BGP and the Internet

Communities, Transit, Collocation

Advanced Community usage

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
```

RFC1998

- **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
```

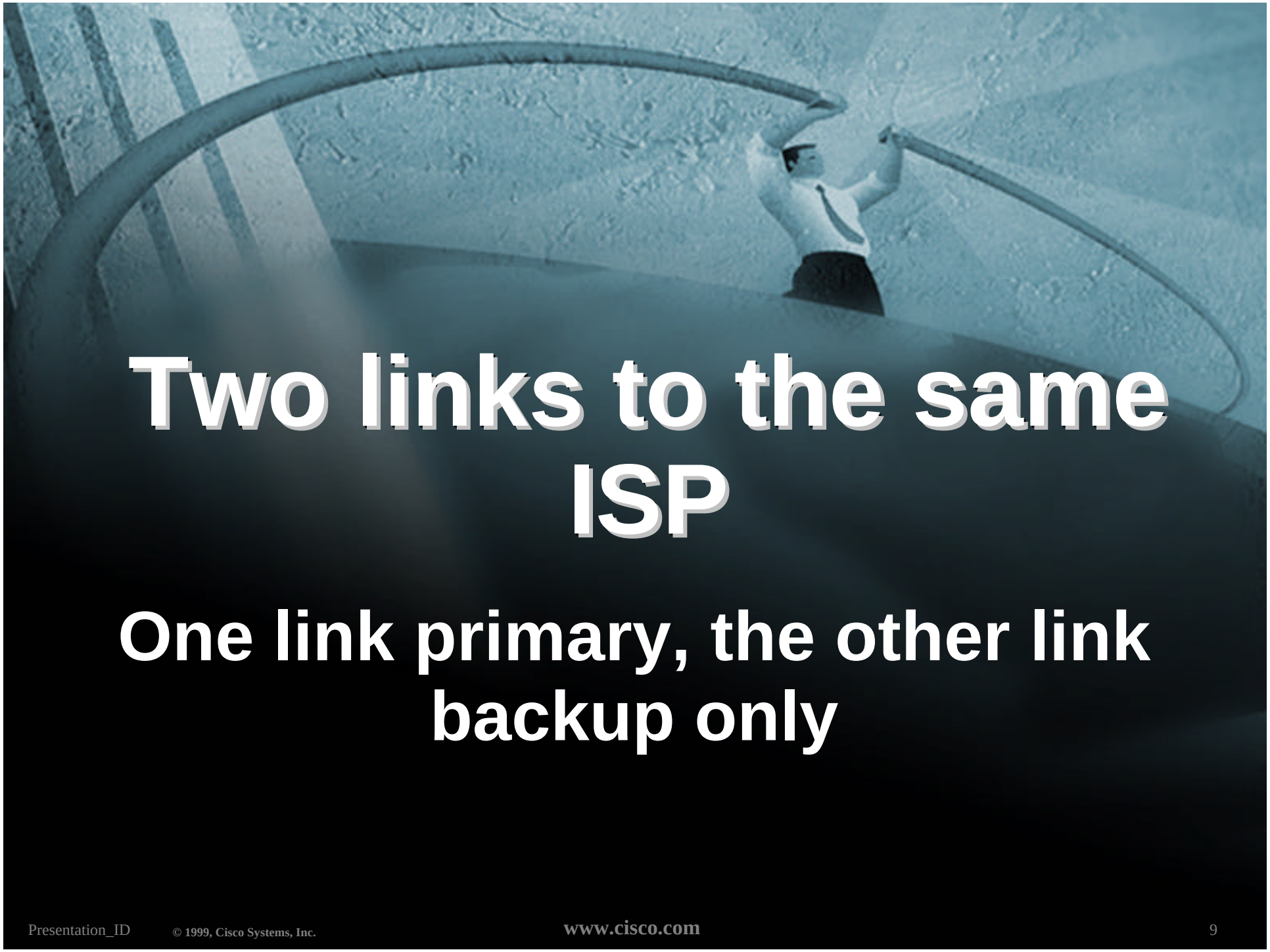
RFC1998

- **Supporting RFC1998**

  many ISPs do, more should

  check AS object in the Internet Routing Registry

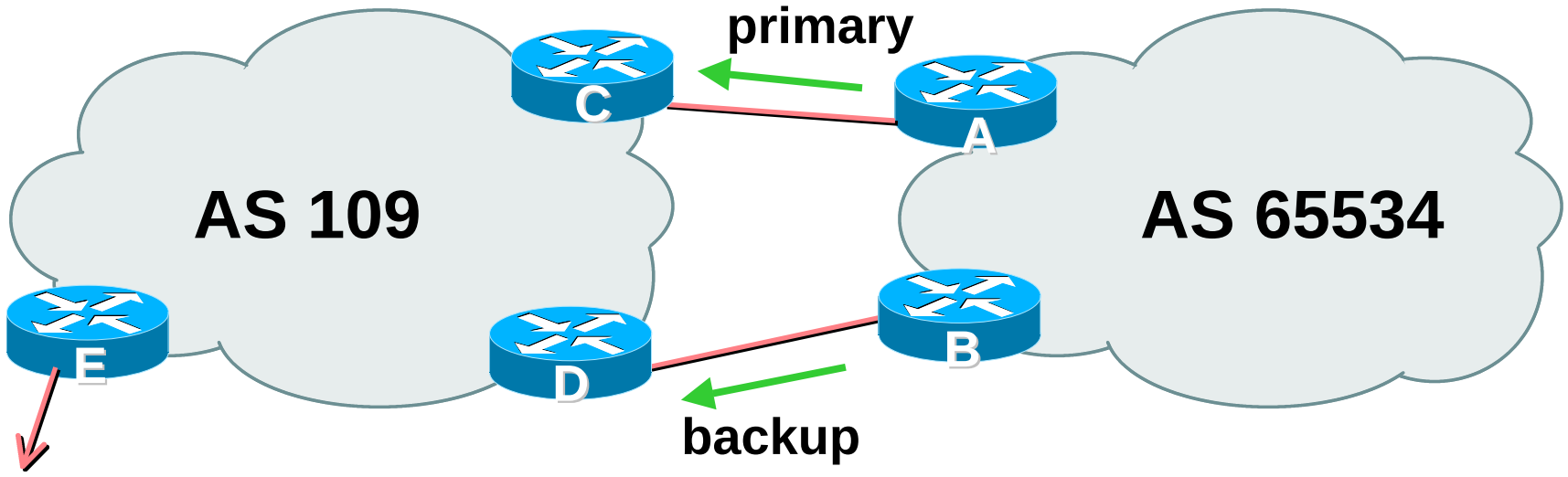
  if you do, insert comment in AS object in the IRR



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)

