

A man in a white shirt and red tie is standing on a blue globe representing Earth. He is holding a large red cable that loops around the globe. The background is a textured yellow and blue sky.

Asymmetric Satellite Services



Agenda

- **Introduction and Background**
- **Transmit Interface Command**
- **Point to Point Example**
- **Point to Multipoint Example**
- **Other Considerations**
- **UDLR**

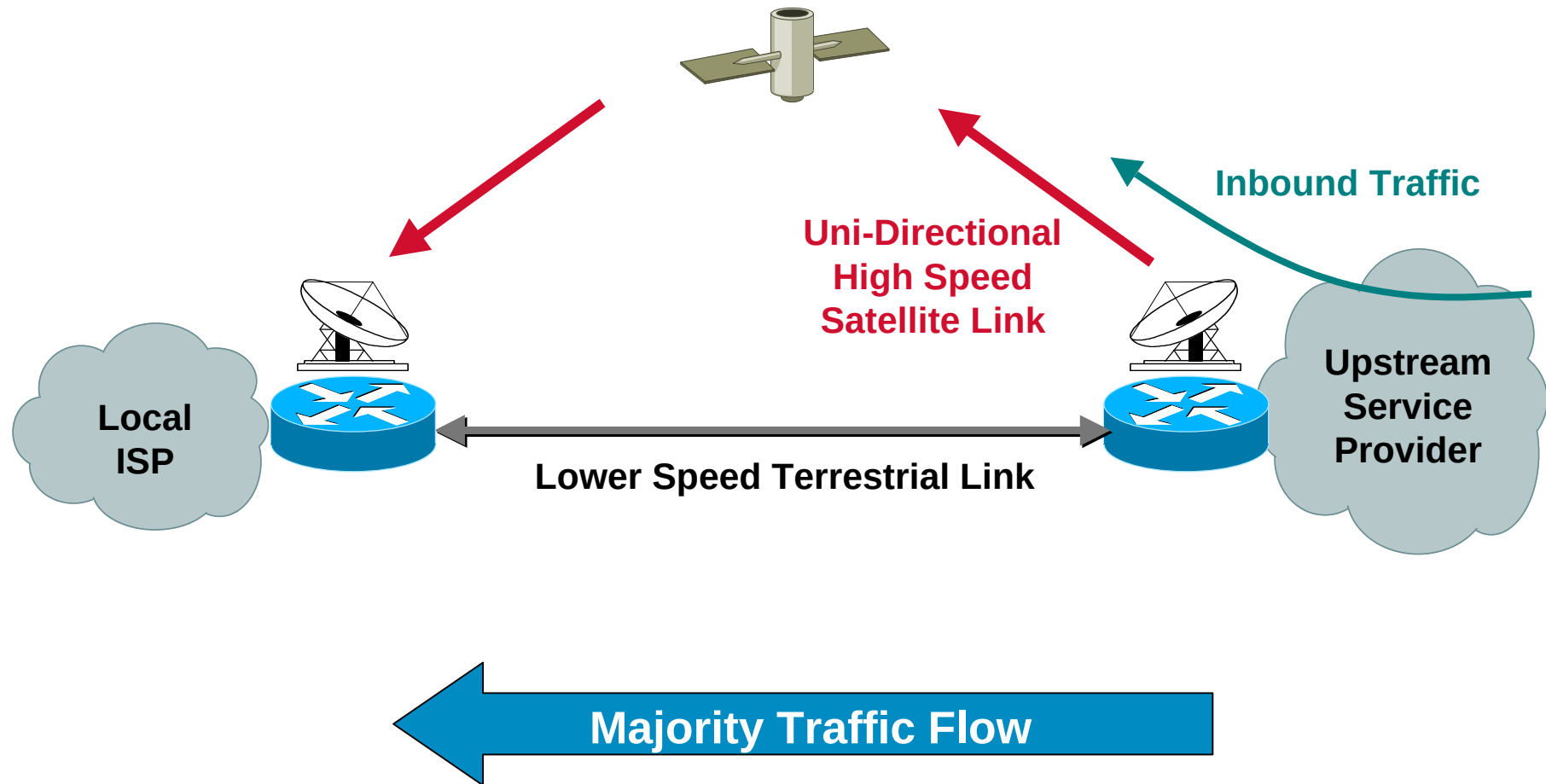


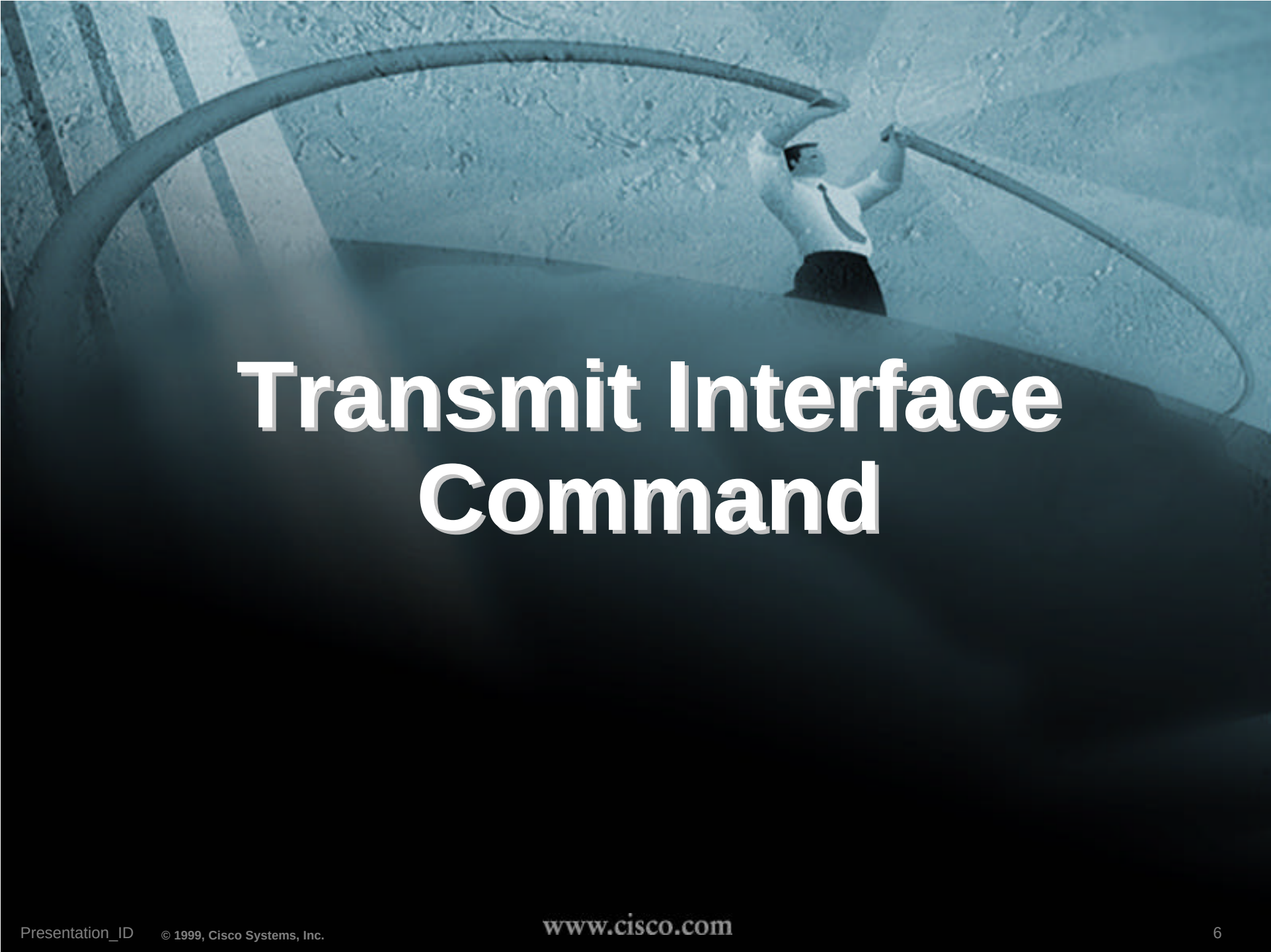
Introduction and Background

Asymmetric Satellite Services

- **Reliable High Speed Terrestrial Data services are not a reality in many parts of the world**
- **If they do exist they are often Cost Prohibitive**
- **Asymmetric Services fit well with the asymmetric pattern many ISP see**
- **In some cases as high as 16:1**

