A Novel Architecture for Triple Play Services

BROADEN YOUR LIFE

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ALCATEL

Agenda

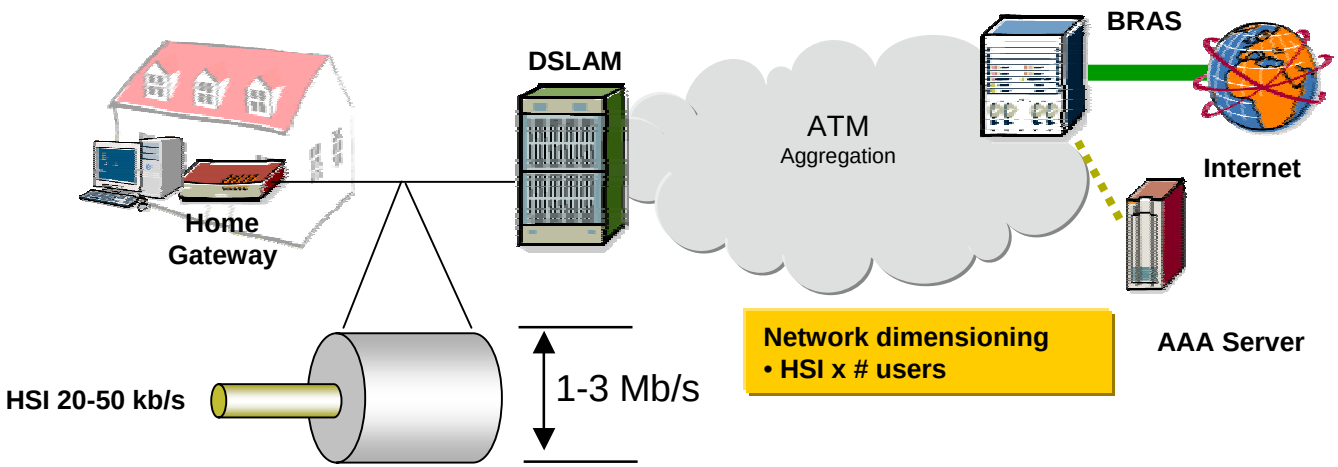
- **Introducing the Triple Play Architecture**
  - HSI and Broadband Aggregation Today
  - New Service Requirements: The Impact of Video
- The Triple Play Architecture
  - What is VPLS?
  - Broadcast TV and Multicasting
  - QoS and Filtering
  - Management and Troubleshooting

Introduction

- What led to this architecture?
  - Customer Requirements
  - Service Requirements
- Not a marketing pitch
- Would like feedback: vach.kompella@alcatel.com

Present Mode of Operation: High Speed Internet Access Today

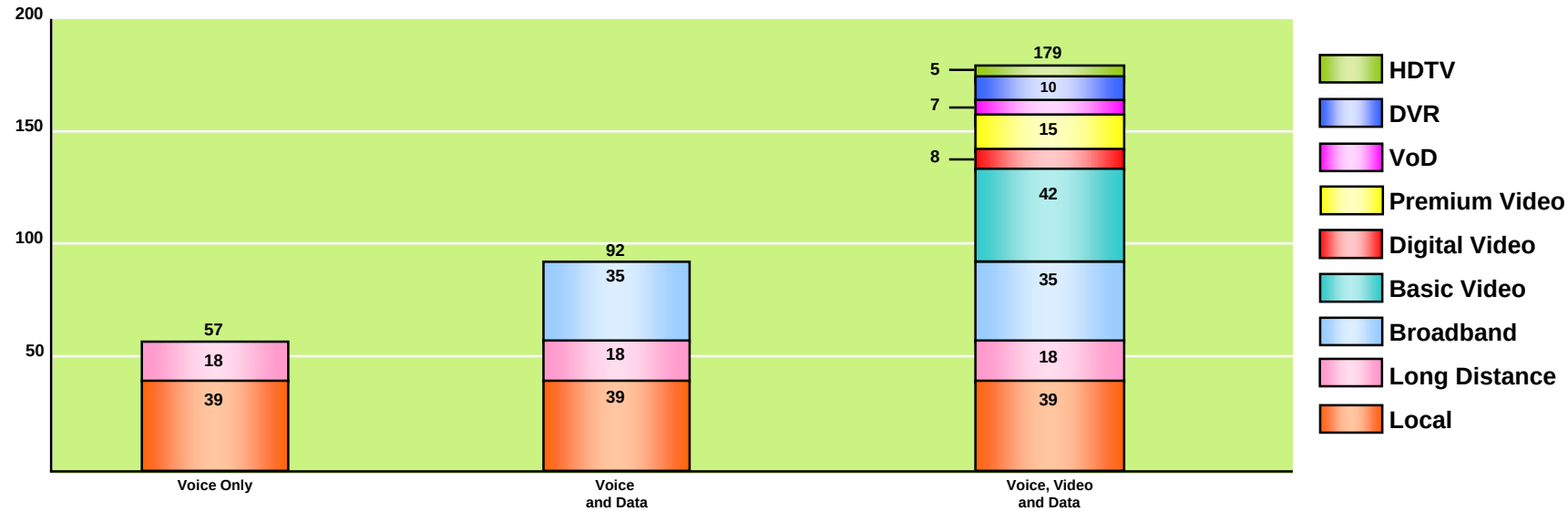
- BRAS optimized for High Speed Internet services
  - Deployed on a single, non-redundant PPP connection to a single BRAS
  - Optimized service delivery network for HSI only (over-subscription, low bandwidth, no services)
  - Service quality variable
    - Downtime of minutes accepted
  - Manual switchover of BRAS in case of failure
    - Tens of thousands of PPP session take considerable time to switch over



Marketing slide alert!

