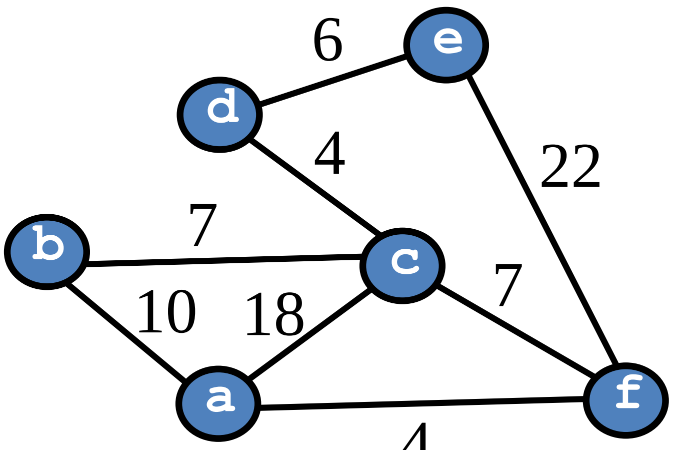
Routing

Recitation #5

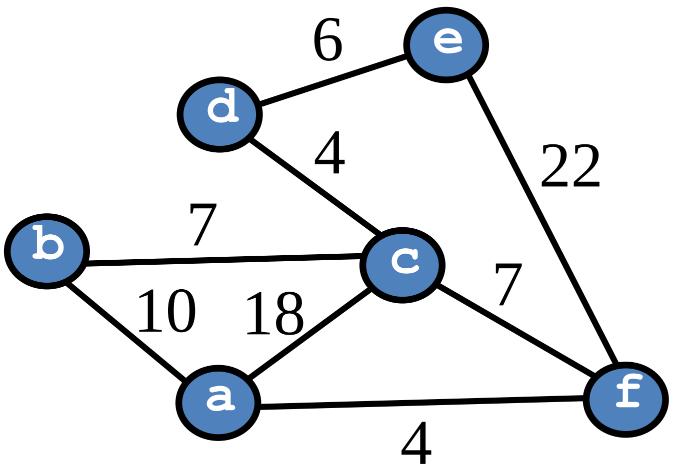
COS 461: Computer Networks
Spring 2014

Link State (Djikstra's)



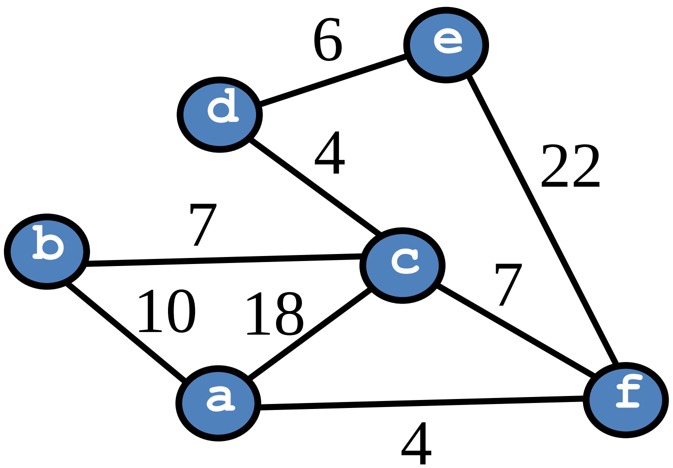
dest	link
b	(a,?)
c	(a,?)
d	(a,?)
e	(a,?)
f	(a,?)

Link State (Djikstra's)



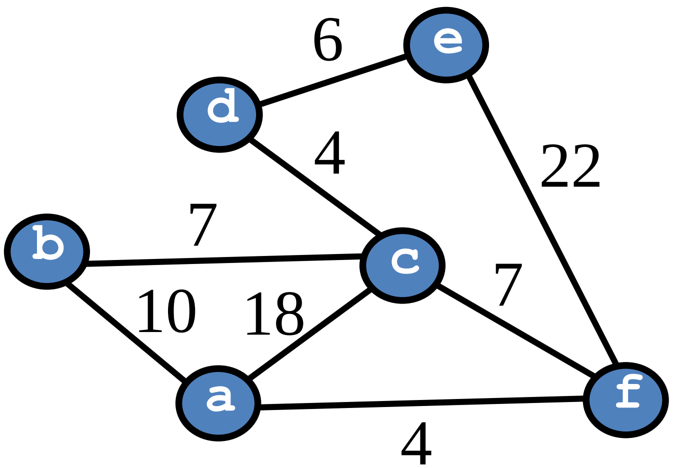
dest	link
b	(a,b)
c	(a,?)
d	(a,?)
e	(a,?)
f	(a,?)

Link State (Djikstra's)



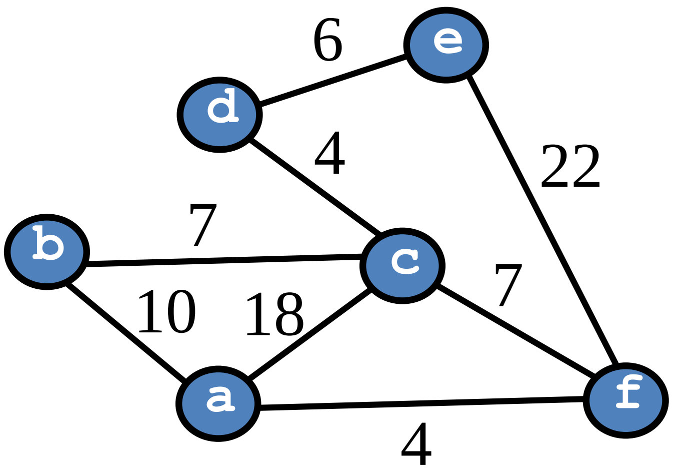
dest	link
b	(a,b)
c	(a,f)
d	(a,?)
e	(a,?)
f	(a,?)

Link State (Djikstra's)



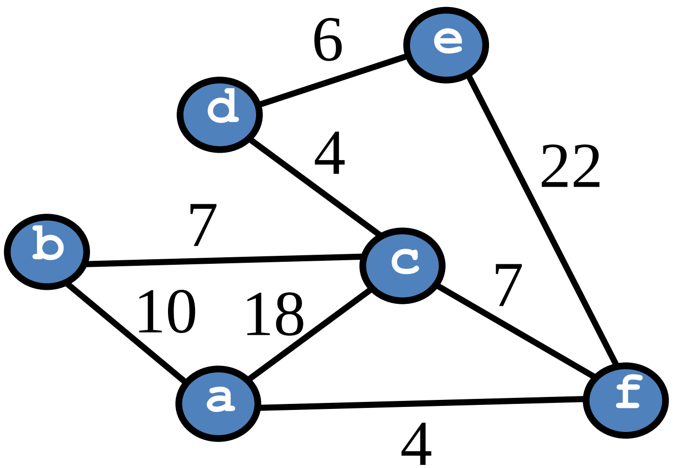
dest	link
b	(a,b)
c	(a,f)
d	(a,f)
e	(a,?)
f	(a,?)

Link State (Djikstra's)



dest	link
b	(a,b)
c	(a,f)
d	(a,f)
e	(a,f)
f	(a,?)

Link State (Djikstra's)



dest	link
b	(a,b)
c	(a,f)
d	(a,f)
e	(a,f)
f	(a,f)

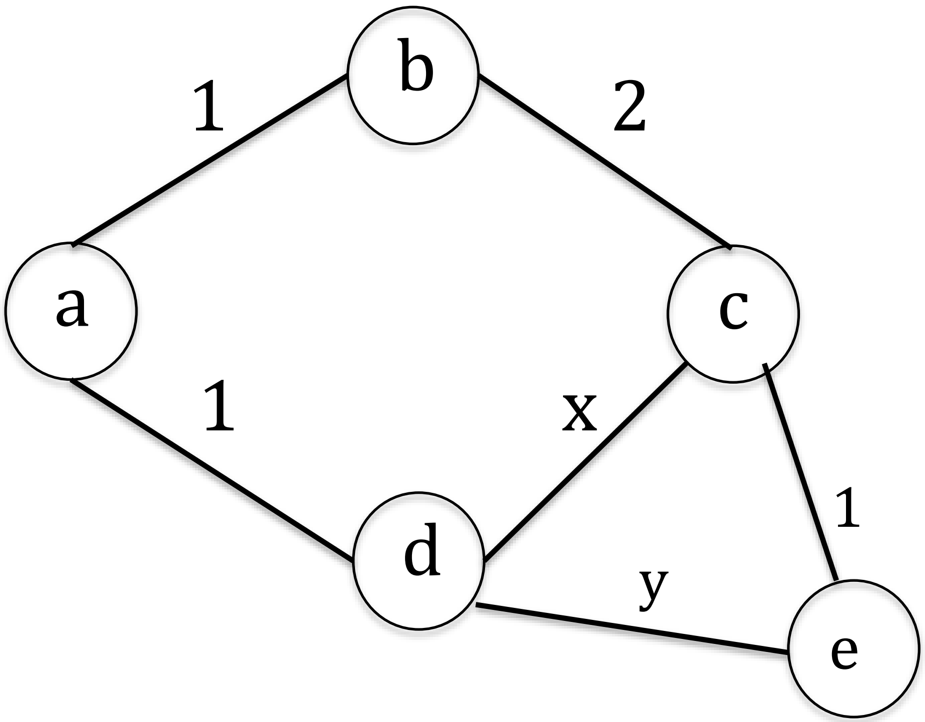
Which routing protocol requires the least amount of state on the router?

a) link state
b) distance vector
c) path vector

Which routing protocol requires the least amount of state on the router?

a) link state
b) distance vector
c) path vector

Which of the following, if true, *ensures* packets from a to e *always* traverse c?



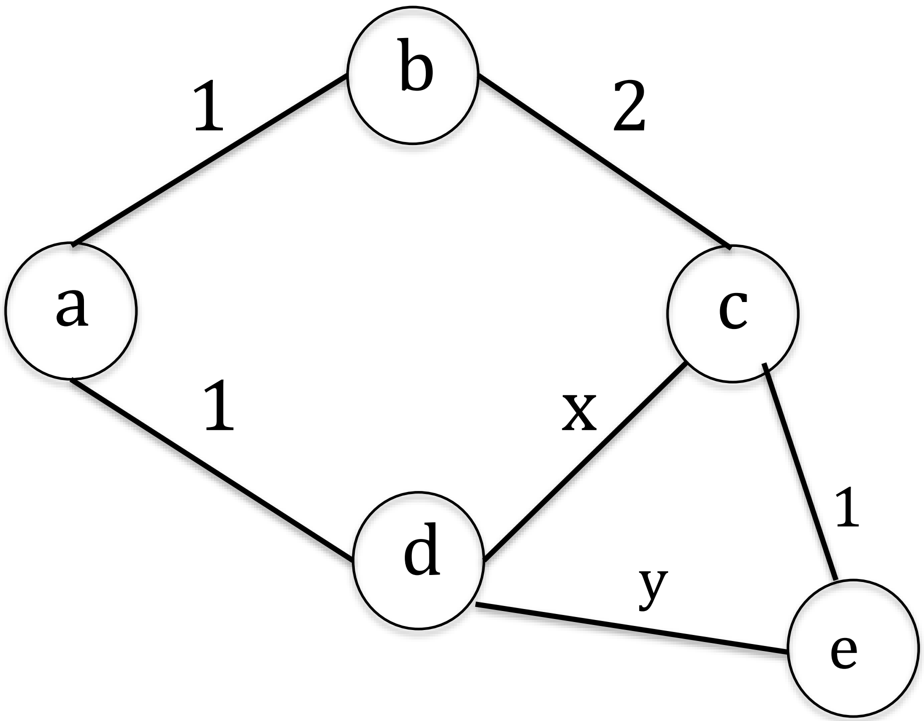
A. Y > 3

B. Y > X + 1

C. Y > X

D. A or B

Which of the following, if true, *ensures* packets from a to e *always* traverse c?



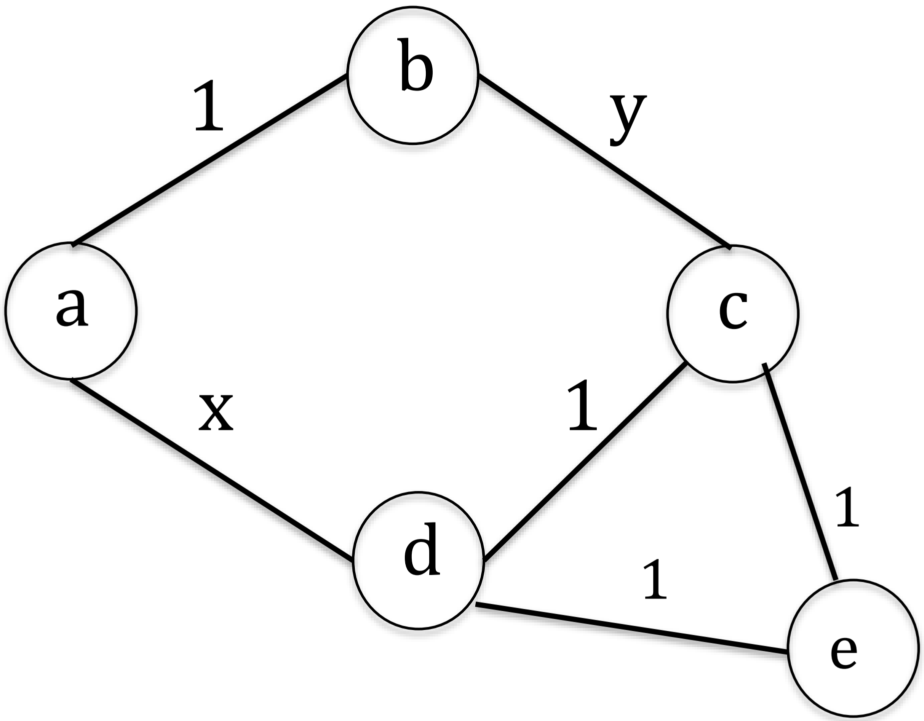
A. Y > 3

B. Y > X + 1

C. Y > X

D. A or B

Which of the following, if true, *ensures* packets from b to e *always* traverse d?



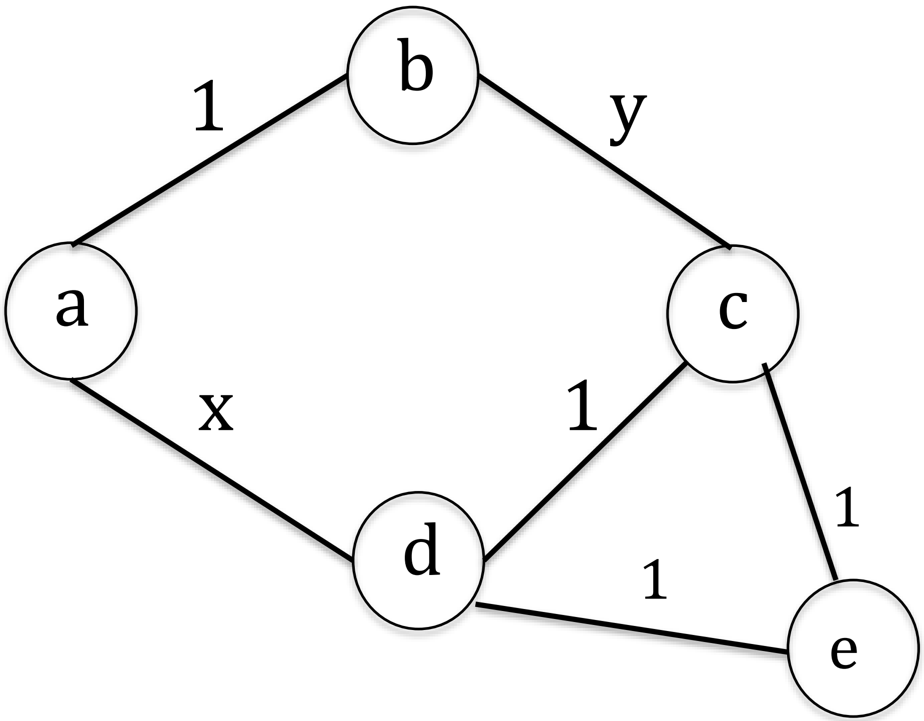
A. Y > 2

B. Y > X + 1

C. Y > X

D. A or B

Which of the following, if true, *ensures* packets from b to e *always* traverse d?



