DEFENSE INFORMATION SYSTEMS AGENCY
P. O. BOX 549
FORT MEADE, MARYLAND 20755-0549

IN REPLY REFER TO: Joint Interoperability Test Command (JTE) **8 May 13**

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Special Interoperability Certification of the Motorola AXS1800 Optical Line Terminals (OLT) with Specified Motorola Optical Network Terminals (ONT) Passive Optical Network (PON) with Software Release 7.4

References: (a) Department of Defense Directive 4630.05, "Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)," 5 May 2004
(b) Department of Defense Instruction 8100.04, "DoD Unified Capabilities (UC)," 9 December 2010
(c) through (e), see Enclosure 1

1. References (a) and (b) establish the Joint Interoperability Test Command (JITC) as the responsible organization for interoperability test certification.

2. The Motorola Gigabit Passive Optical Network (GPON) solution consists of a OLT and a ONT. The Motorola AXS1800 OLT, combined with an ONT (Motorola ONT1120GE, ONT1400GT, SF21000, SF24210, WT21004, WT24004) with Software Release 7.4, are hereinafter referred to as the System Under Test (SUT). The JITC certifies the SUT for use in the High Availability Assured Service Local Area Network (ASLAN) as a PON. The SUT can be deployed to extend Local Area Network (LAN) services to Camps, Posts, and Stations. The SUT supports Layer 2 failover as specified in Unified Capabilities Requirements (UCR) 2008 Change 3, Section 5.3.1.3.2 Port Parameter Requirements. The SUT may be directly connected to either Core or Distribution IP switches. As per the UCR, it is recommended that those switches also support the requirements in UCR 2008 Change 3, section 5.3.1.3.2. As specified in the UCR, if the core or distribution switch is not configured for high availability (e.g. via Multi-Service Transport Platform or Link Aggregation Control Protocol), only 96 telephony users or less may be connected via each AXS1800 OLT for High Availability ASLAN. The operational status of the SUT will be verified during deployment. Any new discrepancies that are discovered in the operational environment will be evaluated for impact and adjudicated to the satisfaction of the Defense Information Systems Agency (DISA) in a vendor Plan of Action and Milestones to address the concern(s) within 120 days of identification. JITC conducted testing using PON requirements within the UCR 2008, Change 3, Reference (c). JITC tested the SUT using PON test procedures, Reference (d). JITC does not certify any other configurations, features, or functions, except those cited within this memorandum. This certification expires upon changes that affect interoperability, but no later than three years from the date SUT of this certification memorandum.

3. This finding is based on interoperability testing conducted by JITC, review of the Vendor's Letters of Compliance, and Information Assurance (IA) Certification Authority (CA) approval of the IA configuration. JITC conducted Interoperability testing at its facility in Indian Head Maryland, from 20 August through 9 October 2012. JITC published the IA findings in a separate report, Reference (e). The DISA IA CA reviewed the JITC published IA Assessment Report for the SUT and provided a positive recommendation on the IA configuration on 13 December 2012. The acquiring agency or site will be responsible for the Department of Defense IA Certification and Accreditation Process accreditation. Enclosure 2 documents the test results and describes the tested network and system configurations. Enclosure 3 lists the PON Capability Requirements (CR) and Functional Requirements (FR).

4. Section 5.3 of the UCR establishes the interfaces and threshold CRs/FRs used to evaluate the interoperability of the SUT as a GPON. Tables 1 and 2 list the GPON, sponsor-requested interfaces, CRs, FRs, and component status of the SUT.

Table 1. SUT Interface Interoperability Status

Interface	Critical	Reference (UCR 2008, Change 3)	CR/FR Requirements	Motorola ASX1800 OLT	Specified Motorola ONTs (See note 1.)	Remarks
NNI-NNI						
100 Mbps	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 22, 23, 24, 25, 26, 27	NA	NA	See note 2.
GbE	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 27	Certified	NA	See note 2.
10 GbE	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 27	NA	NA	See note 2.
PON						
GPON	Yes	5.3.1.10.2.2	11, 17, 18	Certified	Certified	
NM						
10Base-X	Yes	5.3.2.4.4	1, 6, 23, 24, 26, 27	Certified	NA	See note 3.
100Base-X	Yes	5.3.2.4.4	1, 6, 23, 24, 26, 27	Certified	NA	See note 3.
UNI						
10 Mbps	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27	NA	Certified	See note 4.
100 Mbps	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27	NA	Certified	See note 4.
GbE	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27	NA	Certified	See notes 4 and 5.

Table 1. SUT Interface Interoperability Status (continued)

NOTES:
1. Specified Motorola ONTs consisted of Motorola ONT1120GE, ONT1400GT, SF21000, SF24210, WT21004, WT24004.
2. The OLT NNI-NNI port shall support at least one of the required interface rates (other rates and IEEE standards may be provided as conditional interfaces).
3. The NM interfaces were available only on AXS1800 OLTs and all the configuration, alarm, and other event management for Motorola ONTs were performed via OLTs.
4. The ONT UNI port shall support at least one of the required interface rates (other rates and IEEE standards may be provided as conditional interfaces).
5. ONT1400GT2 and ONT1120GE was unable to support full 1GbE upstream and downstream. The two ONTs were only able to support 500 Mbps up and down. A Test Descrepancy Report was created and was adjudicated stating that an access layer device is require to support an 8:1 blocking factor and the ONTs are performing at a 2:1 blocking factor. A change requirement will be added to the next UCR Change.

LEGEND:

10Base-X	10 Mbps Ethernet generic designation	NM	Network Management
100Base-X	100 Mbps Ethernet generic designation	NNI	Network-to-Network Interface
CR	Capability Requirement	OLT	Optical Line Terminal
FR	Functional Requirement	ONT	Optical Network Terminal
GbE	Gigabits Ethernet	PON	Passive Optical Network
GPON	Gigabit Passive Optical Network	SUT	System Under Test
IEEE	Institute of Electrical and Electronic Engineers	UCR	Unified Capabilities Requirements
Mbps	Megabits per second	UNI	User Network Interface
NA	Not Applicable		

Table 2. SUT CRs and FRs Status

CR/FR ID	Capability/Function	Applicability (See note 1.)	Reference (UCR 2008 Change 3)	Status	Remarks
GPON Requirements					
1	Interfaces	Required	5.3.1.10.2	Partially Met	See notes 2, 3 and 4.
2	Class of Service Markings	Required	5.3.1.10.3	Met	See notes 2, 3 and 5.
3	VLAN Capabilities	Required	5.3.1.10.4	Met	See notes 2 and 3.
4	Protocols	Conditional	5.3.1.10.5	Met	See notes 2 and 3.
5	Quality of Service Features	Required	5.3.1.10.6	Met	See notes 2, 3, 5 and 6.
6	Network Monitoring	Required	5.3.1.10.7	Partially Met	See notes 2, 3 and 4.
7	Voice Services	Required	5.3.1.10.8	Met	See note 2, 5 amd 6.
8	Video Services	Required	5.3.1.10.9	Met	See note 2, 5 and 6.
9	Data Services	Required	5.3.1.10.10	Met	See note 2. 5 and 6.
10	Information Assurance Requirements	Required	5.3.1.10.11	Met	See note 2.
11	PON Network Management Requirements	Required	5.3.1.10.12	Partially Met	See notes 2, 3 and 4
12	Configuration Control	Required	5.3.1.10.13	Met	See notes 2 and 3.
13	Operational Changes	Required	5.3.1.10.14	Met	See notes 2 and 3.
14	Performance Monitoring	Required	5.3.1.10.15	Met	See notes 2 and 3.
15	Alarms	Required	5.3.1.10.16	Met	See notes 2 and 3.
16	Reporting	Required	5.3.1.10.17	Met	See notes 2 and 3.
17	Fiber Media	Required	5.3.1.10.18	Met	See notes 2 and 3.
18	RF-over-Glass	Conditional	5.3.1.10.19	Not Tested	System supports feature but was not tested.
19	Traffic Engineering	Required	5.3.1.10.20	Met	See notes 2 and 3.
20	VLAN Design and Configuration	Required	5.3.1.10.21	Met	See notes 2 and 3.
21	Power Backup	Required	5.3.1.10.22	Met	See notes 2 and 3.
22	Availability	Conditional	5.3.1.10.23	Met	See notes 2 and 3.
23	Redundancy	Required	5.3.1.10.24	Met	See notes 2 and 3.
24	Survivability	Required	5.3.1.10.25	Met	See notes 2 and 3.

Table 2. SUT CRs and FRs Status (continued)

25	Summary of LAN Requirements by Subscriber Mission	Required	5.3.1.10.26	Met	See notes 2 and 3.
26	IPv6	Required	5.3.5.4	Met	See notes 2, 3 and 7.
27	Network Management	Required	5.3.2.4.4	Partially Met	See notes 2, 3, 4 and 8.

NOTES:
1. Annotation of "required" refers to high-level requirement category. Applicability of each sub-requirement is provided in Enclosure 3.
2. Any Motorola ONT1120GE, ONT1400GT, SF21000, SF24210, WT21004, WT24004 ONT combined with a Motorola AXS1800 OLT creates a GPON solution that meets the CRs and FRs set forth by UCR 2008, Change 3.
3. The SUT met the requirement via interoperability testing and review of vendor LoC.
4. The SUT does not support SNMP Version 3. A TDR was created and Vendor provided a POA&M date of Early 3rd Quarter 2013.
5. SUT supports only VLAN CoS, so we tested the IP-QoS Feature by mapping the IP-QoS DSCP values to VLAN-CoS values in the SUT.
6. We tested Voice, Video, and Data Services in Real-Time mode by sending actual Voice and Video services through the SUT and also in a simulated mode by using test equipments with four individual Voice, Video, Preferred-Data, and Best-effort-Data stream tagged with their respective DSCP value (DSCP 49, 39, 11, 0).
7. This requirement was met via dual stack IPv4/IPv6 testing and review of vendor LoC.
8. The NM interface was available only on AXS1800 OLT, and all the configuration, alarm, other event management for Motorola Series ONTs were performed via OLT.

LEGEND:

CoS	Class of Service	OLT	Optical Line Terminal
CR	Capabilities Requirement	ONT	Optical Network Terminal
DSCP	Differentiated Services Code Point	POA&M	Plan of Action and Milestones
FR	Functional Requirement	PON	Passive Optical Network
GPON	Gigabit Passive Optical Network	QoS	Quality of Service
ID	Identification	RF	Radio Frequency
IP	Internet Protocol	SNMP	Secure/Simple Network Management Protocol
IPv4	Internet Protocol version 4	SUT	System Under Test
IPv6	Internet Protocol version 6	TDR	Test Descrepancy Report
LAN	Local Area Network	UCR	Unified Capabilities Requirements
LoC	Letter of Compliance	VLAN	Virtual Local Area Network
NM	Network Management		

5. In accordance with the Program Manager's request, JITC did not develop a detailed test report. JITC distributes interoperability information via the JITC Electronic Report Distribution system, which uses Unclassified-But-Sensitive Internet Protocol Router Network (NIPRNet) e-mail. More comprehensive interoperability status information is available via the JITC System Tracking Program, which .mil/.gov users can access on the NIPRNet at https://stp.fhu.disa.mil. Test reports, lessons learned, and related testing documents and references are on the JITC Joint Interoperability Tool at http://jit.fhu.disa.mil (NIPRNet). Information related to Approved Products List (APL) testing is available on the DISA APL Testing and Certification website located at http://www.disa.mil/Services/Network-Services/UCCO. All associated test information is available on the DISA Unified Capability Certification Office APL Integrated Tracking System (APLITS) website located at https://aplits.disa.mil.