Business Requirements – Triple Play Services

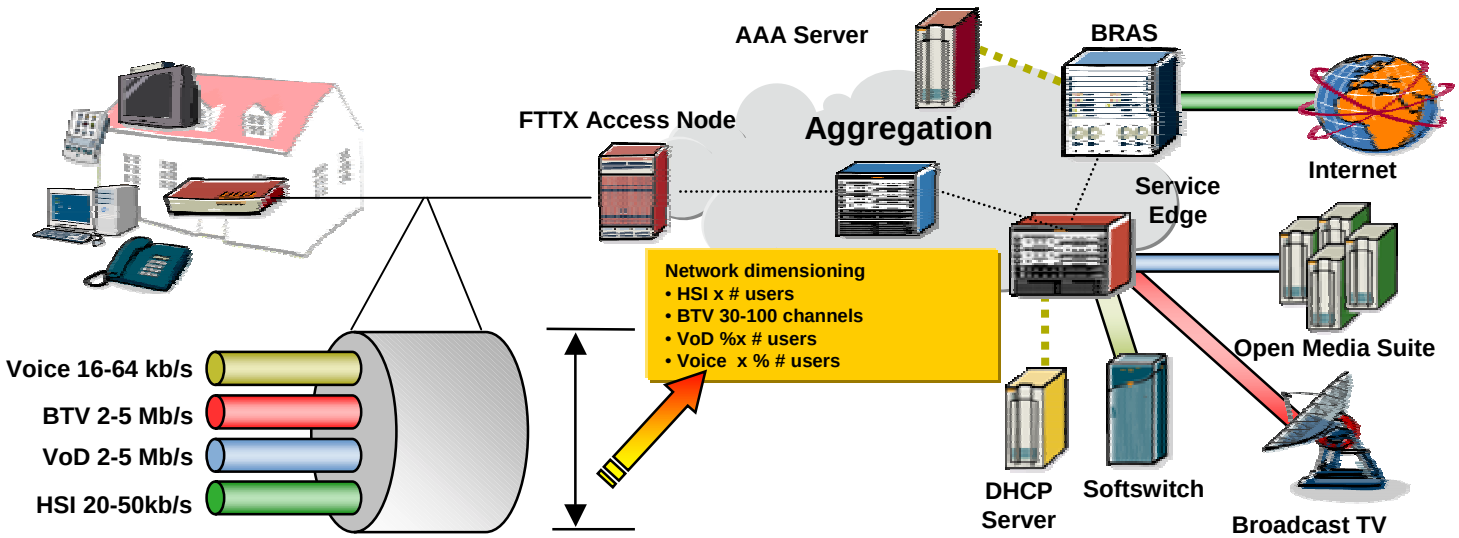
- Increase ARPU and margin contribution with bundled high-SLA services
- Maximize customer retention, gain market share
- Streamline network and business operations for faster TTM
- Achieve economies of scale skill and scope



Source: Yankee group, 2004
ARPU, US market in US$

New Service Requirements

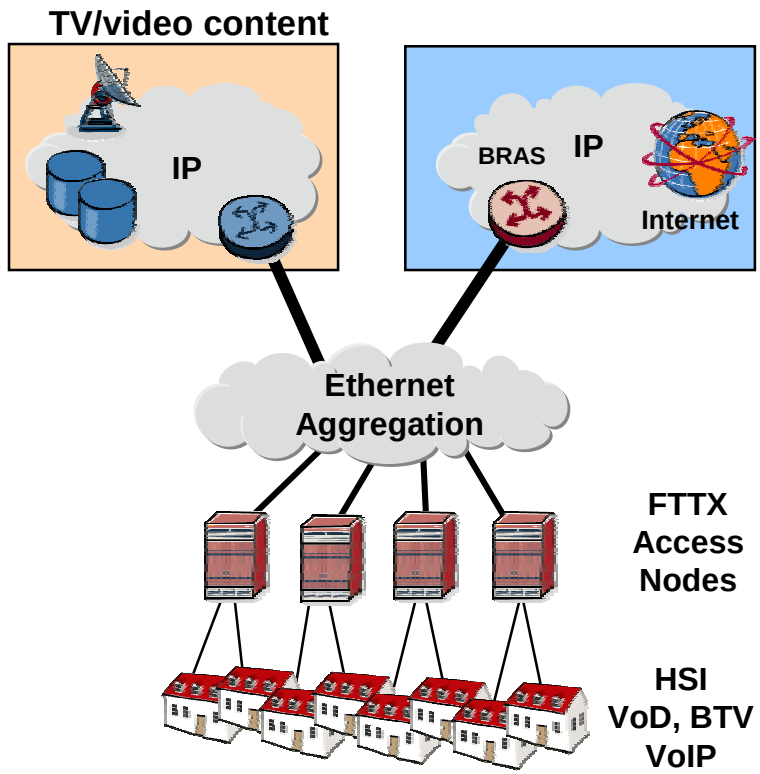
- Increasingly diverse requirements for new service types
  - Multiple services on a single network architecture
  - Mix and match services easily on a per customer basis
  - Flexible infrastructure must support combinations of services
  - Must cater to different take rates, densities, channel line-ups, and mode of distribution for BTV today and HDTV VoD in short term



New Services Impact Architectural Designs

Video is different from HSI

- Managed at the application level (CAC)
- Bandwidth: 20 Mb/s+ vs. 100 Kb/s for HSI
  - Impact on density, throughput requirements
- Loss, delay and jitter sensitive
- Optimized with greater distribution
- Higher reliability requirement
- Multicast and asymmetric
- Device-authenticated
- Different density of subscribers

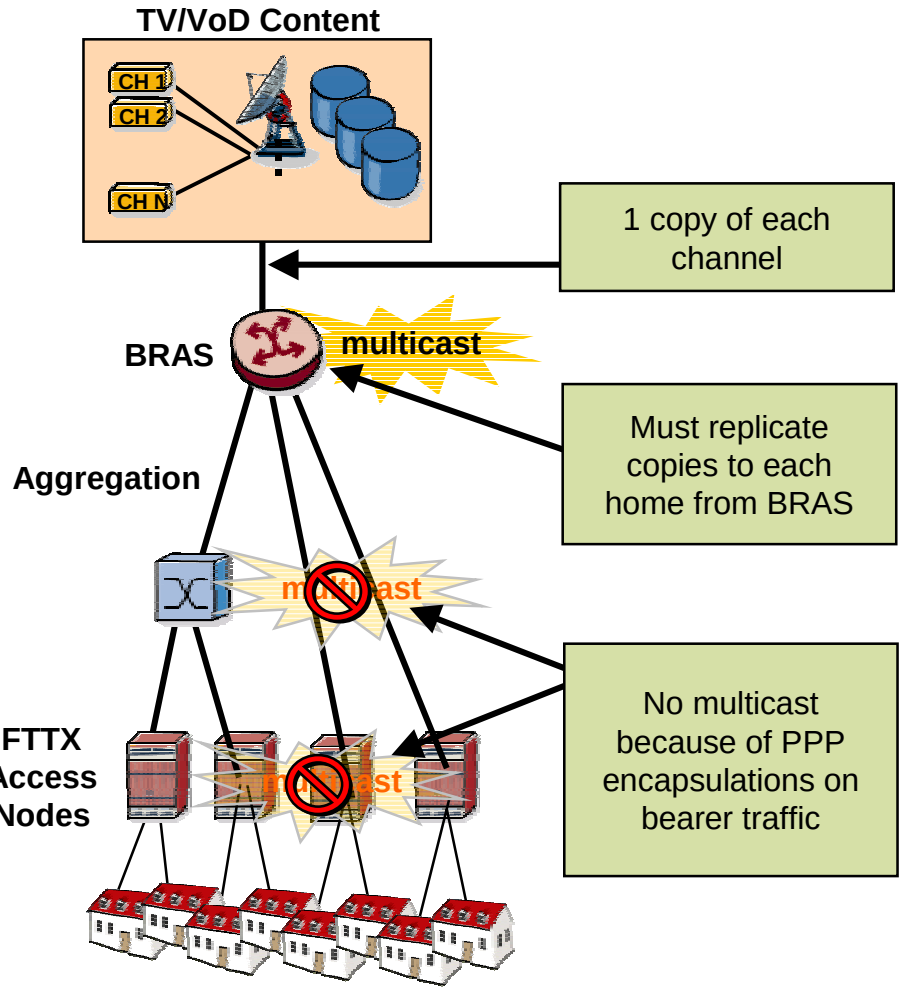


Video and VoIP: Service Requirements

- **QoS**
  - QoS for video consists in CAC, prioritization and guaranteed delay/jitter/loss for the service aggregate
  - Video server/softswitch admit the video/voice call, dictate bandwidth levels required
  - Excess bandwidth has little effect on user experience/SLA
- **Accounting**
  - Accounting is call/session based – handled at application layer
- **Filtering**
  - Thousands of anti-spoofing rules required
  - Authentication and access to content handled by middleware

