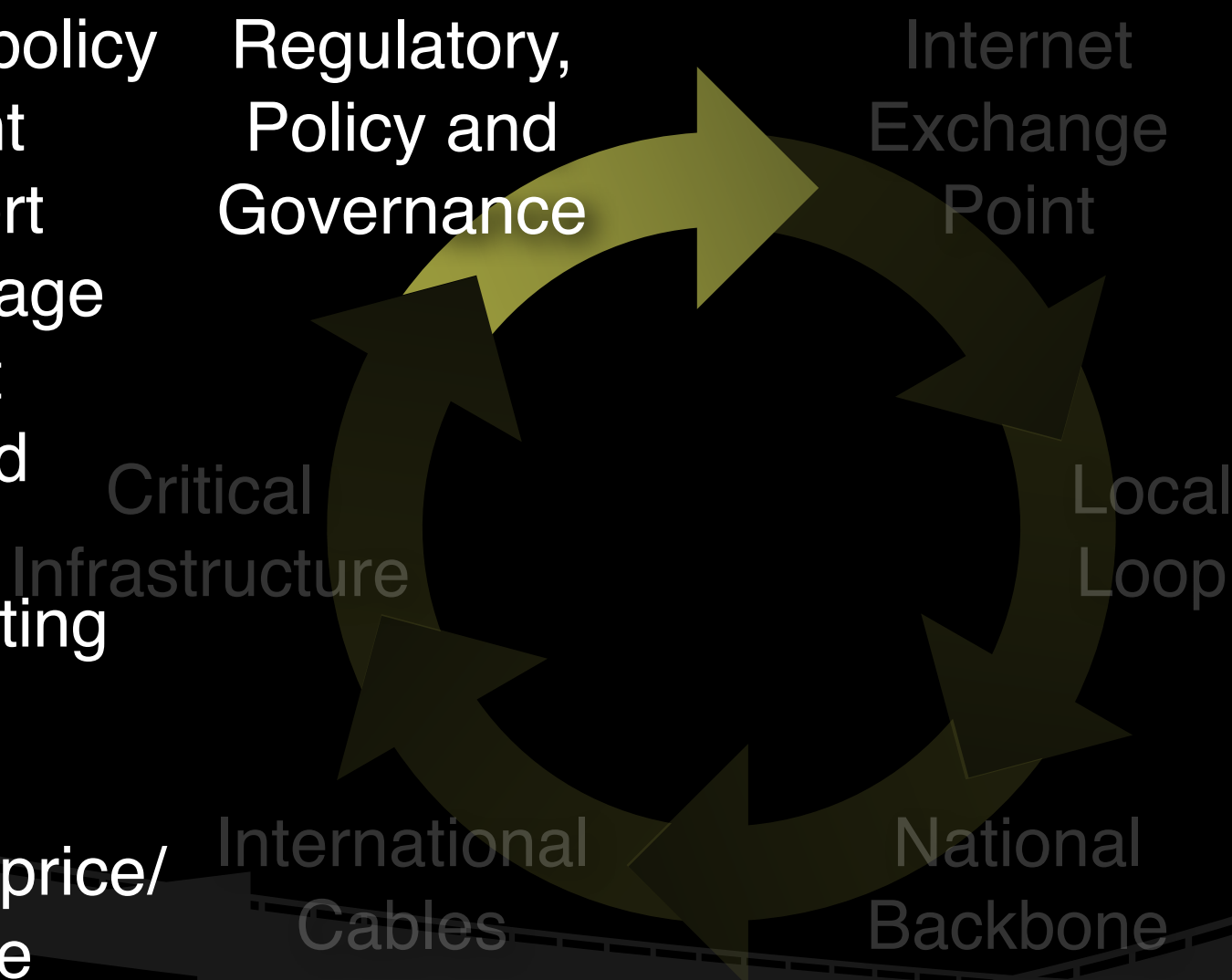
The Virtuous Cycle of Upgrades

Critical infrastructure like root and ccTLD nameservers, data-centres CERTs, and law enforcement intercept, must be speedy enough to keep up with the rest of the network.