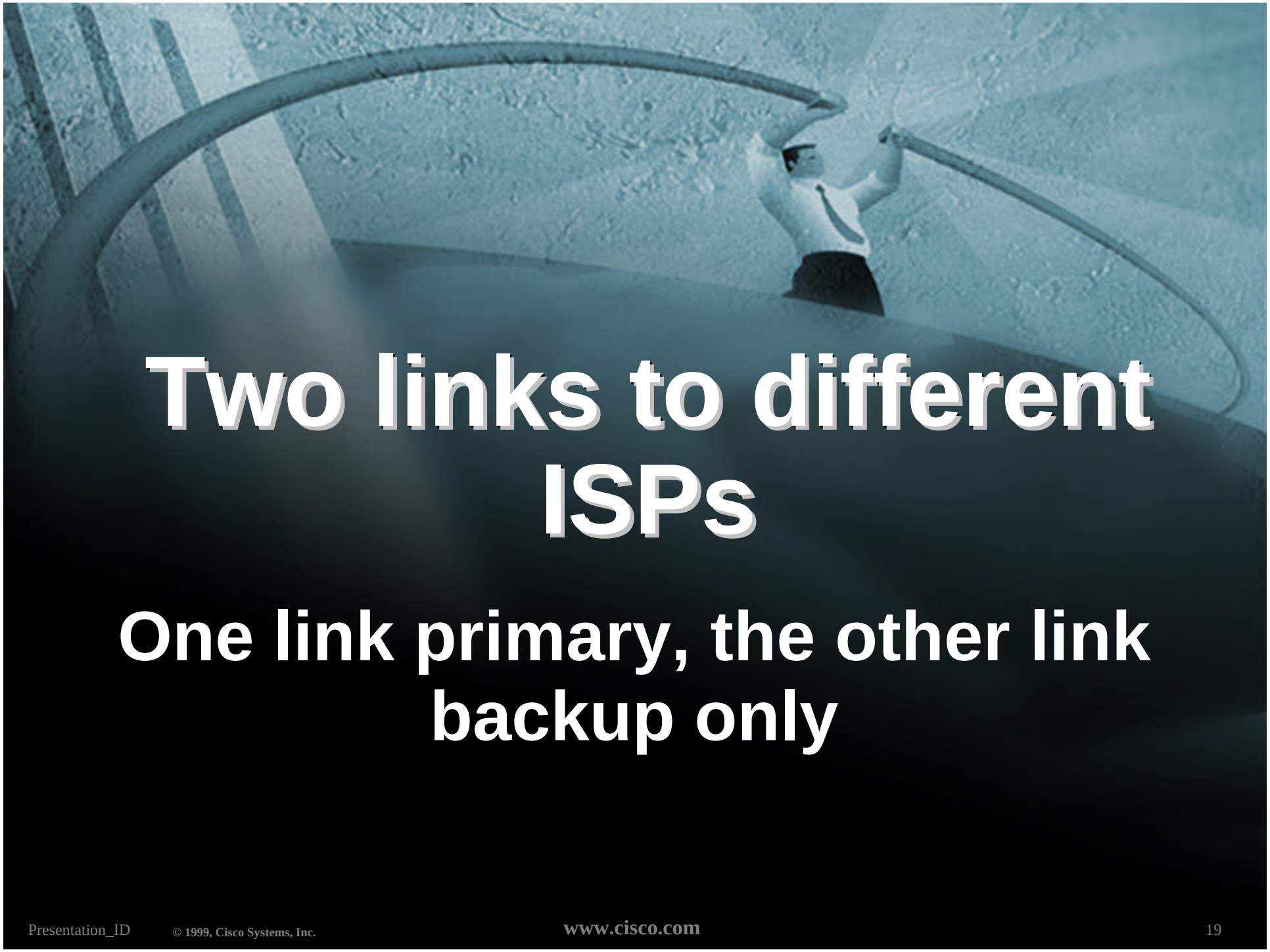
```
  ip prefix-list Customer permit 221.10.0.0/19
  ip prefix-list default permit 0.0.0.0/0
  !
  ip community-list 90 permit 109:90
  !
<snip>
  route-map bgp-cust-in permit 30
   match community 90
   set local-preference 90
  route-map bgp-cust-in permit 40
   set local-preference 100
```

