NORTEL NETWORKS
BUSINESS WITHOUT BOUNDARIES

MPLS based Layer 2 Virtual Private Network Services

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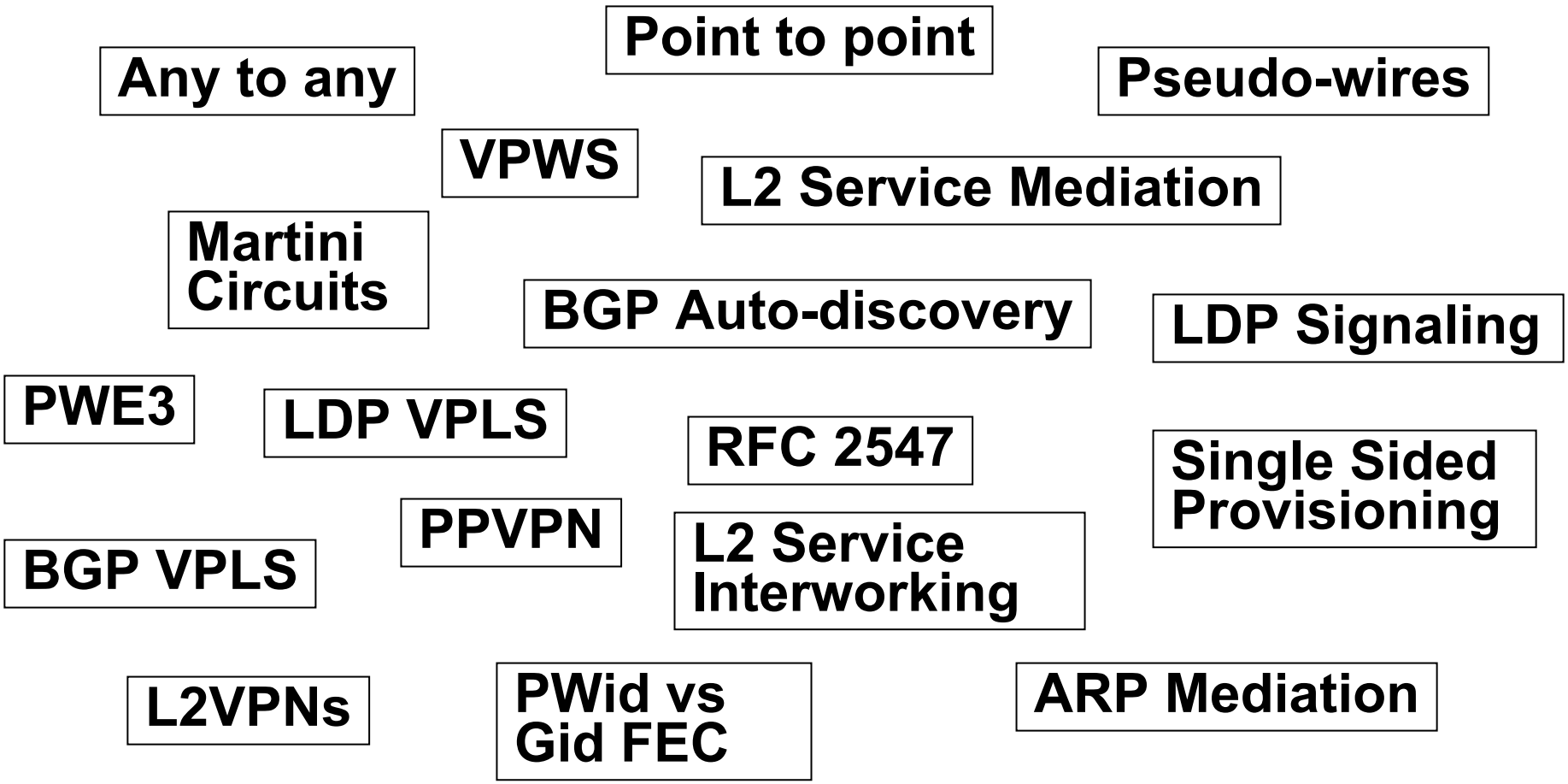
L2 VPNs and Related Standards

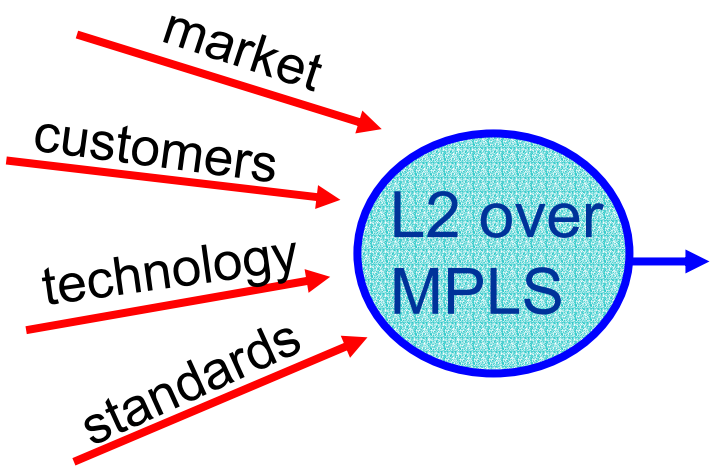


A lot of New Terms, Confusion in the Industry

Scope

This presentation will …

- Explain the motivation behind the **Layer 2 over MPLS technology**
- **Go over the related Technical Concepts, Standards**



The Goal is to help you …

- **understand the technology, latest developments**
- **determine applicability to your business model**
- **be ready to implement it**

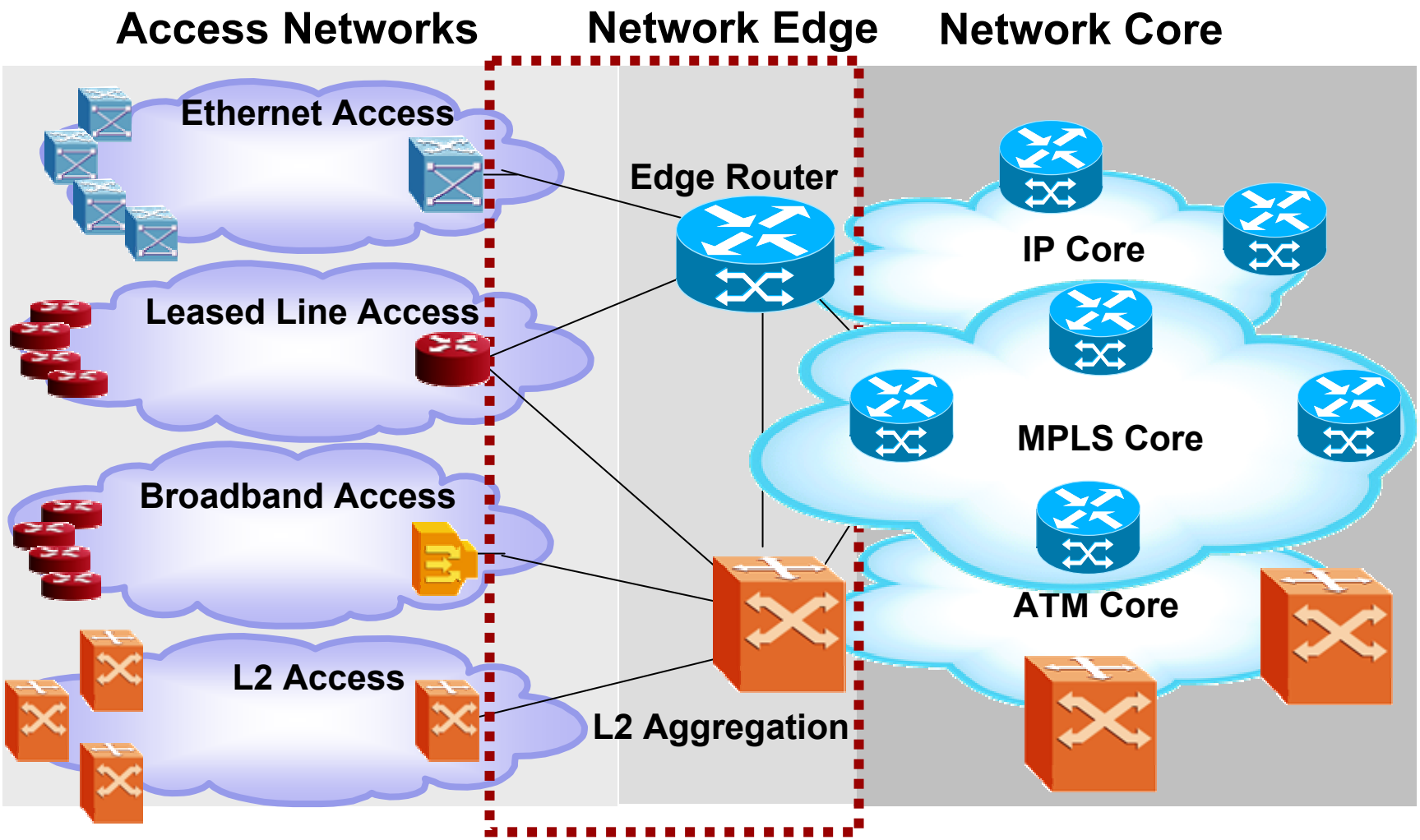
Focus on the technology side: How Does it Work?

Agenda

- **Introduction to L2VPNs over MPLS**
  - Drivers, Definitions, Standards
- **IETF Generic Models (L2VPNs)**
- **Virtual Private Wire Service (VPWS)**
- **Layer 2 Service Interworking**
- **Virtual Private LAN Service (VPLS)**
- **Summary**

Drivers for L2VPN over MPLS

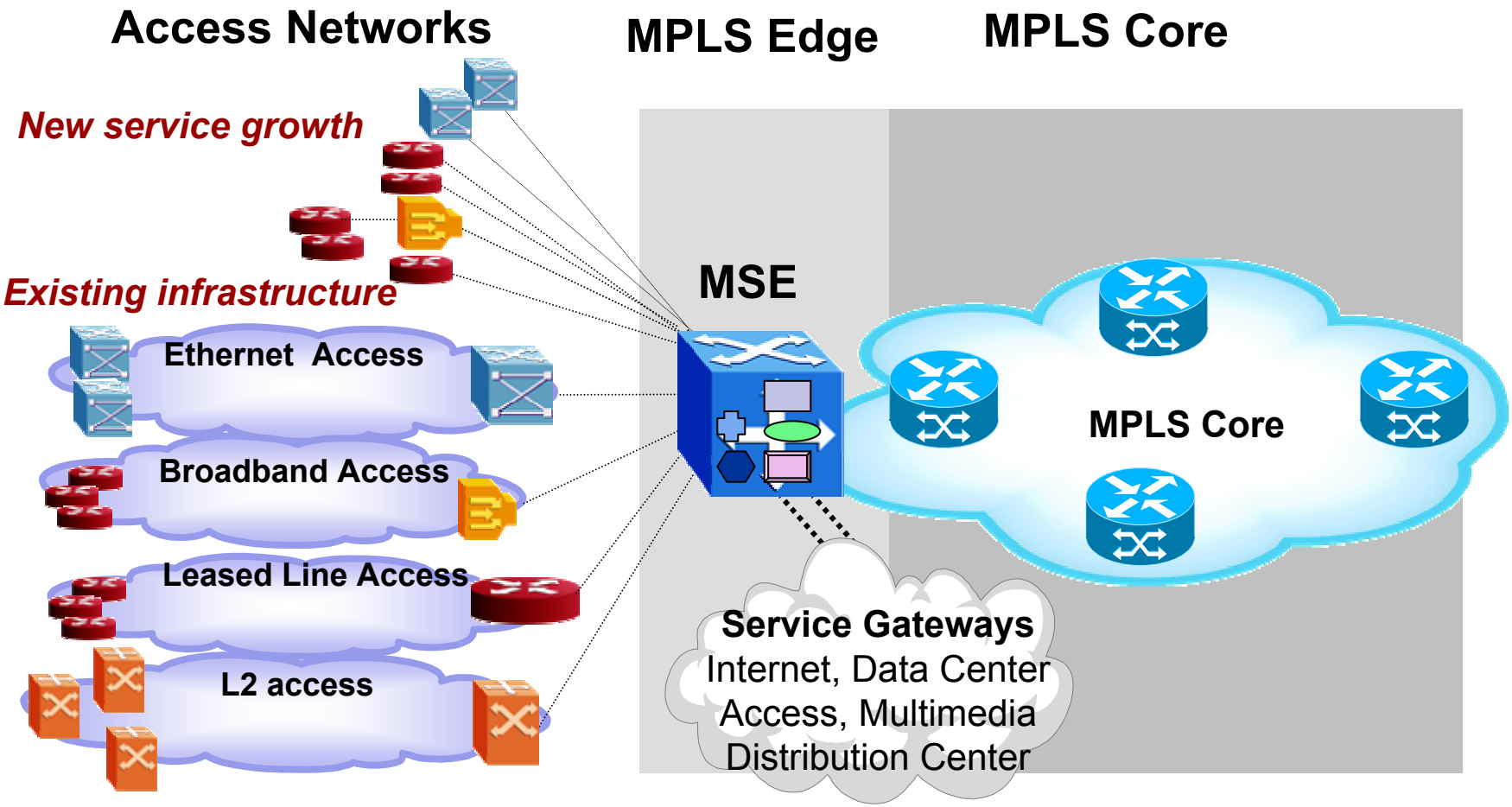
Backbone Convergence – Present Mode of Operation



Multiple access networks connected to multiple cores.
Equates to complex management / high costs

Drivers for L2VPN over MPLS

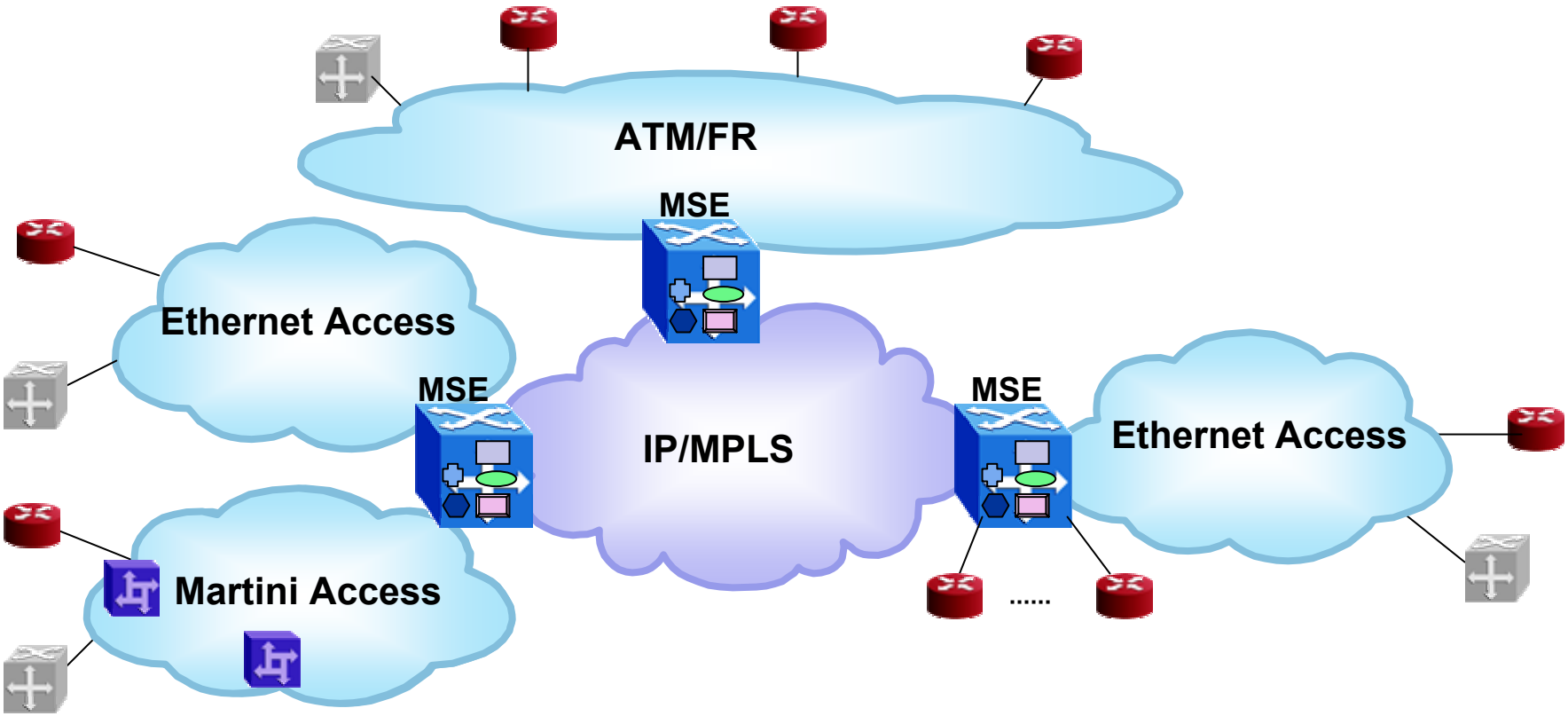
Backbone Convergence - Any Access, Any Service/MPLS



- **Support growth of new services** – i.e. IP VPNs, Triple Play, Ethernet L2
- **Interwork to existing "Cash Cows"** – i.e. ATM, FR, Existing DSL Networks…

Drivers for L2VPN over MPLS

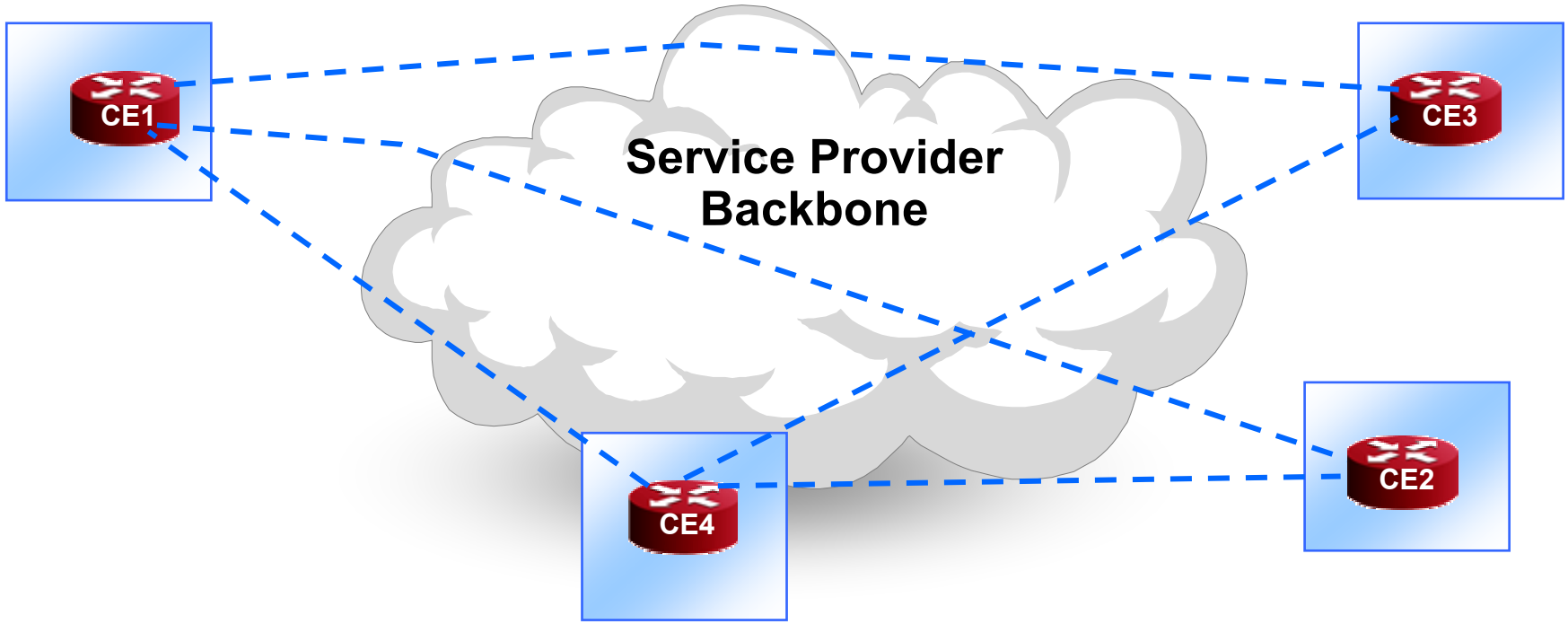
Evolution of Ethernet Services



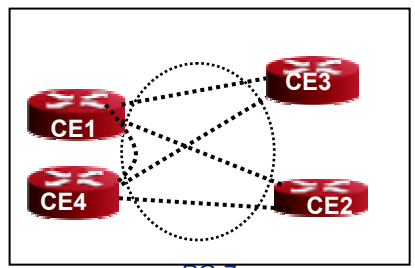
- Expanding the coverage, scope via MPLS
- Ethernet to FR/ATM Interworking – Protocol, QoS, OAM, Resiliency
- Evolving to Consolidated, NextGen Access – Ethernet over Martini PWs

Virtual Private Wire Service (VPWS)

Enterprise Perspective

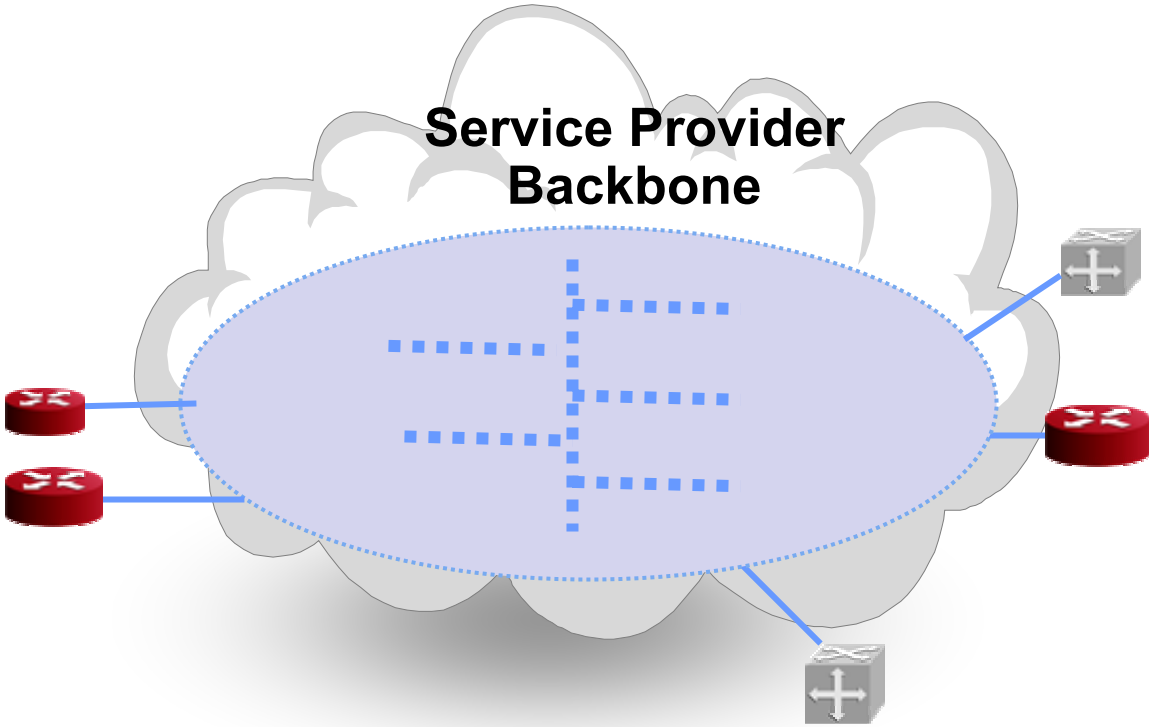


Same Service as Traditional (ATM/FR) L2VPN

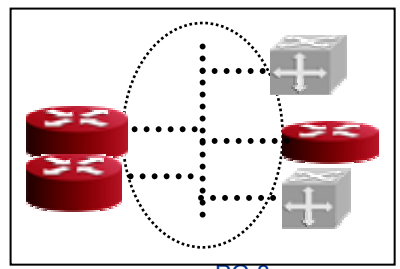


Virtual Private LAN Service (VPLS)