Asymmetric Satellite Services





Transmit Interface Command

Transmit Interface

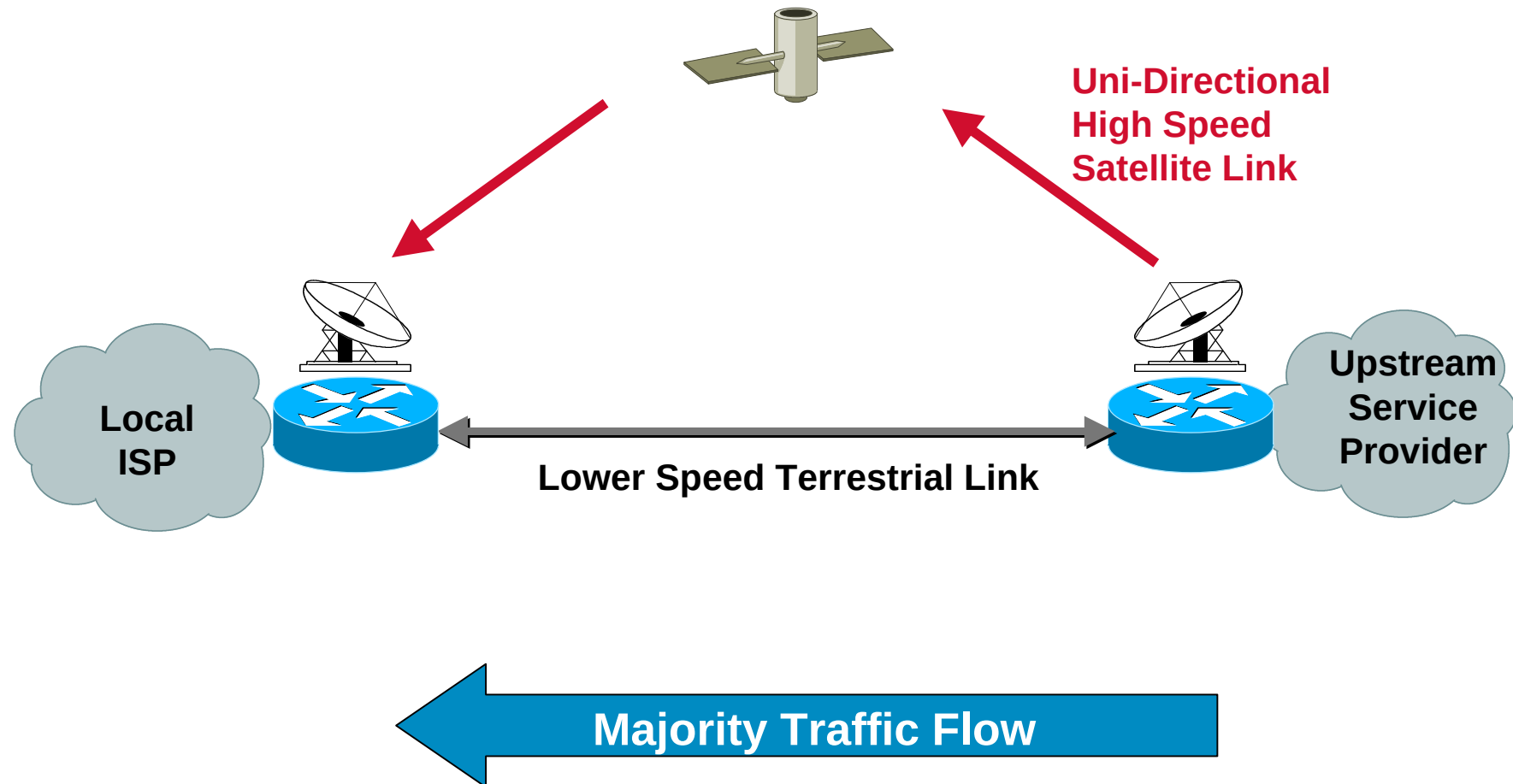
- **‘Transmit Interface’ Command has existed for some time**
- **Key Issue - simplex transmission only on each link**

```
interface Serial3/5
  transmit-interface Serial3/6
  ip address 10.1.1.1 255.255.255.0
  no ip directed-broadcast
!
interface Serial3/6
  no ip address
  no ip directed-broadcast
```

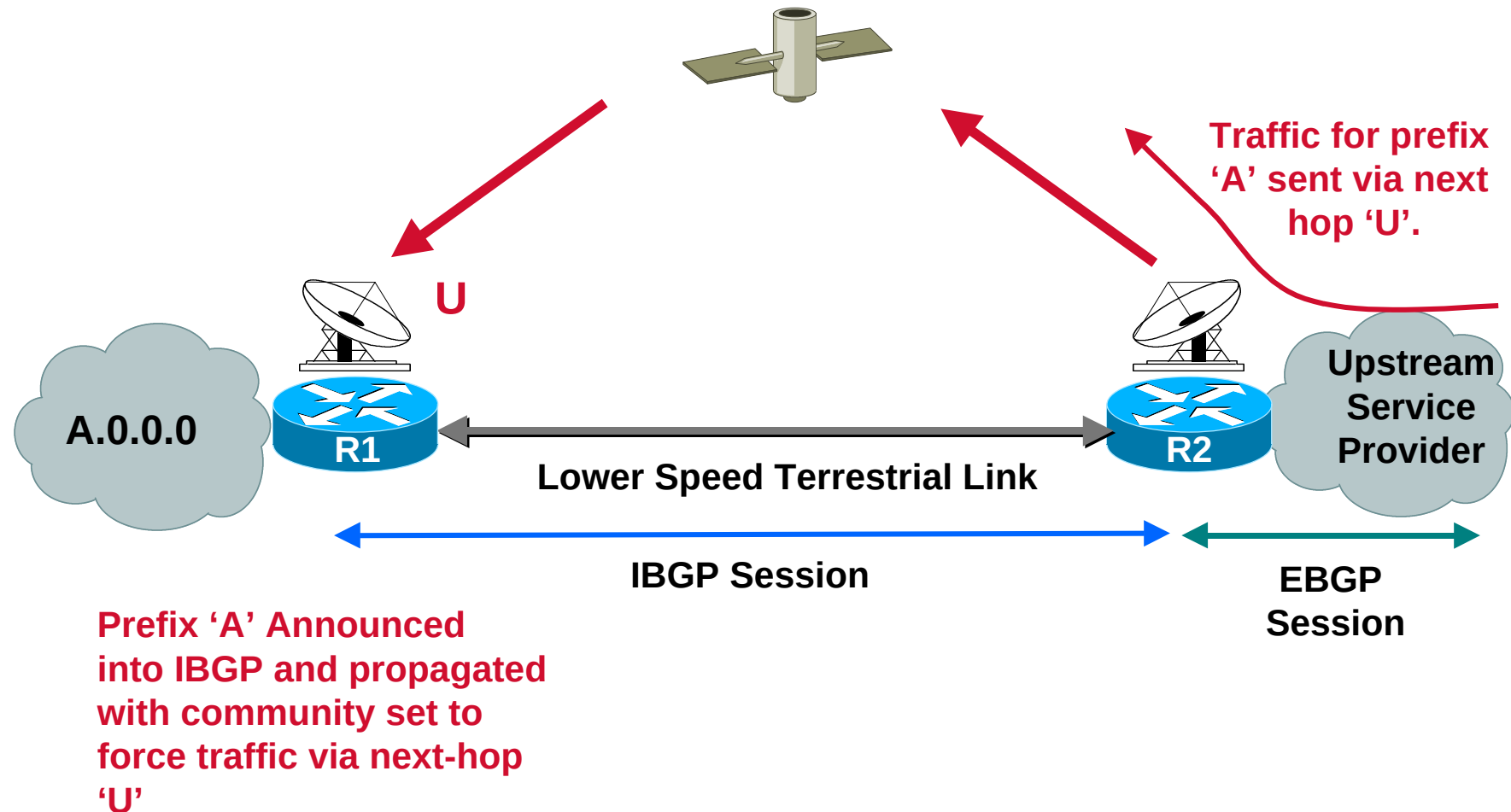



Point to Point Example

Point to Point Scenario



Point to Point Scenario



Configuration - Router 1

```
router bgp 10000
  no synchronization
  redistribute static route-map static-to-bgp
  neighbor 10.0.11.1 remote-as 10000
  neighbor 10.0.11.1 update-source Loopback0
  neighbor 10.0.11.1 send-community
  no auto-summary
!
ip classless
ip route 10.0.1.0 255.255.255.0 10.0.4.1
ip route 10.0.2.0 255.255.255.0 10.0.4.1
ip route 10.0.3.0 255.255.255.0 10.0.4.1
ip bgp-community new-format
!
access-list 10 permit 10.0.1.0 0.0.0.255 ! this prefix via Satellite
access-list 11 permit 10.0.2.0 0.0.0.255
route-map static-to-bgp permit 10
  match ip address 10
  set community 10000:1
!
route-map static-to-bgp permit 20 ! Terrestrial Path
  match ip address 11
  set community 10000:2
```


Configuration - Router 2

```
router bgp 10000
  no synchronization
  neighbor 10.0.12.1 remote-as 10000
  neighbor 10.0.12.1 update-source Loopback0
  neighbor 10.0.12.1 send-community
  neighbor 10.0.12.1 route-map set-next-hop in
  no auto-summary
!
ip classless
ip bgp-community new-format
ip community-list 1 permit 10000:1
ip community-list 2 permit 10000:2
!
! Send this traffic via Satellite
route-map set-next-hop permit 10
  match community 1
  set ip next-hop 10.0.8.2      ! Satellite Path
!
route-map set-next-hop permit 20
  match community 2
  set ip next-hop 10.0.5.1     ! Terrestrial Path
```



