1.4.10 Optical Wavelength Service over Wave Division Multiplexing (OWS over WDM) [C.2.5.4.1]

Agencies will have protocol transparent connectivity to their offices in different regions in the United States and internationally by use of the Optical Wavelength Service over Wave Division Multiplexing (OWS over WDM) solution. AT&T has deployed long-haul WDM systems that support multiple Synchronous Optical Network (SONET) standards-compliant 2.5 and 10 Gbps signals. This level of system capacity enables AT&T to cost effectively support high-performance applications and to quickly respond to bandwidth demands, giving Agencies unprecedented flexibility to handle large unexpected traffic surges.

1.4.10.1 Technical Approach to Transport/IP/Optical Service Delivery [L.34.1.4.1]

1.4.10.1.a Approach to Service Delivery

(a) Analyze the service requirements specified in this solicitation and describe the approaches to service delivery for each service.

Gartner

"…By deploying new-generation optical technology, AT&T can compete with legacy-free carriers and has moved ahead of other established carriers."

Intercity and metropolitan transport in the U.S. is critically dependent on Wavelength Division Multiplex (WDM) technology to meet today's explosive demand growth. WDM technology consists of optical transport systems (OTS), each transporting large numbers of wavelengths at 2.5 or 10 Gb/sec between two nodes, with each channel being assigned a specific optical wavelength. These wavelengths are connected together optically, in series, to form an optical transparent network capable of transporting multiple 2.5 or 10 Gb/sec signals within metro areas or long distances for high-bandwidth applications.

AT&T's proposed Optical Wavelength Service (OWS) solution is based on new WDM technologies that we continue to deploy and integrate into our intercity and metropolitan network infrastructure. **Figure 1.4.10.1-1** shows our WDM services architecture.

Figure 1.4.10.1-1: AT&T WDM Services Layer.

In the 1990s, AT&T began deploying eight 2.5 Gbps wavelengths of synchronous optical network (SONET) standards-compliant signals that aggregated to 20 Gbps. In 2001, AT&T began deploying high-capacity long-haul WDM systems capable of providing 160 10-Gbps wavelengths of SONET standards-compliant signals that aggregated to 1.6 terabits per second. AT&T is

now deploying ultra longhaul WDM systems, capable of providing an additional 80 10-Gbps wavelengths of SONET standards-compliant signals that aggregate to 800 Gbps. [redacted] AT&T is prepared to support the OWS bandwidth demand of Agencies.

Table 1.4.10.1-1 lists available types of AT&T OWS.

SERVICE TYPE	DESCRIPTION	DATA RATE	OPTIONS
2.5 Gbps	High-capacity digital service offering 2.5 Gbps	2.5 Gbps	• 2-fiber unprotected interface • Cost-effective alternative to purchasing dark fiber • Protocol transparent/application agnostic – supports Internet protocol (IP), asynchronous transfer mode (ATM), frame relay (FR), etc. • Option to provide with diverse route
10 Gbps	High-capacity digital service offering 10 Gbps	10 Gbps	
40 Gbps (Future Offering)	High-capacity digital service offering 40 Gbps (Future)	40 Gbps	• AT&T is evaluating WDM systems to support 40 Gbps wavelengths

Table 1.4.10.1-1: AT&T OWS. *AT&T provides multiple bandwidth options for OWS, customized for the unique needs of the Agency.*

As a framework for providing OWS, the AT&T solution enables:

- High reliability
- High survivability
- Superior security and information assurance
- Robust interoperability
- Efficient provisioning
- End-to-end maintenance
- Extensibility and reach.

Table 1.4.10.1-2 summarizes AT&T's approach in delivering OWS to the Agency.

SERVICE APPROACH	TECHNICAL DESCRIPTION
High Reliability	AT&T continuously maximizes the availability of our core network by using proactive and preventive quality policies and programs. AT&T takes proactive measures to build reliability into the network and to monitor performance on a continuing basis. AT&T uses a unique combination of fully diverse intercity and metro WDM systems to offer the highest levels of reliability.
High Survivability	By continually increasing our global presence of fiberoptic cable and WDM systems, AT&T has designed a highly survivable network, with diverse routing and protected WDM configurations.
Maximum Security and Information Assurance	AT&T Security Organization is responsible for the overall security management of AT&T network. AT&T Security Organization prepares, oversees, and manages the security plans and processes for AT&T network operations. AT&T Security Organization supports and enforces physical and system access controls to provide personnel, facility, and information assurance and security.

SERVICE APPROACH	TECHNICAL DESCRIPTION
Full Interoperability	AT&T's OWS use fully compatible communications systems and consistent engineering methods and software platforms, providing virtually seamless interoperations with interfacing networks. AT&T's OWS are compliant with American National Standards Institute (ANSI) and Telcordia (GR-253-Core) standards.
Efficient Provisioning	AT&T **Business**Direct is the secure AT&T website that delivers online tools for efficient, effective, convenient e-servicing capabilities, 24x7. [redacted]
Extensibility and Reach	AT&T has an extensive network that includes: [redacted]
End-to-End Maintenance	AT&T has developed a state-of-the-art Network Operations Center (NOC) for the seamless operation of critical network management components, including fault detection, isolation and restoration; inventory and configuration management; performance and security management.