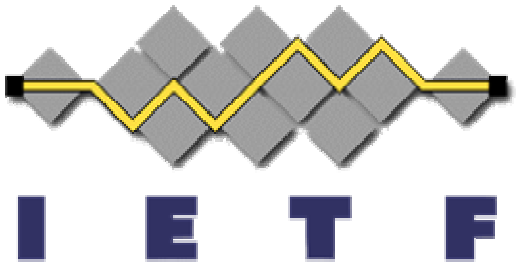
Enterprise Perspective

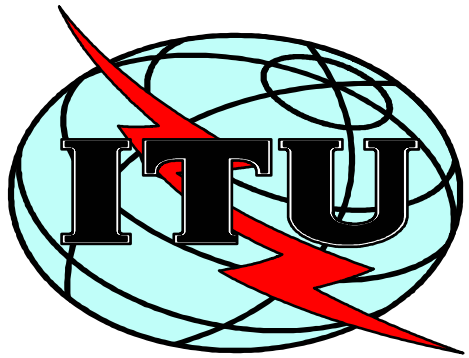


"Carrier Grade" LAN Emulation Solution

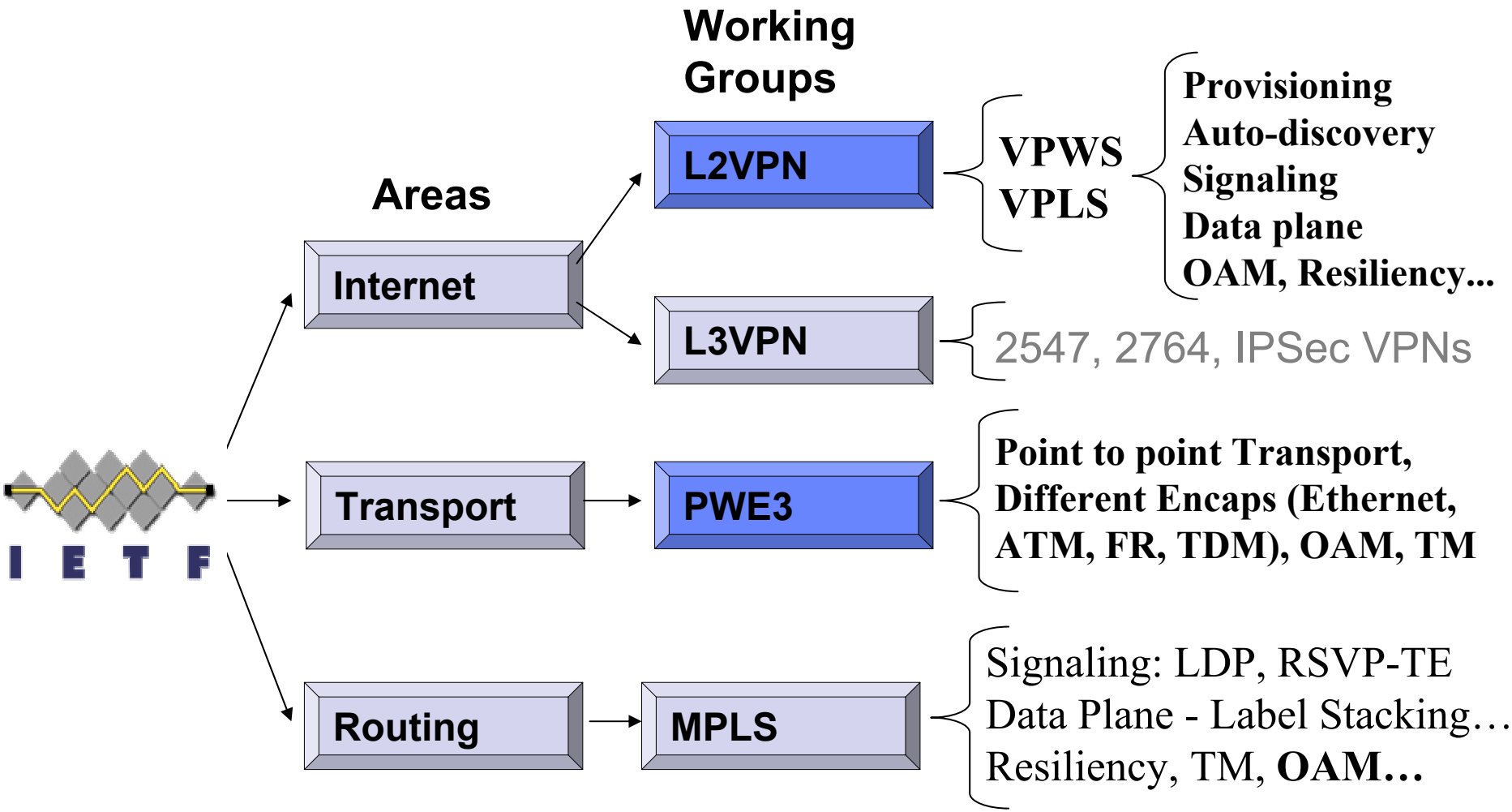


Standards Scene





New L2 VPNs & Related IETF Working Groups



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- **IETF Generic Models (L2VPNs)**
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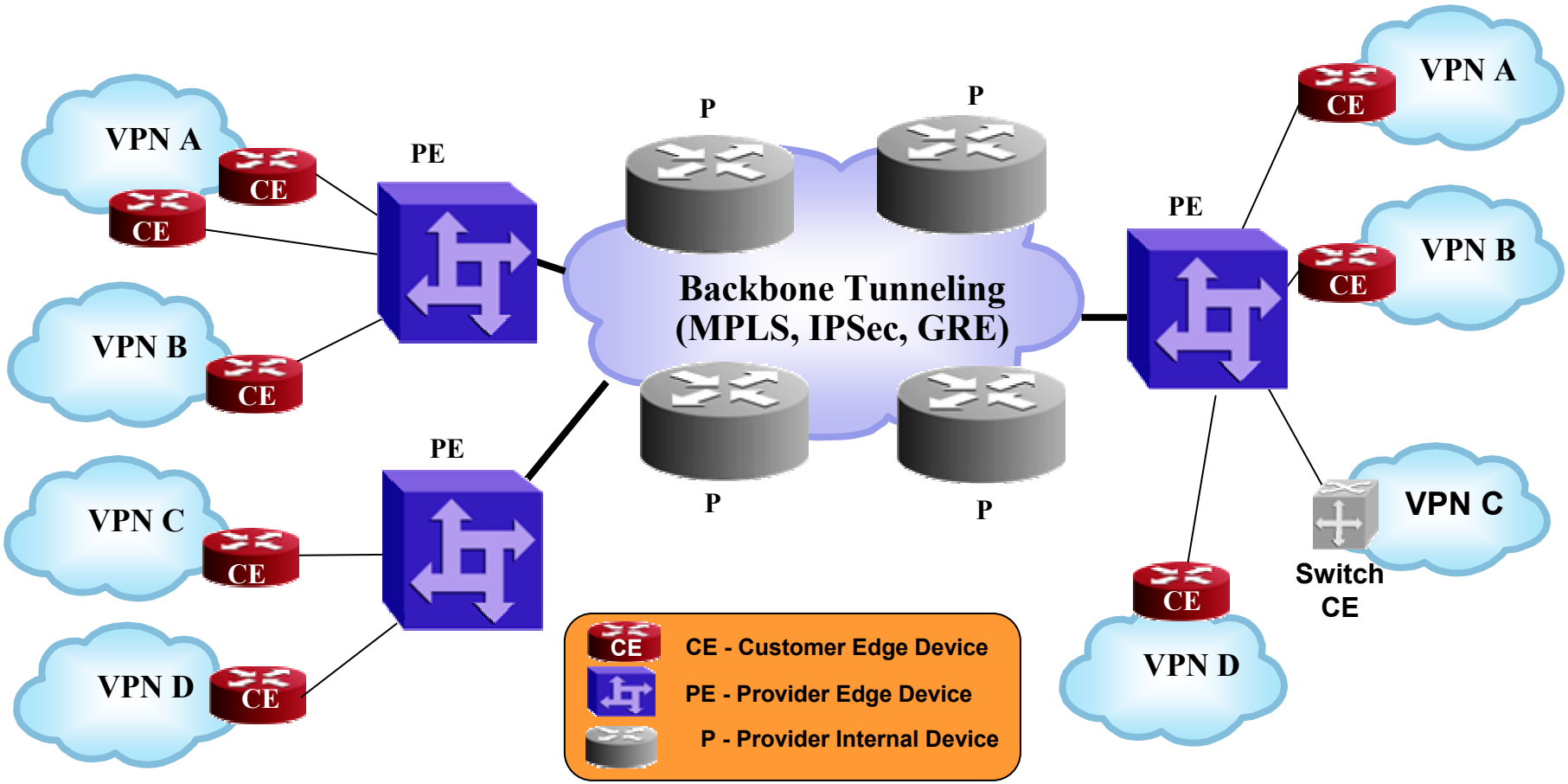
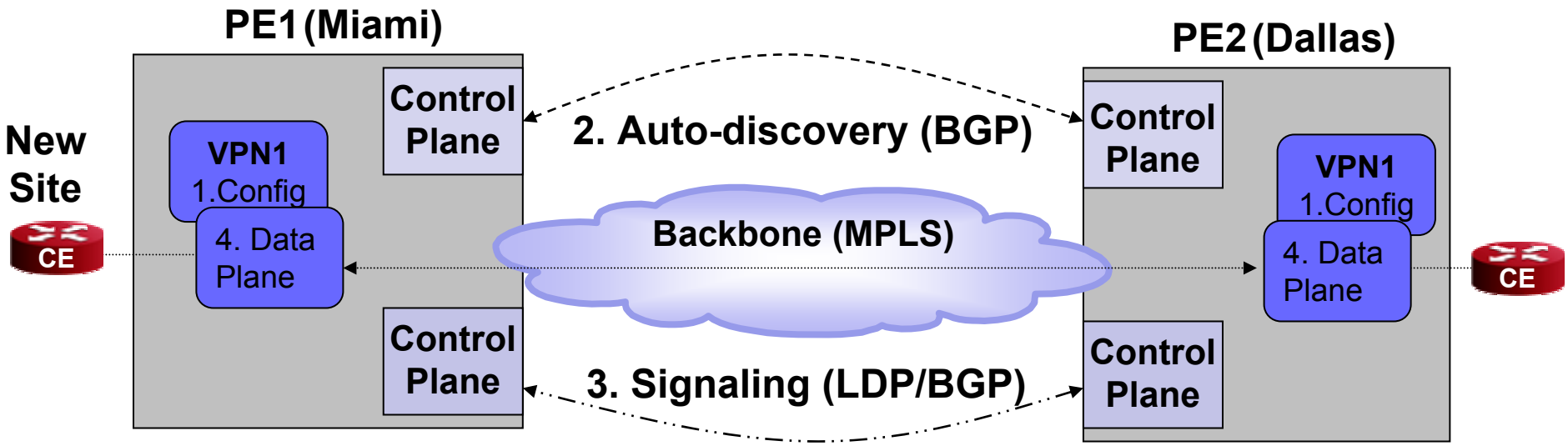
IETF Reference Model for VPNs



Service Providers Focus: i.e. VPNs for which the Carrier participates in management and provisioning of the VPN.

Building Blocks for L2 VPN

Provisioning, Control Plane



1. I want to add a new member of Blue VPN in PE1?

- **Provision (Setup)** the local interface(s) and the required membership info

2. What is the Blue VPN community, where are the others related PEs?

- **Auto-discovery/Provisioning** – provides the list of "locations" for **"Blue"** Entities

3. How are links established between Endpoints (i.e. Sites)?

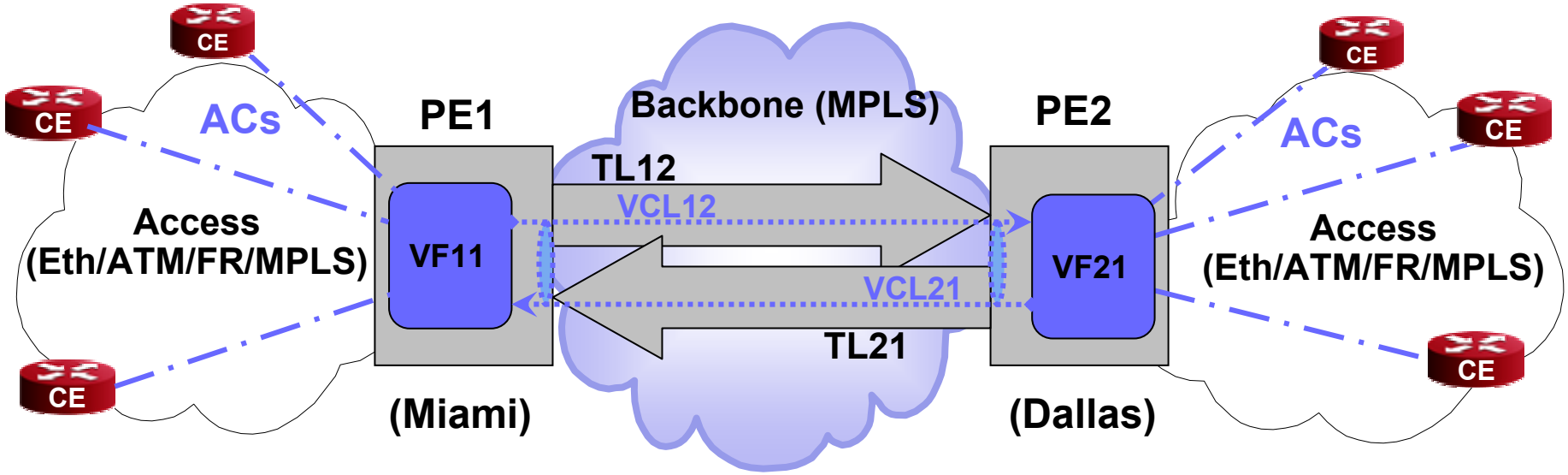
- **Signaling –** sets up the path between VPN entities

4. How are packets moved between sites?

- **Data Plane** – procedures related to packet forwarding

Building Blocks for L2 VPN

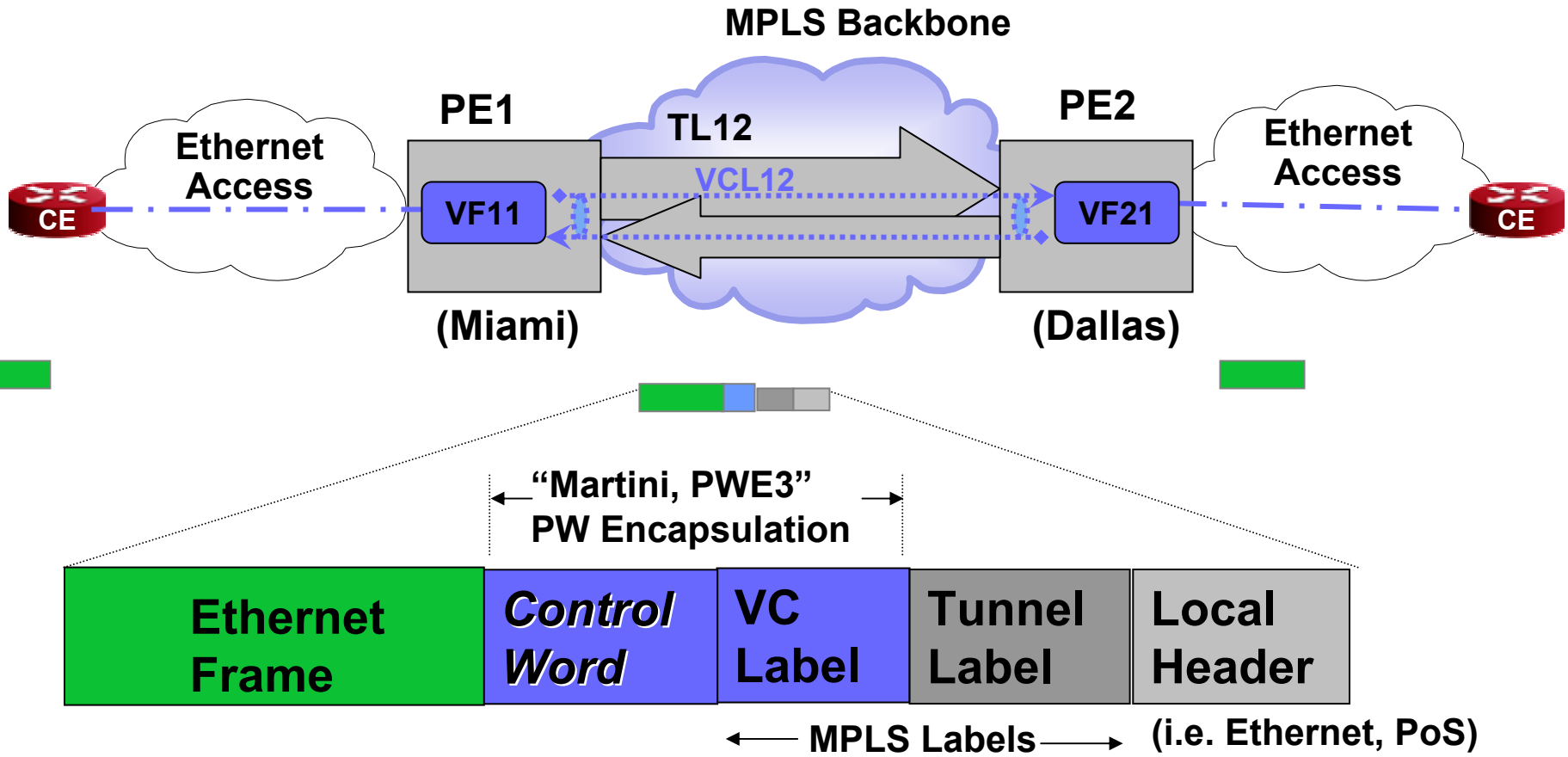
Data Plane Components, Terminology



- **Tunnel (Labels - TL) –** The path between PE1 and PE2
- **Attachment Circuits (AC) –** L2 connection between CE and PE
  - i.e. FR DLCIs, ATM VCs, VLAN Qtags
- **Virtual Forwarders (VF) –** Service specific processing, forwarding
  - i.e. same type of functionality as 2547 VRFs
- **(MPLS) Pseudo-wire –** Paths between VFs = (VC Label -VCL, TL)
  - Pseudo-wire End Service = pair of unidirectional LSPs

IETF L2 VPN Model

Data Plane Encapsulation – Ethernet Example



Same procedure, encapsulation format in the reverse direction

Different Encapsulations Handled in IETF PWE3 Working Group

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VPWS Agenda

Individual Pt2pt Virtual Circuits

- Double Sided, Single Sided Provisioning
  - ***Provisioning Model, Signaling, Packet Walkthrough, Configuration Examples***
- Pseudo-wire OAM

Solutions for Migrating Legacy L2 Services to MPLS

Focus on the different Information Models, Provisioning Steps

- Similar Procedures in the Control and Data Plane

Individual Point-to-point VCs

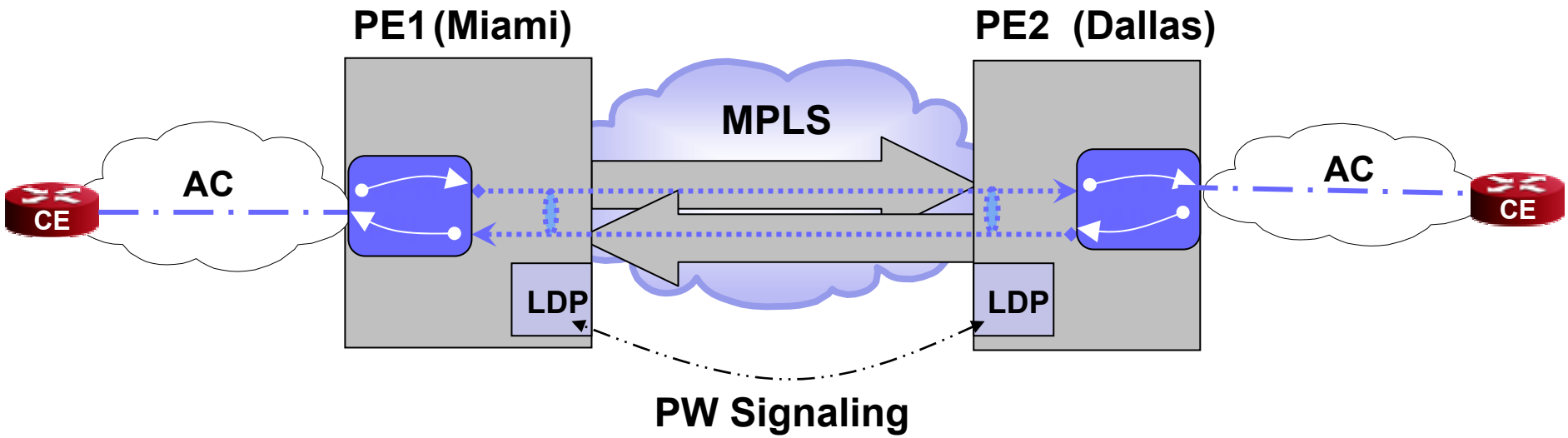
Logical Service View (Simplified)

Enterprise perspective of the Service – ATM/FR VC, Ethernet VLAN

- *known also in the industry as Martini Pseudo-wires*

Individual Point-to-point VCs

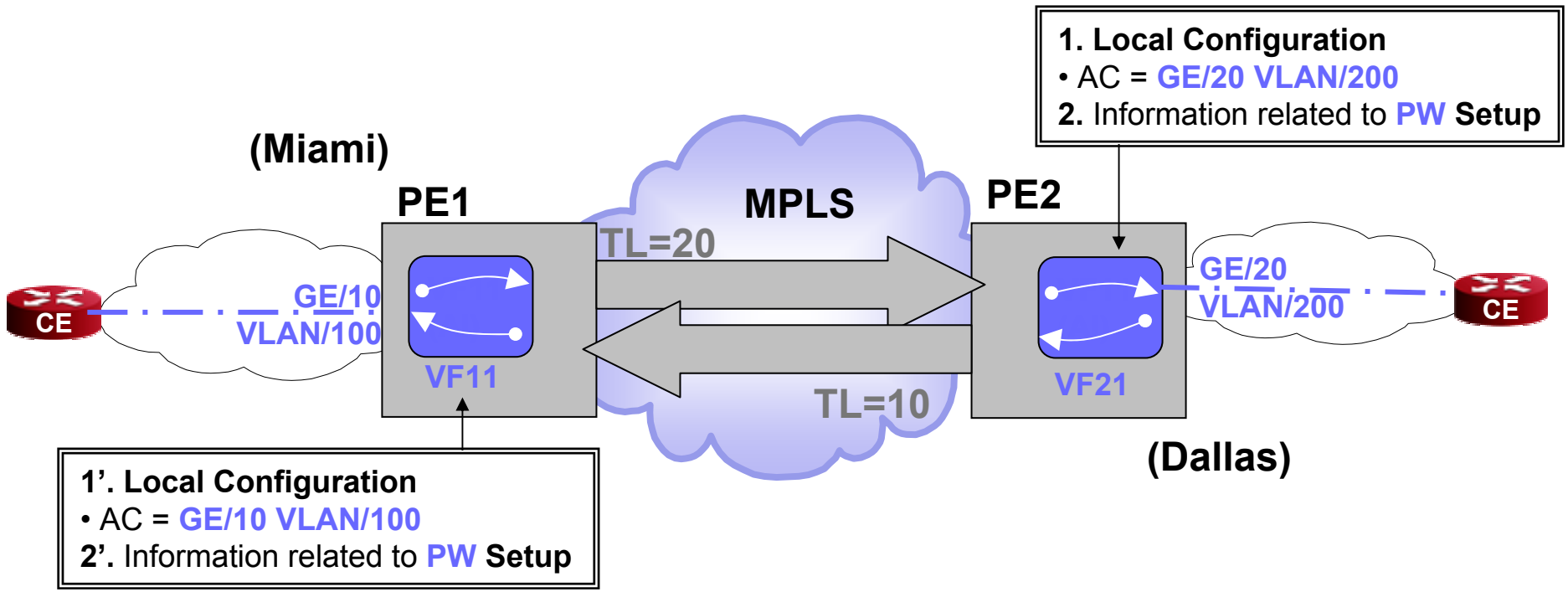
Double Sided Provisioning – Control & Data Plane