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
```

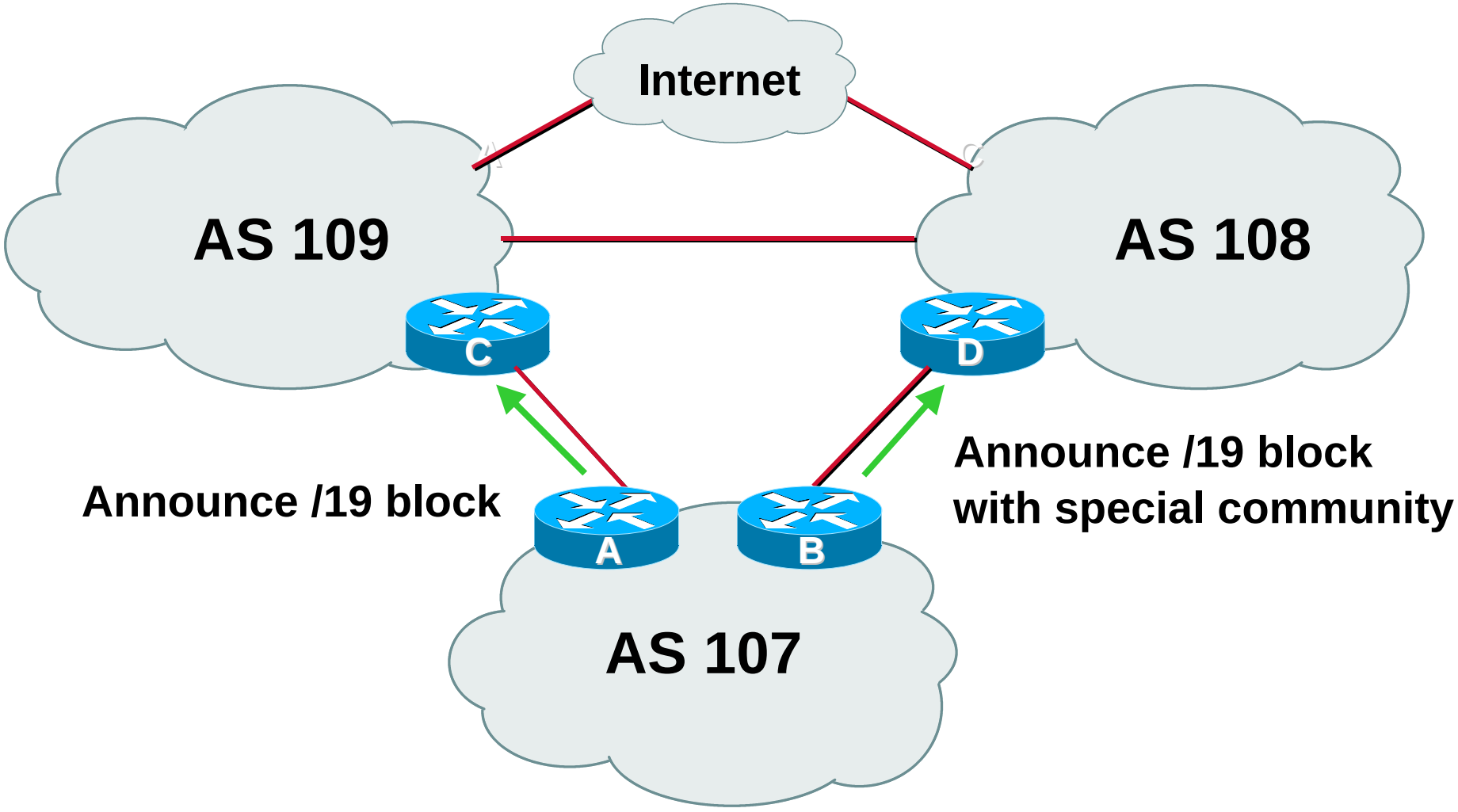
- **Router E removes prefixes in the private AS from external announcements**
- **Private AS still visible inside AS109**



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

  custom additions to 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)

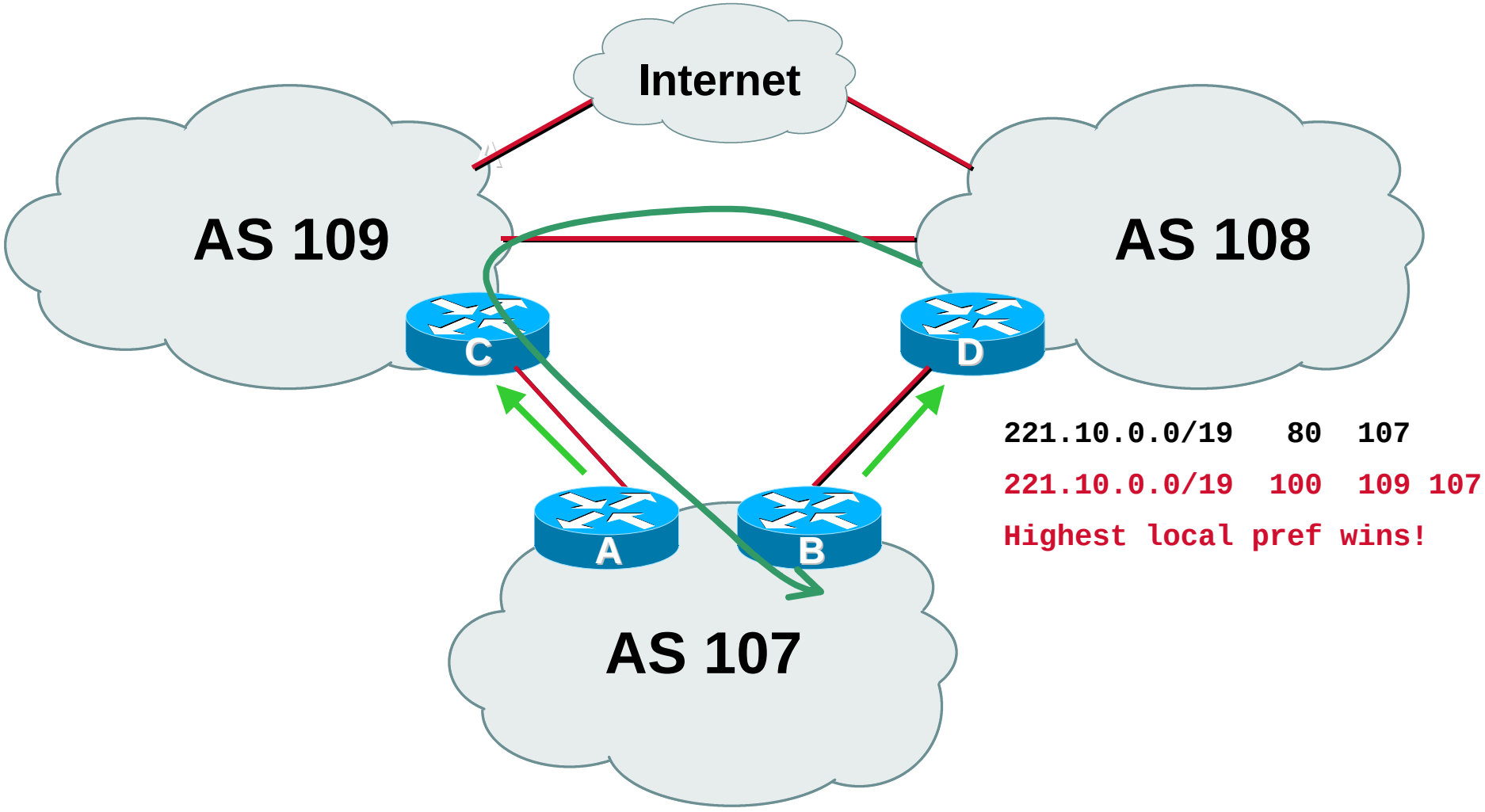
- **Router D**

  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

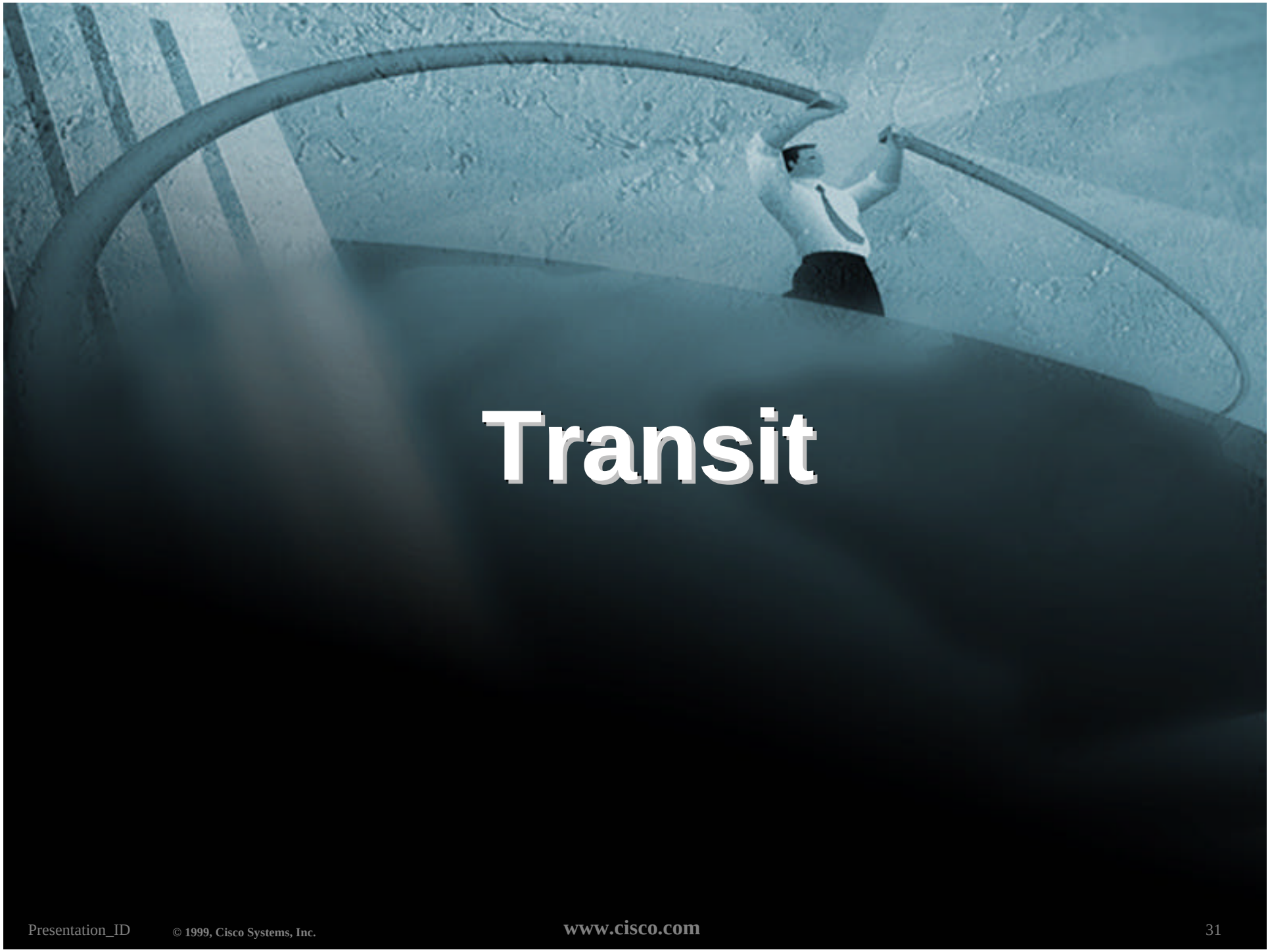
  sends community 108:100 to router C

  sends community 109:80 to router B

- AS108 and AS109 NOC intervention not required

Summary

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



Definitions

- **Transit - carrying traffic across a network, usually for a fee**

  traffic and prefixes originating from one AS are carried across an intermediate AS to reach their destination AS

- **Exchange Points - common interconnect location where several ASes exchange routing information and traffic**

ISP Transit Issues

- Only announce default to your BGP customers unless they need more prefixes
- Only accept the prefixes which your customer is entitled to originate
- If your customer hasn't told you he is providing transit, don't accept anything else

ISP Transit Issues

Many mistakes are made on the Internet today due to incomplete understanding of how to configure BGP for transit

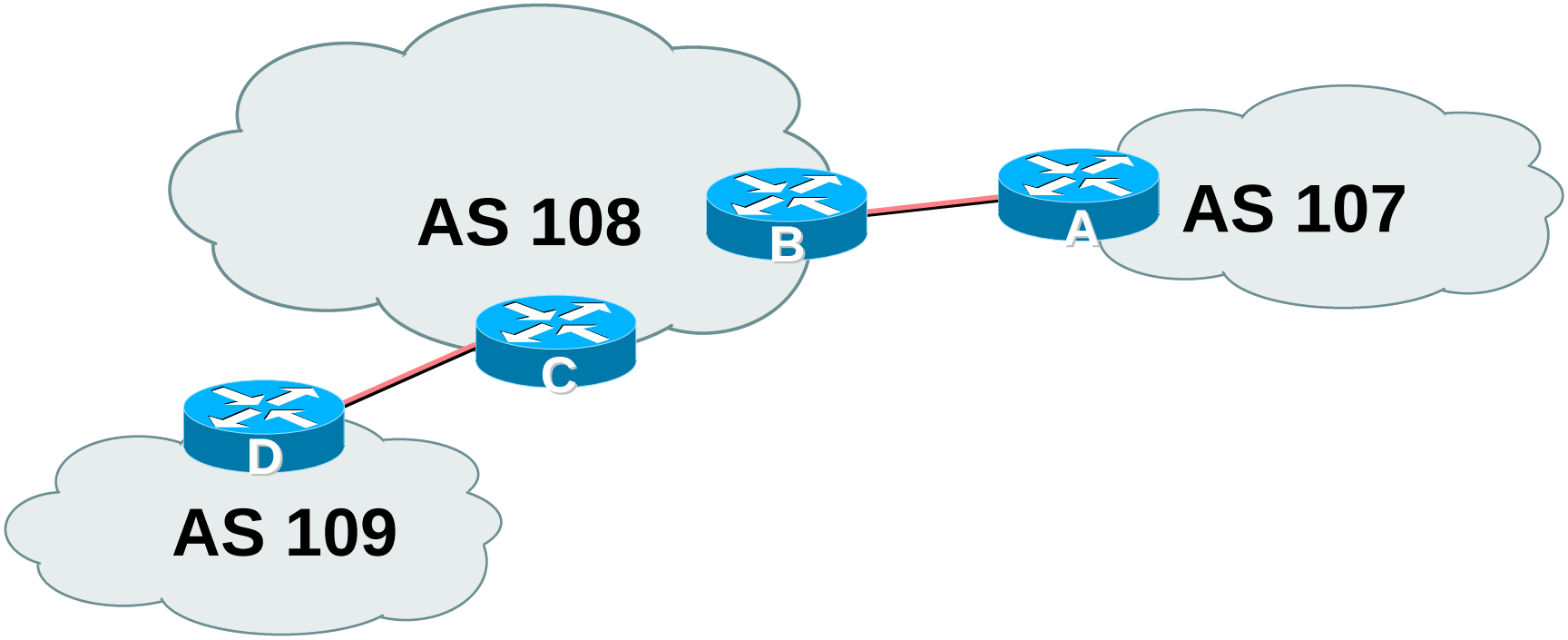
ISP Transit Provider

Simple Example

ISP Transit

- **AS107 and AS109 are stub/customer ASes of AS108**
  - **they may have their own peerings with other ASes**
  - **minimal routing table desired**
  - **minimum complexity required**

ISP Transit



- **AS108 is transit provider between AS107 and AS109**

ISP Transit

- **Router A Configuration**

