Asymmetric Satellite Services

Agenda

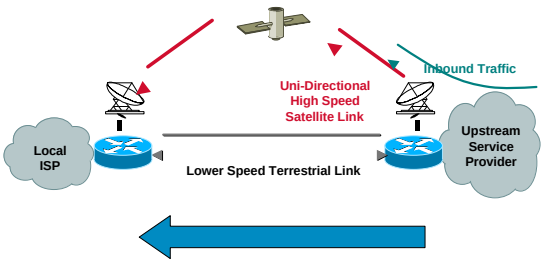
- Introduction and Background
- Transmit Interface Command
- Point to Point Example
- Point to Multipoint Example
- Other Considerations
- UDLR

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

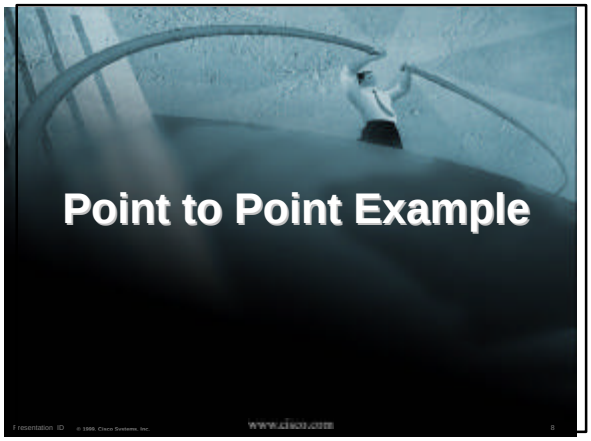


Transmit Interface Command

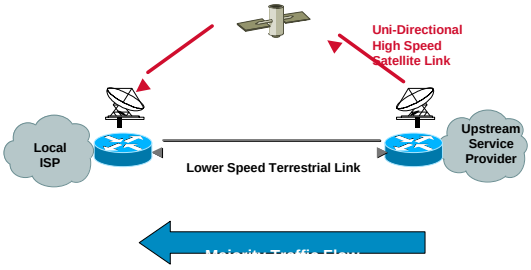
Transmit Interface

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

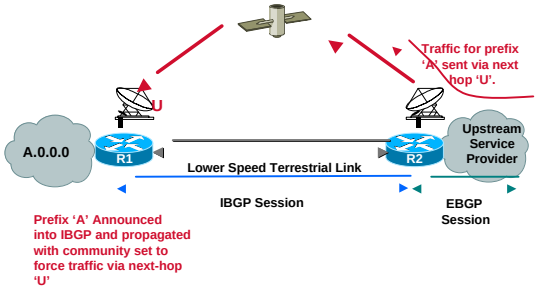
```
interface Serial3/5
 transmit-interface Serial3/6
 ip address 10.1.1.1 255.255.255.0
 no ip directed-broadcast
!
interface Serial3/6
 no ip address
 no ip directed-broadcast
```