JITC Memo, JTE, Special Interoperability Certification of the Motorola AXS1800 Optical Line Terminals (OLT) with Specified Motorola Optical Network Terminals (ONT) Passive Optical Network (PON) with Software Release 7.4

6. JITC testing point of contact is Mr. Son Pham, commercial (301) 743-4258. His e-mail address is Son.m.Pham2.civ@mail.mil; mailing address: 3341 Strauss Avenue, Suite 236, Indian Head, Maryland 20640-5149. The UCCO Tracking Number is 1213601.

FOR THE COMMANDER:

3 Enclosures a/s

for RICHARD A. MEADOR
Chief
Battlespace Communications Portfolio

Distribution (electronic mail):
DoD CIO
Joint Staff J-6
USD (AT&L)
ISG Secretariat, DISA, JTA
U.S. Strategic Command, J665
US Navy, OPNAV N2/N6FP12
US Army, DA-OSA, CIO/G-6 ASA (ALT), SAIS-IOQ
US Air Force, A3CNN/A6CNN
US Marine Corps, MARCORSYSCOM, SIAT, A&CE Division
US Coast Guard, CG-64
Defense Information Systems Agency, TEMC
DIA, Office of the Acquisition Executive
NSG Interoperability Assessment Team
DOT&E, Netcentric Systems and Naval Warfare
Medical Health Systems, JMISIV&V

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ADDITIONAL REFERENCES

(c) Office of the Assistant Secretary of Defense, "Department of Defense Unified Capabilities Requirements 2008, Change 3," September 2011
(d) Joint Interoperability Test Command, "Passive Optical Network Test Procedures," 20 February 2012
(e) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Motorola AXS1800 Optical Line Terminals (OLT) Gigabit Passive Optical Network (GPON), with Software Release 7.4 (TN 1213601)," 13 December 2012

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CERTIFICATION TESTING SUMMARY

1. SYSTEM TITLE. The Motorola AXS1800 Optical Line Terminals (OLT) with Specified Motorola Optical Network Terminals (ONT) Passive Optical Network (PON) with Software Release 7.4.

2. SPONSOR. Mr. Jordan Silk, Program Manager, Headquarters USA Information Systems Engineering Command, AMSEL-IE-IS, Building 53302, Fort Huachuca, AZ 85613, e-mail: Jordan.R.Silk.civ@mail.mil.

3. SYSTEM POC. Mr. Mike Zegarski, Product Manager, Motorola Mobility LLC, 900 Chelmsford Street, Lowell, MA 01851. E-mail: mikez@Motorola.com.

4. TESTER. Joint Interoperability Test Command (JITC), Indian Head, Maryland.

5. SYSTEM DESCRIPTION. There are three main components in a PON, other than the fiber itself. The PON OLT is the network concentrator; the splitter (or splitters) allows a single fiber to be shared among a number of subscribers, and the ONT serves a local site. PON is a technology that is composed of an OLT, a varying number of Optical Network Units (ONU) or ONT with fiber optic cable and splitters connecting them. Interface from the backbone network (NNI or Ingress) is provided by the OLT while the user interface (UNI or Egress) is provided by the ONT. A PON is a converged transport schema that is designed to carry multiple services such as VoIP, Data, IP Video, and RF Video.

The Motorola AXS1800 next generation OLT is designed to deliver end-to-end Ultra-Broadband. The AXS1800 offers density, scalability and flexibility that allows service providers to deliver video, voice, and data to every subscriber they pass. The AXS1800 extends fiber to the edge of the service provider networks to enable the delivery of end-to-end Ultra-Broadband services to subscribers in small office and multi-dwelling units. The AXS1800 performs the function of the GPON OLT. The AXS1800 features flexible and high capacity GPON access and Wide Area Network (WAN) uplinks, scalability, and line rate performance with a 200 Gigabits per second (Gbps) fully non-blocking switch fabric in a high-density chassis that supports over 4600 residential and business subscribers.

The suite of Motorola ONT products consists of: ONT1120GE, ONT1400GT, SF21000, SF24210, WT21004, and WT24004.

Basic descriptions of the ONT products are listed below:

ONT1120GE - Provides 4 x 10/100/1000Base-T Ethernet ports

Highlights include:

- Enables the delivery of Internet Protocol Television (IPTV) - voice, video and data-services over a single fiber GPON
- Provides Internet access at speeds up to 200 Megabits per second (Mbps) sustained and 400 Mbps burst over Ethernet
- Supports interactive packet-based video and IPTV with Ethernet
- Enables easy installation supported through preprovisioned service profiles

ONT1400GT - Telephony Interface: 2 x Plain Old Telephone service, Insulation Displacement Connection terminals (Tip/Ring) and Registered Jack (RJ)-11 gel-filled test point connections, 5 Ringer equivalence number (REN) (max) per line, 10 REN (max) across all lines, Data Interfaces: 2 x Ethernet 10/100/1000Base-T ports, RJ-45 gel-filled connector, Multimedia over Coax (MoCA) WAN/Local Area Network (LAN) and Return Path Demodulation (RPD) over F-type connector, Video Interface (optional): 75-ohm F-type connector, +18dBmV

Highlights include:

- Enables the delivery of IPTV - voice, video and data services over a single fiber GPON
- Provides two lines of Class 5 or softswitch-served Voice over Internet Protocol (VoIP) quality voice service
- Provides Internet access at speeds up to 200 Mbps sustained and 400 Mbps burst over Ethernet, Supports interactive packet-based video and IPTV with Ethernet or MoCA
- Works with existing in-home wiring
- Enables easy installation supported through pre-provisioned service profiles
- Provides integrated RPD signaling in support of interactive services
- Leverages an environmentally hardened enclosure for true outdoor capabilities, even in extreme conditions
- Optional uninterruptible power supply to assure continuous operations in emergency situations

SF21000 - Provides 1x Gigabit Ethernet (GE) port, RJ-45 connector

Highlights include:

- Enables the delivery of IPTV, voice and data services over a single fiber GPON
- Provides Internet access at speeds up to 600 Mbps sustained and 800 Mbps burst over Ethernet
- Enables easy installation supported through preprovisioned service profiles

SF24210 - Provides 1 x 10/100/1000Base-T, 3 x 10/100Base-T Ethernet ports

Highlights include:

- Ideal for corporate enterprise settings, dormitories, hospital rooms and airport terminals
- Enables easy installation supported through pre-provisioned service profiles
- Provides 1 F connector to support Radio Frequency (RF) video

WT21004 – Provides 4 x 10/100/1000Base-T ports, RJ-45 connectors with Institution of Electrical Engineers (IEEE) 802.3af/802.3at-2009 Power over Ethernet (PoE)

Highlights include:

- Enables the delivery of secure converged networks providing gigabit data services, quality Internet Protocol (IP) voice, and enterprise IP video applications
- Enables easy installation supported through pre-provisioned service profiles and intelligent rule-based dynamic provisioning mechanisms
- Enables significant power savings to address “Green Information Technology (IT)” initiatives
- Supports four PoE ports to power VoIP phones, wireless access points and security cameras
- Provides two battery backup options for continued connectivity in case of an outage

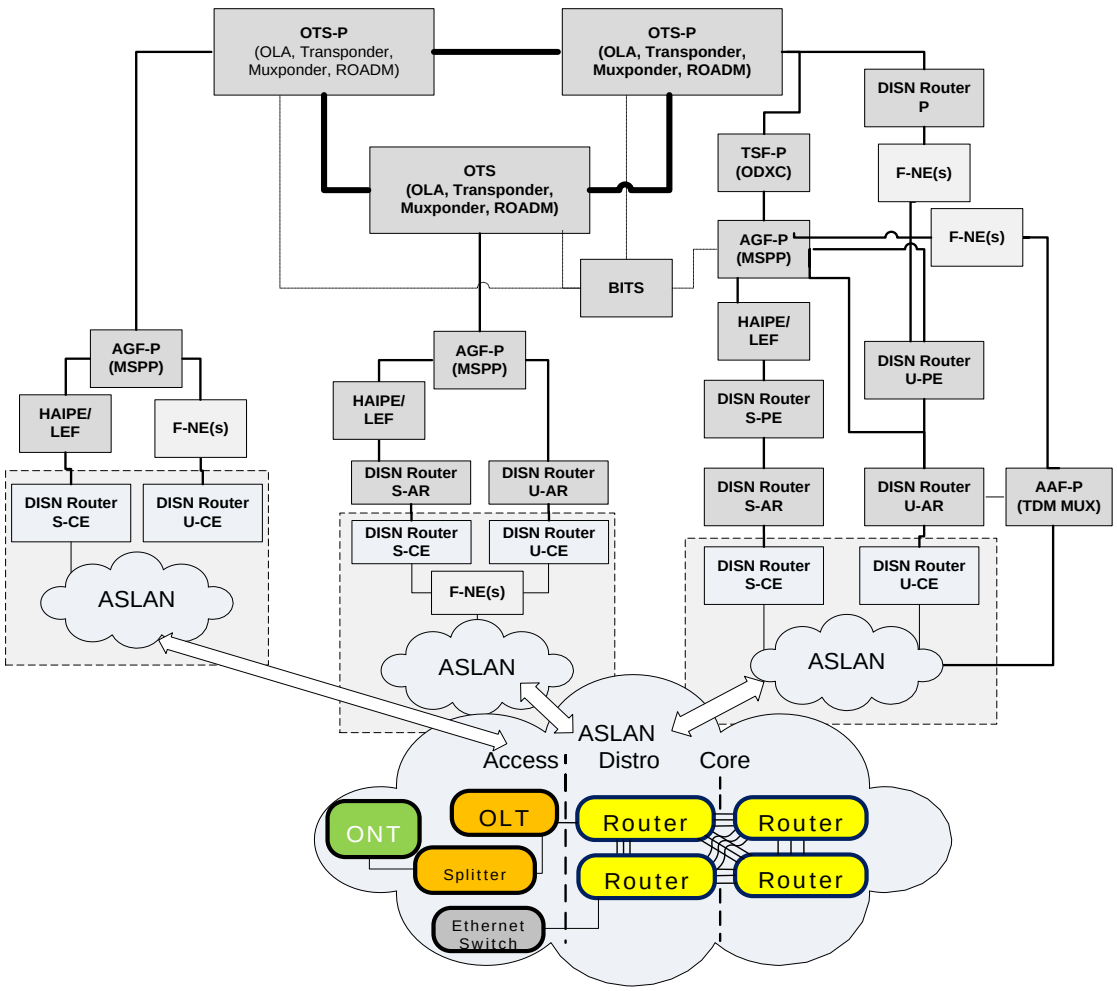
WT24004 Chassis and WT24004 Module Maximum four Modules Per Chassis – Provides 4 x 10/100/1000Base-T ports per module, RJ-45 connectors with IEEE 802.3af-2003/802.3at-2009 PoE

Highlights include:

- Enables the delivery of secure converged networks providing quality IP voice, gigabit data services, and any enterprise IP video application
- Enables easy installation supported through pre-provisioned service profiles and intelligent rule-based dynamic provisioning mechanisms
- Enables significant power savings to address “Green IT” initiatives
- Supports up to 16 PoE ports to power VoIP phones, wireless access points, & security cameras

Motorola designed the ONTs to deliver narrowband and broadband subscriber services. The Motorola ONTs are GPON access devices that provide service termination for the subscriber ports of the platforms. The ONTs were tested peripherals to the AXS1800 platform. The Motorola-AXS1800 and the ONTs are components of the GPON system International Telecommunication Union-Telecommunication (ITU-T) Standardization Sector G.984 standard.

