MPLS Virtual Private Network (VPN) Routing and Forwarding Webinar

ILLINOIS CENTURY NETWORK™
Central Management Services

Welcome and Introduction

Today's Topic: MPLS VPN(VRF)
Comments or questions -
Valerie Bolinger
Frank Walters -
Network Architect -
Illinois Century Network

Participants must connect to the audio bridge in order to hear our presenter.
Toll Free: 1-888-494-4032
Access Code: 9310194524

Audience

- Network Designers
- Technical Coordinators
- The Perpetually Curious?

Topics for Today's Discussion

- MPLS in Real and Relatively High Level Introduction
- Keywords
- MPLS VPNs
  - Benefits
  - From the Customer's Perspective
  - Case Studies

What is MPLS?

Multi Protocol Label Switching

What Else?

Built with the unknown future in mind, it has proven very versatile.

For instance:
Martini Draft applications, like ATOM and AToM (L2 Point to Point Circuits) resulting in many new TLAs

And...

?

Major Technology Shifts

How long has ICN operated an MPLS network and why?

- ICN has operated an MPLS network for over a decade.
- Major Technology Shifts – preparing for the future.
- Initially for speed and traffic engineering
- Advanced services like low latency point to point circuits and VPN/VRF cloud type network services.

The Basics

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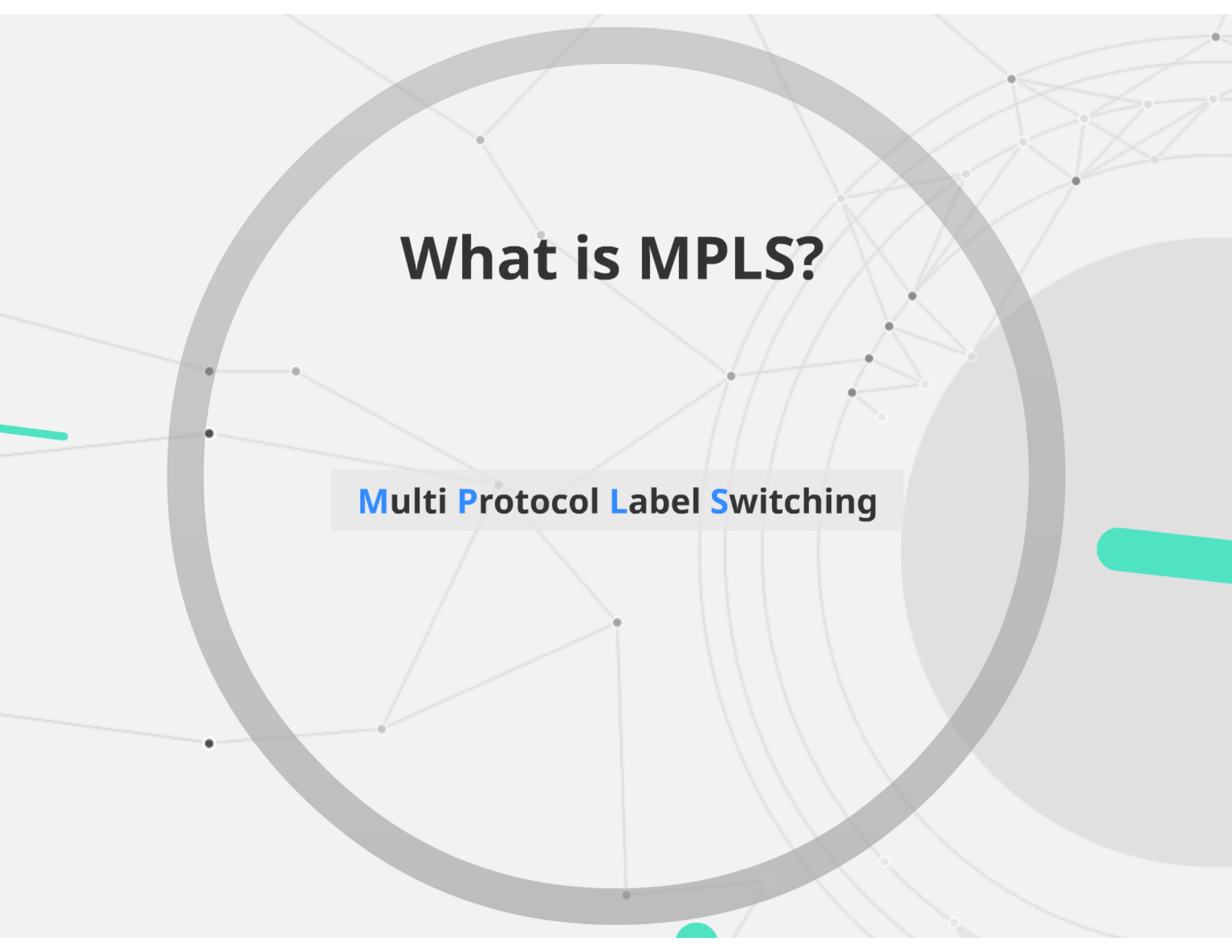
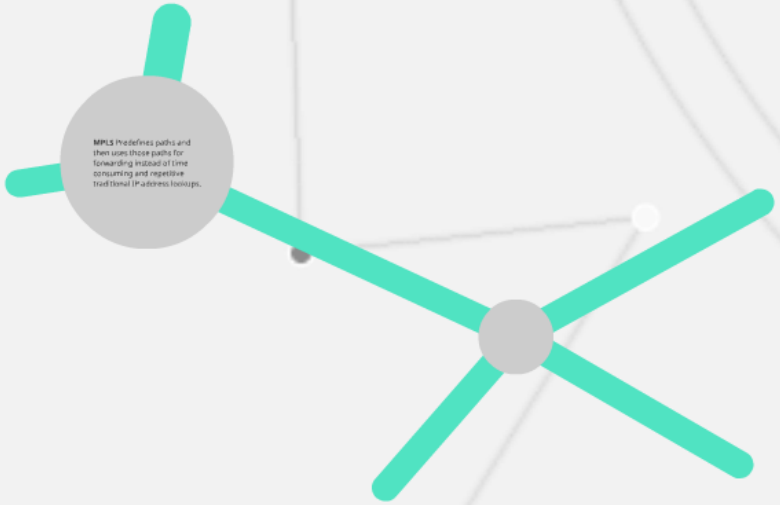

What is MPLS?
Multi Protocol Label Switching

And...

?

MPLS is a different way of routing (forwarding) packets.

At it's most basic?



MPLS Predefines paths and then uses those paths for forwarding instead of time consuming and repetitive traditional IP address lookups.

What Else?

Built with the unknown future in mind, it has proven very extensible.

For instance:
Martini Draft applications, like AToM and EoMPLS (Point to Point ‘Circuits’) resulting in many new TLAs

Three Letter Acronyms

Of course there are new acronyms!

