

# ESM IPv4: Multicast in a Wholesale/Retail Scenario

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## In This Chapter

This section describes ESM IPv4 multicast configurations in a wholesale/retail scenario.

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## Applicability

This configuration example is applicable to the 7750 SR-7/12/12e with IOM3-XP and IMMs, the 7450 ESS -7/12 chassis in mixed mode with IOM3-XP and IMMs, and also to the 7750 SR-c4/12 platforms, and requires chassis mode C as a minimum. Note that the 7450 will only operate as an L2TP Access Concentrator (LAC) for L2TP services.

The configuration was tested on release 11.0.R1 and covers both IPoE and PPPoE subscribers.

## Overview

Alcatel-Lucent's Triple Play Service Delivery Architecture (TPSDA) allows operators to integrate High Speed Internet (HSI), voice and video services within a single network infrastructure. The goal of this configuration example is to provide a walk through of a wholesale/retail multicast setup.

There are two wholesale/retail models in TPSDA. In the first model, the retail service is co-located with the wholesale service whereas in the second model, for PPP services only, the retail service is on a separate BNG. The network topology shown in Figure 334 is the first model. It consists of two 7750s; BNG-1 is a wholesaler Broadband Network Gateway (BNG) with the retail service co-located and the second is a retailer router. Figure 335 shows the second model where the retail service is a separate router and the connection between the wholesale and retail utilizes L2TP. The 7450 in both cases is used as an aggregation switch to aggregate all subscribers.

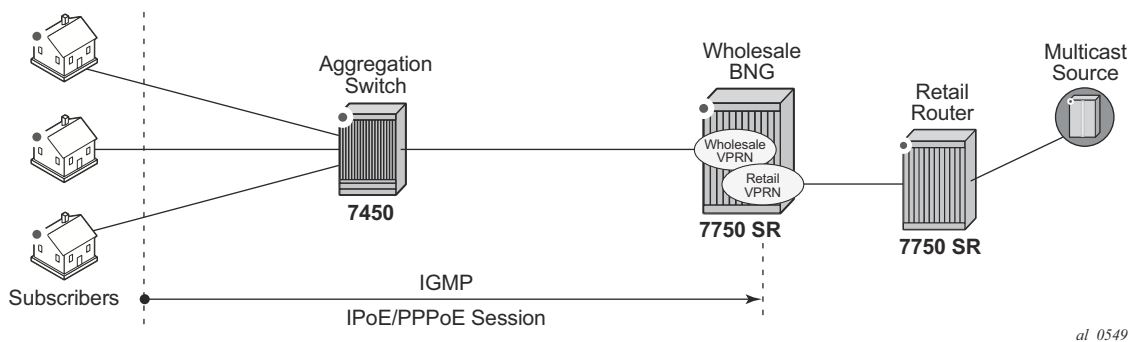


Figure 334: Wholesale/Retail Model 1

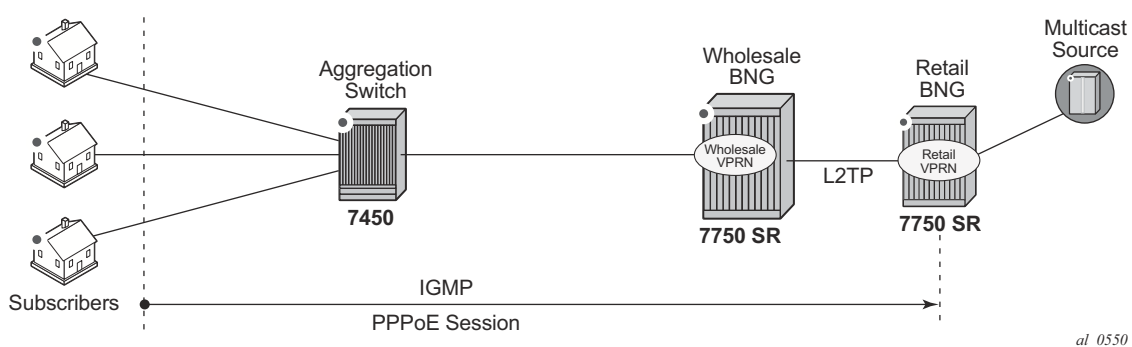


Figure 335: Wholesale/Retail Model 2

## Overview

The second 7750 is connected directly to the multicast source. On the access side, the BNG is connected to an aggregation switch aggregating both PPPoE and IPoE subscribers.