6. OPERATIONAL ARCHITECTURE. Under the direction of the Unified Capabilities (UC) Certification Office, the SUT is being tested and evaluated as a PON. Figure 2-1 shows the role of the SUT in a Defense Information System Network (DISN) architecture.



LEGEND:

AAF-P	Access Aggregation Function Product
AGF-P	Access Grooming Function Product
ASLAN	Assured Service Local Area Network
BITS	Building Integrated Timing Supply
DISN	Defense Information System Network
Distro	Distribution
F-NE	Fixed Network Element
HAIPE	High Assurance Internet Protocol Encryptor
LEF	Link Encryption Family
MSPP	Multi-Service Provisioning Platform
MUX	Multiplexer
ODXC	Optical Digital Cross Connect
OLA	Optical Line Amplifier
OLT	Optical Line Terminal
ONT	Online Network Terminal
OTS	Optical Transport System
OTS-P	Optical Transport System Product
P	Provider Router
ROADM	Reconfigurable Optical Add and Drop Multiplexer
S-AR	Secret Aggregation Router
S-CE	Secret Customer Edge Router
S-PE	Secret Provider Edge Router
TDM	Time Division Multiplexing
TSF-P	Transport Switch Function Product
U-AR	Unclassified Aggregation Router
U-CE	Unclassified Customer Edge Router
U-PE	Unclassified Provider Edge Router

Figure 2-1. DISN Architecture

7. INTEROPERABILITY REQUIREMENTS. The interface, Capability Requirements (CR), Functional Requirements (FR), Information Assurance (IA), and other requirements for GPON products are established by the Department of Defense (DoD) Unified Capabilities Requirements (UCR) 2008, Change 3, Section 5.3.1.10.

7.1 Interfaces. The GPON products use their interfaces to connect to a Local Area Network (LAN) or DISN WAN infrastructure. The threshold requirements for interfaces specific to the GPON products are listed in Table 2-1.

Table 2-1. GPON Interface Requirements

Interface	Critical	Reference (UCR 2008 Change 3)	CR/FR Requirements	Criteria	Remarks
NNI-NNI					
100 Mbps	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 22, 23, 24, 25, 26, 27	Meet minimum CR/FRs and interface standards	See note 1.
GbE	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 27		
10 GbE	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 27		
PON					
GPON	Yes	5.3.1.10.2.2	11, 17, 18	Meet minimum CR/FRs and interface standards	
NM					
10Base-X	Yes	5.3.2.4.4	1, 6, 23, 24, 26, 27	Meet minimum CR/FRs and interface standards	
100Base-X	Yes	5.3.2.4.4	1, 6, 23, 24, 26, 27		
UNI					
10 Mbps	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27	Meet minimum CR/FRs and interface standards	See note 2.
100 Mbps	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27		
GbE	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27		

NOTES:
1. The OLT NNI-NNI port shall support at least one of the required interface rates (other rates and IEEE standards may be provided as conditional interfaces).
2. The ONT UNI port shall support at least one of the required interface rates (other rates and IEEE standards may be provided as conditional interfaces).

LEGEND:

10Base-X	10 Mbps Ethernet generic designation	NM	Network Management
100Base-X	100 Mbps Ethernet generic designation	NNI	Network-to-Network Interface
CR	Capability Requirement	OLT	Optical line Terminal
FR	Functional Requirement	ONT	Optical Network Terminal
GbE	Gigabits Ethernet	PON	Passive Optical Network
GPON	Gigabit Passive Optical Network	UCR	Unified Capabilities Requirements
IEEE	Institute of Electrical and Electronic Engineers	UNI	User Network Interface
Mbps	Megabits per second		

7.2 CRs and FRs. The PON products have required and conditional features and capabilities that are established by UCR 2008, Change 3, Section 5.3.1.10. The SUT does not need to provide non-critical (conditional) features and capabilities. If they are present, however, they must function according to the specified requirements.

Table 2-2 lists the features and capabilities and their associated requirements for the SUT products. Table 3-1 of Enclosure 3 provides detailed CR/FR requirements.

Table 2-2. SUT CRs and FRs

CR/FR ID	Capability/Function	Applicability (See note.)	Reference (UCR 2008 Change 3)	Criteria
GPON Requirements				
1	Interfaces	Required	5.3.1.10.2	Meet UCR Requirements
2	Class of Service Markings	Required	5.3.1.10.3	Meet UCR Requirements
3	Virtual LAN Capabilities	Required	5.3.1.10.4	Meet UCR Requirements
4	Protocols	Conditional	5.3.1.10.5	Meet UCR Requirements
5	Quality of Service Features	Required	5.3.1.10.6	Meet UCR Requirements
6	Network Monitoring	Required	5.3.1.10.7	Meet UCR Requirements
7	Voice Services	Required	5.3.1.10.8	Meet UCR Requirements
8	Video Services	Required	5.3.1.10.9	Meet UCR Requirements
9	Data Services	Required	5.3.1.10.10	Meet UCR Requirements
10	Information Assurance Requirements	Required	5.3.1.10.11	Meet UCR Requirements
11	PON Network Management Requirements	Required	5.3.1.10.12	Meet UCR Requirements
12	Configuration Control	Required	5.3.1.10.13	Meet UCR Requirements
13	Operational Changes	Required	5.3.1.10.14	Meet UCR Requirements
14	Performance Monitoring	Required	5.3.1.10.15	Meet UCR Requirements
15	Alarms	Required	5.3.1.10.16	Meet UCR Requirements
16	Reporting	Required	5.3.1.10.17	Meet UCR Requirements
17	Fiber Media	Required	5.3.1.10.18	Meet UCR Requirements
18	RF-over-Glass	Conditional	5.3.1.10.19	Meet UCR Requirements
19	Traffic Engineering	Required	5.3.1.10.20	Meet UCR Requirements
20	VLAN Design and Configuration	Required	5.3.1.10.21	Meet UCR Requirements
21	Power Backup	Required	5.3.1.10.22	Meet UCR Requirements
22	Availability	Conditional	5.3.1.10.23	Meet UCR Requirements
23	Redundancy	Required	5.3.1.10.24	Meet UCR Requirements
24	Survivability	Required	5.3.1.10.25	Meet UCR Requirements
25	Summary of LAN Requirements by Subscriber Mission	Required	5.3.1.10.26	Meet UCR Requirements
26	IPv6	Required	5.3.5.4	Meet UCR Requirements
27	Network Management	Required	5.3.2.4.4	Meet UCR Requirements

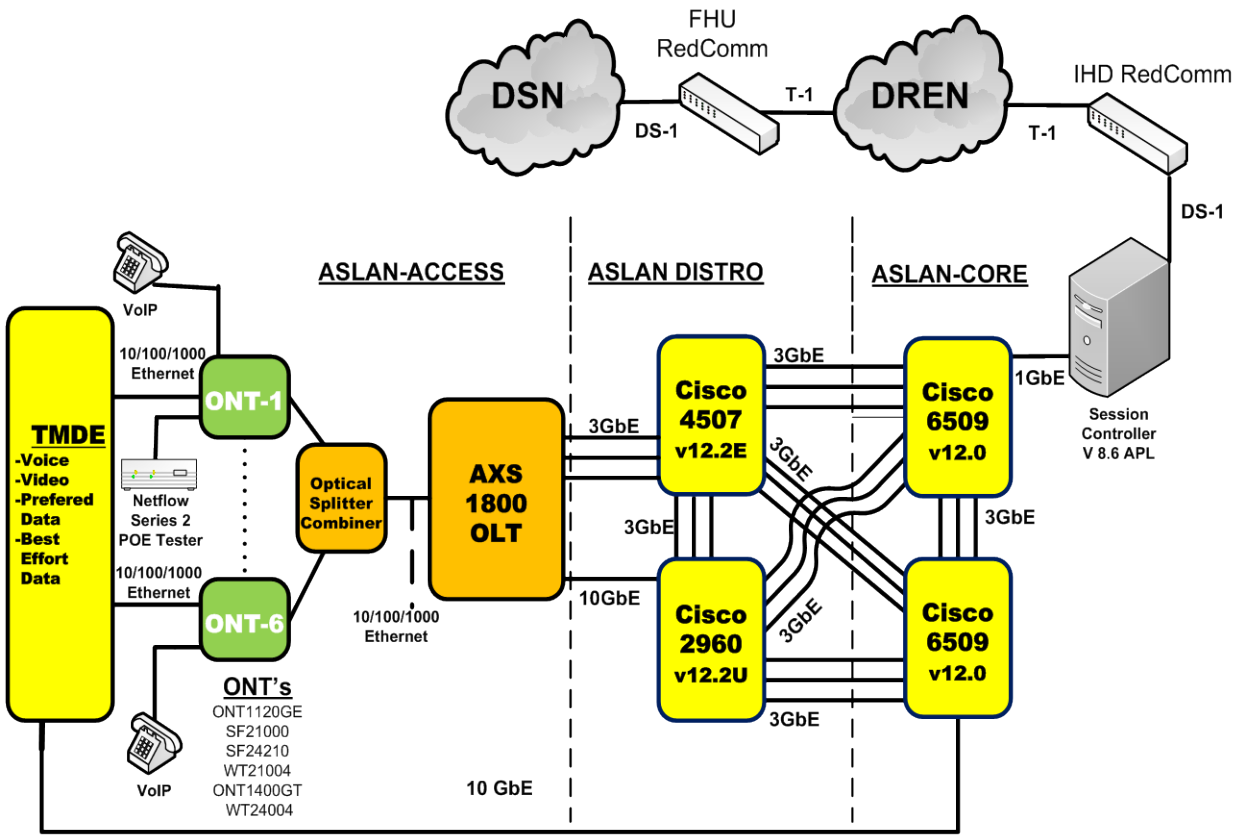
NOTE: Annotation of "required" refers to high-level requirement category. Applicability of each sub-requirement is provided in Enclosure 3.

LEGEND:

CR	Capabilities Requirement	PON	Passive Optical Network
FR	Functional Requirement	RF	Radio Frequency
ID	Identification	SUT	System Under Test
IPv6	Internet Protocol version 6	UCR	Unified Capabilities Requirements
GPON	Gigabit Passive Optical Network	VLAN	Virtual Local Area Network
LAN	Local Area Network		

7.3 Other. None.

8. TEST NETWORK DESCRIPTION. JITC tested the SUT at its facility in Indian Head, Maryland. Figure 2-2 shows the SUT's Test Configuration.



