4.0 TRANSPORT/IP/OPTICAL SERVICES (L.34.1.4, M.2B)

4.1 MANDATORY SERVICES (M.2.1.2)

Qwest is an established leader in the delivery of Internet Protocol (IP)-based services and has successfully built a converged Multi-Protocol Labeled Switched (MPLS) network architecture that supports Internet Protocol Service (IPS). Qwest offers proven IP-based service capabilities:

- Qwest is recognized as one of the top five global providers of Internet services.
- Qwest was one of the first to offer IP-based VPN services and has successfully implemented these services for several Agencies.
- Qwest has successfully deployed a VoIP transport platform and currently carries more than four billion minutes of voice traffic every month.

4.1.1 INTERNET PROTOCOL SERVICE (L.34.1.4, M.2.1.2(a), C.2.4.1)

Qwest's IPS offers a high-quality, cost-effective, and global capability with a track record of success with Federal Agencies.

Qwest is ideally positioned to offer IPS to Agencies through the Networx Program. Qwest offers a world-class backbone network, a full complement of access options, and in-depth experience garnered from successful service delivery to a broad set of Federal and commercial customers. Qwest owns and operates a Tier 1 global Internet backbone, built on top of our 10 Gbps-based private MPLS core. This core network provides the foundation for many services, including IPS, thereby creating opportunities for service convergence from the outset of the Networx program.

Qwest IPS also provides flexible access solutions for the Agencies—Fractional T-1 and T-1 through OC-192c dedicated access, Ethernet, Asynchronous Transfer Mode (ATM), Frame Relay (FR), dial-up, and Digital Subscriber Line (DSL). We support a wide range of Service-Enabling Devices (SEDs) to connect Agencies to the Internet. [redacted]

Qwest provides services to the world's largest ISPs, [redacted] as well as numerous Federal Agencies and Fortune 500 companies. Qwest already provides IP services to several Federal Agencies, [redacted] Qwest's iQ Networking family of services, of which IPS is an integral part, was recognized for our superlative service by *Network Computing* magazine's Best Value Award for Wide Area Networking (WAN) solutions in August 2005.

Figure 4.1.1-1 provides an easy reference to correlate narrative requirements to our proposal response.

Figure 4.1.1-1. Table of IPS Narrative Requirements

Req_ ID	RFP Section	Proposal Response
30667	C.2.4.1.1.4(2)	4.1.1.3.1.1

4.1.1.1 Qwest's Technical Approach to IPS Delivery (L.34.1.4.1, M.2.1.2(b), C.2.4.1.1-C.2.4.1.3)

The Qwest technical approach to providing fully-compliant IPS is based on our strong commitment to our customers, adherence to proven engineering practices, and a standards-based, global network. Qwest IPS combines our 10 Gbps-based private MPLS core network and reliable Internet access from dial-up to high-speed optical connections, with a dedicated support organization to engineer, install, maintain, and modify IPS for Agencies. Our IPS offers significant benefits to Agencies, including:

- High service quality derived from our Tier 1 network
- Service continuity stemming from a rich set of access options
- Reliable service delivery led by Qwest Government Services, Inc.
- High levels of security provided by our corporate security organization
- Use of the standard Transmission Control Protocol Internet Protocol TCP/IP protocol suite

Our extensive experience has also created an in-depth understanding of the problems we may encounter in the delivery of IPS, resulting in proactive operational support. Qwest offers a comprehensive approach to IPS for the Networx program.

The sections that follow describe our approach to service delivery and how our approach benefits the Government. We'll also describe how Qwest IPS will facilitate the Federal Enterprise Architecture (FEA) objectives, how Qwest proposes to address problems that may be encountered in providing IPS, and how our synchronization network architecture supports IPS.

4.1.1.1.1 Approach to IPS Delivery (L.34.1.4.1 (a))

Qwest's approach to service delivery encompasses the people, operational processes, and network platform necessary to deliver exceptional services.

Proven Engineering Practices

Qwest Operations and Engineering groups are committed to keeping the network robust and feature rich. The network is monitored constantly, and any maintenance work is carefully planned and performed off-hours whenever possible. Proven engineering and operational practices and guidelines are strictly followed. Additional details on how Qwest Operations and Engineering support the delivery of IPS can be found in Section 4.1.1.4.3, *IPS Measures and Engineering Practices*.