Table 1.4.10.1-2: Approach in Delivering OWS. *Agencies benefit from a reliable and upgradeable network so that OWS will be delivered with the highest availability.*

AT&T's solution proposes OWS that provides high-capacity bandwidth over a WSM infrastructure. AT&T's OWS is composed of an end-to-end, integrated OWS that includes the following components:

- Metropolitan optical wavelength access service
- Wide-area OWS
- Global OWS.

WDM is a well-established technology for longhaul optical backbone networks. As the technology matures, WDM is also being used in metropolitan area networks (MANs) to enhance the network flexibility, as well as to improve capacity. The challenge in metro-WDM is to balance network capacity, reliability, service diversity, and flexibility and cost.

In metropolitan areas, AT&T has used WDM optical networking techniques to invent new network architectures for customer access. Our primary emphasis has been the development of flexible, cost-effective, broadband architectures for business access. By focusing on the WDM layer, we keep abreast of advances in optical components, and leverage these newly commercialized

technologies (such as semiconductor optical amplifiers and coarse WDM optics) to improve functionality and reduce costs. Based on our knowledge of access systems, we are in a unique position to deploy new subsystems that will positively impact network performance.

AT&T Labs Research has a four-node metro WDM ring test bed for developing and implementing various optical network technologies (**Figure 1.4.10.1-2**). This test bed enables AT&T to study system performance experimentally. The test bed has been configured and enhanced so that it will readily evaluate system impacts, and optimize the reliability and performance of new component technologies. Transport network reliability has been a fundamental cornerstone of the AT&T control plane research. AT&T Research has developed new approaches to fast restoration, demonstrating an effective tradeoff between restoration speed and network efficiency, through simulations and software implementation, based on extensions to standard protocols.

Agencies will benefit from an OWS offering that is highly reliable, highly survivable, secure, highly interoperable with other services, easy to provision and fully maintained to serve present and future requirements.

Figure 1.4.10.1-2: AT&T Baseline Hubbed [redacted].

1.4.10.1.b Benefits to Technical Approach

(b) Describe the expected benefits of the offeror's technical approach, to include how the services offered will facilitate Federal Enterprise Architecture objectives (see http://www.whitehouse.gov/omb/egov/a-1-fea.html).

AT&T's Networx services, in general, and OWS, in particular, support the Government's vision of transformation through the use of the Federal Enterprise Architecture (FEA) by providing the technologies that contribute to the Agency's mission objectives. **Table 1.4.10.1-3** describes each service in relation to FEA, summarizes its contribution, and/or provides an example of how it facilitates FEA implementation.

SERVICE DELIVERY APPROACH	BENEFITS	FEA FACILITATION
High Reliability	Agencies benefit from protection against hard failures anywhere within AT&T network. AT&T metro WDM systems are designed with the following principles: • *Automatic Protection Switching*: Metro WDM rings provide the highest level of reliability by using a dedicated protection path • *Restoration*: Supports per wavelength protection switching with a restoration speed of 50 milliseconds • *Technology Diversity*: Multivendor equipment provides metro WDM equipment diversity for sustained, continuous operation AT&T standards require fully diverse fiber ingress and egress connections to the AT&T points-of-presence (POPs)	Provides high quality service delivery of the Technical Reference Model's (TRM's) service transport technologies
High Survivability	AT&T offers disaster recovery services as part of network	Provides network

SERVICE DELIVERY APPROACH	BENEFITS	FEA FACILITATION
	assurance to Agencies that their network will survive any outages caused by disasters. Disaster recovery services provide fast, assured recovery capabilities for Agencies' critical business components workcenters, applications/platforms, data, and networks.	survivability in case of a manmade or natural disaster of TRM service transport networks
Maximum Security and Information Assurance	Agencies are ensured that any services transported over the optical network are secure.	TRM service transport network offers information assurance for higher layer services
Full Interoperability	Agencies will have seamless interoperations with other interfacing networks. Protocol transparency for multiservice support allows deployment of a transparent optical infrastructure independent of the transport protocol	TRM service transport network provides connectivity to virtually any Agency network
Efficient Provisioning	AT&T **Business**Direct provides Agencies with the ability to manage their dedicated OWS network on a web portal. Agencies benefit from the features of AT&T **Business**Direct as follows: • Save time by minimizing the need to place phone calls and waiting for callbacks • Improve productivity by increasing automation and minimizing manual data entry • Improve accuracy of transactions by reducing or eliminating data entry errors • Reduce costs by increasing productivity and redirecting headcount • Experience superior service	Facilitates day-to-day business operations, as defined by the Business Reference Model (BRM) for e-Government applications
Extensibility and Reach	• AT&T has extensive network reach with our local, regional, intercity contiguous United States (CONUS) and international (outside contiguous United States [OCONUS]) coverage. To ensure that Agencies' future needs are met, the network is constantly being expanded and improved. • More than 16,000 route miles of 40 Gbps capable fiber has been deployed to support advanced, high-speed 40 Gbps OWS when they become commercially available. • AT&T's intercity WDM network features the following: • Multiple vendor, next-generation network with longhaul and ultra longhaul service platforms to provide high-capacity bandwidth	• Horizontal and Vertical Information Sharing • Ubiquitous coverage for support of TRM's service transport technologies • Budget/Performance Integration
End-to-End Maintenance	• Performance of optical network is constantly monitored and maintained. • Dedicated Project Implementation Manager (PIM) serves as the single point-of-contact for the Agency, from implementation, service acceptance, and maintenance of the service	Performance Reference Model is maintained by permitting the service transport is constantly monitored for high quality performance

Table 1.4.10.1-3 Agency Benefits and FEA Facilitation. *Agencies can receive products and services components that are easily integrated, commonly manageable, and aligned to support FEA objectives and meet FEA guidelines.*

Agencies will benefit from the OWS by consolidating their network infrastructure and simplifying their access and transport strategy, with a seamless network to support OWS. AT&T has the technology, systems

integration expertise, management processes, and, most importantly, knowledgeable and skilled personnel to support OWS for the Agencies.