- MPLS – Multi Protocol Label Switching
- VRF – Virtual Route Forwarding
- VPLS – Virtual Private LAN Service
- EoMPLS or AToM – Ethernet over MPLS, or Any Thing over MPLS
- P, PE and CE Router Types
- Core, Distribution and Access Routers are now Provider, Provider Edge and Customer Edge Routers
- TE – Traffic Engineering
- And Many Others

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Major Technology Shifts

The Basics

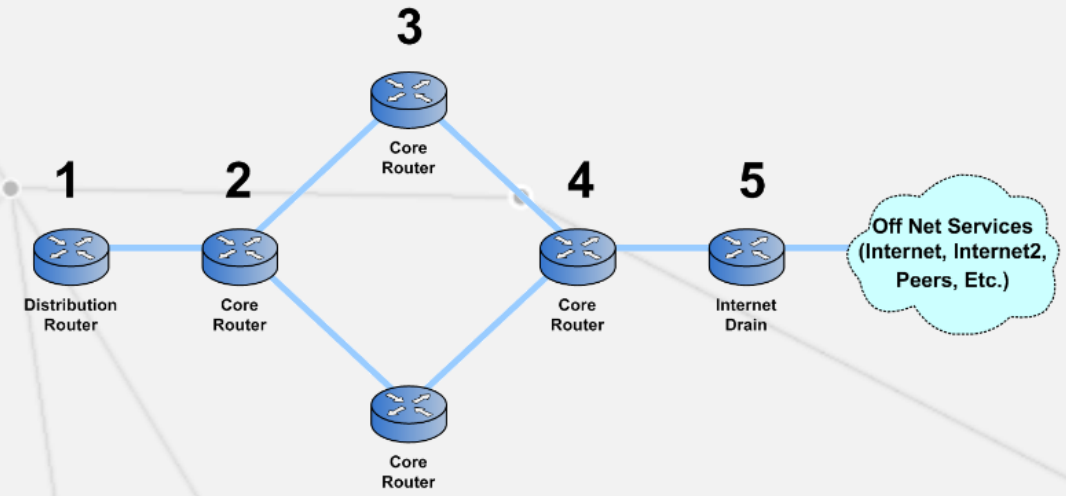
MPLS is often characterized as a Layer 2.5 networking protocol.

It can act like Layer 2 as well as Layer 3.

It depends on both, kind of acts like both, but really sits in between them.

What happens on a ‘traditional IP network?’

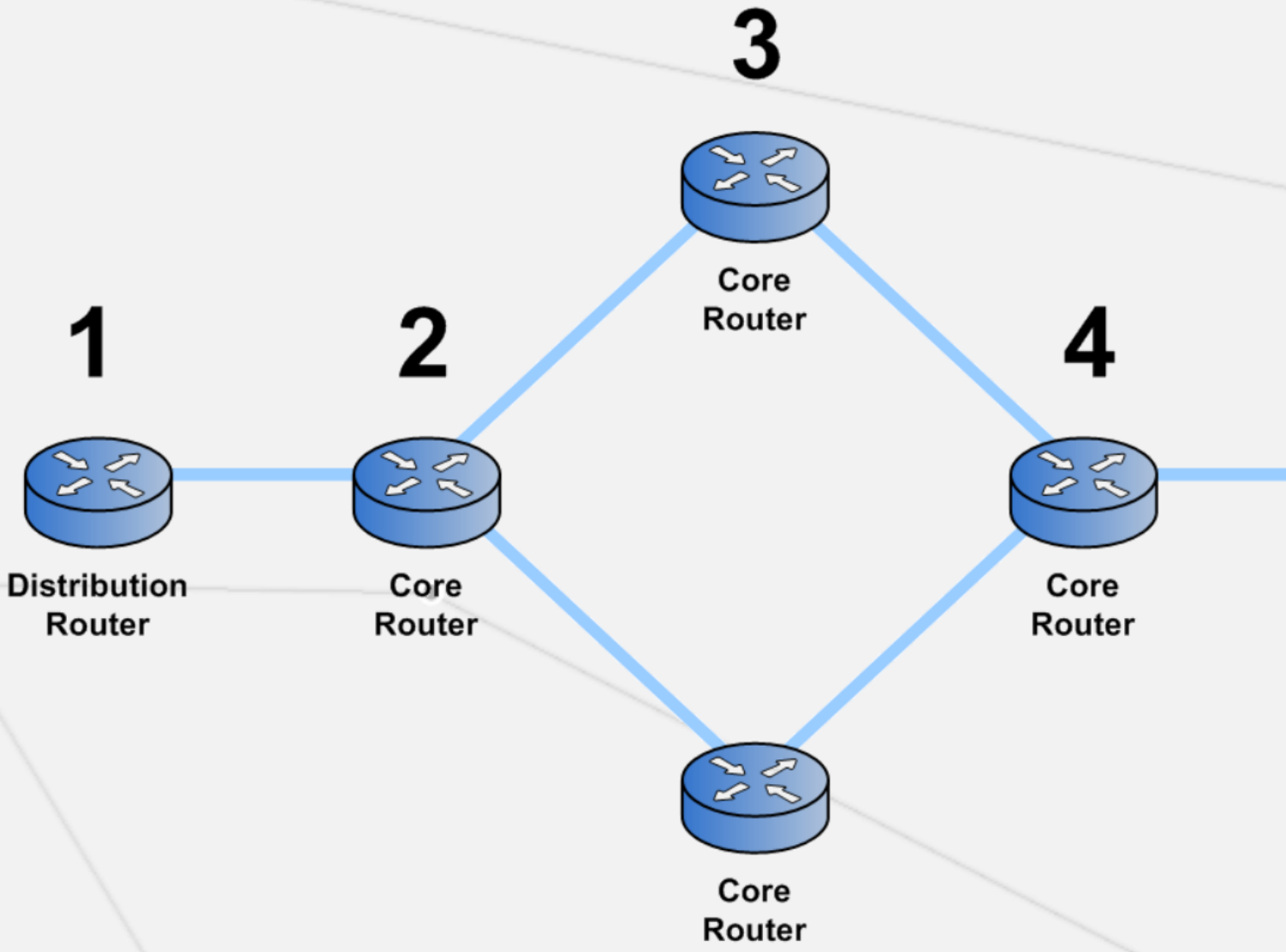
- Each router performs an IP lookup, determines the next-hop based on it’s (HUGE) routing table and then forwards the packet to that destination.
- Of course that’s usually not the actual destination, so on the next router, this process is repeated, multiple lookups, requiring huge routing tables and CPU ticks (whether on the main processor or distributed).



What does this mean?

Lots of memory and CPU is required in lots of places on the network.
Wasted time re-deciding something that was already determined multiple times before.

distributed).