```
router bgp 107
 network 221.10.0.0 mask 255.255.224.0
 neighbor 222.222.10.2 remote-as 108
 neighbor 222.222.10.2 prefix-list upstream out
 neighbor 222.222.10.2 prefix-list default in
!
ip prefix-list default permit 0.0.0.0/0
ip prefix-list upstream permit 221.10.0.0/19
!
ip route 221.10.0.0 255.255.224.0 null0
```

ISP Transit

- **Router B Configuration**

```
router bgp 108
 neighbor 222.222.10.1 remote-as 107
 neighbor 222.222.10.1 default-originate
 neighbor 222.222.10.1 prefix-list Customer107 in
 neighbor 222.222.10.1 prefix-list default out
!
ip prefix-list Customer107 permit 221.10.0.0/19
ip prefix-list default permit 0.0.0.0/0
```

- **Router B announces default to Router A, only accepts customer /19**

ISP Transit

- **Router C Configuration**

```
router bgp 108
 neighbor 222.222.20.1 remote-as 109
 neighbor 222.222.20.1 default-originate
 neighbor 222.222.20.1 prefix-list Customer109 in
 neighbor 222.222.20.1 prefix-list default out
!
ip prefix-list Customer109 permit 219.0.0.0/19
ip prefix-list default permit 0.0.0.0/0
```

- **Router C announces default to Router D, only accepts customer /19**

ISP Transit

- **Router D Configuration**