1.4.10.1.c Major Issue to Service Delivery

(c) Describe the problems that could be encountered in meeting individual service requirements, and propose solutions to any foreseen problems.

In transitioning into any new service delivery model, whether it be task-based or fully outsourced, unforeseen issues can always arise. Therefore, it is important that GSA selects a service provider, such as AT&T, which brings the depth and background that minimize an Agency's risk during transition. Our experience has enabled us to develop proven methods, processes, and procedures applicable to the simplest or the most complex projects.

Table 1.4.10.1-4 lists the top 10 service delivery risks and our mitigation strategy. [redacted]

RISKS	RISK DESCRIPTION	RISK MITIGATION
Business disruption	Agencies are concerned about business disruption when moving to a managed service. Adequate planning can minimize this risk.	[redacted]
Requirements changes	Requirements changes before and after service delivery contributes to budget overruns, schedule slips, and missed expectations.	[redacted]
Complete and accurate location information	Location information often is not accurate and site POCs are no longer valid.	[redacted]
Schedule slippage	Many issues can contribute to schedule slippage; a detailed project schedule can minimize	[redacted]

RISKS	RISK DESCRIPTION	RISK MITIGATION
	this risk.	
Implementation	Risk to on-time and on-budget implementation for a large Agency with many sites scattered throughout the world.	
Fiber cuts	Cuts to fiber along the transmission routes normally caused by construction activities can result in service disruption	
Equipment failures	Failures to any of the network element equipment along the transmission routes can cause service disruption.	
Inability to reach Agency SDP	Agencies require an optical network that has sufficient reach to connect to any of their locations within CONUS and internationally.	
Service below acceptable quality	Agencies expect that the optical network be deployed with the highest level of quality service.	
Manmade and	Disasters that affect the service	

RISKS	RISK DESCRIPTION	RISK MITIGATION
natural disasters	delivery point (SDP) building infrastructure, be it manmade (terrorist activity) or natural (earthquake, flood, etc.) that will cause service disruption.	[redacted]

Table 1.4.10.1-4: AT&T Service Delivery Lessons Learned and Risk Mitigation Strategies. *Agencies benefit from lessons learned and experience implementing OWS, which ultimately minimize service delivery risks.*

[redacted]

AT&T has taken steps to identify risk and provide risk mitigation associated with delivering OWS. AT&T is committed to service excellence and will work with the Agency to identify and resolve potential problems that might occur during service delivery. AT&T engineers its underlying OWS network with enough resiliency to mitigate risks that causes service outages to deliver highly reliable service to the Agency SDPs.

1.4.10.1.d Network Architecture Synchronization

(d) Describe the synchronization network architecture to support the offeror's access and transport networks.

AT&T is a leader in the area of network synchronization, by virtue of our active role in the international and domestic standards organizations. We have an existing industry-unique, dedicated timing and synchronization network for distributing Stratum 1 traceable timing to our own national and international telecommunications networks.

Synchronization for access and transport networks begins with the Federal Government's cesium-based standard signal, which is distributed to a series of global positioning satellites (GPS) systems. [redacted]

1.4.10.2 Satisfaction of Transport/IP/Optical Performance Requirements [L.34.1.4.2]

1.4.10.2.a Service Quality and Performance

(a) Describe the quality of the services with respect to the performance metrics specified in Section C.2 Technical Requirements for each service.

AT&T understands that the KPIs chosen by the Government are built around realistic thresholds that represent operational assurance. The critical availability of 99.999 percent allows for less than 5 minutes and 15 seconds of downtime per year. The routine availability of 99.9 percent allows for less than 4 hours and 32 minutes of downtime per year. **Table 1.4.10.2-1** summarizes the performance metrics that AT&T adheres to versus the Government's targets.

KEY PERFORMANCE INDICATOR (KPI)	SERVICE LEVEL	PERFORMANCE STANDARD (THRESHOLD)	PROPOSED SERVICE QUALITY LEVEL
AVAILABILITY (OWS OVER WDM)	Routine	99.9%	[redacted]
	Critical	99.999%	
TIME TO RESTORE (TTR)	Without Dispatch	4 hr	
	With Dispatch	8 hr	
GRADE OF SERVICE (RESTORATION TIME)	Routine	100 ms	
	Critical	60 ms	
BIT ERROR RATIO (BER)	Routine	10^{-12} Out of Service Monitoring *	
[redacted]			

Table 1.4.10.2-1: OWS Network Performance Parameters. *Agencies will be positioned to better manage telecommunications and information services through performance-based contracts that deliver the quality of service (QoS) required to meet Agency performance objectives.*

[redacted]

1.4.10.2.b Approach to Monitoring and Measuring Performance

(b) Describe the approach for monitoring and measuring the Key Performance Indicators (KPIs) and Acceptable Quality Levels (AQLs) that will ensure the services delivered are meeting the performance requirements.