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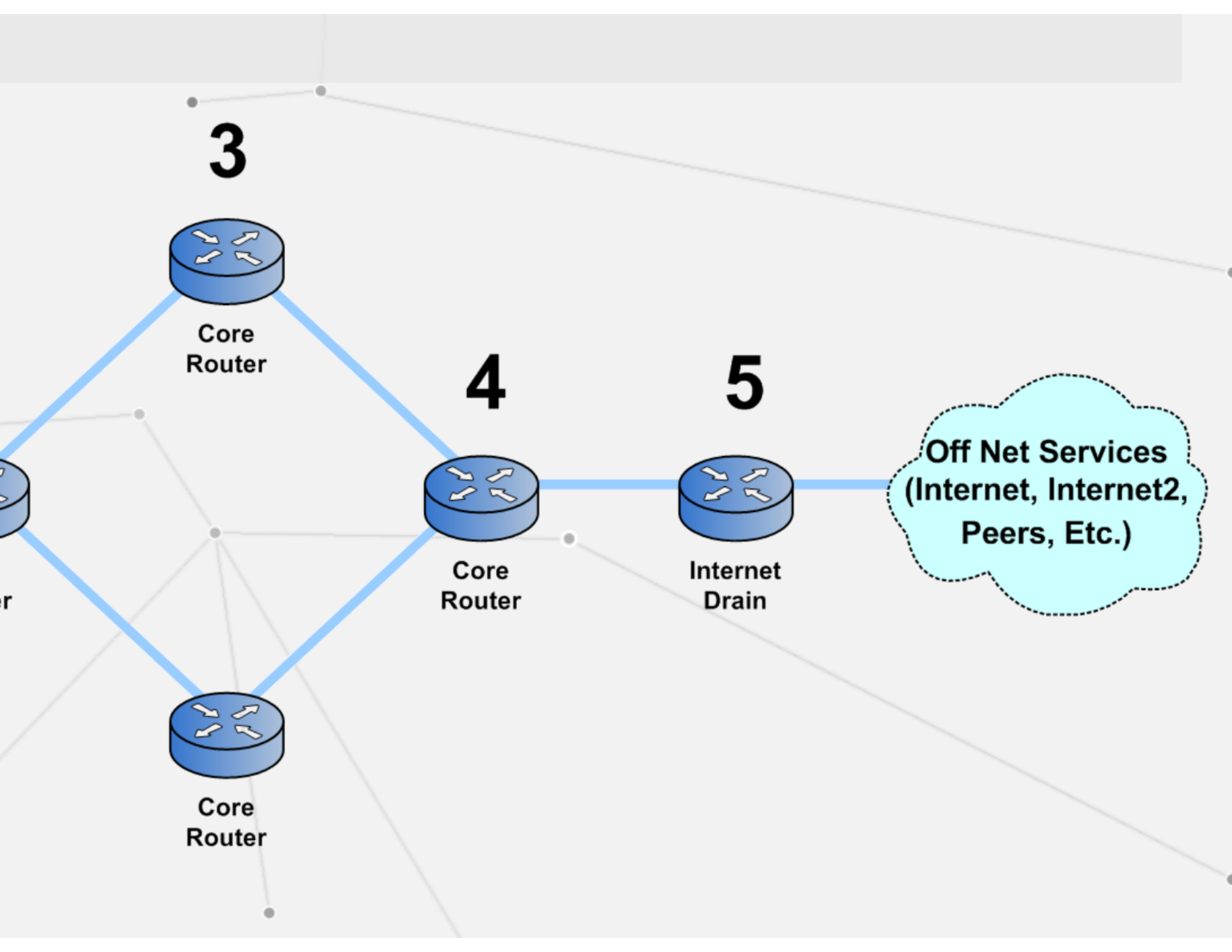

3
Core
Router
4
5
Off Net Services
(Internet, Internet2,
Peers, Etc.)
Core
Router
Internet
Drain
Core
Router

Core
Router

What does this mean?

Lots of memory and CPU is required in lots of places on the network.
Wasted time re-deciding something that was already determined multiple times before.

What makes MPLS Special?

Well, at first it isn't...

It does a lookup, just like the traditional routing model.

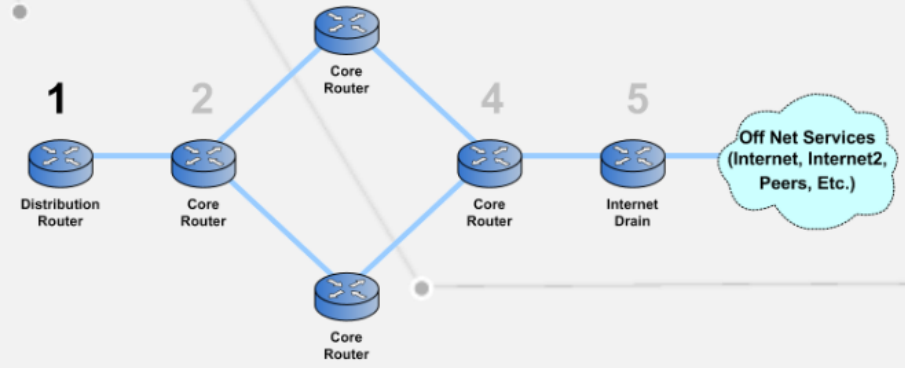
However, instead of searching for the next hop it looks for the destination.

Also, importantly, MPLS performs EXACT match comparisons, instead of Longest Path. Result? Much faster comparison and lookups don't have to happen multiple times per hop.

Once it finds that path (this path was already created, it's just waiting to be selected) the router applies a 'label' to the packet(s).

Now, instead of many lookups, the other routers in the path use that label. No more IP lookups, and really, no more decisions until the end of the path.

These paths are called LSPs, or Label Switch Paths.



What makes it faster?

- The Internet routing table surpassed 500,000 routes this year.
- This table can be even bigger if, like ICN, you have Internet, Internet2 and many private peers in the mix.
- Selecting the right path takes a while, and it's done over and over again in the traditional model. (At every router hop)
- In contrast, a large network might have 2,000 LSPs, and even then, the decision process only happens once and then an LSP is chosen.

Is that it? What else can it do? "What Advanced Services?"

- MPLS Point to Point services (AToM, EoMPLS)
- VPLS Virtual Private LAN Service
- Traffic Engineering (making the packets go the direction that we want them to go.
- And, of course,

MPLS VPNs (err, VRFs)

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MPLS VPNs (err, VRFs)

VPN = Virtual Private Network

or, more precisely,

VRF=Virtual Route Forwarding

What MPLS VPNs are...

- MPLS VPNs are a tool to provide customers with the ability to separate their traffic from other customers.
- To truly have their own Virtual Private Network (or multiples).
- Really, it's a widget to put into your toolbox.

What they are not...

What do most people (technologists) think when they think

"VPN"

?