Motorola SUT Test Configuration GPON

LEGEND:

10/100/1000	10/100/1000 Megabits per second	OLT	Optical Line Terminal
APL	Approved Products List	ONT	Optical Network Terminal
ASLAN	Assured Service Local Area Network	PCM	Pulse Code Modulation
DREN	Defense Research and Engineering Network	PoE	Power-Over-Ethernet
DS-1	Digital Signal Level 1 (1.544 Mbps)	SUT	System Under Test
DSN	Defense Switched Network	T-1	Transmission Link Level 1 (1544 Mbps, 24-channel PCM)
FHU	Fort Huachuca		
GbE	Gigabit Ethernet	TMDE	Test, Measurement, and Diagnostic Equipment
GPON	Gigabit Passive Optical Network	V/v	Version
IHD	Indian Head, MD	VoIP	Voice over Internet Protocol
Mbps	Megabits per second		

Figure 2-2. SUT's Test Configuration

9. SYSTEM CONFIGURATION. Table 2-3 lists the Hardware/Software Tested SUT Equipment shown in Figure 2-2, Table 2-4 lists the Non-SUT Equipment, and Table 2-5 lists the test equipment used to generate voice, video, and IP data traffic.

Table 2-3. Hardware/Software Tested SUT Equipment

Platform	Software Release	UC Product Type
ONT1120GE	7.4	ONT
ONT1400GT	7.4	ONT
SF21000	7.4	ONT
SF24210	7.4	ONT
WT21004	7.4	ONT
WT24004	7.4	ONT
AXS1800	7.4	OLT
Oracle Database 5 Named User License SE	Version 10 - Oracle Standard Edition	NM

SUT - Equipment List		
Quantity	**Description**	**Part Number**
1	GPON OLT RoHS Compliant ETSI Standard Chassis – includes 6 fan-unit fan assembly.	AXS1800
1	Mounting Bracket for AXS1800 chassis to comply with 19" racks	AXS1800-BKT-19
2	System Controller for the AXS1800 & AXS2200; temperature-hardened. Backward compatible. Provides increased memory and CPU power. Ability to support 128 splits in a future release. Requires R7.1 or later.	ASYSD
12	Single full height blank filler card.	BLANKA
2	10km SFP LX (GbE) standard pluggable optics module, Industrial Temperature, RoHS compliant.	GbE-SFP-10
2	10km XFP (10 GbE) standard pluggable optics module, Industrial Temperature, RoHS compliant. For use with the ASW200D pack.	10GbE-XFP-10
2	200 Gbps Switch and processor with integrated six 1 GbE and one 10 GbE uplink ports; SFP and XFP optical modules not included	ASW200D
2	Four Port 2.4/1.2 Gbps G.984 interface. Supports multiple T-CONTs. Requires R7.0 or later	AGPOND
2	ONT1120GE Optical Network Terminal, desktop/wall mount, 4 - 10/100/1000 Ethernet ports, SC/UPC adaptor	ONT1120GE-SC
2	SF21000 Indoor ONT with SC/APC adaptor, desktop or wall mounted, 1 GbE port, with integrated power supply. Requires "country-specific" power cord (e.g. ONT-PC-B) which must be ordered separately.	SF21000
2	SF24210 Indoor ONT with SC/APC adaptor, desktop or wall mounted, 1 GE + 3 10/100 Ethernet ports, RF Video (no RF Return Path), and 2 POTS; includes integrated battery compartment and power supply. Requires "country-specific" power cord (e.g. ONT-PC-TYP-B), and dual lithium-ion batteries (qty of 0,1, or 2); these items must be ordered separately.	SF24210
2	WT21004 indoor ONT, desktop with dock, 4 - 10/100/1000 PoE ports, SC connector , includes an integrated fiber slack storage compartment, integrated battery compartment, and power supply. Requires external battery backup unit (if longer backup times are required), "country-specific" power cord (e.g. ONT-PC-TYP-B), and dual lithium-ion batteries (qty of 0,1, or 2); these items must be ordered separately.	WT21004
8	AC PWR CRD, BLK, 2m, 3-COND w/Type B Plug for the following countries: North America, Central America, Brazil, Colombia, Ecuador, China, Taiwan and Japan.	ONT-PC-TYP-B
1	WT24004-Chassis, GPON ONT chassis, 1.5 U rack mount, 4 slots for WT24004-Module, 100-240v, 50/60cycle AC PWR. Lead-free/RoHS compliant finished good. Requires "country-specific" power cord (e.g. ONT-PC-TYP-B); this item must be ordered separately.	WT24004-Chassis
4	WT24004-Module, GPON ONT module, 4 - 10/100/1000 PoE ports, SC connector, Finished good. Requires “WT24004-Chassis”; this item must be ordered separately.	WT24004-Module

Table 2-3. Hardware/Software Tested SUT Equipment (continued)

1	MDU AC power cord, 3-COND, with C13 RCPTL supporting Type "B" countries: Brazil, Canada, Colombia, Japan, Mexico, Saudi Arabia, Taiwan, United States.	ONT-PWR-CORD-C13-B
2	A single 7.2 AH battery used in conjunction with power supplies to provide battery backup for all ONTs	ONT-BATT
2	ONT1400GT2 ONT, wavelength overlay w/1GHz support, 2-POTS, 1 RF port, 2 - 10/100/1000 Ethernet, with SCTE-55-1 RP and includes SC/APC adaptor. Includes BBU 7 pin-Phoenix screw connector.	ONT1400GT2-SC
2	Power supply for ONT1000M, ONT1000GT2, ONT1400GT/2 product families. Converts 120VAC to 12VDC and drives the ONT. Includes SOPS and SBBPS but not 7.2 AH battery. Does not include cable between SOPS and SBBPS or cable between SBBPS and ONT. Does not include ONT 7-pin Phoenix-style power connector.	ONT1000-PS-SFU
1	Turnkey AXSVision Server/Client Platform for US Deployment (serves up to 5 OLTs, 10,000 ONTs and 5 simultaneous users). Includes Solaris 10 OS, Sun three year Silver service, Oracle 11g DB, Oracle license, 1st year Oracle SW maintenance and AXSVision server SW pre-installed. Includes three year warranty and power cord for US.	AXSVISION-TK-PLAT-S - LATEST RELEASE

LEGEND:

10/100/1000	10/100/1000 Megabits per second	PoE	Power-over-Ethernet
AC	Alternating Current	PON	Passive Optical Network
AH	Acid Hazzard	POTS	Plain Old Telephone Service
APC	American Power Conversion	PWR	Power
BBU	Battery Backup Unit	qty	Quantity
BLK	Black	R	Release
CPU	Central Processing Unit	RCPTL	Receptical
CRD	Cord	RF	Radio Frequency
DB	Database	RoHS	Restriction of the Use of Certain Hazardous Substances
ETSI	European Telecommunications Standards Institute	RP	Reverse polarity
G.984	ITU-T recommendations for GPON	SBBPS	Serial Battery Backup Power Supply
GbE	Gigabit Ethernet	SC	Subscriber Connector
Gbps	Gigabits per second	SE	Standard Edition
GHz	Gigahertz	SFP	Small Form-Factor Pluggable
GPON	Gigabit Passive Optical Network	SOPS	Serial ONT Power Supply
ITU-T	International Telecommunication Union – Telecommunication	SUT	System Under Test
		SW	Software
km	kilometer	T-CONT	Transmission Containers
LX	Long Wave Length	U	Units
m	meters	UPC	Universal Power Cord
Mbps	Megabits per second	US	United States
MDU	Multiplexer Decoder Unit	VAC	Volt Alternating Current
NM	Network Manager	VDC	Volt Direct Current
OLT	Optical Line Terminal	w/	with
ONT	Optical Network Terminal	XFP	X-Form-Factor Pluggable
OS	Operating System		

Table 2-4. Non-SUT Equipment

Component	Software Version	Function	Subcomponent
Cisco 6509	Version 12.2	Router	1 GbE, 10 GbE LAG
Cisco 4507	Version 12.2E	Router	10/100/1000, 1 GbE, 10 GbE LAG
Cisco 2960	Version 12.2U	Router	10/100/1000, 10 GbE

LEGEND:

GbE	Gigabit Ethernet	SUT	System Under Test
LAG	Ling Aggregation Group		

Table 2-5. Test, Measurement, and Diagnostic Equipment

Manufacture	Type	Port Type	Software Version
Agilent	Optical Tester	1550 nm	A.06.01
		1310 nm	
	Router Tester 900	OC-3/OC-12 /POS	6.11
		OC-48 Multilayer	
		1000Base-X	
Ixia	Traffic generator	10 G	5
		LM1000STX	
Agilent	Rack Mounted Router Tester 900	10 G LAN/WAN	6.11
		10/100/1000Base-T	
		1000Base-X	
		OC-48c POS	
		OC-3/12/POS	

LEGEND:

10/100/1000 Base-T	10/100/1000 Mbps (Baseband Operation, Twisted Pair) Ethernet	Mbps	Megabits per second
		nm	Nanometer
1000Base-X	1000 Mbps Ethernet Generic Designation	OC	Optical Carrier
G	Gigabit	POS	Packet Over Synchronous Optical Network
LAN	Local Area Network	STX	Ixia Product Name
LM	Light Manager	WAN	Wide Area Network

10. TEST LIMITATIONS. The JITC Indian Head testers noted the following test limitations during testing of the system:

a. There were no real users connected to the GPON-ONTs so JITC test team simulated all the functionality of the real users using test equipments. Operational impact is minimal.

b. The JITC test team tested VoIP using Cisco IP phones. They were limited to using three phones for the test efforts. Operational impact is minimal.

11. INTEROPERABILITY EVALUATION RESULTS. The SUT meets the critical interoperability requirements for PON, and JITC certifies its joint use within the DISN. Additional discussion regarding specific testing results is contained in subsequent paragraphs.

11.1 Interfaces. The SUT's GPON interface status is provided in Table 2-6.

Table 2-6. SUT GPON Interface Requirements Status

Interface	Critical	Reference (UCR 2008, Change 3)	CR/FR Requirements	Motorola ASX1800 OLT	Specified Motorola ONTs (See note 1.)	Remarks
NNI-NNI						
100 Mbps	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 22, 23, 24, 25, 26, 27	NA	NA	See note 2.
GbE	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 27	Certified	NA	See note 2.
10 GbE	No	5.3.1.10.2.1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 27	NA	NA	See note 2.
PON						
GPON	Yes	5.3.1.10.2.2	11, 17, 18	Certified	Certified	
NM						
10Base-X	Yes	5.3.2.4.4	1, 6, 23, 24, 26, 27	Certified	NA	See note 3.
100Base-X	Yes	5.3.2.4.4	1, 6, 23, 24, 26, 27	Certified	NA	See note 3.
UNI						
10 Mbps	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27	NA	Certified	See note 4.
100 Mbps	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27	NA	Certified	See note 4.
GbE	No	5.3.1.10.2.4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27	NA	Certified	See note 4 and 5.

NOTES:
1. Specified Motorola ONTs consisted of Motorola ONT1120GE, ONT1400GT, SF21000, SF24210, WT21004, WT24004.
2. The OLT NNI-NNI port shall support at least one of the required interface rates (other rates and IEEE standards may be provided as conditional interfaces).
3. The NM interfaces were available only on AXS1800 OLTs and all the configuration, alarm, and other event management for Motorola ONTs were performed via OLTs.
4. The ONT UNI port shall support at least one of the required interface rates (other rates and IEEE standards may be provided as conditional interfaces).
5. ONT1400GT2 and ONT1120GE was unable to support full 1 GbE upstream and downstream. The two ONTs were only able to support 500 Mbps up and down. A Test Discrepancy Report was created and was adjudicated stating that an access layer device is require to support an 8:blocking factor and the ONTs are performing at a 2:1 blocking factor. A change requirement will be added to the next UCR Change.

