BGP

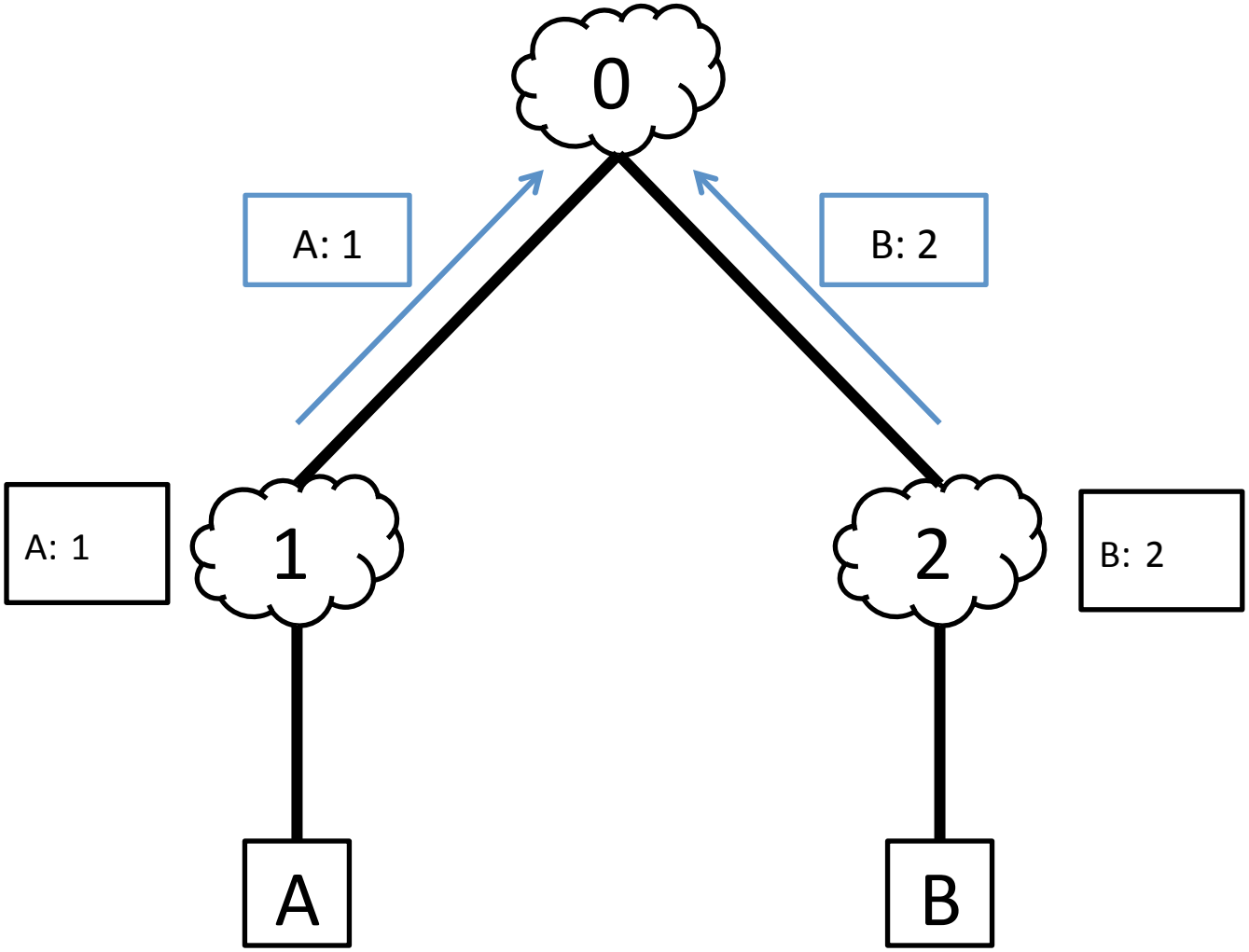
Border Gateway Protocol

EE122 Section 3

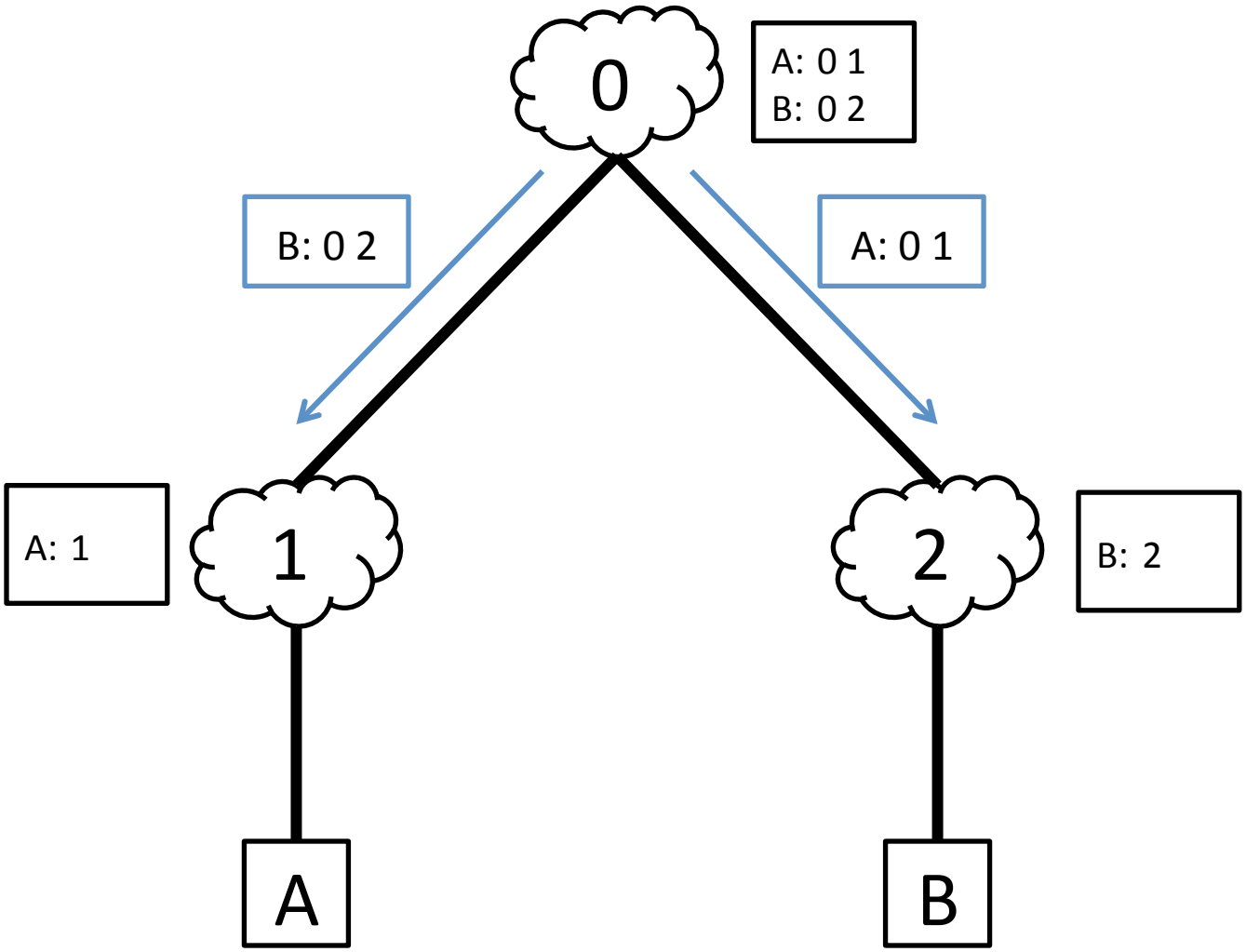
Border Gateway Protocol

- Protocol for inter-domain routing
- Designed for policy and privacy
- Why not distance-vector?
  - Shortest path may not be policy-compliant
  - …and policies vary across domains!
- Why not link-state?
  - Everybody knows everything – privacy goes for a toss!
- Enter path vector!

