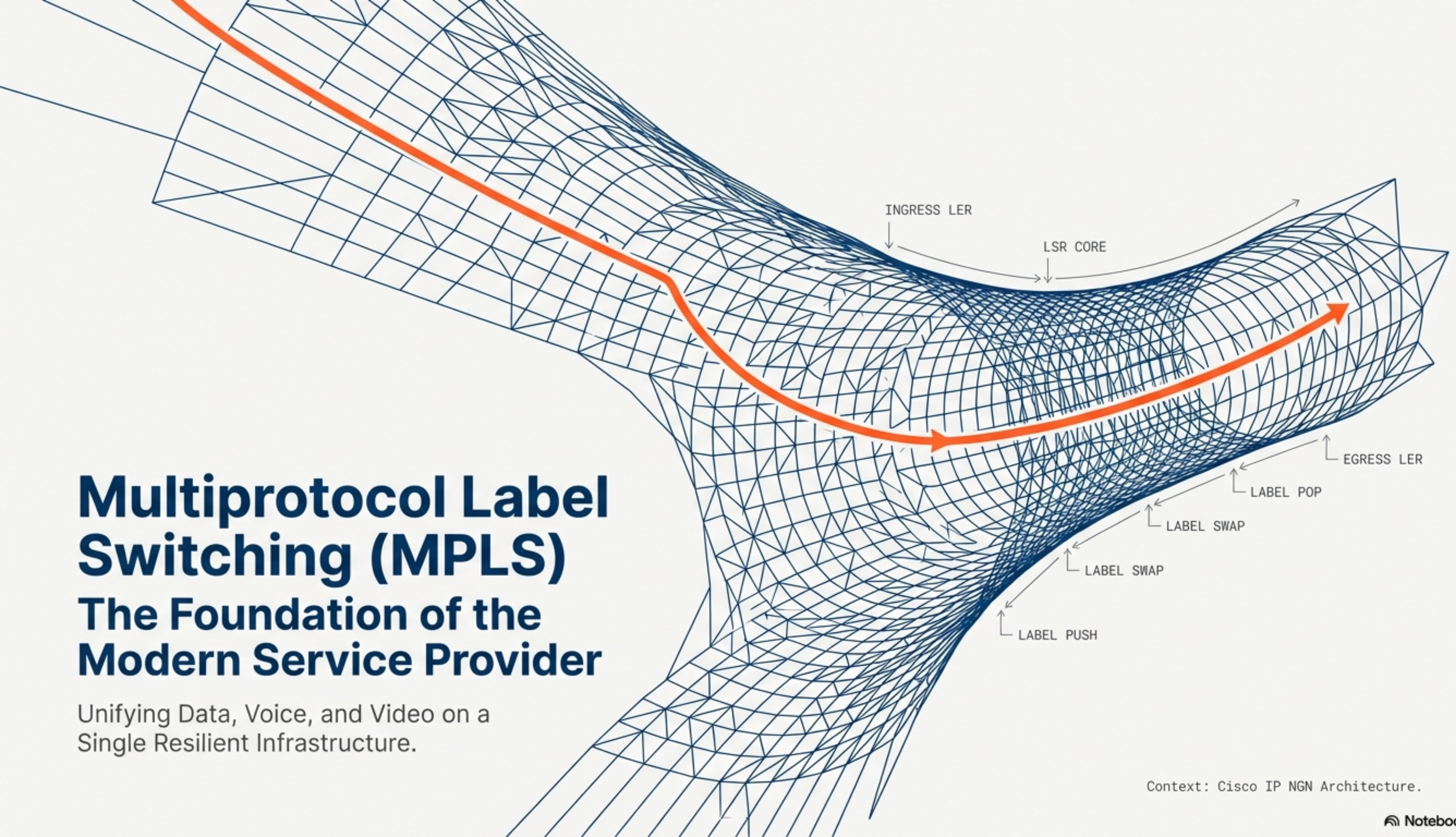
Multiprotocol Label Switching (MPLS)

