BGP and the Internet

Advanced Community Usage

Cisco Systems

RFC1998

- Informational RFC
- Describes how to implement loadsharing and backup on multiple inter-AS links
  - BGP communities used to determine local preference in upstream's network
- Gives control to the customer
- Simplifies upstream's configuration
  - simplifies network operation!

RFC1998

- **Community values defined to have particular meanings:**

ASx:100	**set local pref 100**	**preferred route**
ASx:90	**set local pref 90**	**backup route if dualhomed on ASx**
ASx:80	**set local pref 80**	**main link is to another ISP with same AS path length**
ASx:70	**set local pref 70**	**main link is to another ISP**

RFC1998

- **Sample Customer Router Configuration**

```
router bgp 107
 neighbor x.x.x.x remote-as 109
 neighbor x.x.x.x description Backup ISP
 neighbor x.x.x.x route-map config-community out
 neighbor x.x.x.x send-community
!
ip as-path access-list 20 permit ^$
ip as-path access-list 20 deny .*
!
route-map config-community permit 10
 match as-path 20
 set community 109:90
```

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- **Sample ISP Router Configuration**

```
! Homed to another ISP
ip community-list 70 permit 109:70
! Homed to another ISP with equal ASPATH length
ip community-list 80 permit 109:80
! Customer backup routes
ip community-list 90 permit 109:90
!
route-map set-customer-local-pref permit 10
 match community 70
 set local-preference 70
```

RFC1998

- **Sample ISP Router Configuration**

```
route-map set-customer-local-pref permit 20
 match community 80
 set local-preference 80
!
route-map set-customer-local-pref permit 30
 match community 90
 set local-preference 90
!
route-map set-customer-local-pref permit 40
 set local-preference 100
```

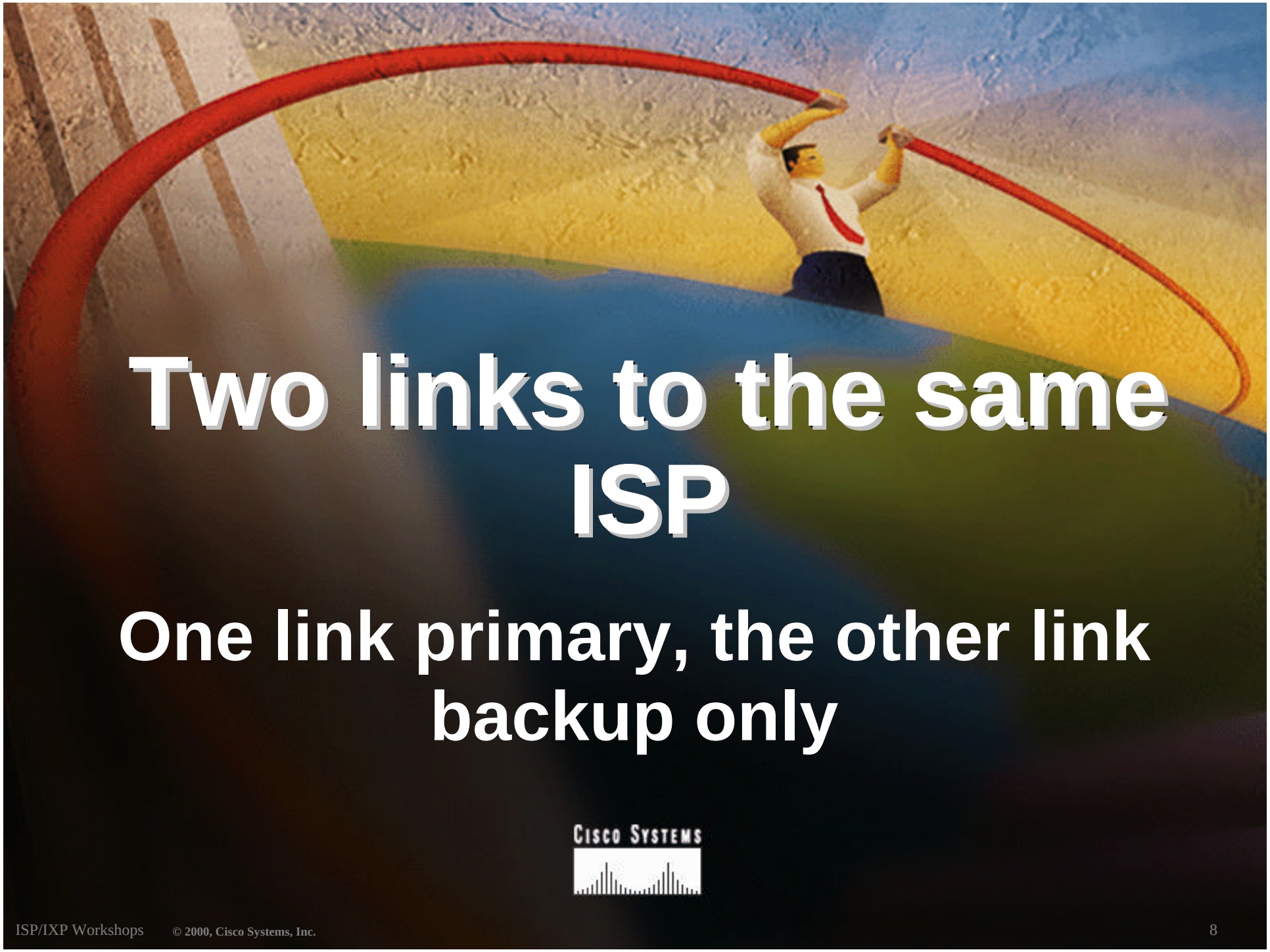
RFC1998

- **Supporting RFC1998**

  many ISPs do, more should

  check AS object in the Internet Routing Registry

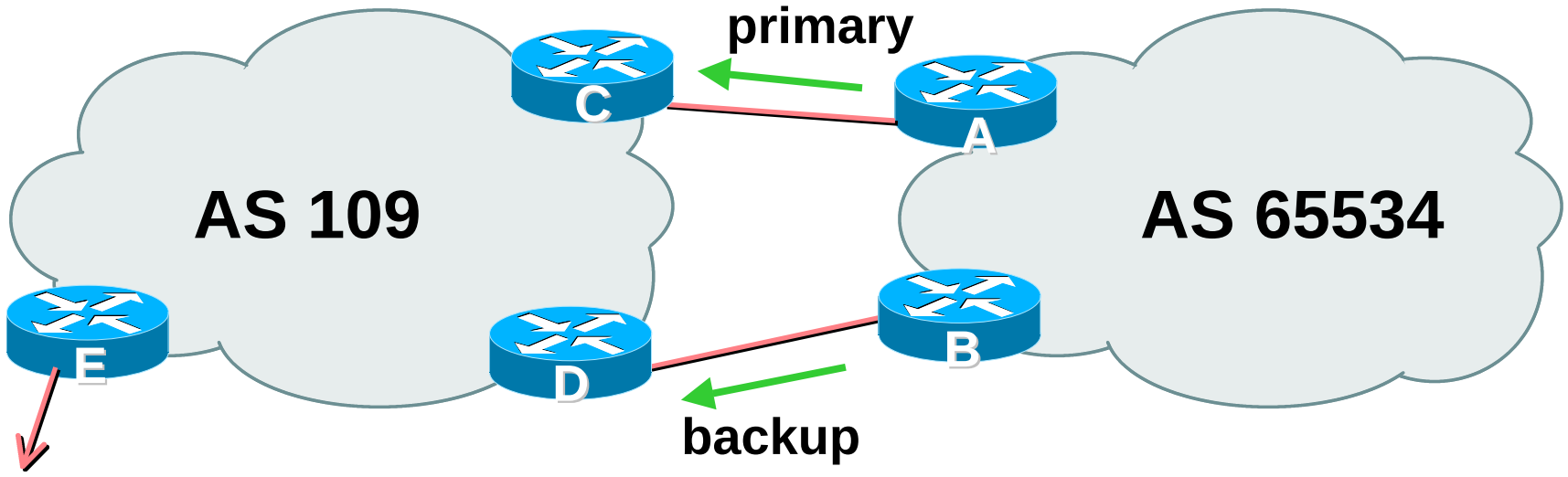
  if you do, insert comment in AS object in the IRR