Once service is provisioned, operational support becomes a key element of service delivery. Qwest's Operational Support group ensures that our services meet performance goals. Qwest's [redacted] Network Operations Centers (NOCs) continually monitor Qwest IPS. Because Qwest's network is converged on MPLS technology, these Centers support operations for all of Qwest IP data services, as well as for traditional data services such as ATM and Frame Relay. Service convergence facilitates interoperation among services and enables trouble management for the complex services. For example, our NOCs have an inherent ability to monitor SDP-to-SDP IPS that includes Qwest ATM/FR access.

Qwest's NOCs proactively monitor the network and issue alerts on events affecting the Qwest global network to ensure that potential problems are resolved through rapid fault assessment and deployment. Each Qwest NOC is equipped with highly trained and experienced personnel who understand Agency network and internetworking equipment. All required

network management information is available to both Qwest Networx program team members and Agencies through the Qwest Control Networx Portal.

Qwest's NOC senior management continually reviews Key Performance Indicators (KPIs) and best practices to identify preventive steps to address customer issues, to ensure that performance issues are resolved promptly, and to validate that the customers' network performance meets required standards. From a single, accountable, one-call-resolve support structure to convenient, quick, Web-based management and reporting tools, the Qwest Networx program and customer support teams will address all issues that affect service.

Standards-Based, Global Network

Domestically, Qwest's IPS service is provided over Qwest's 10 Gbps-based private MPLS core network. The MPLS core network architecture is based on Qwest core high-speed backbone Points of Presence (TeraPOPs), a system of multiple high-capacity, router-based POPs located throughout the Continental United States (CONUS). Each TeraPOP contains at least two core MPLS routers, directly connected with redundant and diverse 10 Gbps wavelength circuits to at least two other TeraPOPs. This architecture achieves both core element and backbone link redundancy. Design rules are in place to ensure that the failure of any backbone link does not negatively impact the delivery of MPLS packets on the backbone. The MPLS core network functions as a secure fast-forwarding network plane, as described in Section 3.0, *Architecture*. It contains no Internet routes itself, and is not visible outside of the Qwest network operations environment.

[redacted]

[redacted]

Unlike other providers who waited to deploy MPLS in their production network operations, Qwest has been using MPLS for more than four years to improve the operations of all of our IP-based transport services.

[redacted]

Qwest has converged data services on a common MPLS core, thus eliminating the need for the customer to have multiple access circuits to different networks and exceeding the service restoration rate of traditional IP over Synchronous Optical Network (SONET) networks. [redacted]

[redacted]

[redacted]

[redacted]The high quality of the Qwest network is evidenced in its ability to provide connectivity for carrier quality voice services using VoIP technology. Qwest committed early to VoIP. In 2001, we became one of the first carriers to use the IP network to transport large volumes of long-distance traffic. Qwest moves more than four billion minutes of toll-quality VS as VoIP traffic every month.

Complementing our MPLS core network, Qwest aggressively developed a broad set of network access capabilities that include both alternate modes of access and extensive reach to Agency locations. Qwest has a rich set of capabilities and suppliers to deliver these access services. Our flexible access options include:

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

Sections 3.2.1 and 3.4 of this volume provide further detail for each of these access capabilities.

Qwest's IPS platform also extends internationally. The IPS backbone spans the Asia Pacific region, Hawaii, and CONUS, with [redacted] public and private peering points providing more than [redacted] Gbps of public and private

Internet peering. Outside of these regions, [redacted] are privately peered to the Qwest Internet at multiple locations. Section 3.4.1 of this proposal discusses Qwest's international peering experience in further detail.

Commitment to Customers

Qwest staff rigorously lives up to our *Spirit of Service* motto by closely collaborating with our customers to identify requirements and deliver the services that best suit our customers' needs. Our operations and infrastructure take full advantage of IP-based convergence to create one of the most efficient network platforms in the industry.

Our IPS strategy provides an Agency with many advantages, including ease of use, flexible access alternatives, and scalability. Our network and active management of our suppliers provide the underlying infrastructure to enable our service delivery capability, ensuring worldwide continuity of service for Agencies.

Qwest's approach to services delivery starts with our people. Qwest understands the Government's need to employ comprehensive and easy-to-use IPS all over the world. Our Networx program management staff and sales engineers will work closely with Agencies to ensure that we understand requirements and configure IPS to suit Agency-specific needs. Qwest Operations will work with our Networx team to engineer, provision, and operate IPS service. Qwest sales engineers will work with Agencies to recommend appropriate SED and service configurations to meet their requirements.

Qwest takes complete responsibility for the provisioning of any IPS. This includes the ordering and installation of the SED, the ordering and

provisioning of the requested access method, configuration of IPS, and complete testing and turn-up.