The Foundation of the Modern Service Provider

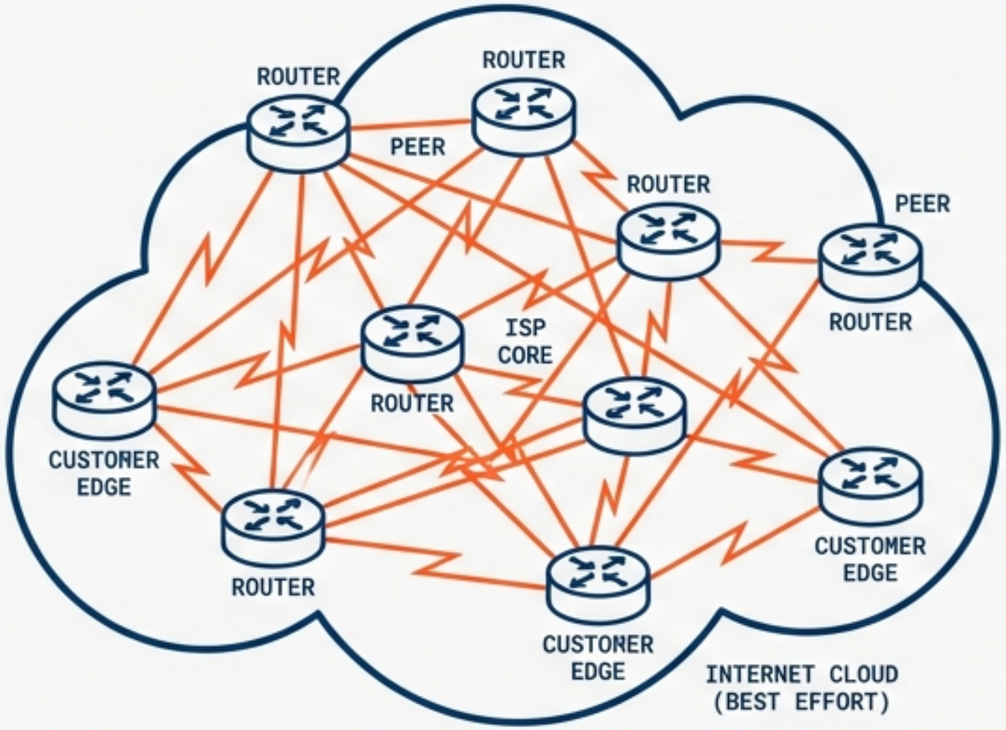
Unifying Data, Voice, and Video on a Single Resilient Infrastructure.



Context: Cisco IP NGN Architecture.

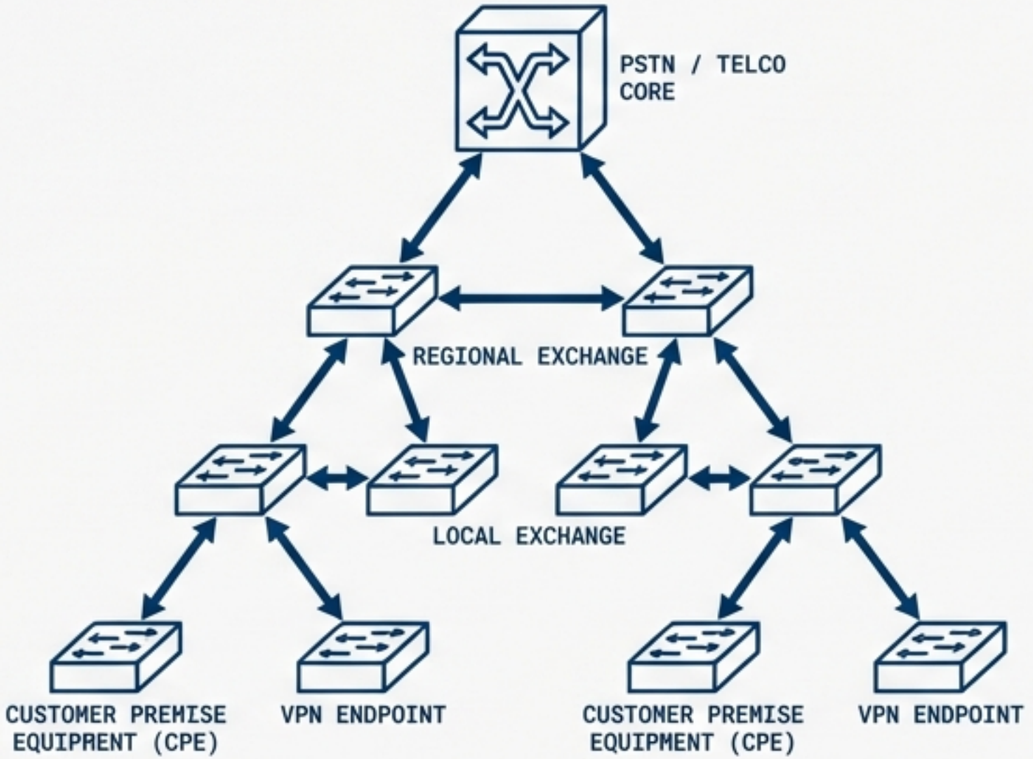
The Legacy Divide: Fragmented Infrastructures

Traditional ISP (Internet)