There are two basic requirements for a subscriber to receive multicast streams. First, the group interface for the subscribers must have IGMP enabled. Second, the Enhanced Subscriber Management (ESM) subscriber must be allowed to receive multicast streams by having IGMP enabled. When both requirements are met, the BNG will process the subscribers' IGMP messages, otherwise, IGMP messages are dropped. All customer premise device (CPE) originated IGMP messages are aggregated via the 7450 and passed onto the wholesale BNG. It is always the retail VPRN that processes the IGMP messages. The wholesale VPRN SAPs performs the forwarding of the actual multicast streams.

## Configuration

Note that a basic knowledge of multicast and ESM is assumed.

### ESM Wholesale-Retail Multicast

There are various ways to provide wholesale and retail multicast function.

- For the IPoE and PPPoE Layer 3 wholesale/retail model, the wholesale and the retail services reside on separate VPRNs.
- For the PPPoE Layer 2 wholesale/retail model, L2TP is used.

### ESM Layer 3 Wholesale-Retail Multicast

Figure 336 depicts a Layer 3 wholesale/retail scenario for both IPoE and PPPoE. The first BNG contains both the wholesale and retail configuration. There are two options for the retail BNG to deliver the multicast streams to the wholesale BNG:

1. MVPN between the BNGs  
or
2. If using a routed interface between the BNGs, multicast routing is required.

This example will use the second option for delivery of the multicast streams in order to keep the configuration simple.

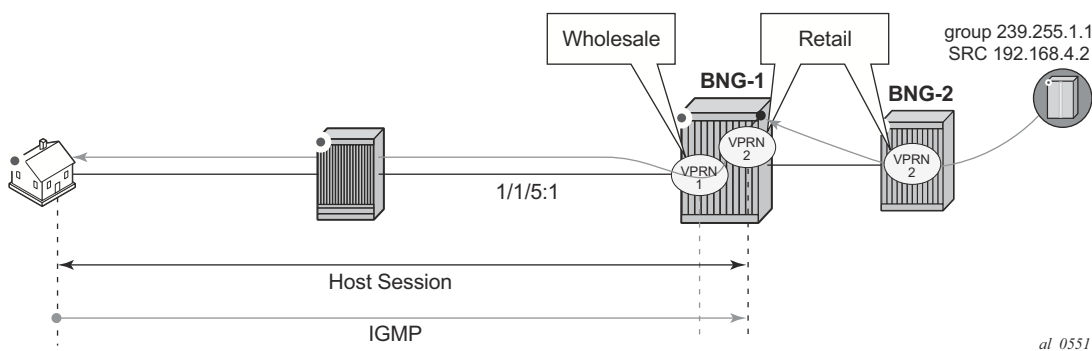


Figure 336: Layer 3 Wholesale/Retail

**Step 1.** Below is a configuration extract from the wholesale service on BNG-1 with the group interface added to IGMP. This configuration applies to both IPoE and PPPoE.

```
*A:BNG-1> config>service>vprn>sub-if# info
-----
unnumbered "system"
group-interface "wholesale-sub-int-1" create
  dhcp
    client-applications dhcp ppp
    no shutdown
  exit
  authentication-policy "auth-policy-1"
  sap 1/1/5:1 create
    sub-sla-mgmt
      def-sub-id use-sap-id
      def-sub-profile "multicast-profile-1"
      def-sla-profile "sla-profile-1"
      sub-ident-policy "sub-ident-policy-1"
      multi-sub-sap 10
      no shutdown
    exit
  exit
  pppoe
    session-limit 10
    sap-session-limit 10
    no shutdown
  exit
exit
igmp
  group-interface "wholesale-group-int-1"
    no shutdown
  exit
  no shutdown
exit
```

**Step 2.** Also on BNG-1, a separate VPRN is configured for the retailer. The retail configuration is a little different from the wholesale configuration. Below is a configuration extract from the retail VPRN with IGMP enabled. This configuration is applicable to both IPoE and PPPoE. The multicast streams received in the retail VPRN are forwarded to the wholesale VPRN. Other retail VPRNs can offer multicast streams as well, and the same multicast addresses can be re-used as long as the address is assigned to a different retail VPRN.

```
*A:BNG-1> config>service>vprn# info
-----
route-distinguisher 65536:2
subscriber-interface "retail-sub-int-1" fwd-service 1
  fwd-subscriber-interface "wholesale-sub-int-1" create
  address 10.255.255.254/8
  dhcp
    server 192.168.0.1
    client-applications dhcp ppp
    gi-address 10.255.255.254
    lease-populate 10
    no shutdown
```

```

        exit
    exit
igmp
    group-interface fwd-service 1 "wholesale-group-int-1"
        no shutdown
    exit
exit
ospf 192.168.2.2
    area 0.0.0.0
        interface "system"
            no shutdown
        exit
        interface "retail-sub-int-1"
            no shutdown
        exit
        interface "int-BNG-1-BNG-2"
            no shutdown
        exit
    exit
exit
pim
    interface "int-BNG-1-BNG-2"
        exit
exit