4.1.1.1.2 Benefits of Qwest's IPS Technical Approach (L.34.1.4.1 (b))

Agencies will enjoy flexible access from any location to a converged IP MPLS network and a simplified operational environment through the Qwest Control Networx Portal. Qwest tailors IPS to the specific application priorities of each Agency. ***Figure 4.1.1-3*** summarizes the benefits of our solution.

Figure 4.1.1-3. Qwest's IPS Features and Benefits

Feature	[redacted]	[redacted]
High-Availability, High-Capacity 10 Gbps-based MPLS Core.	[redacted]	[redacted]
Qwest's IPS supports multiple local access methods including PL, ATM, and FR. Flexible and standards-based access protocols include High-level Data Link Control, Point-to-Point Protocol (PPP), FR, ATM, x Digital Subscriber Line (xDSL), T-1, Digital Signal Level-3, Optical Carrier Level (OC)-x, and Ethernet.	[redacted]	[redacted]
Private MPLS Core.	[redacted]	[redacted]
Advanced Distributed Denial of Service (DDoS) detection systems and proactive measures.	[redacted]	[redacted]
ILEC and CLEC Ethernet Access.	[redacted]	[redacted]

Feature	[redacted]	[redacted]
Qwest is among the top five Internet providers.	[redacted]	[redacted]
Extensive local dial-up and ISDN access combined with an application to ensure local calling, wireless fidelity (Wi-Fi) and international roaming.	[redacted]	[redacted]

Because the Internet has become a fundamental tool for Government information and communications, Qwest's IPS also supports the FEA objectives for improved utilization of Government information resources, increased cost savings and cost avoidance, increased collaboration and interoperability, and reliability, as shown in ***Figure 4.1.1-4***.

Figure 4.1.1-4. Qwest's IPS Support to FEA Objectives

FEA Objective	[redacted]
Improves utilization of Government information resources	[redacted]
Enhances cost savings and cost avoidance	[redacted]
Increases cross-Agency and inter-government collaboration	[redacted]

4.1.1.1.3 Solutions to IPS Problems (L.34.1.4.1 (c))

Qwest has extensive experience in the delivery of IPS. We apply this experience to ensure the delivery of high-quality IPS to Agencies. Extensive pre-deployment laboratory system and integration testing identifies the majority of problems. Qwest's proactive network and configuration management/fault management systems and methods are leveraged to

quickly resolve operational issues. ***Figure 4.1.1-5*** summarizes some of the problems we foresee and the solutions we apply to resolve them.

Figure 4.1.1-5 Qwest's Approach to Common IPS Delivery Challenges

Problem	[redacted]
Customer needs assistance from Qwest to thwart security threats and denial of service (DoS) malicious actions.	[redacted]
Customer needs to modify (Move, Add, Change, Delete) their IPS on short notice.	[redacted]
Customer requires Class of Service (CoS) prioritization on specific types of data traversing their IPS connections to fix problems with IP-based services such as VoIP or video.	[redacted]
Customer's Primary Domain Name Services have failed and their email is now bouncing back to the original sender.	[redacted]

4.1.1.1.4 Synchronization Network Architecture (L.34.1.4.1 (d))

[redacted]

[redacted]

[redacted]

[redacted]		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

[redacted]

4.1.1.2.1 IPS Quality of Service (L.34.1.4.2 (a))

Qwest's IPS [redacted] the Networx program's performance metrics, as shown in ***Figure 4.1.1-8***.

Figure 4.1.1-8. Qwest Complies with Government Performance Metrics for IPS

Key Performance Indicator (KPI)	User Type	Performance Standard (Level/Threshold)	Acceptable Quality Level (AQL)	[redacted]
Av(Port)	Routine	99.95%	≥ 99.95%	[redacted]
	Critical (Optional)	99.995%	≥ 99.995%	[redacted]
Latency	Routine	60 ms	≤ 60 ms	[redacted]

Key Performance Indicator (KPI)	User Type	Performance Standard (Level/Threshold)	Acceptable Quality Level (AQL)	[redacted]
(CONUS)	Critical (Optional)	50 ms	≤ 50 ms	[redacted]
GOS (Data Delivery Rate)	Routine	99.95%	≥ 99.95%	[redacted]
	Critical (Optional)	99.995%	≥ 99.995%	[redacted]
Time to Restore	Without dispatch	4 hours	≤ 4 hours	[redacted]
	With dispatch	8 hours	≤ 8 hours	[redacted]

[redacted]

[redacted]

4.1.1.2.2 Approach for Monitoring and Measuring IPS KPIs and AQLs (L.34.1.4.2 (b))

Qwest monitors and measures the KPIs and AQLs SDP-to-SDP 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.

