T-MPLS Control Plane

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Agenda

- **Features**
- **Requirements**
- **Open issues**
- **Standard evolution**
Transport-MPLS

- T-MPLS is one of the PTN technologies based on CO-PS
- T-MPLS = MPLS + OAM - L3 Complexity
Structure of T-MPLS Network

Control Plane

Management Plane

Forwarding Plane

DCN

Client A

Client Z

LSP
Control Plane

- **Functionalities**
  - Signaling
  - Routing
  - Discovery

- **Foundation**
  - Protocol: GMPLS
  - Architecture: ASON (G.8080)

- **Benefits**
  - Multi-vendor compatibility (E-NNI)
  - Automatic Provisioning
  - Automatic and efficient protection/restoration (resources sharing, multiple faults survivability)
Agenda

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## CS vs PS: Characteristic Difference

<table>
<thead>
<tr>
<th></th>
<th>CS</th>
<th>PS</th>
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<tbody>
<tr>
<td>channel</td>
<td>rigid</td>
<td>flexible</td>
</tr>
<tr>
<td>label</td>
<td>physical</td>
<td>logical</td>
</tr>
<tr>
<td>traffic</td>
<td>predictable</td>
<td>statistical</td>
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<tr>
<td>bandwidth</td>
<td>symmetrical</td>
<td>asymmetrical</td>
</tr>
<tr>
<td>connection QoS</td>
<td>assured</td>
<td>need control</td>
</tr>
<tr>
<td>service</td>
<td>simple</td>
<td>diverse</td>
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</table>
Basic requirements of CP

- Independent of forwarding plane and management plane
- Addresses hiding and independence, addresses mapping or translating
- Call and connection control
- Permanent connection, soft permanent connection and switched connection
- Connection management and maintenance, including establishment, modification and release
- Control domain partitioning and inter-domain operation
- Constraint-based route calculation
- LSP QoS control
- Link discovery and management
- Survivability, including protection and restoration
- Management of control plane
G.8080: CP Architecture

PC: Protocol controller
RC: Route controller
CC: Connection controller
NCC: Network call controller
TAP: Termination & Adaptation
DA: Discovery agent
LRM: Link resource mgmt
Network Model
Agenda

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Resources Management

- **Circuit Switch**
  - Rigid channels
  - Require mapping logical label to corresponding bandwidths
  - Connection’s bandwidth tends to be dynamic
  - **Connection admission control** is required for the client accesses
  - Connections can be more than in circuit switch network
  - Bandwidth management become more complex

- **Packet Switch**
  - Flexible channels

VS
Bi-directional Asymmetric LSP

- Bi-directional LSP is congruent and can be asymmetric
- Signaling extension is needed
- Resources allocation and management become challenging
Nested LSP improves the scalability

IETF RFC 4206, “LSP hierarchy with GMPLS TE”

Protection/restoration of nested LSP is challenging
Link Discovery and Fault Management

- **Link discovery is useful, regardless of the control plane**
  - Functions
    - Auto-discovery link connections between nodes
    - Reduce manual configuration and reduce possibility unexpected errors in configuration
    - Exposing misconnections

- **LMP is an option for the implementation of link discovery and management of T-MPLS**
  - IETF LMP
    - Control channel management
    - Link property correlation
    - Link connectivity verification,
    - Fault management

- **Discovery mechanism can also be achieved in forwarding plane by using OAM**
T-MPLS Survivability

- **Protection**
  - 1:1 protection
  - 1+1 protection
  - Ring protection

- **Restoration**
  - Hard/soft rerouting
  - Pre-computation/dynamic restoration

- **Issues**
  - Triggers to initiate recovery action
  - Segment protection/restoration vs. E2E protection/restoration
  - Different level of survivability depending on GoS
Services support

E-Line
- P2P LSP

E-TREE
- P2MP LSP signaling
- Route optimization
- Protection/ Restoration
- Require enhancement to ASON/GMPLS approach

E-LAN
- No MP2MP LSP signaling
- Multiple P2P LSPs simulation
Multilayer Interconnectivity

- Signaling interworking
- TE-links flooding and abstraction
- Route computation, PCE
- Multilayer survivability
- Peer or overlay
- Still many open issues
Agenda

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Evolution of T-MPLS control plane

- **ITU-T + IETF + OIF**
- **ITU-T focus on**
  - Requirements, architecture and functionalities
- **IETF focus on**
  - Design and extension of control protocols, such as signaling, routing and LMP protocols
  - Clarification and solution of some specific problems of CP
- **OIF focus on**
  - UNI,E-NNI
The End

Thanks!