Two links to the same ISP

One link primary, the other link backup only

Two links to the same ISP



- **AS109 proxy aggregates for AS 65534**

Two links to the same ISP (one as backup only)

- Announce /19 aggregate on each link

  primary link makes standard announcement

  backup link sends community

- When one link fails, the announcement of the /19 aggregate via the other link ensures continued connectivity

Two links to the same ISP (one as backup only)

- **Router A Configuration**

```
router bgp 65534
 network 221.10.0.0 mask 255.255.224.0
 neighbor 222.222.10.2 remote-as 109
 neighbor 222.222.10.2 description RouterC
 neighbor 222.222.10.2 prefix-list aggregate out
 neighbor 222.222.10.2 prefix-list default in
!
ip prefix-list aggregate permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
```

Two links to the same ISP (one as backup only)

- **Router B Configuration**

```
router bgp 65534
 network 221.10.0.0 mask 255.255.224.0
 neighbor 222.222.10.6 remote-as 109
 neighbor 222.222.10.6 description RouterD
 neighbor 222.222.10.6 send-community
 neighbor 222.222.10.6 prefix-list aggregate out
 neighbor 222.222.10.6 route-map routerD-out out
 neighbor 222.222.10.6 prefix-list default in
 neighbor 222.222.10.6 route-map routerD-in in
!
..next slide
```

Two links to the same ISP (one as backup only)

```
ip prefix-list aggregate permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
route-map routerD-out permit 10
 match ip address prefix-list aggregate
 set community 109:90
route-map routerD-out permit 20
!
route-map routerD-in permit 10
 set local-preference 90
!
```

Two links to the same ISP (one as backup only)

- **Router C Configuration (main link)**

```
router bgp 109
 neighbor 222.222.10.1 remote-as 65534
 neighbor 222.222.10.1 default-originate
 neighbor 222.222.10.1 prefix-list Customer in
 neighbor 222.222.10.1 prefix-list default out
!
ip prefix-list Customer permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
```

Two links to the same ISP (one as backup only)

- **Router D Configuration (backup link)**

```
router bgp 109
 neighbor 222.222.10.5 remote-as 65534
 neighbor 222.222.10.5 default-originate
 neighbor 222.222.10.5 prefix-list Customer in
 neighbor 222.222.10.5 route-map bgp-cust-in in
 neighbor 222.222.10.5 prefix-list default out
!
ip prefix-list Customer permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
..next slide
```

Two links to the same ISP (one as backup only)

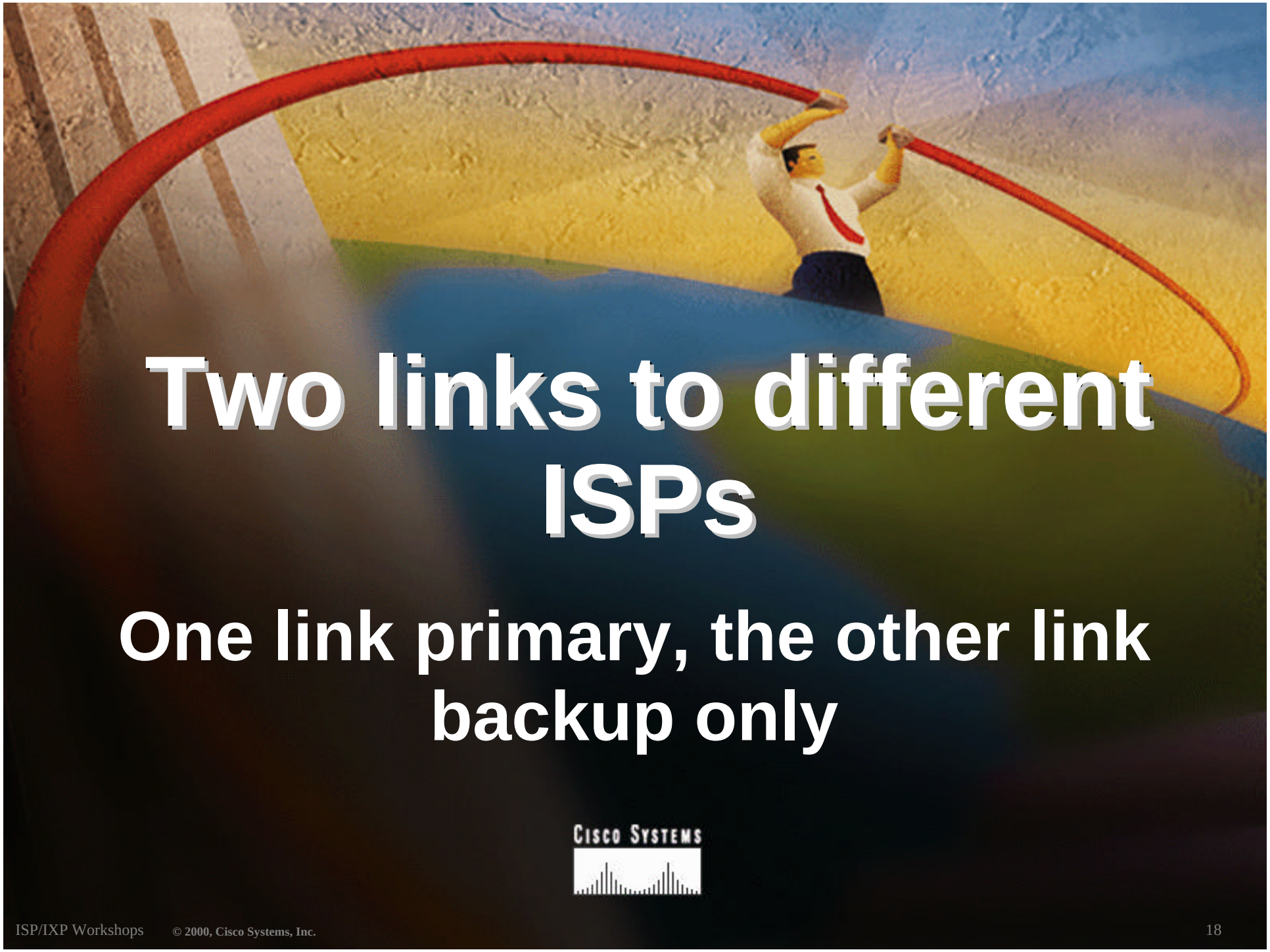
```
ip prefix-list Customer permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
ip community-list 90 permit 109:90
!
<snip>
route-map bgp-cust-in permit 30
 match community 90
 set local-preference 90
route-map bgp-cust-in permit 40
 set local-preference 100
```