LEGEND:

10Base-X	10 Mbps Ethernet generic designation	NM	Network Management
100Base-X	100 Mbps Ethernet generic designation	NNI	Network-to-Network Interface
CR	Capability Requirement	OLT	Optical Line Terminal
FR	Functional Requirement	ONT	Optical Network Terminal
GbE	Gigabits Ethernet	PON	Passive Optical Network
GPON	Gigabit Passive Optical Network	SUT	System Under Test
IEEE	Institute of Electrical and Electronic Engineers	UCR	Unified Capabilities Requirements
Mbps	Megabits per second	UNI	User Network Interface
NA	Not Applicable		

11.2 CRs and FRs. Table 2-7 lists the SUT's CR/FR statuses. The detailed CR/FR requirements are provided in Table 3-1 of the System Functional and Capability Requirements (Enclosure 3).

Table 2-7. SUT CRs and FRs Status

CR/FR ID	Capability/Function	Applicability (See note 1.)	Reference (UCR 2008 Change 3)	Status	Remarks
GPON Requirements					
1	Interfaces	Required	5.3.1.10.2	Partially Met	See notes 2, 3 and 4.
2	Class of Service Markings	Required	5.3.1.10.3	Met	See notes 2, 3 and 5.
3	VLAN Capabilities	Required	5.3.1.10.4	Met	See notes 2 and 3.
4	Protocols	Conditional	5.3.1.10.5	Met	See notes 2 and 3.
5	Quality of Service Features	Required	5.3.1.10.6	Met	See notes 2, 3, 5 and 6.
6	Network Monitoring	Required	5.3.1.10.7	Partially Met	See notes 2, 3 and 4.
7	Voice Services	Required	5.3.1.10.8	Met	See note 2, 5 amd 6.
8	Video Services	Required	5.3.1.10.9	Met	See note 2, 5 and 6.
9	Data Services	Required	5.3.1.10.10	Met	See note 2. 5 and 6.
10	Information Assurance Requirements	Required	5.3.1.10.11	Met	See note 2.
11	PON Network Management Requirements	Required	5.3.1.10.12	Partially Met	See notes 2, 3 and 4
12	Configuration Control	Required	5.3.1.10.13	Met	See notes 2 and 3.
13	Operational Changes	Required	5.3.1.10.14	Met	See notes 2 and 3.
14	Performance Monitoring	Required	5.3.1.10.15	Met	See notes 2 and 3.
15	Alarms	Required	5.3.1.10.16	Met	See notes 2 and 3.
16	Reporting	Required	5.3.1.10.17	Met	See notes 2 and 3.
17	Fiber Media	Required	5.3.1.10.18	Met	See notes 2 and 3.
18	RF-over-Glass	Conditional	5.3.1.10.19	Not Tested	System supports feature but was not tested.
19	Traffic Engineering	Required	5.3.1.10.20	Met	See notes 2 and 3.
20	VLAN Design and Configuration	Required	5.3.1.10.21	Met	See notes 2 and 3.
21	Power Backup	Required	5.3.1.10.22	Met	See notes 2 and 3.
22	Availability	Conditional	5.3.1.10.23	Met	See notes 2 and 3.
23	Redundancy	Required	5.3.1.10.24	Met	See notes 2 and 3.
24	Survivability	Required	5.3.1.10.25	Met	See notes 2 and 3.
25	Summary of LAN Requirements by Subscriber Mission	Required	5.3.1.10.26	Met	See notes 2 and 3.
26	IPv6	Required	5.3.5.4	Met	See notes 2, 3 and 7.
27	Network Management	Required	5.3.2.4.4	Partially Met	See notes 2, 3, 4 and 8.

NOTES:
1. Annotation of "required" refers to high-level requirement category. Applicability of each sub-requirement is provided in Enclosure 3.
2. Any Motorola ONT1120GE, ONT1400GT, SF21000, SF24210, WT21004, WT24004 ONT combined with a Motorola AXS1800 OLT creates a GPON solution that meets the CRs and FRs set forth by UCR 2008, Change 3.
3. The SUT met the requirement via interoperability testing and review of vendor LoC.
4. The SUT does not support SNMP Version 3. A TDR was created and vendor provided a POA&M date of early 3rd Quarter 2013.
5. SUT supports only VLAN CoS, so we tested the IP-QoS Feature by mapping the IP-QoS DSCP values to VLAN-CoS values in the SUT.
6. We tested Voice, Video, and Data Services in Real-Time mode by sending actual Voice and Video services through the SUT and also in a simulated mode by using test equipments with four individual Voice, Video, Preferred-Data, and Best-effort-Data stream tagged with their respective DSCP value (DSCP 49, 39, 11, 0).
7. This requirement was met via dual stack IPv4/IPv6 testing and review of vendor LoC.
8. The NM interface was available only on AXS1800 OLT, and all the configuration, alarm, other event management for Motorola Series ONTs were performed via OLT.

Table 2-7. SUT CRs and FRs Status (continued)

LEGEND:

CoS	Class of Service	OLT	Optical Line Terminal
CR	Capabilities Requirement	ONT	Optical Network Terminal
DSCP	Differentiated Services Code Point	POA&M	Plan of Action and Milestones
FR	Functional Requirement	PON	Passive Optical Network
GPON	Gigabit Passive Optical Network	QoS	Quality of Service
ID	Identification	RF	Radio Frequency
IP	Internet Protocol	SNMP	Secure/Simple Network Management Protocol
IPv4	Internet Protocol version 4	SUT	System Under Test
IPv6	Internet Protocol version 6	TDR	Test Descrepancy Report
LAN	Local Area Network	UCR	Unified Capabilities Requirements
LoC	Letter of Compliance	VLAN	Virtual Local Area Network
NM	Network Management		

a. Interfaces: Overall Interfaces Requirements. In Accordance With (IAW) UCR 2008, Change 3, paragraph 5.3.1.10.2, PON can be composed of Broadband PON, Ethernet PON, and GPON, and the requirements do not delineate between the different types. The UCR defines four types of interfaces in a typical PON: the Network to Network Interface (NNI); the interface from network-to-OLT; the interface from OLT-to-ONT Network Management interface; and the User-to-Network Interface (UNI) interface.

(1) NNI-NNI Interface.

(a) The NNI-NNI interface is composed of the uplink between the OLT and the Core network. This interface is composed of IEEE 802.3 interfaces and may provide a Fiber Channel Interface IAW American National Standard Institute (ANSI) International Committee for Information Technology Standards T11.2 and T11.3 (previously known as X3T9.3). At this time, no minimum rate or type of IEEE 802.3 interface is specified and commercial-off-the-shelf interfaces are accepted. If the Fiber Channel Interface is provided the interface must meet the following requirements: Request For Comment (RFC) 4338 Transmission of IP version (v)6, IPv4, and Address Resolution Protocol; Packets-over-Fiber channel; and RFC 4044 Fiber Channel Management. The SUT met the requirement via IA testing, Letter of Complaince (LoC), and interoperability testing using test equipment and simulated information exchanges.

(b) The OLT NNI-NNI port shall support at least one of the following interface rates (other rates and IEEE standards may be provided as conditional interfaces): 100 Mbps IAW IEEE 802.3u, 1 Gbps IAW IEEE 802.3z, and 10 Gbps IAW IEEE 802.3ae. The NNI ports shall provide the following parameters on a per port basis as specified: Auto-negotiation IAW IEEE 802.3, Force mode IAW IEEE 802.3; Flow control IAW IEEE 802.3x, Filtering IAW RFC 1812; Link Aggregation IAW IEEE 802.1AX (formerly 802.3ad); Spanning Tree Protocol IAW IEEE 802.1D; and Multiple Spanning Tree IAW IEEE 802.1s, Rapid Configuration of Spanning Tree IAW IEEE 802.1. The SUT met the requirement via IA testing, LoC, and interoperability testing using test equipment and simulated information exchanges.

(2) OLT to ONT PON Interface.

The GPON OLT-to-ONT interface is defined by the ONT Management Control Interface protocol and was standardized and defined by the ITU-T standard G.984.4. This interface is composed of the PON port on the OLT and the Fiber port on the ONT. Between these ports are a single strand of Single Mode Fiber and one or more optical splitters. Bi-directional transmission is accomplished by use of separate wavelengths (1310 nanometer (nm) and 1490 nm) for transmission. The number of splitters is driven by local requirements and does not exceed the ITU-T G.984 specification for fiber loss per PON port between the OLT and ONT. There may be 1 to 64 (some vendors support more) ONTs on a single PON port. The number of ONTs is driven by the required bandwidth for each user and IAW the traffic engineering guidelines in paragraph 5.3.1.7.3, Traffic Engineering. The SUT met the requirement via IA testing and vendor LoC.

(3) Network Monitoring.

The GPON products shall support the following network monitoring features: Simple Network Management Protocol (SNMP) IAW RFCs 1157, 3410, 3411, 3412, 3413, and 3414; SNMP Traps IAW RFC 1215, Remote Monitoring IAW RFC 2819; Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework IAW RFC 3584; and The Advanced Encryption Standard Cipher Algorithm in the SNMP User-based Security Model IAW RFC 3826. The SUT partially met the requirement via IA testing, vendor LoC, and interoperability testing using test equipment and simulated information exchanges.

The SUT does not support SNMP Version 3. A Test Descrepancy Report (TDR) was created and the vendor provided a POA&M date of early 3rd Quarter 2013.

(4) UNI Interface.

(a) PON products shall provide at least one of the following interface rates: 10 Mbps IAW IEEE 802.3i, 100 Mbps IAW IEEE 802.3u, 1000 Mbps IAW IEEE 802.3z, and 1000 Mbps IAW IEEE 802.3ab. The PON must also support traffic conditioning, which will ensure that the required bandwidth is available for all network users. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(b) UNI Ports. The UNI ports shall provide the following parameters on a per port basis as specified: Auto-negotiation IAW IEEE 802.3, Force mode IAW IEEE 802.3, Flow control IAW IEEE 802.3x, Filtering IAW RFC 1812, Port-Base Access Control IAW 802.1x, and Link Layer Discover – Media Endpoint Discovery IAW ANSI-Telecommunications Industry Association (TIA)-1057. The SUT met the requirement via IA testing, vendor LoC, and interoperability testing using test equipment and simulated information exchanges.