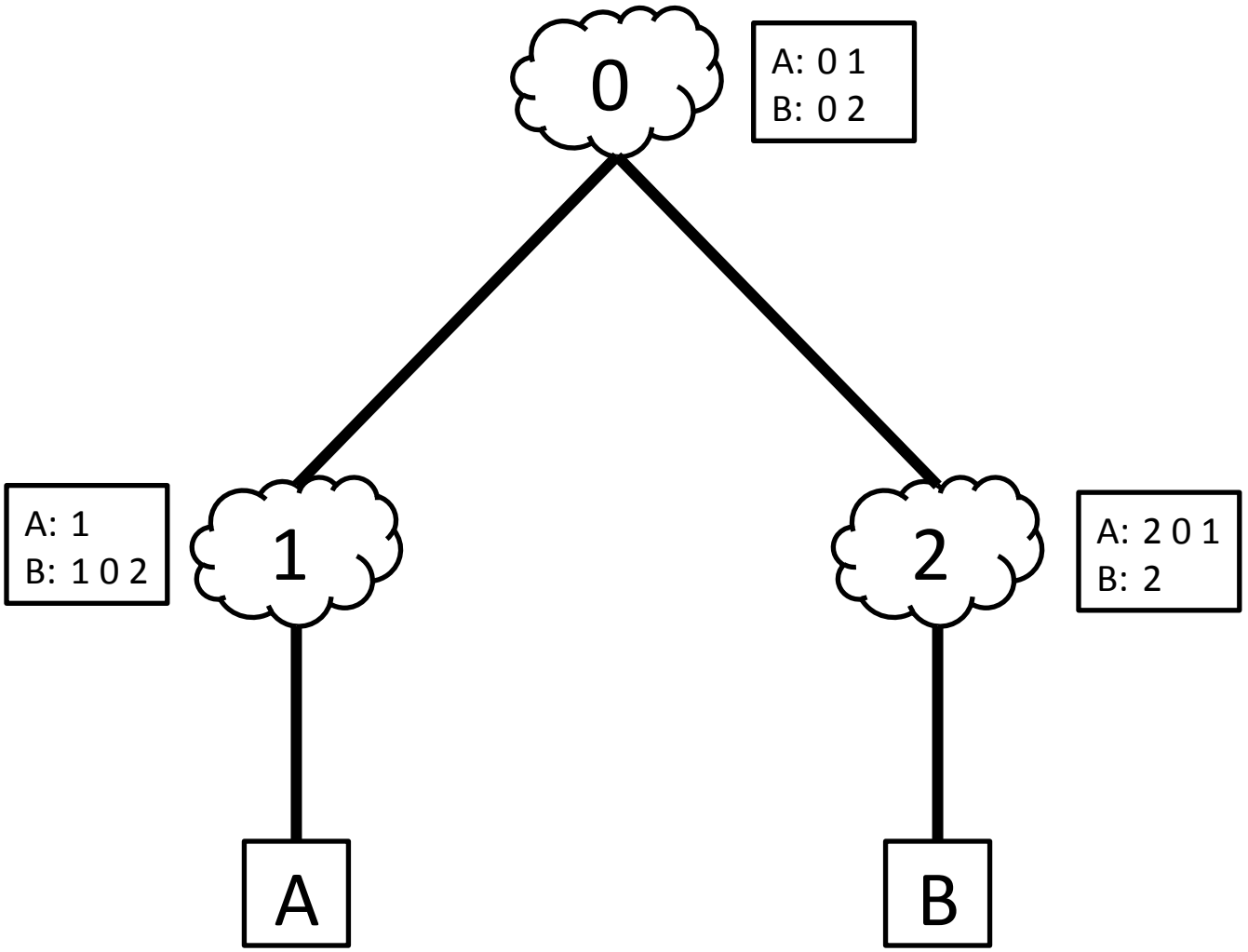
BGP: Path Vector



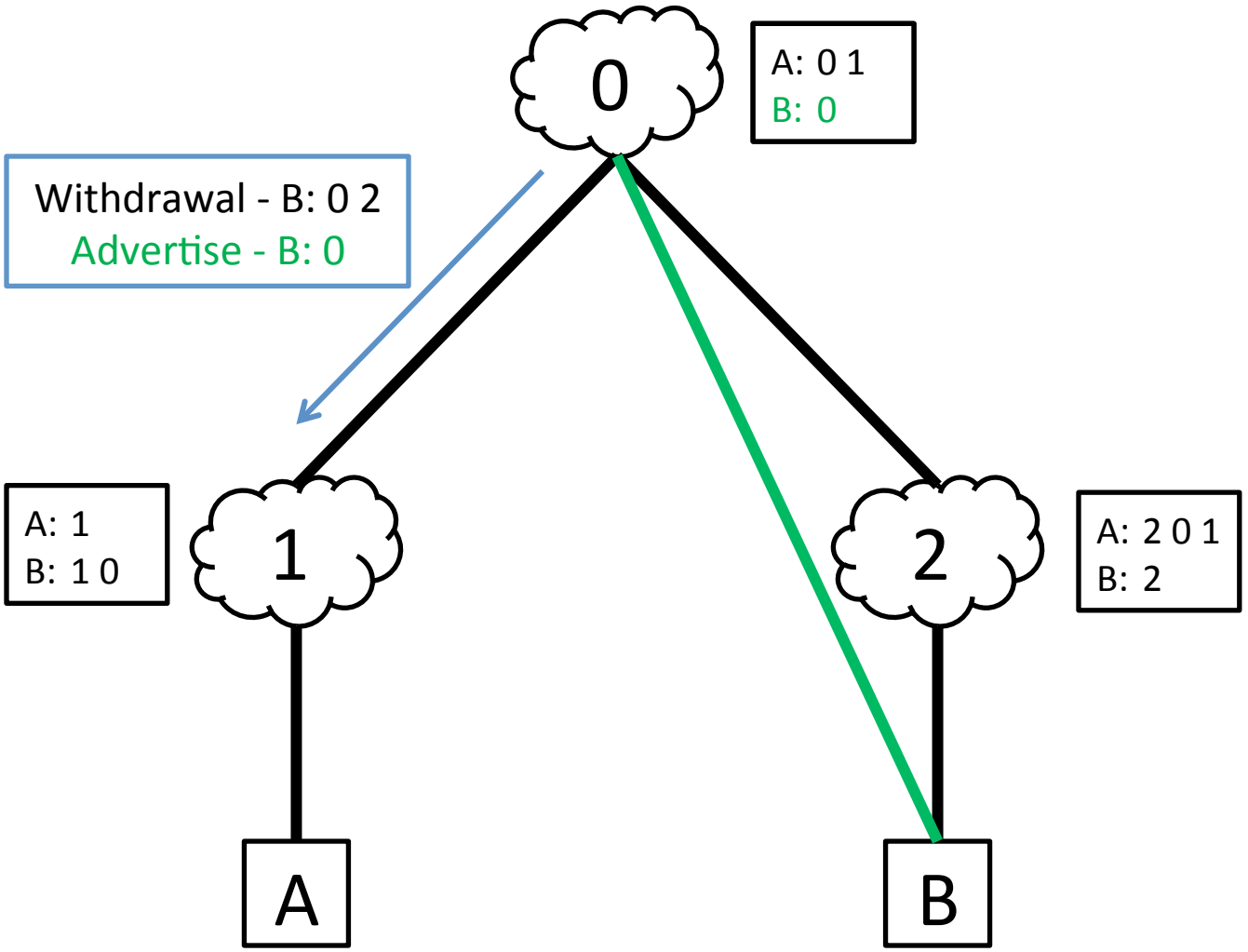
BGP: Path Vector



BGP: Path Vector

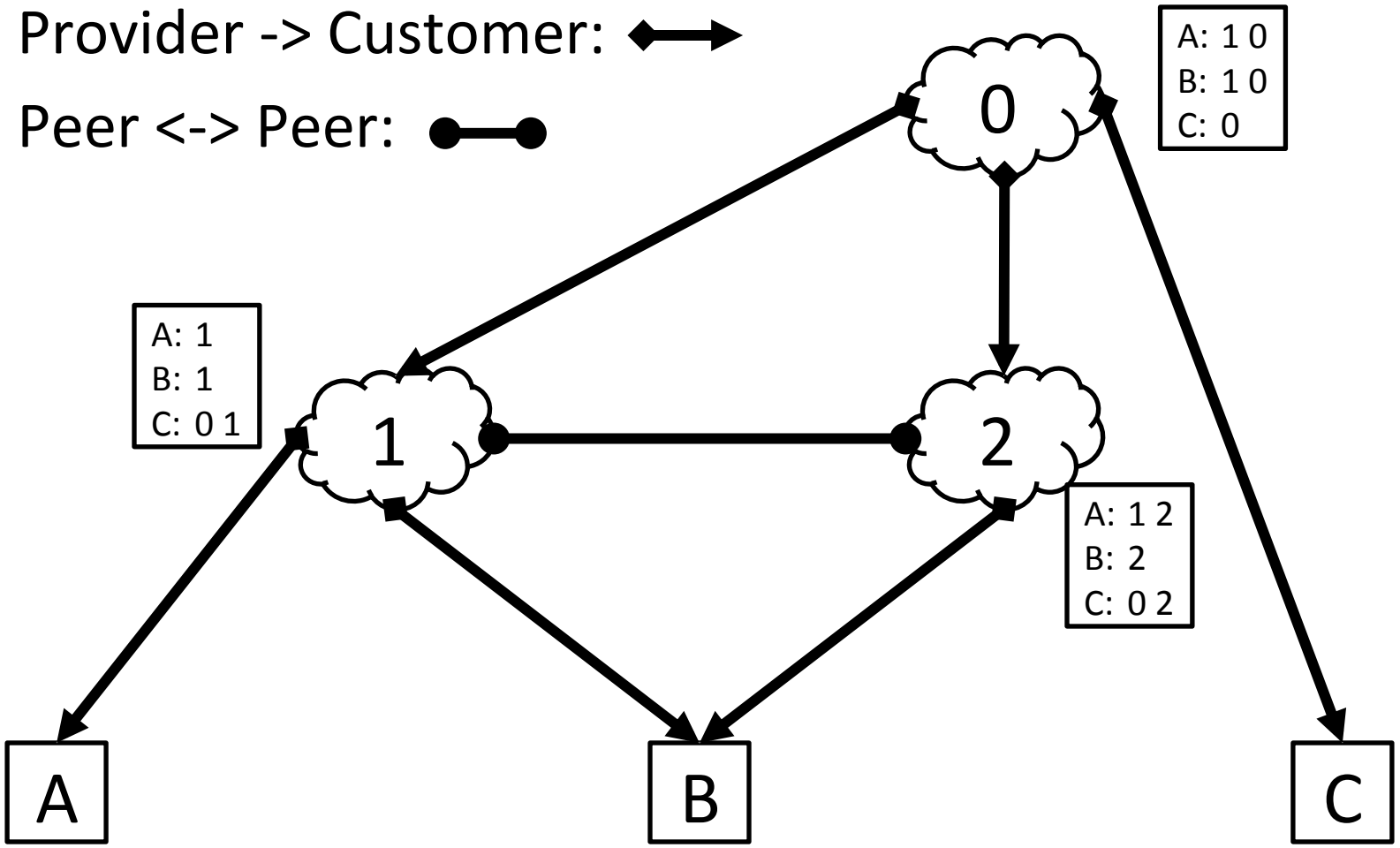


BGP: Path Vector



BGP Relationships

- Provider -> Customer: ◆⟶
- Peer <-> Peer: ●—●



It's all about the money!

- Customer pays provider
- Peers don't pay each other
  - Assume equal flow both ways

- Routing *policies* try to minimize payment

Typical Export Policy

Destination prefix advertised by…	Export route to…
Customer	Everyone (providers, peers, other customers)
Peer	Customers
Provider	Customers