Point to Multipoint Example

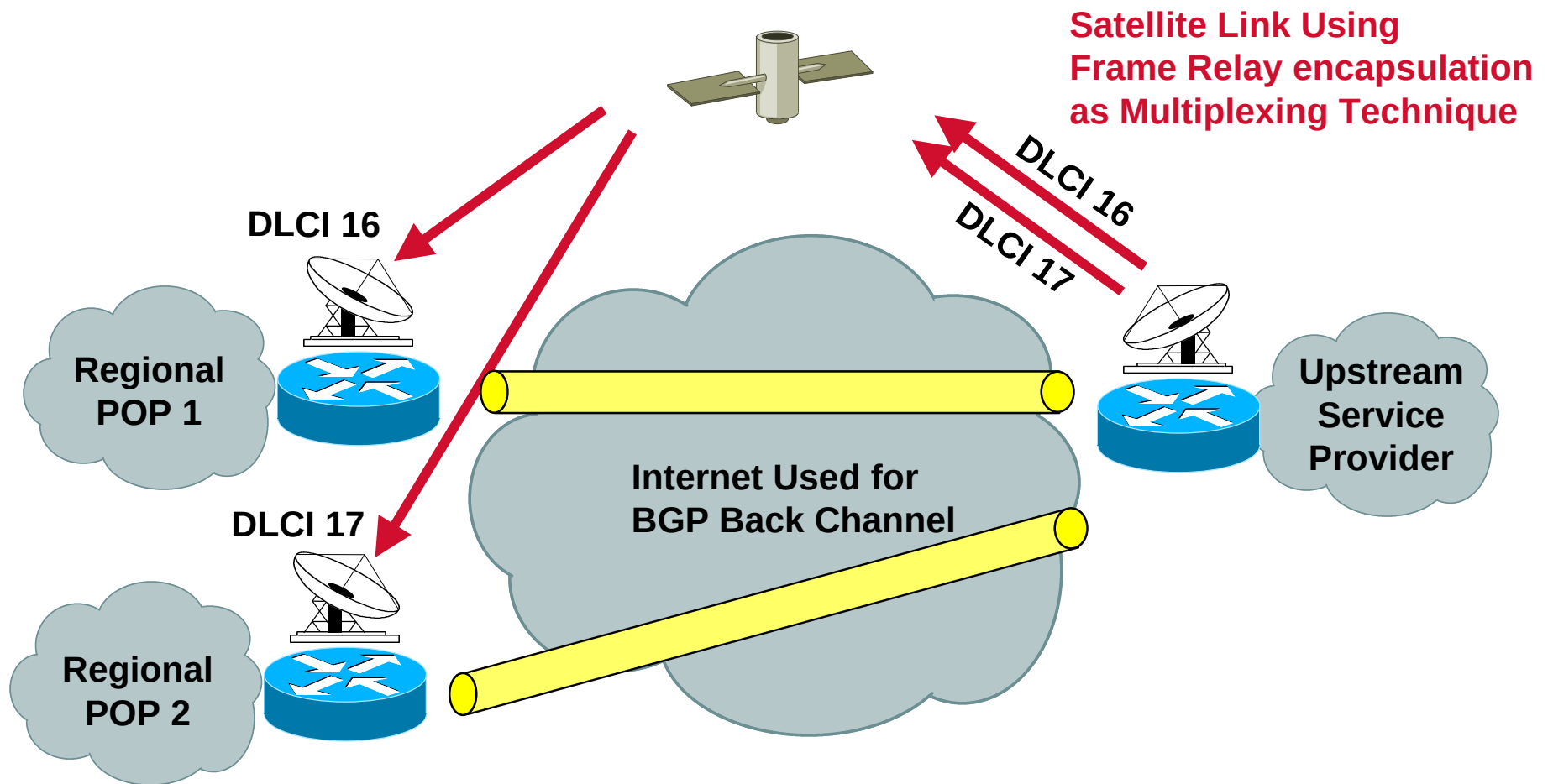
Point to Multi-point -1

- **Many scenarios will require a point to multipoint implementation**
- **i.e. Uplink from USA. Downlink at various POPs within Asia**
- **Internet (and BGP Tunneling) used for back channel traffic in many scenarios**

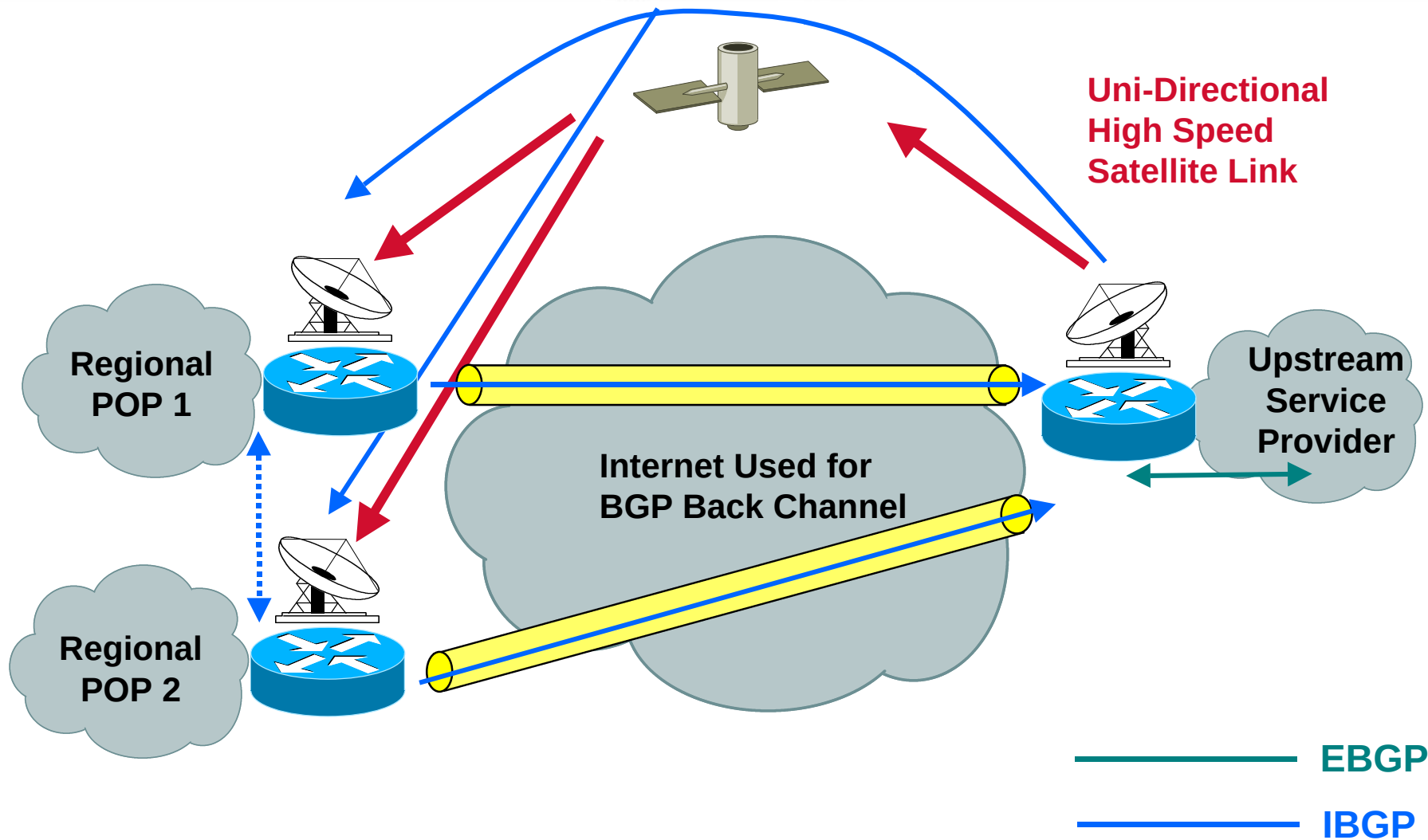
Point to Multi-point -2

- **BGP peer-to-peer traffic travels over satellite path allowing detection satellite path failure**