PPPoE Impact on Multicasting with BRAS

- PPP model breaks multicasting throughout the network
  - Multicast point at BRAS
    - "Second mile" GE limits all VoD and BTV
    - Inefficient: cannot reach 100% viewership with same bandwidth
  - BTV drives greater distribution of BRAS
    - BRAS proliferation = maximized CAPEX
- Implementation issues
  - Cannot scale QoS mechanisms (100k queues per 10 GE required
  - PPPoX is not normal mode of operation for most STB/VoIP appliances
- Impact on redundancy
  - Expensive to implement, with single point of failure



High-Speed Internet: Service Requirements

- **QoS**
  - Per-subscriber bandwidth control/guarantees key to user experience/SLA
  - Operator must prioritize HSI traffic appropriately relative to voice/video
- **Accounting**
  - Usage and policy-matching accounting required on a per-subscriber basis
- **Filtering**
  - DHCP-based: scalable and granular anti-spoofing rules required
  - Scaleable filtering policies required for DOS attack and theft of service
  - PPPoE-based: anti-spoofing is not required

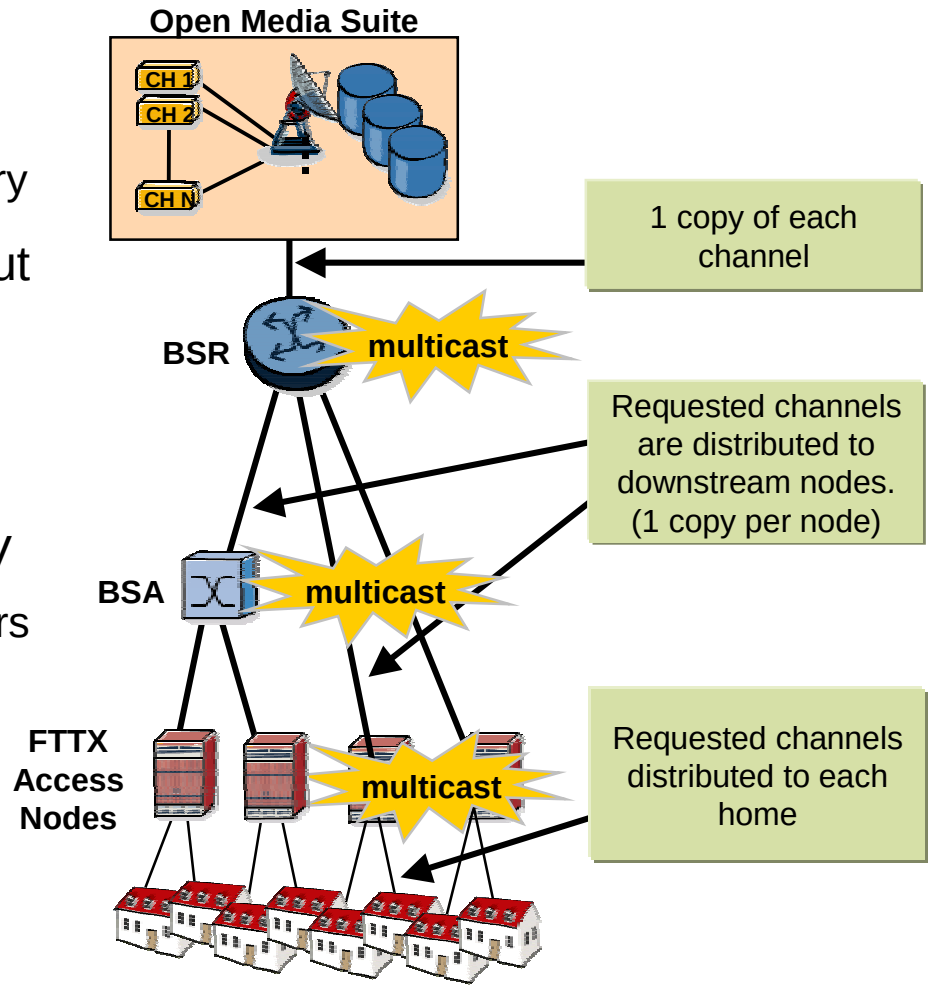
Multiple Edge/Distributed Approach to Multicasting

- Multicasting at all points in the network
  - Optimized bandwidth/content delivery
- Retains infrastructure for HSI without burdening BRAS for multicast
- More efficient use of fiber and aggregation bandwidth
- Scales for 100% viewership for BTV
  - e.g. Superbowl and national disasters

Multiple Edges

Provides the greatest flexibility to optimize the delivery of each service

Improves time-to-market of video by enabling video without operationally changing HSI



Building a Triple Play Architecture

Challenges

- New services drive architectural changes
  - Capacity, subscriber density, critical nature of QoS, multicast
- Getting both subscriber scale and bandwidth capacity is critical
  - Subscriber density and port capacity do not usually scale well together
  - Service and per-subscriber policies are also required to scale

Solution

- Distribute the relevant functions to optimize the design for scalability
  - Scaling per-user QoS by moving queuing, scheduling and accounting closer to the subscriber
  - Optimizing bandwidth by multicasting packet as much as possible
  - Scaling video on demand using GE ports

Architectural Flexibility

- Increase bandwidth to the home
- Introduce QoS controls of jitter, latency, differentiation
- Improve distribution efficiency
- Extend billing mechanisms
- Enhance network reliability

Agenda

- Introducing the Triple Play Architecture
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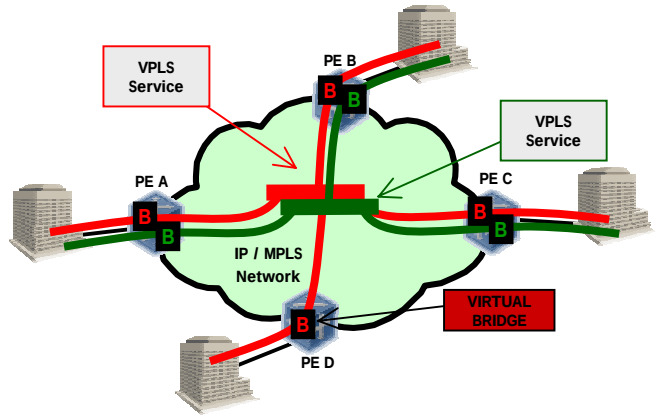
  - New Service Requirements: The Impact of Video

- **The Triple Play Architecture**
  - What is VPLS?
  - Broadcast TV and Multicasting
  - QoS and Filtering
  - Management and Troubleshooting

What is Virtual Private LAN Service (VPLS)?

