4.2 OPTIONAL SERVICES

4.2.1 Ethernet Service (L.34.1.4)

Qwest has extended our SONET and converged IP core network to support Ethernet Service (EthS). These established capabilities enable our delivery of Networx EthS that will bring Federal Agencies to next generation networking.

Qwest provides comprehensive Ethernet Service (EthS) to Agencies by directly leveraging our Synchronous Optical Network (SONET) and Internet Protocol/Multi-Protocol Label Switching (IP/MPLS) data transport backbones and access infrastructure. Qwest's EthS offering meets all Networx service requirements. Networx defines two sections for EthS: Ethernet Private Line (E-Line) and Ethernet Private LAN (E-LAN). Qwest will provide E-Line Services using its Ethernet over SONET, and E-LAN services using Virtual Private LAN Services (VPLS) over its IP/MPLS Wide Area Network (WAN).

Qwest's approach to scalable EthS builds upon the principle of addressing and anticipating a global IP networking environment. Qwest does so by using a packet based infrastructure that delivers end-to-end high value services via broadband access over high-capacity optical transport, and employing integrated management and service controls. Qwest provides Federal Agencies a reliable and secure end-to-end service with the features and benefits realized with the Qwest Global IP Network.

Figure 4.2.1-1 provides an easy reference to correlate narrative requirements to our proposal response.

Figure 4.2.1-1. Table of EthS Narrative Requirements

Req_ ID	RFP Section	RFP Requirement	Proposal Response
5984	C.2.7.1.1.4 (1)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 1. Geographical Coverage. A seamless end-to-end service shall be provided from the SDP Customer Premise Equipment (CPE) traversing the contractor's network (Metro Access/Core and the Long Haul) in order to minimize conversion of protocols.	4.2.1.3.1
7891	C.2.7.1.1.4 (1)(a)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 1. Geographical Coverage. The contractor shall indicate if protocol conversions are required and how they impact the delay when delivering services end-to-end. The following geographical coverage shall be provided: a. Intra-City Ethernet Service – the contractor shall provide Ethernet connections to Agency sites located in the same city inside the US (CONUS and Metro) and outside the US (OCONUS and Non-Domestic).	4.2.1.3.1
5983	C.2.7.1.1.4 (1)(b)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 1. Geographical Coverage. The contractor shall indicate if protocol conversions are required and how they impact the delay when delivering services end-to-end. The following geographical coverage shall be provided: b. Inter-City Ethernet Service – Ethernet connections shall be delivered nationally and internationally (CONUS/Metro, OCONUS/Non-Domestic).	4.2.1.3.1
5981	C.2.7.1.1.4 (2)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 2. The contractor shall support Ethernet UNI (User-to-Network-Interface) to support Layer 2 and Layer 3 clients. Layer 3 clients are Agency devices which support Layer 3 protocol packets such as IPv4, IPv6.	4.2.1.3.1
5980	C.2.7.1.1.4 (3)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 3. The contractor shall support Ethernet Virtual Connections (EVC), which are used to define the association of two or more User-to-Network Interfaces (UNIs).	4.2.1.3.1
5978	C.2.7.1.1.4 (4)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 4. The contractor shall support delivery of the EthS at the Agency's Service Delivery Point (SDP) via a User-to-Network Interface (UNI).	4.2.1.3.1
5977	C.2.7.1.1.4 (5)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 5. The contractor shall support circuit emulation services for FR, ATM and TDM services [Optional]	4.2.1.3.1
5976	C.2.7.1.1.4 (6)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 6. The contractor shall support point-to-point, multipoint-to-multipoint, and point-to-multipoint EVCs.	4.2.1.3.1
5975	C.2.7.1.1.4 (7)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 7. EVC multiplexing shall be supported in order to build more sophisticated services while minimizing the hardware UNIs required.	4.2.1.3.1
5974	C.2.7.1.1.4(8)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 8. The contractor shall describe the Ingress/Egress bandwidth profiles supported per UNI. This applies to electrical as well as optical ports.	4.2.1.3.1

Req_ ID	RFP Section	RFP Requirement	Proposal Response
5967	C.2.7.1.1.4(11)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 11. The contractor shall describe the Ingress/Egress bandwidth profiles per EVC. For example, for a 10 Mbps service, the bandwidth profiles available may be 5 and 10 Mbps.	4.2.1.3.1
5942	C.2.7.1.1.4(14)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 14. The contractor shall indicate what proactive Performance Monitoring (PM) capabilities are supported. a. Signal failure; b. Signal degradation; c. Connectivity or Loss of connectivity; d. Frame loss; e. Errored frames; f. Looping; g. Denial of service (DoS); h. Misinserted frames; i. Maintenance parameters.	4.2.1.3.1
5911	C.2.7.1.1.4(21) (a)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 21. The contractor shall indicate the Virtual Connection Sizes supported by its network. As a minimum, the following shall be supported: a. For point-to-point Ethernet connections – up to 1 Gbps, and 10 Gbps as optional	4.2.1.3.1
5907	C.2.7.1.1.4(23) (a)	The following Ethernet Services (EthS) capabilities are mandatory unless marked optional: 23. The contractor shall indicate whether the EthS enabled by its networks use any of the following transport methods and Protocol Interworking: a. Ethernet over CWDM/DWDM – The contractor shall indicate limitations, if any, when transporting native Ethernet over WDM gear; b. Ethernet over SONET/SDH, ASTN/ Optical Transport Network (OTN) – The contractor shall indicate limitations, if any, when using. Generic Framing Procedure (GFP), LCAS and Virtual Concatenation Technologies; c. Ethernet over ATM; d. Ethernet over FR; e. Ethernet over MPLS – The contractor shall indicate whether “c” and “d” are supported over the MPLS infrastructure and the approach for implementation.	4.2.1.3.1

