



# Unifying the Distributed Enterprise with MPLS Mesh

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## Technical Whitepaper

## Introduction

Businesses are increasingly reliant on information communication technologies. With the increased commitment, comes technological improvements. Today's modern enterprises employ Information Technologies (IT) that deliver higher value, resiliency, and scalability than similar solutions of just a few years ago. One such technology is Multiprotocol Label Switching (MPLS). MPLS is a mature technology first popularized as a cost-effective method for replacing packetized services such as Asynchronous Transfer Mode (ATM) and Frame Relay at branch offices. As the protocol further matured, many businesses found MPLS to be an ideal way to replace the expensive, long-haul Wide Area Network (WAN) circuits connecting their core infrastructures.

In addition to reducing costs, MPLS offers further benefits such as prioritizing voice traffic with Quality of Service (QoS) to improve Voice over Internet Protocol (VoIP) quality, simplifying network complexity, and strengthening disaster recovery and business continuity setups. The advantages of MPLS are especially desirable for distributed enterprises. However, these organizations face unique challenges in implementing services. This whitepaper explores these challenges and how the AireSpring MPLS Mesh product addresses them.

## The Distributed Enterprise MPLS Challenge

Major challenges encountered by distributed enterprises became especially apparent as the number of MPLS networks increased. Many of the problems arose organically from the coverage limitations of individual MPLS carriers. The essential issue is thus: for years, truly ubiquitous coverage was not widely available and or was quite expensive. For many distributed enterprises, the only cost-effective option was to attempt to address their connectivity needs by merging MPLS services from multiple carriers.

These efforts met with several key challenges, including:

- 1. Vendor management complexities:**

*Multiple vendors delivering similar products but with different coverage areas, necessitating separate billing and complicated network handoffs. Depending on the nature of the setup, technical issues on one vendor's network can easily disable the entire merged network.*

- 2. Inconsistent QoS and traffic prioritization:**

*Network traffic is managed by grouping together similar types of data. By labelling data packets, the network is able to keep track of and prioritize certain types of data. This is especially necessary to ensure consistent quality for voice communications. Different networks and vendors often do not share the same labelling protocols.*

- 3. Inconsistent Service Level Agreements (SLAs) and network performance guarantees:**

*SLAs can vary significantly between carriers. Different tolerance levels for jitter, latency, delivery ratio, and transit delivery can impede performance between linked networks, causing one or more to not work optimally.*

In short, while technically possible, merging MPLS services has traditionally been beyond the reach of distributed enterprises that either do not want to introduce additional network complexity or lack the necessary IT resources to adequately manage multiple services.

## Multiple MPLS Providers – Ubiquitous access, with a cost

The merging of MPLS services from multiple providers, by its very nature, implies a multi-vendor solution. While it is important to observe that enterprises who have chosen this option will usually make note of the cost savings achieved, many neglect to account for the additional, and often significant, IT overhead of managing a more complex solution. The net-effect is that the savings from circuits are partially, or in some cases entirely, consumed by additional expert IT resources required to manage and monitor their solution.

## Traffic differentiation – Not all QoS is implemented identically

Differentiated Services (DiffServ) is a mature set of standards, dating back to 1998. DiffServ defines a set of Internet Protocol (IP) traffic markers and policies that can be used to deliver varying tiers of network service for network applications. The core DiffServ standards are documented in the IETF RFCs 2474, 2575, 2997, 3246, and 3260.

With such a rich set of standards in place, a casual observer may assume that these would imply a consistent QoS offering from all network and MPLS service providers. Unfortunately, this is not the case. The reality is that these standards only define how traffic is marked. The IETF RFCs do not supply any specific parameters on how MPLS providers should deploy DiffServ across their network. And the inevitable end result: wide variances in each MPLS provider's QoS implementation. Business enterprises seeking a merged MPLS solution must take special care in managing and maintaining translation tables, which can grow complex as the number of linked networks increases. In many cases, it is often easiest for an enterprise to use the lowest common denominator of common QoS elements from each provider, thereby limiting part of the MPLS value proposition in order to achieve a more consistent service.

## What about SLAs?

The strength of the SLAs offered by each MPLS provider is critical to implementing a successful MPLS strategy for a distributed enterprise. Typical metrics may include service availability, network latency, and mean time to repair (MTTR).