VPLS: A class of VPN that allows the connection of multiple sites in a single bridged domain over a provider managed MPLS network.



From the Providers perspective

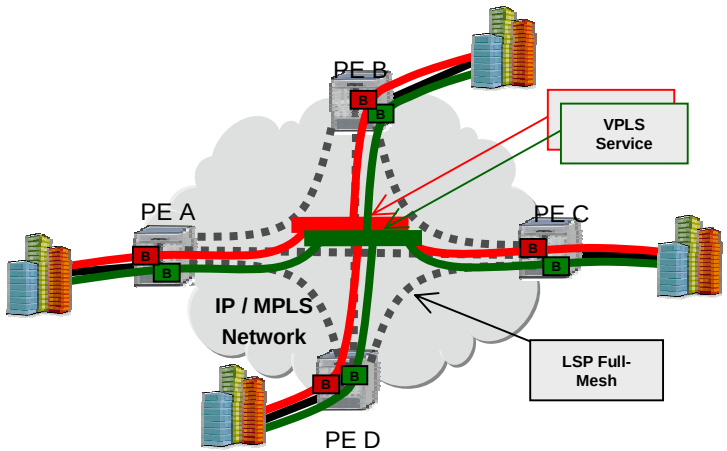
- **Service that leverages the shared IP/MPLS infrastructure.**
- **Service is entirely distributed to the PE's – no centralized functions/servers.**
- **PEs implement MAC address learning, MAC-based forwarding, and protect the network from broadcast storms.**

From the Subscriber's perspective

- **All sites appear to be connected to a single bridged VLAN.**
- **Service bandwidths can scale from to gigabits.**
- **L3-protocol independent service**
- **CPE equipment can be at L2 or L3**

Basic VPLS

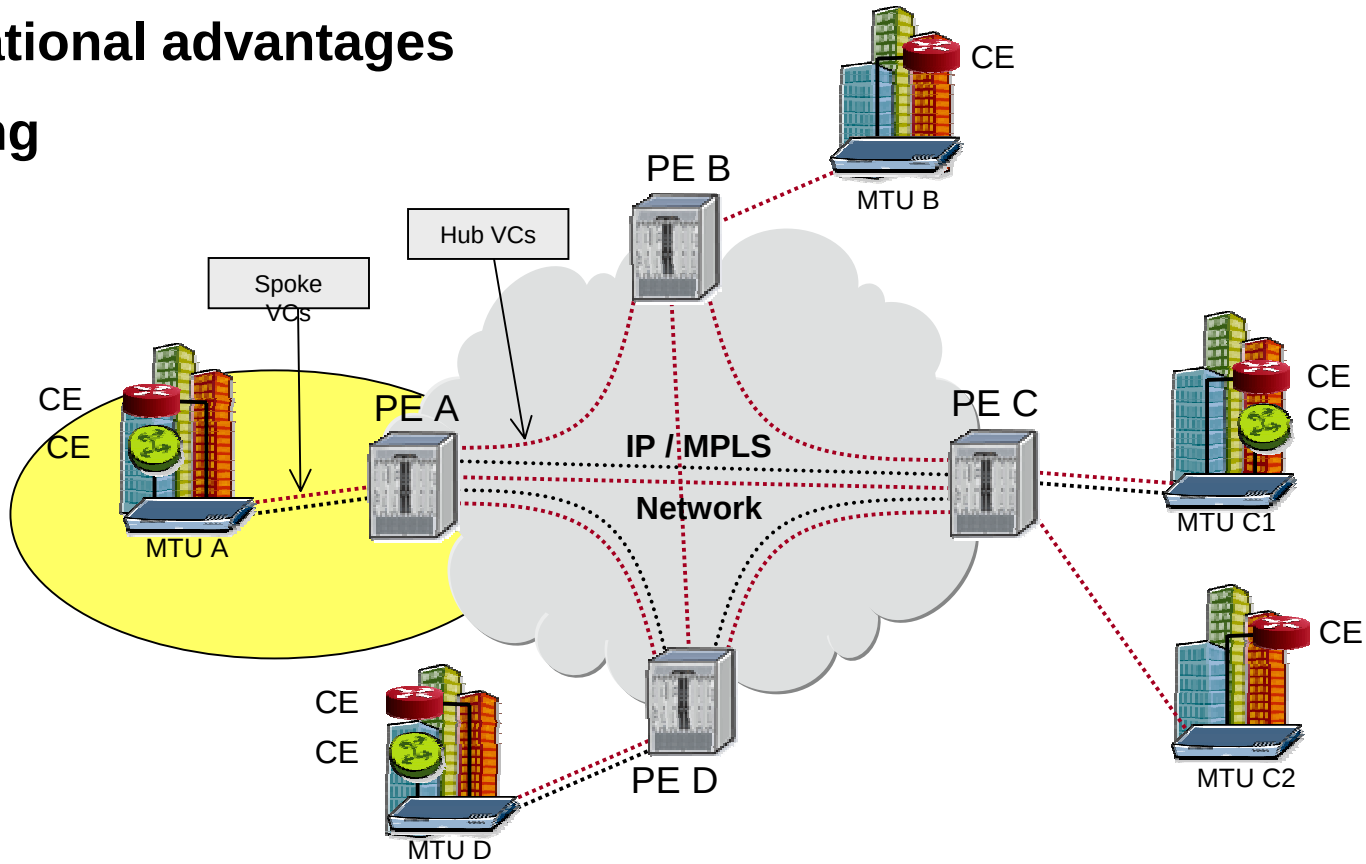
- Full mesh of Pseudowires + ‘split horizon’ in order to avoid loops
- Signalling: LDP (Martini+)
- MPLS label (‘demultiplexor’) identifies VPN and ingress PE



