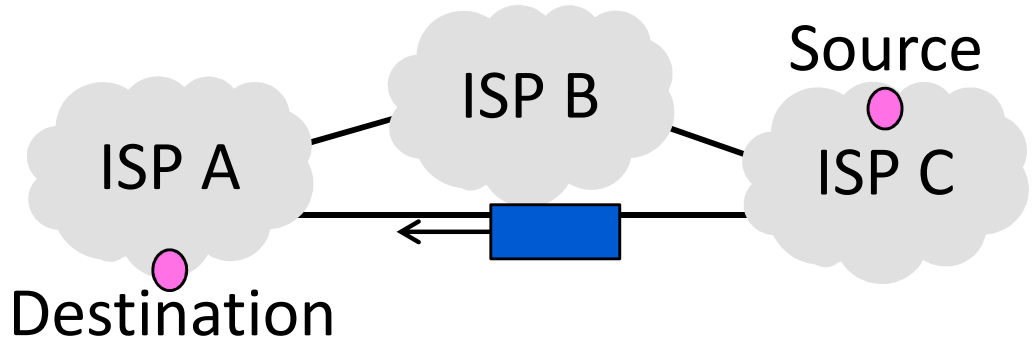
Computer Networks

Border Gateway Protocol (§5.6.7)

David Wetherall (djw@uw.edu)
Professor of Computer Science & Engineering
UNIVERSITY of WASHINGTON

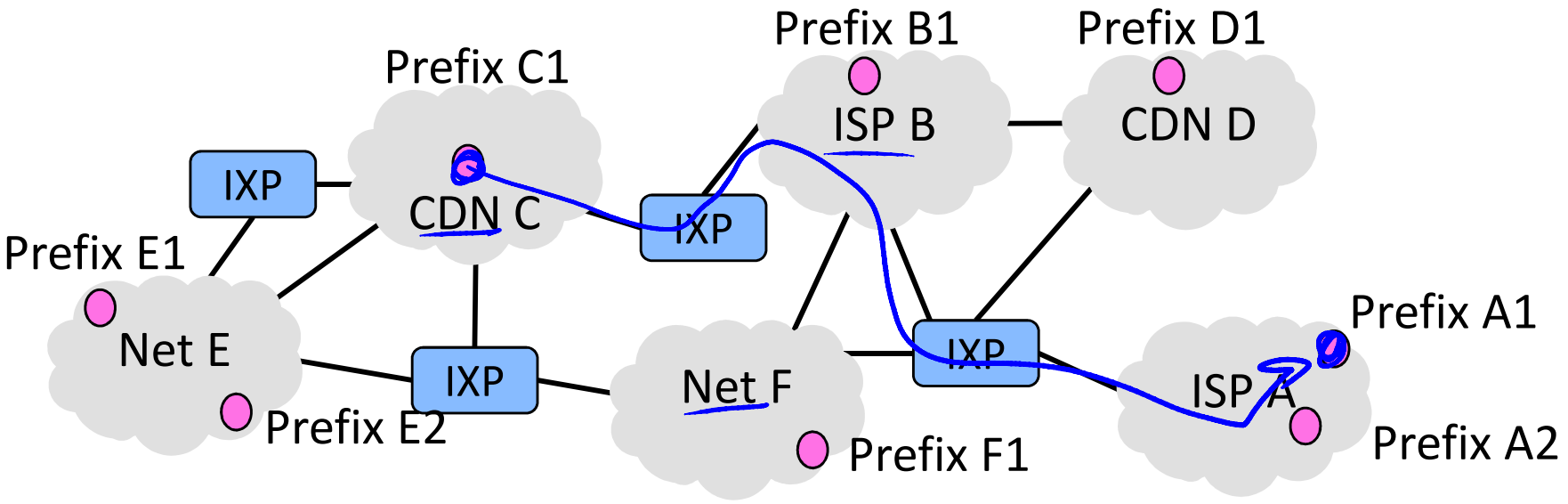
Topic

- How to route with multiple parties, each with their own routing policies
  - BGP computes Internet-wide routes