- Focus: Internet Access
- Architecture: Best Effort / Chaotic

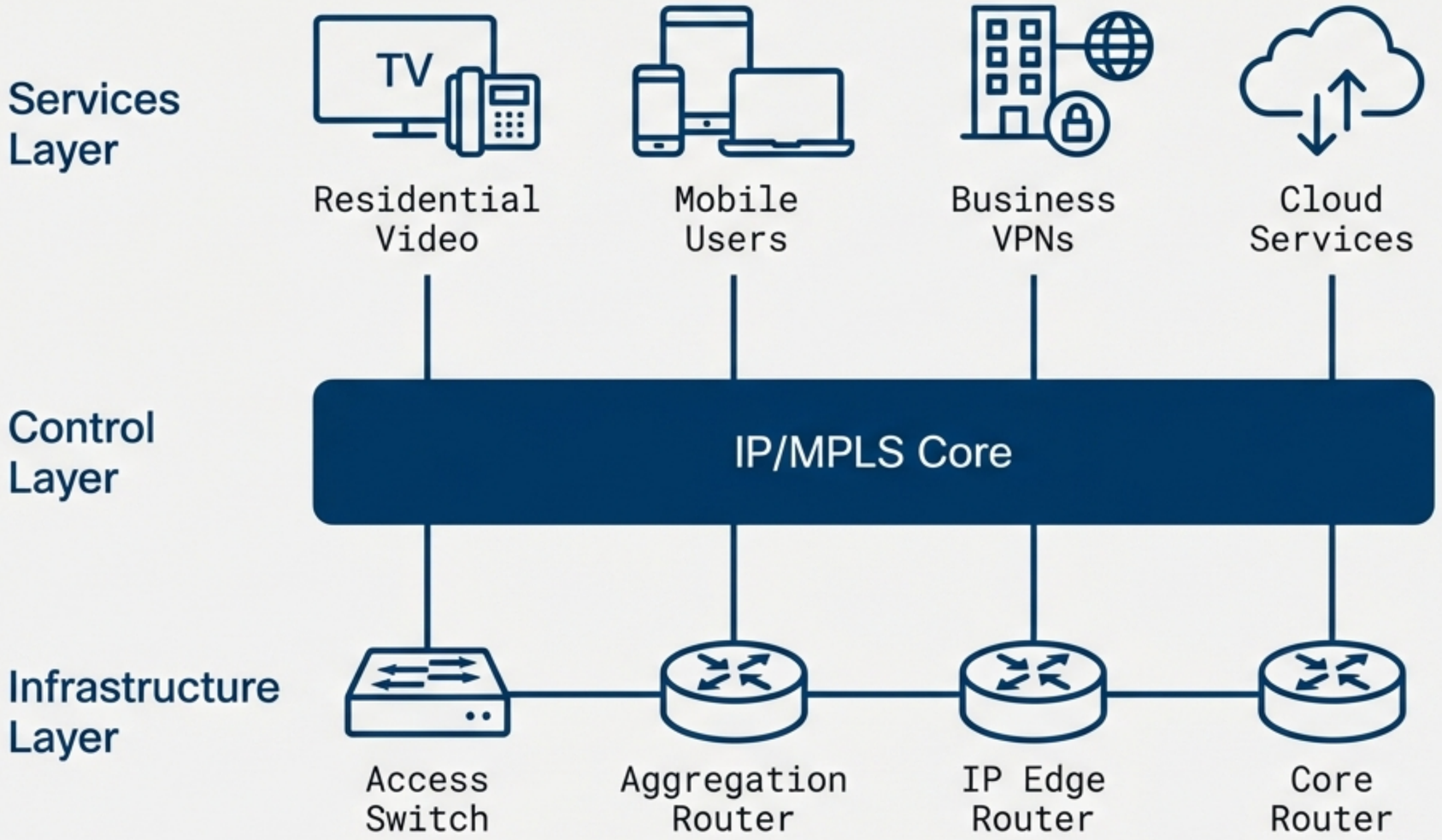
Traditional Telco (Voice/VPN)