(c) Link Aggregation. IAW IEEE 802.1AX (formerly 802.3ad). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(d) Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI). The UNI ports may provide the following feature parameter on a per port basis as specified: DTE Power via MDI. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(e) Power-over-Ethernet (PoE) Plus. PoE Plus or DTE Power via MDI for Conditional Interfaces IEEE 802.3af. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

b. Class of Service Markings. The PON network shall comply with access product requirements, paragraph 5.3.1.3.3, #1 and #3. The SUT met the requirement via interoperability testing using test equipment and simulated information exchanges.

c. Virtual LAN (VLAN) Capabilities. The NNI and UNI PON ports shall comply with paragraph 5.3.1.3.4, VLAN Capabilities. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

d. Protocols. The PON network shall support bridging at Layer-2 of the Open Systems Interconnection model. Bridging will provide for higher survivability and will reduce traffic congestion on the uplinks to the Distribution or Core Layers of the network. Bridging at Layer-2 will be supported for packets that do not require Layer-3 handling. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

e. Quality of Service Features (QoS). The PON shall comply with the Access product requirements listed in paragraph 5.3.1.3.6, QoS Features. PON products targeted for non-assured services are not subject to the Layer-3 queuing requirements in this section and the conditions of fielding will state whether the PON can support Assured Services or not. The SUT met the requirement via interoperability testing using test equipment and simulated information exchanges.

f. Network Monitoring. The PON shall comply with the product requirements listed in paragraph 5.3.1.3.7, Network Monitoring. The SUT met the requirement via a Vendor LoC and interoperability testing using test equipment and simulated information exchanges.

g. Voice Services. GPON product shall comply with the following:

(1) Latency. The PON shall have the capability to transport voice IP packets, media, and signing with no more than 6 milliseconds (ms) latency end-to-end across the PON SUT as measured under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent

voice/signaling, 25 percent IP video, 25 percent preferred data, and 25 percent best effort traffic). The latency shall be achievable over any 5-minute measured period under congested conditions. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(2) Jitter. The PON shall have the capability to transport voice IP packets across the PON SUT with no more than 3 ms of jitter. The jitter shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent voice/signaling, 25 percent IP video, 25 percent preferred data, and 25 percent best effort traffic). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(3) Packet Loss. The PON shall have the capability to transport voice IP packets across the PON SUT with packet loss not to exceed configured traffic engineered (queuing) parameters. Actual measured packet loss across the PON shall not exceed 0.045 percent within the defined queuing parameters. The packet loss shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

h. Video Services. GPON product shall comply with the following:

(1) Latency. The PON shall have the capability to transport video IP packets with no more than 30 ms latency across the PON SUT. Latency is increased over voice IP packets because of the increased size of the packets (230 bytes for voice packets and up to 1518 bytes for video). The latency shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/ signaling, 25 percent video, 25 percent-preferred data, and 25 percent best effort traffic). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(2) Jitter. The LAN shall have the capability to transport video IP packets across the PON SUT with no more than 30 ms of jitter. The jitter shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(3) Packet Loss. The PON shall have the capability to transport video IP packets across the PON SUT with packet loss not to exceed configured traffic engineered (queuing) parameters. Actual measured packet loss across the PON shall

not exceed 0.15 percent within the defined queuing parameters. The packet loss shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

i. Data Services. GPON product shall comply with the following:

(1) Latency. The PON shall have the capability to transport prioritized data IP packets with no more than 45 ms latency across the PON SUT. Latency is increased over voice IP packets because of the increased size of the packets (230 bytes for voice packets and up to 1518 bytes for data). The latency shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(2) Jitter. There are no jitter requirements for preferred data IP packets. JITC tested this IAW the video service jitter requirement, and the SUT met the requirement via interoperability testing using test equipment and simulated information exchanges.

(3) Packet Loss. The PON shall have the capability to transport prioritized data IP packets across the PON SUT with packet loss not to exceed configured traffic engineered (queuing) parameters. Actual measured packet loss across the LAN shall not exceed 0.15 percent within the defined queuing parameters. The packet loss shall be achievable over any 5-minute period measured under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic). The SUT met the requirement via vendor LoC and interoperability testing using test equipments and simulated information exchanges.

j. IA Requirements. All systems must comply with the applicable Security Technical Implementation Guides. The SUT met the requirement via IA testing, vendor LoC, and all IA Requirement testing done by the JITC IA test team. All IA related requirements status was reported separately.

k. PON Network Management (NM) Requirements. Network managers must be able to monitor, configure, and control all aspects of the network and observe changes in network status. The SUT does not support SNMP Version 3. A TDR was created and the vendor provided a POA&M date of early 3rd Quarter 2013.

(1) Secure Shell version 2 (SSHv2). The PON products shall support RFC 4251 through RFC 4254 inclusive. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(2) Telnet. The PON product shall be configured by default not to accept Telnet. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(3) Hypertext Transfer Protocol over Secure Socket Layer (HTTPS). HTTPS shall be used instead of Hypertext Transfer Protocol due to its increased security as described in RFC 2660. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(4) RFC 3414. The LAN products shall support RFC 3414 for SNMP. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(5) LAN Interface. If other methods are used for interfacing between LAN products and the NM System (NMS), they shall be implemented in a secure manner. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

l. Configuration Control. Configuration Control identifies controls, accounts for, and audits all changes made to a site or information system during its design, development, and operational life cycle (DoD Chief Information Officer Guidance IA6-8510 IA). LANs shall have an NM capability that leverages existing and evolving technologies and has the ability to perform remote network product configuration/reconfiguration of objects that have existing DoD Global Information Grid management capabilities. The NMS shall report configuration change events in near-real-time (NRT), whether or not the change was authorized. The system shall report the success or failure of authorized configuration change attempts in NRT. NRT is defined as within 5 seconds of detecting the event, excluding transport time. The SUT met the requirement via vendor LoC and interoperability testing using test equipments and simulated information exchanges.

m. Operational Changes. The PON shall meet the requirements in paragraph 5.3.1.6.2, Operational Changes. The SUT met the requirement via vendor LoC and interoperability testing using test equipments and simulated information exchanges.

n. Performance Monitoring. The PON shall meet the requirements in paragraph 5.3.1.6.3, Performance Monitoring. The SUT met the requirement via vendor LoC and interoperability testing using test equipments and simulated information exchanges.

o. Alarms. The PON shall meet the requirements in paragraph 5.3.1.6.4, Alarms. In addition to the alarms defined in this section, the OLT shall support the alarms as defined by International Telecommunication Union (ITU) G994.4. The SUT met the

requirement via vendor LoC and interoperability testing using test equipments and simulated information exchanges.

p. Reporting. The PON shall meet the requirements in paragraph 5.3.1.6.5, Reporting. In addition, the PON system must report optical errors including degraded optical conditions. The SUT met the requirement via vendor LoC and interoperability testing using test equipments and simulated information exchanges.

q. Fiber Media. Fiber Optic Cable used for the PON shall be Single Mode Fiber. The single mode fiber shall be in compliance with ITU G.652/TIA OS1/International Electrotechnical Commission B1.1. The SUT met the requirement via vendor LoC.

r. Radio Frequency (RF)-over-Glass (RFoG). The PON network shall support RFoG via PON and its RF overlay framework. ITU-T G.984.5 defines this band as an Enhancement band for video distribution services. This ITU-T forum also specifies a wavelength of 1150 nm to 1560 nm. This video capacity is in addition to the 2.4 Gbps downstream and 1.2 Gbps upstream capacity of GPON. It is the responsibility of the ONT to either block or separate the RFoG from the downstream GPON signal of 1480 nm to 1500 nm. The SUT was not tested against this conditional requirement. The spectrum is allocated as follows:

- 40 Analog channels at 54 to 550 Megahertz (MHz)
- 63 Digital 256 Quadrature Amplitude Modulation channels at 225 to 870 MHz
- One Quadrature Phase-Shift Keying Out-of-Band channel at 71 to 125 MHz (R)

s. Traffic Engineering. Bandwidth required per subscriber must be in compliance with paragraph 5.3.1.7.3, Traffic Engineering, and additional DoD regulations as applicable. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

t. VLAN Design and Configuration. VLAN Design and Configuration for all PON networks must be in compliance with Distribution and Access Layer Network Elements (NE) as defined in paragraph 5.3.1.7.4, VLAN Design and Configuration. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

u. Power Backup. To meet Chairman of the Joint Chiefs of Staff requirements, the PON network must be in compliance with paragraph 5.3.1.7.5, Power Backup and Figure 5.3.1-14, ASLAN Uninterruptible Power Supply Power Requirements. Required or Conditional adherence shall be based on whether the PON NE is being placed into an ASLAN or a Non-ASLAN. The SUT met the requirement via vendor LoC.

v. Availability. PON NEs that are used in ASLANs and Non-ASLANs must meet the availability requirements for the appropriate LAN. The PON platform shall support Type B PON Protection as defined in ITU-T G.984.1 3/2008 to provide increased reliability for

all services carried on the PON, including data. The SUT met the requirement via vendor LoC.

w. Redundancy. The PON network shall have no single point of failure that can cause an outage of more than 96 IP telephone subscribers. It should be noted that a PON may be used with a single point of failure for more than 96 subscribers if 96 or fewer are IP telephone subscribers (i.e., 50 data, 20 video, and 50 IP telephony = 120 subscribers). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(1) Single Product Redundancy. Single product redundancy may be met with a modular chassis that at a minimum provides the following:

(a) Dual Power Supplies. The platform shall provide a minimum of two power inputs each with the power capacity to support the entire chassis. Loss of a single power input shall not cause any loss of ongoing functions within the chassis.

(b) Dual Processors (Control Supervisors). The chassis shall support dual control processors. Failure of any one processor shall not cause loss of any ongoing functions within the chassis (e.g., no loss of active calls). Failure of the primary processor to secondary must meet 5-second failover without loss of active calls.

(c) Redundancy Protocol. PON equipment shall support a protocol that allows for dynamic rerouting of IP packets so that no single point of failure exists in the PON that could cause an outage to more than 96 IP subscribers. It should be noted that a PON may be used with a single point of failure for more than 96 subscribers if 96 or fewer are IP telephone subscribers (i.e., 50 data, 20 video, and 50 IP telephony = 120 subscribers). Redundancy protocols will be standards based as specified in this document.

(d) Backplane/Bridging Redundancy. Bridging platforms within the PON shall support a redundant (1+1) switching fabric or backplane. The second fabric's backplane shall be in active standby so that failure of the first shall not cause loss of ongoing events within the OLT. NOTE: In the event of a component failure in the network, all calls that are active shall not be disrupted (loss of existing connection requiring redialing) and the path through the network shall be restored within 5 seconds. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

(2) Dual Product Redundancy. In the case where a secondary product has been added to provide redundancy to a primary product, the failover to the secondary product must not result in any lost calls. The secondary product may be in "standby mode" or "active mode," regardless of the mode of operation the traffic engineering of the links between primary and secondary links must meet the requirements provided in paragraph 5.3.1.7.3, Traffic Engineering. **NOTE**: In the event of a primary product

failure, all calls that are active shall not be disrupted (loss of existing connection requiring redialing) and the failover to the secondary product must be restored within 5 seconds. The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

x. Survivability. For PON Survivability, the PON shall support a Layer-2 Dynamic Rerouting protocol. Failover shall occur in no more than 50 ms. The SUT met the requirement via interoperability testing using test equipment and simulated information exchanges.

y. Summary of LAN Requirements by Subscriber Mission. The PON NEs shall meet the same requirements as specified in Table 5.3.1-2, Summary of LAN Requirements by Subscriber Mission, as applicable for the LAN. The NE will be included within to include meeting the IPv6 requirements as defined in Section 5.3.5, IPv6 Requirements. The PON shall meet all IPv6 requirements applicable as defined for a LAN access switch (Table 5.3.5-6, LAN Switch). The SUT met the requirement via vendor LoC and interoperability testing using test equipment and simulated information exchanges.

z. IPv6 Requirements, Product Requirements. The SUT must meet UCR 2008, Change 3, Section 5.3.5.4 IPv6 requirements for Network Appliance/Simple Server. The SUT is a Layer-2 device and transports IPv4 and IPv6 traffic transparently; therefore, requirements specific relating to Layer-3 do not apply. The SUT met the requirement via vendor LoC and interoperability testing using IPv4/IPv6 dual stack test equipments and IPv4/IPv6 dual stack simulated information exchanges.

aa. NM Requirements. JITC verified the following NM requirements by connecting the NMS to the SUT via all required interfaces. JITC verified performing test configurations, performing alarms monitoring, and performing fault management via utilization of the NMS.