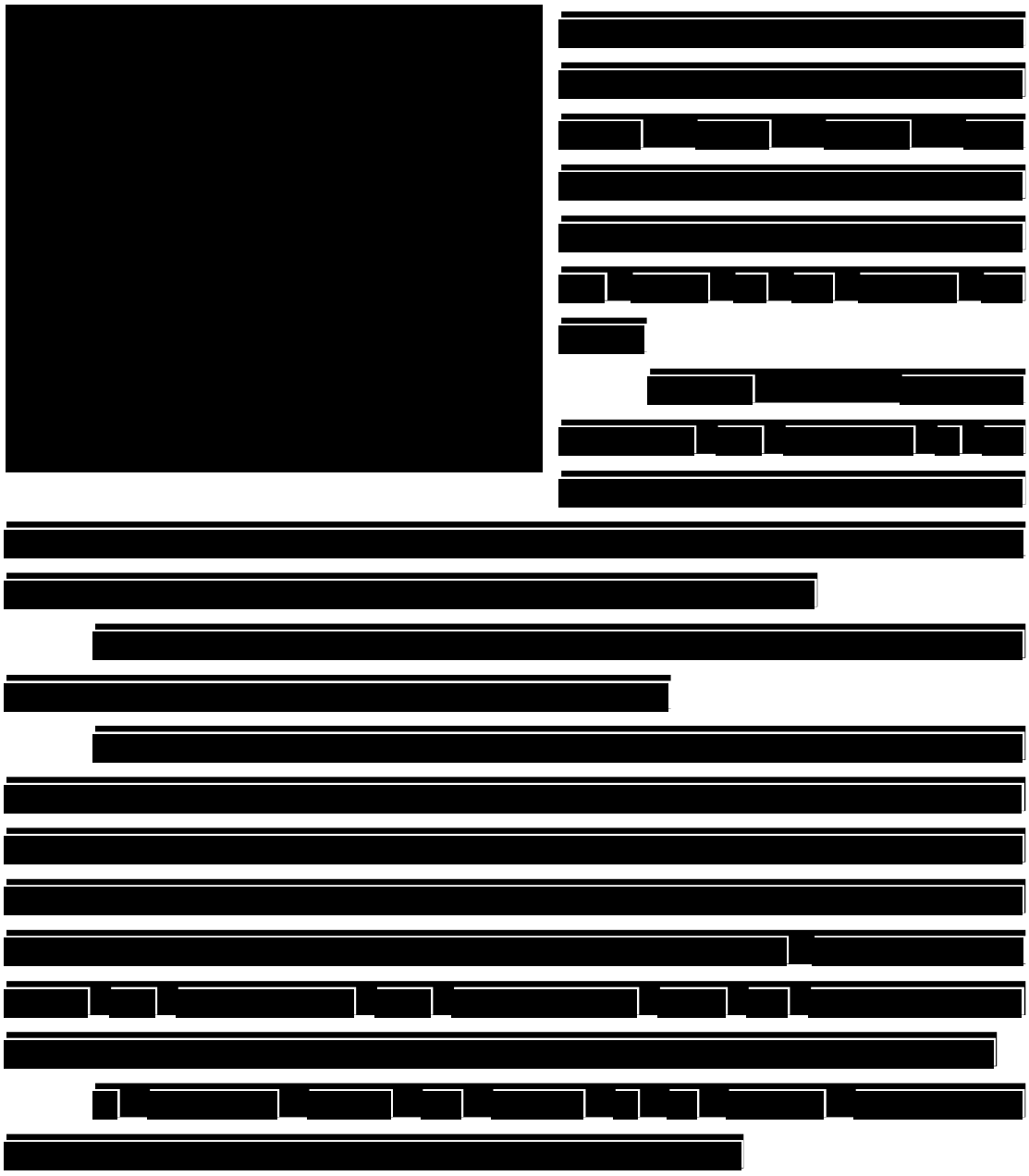
[redacted]

[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

If an Agency orders a Transport/IP/optical service in which they are employing a device, Qwest will provide KPI monitoring and measurement of the delivered service in three ways:

1. Request that the Agency provide SNMP capability to the device for the Qwest NOC
2. Request that the Agency buy a monitoring SED from Qwest
3. Coordinate with the Agency to apply one of the methods described above (e.g., PoP to PoP).

