Slide 1

CISCO SYSTEMS

Asymmetric Satellite Services

1

Slide 2

Agenda

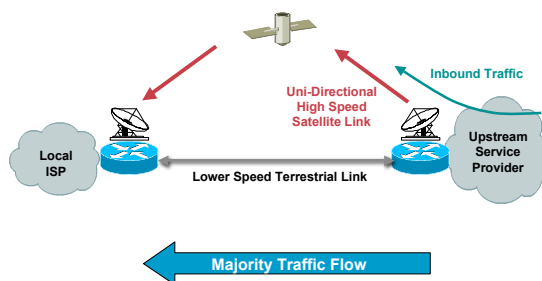- Introduction and Background
- Transmit Interface Command
- Point to Point Example
- Point to Multipoint Example
- Other Considerations
- UDLR

2

Slide 3

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Introduction and Background

3

Slide 4

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

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Slide 5

Asymmetric Satellite Services

Inbound Traffic

Uni-Directional High Speed Satellite Link

Local ISP

Upstream Service Provider

Lower Speed Terrestrial Link

Majority Traffic Flow

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Slide 6

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Transmit Interface Command

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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
```

CISCO SYSTEMS

Point to Point Example

Point to Point Scenario

Uni-Directional High Speed Satellite Link

Local ISP

Upstream Service Provider

Lower Speed Terrestrial Link

Majority Traffic Flow

Point to Point Scenario

Traffic for prefix 'A' sent via next hop 'U'.

U

A.0.0.0   R1

Upstream Service Provider

R2

Lower Speed Terrestrial Link

IBGP Session

EBGP Session

Prefix 'A' Announced into IBGP and propagated with community set to force traffic via next-hop 'U'
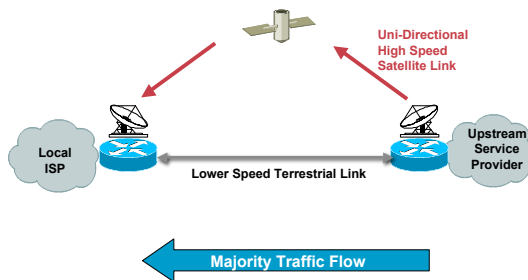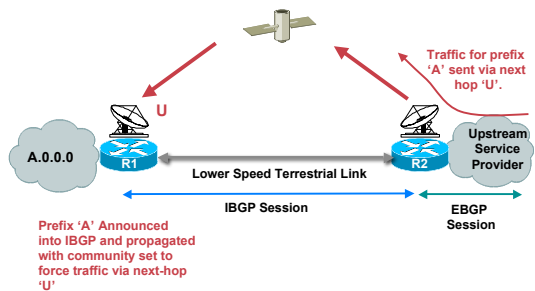
Configuration - Router 1

```
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
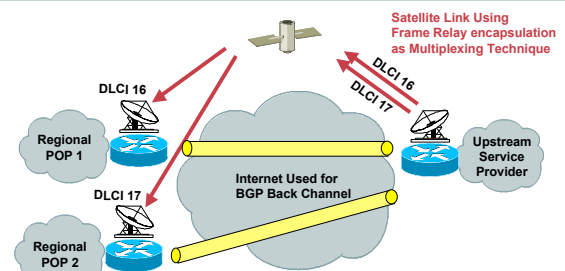```

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## 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**
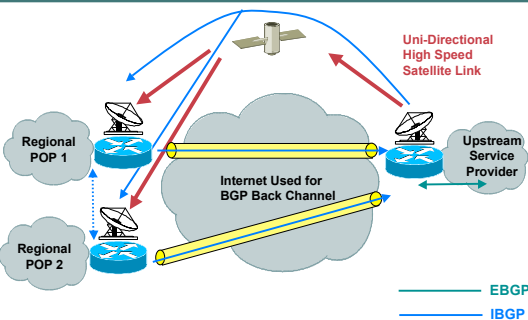- **Internet (and BGP Tunneling) used for back channel traffic in many scenarios**