```
router bgp 109
 network 219.0.0.0 mask 255.255.224.0
 neighbor 222.222.20.2 remote-as 108
 neighbor 222.222.20.2 prefix-list upstream out
 neighbor 222.222.20.2 prefix-list default in
!
ip prefix-list default permit 0.0.0.0/0
ip prefix-list upstream permit 219.0.0.0/19
!
ip route 219.0.0.0 255.255.224.0 null0
```

ISP Transit

- **This is simple case:**
  - **if AS107 or AS109 get another address block, it requires AS108 and their own filters to be changed**
    - **some ISP transit provider are better skilled at doing this than others!**
  - **May not scale if they are frequently adding new prefixes**

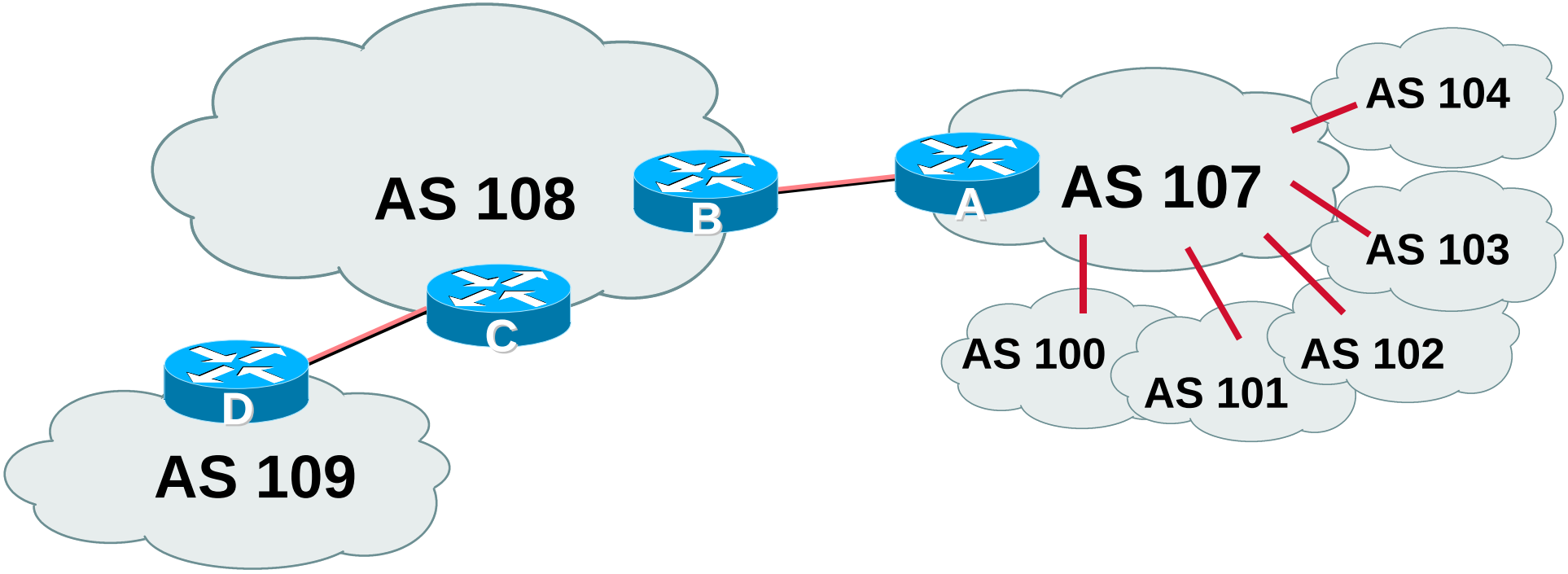
ISP Transit Provider

More Complex Example

ISP Transit

- **AS107 and AS109 are stub/customer ASes of AS108**
  - **AS107 has many customers with their own ASes**
    - **AS104 doesn't get announced to AS108**
  - **AS108 provides transit between AS107 and AS109**

ISP Transit



- **AS107 has several customer ASes connecting to its backbone**

ISP Transit

- **Router A Configuration**

```
router bgp 107
 network 221.10.0.0 mask 255.255.224.0
 neighbor 222.222.10.2 remote-as 108
 neighbor 222.222.10.2 prefix-list upstream-out out
 neighbor 222.222.10.2 filter-list 5 out
 neighbor 222.222.10.2 prefix-list upstream-in in
!
ip route 221.10.0.0 255.255.224.0 null0 250
!
..next slide
```

ISP Transit

```
!
! As-path filters..
ip as-path access-list 5 permit ^$
ip as-path access-list 5 permit ^(100_)+$
ip as-path access-list 5 permit ^101$
ip as-path access-list 5 permit ^102$
ip as-path access-list 5 permit ^103$
ip as-path access-list 5 deny ^104_
!
..next slide
```

ISP Transit

```
! Outbound Martian prefixes to be blocked to eBGP peers
ip prefix-list upstream-out deny 0.0.0.0/8 le 32
ip prefix-list upstream-out deny 10.0.0.0/8 le 32
ip prefix-list upstream-out deny 127.0.0.0/8 le 32
ip prefix-list upstream-out deny 169.254.0.0/16 le 32
ip prefix-list upstream-out deny 172.16.0.0/12 le 32
ip prefix-list upstream-out deny 192.0.2.0/24 le 32
ip prefix-list upstream-out deny 192.168.0.0/16 le 32
ip prefix-list upstream-out deny 224.0.0.0/3 le 32
ip prefix-list upstream-out deny 0.0.0.0/0 ge 25
! Extra prefixes
ip prefix-list upstream-out deny 221.10.0.0/19 ge 20
ip prefix-list upstream-out permit 0.0.0.0/0 le 32
..next slide
```

ISP Transit

```
! Inbound Martian prefixes to be blocked from eBGP peers
ip prefix-list upstream-in deny 0.0.0.0/8 le 32
ip prefix-list upstream-in deny 10.0.0.0/8 le 32
ip prefix-list upstream-in deny 127.0.0.0/8 le 32
ip prefix-list upstream-in deny 169.254.0.0/16 le 32
ip prefix-list upstream-in deny 172.16.0.0/12 le 32
ip prefix-list upstream-in deny 192.0.2.0/24 le 32
ip prefix-list upstream-in deny 192.168.0.0/16 le 32
ip prefix-list upstream-in deny 224.0.0.0/3 le 32
ip prefix-list upstream-in deny 0.0.0.0/0 ge 25
! Extra prefixes
ip prefix-list upstream-in deny 221.10.0.0/19 le 32
ip prefix-list upstream-in permit 0.0.0.0/0 le 32
!
```

ISP Transit

- **Router B Configuration**

```
router bgp 108
 neighbor 222.222.10.1 remote-as 107
 neighbor 222.222.10.1 prefix-list rfc1918-dsua in
 neighbor 222.222.10.1 prefix-list rfc1918-dsua out
 neighbor 222.222.10.1 filter-list 10 in
 neighbor 222.222.10.1 filter-list 15 out
!
ip as-path access-list 15 permit ^$
ip as-path access-list 15 permit ^109$
```

Router B announces AS108 and AS109 prefixes to Router A, and accepts all AS107 customer ASes

ISP Transit

- **Router C Configuration**