Two links to the same ISP (one as backup only)

- **Router E Configuration**

```
router bgp 109
 network 221.10.0.0 mask 255.255.224.0
 neighbor 222.222.10.17 remote-as 110
 neighbor 222.222.10.17 filter-list 1 out
!
ip as-path access-list 1 deny ^(65534_)+$
ip as-path access-list 1 permit ^$
ip route 221.10.0.0 255.255.224.0 null0
```

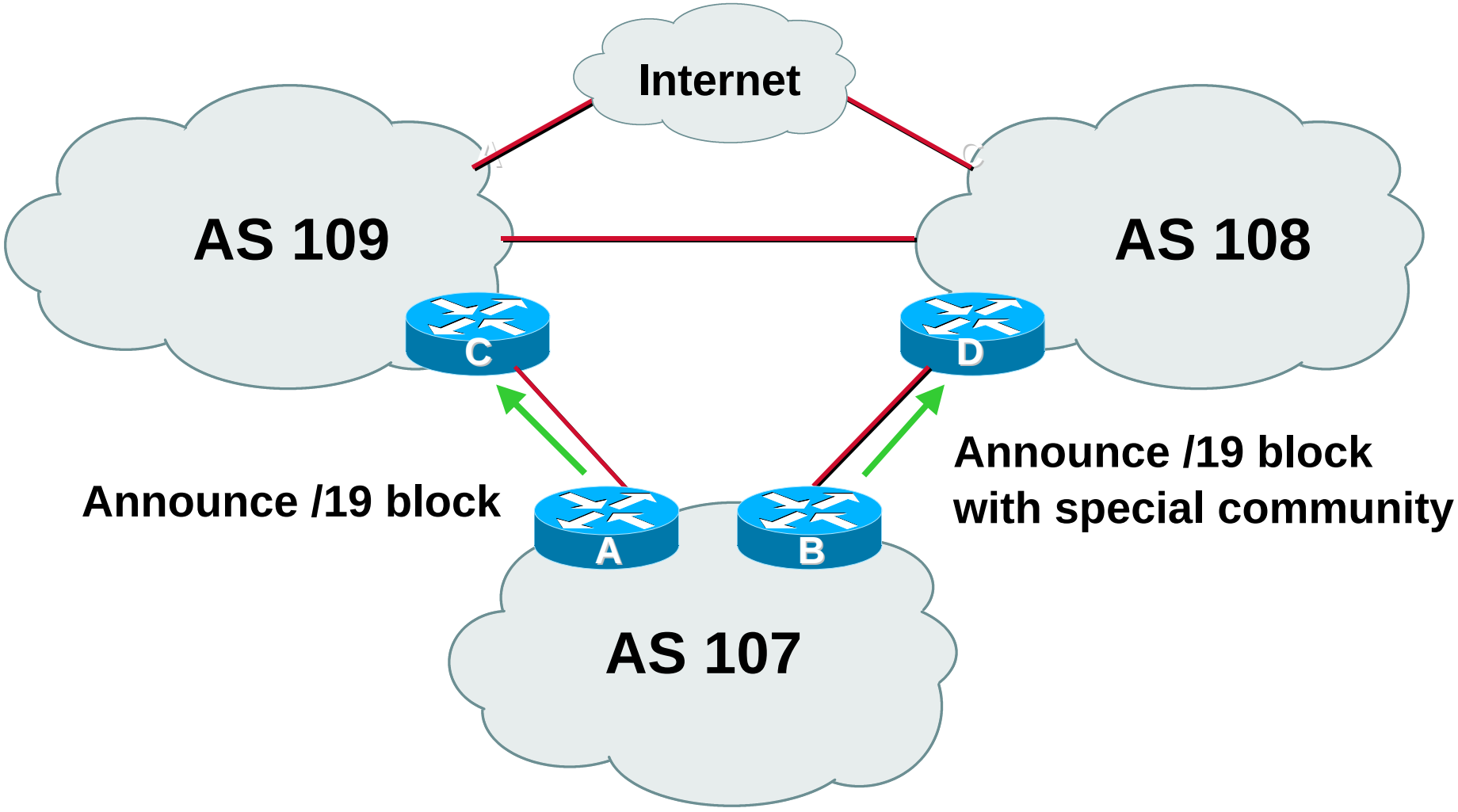
- **Router E removes prefixes in the private AS from external announcements**
- **Private AS still visible inside AS109**



Two links to different ISPs

One link primary, the other link backup only

Two links to different ISPs (one as backup only)



Two links to different ISPs (one as backup only)

- Announce /19 aggregate on each link

  main link makes sends community 109:100 - this sets local pref in AS109 to 100

  backup link sends community 108:80 - this sets local pref in AS108 to 80

- When one link fails, the announcement of the /19 aggregate via the other link ensures continued connectivity

Two links to different ISPs (one as backup only)

- Note that this assumes that AS109 and AS108 are interconnected
- If they are not, AS path length "stuffing" has to be used too

  but that can be done on a per community basis also

  RFC1998++

Two links to different ISPs (one as backup only)

- **Router A Configuration**

```
router bgp 107
 network 221.10.0.0 mask 255.255.224.0
 neighbor 222.222.10.1 remote-as 109
 neighbor 222.222.10.1 prefix-list aggregate out
 neighbor 222.222.10.1 route-map routerC-out out
 neighbor 222.222.10.1 prefix-list default in
!
ip prefix-list aggregate permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
route-map routerC-out permit 10
 set community 109:100
```

Two links to different ISPs (one as backup only)

- **Router B Configuration**

```
router bgp 107
 network 221.10.0.0 mask 255.255.224.0
 neighbor 220.1.5.1 remote-as 108
 neighbor 220.1.5.1 prefix-list aggregate out
 neighbor 220.1.5.1 route-map routerD-out out
 neighbor 220.1.5.1 prefix-list default in
 neighbor 220.1.5.1 route-map routerD-in in
..next slide
```

Two links to different ISPs (one as backup only)

```
ip prefix-list aggregate permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
route-map routerD-out permit 10
 set community 108:80
!
route-map routerD-in permit 10
 set local-preference 80
```

Two links to different ISPs (one as backup only)

- **Router D**

  sees path from router B with community 108:80 set - sets local preference to 80

  sees path from peering with AS109 - default local preference is 100

  local-pref comes before AS Path length

  highest local-pref wins

  traffic for AS107 is sent to AS109

Two links to different ISPs (one as backup only)