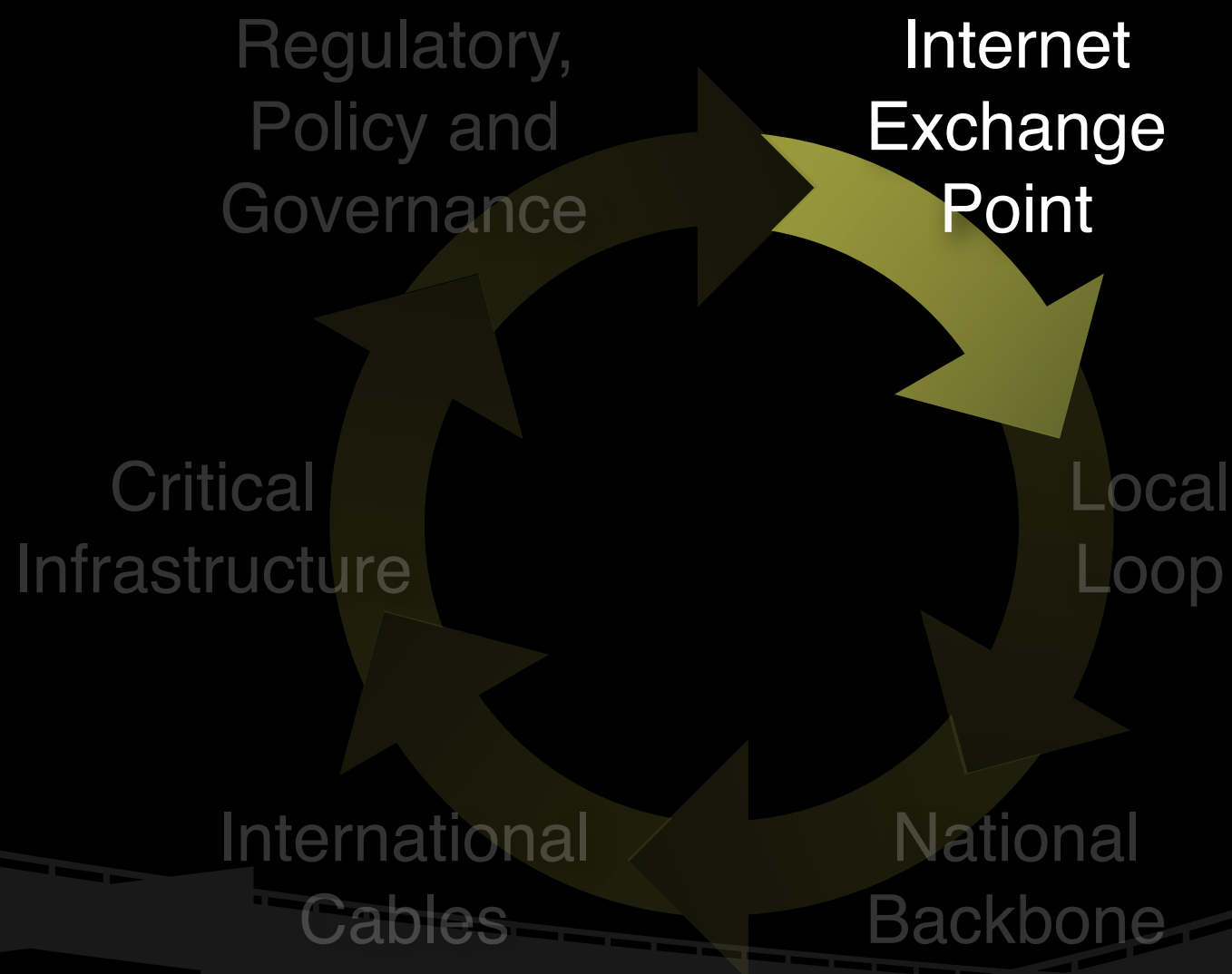


The Virtuous Cycle of Upgrades

The public policy environment must support and encourage new market entrants and competition among existing players to ensure continuous price/performance improvement.



The Virtuous Cycle of Upgrades



...by which time
we're ready to
upgrade our
IXP again.

And so on,
around the
circle.

Q3. Completing the ecosystem

What elements are missing in the local ecosystem?

How do we identify and fix these?

What IXP model best suits your environment?