```
router bgp 108
 neighbor 222.222.20.1 remote-as 109
 neighbor 222.222.20.1 default-originate
 neighbor 222.222.20.1 prefix-list Customer109 in
 neighbor 222.222.20.1 prefix-list default out
!
ip prefix-list Customer109 permit 219.0.0.0/19
ip prefix-list default permit 0.0.0.0/0
```

- **Router C announces default to Router D, only accepts customer /19**

ISP Transit

- **Router D Configuration**

```
router bgp 109
 network 219.0.0.0 mask 255.255.224.0
 neighbor 222.222.20.2 remote-as 108
 neighbor 222.222.20.2 prefix-list upstream out
 neighbor 222.222.20.2 prefix-list default in
!
ip prefix-list default permit 0.0.0.0/0
ip prefix-list upstream permit 219.0.0.0/19
!
ip route 219.0.0.0 255.255.224.0 null0
```

ISP Transit

- **AS107 only hears AS108 and AS109 prefixes**

  inbound AS path filter on Router A is optional, but good practice (never trust a peer)

  DSUA prefix-list filters are mandatory on all Internet peerings

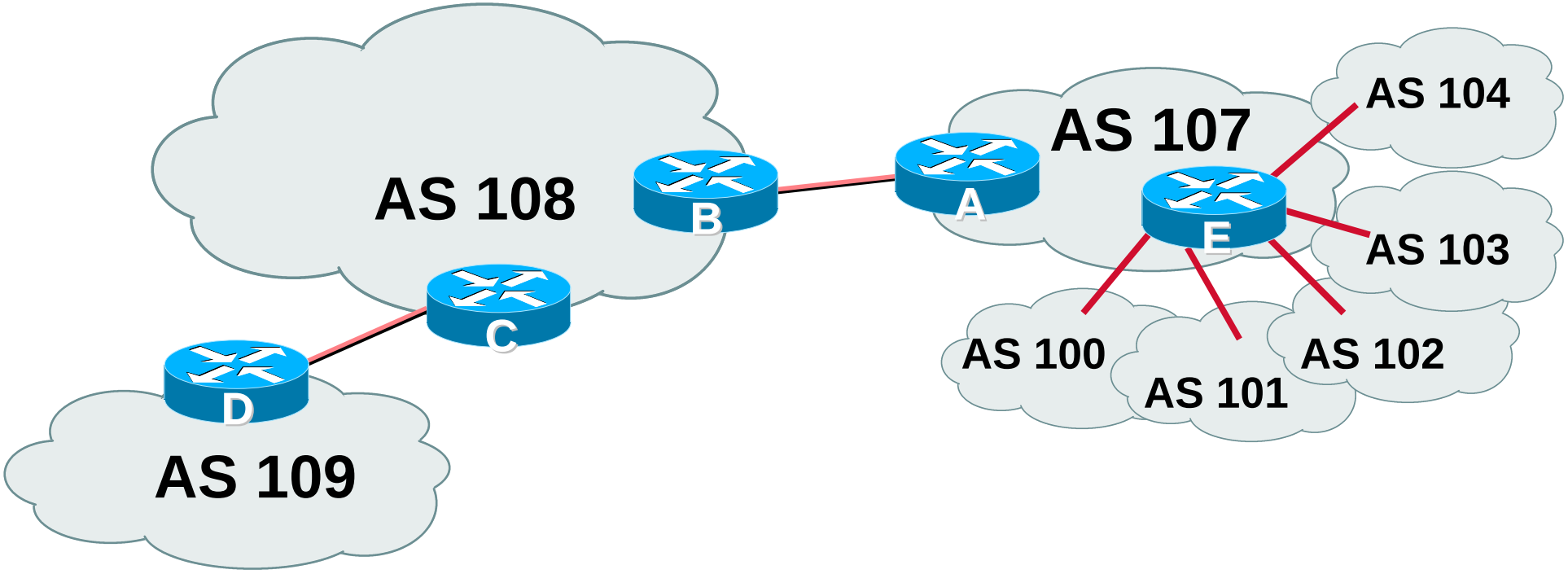
ISP Transit Provider

More Complex Example 2

ISP Transit

- AS107 and AS109 are stub/customer ASes of AS108
  - AS107 has many customers with their own ASes
    - AS104 doesn't get announced to AS108
  - AS108 provides transit between AS107 and AS109
- Same example as previously but using communities

ISP Transit



- **AS107 has several customer ASes connecting to its backbone**

ISP Transit

- **Router A configuration is greatly simplified**

  all prefixes to be announced to upstream are marked with community 107:5100

  route-map on outbound peering implements community policy

  DSUA prefix-lists still required

ISP Transit

- **Router A Configuration**

```
router bgp 107
 network 221.10.0.0 mask 255.255.224.0 route-map setcomm
 neighbor 222.222.10.2 remote-as 108
 neighbor 222.222.10.2 prefix-list upstream-out out
 neighbor 222.222.10.2 route-map to-AS108 out
 neighbor 222.222.10.2 prefix-list upstream-in in
!
ip route 221.10.0.0 255.255.224.0 null0 250
!
..next slide
```

ISP Transit

```
!
ip community-list 5 permit 107:5100
!
! Set community on local prefixes
route-map setcomm permit 10
 set community 107:5100
!
route-map to-AS108 permit 10
 match community 5
!
```

- upstream-in and upstream-out prefix-lists are the same as in the previous example

ISP Transit

- **Router E Configuration**

```
router bgp 107
 neighbor x.x.x.x remote-as 100
 neighbor x.x.x.x default-originate
 neighbor x.x.x.x prefix-list customer100 in
 neighbor x.x.x.x route-map bgp-cust-in in
 neighbor x.x.x.x prefix-list default out
 neighbor x.x.x.x remote-as 101
 neighbor x.x.x.x default-originate
 neighbor x.x.x.x prefix-list customer101 in
 neighbor x.x.x.x route-map bgp-cust-in in
 neighbor x.x.x.x prefix-list default out
..next slide
```

ISP Transit