Well, they are not THAT.

MPLS VPNs do not Encrypt

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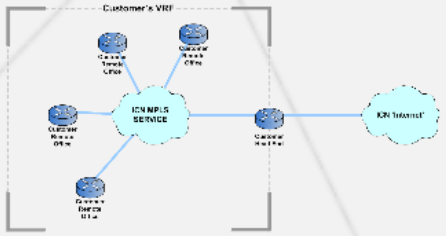
MPLS VPNs do not Encrypt

The Virtual Private Network or VRF provides a separation of traffic, not encryption.

It's like the warm fuzzy feeling you get with frame relay PVCs.

What does it look like to me?

Simple Logical Diagram



How it looks on the interface toward the provider

For TTs

```
interface Serial0/0/0:1.123
 description Main Interface
 no ip address
 encapsulation frame-relay IETF
 frame-relay lmi-type cisco
 frame-relay interface-dlci 444
end

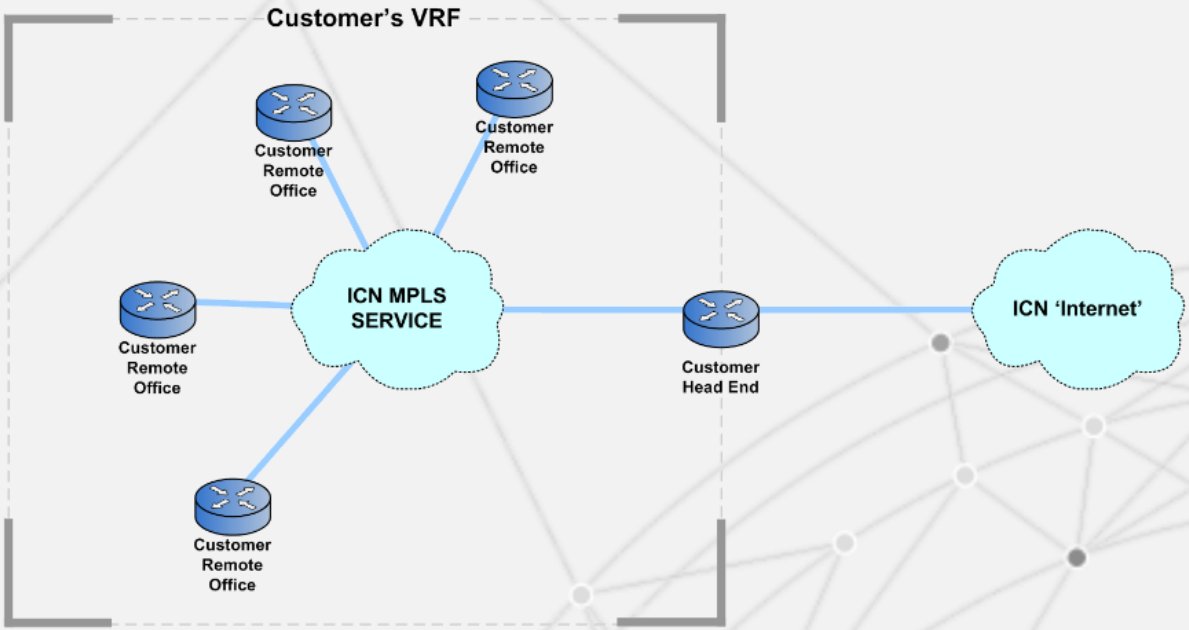
interface Serial0/0/0:1.123.444 point-to-point
 description PVC Interface #1
 ip address n.n.n.n 255.255.255.252
 frame-relay interface-dlci 444
end
```

For Broadband or direct connections

```
interface GigabitEthernet0/1
 description Main Interface
 no ip address
 load-interval 30
end

interface GigabitEthernet0/1.444
 description Main Interface
 encapsulation dot1q 444
 ip address n.n.n.n 255.255.255.252
end
```

Simple Logical Diagram



How it looks on the interface toward the provider

For T1s

```
interface Serial3/0/0/12:0
 description Main Interface
 no ip address
 encapsulation frame-relay IETF
 frame-relay lmi-type cisco
 frame-relay intf-type dte
end

interface Serial3/0/0/12:0.nnn point-to-point
 description PVC Interface #1
 ip address n.n.n.n 255.255.255.252
 frame-relay interface-dlci nnn
end
```