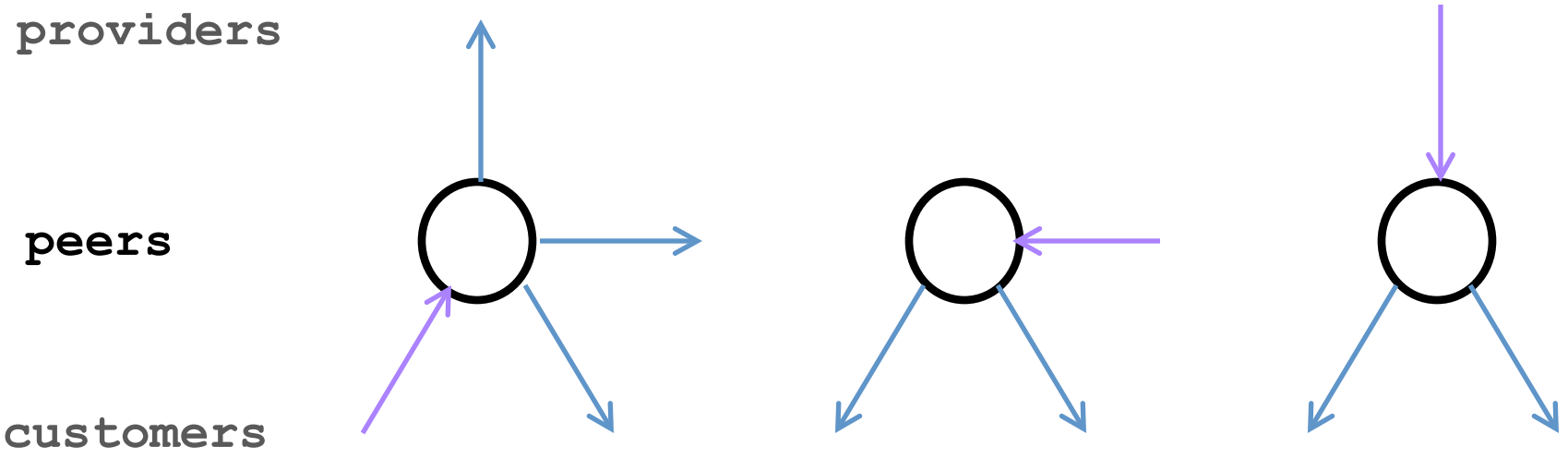
We'll refer to these as the "Gao-Rexford" rules (capture common -- but not required! -- practice!)

Gao-Rexford

providers

peers

customers



With Gao-Rexford, the AS policy graph is a
DAG (directed acyclic graph) and routes are “valley free”

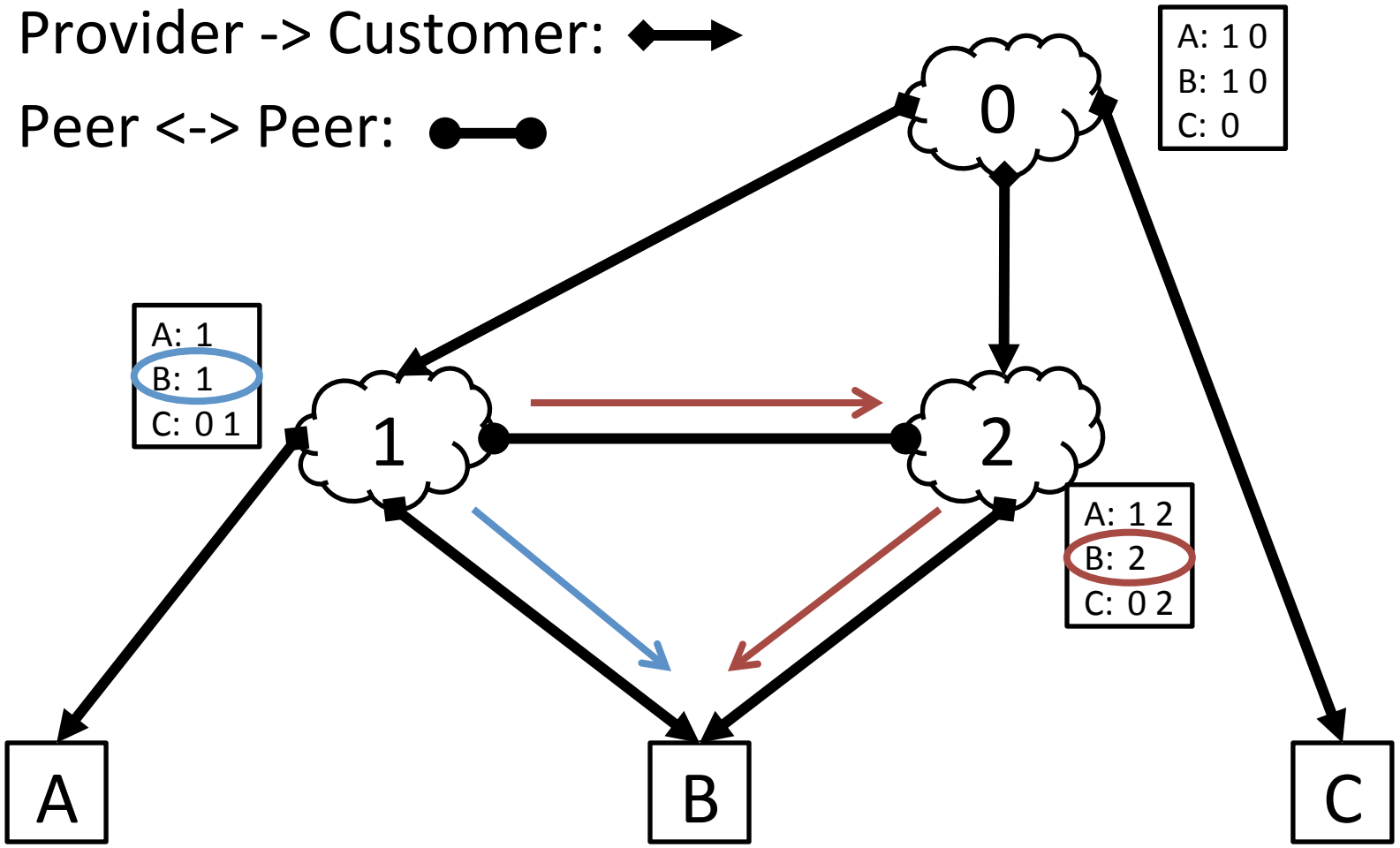
Packets flow where money flows

- **Route Selection**
  - Preference Order: Customer > Peer > Provider

- **Route Export Policy**
  - Peers provide transit between their customers
  - Peers do not provide transit to each other