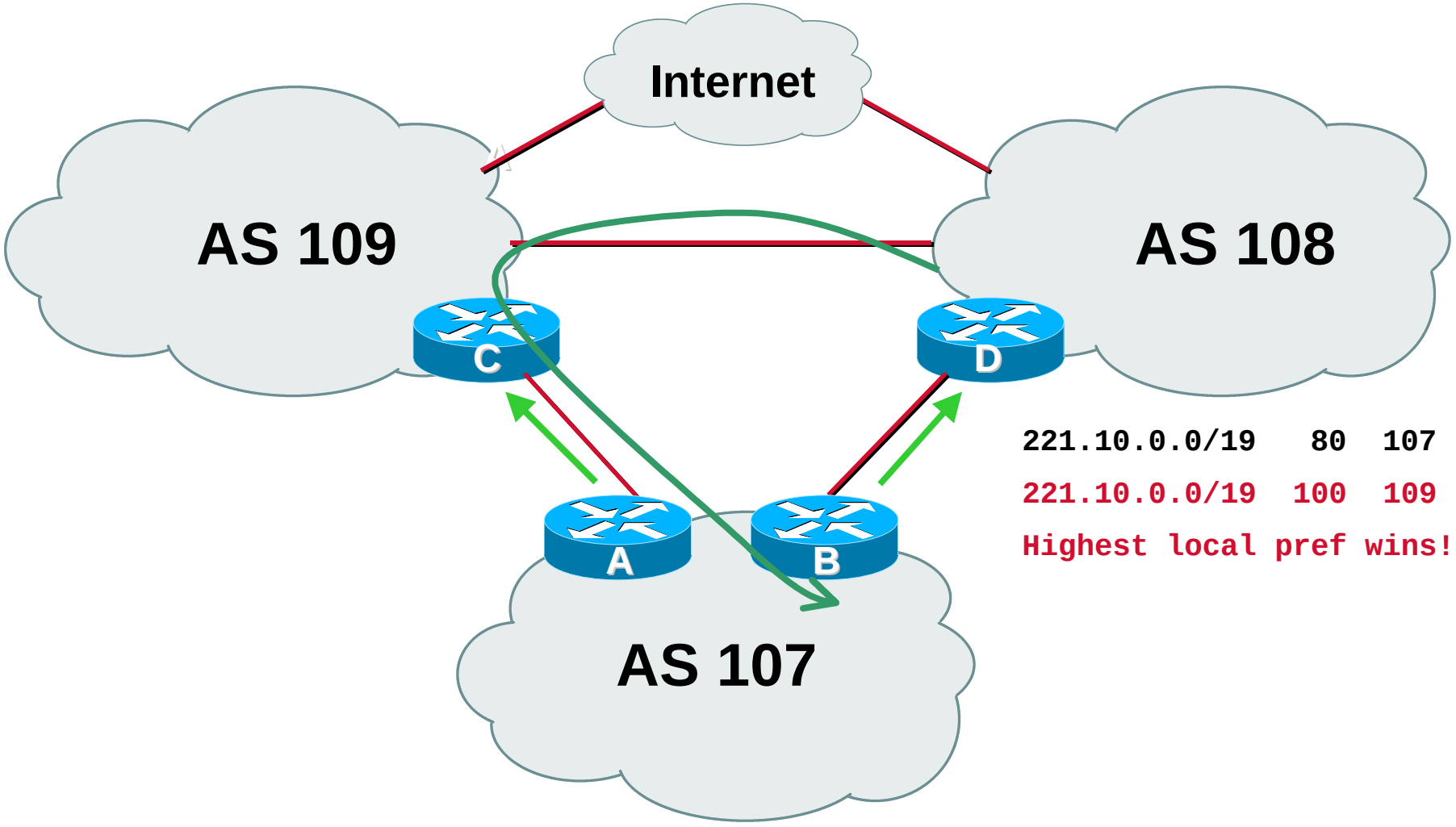
- **Router D**

  Only requires RFC1998 configuration

  no per customer configuration

  scalability!

Two links to different ISPs (one as backup only)




```
221.10.0.0/19    80  107
221.10.0.0/19   100  109 107
Highest local pref wins!
```

Two links to different ISPs (one as backup only)

- If AS107 wants to make the link to AS108 the main link

  sends community 108:100 to router C

  sends community 109:80 to router B

- AS108 and AS109 NOC intervention not required

RFC1998++

Possible enhancements to RFC1998

RFC1998++

- **RFC1998 is okay for “simple” multihomed customers**
  - **assumes that upstreams are interconnected**
- **RFC1998++**
  - **unofficial but often used additions by many ISPs**
  - **assumes nothing!**

RFC1998++

- **More community definitions:**

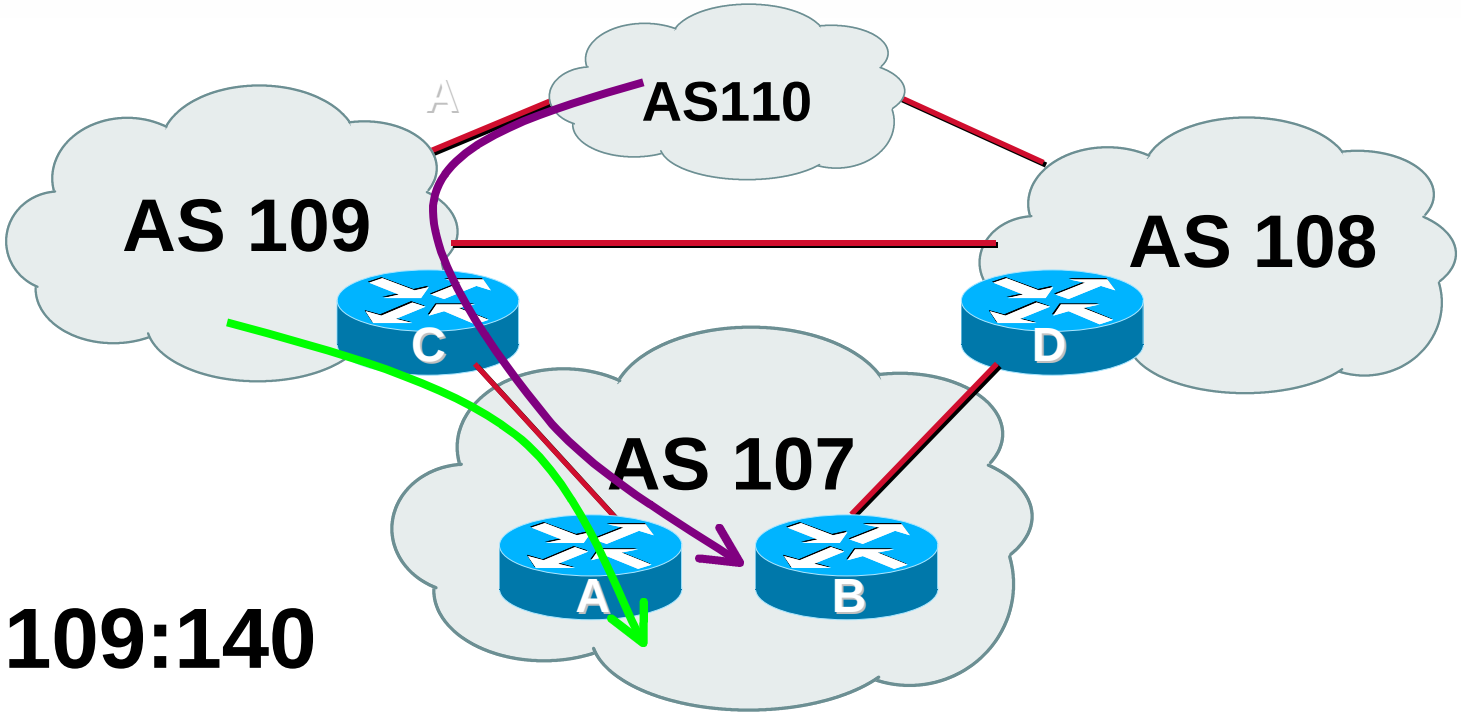
ASx:140	set local pref 140	set local pref high on upstreams
ASx:130	set local pref 130	set local pref low on upstreams
ASx:120	set local pref 120	more preferred (opposite to ASx:80)