Unfortunately, as with the lack of consistency with QoS, distributed enterprises have discovered that SLAs delivered by MPLS providers may vary widely in their treatment of network traffic. While this seldom presents an issue for a network contained entirely on a single MPLS provider's network, IT staff using multiple providers may find otherwise. Particularly troublesome is isolation of network faults and assignment of accountability when multiple MPLS providers are involved.

## AireSpring MPLS Mesh

The AireSpring MPLS Mesh product simplifies the procurement, deployment, and operation of MPLS networks for the distributed enterprise, enabling an enterprise to focus key IT resources on core business activities while AireSpring's expert staff delivers a comprehensive MPLS solution that brings the best benefits of a distributed MPLS network without the drawbacks of self-managing multiple, disparate MPLS solutions.

AireSpring's geographically diverse MPLS network uses multiple underlying carriers to provide the most cost effective access for each location. Longstanding partnerships with a wide variety of local, regional,

and national carriers allows AireSpring to deliver service nationwide at an industry-leading price point. The strength of AireSpring's MPLS network is that unlike traditional MPLS or WAN solutions, AireSpring's network is fully meshed. In this way, AireSpring's MPLS network is able to take full advantage of its nationwide spread, to deliver services securely over a diverse array of preconfigured alternate routes in the event of a core network disruption.