- Focus: Voice & VPNs
- Architecture: Circuit-Switched / Rigid

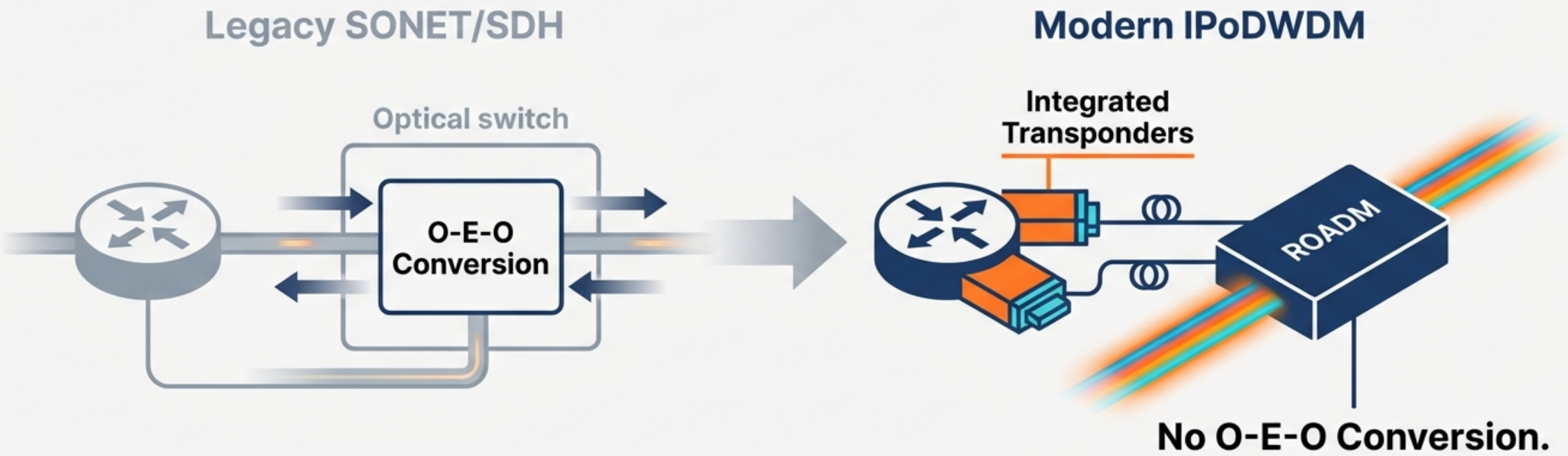
Insight: Maintaining parallel physical infrastructures for different services created massive inefficiency.

The Solution: Service Convergence



The Cisco IP NGN Architecture allows all applications to run over a single IP backbone. MPLS unifies the core and edge.

Physical Evolution: Removing the O-E-O Bottleneck

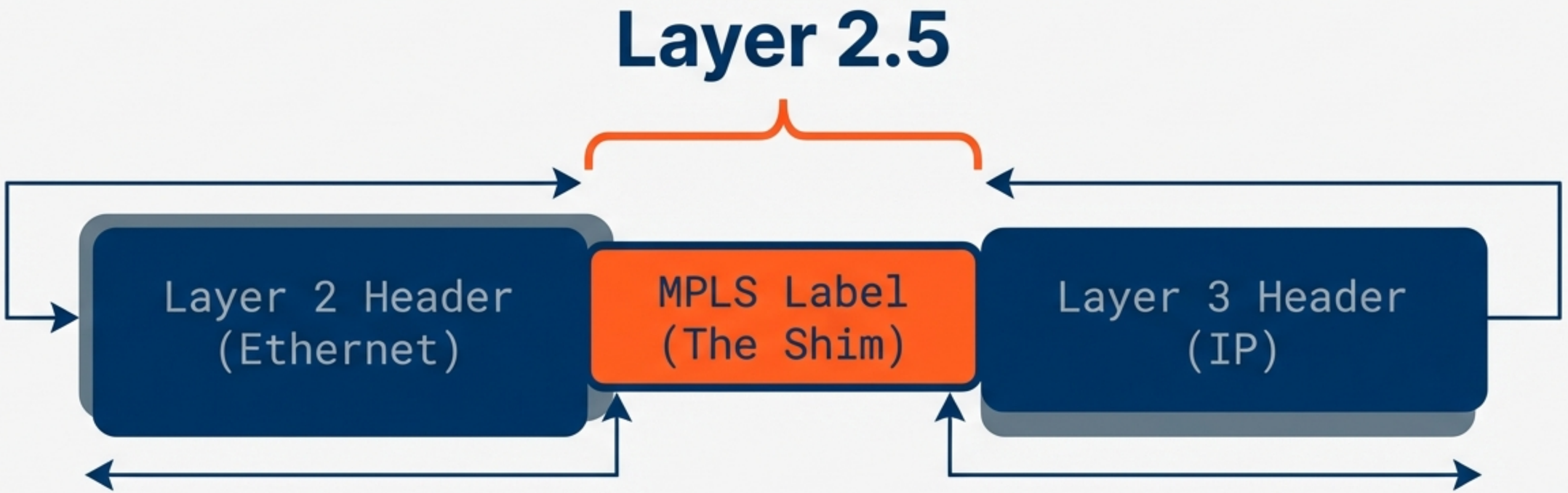


Evolution from STM-1 (155 Mb/s) to 100 Gigabit Ethernet.

