MPLS VPLS Implementation

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MUM Cambodia
2019
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• Guest Lecturer in POLINEMA (Politeknik Negeri Malang), STIMATA (STMIK PPKIA Pradnya Paramita Malang, STIKI (Sekolah Tinggi Informatika dan Komputer Indonesia Malang)
What is MPLS

- MPLS stands for “Multi-Protocol Label Switching”.
- MPLS is best summarized as a “Layer 2.5 networking protocol”.
- MPLS combines layer 2 switching technology and layer 3 routing technology so that it becomes the best network solution in solving speed, scalability, QOS (Quality of Service), and traffic engineering problems.
MPLS LABEL FORMAT
Label Switching

MPLS does “label switching” instead:
The router applies a “label” based on this information.
Future routers use the label to route the traffic
At the final destination router the label is removed.
And the packet is delivered via normal IP routing.
MPLS Operation

• At ingress LSR (Label Switch Router) of an MPLS domain, an MPLS header is inserted to a packet before the packet is forwarded.

• At subsequent LSRs
  • The label is used as an index into a forwarding table that specifies the next hop and a new label.
  • The old label is replaced with the new label, and the packet is forwarded to the next hop.

• Egress LSR strips the label and forwards the packet to final destination based on the IP packet header.
Classification Of VPNs

- **Network Based**
  - **Layer 2**
    - Ethernet
    - P2P
    - VPWS
    - VPLS
  - **Layer 3**
    - MPLS
    - VPN
    - Virtual Router

- **CPE Based**
  - **Layer 3**
    - IPSec
    - GRE

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L2VPN Model
VPLS

• VPLS defines an architecture that allows MPLS networks to offer Layer 2 multipoint Ethernet Services.
• SP emulates an IEEE Ethernet bridge network (virtual).
LDP (Label Distribution Protocol)

Label Distribution Protocol – LDP works between adjacent/non-adjacent peers
LDP sessions are established between peers
LDP messages sent in the form of TLVs (Type, Length, Value)
Label Space Of LDP

LSRs establish one LDP session per label space. Per-platform label space requires only one LDP session, even if there are multiple parallel links between a pair of LSRs.

Per-platform label space is announced by setting the label space ID
Tunnel VPN
R1

IP Address

MTU 1508 in eth1, eth2, eth3
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R1

LDP Settings

LDP Interface
R2

Ether1,2 and 4

MTU ether1, ether2, ether4
R2

OSPF Instance

OSPF Networks

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R2

LDP Settings

LDP Interface
<table>
<thead>
<tr>
<th>Address</th>
<th>Network</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.3.3</td>
<td>3.3.3.3</td>
<td>Loopback</td>
</tr>
<tr>
<td>192.168.2.2/30</td>
<td>192.168.2.0</td>
<td>ether3</td>
</tr>
<tr>
<td>192.168.3.2/30</td>
<td>192.168.3.0</td>
<td>ether4</td>
</tr>
</tbody>
</table>

**R3**

MTU ether 3, ether 4
R3

OSPF Networks

OSPF Instance
LDP Settings

LDP Interface

R3

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R4

IP Address

MTU ether1, ether2
VPLS Interface

R4

Bridge Interface
Name of Bridge: R5

VPLS-LAN2 Interface:
### R4

<table>
<thead>
<tr>
<th>LDP Interface</th>
<th>LDP Neighbor</th>
<th>Accept Filter</th>
<th>Advertise Filter</th>
<th>Forwarding Table</th>
<th>MPLS Interface</th>
<th>Local Bindings</th>
<th>Remote Bindings</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO</td>
<td>1.1.1.1</td>
<td>no</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOT</td>
<td>5.5.5.5</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transport</th>
<th>Send</th>
<th>Peer</th>
<th>Local Transport</th>
<th>Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO</td>
<td></td>
<td>1.1.1.0:0</td>
<td>4.4.4.4</td>
<td>1.1.1.1, 192.168.1.1, 192.168.2.1, 192.168.4.1</td>
</tr>
<tr>
<td>DOT</td>
<td></td>
<td>5.5.5:0</td>
<td>4.4.4.4</td>
<td>5.5.5.5, 10.10.20.2, 192.168.5.2</td>
</tr>
</tbody>
</table>

### R5

<table>
<thead>
<tr>
<th>LDP Interface</th>
<th>LDP Neighbor</th>
<th>Accept Filter</th>
<th>Advertise Filter</th>
<th>Forwarding Table</th>
<th>MPLS Interface</th>
<th>Local Bindings</th>
<th>Remote Bindings</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO</td>
<td>2.2.2.2</td>
<td>no</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOT</td>
<td>4.4.4.4</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
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<tbody>
<tr>
<td>DO</td>
<td></td>
<td>2.2.2.2:0</td>
<td>5.5.5.5</td>
<td>2.2.2.2, 192.168.1.2, 192.168.3.1, 192.168.5.1</td>
</tr>
<tr>
<td>DOT</td>
<td></td>
<td>4.4.4:0</td>
<td>5.5.5.5</td>
<td>4.4.4.4, 10.10.20.2, 192.168.4.2</td>
</tr>
</tbody>
</table>
C:\Users\Duty>ping 10.10.10.1
Pinging 10.10.10.1 with 32 bytes of data:
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64
Ping statistics for 10.10.10.1:
   Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
   Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\Users\Duty>ping 10.10.10.2
Pinging 10.10.10.2 with 32 bytes of data:
Reply from 10.10.10.2: bytes=32 time<1ms TTL=128
Reply from 10.10.10.2: bytes=32 time<1ms TTL=128
Ping statistics for 10.10.10.2:
   Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
   Minimum = 0ms, Maximum = 0ms, Average = 0ms
Control-C
^C
C:\Users\Duty>ping 10.10.20.1
Pinging 10.10.20.1 with 32 bytes of data:
Reply from 10.10.20.1: bytes=32 time=1ms TTL=61
Reply from 10.10.20.1: bytes=32 time<1ms TTL=61
Reply from 10.10.20.1: bytes=32 time<1ms TTL=61
Reply from 10.10.20.1: bytes=32 time<1ms TTL=61
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Trace Route From PC1 to PC2
(Normal and Ether2 (R1) is Down)
Thank You

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