```
 neighbor s.s.s.s remote-as 104
 neighbor s.s.s.s default-originate
 neighbor s.s.s.s prefix-list customer104 in
 neighbor s.s.s.s route-map no-transit in
 neighbor s.s.s.s prefix-list default out
!
! Set community on eBGP customers announced to AS108
route-map bgp-cust-in permit 10
 set community 107:5100
route-map no-transit permit 10
 set community 107:5199
```

Notice that AS104 peering has no route-map to set the community policy

ISP Transit

- AS107 only announces the community 107:5100 to AS108
- Notice how Router E tags the prefixes to be announced to AS108 with community 107:5100
- More efficient to manage than using filter lists

Collocation Practises

How and Why to place equipment overseas

Why Collocate Overseas?

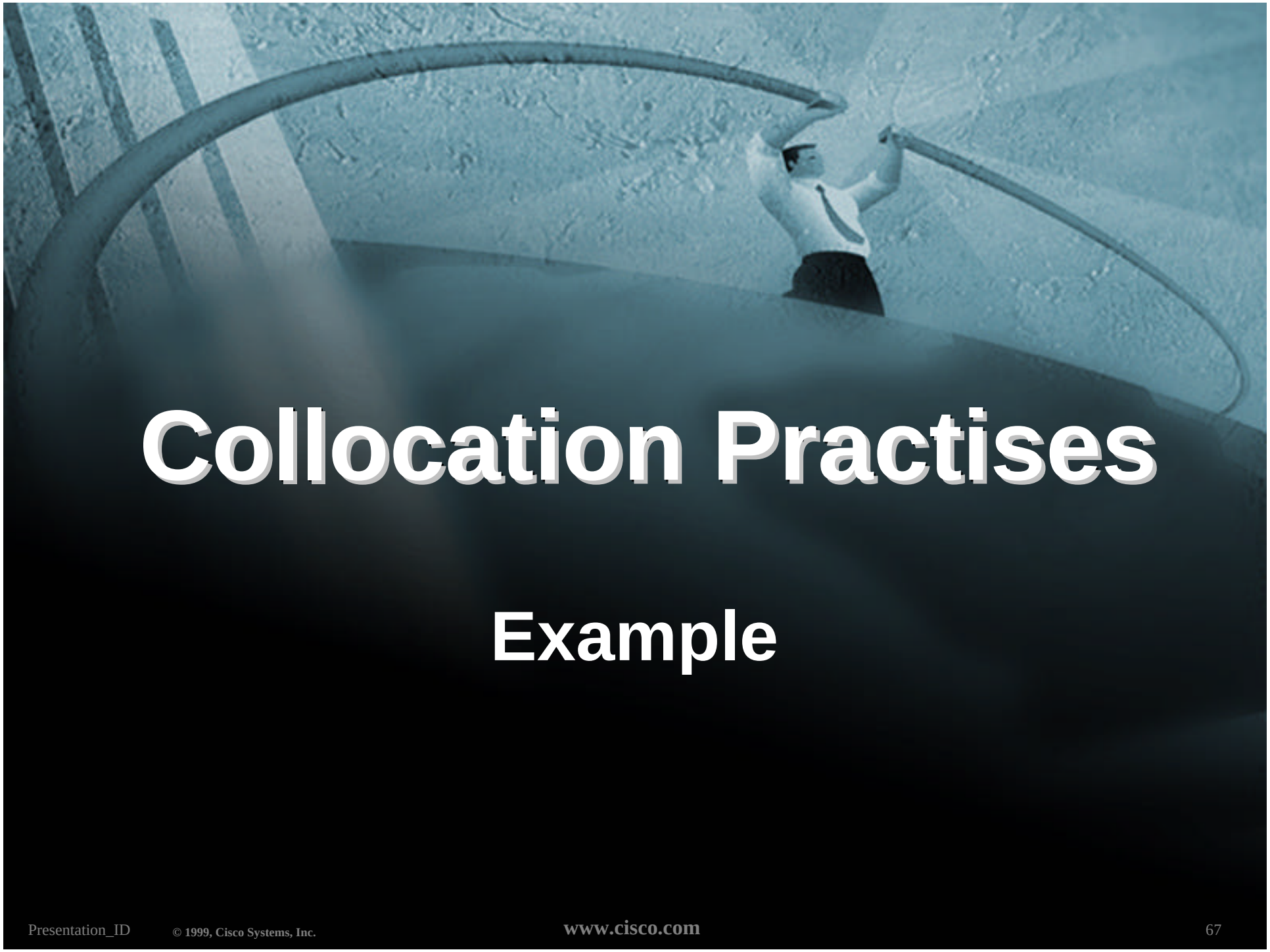
- Hard to re-terminate transoceanic circuit in case of "issues" with upstream ISP
- No Quality of Service
- No Control over infrastructure
- No Monitoring of link performance

Collocation Overseas

- Many AP region ISPs collocate equipment in the US
  - install their own router(s) and other hardware (servers, caches,…)
  - establish peering relationships with US NSPs and domestic ISPs
  - buy facilities management services
    - usually hardware maintenance, installation management

Collocation Overseas

- **Many AP region ISPs collocate equipment in the US**
  - **US domestic circuits are “cheap”**
  - **Easy to change your upstream**
  - **Easy to have multiple upstreams**
  - **Easy to implement QoS related features, service differentiation, etc...**



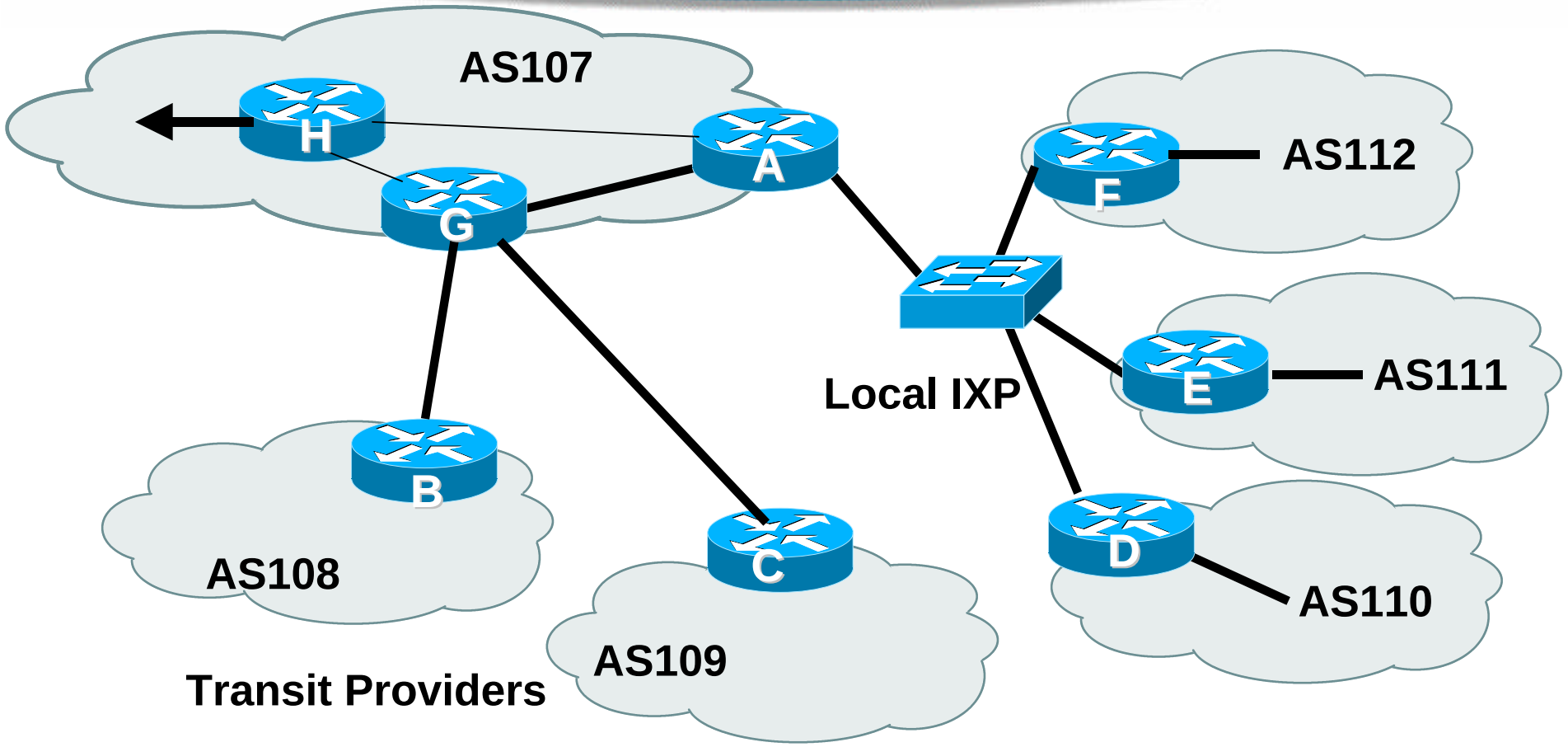
Collocation Practises

Example

Collocation

- **Common Scenario:**
  - **AS107 has collocate space in the US**
  - **AS108 and AS109 are transit providers for AS107**
  - **AS107 is also present at the local exchange point for regional peers**

Collocation



Collocation

- **AS107**

  Router A is dedicated to peering at local IXP

  Router G is dedicated to links with the transit providers

  Router H is dedicated to the transoceanic link

Collocation Router A Configuration