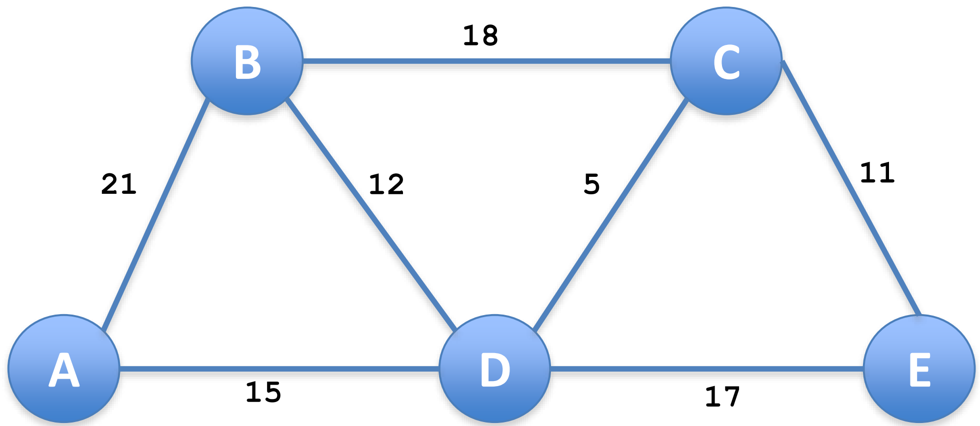
A. Y > 2

B. Y > X + 1

C. Y > X

D. A or B

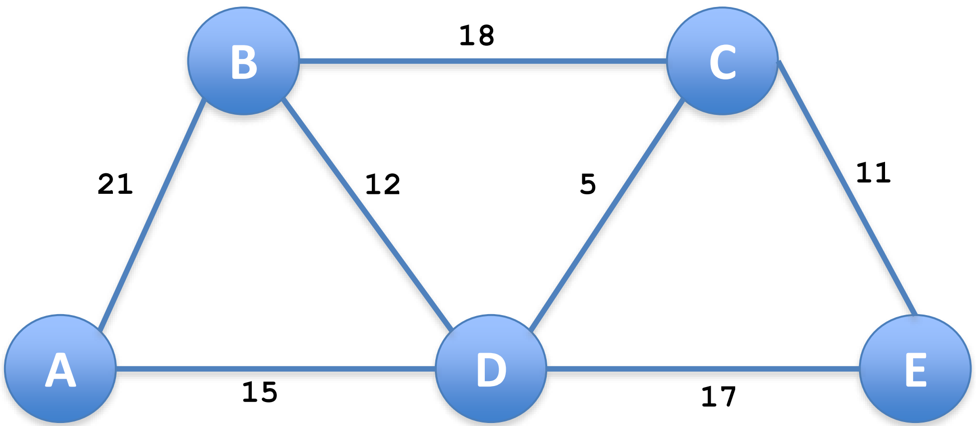
Distance Vector Routing



Initial Routing table at E

Destination	Cost	Next Hop
A		
B		
C		
D		

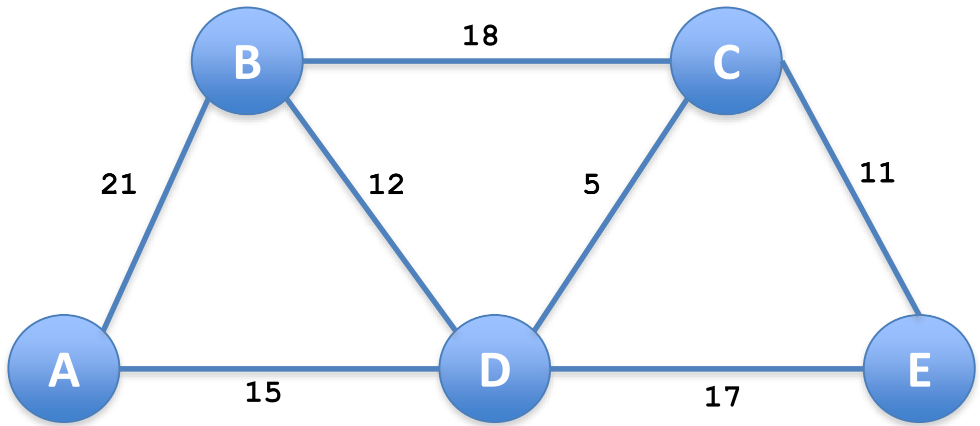
Distance Vector Routing



Initial Routing table at E

Destination	Cost	Next Hop
A	Inf	---
B		
C		
D		

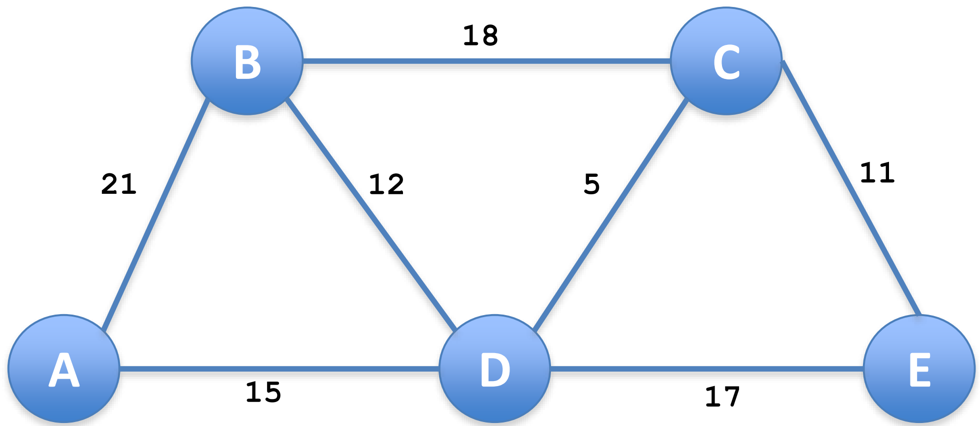
Distance Vector Routing



Initial Routing table at E

Destination	Cost	Next Hop
A	Inf	---
B	Inf	---
C		
D		

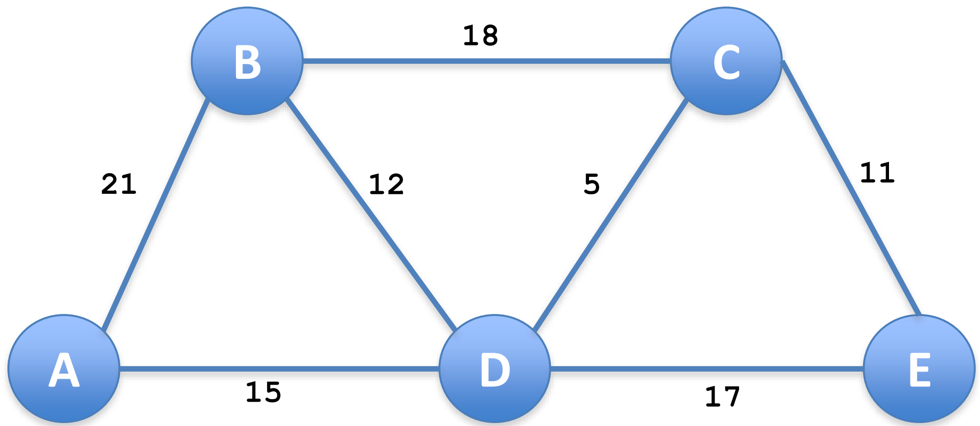
Distance Vector Routing



Initial Routing table at E

Destination	Cost	Next Hop
A	Inf	---
B	Inf	---
C	11	C
D		

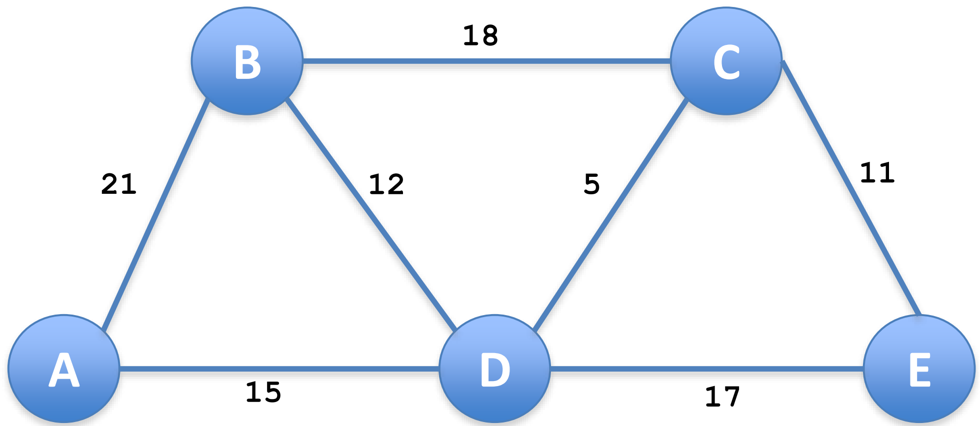
Distance Vector Routing



Initial Routing table at E

Destination	Cost	Next Hop
A	Inf	---
B	Inf	---
C	11	C
D	17	D

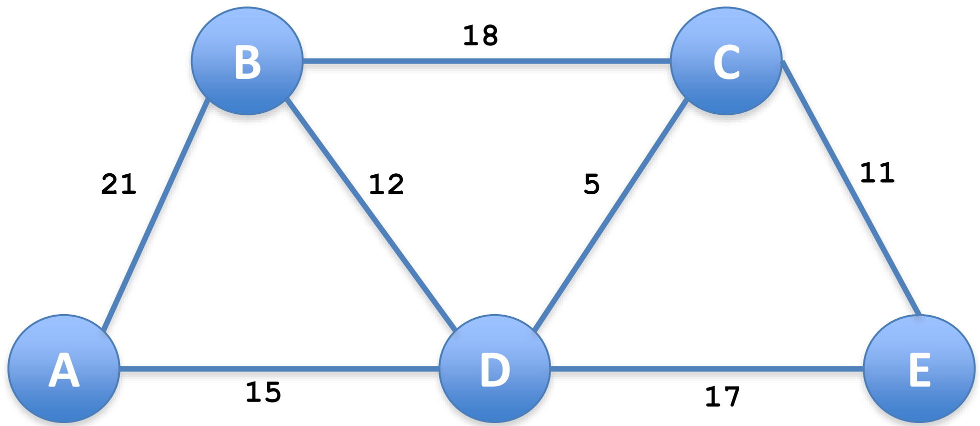
Distance Vector Routing



Routing table at E after one iteration

Destination	Cost	Next Hop
A	Inf	---
B	Inf	---
C	11	C
D	17	D

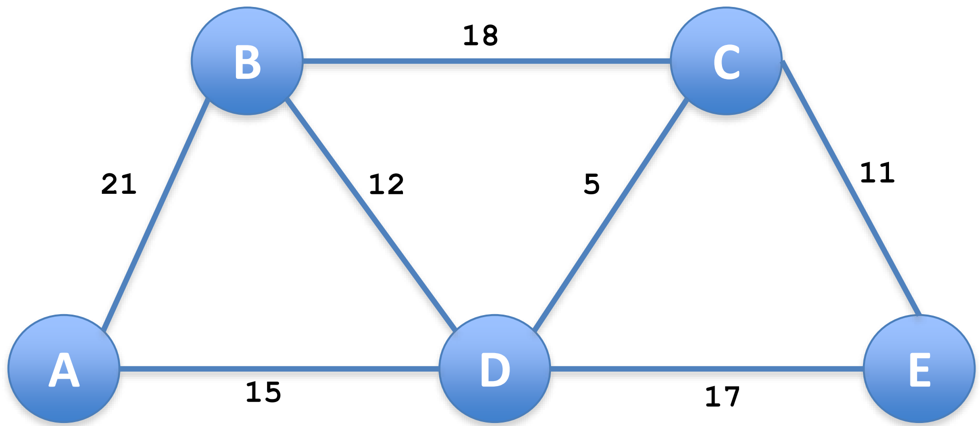
Distance Vector Routing



Routing table at E after one iteration

Destination	Cost	Next Hop
A	32	D
B	Inf	---
C	11	C
D	17	D

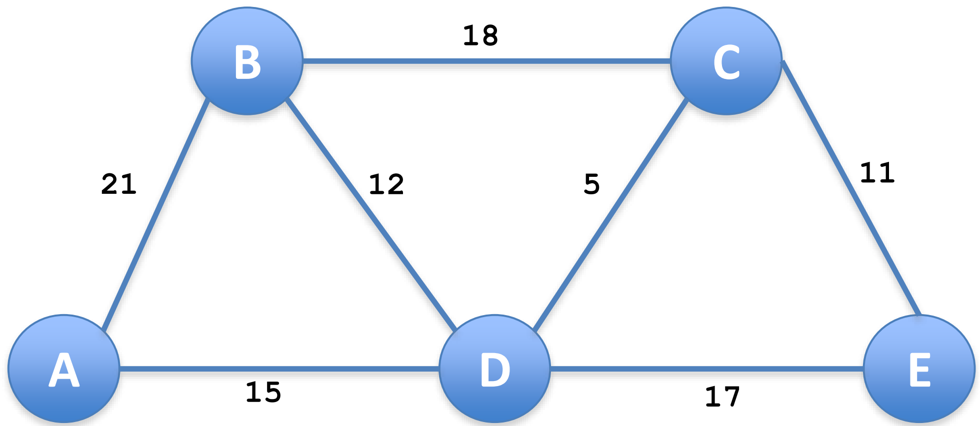
Distance Vector Routing



Routing table at E after one iteration

Destination	Cost	Next Hop
A	32	D
B	29	C
C	11	C
D	17	D

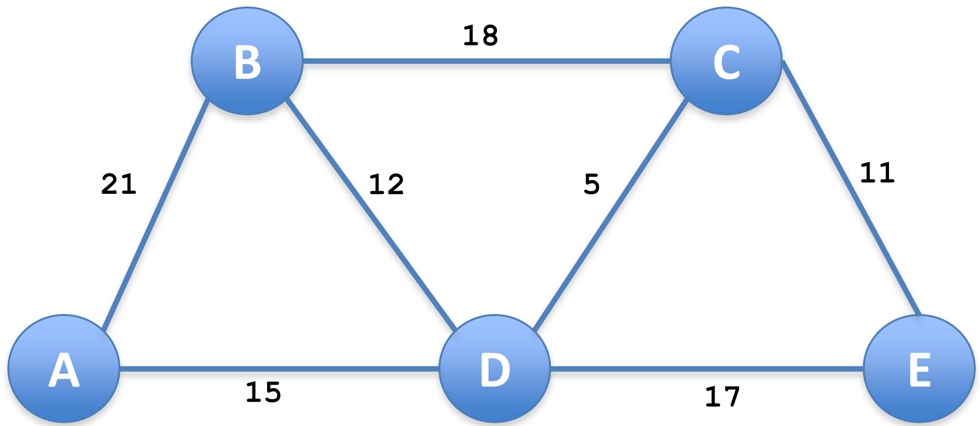
Distance Vector Routing



Routing table at E after one iteration

Destination	Cost	Next Hop
A	32	D
B	29	C
C	11	C