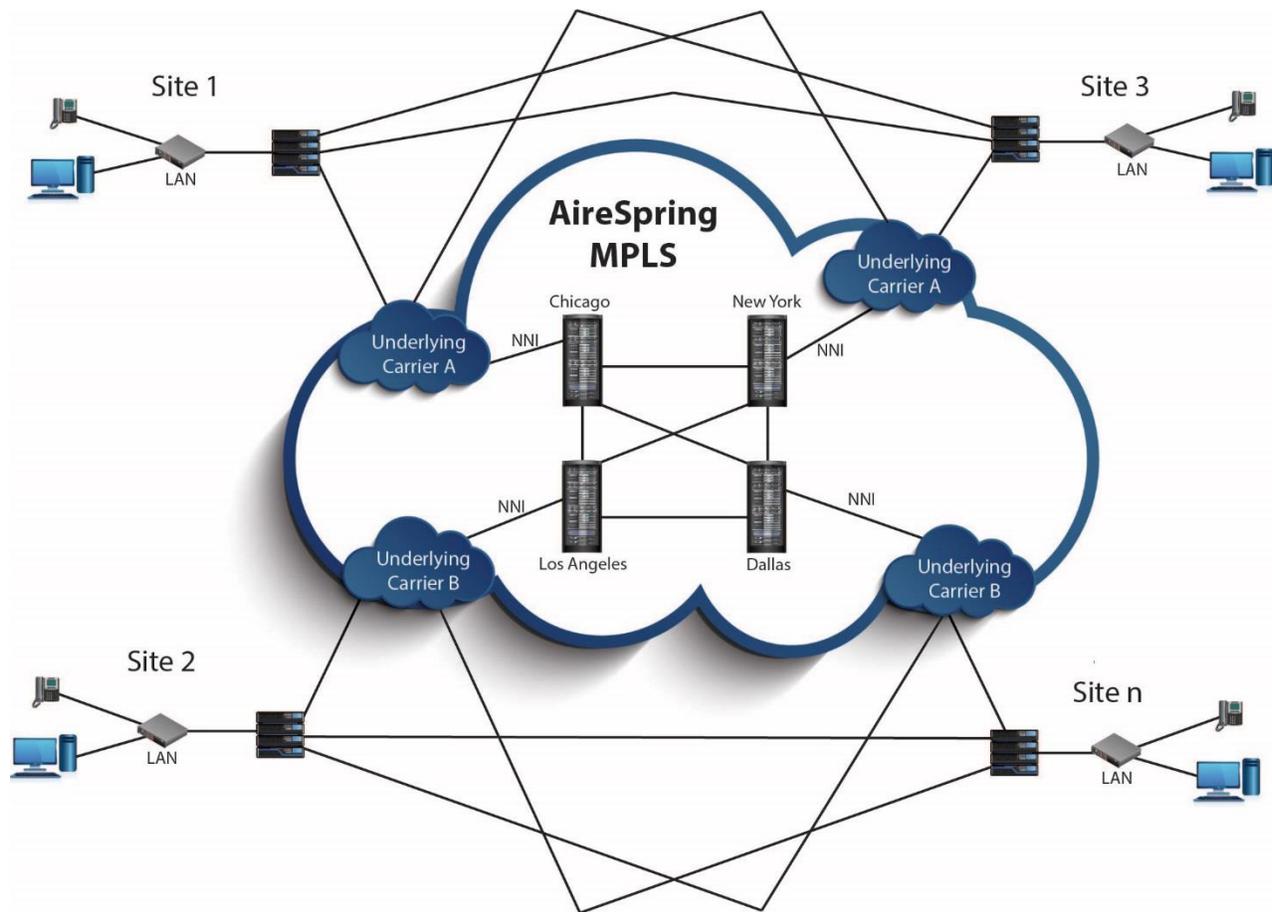


Figure 1 – AireSpring's MPLS Mesh seamlessly combines multiple carriers

## Carrier Diversity

AireSpring MPLS Mesh's ecosystem includes MPLS access services from over fourteen Tier 1 telecom providers, including AT&T, Verizon, Comcast, Sprint, Level 3, Windstream, XO, and CenturyLink.

Feature	Enterprise Benefit
<b>Multi-Carrier Access Options</b>	<p>AireSpring’s MPLS Mesh is carrier agnostic, allowing the distributed enterprise to select the right connectivity for business needs based on:</p> <ul style="list-style-type: none"> <li>• Availability (Footprint)</li> <li>• Cost</li> <li>• Circuit Type</li> <li>• Bandwidth</li> </ul>
<b>Class of Service (CoS)/QoS Harmonization</b>	<p>AireSpring’s expert staff takes the guess work out of managing performance across multiple MPLS providers. Customers can expect to mark their network traffic once for complete end-to-end QoS handling. No longer is there a need for maintaining QoS re-mapping tables.</p>
<b>Fully Managed Customer Premises Equipment (CPE)</b>	<p>Optional AireSpring provided and managed CPE allows for a single point of contact on all matters, removes additional vendor complexity, and eliminates upfront capital expenditures by including the CPE in a monthly service agreement with hardware repair and replacement included.</p>
<b>Integrated MPLS with Optional Internet and managed Voice Services</b>	<p>Optional Internet and Voice Services added to AireSpring’s MPLS Mesh solution simplifies the on-premises equipment requirements by delivering all services through a single CPE. AireSpring will pre-engineer the customer’s service to ensure AireSpring managed voice services are given the highest level of priority.</p>
<b>Single Circuit</b>	<p>The solution further simplifies the on-premises installation by delivering all private IP, Internet, and voice services over a single circuit, thus reducing costs and complexity for the distributed enterprise.</p>
<b>Consolidated Bill</b>	<p>There is no need to reconcile bills from multiple MPLS and telecom providers. AireSpring provides a single bill for all network and voice services.</p>
<b>Single Point of Contact</b>	<p>AireSpring provides simplicity by providing a single point of contact for ordering, provisioning, troubleshooting, billing, and account management.</p>
<b>End-to-End SLA</b>	<p>AireSpring offers a comprehensive SLA for end-to-end MPLS services covering all underlying providers, ensuring consistent service throughout the network.</p>
<b>Multiple Circuits</b>	<p>AireSpring is able to offer true MPLS failover. Multi-circuit access at the customer’s premise is possible, allowing for true network redundancy. Multiple on-site managed routers are also available.</p>
<b>Cost Arbitrage</b>	<p>Leveraging AireSpring’s partners and underlying carriers, MPLS can be connected over fiber, copper, and 4G wireless local loops, or any combination all at a dramatically low price point.</p>

Table 1 – Feature Summary

## AireSpring MPLS Mesh Architecture Overview

The key components of AireSpring’s MPLS Mesh architecture can be broken down into the following areas:

- MPLS Core infrastructure
- MPLS Carrier Integration
- QoS/CoS Remapping and Enforcement
- Customer Premises Design

Using AireSpring’s Mesh MPLS service, a distributed enterprise sees a single, integrated MPLS network and, if ordered, Internet and/or Voice solutions. AireSpring handles the complexities of integrating connectivity from diverse carriers.

