4.2.4 Layer 2 Virtual Private Network Services (L.34.1.4.6)

Qwest has a long history, since 1992, of delivering Layer 2 virtual private network services. Our Networx L2VPNS applies this experience with our converged IP infrastructure to deliver flexible, high quality services.

The Qwest Layer 2 Virtual Private Network Service (L2VPNS) provides Virtual Private Local Area Network (LAN) Service (VPLS) functionality that allows Government Agencies to connect multiple sites in a single bridged domain over the Qwest network.

Qwest delivers L2VPN VPLS through the Qwest MultiProtocol Label Switching (MPLS) core network. The Qwest L2VPN Service delivery approach combines diverse user-to-network interfaces, multiple access types, private alliance provider arrangements, and MPLS-enabled transport services to deliver a flexible and fully functional L2VPN solution to Agencies. Qwest's L2VPN provides four Quality of Service (QoS) categories based on service priority (e.g., network critical, time critical, business critical, and standard application). [redacted]

Qwest L2VPN services, as it relates to the VPLS standard and MPLS, is a recent offering in the telecommunications industry that builds upon the breadth of Qwest experience in legacy L2 services (Asynchronous Transfer Mode (ATM) and Frame Relay (FR)) and our knowledge of L3VPN services (RFC4364 standard). In developing our L2VPN service offering, we apply 14 years of engineering, management, and operational expertise. Qwest already provides ATM, FR, and L3VPN for many Government Agencies [redacted]

[redacted] Qwest is a leader in delivery of L3VPN services and will continue to deliver comprehensive and flexible solutions to Agencies through L2VPNS.

[redacted]

Figure 4.2.4-1 provides an easy reference to correlate narrative requirements to our proposal response.

Figure 4.2.4-1. Table of L2VPNS Narrative Requirements

Req _ ID	RFP Section	RFP Requirement	Proposal Response
7783	C.2.7.12. 1.4 (8)	8 Encapsulation Methods - The contractor shall indicate what encapsulation schemes are supported by its networks in order to support L2VPNS; i.e., Martini encapsulation, Q-tag stacking (Q-i-Q), MAC Address Stacking (MAS) and MAC in MAC (MIM).	4.2.4.3.1

Qwest has responded to the Government's request for further information regarding our plans for VPLS and Virtual Private Wire Service (VPWS) and has included the requested information here.

1. Qwest has deployed the network infrastructure necessary to enable [redacted]

   Qwest is committed to delivering [redacted]

   Networx [redacted]

   Regarding protocol maturity, the fact that [redacted] is not yet a fully standards-based protocol limits interoperability across carriers (e.g., Network to Network Interface (NNI)) because, as implemented, the

protocol remains platform-specific and therefore proprietary. It is expected that this situation will be resolved as standardization progresses.

[redacted]

Further details regarding how we fulfill the Networx VPLS requirements are located below in Section 4.2.4.3.1, *Satisfaction of L2VPNS Capability Requirements*.

4.2.4.1 Reserved (L.34.1.4.6 (a))

4.2.4.2 Reserved (L.34.1.4.6 (b))

4.2.4.3 Satisfaction of L2VPNS Requirements (L.34.1.4.6(c))

This section addresses how Qwest will meet the General Services Administration's (GSA's) L2VPNS features, capabilities, and interface requirements.

Qwest owns and operates a nationwide Layer 2 and 3 MPLS core service infrastructure that satisfies all the mandatory standards, connectivity, capabilities, features, and interfaces required for Networx L2VPNS [redacted].

Qwest uses MPLS technology to provide multifaceted services built on a unified services architecture. We have employed MPLS for many years and have extensive experience in all aspects of network design, operational support, and service delivery.

Qwest will provide the L2VPNs using vendor implementations that comply with all necessary Internet Engineering Task Force (IETF) and Institute of Electrical and Electronic Engineers (IEEE) standards or draft standards. [redacted] Qwest's ongoing participation in many standards and technology forums, such as the IETF, IEEE Standards Committees and Working Groups, and the Metro Ethernet Forum, ensures our awareness and compliance with evolving industry standards.