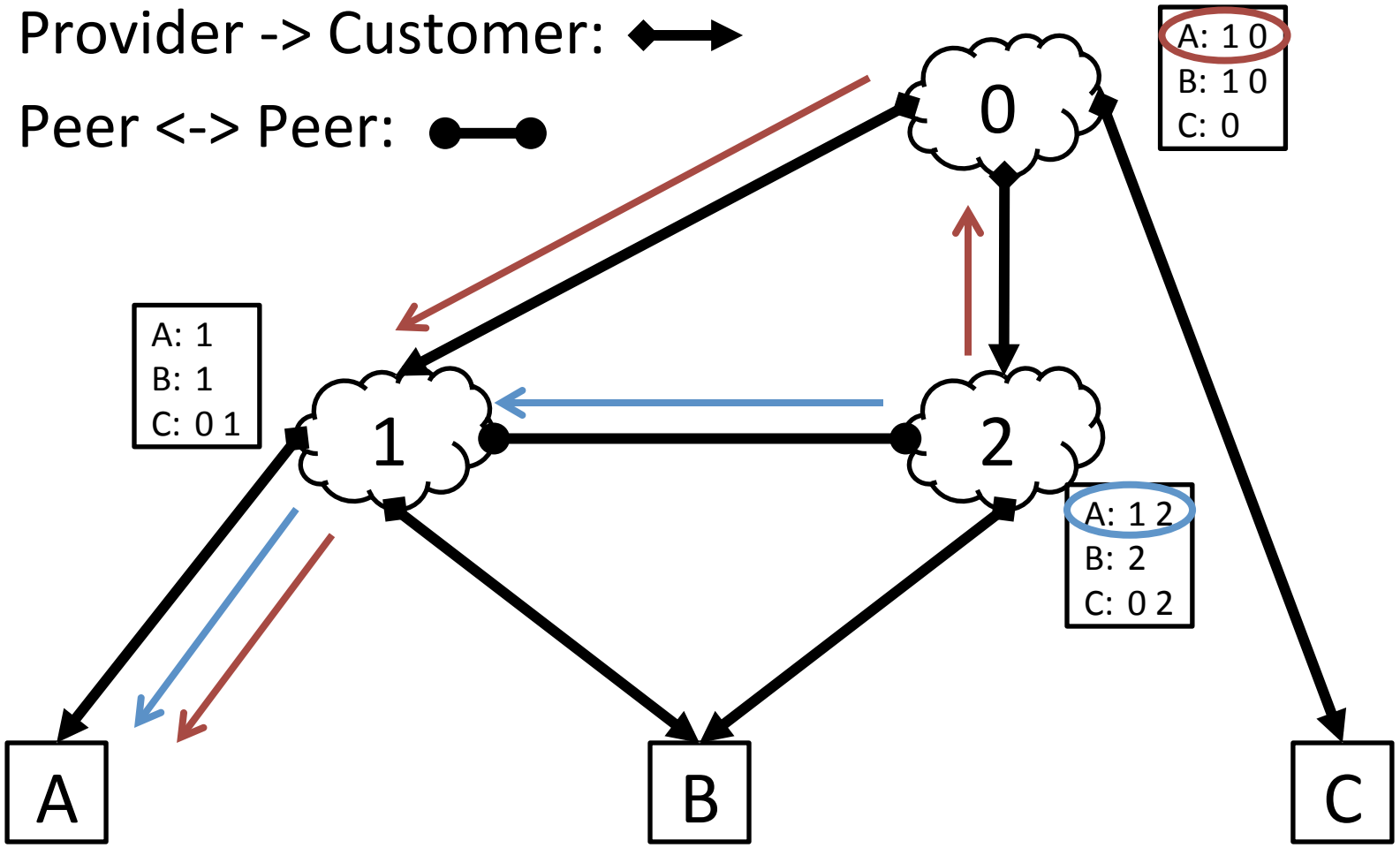
Route Selection: Customer > Peer

- Provider -> Customer: ◆⟶
- Peer <-> Peer: ●—●



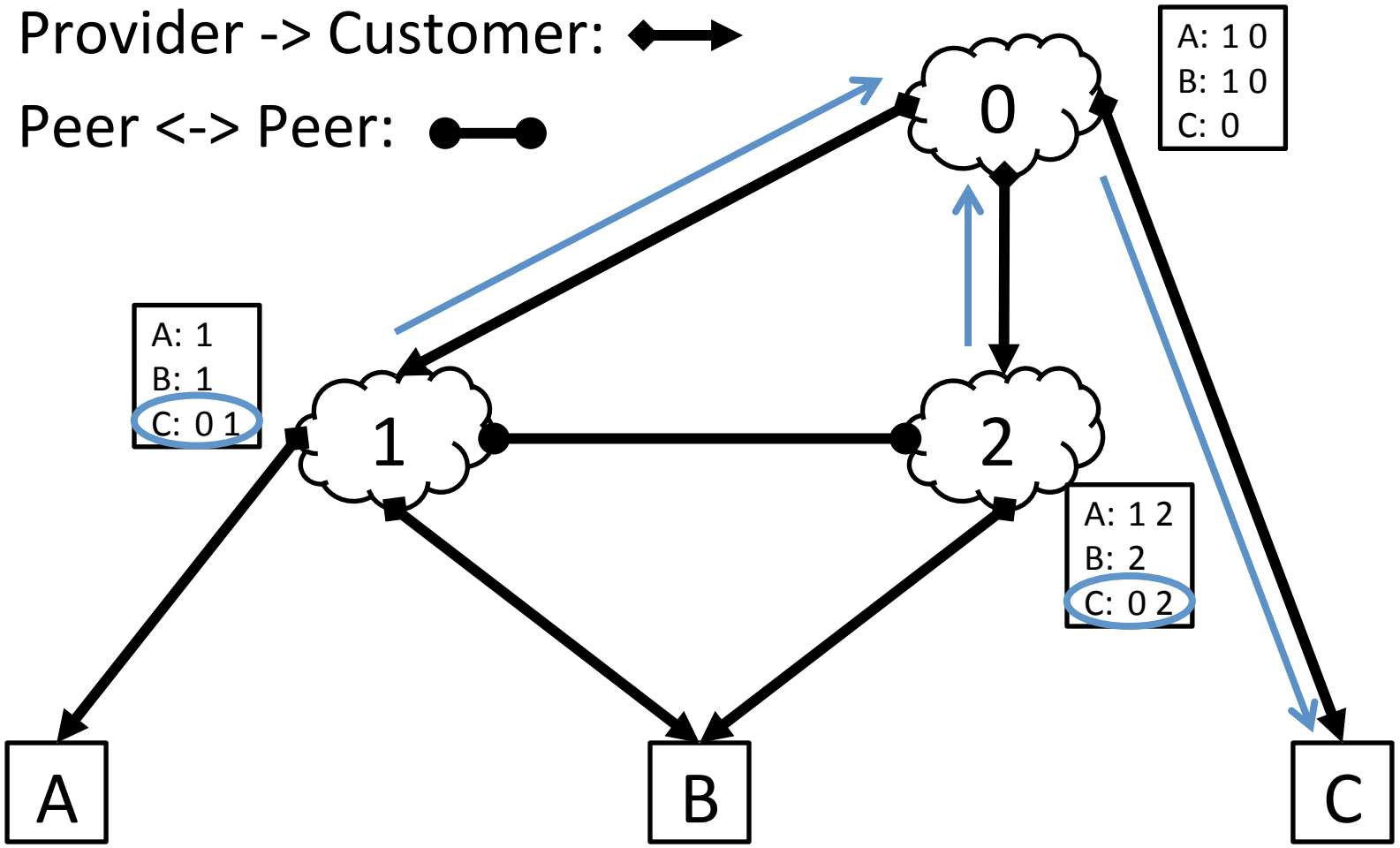
Route Selection : Peer > Provider

- Provider -> Customer:
- Peer <-> Peer:



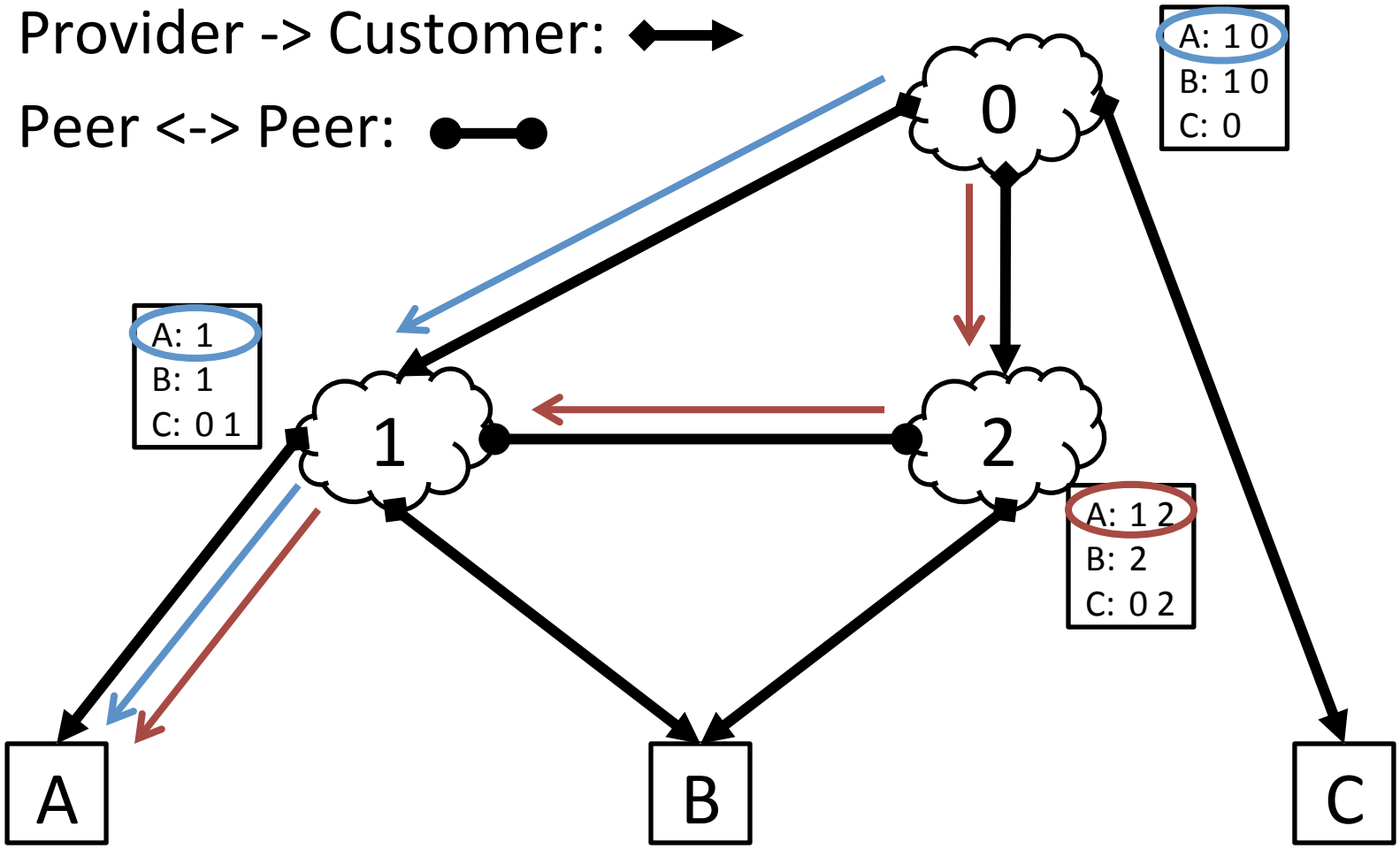
Route Selection : Provider (no choice)

- Provider -> Customer: ◆⟶
- Peer <-> Peer: ●—●



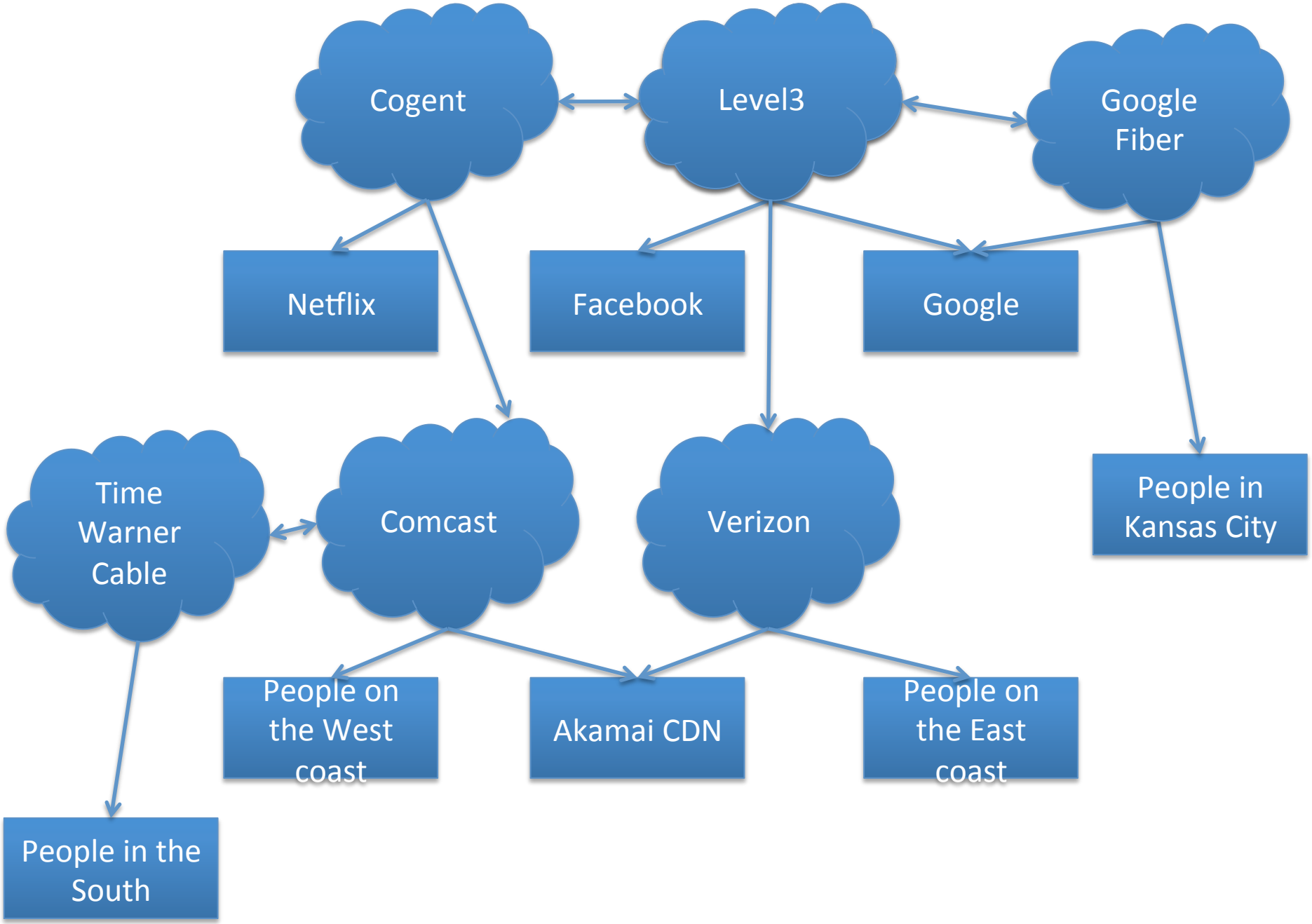
Route Export policy: Advertise customers