<RFC1998 definitions>

ASx:60	set local pref 60	ASx:90 but add 2 times AS PATH
ASx:50	set local pref 50	don't announce to any peer
ASx:40	set local pref 40	and set local pref high on upstreams
ASx:30	set local pref 30	and set local pref low on upstreams

(and variations on this theme depending on local conditions, e.g. IXPs, domestic vs. international transit, etc.)

RFC1998++ example

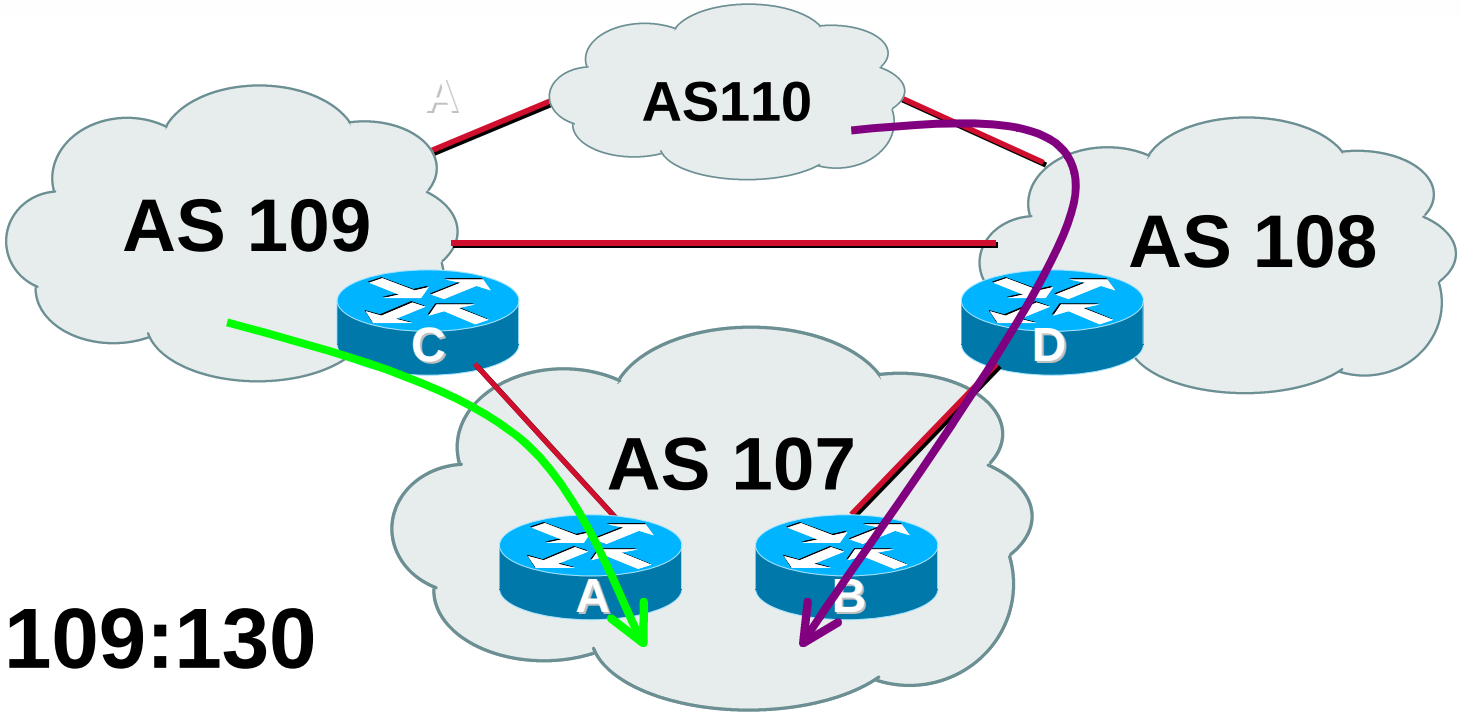


- **109:140**

  traffic in AS109 comes directly to you

  traffic in AS110 sent to AS109 rather than best path

RFC1998++ example



- **109:130**

  traffic in AS109 comes directly to you

  traffic in AS110 sent to AS108 rather than best path

RFC1998++ example

- **109:60**

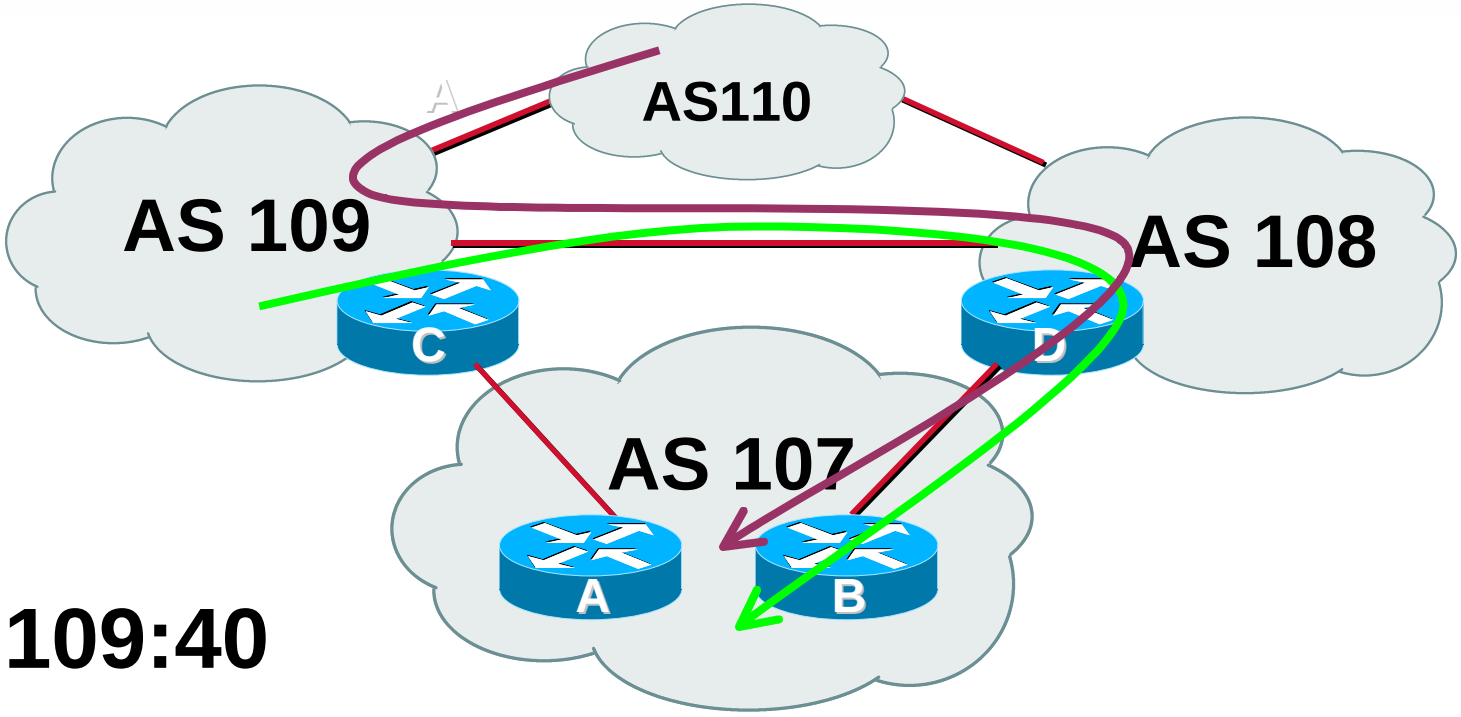
  set local pref low in AS109

  prepend any announcements to peers of AS109 with 109_109 - AS109 is my backup transit AS

- **109:50**

  don’t announce to any peer - used when you have good local connections to AS109 and better long distance via AS108