Qwest has responded to the Government’s request for further information in KUTDI000035 regarding our plans for VPLS and Virtual Private Wire Service (VPWS) and has included the requested information is Section 4.2.4.

4.2.1.1 Reserved (L.34.1.4.6 (a))

4.2.1.2 Reserved (L.34.1.4.6 (b))

4.2.1.3 Satisfaction of EthS Requirements (L.34.1.4.6(c))

Qwest’s EthS provides dedicated and shared duplex transport connectivity between two or more designated end points, over which Agencies’ service applications traverse at Agency-specified bandwidths with minimal protocol conversion. EthS uses two different technical approaches to

service delivery including SONET with Ethernet interfaces and Layer 2 Virtual Private Network (L2VPN) over Qwest's robust carrier grade private MPLS infrastructure.

Qwest delivers EthS by providing solutions using the Qwest Domestic SONET and MPLS Network, international partners, and local access providers. Qwest will engineer, monitor, and manage EthS end-to-end to ensure scalability, interoperability, and high availability of the service to Agencies. EthS provides required capacity and bandwidth for transport of the Government's data traffic using, and conforming to, Metro Ethernet Forum (MEF), Institute of Electrical and Electronics Engineers (IEEE), Internet Engineering Task Force (IETF), International Telecommunications Union (ITU), Ethernet in First Mile (EFM), and 10 Gbps Ethernet Alliance standards. Qwest currently does not support the optional Circuit Emulation Service Definitions specification draft as defined in the MEF. Qwest is closely following other standards, such as 802.17 and G.nni, and will adhere to them when standardized and if required by the Agency.

Qwest will provide comprehensive end-to-end EthS solutions with our EthS portfolio, including a full support of all the standards and will allow Government users globally to connect their geographically distributed (Inter or Intra City) Agency locations to create virtual LANS across WAN/ Metropolitan Area Network (MAN) using both E-Line and E-LAN. These services include support for all types of network topologies such as point-to-point, point-to-multipoint, and multipoint-multipoint.

E-Line: Qwest's E-Line services are provided over Qwest's state-of-the-art SONET and Dense Wave Division Multiplexing (DWDM) systems, built on Qwest's domestic 24,000 mile fiber-optic network. The SONET 4F-Bi-directional Line-switched Ring (BLSR) architecture and wavelength networks use two distinct DWDM backbones. Furthermore, the SONET 4F-BLSR

network routes the working and protect channels on separate fibers, virtually eliminating service disruptions. [redacted]

Qwest's SONET network is deployed on a footprint of Continental United States (CONUS) POPs. Hundreds of aggregation points expand the network reach. Multiplexing and concatenation (standard and virtual) are standard features of the network, included in the current network deployment with no modifications required to deliver the specified service features and requirements. All services are comprised of local access, backbone network, wavelengths, and appropriate SEDs. Qwest EthS provides dedicated or shared duplex bandwidth profiles at rates [redacted] meet all current and future Networx requirements. Qwest's SEDs have the required User-to-Network Interfaces (UNIs) with either SONET or WDM interfaces on the back end with dedicated bandwidth on the Qwest Time Division Multiplexing (TDM) backbone. Qwest is currently providing this service to several Government Agencies including the National Aeronautics and Space Administration and ESnet.

[redacted] depicts a high level diagram of Qwest's implementation

[redacted]

of E-Line services. Qwest's E-Line services are provided from the Service Delivery Point (SDP) SED across both metro and long haul networks with Ethernet-SONET protocol conversions only at the ingress and egress. Qwest E-Line services are available both intra- and inter-city between Agency sites. The services are provisioned over Qwest on-net and off-net facilities using partner facilities where ever required.

[redacted] Since Qwest E-Line services are provisioned on the SONET or DWDM network, it is fully transparent to all Agency protocols at L2 and L3 and does not interact with customer protocols like 802.1q, 802.1p, and Quality of Service (QoS). Qwest can provide full or shared reservation of bandwidth on its SONET network for the E-Line services.

E-LAN: Qwest's E-LAN service is provided by Qwest through its high capacity IP/MPLS core network backbone as shown in [redacted] Several Qwest services, including E-LAN, are converged under a unified IP/MPLS service suite. Qwest's IP/MPLS network is constructed using highly available resilient components engineered through the convergence of many technologies. It combines Ethernet, ATM, FR, IP, and other protocols to form a solution platform capable of being customized to meet many different requirements.