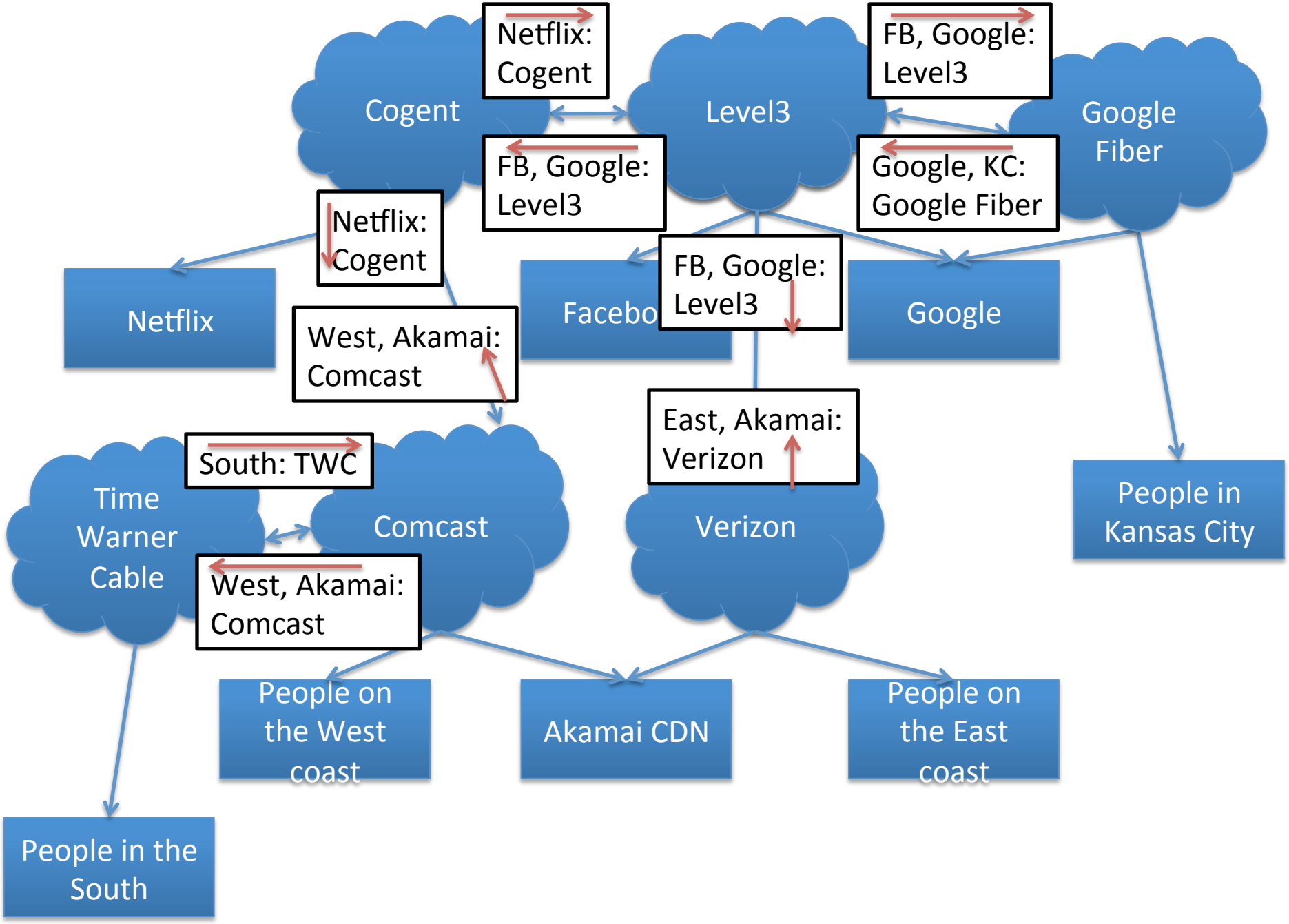
- Provider -> Customer: ◆⟶
- Peer <-> Peer: ●—●

