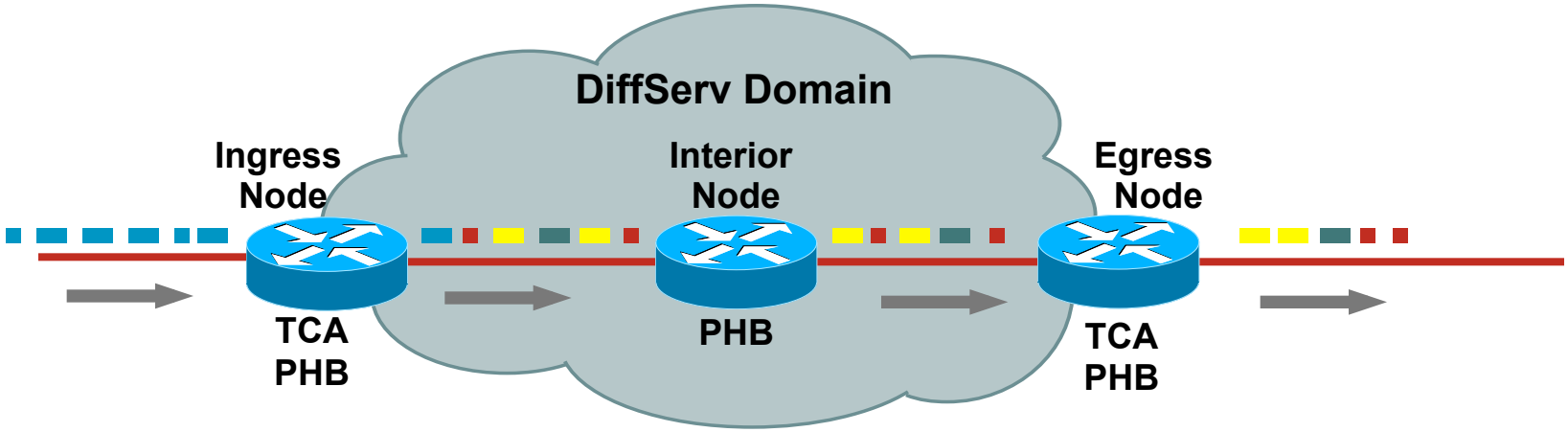
QoS in MPLS Networks

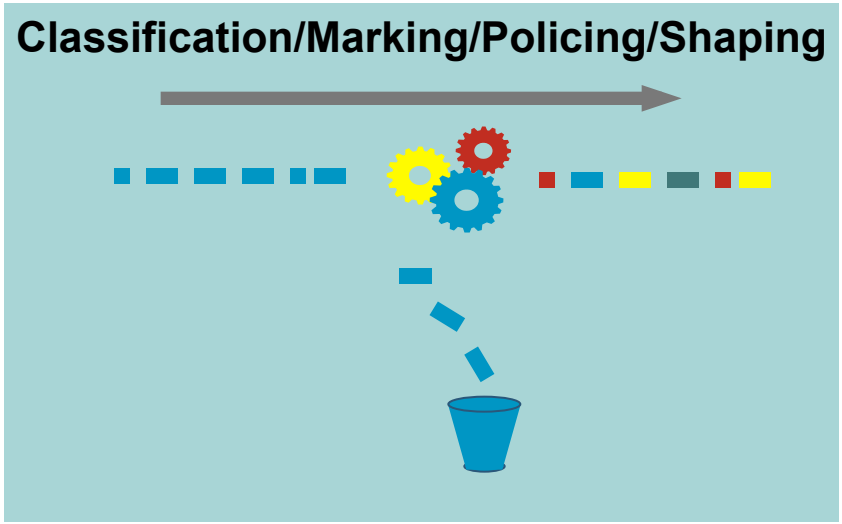
MPLS QoS Architectures

- MPLS does NOT define new QoS architectures
- MPLS QoS uses Differentiated Services (DiffServ) architecture defined for IP QoS
- DiffServ architecture defined in RFC2475
- MPLS support for DiffServ defined in RFC3270