To provide the Agencies with the most accurate representation of the service performance, AT&T has deployed a separate performance measurement infrastructure to collect network performance information. AT&T's measurement methodology, therefore, more closely captures the real performance that end users experience by measuring the data path that is very similar to the paths that the end user data would follow.

AT&T's network operations technical team conducts continuous testing and monitors the network and WDM equipment to make certain we stay within the KPI requirements. Points of presence (POPs), service nodes, wavelength division multiplex (WDM) network elements and spares are monitored 24x7 at each local site and at AT&T's Global Network Operations Control Center (GNOC) in Bedminster, New Jersey. **Table 1.4.10.2-2** summarizes the measuring approach for OWS KPIs.

KEY PERFORMANCE INDICATOR (KPI)	APPROACH TO MONITORING AND MEASURING
Availability (SDP-to-SDP)	[redacted]
Time to Restore (TTR)	[redacted]
Grade of Service (GoS) (Restoration Time)	[redacted]
Bit Error Rate (BER)	[redacted]

Table 1.4.10.2-2: AT&T's Monitoring and Measuring Approach. [redacted]

The GNOC staff monitors and proactively manages the data and voice traffic flowing across AT&T's domestic and global networks 24x7.

Figure 1.4.10.2-1: The [redacted]

Figure 1.4.10.2-1 depicts the GNOC.

[redacted]

The first time the service is provided through the Networx contract, the performance must be verified. The KPIs will be monitored to assess whether the service performance complies with the AQL. [redacted] The service verification process is presented in greater detail in Section 1.3.2.d, Approach to Perform Service Delivery Verification. Agencies benefit from existing systems, processes, and procedures to monitor and measure compliance with KPIs and AQLs for OWS.

1.4.10.2.c Performance Level Improvements

(c) If the offeror proposes to exceed the Acceptable Quality Levels (AQLs) in the Key Performance Indicators (KPIs) required by the RFP, describe the performance level improvements.

Achieving the AQLs defined by the Government for the KPIs will result in superior OWS performance. [redacted]

1.4.10.2.d Rationale and Benefits for Additional Performance Metrics

(d) Describe the benefits of, rationale for, and measurement of any additional performance metrics proposed.

The KPIs defined by the Government for OWS will provide a comprehensive assessment for service verification and service performance monitoring. [redacted]

1.4.10.3 Satisfaction of Transport/IP/Optical Service Specifications [L.34.1.4.3]

1.4.10.3.a Service Description

(a) Provide a technical description of how the service requirements (e.g., capabilities, features, interfaces) are satisfied.

The AT&T CONUS OWS is backed by more than [redacted] of fiber, [redacted] POPs, and [redacted] to make a very

resilient network. **Figure 1.4.10.3-1** depicts a [redacted]

Figure 1.4.10.3-1: AT&T [redacted]

Approximately [redacted] is in place that is capable of supporting [redacted] as part of the intelligent photonics network, which is under construction. **Figure 1.4.10.3-2** shows a [redacted]

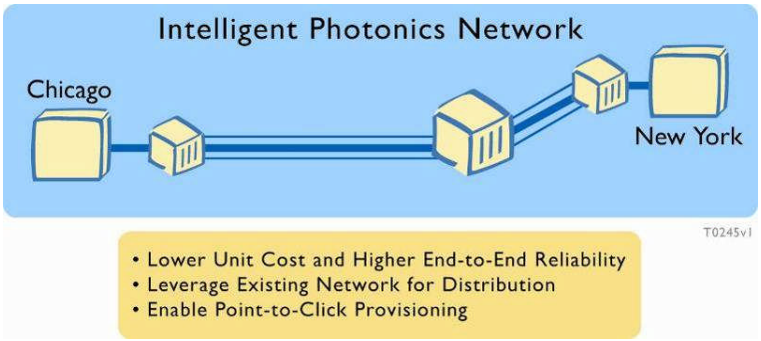

Figure 1.4.10.3-2: AT&T Ultra-Longhaul Network Segment. *Lower in cost than the generation of DWDM technology, the AT&T photonics network allows for OWS over the WDM (ITU G.709 compatible) to be offered to meet Agency bandwidth requirements.*

When Agencies require business continuity alternatives that include what are commonly referred to in the industry as high-availability networks, either the ultravailable network or AT&T Ultravailable Managed OptEring Service is an

ideal solution. A high-availability network is engineered to an Agency's specifications for business continuity and reliability. The solution deployed meets the critical availability SLA target listed in Section C.2.5.4.1.4 of the RFP. **Table 1.4.10.3-1** provides a technical description of the adherence to standards and connectivity options that AT&T's OWS offers.

SERVICE REQUIREMENTS	TECHNICAL DESCRIPTION	BENEFIT TO AGENCY
Standards	All OWS interfaces adhere to the ANSI, ITU-T, and Telcordia standards listed in Section C.2.5.4.1.1.2 of the RFP.	Agencies are provided interoperability with other networks that use standard interfaces.
Connectivity	AT&T's OWS will be engineered and deployed to interface with Government-specified termination (user to network interfaces [UNIs]), as specified in Section C.2.5.4.1.3 of the RFP. Wavelengths ordered will connect and should interoperate with AT&T's metro and intercity networks, the Agency's intranet, the Internet, and other Agency networks.	Agencies are provided interoperability with existing Agency networks, as well as continuity of service for circuits that ride on other carriers networks.