- No Auto-discovery, just LDP for PW Signaling
- Simple Forwarder – forwards everything between 1 PW and 1 AC

Double Sided Provisioning

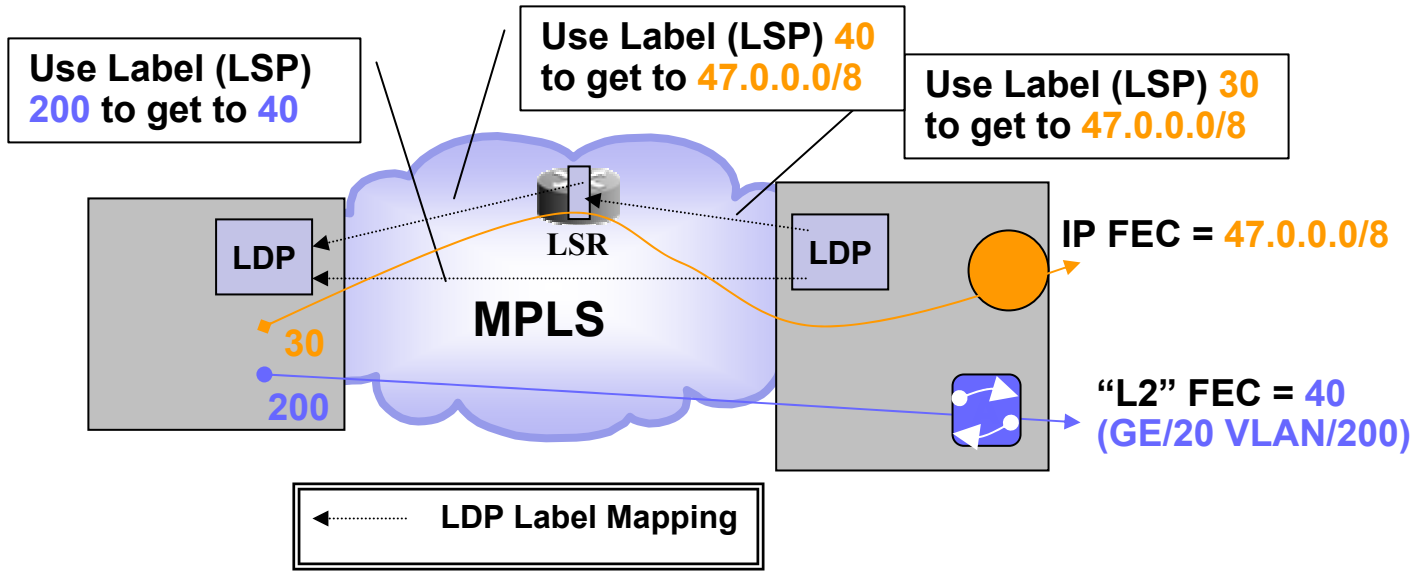
Configuration Example – generic steps



Next - LDP signaling will setup the PW

- using the FEC to identify the PW the VC Label is bound to

LDP Signaling - *Forward Equivalence Class*



FEC = "Forwarding Equivalence Class": a set of packets that are forwarded in the same manner by a MPLS LSR

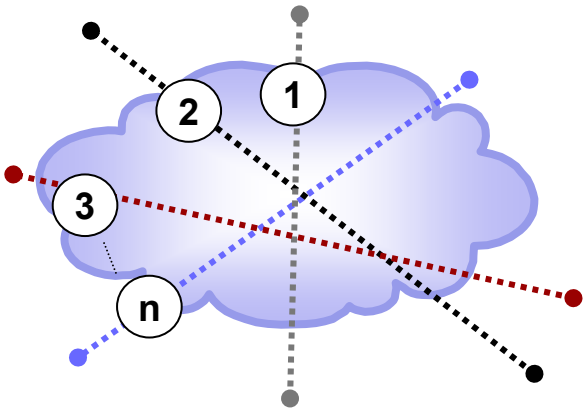
- **Initial usage: a specific entry from the routing table (i.e. IP Host)**

- **L2VPNs – FEC used to identify a particular PW that a particular VC label is bound to**

Two FECs being defined for PWs/VPWS, VPLS – see draft-ietf-pwe3-control-protocol-03.txt

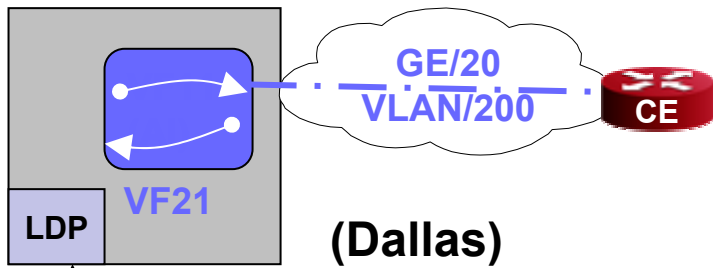
- **PWid FEC** - historically first one to be specified (initial "Martini" Control Plane)
- **Generalized ID FEC (Gid FEC)**

Pseudo-wire Setup using LDP Signaling
PWid FEC



PW identified at both endpoints by the same VCid

PE2



(Dallas)

PWid FEC

PW TLV	C	Ethernet	PW Info Length
Group Id			
PW Id/VCid = 40			
Interface Parameters			

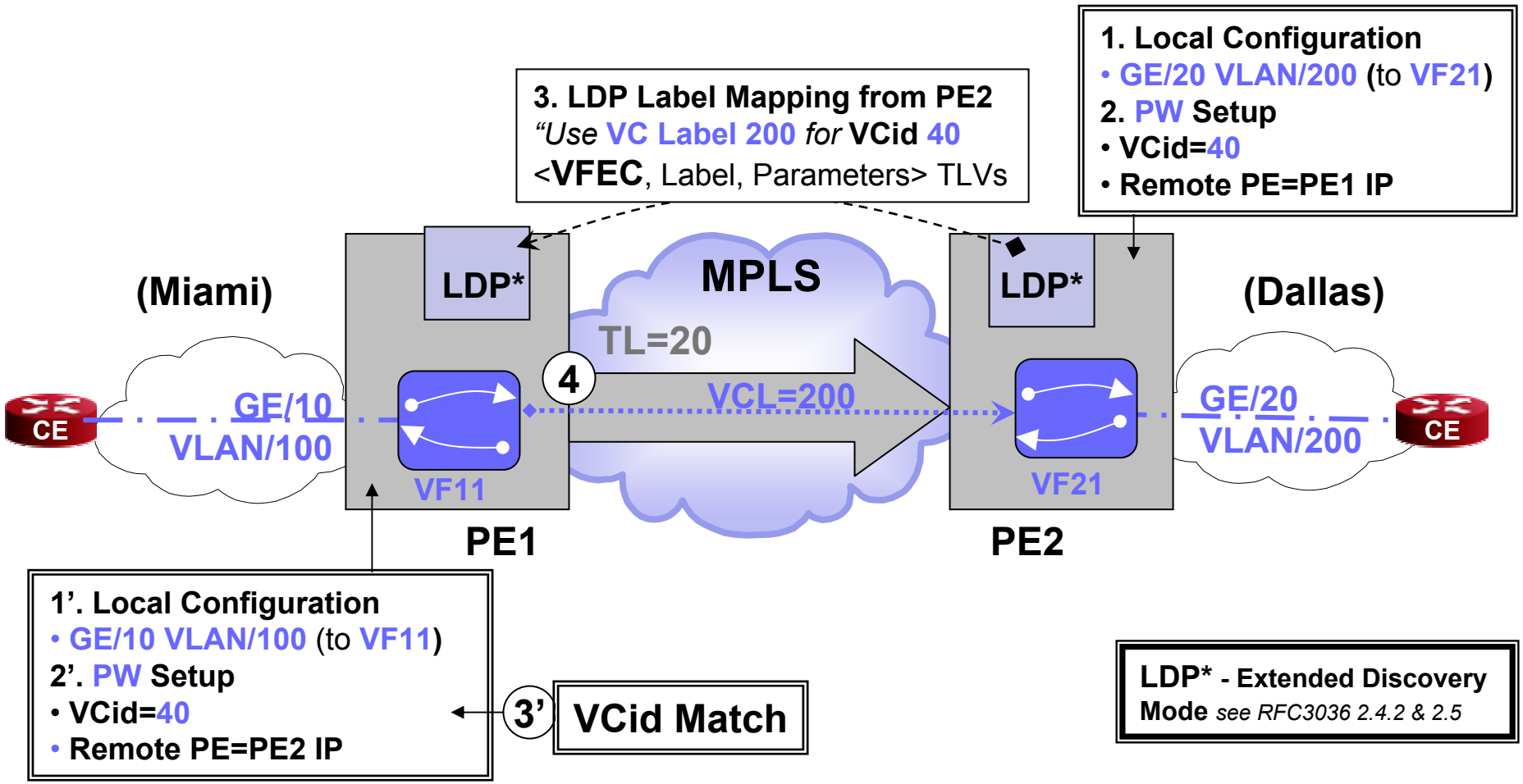
1. Local Configuration
- AC = GE/20 VLAN/200

2. PW Setup
- VCid=40
- Remote PE: PE1 (IP)

LDP Label Mapping <VFEC, Label, Parameters> TLVs

Individual Pt2pt VCs – Double Sided Provisioning

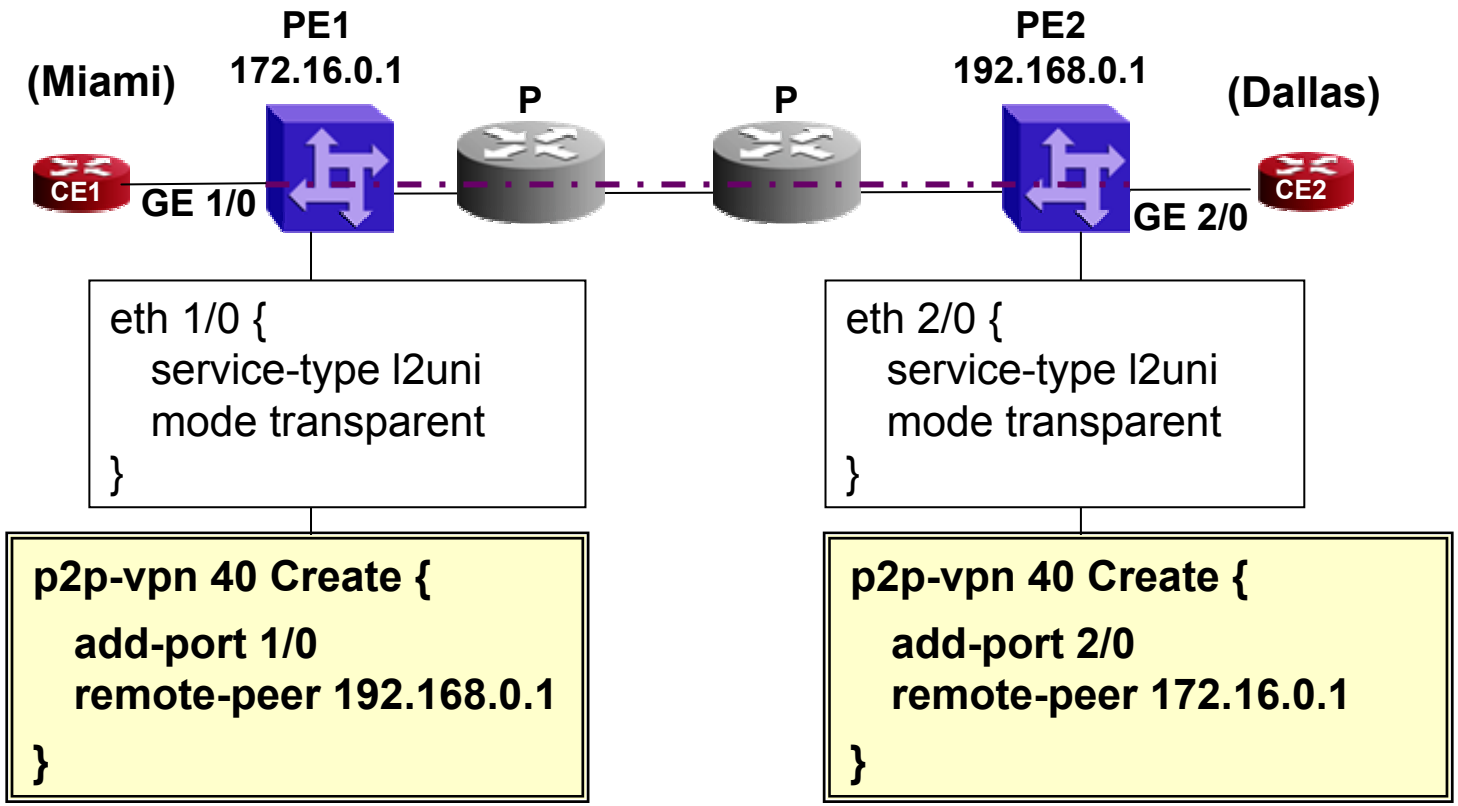
Unidirectional PW Setup – *LDP PWid FEC Example*



Full Provisioning of information about remote endpoint at both sides
Same signaling procedure in the reverse direction

Configuration Example 1 – Nortel PW

Ethernet PW – double-sided provisioning, PWid FEC

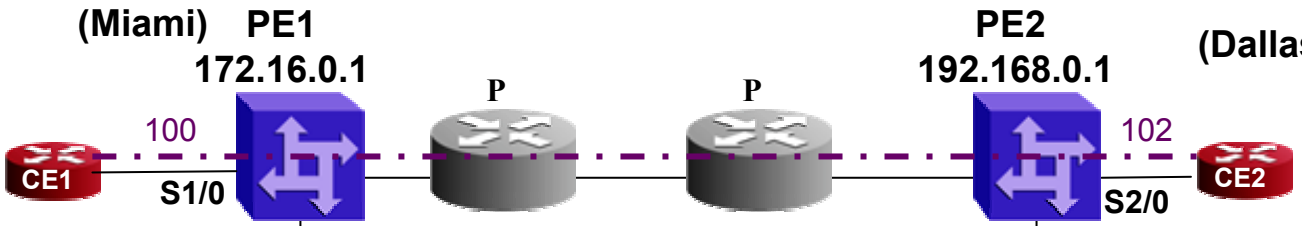


The focus of all the Examples in the package is on the L2VPN configuration.

- Assumes “Backbone-facing” configuration is already in place: i.e. IP (interfaces, OSPF), MPLS (interfaces, LDP, Tunnel LSPs)

Configuration Example 2 – Cisco AToM

Frame Relay PW – double-sided provisioning, PWid FEC



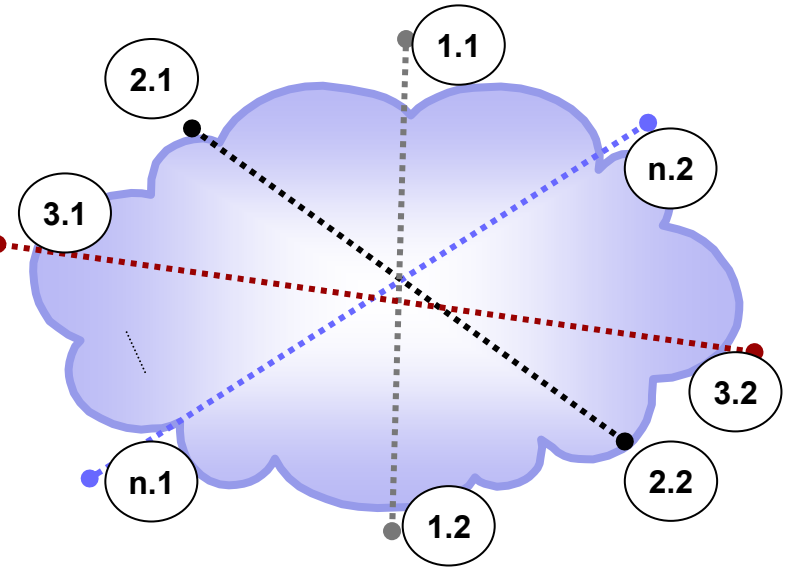
Interface Serial 1/0
Encapsulation frame-relay ***ietf***
Frame-relay intf-type ***dce***
!

Interface Serial 2/0
Encapsulation frame-relay ***ietf***
Frame-relay intf-type ***dce***
!

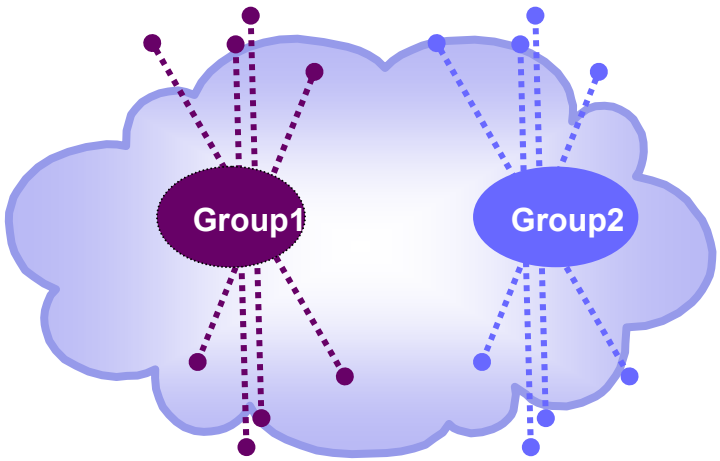
connect frompls1 Serial1/0 100 l2transport
xconnect 192.168.0.1 40 encapsulation mpls

connect frompls2 Serial2/0 102 l2transport
xconnect 172.16.0.1 40 encapsulation mpls

Pseudo-wire Setup using LDP Signaling
Generalized Id (Gid) FEC

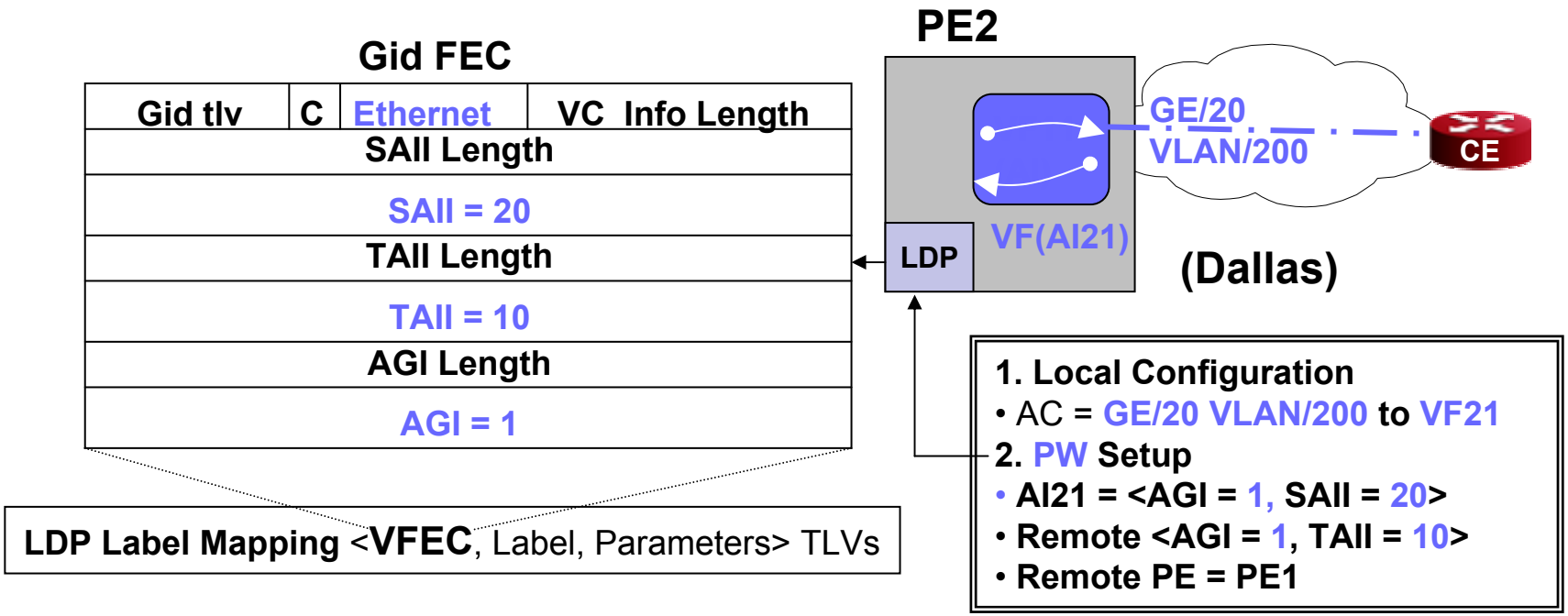


Each PW Endpoint has its own ID/Address
- endpoint could be port <VC>(ATM/10 or ATM/10 Vcc/0.34)



Flexibility in format – could adapt easily to future needs
- **i.e. possibility to form groups of circuits**
- **flexible lengths for different component**

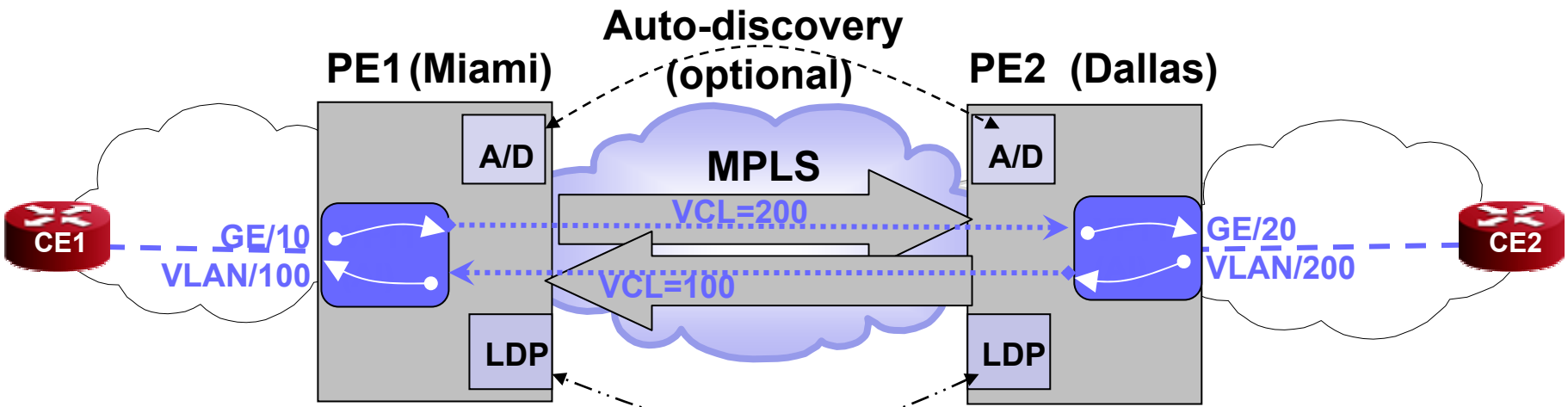
Pseudo-wire Setup using LDP Signaling
Generalized Id (Gid) FEC



