Multicast over VPLS

MPLS WC 2009

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February 2009
Agenda

1. Introduction

2. Multicast in current VPLS deployments
   a) Challenges
   b) Solution tool set
      I. Hierarchical VPLS
      II. P2MP PWs/LSPs
      III. L3 Snooping

3. Conclusions
Introduction
UK

Managed VPLS service covering London

- Access port speeds from 10 Mbps up to 1 Gbps
  - Access sub-rates from 2 Mbps to 900 Mbps
- E-LAN Any to Any connectivity
- 2 CoS

VPLS implementation

- 6 Access PoPs
- 2 Core PoPs

Currently seeing increasing volumes of multicast
Spain

Managed VPLS service covering Spain

- Access port speeds from 10 Mbps up to 1 Gbps
  - Access sub-rates from 1 Mbps to 990 Mbps
- Mainly E-LAN Any to Any connectivity
  - Some E-LINE (P2P) and Hub & Spoke
- 6 CoS

HVPLS implementation.

- 31 PoPs covering 20 provinces.
  - Including the Canary and Balearic Islands.
- 39 PoPs covering 29 provinces by April 2009.
  - Up to 30 additional PoPs FY2009/10
- Core of 4 nodes in 4 PoPs (Madrid and Barcelona)
- 9 VPLS regions covering different geographical areas.

Currently seeing increasing volumes of multicast
Multicast in current VPLS deployments
VPLS deployment models and challenges

Challenge A: Scalability

- Full mesh of pseudowires, LSPs and peering sessions

Challenge B: Head End Replication

- Replication performance
- Duplicate/Multiple packet replication over Physical links

Challenge C: Packet replication to non-member sites
VPLS Multicast Tool Set and solutions to the challenges

1. Solution 1: Hierarchical VPLS
2. Solution 2: Multipoint “P” Trees
3. Solution 3: L3 Snooping
Hierarchy adds scalability and multicast efficiency

- Full mesh of pseudowires, LSPs and peering sessions
- High CAPEX/OPEX
- Source-based BUM replication

- Hierarchy, scalability
- Simplified operations, low cost MTU-s
- Optimized BUM replication
  - Addresses the majority of provider mcast requirements
H-VPLS benefits

- Flexible topologies with replication efficiency
  - Metro access rings (chained spokes), hub and spoke
- Quick service activation
  - Introduction of new service features, including inter-domain expansion, simplified service deployment model — one model fits all
- Covers small, medium and large customers; intra- and inter-domain connectivity

![Diagram of H-VPLS benefits]

- Bandwidth control
- Admin boundaries
1. Challenge A: Scalability
   - Addresses full mesh limitations
   - May be used with PBB for MAC scalability

2. Challenge B: Head End Replication Problem
   - No ingress replication
     - Multiple HVPLS tiers can be built to eliminate ingress replication problems
   - HVPLS rings are possible for drop and continue functionality
   - One protocol and architecture end-to-end
   - Further optimizations may be required in the VPLS mesh domains

3. Challenge C: Packet replication to non-member sites
   - Packets still replicated to non-member sites
VPLS Multicast Tool Set and solutions to the challenges

1. Solution 1: Hierarchical VPLS
2. Solution 2: Multipoint “P” Trees
3. Solution 3: L3 Snooping
Multipoint P Tree Options

MPLS Protocol Options:

1. P2MP RSVP-TE LSPs
   - P2MP LSPs supported
   - Root driven

2. Multicast LDP (mLDP)
   - P2MP and MP2MP LSPs Supported
   - Leaf driven

Types:

1. Point to Multipoint (P2MP)
2. Multipoint to Multipoint (MP2MP)
No “One Size Fits All” for P Tree protocols

<table>
<thead>
<tr>
<th>Protocol</th>
<th>P2MP</th>
<th>MP2MP</th>
<th>Traffic Engineering</th>
<th>50ms resiliency</th>
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<tr>
<td>mLDP</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>P2MP RSVP-TE LSPs</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
1. Challenge A: Scalability
   - ☒ Adds control-plane state to P-routers

2. Challenge B: Head End Replication Problem
   - ☑ No ingress replication
   - ☑ Leverage MPLS for 50ms resiliency
   - ☑ Options for P2MP and MP2MP
   - ☑ Flexible deployment options
     - ☑ Trees per PE, per VPLS, per mc stream (more later)
   - ? Operator needs to understand application requirements fully before selecting which protocol to build trees

3. Challenge C: Packet replication to non-member sites
   - ☒ Packets still replicated to non-member sites
VPLS Multicast Tool Set and solutions to the challenges

1. Solution 1: Hierarchical VPLS
2. Solution 2: Multipoint “P” Trees
3. Solution 3: L3 Snooping
IGMP, PIM and MLD snooping

- PEs snoop IGMP/PIM/MLD messages on AC and PWs attached to the VPLS
  - IP multicast (*,G) or (S,G) state is kept on each PE
- Packets are not sent to non member sites
  - Solves challenge C
- Supported independent of infrastructure
  - Works with VPLS, H-VPLS, P2MP LSPs etc!
L3 Snooping Solution Summary

1. Challenge A: Scalability
   - ✗ Does not help scalability

2. Challenge B: Head End Replication Problem
   - ✗ Does not help head end replication

3. Challenge C: Packet replication to non-member sites
   - ✓ Packets sent only to member sites
Deployment Options and Tradeoffs

Sub-Optimal Flooding Example

Video Source (S1,G1)

RED packets may be received at GREEN sites

1. A P2MP tree per MC stream per VPLS
2. A P2MP tree per PE per VPLS (mesh)
3. Single MP2MP tree per VPLS
4. A P2MP tree per PE for many VPLS (mesh)
5. A MP2MP tree for many VPLS

Aggregated Inclusive Trees

Packets are received at non member end points.
Deployment Options and Tradeoffs
Adding L3 Snooping and Selective P2MP Trees Example

Non Aggregated Selective Trees
1. A P2MP tree per MC stream per VPLS
2. A P2MP tree per PE per VPLS (mesh)
3. Single MP2MP tree per VPLS
4. A P2MP tree per PE for many VPLS (mesh)
5. A MP2MP tree for many VPLS

L3 Snooping provides more optimal flooding domains.
P Tree Deployment Options and Tradeoffs

Non Aggregated Selective Tree Example

Mesh required to build full topology.

Non Aggregated Selective Trees

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P Tree Aggregation Options and Tradeoffs

![Diagram showing P Tree Aggregation Options and Tradeoffs]

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Ultimately depends on congruence between communities of interest and acceptable bandwidth utilization/availability.
Applying the Multicast Toolset in Large Networks

- H-VPLS is required for large network scaling
- Head end replication problem solved
  - H-VPLS provides mcast replication in edge and aggregation portions of the network
- Packets received at non member sites solved with L3 snooping
- P2MP LSPs are complimentary to HVPLS for multicasting
  - Perfect fit for in VPLS mesh
  - Supports network domains where different tunnel protocols are deployed
  - Mitigates P2MP LSP scaling requirements
3 Conclusions
Conclusions

- H-VPLS is required to scale networks to thousands of systems and tens of thousands of services.
- H-VPLS and P2MP LSPs are both options for resolving head end replication challenges
- L3 Snooping is the only solution solving sending packets to non-member sites
  - Supported on VPLS, H-VPLS, with or without P2MP
- H-VPLS fits all the multicast applications with the best balance between scalability and optimality, adding flexibility and using the same control/data planes used today for unicast, broadcast and unknown traffic
  - Optimality can be improved with snooping techniques and other tools
  - P2MP PWs/LSPs are complimentary to HVPLS techniques for supporting multicast