D	17	D

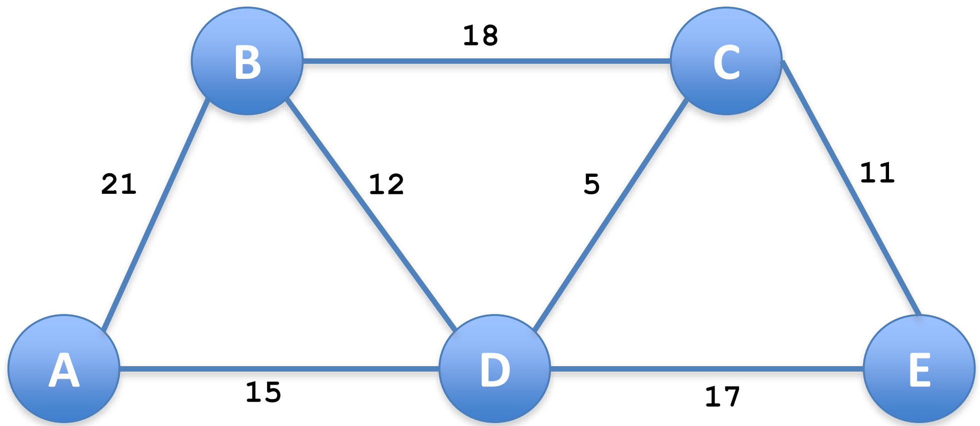
Distance Vector Routing



Routing table at E after one iteration

Destination	Cost	Next Hop
A	32	D
B	29	C
C	11	C
D	16	C

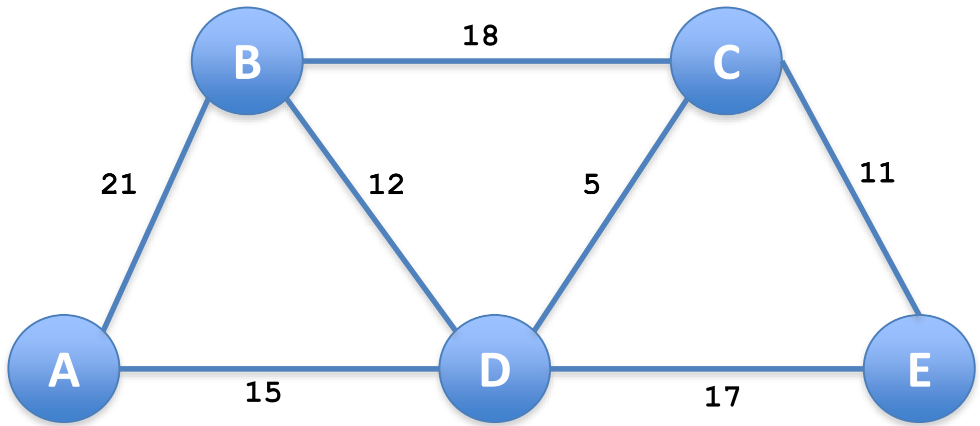
Distance Vector Routing



Routing table at E after two iterations

Destination	Cost	Next Hop
A	32	D
B	29	C
C	11	C
D	16	C

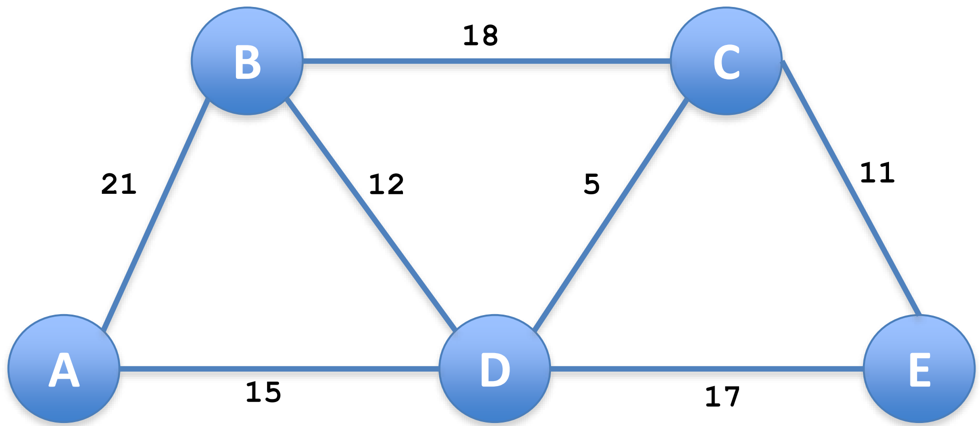
Distance Vector Routing



Routing table at E after two iterations

Destination	Cost	Next Hop
A	31	C
B	29	C
C	11	C
D	16	C

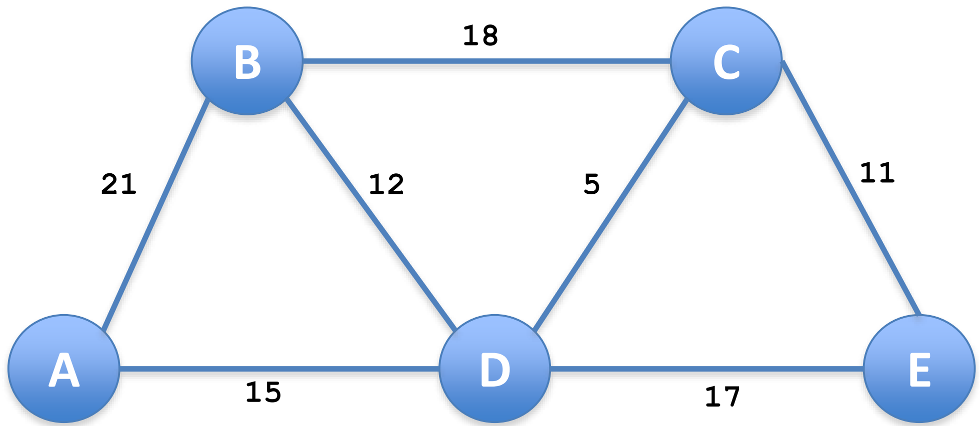
Distance Vector Routing



Routing table at E after two iterations

Destination	Cost	Next Hop
A	31	C
B	28	C
C	11	C
D	16	C

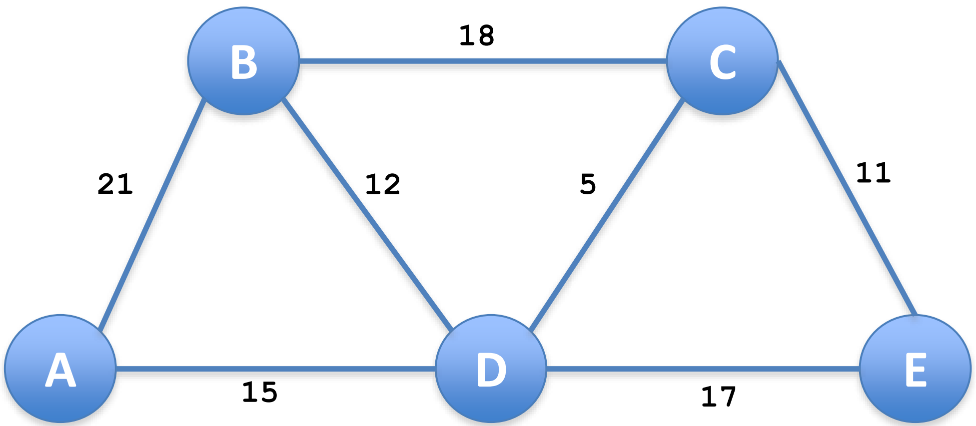
Distance Vector Routing



Routing table at E after two iterations

Destination	Cost	Next Hop
A	31	C
B	28	C
C	11	C
D	16	C

Distance Vector Routing



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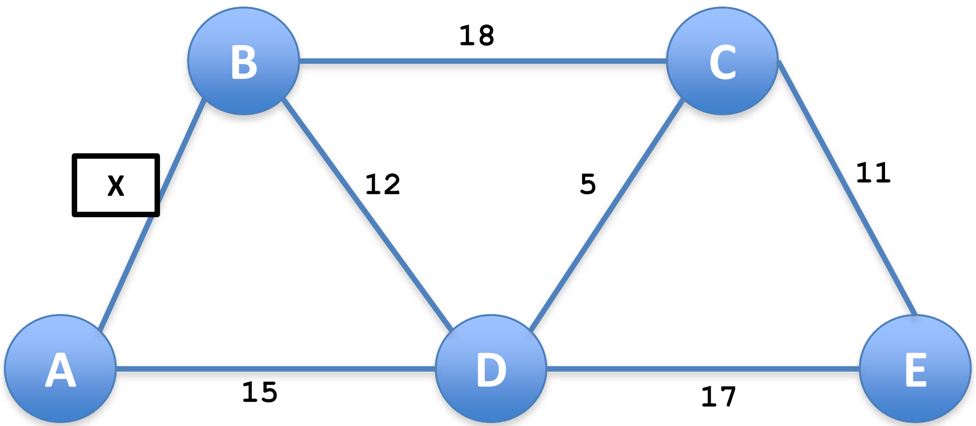
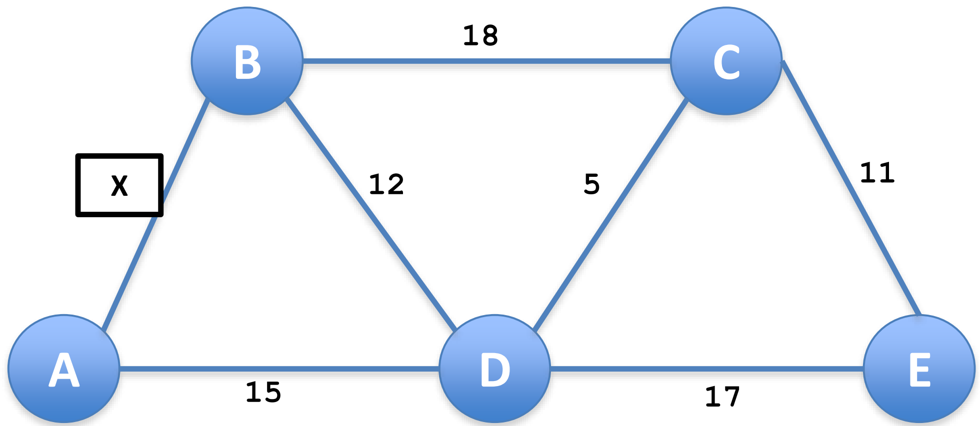
Distance Vector Routing



For what value of x does the routing table at E not change anymore after two iterations?

(a) For all X >= 2
(b) For all X >= 3
(c) For all X <= 4
(d) For all X <= 3

Distance Vector Routing



For what value of x does the routing table at E not change anymore after two iterations?

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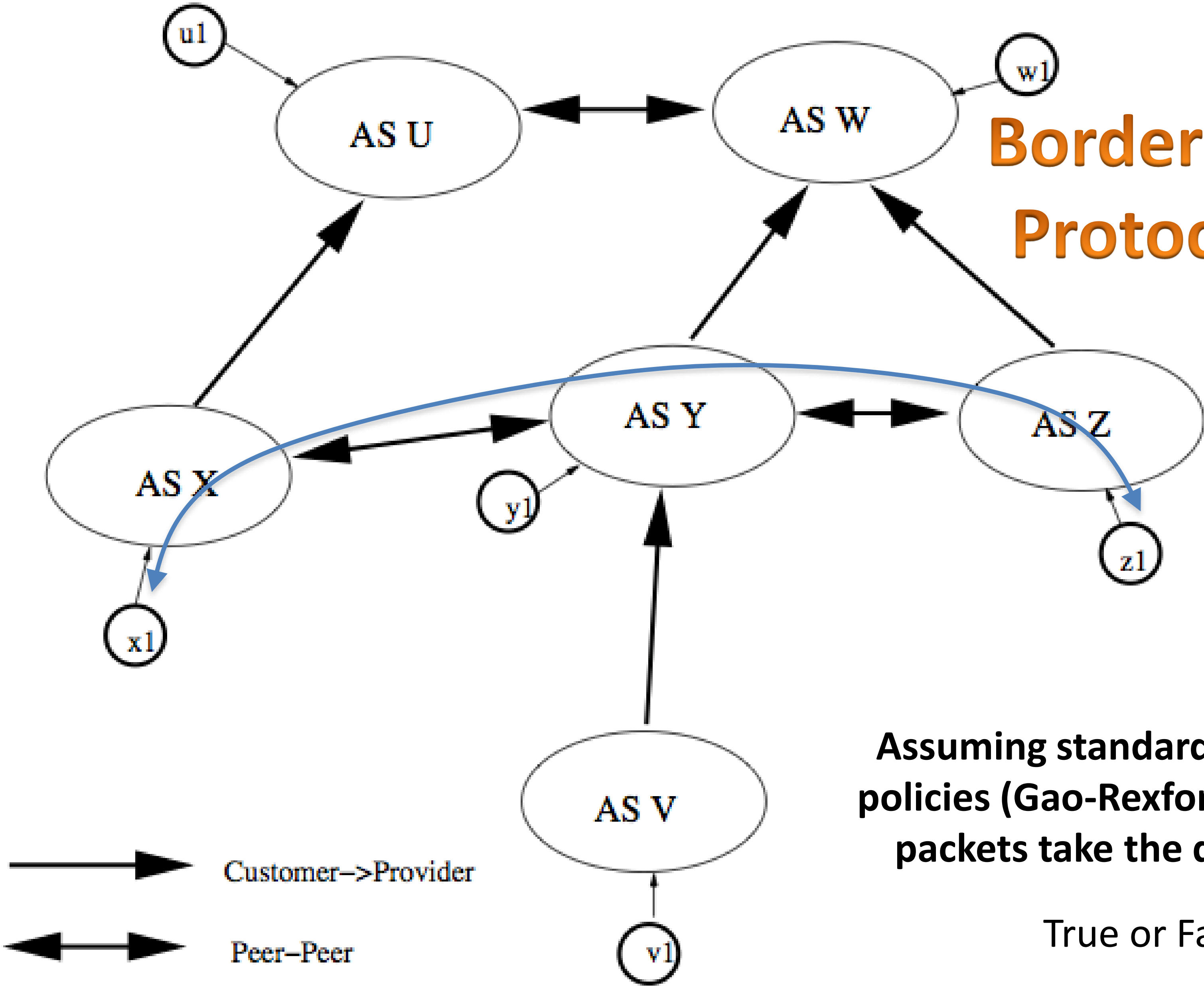
(d) For all X <= 3

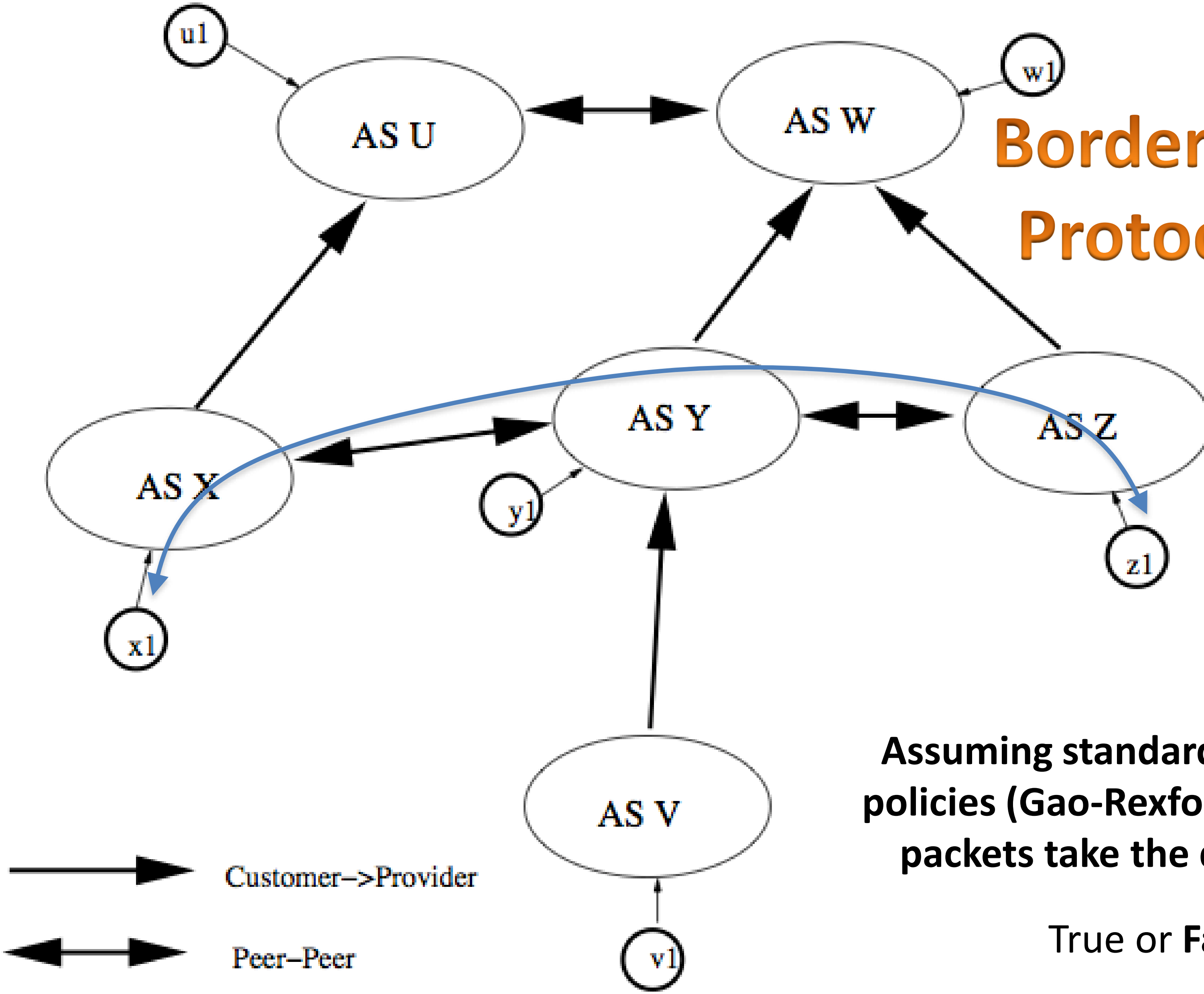
Border Gateway Protocol (BGP)



Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or False

Border Gateway Protocol (BGP)

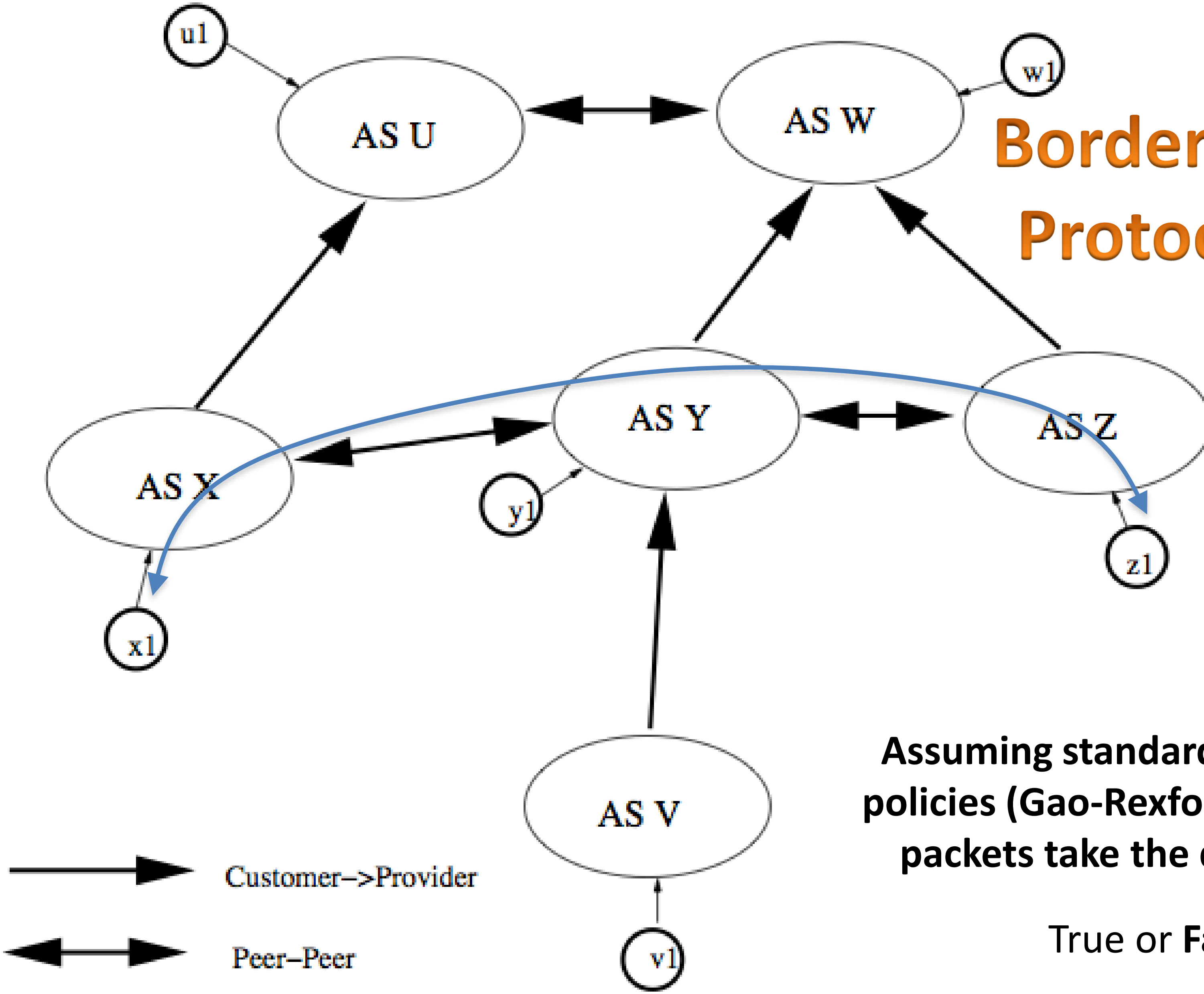


Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or **False**

Why?

Border Gateway Protocol (BGP)



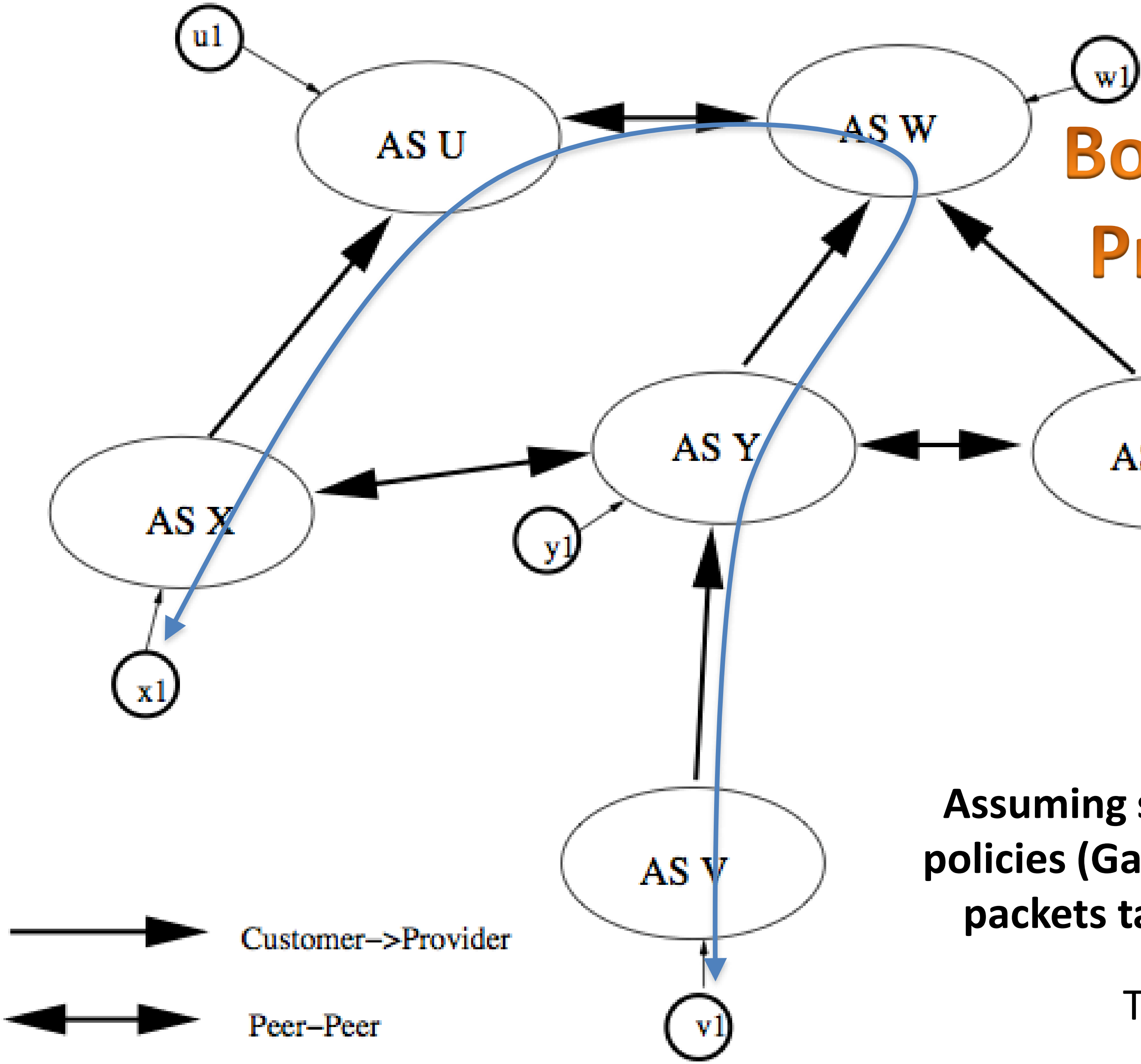
Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or **False**

Why?

Don't export routes learned from a peer or provider to another peer or provider

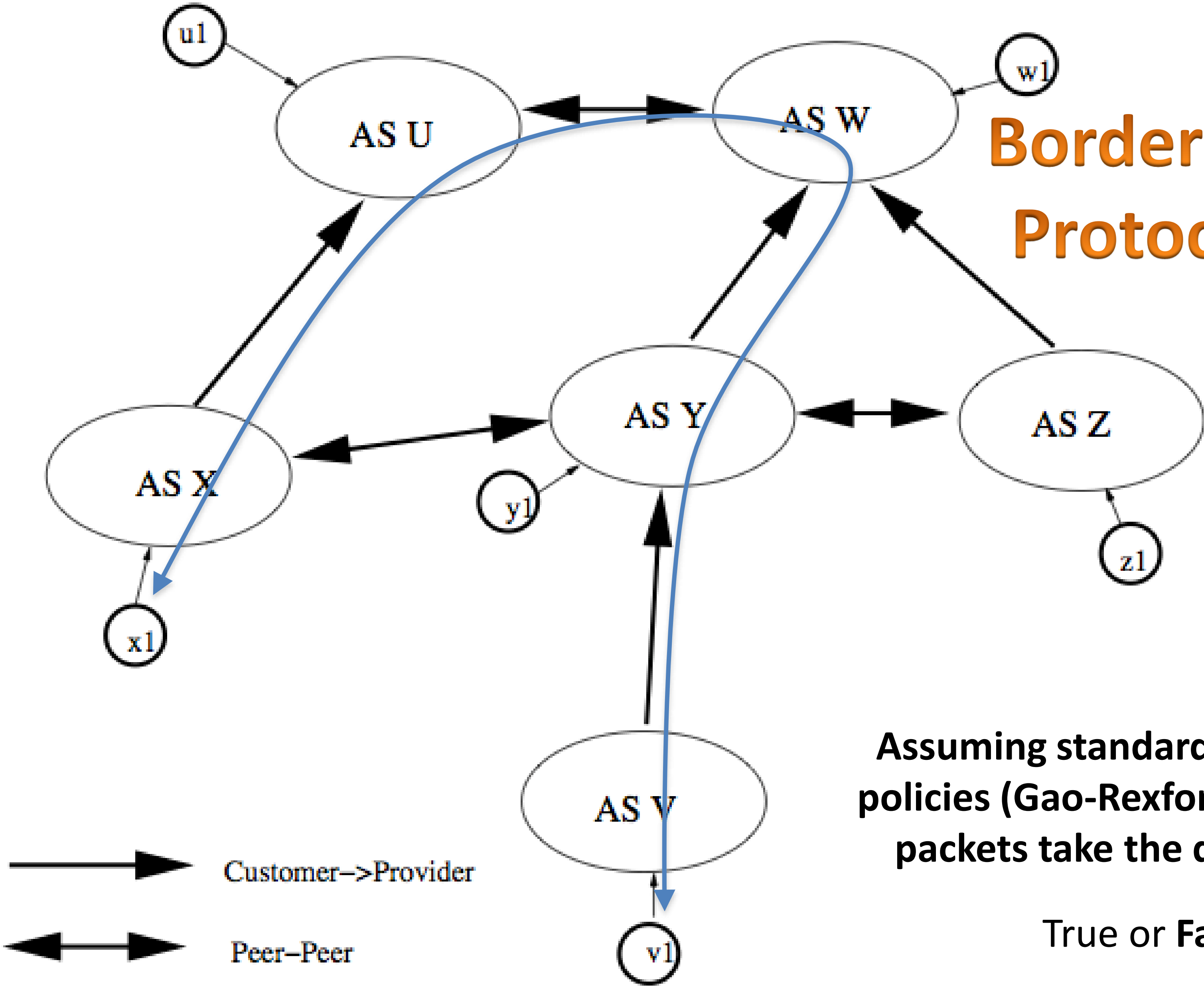
Border Gateway Protocol (BGP)



Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or False

Border Gateway Protocol (BGP)



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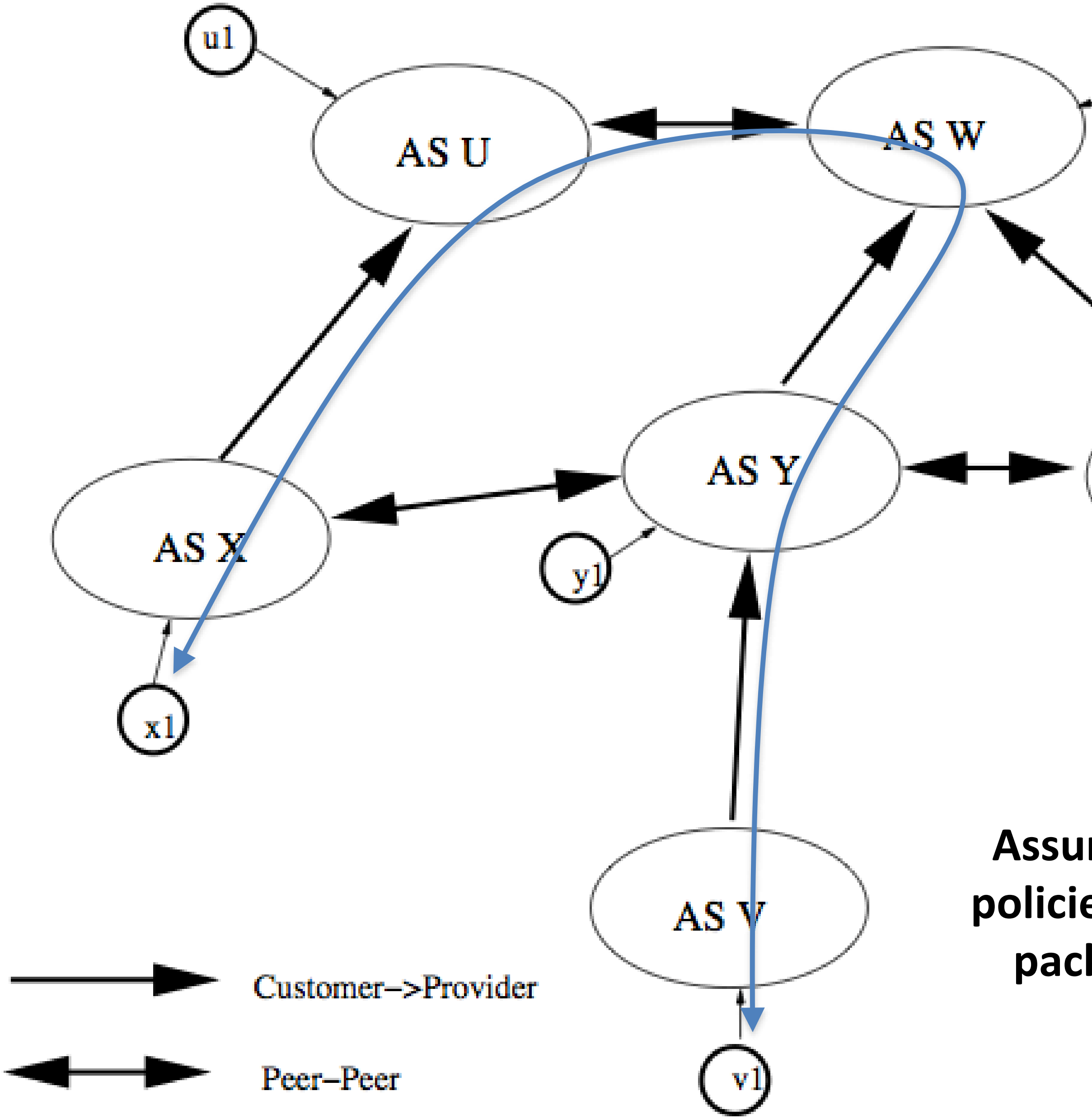
True or **False**

Why?