Each Virtual Forwarder uniquely Identified by "Attachment Identifier" (AI)
- AI = <AGI (**Attachment Group Identifier**), AII (**Attachment Individual Identifier**)>
- Concepts of Source AI (SAI – local VF) and Target AI (TAI – remote VF)

PW Signaling similar with the PWid FEC for Double-Sided Provisioning

Individual Pt2pt VCs - *Single Sided Provisioning*



- AC = GE/10 VLAN/100 to VF1
- <AGI = 1, SAII = 10>
- Remote <AGI = 1, TAII =?>
- **Remote PE = ?**

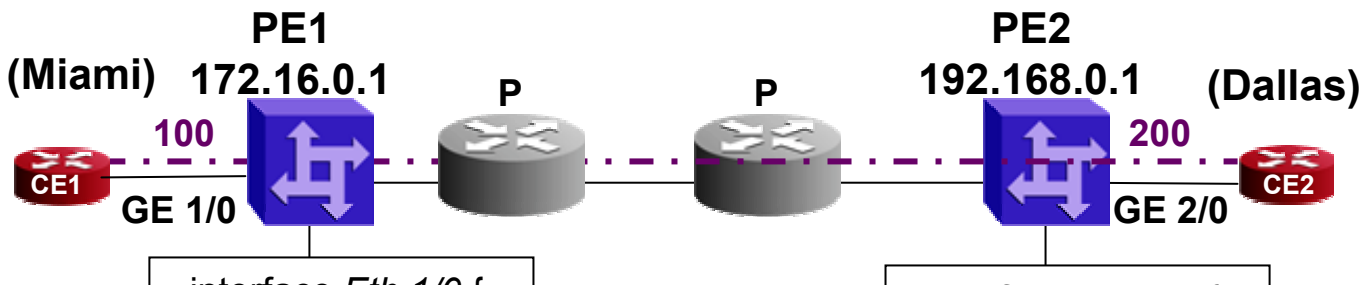
- AC = GE/20 VLAN/200 to VF21
- <AGI = 1, SAII = 20>
- Remote <AGI = 1, TAII = 10>
- **Remote PE = PE1 ID**

No reconfiguration required when moving Attachment Circuit

- *compared with Double Sided Provisioning*

Configuration Example 3- Nortel

Ethernet PW – single-sided provisioning, Gid FEC




```
interface Eth 1/0 {
   unit 10 {
      vlan-id 100
      vpws { }
   }
}
```

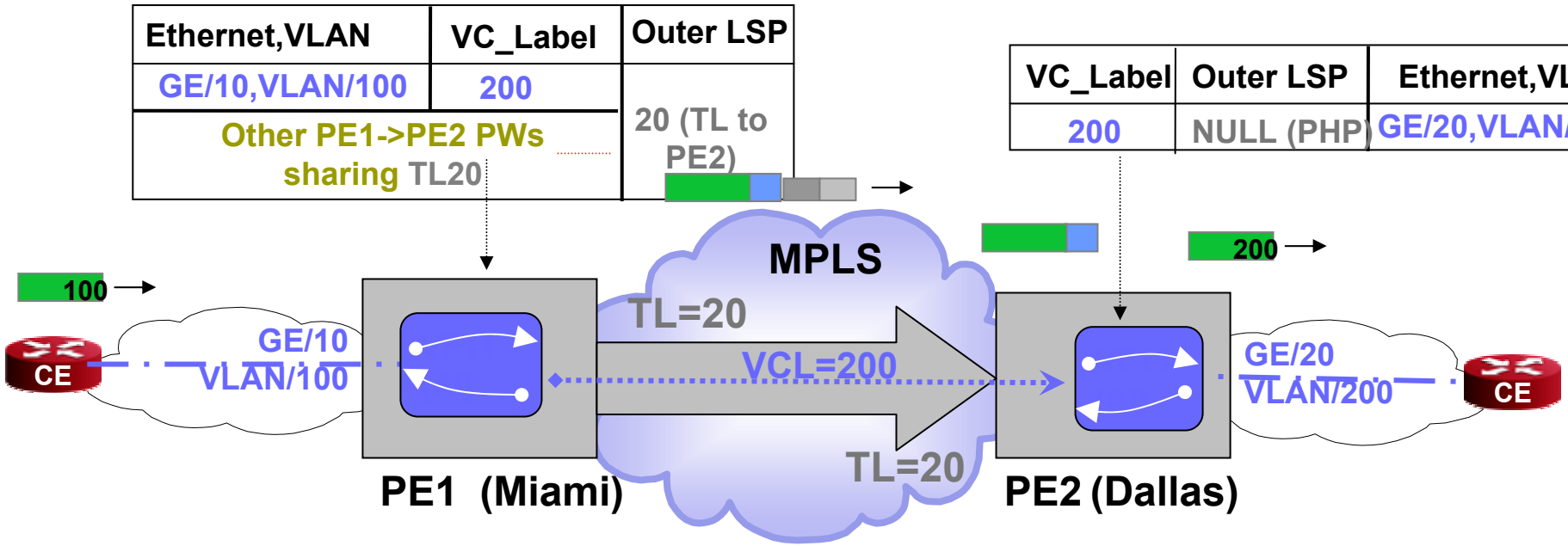
```
interface Eth 2/0 {
   unit 20 {
      vlan-id 200
      vpws { }
   }
}
```

```
pseudo-wires {
  agi 1 {
     sa 10100 {
        net-encapsulation ethernet-vlan
        interface eth 1/0.10
     }
  }
}
```

```
pseudo-wires {
  agi 1 {
     sa 20200 {
        net-encapsulation ethernet-vlan
        interface eth 2/0.20
        ta 10100 {
           neighbor 172.16.0.1
        }
     }
  }
}
```

Individual Point-to-point VCs

Example of Data Forwarding – same for both models



Simple VF: forwards data between 1 AC & 1 PW

Pseudo-wire OAM Tools

1. **Label Withdraw**

   Default behavior, tears down service on fault

2. **Status TLV**

   Capability must be negotiated at setup

   Enables a pseuedowire to be put in an inactive state

   - New service turn-up, testing
   - Fault propagation

3. **VCCV – (LSP) Ping, BFD**

   Capability must be negotiated at setup

   In-band OAM on the transfer plane

   Capabilities:

   - Diagnostic Test
   - Fault Detection
   - Fault Propagation

Example VCCV – Diagnostic Test

Syntax

ping pseudo-wire <count *count* | continuous> <pad *pad-size*> *attachment-circuit*

count *count*—(Optional) Number of ping requests to send. If count is not specified, 5 ping requests are sent.
continuous—(Optional) Specifies that echo requests should be sent until the *control-c* character is received.
pad *pad-size*—(Optional) Specifies the number of bytes to be appended to the LSP ping packets.
attachment-circuit—Name of L2 attachment circuit from which to ping.

Sample Output

XXXX@node32> **ping pseudo-wire eth 1/0 100**
Ping request for pseudo-wire started on 20-jan-03 23:10:10:
Remote PE Address: 192.168.0.1
Source PE Address: 172.16.0.1
Outgoing Service Label: 32
Incoming Service Label: 100
Outgoing Tunnel: 192.168.0.1/234
PW Address: genid agi LNH, sa Miami, ta Dallas
23:10:10 86 byte echo reply received on fr-1/2:3.200: seq=1 time=0.456 ms
23:10:11 86 byte echo reply received on fr-1/2:3.200: seq=2 time=0.656 ms
23:10:12 86 byte echo reply received on fr-1/2:3.200: seq=3 time=0.556 ms
23:10:13 86 byte echo reply received on fr-1/2:3.200: seq=4 time=0.466 ms
23:10:14 86 byte echo reply received on fr-1/2:3.200: seq=5 time=0.490 ms
--- pseudo-wire ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss round-trip min/avg/max = 0.456/0.525/0.656 ms

VPWS Agenda

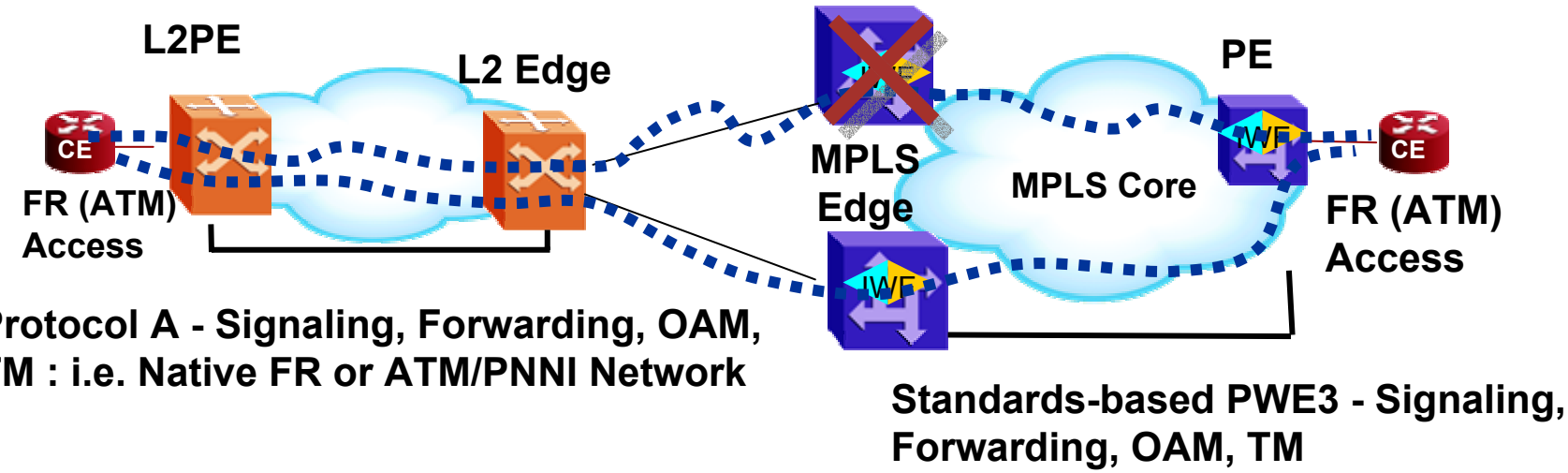
Provisioning Models - Individual Pt2pt Virtual Circuits

Solutions for Migrating Legacy L2 Services to MPLS

- Mediation to existing Layer 2 Services
- Network Inter-working over MPLS
- L2 Service Inter-working over MPLS

Dynamic Service Mediation with L2 services

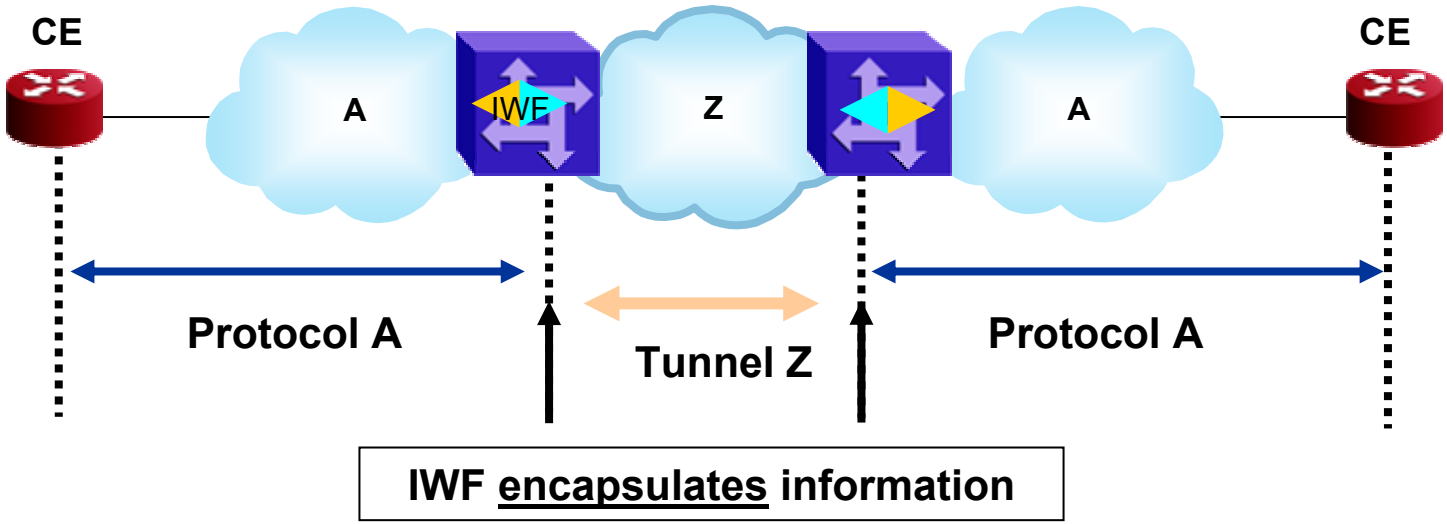
Problem Space



Dynamic mediation between the MPLS and the Layer 2 network

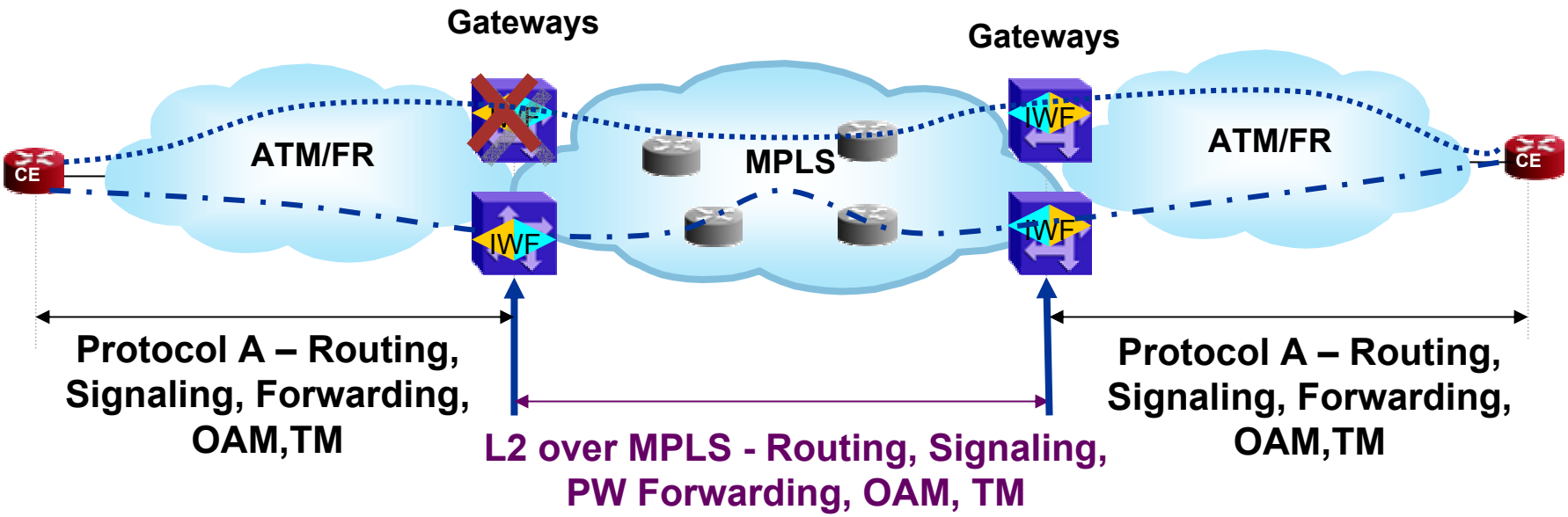
- Enable dynamic Layer 2 call establishment end-to-end
- Support resiliency under multiple failure conditions
- Eliminate per call configuration at the Layer 2 mediation points

What is Network Inter-working?



- **Inter-working required between networks of similar protocols across an intermediary/core network having a different protocol (e.g. MPLS transport between two ATM networks)**
- **Complete or part of the protocol control information used in the two similar networks are transferred transparently by an inter-working function (IWF) across the intermediary/core network**

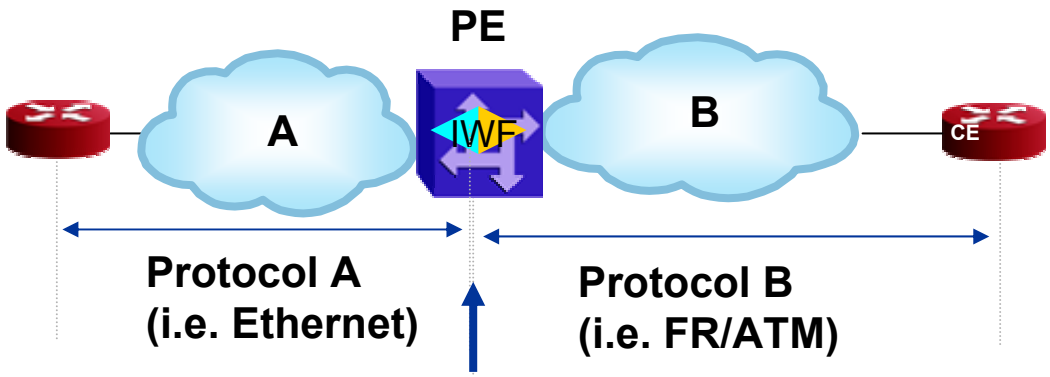
Network Inter-working over MPLS
Problem Space



Layer 2 Network Interworking over MPLS

- Need scalable solution from both network & platform perspectives
- Need to support existing service QOS
- Should preserve existing Layer2 networking features

L2 Service Inter-working – General



- Inter-working function (IWF) terminates the protocol used in one network, and translates its protocol control information to that of the protocol used in the other network
- Generally implies inter-working function done on a one-to-one connection basis

See details in the following section …

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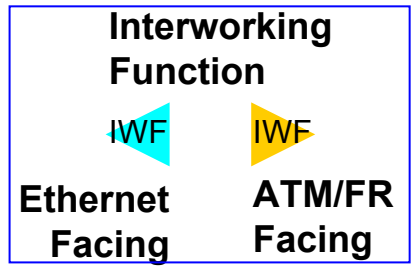
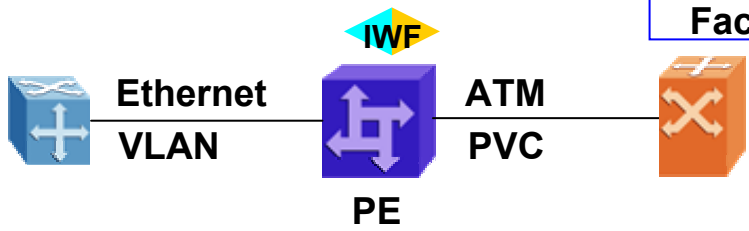
Pseudo-wire Options

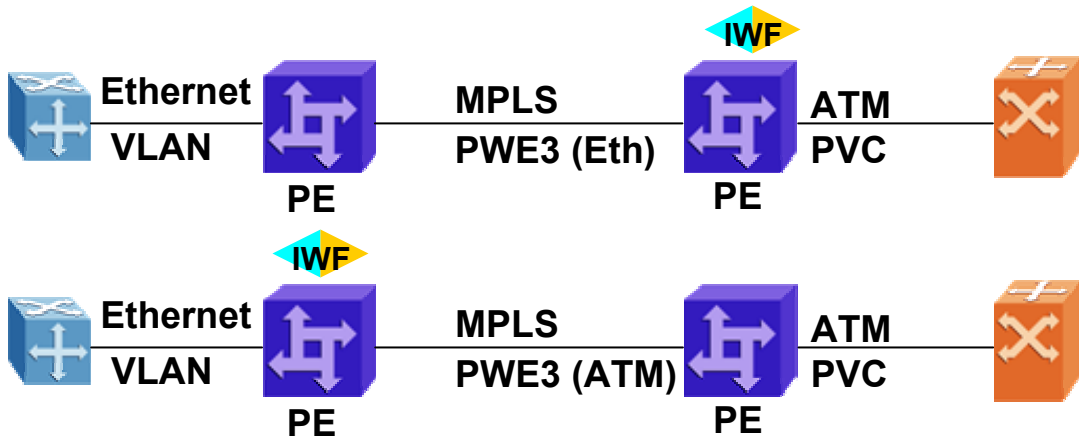
Ethernet to ATM



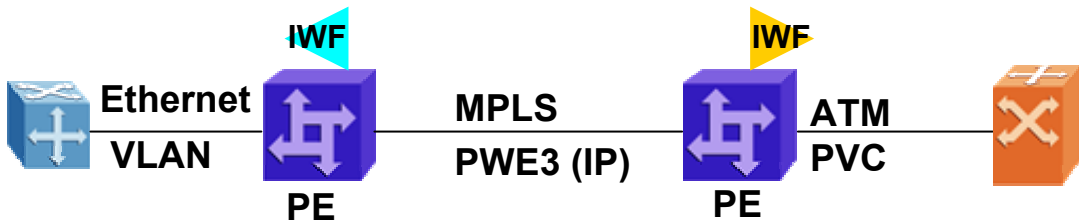
Local Switching



Single Sided IWF MPLS Pseudo-wire

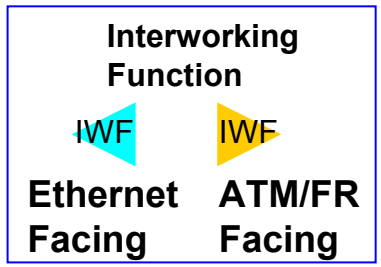


Distributed IWF IP over MPLS
(routed mode only)