Table 1.4.10.3-1: Standards and Connectivity Options of AT&T's OWS. *AT&T is compliant to all standards and connectivity requirements for OWS.*

Table 1.4.10.3-2 provides a technical description of the adherence to the technical capabilities that AT&T's OWS offers.

SERVICE REQUIREMENTS	TECHNICAL DESCRIPTION	BENEFIT TO AGENCY
Metro Wavelength Services	Ring network. AT&T provides single point-to-point, bi-directional wavelengths that support the connectivity of two Agency sites in the same city by the wavelengths provisioned over the DWDM ring.	Agencies benefit from point-to-point connectivity between locations within a metropolitan area for OWS.
Intercity Wavelengths	AT&T provides single point-to-point, bi-directional wavelengths throughout its CONUS ultra-longhaul network in a redundant manner that will allow for high availability of the OWS-WDM service.	Agencies benefit from point-to-point connectivity between CONUS locations for OWS.
Global Wavelengths	AT&T can provide single point-to-point, bi-directional wavelengths throughout its international optical network in a redundant manner that will allow for high availability of the OWS-WDM service. The end-to-end wavelength service will drop and pick up traffic to and from cities and different areas of the globe, as required by the Agency.	Agencies benefit from global connectivity for OWS.
Transmission Rates	Current transmission rates supports are 2.5 and 10 Gbps. [redacted]	Agencies have the choice of standard available high-speed wavelength interfaces for their networks.
Clock Transparency	Clock signals originating from an Agency site will pass through the AT&T optical network without re-clocking the signal.	Agencies benefit from the ability to pass SONET synchronization transparently through WDM network.
Protocol Transparency (optional)	Optical wavelengths, provided as part of AT&T's OWS-WDM service, are protocol transparent. Rate independence will be provided to Agencies once commercially available.	Agencies benefit from the ability to transport any type of traffic over WDM network, regardless of native

SERVICE REQUIREMENTS	TECHNICAL DESCRIPTION	BENEFIT TO AGENCY
		protocol.
Byte Transparency	SONET and SDH overhead bytes are passed through AT&T optical wavelength network without being overwritten; therefore, byte transparency is offered on the AT&T OWS-WDM. • All SONET/SDH transport overhead (TOH) bytes will be transported without being overwritten, with the exception of the A1 and A2 bytes, B0 and J1, which will be used to monitor the framing integrity of the incoming SONET/SDH signal. [redacted]	Agencies benefit from the ability to pass SONET/SDH overhead bytes through WDM network unaltered.
Concatenation	Standard and virtual concatenation will be supported transparently for framed wavelengths on the AT&T optical network.	Agencies benefit from improved bandwidth efficiency, simplified network control, and improved balance of optical wavelength network load.
Channelization	All mandatory UNIs listed in Section C.2.5.4.1.3 are supported in the AT&T optical network.	Interoperation to various UNIs are ensured for the ultimate in network flexibility.
Wavelength Delivery	Wavelengths will be delivered to the Agency SDP by two fibers over a two-port demarc, typically a fiber distribution panel (FDP) that will be connected to the DWDM equipment collocated at the Agency SDP equipment room.	Agencies benefit from a standard service handoff from AT&T at a clearly defined demarc for service monitoring.
Access Methods	Access for wavelength delivery to the Agency SDP will be achieved by use of one of the following methods: • AT&T ultravailable metro DWDM service. This service will connect the closest AT&T POP and AT&T local network service (LNS) node to the Agency SDP requiring the optical wavelength at each end point of the end-to-end ordered service. • If the Agency SDP is located in an area where the AT&T ultravailable metro DWDM service is not available, AT&T will indicate to the Agency which alternatives exist to enable the end-to-end service. AT&T uses the following method to deliver OWS to the Agency SDP • Collocate DWDM equipment at the Agency SDP and deliver wavelength service on short reach optical interfaces. This eliminates the need for the Agency to determine the optical reach of interfaces for access provided on the backbone of the longhaul DWDM system. • In the event that the Agency does not prefer this arrangement, AT&T will work with the Agency to determine a custom solution on an individual case basis.	Agencies benefit from a carrier single POC for managed, end-to-end OWS. Agencies will not have to bother with arranging access to the SDP on another carrier.
Customer Premises Equipment (CPE) Support	AT&T will provide interoperability support to the CPE owned by the Agency by providing UNI connectivity as follows: • Short reach or very short reach (as appropriate, when commercially available) optics to connect the AT&T-	Agencies are ensured seamless interconnectivity with other interfacing networks for the transmission of different

SERVICE REQUIREMENTS	TECHNICAL DESCRIPTION	BENEFIT TO AGENCY

	managed WDM system to the Agency CPE where the WDM equipment is collocated in the Agency's office.
	• Long-reach optics will be used to reach the CPE at the Agency site when the AT&T managed WDM system is located at a carrier hotel. This will require a dark fiber solution, managed either by the Agency or by AT&T, to be used for the connection between the carrier hotel and the Agency office.
	• At the Agency's request, AT&T will provide the Agency CPE connectivity to the network by way of native protocols, such as ATM, Ethernet, Packet over SONET, or ATM over SONET.
	• AT&T's OWS supports the following CPE interfaces:
	  • Enterprise system connection (ESCON)
	  • Fiber connectivity (FICON)
	  • Fiber Channel
	  • D1
	  • Fiber distributed data interface (FDDI)
	  • Gigabit Ethernet
	  • D1 Video
	  • External timing reference (ETR)
	  • 2.5 Gbps
	  • 10 Gbps
		service types.