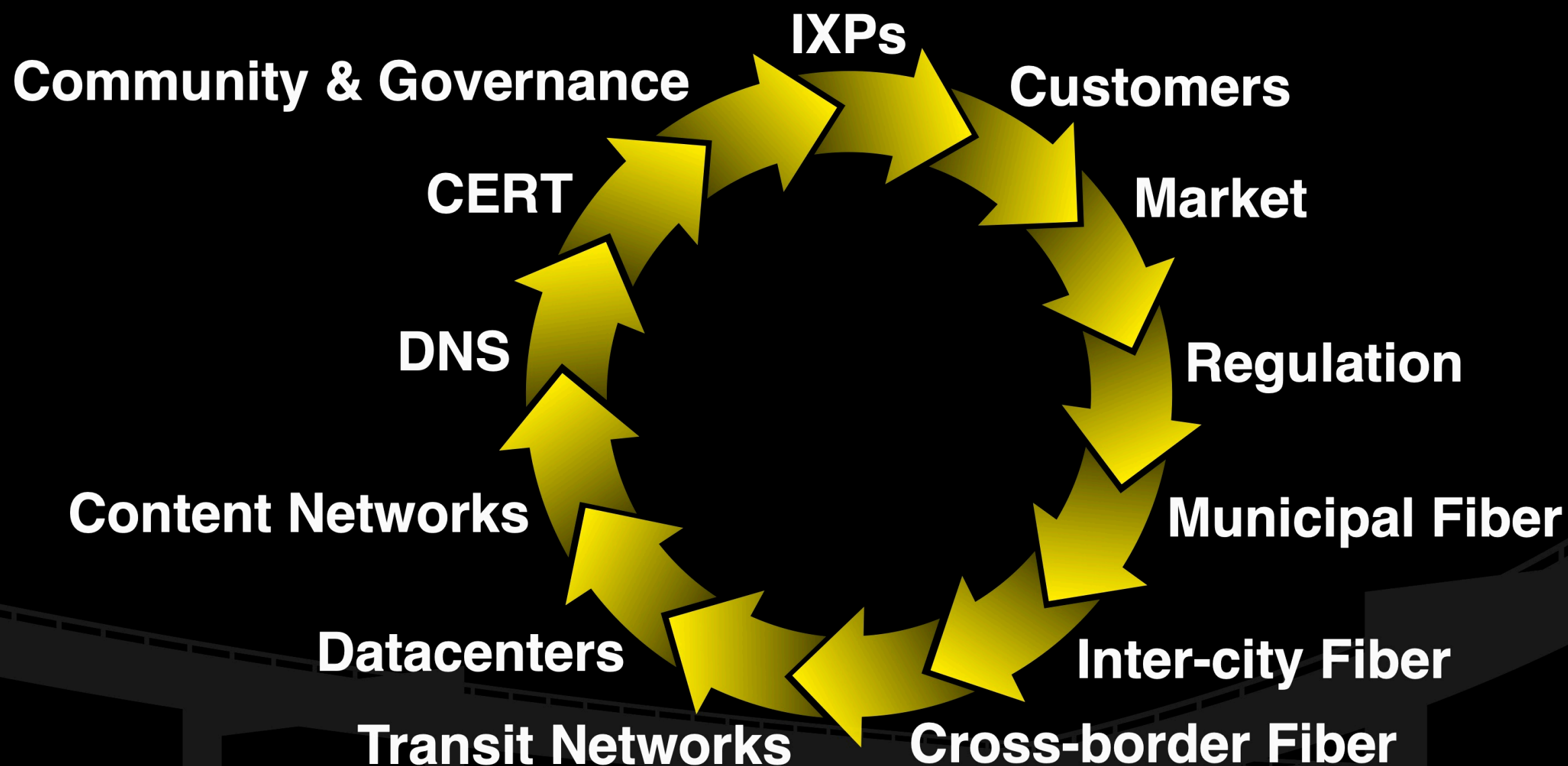
What help do you need ?