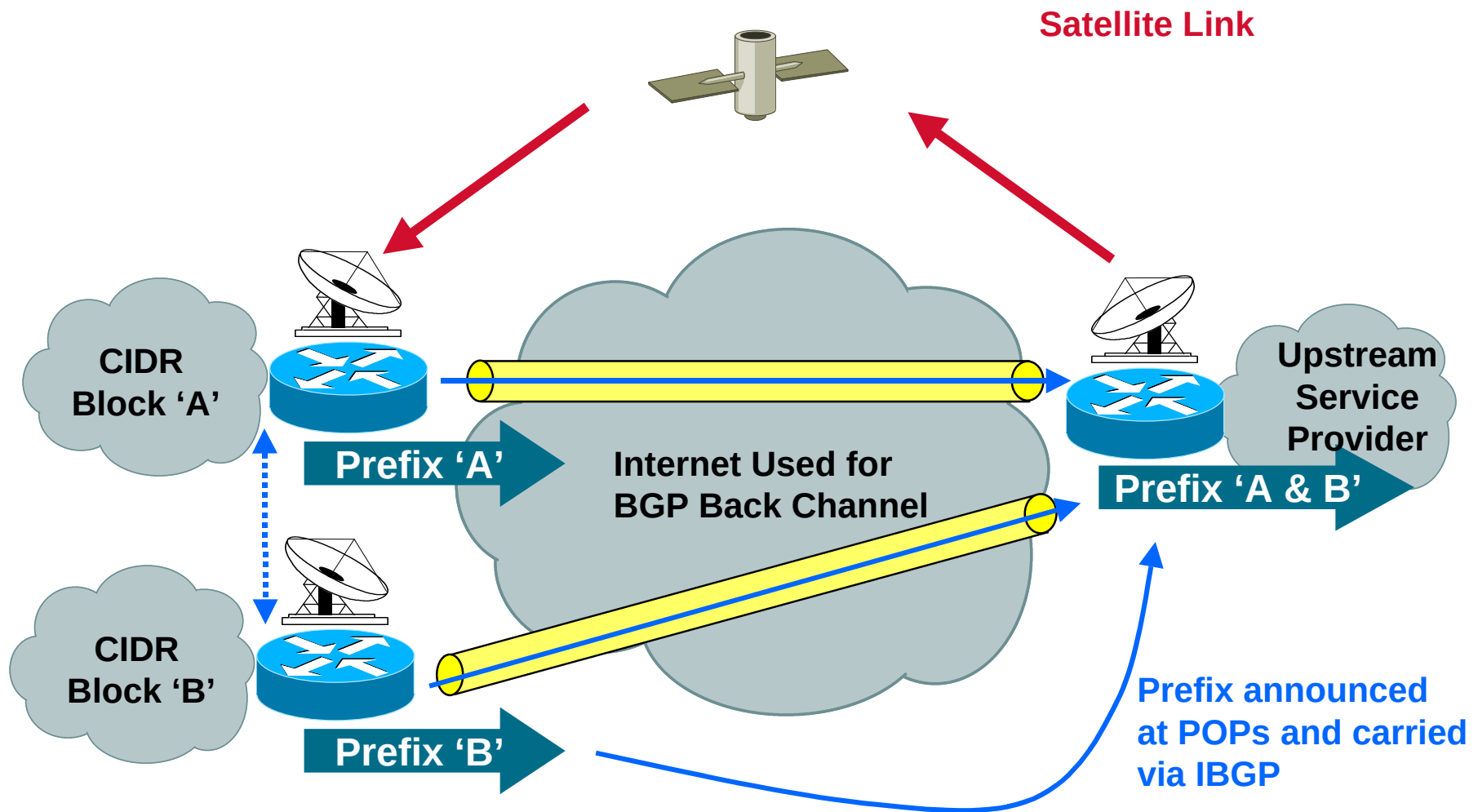
Point to Multi-point -1



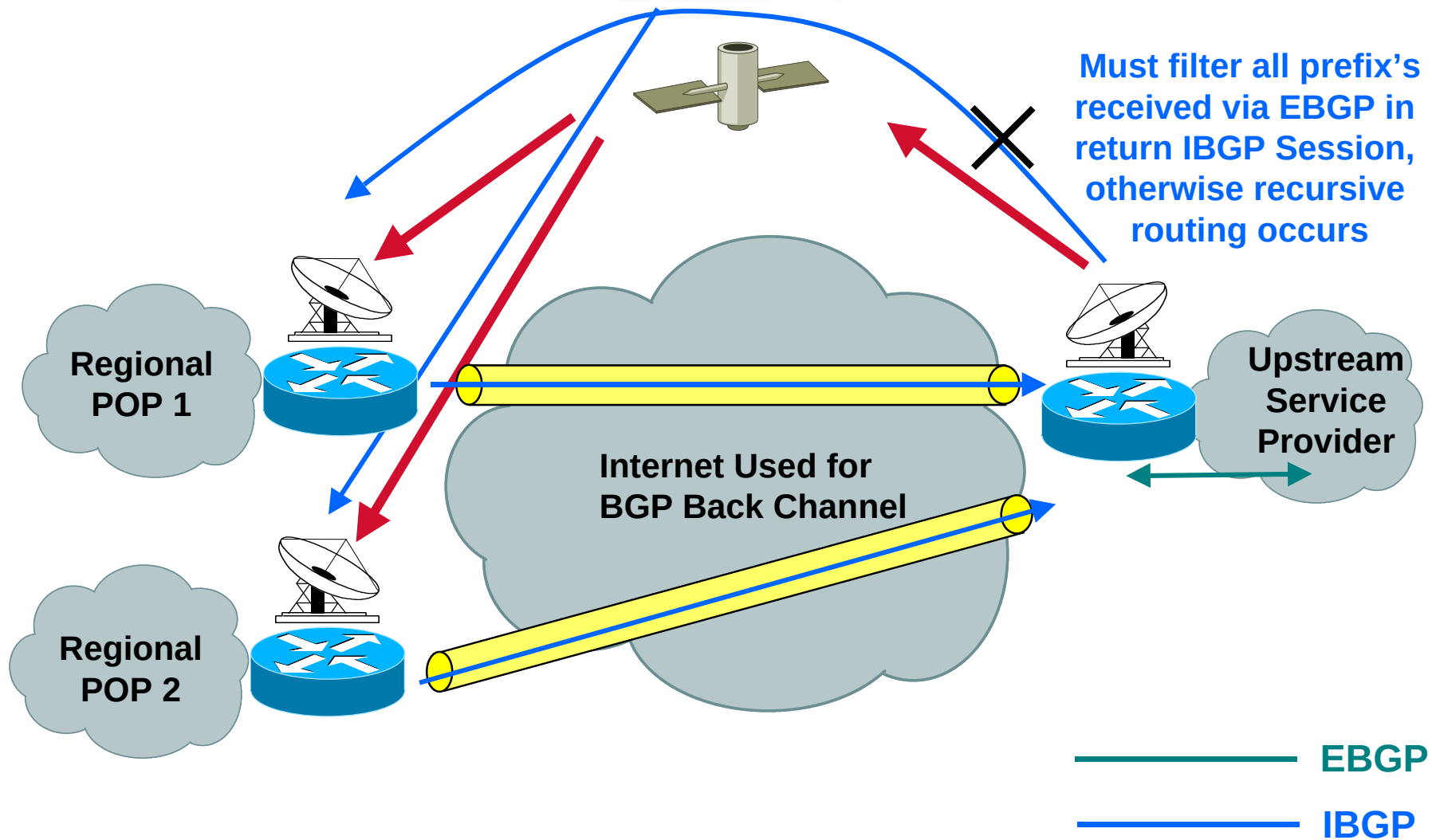
Point to Multi-point -2



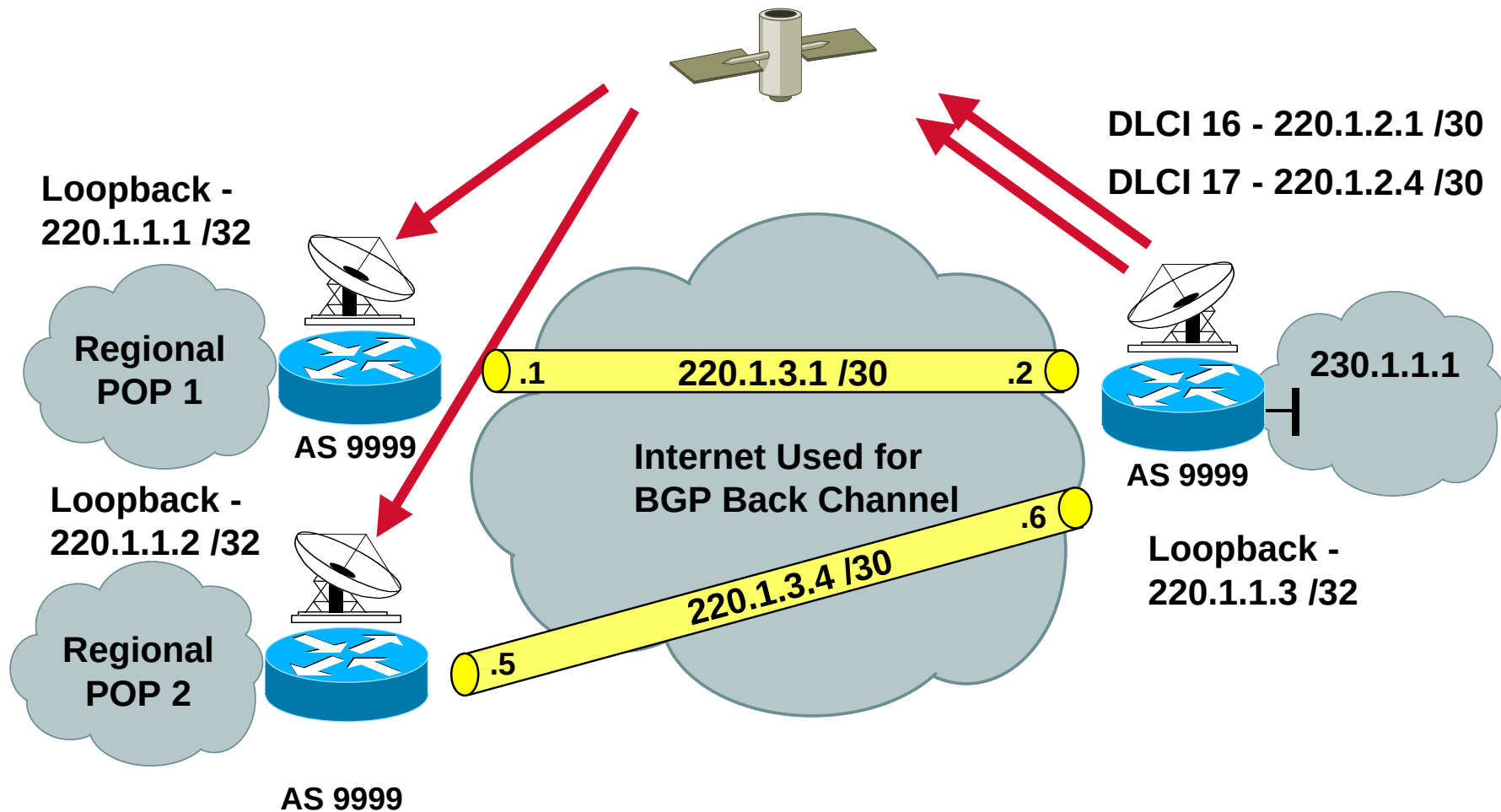
Point to Multi-point -3



Point to Multi-point -4



Configuration



Configuration - Frame Relay - Tx

```
interface Serial2/0/0
  description Tx to Satellite - Rx Looped
  no ip address
  encapsulation frame-relay
  no ip route-cache optimum
  ip route-cache distributed
  no keepalive ! Turns off LMI
!
interface Serial2/0/0.1 point-to-point
  description DLCI to POP 1
  ip address 220.1.2.1 255.255.255.252
  frame-relay interface-dlci 16
!
interface Serial2/0/0.2 point-to-point
  description DLCI to POP 2
  ip address 220.1.2.5 255.255.255.252
  frame-relay interface-dlci 17
!
```


Configuration - Frame Relay - Rx

```
interface Serial0/0/0
no ip address
encapsulation frame-relay
no ip route-cache optimum
ip route-cache distributed
no keepalive
no cdp enable
!
interface Serial0/0/0.1 point-to-point
description Black Hole for POP 1
no ip address
no cdp enable
frame-relay interface-dlci 101
!
interface Serial0/0/0.2 point-to-point
description Rx Interface for POP 2
ip address 220.1.2.5 255.255.255.252
no cdp enable
frame-relay interface-dlci 100
```

Configuration - BGP (Uplink)

```
router bgp 9999
  no synchronization
  ...
  neighbor 220.1.1.1 remote-as 9999
  neighbor 220.1.1.1 description IBGP to POP1
  neighbor 220.1.1.1 update-source Loopback1
  neighbor 220.1.1.1 route-map FILTER-TO-POPS out
  ...
  neighbor 220.1.1.2 remote-as 9999
  neighbor 220.1.1.2 description IBGP to POP2
  neighbor 220.1.1.2 update-source Loopback1
  neighbor 220.1.1.2 route-map FILTER-TO-POPS out
  ...
  neighbor 230.1.X.X remote-as 1000
  neighbor 230.1.X.X description To Upstream ISP
  ...
  !
```

Configuration - BGP (POP 1)

```
!  
router bgp 9999  
  no synchronization  
  ...  