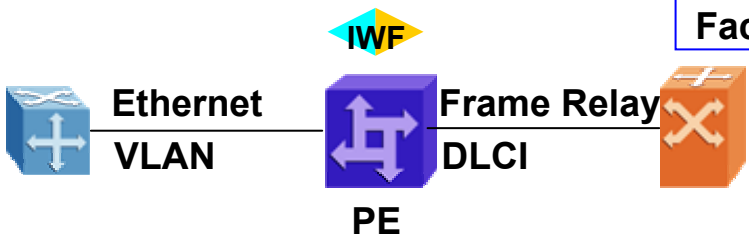


Pseudo-wire Options

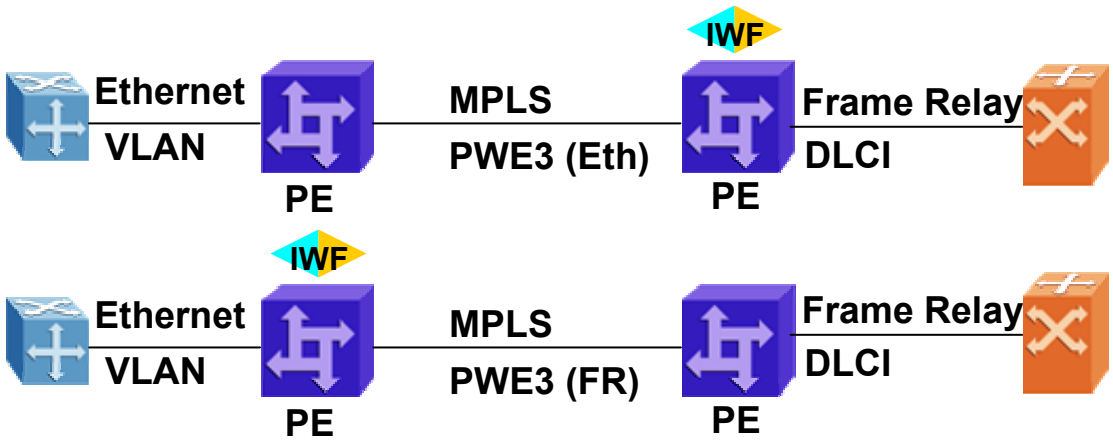
Ethernet to Frame Relay



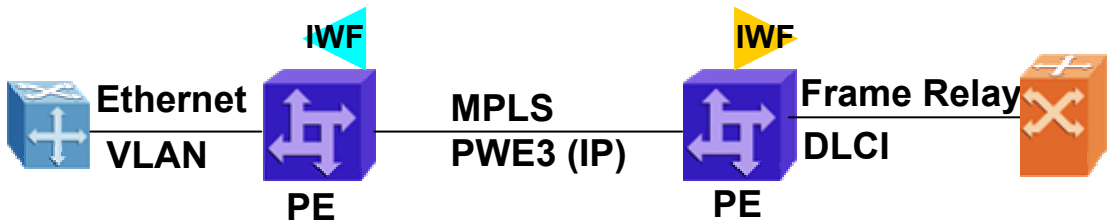
Local Switching



Single Sided IWF
MPLS Pseudo-wire

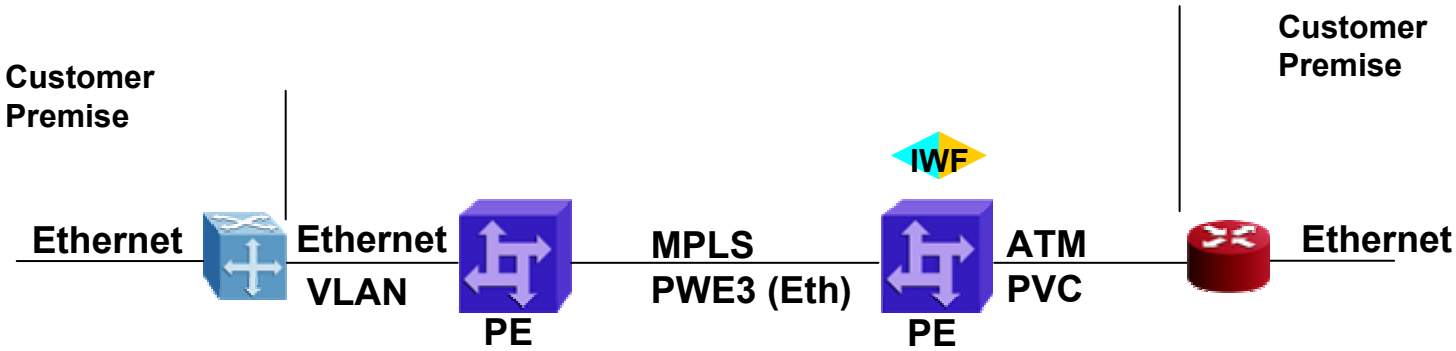


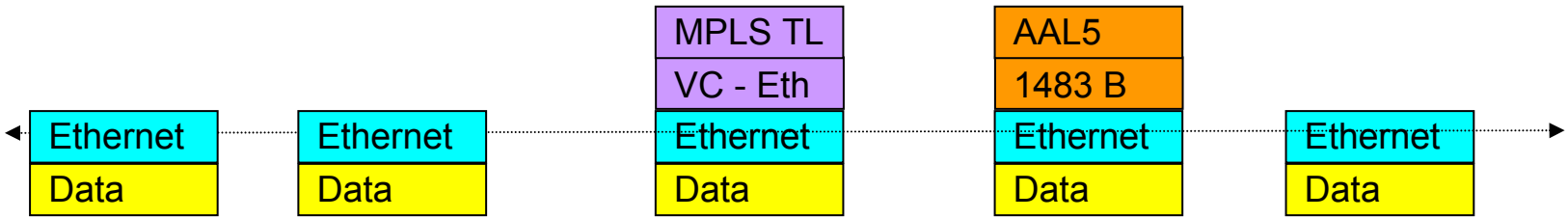
Distributed IWF
IP over MPLS
(routed mode only)

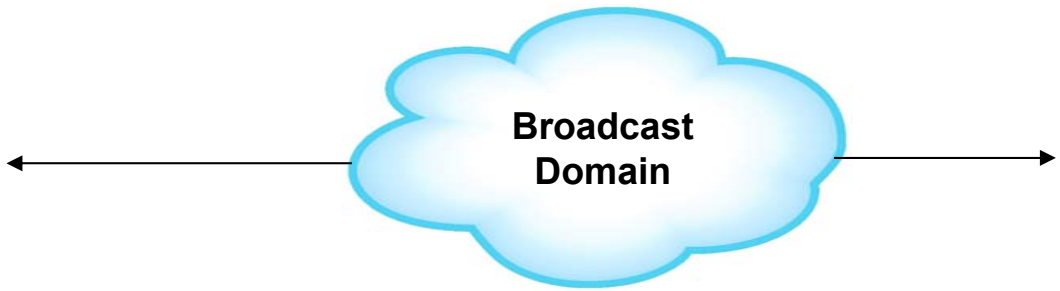


RFC 2684 (1483) Bridged Mode

Packet Walkthrough

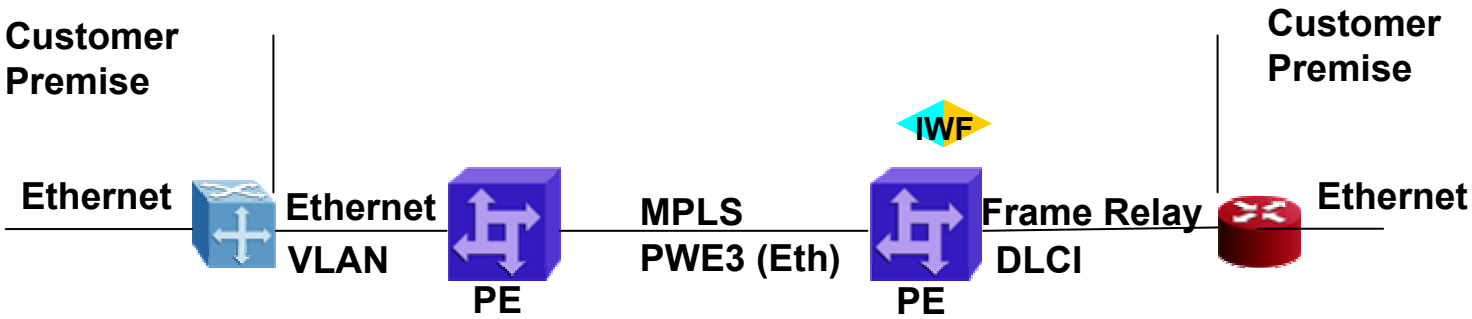


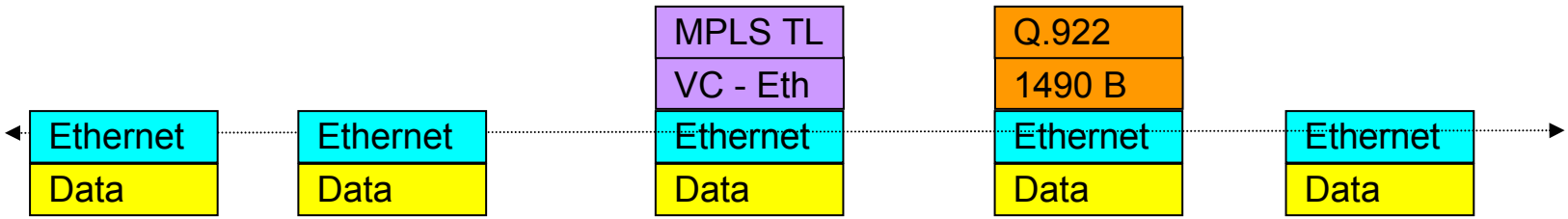


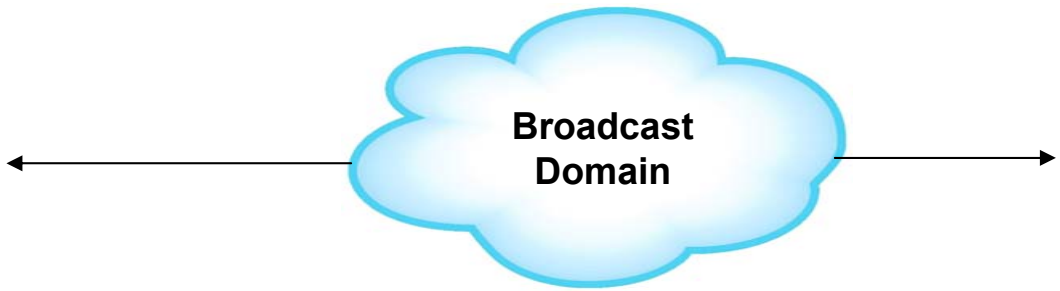


RFC 2437 (1490) Bridged Mode

Packet Walkthrough

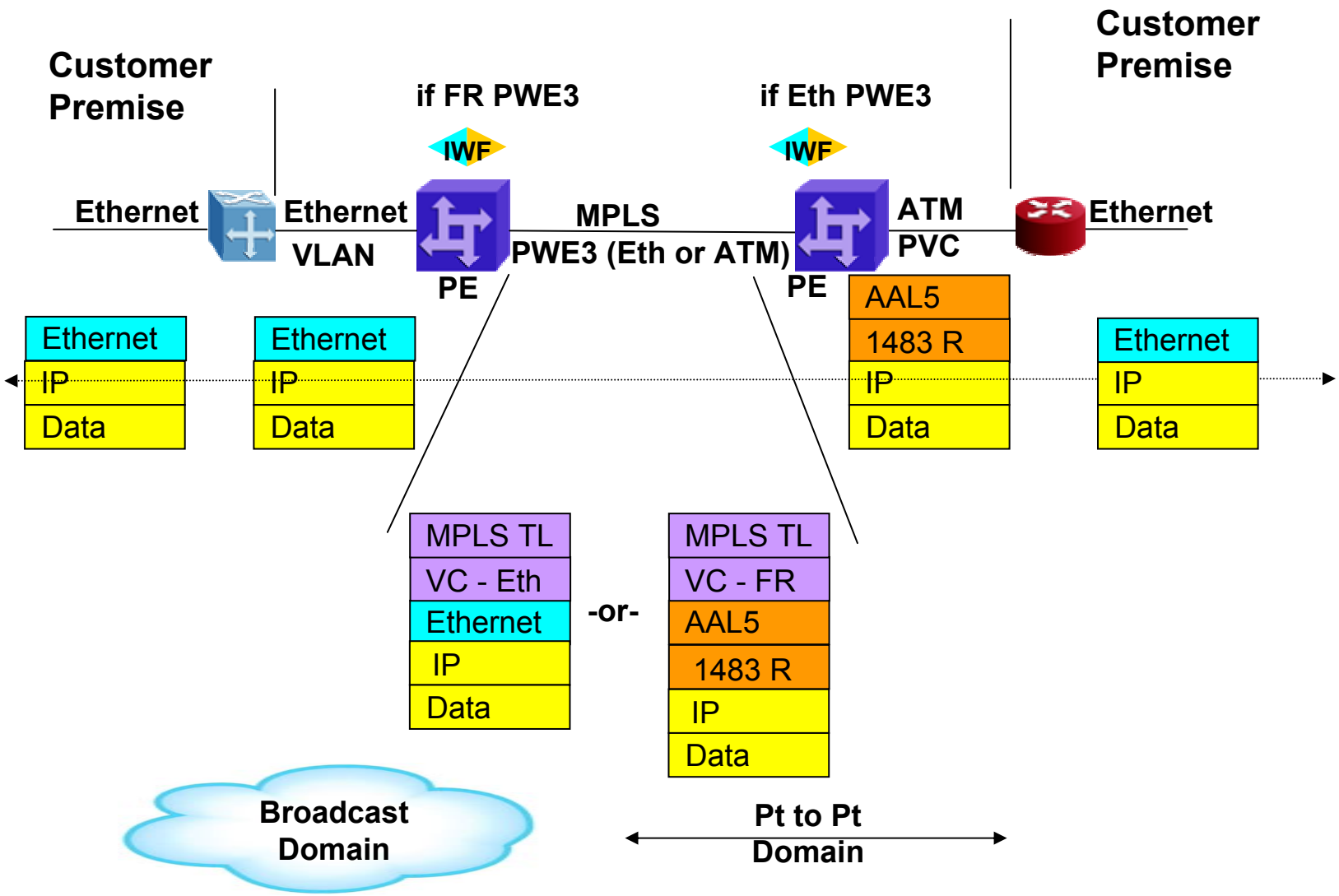






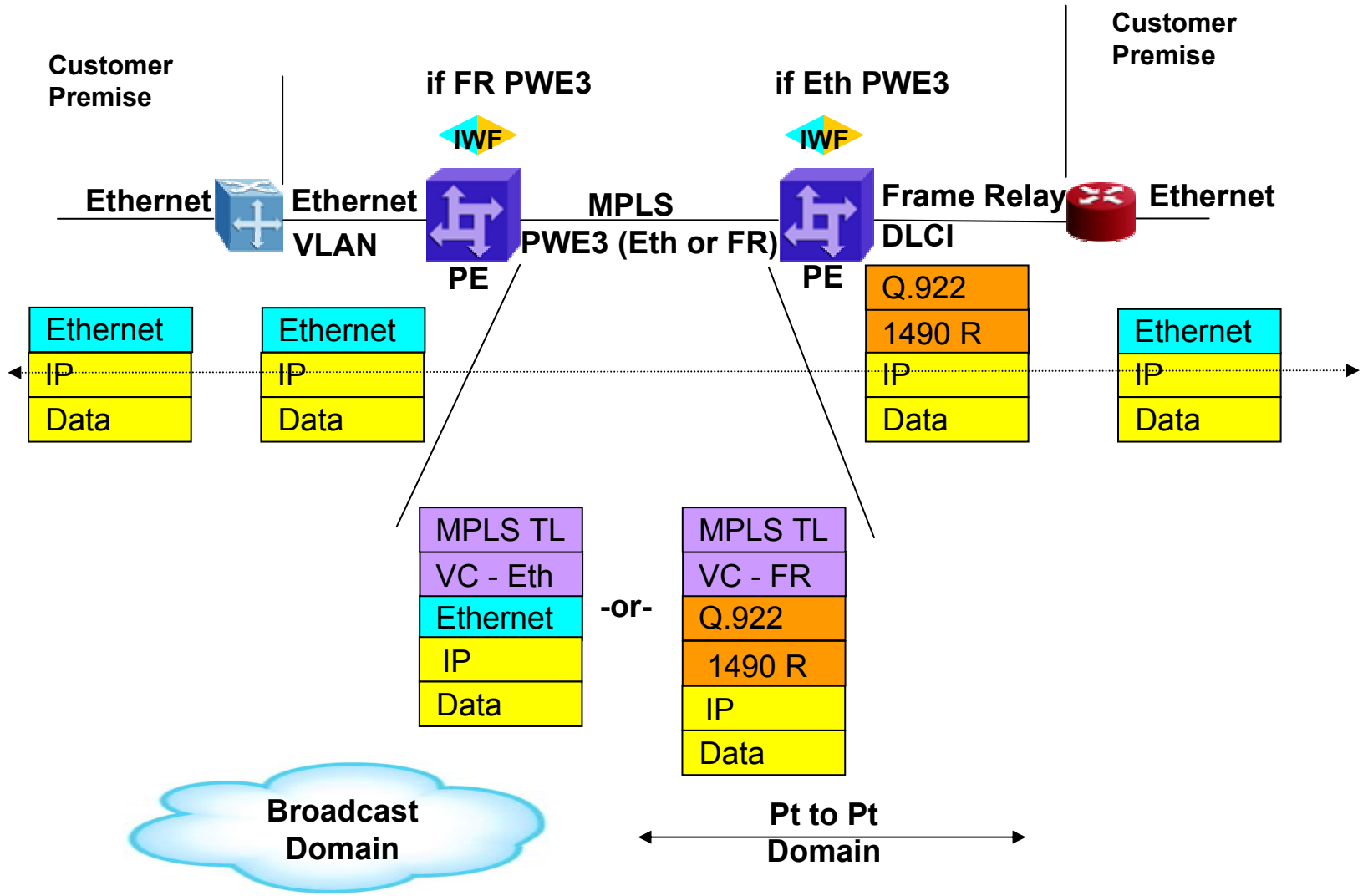
RFC 2684 (1483) Routed Mode

Packet Walkthrough



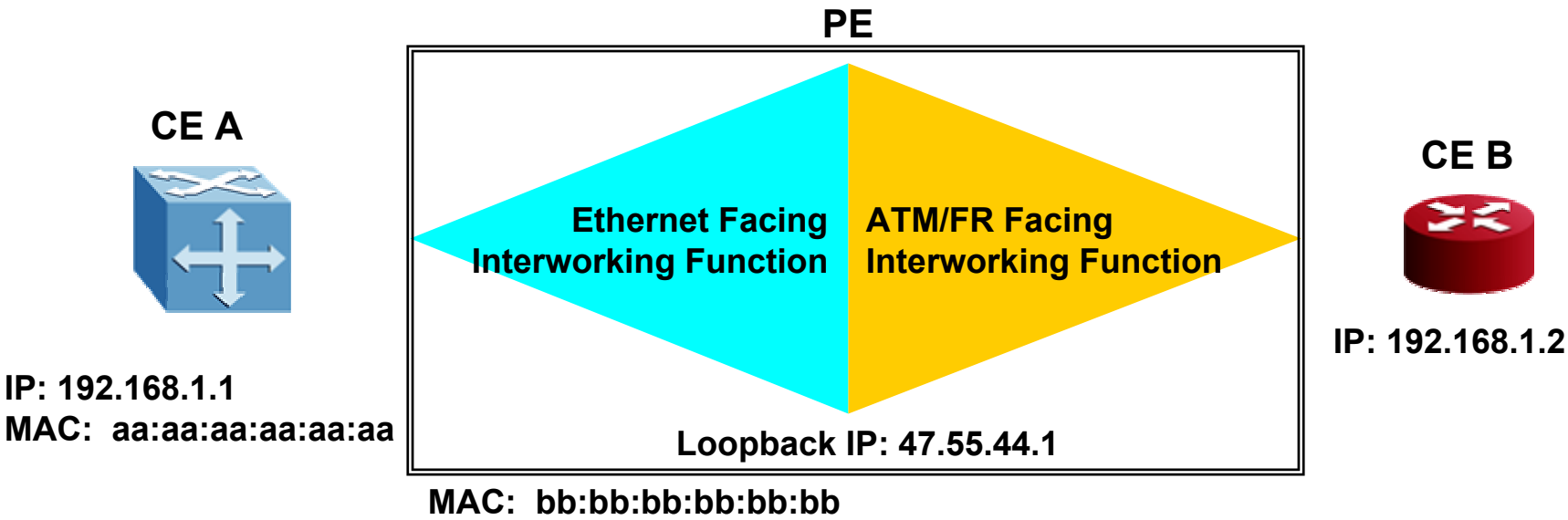
RFC 2437 (1490) Routed Mode

Packet Walkthrough



Routed Interworking

PE Device

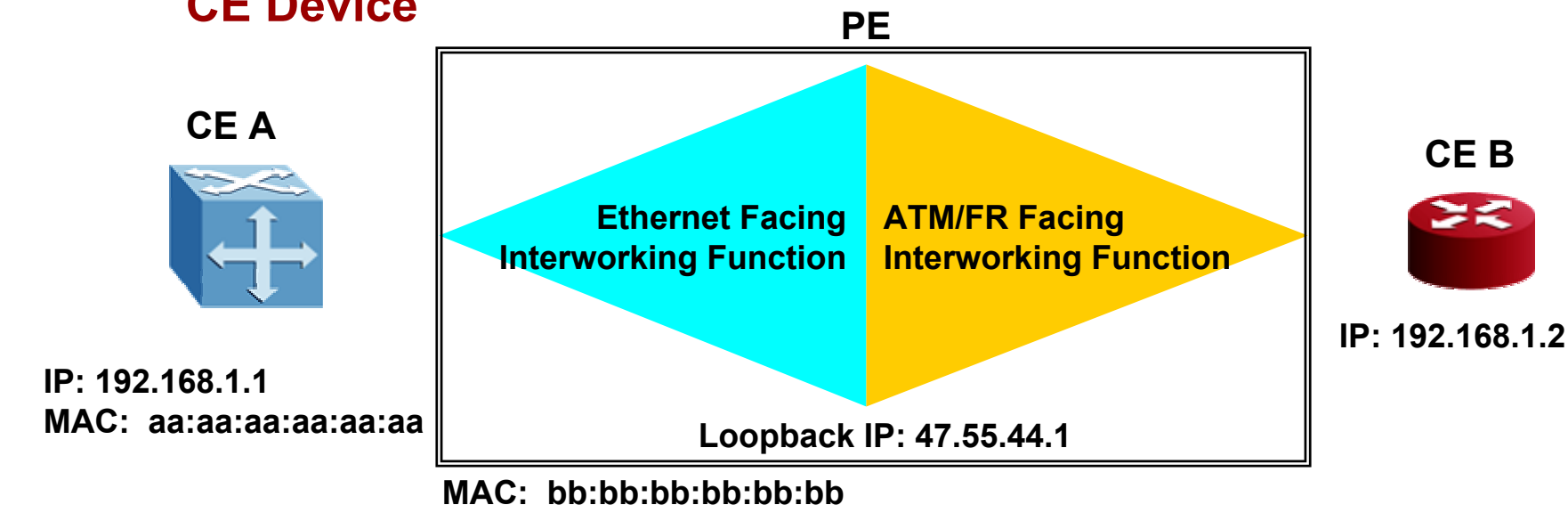


- Remove ATM/FR Data link header
- Add Ethernet Data link header
  - Source MAC = PE interface MAC
  - Destination MAC = Eth CE Interface MAC

PE (Eth IWF) must know the hardware address of CE A

Routed Interworking

CE Device



CE send packets destined for next hop = CE B (192.168.1.2) to hardware address bb:bb:bb:bb:bb:bb

IWF forwards all IP packets received on interworking interface (port, VID) to appropriate PVC

