# Inter-SDN in Seamless MPLS for Mobile Backhaul

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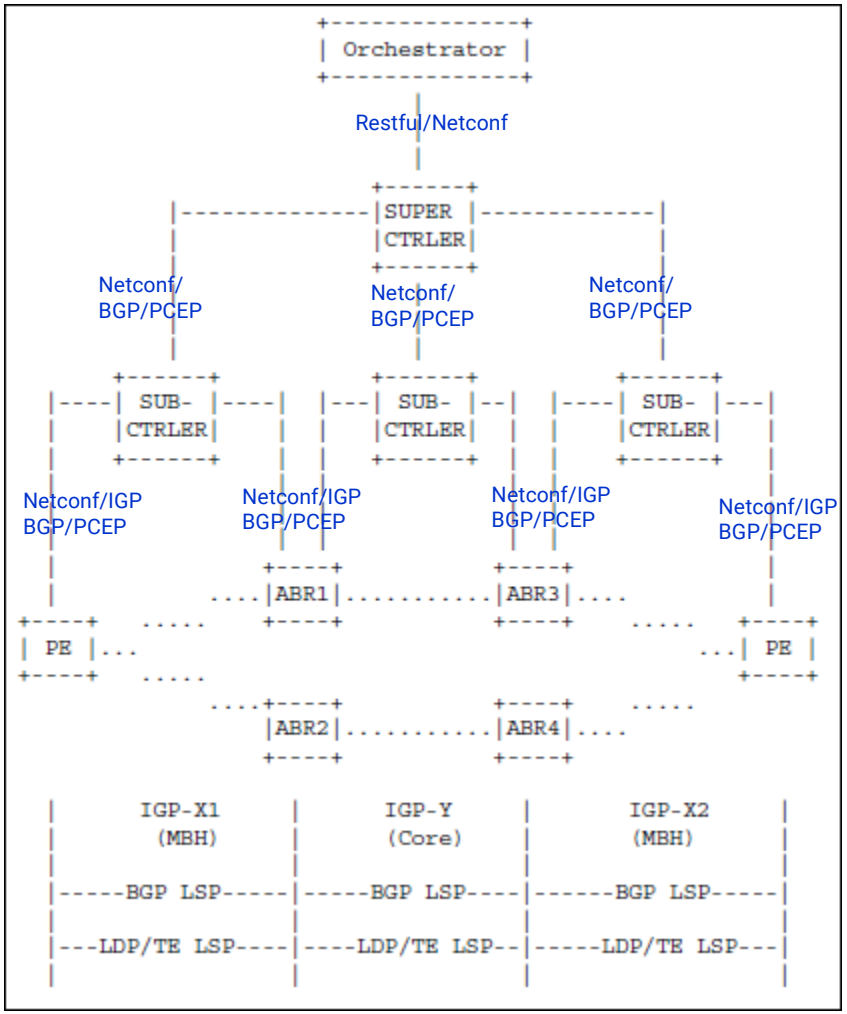
# Introduction

- Background
  - Seamless MPLS solution has been introduced to Mobile Backhaul Network to deal with the integration of multiple access networks and core/aggregate networks.
  - SDN has been developed to facilitate network operation and management
  - When SDN is introduced to Seamless MPLS Mobile Backhaul Network, for each domain there may be one controller. In order to implement the end-to-end service provision, there should be orchestration among multiple domain controllers.
- The document proposes the inter-SDN Seamless MPLS network architecture and requirements in Mobile Backhaul Network.

# Challenges

- SDN Architecture of  Large-Scale Inter-Domain Network
  - Hierarchy SDN Controller
  - Peer SDN Controller
  - Functionality Division
  - Orchestration of Different Controller
- Inter-Domain Traffic Optimization
  - Topology Abstraction
  - End-to-end traffic Optimization based on abstract topology
  - Interworking of Up/Down Layer’s traffic optimization
- Identification Requirements which is lack in the existing solutions.

# Inter-SDN architecture introduction




**Orchestrator**

•Provides E2E cross-controller orchestration, and downloads path optimization policy to manage traffic on demand.