Qwest's E-LAN services are supported using VPLS, allowing Ethernet Layer 2, fully meshed, secure connectivity across a MAN or WAN.

[redacted]

VPLS is the implementation of a LAN or bridged network environment between multiple locations. VPLS will provide Ethernet ports to Agencies which are set up as part of the same LAN across the WAN. Normally a LAN is restricted to an office floor or building. With VPLS, however, the LAN is configured across and between buildings, states, and countries. Traditional Ethernet networks are comprised of locations in the same local area. VPLS is an Ethernet bridged/switched network with locations geographically dispersed. Qwest E-LAN service is available CONUS and supports a variety of access methods including, but not limited to, Ethernet as a native mode LAN interface.

[redacted]

[redacted]

At the Qwest POP, PE devices create EVCs for each unique Agency enterprise. The EVC does not have any geographical boundaries, compared to a physical LAN switch, allowing Qwest flexibility in refining and expanding the E-LAN scope of coverage as needed. The EVC creates a Closed User Group (CUG) for each VPLS enterprise providing privacy and security comparable to FR Service and Asynchronous Transfer Mode. As previously shown in *Figure 4.2.1-3,* the traffic from one Agency's Ethernet Virtual Connection (EVC) will not communicate with another Agency's EVC. Qwest will provide an Ethernet hand-off at all Agency locations. Through the Qwest E-LAN provisioning process, each SDP is automatically associated with the appropriate EVC in a full mesh providing a degree of connection simplicity.

4.2.1.3.1 Satisfaction of EthS Capabilities, Features and Interfaces Requirements (L.34.1.4.6(c); C.2.7.1.1.4)

Qwest fully complies with all mandatory stipulated and narrative features, capabilities, and interface requirements for EthS. The following ***Figure 4.2.1-4*** summarizing Qwest's response to the EthS capabilities listed in RFP C.2.7.1.1.4 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 4.2.1-4. Qwest's Technical Approach to EthS Capabilities

ID #	Capability	[redacted]
1	Geographic Coverage	[redacted]

ID #	Capability	[redacted]
		[redacted]
2	UNI to Layer 2 and Layer 3 Clients	[redacted]
3	EVC Support	[redacted]
4	Delivery of EthS via a UNI at Agency SDP	[redacted]
5	CE Support for FR, ATM, TDM (optional)	[redacted]
6	Point and Multipoint EVCs	[redacted]
7	EVC Multiplexing	[redacted]
8	Bandwidth Profiles Supported	[redacted]
9	Rate-Limited Throughput	[redacted]
10	Rate-Limiting at SDP	[redacted]
11	Bandwidth Profiles per EVC	[redacted]
12	Privacy and Security	[redacted]

ID #	Capability	[redacted]
13	Service Attributes	[redacted]
14	Performance Monitoring	[redacted]
15	Maintenance Functions	[redacted]

ID #	Capability	[redacted]
16	Last Mile Media	[redacted]
17	Access Methods	[redacted]
18	Network Topologies	[redacted]
19	Geographical Diversity	[redacted]
20	Bridging Support	[redacted]
21	VC Sizes	[redacted]
22	Notification of Protection updates	[redacted]
23	Transport Methods and Protocol Interworking	[redacted]
24	Quality of Service	[redacted]
25	Traffic Reconfiguration Support	[redacted]

Geographic Coverage for End-to-End Service

(Req_ ID 5984; C.2.7.1.1.4(1))

E-LINE and E-LAN are being offered everywhere required by the Networx traffic model. They will be provided as a seamless end-to-end service from the SDP. E-LINE traverses the Qwest SONET network and E-

LAN traverses the Qwest MPLS network in order to minimize conversion of protocols.

Intra-City Ethernet Service (Req_ ID 7891; C.2.7.1.1.4 (1)(a))

E-LINE is offered in accordance with the requirements of RFP Section J.2. Qwest will evaluate E-Line service for OCONUS and/or non-domestic coverage as Agency requirements are identified. Same city connections would be provided using either Qwest E-Line service on-net capabilities or those of third party local providers.

E-LAN is offered in accordance with the requirements of RFP Section J.2. Qwest will evaluate E-LAN service for OCONUS and/or non-domestic coverage as Agency requirements are identified. E-LAN will be supported as an MPLS L2VPN (VPLS) service and will use standards-based MPLS encapsulation to ensure minimal delay when delivering services end-to-end. When E-LAN is offered within the same city, Qwest may offer the service as a native Ethernet-switched service, or as an MPLS encapsulated L2VPN (VPLS) service. In either implementation, the end-to-end delay is expected to be minimal, matching that of a standard packet-switched network.

Inter-City Ethernet Service (Req_ ID 5983; C.2.7.1.1.4(1)(b))

E-Line is offered in accordance with the requirements of RFP Section J.2. Qwest will evaluate E-Line service for OCONUS and/or non-domestic coverage as Agency requirements are identified. Inter-City E-Line service will be provided using Qwest E-Line service, which utilizes an Ethernet over SONET protocol to minimize protocol conversion and delay end-to-end.