For Broadband or direct connections

```
interface GigabitEthernet2/19
 description Main Interface
 no ip address
 load-interval 30
end

interface GigabitEthernet2/19.nnn
 description Main Interface
 encapsulation dot1Q nnn
 ip address n.n.n.n 255.255.255.252
end
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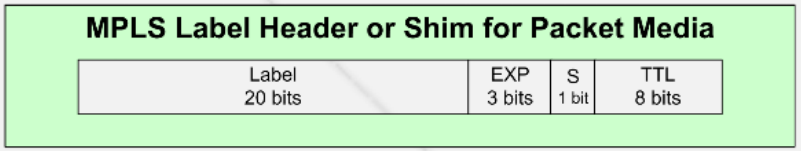
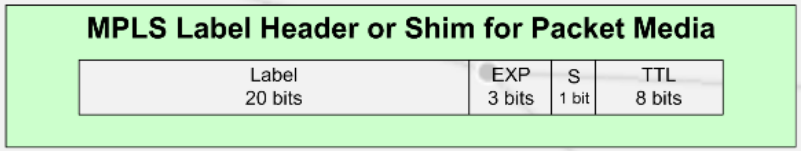
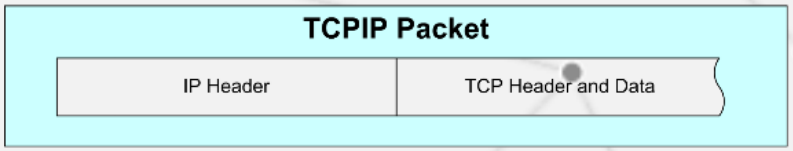
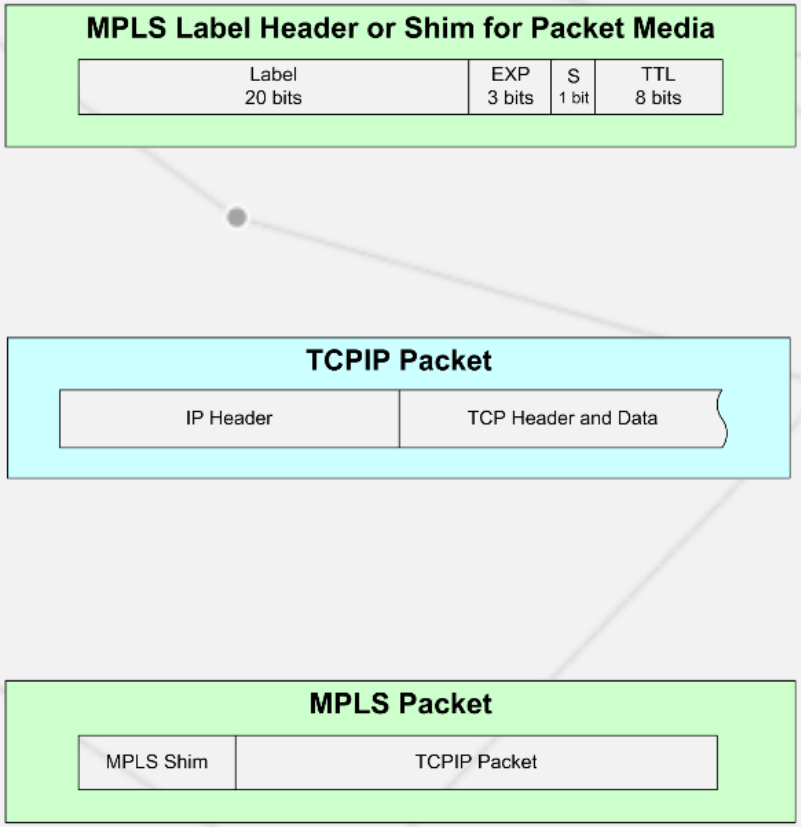


Label: 20 bits to allow for LSPs
EXP: 3 bits, QoS
S: Bottom of Stack shim, 1 or 0
TTL: 8 bits for separately tracked TTL

One 32 bit 'Word', and multiple can be added to a single packet for advanced services.


MPLS Label Header or Shim for Packet Media
Label
20 bits
EXP
3 bits
S
1 bit
TTL
8 bits


TCPIP Packet
IP Header
