

The Economy of the Internet is Inextricably Linked to the Topology of the Internet

Building Blocks of the Internet

The Internet is a network composed of smaller networks.

Those smaller networks have four distinct stages of growth.

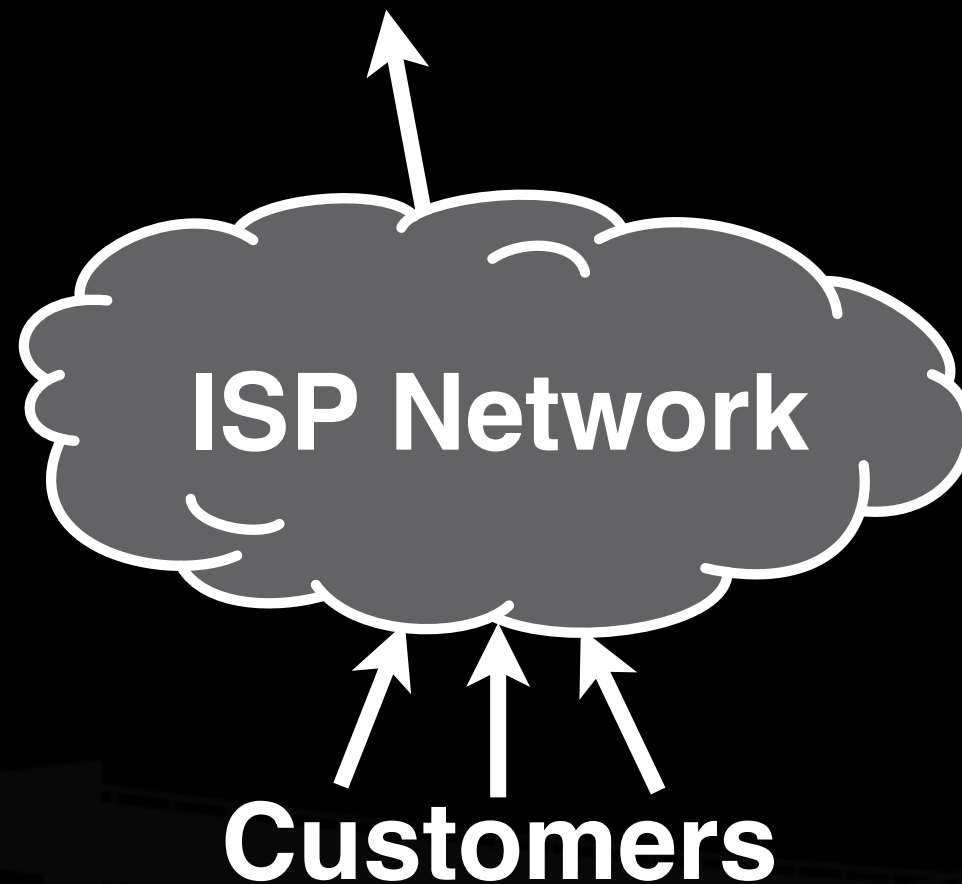
Those networks are interconnected in only two ways.

If you understand the four forms the networks can take, and the two ways they can interconnect, you understand the topology of the Internet, how it generates value, and how it's paid for.

Internet Service Provider Lifecycle

Phase 1: Simple Aggregator

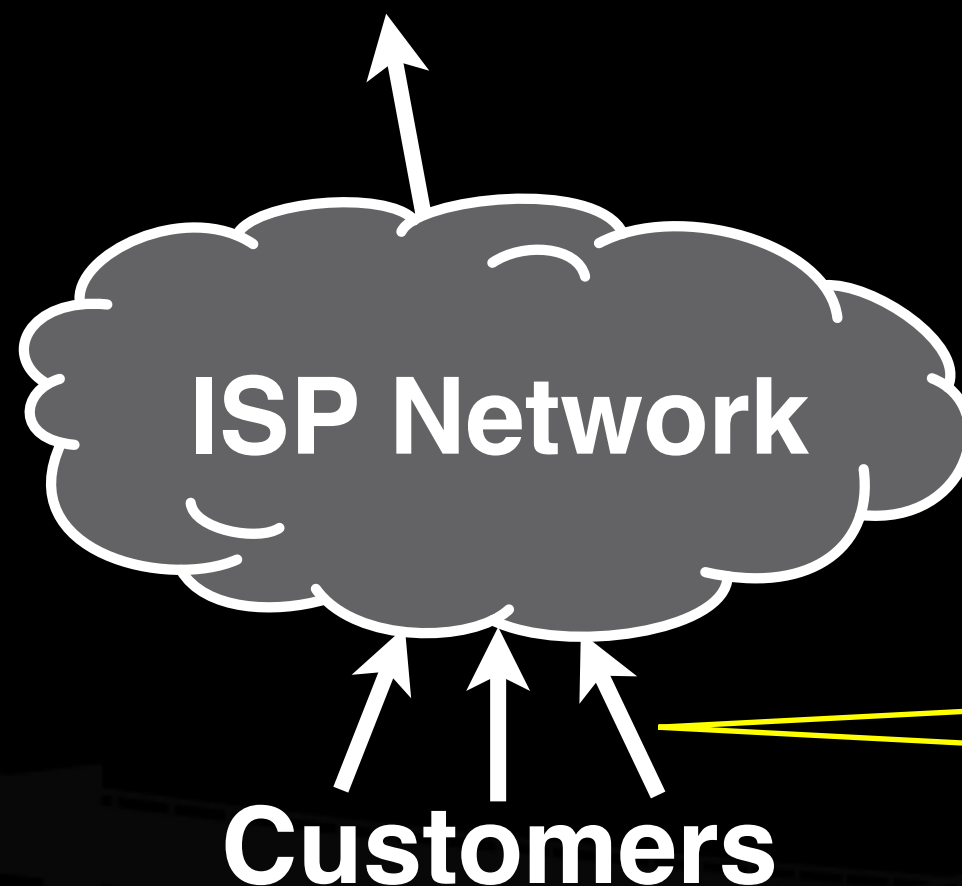
Single Transit Provider ——— IXPs



Internet Service Provider Lifecycle

Phase 1: Simple Aggregator

Single Transit Provider ——— IXPs

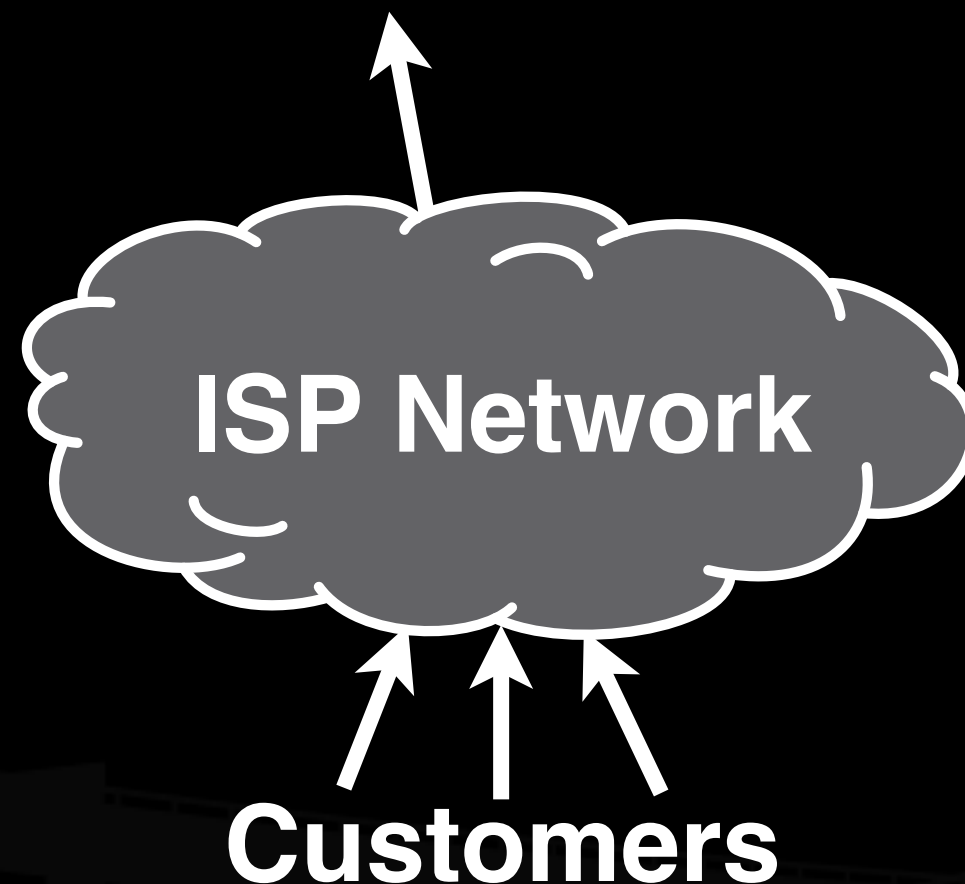


Vertical connections are transit: service travels downward, money travels upward.