Border Gateway Protocol (BGP)



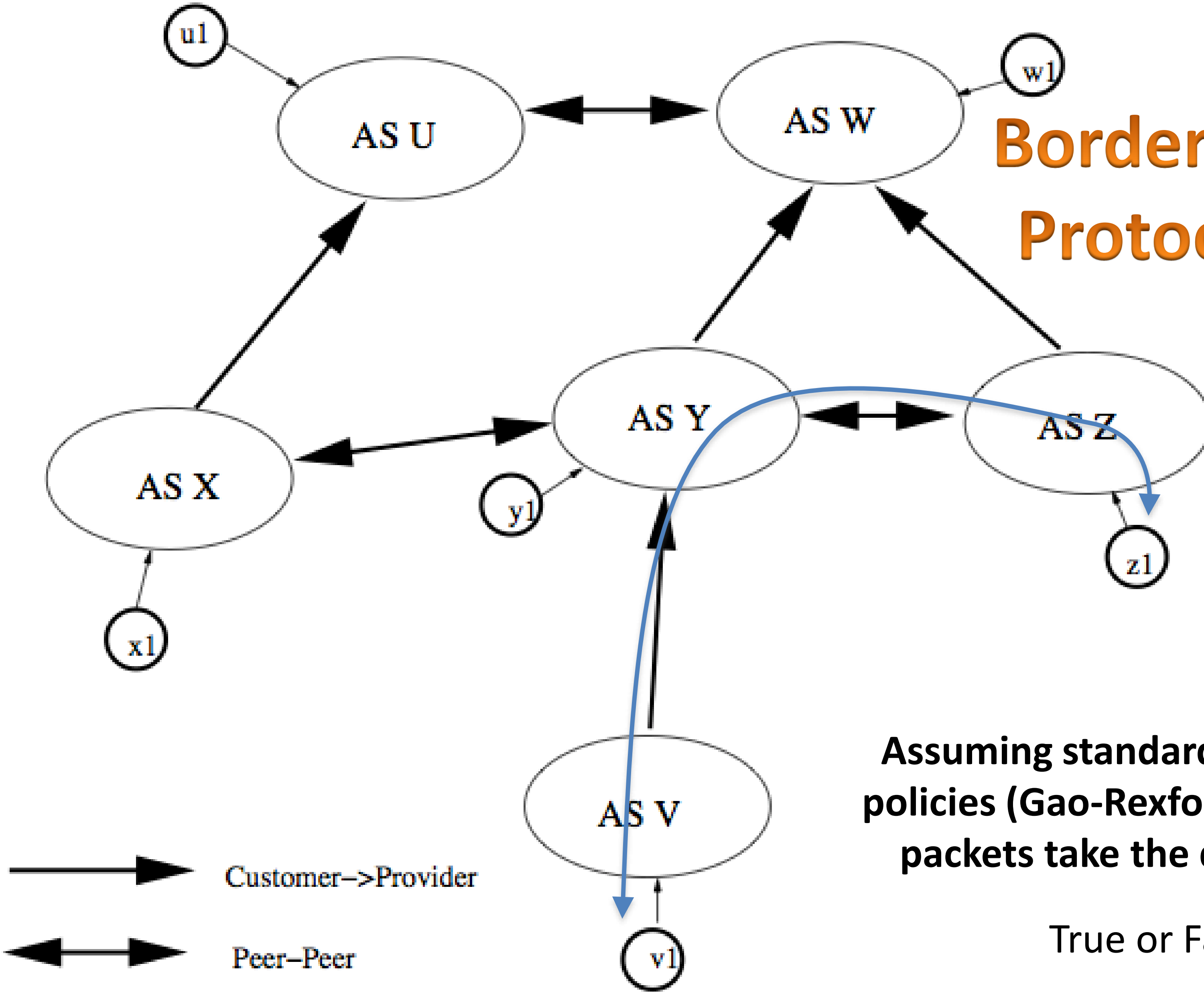
Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or **False**

Why?

AS X would have to pay AS U whereas it could go through AS Y for free

Border Gateway Protocol (BGP)



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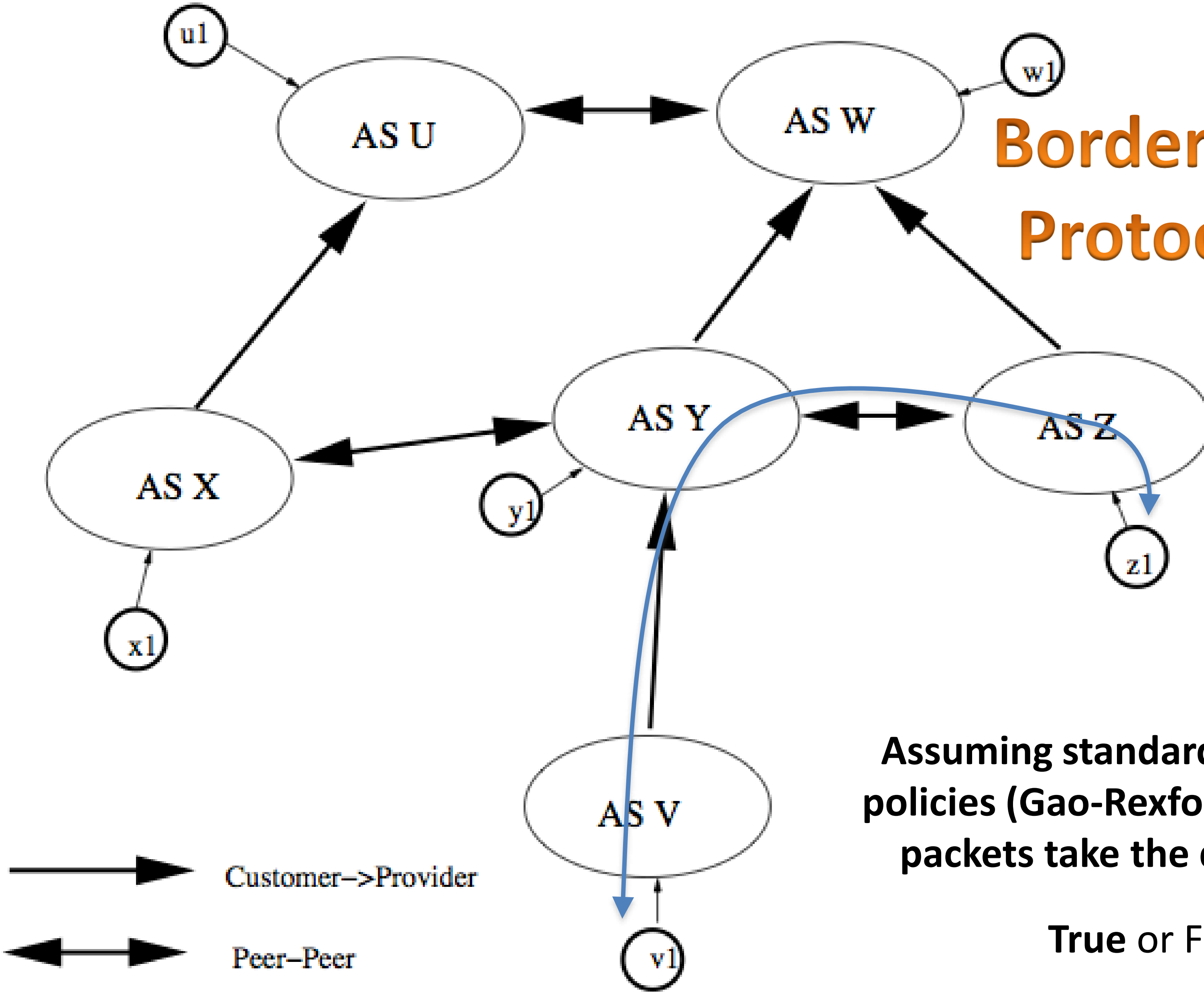

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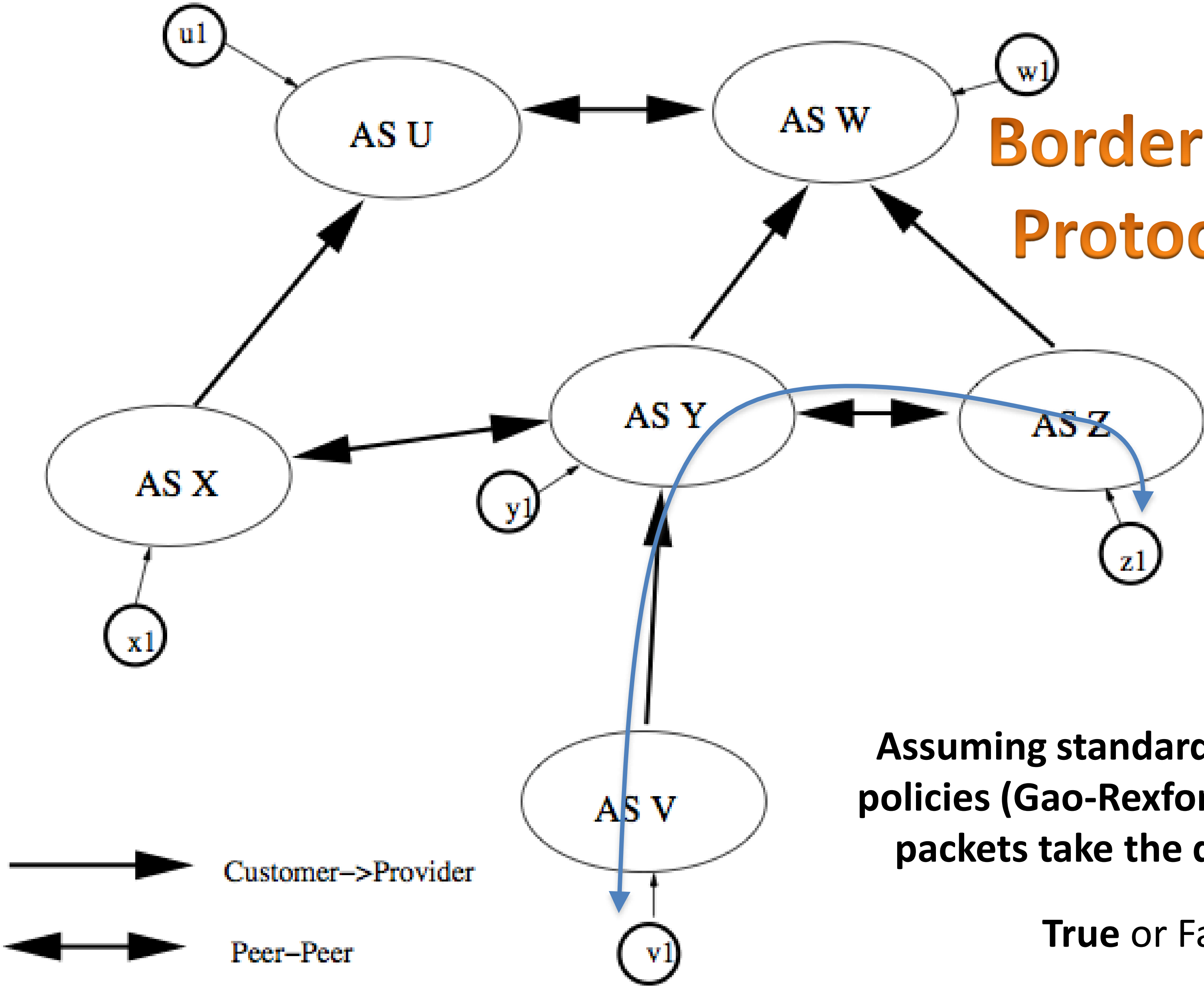
True or False

Why?

Border Gateway Protocol (BGP)



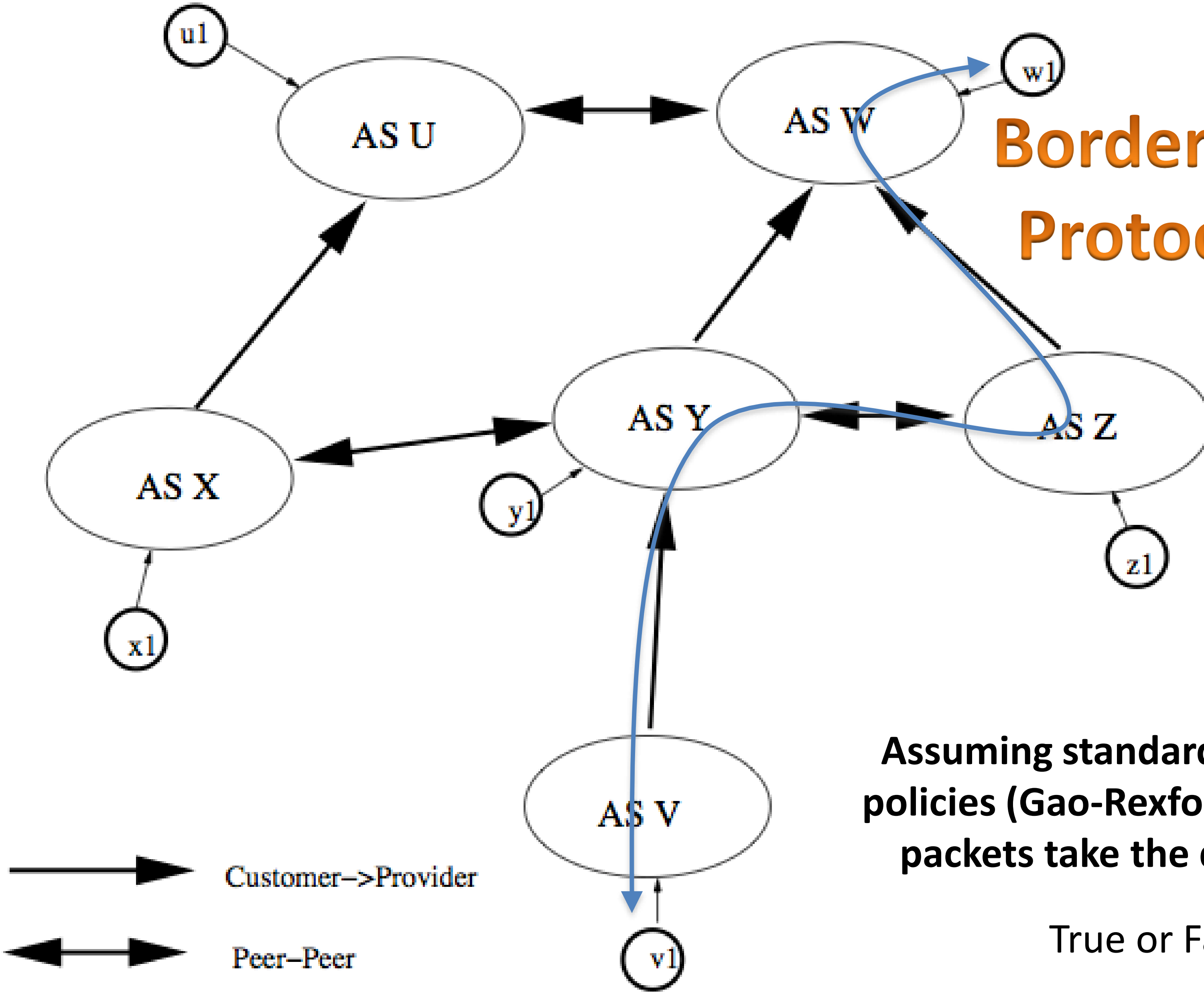
Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or False

Why?

Y and Z would prefer the peering link over the provider link through W to save money.