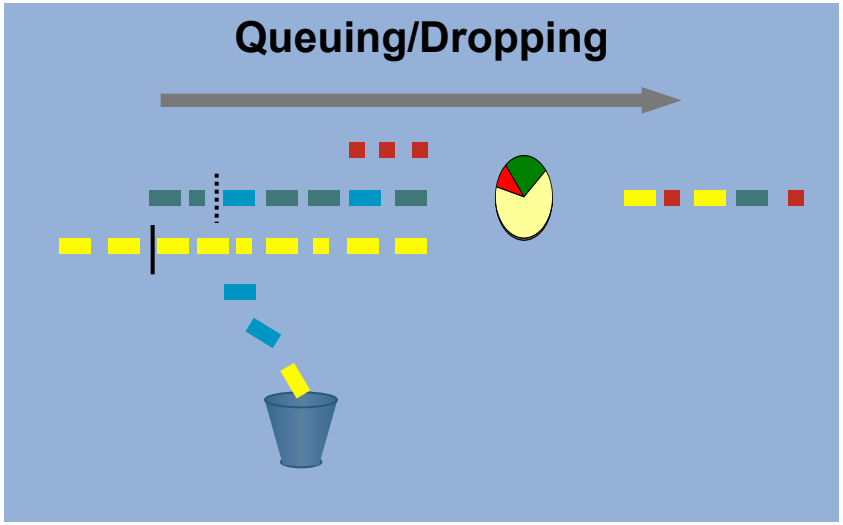
Differentiated Services Architecture



Traffic Conditioning Agreement (TCA)



Per-Hop Behavior (PHB)



What's Unchanged in MPLS Support of DiffServ

- Functional components (TCA/PHB) and where they are used

  Classification, marking, policing, and shaping at network boundaries

  Buffer management and packet scheduling mechanisms used to implement PHB

- PHB definitions

  Expedited Forwarding (EF): low delay/jitter/loss

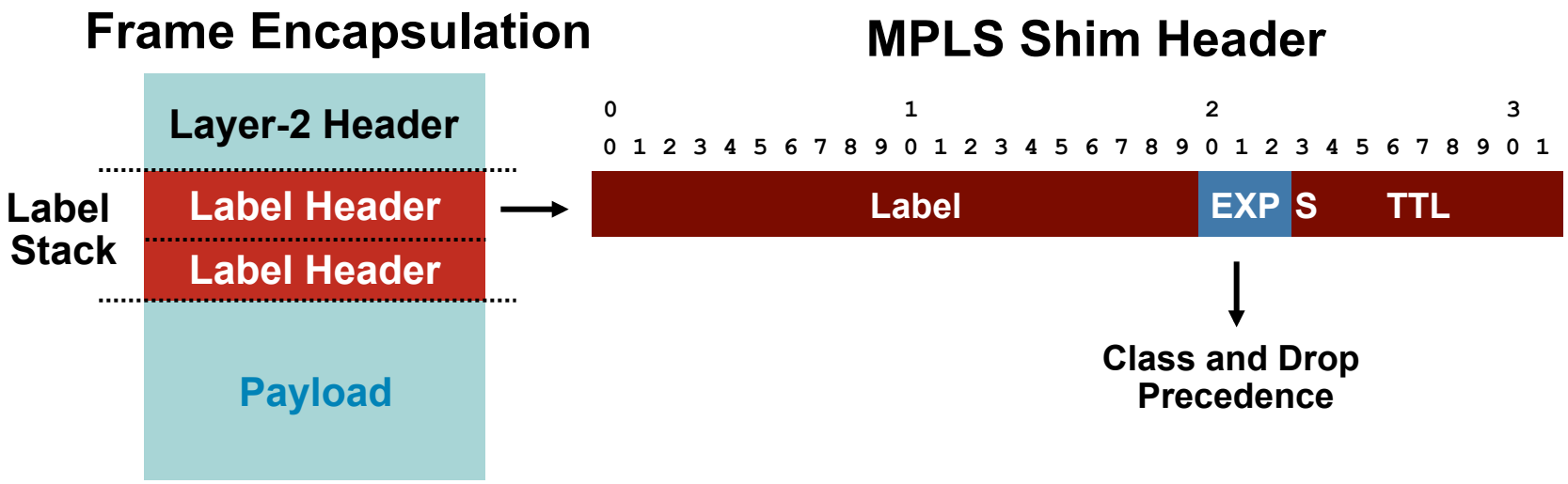
  Assured Forwarding (AF): low loss

  Default (DF): No guarantees (best effort)

What's New in MPLS Support of DiffServ

- How aggregate packet classification is conveyed (E-LSP vs. L-LSP)
- L-LSP not widely implemented and deployed
- Interaction between MPLS DiffServ info and encapsulated DiffServ info (e.g. IP DSCP)