Internet Service Provider Lifecycle

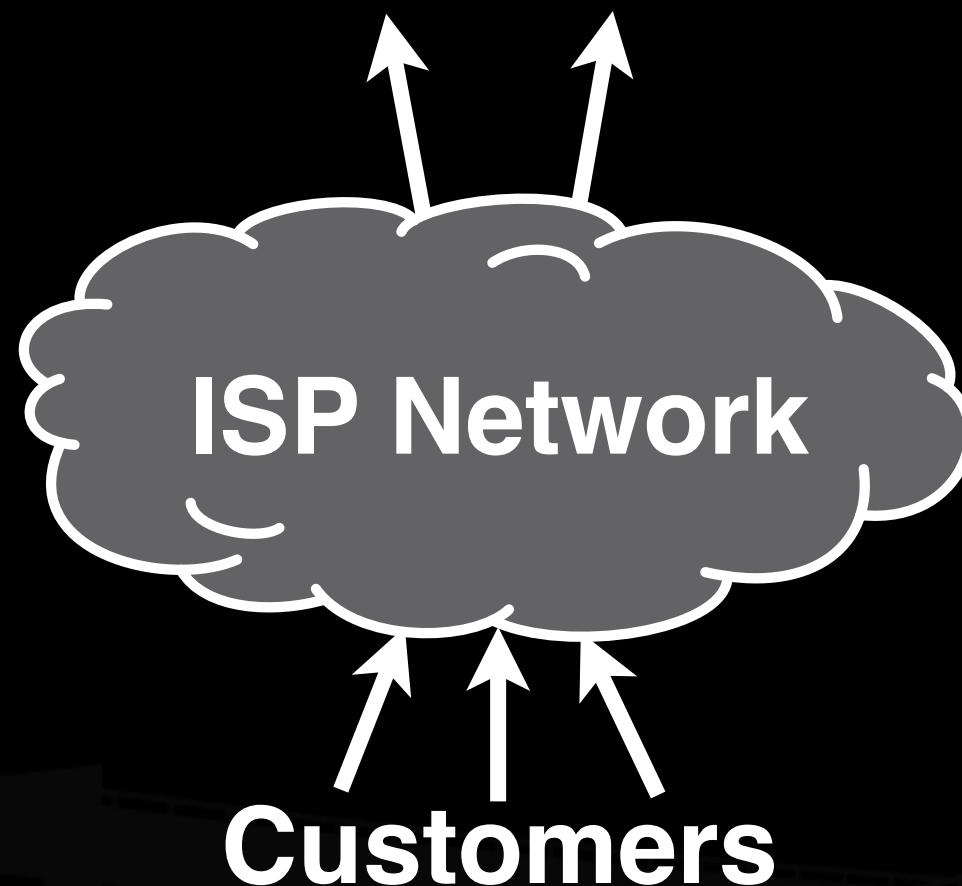
Phase 1: Simple Aggregator

Single Transit Provider ——— IXPs



Internet Service Provider Lifecycle Phase 2: Redundancy & Efficiency

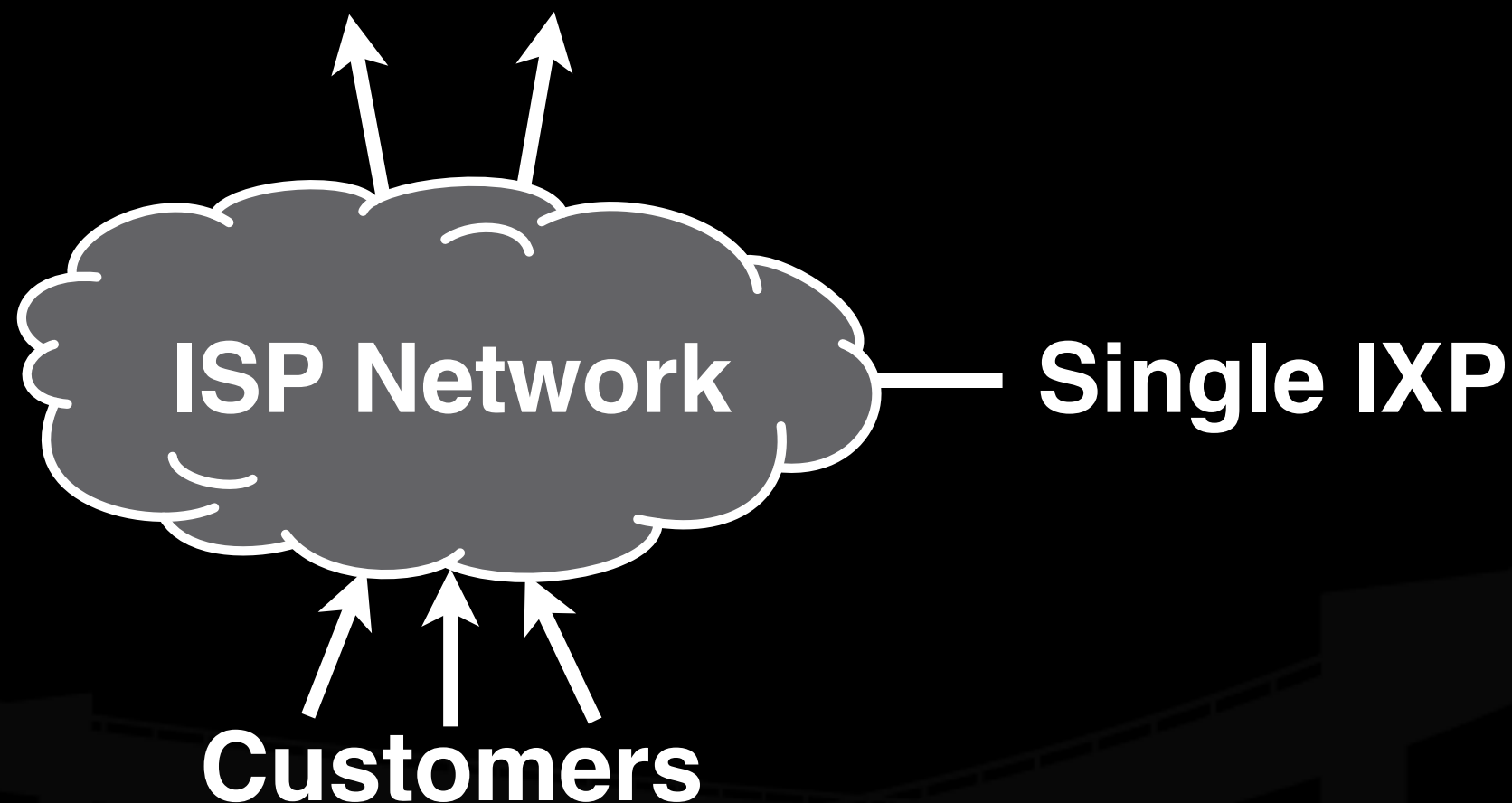
Redundant Transit Providers — IXPs



Internet Service Provider Lifecycle

Phase 3: Local Peering

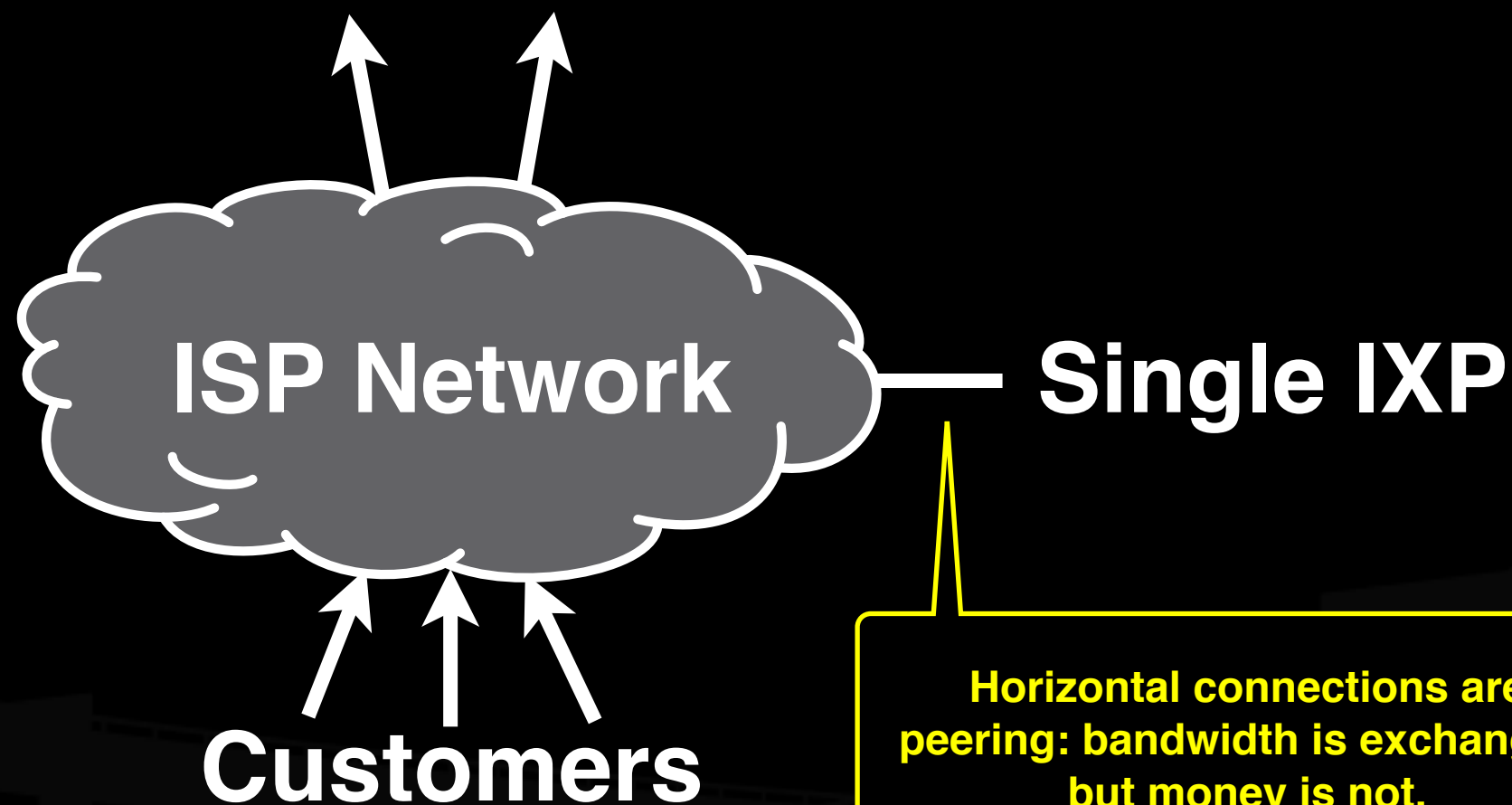
Redundant Transit Providers — IXP



Internet Service Provider Lifecycle

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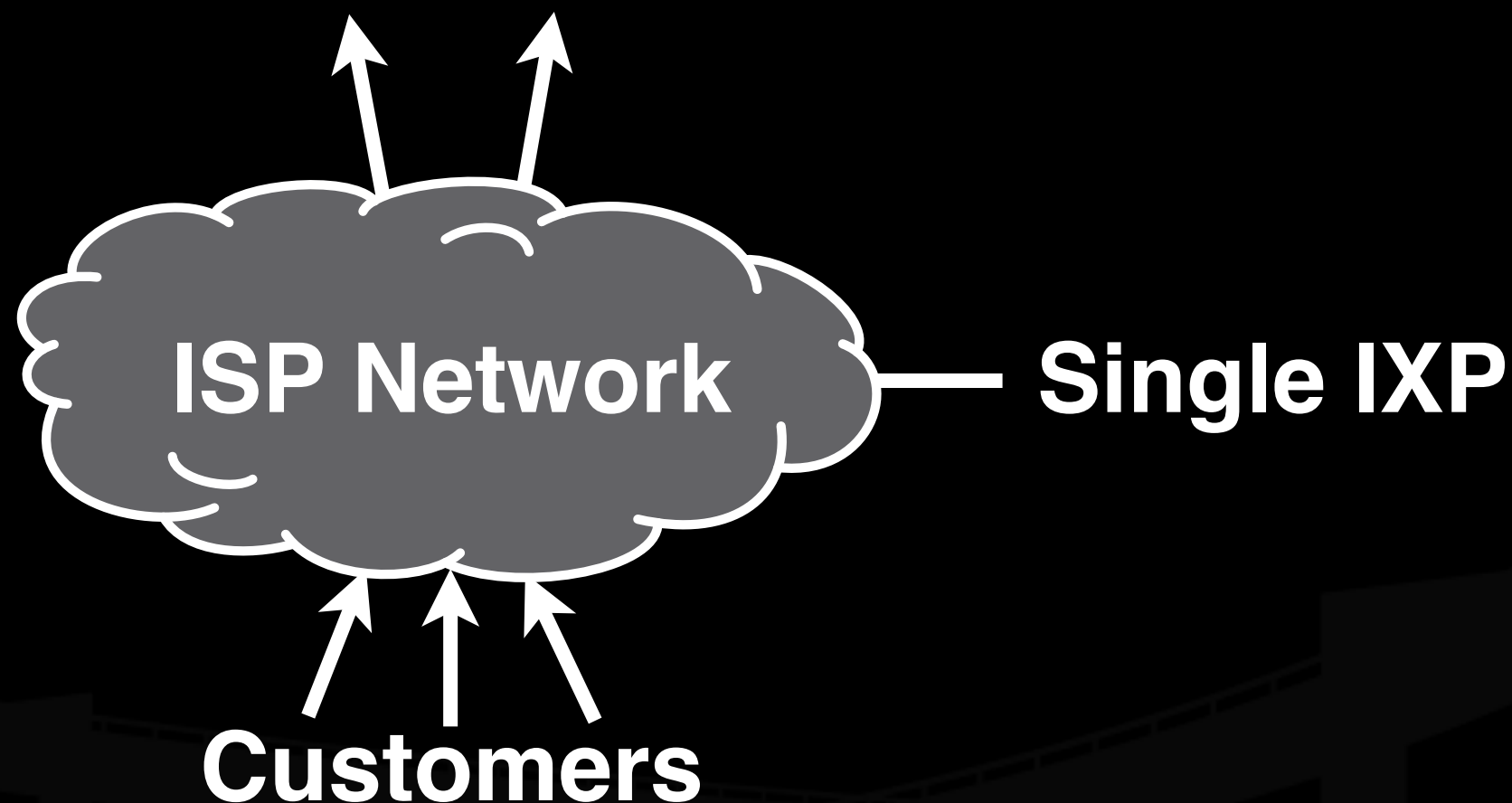
Redundant Transit Providers — IXPs