Border Gateway Protocol (BGP)



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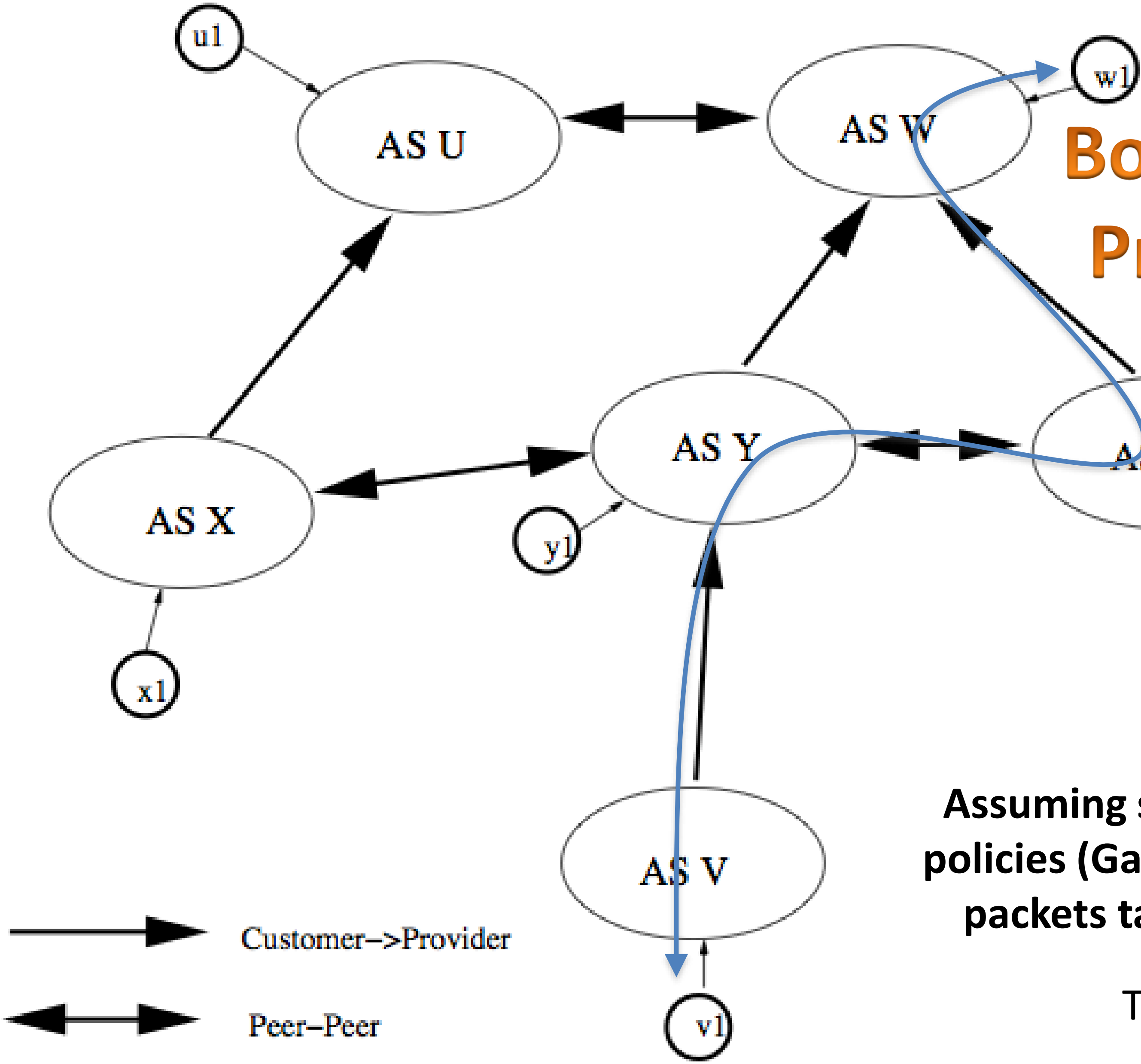
True or False

Border Gateway Protocol (BGP)



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True or **False**

Why?

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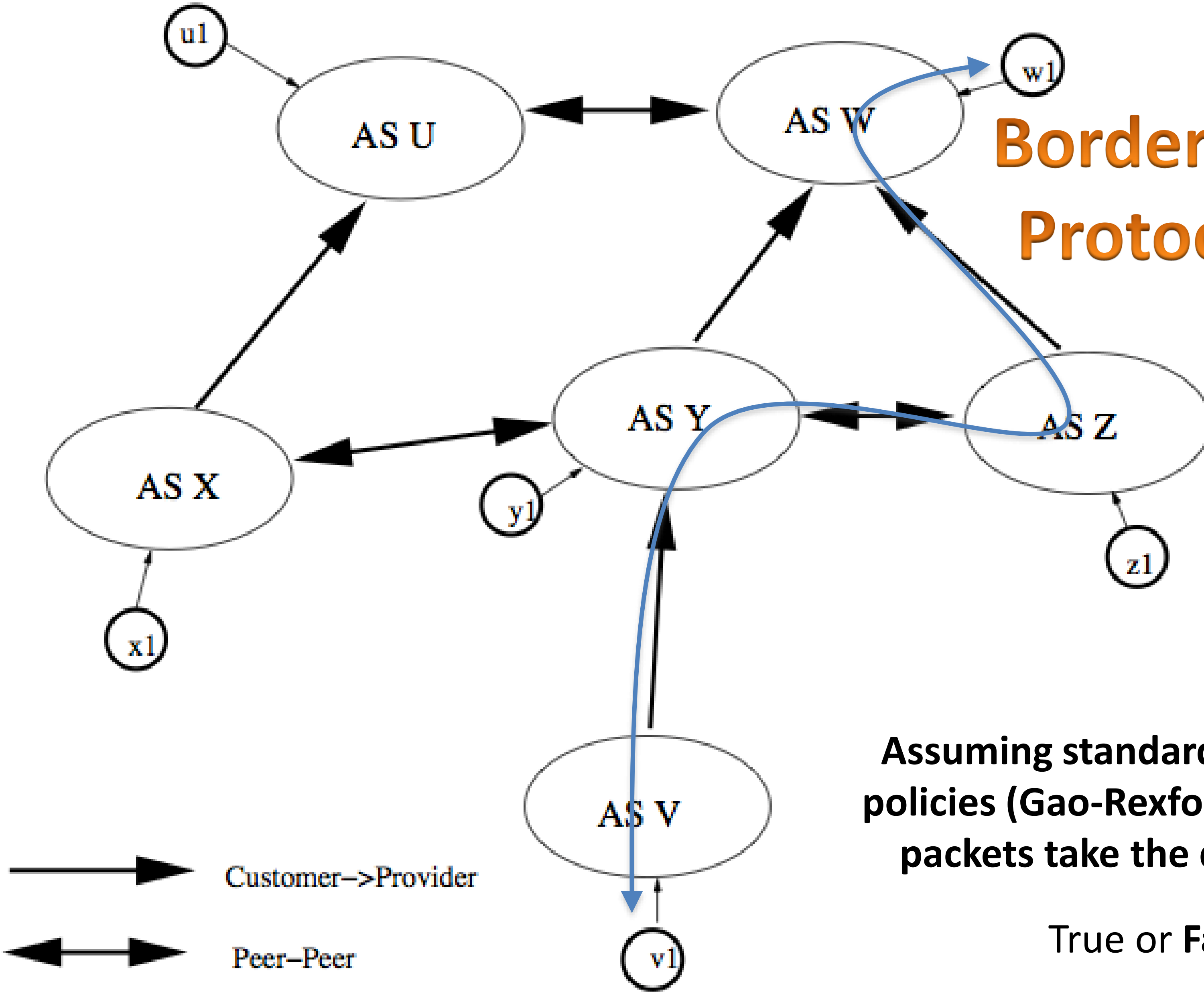


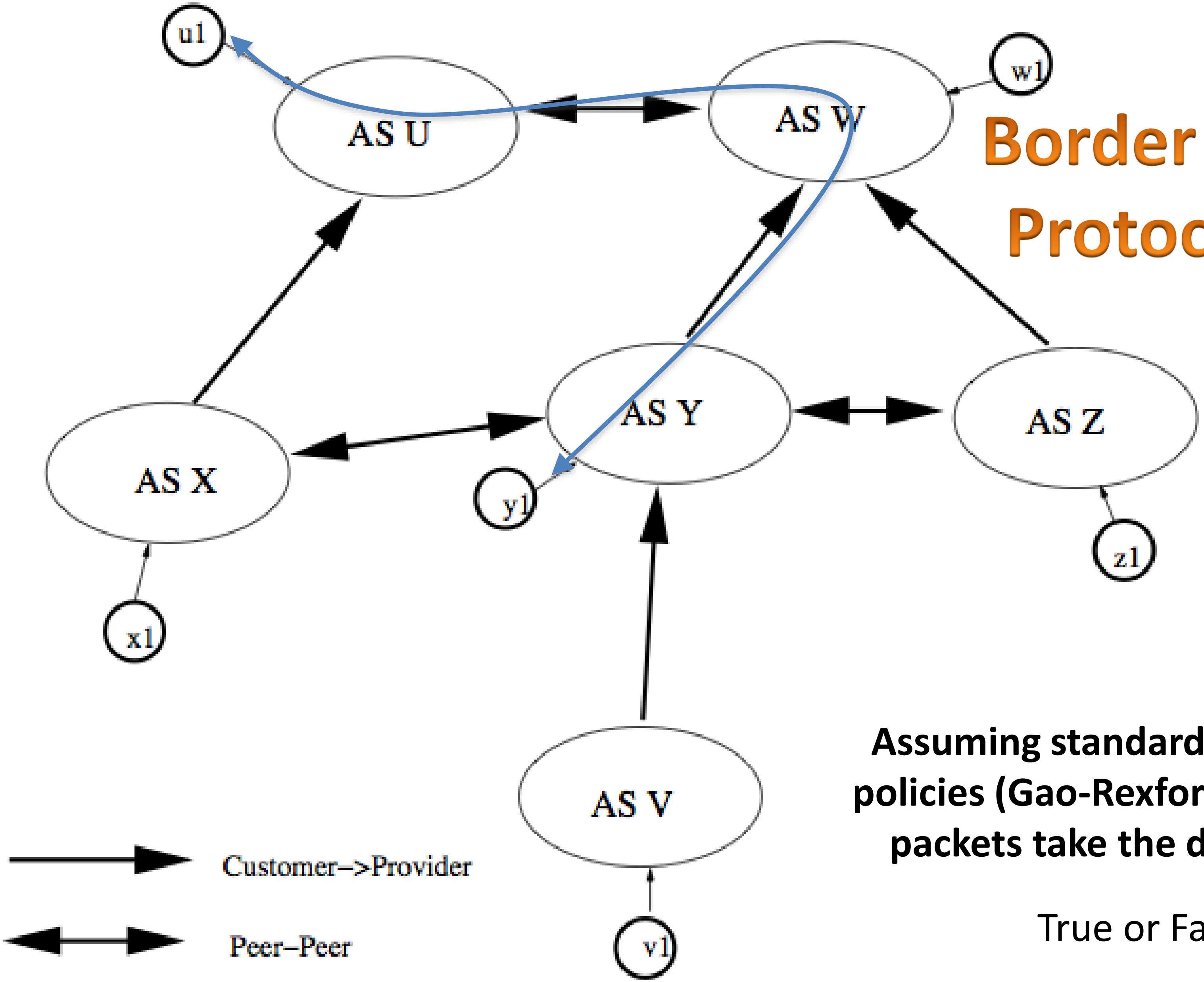
Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or **False**

Why?

AS Z would not advertise a route to its provider, AS W, to its peer, AS Y, and vice versa

Border Gateway Protocol (BGP)



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True or False

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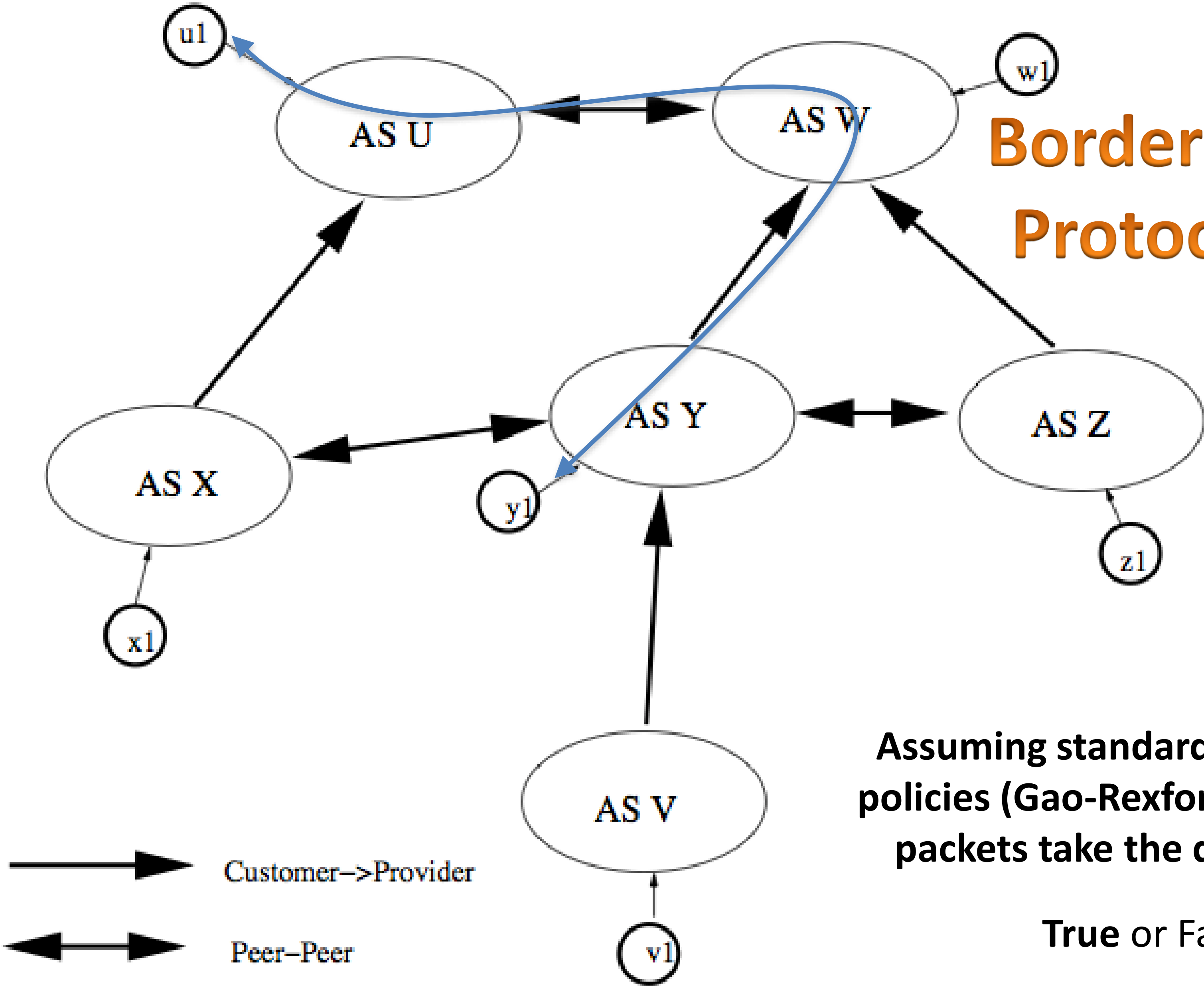