4.2.4.3.1 Satisfaction of L2VPNS Capability Requirements (L.34.1.4.6(c); C.2.7.12.1.4)

Qwest fully complies with all mandatory stipulated and narrative features, capabilities, and interface requirements for L2VPNS. The following ***Figure 4.2.4-2*** summarizing Qwest's response to the L2VPNS capabilities listed in Request for Proposal (RFP) C.2.7.12.1.4 is intended to provide the technical description required per L.34.1.4.6(c) and does not limit or caveat Qwest's compliance in any way. More information about how Qwest supports these capabilities follows the figure.

Figure 4.2.4-2. Qwest's Technical Approach to L2VPNS Capabilities

ID #	Capability	[redacted]
1	VPLS (Optional)	[redacted]

ID #	Capability	[redacted]
		[redacted]
2	VPWS (Optional)	[redacted]
3	Service Internet-working	[redacted]
4	Network Internet-working	[redacted]

ID #	Capability	[redacted]
5	Routing Control	[redacted]
6	Scalability	[redacted]
7	UNIs	[redacted]
8	Encapsulation methods	[redacted]
9	Traffic types	[redacted]
10	Supported topologies	[redacted]
11	Configuration not broadcast or visible	[redacted]
12	Traffic separation	[redacted]
13	QoS	[redacted]
14	Management	[redacted]

ID #	Capability	[redacted]
15	Interoperability	[redacted]
16	Multiple contractor networks (Optional)	[redacted]

Qwest's L2VPNS technical capabilities include:

[redacted]

***Network Layer Transparency*:** L2VPNS [redacted] provides network layer transparency, which facilitates network interworking with a variety of protocols, including TCP/IP and IPX. Agencies retain complete control of Layer 3 addressing and Layer 3 routing and tunneling protocols such as OSPF, EIGRP, BGP, RIP and LDP.

***L2VPNS Closed User Groups*:** Qwest L2VPNS is separated from third parties and other Agency L2VPNs. Qwest supports multiple [redacted] closed user group instances using logical VLAN interfaces over a single shared Ethernet Access loop. This prevents Qwest from seeing Agency [redacted] addresses and enables address duplication by the Agency in different [redacted] instances.

L2VPNS Encapsulation Methods (Req_ID 7783; C.2.7.12.1.4 (8))

The two major encapsulation options used for building [redacted] instances are still in draft state in the IETF. The first draft is [redacted] the Lasserre draft. The second draft is [redacted] the Kompella draft. [redacted]

[redacted]

4.2.4.3.2 Satisfaction of L2VPNS Feature Requirements (L.34.1.4.6(c); C.2.7.12.2)

Qwest L2VPNS satisfies all the mandatory feature requirements as listed in the Networx RFP. Through the flexibility of our core IP/MPLS backbone, combined with the experience and knowledge of the Qwest Program Management and Operation support teams, Qwest is able to offer a wide array of L2VPN service features. Our MPLS backbone network enables the support of Class of Service (CoS) through the implementation of separate traffic classes. The MPLS backbone also provides a high degree of service availability and the inherent security associated with a non-peered private network.

Qwest fully complies with all mandatory stipulated and narrative features, capabilities, and interface requirements for L2VPNS. The following ***Figure 4.2.4-3*** summarizes Qwest's response to the L2VPNS features listed in RFP C.2.7.12.2, is intended to provide the technical description required per L.34.1.4.6(c), and does not limit or caveat Qwest's compliance in any way. More information about how Qwest supports these features follows the figure.

Figure 4.2.4-3. Qwest's Technical Approach to L2VPNS Features

ID #	Feature	[redacted]
1	Class of Service (CoS)	[redacted]

ID #	Feature	[redacted]
		[redacted]
2	Non-Peered Private IP Network (Optional)	[redacted]
3	High Availability Options	[redacted]

4.2.4.3.3 Satisfaction of L2VPNS Interface Requirements (L.34.1.4.6 (c); C.2.7.12.3)

Qwest L2VPNS satisfies all mandatory and several optional interface requirements defined in the Networx RFP. Using the native capabilities on the Qwest local broadband infrastructure, combined with Incumbent Local Exchange Carrier (ILEC) and Competitive Local Exchange Carrier (CLEC) alliance relationships, Qwest is able to offer a variety of Ethernet access options for L2VPN [redacted] Qwest L2VPN [redacted] UNIs and SEDs are provided, as specified in the Networx RFP, at speeds ranging from 10Mbps up to 10Gbps. We support both copper and fiber media types. L2VPN service SEDs are customized depending on access method or selected feature (for example, the L2VPN high availability feature). Qwest may substitute other SEDs of equivalent functionality and performance over the course of the Networx program.