```

**Step 3.** Per host replication is mandatory in a wholesale/retail scenario. A single wholesale SAP might be shared among different retailers. A wholesale host that has requested a multicast group will always have the multicast delivered directly. Other hosts on the SAPs might belong to a different retailer and therefore 1) retailers might not have the same multicast group and sources and 2) their bandwidth should not be impacted by other hosts' multicast. Per-host replication is configured in the **igmp-policy igmp-policy-1**. This is mandatory for both IPoE and PPPoE subscribers.

```

*A:BNG 1> config>subscr-mgmt>igmp-policy# info
-----
per-host-replication

```

**Step 4.** The interfaces are added to OSPF and to PIM on the retail BNG that is connected to the multicast source.

```

*A:BNG-2> config>service>vprn# info
-----
ospf
    area 0.0.0.0
        interface "system"
            no shutdown
        exit
        interface "int-BNG-2-BNG-1"
            no shutdown
        exit
        interface "int-multicast-source"
            no shutdown
        exit
    exit
exit

```

## ESM Layer 3 Wholesale-Retail Multicast

```
pim
  interface "int-BNG-2-BNG-1"
  exit
  interface "int-multicast-source"
  exit
  rp
    static
      address 192.168.4.1
      group-prefix 224.0.0.0/4
    exit
  exit
exit
```

With the above the configuration, the wholesale/retail setup is ready to process IGMP messages. Now send an IGMPv3 request to the wholesale SAP. The (S,G) is (192.168.4.2, 239.255.1.1) and the subscriber IP address is 10.0.0.2. The output below shows that the (S,G) is not registered in the wholesale VPRN but is in the retail VPRN.

```
*A:BNG-1> show router 1 igmp group
=====
IGMP Interface Groups
=====
IGMP Host Groups
=====
IGMP SAP Groups
=====
No Matching Entries
=====
```

```
*A:BNG-1> show router 2 igmp group
=====
IGMP Interface Groups
=====
IGMP Host Groups
=====
(192.168.4.2,239.255.1.1)
  Fwd List   : 10.0.0.2           Up Time   : 0d 00:13:01
=====
IGMP SAP Groups
=====
(*,G)/(S,G) Entries : 1
=====
```



To view all subscribers' (S,G) pairs, use the following command.

```
*A:BNG-1> show service active-subscribers igmp detail
=====
Active Subscribers Detail
=====
Subscriber                               IGMP-Policy
HostAddr                                 GrpItf                               NumGroups
  GrpAddr                                 Type                                 Mode
  SrcAddr                                 Type                                 Blk/Fwd
-----
video_user_01                            igmp-policy-1
  10.0.0.2                                whole-sale                            1
  239.255.1.1                            Dynamic                               0d 01:37:55  Include
  192.168.4.2                            Dynamic                               Fwd
-----
Number of Subscribers : 1
=====
```

Only the retail VPRN is responsible for processing the IGMP messages. Therefore to troubleshoot a wholesale/retail setup, debug is only relevant on the retail router instance.

```
debug
  router "2"
    igmp
      group-interface fwd-service "1" "whole-sale"
      host "10.0.0.2"
      packet mode egr-ingr-and-dropped
    exit
  exit

7648 2013/05/24 16:59:41.02 EST MINOR: DEBUG #2001 vprn2 IGMP[14]
"IGMP[14]: RX-PKT
[013 07:56:53.680] IGMP host 10.0.0.2 V3 PDU: 10.0.0.2 -> 224.0.0.22 pduLen
20
  Type: V3 REPORT maxrespCode 0x0 checksum 0xddf6
  Num Group Records: 1
  Group Record 0
  Type: ALW_NEW_SRCS, AuxDataLen 0, Num Sources 1
  Mcast Addr: 239.255.1.1
  Source Address List
    192.168.4.2

"

7649 2013/05/24 16:59:41.02 EST MINOR: DEBUG #2001 vprn2 IGMP[vprn2 inst 1
4]
"IGMP[vprn2 inst 14]: igmpIfGroupAdd
Adding 239.255.1.1 to IGMP host 10.0.0.2 database"

7650 2013/05/24 16:59:41.02 EST MINOR: DEBUG #2001 vprn2 IGMP[vprn2 inst 1
4]
"IGMP[vprn2 inst 14]: igmpProcessGroupRec
Process group rec ALW_NEW_SRCS received on host 10.0.0.2 for group 239.255.1.1 i
n mode INCLUDE. Num srcs 1"
```