Efficient Transport	Wavelengths provided by AT&T are protocol independent; a single wavelength is capable of transporting different types of traffic. Wavelengths do not need to be separated by the different types of services for which they are used.	Agencies benefit from a transport technology that is truly protocol independent. This helps the Agency to lower the overall network total cost of operations by reducing the number of dedicated networks separated by service type.

Table 1.4.10.3-2: Technical Capabilities of AT&T's Optical Wavelength Service. *The resilient and feature-rich optical network ensures compliancy to OWS technical capabilities.*

Table 1.4.10.3-3 provides a technical description of the adherence to the required features that AT&T's OWS offers.

SERVICE REQUIREMENTS	TECHNICAL DESCRIPTION	BENEFIT TO AGENCY
Equipment Protection 1:1 CPE	[redacted]	Agencies benefit from redundancy of client side interfaces to Agency-owned equipment.
Equipment Protection 1+1 CPE	Client side 1+1 protection is available as a standard offering	Agencies benefit from full redundancy of client side interfaces to Agency-owned equipment for superior protection from equipment interface failures.
Equipment Protection – Network Side	Channels facing the network will be engineered in a fully redundant, premium configuration	Agencies experience the benefits of a self-healing network. No service outage should be experienced in case of a network side equipment or route failure.
Geographical Diversity – Non-Domestic and CONUS Wavelengths	For non-domestic (international) and domestic intercity (CONUS) wavelengths, geographical diversity will be maintained in the AT&T network to protect the Agency against hard failures. Per RFP requirements, diversity will be maintained in the metropolitan area for delivery of the wavelengths to two Agency SDPs. [redacted]	Agencies benefit from a resilient OWS architecture that provides high reliability.
Geographical Diversity – Metro Wavelengths	Diversity will be maintained through metro DWDM ring network for delivery of wavelength services to two Agency SDPs.	Agencies benefit from a resilient metro OWS architecture that provides high reliability for service delivery to two Agency SDPs.
Geographic Diverse Wavelength – Single-Site Delivery	Geographical diversity for wavelength delivery from SDP Site Number 1 to SDP Site Number 2 will be supported on different fiber paths that traverse in different geographies. [redacted]	Agencies benefit from an OWS architecture that provides high reliability and resiliency. The network is protected from catastrophic failures that affect a single site within a geographic region.
Geographic Diverse Wavelength – Dual-Site Delivery	Geographical diversity for wavelength delivery from SDP Site Number 1 to SDP Sites Numbers 2 and 3 will be supported on different fiber paths that traverse in different geographies. [redacted]	Agencies benefit from a highly resilient OWS architecture that provides high reliability is service delivery to two sites. Catastrophic failures within a geographic region will not affect the network.
Geographic Diverse Wavelength – Single Metro Hub	CONUS and non-domestic wavelengths can be transported to the Agency SDP through the metropolitan network by way of an AT&T metro node that serves as a single metro hub.	Agencies benefit from a resilient metro OWS architecture that provides high reliability in service delivery from the CONUS and/or non-domestic network to the SDP on the single metro hub location.

SERVICE REQUIREMENTS	TECHNICAL DESCRIPTION	BENEFIT TO AGENCY
Geographic Diverse Wavelength – Dual Metro Hub	CONUS and non-domestic wavelengths can be transported to the Agency SDP through the metropolitan network by way of a dual AT&T metro node architecture that serves as dual metro hubs. The dual-hub architecture provides added diversity to the paths that the wavelengths travel from City A to City B.	Agencies benefit from a resilient metro OWS architecture that provides high reliability in service delivery from the CONUS and/or Non-domestic network to the SDP. Agencies benefit from added geographical diversity options that the dual hub metro architecture provides.
Protected Metro Wavelength	Wavelength protection is provided by a [redacted] architecture used by the AT&T metro DWDM network. [redacted]	Agencies benefit from a resilient metro OWS architecture that provides high reliability. Agencies are ensured a redundant OWS network from the AT&T POP to the Agency SDP that is protected from any single point of failure.

Table 1.4.10.3-3: Optical Wavelength Service Features. *AT&T's technical equipment and methodologies provide the required OWS performance for Agencies.*

Technologies, such as WDM, were previously restricted to carrier backbones. DWDM is now being deployed in the metro space, creating cost-effective, readily available bandwidth that will accelerate network-based services, such as content distribution, outsourced storage, streaming video, and other data-intense applications. AT&T metro WDM service provides private (network) or individual lambdas (wavelength) use of a secure fiberoptic MAN with WDM technology (**Figure 1.4.10.3-3**). This secure fiberoptic MAN provides the communication path between the Agency SDP, the AT&T point-of-presence (POP)/LNS node(s), as well as any third-party provider fiber node.

Introduced by AT&T in 2001, the first metro WDM rings were focused exclusively on meeting a client's information technology needs. Generally, this meant data replication applications, such as high-bandwidth connections

between a mainframe at one customer premises to storage devices at a remote location. Clients began to request more functionality, including the addition of an AT&T node to the rings and the ability to support traditional access services and interoffice channels (IOC) between metro rings.

Figure 1.4.10.3-3: AT&T Metro Protected WDM Ring. *Agencies will benefit from an ultra-high bandwidth, scalable, managed private fiberoptic network, typically installed in a metropolitan area in a ring configuration. These rings typically support high-availability applications, such as storage area network (SAN) replication and disaster recovery services (DRS).*

Agencies will benefit from AT&T's metro WDM rings in the manner as our other clients, whether using SAN replication, disaster recovery services, or traditional high-availability access services.

