Mapping SLAs to MPLS

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SLAs revisted

SLAs describe properties like

- Bandwidth (average, peak, burstsize)
- Delay (latency)
- Jitter (Delay variation)
- Loss
- Availability and Reliability (99.999%)

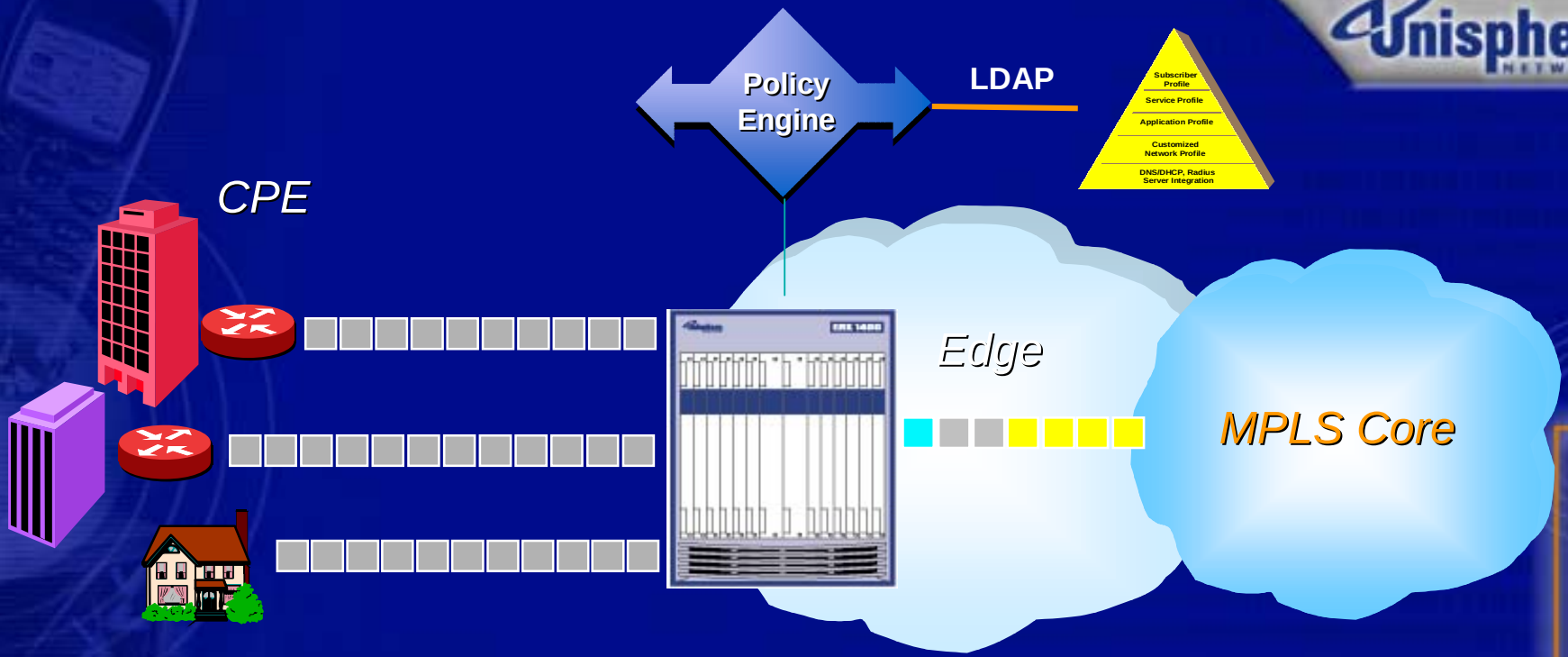
Reality Check – IP SLAs

IP2 QoS Codepoint Allocation

Classes of Service:

Product Naming		Technical Meaning
Premium Voice "Voice over IP"	⟷	**"voice"** Delay & Jitter Sensitive
Premium II "multi-media"	⟷	**"low delay"** Delay Sensitive
Premium I "mission-critical"	⟷	**"low loss"** Loss Sensitive
Standard "VPN/Public"	⟷	**"best effort"** Price Efficient