**Super Controller**

- **Network model management:** Network model abstraction.
- **Inter-domain topology management：** global network topology management
- **Inter-domain path management：**
  - -- Compute BGP LSP across domains based on inter-domain topology;
  - -- Inform sub-controller to create/modify/delete LSP inside the domain.

•**Network configuration:** Downloads configuration according to network model to Sub-Controller.

**Sub-Controller**

•**Network model management:** network model abstraction.

•**Intra-domain topology management：** Collect intra-domain topology, and report it to Super Controller.

- **Intra-domain path management：** acts as PCE server
  - -- Compute TE LSP Intra-domain based on Intra-domain topology;
  - -- Inform distributed devices to create/modify/delete LSP.
- **Network configuration:** Downloads configuration according to the network model.

# Inter-SDN Procedures

- Traffic Optimization in Each Domain
- End-to-End Traffic Optimization
- End-to-End Service Provision
- Auto Discovery

# Traffic Optimization in Each Domain

- **Topology Information Collection**
  - Both IGP and BGP-LS [I-D.ietf-idr-ls-distribution] can be used to collect the network topology
- **Traffic Optimization**
  - Sub-Controller here acts as PCE server
    - Scenario 1: There is only MPLS TE tunnel optimization, and the optimization requirement is sent from Orchestrator to Super-Controller to Sub-Controller
      - Case1: PCE will initiate the new path calculation, and the path will be sent to PCC to re-optimize the existing tunnel
      - Case2: PCE will initiate the new path calculation and set up, the new LSP will be created in PCC without tunnel configuration
    - Scenario 2: Label BGP LSP optimization triggers dynamic MPLS TE, the requirement of BGP LSP optimization will be sent from orchestrator to Super-Controller to Sub-Controller
      - Case 1: Label BGP LSP reuses the existing MPLS TE tunnel. Then PCE will initiate the new path calculation and the path will be sent to PCC to re-optimize the existing tunnel
      - Case 2: PCE will initiate a new path calculation when there is no existing tunnel for the re-optimized BGP LSP, and the new LSP will be created in PCC without tunnel configuration

# End-to-End Traffic Optimization

- **Label BGP Route Collection**
  - BGP run between the device and Sub-Controller , as well as between Sub-Controller and PE/ABR, which should enable add-path capability, so as to collect all of the label BGP routes.
- **Topology Information Collection**
  - Super-Controller get network topology from Sub-Controller
    - Collect all topology information
    - Collect abstract topology information
- **Traffic Optimization for Label BGP LSP**
  - The orchestrator can determine what label BGP LSP should be optimized and the constraints and the policy.
  - Super-Controller calculate the optimal path for the label BGP route, which may change the BGP LSP's nexthop or only optimize the TE tunnel. Super-Controller will send the optimization policy to Sub-Controller.
  - If only TE tunnel need to be optimized or the label BGP route is optimized, please refer to the traffic optimization in each domain. The Sub-Controller will use the Netconf or BGP extensions to make the corresponding label BGP route to change the nexthop and correspondingly reuse the existing MPLS TE tunnel or use the new tunnel to the new nextop.

# End-to-End Service Provision

- MPLS TE Tunnel in Each Domain
  - As the PCE initiated LSP is adopted, the configuration for MPLS TE tunnel in the network devices can be reduced, and the MPLS TE tunnel is trigger by label bgp route
- Label BGP Route
  - Static configuration can be provided to guarantee that there is always connectivity between any pair of nodes.
  - In order for the access node with limited capability, BGP pull mode based on the BGP ORF extension should be introduced between Sub-Controller and the access node to introduce routes on demand.
- L3VPN/L2VPN Service Provision
  - The Orchestrator will provide the simplified user-oriented VPN provision method based on the abstract topology information collected from the Super Controller.
  - When Super Controller receives the VPN provision requirement, it will convert the user-based VPN model to device-based VPN model.

# Auto Discovery

- As the increasing of controller and network nodes, IGP and BGP extensions can be introduced for auto discovery.
  - Advertisement of the role info of different components.
  - Advertisement of the capability info of different components.

# Next Step

- Combine with work of H-PCE and H-BGP.
- Solicit comments and revise drafts.