Internet Service Provider Lifecycle

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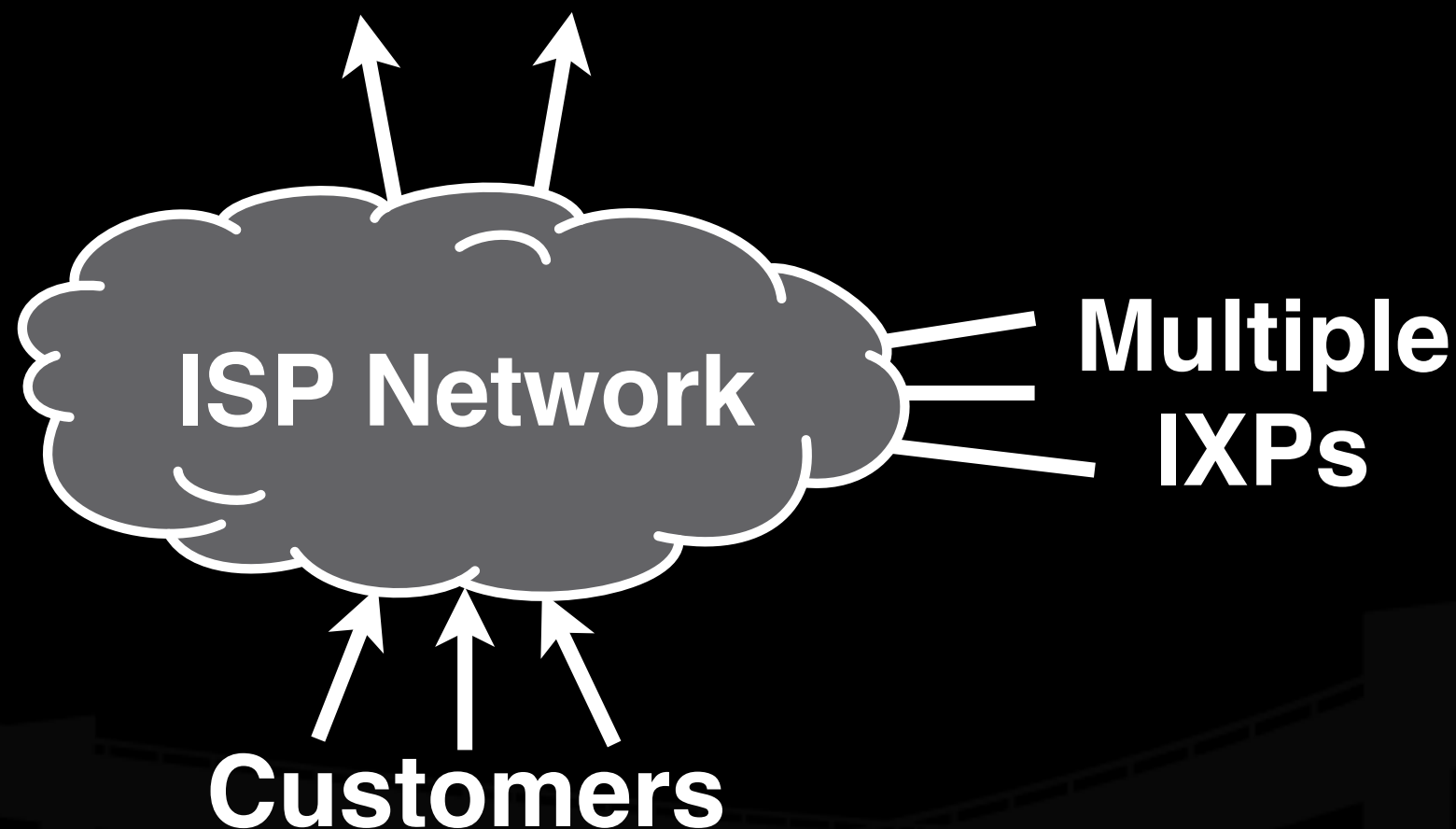
Redundant Transit Providers — IXP



Internet Service Provider Lifecycle

Phase 4: Diverse Peering

Redundant Transit Providers — IXPs





IXP

IXP

IXP

IXP

IXP

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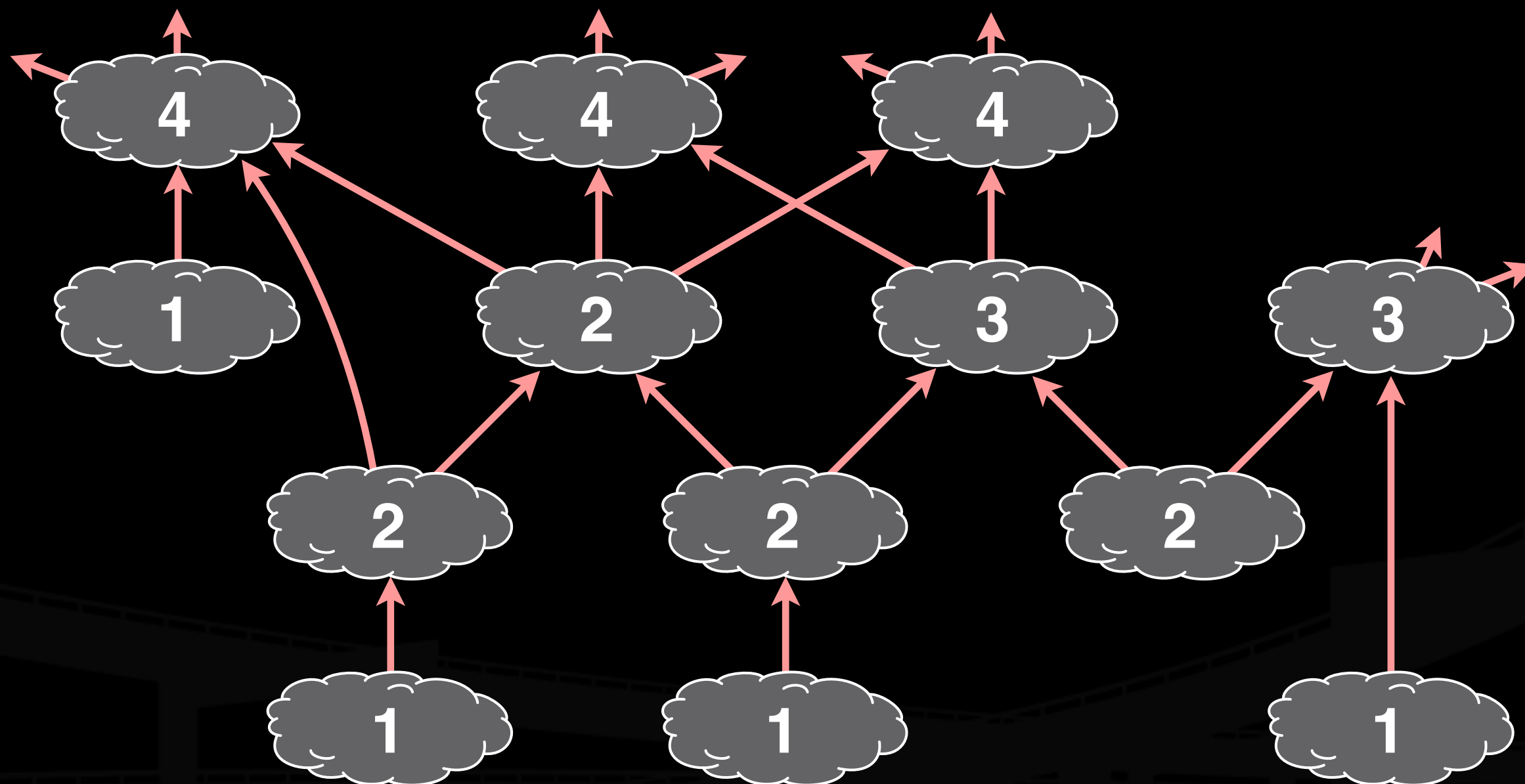
IXP