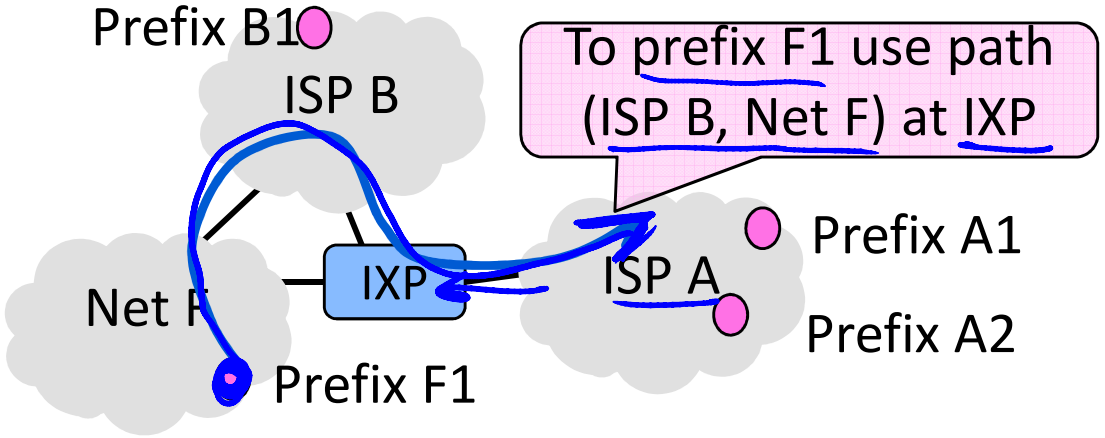
Recall

- Internet is made up of independently run networks
- Each network has its own route preferences (policies)



BGP (Border Gateway Protocol)