E-LAN is offered in accordance with the requirements of RFP Section J.2. Qwest will evaluate E-LAN service for OCONUS and/or non-domestic coverage as Agency requirements are identified. Inter-City E-LAN service will be provided using the Qwest MPLS backbone, which utilizes an IETF

standard-based MPLS encapsulation method to carry Ethernet frames end-to-end.

Ethernet Support for Layer 2 and Layer 3 Clients (Req_ ID 5981; C.2.7.1.1.4 (2))

The Ethernet UNI will be standard IEEE 10 Mbps, 100 Mbps, and 1,000 Mbps interfaces. Any protocols that operate transparently over Ethernet will be supported, including IPv4 and IPv6.

Ethernet Virtual Connections (Req_ ID 5980; C.2.7.1.1.4(3))

Qwest will support EVCs with E-LAN.

Ethernet UNI at SDP (Req_ ID 5978; C.2.7.1.1.4(4))

EthS will be delivered over a standard IEEE UNI operating at 10Mbps, 100Mbps, or 1000Mbps, as specified by the Agency.

Circuit Emulation Support (Req_ ID 5977; C.2.7.1.1.4(5))

E-LAN will support IETF-based standards for service-interworking capabilities so that the Agency can use a mix of FR, ATM, and Ethernet attachment circuits, similar to the capabilities offered under the VPLS (L2VPN) product.

Support for EVC Topologies (Req_ ID 5976; C.2.7.1.1.4 (6))

E-LAN will support point-to-point, multipoint-to-multipoint, and point to multipoint EVCs through VPLS.

EVC Multiplexing (Req_ ID 5975; C.2.7.1.1.4 (7))

E-LAN will support EVC multiplexing such that multiple EVCs in the form of VLANs may be delivered over a single physical Ethernet port.

Ingress/Egress Bandwidth Profiles per UNI (Req_ ID 5974; C.2.7.1.1.4 (8))

Qwest supports ingress/egress profiles per UNI as follows:

- [redacted]
- [redacted]

- [redacted]
- [redacted]

Ingress/Egress Bandwidth Profiles per EVC (Req_ ID 5967; C.2.7.1.1.4 (11))

Qwest supports ingress/egress profiles per EVC as follows:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

Proactive Performance Monitoring for Signal Failure (Req_ ID 5942; C.2.7.1.1.4 (14))

Qwest meets the performance monitoring capabilities for signal failure. Qwest network devices can detect signal failures and Qwest monitoring systems will generate alarms real-time.

Qwest meets the performance monitoring requirements for signal degradation for EthS. Qwest network devices can detect signal degradations based on multiple parameters (i.e. receive signal strength) and Qwest monitoring systems will generate alarms real-time.

Qwest meets the performance monitoring capabilities for connectivity or loss of connectivity. Qwest network devices can detect connectivity status and Qwest monitoring systems will generate alarms real-time.

Qwest meets the performance monitoring capabilities for frame loss for EthS. In regard to E-Line, the service is transparent to the upper layers. In regard to E-LAN, Qwest network devices can detect frame losses and Qwest monitoring systems will generate alarms real-time.

Qwest meets the performance monitoring capabilities for errored frames for EthS. In regard to E-Line, the service is transparent to the upper

layer. In regard to E-LAN, Qwest network devices can detect errored frames and Qwest monitoring systems will generate alarms real-time.

Qwest meets the performance monitoring capabilities for looping for EthS. Qwest SONET systems can generate physical and logical layer loopbacks for any PM functions.

Qwest meets the performance monitoring capabilities for DoS for EthS. Qwest's MPLS PE devices have anti-DoS protection capabilities, and using protocols like netflow or external security devices, Qwest's NOC is informed real time of any DoS attacks.

Qwest meets the performance monitoring capabilities for mis-inserted frames. Qwest PE devices detect and inform our NOC via SNMP if there are dropped packets because of mis-inserted frames.

Qwest meets the performance monitoring capabilities for maintenance parameters such as environmental, errored seconds and utilizations. Reports will be generated, as required, for desired parameters.

Virtual Connection Sizes, Ethernet 1/10 Gbps (*Req_ ID 5911*; C.2.7.1.1.4 (21a))

EthS will support point-to-point virtual connections up to 1 Gbps by using the Qwest MPLS infrastructure. [redacted]

Ethernet Over CWDM/DWDM (*Req_ ID 5907*; C.2.7.1.1.4 (23a))

For the EthS/E-Line service, [redacted] There are no limitations for transporting native Ethernet over WDM gear. For the EthS/E-LAN service, Qwest supports DWDM/CWDM in the access network.

For the EthS/E-Line service, Ethernet over SONET is used for delivering this service. There are no limitations when using GFP or LCAS. For

VCAT, all the virtual concatenation channels must be on the same path. The EthS/E-LAN service may use any of these technologies in the access loop.