## ESM Layer 3 Wholesale-Retail Multicast

```
7651 2013/05/24 16:59:41.02 EST MINOR: DEBUG #2001 vprn2 IGMP[vprn2 inst 1
4]
"IGMP[vprn2 inst 14]: igmpIfSrcAdd
Adding i/f source entry for host 10.0.0.2 (192.168.4.2,239.255.1.1) to IGMP fwdList
Database, redir if N/A"
```

The same **debug** command can be used for troubleshooting IGMP leave messages as shown below.

```
7652 2013/05/24 16:59:43.90 EST MINOR: DEBUG #2001 vprn2 IGMP[14]
"IGMP[14]: RX-PKT
[013 07:56:56.560] IGMP host 10.0.0.2 V3 PDU: 10.0.0.2 -> 224.0.0.22 pduLen
20
Type: V3 REPORT maxrespCode 0x0 checksum 0xdcf6
Num Group Records: 1
Group Record 0
Type: BLK_OLD_SRCS, AuxDataLen 0, Num Sources 1
Mcast Addr: 239.255.1.1
Source Address List
192.168.4.2
```

"

```
7653 2013/05/24 16:59:43.90 EST MINOR: DEBUG #2001 vprn2 IGMP[vprn2 inst 1
4]
"IGMP[vprn2 inst 14]: igmpProcessGroupRec
Process group rec BLK_OLD_SRCS received on host 10.0.0.2 for group 239.255.1.1 i
n mode INCLUDE. Num srcs 1"
```

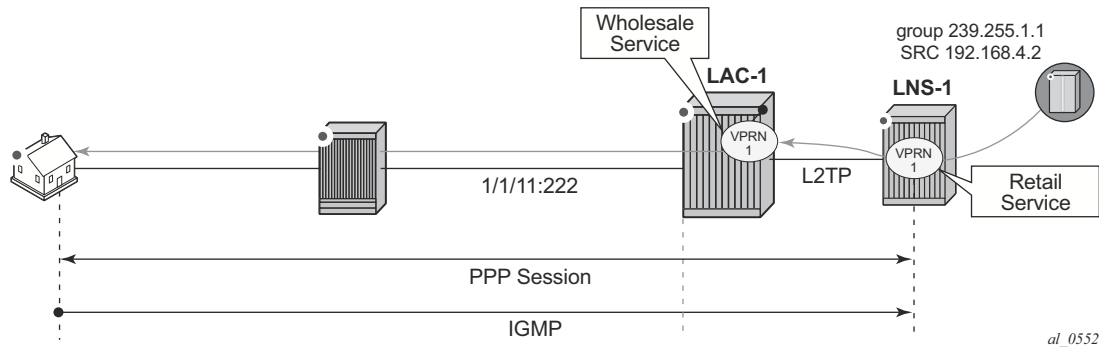
```
7654 2013/05/24 16:59:43.90 EST MINOR: DEBUG #2001 vprn2 IGMP[vprn2 inst 1
4]
"IGMP[vprn2 inst 14]: igmpProcessIfSrcTimerExp
Source Timer expired for IGMP host 10.0.0.2 (192.168.4.2,239.255.1.1)"
```

```
7655 2013/05/24 16:59:43.90 EST MINOR: DEBUG #2001 vprn2 IGMP[vprn2 inst 1
4]
"IGMP[vprn2 inst 14]: igmpIfSrcDel
Deleting i/f source entry for host 10.0.0.2 (192.168.4.2,239.255.1.1) from IGMP Dat
abase. DeleteFromAvl: 1 !Redir 0"
```

```
7656 2013/05/24 16:59:43.90 EST MINOR: DEBUG #2001 vprn2 IGMP[vprn2 inst 1
4]
"IGMP[vprn2 inst 14]: igmpIfGroupDel
Deleting 239.255.1.1 from IGMP host 10.0.0.2 database"
```

## ESM L2TP Wholesale/Retail Multicast

As previously mentioned, the other option for PPPoE wholesale/retail is to use an L2TP connection as shown in [Figure 337](#). LAC-1 contains the wholesale configuration while LNS-1 contains the retail configuration.