The Friction of Traditional IP Routing

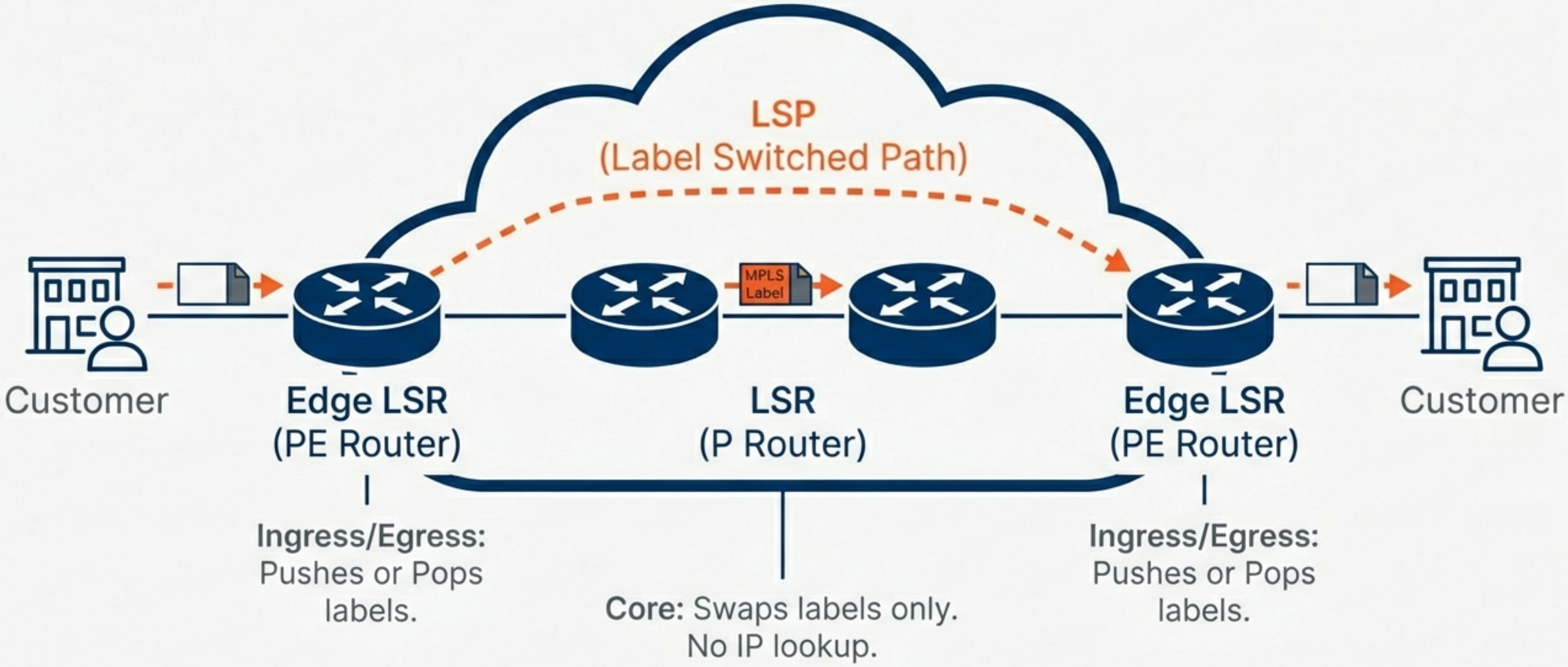
- Independent Decisions: Every hop performs a full routing table lookup.
- Processor Intensive: The control plane is engaged for every packet.
- Result: High latency and lower throughput.