## Point to Multi-point -2

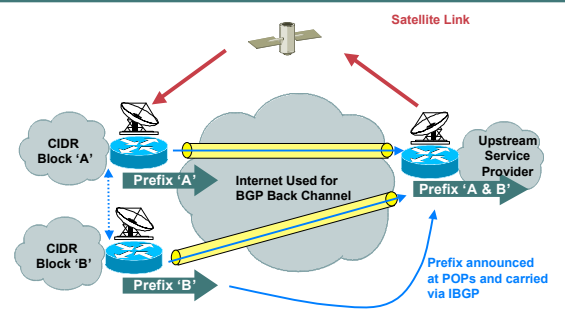- **BGP peer-to-peer traffic travels over satellite path allowing detection satellite path failure**
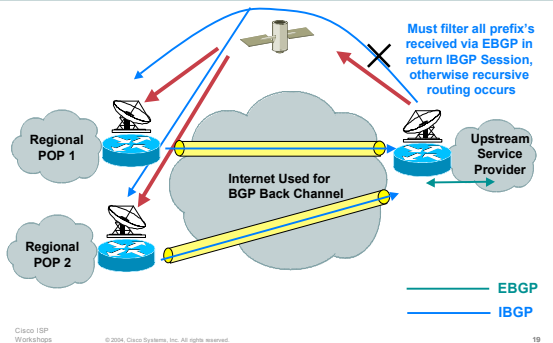
## Point to Multi-point -1



Satellite Link Using Frame Relay encapsulation as Multiplexing Technique

DLCI 16
DLCI 17
DLCI 16
DLCI 17

Regional POP 1

Regional POP 2

Internet Used for BGP Back Channel

Upstream Service Provider

## Point to Multi-point -2



Uni-Directional High Speed Satellite Link

Regional POP 1

Regional POP 2

Internet Used for BGP Back Channel

Upstream Service Provider

EBGP
IBGP

## Point to Multi-point -3



Satellite Link

CIDR Block 'A'

CIDR Block 'B'

Prefix 'A'
Prefix 'B'

Internet Used for BGP Back Channel

Upstream Service Provider

Prefix 'A & B'

Prefix announced at POPs and carried via IBGP

## Point to Multi-point -4



**Must filter all prefix's received via EBGP in return IBGP Session, otherwise recursive routing occurs**

Regional POP 1

Regional POP 2

Internet Used for BGP Back Channel

Upstream Service Provider

— EBGP
— IBGP

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---

## Configuration



DLCI 16 - 220.1.2.1 /30
DLCI 17 - 220.1.2.4 /30

Loopback - 220.1.1.1 /32

Regional POP 1

Loopback - 220.1.1.2 /32

Regional POP 2

AS 9999

.1  220.1.3.1 /30  .2

Internet Used for BGP Back Channel

.5  220.1.3.4 /30  .6

221.1.1.1

AS 9999

Loopback - 220.1.1.3 /32

AS 9999

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---

## 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
!
```

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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
```

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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
 ...
!
```

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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
!
```

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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
!
```

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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
!
```

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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
!
```

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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
!
```

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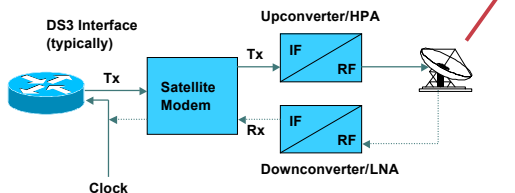
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Other Considerations

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Interfacing to the Satellite Modem Equipment

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Presentation_ID.scr

5

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**

CISCO SYSTEMS

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**
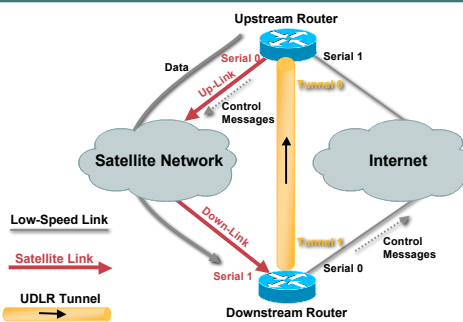- **IGMP-UDLR for large-scale multicast routing**