**Figure 337: L2TP Wholesale-Retail Multicast**

Below is a configuration extract for the wholesale L2TP Access Concentrator (LAC) in the wholesale service. It is using the local database, under the **pppoe user-db** configuration, to authenticate the subscriber. The wholesale LAC does not process any IGMP messages so it passes all messages to the retailer LNS.

```
*A:LAC-1> config>service>vprn>sub-if# info
-----
description "L2TP"
unnumbered "system"
group-interface "LAC-sub-int-1" create
  sap 1/1/11:222 create
  sub-sla-mgmt
  def-sub-id use-sap-id
  def-sub-profile "multicast-profile-1"
  def-sla-profile "sla-profile-1"
  sub-ident-policy "sub-ident-policy-1"
  multi-sub-sap 10
  no shutdown
  exit
exit
pppoe
  session-limit 10
  sap-session-limit 10
  user-db "ppp-db-1"
  no shutdown
  exit
exit
l2tp
  group "l2tp-group-1" create
```

## ESM L2TP Wholesale/Retail Multicast

```
tunnel "tunnel-1" create
  auto-establish
  local-name "LAC"
  peer 192.0.2.3
  no shutdown
exit
no shutdown
exit
no shutdown
```

The retailer BNG serves as the L2TP Network Server (LNS). Below is a configuration extract for the LNS. IGMP must be enabled on the ESM group-interface in the retail service.

```
*A:LNS-1> config>service>vprn>sub-if# info
-----
address 10.255.255.254/8
group-interface "LNS-group-int-1" lns create
  sap-parameters
    sub-sla-mgmt
      def-sub-id use-sap-id
      def-sub-profile "multicast-profile-1"
      def-sla-profile "sla-profile-1"
      sub-ident-policy "sub-ident-policy-1"
      multi-sub-sap 10
      no shutdown
    exit
  exit
  dhcp
    server 192.168.0.1
    client-applications ppp
    gi-address 10.255.255.254
    lease-populate 10
    no shutdown
  exit
exit
l2tp
  group "l2tp-group-1" create
    tunnel "tunnel-1" create
      lns-group 1
      ppp
        authentication-policy "auth-policy-1"
        default-group-interface "LNS-group-int-1" service-id 1
        mtu 1500
        proxy-authentication always
        proxy-lcp always
      exit
      remote-name "LAC"
      no shutdown
    exit
    no shutdown
  exit
  no shutdown
igmp
  group-interface "LNS-group-int-1"
    no shutdown
  exit
  no shutdown
```

With the above configuration applied, the wholesale/retail multicast setup can be verified. Firstly, send an IGMP message from the subscriber, the example below uses IGMPv3. The (S,G) sent is (192.168.4.2, 239.255.1.1) from the subscriber with IP address 10.0.0.2. The show commands below can be used to verify the multicast group being sent to the subscriber.

```
*A:LNS-1> show service active-subscribers igmp detail
=====
Active Subscribers Detail
=====
Subscriber                               IGMP-Policy
HostAddr      GrpAddr      GrpItf      NumGroups
                SrcAddr      Type        Up-Time     Mode
                SrcAddr      Type        Type        Blk/Fwd
-----
LNS1-pppoe-sub-01          igmp-policy-1
10.0.0.2                    LNS
239.255.1.1                Dynamic     0d 00:04:41  1
192.168.4.2                Dynamic     Include
                               Fwd
-----

Number of Subscribers : 1
=====
```

The IGMP group is not seen in the wholesale router instance (as shown by the first output below on LAC-1), however, it is seen in the retail router instance (as shown by the second output below on LNS-1).

```
*A:LAC-1> show router 1 igmp group
=====
IGMP Interface Groups
=====
IGMP Host Groups
=====
IGMP SAP Groups
=====
No Matching Entries
=====

*A:LNS-1> show router 1 igmp group
=====
IGMP Interface Groups
=====
IGMP Host Groups
=====
(192.168.4.2,239.255.1.1)
  Fwd List   : 10.0.0.2          Up Time : 0d 00:08:27
=====
IGMP SAP Groups
=====
```