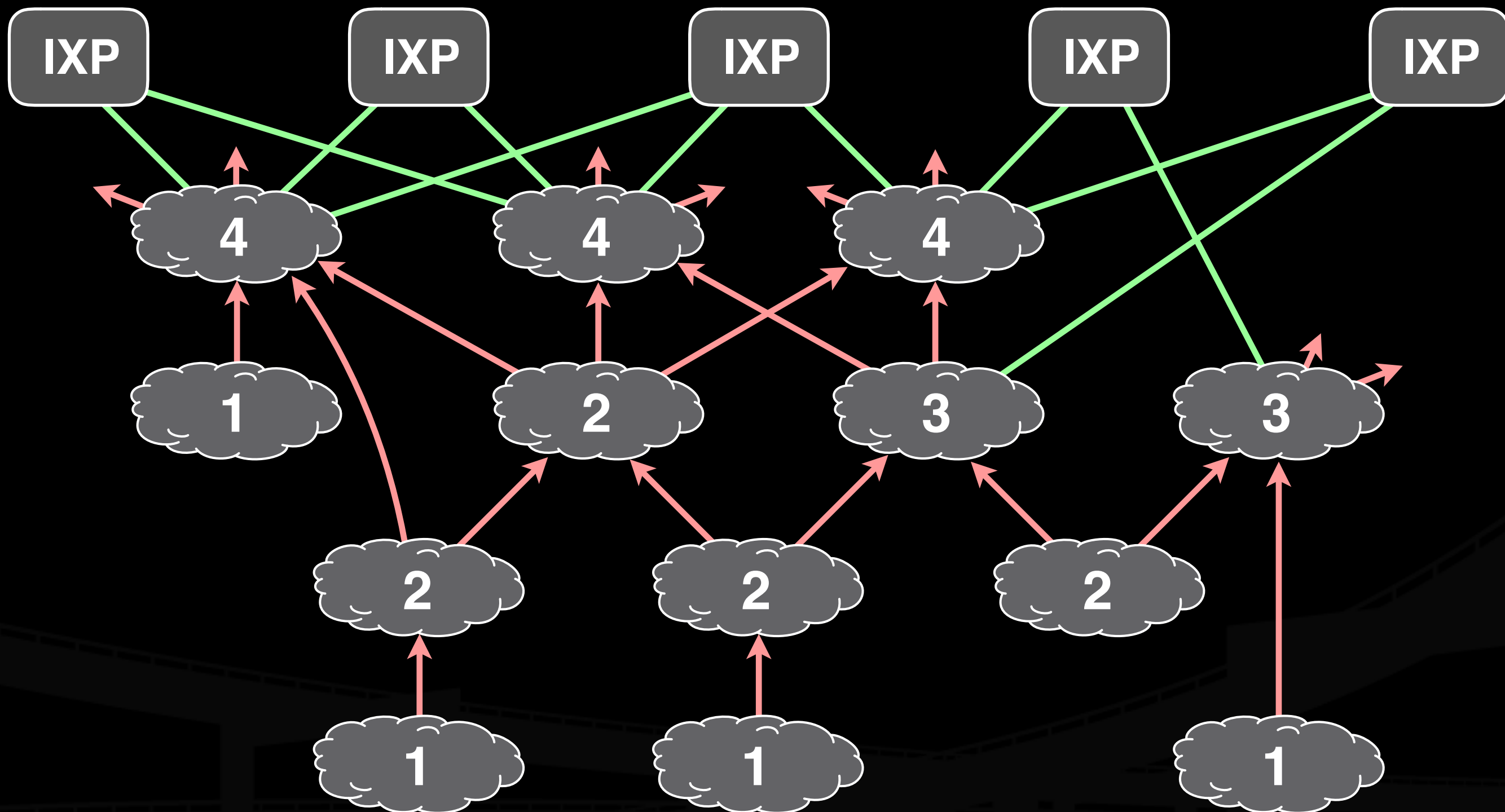
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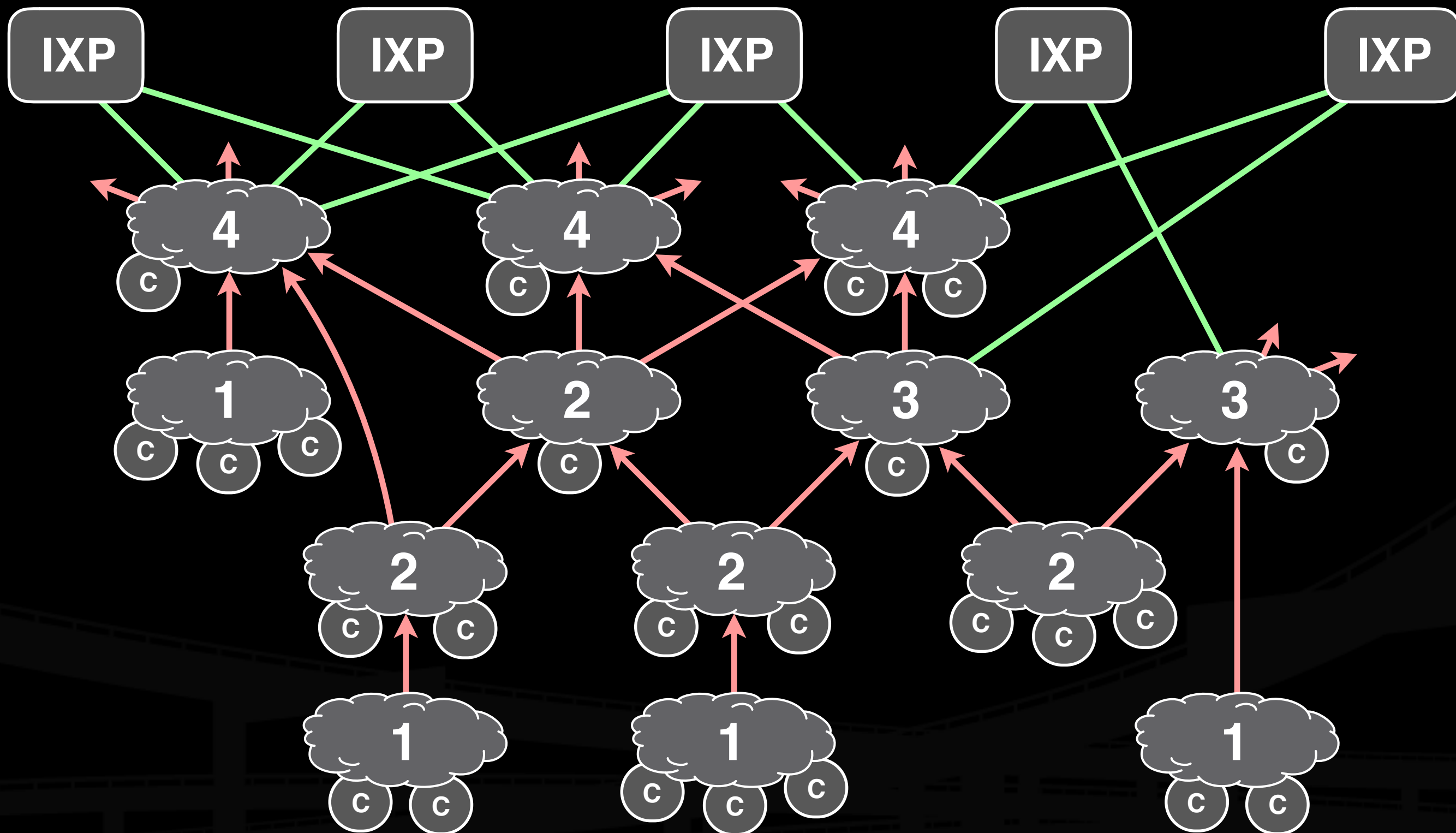
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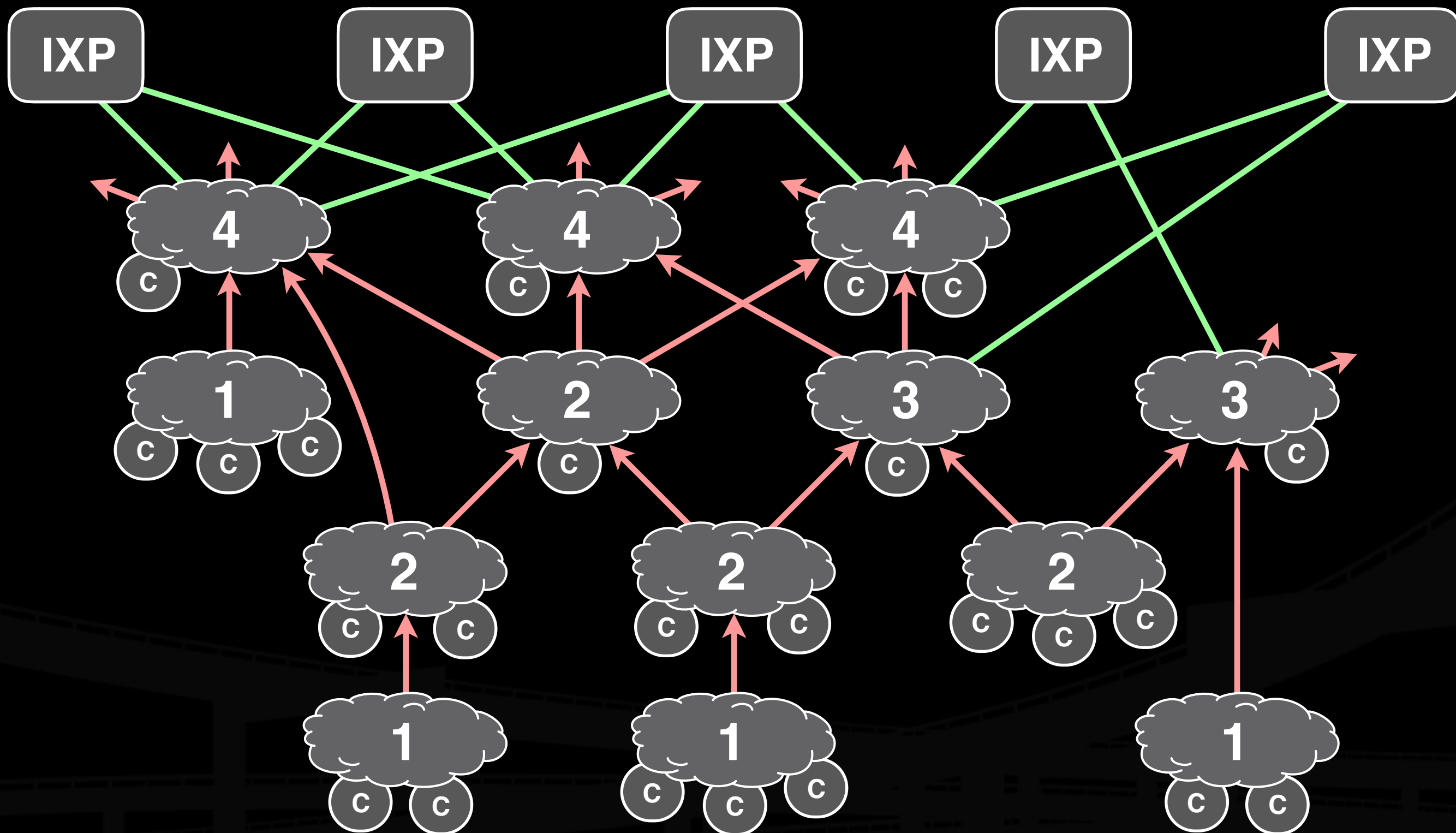
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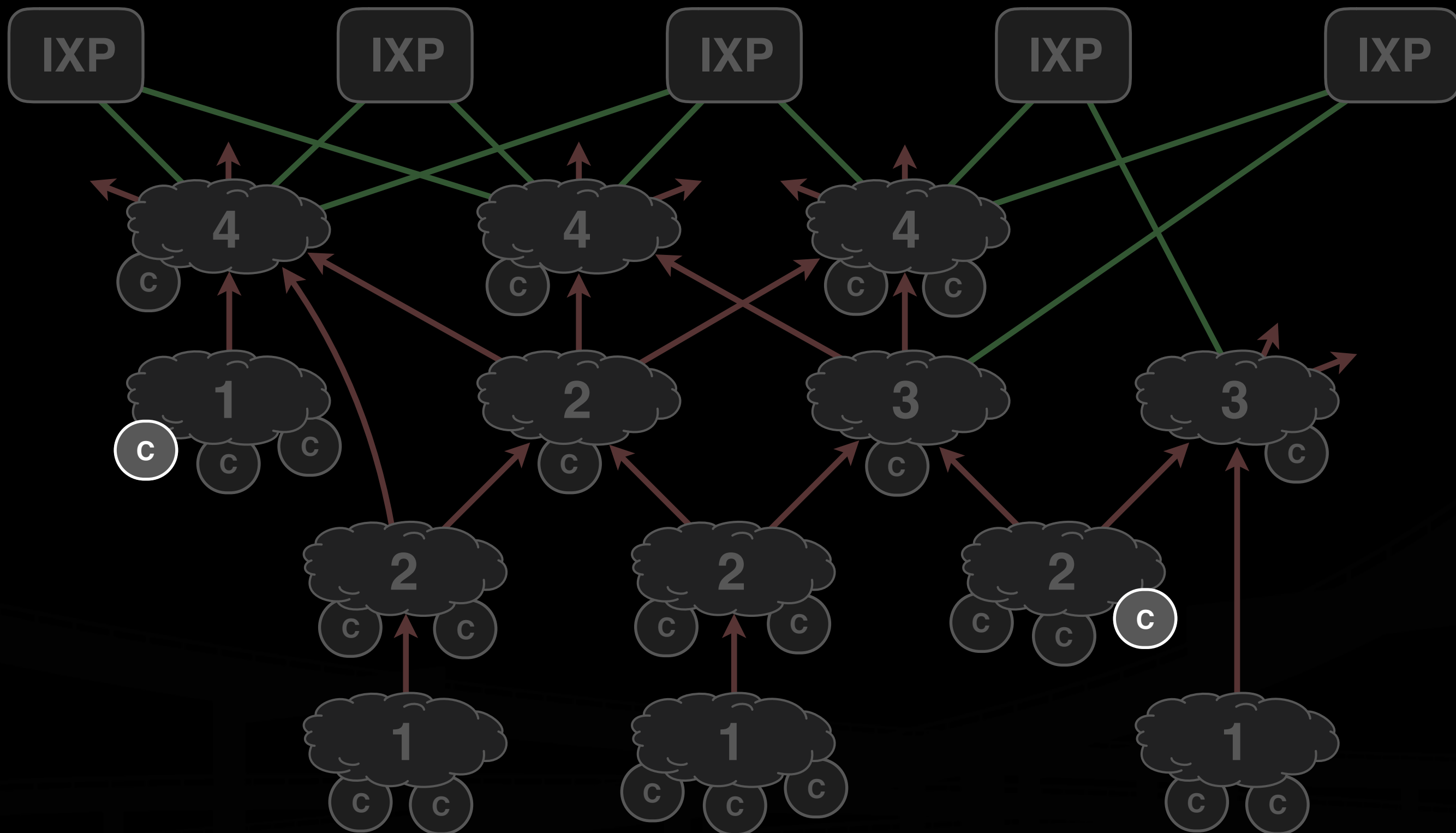
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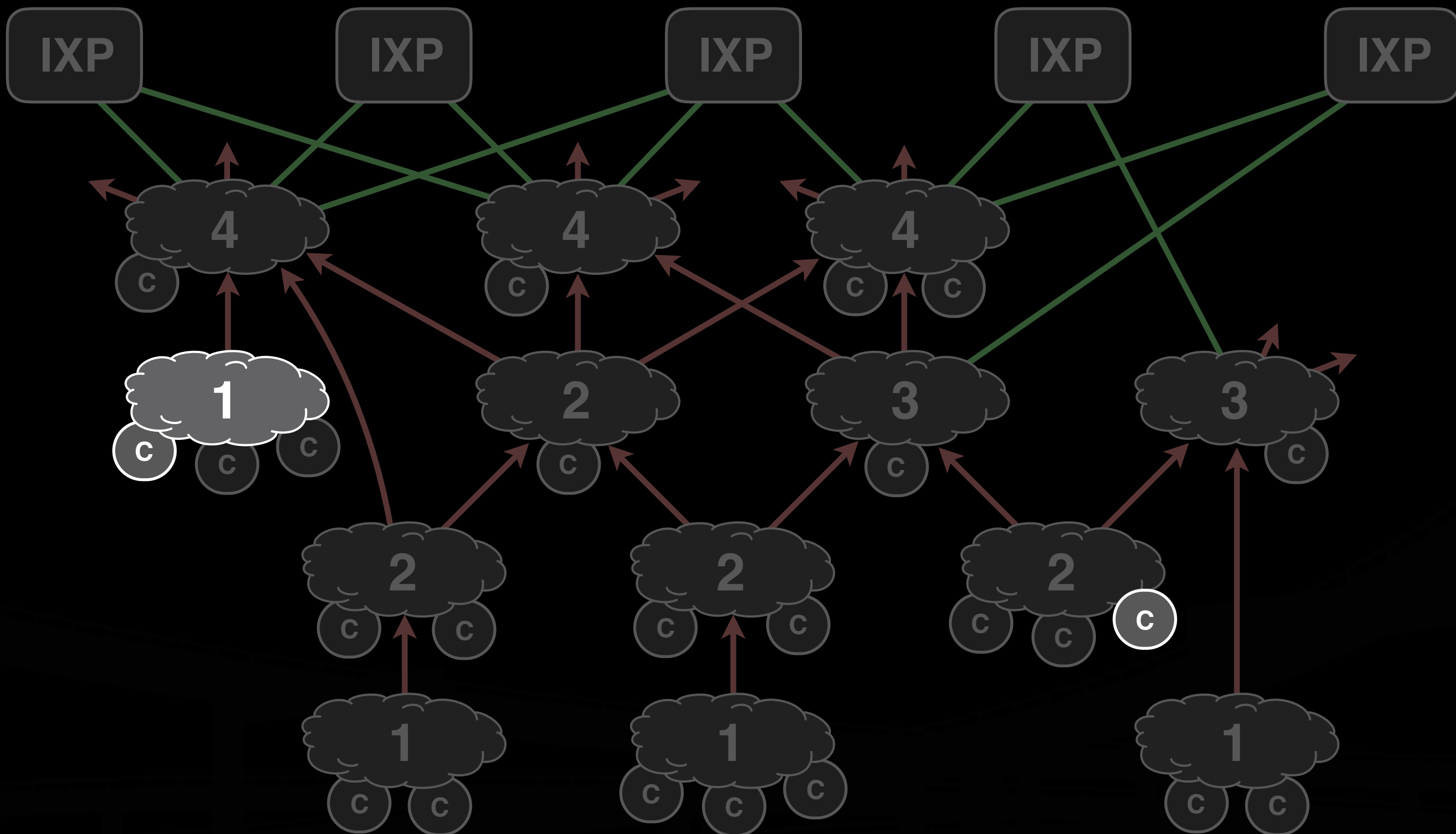