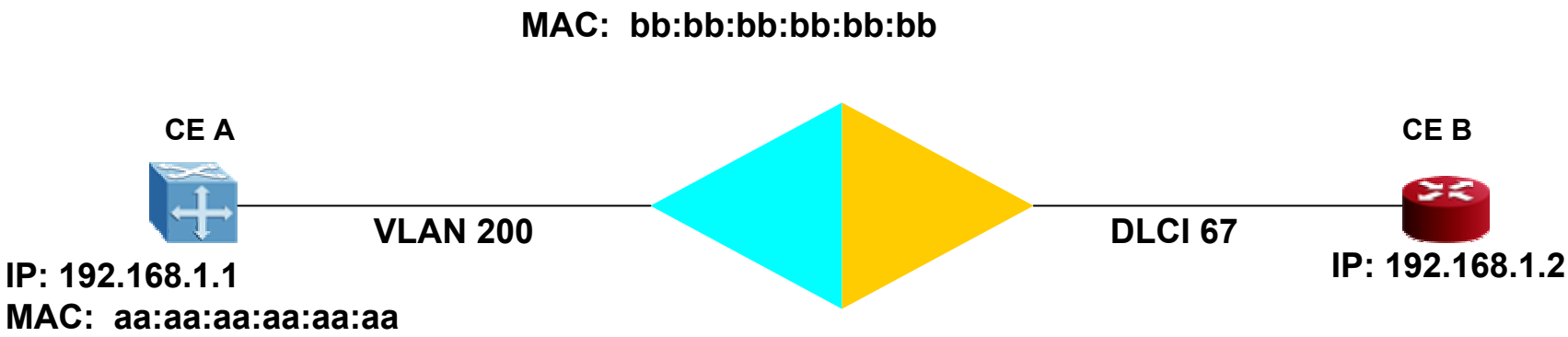
CE A must have Eth IWF hardware address for next hop = CE B

ARP Mediation

- **Static mapping IP Address to Hardware Address**
  - Configuration on CE & PE
- **Provision IWF with CE IP Addresses**
  - Hardware address discovered through ARP Mediation
- **Dynamic Discovery of CE Addresses**
    - ‘Sniffing’ packets received from CE
    - Send ICMP RDP

Dynamic Discovery OSPF Example

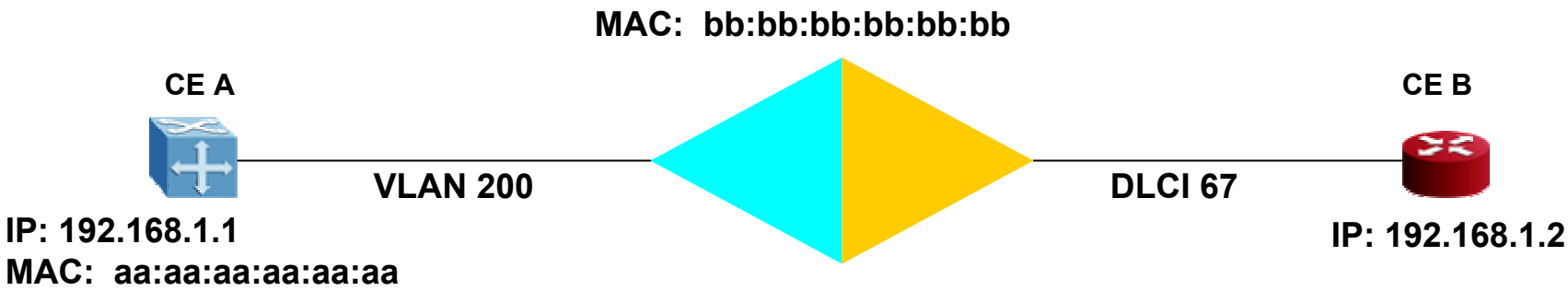
Ethernet side of IWF: IWF to CE forwarding



1. **CE A sends hello packet**
   Data Layer - DA MAC = 0100.5E00.0006 SA MAC = aaaa.aaaa.aaaa VID = 200
   IP Layer – DST IP = 224.0.0.5 SRC IP = 192.168.1.1
2. **IWF forwards hello packet to DLCI 67**
3. **Ethernet side of interworking function learns CE A Addressing**
4. **IWF can now forward packets from CE B to CE A**

Dynamic Discovery OSPF Example

Ethernet side of IWF: CE to IWF forwarding

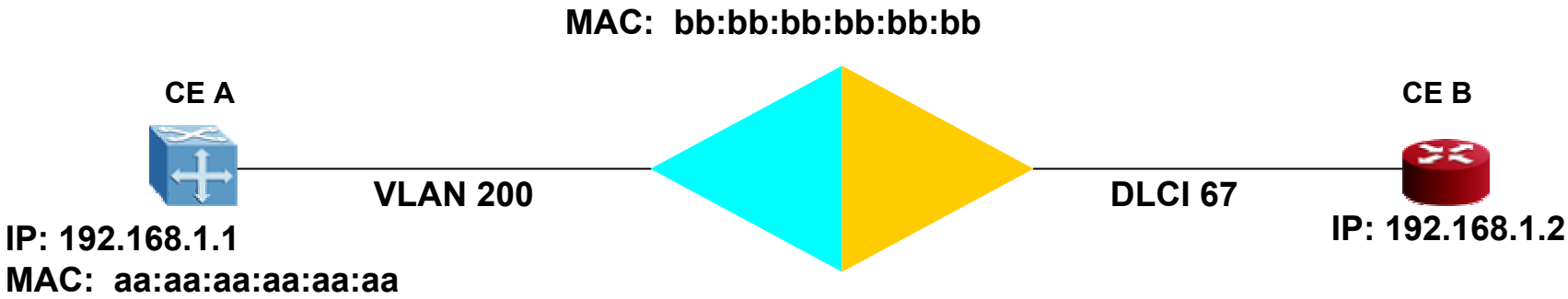


1. CE A sends ARP request on VLAN 200 for Next hop IP address
2. IWF sends ARP reply with MAC = bb:bb:bb:bb:bb:bb
3. CE A can now forward packets to CE B

NOTE – interworking circuit must be point to point and contain only 2 customer routers

Dynamic Discovery OSPF Example

FR side of IWF

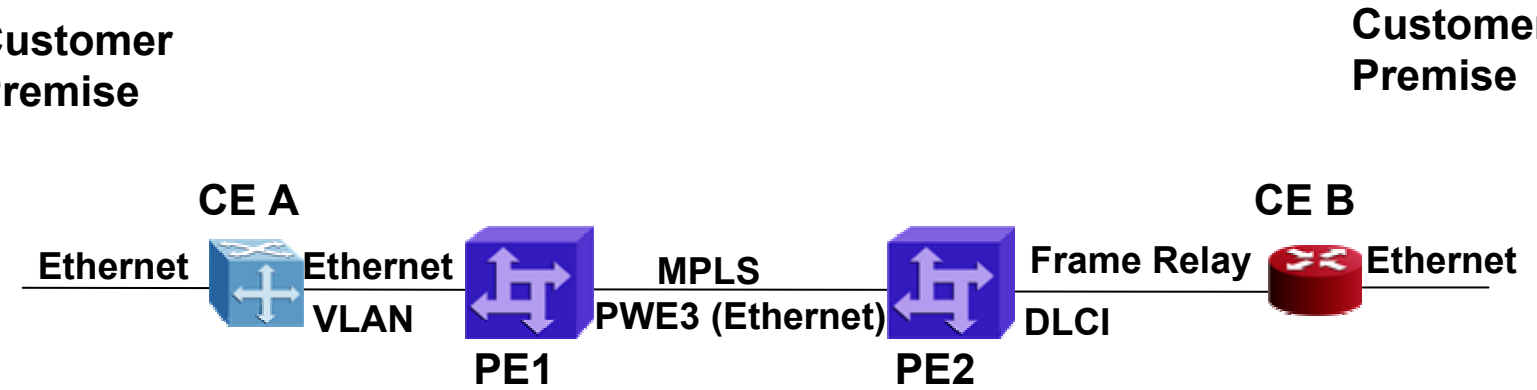


Interworking function remove/apply data link layer header

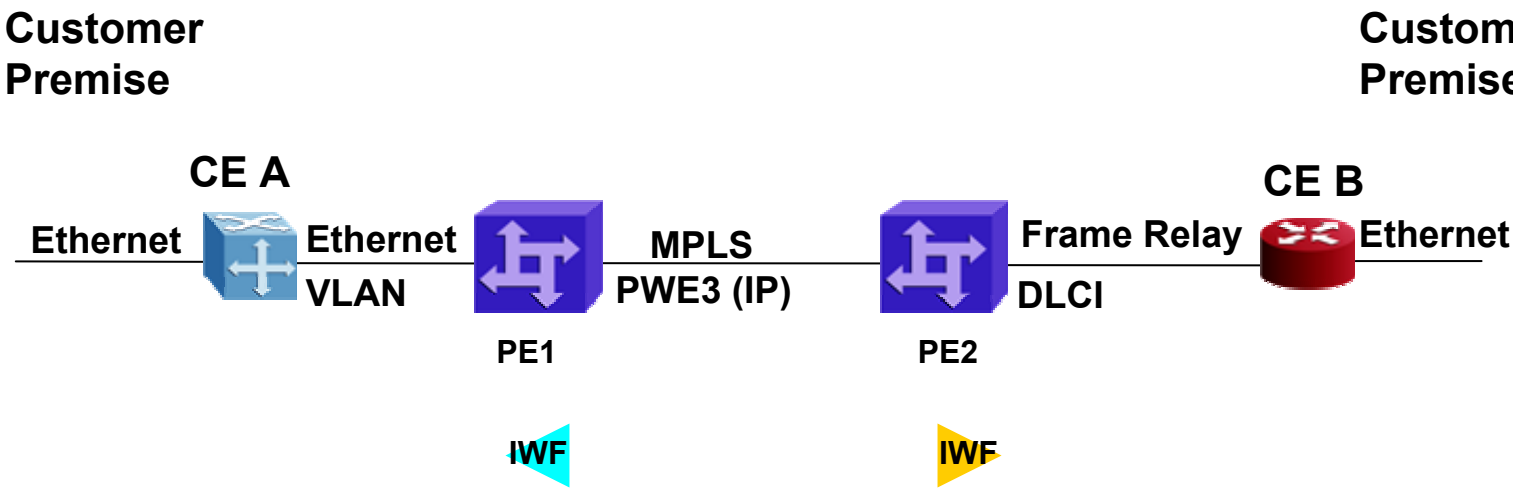
IWF can respond to invARP from CE B

NOTE – interworking circuit must be point to point and contain only 2 customer routers.

ARP Mediation
Single Sided Solution



ARP Mediation
Double Sided Solution



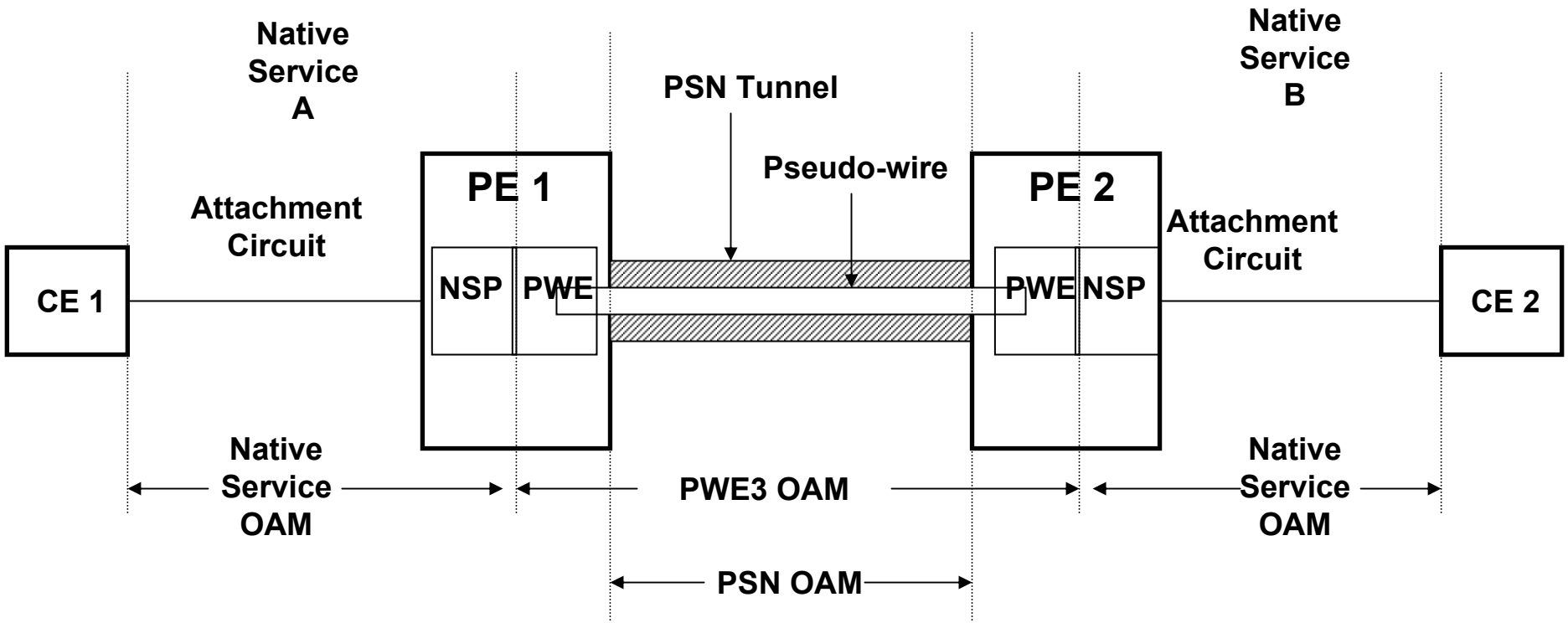
ARP Request
ARP Reply

IWF responds ARP request with MAC of interworking function

ARP Request
ARP Reply

IWF sends ARP request for IP of CE A to learn CE A MAC

Multiservice Interworking OAM Reference Model



OAM Mapping Function – Fault

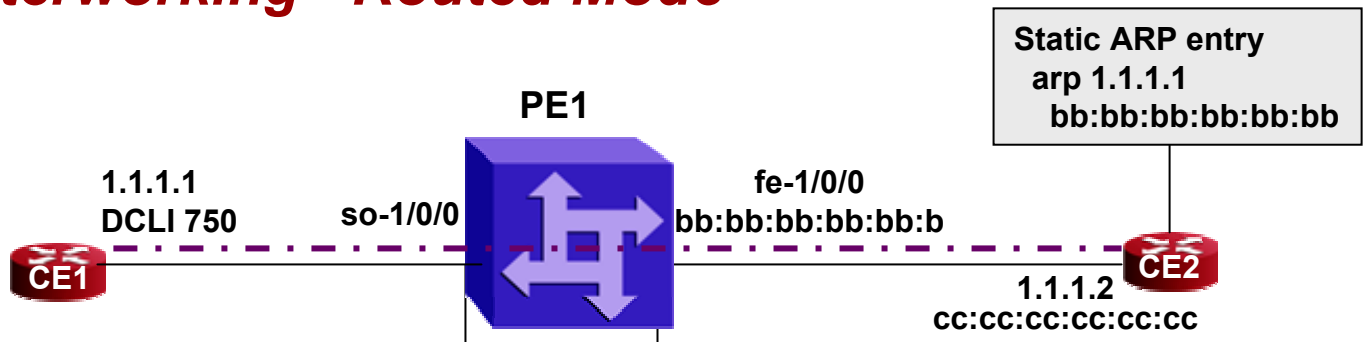
PWE3 OAM <-> Native Service OAM when Service Interworking

Function	Boundary Action	Example Technologies
Fault Diagnostics	Respond	802.3ah loopback (Ethernet port mode) F4/F5 Loopback OAM VCCV
Fault Propagation	Map OAM	802.3ah critical event (Ethernet port mode) AIS/RDI, LMI a-bit VCCV, Status TLV, Label Withdraw
Fault Detection	Further Study	VCCV + BFD ATM Continuity Check

Performance Management for Further Study

Configuration Example 4 – Juniper TCC

L2 Interworking - Routed Mode



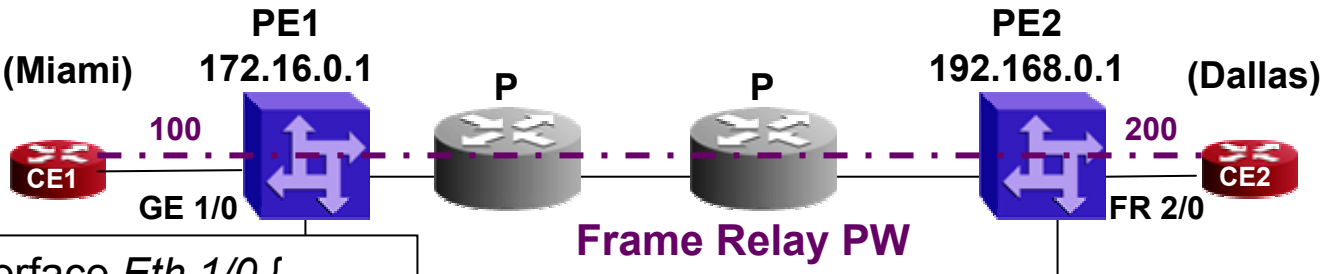

```
interfaces {
    so-1/0/0 {
        dce;
        encapsulation frame-relay-tcc
            unit 750 {
            point-to-point;
            encapsulation frame-relay-tcc
            dlci 750
        }
    }
}
```

```
interfaces {
    fe-1/0/0 {
        encapsulation ethernet-tcc
        unit 0 {
            family tcc {
                remote {
                    mac-address cc:cc:cc:cc:cc:cc
                }
```

```
protocols {
    mpls{
        interface so-1/0/0.750
        interface fe-1/0/0.0
    }
    connections {
        interface-switch FR-to-Ether {
        interface so-1/0/0.750
            interface fe-1/0/0.0
        }
    }
}
```

Configuration Example 5 - Nortel

FR-Ethernet Interworking – Routed Mode with ARP Mediation




```
interface Eth 1/0 {
  unit 10 {
    vlan-id 100
    vpws {
      interworking ip
      discovery { }
    }
  }
}
```

```
pseudo-wires {
  agi 1 {
    sa 10100 {
      net-encapsulation fr-dlci
      interface eth 1/0.10
      ta 20200 {
        neighbor 192.168.0.1
      }
    }
  }
}
```

```
FR 2/0 {
  unit 20 {
    dlci 200
    vpws { }
  }
}
```

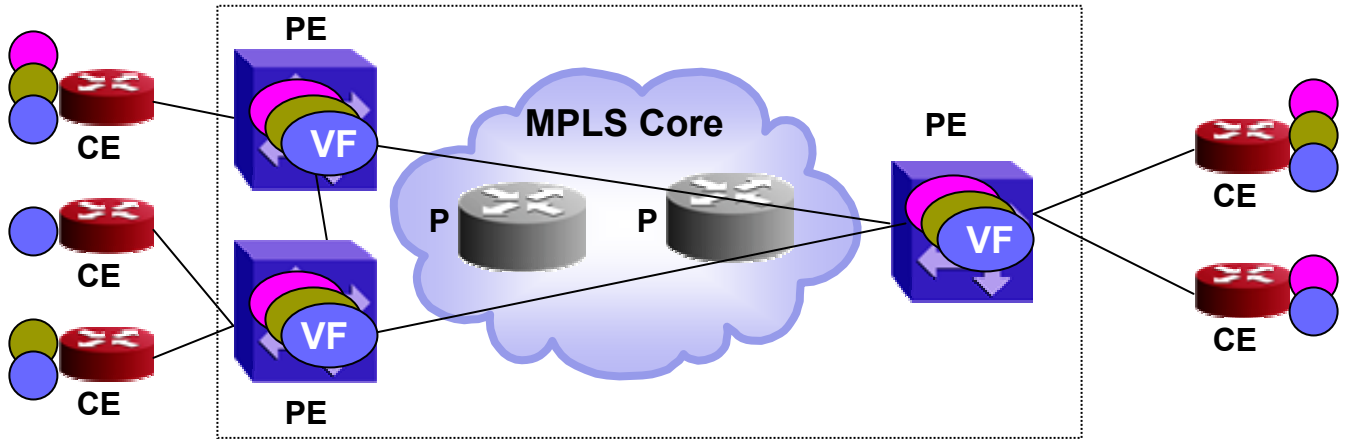
```
pseudo-wires {
  agi 1 {
    sa 20200 {
      net-encapsulation fr-dlci
      interface fr 2/0.20
    }
  }
}
```

Agenda

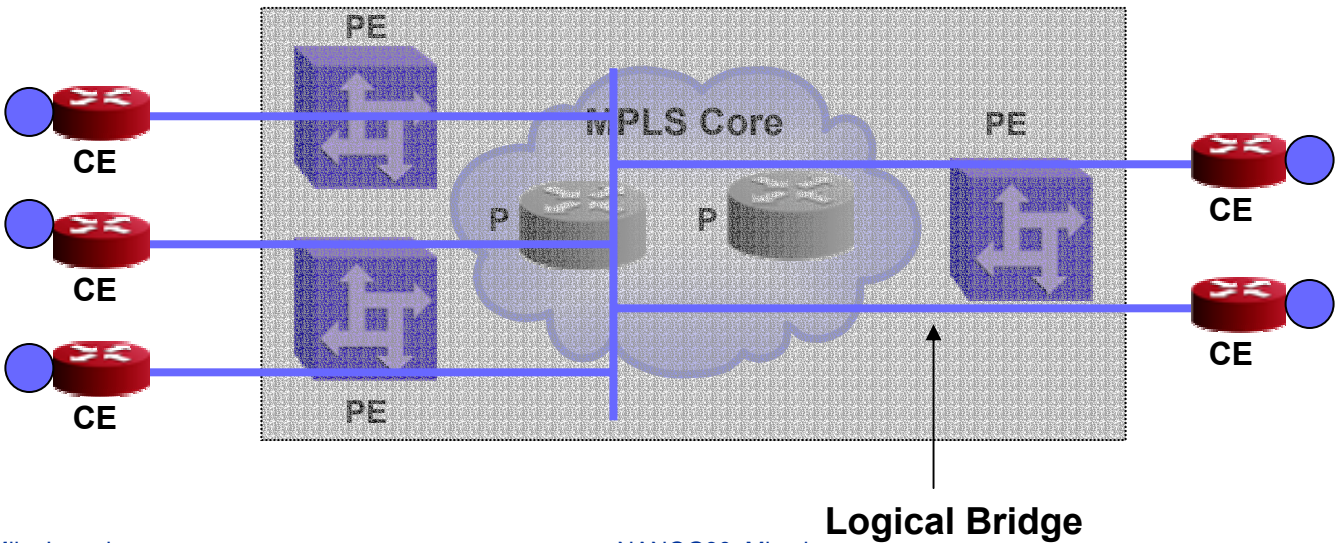
- Introduction to L2VPNs over MPLS
- IETF Generic Models (L2VPNs)
- Virtual Private Wire Service (VPWS)
- Layer 2 Service Interworking
- **Virtual Private LAN Service (VPLS)**
- **Summary**

Virtual Private LAN Service (VPLS)

Service Provider View



Enterprise View



VPLS Completes A2A Portfolio

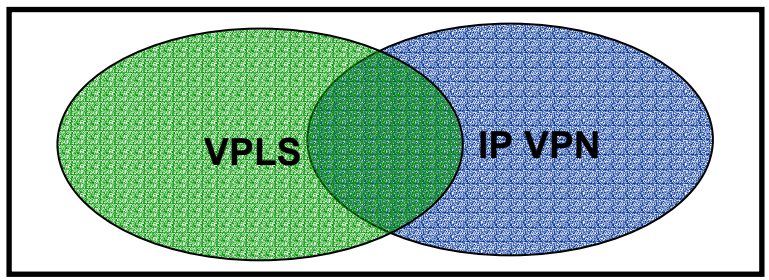
Value for Enterprises

- **Any to Any connectivity** - Shared BW pool for HQ, Datacenter
- **L2 Service** - No L3 peering required – trust, security, outsourcing concerns
- **Low cost intra-metro service**
- **No CE re-configuration, L3 addressing independence**