Point to Point 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

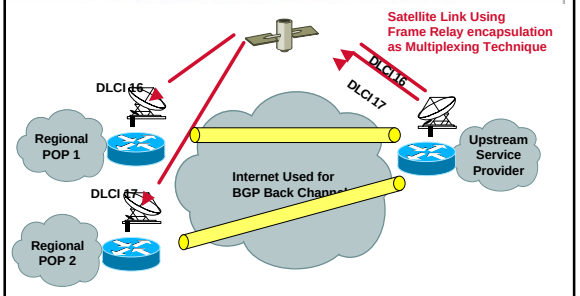
Point to Multi-point -1

- 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

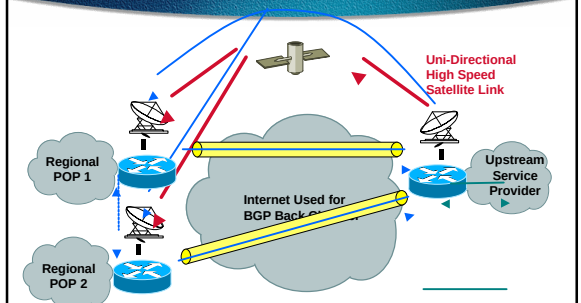
Point to Multi-point -2

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

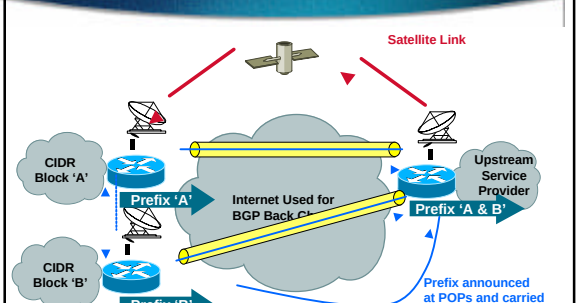
Point to Multi-point -1



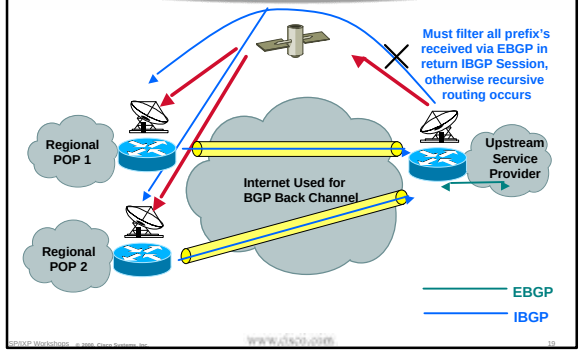
Point to Multi-point -2



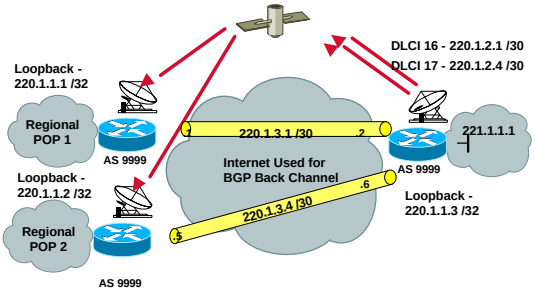
Point to Multi-point -3



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 16
!
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 17
```

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 221.1.X.X remote-as 1000
 neighbor 221.1.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 221.1.1.3 remote-as 9999
 neighbor 221.1.1.3 description IBGP to Sat Uplink
 neighbor 221.1.1.3 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 221.1.1.1 ! Globally reachable
!
ip route 221.1.1.3 255.255.255.255 220.1.3.2
!
```


Configuration - Route Return BGP Sessions over Satellite Path

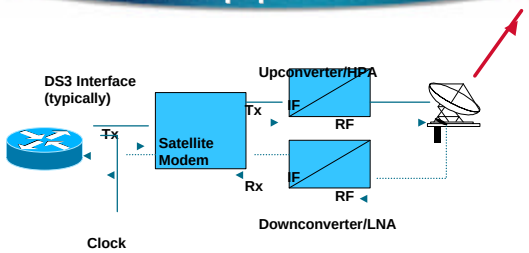
```
Uplink Site Router
------------------

! 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

- 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)

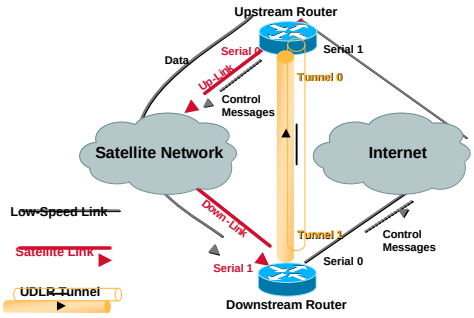
Cisco Solutions

- 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)

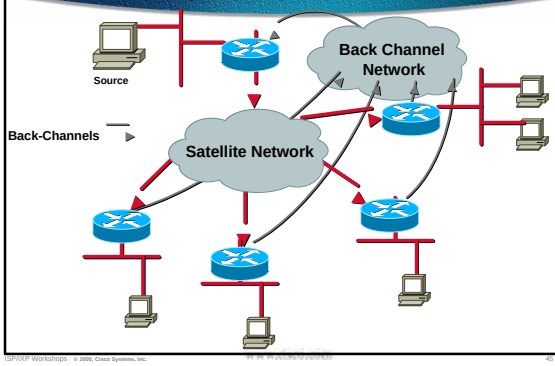
UDLR-Tunnels

- 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

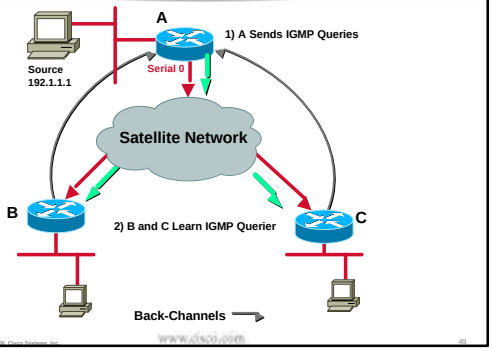
IGMP-UDLR—Basic Idea (Cont.)

- 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

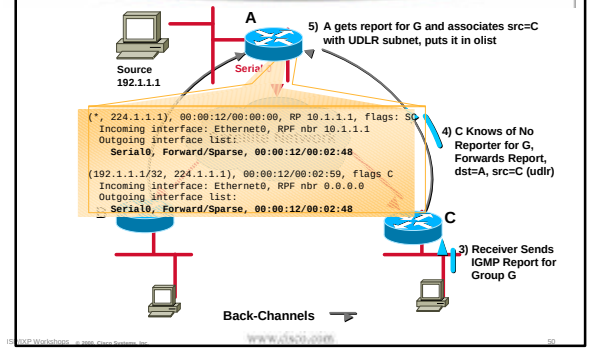
IGMP-UDLR Scalability

- 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)

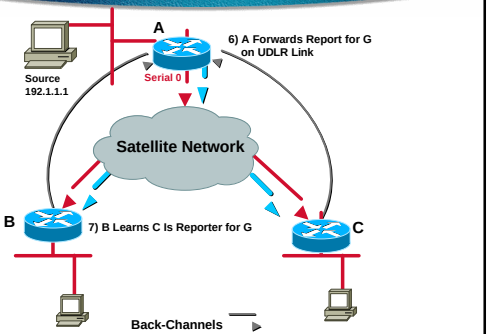
IGMP-UDLR Details for Joining



IGMP-UDLR Details for Joining



IGMP-UDLR Details for Joining



IGMP-UDLR Details for Joining