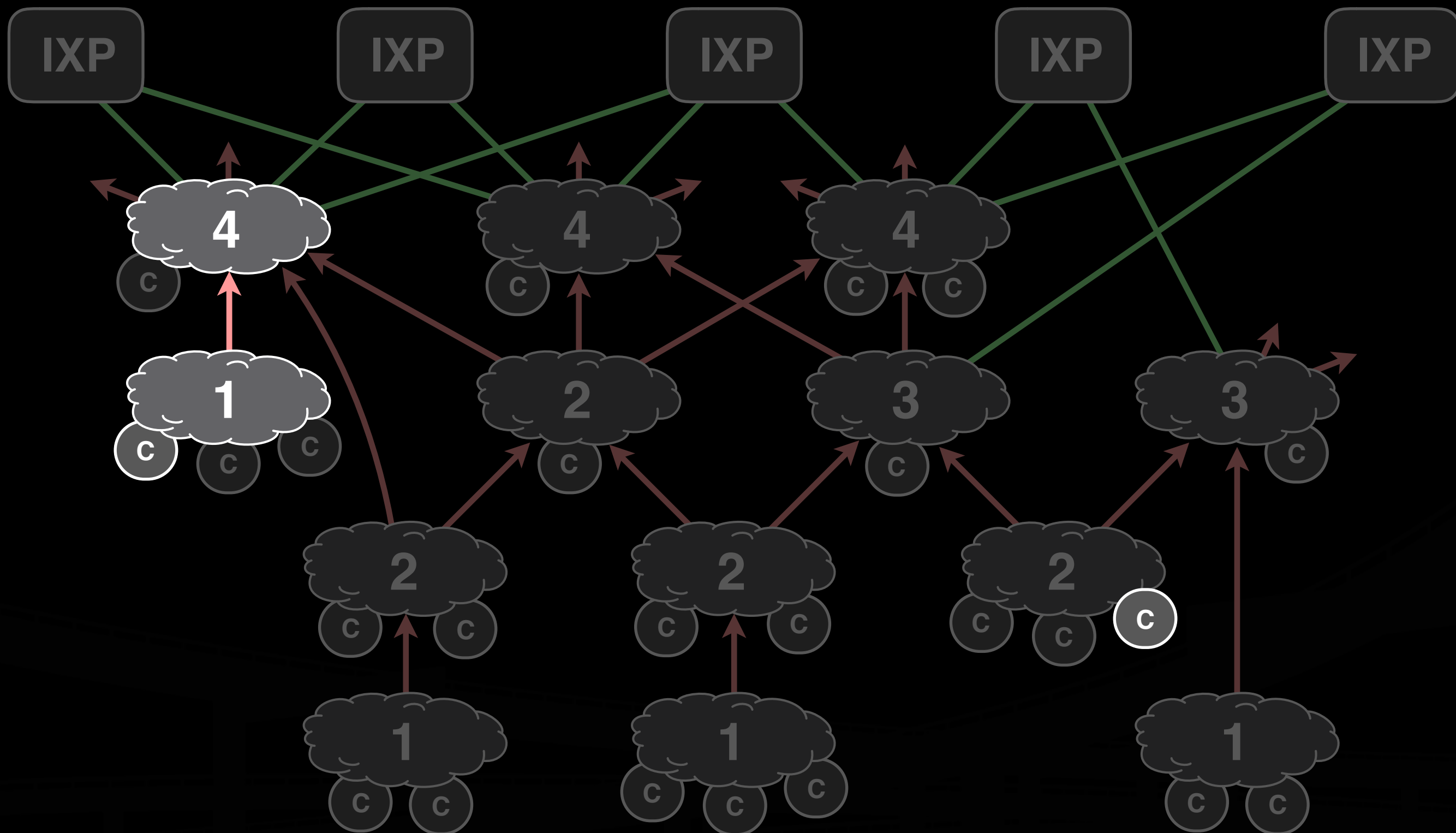


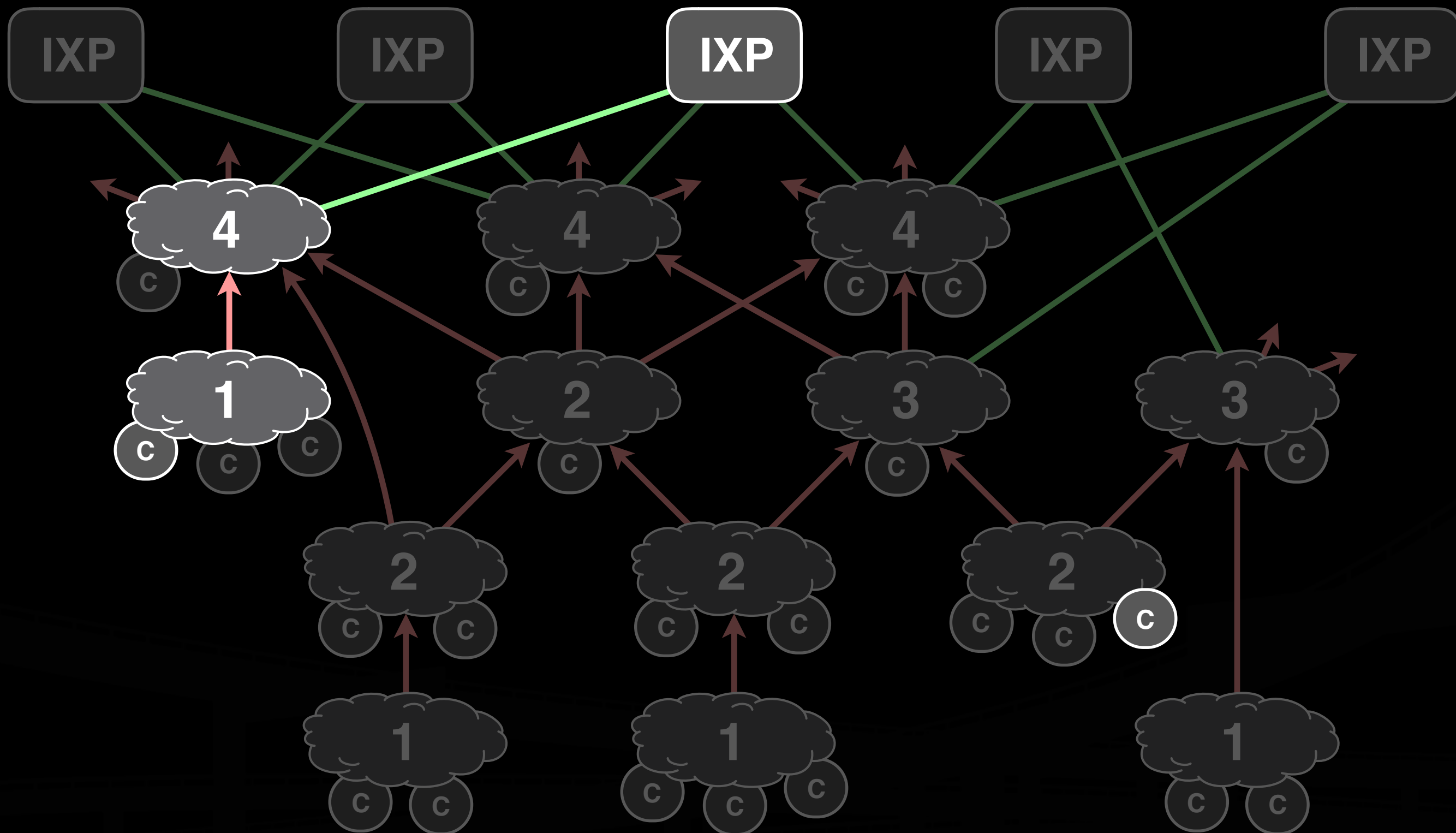


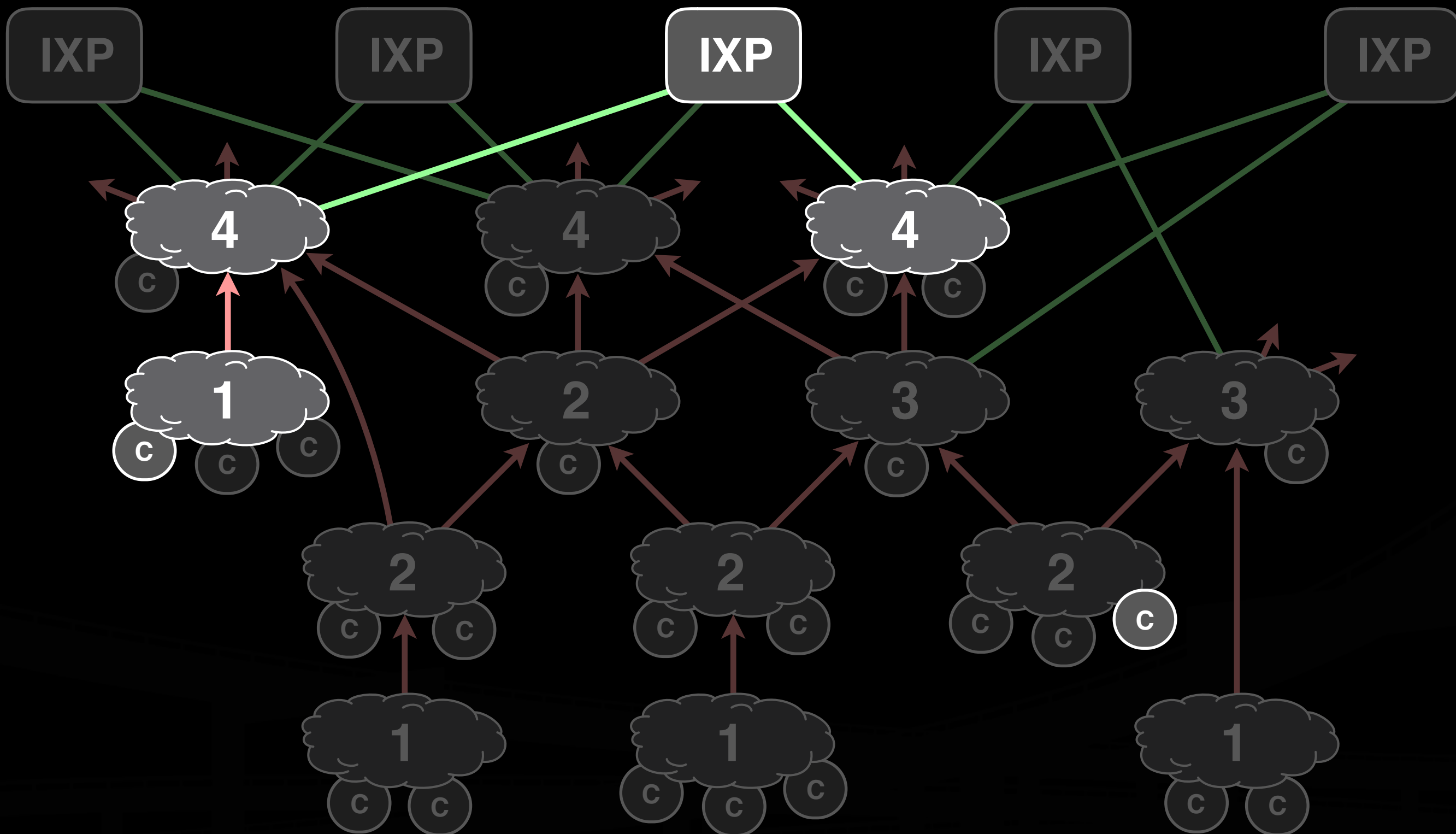


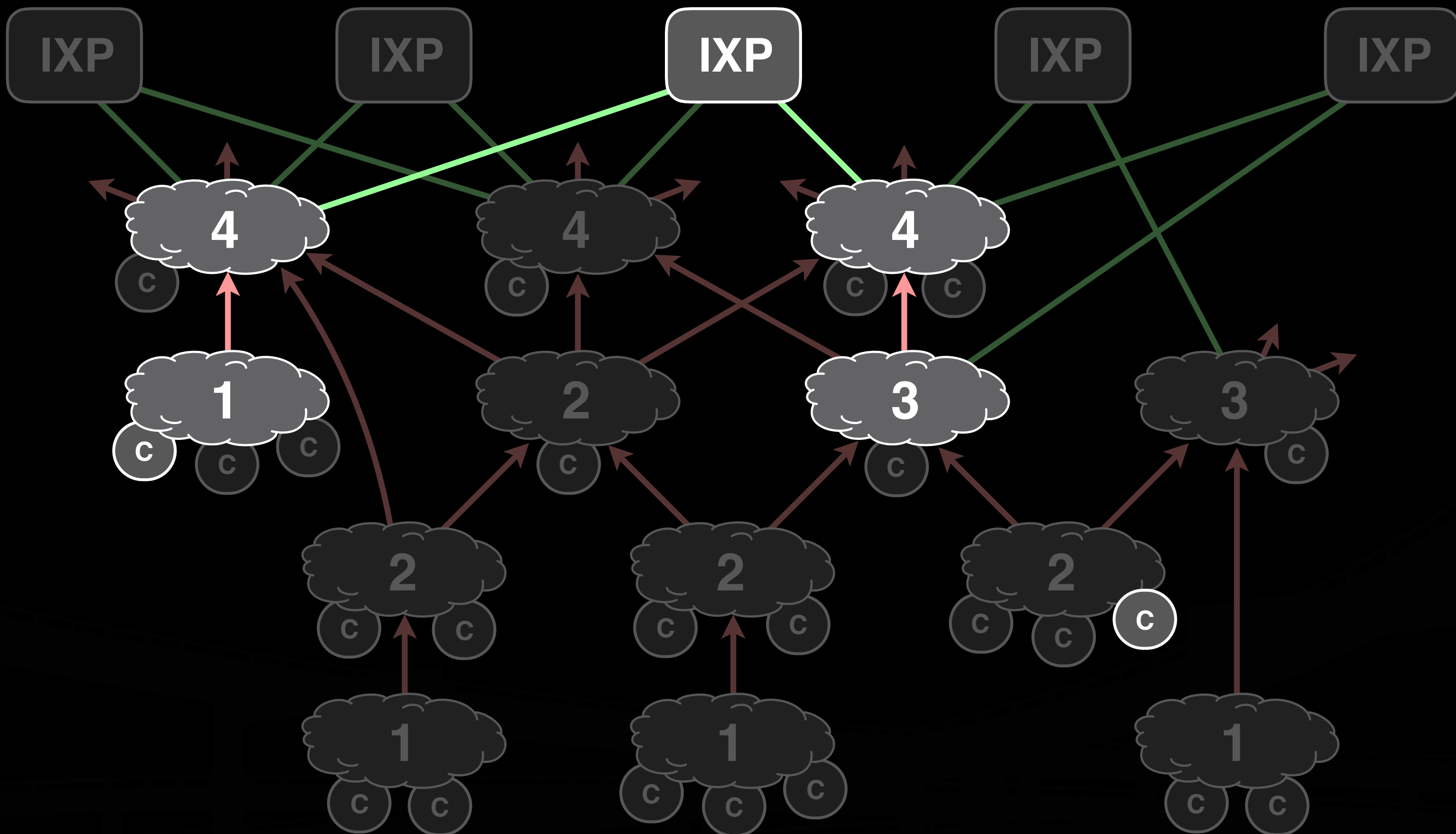


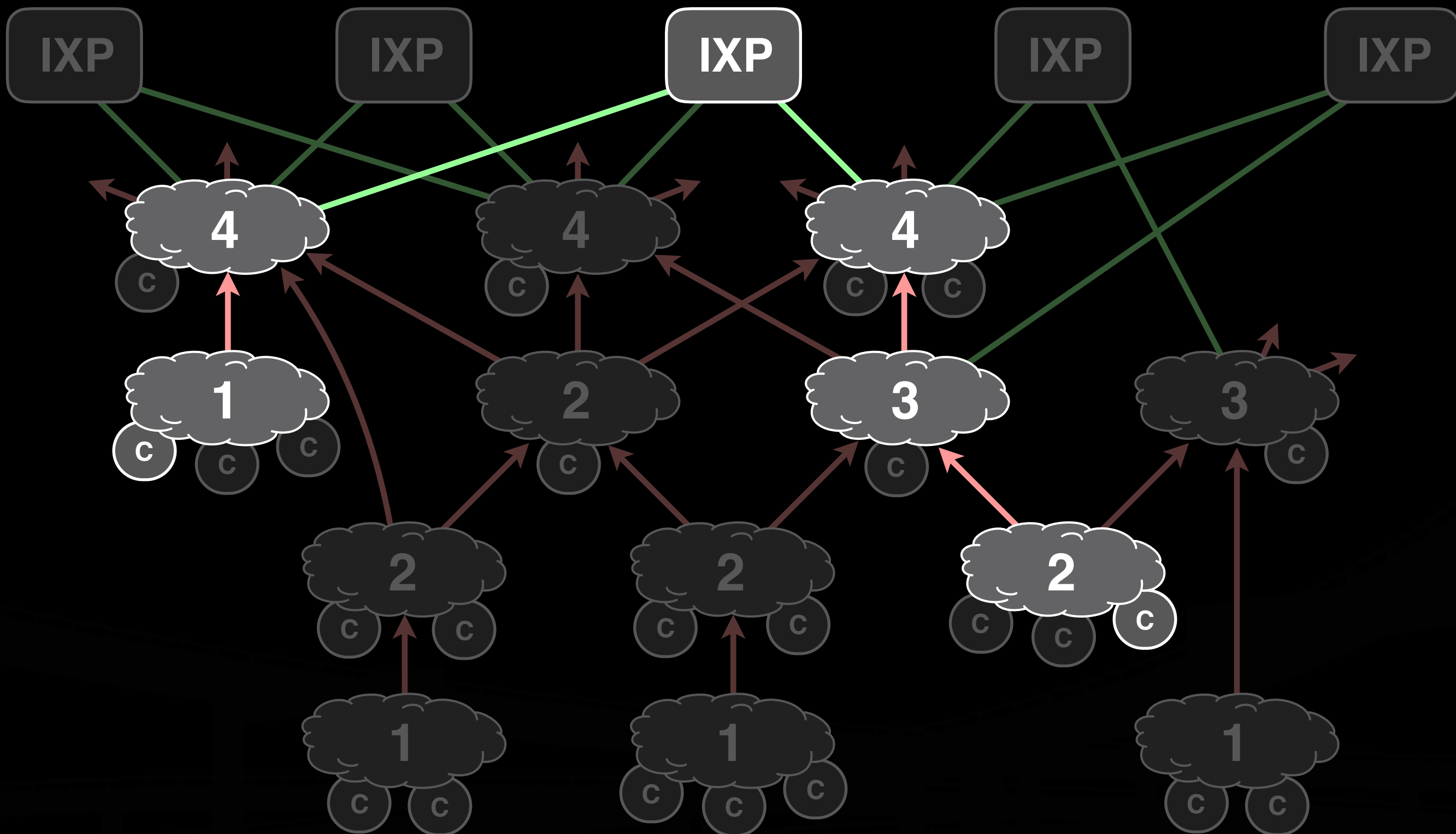






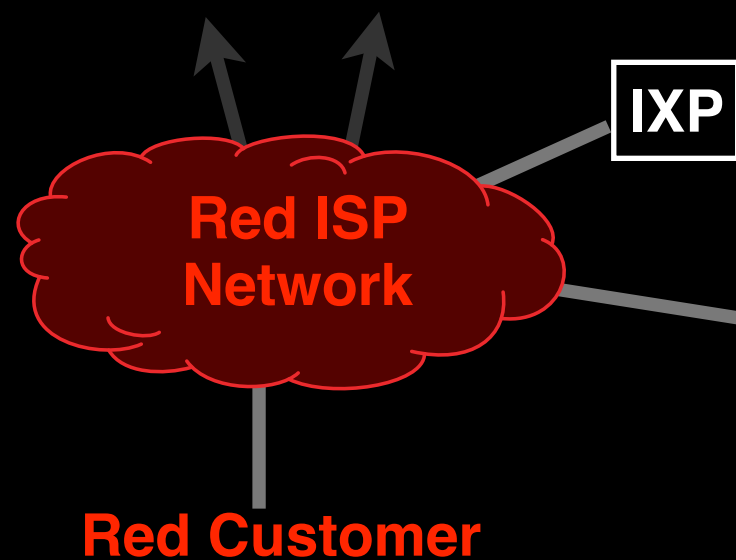




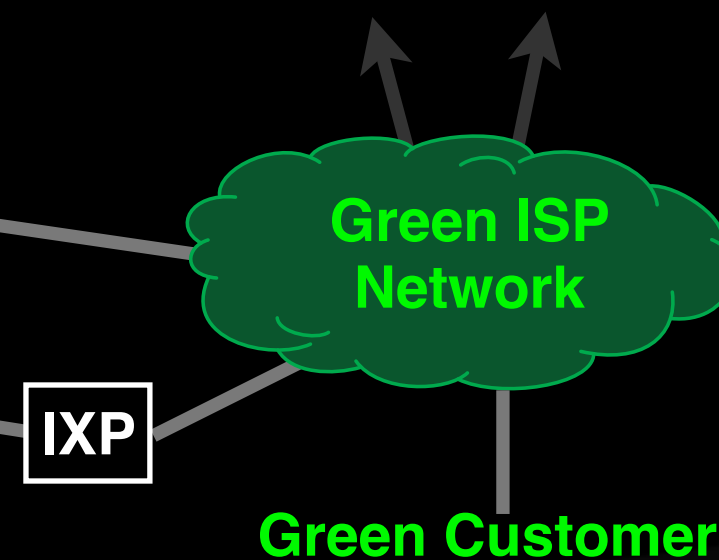


Hot Potato Routing

Redundant Transit Providers

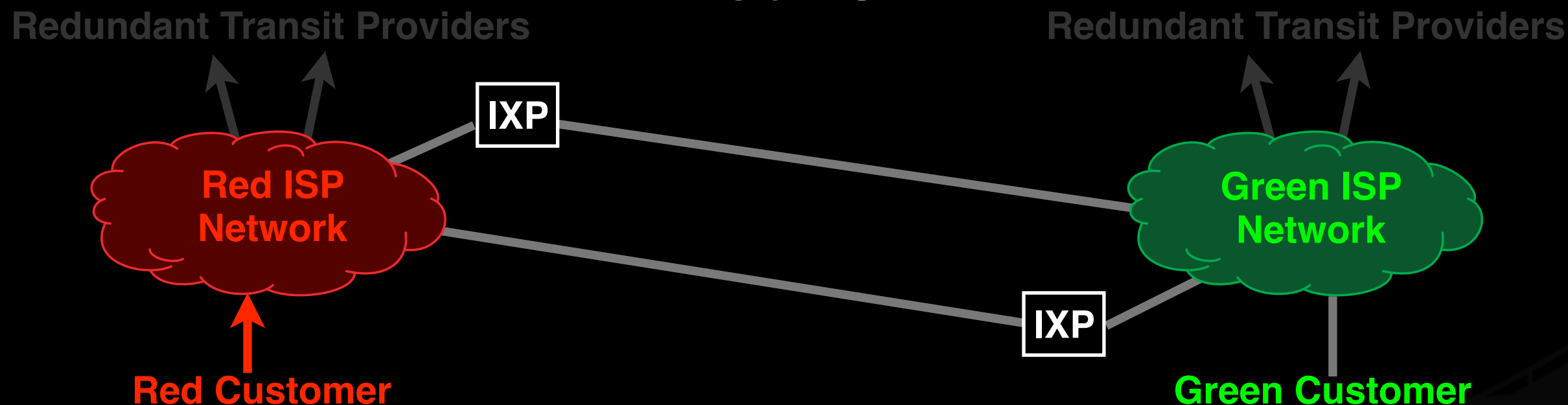


Redundant Transit Providers



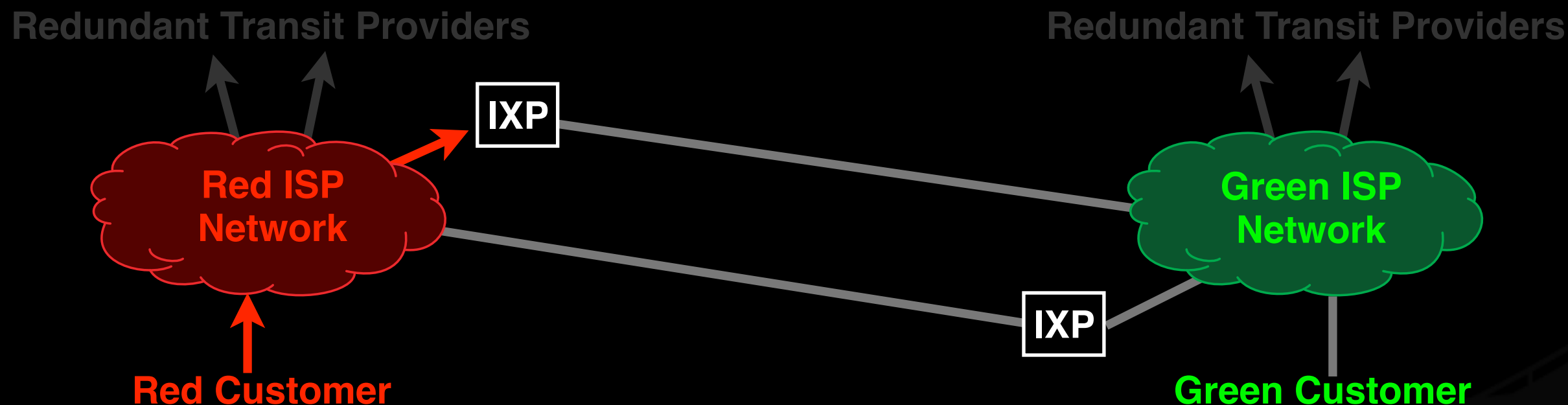
Hot Potato Routing

Red Customer sends to Green Customer via Red ISP



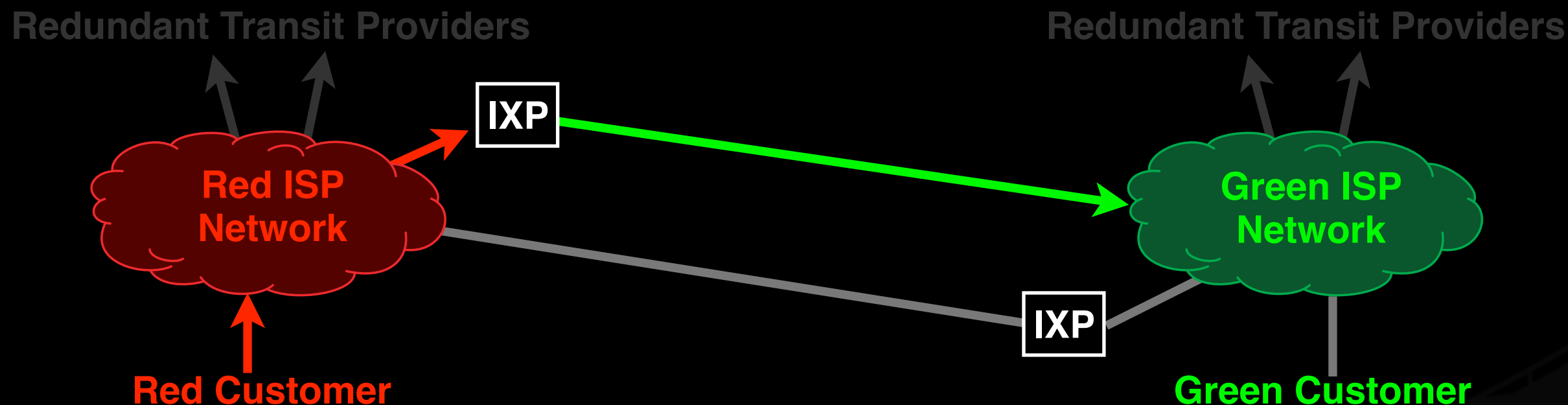