[redacted]

4.2.1.3.2 Satisfaction of EthS Feature Requirements (L.34.1.4.6(c); C.2.7.1.2)

Qwest E-Line and E-LAN services satisfy all the mandatory feature and technical requirements as listed in the Networx RFP (specifically Sections C.2.7.1.1.4 and C.2.7.1.2). Some of the optional requirements like QoS and security filters are also supported. Optional item circuit emulation is not currently supported.

Through the flexibility of our private SONET backbone and private 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 Ethernet service features. Our MPLS backbone network enables the support of QoS through the implementation of separate traffic classes. Both SONET and IP/MPLS backbone also provide a high degree of service availability and the inherent security associated with a non-peered private network.

Figure 4.2.1-5 summarizes Qwest's technical approach to satisfy the feature requirements of E-LAN and E-Line, providing the technical description required per L.34.1.4.6(c), and does not limit or caveat Qwest's compliance in any way. Qwest fully complies with all mandatory stipulated and narrative features, capabilities, and interface requirements for EthS.

Figure 4.2.1-5 Qwest's Approach to Meet Technical and Feature Requirements

ID #	Name of Feature	[redacted]
1	Quality of Service and service parameters	[redacted]
2	EVC and UNI Service Attributes	[redacted]

ID #	Name of Feature	[redacted]
		[redacted]
3	High Availability Options	[redacted]
4	Geographical Coverage	[redacted]

ID #	Name of Feature	[redacted]
5	Security and Privacy	[redacted]
6.	Service Features	[redacted]

4.2.1.3.3 Satisfaction of EthS Interface Requirements (L.34.1.4.6(c); C.2.7.1.3)

Qwest's EthS satisfies all mandatory and several optional UNI interface requirements as listed in the Networx RFP (specifically, Section C.2.7.3.1). Using the native capabilities of the Qwest local broadband infrastructure combined with ILEC and CLEC partnering arrangements, Qwest is able to offer a variety of Ethernet access options for both E-Line and E-LAN as shown in ***Figure 4.2.1-6.*** Qwest E-LAN UNI (User to Network Interface) and SEDs (Service Enabling Device) are provided, as specified in the RFP, at speeds ranging from 1 Mbps up to 1000 Mbps in both copper and fiber media types for both E-Line and E-LAN services. For E-Line services, 10G interfaces are also available. E-LAN service SEDs are customized depending on the access method or features.

Qwest fully complies with all mandatory stipulated and narrative features, capabilities, and interface requirements for EthS. The text in the following table 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.

Figure 4.2.1-6. Qwest Ethernet SDP to Qwest Edge Connectivity

Uni Type	Interface Type	Standard	Frequency of Operation Fiber Type	Payload Data Rate or Bandwidth	Signaling Protocol Type/Granularity	[redacted]
1	Optical	IEEE 802.3z	1310 nm	1.25 Gbps	Gigabit Ethernet	[redacted]
2	Optical	IEEE 802.3z	850 nm	1.25 Gbps	Gigabit Ethernet	[redacted]

Uni Type	Interface Type	Standard	Frequency of Operation Fiber Type	Payload Data Rate or Bandwidth	Signaling Protocol Type/Granularity	[redacted]
3	Optical	IEEE 802.3	1310 nm	125 Mbps	Fast Ethernet	
4 (Optional)	Optical	IEEE 802.3ae	1310 nm	10 Gbps	10GBASE-SR	
5 (Optional)	Optical	IEEE 802.3ae	850 nm	10 Gbps	10GBASE-SW	
6 (Optional)	Optical	IEEE 802.3ae	1550 nm	10 Gbps	10GBASE-ER	
7 (Optional)	Optical	IEEE 802.3ae	1310 nm	10 Gbps	10GBASE-LR	
8 (Optional)	Optical	IEEE 802.3ae	1550 nm	10 Gbps	10GBASE-LW	
9 (Optional)	Optical	IEEE 802.3ae	1310 nm Multimode	10 Gbps	CWDM 10GBASE-LX4 (300 meters)	
10 (Optional)	Optical	IEEE 802.3ae	1310 nm Single mode	10 Gbps	CWDM 10GBASE-LX4 (10,000 meters)	
11 (Optional)	Optical	IEEE 802.3ae	1310 nm Single mode	10 Gbps	10GBASE-LW (10,000 meters)	
12 (Optional)	Optical	IEEE 802.3ae	1550 nm Single mode	10 Gbps	10GBASE-EW (40,000 meters)	
13 (Optional)	Optical	IEEE 802.3ae	N/A	10 Gbps	10 Base	
14	Electrical	IEEE 802.3	N/A	100 Mbps	100 Base	
15	Optical	IEEE 802.3		1 Gbps	1000 Base	
16	Optical	ITU-T G.707	1310 nm	STM-4	SDH STM-1, VC-11 (DS1), VC-12 (E1)	
17	Optical	ITU-G.707	1300 nm	STM-4c	VC-4-4c	
18	Optical	IEEE 802.3z IEEE 802.3ab	Multimode	1 Gbps	1000BASE-LX	
19	Optical	IEEE 802.3z IEEE 802.3ab	Multimode	1 Gbps	1000BASE-SX	
20 (Optional)	Electrical (Copper)	IEEE 802.3z	N/A	1 Gbps	1000BASE-CX	
21 (Optional)	Electrical (Twisted pair)	IEEE 802.3ab	N/A	1 Gbps	1000BASE-T	