Signalling SLA requirements



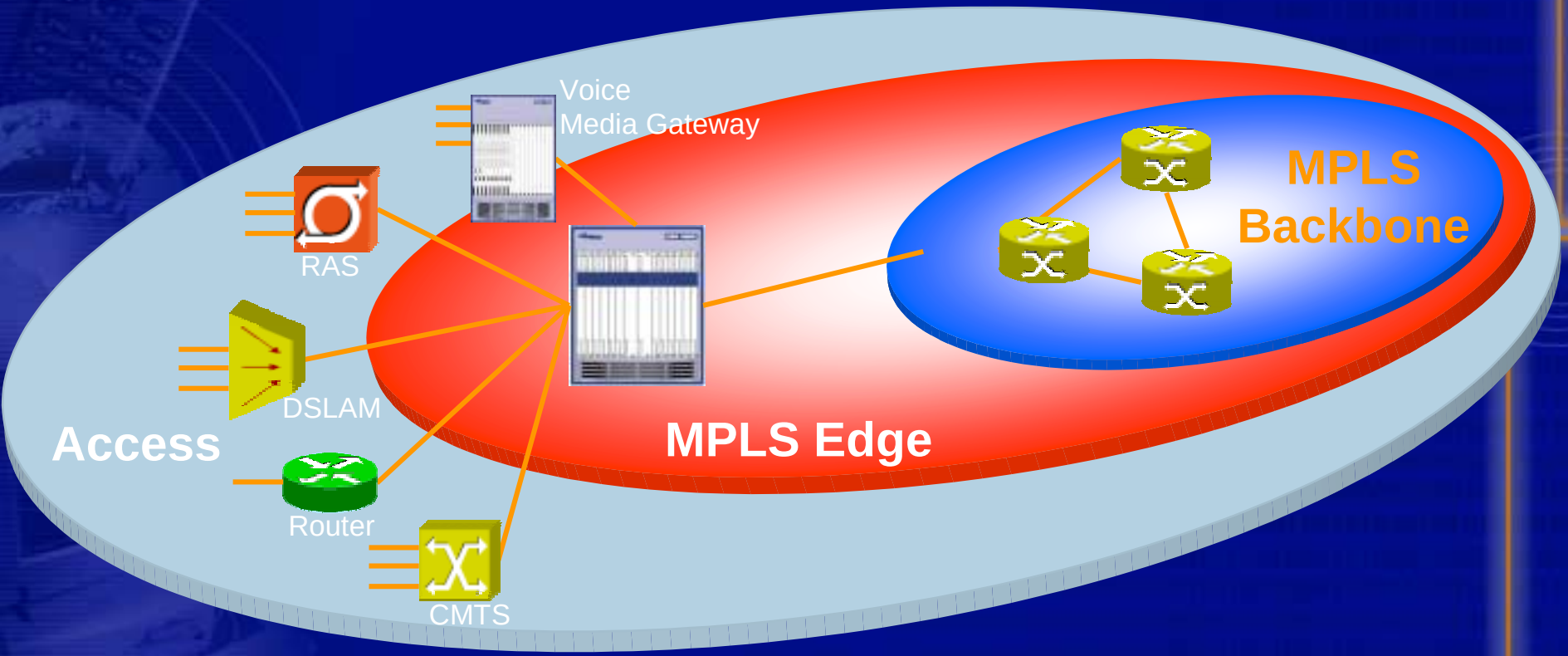
Static

- SLA Contract with Service Provider

Dynamic

- Inband Signalling e.g. DiffServ
- Outband Signalling e.g. COPS (Service Selection/Policy driven)