For all services that Qwest offers, we use the [redacted] trouble ticketing system. [redacted] is an industry-leading, commercial-off-the-shelf trouble ticketing application which we have customized to make more effective for our needs. From this system, we collect many useful metrics that we use internally to evaluate and improve our processes, including Time to Restore (TTR). The calculation for TTR uses the same business rules that the Government requires for its services.

The Qwest Infrastructure Group monitors IP network utilization. The group also reports statistics to the Data Network Planning and Design group. This information also is distributed to internal databases and is available to customers through the Qwest Control Networx Portal. The Portal provides Agencies with performance statistics to verify that customer-specified AQLs are met. Agencies may also submit a real-time performance query to the Qwest North America IP network. [redacted]

[redacted]

4.1.1.2.4 Additional IPS Performance Metrics (L.34.1.4.2 (d))

In addition to measuring latency, packet delivery, and availability, [redacted]

4.1.1.3 Satisfaction IPS Specifications (L.34.1.4.3, M.2.1.2(d))

Qwest's standards-based approach satisfies all of the specifications for IPS. Qwest combines our IP/MPLS core network, comprehensive access methods, global peering capabilities, SEDs, and international relationships to deliver all required IPS capabilities, features, and interfaces. Qwest's IP service infrastructure already serves many of the largest Federal Government Agencies as well as some of the world's largest commercial enterprises.

4.1.1.3.1 Satisfaction of IPS Requirements (L.34.1.4.3 (a))

The following three subsections describe how Qwest will satisfy the capabilities, features, and interfaces requirements of the RFP.

4.1.1.3.1.1 Satisfaction of IPS Capabilities Requirements (L.34.1.4.3(a), Req_ID 30667, C.2.4.1.1.4(2))

Qwest's IP/MPLS network infrastructure enables a broad range of technical service capabilities and supports all of the technical capabilities required for IPS. ***Figure 4.1.1-11*** summarizes Qwest's technical approach to supporting the IPS capabilities. Qwest fully complies with all mandatory stipulated and narrative capabilities requirements for IPS. The text in Figure 4.1.1-11 provides the technical description required per L.34.1.4.3(a) and does not limit or caveat Qwest's compliance in any way.

Figure 4.1.1-11. Qwest's Technical Approach to IPS Capabilities

ID #	Capability	[redacted]
1	Port Rates	[redacted]
2	Access Services Support	[redacted]
3(a)	Public Peering Arrangements	[redacted]
3(b)	Private Peering Arrangements	[redacted]
3(c)	IP Addresses and Domain Names	[redacted]
3(d)	Primary and Secondary Domain Name Service (DNS)	[redacted]
4	BGP Support	[redacted]

Access Service Support [Req_ID 30667]

If access is required, Qwest will support appropriate access arrangements to connect Agencies' SDPs to Qwest's IPS. Qwest supports switched and dedicated access to provide for 1) connectivity of the SDP to the Qwest POP and 2) connectivity where the SDP is located in a Qwest POP.

Qwest supports dial-up access from the local Central Office servicing the SDP. Qwest owns and operates one of the largest dial-up access networks in the nation. With coverage [redacted] the CONUS local calling areas, and a total of more than [redacted] for both analog and ISDN, Qwest is a leading wholesale provider of this service to major ISPs as well as Agencies[redacted]

[redacted]

Qwest uses our own and leased access facilities to connect Agency locations to Qwest network services. Qwest uses a variety of technologies, from dark fiber to emerging standards like worldwide interoperability for microwave access (WiMAX). In each case, Qwest performs network engineering and planning, ensuring that the access from our backbone to the Agency's location meets our strict standards for high-quality, reliable services.

[redacted]

Qwest's key differentiator is the ability to provide robust end-to-end solutions, including local access through our own metro facilities and through the traditional ILECs and CLECs. This combination enables Qwest to leverage itself—as an ILEC in 14 states in the western U.S. and to the other ILECs and CLECs—to provide robust access solutions that meet Agencies' needs.

4.1.1.3.1.2 Satisfaction of IPS Features Requirements (L.34.1.4.3(a), C.2.4.1.2)

Our IPS supports all of the IPS features required for the Networx program. ***Figure 4.1.1-13*** summarizes our approach to supporting each required feature. Qwest fully complies with all mandatory stipulated and narrative features requirements for IPS. The text in Figure 4.1.1-13 provides the technical description required per L.34.1.4.3(a) and does not limit or caveat Qwest's compliance in any way.