Qwest fully complies with all mandatory stipulated and narrative features, capabilities, and interface requirements for L2VPNS. The following Figure 4.2.4-4 summarizes Qwest's response to the L2VPNS interfaces listed in RFP C.2.7.12.3, is intended to provide the technical description required per L.34.1.4.6(c), and does not limit or caveat Qwest's compliance in any way. More information about how Qwest supports these interfaces follows the figure.

Figure 4.2.4-4. Qwest-provided L2VPNS Interfaces at the SDP

UNI Type	Media Type	IEEE Standard	Max Speed Supported	Bandwidth Profiles Supported	[redacted]
1 (Optional)	Optical (same as 14)	802.3z	1000Mbps	100Mbps to 1000Mbps	[redacted]
2 (Optional)	Optical (same as 15)	802.3z	1000Mbps	100Mbps to 1000Mbps	[redacted]
3	Optical (Singlemode)	802.3u	100Mbps	10Mbps to 100Mbps	[redacted]
4 (Optional)	Optical	IEEE 802.3ae	1310 nm	10Gbps	[redacted]

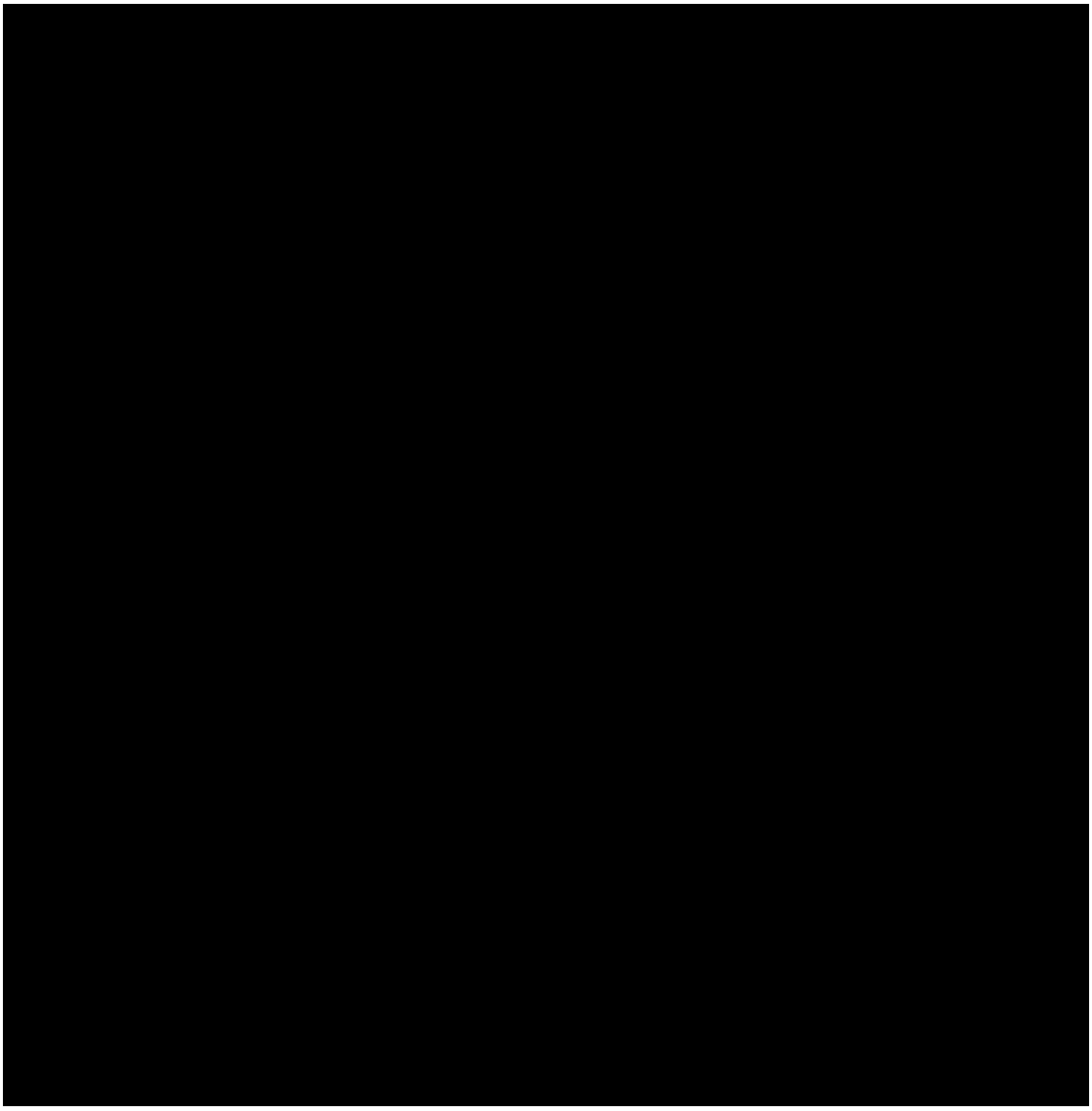
UNI Type	Media Type	IEEE Standard	Max Speed Supported	Bandwidth Profiles Supported	[redacted]
5 (Optional)	Optical	IEEE 802.3ae	850 nm	10Gbps	[redacted]
6 (Optional)	Optical	IEEE 802.3ae	1550 nm	10Gbps	[redacted]
7 (Optional)	Optical	IEEE 802.3ae	1310 nm	10Gbps	[redacted]
8 (Optional)	Optical	IEEE 802.3ae	1550 nm	10Gbps	[redacted]