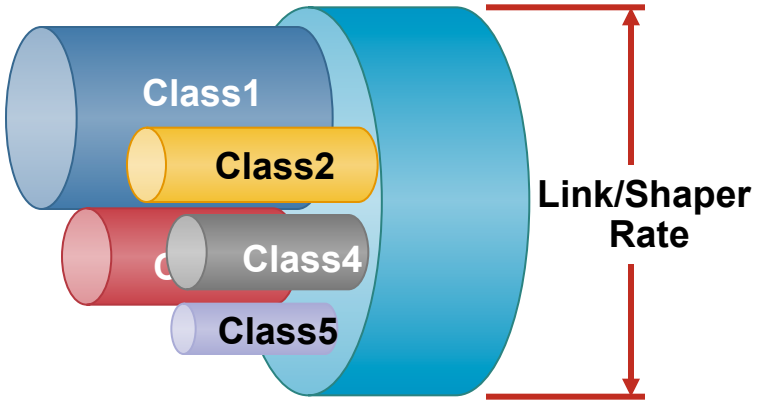
EXP-Inferred-PSC* LSP (E-LSP)



- Packet Class and drop precedence inferred from EXP (3-bit) field
- RFC3270 does not recommend specific EXP values for DiffServ PHB (EF/AF/DF)
- Used for frame-based MPLS

***Per-Hop Behavior Scheduling Class**

Site IP SLA

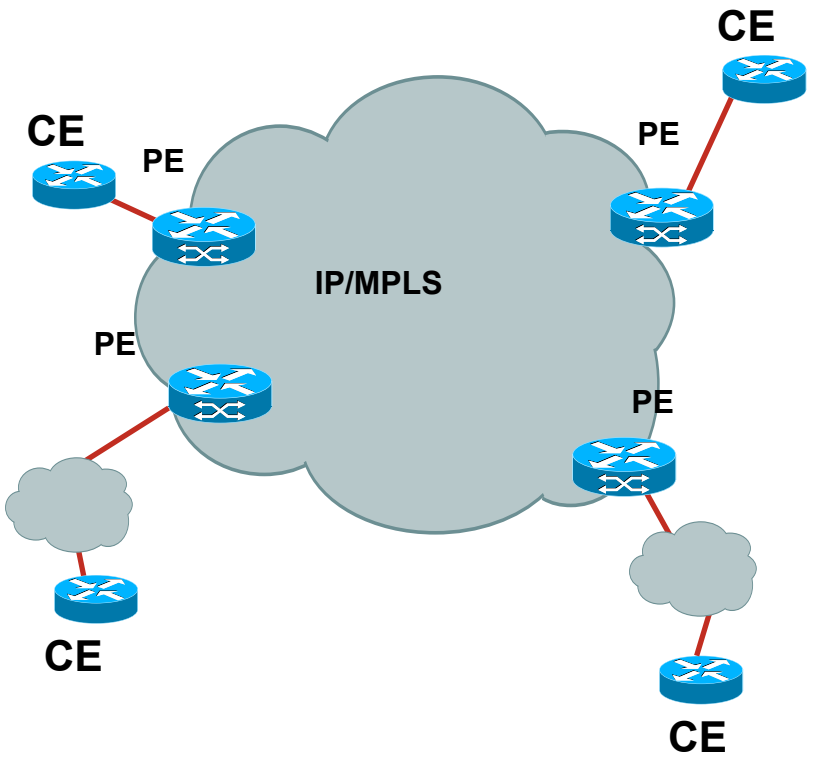


Class	Committed BW	Delay	Jitter	Loss
Real time	X	Low	Low	Low
Interactive	Y	Low	NA	Low
Business	Z	NA	NA	Low
Best Effort	NA	NA	NA	NA