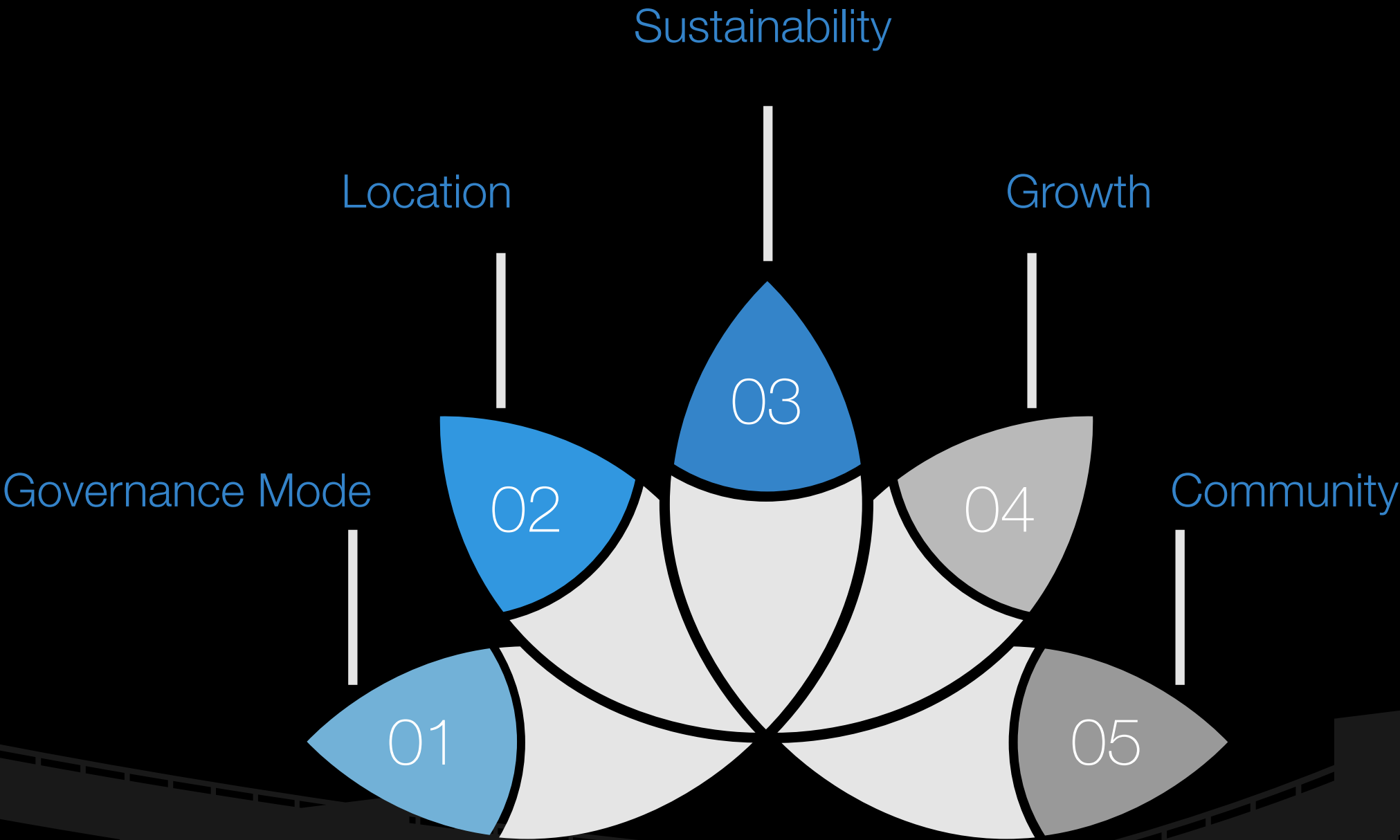
Thanks, and Questions?

Copies of this presentation are available in PDF format.

Nishal Goburdhan
Packet Clearing House
nishal@pch.net

Components of the Internet Economy





Governance

- **Community non-profit**
 - Inherent (selfish) interest in a peering network wanting the IX to be online.
 - Peering networks can offer skills to supplement IX.
 - Community management will ensure that the IX works to serve a purpose; not extract rents.
 - Non-profits are protected by law from buyouts.
 - Inherent dependency on an active community.

Location

- **Neutrality is best.** But don't overcomplicate this.
 - Consensus is more important than cost.
 - Accessibility and trust are vital.
 - Room to grow is essential
 - Building a data-centre, to support an IX is a recipe for failure.

Sustainability

- **Community non-profit.**
 - Continue to reduce APBDC.
 - Donations are widely available (eg. PCH donate switches to startup IXPs to help keep costs down. ISOC donate servers etc.)
 - Project budgets create less friction than fixed fees.

If we build it ..

- **Building an IX **must** be to support your domestic community**
 - The “Field of Dreams” approach does not work with an IX
 - An IX does not guarantee that CDNs are going to start peering!
 - It is unwise to extend yourself financially in the hopes of “making a profit” later

Invest wisely

- **No IX succeeds without a community**
- **If you have an IX in your community, does it arrange**
 - training dates to promote best practices?
 - meet-ups between peers to promote peering?
- **Learn to compete at commercial level, and collaborate at technical level.**

Growing your IX

- **Make your IX the technical showcase for talent.**
- **Run community-good services**
 - Anycast DNS services (hint: write to PCH)
 - NTP servers, RPKI validators, mailing lists
 - host regular meetups to discuss technology
- **We compete at commercial level but collaborate at technical level.**

What can go wrong?

- Increasing the APBDC to peers
- “Inventing work”
- Competing with peers for services
- Running an “Old Boys Club”
- Misalignment of the IX’s role
- “Betting on one horse”

Q3. Completing the ecosystem

What elements are missing in the local ecosystem?

How do we identify and fix these?

What IXP model best suits a startup environment?