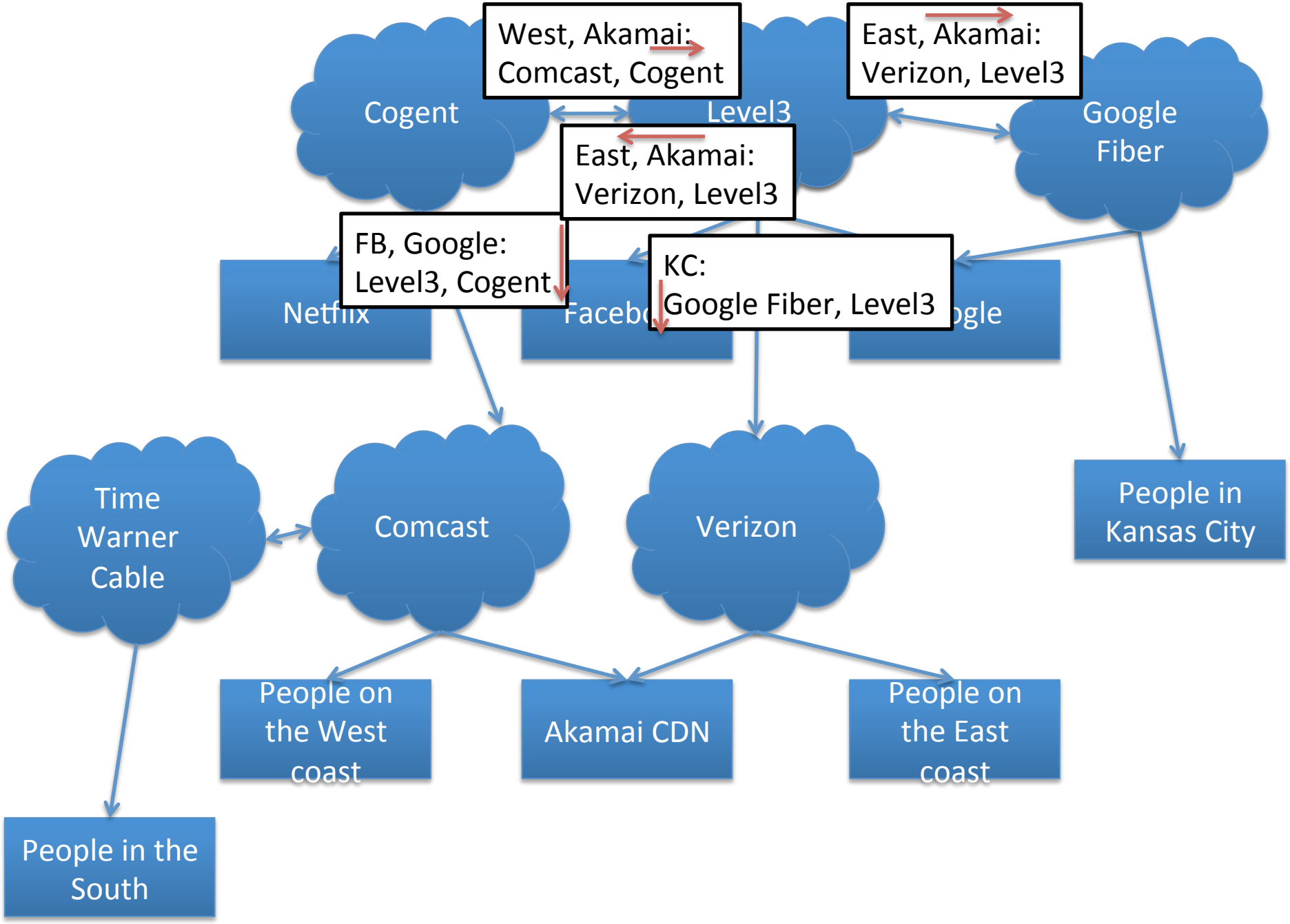


BGP Routing Game!

- No talking! Communicate via pieces of paper
- **Route selection precedence**
  - Customer > Peer > Provider
- **Export policy**: Advertise customers
- Message format:
  - Withdrawal - <host network>: <path>
  - Advertise - <host network>: <path>
  - Ping - <destination>
- **Goal**: Reach steady state


Cogent
Level3
Google Fiber
Netflix
Facebook
Google
Time Warner Cable
Comcast
Verizon
People in Kansas City
People on the West coast
Akamai CDN
People on the East coast
People in the South


Cogent
Netflix: Cogent
Level3
FB, Google: Level3
Google Fiber
FB, Google: Level3
Google, KC: Google Fiber
Netflix: Cogent
Netflix
Facebo
FB, Google: Level3
Google
West, Akamai: Comcast
East, Akamai: Verizon
People in Kansas City
South: TWC
Time Warner Cable
Comcast
Verizon
West, Akamai: Comcast
People on the West coast
Akamai CDN
People on the East coast
People in the South


West, Akamai:
Comcast, Cogent
East, Akamai:
Verizon, Level3
Cogent
Level3
Google
Fiber
East, Akamai:
Verizon, Level3
FB, Google:
Level3, Cogent
KC:
Google Fiber, Level3
Netflix
Facebo
ogle
Time
Warner
Cable
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People in
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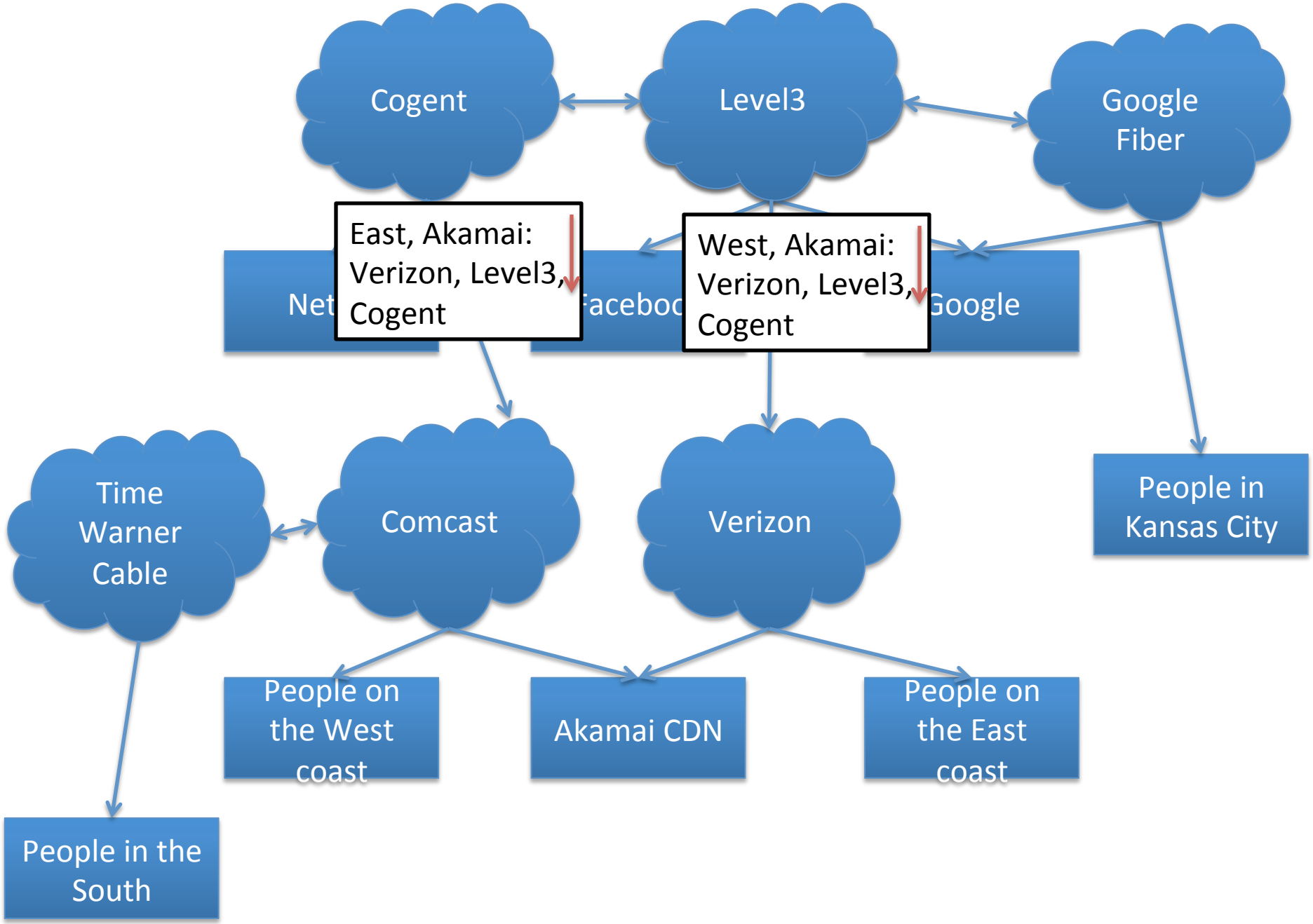
the West
coast
Akamai CDN
People on
the East
coast
People in the
South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