TCP Header and Data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Label
20 bits
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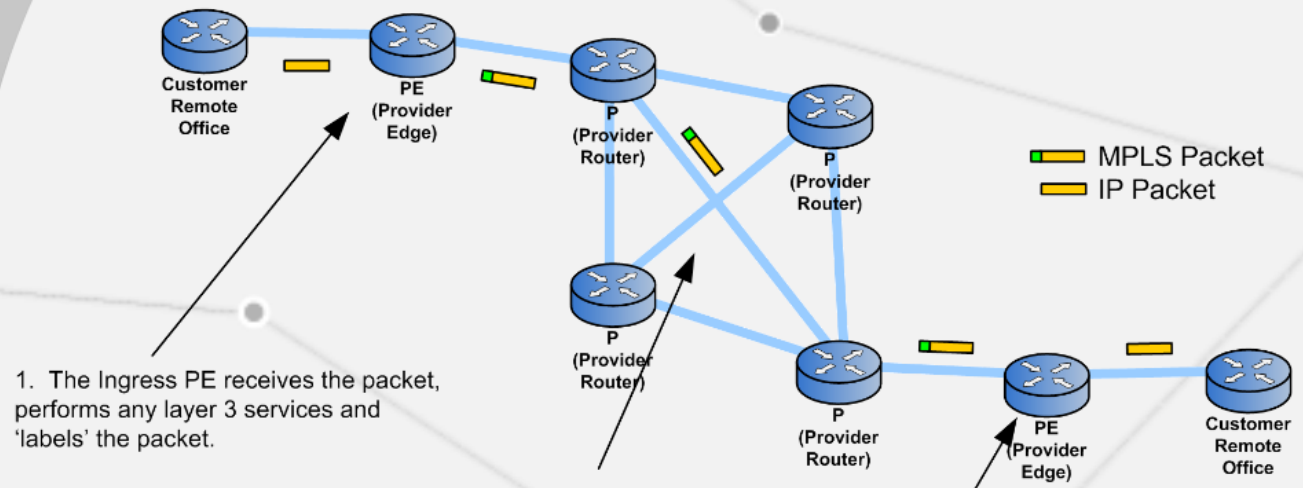
TCPIP Packet
IP Header
TCP Header and Data
MPLS Packet
MPLS Shim
TCPIP Packet

Existing network with MP-BGP and MPLS savvy IGP (ISIS in our case)

This means that the LDP (Label Distribution Protocol) has established label to destination mappings. Basically, an MPLS savvy network will at all times have a label mapped per prefix.



1. The Ingress PE receives the packet, performs any layer 3 services and 'labels' the packet.

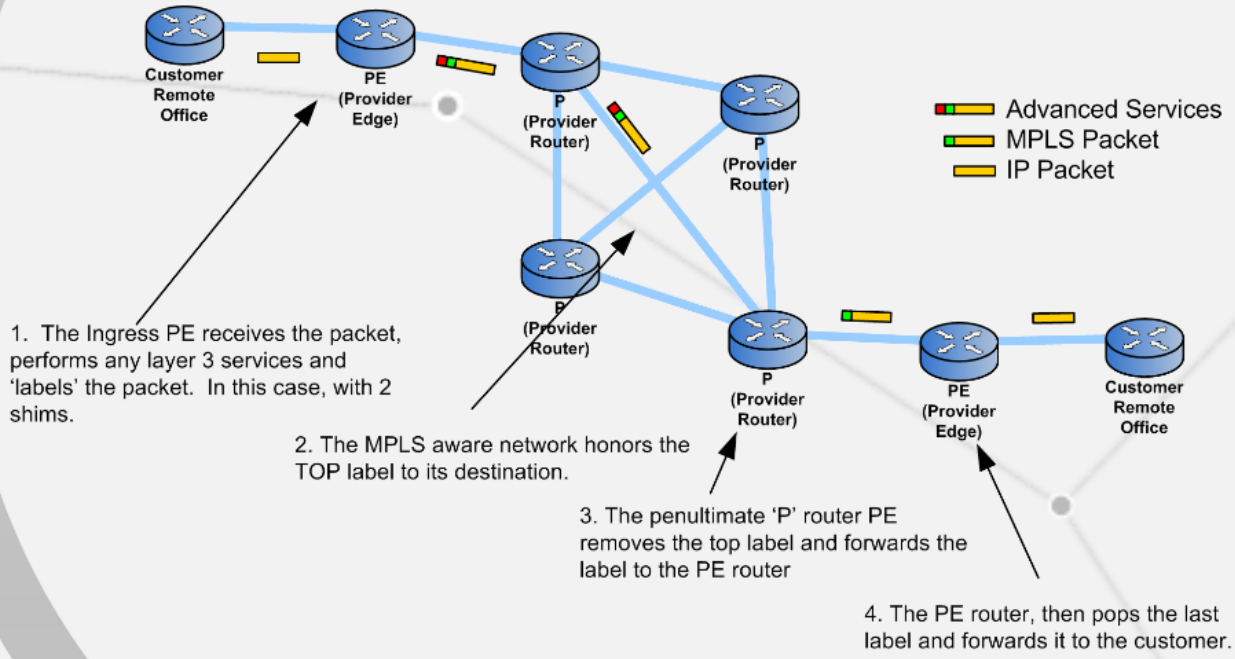
2. The MPLS aware network honors that label to its destination.

3. The destination PE removes the label and delivers the packet… *

* In the case of PHP (Penultimate Hop Popping), the last provider router removes (or 'pops' the label). It is, after all, unnecessary at this point.