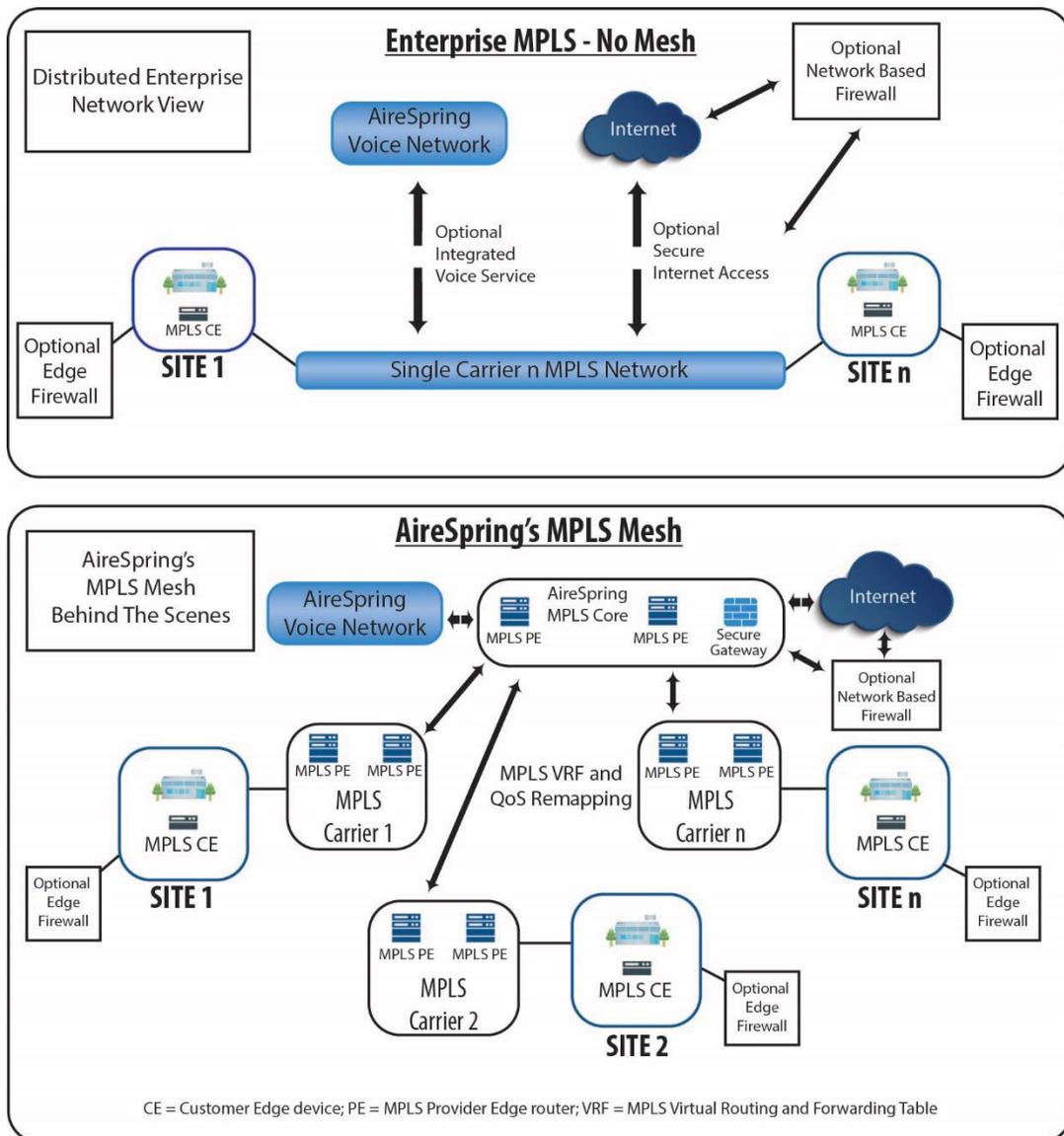


Figure 2 – MPLS Connectivity Simplified

## AireSpring MPLS Core

At the heart of AireSpring's MPLS Mesh service is a carrier-grade MPLS core network designed with maximum resiliency and multiple points of geo-redundancy.