Hot Potato Routing

Red ISP delivers outbound at *nearest* IXP



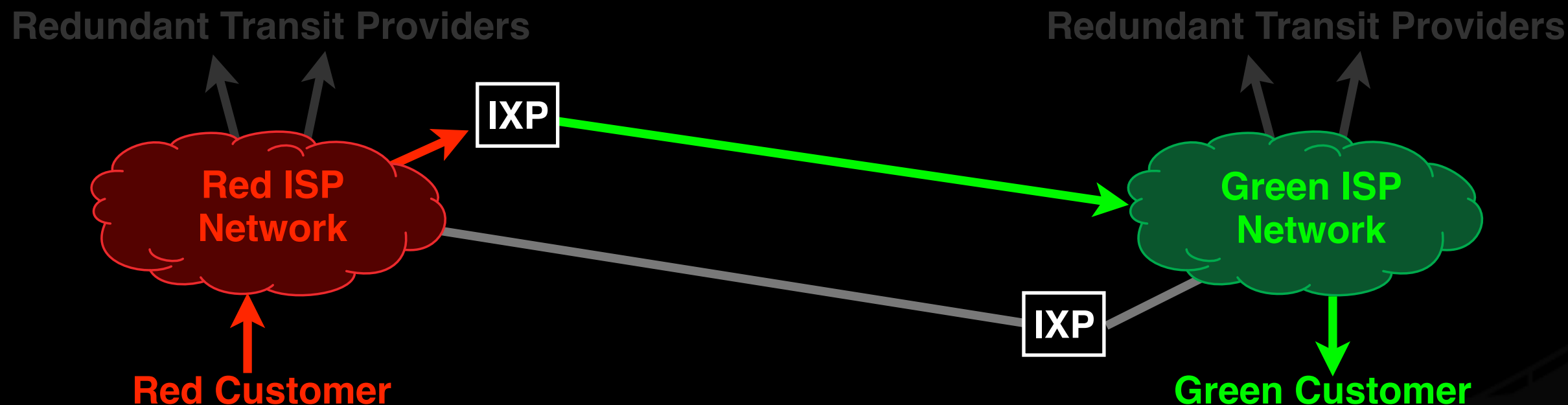
Hot Potato Routing

Green ISP backhauls inbound from distant IXP



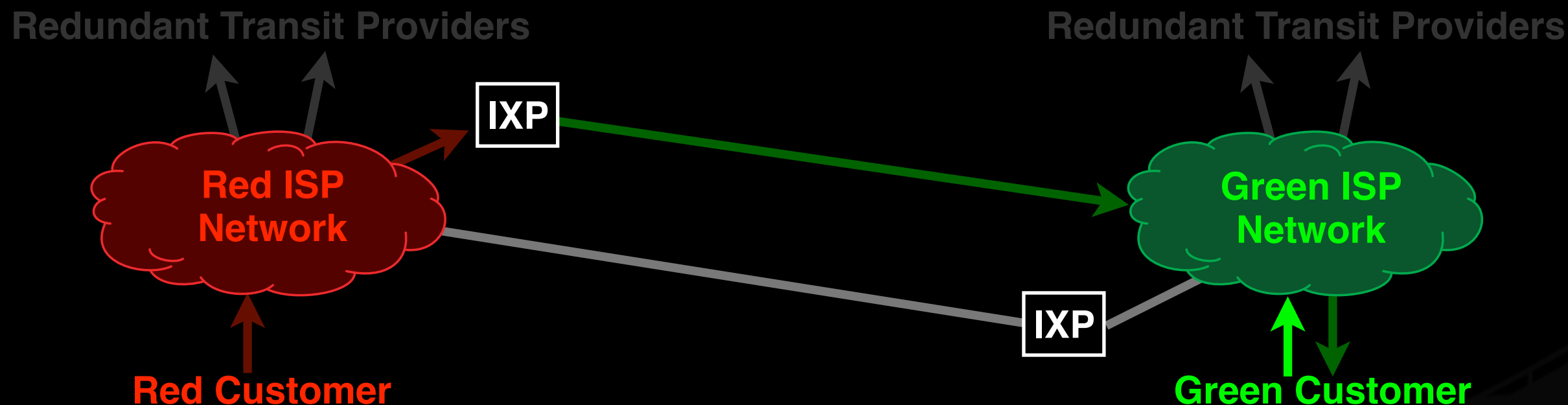
Hot Potato Routing

Green ISP delivers to Green Customer



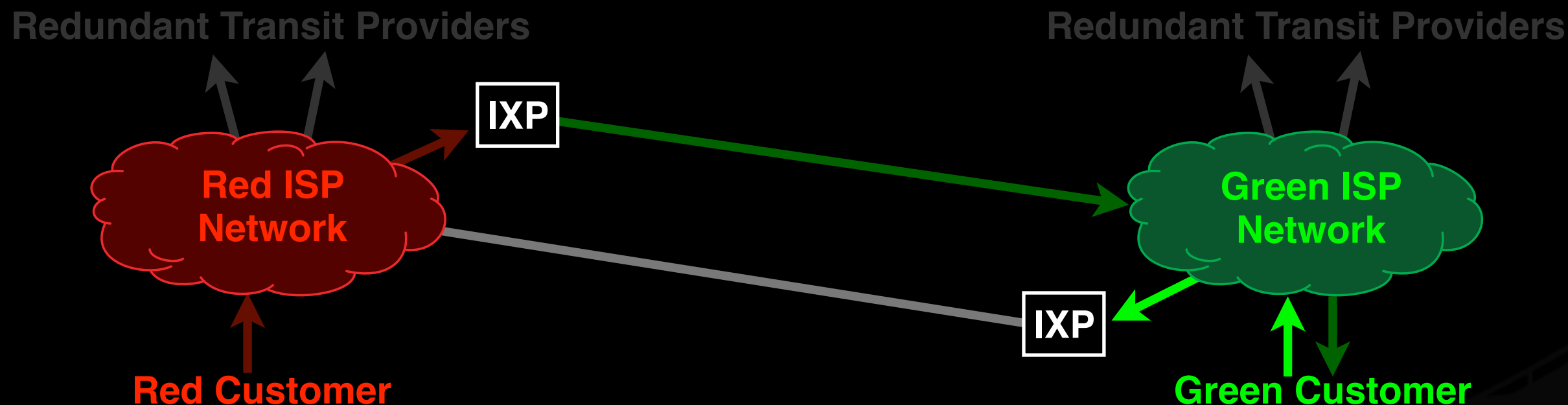
Hot Potato Routing

Green Customer replies via Green ISP



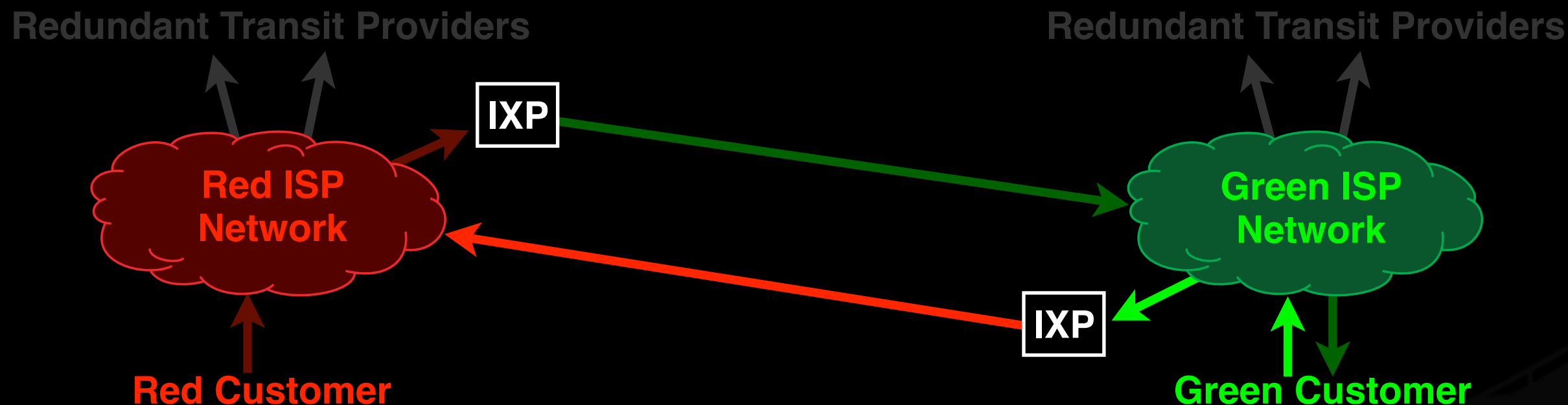
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Hot Potato Routing

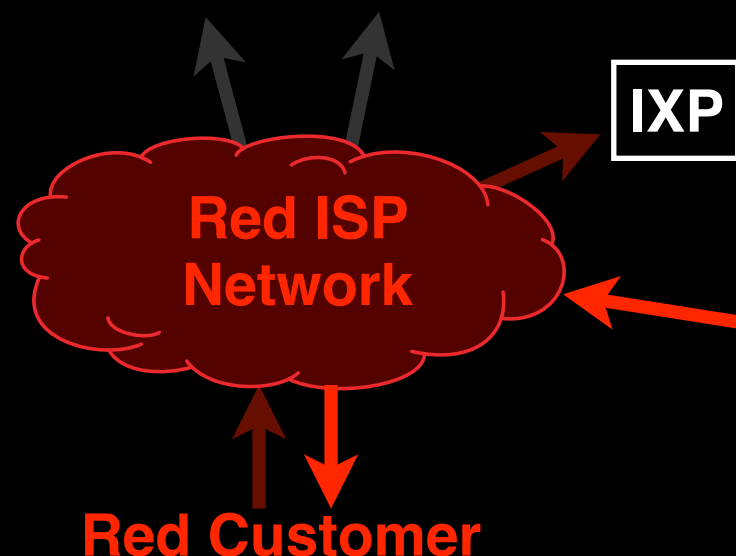
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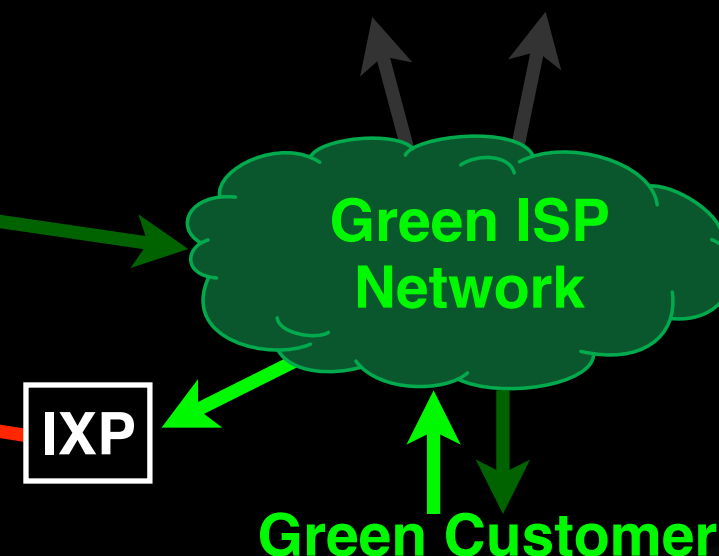