Value for Service Providers

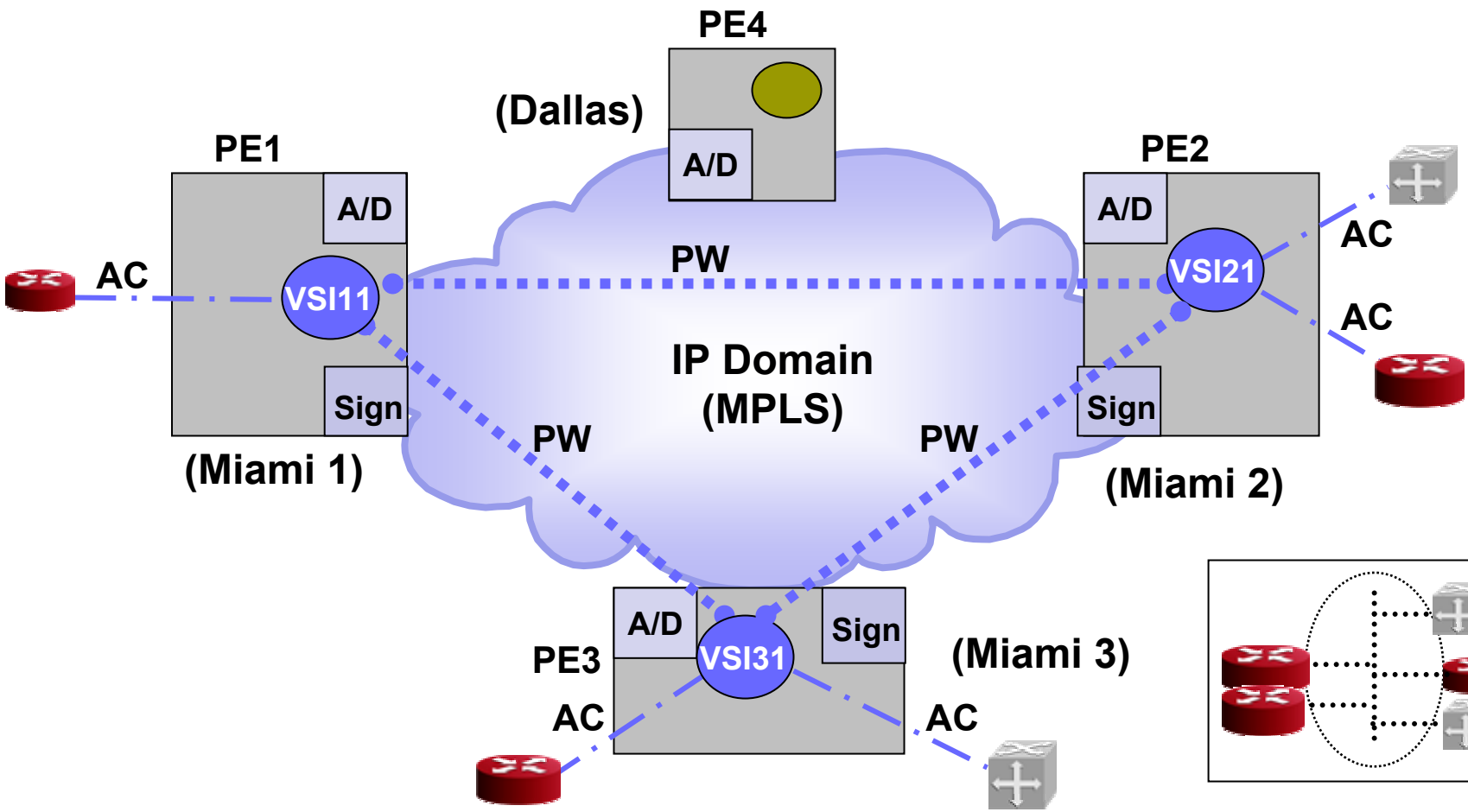
- **Simplified provisioning**
  - Rapidly turn up services and reduce OPEX
  - No route policies, no L3 protocols – simply define VLAN handoff and SLA
- **Extend, Scale Metro Ethernet offerings**
- **Re-use core MPLS infrastructure**

Complimentary service offering to IP VPN



Expands addressable Any to Any VPN Market!

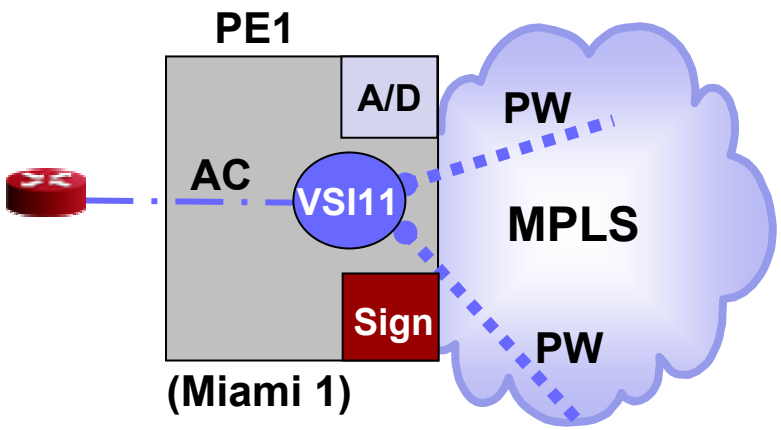
VPLS – Control & Data Plane Components



- A/D = Auto-discovery of PEs that contain at least one site in Blue VPN
- Sign = PW Signaling – should link all the Blue VSIs via a full mesh of PWs
- Virtual Forwarder called Virtual Switched Instance (VSI)

VPLS Models: LDP-VPLS versus BGP-VPLS

(draft-ietf-ppvpn-vpls-ldp-00.txt, draft-ietf-ppvpn-vpls-bgp-00.txt)



Commonalities

- **Pseudo-wire Encapsulation (PWE3)**
- **Data Forwarding: MAC Learning, etc..**
- **BGP for Auto-discovery**
  - Included in BGP-VPLS specification
  - Being specified for LDP-VPLS

Major Difference

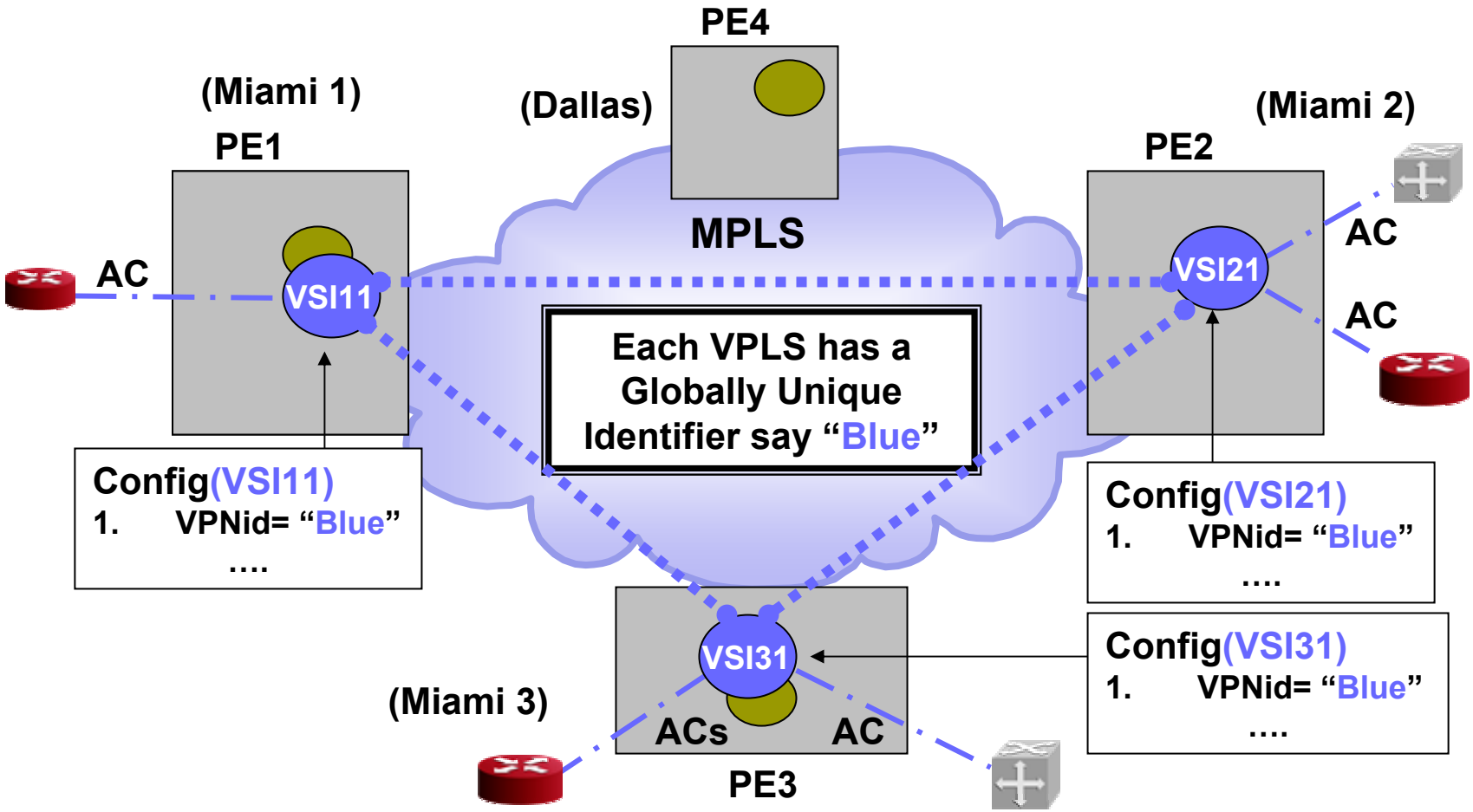
What to use for Pseudo-wire Signaling?

- BGP-VPLS – BGP
  - For both Auto-discovery and Signaling
- LDP-VPLS – LDP

Signaling discussion for LDP-VPLS
- Data Plane details apply to both Models

VPLS Information Model

General Addressing Philosophy

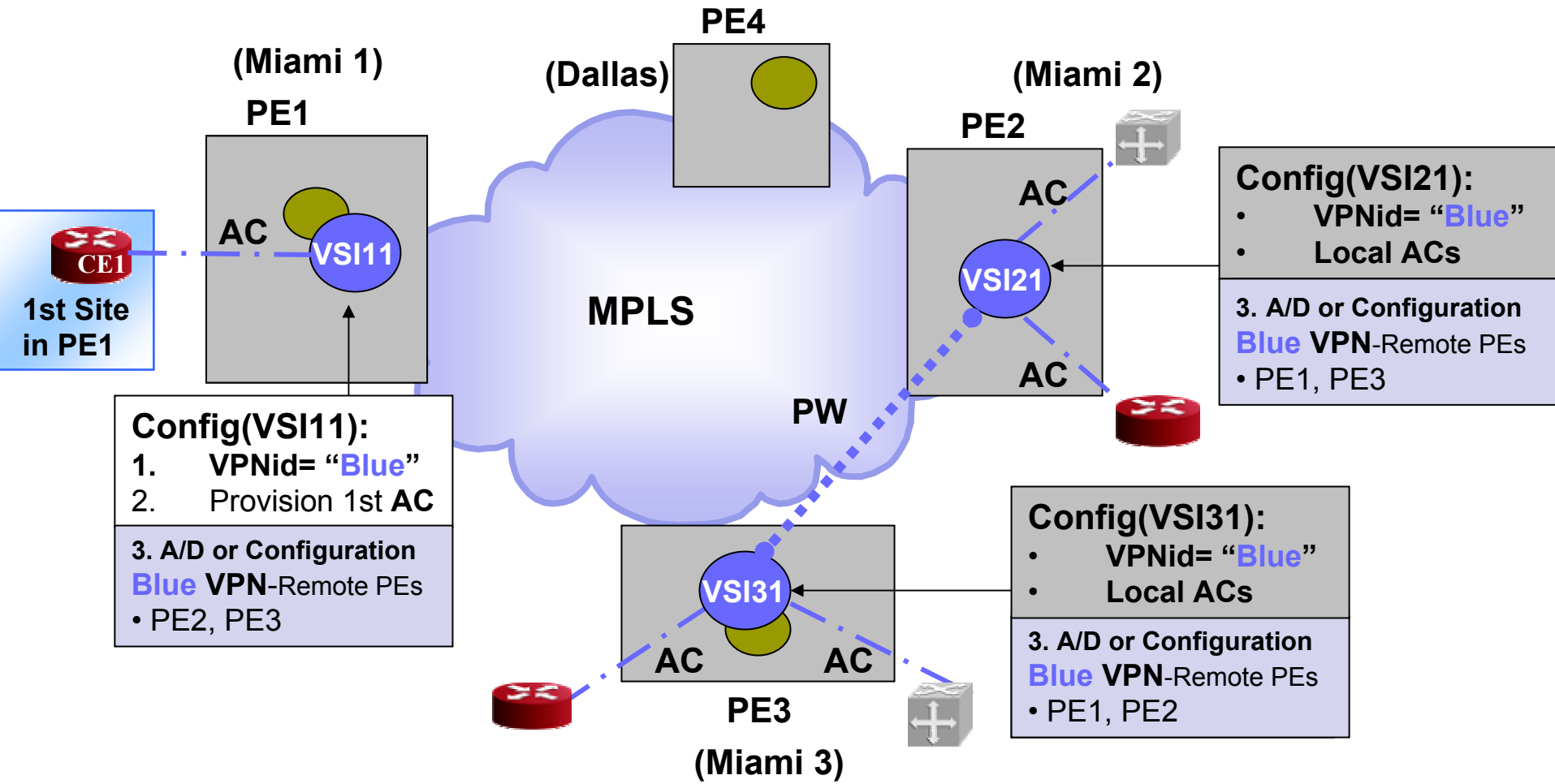


PW Endpoint uniquely identified by <PE IP, VPNid>

- *I need to interconnect through signaling just the VSIs not the ACs*
- *Full Mesh of PWs – no variations in topology*

VPLS Information Model

Configuring a new VSI on PE1

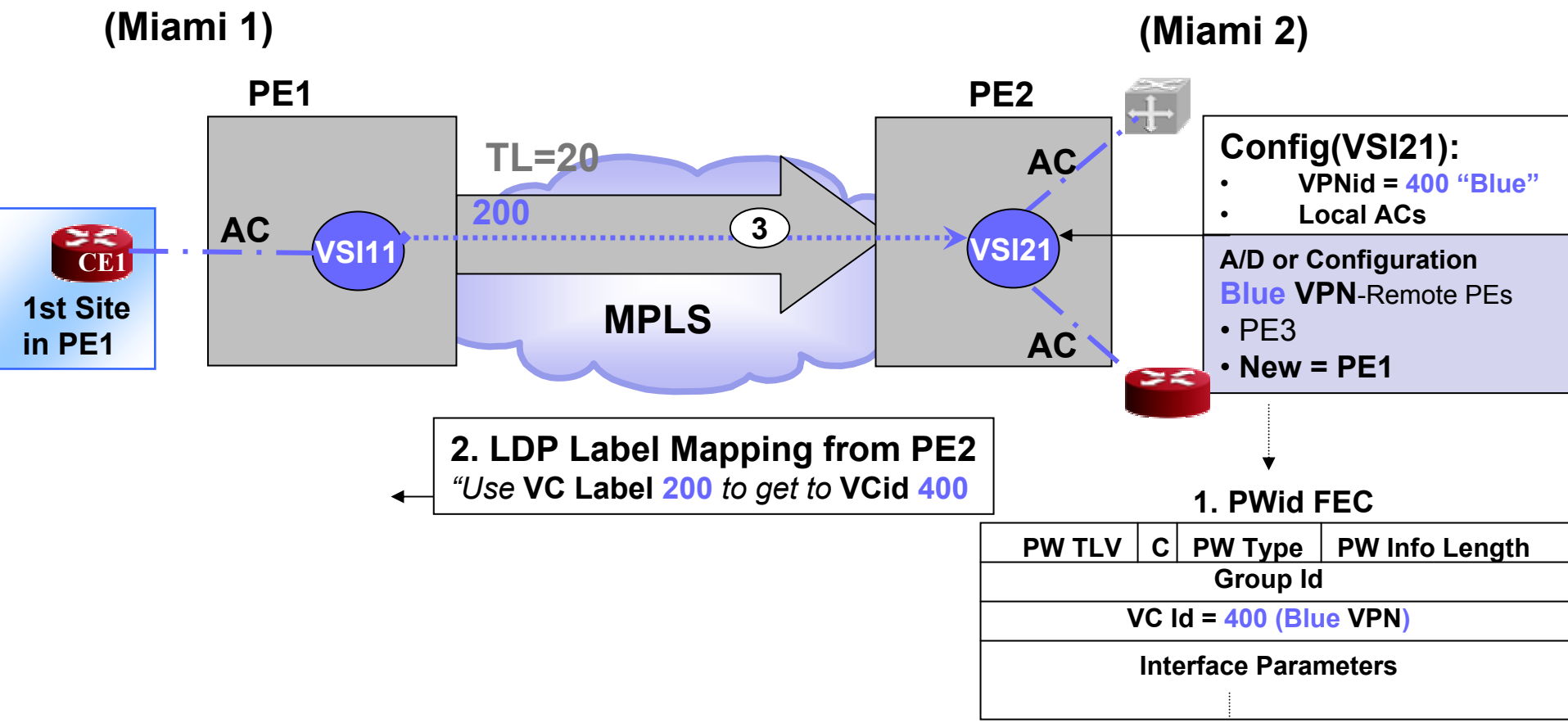


List of (related) Remote PEs could be generated by an A/D process (BGP)