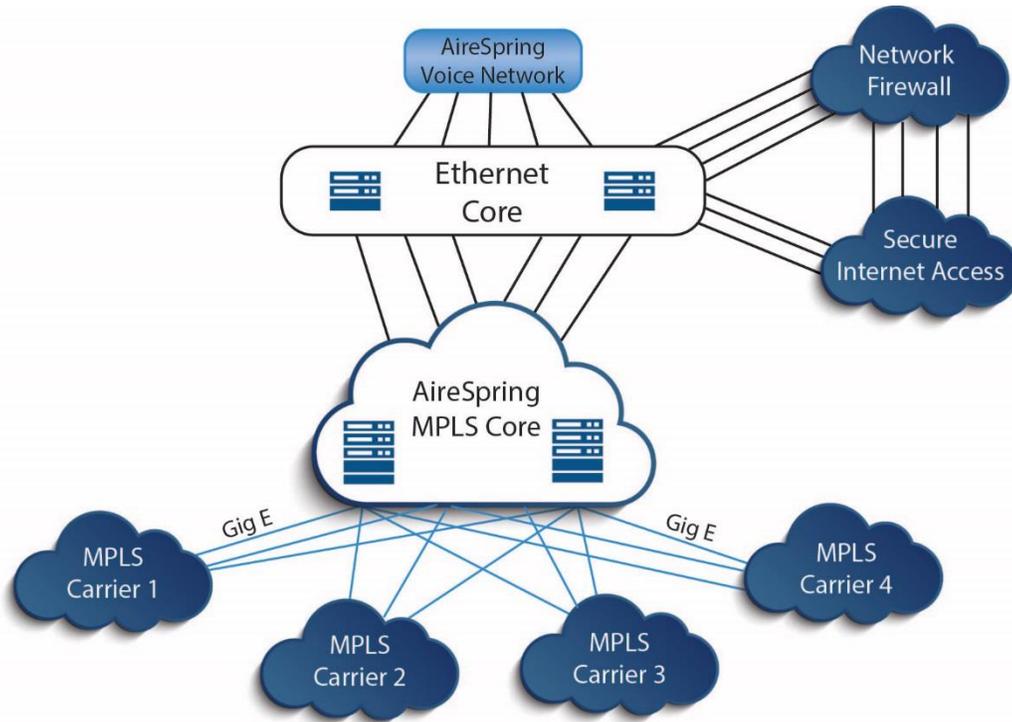


Figure 3 – Architecture Overview

Using Cisco core routers and Cisco Catalyst core Ethernet switches, AireSpring's network is failure-resistant, designed with full power, processor, and I/O redundancy.

Native, fiber fed Ethernet is used in AireSpring's MPLS core, thus reducing dependencies on legacy technologies such as Frame Relay and ATM.

## Carrier Integration

AireSpring inter-connects with MPLS access providers using industry best practices described in [RFC 4364](#), Section 10. This method, often abbreviated as MPLS Option A and MPLS Option B peering, allows AireSpring to seamlessly merge MPLS Virtual Private Networks (VPNs) into a common infrastructure.