Mapping SLAs on the Edge

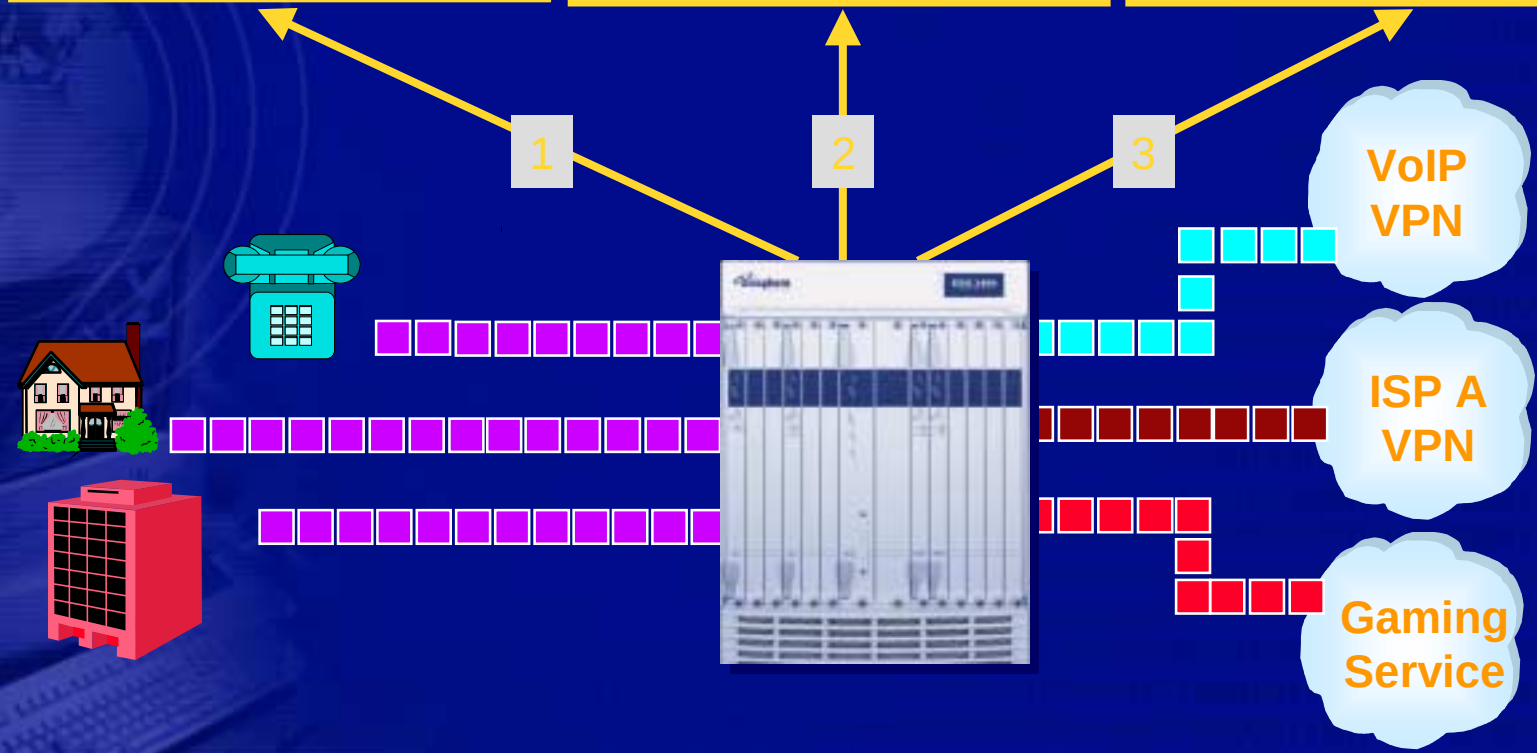


SLA Functions at the Edge

Classify the data/user and enforce SLA policies

Allocate Resources & applying SLA-specific policies

Mark and Transport data using desired MPLS Technology

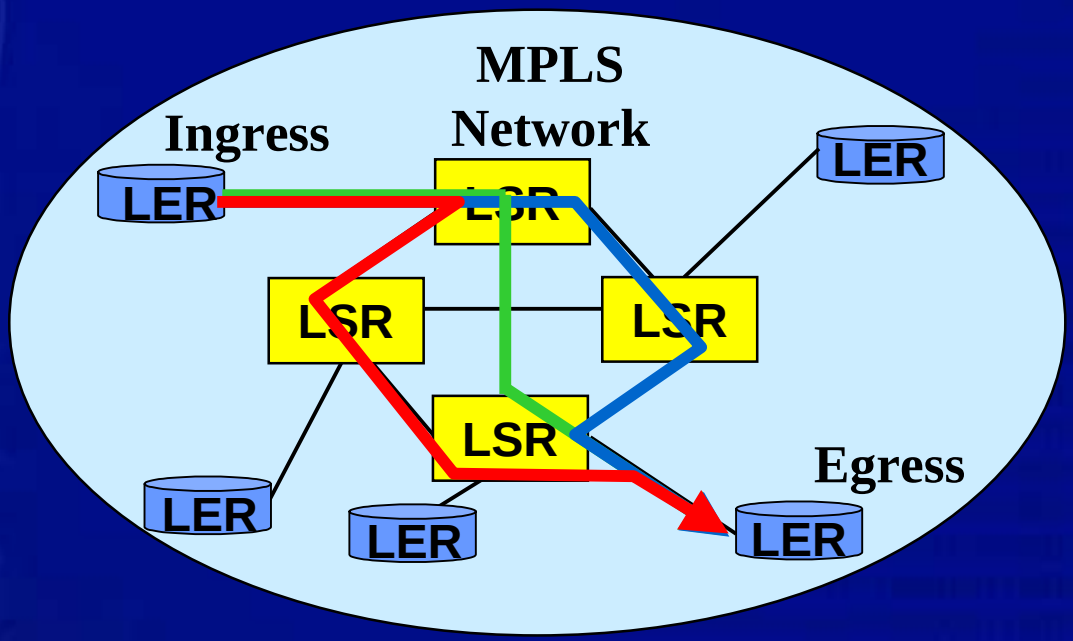


Identifying Traffic

- Source interface
  - •Physical Interface (e.g. E1)
  - •Logical Interface (e.g. VC, DLCI, VLAN)
- Login/Domain name
- IP header info
  - •Source/Destination address
  - •Source/Destination ports
  - •Protocols
  - •Payload
- MPLS label
- Traffic Situation

MPLS Fundamentals

- FEC - **a group of packets that are forwarded the same way**
  - Packets are mapped to FECs which are then mapped to LSPs
  - LSPs have different capabilities to handle different traffic types



MPLS and QoS/CoS

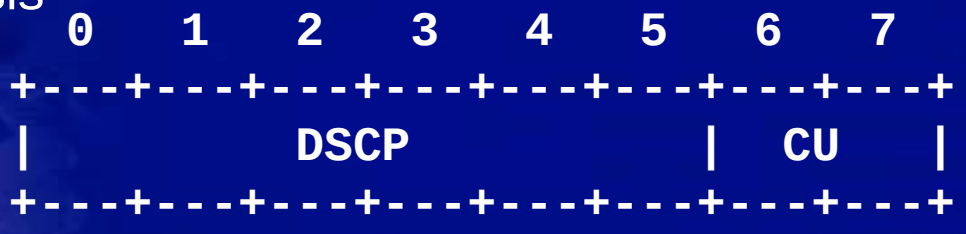
- Traffic engineered LSP determines QoS for the LSP
- Mapping packets to FECs and then to LSPs determines path through the network and Class of Service (CoS) for the “flow”
- Packets can be mapped to FECs via different criteria
  - Traditional shortest path routing algorithms (defacto)
  - Use of DiffServ byte in IP header
  - Application of policy and traffic engineering (bandwidth, delay)
  - Further examination of IP packet contents to application layer

MPLS Resource Control Mechanisms (RSVP-TE, CR-LDP)

- Admission Control
  - Answers the question “can I”
  - Node determines if it has the resources to satisfy the request
  - May tear down (existing) LSPs with a lower priority to “steal” resources
  - Does the local accounting
  - Triggers IGP updates on resource capabilities
- Policy Control
  - Answers the question “should I”
  - Node determines if the requester has permission to make such a request

Diffserv Defined

- Enable service differentiation without hop-by-hop state and signaling
- Redefines TOS bits as DS byte to identify different service levels
- Defines a set of building blocks which are deployed in network nodes
  - Mark (set bits) at network boundaries to identify service level
  - Queue and forward packets based upon how they are marked
  - Condition the packets in accordance with the rules of their service
  - Necessarily means behaviors are implemented on a per-hop basis



6 bits for codepoint, 2 bits reserved

Diffserv Per Hob Behaviors (PHBs)