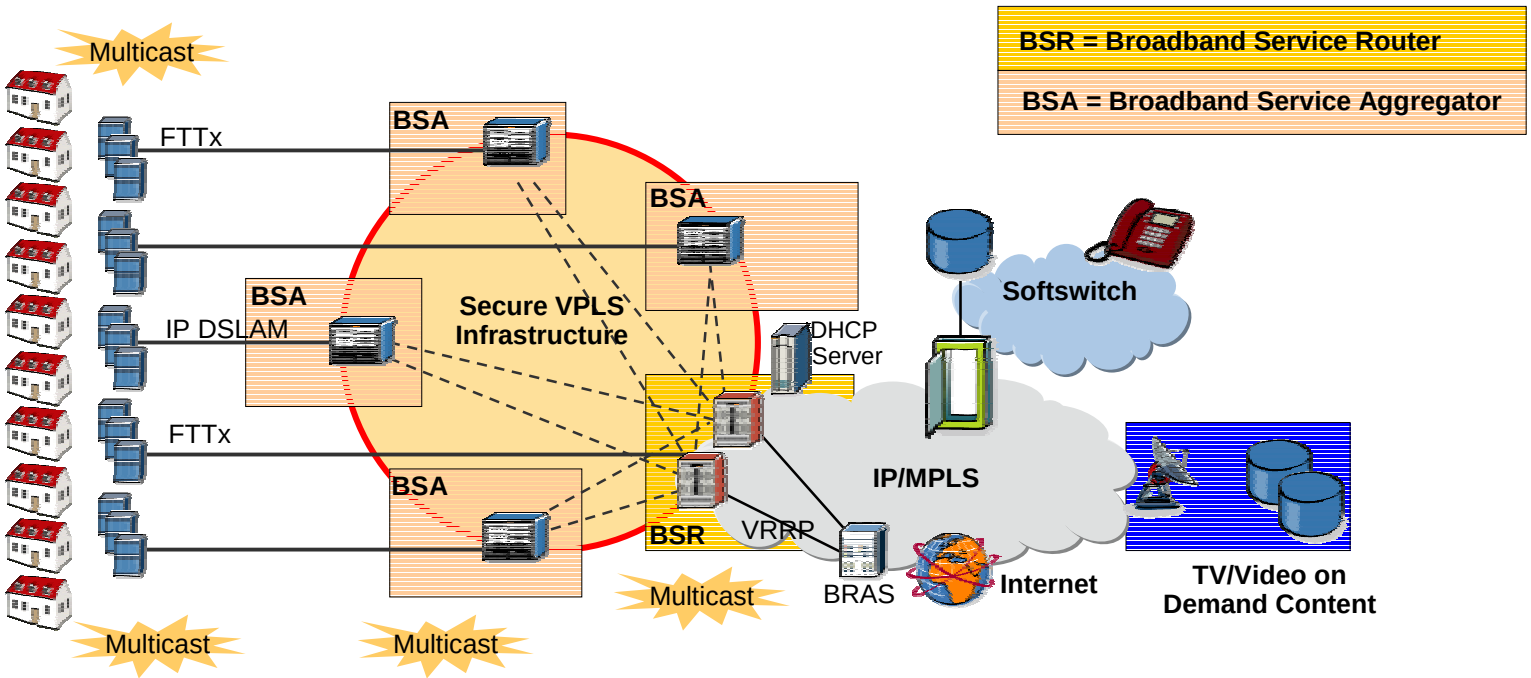
Hierarchical VPLS

Introduces hierarchy in the base VPLS solution to provide

- **Operational advantages**
- **Scaling**



Triple Play Architecture

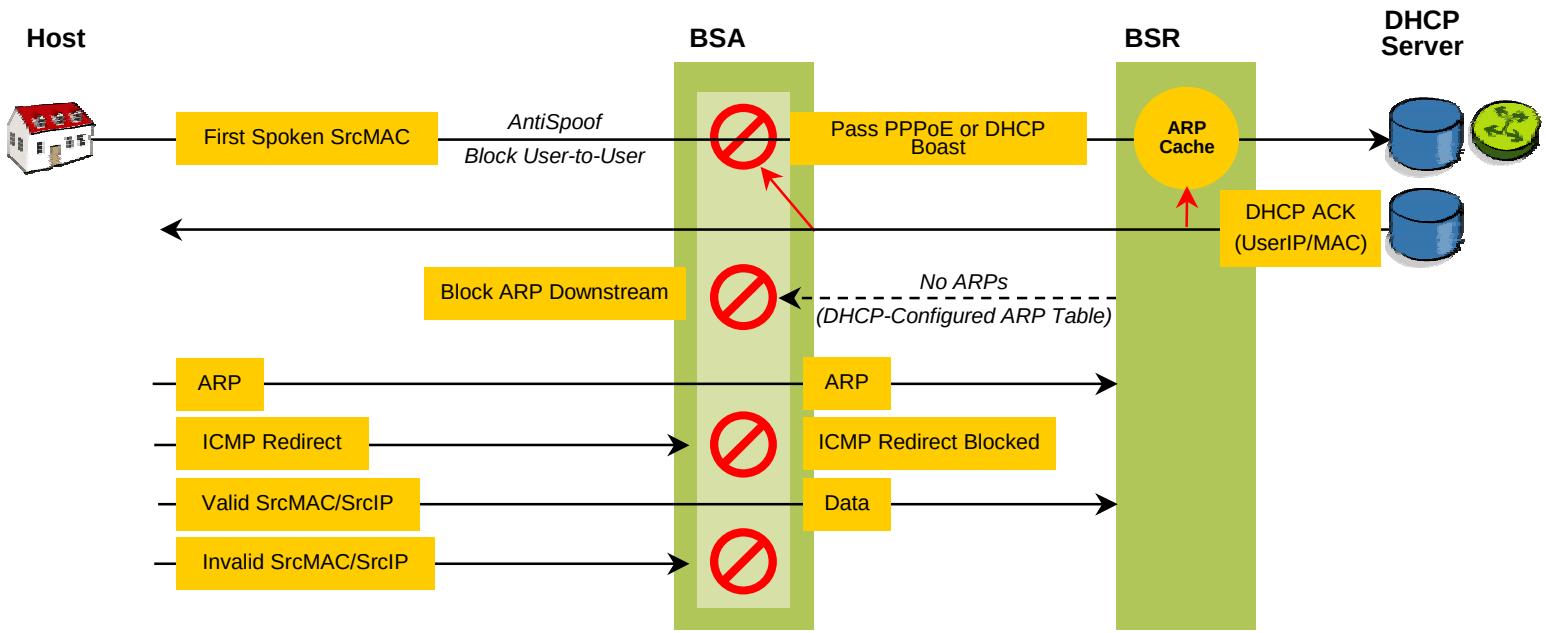


> BSA performs per-sub queuing, accounting and policy enforcement – allows QoS to scale
> Secure Layer 2 forwarding model to BSR
> Multicast enabled (IGMP proxy).

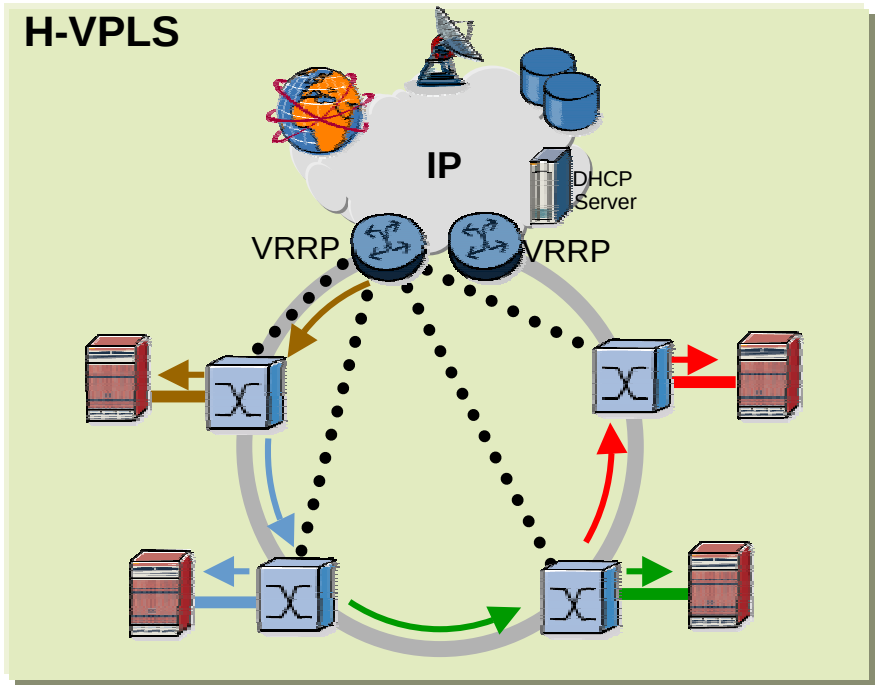
> BSR is the IP service edge
  - Layer 2 termination and IP unicast/multicast routing
  - Reduced queue and interface scale
> QoS per-service and per-content