Qwest can deliver service to Agencies via multiple access methods. In the first/last mile, Qwest supports Ethernet delivery over Digital Subscriber Line, broadband Ethernet access, and broadband wireless access arrangements. Qwest has many options at its disposal for delivering service in the last mile and internationally through local access partnerships, on-net facilities, and custom builds. We have procedures in place to provide real-

time monitoring and performance statistics of these methods. We have strict guidelines on how we connect to LECs – dual entrance facilities, OC-48 capacity, and operations agreements. The company has physical connectivity with CLECs, ILECs, and fiber providers to deliver outstanding service to anywhere Agencies may require it.

Qwest provides the access arrangements for EthS as needed to satisfy the diverse requirements of Agencies. The most common method of access for EthS will be via twisted pair, copper or fiber interface, although others are also available.

Qwest will provide connections between the Agency's LANs, providing SDP to SDP connectivity across both the MAN and the WANs. Connectivity is provided through the use of two primary service components: Ethernet local access and E-LAN port. ELA provides the last mile transport to the Qwest E-LAN or E-Line POP.

ELA is provided in two forms; Ethernet over SONET (EoS) or Native Ethernet Local Access. The default access method for E-LAN is Native Ethernet Access and for E-Line is EoS. EoS can also be used for E-LAN where required. Ethernet over SONET Local Access (ELA – EoS) is provisioned as an Ethernet interface over a SONET network as illustrated below in [redacted] The Ethernet SDP is provided on a SONET mux placed by Qwest at the Agency location. The Ethernet traffic is then mapped into a circuit across a SONET network/backbone back to the Agency location.

[redacted]

By its nature, this is a dedicated connection, so each port is dedicated to the Agency. ELA - EoS will be provisioned using either Qwest on-net E-Line network or ILEC/CLEC partnerships.

Native Ethernet Local Access is a type of local loop provided via a shared metro optical Ethernet network at speeds ranging from 1 Mbps to 1,000 Mbps as illustrated in [redacted]. The Ethernet SDP is provided on an Ethernet switch placed by an ELA partner. Qwest's ELA partner networks provide point-to-point Ethernet connection over a shared Ethernet switched aggregation network back to a Qwest switch, which aggregates ELA at the Qwest POP. At the Qwest POP, the ELA aggregation switch connects to the Qwest PE router. Access is delivered to the Qwest E-LAN backbone via trunk ports at key aggregation points. Native Ethernet Local Access uses a QoS mechanism within the switched infrastructure to provide packet delivery and capacity controls.

Qwest will work to augment ELA to meet the developmental changes of Agencies as the need arises.

[redacted]

4.2.1.4 EthS - Quality of Service (L.34.1.4.6 (d))

Qwest understands and fully complies with the applicable EthS Key Performance Indicators (KPIs) measurements as listed in the RFP. Qwest EthS provides several performance metrics designed to measure and maintain the service quality. ***Figure 4.2.1-9*** summarizes the comparison of the required Performance Standards and the Qwest proposed EthS for

Networx. Qwest complies with all requirements and meets the availability standard for routine service levels.

Figure 4.2.1-9. Qwest meets all Ethernet KPIs and Acceptable Quality Levels and exceeds routine availability service level.

Key Performance Indicators	Service Level	Acceptable Quality Level (AQL)	Performance Standard (Level/threshold)	[redacted]
Availability (EthS)	Routine	99.5%	≥ 99.5%	
	Critical	99.99%	≥ 99.99%	
Latency	(CONUS)	100ms	≤ 100ms	
	(OCONUS)	200ms	≤ 200ms	
Jitter (Packet)	Routine	10ms	≤ 10ms	
Grade Of Service (Packet Delivery Rate)	Routine	99.95% at all times	≥ 99.95% at all times	
	Critical	99.99% at all times	≥ 99.99% at all times	
Time to Repair (TTR)	Without dispatch	4 hours	≤ 4 hours	
	With dispatch	8 hours	≤ 8 hours	
Grade of Service (Failover Time)	Routine	1 minute	1 minute	
	Critical	100 ms	≤ 100 ms	

The Qwest E-Line network is designed to meet a performance metric of 99.999 percent availability, [redacted] TTR and Grade of Service (Failover Time) performance standards are easily met using the robust SONET infrastructure.