- Expedited Forwarding (EF)
  - Premium service – a low loss, low latency, low jitter, assured bandwidth, end-to-end service through DS domains
- Assured Forwarding (AF)
  - Assured service – provides delivery of IP packets in 4 independently forwarded AF classes.
  - Each AF class has three different levels of drop precedence

	Class 1	Class 2	Class 3	Class 4
Low Drop Prec	001010	010010	011010	100010
Medium Drop Prec	001100	010100	011100	100100
High Drop Prec	001110	010110	011110	100110

IP QoS and Bandwidth Management

- Wirespeed Classification
  - Multi-field or ToS
- DiffServ & ATM QoS (CBR, nrt-VBR, UBR)
- Color –Based Thresholding
- Excess Frames are dropped on congestion onset
  - Conforming Frames are dropped next
  - Committed Frames are dropped on line oversubscription
- Traffic Shaping
- MPLS Traffic Engineering
- Low Latency Service

Example: Label Forwarding Model for Diff-Serv LSRs

Label Forwarding by Diff-Serv LSRs in four stages

- Incoming PHB Determination (A)
- Outgoing PHB Determination with Optional Traffic Conditioning(B)
- Label Forwarding (C)
- Encoding of Diff-Serv information into Encapsulation Layer (EXP, CLP, DE, User_Priority) (D)

Example: Mapping Diff-Serv to MPLS

A Diff-Serv Context for a label is defined as comprising:

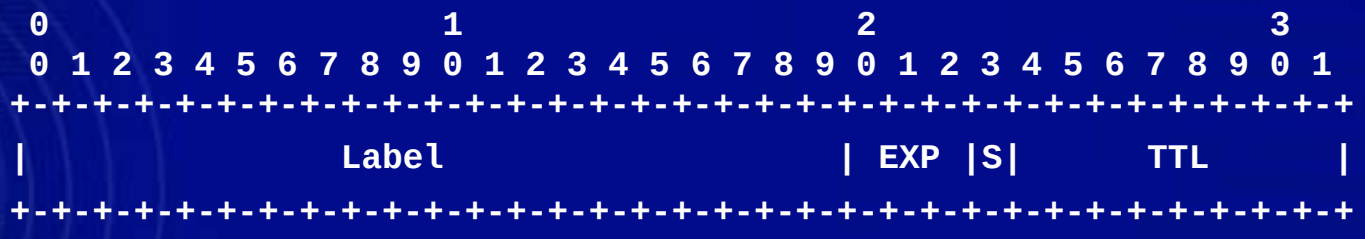
1. `LSP type (ie E-LSP or L-LSP)'
2. `supported PHBs'
3. `Encaps-->PHB mapping' for an incoming label
4. `Set of PHB-->Encaps mappings' for an outgoing label

Acronyms:

- PSC — PHB Scheduling Class
- E-LSP — EXP-Inferred-PSC LSP
- L-LSP — Label-Only-Inferred-PSC LSP

MPLS Shim Header Format

32-bit header inserted between data link and network layer headers



- Header = 4 octets; 1 header per label level
  - Label = label value for packet (20 bits)
  - EXP = experimental bits, used for CoS (3 bits)
  - S = bottom of stack indicator (1 bit)
  - TTL = time to live (8 bits)

EXP-Inferred-PSC LSPs (E-LSP)

EXP-Inferred-PSC LSPs (E-LSP)

A single LSP can be used to support up to eigh BAs of a given FEC. The EXP field of the MPLS Shim Header is used by the LSR to determine the PHB to be applied to the packet. This includes both the PSC and the drop preference.

The mapping from EXP field to PHB (ie to PSC and drop precedence), is either explicitly signaled at label set-up or relies on a pre-configured mapping.