  redistribute static route-map ANNOUNCE-1  
  neighbor 180.1.1.1 remote-as 2000      ! EBGP Peer  
  neighbor 180.1.1.1 update-source Loopback0  
  neighbor 180.1.1.1 send-community  
  ...  
  neighbor 230.1.1.3 remote-as 9999  
  neighbor 230.1.1.3 description IBGP to Sat Uplink  
  neighbor 230.1.1.3 update-source Loopback0  
  ...  
  no auto-summary  
!
```


Configuration - Tunnels (Uplink)

```
!  
interface Tunnel0  
  description tunnel from POP1  
  ip address 220.1.3.2 255.255.255.252  
  ip route-cache distributed  
  tunnel source FastEthernet1/0/0  
  tunnel destination 220.1.1.1 ! Or other reachable address  
  ! Nothing should go back this way  
!  
interface Tunnel1  
  description tunnel from POP2  
  ip address 220.1.3.6 255.255.255.252  
  ip route-cache distributed  
  tunnel source FastEthernet1/0/0  
  tunnel destination 220.1.1.2 ! Or other reachable address  
  ! Nothing should go back this way  
!
```


Configuration - Tunnels (POP1)

```
!  
interface Tunnel0  
  description tunnel satellite uplink router  
  ip address 220.1.3.1 255.255.255.252  
  ip route-cache distributed  
  tunnel source Loopback0  
  tunnel destination 230.1.1.1 ! Globally reachable  
!  
ip route 230.1.1.3 255.255.255.255 220.1.3.2  
!
```

Configuration - Route Return BGP Sessions over Satellite Path

Uplink Site Router

```
! Send return BGP traffic via satellite link
!  
ip route 220.1.1.1 255.255.255.255 220.1.2.2  
ip route 220.1.1.2 255.255.255.255 220.1.2.6  
!
```

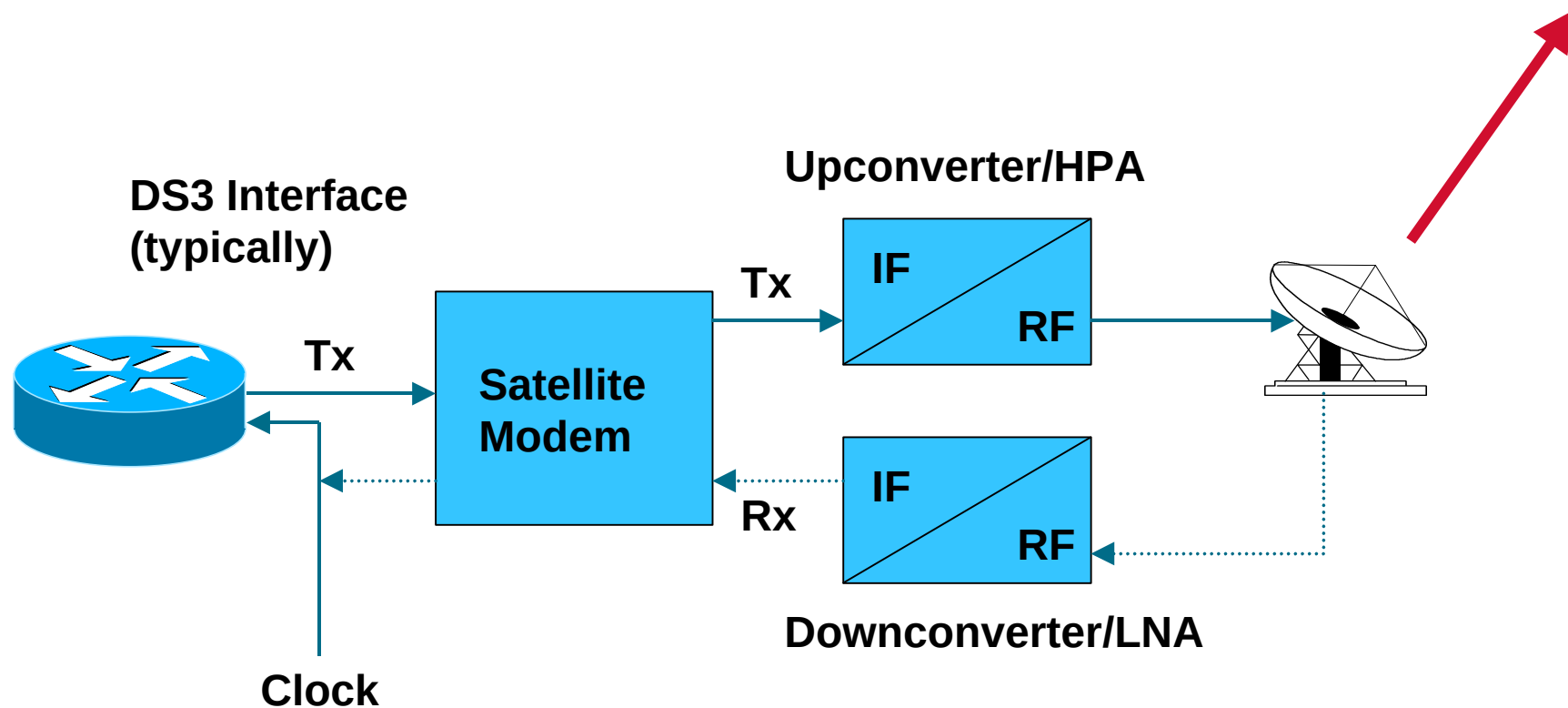
Configuration - Blocking Routes over Satellite Link

```
!  
Router bgp 9999  
...  
neighbor 220.1.1.1 remote-as 9999  
neighbor 220.1.1.1 description IBGP to POP 1  
neighbor 220.1.1.1 route-map FILTER-TO-POPS out  
...  
!  
ip as-path access-list 1 deny .*  
!  
route-map FILTER-TO-POPS permit 10  
  match as-path 1  
!
```