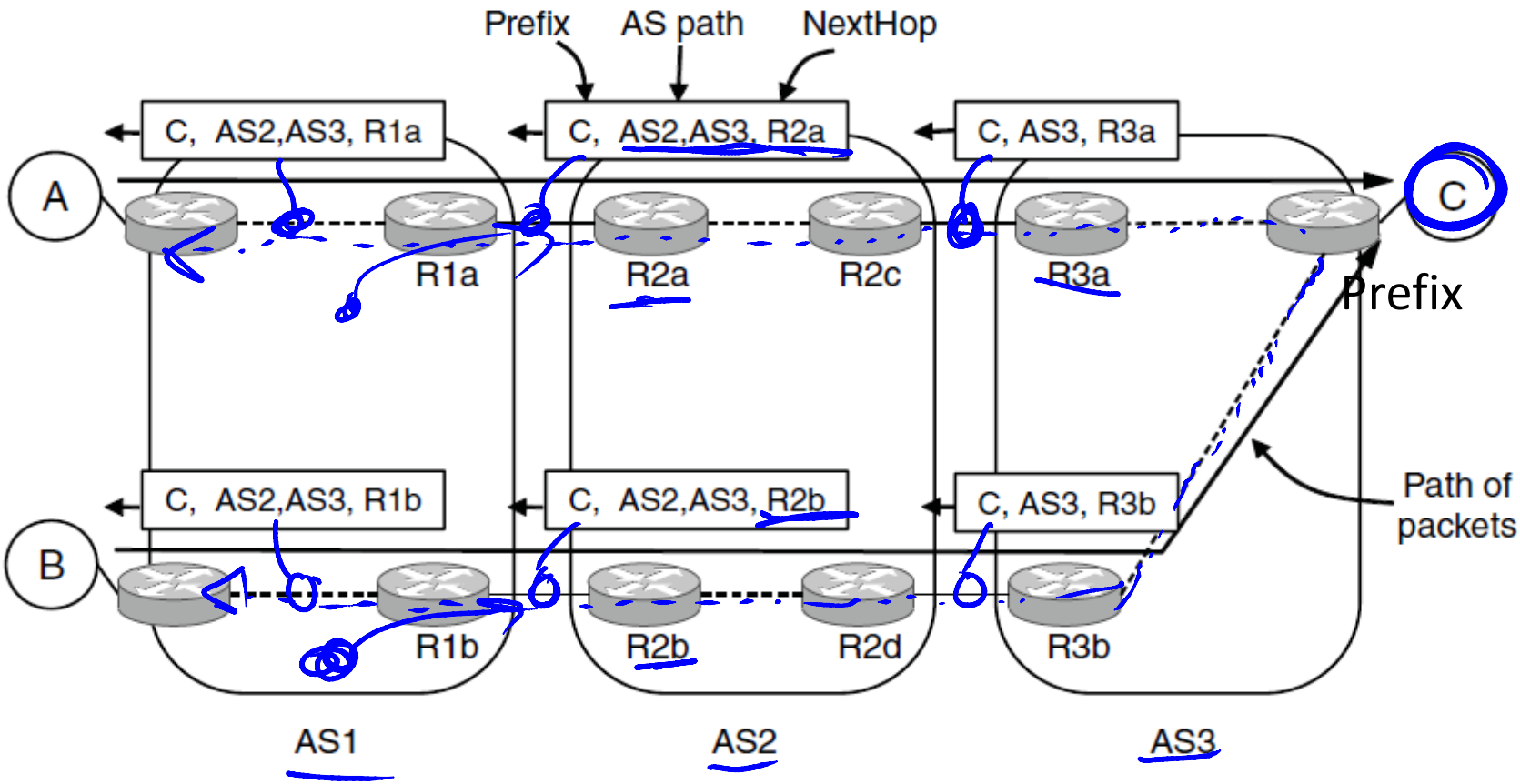
- BGP is the protocol that computes interdomain routes in the Internet
  - Path vector, a kind of distance vector



BGP (2)

- Different parties like ISPs are called AS (Autonomous Systems)
- Border routers of ASes announce BGP routes to each other
- Route announcements contain an IP prefix, path vector, next hop
  - Path vector is list of ASes on the way to the prefix; list is to find loops
- Route announcements move in the opposite direction to traffic

BGP (3)


Prefix
AS path
NextHop
C, AS2,AS3, R1a
C, AS2,AS3, R2a
C, AS3, R3a
A
C
R1a
R2a
R2c
R3a
Prefix
C, AS2,AS3, R1b
C, AS2,AS3, R2b
C, AS3, R3b
Path of packets
B
R1b
R2b
R2d
R3b
AS1
AS2
AS3