## ESM L2TP Wholesale/Retail Multicast

```
(* ,G) / (S,G) Entries : 1
```

Only the retail BNG (LNS-1) is responsible for processing the IGMP messages. Therefore to troubleshoot ESM multicast for an L2TP service, the following debug commands are used on the LNS.

```
debug
  router "1"
    igmp
      group-interface "LNS-01"
      host "10.0.0.2"
      packet mode egr-ingr-and-dropped
    exit
  exit
7604 2013/05/24 16:55:49.46 EST MINOR: DEBUG #2001 vprn1 IGMP[8]

"IGMP[8]: RX-PKT
[013 07:53:02.120] IGMP host 10.0.0.2 V3 PDU: 10.0.0.2 -> 224.0.0.22
pduLen 20
  Type: V3 REPORT maxrespCode 0x0 checksum 0xddf6
  Num Group Records: 1
  Group Record 0
  Type: ALW_NEW_SRCS, AuxDataLen 0, Num Sources 1
  Mcast Addr: 239.255.1.1
  Source Address List
    192.168.4.2

"
7605 2013/05/24 16:55:49.46 EST MINOR: DEBUG #2001 vprn1 IGMP[vprn1 inst 8
]
"IGMP[vprn1 inst 8]: igmpIfGroupAdd
Adding 239.255.1.1 to IGMP host 10.0.0.2 database"

7606 2013/05/24 16:55:49.46 EST MINOR: DEBUG #2001 vprn1 IGMP[vprn1 inst 8
]
"IGMP[vprn1 inst 8]: igmpProcessGroupRec
Process group rec ALW_NEW_SRCS received on host 10.0.0.2 for group 239.255.1.1 in mode
INCLUDE. Num srcs 1"

7607 2013/05/24 16:55:49.46 EST MINOR: DEBUG #2001 vprn1 IGMP[vprn1 inst 8
]
"IGMP[vprn1 inst 8]: igmpIfSrcAdd
Adding i/f source entry for host 10.0.0.2 (192.168.4.2,239.255.1.1) to IGMP fwd
List Database, redir if N/A"
```

The IGMP leave messages can also be seen in the debug, as shown below.

```
7615 2013/05/24 16:58:06.38 EST MINOR: DEBUG #2001 vprn1 IGMP[8]
"IGMP[8]: RX-PKT
[013 07:55:19.040] IGMP host 10.0.0.2 V3 PDU: 10.0.0.2 -> 224.0.0.22
pduLen 20
```

## ESM IPv4: Multicast in a Wholesale/Retail Scenario

```
Type: V3 REPORT maxrespCode 0x0 checksum 0xdcf6
Num Group Records: 1
  Group Record 0
    Type: BLK_OLD_SRCS, AuxDataLen 0, Num Sources 1
    Mcast Addr: 239.255.1.1
    Source Address List
      192.168.4.2
```

"

```
7616 2013/05/24 16:58:06.38 EST MINOR: DEBUG #2001 vprn1 IGMP[vprn1 inst 8
]
"IGMP[vprn1 inst 8]: igmpProcessGroupRec
Process group rec BLK_OLD_SRCS received on host 10.0.0.2 for group 239.255.1.1 in mode
INCLUDE. Num srcs 1"
```

```
7617 2013/05/24 16:58:06.38 EST MINOR: DEBUG #2001 vprn1 IGMP[vprn1 inst 8
]
"IGMP[vprn1 inst 8]: igmpProcessIfSrcTimerExp
Source Timer expired for IGMP host 10.0.0.2 (192.168.4.2,239.255.1.1)"
```

```
7618 2013/05/24 16:58:06.38 EST MINOR: DEBUG #2001 vprn1 IGMP[vprn1 inst 8
]
"IGMP[vprn1 inst 8]: igmpIfSrcDel
Deleting i/f source entry for host 10.0.0.2 (192.168.4.2,239.255.1.1) from IGMP
Database. DeleteFromAvl: 1 !Redir 0"
```

```
7619 2013/05/24 16:58:06.38 EST MINOR: DEBUG #2001 vprn1 IGMP[vprn1 inst 8
]
"IGMP[vprn1 inst 8]: igmpIfGroupDel
Deleting 239.255.1.1 from IGMP host 10.0.0.2 database"
```

## Conclusion

Multicast is an essential part of Triple Play Services. The SR/ESS TPSDA solution offering is much more than a baseline multicast delivery, it includes individual subscriber awareness and provides each retailer a separate routing context to manage their own multicast content. Subscriber awareness allows for the fine tuning of each subscriber multicast experience and also for troubleshooting on a per subscriber basis. This example provides a complete configuration walk through for multicast delivery for both IPoE and PPPoE in a wholesale/retail model.