9 (Optional)	Optical	IEEE 802.3ae	1310 nm single mode	10Gbps	[redacted]
10 (Optional)	Optical	IEEE 802.3ae	1550 nm single mode	10Gbps	[redacted]
11	Electrical	802.3	10Mbps	10Mbps	[redacted]
12	Electrical	802.3u	100Mbps	10Mbps to 100Mbps	[redacted]
13	Optical	802.3z	1000Mbps	100Mbps to 1000Mbps	[redacted]
14	Optical (Multimode)	802.3z	1000Mbps	100Mbps to 1000Mbps	[redacted]
15	Optical (SingleMode)	802.3z	1000Mbps	100Mbps to 1000Mbps	[redacted]
16	Electrical 1000BASE-CX (Copper)	802.3z	1000Mbps	100Mbps to 1000Mbps	[redacted]
17	Electrical 1000BASE-T (Twisted pair)	802.3ab	1000Mbps	100Mbps to 1000Mbps	[redacted]
18 (Optional)	Optical	GR-253, ITU-T G.707	1310 nm	10Gbps	[redacted]

Qwest provides the access arrangements for L2VPNS needed to satisfy the diverse requirements of Agencies. UNI/SEDs connect to several types of access including Wireline, Ethernet, Digital Subscriber Line, and Broadband Wireless [redacted]

[redacted]

[redacted]

[redacted]



4.2.4.4 L2VPNS - Quality of Service (L.34.1.4.6 (d))

Qwest understands and fully complies with Networx L2VPNS performance requirements. ***Figure 4.2.4-10*** compares the Networx L2VPNS Performance Standards to the Qwest-proposed L2VPN QoS for Networx.