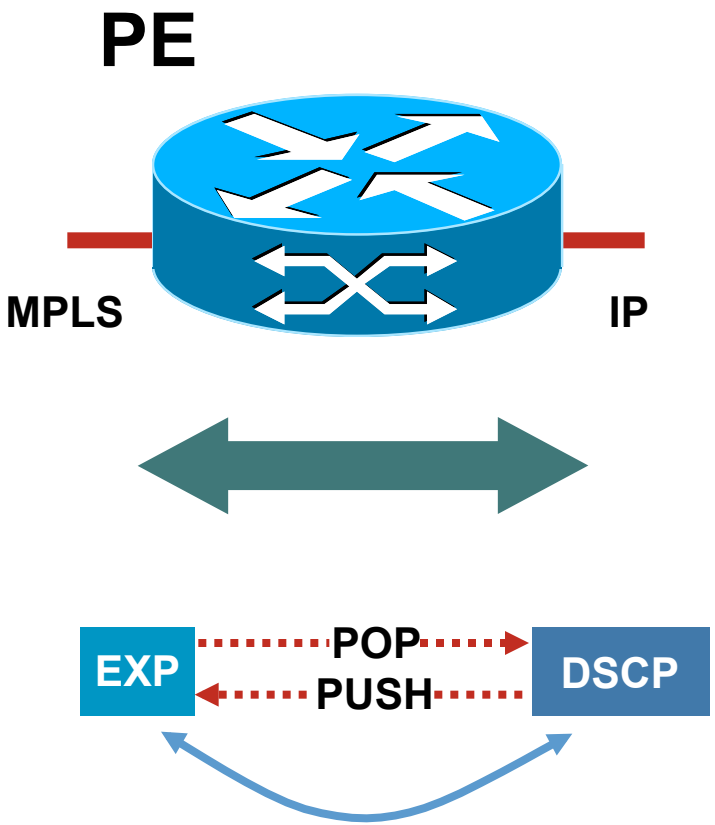
- Typically between 3 and 5 classes (real time, video, interactive, business, BE)
- Delay, jitter and loss guarantees for conforming real-time traffic
- Combination of delay and loss guarantees for data traffic
- Sum of committed bandwidth (per-class CIR) not to exceed link/ shaper rate
- Additional classes not visible to customer may exist (e.g. management, control traffic)

IP SLA Between Sites

- Site-to-network (point-to-cloud) guarantees for conforming traffic
- Each site may send x% of class n to network per SLA
- Each site may receive x% of class n from network per SLA
- No site-to-site (point-to-point) guarantees