Other Considerations

Interfacing to the Satellite Modem Equipment



Other Considerations

- **SRAM (buffer) Memory on VIP cards is a consideration- The more the better**
- **Run WRED on the uplink side of the link to achieve maximum throughput**

Other Considerations

- **Web caching**
- **Compression via Compression Service Adapters (CSA) on VIP cards**



UDLR

Unidirectional Link Routing

UDLR

- **Applicable environments**
- **The problem**
- **Cisco solutions**

UDLR-Tunnels

IGMP-UDLR

Applicable Environments

- **Satellite systems**
- **ADSL connections**
Where bandwidths are asymmetric
- **Cable systems**
Where bandwidths and link-type are asymmetric
- **ATM partially meshed SVCs**

The Fundamental Problem

- **Both unicast and multicast routing protocols forward data on interfaces in which they have received routing control information**
- **The model can only work on bi-directional links**

The Problem (In More Detail)

- **Unicast routing**

If I received an update on interface serial0 for prefix P, then I will forward data for destinations that match prefix P out serial0 (distance vector)

- **Multicast routing**

If I receive a Join on interface serial0 for group G, then I will forward data for traffic destined for group G out serial0 (sparse-mode)

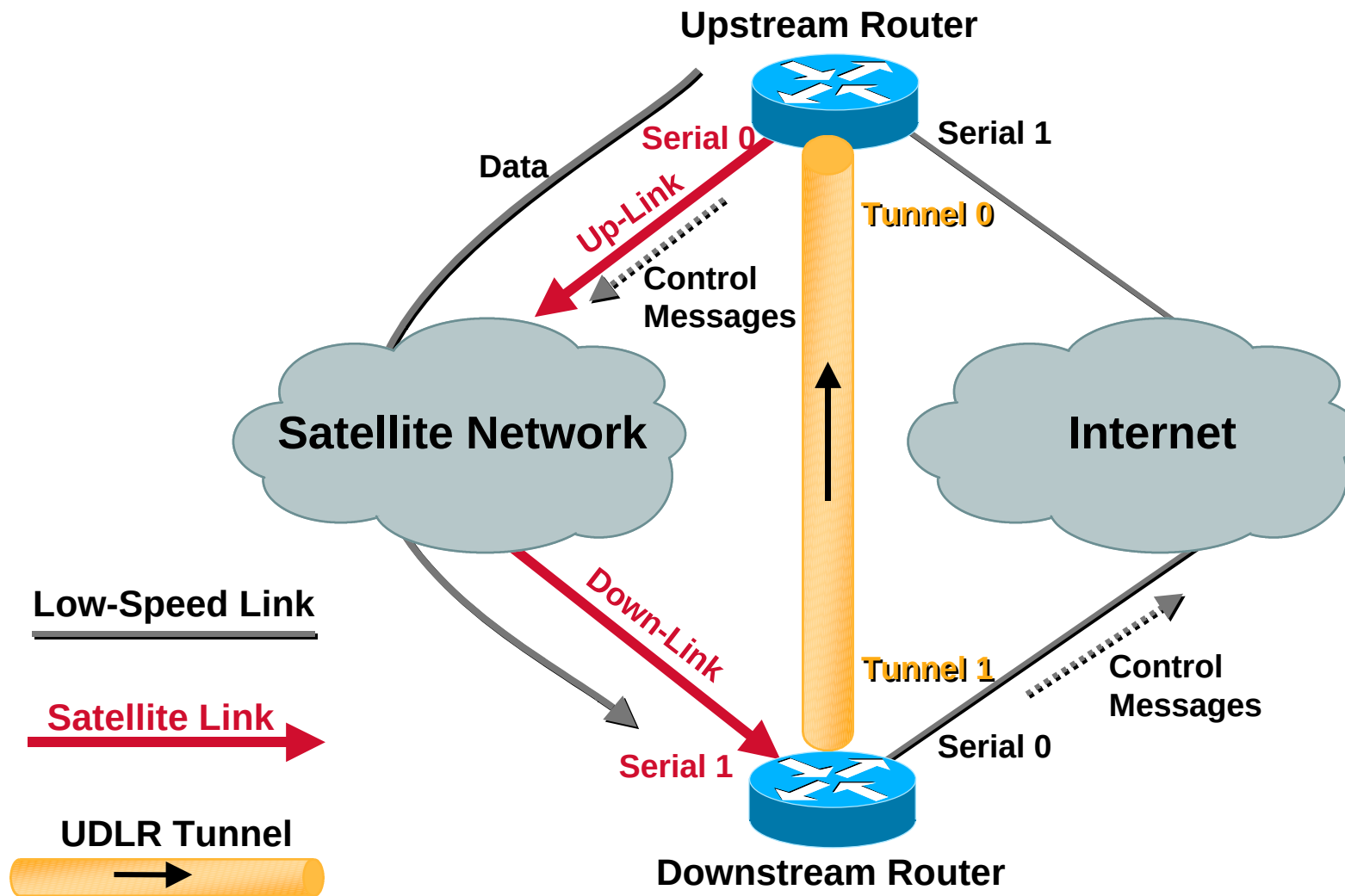
Cisco Solutions

- **UDLR-Tunnels for unicast and multicast routing**
- **IGMP-UDLR for large-scale multicast routing**

UDLR-Tunnels

- **Extend GRE tunnels to be configured as one-way**
- **Associate the one-way tunnel with a one-way interface (which goes in the opposite direction)**
- **ULPs don't see tunnel as an interface**
- **Mapping performed at the link-layer so real one-way interface looks bi-directional**

UDLR-Tunnels



UDLR-Tunnels

- **How to configure (upstream router)**

```
interface tunnel0
```

```
tunnel udlr receive-only serial0
```

- **How to configure (downstream router)**

```
interface tunnel1
```

```
tunnel udlr send-only serial1
```


UDLR-Tunnels

- **Features**

All IP unicast routing protocols supported

IS-IS (via CLNS) is supported

All IP multicast routing protocols supported

HDLC keepalives

PPP Link Quality Monitoring (LQM)