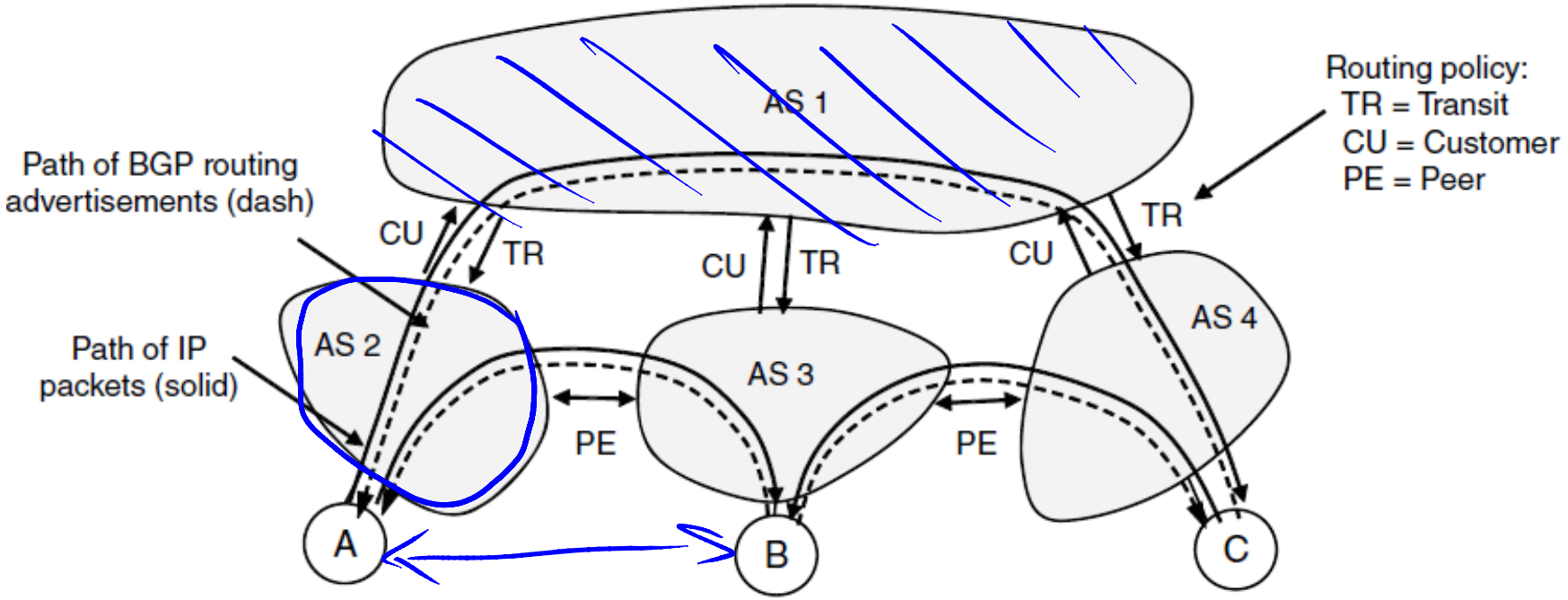
BGP (4)

Policy is implemented in two ways:

1. Border routers of ISP announce paths only to other parties who may use those paths
   - Filter out paths others can't use
2. Border routers of ISP select the best path of the ones they hear in any, non-shortest way