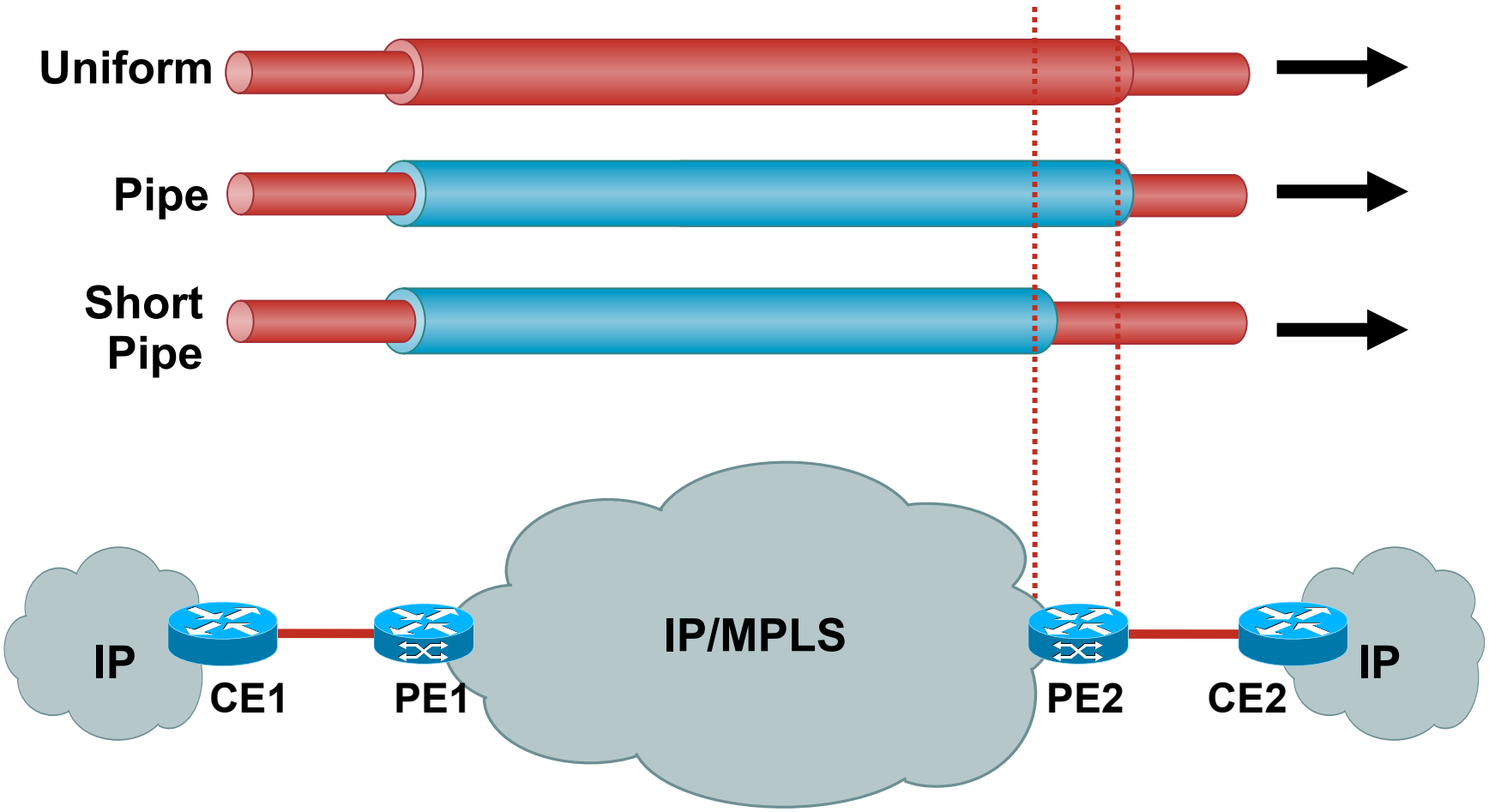


How DiffServ Markings Interact: DiffServ Tunneling Modes

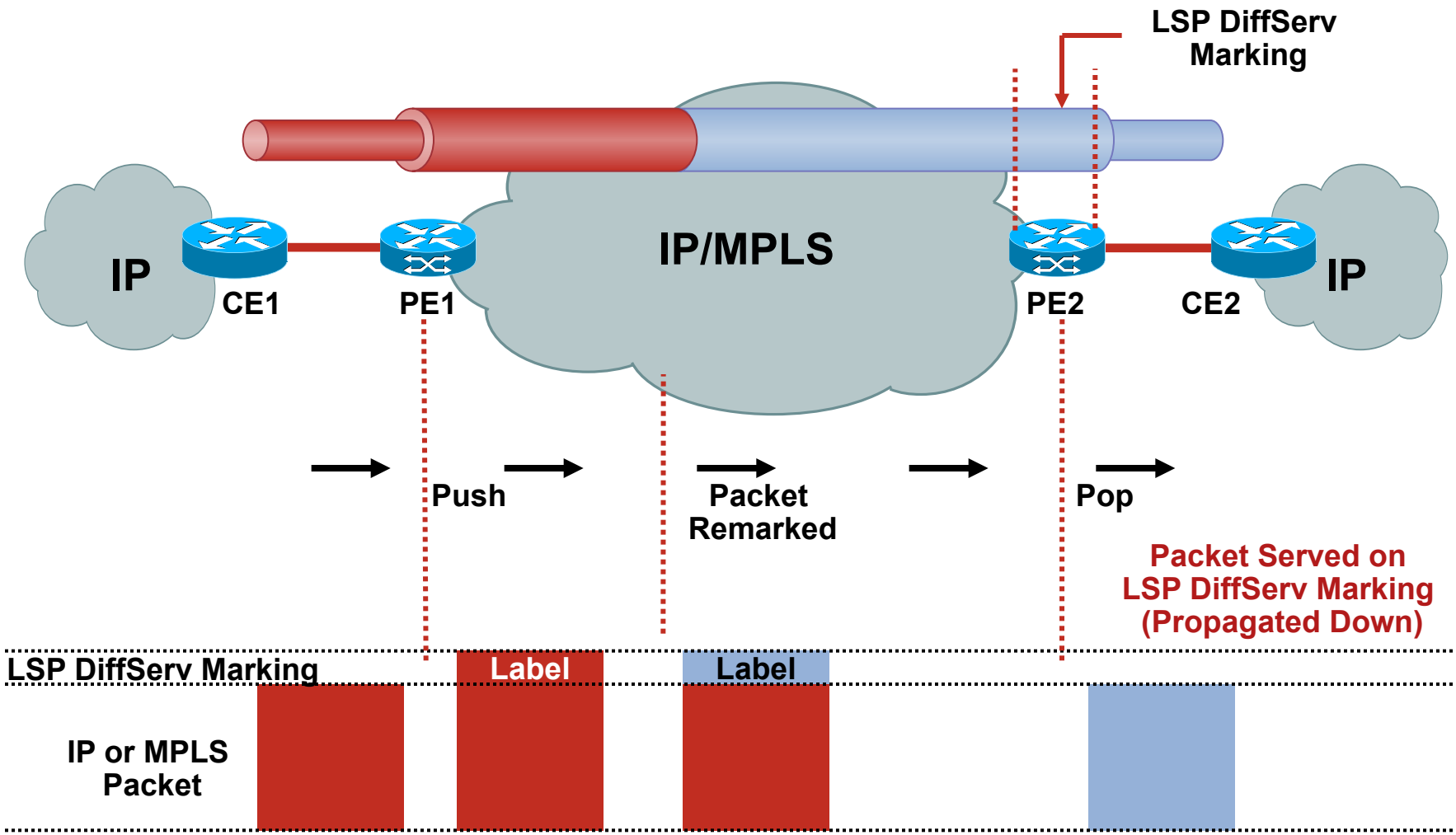


- Several models (modes) of interaction between these markings
- RFC2983 defines models (uniform/pipe) for DiffServ with IP tunnels
- RFC3270 defines models (uniform/pipe/short-pipe) for MPLS
- Only relevant where pop or push operations take place (both on IP or MPLS packets)
- Explicit NULL label may be used for managed services