DHCP-based Implementation

- Provides plug-and-play connectivity for DHCP-optimized appliances
- DHCP allows for simple, optimized multicast implementation



Broadcast TV based on H-VPLS Ring

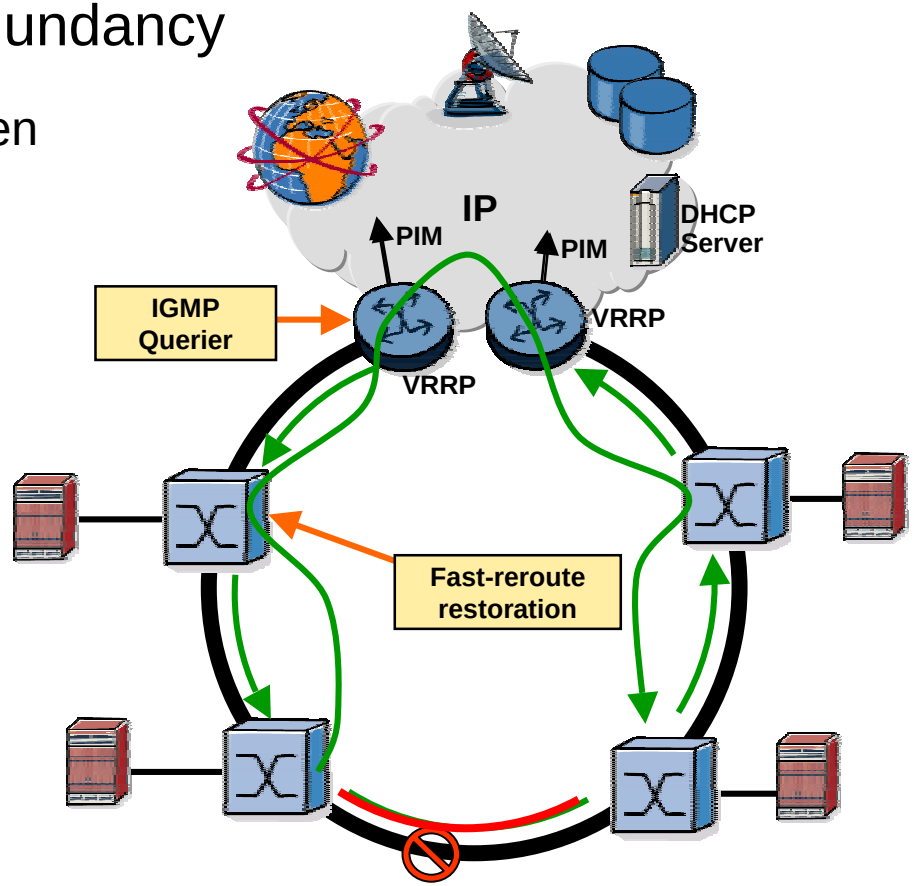


H-VPLS benefits in ring topology:

- Signaled Layer 2 forwarding topology
- No spanning tree
- Sub-50 ms recovery with MPLS fast-reroute
- Bandwidth efficiency for broadcast TV service with H-VPLS

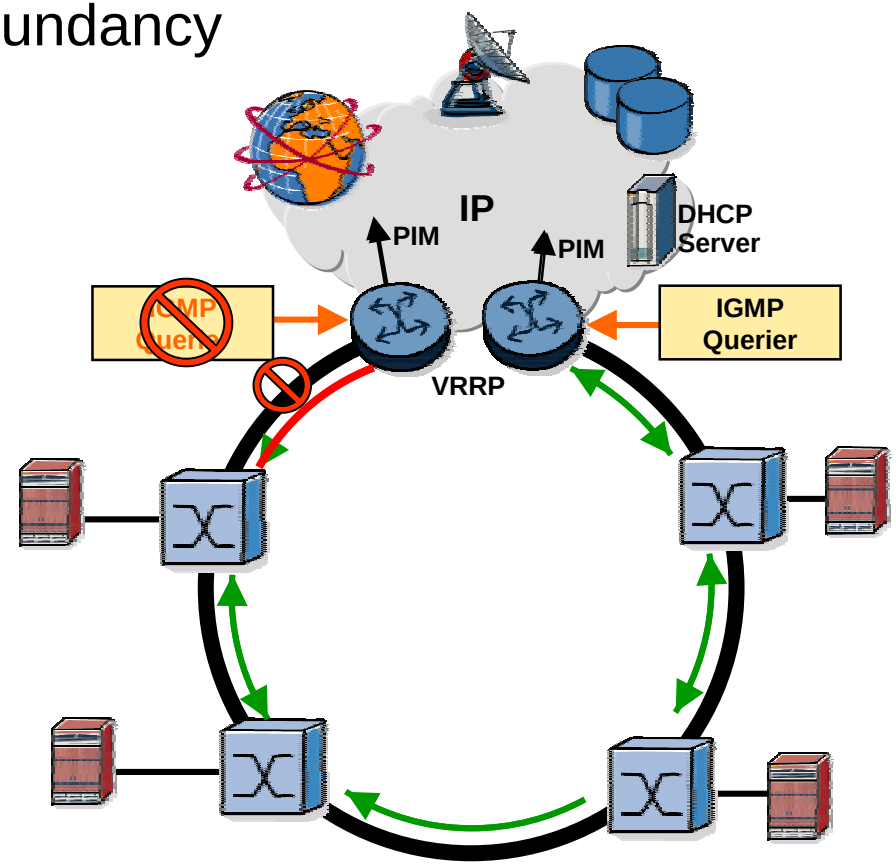
Broadcast TV based on H-VPLS Ring: Redundancy

- H-VPLS ring provides full redundancy
- In case of link failure on ring between aggregation nodes, recovery is via MPLS fast reroute
  - Sub 50 ms recovery