Figure 4.1.1-13. Qwest's Technical Approach to IPS Features

ID Number	Name of Feature	[redacted]
1	Dial-up backup of dedicated ports	[redacted]
2 [Optional]	Web-based Directory Services	[redacted]

4.1.1.3.1.3 Satisfaction of IPS Interface Requirements (L.34.1.4.3(a), C.2.4.1.3)

Qwest's IPS provides all IPS interfaces required. ***Figure 4.1.1-14*** identifies the specific SEDs we intend to employ (note that we may elect to use different SEDs that provide the same capability over time). Qwest fully complies with all mandatory stipulated and narrative interface requirements for IPS. The text in Figure 4.1.1-14 provides the technical description required per L.34.1.4.3(a) and does not limit or caveat Qwest's compliance in any way.

Figure 4.1.1-14. Qwest-provided IPS Interfaces at the SDP

UNI Type	Networx Service	Network Side or Interface	Protocols	[redacted]
1	Asynchronous Transfer Mode Service	1. T-1 2. T-3 3. OC-3c [Optiona] 4. OC-12c [Optional]	IPv4/v6 over ATMS	
2	Cable High Speed Access	320 Kbps up to 10 Mbps	Point-to-Point Protocol, IPv4/v6	
3	Circuit Switched Data Service	1. ISDN at 64 Kbps 2. ISDN at 128 Kbps 3. ISDN dial backup at 64 Kbps 4. ISDN dial backup at 128 Kbps	Point-to-Point Protocol, IPv4/v6	
4	Ethernet Interface	1. 1 Mbps up to 1GbE (Gigabit Ethernet) 2. 10GbE [Optiona]	IPv4/v6 over Ethernet	
5	Frame Relay Service	1. 56 Kbps with 32 Kbps CIR 2. Fractional T-1 1. 128 Kbps with 64 Kbps CIR 2. 256 Kbps with 128 Kbps CIR 3. 384 Kbps with 128 Kbps CIR 4. 512 Kbps with 256 Kbps CIR 5. 768 Kbps with 384 Kbps CIR 3. T-1 1. 1.536 Mbps with 768 Kbps CIR 2. 1.536 Mbps with 1024 Kbps CIR 4. Fractional T-3 1. 3 Mbps 2. 6 Mbps 3. 12 Mbps 4. 24 Mbps 5. 45 Mbps 5. T-3	IPv4/v6 over FRS	
6	IP over SONET	1. OC-3c [Optiona] 2. OC-12c [Optional]	IP/PPP over SONET	

UNI Type	Networx Service	Network Side or Interface	Protocols	[redacted]
	Service	3. OC-48c [Optional] 4. OC-192c [Optiona]		
7	Private Line Service	1. T-1 2. Fractional T-3 3. T-3 4. OC-3c [Optional} 5. OC-12c [Optional] 6. OC-48c [Optional] 7. OC-192c [Optiona]	IPv4/v6 over PLS	
8	Voice Service	1. Analog dial-up at 56 Kbps	Point-to-Point Protocol, IPv4/v6	
9	DSL Service	1. xDSL access at 1.5 to 6 Mbps	Point-to-Point Protocol, IPv4/v6	
10 [Optiona]	Multimode/Wireless LAN Service			
11 [Optiona]	Wireless Access			
12 [Optiona]	Satellite Access			

Qwest's IPS solution complies with the technical standards and accepted industry standards required by the Networx program, including industry standard configurations, interfaces and equipment. An abbreviated list of Qwest's ANSI and ITU standards supported includes LMI-User, LMI-network, Annex A-user, Annex A-network, Annex D-user, Annex D-network, and the ANSI extensions for LMI, User Network Interface (UNI), Network-to-Network Interfaces, and International Telecommunication Union-Telecommunication technology standards. In addition, Qwest IPS is compliant with many of the Layer 2 Frame Relay and MPLS Forum standards. Qwest participates in the ANSI and its Nanotechnology Standards Panel; the Accredited Standards Committee; the SysAdmin, Audit, Network, Security Institute; and the Center for Internet Security.

4.1.1.3.2 Proposed Enhancements for IPS (L.34.1.4.3 (b))

[redacted]

4.1.1.3.3 Network Modifications Required for IPS Delivery (L.34.1.4.3 (c))

Qwest's current commercial IP services solutions support all IPS requirements. Qwest does not need to generate network or service delivery modifications for IPS.