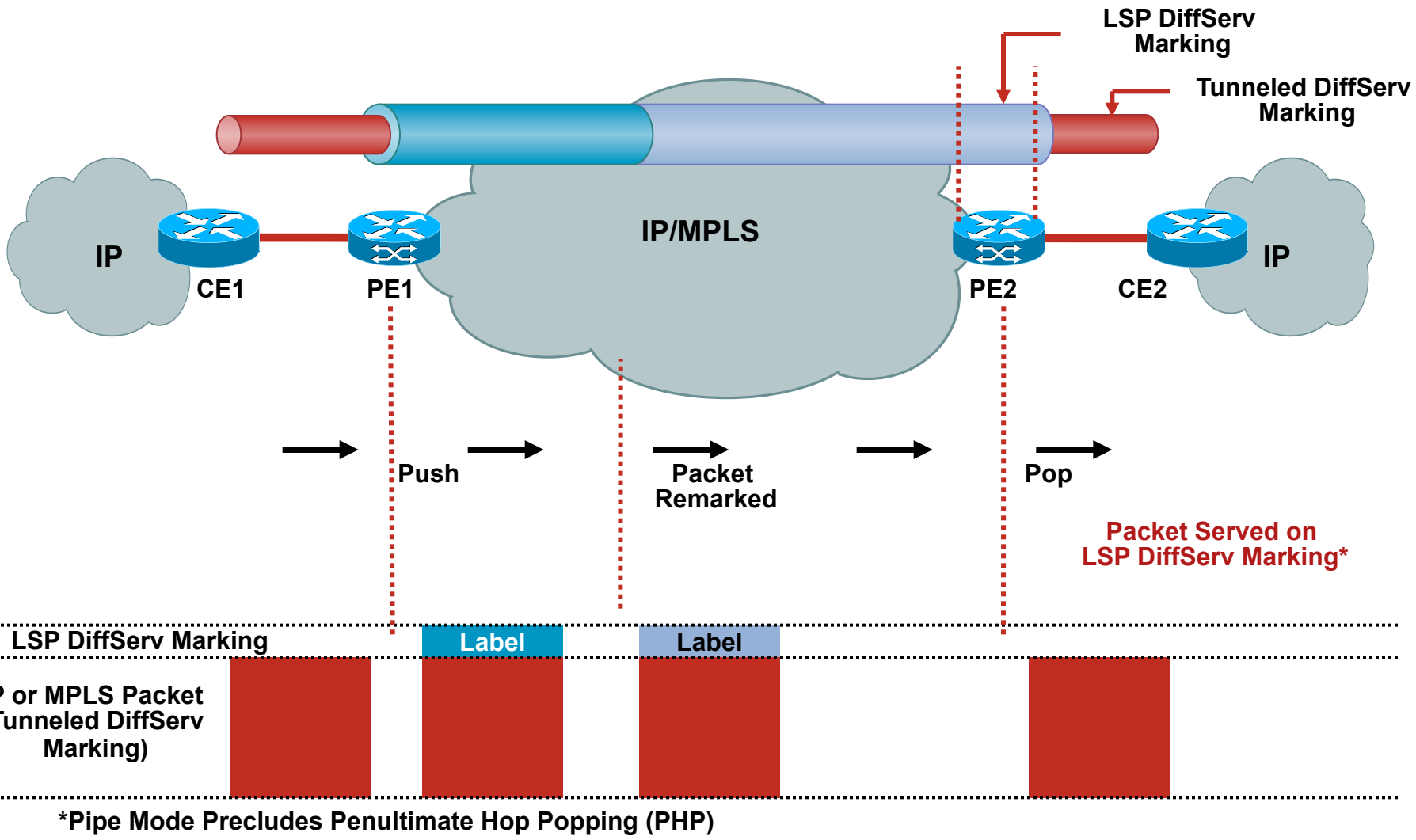
MPLS DiffServ Tunneling Modes



Uniform Mode

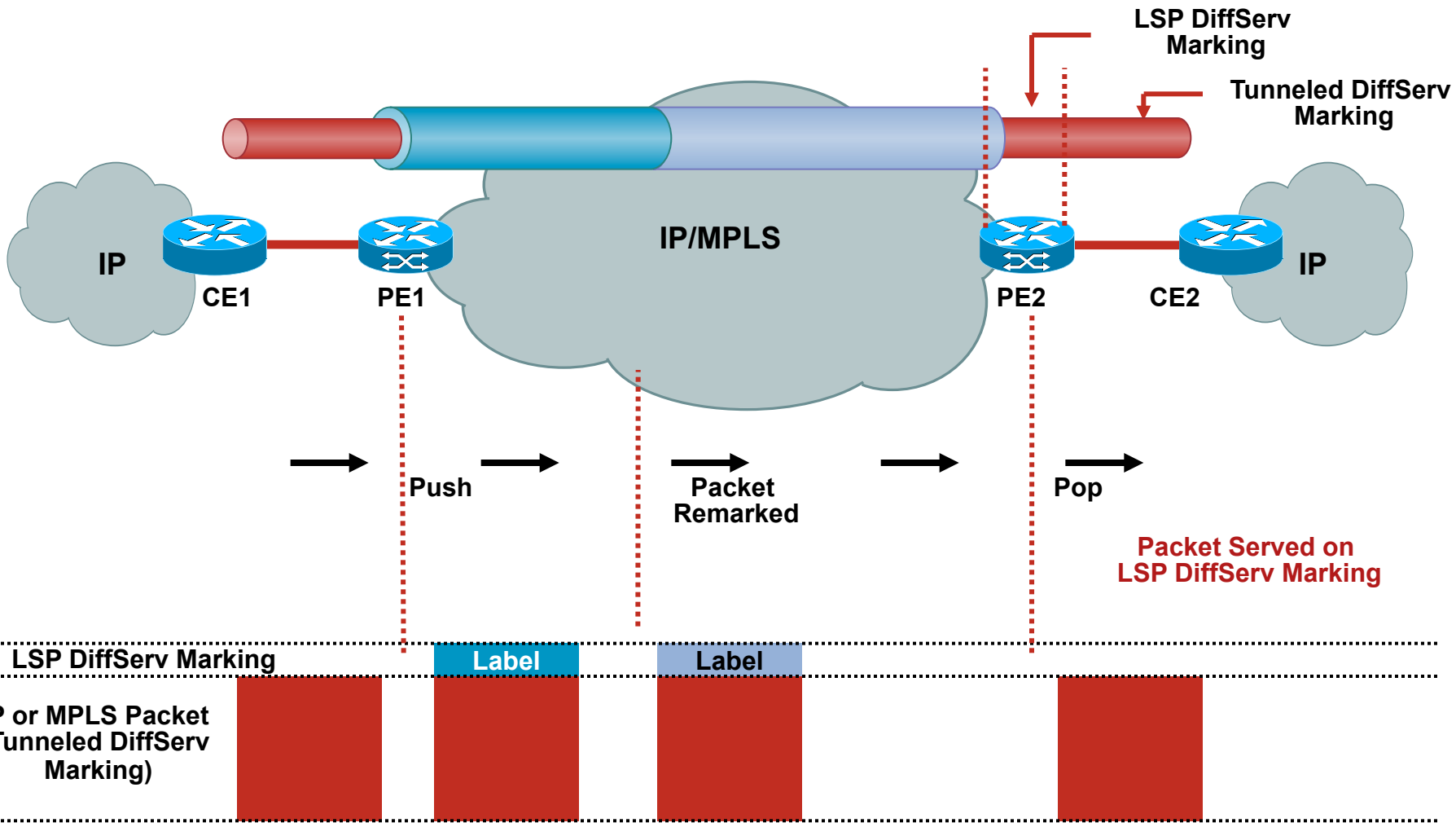


Pipe Mode

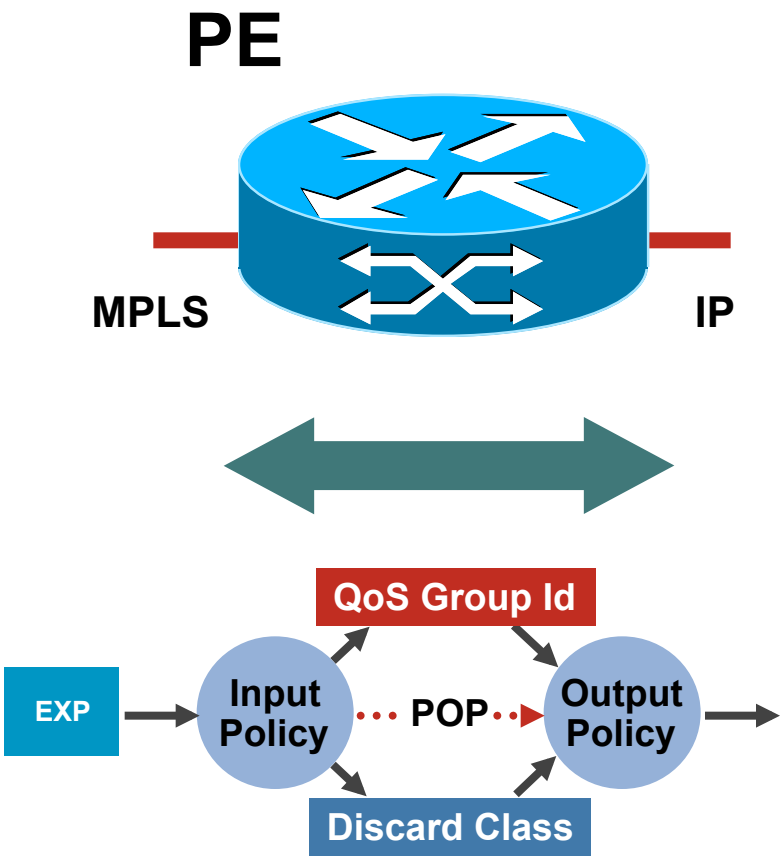


*Pipe Mode Precludes Penultimate Hop Popping (PHP)

Short Pipe Mode

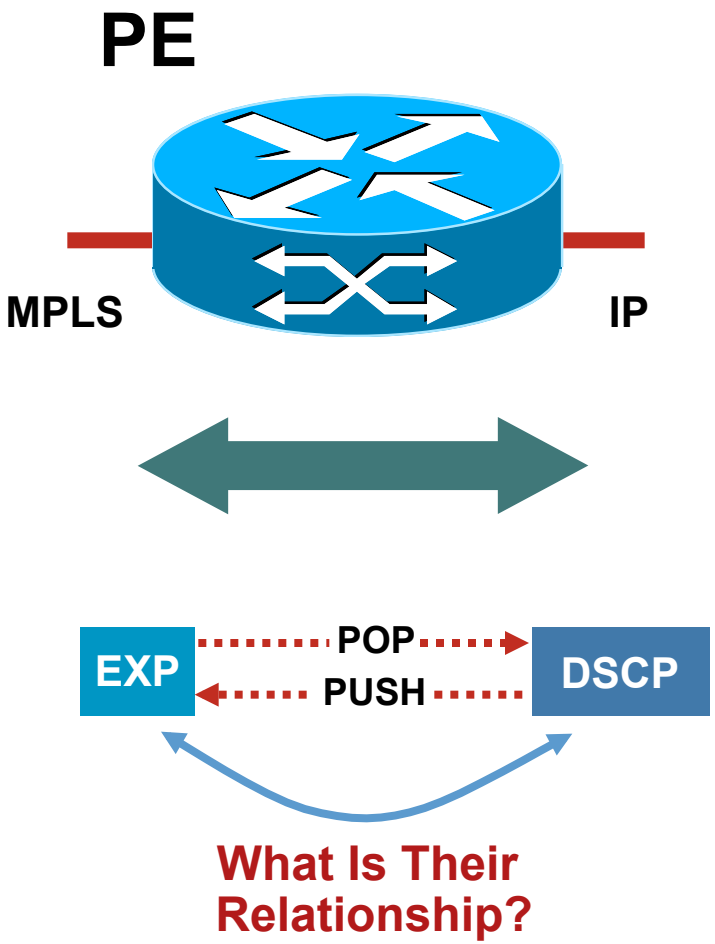


Local Packet Marking



- QoS Group Id and discard class for local packet marking
- Always an input feature (before label POP)
- Used to implement uniform and pipe mode
- Recommended semantics
  - QoS group identifies class
  - Discard class identifies drop precedence
- Discard class can drive WRED
- Not all classes will have a drop precedence (e.g. EF, best effort)

DiffServ Tunneling Modes: Keep in Mind...



- When input policy defines EXP to be imposed, value applies to all imposed labels
- If no imposition EXP defined, IP precedence copied to all imposed labels
- EXP maintained during label swaps
- EXP not propagated down by default during disposition
- Pipe mode precludes PHP