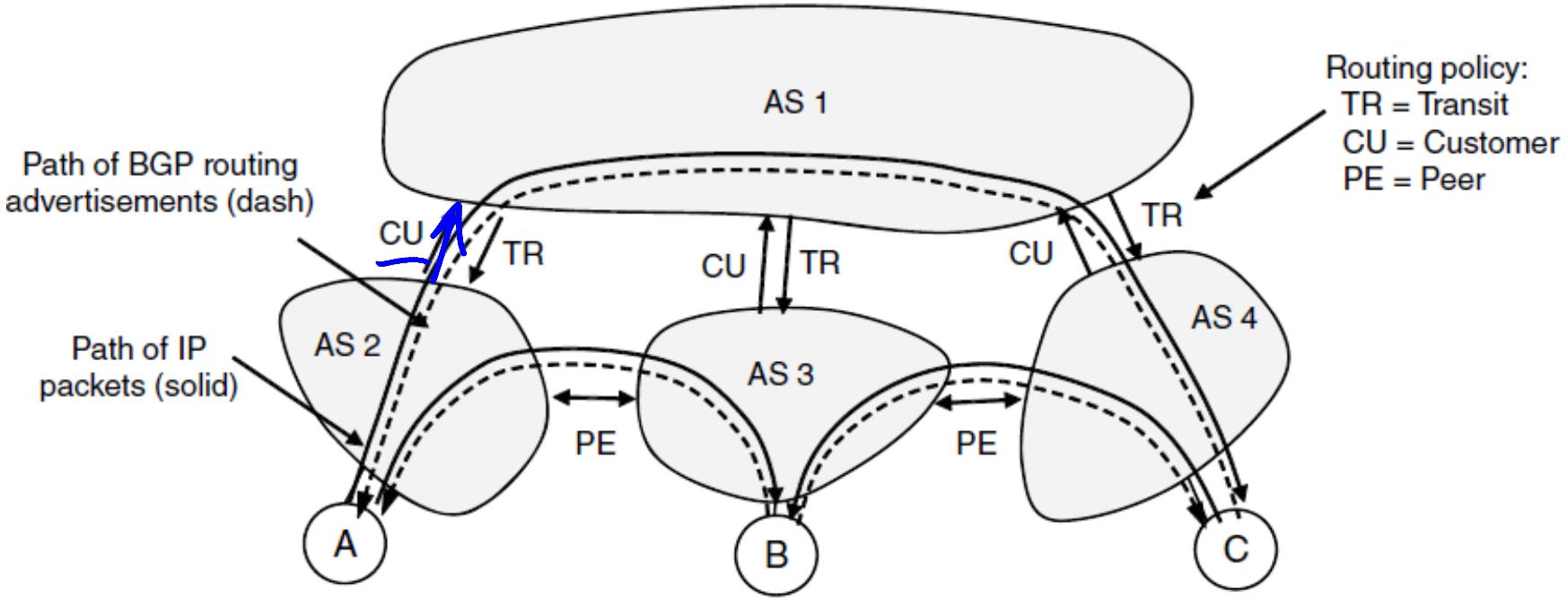
BGP Example

- AS2 buys TRANSIT service from AS1 and PEER service from AS3



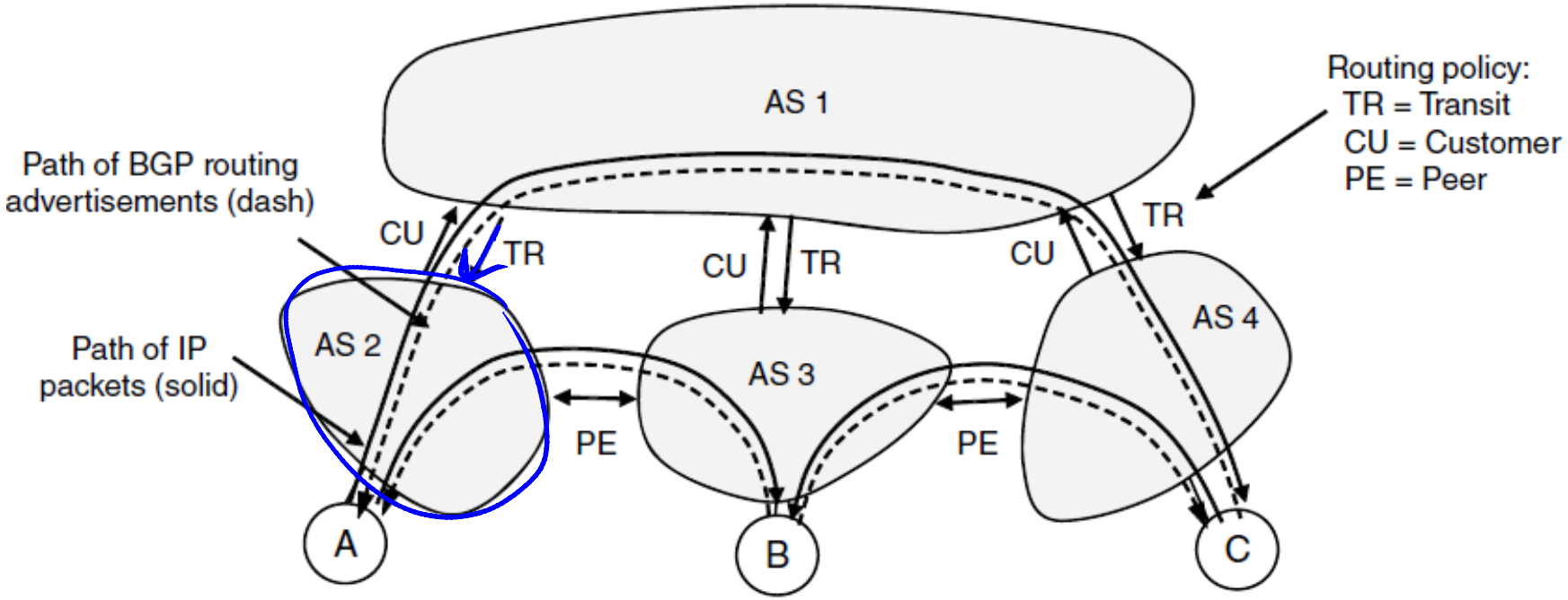
BGP Example (2)