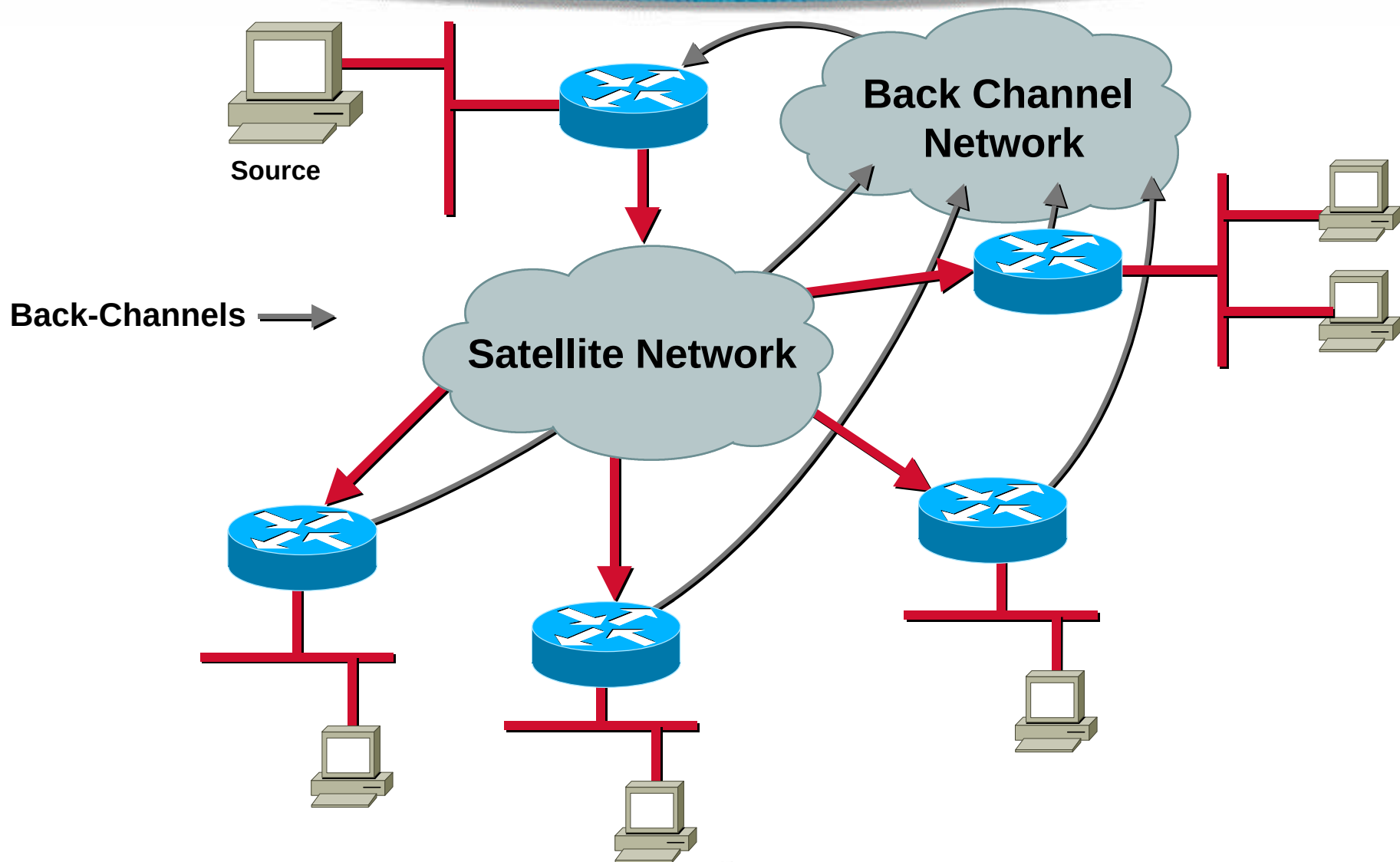
UDLR-Tunnels

- **Caution!**
- **This is not a general purpose scalable solution for UDLR routing**
- **You have to limit the number of tunnels that fan-into the upstream router**
- **Useful for small transit clouds**

IGMP-UDLR

- **Used for large scale multicast routing over widespread unidirectional links**
- **Design goals**
 - Eliminate static multicast routes and static group membership**
 - Reduce the number of control messages sent**
 - Built-in fault tolerance**

IGMP-UDLR Environment



IGMP-UDLR—Basic Idea

- **Downstream routers listen for IGMP queries**
- **They select a querier**
- **Host sends IGMP report to join group**
- **Downstream router forwards IGMP report to querier**
- **Querier (upstream router) populates olist for data forwarding**
- **Querier echos IGMP report back out one-way link to suppress other downstream reports**

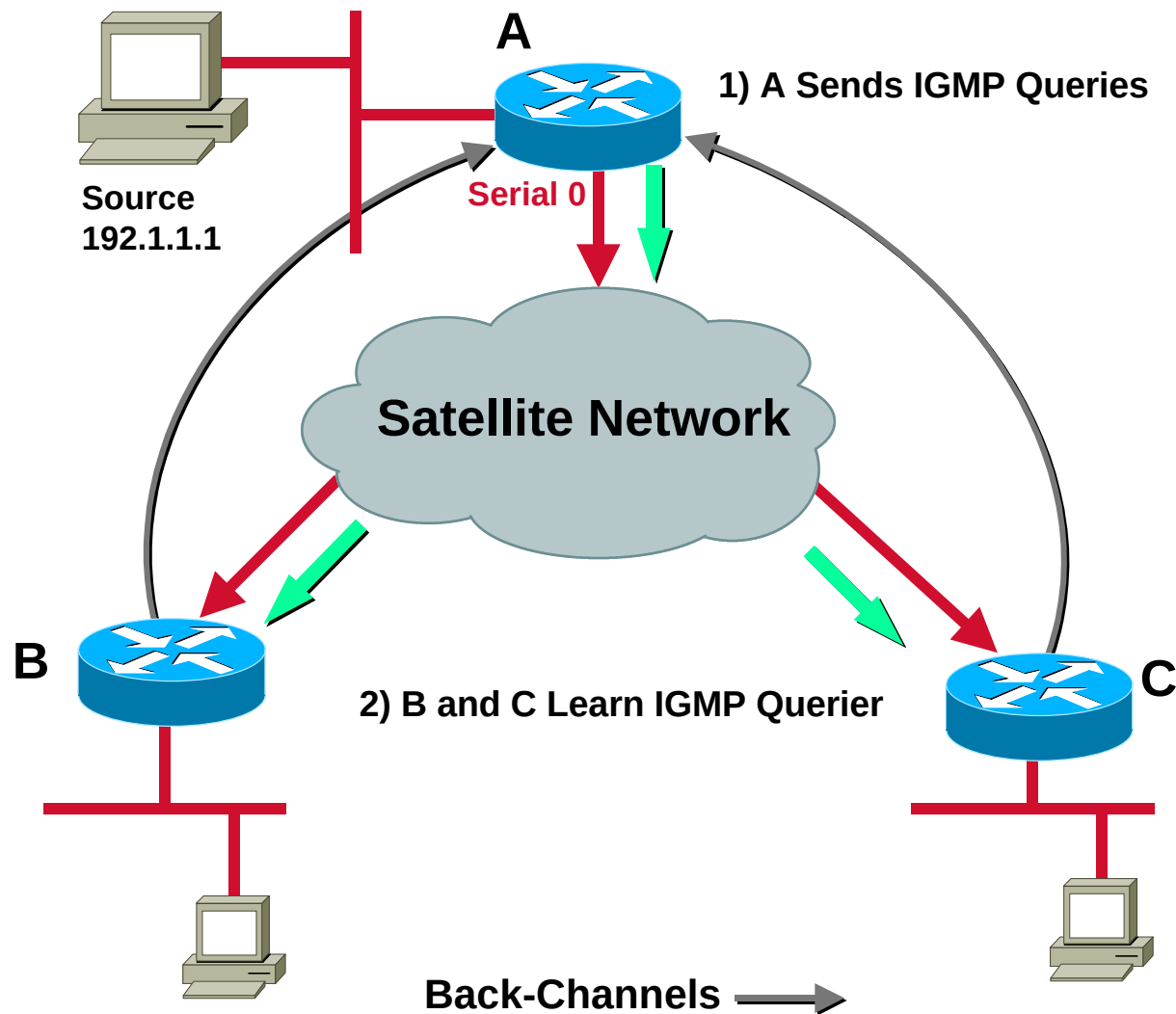
IGMP-UDLR—Basic Idea (Cont.)

- **Other downstream routers remember reporter for group and monitor it's reporting status for the group**
- **When the reporter goes down or leaves the group, a new reporter forwards IGMP reports**
- **Leaves work the same way**

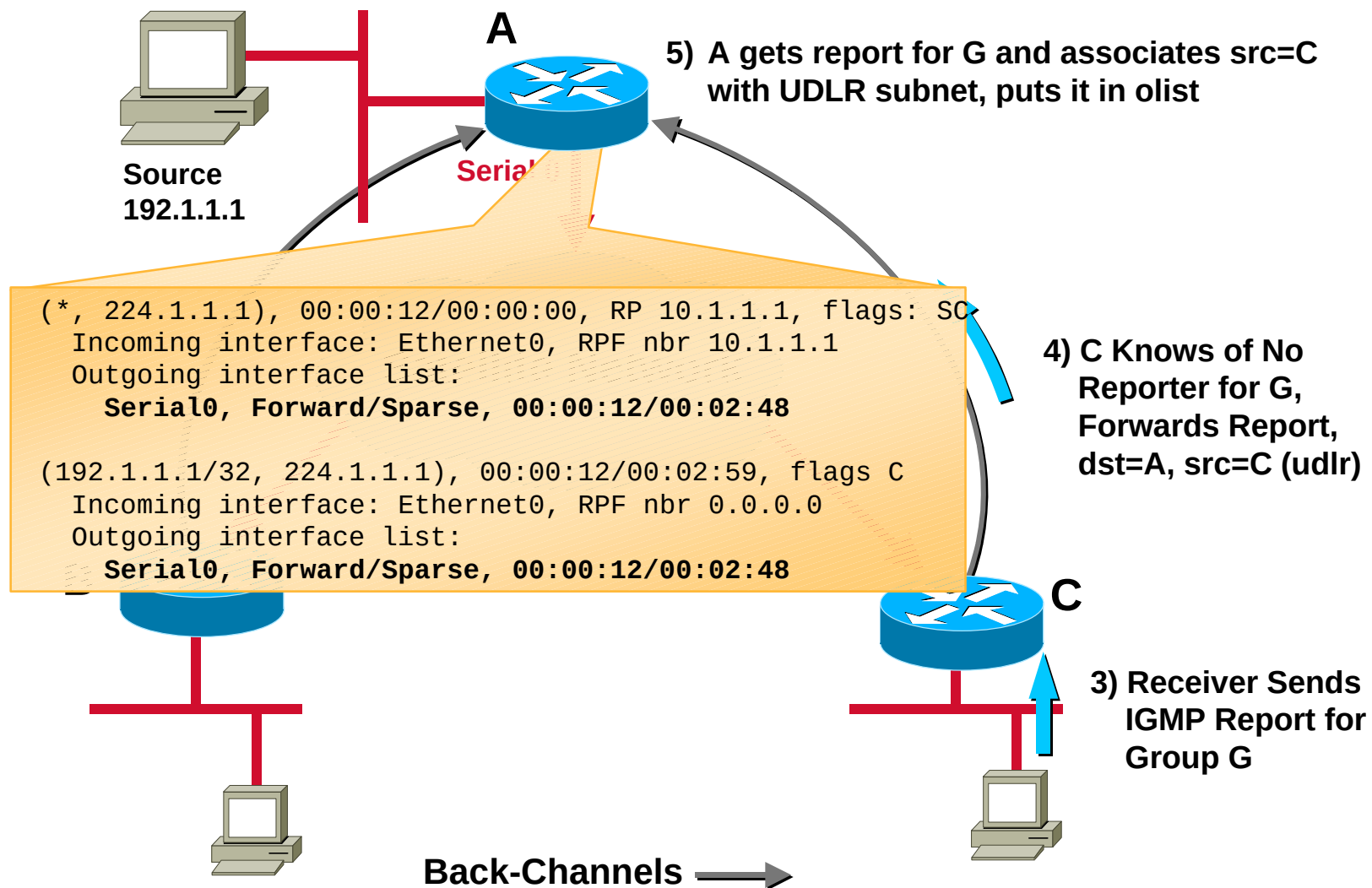
IGMP-UDLR Scalability

- **Groups are dynamic so only joined group traffic traverses UDLR link**
- **Report suppression allows one report per group per UDLR link (irrespective of the number of members and member subnets)**