The Qwest IP/MPLS network over which E-LAN services are provided is designed as part of a geographically distributed and redundant topology. Network latency and jitter is controlled and minimized by strategically placing core and edge network elements within major US cities. E-LAN PE devices have high-speed MPLS tunnels to all other PE devices creating primary and secondary paths in the case of failure. E-LAN hardware and software

components are configured in a redundant fashion, further increasing overall availability, and improving efficient allocation of support resources. Network support staff can dedicate more time to resolving outages and thereby lessen the TTR. All of the improvements to packet performance metrics such as availability, latency, jitter, packet delivery and TTR result in a general improvement in the grade of service.

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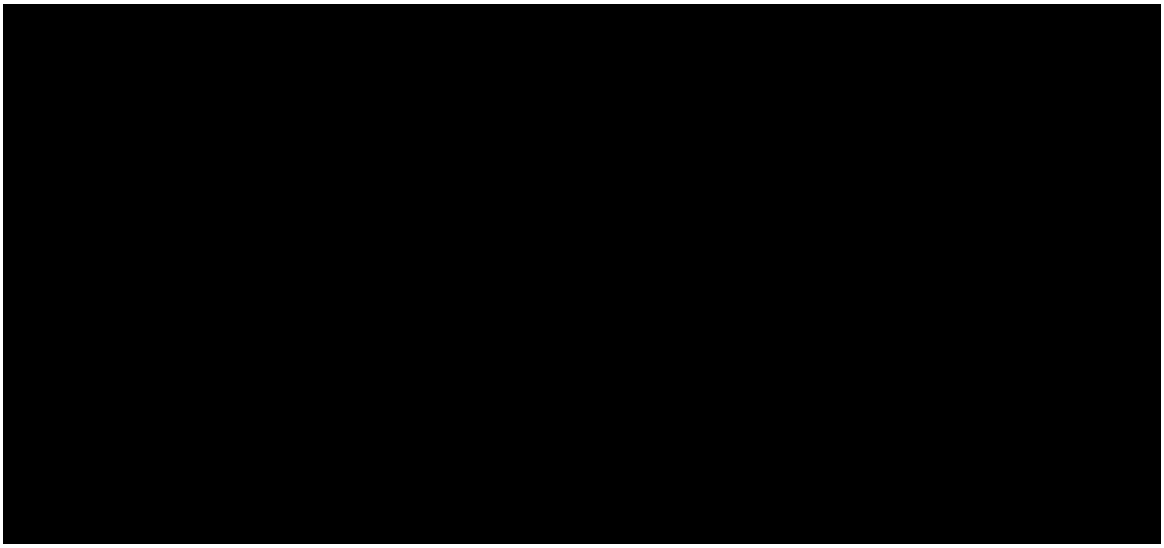

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4.2.1.7 Verification of EthS (L.34.1.4.6 (g))

For all EthS requested in Networx, Qwest executes several gates of testing, beginning at proof-of-concept and continuing through the lifecycle of the product to ensure 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 in our live network elements. Software upgrades are non-service impacting wherever possible and can be reverted to previous versions without disrupting operations of the network elements if that software load is not successful. Our procurement processes ensure that vendors execute extensive testing of incremental additions such as optical transponders, switching blades, and SFP/GBIC pluggables prior to shipping to Qwest. Before handing any service over Agencies, the provisioned circuits will be tested to ensure they meet our standards.

For EthS, the Network Elements (NEs) capture and maintain performance data on equipment and circuits. [redacted] from the NEs on a pre-established time cycle (e.g., once a day, every 15 minutes, etc.) and to store the data in a server for monitoring and reporting. Qwest uses this data in several ways:

- We compare performance results to the performance thresholds that we set to trigger alarms
- Results can create auto-generated trouble tickets in our trouble ticketing system based on defined alarm thresholds

- Results are calculated and displayed on the network scorecard. Required Key Performance Indicators can be viewed in the Qwest Control Networx Portal.

Qwest monitors all NEs of the EthS and SEDs on a 7x24x365 basis. This monitoring includes, but is not limited to:

- General NE requirements validation: System turn-up, craft, EMS/ Network Management System interfaces, security, software management, electrical and mechanical compliance, alarming, safety, systems connectivity, fault management, performance management
- Validate Network Equipment Building Systems: GR-63-Core (transportation and storage stress, operating temperature and humidity, heat dissipation, equipment shock, vibration, and acoustic noise) and GR-1089-CORE (Electrostatic Discharge, Electromagnetic Interference, Electromagnetic Compatibility, electrical safety, corrosion, bonding and grounding)

Qwest maintains a central data repository for key network performance information. These performance indicators are generated by a combination of system specific statistics. Logs and traps are generated by our network management system and sent to the Network Monitoring Team for instant responses. Data is analyzed, formatted, and sent to operations, engineering, and planning for pro-active network enhancement and capacity planning. Qwest's centralized engineering team applies a consistent capacity management model to all data services.

On our transport network, new network elements undergo a comprehensive testing process before they are deployed in the network. All the functional aspects that will be deployed are tested to ensure that the equipment performs properly. Before any circuit is placed into service, the

metrics are measured and circuits must exceed every AQL to ensure circuits are ready to carry traffic.