Label-Only-Inferred-PSC LSPs (L-LSP)

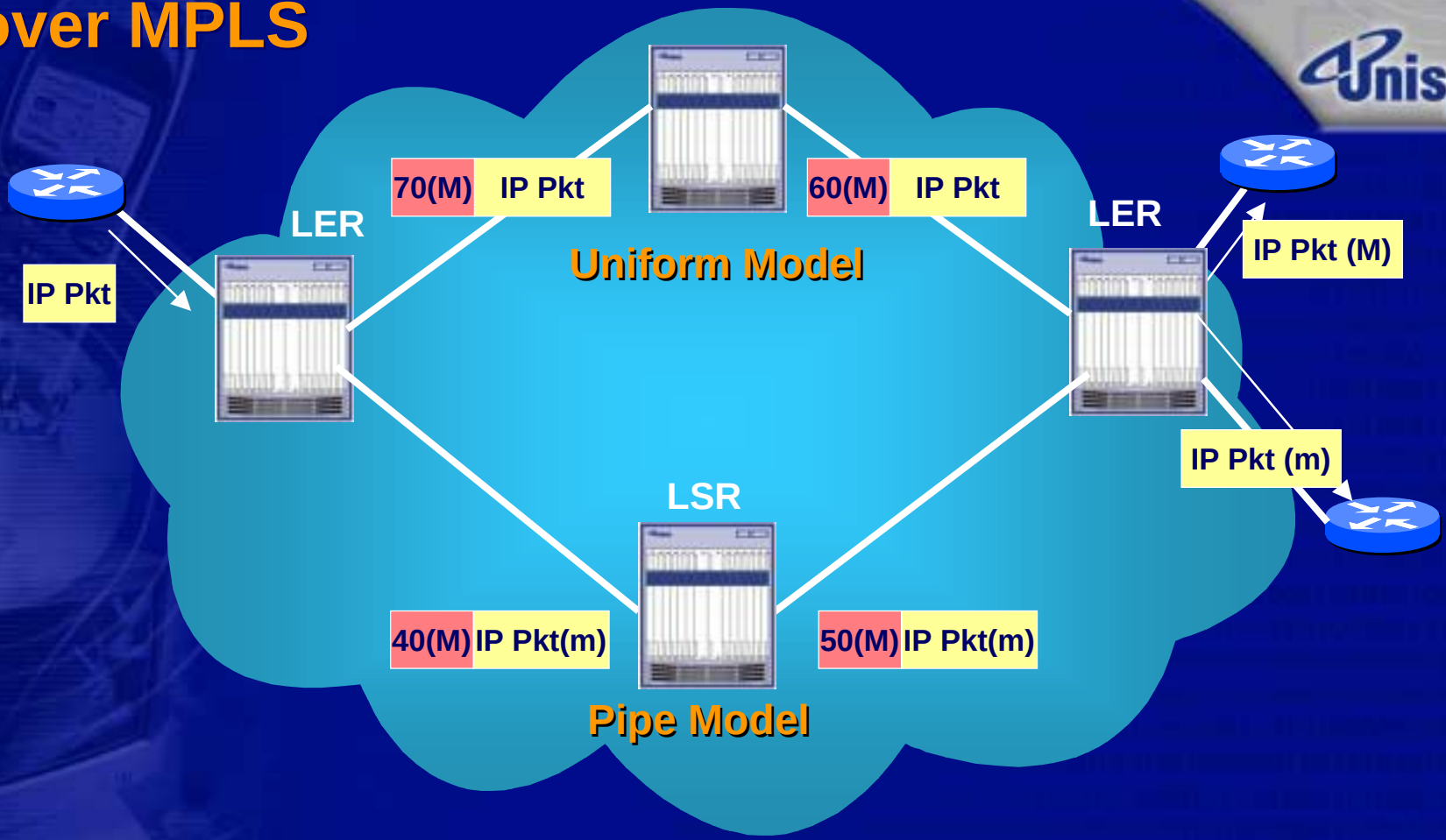
Label-Only-Inferred-PSC LSPs (L-LSP)

A separate LSP can be established for a single <FEC, PHB> pair.

PSC is explicitly signaled at label establishment time

When the Shim Header is used, the Drop Precedence to be applied by the LSR to the labeled packet, is conveyed inside the labeled packet MPLS Shim Header using the EXP field. When the Shim Header is not used (e.g. MPLS Over ATM), the Drop Precedence to be applied by the LSR to the labeled packet is conveyed inside the link layer header encapsulation using link layer specific drop precedence fields (e.g. ATM CLP).

Diff-Serv Tunneling Models over MPLS



- (M) represents the "LSP Diff-Serv information"
- (m) represents the "Tunneled Diff-Serv information"

Thank You

Questions?

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