Agencies benefit from a robust OWS offering that meets all capabilities, features, and interfaces required. Services are delivered in a low-risk manner and is deployed and operated in a high-quality manner.

1.4.10.3.b Attributes and Values of Service Enhancements

(b) If the offeror proposes to exceed the specified service requirements (e.g., capabilities, features, interfaces), describe the attributes and value of the proposed service enhancements.

In addition to the standard services, Agencies can enhance their OWS with additional features and capabilities [redacted] **Table 1.4.10.3-4** highlights additional service features and capabilities available with OWS. AT&T proposes the attributes in **Table 1.4.10.3-4** as service enhancements.

PROPOSED SERVICE REQUIREMENT	TECHNICAL DESCRIPTION	BENEFITS
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Table 1.4.10.3-4: [redacted] **Reliability.** [redacted]

[redacted]

Figure 1.4.10.3-4 [redacted]

Figure 1.4.10.3-4: Architecture of [redacted]

[redacted]

1.4.10.3.c Service Delivery Network Modifications

(c) Describe any modifications required to the network for delivery of the services. Assess the risk implications of these modifications.

Agencies receive a low-risk solution through AT&T's ability to offer OWS upon contract award, without modifications to the network or operational support systems.

1.4.10.3.d Transport/IP/Optical Service Experience

(d) Describe the offeror's experience with delivering the mandatory Transport/IP/ Optical Services described in Section C.2, Technical Requirements.

AT&T has nearly [redacted] WDM systems online. **Tables 1.4.10.3-5** through **1.4.10.3-7** summarize a deployment of OWS to service various customers.

[redacted]

CLIENT NEED	SOLUTION	CREATED VALUE
[redacted]	[redacted]	[redacted]

Table 1.4.10.3-5: Optical Wavelength Service Value Creation for a [redacted]

[redacted]

CLIENT NEED	SOLUTION	CREATED VALUE
[redacted]	[redacted]	[redacted]

Table 1.4.10.3-6: Optical Wavelength Service Value Creation for [redacted]

CLIENT NEED	SOLUTION	CREATED VALUE
[redacted]	[redacted]	[redacted]

Table 1.4.10.3-7: Optical Wavelength Service value creation for [redacted]

In 1995, AT&T was the first carrier to use WDM to dramatically increase the overall capacity of the optical network backbone. AT&T looks forward to offering OWS to Agencies as part of the Networx contract. Agencies will benefit from the same high-quality service experienced by [redacted]

1.4.10.4 Robust Delivery of Transport/IP/Optical Services [L.34.1.4.4]

1.4.10.4.a Network Traffic Utilization

(a) Given the offeror's current network capacity and utilization, explain how the offeror will support the Government requirements specified in the traffic model. Describe the impact on capacity and utilization, as well as any infrastructure build out contemplated.

[redacted]

To assess the impact of the Agencies' OWS traffic on the AT&T network, the forecasted traffic in the Networx hosting model has been compared against the growth of AT&T's network. **Table 1.4.10.4-1** describes the impact of the Agencies' forecasted OWS traffic growth from Years 1 through 10.

[redacted]

CONTRACT YEAR	GOVERNMENT FORECASTED BANDWIDTH USAGE (GBPS, AGGREGATED)	%NETWORK BANDWIDTH USED
1	[redacted]	[redacted]
2	[redacted]	[redacted]
3	[redacted]	[redacted]
4	[redacted]	[redacted]
5	[redacted]	[redacted]
6	[redacted]	[redacted]
7	[redacted]	[redacted]
8	[redacted]	[redacted]
9	[redacted]	[redacted]
10	[redacted]	[redacted]

Table 1.4.10.4 -1: [redacted] for Traffic Model Growth. [redacted]

1.4.10.4.b System Robustness and Resiliency

(b) Describe the measures and engineering practices designed to provide robustness of the access and backbone networks, ensure resiliency, and plan for growth.

Robustness and resiliency of optical wavelength circuits are provided by the methods summarized in **Table 1.4.10.4-2**.

ROBUSTNESS AND RESILIENCY METHOD	DESCRIPTION
Diverse Layer 1 Wavelength Slotting	Wavelength transmission paths are slotted as service demands onto AT&T's physical (Layer 1) network. Many diversely routed wavelength transmission paths correspond to *natural* fiber paths, where the physical routing will usually correspond to physically diverse routes. For example, wavelengths from Seattle to Oakland, and Seattle to Denver, are Layer 1 diverse.

Table 1.4.10.4-2: Methods Used for Robustness and Resiliency. *AT&T uses wavelength slotting to produce a flexible, fast, and highly reliable OWS*

Figure 1.4.10.4-1 shows the network performance of the OWS network in 2004. Rigorous engineering practices and measurements of the network allow Agencies to obtain a scalable, reliable service to build and operate their mission-critical applications. OWS capacity planning within the AT&T network is driven by three main factors (**Table 1.4.10.4-3**).

Figure 1.4.10.4-1: [redacted]

MAJOR CAPACITY PLANNING FACTORS	
Business Planning	Annual business planning forecasts of all existing and new AT&T services that use the SONET backbone network and connected service give combined prediction of use.
Technology Migrations	Capacity for planned technology migrations and insertions are built into system before migration is started.
Historic Growth	Historic traffic growth of existing services, as measured over time, allows for buildout, based on increasing use by AT&T customers.