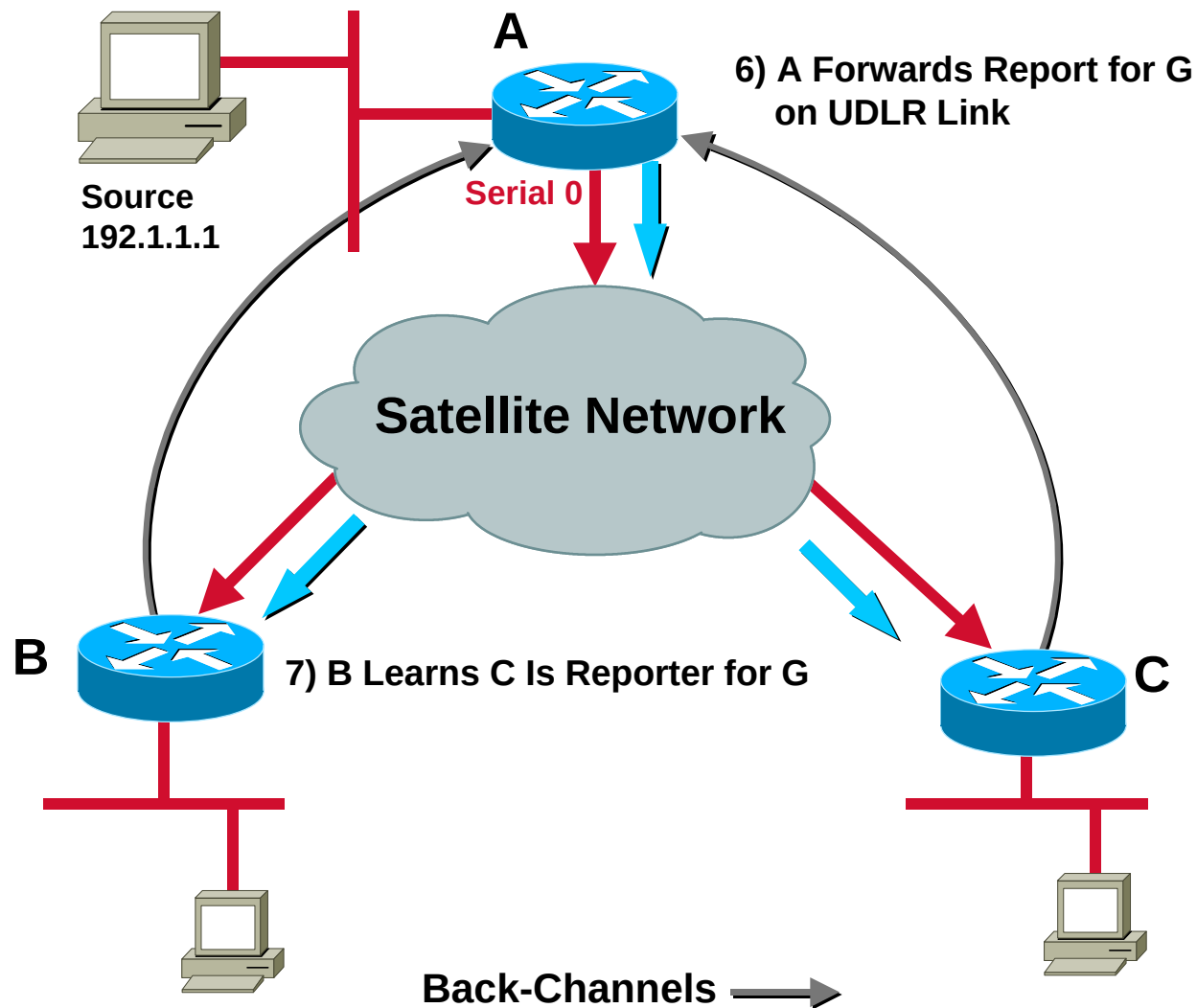
IGMP-UDLR Details for Joining



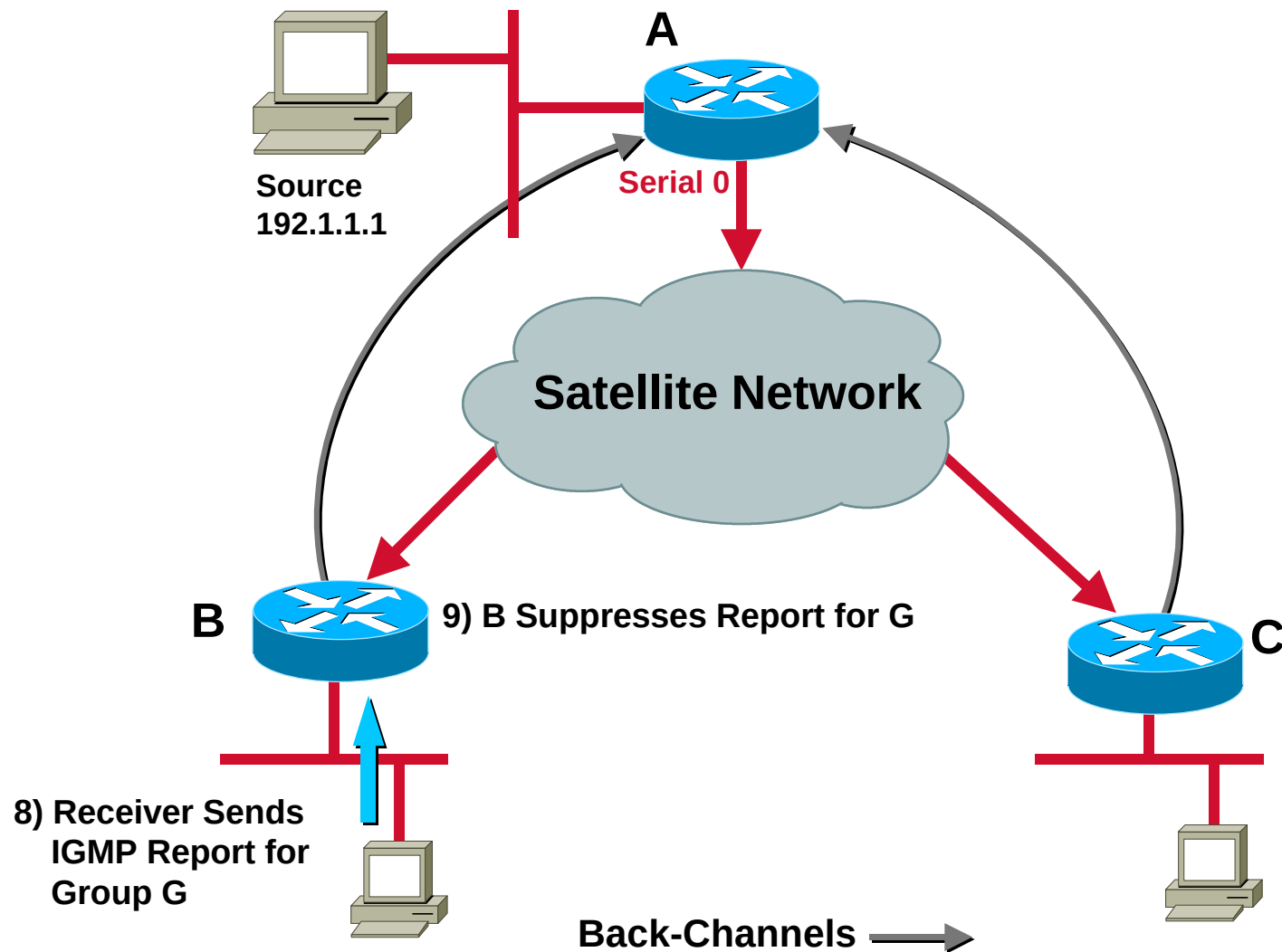
IGMP-UDLR Details for Joining



IGMP-UDLR Details for Joining



IGMP-UDLR Details for Joining



CISCO SYSTEMS



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