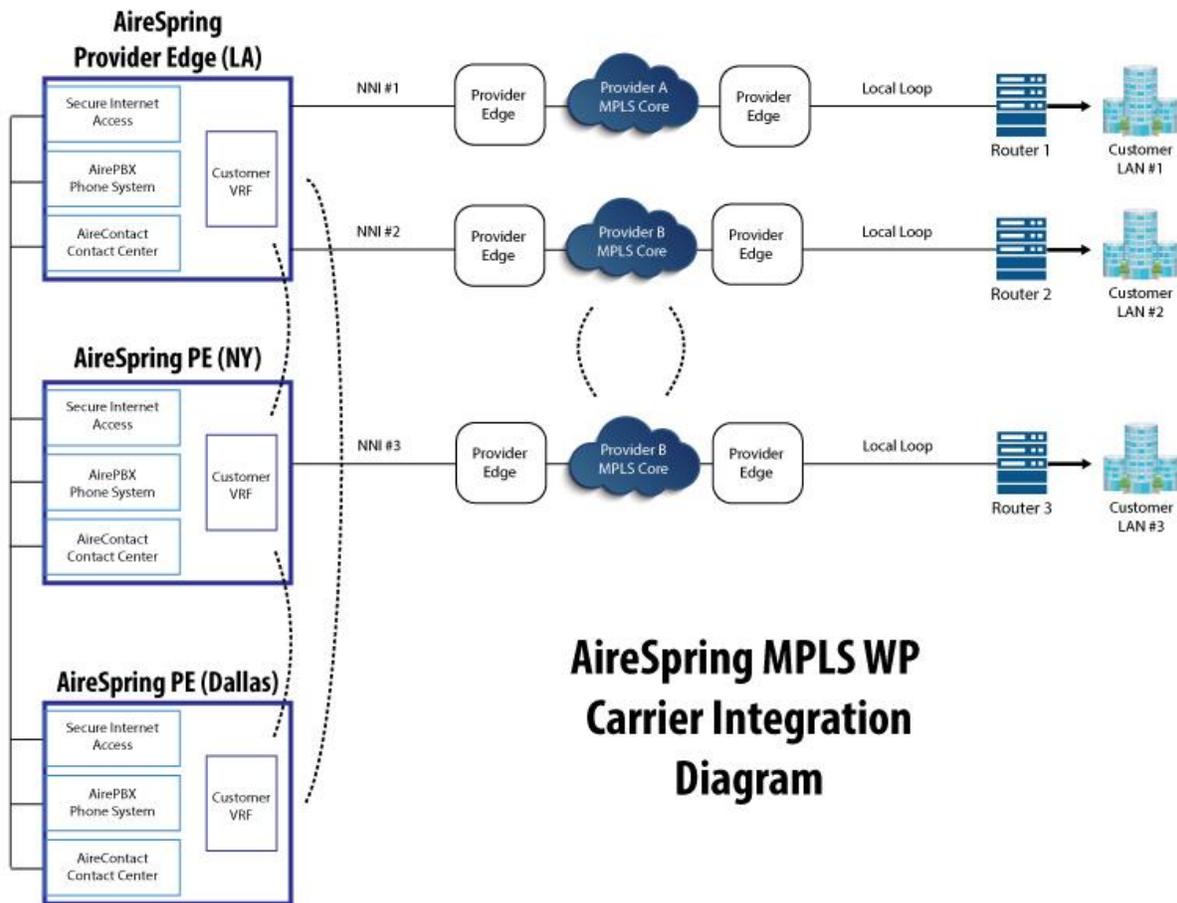


Figure 4 – MPLS Carrier Integration

Carriers employing MPLS Option A peering do not actually exchange MPLS labels across an MPLS Network to Network Interface (NNI). Instead, traffic is isolated through sub-interfaces dedicated to each unique customer VPN. Since AireSpring uses fiber fed Ethernet exclusively for MPLS NNIs, customer VPN isolation is achieved through the use of unique Virtual Local Area Networks (VLANs) at the NNI interface. Within the MPLS core, AireSpring uses a full MPLS protocol stack, including MP-BGP (defined in IETF RFC 4670), to isolate customer traffic into unique VPNs.

## Quality of Service Harmonization

AireSpring’s engineering staff has worked closely with each MPLS carrier in the ecosystem to design a comprehensive end-to-end QoS solution for customers. The resulting work allows a customer to use a published set of Differentiated Services Code Point (DSCP) markings provided by AireSpring which will automatically be translated between each underlying MPLS carrier. As shown in Figure 5, AireSpring’s MPLS Mesh network elements perform any translations necessary.