Figure 4.2.4-10. Qwest Compliance with Government L2VPNS Performance Metrics

Key Performance Indicator (KPI)	Service Level	Performance Standard Level	Acceptable Quality Level (AQL)	[redacted]
Availability	Routine	99.8%	≥ 99.8%	[redacted]
	Critical (optional)	99.999%	≥ 99.999%	[redacted]
Latency (CONUS)	Routine	100ms	≤ 100ms	[redacted]
Latency (OCONUS)	Routine	400ms	≤ 400ms	[redacted]
Time to restore	Without dispatch	4 hours	≤ 4 hours	[redacted]
	With dispatch	8 hours	≤ 8 hours	[redacted]
Jitter (Packet)	Routine	10ms	≤ 10ms	[redacted]
Grade of Service (Data Delivery)	Routine	99.9%	≥ 99.9%	[redacted]
	Critical (optional)	99.95%	≥ 99.95%	[redacted]

The Qwest L2VPN network is designed as part of a geographically distributed and redundant topology. [redacted]

4.2.4.5 Proposed Enhancements for L2VPNS (L.34.1.4.6 (e))

[redacted]

[redacted]

4.2.4.6 Qwest Experience with L2VPNS (L.34.1.4.6 (f))

Qwest has several years of experience delivering similar services (e.g., Network-based IP VPN via MPLS RFC2547bis standard and legacy L2VPN services (ATM and FR)). L2VPNS employs relatively new technology and standards with approximately two years of general commercial and Government use.

Qwest has successfully offered ATM service nationwide since 1997. Qwest was an early adopter of MPLS technology to provide high-quality Layer 3 VPNs with the same security profile as traditional Layer 2 methods such as ATM and FR. [redacted]

4.2.4.7 Verification of L2VPNS (L.34.1.4.6 (g))

For all L2VPNS requested in Networx, Qwest executes several gates of testing beginning at proof-of-concept and continuing through the lifecycle of the product to ensure that services perform as specified. Additionally, Qwest thoroughly tests all hardware equipment and software loads in our own labs before deploying on our network. This ensures that problems are identified in our test environment, virtually eliminating the possibility that a new hardware or software install will create a service interruption. For contingencies, a version of all network elements and corresponding software is maintained in Qwest labs to provide direct, organic support in the event troubles occur.

Software upgrades are always tested in Qwest labs to ensure they will operate appropriately prior to deployment on our live network elements. Software upgrades are non-service impacting wherever possible and can be reverted to the previous version without disrupting operations of the network elements in the extremely unlikely event that the software load is not successful. Our procurement processes ensure that vendors execute extensive testing of incremental additions such as optical transponders, switching blades, and small form-factor/Gigabit Interface Converter (SFP/GBIC) pluggables prior to shipping to Qwest. Before handing any service over to Agencies, the provisioned circuits will be tested to ensure they meet our standards.

Qwest monitors and measures the KPIs and AQLs using automated processes that pull data from the root source, summarize it, and display it using Web tools. These Web tools display actual results and provide a color-coded visual indicating whether performance goals have been achieved. Our approach is to completely automate the Web display of results from data collection. This ensures that the focus is on responding to performance issues, rather than on performance report generation. The automated

reporting process eliminates any question of manipulating the performance data.

Measuring SDP-to-SDP Latency, Packet Loss, and Jitter and the Role of SEDs

[redacted]

[redacted]