Enter MPLS: Switching, Not Routing

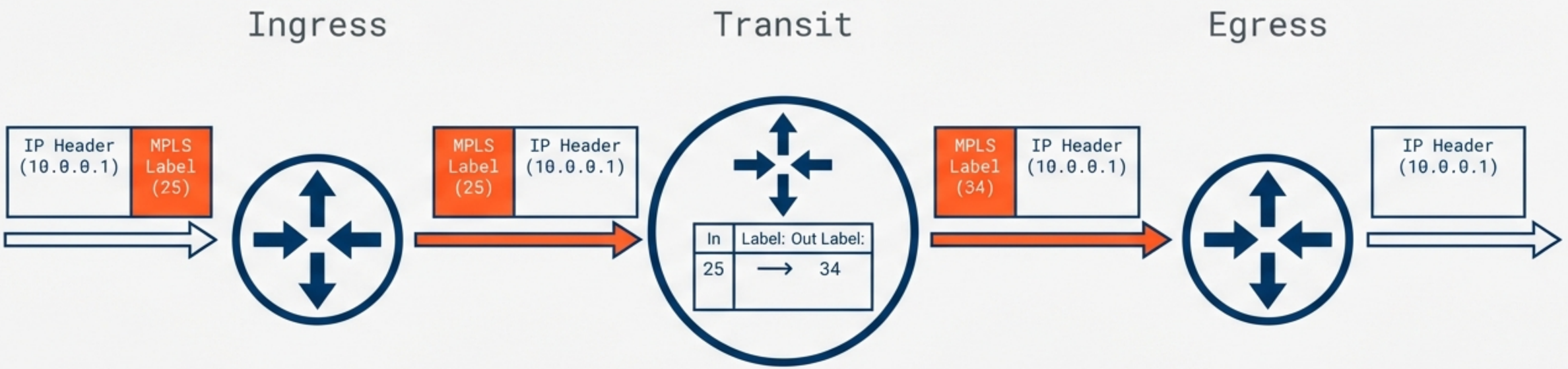


Analyze the IP header once on ingress. Switch based on the short Label forever after.

The MPLS Architecture & Terminology



The Life of a Label: Push, Swap, Pop



PUSH

Router attaches a label '25'.
Slate Grey Inter

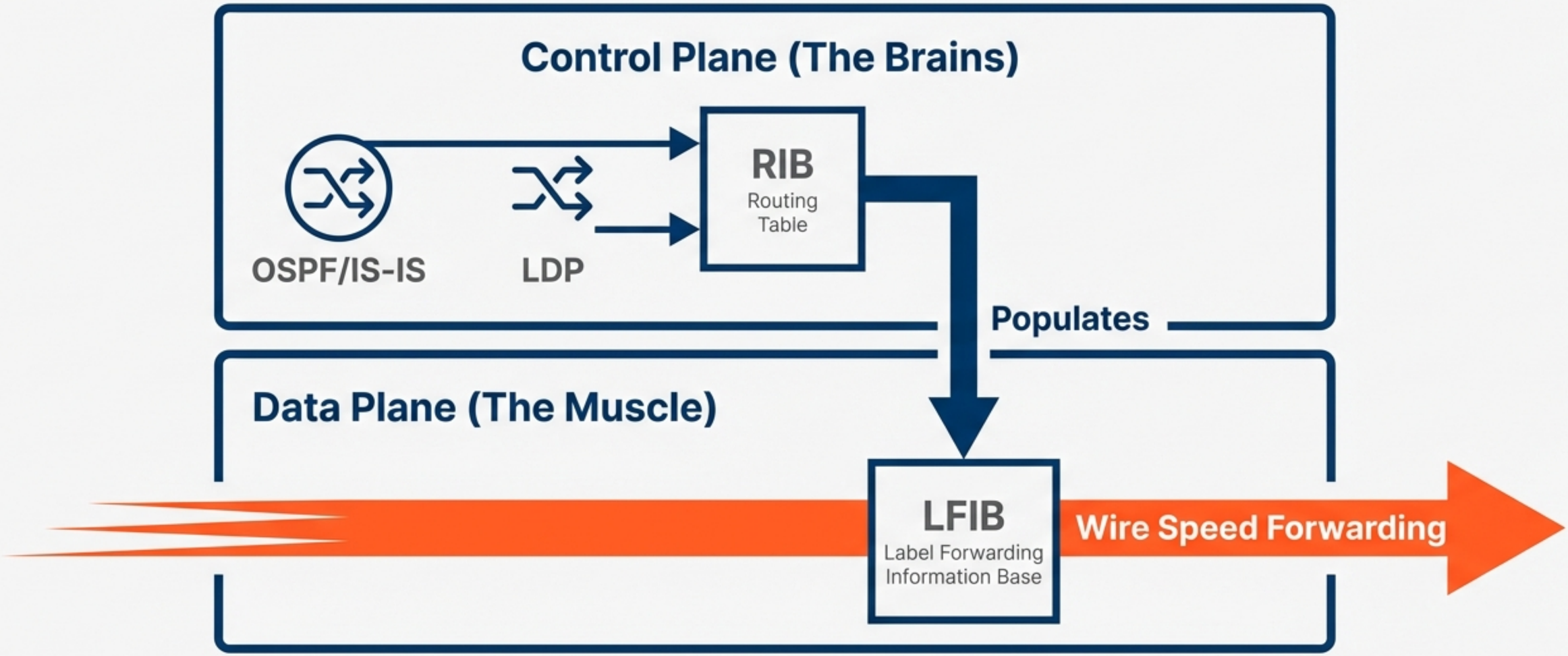
SWAP

Router receives label '25', checks table, and changes it to '34'.
Slate Grey Inter