How is this really extensible? It isn't until you find that the labels, or shims, can be stacked…!

This allows us to use an additional label for other purposes, like limiting the routes to a particular customer network. For instance, at an extremely high level, the second shim could restrict the packets to a particular customer 'cloud'. The packet is then popped at the end like normal, no one the wiser...

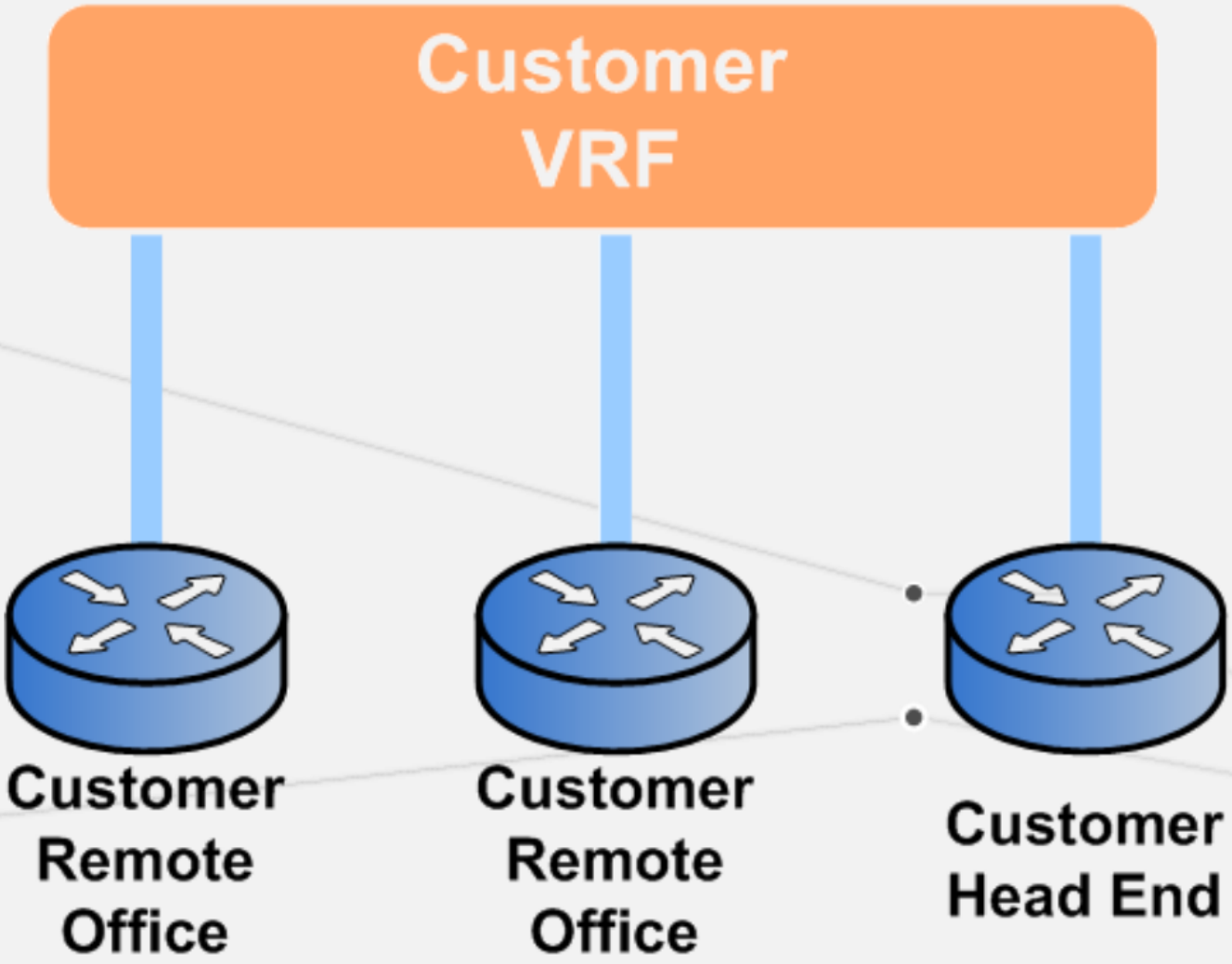


And Finally,

"What Can I Do With It?"

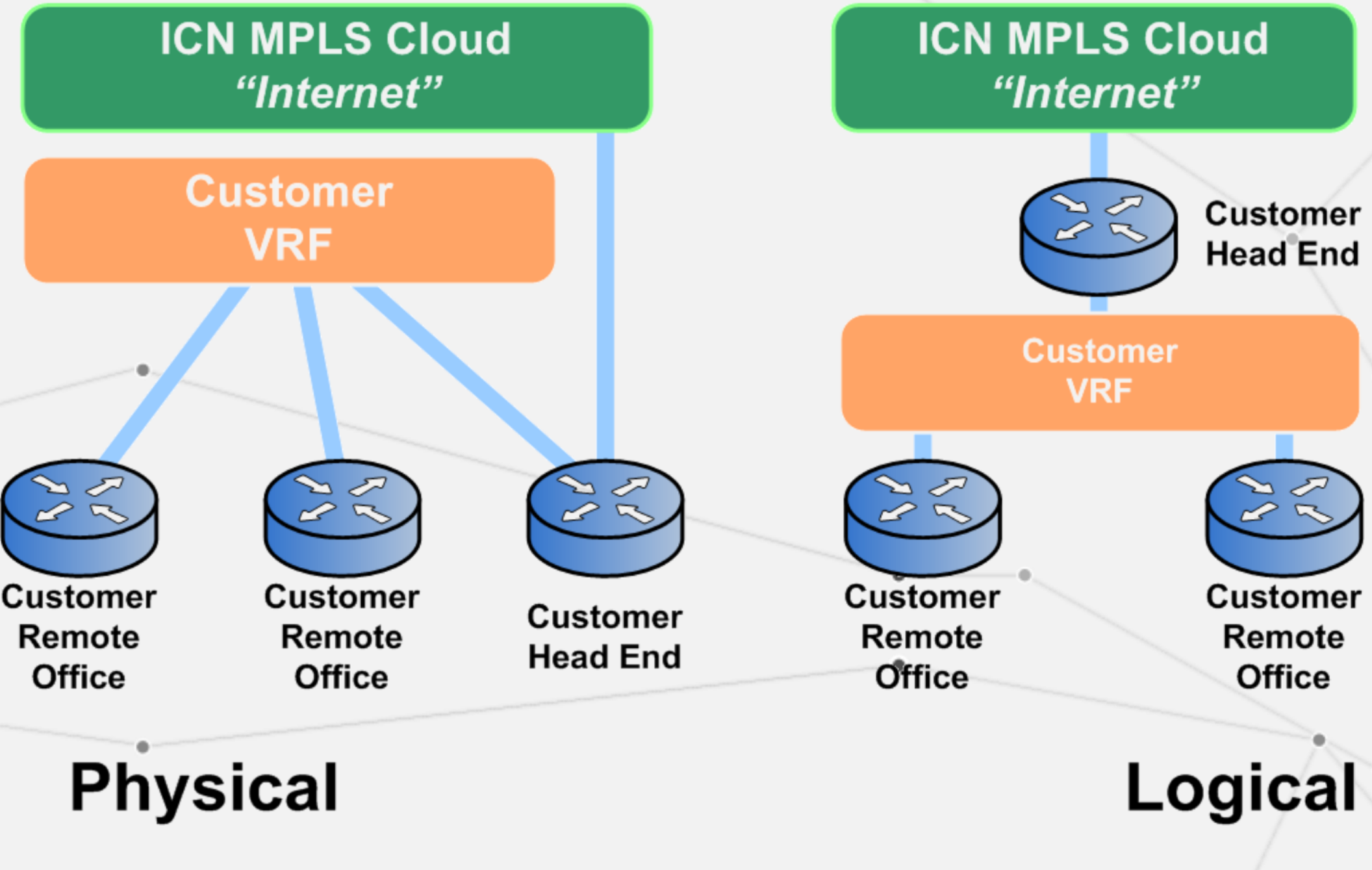
- Internal Only Network
- Private Network with Internet Access (from a single or multiple Head Ends)
- Internet Access and DR Failover
- Separating Types of Service (VOIP/SIP)
- Faculty/Admin and Dorm Separation