RFC1998++ example

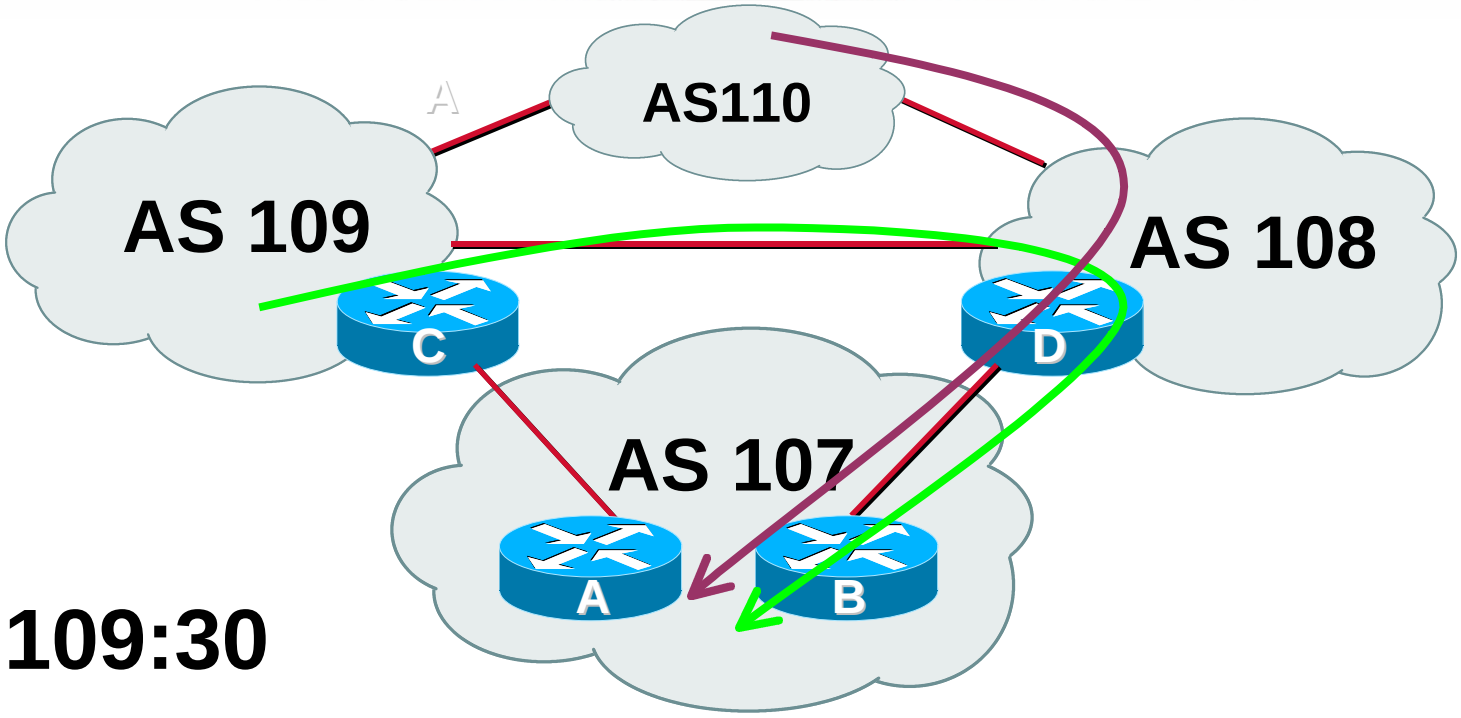


- **109:40**

  traffic in AS109 sent to AS108

  traffic in AS110 sent to AS109 rather than best path

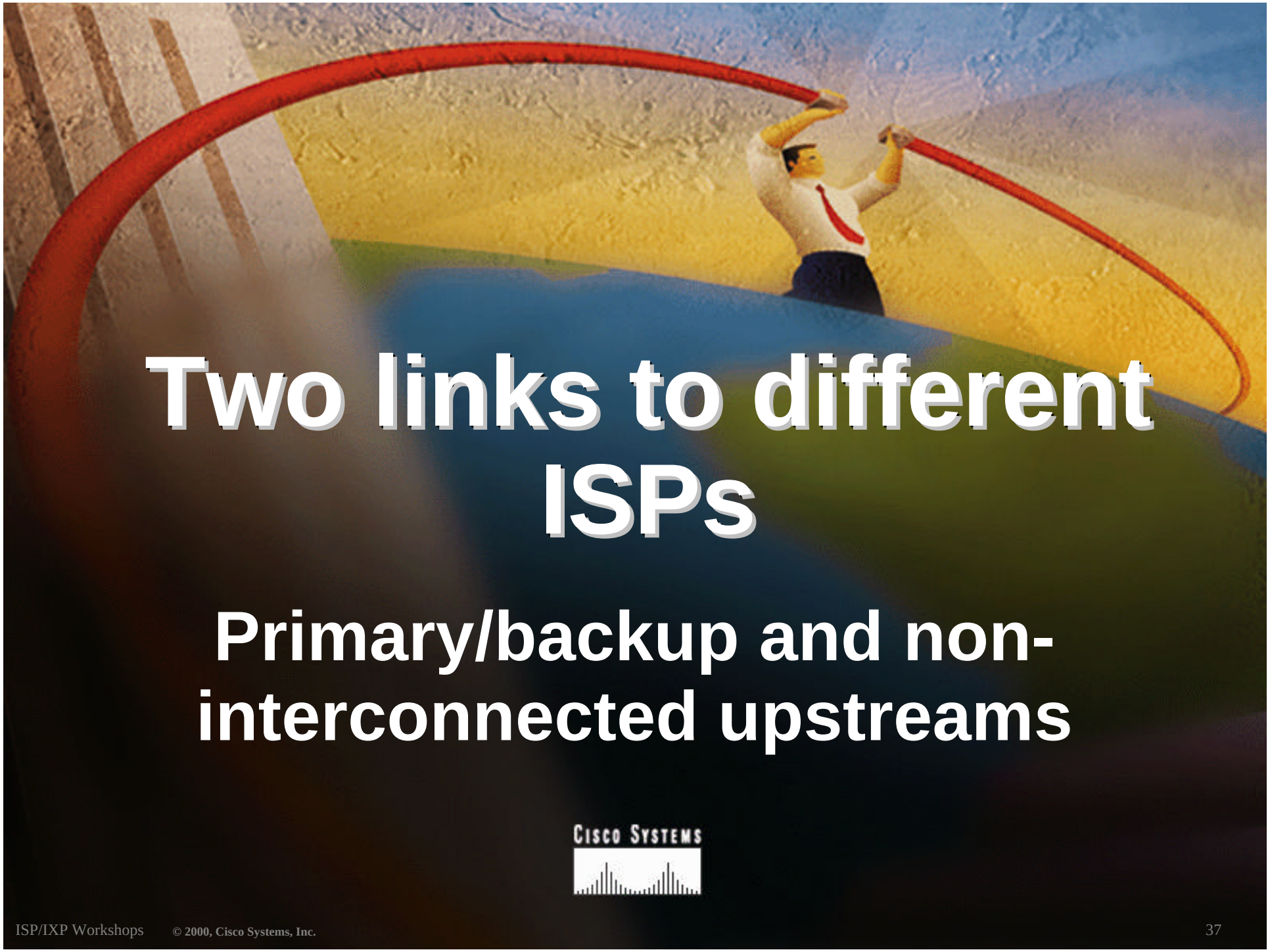
RFC1998++ example



- **109:30**

  traffic in AS109 sent to AS108

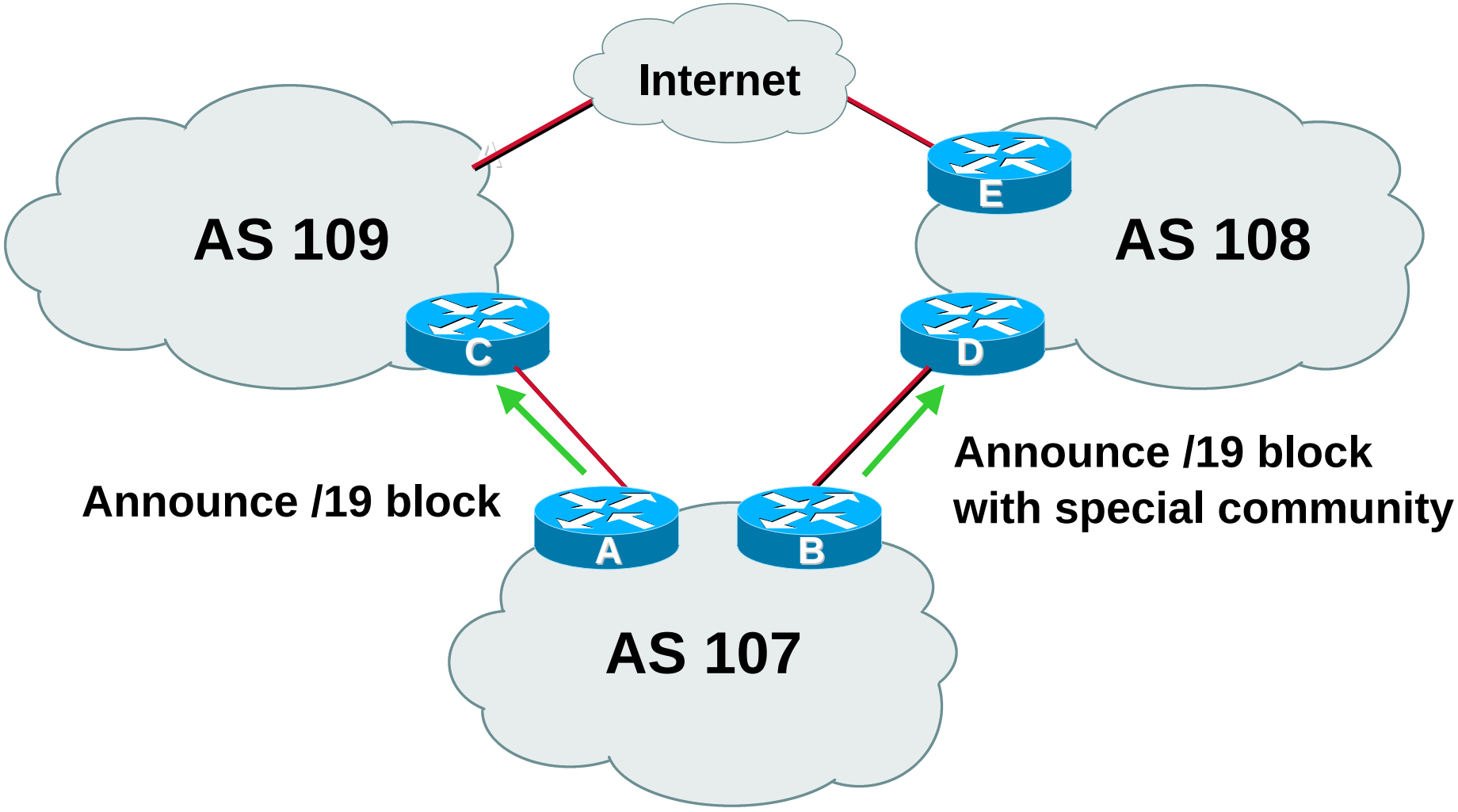
  traffic in AS110 sent to AS108 rather than best path



Two links to different ISPs

Primary/backup and non-interconnected upstreams

Two links to different ISPs (RFC1998++)



Two links to different ISPs (RFC1998++)

- Announce /19 aggregate on each link

  main link makes sends community 109:100 - this sets local pref in AS109 to 100

  backup link sends community 108:60 - this sets local pref in AS108 to 60

- When one link fails, the announcement of the /19 aggregate via the other link ensures continued connectivity

Two links to different ISPs (RFC1998++)

- **Router A Configuration**

```
router bgp 107
 network 221.10.0.0 mask 255.255.224.0
 neighbor 222.222.10.1 remote-as 109
 neighbor 222.222.10.1 send-community
 neighbor 222.222.10.1 prefix-list aggregate out
 neighbor 222.222.10.1 route-map routerB-out out
 neighbor 222.222.10.1 prefix-list default in
!
ip prefix-list aggregate permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
route-map routerB-out permit 10
 set community 109:100
```