Hot Potato Routing

Red ISP delivers to Red Customer

Redundant Transit Providers

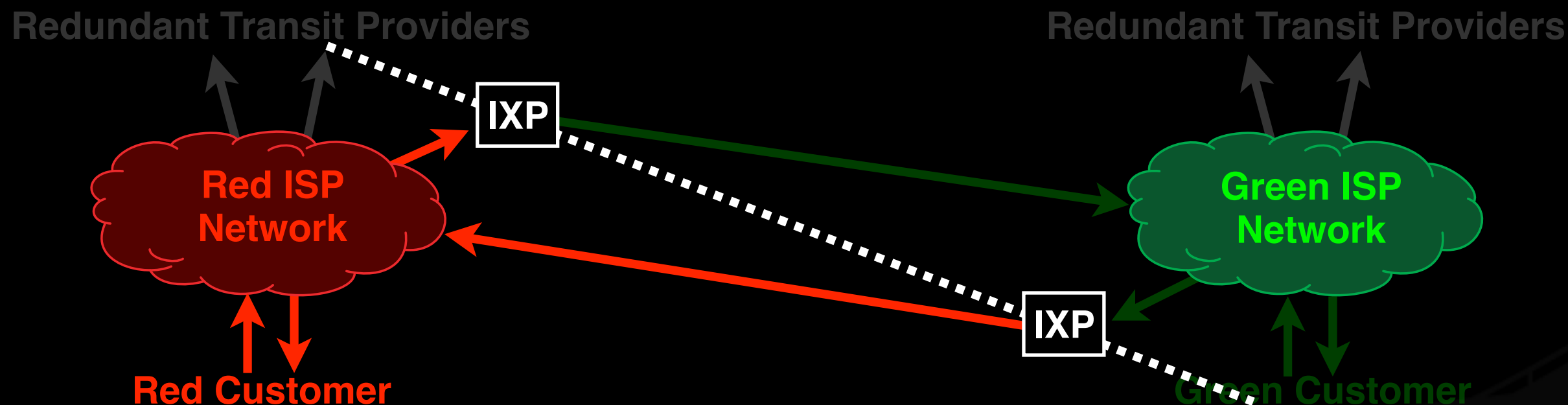


Redundant Transit Providers



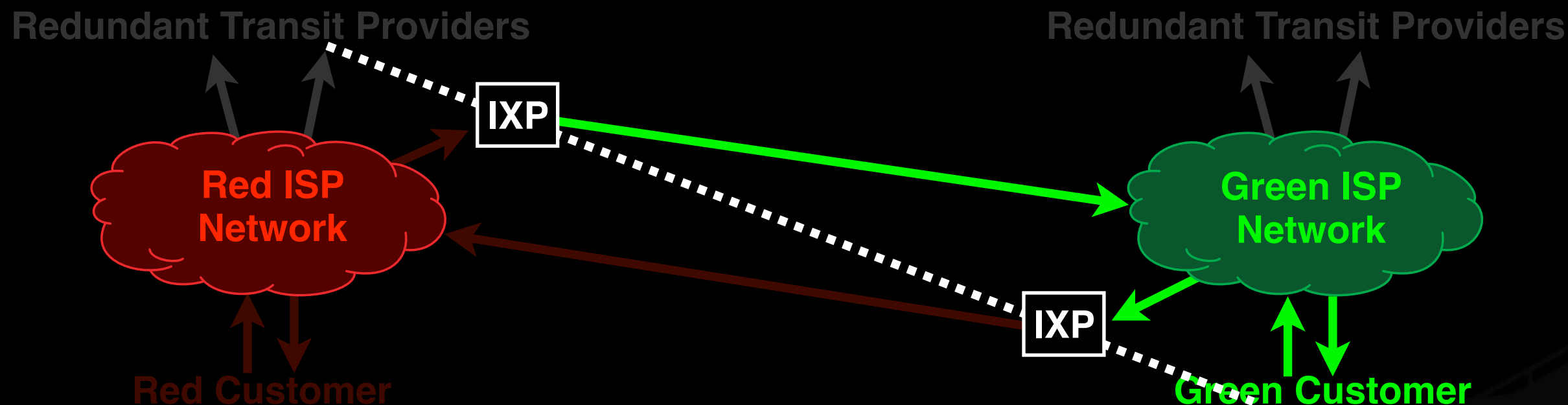
Hot Potato Routing

Red Network is responsible for its own costs



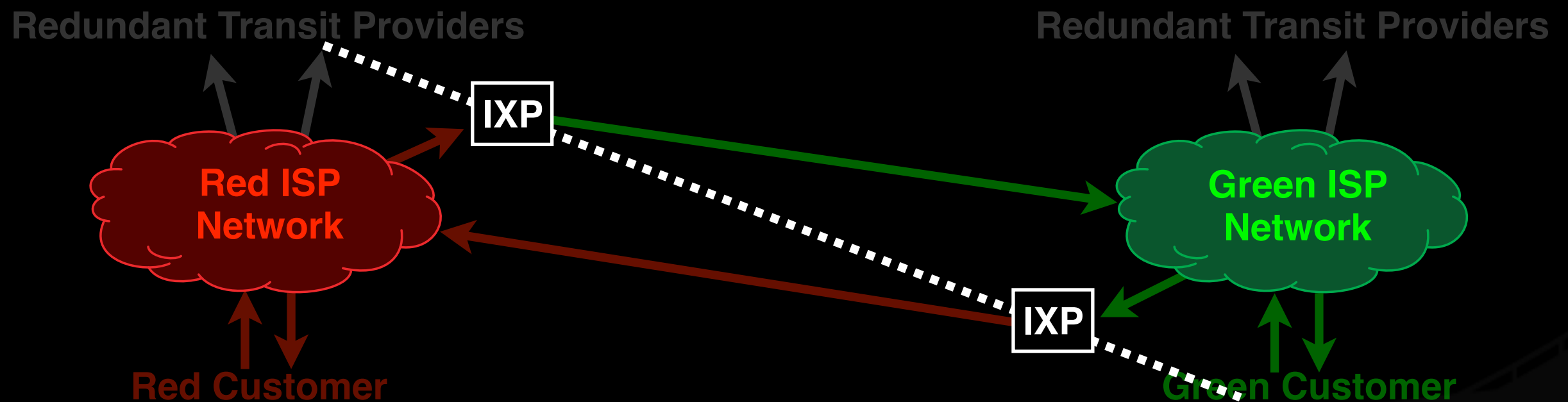
Hot Potato Routing

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, there must be a pair of exchanges, one near each party.

The Corollary:

Regions which haven't yet built Internet Exchange Points disadvantage themselves, and export capital to regions that already have.

Principles of Internet Economics



Principles of Internet Economics

Internet bandwidth is similar to a perishable commodity:

- It's produced at Internet exchange points
- It's consumed by people and organizations
- There's a ratio of production to consumption
- Shortfalls must be met through importation
- Regions are net importers or net exporters
- Importing bandwidth requires exporting capital
- Exporting bandwidth brings in revenue
- Value decreases as a function of time and distance

Distribution of 540 IXPs in 2018