- Current LDP-VPLS draft - Manual Configuration

VPLS-LDP – Signaling Transport PWs

Using PWid FEC to identify VSIs as PW Endpoints

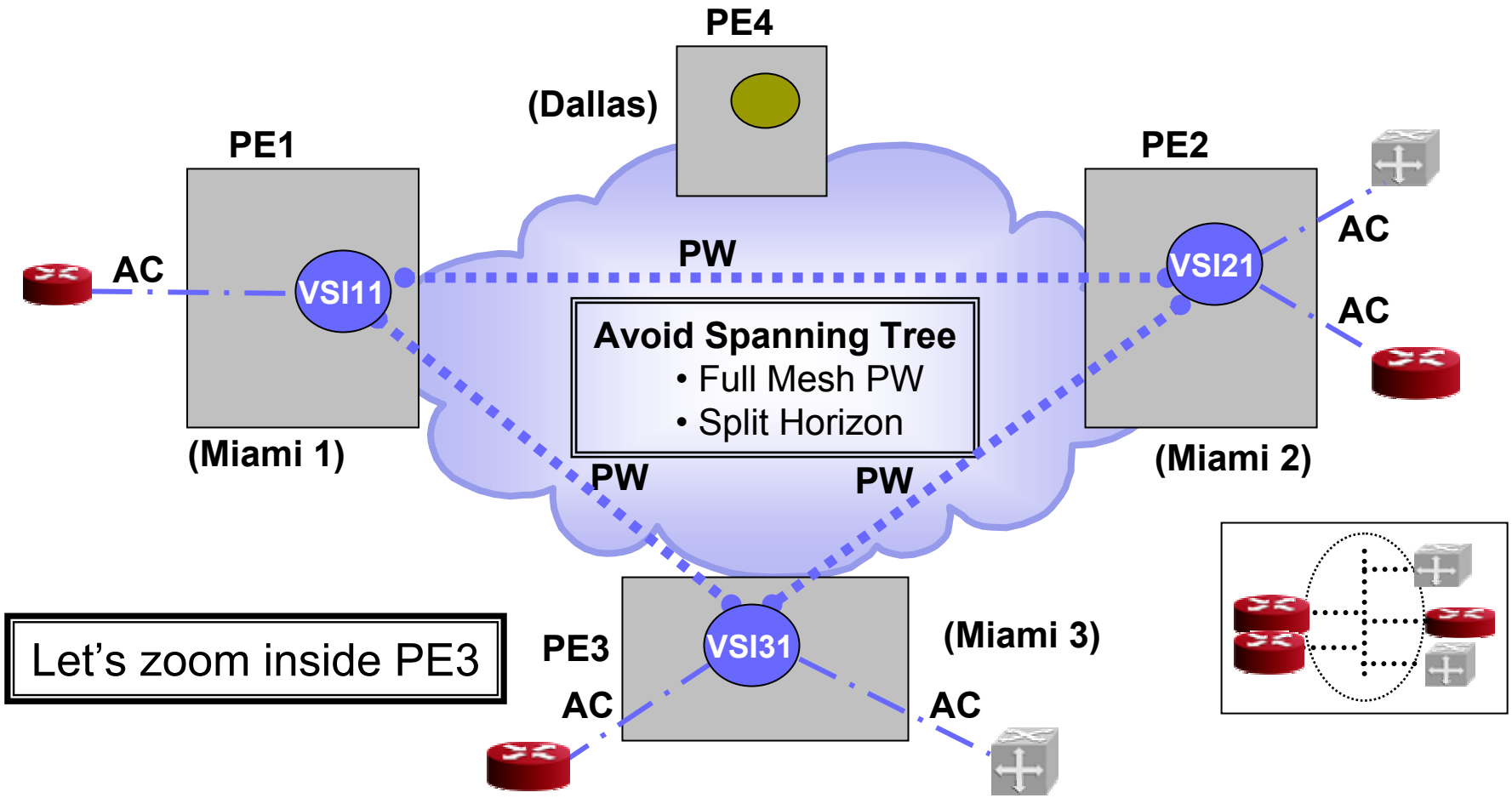


Similar procedure with the setup of Individual pt2pt VC

- ***but PW connects logical entities not ACs on physical ports***

VCid has to be unique per network – Identifies a VPLS Service

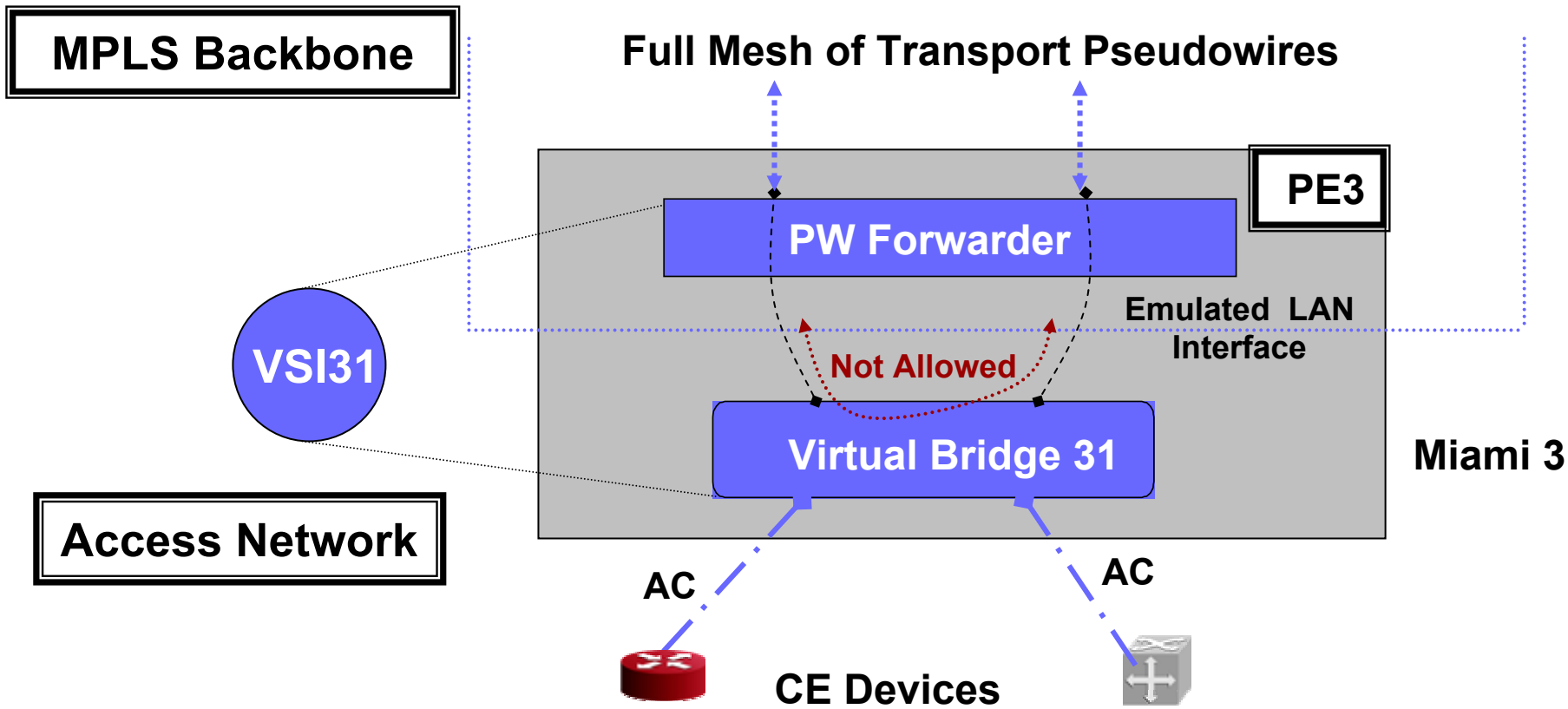
VPLS Data Plane – High Level View



Split Horizon explained in the next slide

VPLS PE Data Plane Architecture

Per VPLS Processing Entities – Split Horizon

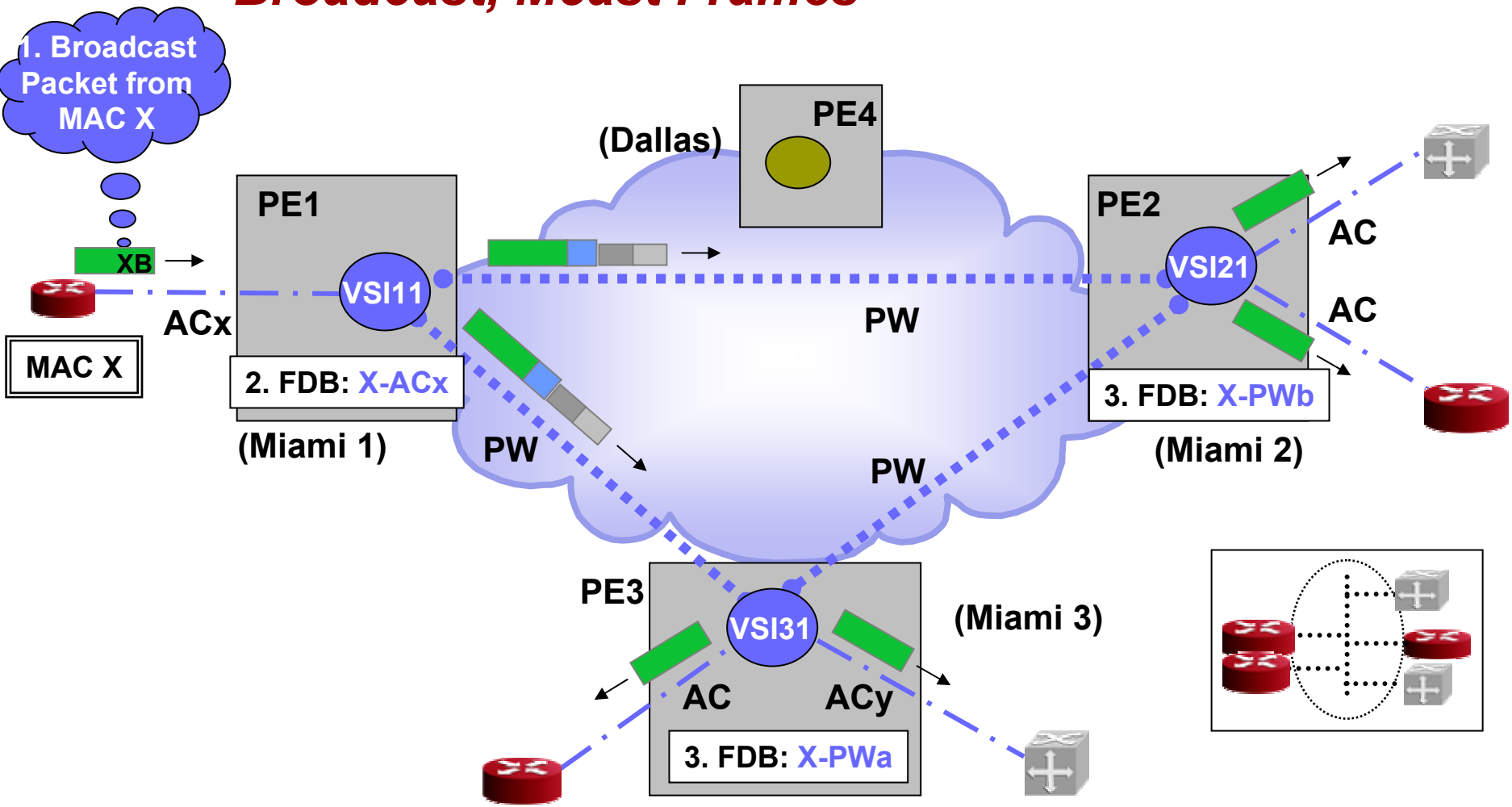


Split Horizon on each PE: do not forward between Backbone PW

- Forward just between ACs or between ACs and Backbone PWs

VPLS Data Plane – Packet Walkthrough

Broadcast, Mcast Frames

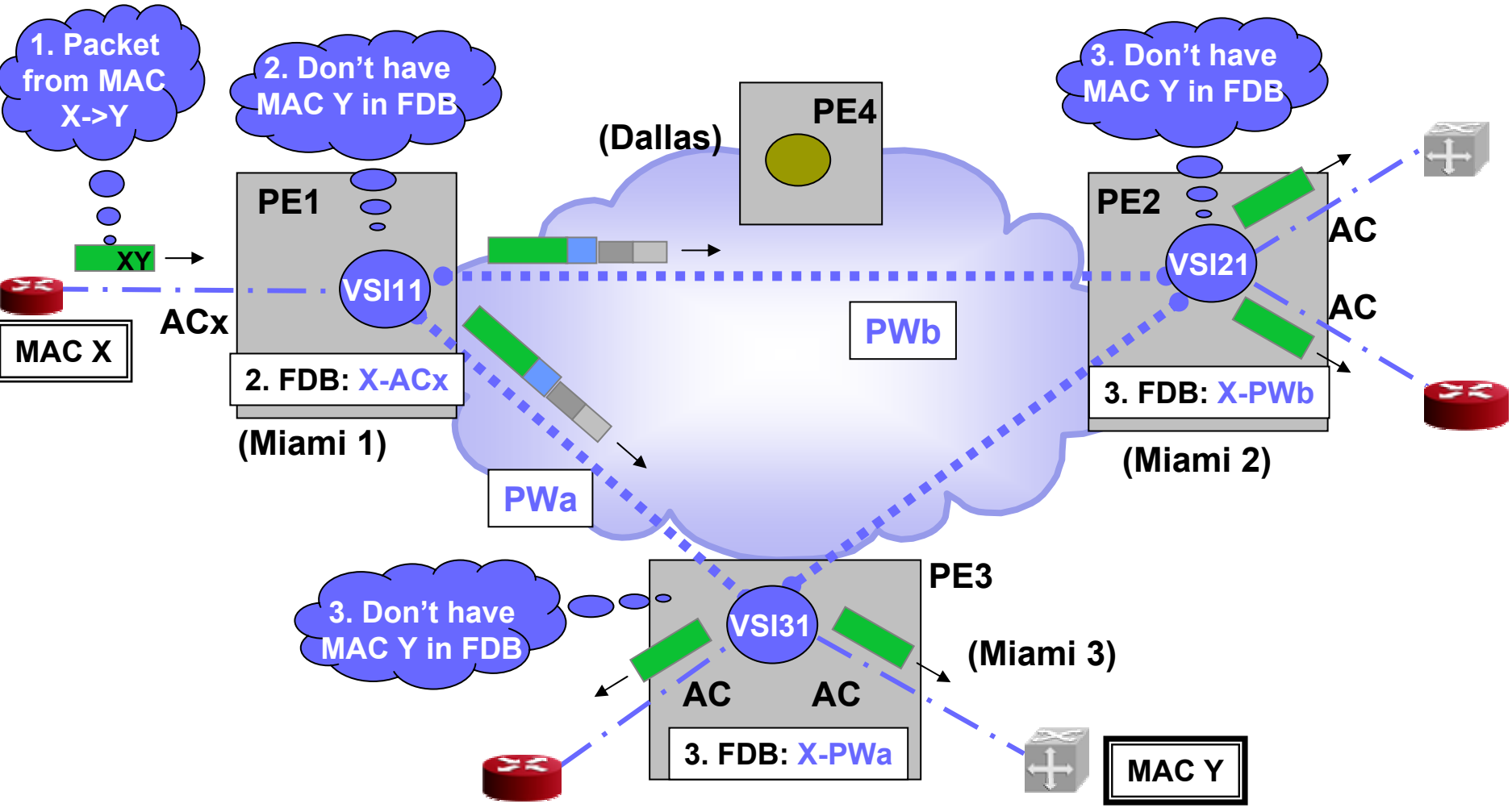


Frames Broadcasted through the Provider Network

- to any PE with at least one site in Blue VPN, replicated as needed

VPLS Data Plane – Packet Walkthrough

Unicast Frame – Broadcast Phase

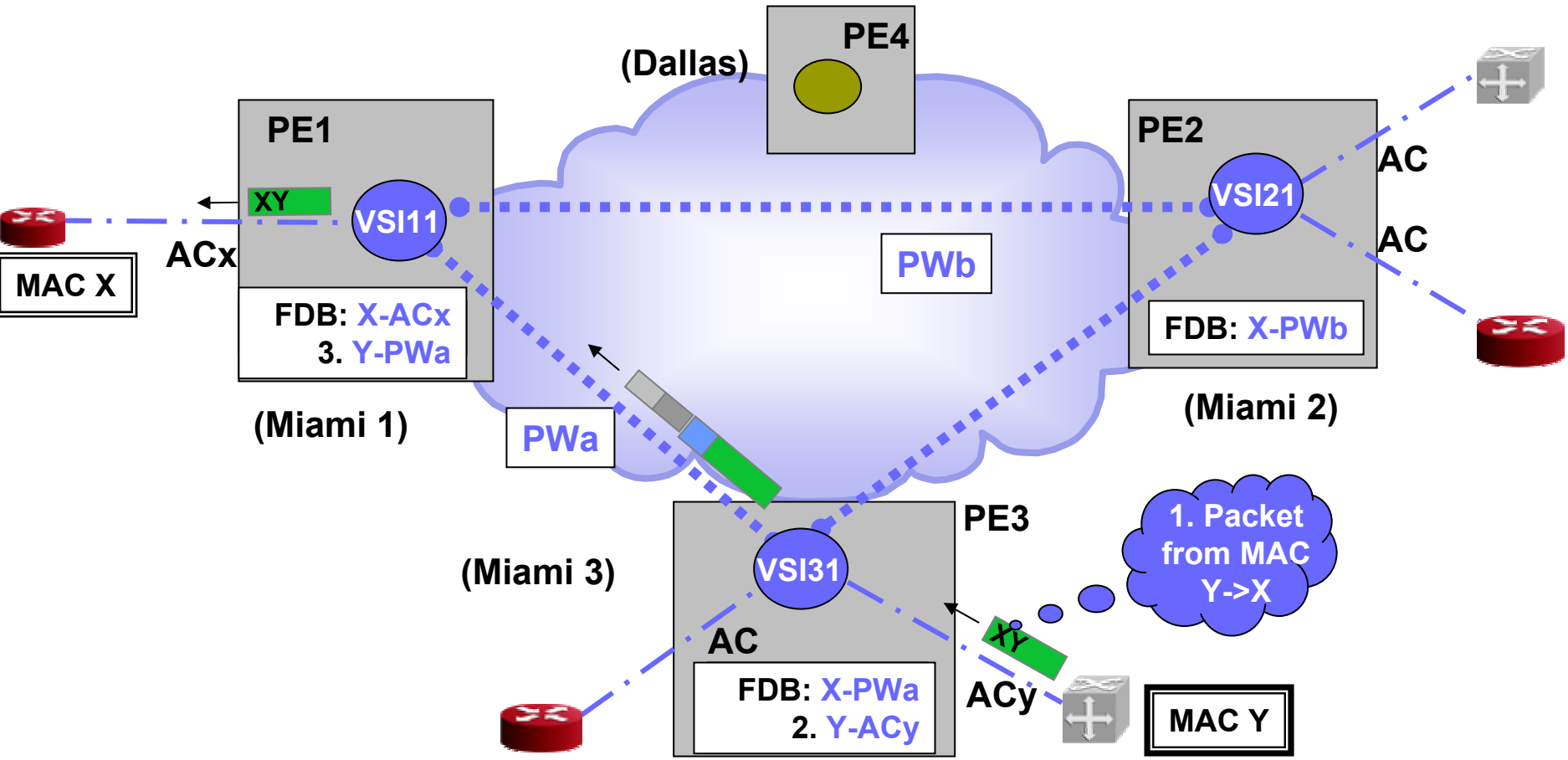


Frames Broadcasted through the Provider Network

- to any PE with at least one site in Blue VPN, replicated as needed

VPLS Data Plane – Packet Walkthrough

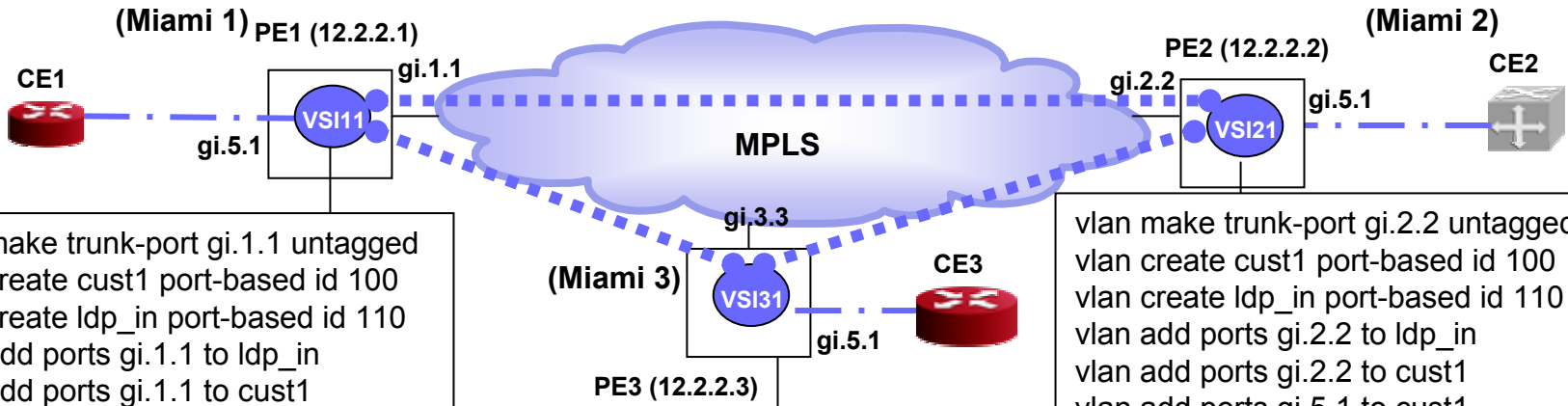
Unicast Frame – Unicast Phase



Unicast in the reverse direction is unicasted through SP Backbone

- in the same time PE2 and then PE1 learn the location of MAC Y

VPLS Configuration Example 6 – Riverstone



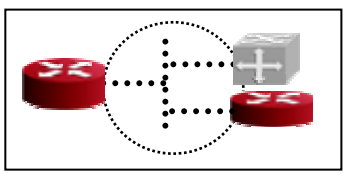

```
vlan make trunk-port gi.1.1 untagged
vlan create cust1 port-based id 100
vlan create ldp_in port-based id 110
vlan add ports gi.1.1 to ldp_in
vlan add ports gi.1.1 to cust1
vlan add ports gi.5.1 to cust1
```

```
vlan make trunk-port gi.2.2 untagged
vlan create cust1 port-based id 100
vlan create ldp_in port-based id 110
vlan add ports gi.2.2 to ldp_in
vlan add ports gi.2.2 to cust1
vlan add ports gi.5.1 to cust1
```

```
vlan make trunk-port gi.3.3 untagged
vlan create cust1 port-based id 100
vlan create ldp_in port-based id 110
vlan add ports gi.3.3 to ldp_in
vlan add ports gi.3.3 to cust1
vlan add ports gi.5.1 to cust1
```

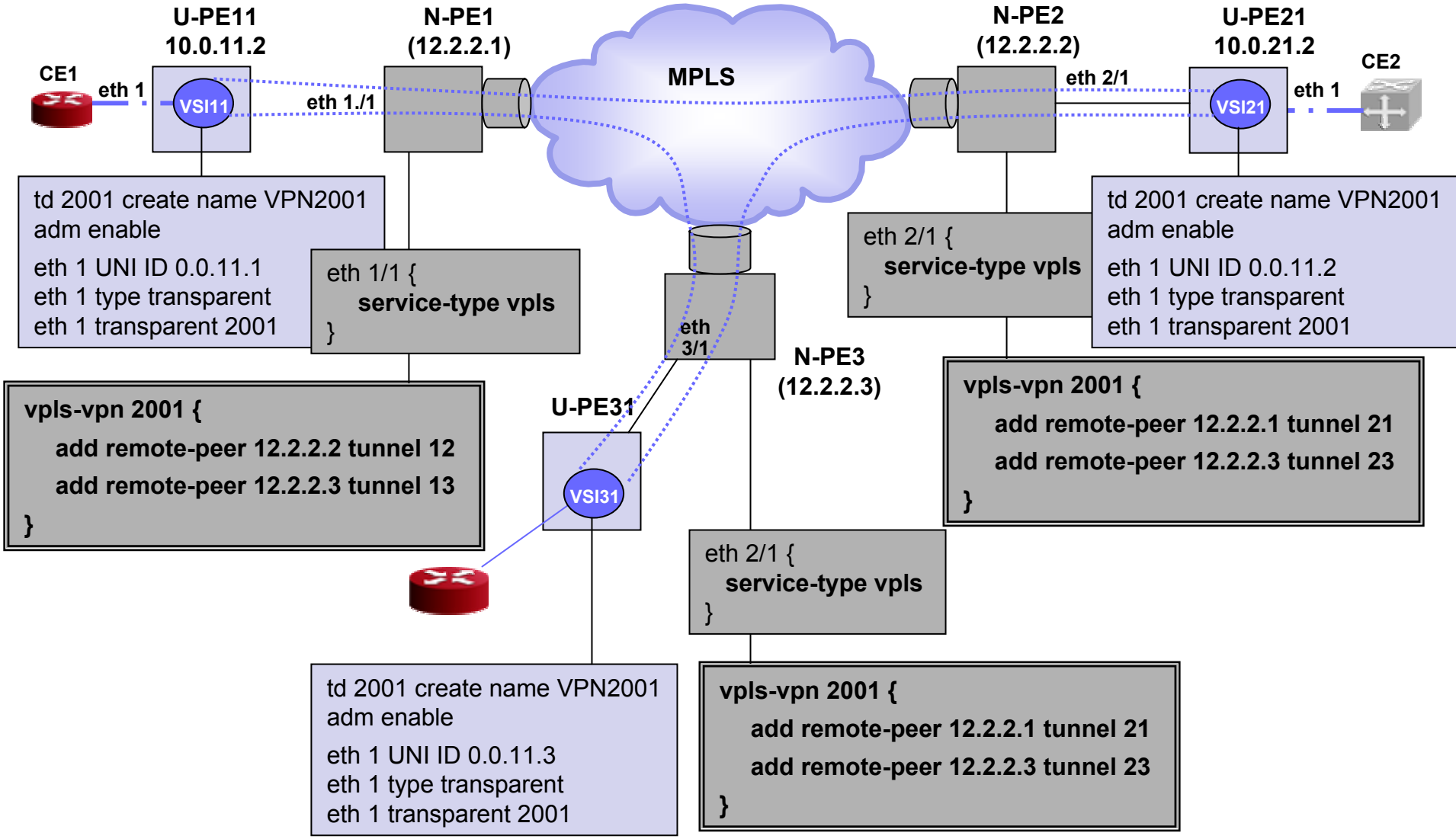
```
mpls set customer-profile BLUE customer_id 400 vlans 100
in-port-list gi.5.1  type port-vlan
ldp add remote-peer 12.2.2.2
ldp add remote-peer 12.2.2.3
ldp connect customer-profile BLUE remote-peer 12.2.2.2
ldp connect customer-profile BLUE remote-peer 12.2.2.3
```

```
mpls set customer-profile BLUE customer_id 400 vlans 100
in-port-list gi.5.1  type port-vlan
ldp add remote-peer 12.2.2.1
ldp add remote-peer 12.2.2.3
ldp connect customer-profile BLUE remote-peer 12.2.2.1
ldp connect customer-profile BLUE remote-peer 12.2.2.3
```



```
mpls set customer-profile BLUE customer_id 400 vlans 100
in-port-list gi.5.1  type port-vlan
ldp add remote-peer 12.2.2.1
ldp add remote-peer 12.2.2.2
ldp connect customer-profile BLUE remote-peer 12.2.2.1
ldp connect customer-profile BLUE remote-peer 12.2.2.2
```

VPLS Decoupled Model - Configuration Example 7 Nortel



Agenda

- Introduction to L2VPNs over MPLS
- IETF Generic Models (L2VPNs)
- Virtual Private Wire Service (VPWS)
- Virtual Private LAN Service (VPLS)
- Layer 2 Interworking
- **Summary**

Summary

Common Building Blocks for All L2VPNs

- Information Model/Provisioning, Auto-discovery, Signaling, Data Plane

Auto-discovery - BGP seems the mechanism of choice

PW Signaling - Contention Point between BGP, LDP: LDP seems to prevail

- LDP Implementations announced by most of the Vendors
- **Gid FEC** (LDP) to be used where more addressing flexibility, functionality is required

Data Plane Encapsulation – "PWE3-style"

- Proved Interoperability of Layer 2 Point-to-point service over MPLS

Status of different Information Models/Services presented

- **Individual Pt2pt VCs**
  - Double-Sided Provisioning - **Interoperable Implementations, some deployment**
  - Single-Sided Provisioning – **Interesting applicability for Migrating L2 Legacy…**
- **Migrating Legacy L2 Services to MPLS – Possibly the Next Big Tide**
- **VPLS** – New service type, complementing existing service types (i.e. pt2pt, IPVPNs)

References

Suggested reading - IETF Drafts

Auto-discovery – draft-ietf-ppvpn-bgpvpn-auto-05.txt

Signaling - draft-ietf-l2vpn-signaling-00.txt, draft-ietf-pwe3-control-protocol-03.txt

Data Plane Encapsulation - draft-ietf-pwe3-<protocol>-encap-xx.txt

- i.e. for Ethernet would be draft-ietf-pwe3-ethernet-encap-03.txt

Information Models - draft-ietf-l2vpn-signaling-00.txt

Solutions

- draft-ietf-ppvpn-vpls-ldp-00.txt, draft-ietf-ppvpn-vpls-bgp-00.txt

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