Two links to different ISPs (RFC1998++)

- **Router B Configuration**

```
router bgp 107
 network 221.10.0.0 mask 255.255.224.0
 neighbor 220.1.5.1 remote-as 108
 neighbor 220.1.5.1 prefix-list aggregate out
 neighbor 220.1.5.1 route-map routerD-out out
 neighbor 220.1.5.1 prefix-list default in
 neighbor 220.1.5.1 route-map routerD-in in
..next slide
```

Two links to different ISPs (RFC1998++)

```
ip prefix-list aggregate permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
route-map routerD-out permit 10
 set community 108:60
!
route-map routerD-in permit 10
 set local-preference 80
```

Two links to different ISPs (RFC1998++)

- **Router D Configuration**

```
router bgp 108
 neighbor 220.1.5.2 remote-as 109
 neighbor 220.1.5.2 default-originate
 neighbor 220.1.5.2 prefix-list Customer in
 neighbor 220.1.5.2 route-map bgp-cust-in in
 neighbor 220.1.5.2 prefix-list default out
!
ip prefix-list Customer permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
!
..next slide
```

Two links to different ISPs (RFC1998++)

```
  ip prefix-list Customer permit 221.10.0.0/19
  ip prefix-list default permit 0.0.0.0/0
  !
  ip community-list 60 permit 108:60
  !
<snip>
  route-map bgp-cust-in permit 10
   match community 60
   set local-preference 60
   set community 108:4000
<snip>
```

Two links to different ISPs (RFC1998++)

- **Router D**

  sees path from router B with community 108:60 set:

  sets local pref to 60

  changes community to AS108 community which prepends two times AS108

Two links to different ISPs (RFC1998++)

- **Router D (contd)**

  sees path from AS109 via Internet - default local preference is 100

  local-pref comes before AS Path length

  highest local-pref wins

  traffic for AS107 is sent via Internet

Two links to different ISPs (RFC1998++)

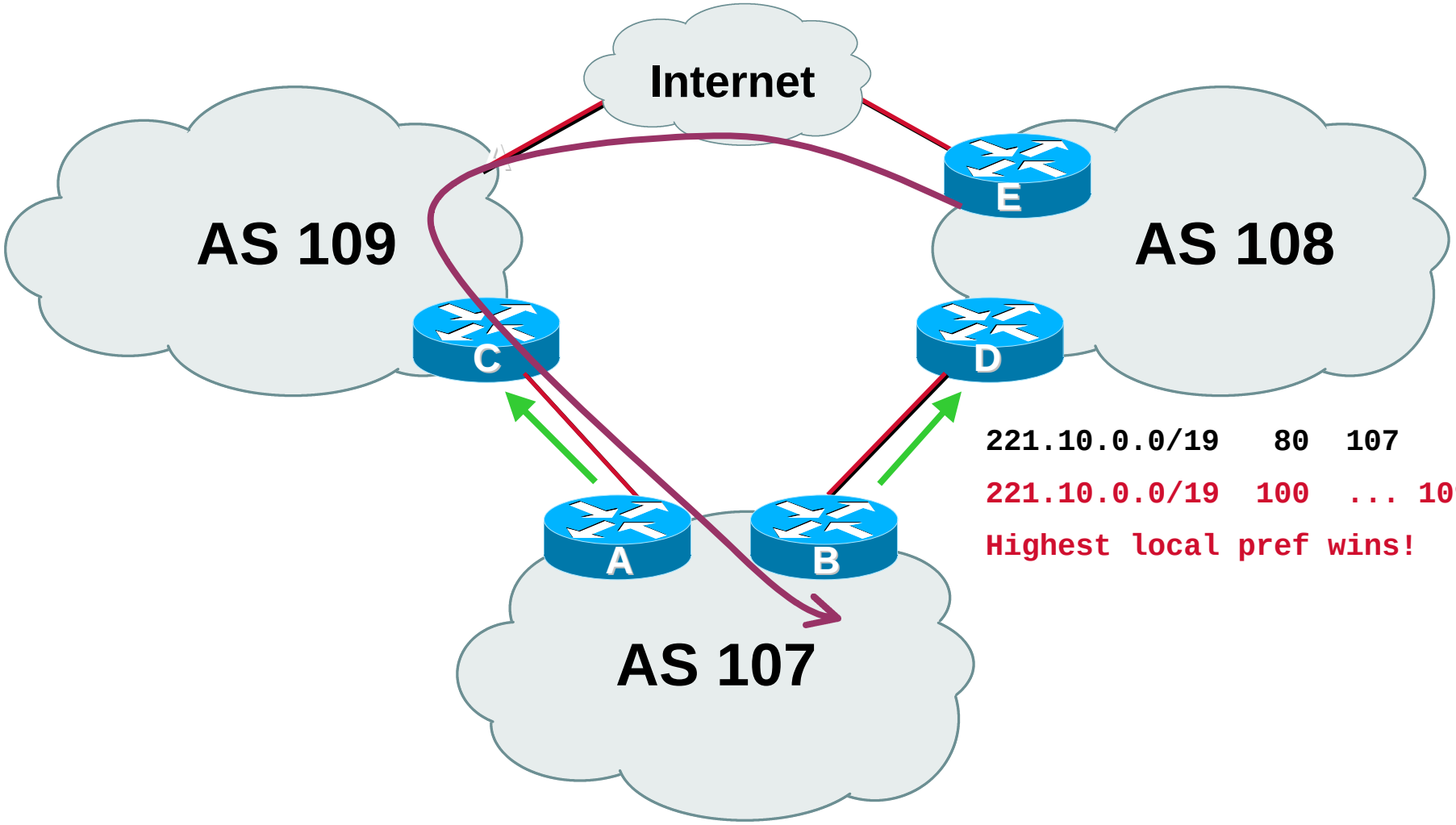
- **Router E Configuration**

```
router bgp 108
 neighbor x.x.x.x remote-as UP-ASN
 neighbor x.x.x.x prefix-list Upstream in
 neighbor x.x.x.x route-map upstream-in in
 neighbor x.x.x.x prefix-list AS108-list out
 neighbor x.x.x.x route-map upstream-out out
!
..next slide
```

Two links to different ISPs (RFC1998++)

```
! Customer peers who want AS-PATH prepend
ip community-list 1 permit 108:4000
! Customer peers who want control one set away from us
ip community-list 2 permit 108:4010
!
<snip>
  route-map upstream-out permit 10
   match community 1
   set as-path prepend 108 108
  route-map upstream-out permit 20
   match community 2
   set community UP-ASN:80
<snip>
```

Two links to different ISPs (RFC1998++)



Two links to different ISPs (RFC1998++)

- If AS107 wants to make the link to AS108 the main link

  sends community 108:100 to router D

  sends community 109:60 to router C

- AS108 and AS109 NOC intervention not required

Communities

- **Communities are fun! ☺**
- **And they are extremely powerful tools**
- **Think about community policies, e.g. like RFC1998++**
- **Supporting extensive community usage makes customer configuration easy**
- ***Watch out for routing loops!***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