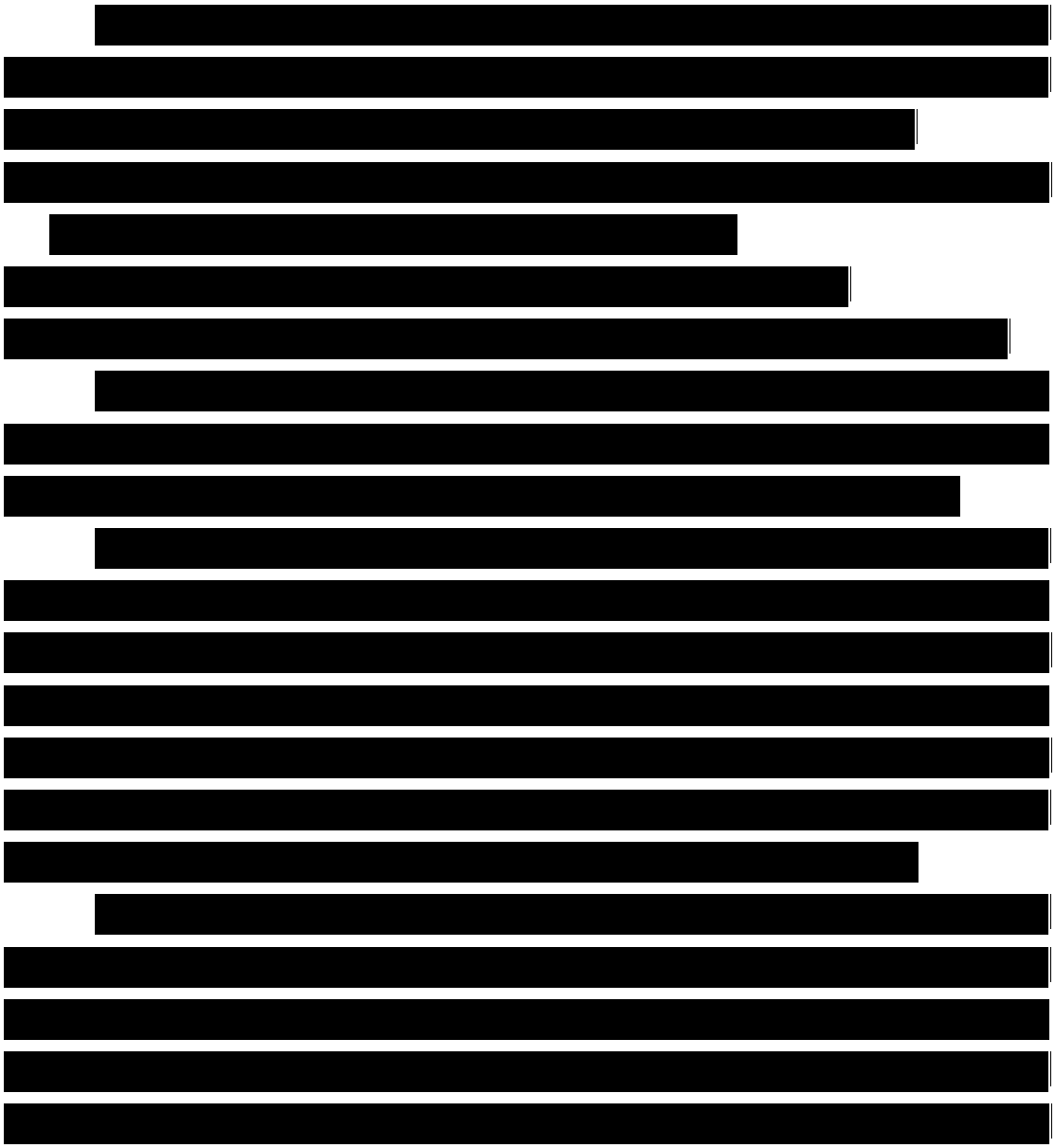
[redacted]

[redacted]

Use of Statistical Sampling in lieu of Direct KPI Measurements

Qwest does not propose to use statistical sampling in lieu of direct KPI measurements. While our approach to KPI measurements does use probe measurements, the measurements are taken on the actual network data and are direct, unfiltered measurements, not statistical extrapolations.

The Use of Government Furnished Property



[redacted]

4.2.4.8 Impact of L2VPNS Delivery on Network Architecture (L.34.1.4.6(h))

The L2VPN service will be provided using MPLS technology that has been deployed in the Qwest network for a number of years. The impact of offering this service on the network architecture is not expected to be significant due to the fact that it is relying on an architecture that has already been deployed.

[redacted]

Since the L2VPN service is built over an MPLS Fast-ReRoute protected backbone, the backbone network will be able to recover from any link or node failures within a matter of [redacted] milliseconds. Due to the packet switched nature of the backbone network, the network will reroute around failures almost instantaneously, providing a high degree of reliability to the service.

The L2VPN service will run over an OC-192 packet switched network that is carrying in excess of 4 billion minutes of VoIP traffic every month. This is proof that the network that will offer the L2VPN service is capable of meeting the most stringent requirements [redacted]

4.2.4.9 Approach for Technological Enhancements to L2VPNS (L.34.1.4.6 (i))

[redacted]

[redacted]