[redacted]

[redacted]

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[redacted]

[redacted]

4.1.1.3.4 Experience with IPS Delivery (L.34.1.4.3 (d))

Qwest's IP services solutions have supported Federal, commercial, and educational enterprises for more than 20 years, including our past experience as U.S. WEST. Current Government IPS customers include [redacted]

Qwest provides IP transport services on a nationwide and global basis to a majority of the Fortune 500 U.S.-based businesses and continues to exceed industry performance measurements for service, features, and availability. [redacted]

[redacted]

4.1.1.4 Robust Delivery of IPS (L.34.1.4.4, M.2.1.2(e))

Qwest combines a robust technical design with well established, detailed, and continuous planning, engineering, and operations to provide world-class IPS services to Agencies. With a solid and proven network design, established procedures and tools for monitoring capacity and traffic, along with a well trained and experienced operations group, Qwest will ensure high performance IPS services to Agencies, both initially and as the usage of the network grows.

4.1.1.4.1 Support for Government IPS Traffic (L.34.1.4.4 (a))

Qwest has examined the IPS traffic requirements forecast by the Government's traffic model, and has concluded that we can support the required traffic with minimal impact on the capacity or utilization of our network, and without any infrastructure build-out. Specifically, Qwest understands that the Networx traffic model indicates a forecast demand that includes:

- [redacted]
- [redacted]

Based on our current backbone utilization and capacity, the bandwidth requirements specified in the traffic model will not require any significant backbone upgrades. In addition, the total number of ports in the model does not represent a number significant to our edge router capacity planning. Qwest closely and continuously monitors our backbone network links and has

an aggressive upgrade policy to minimize any effects of congestion on customer traffic flows.

4.1.1.4.2 IPS Congestion and Flow Control Strategies (L.34.1.4.4 (b))

Qwest has tremendous backbone bandwidth based on our implementation of Dense Wavelength Division Multiplexing (DWDM) and aggressive capacity planning to ensure no congestion in our data and voice services networks. Qwest data networks have significant POP redundancy, including multiple redundant core MPLS routers and access routers, as well as route-diverse wavelength and SONET transport to redundant POPs. Our network planning engineers examine all failure modes and design network capacity and switch or router redundancy to ensure performance during failures. While Qwest engineers our network to handle congestion, our primary approach to maintaining service quality is to plan, engineer, and operate the network to avoid congestion and single points of failure.

Network resiliency is also built into our data network services. For example, [redacted]

[redacted]

The Qwest IP backbone is already MPLS-enabled and runs resource reservation protocol. This provides a solid foundation upon which to build end-to-end bandwidth management. This approach to traffic engineering allows sets of bandwidth-guaranteed LSPs to carry different classes of traffic—meaning our core will ensure that our VoIP and MPLS VPN traffic is prioritized over Internet-type service—further ensuring the ability to handle both predicted traffic loads as well as increased loads due to unexpected events such as trunk or router failures.

Qwest utilizes only carrier-class equipment to achieve high network availability. Throughout the equipment lifecycle process, from technology insertion to decommissioning, Qwest employs a rigorous testing and evaluation program to ensure the equipment we select for our network meets our network availability objectives. Qwest's Technology Management department evaluates the equipment reliability analysis and sparing strategy and determines which equipment components need to be redundant.

To ensure high availability of our IPS, Qwest employs redundant port cards, line cards, control processors, and switching fabrics in our carrier-class equipment. This redundant and reliable equipment is then replicated either locally or in a geographically diverse location. In the event of a loss of a single router or switch (combined with our rigorous capacity planning methodology), an Agency will not only see continued service, but also will experience no degradation of service.

Qwest networks are built with significant extra capacity to allow for bursting and to absorb changes in traffic patterns when failure conditions

exist. Qwest also adopts a stringent capacity planning methodology to ensure there is enough room in the backbone network to accommodate traffic surges in the event of micro-bursts, DoS attacks, or link failures. By rigorously following such capacity planning rules, we ensure that the Qwest backbone network will maintain service quality for Agencies.

[redacted]

Qwest has the ability to respond to unusual and extreme traffic flows. This includes the ability to distribute black-hole routes to the edges of the network and the ability to control the flow of traffic between services. Black-hole routing allows targeted, granular, route-level traffic control through a standard NOC interface.

4.1.1.4.3 IPS Measures and Engineering Practices (L.34.1.4.4 (c))

[redacted]

[redacted]

Qwest builds our network to provide high availability to our customers. Qwest's performance measures and engineering practices are designed to provide robustness of the access and backbone networks to ensure resiliency and prepare for growth. Our design procedures, network modeling, and circuit route checks provide high levels of customer service.

[redacted]

[redacted]

[redacted] These organizations continually monitor network performance, and the capacity utilization of core network connections and our peering points, to ensure the highest performance for our customers. In addition, Qwest's centralized engineering team applies a consistent capacity management model to all data services.