For E-Line oriented services, the NEs capture and maintain performance data at the equipment and circuit level and we use Qwest's performance management tools to reach out to all of the NEs to retrieve the performance data on a cycle that we set and store the data into a server for monitoring and reporting. The data is used in several ways:

- Results are compared to thresholds to trigger alarms
- Results create auto-generated trouble tickets for immediate resolution
- Results are used to calculate the KPIs to ensure we are meeting our AQLs

For the E-LAN oriented services, Qwest has deployed a set of network probes that connect across the IP/MPLS cloud and measures the network from an end device perspective. The probes are deployed in all TeraPOPs and provide a full mesh view of all the point-to-point SLA metrics and are assessed on an individual site or site-pair basis where applicable.

Qwest provides CE-based performance measures, including PE to CE and CE to CE measurements. These measurements are in addition to the PE to PE measurements. Probes are distributed to each POP that has PE routers and measurements are taken from the probes to Agency CE devices. This service requires access from the probes to the Agency CE devices and is therefore not enabled unless specifically ordered by the customer.

4.2.1.8 Impact of EthS Delivery on Network Architecture (L.34.1.4.6(h))

The delivery of EthS has little impact on the architecture of the underlying SONET network. Since the only change to the SONET network is an additional Add Drop Multiplexer in the POP with Ethernet interface cards, it is unlikely that any adverse security, quality, reliability, or performance issues would arise. The Qwest SONET network has been operating at a very high

level of performance for over nine years and has all major routes already incorporated into the network, as well as the capacity to handle E-Line transport well into the future. The network will continue to evolve as Agency needs change.

Since Qwest is proposing to use dedicated SONET or DWDM capacity to provision E-Line service, security on the network is the same as any SONET, PLS or Optical Wavelength Services. It is very difficult to gain unauthorized entry into a physical layer service, and any tapping into the line would be intrusive and detected immediately. The E-Line service is provisioned on dedicated, full-time physical circuits. Each Agency circuit will have its own dedicated path between two endpoints.

The E-Line service rides the reliable Qwest four fiber BLSR network where availability is consistently very high (99.999 percent system wide). The E-Line service benefits from the 24x7x365 surveillance and alarm monitoring across all Networx services. Technicians are well trained and consistently deliver a highly reliable service.

The E-LAN service will be provided using MPLS technology that has been deployed in the Qwest network for a number of years. E-LAN services will use the same architecture that is used for MPLS L2VPN service. The impact of offering this optional E-LAN 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.

E-LAN services offered over a MPLS L2VPN implementation will meet the security standards of MPLS VPNs in general. Traffic belonging to a particular E-LAN instance will be separated from all other traffic types, and the network elements used to offer E-LAN services will be “private” in the sense that they will not directly be connected to the Internet, eliminating the risk of attacks originating from the Internet.

Like the MPLS L2VPN service, the E-LAN service will have available multiple classes of service to allow the Agency to prioritize different traffic types within an E-LAN. The E-LAN service will be provisioned over a packet-switched network and, therefore, will not have TDM channels allocated for traffic. Capacity planning rules and capacity modeling will ensure that adequate bandwidth is available for the E-LANs to burst up to full port speed if necessary. Moreover, if required, Qwest could provide traffic engineering over the Qwest IP/MPLS network, thus guaranteeing service if desired by the Agency.

Since the E-LAN service is built over a MPLS Fast-ReRoute protected backbone, the backbone network will be able to recover from any link or node failures within a matter of tens (10s) of 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 E-LAN service.

The E-LAN 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 E-LAN service is capable of meeting the most stringent requirements for latency, jitter, packet-loss, and reliability.

4.2.1.9 Approach for Technological Enhancements to EthS (L.34.1.4.6 (i))

Private Line, SONET, and Wavelength service interworking are addressed largely through the introduction of the Multi-Service Provisioning Platforms (MSPP). In the event that end-to-end interoperability is required, wavelengths based upon G.709 Optical Transport Networks (OTNs) ensure complete transparency. Ethernet interfaces are now available on Qwest's MSPPs and use of new technologies like Virtual Concatenation (VCAT),

Generic Framing Procedure (GFP), and Link Capacity Adjustment Scheme (LCAS) further enable efficient transport of services.

The E-LAN service will be delivered as an MPLS L2VPN Service (VPLS). MPLS is a mature technology, and implementations of VPLS are stable. [redacted] Qwest will continue to test and evaluate such vendor implementations in order to offer a more robust and full-featured product to the Agencies.

[redacted]

Qwest is always testing and evaluating new technologies for use in its many different networks. The company works closely with incumbent vendors to get the most out of existing technology, and when it is time to change platforms, to get the best feature functionality for its investment. Qwest is constantly planning technology refreshes for entire networks or components

within the network. Qwest runs business cases and Return on Investment models on new technology choices as well. The approach to managing the incorporation of new technology into the network involves a combination of the aforementioned activities, making sure all criteria are met before implementing the changes. When a decision is approved for new technology or an enhancement to an existing one, Qwest begins its change management process that involves planning, project management, implementation, and ultimately Agency migration and decommissioning of the old technology.