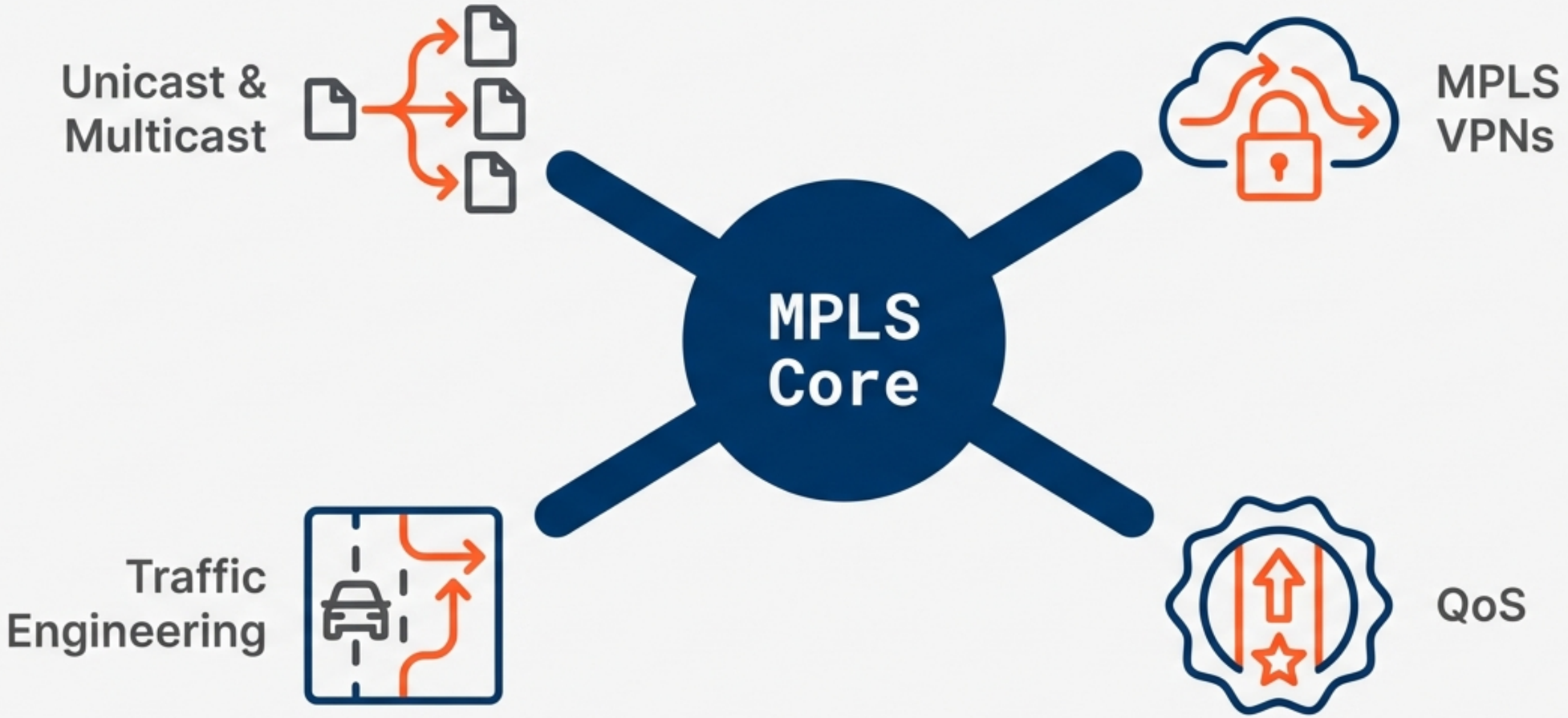
POP

Router receives label '34', removes it entirely, and sends the IP packet.
Slate Grey Inter