(1) Voice and Video over Internet Protocol (VVoIP) NMS Interface Requirements. The physical interface between the Defense Information Systems Agency VVoIP Element Management System (EMS) and the network components (i.e., Local Session Controller, Multifunction Soft Switch, Edge Boundary Controller, Customer Edge Router is a 10/100 Mbps Ethernet interface. The interface will work in either of the two following modes using auto-negotiation: IEEE, Ethernet Standard 802.3, 1993; or IEEE, Fast Ethernet Standard 802.3u, 1995.

(2) General Management Requirements. The SUT must support SNMPv3 format. A network appliance shall have Operations interfaces that provide a standard means by which management systems can directly or indirectly communicate with and, thus, manage the various network appliances in the DISN. The physical interface between the Local EMS and the VVoIP network components shall be an Ethernet connection IAW UCR 2008, Change 3, paragraph 5.3.2.4.4, VoIP NMS Interface Requirements. The physical interface between the VVoIP EMS and the VVoIP network

components shall also be an Ethernet connection IAW UCR 2008, Change 3, paragraph 5.3.2.4.4. There shall be a local craftsperson interface (Craft Input Device for Operations Administration and Management) for all VVoIP network components.

The SUT does not support SNMP Version 3. A TDR was created and the vendor provided a POA&M date of early 3rd Quarter 2013.

11.3 Other. None.

12. TEST AND ANALYSIS REPORT. In accordance with the Program Manager's request, JITC did not prepare a detailed test report. JITC distributes interoperability information via the JITC Electronic Report Distribution system, which uses Unclassified-But-Sensitive Internet Protocol Router Network (NIPRNet) e-mail. More comprehensive interoperability status information is available via the JITC System Tracking Program, which .mil/gov users can access on the NIPRNet at https://stp.fhu.disa.mil.
Test reports, lessons learned, and related testing documents and references are on the JITC Joint Interoperability Tool at http://jit.fhu.disa.mil (NIPRNet). Information related to DISN testing is on the Telecommunications Switched Services Interoperability website at http://jitc.fhu.disa.mil/tssi.

SYSTEM FUNCTIONAL AND CAPABILITY REQUIREMENTS

The Passive Optical Network (PON) has required and conditional features and capabilities that are established by the Unified Capabilities Requirements. The System Under Test does not need to meet conditional requirements. If they are provided, they must function according to the specified requirements. The detailed Functional Requirements and Capability Requirements for PON's are listed in Table 3-1.

Table 3-1. PON CRs/FRs

ID	Requirement	Reference (UCR 2008 Change 3)	PON
1	[Required: PON] The NNI-NNI interface is composed of the uplink between the OLT and the Core network. This interface is composed of IEEE 802.3 interfaces and may provide a Fiber channel interface IAW ANSI INICITS T11.2 and T11.3 (previously known as X3T9.3). At this time, no minimum rate or type of IEEE 802.3 interface is specified and COTS interfaces are accepted. If the Fiber Channel Interface is provided the interface must meet: RFC 4338 Transmission of IPv6, IPv4 and ARP Packets over Fiber channel, and RFC 4044 Fiber Channel Management	5.3.1.10.2.1	R
1A	[Required: PON] The OLT NNI-NNI port shall support at least one of the following interface rates (other rates and IEEE standards may be provided as conditional interfaces)): • 100 Mbps IAW IEEE 802.3u • 1 Gbps IAW IEEE 802.3z • 10 Gbps IAW IEEE 802.3ae The NNI ports shall provide the following parameters on a per port basis as specified: • Auto-negotiation IAW IEEE 802.3 • Force mode IAW IEEE 802.3 • Flow control IAW IEEE 802.3x • Filtering IAW RFC 1812 • Link Aggregation IAW IEEE 802.1AX (formerly 802.3ad) • Spanning Tree Protocol IAW IEEE 802.1D • Multiple Spanning Tree IAW IEEE 802.1s • Rapid Configuration of Spanning Tree IAW IEEE 802.1w		R
2	5.3.1.10.2.2 OLT to ONT PON Interface [Required: PON] The GPON OLT to ONT interface is defined by the OMCI protocol and was standardized and defined by the ITU standard G.984.4. This interface is composed of the PON port on the OLT and the Fiber port on the ONT. Between these ports are a single strand of Single Mode Fiber and one or more optical splitters. Bi-directional transmission is accomplished by use of separate wavelengths (1310 nm and 1490 nm) for transmission. The number of splitters is driven by local requirements, and does not exceed the ITU-T G.984 specification for fiber loss per PON port between the OLT and ONT. There may be one to 64 (some vendors support more) ONTs on a single PON port. The number of ONTs is driven by the required bandwidth for each user and IAW the traffic engineering guidelines in Section 5.3.1.7.3, Traffic Engineering. The OLT to ONT interface will support the Telcordia Standards shown in Table 5.3.1-17, OLT to ONT Signaling Standards.	5.3.1.10.2.2	R
3	5.3.1.10.2.3 Network Monitoring [Required: PON] The GPON products shall support the following network monitoring features: • SNMP IAW RFCs 1157, 3410, 3411, 3412, 3413, and 3414 • SNMP Traps IAW RFC 1215 • RMON IAW RFC 2819 • Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard NM Framework IAW RFC 3584 • The AES Cipher Algorithm in the SNMP User-based Security Model IAW RFC 3826	5.3.1.10.2.3	R

Table 3-1. PON Capability/Functional Requirements (continued)

ID	Requirement	UCR Reference (UCR 2008 Change 3)	PON
4	5.3.1.10.2.4 UNI Interface [Required: PON] PON products shall provide at least one of the following interface rates: • 10 Mbps IAW IEEE 802.3i • 100 Mbps IAW IEEE 802.3u • 1000 Mbps IAW IEEE 802.3z • 1000 Mbps IAW IEEE 802.3ab In addition, PON must support traffic conditioning, which will insure that the required bandwidth is available for all network users.	5.3.1.10.2.4	R
4A	5.3.1.10.2.4.1 UNI Ports [Required: PON] The UNI ports shall provide the following parameters on a per port basis as specified: • Auto-negotiation IAW IEEE 802.3 • Force mode IAW IEEE 802.3 • Flow control IAW IEEE 802.3x • Filtering IAW RFC 1812 • Port-Base Access Control IAW 802.1x • Link Layer Discover – Media Endpoint Discovery IAW ANSI-TIA-1057	5.3.1.10.2.4.1	R
4B	[Conditional: PON] Link Aggregation IAW IEEE 802.1AX (formerly 802.3ad)	5.3.1.10.2.4.1	C
4C	[Conditional: PON] The UNI ports may provide the following features parameters on a per port basis as specified: DTE Power via MDI PoE for Conditional Interfaces IEEE 802.3af.	5.3.1.10.2.4.1	C
4D	• PoE Plus or DTE Power via MDI for Conditional Interfaces IEEE 802.3af	5.3.1.10.2.4.1	C
5	5.3.1.10.3 Class of Service Markings [Required: PON] The PON network shall comply with access product requirements, Section 5.3.1.3.3, #1 and #3.	5.3.1.10.3	R
6	5.3.1.10.4 Virtual LAN Capabilities [Required: PON] The NNI and UNI PON ports shall comply with Section 5.3.1.3.4, VLAN Capabilities	5.3.1.10.4	R
7	5.3.1.10.5 Protocols [Conditional: PON] The PON network shall support bridging at Layer-2 of the OSI model. Bridging will provide for higher survivability as well as reducing traffic congestion on the uplinks to the Distribution or Core Layers of the network. Bridging at Layer-2 will be supported for packets that do not require Layer-3 handling.	5.3.1.10.5	C
8	5.3.1.10.6 Quality of Service Features [Required: PON] The PON shall comply with the Access product requirements listed in Section 5.3.1.3.6, QoS Features. PON products targeted for non-assured services are not subject to the Layer-3 queuing requirements in this section and the conditions of fielding will state whether the PON can support Assured Services or not.	5.3.1.10.6	R
9	5.3.1.10.7 Network Monitoring [Required: PON] The PON shall comply with the product requirements listed in Section 5.3.1.3.7, Network Monitoring.	5.3.1.10.7	R
10A	5.3.1.10.8.1 Latency [Required: PON] The PON shall have the capability to transport voice IP packets, media, and signing, with no more than 6 ms latency E2E across the PON SUT as measured under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent voice/signaling, 25 percent IP video, 25 percent preferred data, and 25 percent best effort traffic). The latency shall be achievable over any 5-minute measured period under congested conditions.	5.3.1.10.8.1	R
10B	5.3.1.10.8.2 Jitter [Required: PON] The PON shall have the capability to transport voice IP packets across the PON SUT with no more than 3 ms of jitter. The jitter shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering 25 percent voice/signaling, 25 percent IP video, 25 percent preferred data, and 25 percent best effort traffic).	5.3.1.10.8.2	R

Table 3-1. PON Capability/Functional Requirements (continued)

ID	Requirement	UCR Reference (UCR 2008 Change 3)	PON
10C	5.3.1.10.8.3 Packet Loss [Required: PON] The PON shall have the capability to transport voice IP packets across the PON SUT with packet loss not to exceed configured traffic engineered (queuing) parameters. Actual measured packet loss across the PON shall not exceed 0.045 percent within the defined queuing parameters. The packet loss shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic).	5.3.1.10.8.3	R
11A	5.3.1.10.9.1 Latency [Required: PON] The PON shall have the capability to transport video IP packets with no more than 30 ms latency across the PON SUT. Latency is increased over voice IP packets because of the increased size of the packets (230 bytes for voice packets and up to 1518 bytes for video). The latency shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic).	5.3.1.10.9.1	R
11B	5.3.1.10.9.2 Jitter [Required: PON] The LAN shall have the capability to transport video IP packets across the PON SUT with no more than 30 ms of jitter. The jitter shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic)	5.3.1.10.9.2	R
11C	5.3.1.10.9.3 Packet Loss [Required: PON] The PON shall have the capability to transport video IP packets across the PON SUT with packet loss not to exceed configured traffic engineered (queuing) parameters. Actual measured packet loss across the PON shall not exceed 0.15 percent within the defined queuing parameters. The packet loss shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic).	5.3.1.10.9.3	R
12A	5.3.1.10.10.1 Latency [Required: PON] The PON shall have the capability to transport prioritized data IP packets with no more than 45 ms latency across the PON SUT. Latency is increased over voice IP packets because of the increased size of the packets (230 bytes for voice packets and up to 1518 bytes for data). The latency shall be achievable over any 5-minute measured period under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic).	5.3.1.10.10.1	R
12B	5.3.1.10.10.2 Jitter There are no jitter requirements for preferred data IP packets.	5.3.1.10.10.2	
12C	5.3.1.10.10.3 Packet Loss [Required: PON] The PON shall have the capability to transport prioritized data IP packets across the PON SUT with packet loss not to exceed configured traffic engineered (queuing) parameters. Actual measured packet loss across the LAN shall not exceed 0.15 percent within the defined queuing parameters. The packet loss shall be achievable over any 5-minute period measured under congested conditions. Congested conditions are defined as 100 percent of link capacities (as defined by baseline traffic engineering (25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic).	5.3.1.10.10.3	R
13	5.3.1.10.11 Information Assurance Requirements [Required: PON] All systems must comply with the applicable STIGs.	5.3.1.10.11	R