- CUSTOMER (other side of TRANSIT): AS2 says [A, (AS2)] to AS1



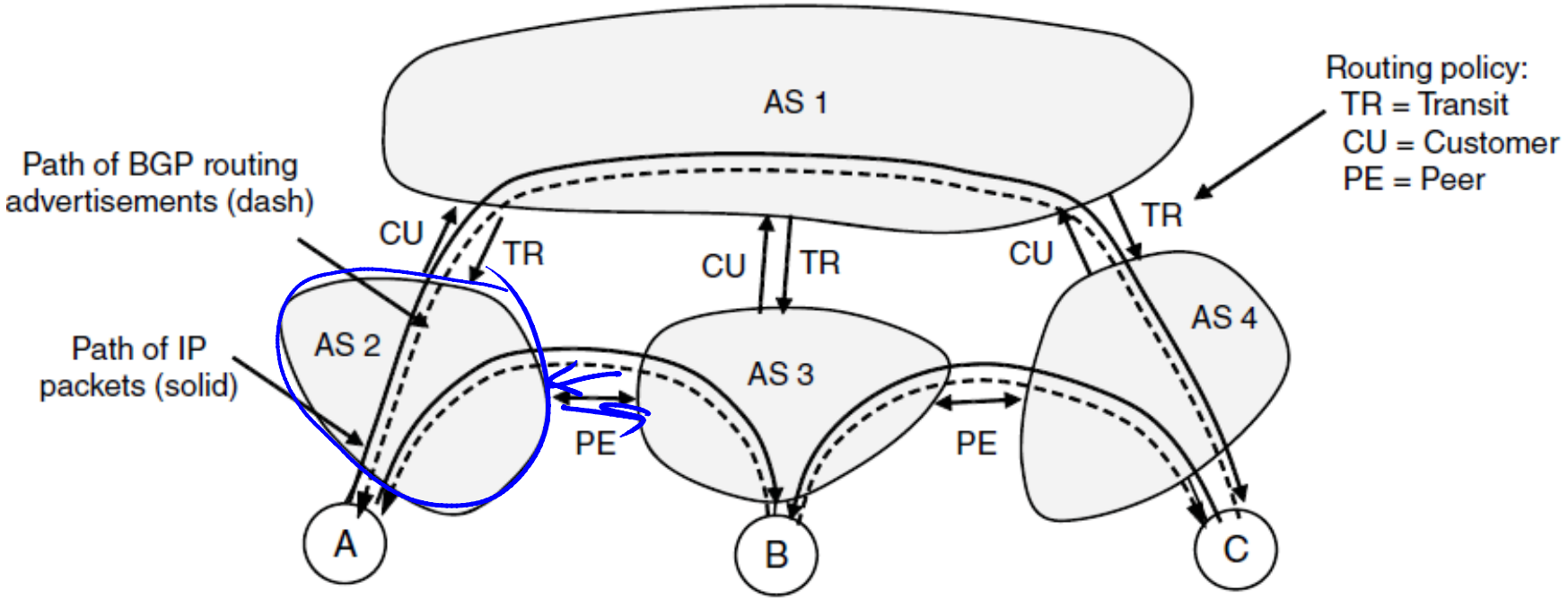
BGP Example (3)