4.1.1.5 IPS Optimization and Interoperability (L.34.1.4.5, M.2.1.2(f))

Qwest's Network Engineering and Planning organizations continually improve the technology and performance of Qwest IPS. [redacted]

[redacted] The core and edge model also provides our IPS customers with significant interoperability with other Qwest-provided services, such as NBIP-VPNS, ATMS, FRS, and VoIP services.

4.1.1.5.1 Optimizing the Engineering IPS (L.34.1.4.5 (a))

Qwest closely monitors the KPIs (latency, packet loss, [redacted] and constantly optimizes network performance for our customers. Qwest's approach to optimizing the engineering of IP-based and optical services begins with the collection and analysis of network performance data such as availability, packet delivery rate, delay, [redacted] This data, along with historical growth rates, is input into network simulation models. The simulation results are compared to AQL targets. Based on the results, Qwest performs additional analyses and take steps to reroute traffic or add network resources as necessary to maintain AQLs.

For example, if analysis results show that AQL can be maintained by link metric adjustments, Qwest will update the configuration immediately. If additional equipment and/or new backbone links are required, Qwest engineers will design the solution, deploy new equipment, and install new circuits.

4.1.1.5.2 Methods Applied to Optimize the Network Architecture (L.34.1.4.5 (b))

We use a variety of methods to optimize our network architecture. The current Qwest network-based MPLS service offering is built on a nationwide OC-192 core IP/MPLS network. [redacted]

[redacted] Therefore, Qwest has the advantage of not having to accommodate pockets of legacy equipment in our MPLS network.

Qwest is constantly evaluating and optimizing the network architecture in order to support changes in:

a) Services – what services are riding on the network for our customers

b) Network Growth – what is the projected utilization of the network

c) Technology Evolution – what new technology is available that will help us deliver better service to our customers

Architecture Optimization for Services

Every Qwest product is developed and tested against the current architecture. If the existing architecture does not support the product, it is modified and optimized. [redacted]

Architecture Optimization for Network Growth

The IPS network has been carrying a growing amount of traffic. As the volume of traffic grows, the network architecture is reviewed to ensure that it remains scalable and can be continually improved to provide excellent service to our customers. [redacted]

[redacted]

Architecture Optimization for Technological Advances

Over the years, the IPS network has evolved to be a strategic network for Qwest, and we have always stayed ahead of the technology curve. As the equipment vendors have provided improved platforms with more features and functionality, Qwest evaluates them against the current architecture. With the help of this evaluation, Qwest can optimize any part of the network and grow with services and customer requirements. [redacted]

For Qwest, the architecture is dynamic and can be continually optimized to meet customer requirements in a cost-effective manner. We are a facilities based provider with our own fiber, transport, and IPS network and, as shown in the examples above, we leverage technology and architecture at all layers of network to deliver and build the best-of-class network.

4.1.1.5.3 Access Optimization for IPS (L.34.1.4.5(c))

[redacted]

Qwest has designed, engineered, and deployed multi-service edge switch routers with high-port density to provide a full suite of services for diverse customer applications. These multi-service edges are connected

directly to the core routers via multiple high-speed uplinks for diversity and redundancy. These intelligent edge routers allow Qwest to create new, differentiated service offerings, continue support for existing services, and optimize the network infrastructure. [redacted]

With these multi-service edges, the network has less equipment, fewer layers of equipment, and less complexity to operate and manage. Qwest will no longer have to add older IP routers and older Layer 2 switches that were built with limited services and port density and thus will improve performance. Further, technology advancement can be realized as older equipment at the POPs is being decommissioned and removed after traffic has been migrated over to the new multi-service edges.

4.1.1.5.4 Vision for Service Internetworking (L.34.1.4.5(d))

Qwest is committed to the elimination of single-purpose, stovepipe networks that create planning, operations, and interoperability issues for our customers.

Qwest's service delivery model supports multiple types of customer requirements. Qwest's approach for network architecture evolution guides our investments and provides the overall direction for our technology evolution and services convergence. Qwest's service delivery model also allows us to assess the interoperability impacts of changes in the technical elements in each network area (e.g., access, service control, edge, core, MPLS, and optical).

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

In summary, the Qwest backbone has been transformed from primarily serving Internet traffic to a general-purpose packet transport network with TDM-like quality characteristics, capable of serving multiple kinds of

application traffic, including Internet, L2VPNs, L3VPNs, VoIP, Video over IP, Storage over IP, and other traffic.