Table 1.4.10.4-3: Key Capacity Planning Factors. *Network capacity buildout is based on both predictive and measured data. AT&T strives to provide service from a network with more than enough capacity to do the job and grow.*

The OWS provided to the Agencies is secure, scalable, and reliable. The backbone and access OWS networks are engineered for robustness and also easily scalable to accommodate Agency requirements for bandwidth growth.

1.4.10.5 Transport/IP/Optical Service Optimization and Interoperability [L.34.1.4.5]

1.4.10.5.a Approach to Optimizing IP-based and Optical Services

(a) Describe the offeror's approach for optimizing the engineering of IP-Based and Optical Services.

Engineering optimization of the IP-based and optical services is described in Section 1.3.6.2.a, Approach to Optimizing IP-Based and Optical Services.

1.4.10.5.b Network Architecture Optimization

(b) Describe how the offeror will use methods such as remote concentration, switching/routing capabilities, and high bandwidth transmission facilities to optimize the network architecture.

Optimization of the network architecture through the use of remote concentration, switching/routing capabilities, and high bandwidth transmission facilities is described in Section 1.3.6.2.b, Methods for Optimizing the Network Architecture.

1.4.10.5.c Optimizing Engineering Techniques

(c) Describe the engineering techniques for optimizing access for improved performance or increased efficiency in areas where large concentrations of diverse customer applications exist (e.g., the use of multi-service edge platforms).

Optimization of the access for improved performance or increased efficiency through the use of multiservice edge (MSE) platforms is described in Section 1.3.6.2.c, Performance Level Improvements.

1.4.10.5.d Vision to Implement Service Internetworking

(d) Describe the offeror's vision for implementing service internetworking over a common infrastructure (e.g., IP-centric architecture). Include a view on network interoperability, control plane integration, and optical infrastructure support for IP-Based Services. Describe the benefits and rationale of the offeror's approach.

The implementation of service internetworking over a common infrastructure, including network interoperability, control plane integration and optical infrastructure support, is described in Section 1.3.6.2.d, Vision for Service Interoperability.

1.4.10.6 Narrative Responses

1.4.10.6.1 Protocol Transparency – CONUS and Non-Domestic (Optional) [C.2.5.4.1.1.4 (7)]

7. [Optional] Protocol Transparency – CONUS and Non-Domestic. The contractor shall support CONUS and Non-Domestic Wavelengths that are rate and protocol independent.

Protocol transparency will enable Agencies to send different bit rates, framing conventions, etc. over an optical wavelength. [redacted] as they become commercially available.

1.4.10.6.2 Byte transparency [C.2.5.4.1.1.4 (8) (b)]

The support to framed wavelengths shall include byte transparency where the overhead bytes are passed through without being overwritten (i.e. non-intrusive Synchronous Optical Network/Synchronous Digital Hierarchy (SONET/SDH) processing of the signals).
b. If the framed wavelengths supported rare not fully transparent, the contractor shall indicate the level of transparency offered for wavelengths at 2.5 Gbps and 10 Gbps.

Framed wavelength is fully transparent. SONET and SDH overhead bytes are passed through the AT&T optical wavelength network without being overwritten; therefore, byte transparency is offered on the AT&T OWS-WDM, which has the following features:

- All the SONET/SDH transport overhead (TOH) bytes will be transported without being overwritten, with the exception of the A1 and A2 bytes, which will be used to monitor the framing integrity of the incoming SONET/SDH signal.
- Fully transparent wavelengths at 2.5 Gbps will be supported [redacted]
- Fully transparent wavelengths at 10 Gbps will be supported [redacted]

1.4.10.6.3 Access Methods [C.2.5.4.1.1.4 (12) (a)]

The contractor shall provide access methods to the ordered wavelength service for an end-to-end offering.
a. If the contractor is not able to provide access on his network, it shall indicate what alternatives exist to enable the service end-to-end.

If the Agency SDP is located in an area where the AT&T ultravailable metro DWDM service is not available, AT&T will indicate to the Agency which alternatives exist to enable the end-to-end service, such as AT&T ordering wavelength service (either from the serving local exchange carrier [LEC] or a competitive local exchange carrier [CLEC] that has services in the area).

1.4.10.6.4 Access Methods [C.2.5.4.1.1.4 (12) (c)]

The contractor shall provide access methods to the ordered wavelength service for an end-to-end offering.
12. Access Methods – The contractor shall provide access methods to the ordered wavelength service for an end-to-end offering.
c. When Agency access is provided via the backbone of the Long Haul (LH) DWDM systems and is not collocated, the contractor shall specify the appropriate reach of the optical interface to be used.

[redacted]

1.4.10.6.5 Access Methods [C.2.5.4.1.1.4 (12) (c)]

The contractor shall provide access methods to the ordered wavelength service for an end-to-end offering.
12. Access Methods – The contractor shall provide access methods to the ordered wavelength service for an end-to-end offering.
c. If the distance is too long for interfaces such as FICON, Fiber Channel, etc., the mediation devices or gateways needed shall be specified in order to compensate for distance limitations.

[redacted]

[redacted]

1.4.10.7 Stipulated Deviations

AT&T takes neither deviation nor exception to the stipulated requirements.

1.4.10.7.1 Reserved