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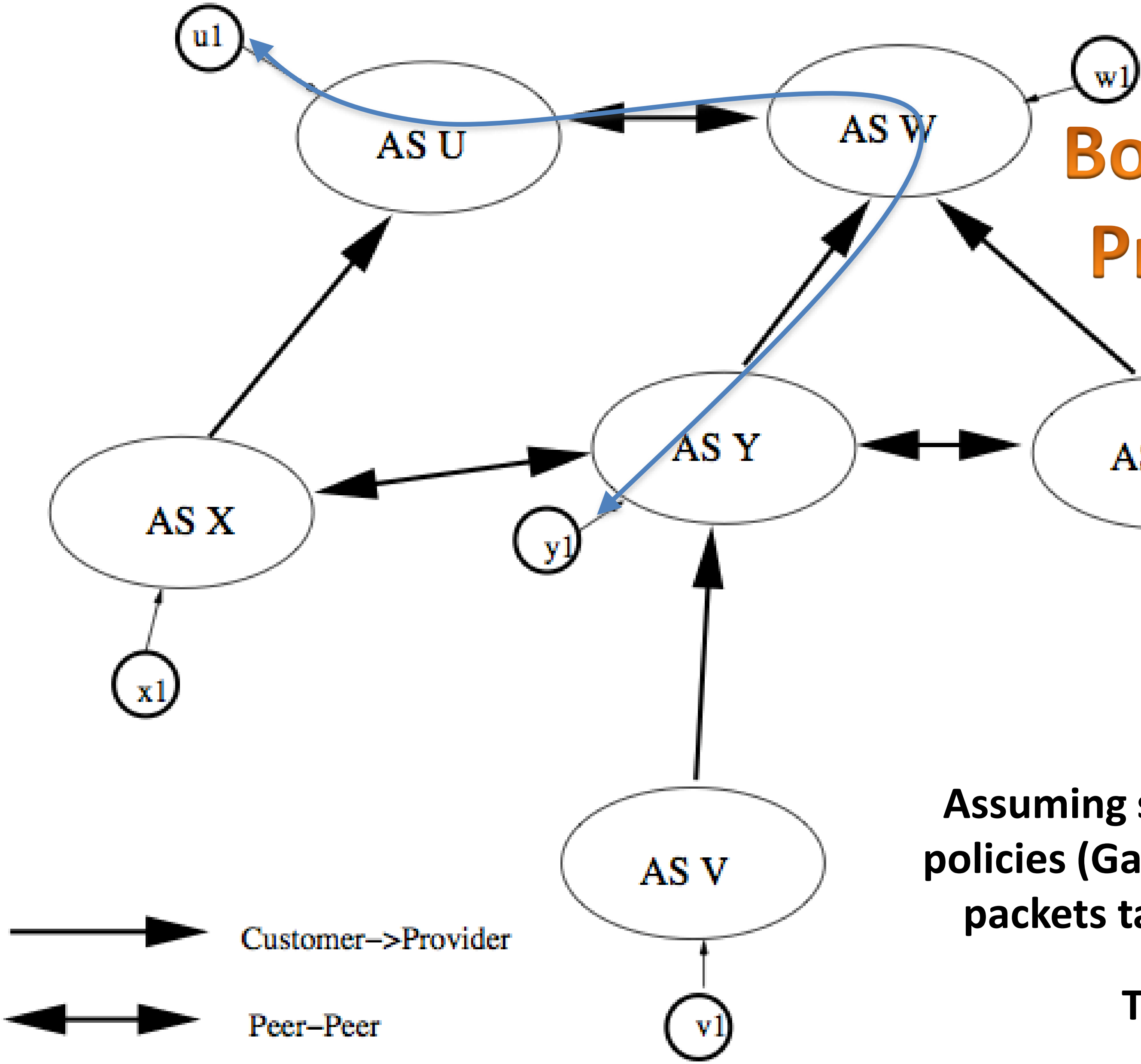
True or False

Why?

Border Gateway Protocol (BGP)



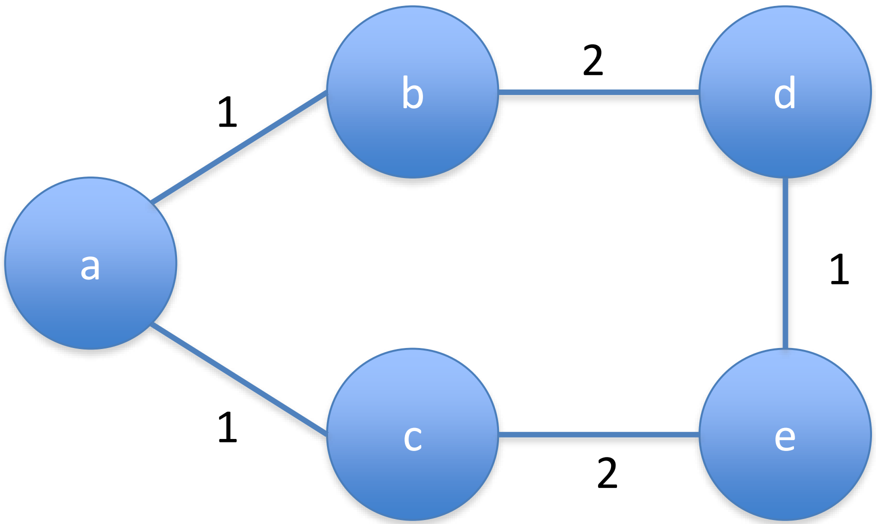
Assuming standard BGP routing policies (Gao-Rexford model), will packets take the drawn path?

True or False

Why?

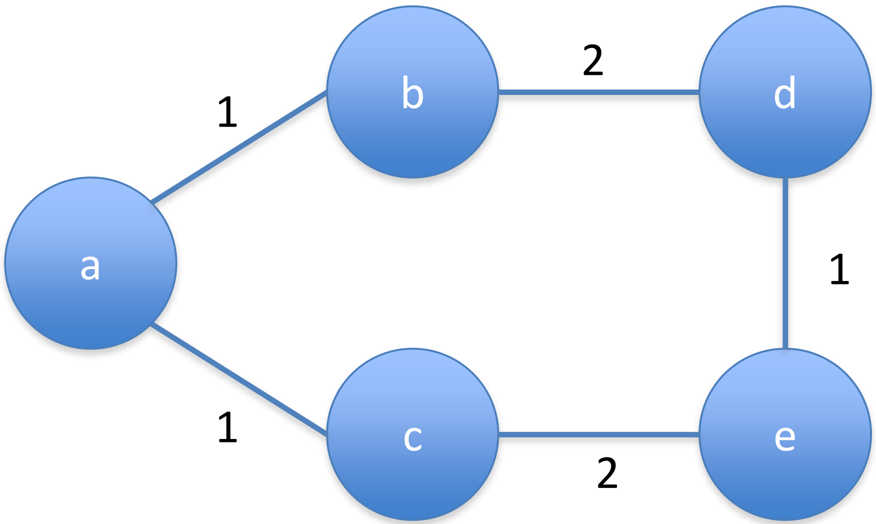
AS X would not advertise a peer link to its provider, AS U (it would pay for being a middle man)

Routing Loops



If the link (c – e) fails, and the nodes run a link-state routing protocol, can a *temporary* forwarding loop occur? If so, which node pairs may see their traffic loop?

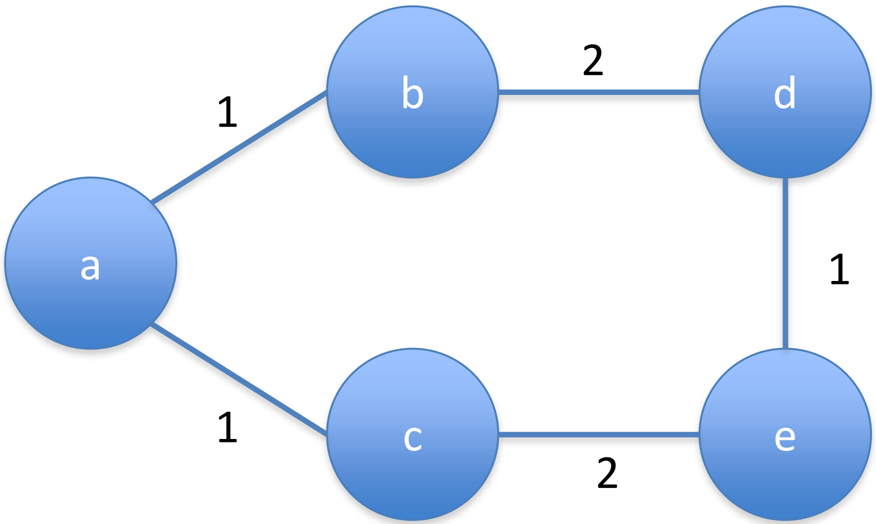
Routing Loops



Nodes *a*, *c*, *d*, and *e* could potentially see their outgoing packets loop.

a → e c <-> e d → c

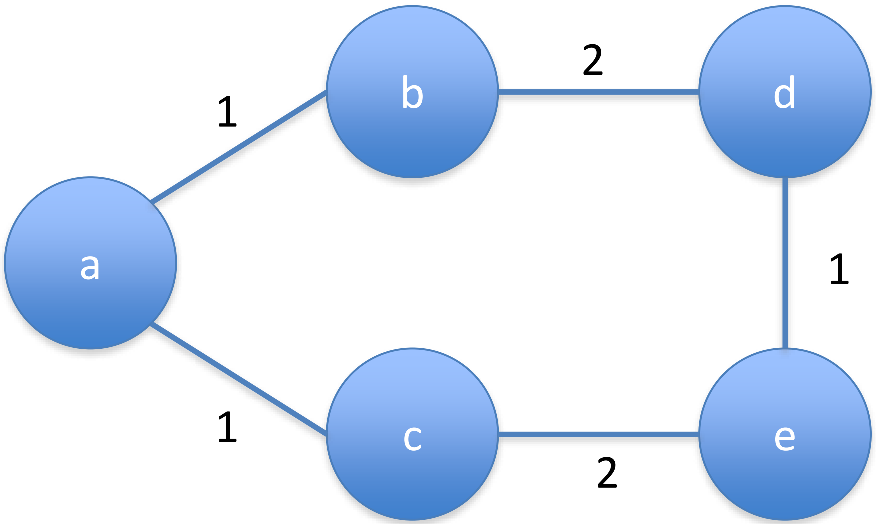
Routing Loops



Suppose network operator Olivia decides to bring down the link c – e for maintenance. Olivia figures she can issue a series of link weight changes in the network to shift traffic away from c – e such that no *temporary* forwarding loops occur.

She's right; what series of changes to c – e's weight would achieve this?

Routing Loops



Change c – e weight to 4.

a to e moves to a – b.

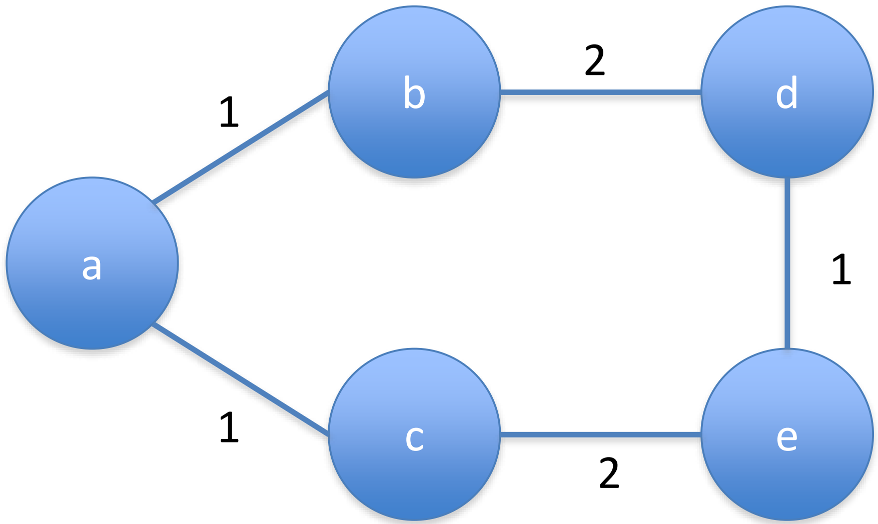
c to e remains on c – e.

d to c moves to d – b.

e to c remains on c – e.

c to d?

Routing Loops

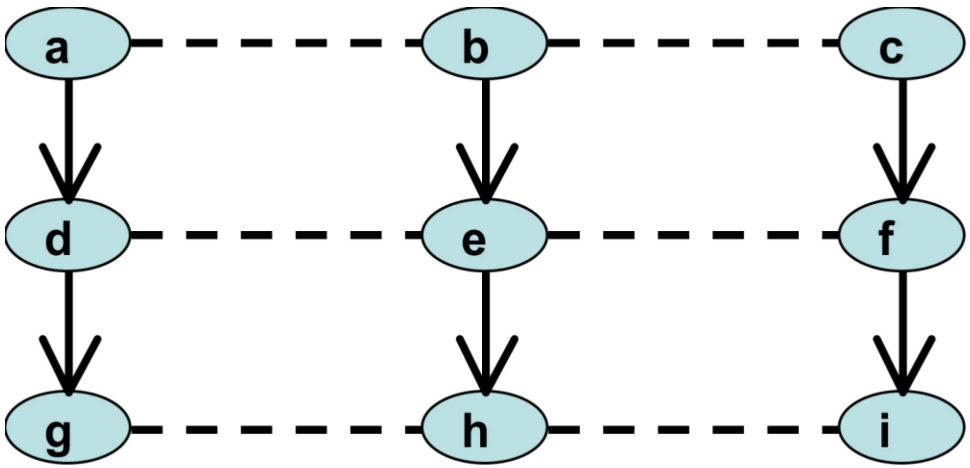


Change c – e weight to 6.

c to e moves to c – a.

e to c moves to e – d.

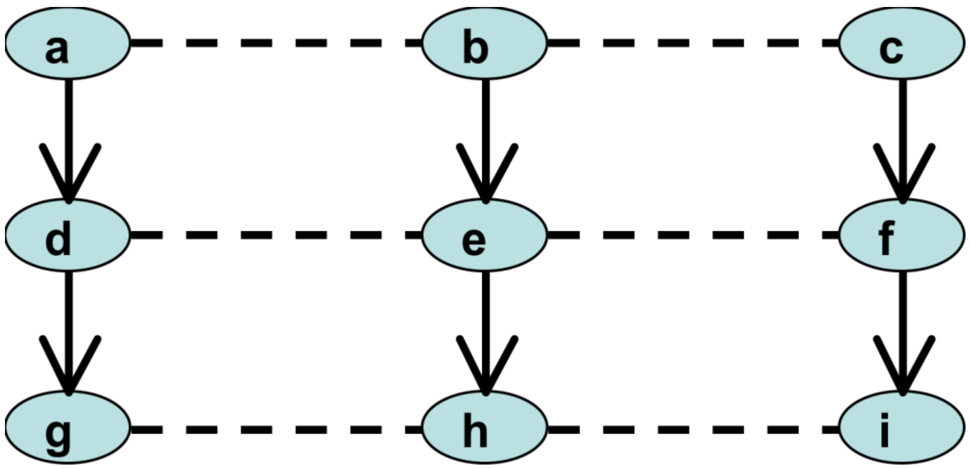
No traffic left on c – e. Olivia can bring down the link.