- TRANSIT: AS1 says [B, (AS1, AS3)], [C, (AS1, AS4)] to AS2



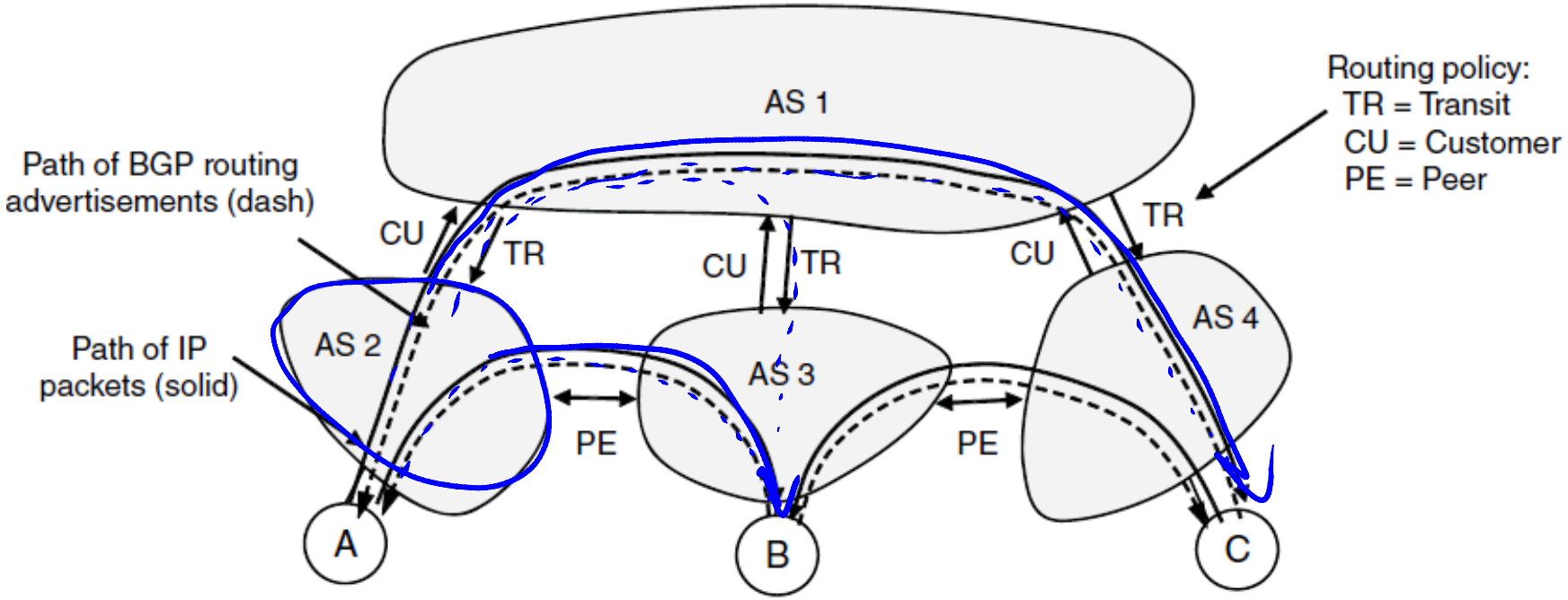
BGP Example (4)

- PEER: AS2 says [A, (AS2)] to AS3, AS3 says [B, (AS3)] to AS2



BGP Example (5)

- AS2 hears one route to C, and two routes to B (chooses AS3!)



Closing Thoughts

- Much more beyond basics to explore!
- Policy is a substantial factor
  - Can we be sure independent decisions will yield sensible overall routes?
- Other important factors:
  - Convergence effects
  - How well it scales
  - Integration with routing within ISPs
  - And more …

END