Internal Only Network

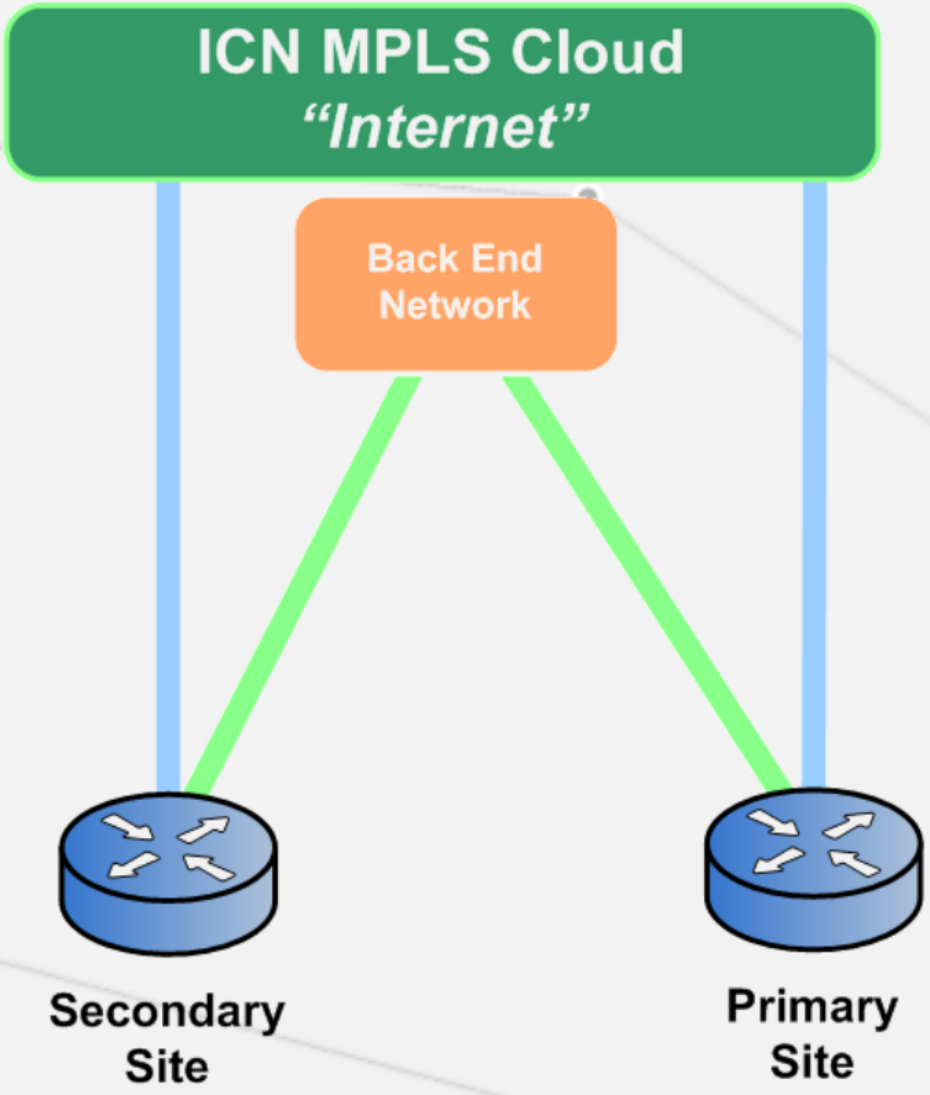


Physical & Logical

Private Network with Internet Access

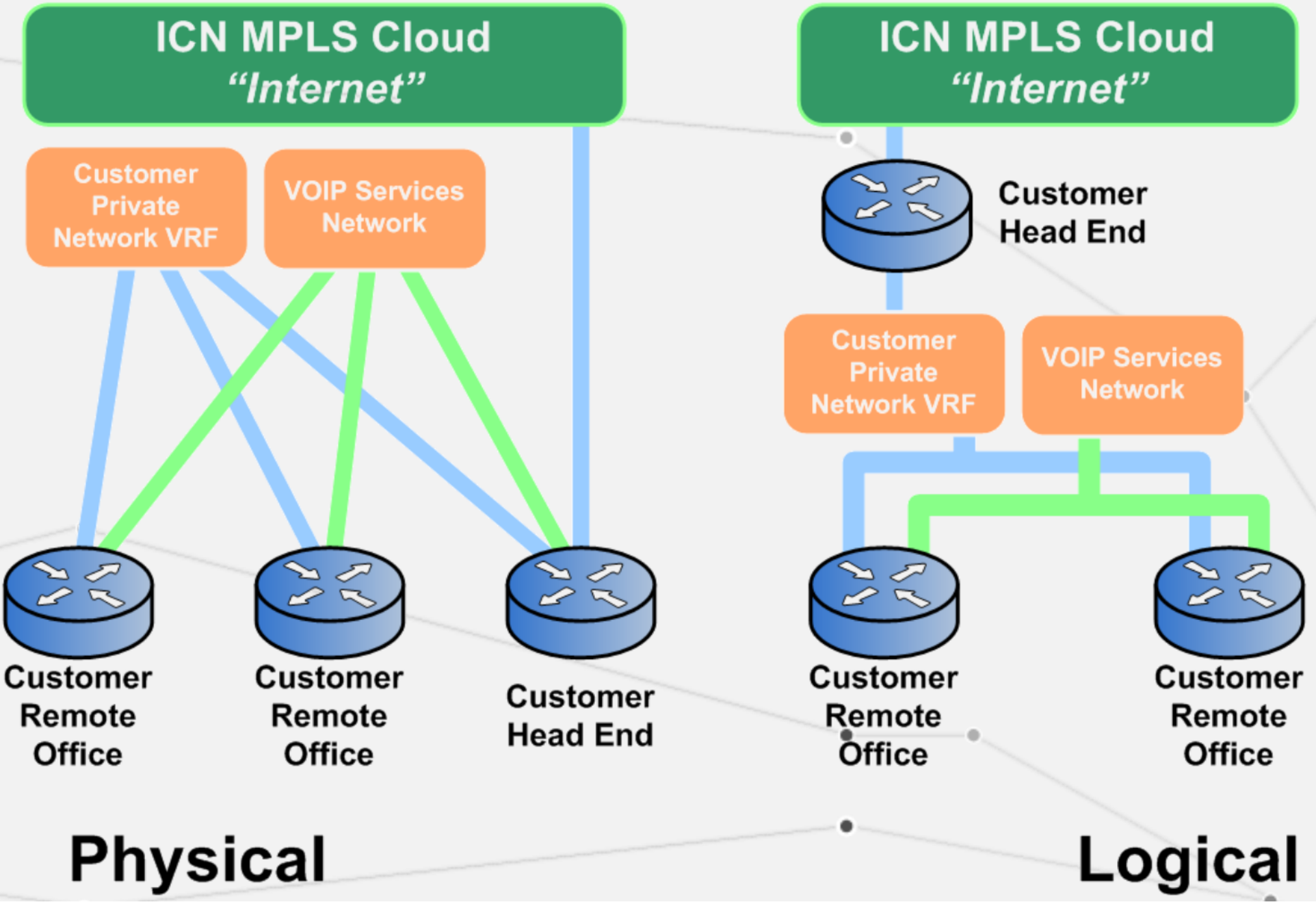


Internet Access with DR Failover

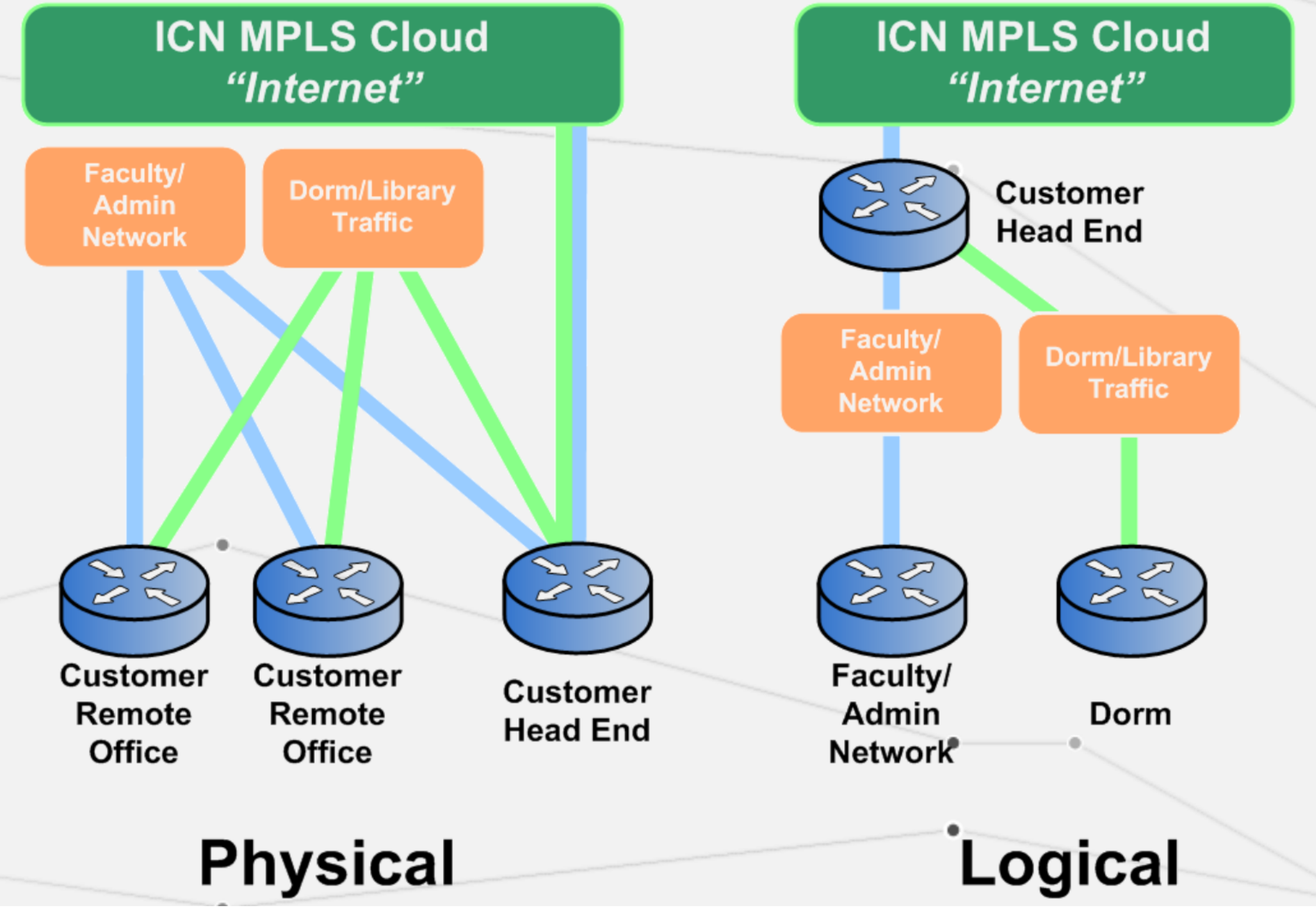


Physical & Logical

Service Separation (VOIP)



Faculty/Admin and Dorm Separation



Other Notes and Concerns

- Monitoring
- Security

How ICN The Pricing Model Impacts MPLS Services And How MPLS Services Affect Cost

Our current rates are published at www.illinois.net and more information is available to all constituents via their local RTC.

ICN is currently in the process of revising its services and rates and we will publish those as soon as it is finalized.

A future webinar will be hosted once the rates are finalized.

Thank You!!

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