Peer ----- Peer
Provider -> Customer

1. Which of the following paths to d are valid?

(a) b->a->d
(b) h->e->d
(c) f->e->d
(d) c->b->e->d




```
Peer ----- Peer
Provider -> Customer
```

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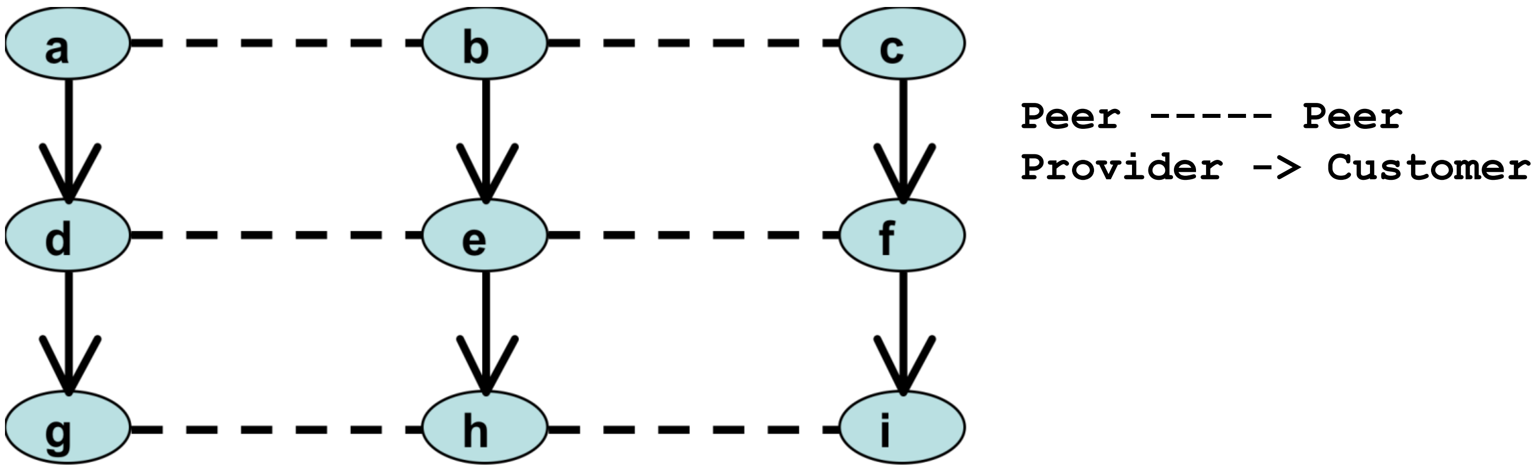
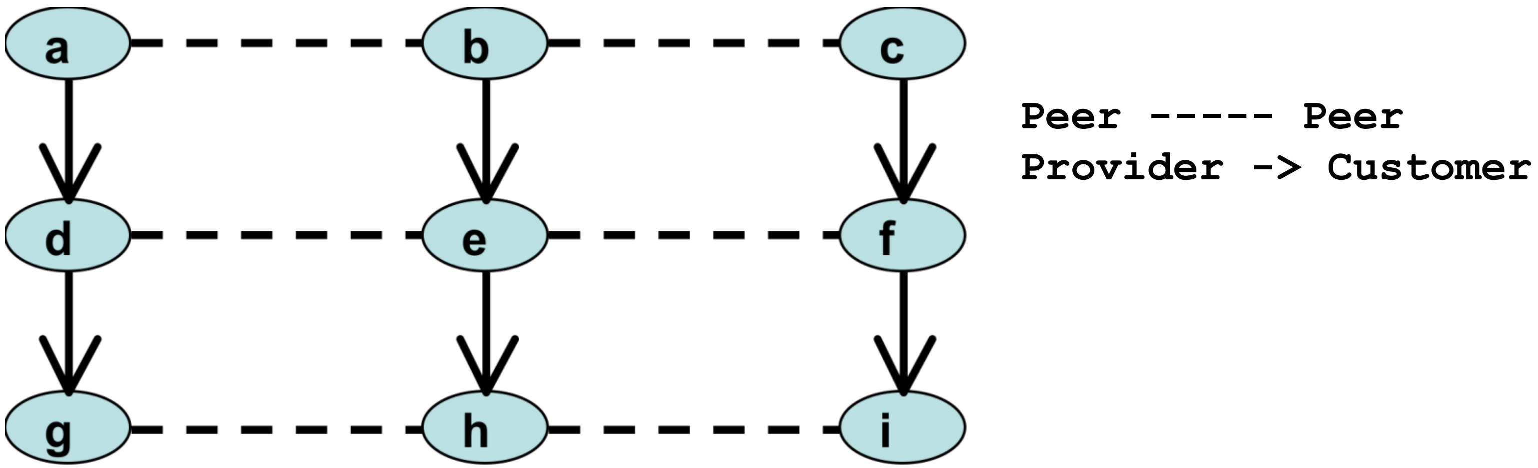
(b) h->e->d
(c) f->e->d
(d) c->b->e->d



2. Which path does e take to reach i ?

(a) e->h->i
(b) e->f->i
(c) e->b->c->f->i
(d) e->d->g->h->i



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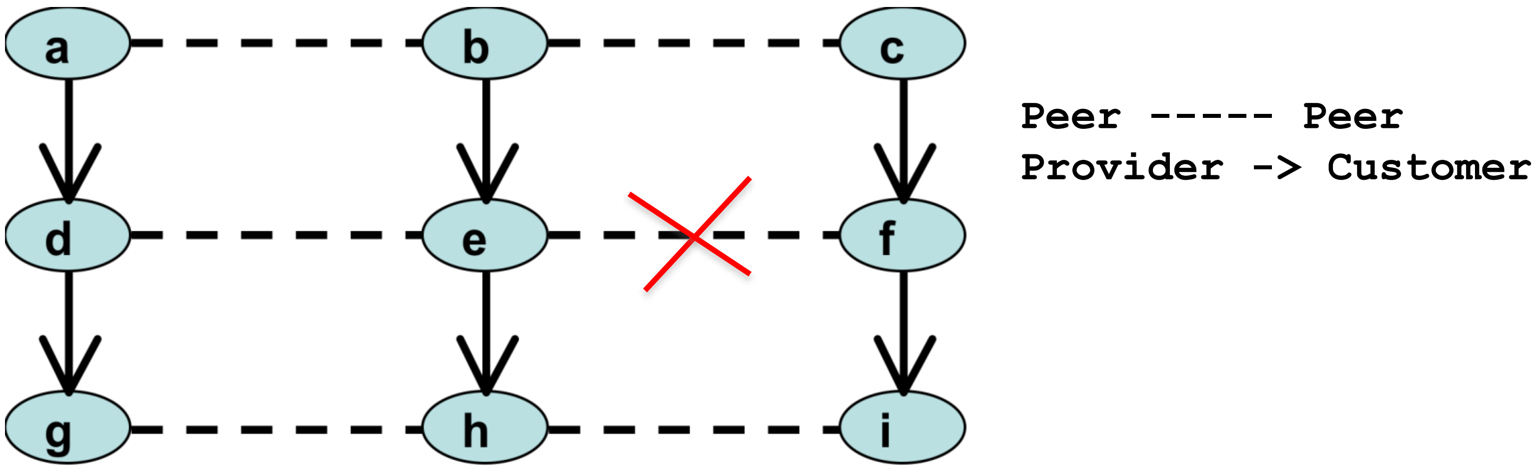
(a) e->h->i
(b) e->f->i
(c) e->b->c->f->i
(d) e->d->g->h->i



3. If the link e-f is removed then which path does e take to reach i ?

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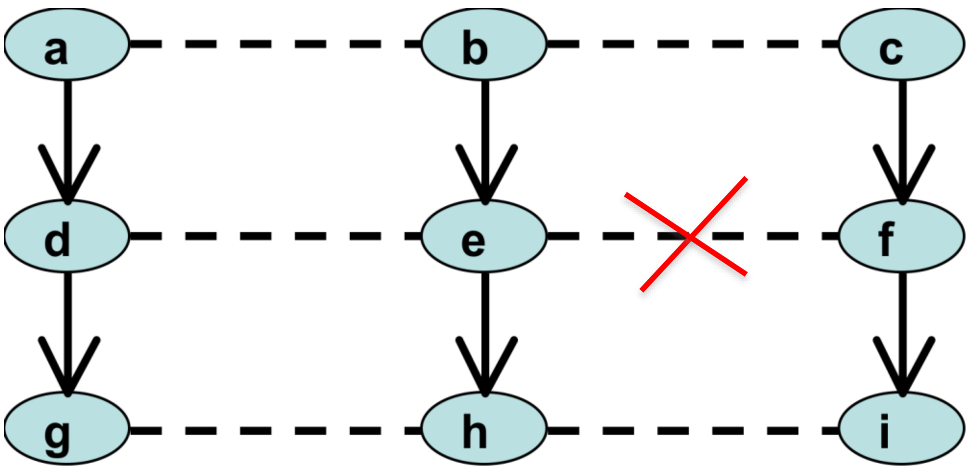

Peer ----- Peer
Provider -> Customer

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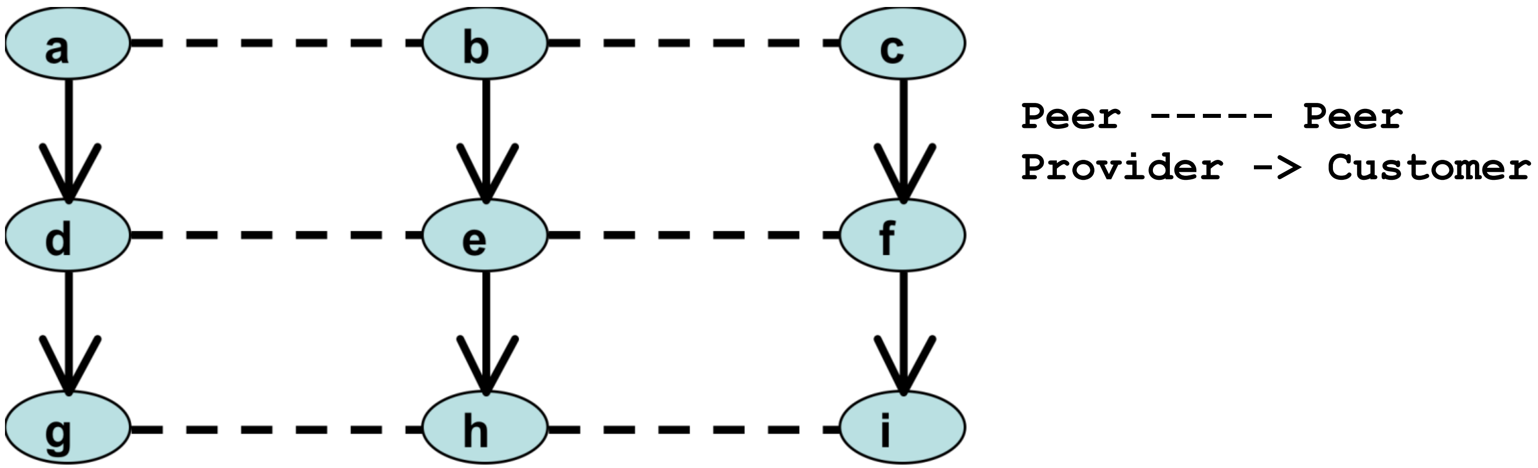

4. Suppose AS b provides a dump of all BGP routes they learn for every destination and we use them to reconstruct the AS-level topology, which of the following business relations will be missing ?

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(c) f->i
(d) d->g
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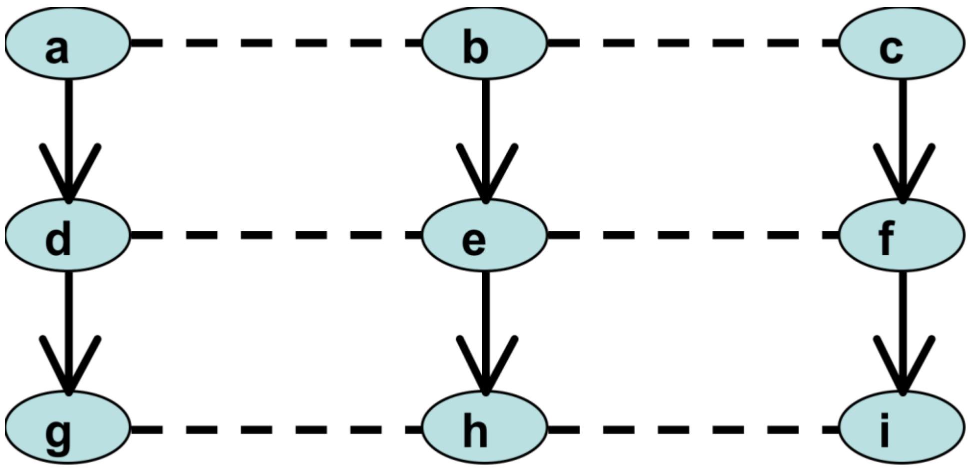

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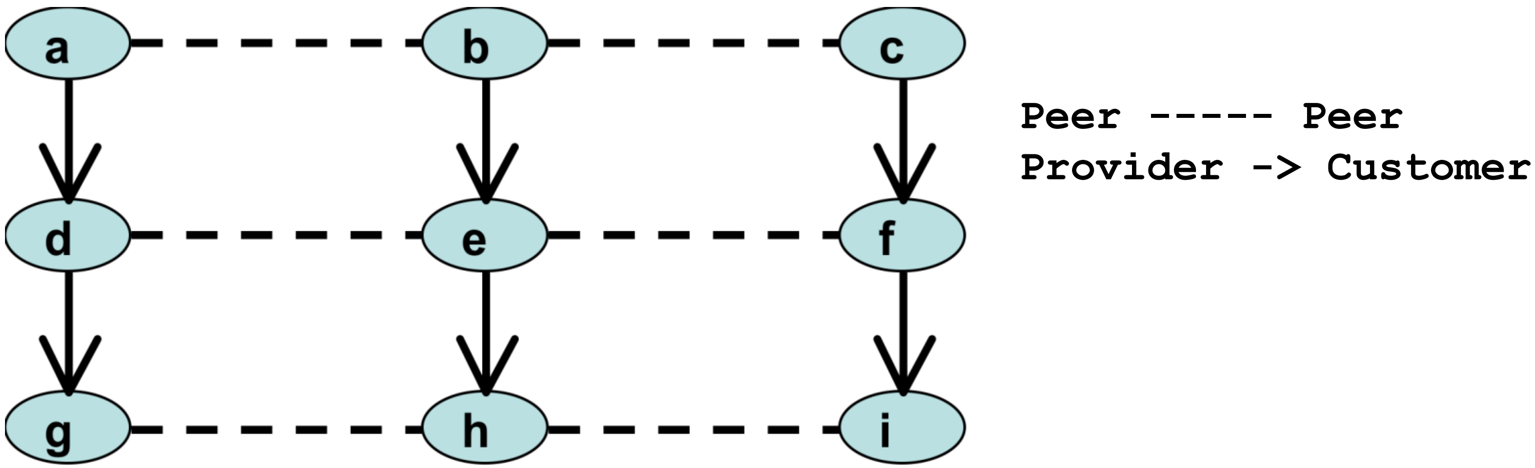
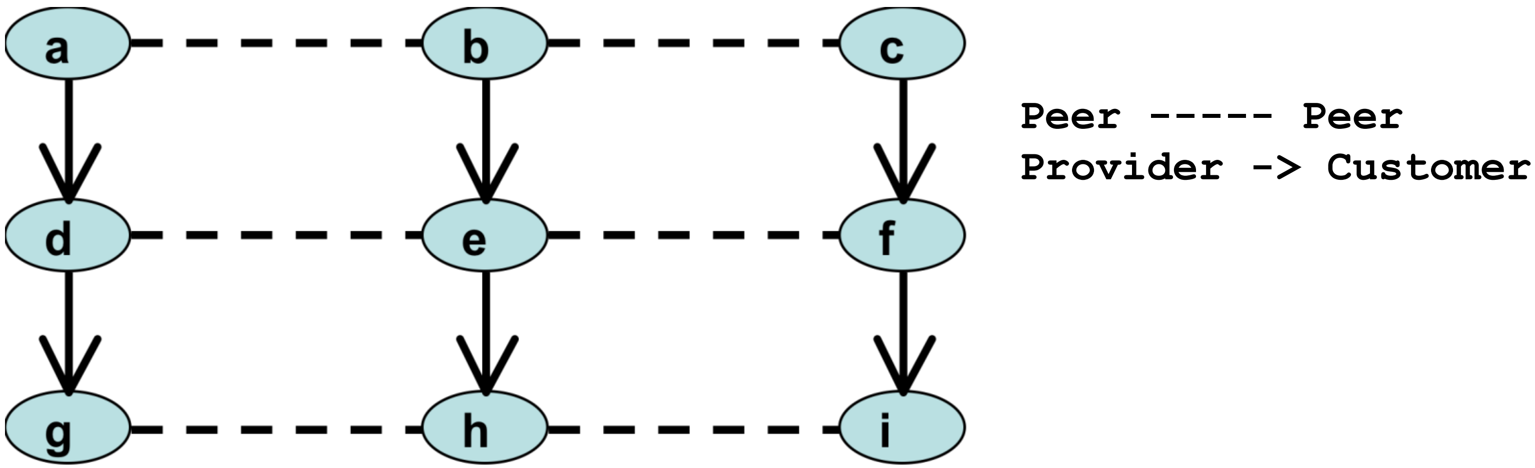


5. What is the minimum set of ASes that must provide "dumps" of every AS path they learn for every edge in the graph to be visible in at least one dump?

(a) a and h
(b) a and c
(c) a, b and h
(d) a, b and c
(e) h



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Directing traffic through a customer generates revenue, whereas sending through a peer or provider is (at best) revenue neutral and may, in fact, cost money.

The policy is realized in BGP by having an import policy that assigns a higher local-preference value to routes learned from customer ASes.