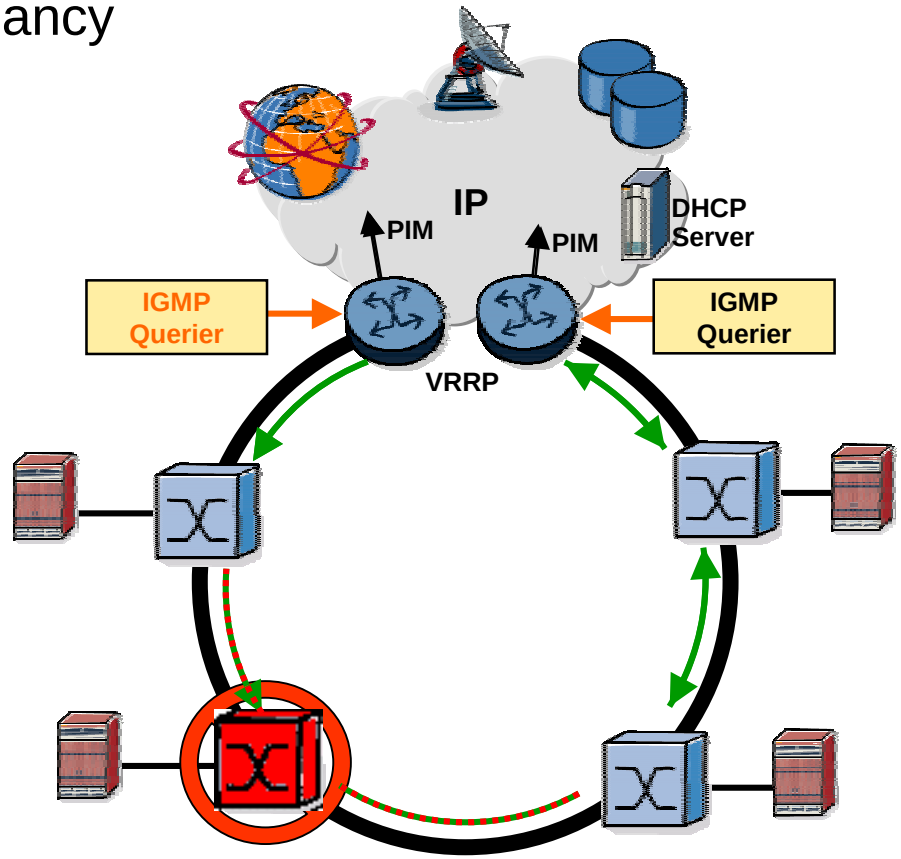
Broadcast TV based on H-VPLS Ring: Redundancy

- H-VPLS ring provides full redundancy
- In case of link failure to multicast router, IGMP election process will cause switchover of multicast router
  - 2-3s recovery (IGMP timers)

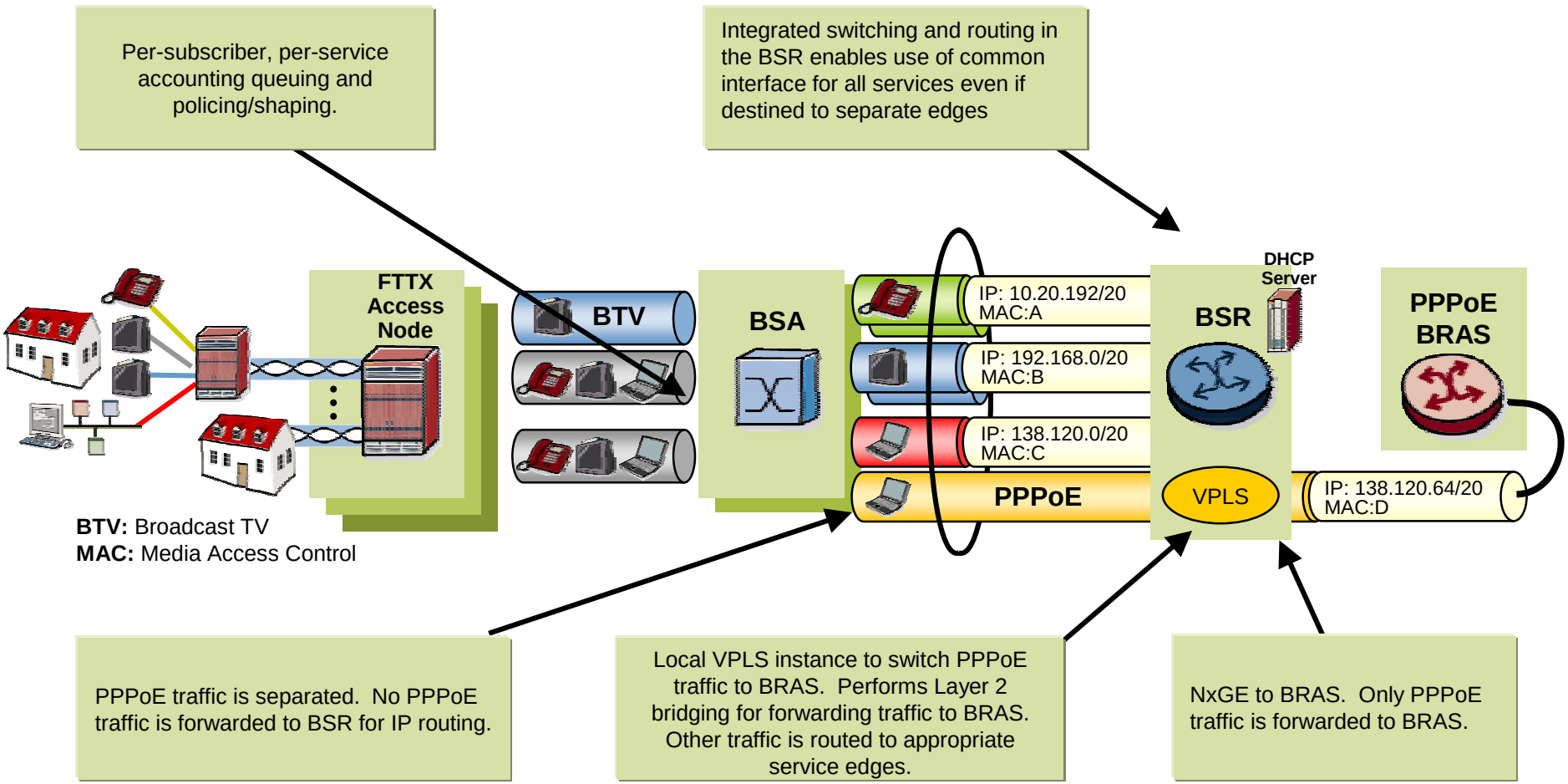


Broadcast TV based on H-VPLS Ring: Redundancy

- H-VPLS ring provides full redundancy
- In case of aggregation node failure, the ring is broken and both multicast routers become active
  - 2-3s recovery