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**
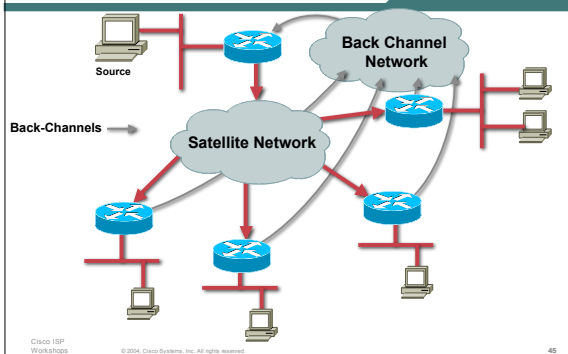- **Useful for small transit clouds**

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**
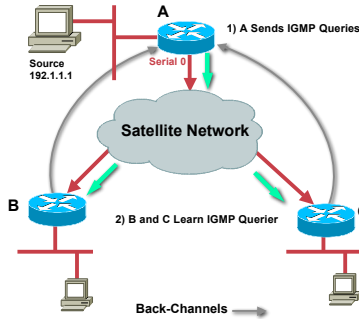- **Leaves work the same way**

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)**
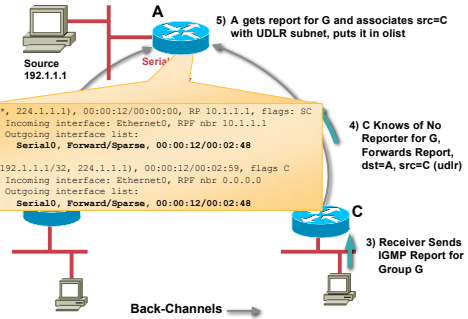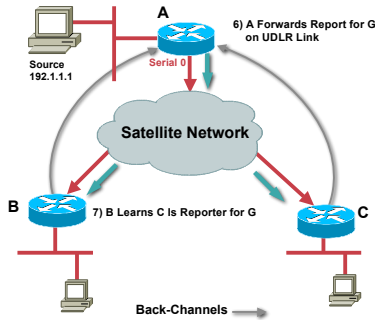
IGMP-UDLR Details for Joining

A
1) A Sends IGMP Queries
Source 192.1.1.1
Serial 0

Satellite Network

B
2) B and C Learn IGMP Querier
C

Back-Channels →

IGMP-UDLR Details for Joining

A
5) A gets report for G and associates src=C with UDLR subnet, puts it in olist
Source 192.1.1.1
Serial

```
(*, 224.1.1.1), 00:00:12/00:00:00, RP 10.1.1.1, flags: SC
  Incoming interface: Ethernet0, RPF nbr 10.1.1.1
  Outgoing interface list:
    Serial0, Forward/Sparse, 00:00:12/00:02:48

(192.1.1.1/32, 224.1.1.1), 00:00:12/00:02:59, flags C
  Incoming interface: Ethernet0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Serial0, Forward/Sparse, 00:00:12/00:02:48
```

4) C Knows of No Reporter for G, Forwards Report, dst=A, src=C (udlr)

C
3) Receiver Sends IGMP Report for Group G

Back-Channels →

IGMP-UDLR Details for Joining

A
6) A Forwards Report for G on UDLR Link
Source 192.1.1.1
Serial 0

Satellite Network

B
7) B Learns C Is Reporter for G
C

Back-Channels →

IGMP-UDLR Details for Joining

A
Source 192.1.1.1
Serial 0

Satellite Network

B
9) B Suppresses Report for G
C

8) Receiver Sends IGMP Report for Group G

Back-Channels →

CISCO SYSTEMS

Asymmetric Satellite Services