Brains vs. Muscle: Separating Control & Data Planes

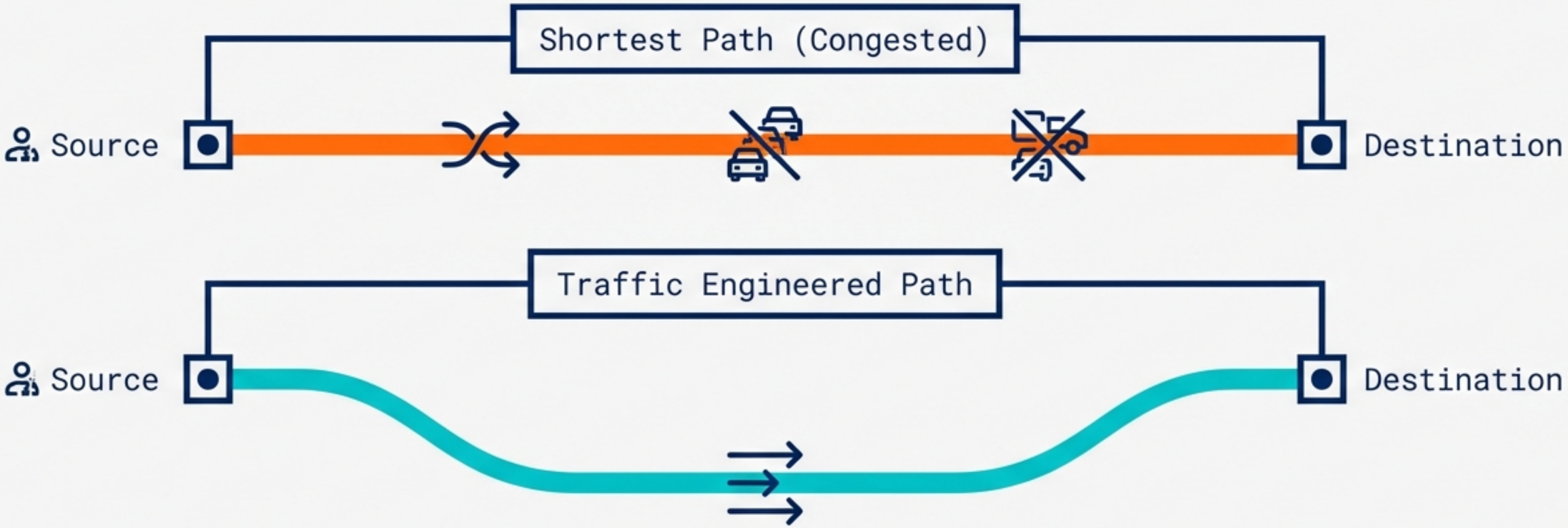


Beyond Speed: The MPLS Application Suite



Any traditional telco service can be implemented in an MPLS-enabled environment with greater flexibility.

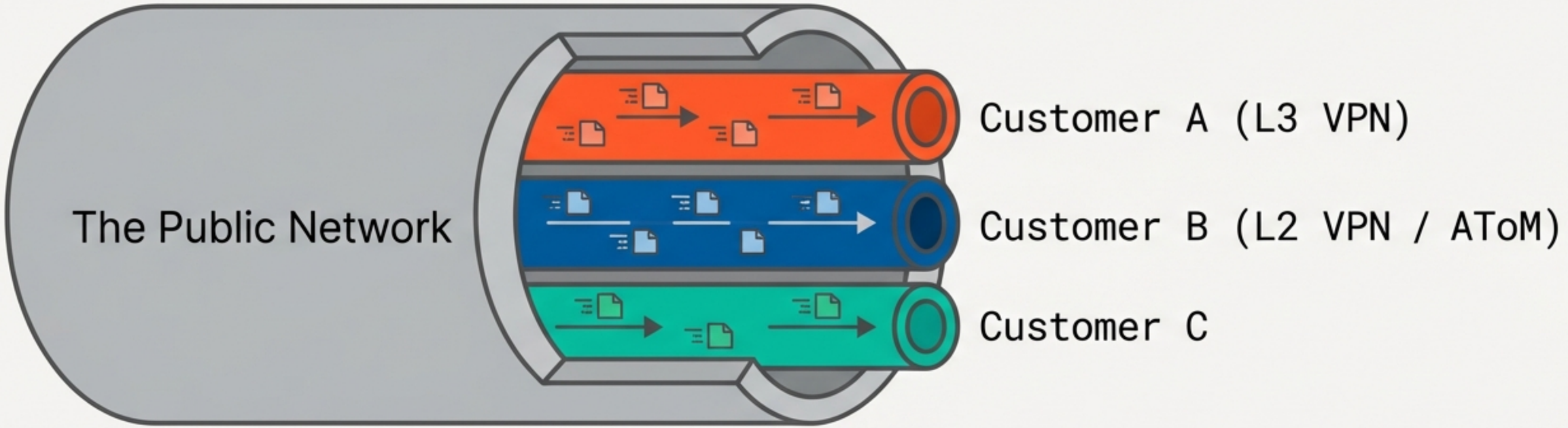
Traffic Engineering: Steering the Flow



Problem: IP Routing blindly jams the shortest path.

Solution: MPLS TE utilizes all available bandwidth by steering traffic around bottlenecks.

MPLS VPNs: Privacy over Public Infrastructure



MPLS allows Service Providers to create completely **isolated private networks** over a **shared core**, replacing expensive physical leased lines.

Summary: The Modern Converged Network

- **Convergence:** Unites Data, Voice, and Video on one IP infrastructure.
- **Efficiency:** Replaces slow routing lookups with fast label swapping.
- **Architecture:** Decouples the Control Plane from the Data Plane.
- **Versatility:** Enables VPNs and Traffic Engineering without new hardware.