```
interface loopback 0
 description Border Router Loopback
 ip address 221.0.0.1 255.255.255.255
!
interface fastethernet 0/0
 description Exchange Point LAN
 ip address 220.5.10.2 255.255.255.224
 ip verify unicast reverse-path
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
!
```

..next slide

Collocation Router A Configuration

```
interface fastethernet 1/0
 description Crossover 100Mbps Connection to Router G
 ip address 221.0.10.2 255.255.255.252
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
!
interface fastethernet 2/0
 description Crossover 100Mbps Connection to Router H
 ip address 221.0.10.6 255.255.255.252
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
```

..next slide

Collocation
Router A Configuration

```
router bgp 107
 neighbor ixp-peers peer-group
 neighbor ixp-peers soft-reconfiguration in
 neighbor ixp-peers prefix-list myprefixes out
 neighbor 221.0.0.2 remote-as 107
 neighbor 221.0.0.2 description Router G - Upstream Peers
 neighbor 221.0.0.2 update-source loopback 0
 neighbor 221.0.0.3 remote-as 107
 neighbor 221.0.0.3 description Router H - transpacific router
 neighbor 221.0.0.3 update-source loopback 0
 neighbor 221.0.0.4 remote-as 107
 neighbor 221.0.0.4 description Router at HQ
 neighbor 221.0.0.4 update-source loopback 0
..next slide
```

Collocation Router A Configuration

```
 neighbor 220.5.10.4 remote-as 110
 neighbor 222.5.10.4 peer-group ixp-peers
 neighbor 222.5.10.4 prefix-list peer110 in
 neighbor 220.5.10.5 remote-as 111
 neighbor 222.5.10.5 peer-group ixp-peers
 neighbor 222.5.10.5 prefix-list peer111 in
 neighbor 220.5.10.3 remote-as 112
 neighbor 222.5.10.3 peer-group ixp-peers
 neighbor 222.5.10.3 prefix-list peer112 in
!
ip prefix-list myprefixes permit 221.10.0.0/19
ip prefix-list peer110 permit 222.12.0.0/19
ip prefix-list peer111 permit 222.18.128.0/19
ip prefix-list peer112 permit 222.1.32.0/19
```

Collocation
Router A Configuration

- **Router A does NOT originate AS107's prefix block**

  if router is disconnected from AS107 either locally or across the ocean, announcement could cause blackhole

- **Prefix-list filtering is the minimum required**

  usually include AS path filtering too

Collocation Router G Configuration

```
interface loopback 0
 description Peering Router Loopback
 ip address 221.0.0.2 255.255.255.255
!
interface fastethernet 0/0
 description Crossover 100Mbps Connection to Router A
 ip address 221.0.10.1 255.255.255.252
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
!
..next slide
```

Collocation Router G Configuration

```
interface hssi 1/0
 description T3 link to BigISP
 ip address 222.0.0.2 255.255.255.252
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
!
interface hssi 2/0
 description T3 link to MegaISP
 ip address 218.6.0.2 255.255.255.252
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
```

..next slide

Collocation
Router G Configuration

```
router bgp 107
 neighbor 221.0.0.1 remote-as 107
 neighbor 221.0.0.1 description Router A - US Local IXP
 neighbor 221.0.0.1 update-source loopback 0
 neighbor 221.0.0.1 prefix-list myprefixes out
 neighbor 221.0.0.3 remote-as 107
 neighbor 221.0.0.3 description Router H - transpacific router
 neighbor 221.0.0.3 update-source loopback 0
 neighbor 221.0.0.4 remote-as 107
 neighbor 221.0.0.4 description Router at HQ
 neighbor 221.0.0.4 update-source loopback 0
```

..next slide

Collocation Router G Configuration

```
 neighbor 222.0.0.1 remote-as 108
 neighbor 222.0.0.1 prefix-list myprefixes out
 neighbor 222.0.0.1 prefix-list rfc1918-dsua in
 neighbor 218.6.0.1 remote-as 109
 neighbor 218.6.0.1 prefix-list myprefixes out
 neighbor 218.6.0.1 prefix-list rfc1918-dsua in
!
ip prefix-list myprefixes permit 221.10.0.0/19
```

Collocation
Router G Configuration

- Router G accepts full BGP prefixes from both AS108 and AS109
- Router G announces AS107 prefix to upstreams
- Simple Example - policy may also be required for loadsharing etc

Collocation
Router H Configuration

```
interface loopback 0
 description Peering Router Loopback
 ip address 221.0.0.3 255.255.255.255
!
interface fastethernet 0/0
 description Crossover 100Mbps Connection to Router A
 ip address 221.0.10.5 255.255.255.252
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
!
..next slide
```

Collocation
Router H Configuration

```
interface hssi 1/0
 description T3 link back to home
 ip address 221.1.0.1 255.255.255.252
 rate-limit output access-group 195 ..etc
 no ip directed-broadcast
 no ip proxy-arp
 no ip redirects
!
..next slide
```

Collocation
Router H Configuration

```
router bgp 107
 neighbor 221.0.0.1 remote-as 107
 neighbor 221.0.0.1 description Router A - US Local IXP
 neighbor 221.0.0.1 update-source loopback 0
 neighbor 221.0.0.2 remote-as 107
 neighbor 221.0.0.2 description Router G - peering router
 neighbor 221.0.0.2 update-source loopback 0
 neighbor 221.0.0.4 remote-as 107
 neighbor 221.0.0.4 description Router at HQ
 neighbor 221.0.0.4 update-source loopback 0
!
```

Collocation
Router H Configuration

- **Router H is dedicated to transoceanic link**

  part of ISP core iBGP mesh

- **More complex configuration likely**

  CAR, RED, etc

- **More complex links likely**

  e.g satellite uplink for low revenue latency insensitive traffic

Collocation

- **Richer interconnectivity possible**
- **Better redundancy possible**
- **Overall advantage - control!**

Summary

- **Advanced Community Usage**
- **Transit**
- **Collocation**

- **Any questions?**