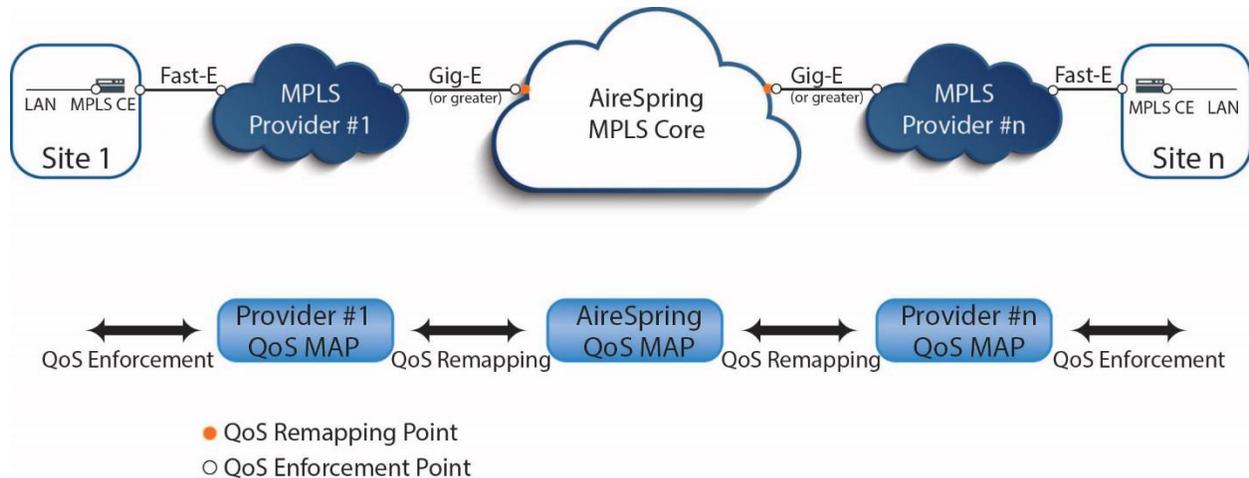


Figure 5 – AireSpring QoS Enforcement Points

AireSpring will provide customers with proper IP QoS marking instructions that are specific to each MPLS carrier. Traffic entering AireSpring’s MPLS Mesh will be normalized to the QoS values shown in Table 2.

Queue Name	AireSpring DSCP	AireSpring IPP
<b>Real Time</b>	EF	5
<b>Critical</b>	CS4	4
<b>Priority</b>	CS2	2
<b>Standard</b>	0	0

Table 2 – QoS DSCP Mapping

For customers seeking a deeper understanding of AireSpring’s QoS handling, the full table, including queue management is shown in Table 3. Queue depth is automatically managed by AireSpring’s Cisco MPLS routers using built-in algorithms.

Queue Name	Queue / Priority	Queue Management	IP TOS Marking	IP DSCP Marking
<b>Real Time</b>	1	Strict Priority	5	EF
<b>Business Critical</b>	2	WFQ	4, 6, 7	CS4 (AF41, AF42, AF43) CS6 CS7
<b>Priority</b>	3	WFQ	1, 2, 3	CS1 (AF11, AF12, AF13) CS2 (AF21, AF22, AF23) CS3 (AF31, AF32, AF33)
<b>Standard</b>	4 (default)	WFQ	0	0

Table 3 – Full QoS DSCP Mapping table

## Secure Internet Access

Customers may bundle secure Internet access with their MPLS Mesh service. With Secure Internet Access, customers leverage AireSpring’s cloud security infrastructure to deliver an Internet gateway function. Key features delivered by AireSpring’s Secure Internet Access include:

- Access public systems from private address space via Network Address Translation (NAT), with Application Layer Gateway (ALG) capabilities for protocols requiring advanced support such as FTP, SIP, and RTSP.
- Custom rules for customer-hosted servers, such as web and email.
- Geographic redundancy (optional), for customers requiring optimal Internet performance with a high level of resiliency.

Since AireSpring’s Secure Internet Access is delivered entirely from the cloud, no additional configurations or hardware are needed at the customer premises.

## Network Firewall

For large, multi-location customers, AireSpring offers an option for dedicated connectivity through a network-based firewall. This replaces the need for multiple premise-based firewall devices by providing redundant firewall devices inside AireSpring’s colocation centers.

## Customer Premises Design

AireSpring's MPLS Mesh product is implemented using a single or dual CPE deployed at the customer premises. CPE may be Customer provided (only available with certain hardware models of Dell's SonicWALL brand Firewall Systems) or supplied by AireSpring.

A key benefit of AireSpring's MPLS Mesh solution is the flexibility for a customer designing the LAN to maintain strict priority of Voice traffic and relative priority for all other data traffic.