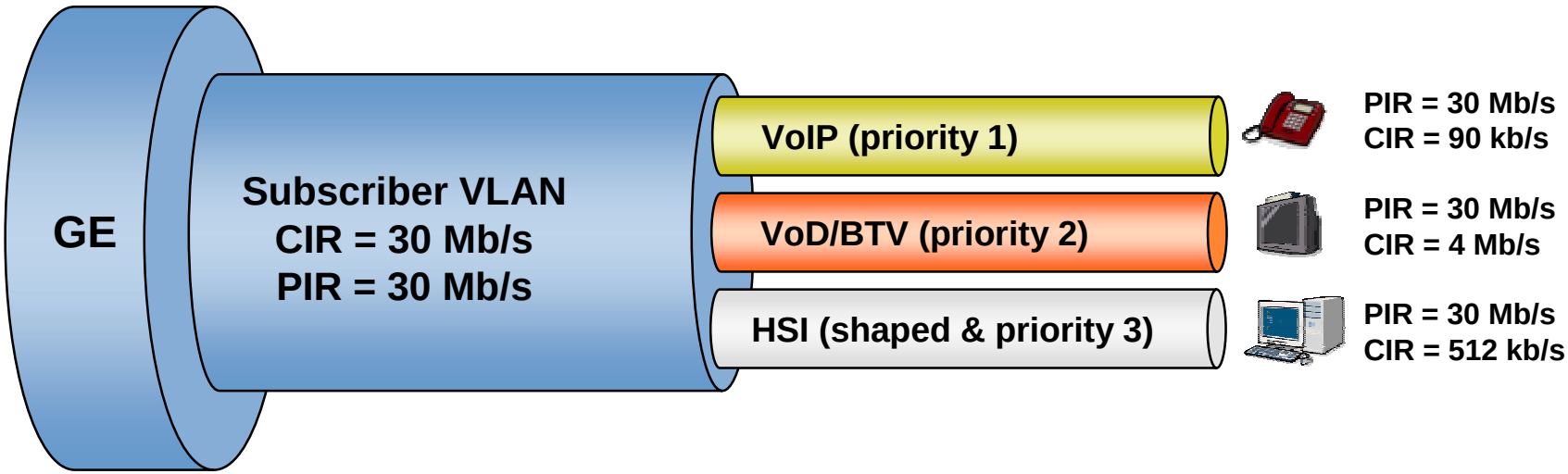


Maintaining PPPoE-based HSI

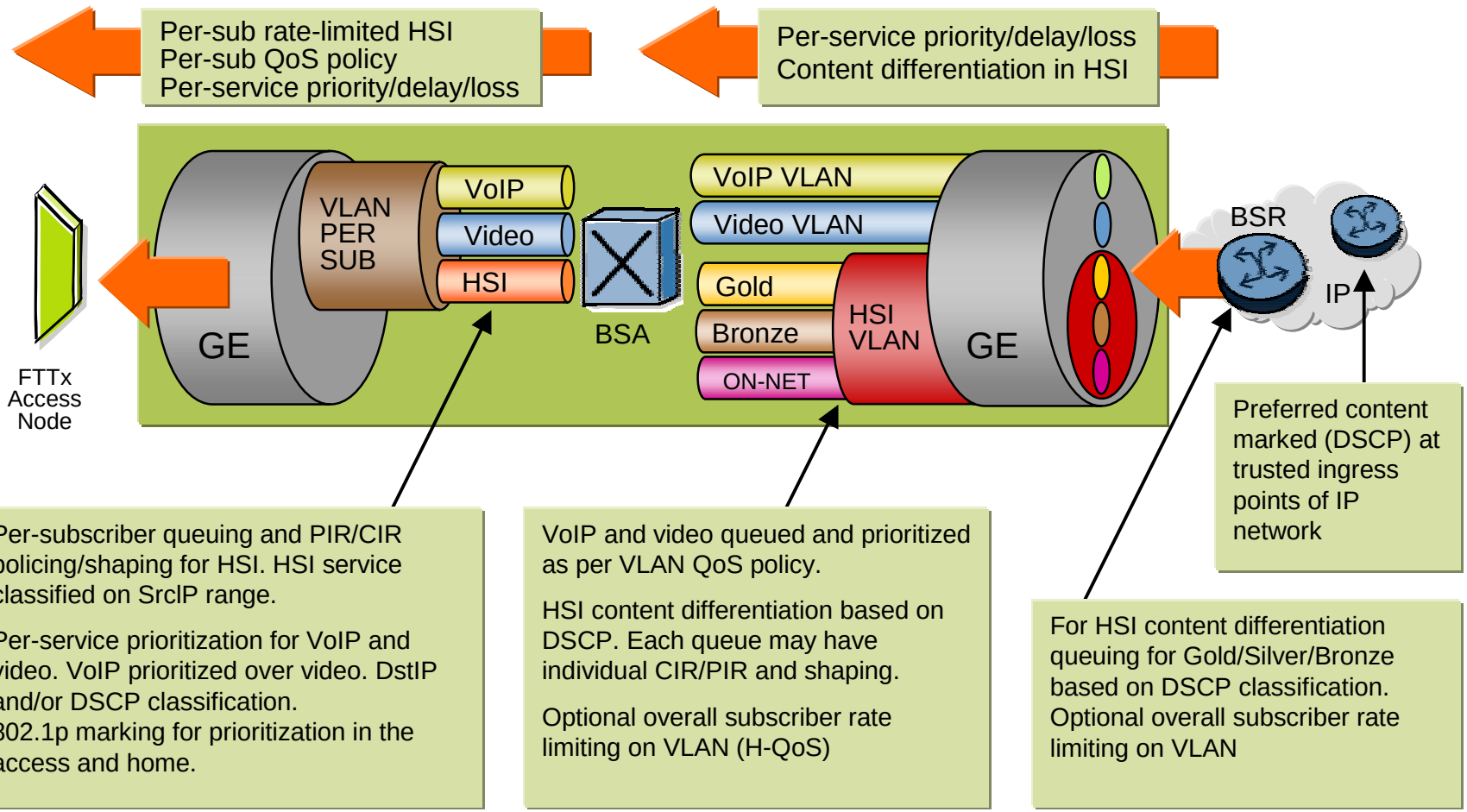


QoS Model to the Subscriber

- Differentiate service levels in the aggregation network
- Enforce subscriber's access rate in the aggregation network
  - Reserve CIRs for critical applications
  - Define bandwidth sharing policy with PIR and scheduling configuration
  - H-QoS enables the service bandwidth to be shared within the subscriber's access rate
- Enable low priority and best-effort traffic to burst up to full access rate if bandwidth is available (high priority traffic using less than committed rate)



QoS Management



Triple Play Service Requirements Addressed

- Scale per-subscriber QoS
  - Distribute per-subscriber queuing past last major downstream contention point
  - Implement per-subscriber queuing on edge node (BSA)
- Scale per-subscriber accounting, anti-spoofing, and policy enforcement
  - Distribute what could be 100s of thousands of rules across multiple BSAs
- Keep provisioning simple
  - Use VPLS (H-VPLS) to automatically set up logical mesh
  - Develop service-oriented OAM tools to troubleshoot across BSA/BSR
  - Auto-configuration of security and QoS rules

Thank You – Q&A

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