Table 3-1. PON Capability/Functional Requirements (continued)

ID	Requirement	UCR Reference (UCR 2008 Change 3)	PON
14	5.3.1.10.12 PON NM Requirements [Required: PON] NMs must be able to monitor, configure, and control all aspects of the network and observe changes in network status. The PON infrastructure components shall have a NM capability that leverages existing and evolving technologies and has the ability to perform remote network product configuration/reconfiguration of objects that have existing DoD GIG management capabilities. The PON infrastructure components must be able to be centrally managed by an overall NMS. In addition, MIB II shall be supported for SNMP. In addition, if other methods are used for interfacing between PON products and the NMS, they shall be implemented in a secure manner, such as with the following methods:	5.3.1.10.12	R
14A	5.3.1.10.12.1. [Required: PON] SSHv2. The PON products shall support RFC 4251 through RFC 4254 inclusive.	5.3.1.10.12.1	R
14B	5.3.1.10.12.2 [Required: PON] The PON product shall be configured by default, not to accept Telnet.	5.3.1.10.12.2	R
14C	5.3.1.10.12.3 [Conditional: PON] HTTPS. HTTPS shall be used instead of HTTP due to its increased security as described in RFC 2660.	5.3.1.10.12.3	C
14D	5.3.1.10.12.4 [Conditional: PON] The LAN products shall support RFC 3414 for SNMP.	5.3.1.10.12.4	C
14E	5.3.1.10.12.5 [Conditional: PON] If other methods are used for interfacing between LAN products and the NMS, they shall be implemented in a secure manner.	5.3.1.10.12.5	C
15	5.3.1.10.13 Configuration Control [Required: PON] Configuration Control identifies, controls, accounts for, and audits all changes made to a site or information system during its design, development, and operational life cycle (DoD CIO Guidance IA6-8510 IA). LANs shall have an NM capability that leverages existing and evolving technologies and has the ability to perform remote network product configuration/reconfiguration of objects that have existing DoD GIG management capabilities. The NMS shall report configuration change events in NRT, whether or not the change was authorized. The system shall report the success or failure of authorized configuration change attempts in NRT. NRT is defined as within 5 seconds of detecting the event, excluding transport time.	5.3.1.10.13	R
16	5.3.1.10.14 Operational Changes [Required: PON] The PON shall meet the requirements in Section 5.3.1.6.2, Operational Changes.	5.3.1.10.14	R
17	5.3.1.10.15 Performance Monitoring [Required: PON] The PON shall meet the requirements in Section 5.3.1.6.3, Performance Monitoring.	5.3.1.10.15	R
18	5.3.1.10.16 Alarms [Required: PON] The PON shall meet the requirements in Section 5.3.1.6.4, Alarms. In addition to the alarms defined in this section, the OLT shall support the alarms as defined by ITU G994.4.	5.3.1.10.16	R
19	5.3.1.10.17 Reporting [Required: PON] The PON shall meet the requirements in Section 5.3.1.6.5, Reporting. In addition, the PON system must also report optical errors to include degraded optical conditions.	5.3.1.10.17	R
20	5.3.1.10.18 Fiber Media [Required: PON] Fiber Optic Cable used for the PON shall be Single Mode Fiber. The single mode fiber shall be in compliance with ITU G.652/TIA OS1/IEC B1.1.	5.3.1.10.18	R
21	5.3.1.10.19 RFoG Video [Conditional: PON] The PON network shall support RFoG via PON and its RF overlay framework. ITU-T G.984.5 defines this band as an Enhancement band for video distribution services. This ITU forum also specifies a wavelength of 1150 nm to 1560 nm. This video capacity is in addition to the 2.4 Gbps downstream and 1.2 upstream capacity of GPON. It is the responsibility of the ONT to either block or separate the RFoG from the downstream GPON signal of 1480 to 1500 nm. The spectrum is allocated as follows: • 40 Analog channels at 54 to 550 MHz • 63 Digital 256 QAM channels at 225 to 870 MHz • One QPSK OOB channel at 71 to 125 MHz	5.3.1.10.19	C

Table 3-1. PON Capability/Functional Requirements (continued)

ID	Requirement	UCR Reference (UCR 2008 Change 3)	PON
22	5.3.1.10.20 Traffic Engineering [Required: PON] Bandwidth required per subscriber must be in compliance with Section 5.3.1.7.3, Traffic Engineering and additional DoD regulations as applicable.	5.3.1.10.20	R
23	5.3.1.10.21 VLAN Design and Configuration [Required: PON] VLAN Design and Configuration for all PON networks must be in compliance with Distribution and Access Layer Network Elements as defined in Section 5.3.1.7.4, VLAN Design and Configuration.	5.3.1.10.21	R
24	5.3.1.10.22 Power Backup [Required: ASLAN Network PON – Conditional: Non-ASLAN Network PON] To meet CJCS requirements the PON network must be in compliance with Section 5.3.1.7.5, Power Backup, and Figure 5.3.1-14, ASLAN UPS Power Requirements. Required or Conditional adherence shall be based on whether the PON Network Element is being placed into an ASLAN or a Non-ASLAN.	5.3.1.10.22	R
25	5.3.1.10.23 Availability Availability of a PON network will be determined the same as for active Ethernet networks as defined in Section 5.3.1.7.6, Availability, and Table 5.3.1-12, Methods of Expressing Availability. PON Network Elements that are utilized in ASLANs and Non-ASLANs must meet the availability requirements for the appropriate LAN. [Conditional: PON] The PON platform shall support Type B PON Protection as defined in ITU-T G.984.1 3/2008 to provide increased reliability for all services carried on the PON, including data.	5.3.1.10.23	C
26	5.3.1.10.24 Redundancy The following paragraphs outline the redundancy requirements for the PON Network: [Required: PON in ASLAN – Conditional: PON in Non-ASLAN] The PON network shall have no single point of failure that can cause an outage of more than 96 IP telephone subscribers. It should be noted that a PON may be used with a single point of failure for more than 96 subscribers if 96 or less are IP telephone subscribers (i.e., 50 data, 20 video, and 50 IP telephony = 120 subscribers).	5.3.1.10.24	R
26A	5.3.1.10.24.1 Single Product Redundancy [Conditional: PON] Single product redundancy may be met with a modular chassis that at a minimum provides the following: 1. Dual Power Supplies. The platform shall provide a minimum of two power inputs each with the power capacity to support the entire chassis. Loss of a single power input shall not cause any loss of ongoing functions within the chassis. 2. Dual Processors (Control Supervisors). The chassis shall support dual control processors. Failure of any one processor shall not cause loss of any ongoing functions within the chassis (e.g., no loss of active calls). Failure of the primary processor to secondary must meet 5-second failover without loss of active calls. 3. Redundancy Protocol. PON equipment shall support a protocol that allows for dynamic rerouting of IP packets so that no single point of failure exists in the PON that could cause an outage to more than 96 IP subscribers. It should be noted that a PON may be used with a single point of failure for more than 96 subscribers if 96 or less are IP telephone subscribers (i.e., 50 data, 20 video, and 50 IP telephony = 120 subscribers). Redundancy protocols will be standards based as specified in this document. 4. Backplane/Bridging Redundancy. Bridging platforms within the PON shall support a redundant (1+1) switching fabric or backplane. The second fabric's backplane shall be in active standby so that failure of the first shall not cause loss of ongoing events within the OLT. NOTE: In the event of a component failure in the network, all calls that are active shall not be disrupted (loss of existing connection requiring redialing) and the path through the network shall be restored within 5 seconds.	5.3.1.10.24.1	C

Table 3-1. PON Capability/Functional Requirements (continued)

ID	Requirement	UCR Reference (UCR 2008 Change 3)	PON
26B	5.3.1.10.24.2 Dual Product Redundancy [Conditional: PON] In the case where a secondary product has been added to provide redundancy to a primary product, the failover over to the secondary product must not result in any lost calls. The secondary product may be in "standby mode" or "active mode," regardless of the mode of operation the traffic engineering of the links between primary and secondary links must meet the requirements provided in Section 5.3.1.7.3, Traffic Engineering. NOTE: In the event of a primary product failure, all calls that are active shall not be disrupted (loss of existing connection requiring redialing) and the failover to the secondary product must be restored within 5 seconds.	5.3.1.10.24.2	C
27	5.3.1.10.25 Survivability Network survivability refers to the capability of the network to maintain service continuity in the presence of faults within the network. This can be accomplished by recovering quickly from network failures and maintaining the required QoS for existing services. [Required: PON] For PON Survivability, the PON shall support a Layer-2 Dynamic Rerouting protocol. Failover shall occur in no more than 50 ms.	5.3.1.10.25	R
28	5.3.1.10.26 Summary of LAN Requirements by Subscriber Mission [Required: PON] The PON Network Elements shall meet the same requirements as specified in Table 5.3.1-14, Summary of LAN Requirements by Subscriber Mission, as applicable for the LAN the Network Element will be included within to include meeting the IPv6 requirements as defined in Section 5.3.5, IPv6 Requirements. The PON shall meet all IPv6 requirements applicable as defined for a LAN access switch (Table 5.3.5-6, LAN Switch).	5.3.1.10.26	R

LEGEND:

AES	Advanced Encryption Standard	MDI	Media Dependent Interface
ANSI	American National Standards Institute	MIB	Management Information Base
ARP	Address Resolution Protocol	ms	Millisecond
ASLAN	Assured Services LAN	nm	nanometer
C	Conditional	NM	Network Management
CIO	Chief Information Officer	NMS	NM System
CJCS	Chairman of the Joint Chiefs of Staff	NNI	Network-to-Network Interface
COTS	Commercial Off the Shelf	NRT	Near Real Time
CR	Capability Requirement	OLT	Optical Line Terminal
DoD	Department of Defense	OMCI	ONT Management Control Interface
DTE	Data Terminal Equipment	ONT	Optical Network Terminal
E2E	End-to-End	OOB	Out-of-Band
FR	Functional Requirement	OSI	Open Systems Interconnect
Gbps	Gigabits per second	PoE	Power-Over-Ethernet
GIG	Global Information Grid	PON	Passive Optical Network
GPON	Gigabit Passive Optical Network	QAM	Quadrature Amplitude Modulation
HTTP	Hypertext Transfer Protocol	QoS	Quality of Service
HTTPS	Hypertext Transfer Protocol over SSL	QPSK	Quadrature Phase-Shift Keying
IAW	In Accordance With	R	Required
ID	Identification	RF	Radio Frequency
IEC	International Electrotechnical Commission	RFC	Request For Comment
IEEE	Institute of Electrical and Electronic Engineers	RFoG	Radio Frequency over Glass
INICITS	International Committee for Information Technology Standards	RMON	Remote Monitoring
		SNMP	Simple Network Management Protocol
IP	Internet Protocol	SSHv2	Secure Shell version 2
IPv4	Internet Protocol version 4	SSL	Secure Socket Layer
IPv6	Internet Protocol version 6	STIG	Security Technical Implementation Guideline
ITU	International Telecommunications Union	SUT	System Under Test
ITU-T	International Telecommunications Union - Telecommunications Sector	TIA	Telecommunications Industry Association
		UCR	Unified Capabilities Requirements
LAN	Local Area Network	UNI	User Network Interface
Mbps	Megabits per second	UPS	Uninterruptible Power Supply
MHz	Megahertz	VLAN	Virtual Local Area Network