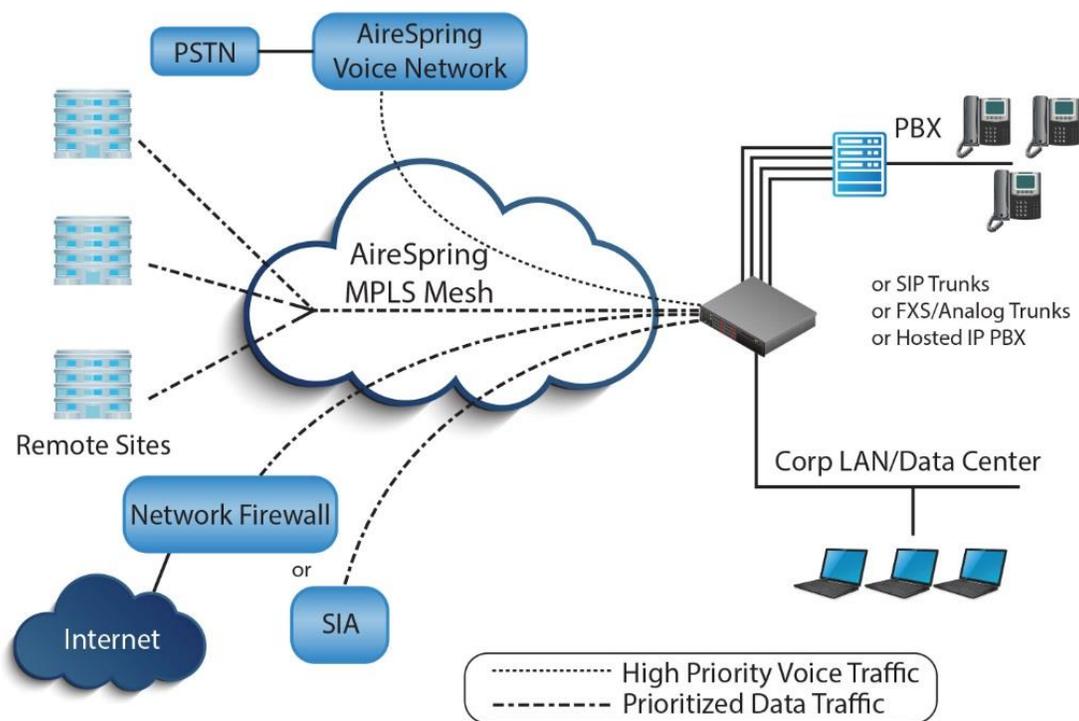


Figure 6 – Site deployment details for centralized Internet at one node

Customers must mark their traffic with the appropriate Differentiated Services Code Point (DSCP) or IP ToS settings prior to sending traffic through the MPLS Mesh.

## IP Addressing

Customers using AireSpring's MPLS Mesh service need not worry about renumbering their corporate LAN infrastructure. AireSpring allows customers to use existing private IP address space. The only restriction is that a customer's private IP address space must be unique at each of the customer sites within the same MPLS VPN.

## IP Routing

AireSpring currently supports static IP Routing at customer premises. For most customers, this is the simplest and most efficient method of interconnecting to the AireSpring MPLS Mesh.

## Network Monitoring Service

AireSpring uses carrier-class systems for monitoring the health of customer MPLS VPNs using the industry-standard Simple Network Management Protocol (SNMP) and Internet Control Message Protocol (ICMP). All MPLS services and network elements are proactively monitored for abnormal behavior, including faulty links and degraded performance. In the event that service outage or service degradation is detected, AireSpring Customer Support will notify affected customers. Corrective action to restore service will commence immediately and will include the coordination of senior engineers from each of the MPLS Mesh Access providers to ensure rapid resolution. The customer must give AireSpring permission to access the MPLS network, in order to perform network monitoring.

AireSpring's WAN Network Monitoring Service (AireNMS) is automatically configured to monitor each customer's CPE for reachability. Additionally, each access circuit proactively is monitored for utilization, latency and packet loss. Customers are able to view comprehensive performance reports, including: Live and historical statistics for service/interface management, router CPU utilization, latency, bandwidth utilization, error checks, and more.

## About AireSpring

Headquartered in Los Angeles, AireSpring is an award-winning provider of cloud communications and connectivity solutions serving thousands of businesses nationwide. AireSpring provides fully managed and connected end-to-end, next-generation solutions for multi-location enterprise customers, including Cloud Contact Center, Unified Communications, Business VoIP Phone Systems, SIP Trunking, MPLS, and Internet. AireSpring's solutions are offered through a diversified network of channel partners that includes distributors, master agents, managed service providers, and value added resellers. AireSpring's services are delivered over its revolutionary nationwide MPLS mesh network, providing customers a fully integrated, end-to-end solution from a single vendor.

AireSpring has received numerous industry awards for "Product of the Year," "Best Telecom Deal," "Best in Show," and "Top Channel Program." AireSpring is privately held, diversified, debt-free, and renowned in the industry for delivering a broad range of innovative cloud communications and connectivity solutions at competitive rates. To find product information or to become an AireSpring partner or agent, please visit [www.airespring.com](http://www.airespring.com), contact us at 888-389-2899, or send an email to [sales@airespring.com](mailto:sales@airespring.com)

